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# From Major Decision to Successfully Graduating A Motivational Perspective on the Process of Study Success

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#### **Contributions Based on This Dissertation**

The scientific findings of this dissertation have been published or submitted for publication as follows. Included are the manuscripts in the preprint version. I conducted minor changes in the format (e.g., numbering of tables) for better readability and structural unity within this dissertation, but no content has been changed.

- Messerer, L. A. S., Karst, K., & Janke, S. (2023). Choose Wisely: Intrinsic Motivation for Enrollment is Associated With Ongoing Intrinsic Learning Motivation, Study Success and Dropout. *Studies in Higher Education*, 48(1), 137–150. https://doi.org/10.1080/03075079.2022.2121814
- Messerer, L. A. S., Merkle, B., Karst, K., & Janke, S. (2022). Interest-Major Fit Predicts Study Success? Comparing Different Ways of Assessment. *Manuscript submitted for publication*.
- Messerer, L. A. S., Scherer, R., Karst, K., & Janke, S. (2023). Is Every Semester the Same? The Interplay Between Intrinsic Motivation and Grades and How They Relate to Dropout Over the Course of University Studies. *Manuscript submitted for publication*.

#### **Declaration of Support Received**

In accordance with §9 section 1c) of the "Promotionsordnung" of the Faculty of Social Sciences at the University of Mannheim, I, Laura Aglaia Sophia Messerer, confirm with my signature that all manuscripts listed were primarily conceived, prepared, produced, and written by me. In doing so, I was supported by my co-authors through discussions about my ideas during all stages of the research process and their direct suggestions for improvement to the working versions of the manuscripts. The hypotheses investigated in the three manuscripts were developed by me. I mainly conducted the data analyses, and the corresponding interpretation of the data were primarily carried out by me. The data collection was carried out by me, except of Study 1a in Manuscript 1, where I used data collected by Stefan Janke. In individual cases, data collection and processing were supported by the following research assistants and interns: Vanessa Kupfer, Lena Hopf, Marie Godow, Kim Gericke, Paula Schmelzer, Pia Vogel, Simon Steiger, Lena Goetjes and Gabriela Ay.

In the introduction (chapter 1) and discussion (chapter 5) of this dissertation, I refer to "I" to present my individual ideas and conclusions. I refer to "we" when presenting the empirical studies to include my co-authors.

#### Summary

This dissertation is dedicated to the topic of university major choice, the process of dropping out of university and of studying successfully at university. Study success and the prevention of dropping out from the studies is important from the individuals perspective (preventing the risk of lower mental health and unemployment; Ajjawi et al., 2020; Davies & Elias, 2003; Faas et al., 2018) and also from the societies perspective (need of skilled workers and prevention of misinvestments; Grunschel & Dresel, 2021; Neugebauer et al., 2019; Sarcletti & Müller, 2011). Four longitudinal studies investigate how university entry criteria and study success outcomes are related and how they are associated with study success and dropout from higher education. Previous models mention several variables as predictors or outcomes of study success (Bean & Metzner, 1985; Heublein, 2014; Tinto, 1975). However, a shortcoming is that a detailed explanation of the psychological processes, data regarding objective outcomes and the longitudinal perspective taking different phases during the study process into account are missing. The overarching goal of this dissertation is therefore to develop a process model of study success and dropout by identifying prerequisites of study success and investigate which variables (most strongly) influence study success at which point of time during the studies and the underlying psychological mechanisms.

In more detail the goals of this dissertation are: Firstly, (1) to *establish the connection* between a major choice based on the interests of prospective students and enhanced study success. Secondly, (2) to *clarify constructs and assessments* of Person-Environment Fit (Edwards et al., 1998; Edwards & Shipp, 2007) regarding the university context, particularly to compare two different kinds of assessment of how well prospective students fit their major and their impact on study success. Thirdly, (3) to *understand the process* of studying at university in more depth and how study success outcomes are related longitudinally, particularly how intrinsic motivation and university grades are connected over the whole course of the bachelor's degree. And finally, this dissertation aims to (4) *explore boundary conditions* of when and how different study entry criteria and study success outcomes contribute to dropout from higher education in different phases over the course of studies. Together with my co-authors, I conducted four longitudinal field studies to reach the abovementioned goals.

Study 1a investigated whether an interest-based major choice was beneficial for study success. In accordance with the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) congruence between the interests of students and their major should lead to enhanced study success. A sample of N = 536 students was investigated regarding their intrinsic motivation for enrollment (= choosing the major out of interest in the major) and intrinsic learning motivation during the studies with two measurement points. The results showed that intrinsic motivation for enrollment was associated with intrinsic learning motivation and that this effect was stable even if intrinsic learning motivation at an earlier time point was considered. This suggests that intrinsic motivation for enrollment is beneficial for the positive development of intrinsic learning motivation.

Based on these results, we investigated whether intrinsic motivation for enrollment was also associated with other outcomes of study success. Study 1b contained a sample of N = 1185 students and included three measurement points. Using a structural equation model we conducted a mediation analysis, with intrinsic motivation for enrollment as predictor, intrinsic learning motivation as mediator and dropout intention, dropout, and university GPA as outcomes. The findings revealed that intrinsic learning motivation (partly) mediated the associations between intrinsic motivation for enrollment and dropout (intentions) and university GPA. Those findings illustrate the importance of interest-based major choices and intrinsic motivation as a key factor to other study success outcomes. Further the findings are a starting point for a process-orientated perspective on the impact of interest-based major choices on study success. In sum, the connection between an interest-based major choice and study success could be established.

Building on those results, the goal for Study 2 was to clarify how the fit between (prospective) students and their major should be assessed to optimize the prediction of study success through this fit. For this we compared two different kinds of Person-Environment Fit (using two kinds of Online Self-Assessments) regarding their differential associations with study success. Person-Environment Fit Theory suggests that a more concrete measure of fit is better suited to predict success (Edwards et al., 1998; Edwards & Shipp, 2007). In a longitudinal sample of N = 455 students we assessed Interest-Major Fit, using (a) a general measure of vocational interest (Eder & Bergmann, 2015;

Holland, 1997) and (b) a university- and major-specific approach (Messerer et al., 2020). We found that the major-specific assessment of Interest-Major Fit was more closely related to study success. When controlling for high school GPA, fit was only associated with subjective outcomes of study success (study satisfaction) and not with objective outcomes (university GPA). The findings illustrate that a commensurate assessment of fit between the interests of students and their major is important.

Further, we wanted to understand the process of the longitudinal reciprocal interplay between intrinsic learning motivation and university GPA as the two main reasons for dropout (Heublein, 2014). This association is important because (a) intrinsic learning motivation was found to be directly influenced by interest-based major choices and (b) the relation between intrinsic motivation and academic achievement is not yet clear as different studies find different directions of relations (Froiland & Worrell, 2016; Garon-Carrier et al., 2016; Hebbecker et al., 2019; Schaffner et al., 2016; Taylor et al., 2014; Toste et al., 2020) – even though Self-Determination Theory indicates a positive mutual association (Deci & Ryan, 2000; Ryan & Deci, 2000, 2020). Study 3 investigates N = 1349 students about their intrinsic learning motivation and university GPA (as measure of academic achievement) over the course of six semesters with one measurement point at the beginning of each semester. Using a Random-Intercept Cross-Lagged Panel Model (Hamaker et al., 2015) we found a correlation between the stable part of intrinsic motivation and university GPA. However, carry-over effects were only found from intrinsic motivation on university GPA.

Moreover, Study 3 also explored the boundary conditions of when and how dropout occurs. The conducted Survival Analysis showed that there were differences in different study phases. Dropout in the first and fifth semester was associated with university GPA while dropout in the second semester was associated with intrinsic motivation and high school GPA. This supports the idea that there are different challenges that the students have to overcome in each study phase (Bettinger et al., 2022; Holmegaard et al., 2014; Webb & Cotton, 2019) and that boundary conditions need to be taken into account when aiming to describe the process of student dropout.

In sum, the four studies reveal longitudinal associations between study success prerequisites and outcomes. An interest-based major choice is beneficial, especially when a major-specific approach of the assessment of the congruence between students' interests and the content of the major is used. Investigating the process of study success, intrinsic motivation and academic achievement were related longitudinally. Further, exploring the boundary conditions of dropout we found different associations in different study phases. Integrating all the findings, a temporal process model of study success and dropout accounting for different study phases was developed.

# **Dissertation Outline and Overview**

The research program of this dissertation consists of three manuscripts which contain data from four survey studies. One of the manuscripts is already published in a peer-reviewed journal and the other two manuscripts are currently under review.

This dissertation comprises five chapters. I will first introduce the general research goals and questions in chapter 1. The chapters 2 to 4 are the manuscripts on which this dissertation is built. All studies are longitudinal survey studies examining study success of university students. A graphical overview of the research program on study success is given in Figure 1.1. In chapter 5, I will discuss the overall findings, limitations and implications of the conducted research and present a model of study success derived from my findings.

My overall goal is to better explain the development of study success and by doing so lay the foundation to better foster study success of university students and through this developing a process model of study success. With my research program I wanted to gain more elaborated insights into the process of study major choices and how this influences study success in terms of intrinsic learning motivation, study satisfaction, university grades, dropout intention, and student dropout as a counterpart of study success. Also, the interplay of different study success measures was investigated in more detail to gain a deeper understanding of the process of study success. Through this I aimed to derive a longitudinal process model of the study process over the time span of a full bachelor's degree.

Chapter 2 presents the first manuscript of this dissertation, investigating the impact of intrinsic motivation for enrollment on study success with two longitudinal studies (Study 1a and Study 1b). The manuscript is named "Choose Wisely: Intrinsic Motivation for Enrollment is Associated With Ongoing Intrinsic Learning Motivation, Study Success and Dropout", and was published in the Journal *Studies in Higher Education*. As we investigated a process of educational psychology in the context of higher education we chose this outlet which is a Q1 journal in the category "education" according to the SJR rankings of 2021 (SCImago, 2023).

Chapter 3 includes the second manuscript called "Interest-Major Fit Predicts Study Success? Comparing Different Ways of Assessment", which is currently under review in a peer-reviewed journal. This manuscript compares two different ways of assessment of Interest-Major Fit and investigates how they are related to study success. Further, the two prerequisites of study success, interest-based major choice and high school GPA are investigated regarding their association with study success outcomes.

The third manuscript (chapter 4) is named "Is Every Semester the Same? The Interplay Between Intrinsic Motivation and Grades and How They Relate to Dropout Over the Course of University Studies" and is currently under review in a peer-reviewed journal. This manuscript investigates the longitudinal associations of study success outcomes with a Random-Intercept Cross-Lagged Panel Model. Further this model is combined with a Survival Analysis to explain which study success outcomes contribute to dropout during certain study phases, exploring the boundary conditions for dropout more closely.

In chapter 5, I discuss the results of the three manuscripts and provide an overall summary of the findings. Furthermore, I discuss how the findings of this dissertation contribute to the development of an evidence-based and theoretically sound temporal process model of study success and dropout from a major in higher education. Further, I provide practical implications of the findings and discuss the limitations and strengths of the studies. Additionally, I will elaborate on directions for future research based on the findings and theoretical considerations of this dissertation. Finally, I end with an overall conclusion.

# Figure 1.1

# Graphical Overview of the Research Program on Study Success.



#### Introduction to Motivated Major-Choices and Study Success

How can it be ensured, that prospective students choose a major in which they study successfully – also in the long-term perspective? This question is the basis of my dissertation, and the answer may seem simple: prospective students should choose a major, which fits their interests because this is beneficial for different aspects of study success. But how can prospective students find out which major fits their interests? To what extent can an interestbased major choice predict study success? And what complex psychological processes are in play that impact study success in the longitudinal perspective?

As the transition from school to university approaches, prospective students face the challenge of finding a field of study that suits them. About 40% of the prospective students state that they struggle when deciding on a course of study, due to the increasing variety of majors on offer and are becoming increasingly uncertain about their choice (Heine et al., 2010; Oechsle et al., 2010; Schneider et al., 2017). This uncertainty might lead to poor major choices, which in turn are associated with impaired study success and consequently dropout. Recent statistics reveal that in the last 10 years there have been about 320 000 freshmen starting a bachelor's degree in Germany each year, while there were only around 230 000 students who graduated from their bachelor's degree (Heublein et al., 2022). This means that nearly 30% of the students in a bachelor's degree drop out before attaining a degree. Not only in Germany but also in many other countries the amount of dropouts is very high at around 30% in OECD countries (OECD, 2018).

The issue of ensuring study success has become more important in recent years due to for example the consideration of study success for the accreditation of study programs as well as the performance-oriented allocation of funds at higher education institutions (Hochschulrektorenkonferenz, 2010; Neugebauer et al., 2021). In addition, the fact that skilled workers are urgently needed in a number of industries is a current issue (Grunschel & Dresel, 2021; Neugebauer et al., 2019; Sarcletti & Müller, 2011). It is therefore important that study programs that have been started are actually completed and that the graduates are available to the labor market as skilled workers. From the student perspective dropout is associated with several negative consequences like poorer mental health, lower income and lower socioeconomic status as well as higher risk of unemployment (Davies & Elias, 2003; Faas et al., 2018).

#### Chapter 1: General Introduction

Considering the importance of study success for both, the society and the individual, the question remains how study success can be ensured. In the literature, there are different models which aim to describe study success and reasons for dropout from higher education (c.f. Bean & Metzner, 1985; Heublein, 2014; Tinto, 1975). Those models name a plethora of variables that contribute to dropout and those variables are also often connected with each other in those models.

However, some major shortcomings of the existing models are that they often lack empirical evidence, do not take a longitudinal perspective on dropout regarding different study phases, and do not provide a psychological explanation on how the different measures of study success are connected – especially in a longitudinal perspective (Sarcletti & Müller, 2011). In this dissertation I want to address those shortcomings by a) providing theoretical explanations why study success predictors and outcomes are related, b) examine the theoretical assumptions about the relations of study success predictors and outcomes with empirical studies and c) provide a longitudinal perspective on the connection of study success measures using several measurement points and also take into account, that variables (e.g., motivation) might change during the course of the studies.

To take a closer look at the theoretical background and underlying psychological mechanism regarding study success, I first will define what I mean by study success. Then, I am going to elaborate on prerequisites of study success relevant to my dissertation. Moreover, I am going to illustrate how prerequisites of study success as well as different study success outcomes are associated.

#### Aspects of Study Success

Whether studying at university is successful can be viewed from different perspectives: *Institutional* study success means the effectiveness of the educational system regarding the costs-efficiency, *market-based* study success addresses the success of graduates in the labor market, and *individual* study success describes academic success from the student's perspective (Heinze, 2018; Sarcletti, 2020). In this dissertation I take the student perspective and focus on certain aspects of the multi-dimensional construct individual study success: dropout (as counterpart to graduation), grades, dropout intention, study satisfaction and intrinsic motivation.

Those aspects of study success can be categorized into academic/objective outcomes and psychological/subjective outcomes (Bean & Metzner, 1985; Heinze, 2018). Objective aspects are variables that can be measured externally, while subjective aspects are characterized by the subjective feelings of the person being investigated. Dropout and grades are objective aspects of study success while satisfaction, dropout intention and intrinsic learning motivation are subjective aspects. Subjective indicators are less simple to observe and are often inquired via self-report measures (Paulhus & Vazire, 2007). I will elaborate on those five outcomes, why they are important for a holistic perspective on study success and how they are theoretically connected in the following sections. An overview of the aspects and prerequisites of study success is given in Figure 1.2.

# Figure 1.2

*Graphical Overview of the Predictors and Outcomes of Study Success Investigated in This Dissertation.* 



# Dropout From a Major vs. Graduation

Whether students have finished their studies can be regarded as the most obvious definition of study success. The advantage here is that it is a binary variable which is easy to assess - or at least it seems to be. When taking a closer look at dropout however, there are different possible factors to consider and different authors give different definitions of dropout (Heublein et al., 2022; Hovdhaugen, 2009; Mouton et al., 2020). I define dropout as enrolling in a major and leaving it without attaining the aspired degree. Following this definition also defines changing the major but staying at the same university as dropout. This follows recent findings that quitting the studies and changing the major are two separable constructs (Bäulke et al., 2022). Not all authors define this as dropout, however given the German university context in which there is no general orientation phase, and given the scope of this dissertation, this seemed like the appropriate definition. As I aimed to find measures that predict study success even before the major choice and as I especially take interest in the major into account, this fits my operationalization of dropout. If students chose a major, in which they do not graduate, something went wrong regarding the major-choice, and even if they continue at the same university, the initial major choice was not optimal. Moreover, if students change their major, they need to start over (nearly) completely with the courses of the new major and can transfer no or very few credit points from the previous major. Changing university but continuing studying the same major is not regarded as dropout. In this case the major choice based on the interests was right, but personal living conditions can change so that it suits the students better to live and study at another place. Even though there might be exceptions, I propose that this definition of dropout serves my research questions for the majority of the students.

On a side note, it has to be mentioned that dropout from a major does not have to be necessarily bad as dropout could be also positive under certain circumstances. If people figure out that another career suits them better, it may be beneficial to drop out and pursue this path. Dropping out early might be the best solution in this case as individuals do not spend more time on a career path they do not want to pursue further, nor do the universities spend resources on students that do not graduate in the end (Rindermann & Wagner, 2003; Voelkle & Sander, 2008). However, dropping out from a major is also an experience of failure, which might negatively affect students' general well-being (Ajjawi et al., 2020). Therefore, dropping out should not be condemned, but at the same time prevented if possible. This means for example that students who merely lack support structures to find a major that fits them should be supported in doing so. *Dropout Intention* 

Actual dropout from a major is often not easy to assess in longitudinal survey studies, because if participants stop answering the survey it remains unknown if they only stopped answering the survey or if they dropped out from their studies. However, because objective data on dropout is difficult to obtain (e.g., due to data privacy) many studies assess dropout intention (Bardach et al., 2020; Bohndick, 2020; Höhne & Zander, 2019; Respondek et al., 2017; Scheunemann et al., 2021; Suhlmann et al., 2018). Different models of dropout state, that dropout intentions are the best predictors of dropout (Bean & Metzner, 1985; Heublein, 2014). However, temporary financial or psychological crises, failing an exam or receiving a bad grade could temporarily lead to thoughts about dropout that do not necessarily lead to actual dropout. It also has to be noted that dropout intentions can be divided in different phases from first thoughts about misfit to the actual decision and that dropout is a multi-staged process which might take a longer period of time (Bäulke et al., 2022). According to the process model of student dropout intentions, dropout can be divided in the phases non-fit perception, thoughts of quitting the studies/changing the major, deliberation, information search, and final decision (Bäulke et al., 2022). The claim of this model is that there is a temporal order and that the phases are passed through sequentially. Given this model with these different stages of dropout intentions (see Bäulke et al., 2022), there is no model that describes the different time points during the course of the studies (first semester until last semester) in which certain variables contribute to dropout. Academic Achievement

University grades can be defined as an assessment that reflects the academic success and the degree of knowledge and comprehension of a student in a course or program and is a proxy for various cognitive and non-cognitive characteristics of an individual (Schüpbach et al., 2006). Good performance at university is important not only because students can only continue their studies with a minimum level of performance, but also because good grades are an indicator of competence, which people strive for (Niemiec & Ryan, 2009).

Empirical research regarding study success often takes university grades into account (Heinze, 2018). The advantage of university grades as a measure of

study success is surely that grades are numerical and therefore seem highly objective. However, the objectivity of this measure is weakened by the fact that grades in different majors are not directly comparable. Therefore, consideration must be given to how comparability can be established between different majors. Several statistical methods are possible here and should be applied. Nevertheless, university grades are one of the few objective measures of study success – especially if it is possible to obtain them objectively and not via selfreport.

#### Intrinsic Learning Motivation

People experience intrinsic learning motivation when they do an activity because they enjoy doing it for their own sake. In the context of studying it refers to the extent to which students enjoy dealing with the content of their major and study because they are genuinely interested in it (Deci & Ryan, 2010, 2013; Ryan & Deci, 2020).

Intrinsic learning motivation is often included in models of study success. However, it is often regarded as a predictor or mediator of study success – rather than an outcome to measure study success (e.g., Hardre & Reeve, 2003; Howard et al., 2021; Jeno et al., 2018). This is also due to the fact that models of study success take the perspective that study success is just finishing the studies rather than incorporate the idea that study success can be regarded as a transformative process that can be measured during the whole process of studying which also includes subjective indicators (for more details on transformative study success see Janke, 2022). In this dissertation I also include the process-orientated view on study success and include study success outcomes that can already be measured during the study process. Therefore, intrinsic learning motivation is included as a study success outcome – even though it is also associated with other study success outcomes and might even impact other study success outcomes.

Intrinsic learning motivation is known to decline over time as many studies in the school context show (Musu-Gillette et al., 2015; Scherrer & Preckel, 2019). This indicates that educational settings fail to create an environment in which students' needs are met (Gnambs & Hanfstingl, 2016). This decline of motivation over time can also be assumed for the university context (Heublein, 2014). Fostering intrinsic learning motivation therefore seems essential considering its importance a) for students to enjoy their studies and b) as a study success outcome that is related to other study success outcomes.

#### **Study Satisfaction**

Successful students do not only exhibit academic achievement but are also satisfied with their learning environment (OECD, 2017). Study satisfaction refers to what students think and feel about their studies and can be described as cognitive well-being of university students (Diener et al., 2018; Grunschel et al., 2016). This evaluation of the studies can include aspects like the content of the major, the study conditions and how students manage to cope with study-related stress (Westermann & Heise, 2018). As this dissertation focuses on majorchoices and how they contribute to long-term study success, I will focus on how satisfied students are with the content of their current major.

# **Prerequisites of Study Success**

After having clarified which aspects of study success should be achieved, the question remains how this can be done. Literature names a plethora of prerequisites of study success (Heinze, 2018; Heublein, 2014). In this dissertation I focus on high school GPA, intrinsic motivation for enrollment and Interest-Major Fit because these seem the most promising as I will illustrate in the subsequent sections. Moreover, those factors can be assessed even before enrolling in a major which yields the advantage of predicting study success in a certain major at an early stage. This could prevent prospective students from choosing a major that is not suited for them and protect them from a potential failure and disappointment. As for the aspects of study success, I combine subjective and objective variables to get a comprehensive view.

# High School GPA

High school GPA (in German: "Note der

Hochschulzugangsberechtigung") can be regarded as a proxy for prior knowledge of the students and for their general academic performance (Braun et al., 2014; Schiefele et al., 2003). It has an extraordinarily good validity and predictivity of study success – especially on university grades (Fries, 2002; Janke & Dickhäuser, 2018; Richardson et al., 2012; Trapmann et al., 2007). The high school GPA is also a good proxy variable of several cognitive and noncognitive characteristics of the prospective students. One advantage of the high school GPA compared to, for example, major-specific aptitude tests is that it does not have to be collected at great effort but is already available for every prospective student as it is a prerequisite to enter higher education (Tent & Birkel, 2010). Various studies find a medium-sized correlation between high school GPA and study success in both Germany (Blömeke, 2009; meta-analysis by Trapmann et al., 2007) and the United States (meta-analysis by Robbins et al., 2004). Thus, high school GPA is a rather strong prerequisite of study success.

#### Interest-Based Major Choices

The foundation for successful studies is already laid when choosing a fitting major. *Intrinsic motivation for enrollment* can be defined as the extent to which prospective students base their major choice primarily on their personal interests (Janke et al., 2021; Ramm et al., 2014; Rump et al., 2017). This can be contrasted with other motivators of major choice, such as an extrinsic motivation for enrollment. This means individuals choose a major because of subsequent good earnings or socially-induced motivation for enrollment, meaning individuals choose a major because of advice by parents or friends (c.f. Janke et al., 2021). Intrinsic motivation for enrollment can be assessed by directly asking the (prospective) students if they based their major choice on their interests. However, this requires (a) self-reflection by the students and (b) students need to be aware of the content of the major. However, studies have shown that students often have misconceptions about the content of a major (Hasenberg & Schmidt-Atzert, 2013) or are not informed enough to actually take a fact-based decision (Stoll, 2019).

This challenge can be addressed by assessing the fit between a students' interests and the actual content of the major (*Interest-Major Fit*). This requires more detailed questionnaires than intrinsic motivation for enrollment but secures a more objective assessment of the fit. A popular approach to support prospective students in finding a fitting major, help them with self-reflection about their fit with a major and provide more information about the major are *Online Self-Assessments* (OSAs; Milbradt et al., 2008; Stoll, 2019). Online Self-Assessments are web-based, free-of-charge services designed to support prospective students in their study decisions (Kubinger et al., 2007). By providing information about the study content, requirements of specific majors, and the possibility to compare one's interest with the study content, OSAs provide the basis for an informed study decision. As the results of OSAs have no direct consequences for the admission to a major they are a self-selection tool with a high degree of personal responsibility because the prospective students decide which major fits them best – compared to aptitude tests or other

admission criteria by the university (Kubinger et al., 2007). This self-selection and self-reflection aspects are beneficial because they open up the opportunity to include motivational and interest measures which have an impact on both the major choice and study success – but can be manipulated easily and are therefore not helpful in aptitude tests (Nye et al., 2012; Spengler et al., 2013). Another advantage of Online Self-Assessments is that they do not have limitations regarding the capacity of students that can take them and also that they can be offered regardless of time and place (Diercks et al., 2009).

Thus, Online Self-Assessments are a good tool to help prospective students in their major choice. But how do Online Self-Assessments need to be designed to be helpful for prospective students? While the positive effect of Online Self-Assessments on study success has been established, it has not yet been conclusively clarified how Online Self-Assessments should be developed and how the interests should be assessed to be most effective. The most common approach is that interests are measured with the established RIASEC model of vocational interests (Allen & Robbins, 2010; Eder & Bergmann, 2015; Holland, 1959, 1997; Usslepp et al., 2020). According to the RIASEC model, there are six different categories of vocational interests: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Using this structure, the Interest-Major Fit can be calculated by comparing the prospective students' interest profiles with the environment profile of the major (Brown & Gore, 1994; Camp & Chartrand, 1992). Chapter 3 (Manuscript 2) compares this approach with a more major- and university-specific measurement of fit between students and the major following the view that commensurate assessment of Interest-Major Fit is important (Edwards et al., 1998).

Another important consideration regarding interest-based major choice is whether prospective students' interests can be predictive of later study success at all, since it could be argued that interests might change over time. However, findings of previous studies show that it can be assumed that interests can still change strongly in childhood and adolescence, but stabilize thereafter (Etzel & Nagy, 2021; Low et al., 2005; Low & Rounds, 2007). Therefore, interests can be considered as reliable predictors of study success.

To sum up, I have identified three prerequisites of study success and five aspects of study success that should be investigated further. By combining subjective and objective measures of prerequisites and outcomes of study success, I aim to gain a holistic understanding of the process of study success. In the following paragraphs possible connections between those variables will be illustrated. The theoretical foundation are the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) and the Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2000, 2020). Further I will illustrate which connections between study success predictors and outcomes have been already investigated in existing research and which new goals I want to achieve beyond that.

#### Interplay Between Study Success Prerequisites and Outcomes

Going beyond existing literature and models of study success, I want to illustrate psychological mechanisms underlying the genesis of study success and will take a closer look at their relations. Doing that, I will especially pay attention to the longitudinal perspective and apply psychological theories – in particular the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) and the Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2000, 2020).

## Impact of Interest-Based Major Choices on Study Success

Person-Environment Fit Theory describes that individuals who feel comfortable in their environment and who experience a fit between themselves and their environment will respond positively to it (Edwards et al., 1998; Edwards & Shipp, 2007). More specifically, the individual will be more satisfied, feel more intrinsically motivated, perform better, and be more likely to want to stay in that environment. In contrast to this, a person who experiences a misfit between him/herself and the environment will be more dissatisfied, less motivated, less willing to perform, and more likely to want to leave the environment (Edwards et al., 1998; Edwards & Shipp, 2007). The Person-Environment Fit Theory has already been applied to several contexts (e.g., workrelated; Kristof-Brown et al., 2005; Nye et al., 2017) and also to the context of interest-driven major choices in higher education: In this context, the Interest-Major Fit is particularly relevant (Allen & Robbins, 2010). The interests of the (prospective) students need to fit the content and requirements of the major. If there is a congruence between the students' interests and the major-specific content, higher study satisfaction, intrinsic motivation, better performance and less (intentions to) dropout (= leave their current environment) can be expected – based on the Person-Environment Fit Theory (Edwards & Shipp, 2007). This means an interest-based major choice is a good foundation for the further development of study success.

But how are study success outcomes related to each other (over the course of studies)? To answer this question, it is beneficial to take a look at the different aspects of study success separately.

For *intrinsic study motivation*, it is arguable whether this is really a study success outcome or a prerequisite or mediator (Heinze, 2018; Heublein, 2014). It seems self-evident that an interest-based major choice has the most direct impact on motivational aspects. Therefore, it could be argued that intrinsic study motivation is both, a mediator of study success and a study success outcome. Students who successfully make an interest-based major choice and therefore experience interest-major fit (Bretz & Judge, 1994) are more likely to experience joy and interest in the content of the major, and consequently experience intrinsic learning motivation (Deci & Ryan, 2010). As a result, an interest-based major choice is likely to positively affect intrinsic learning motivation.

In addition, an interest-based major choice and resulting interest-major fit may lead to *satisfaction* with the study content (Etzel & Nagy, 2016). This is because it is likely that students who chose their major out of interest consider the content of the major enjoyable and satisfying (Westermann & Heise, 2018).

Further, an interest-based major choice is likely to be a protective factor against dropout intentions (Etzel & Nagy, 2016), as a non-fit perception between personal interests and study content can be regarded as the first step towards thoughts about dropout (Bäulke et al., 2022). This association between an interest-based study choice and dropout intentions can be explained by the process model of student dropout intentions (Bäulke et al., 2022). This model describes that the first step towards dropout intention is the students' impression that they do not fit into their environment. This aligns with the consideration of the Person-Environment Fit Theory (Edwards & Shipp, 2007). Empirical studies found that dropout intentions were related to subsequent lower study satisfaction (Scheunemann et al., 2021). Interest-based major choices are associated with successfully graduating and less *dropout* as empirical studies indicate (Dresel & Grassinger, 2013; Heublein et al., 2017). However, most of these studies are cross-sectional, lack objective assessment of dropout and do not investigate psychological mechanisms that could account for the discovered associations. Therefore, I aimed to gain a deeper understanding of the processes underlying the formation of dropout and the longitudinal process that leads to dropout.

An interest-based major choice could also have an indirect impact on *academic achievement* (mediated by intrinsic learning motivation), as

performance depends on optimal motivation just as much as it does on ability (Edwards & Shipp, 2007; Kriegbaum et al., 2018). This is supported by empirical evidence which found that intrinsic learning motivation is an important predictor for performance (Hattie, 2009; Liu & Hou, 2017). This indicates that students are more likely to perform below expectations at university if they are unable to develop intrinsic learning motivation due to a non-optimal major choice. While the claim that an interest-based major choice has a positive association with performance is covered by the Person-Environment Fit Theory (Allen & Robbins, 2010; Tracey & Robbins, 2006), it cannot explain longitudinal associations between intrinsic learning motivation and academic achievement.

However, especially in the school context, it is often assumed that intrinsic motivation is also influenced by academic achievement or that there is a reciprocal relation between intrinsic motivation and academic achievement (Hebbecker et al., 2019; Schaffner et al., 2016; Taylor et al., 2014; Toste et al., 2020). Still, other studies only find unidirectional associations – and the direction is not consistent in different studies: On the one hand studies have found that intrinsic learning motivation impacts academic achievement (Froiland & Worrell, 2016; Liu & Hou, 2017). On the other hand, there is evidence for a unidirectional impact of academic achievement on intrinsic learning motivation (Garon-Carrier et al., 2016). The direction of these associations in a longitudinal setting and in the context of higher education has not been fully explained yet. Given those inconsistent associations, sometimes in one direction and sometimes in the other, it is not possible to make a statement about the relation of intrinsic motivation and academic achievement. As this is important considering the temporal association between two variables that might lead to dropout from higher education, I aimed to investigate this association in my dissertation project. Through this, I aimed to clarify the inconsistencies in previous findings, using a longitudinal study design with multiple measurement points.

The Self-Determination Theory (Ryan & Deci, 2019, 2020) can explain the psychological interactions underlying the association between intrinsic motivation and academic achievement. In particular, this theory proposes that cultivating a sense of competence is advantageous to fostering intrinsic motivation (Niemiec & Ryan, 2009; Pintrich, 2004; Ryan & Deci, 2020; Ryan & Moller, 2017). Receiving good grades is closely linked to the feeling of competence (Leondari & Gialamas, 2002) and as a result likely with intrinsic motivation as well. If students experience repeated failures, this may lower their intrinsic motivation. This may explain the impact from academic achievement on intrinsic motivation via perceived competence. Self-Determination Theory also explains why intrinsic motivation might influence academic achievement: If students are intrinsically motivated, they are apparently also more likely to like their studies and will, therefore, work harder and devote more time to their studies (Ryan & Deci, 2020). As a result, they probably perform better on subsequent exams and receive better grades (Hebbecker et al., 2019; Taylor et al., 2014).

The previous considerations illustrate how an interest-based major choice is related to study success. In the following, I will focus on high school GPA as an objective predictor of study success.

# Impact of High School GPA on Study Success

The strongest predictor of study performance is prior performance (Casillas et al., 2012; Manganelli et al., 2019), e.g., high school GPA is very predictive for performance at university (Geiser & Santelices, 2007; Janke & Dickhäuser, 2018; Maslov Kruzicevic et al., 2012; Trapmann et al., 2007). Therefore, high school GPA is considered a relevant predictor when regarding university GPA. As described above university GPA is associated with other aspects of study success. Consequently, it can be assumed that high school GPA is at least indirectly associated with other aspects of study success as well (partly mediated by university GPA). In line with this assumption, empirical evidence shows that high school GPA is predictive for dropout from a major (Berzenski, 2021). High school GPA is predictive for dropout from a major (Berzenski, selected for this dissertation project are to some extent associated with each other.

In this dissertation I mainly use high school GPA as a control variable to explore if an interest-based major choice is beneficial for study success – even if controlling for high school GPA as the strongest predictor of study success. *Longitudinal Interplay of Study Success Outcomes Contributing to Dropout* 

Lack of intrinsic motivation and performance problems are among the main reasons for dropout from university (Heublein, 2014). Both performance and intrinsic study motivation are considered as theoretically and empirically distinct aspects of study success (Jeno et al., 2018; Taylor et al., 2014). While performance is a powerful predictor for an individuals' ability not to drop out of

university and instead successfully attain a degree (Casanova et al., 2018; Heublein, 2014; Li & Carroll, 2017), intrinsic study motivation is associated with subjective well-being and study engagement (Bailey & Phillips, 2016; Patall et al., 2008; Siu et al., 2014), but also with persistence (Dresel & Grassinger, 2013; Hardre & Reeve, 2003; Heublein et al., 2017; Schiefele et al., 2007; Vansteenkiste et al., 2004). Thus, both factors should be considered when aiming for a comprehensive perspective on dropout.

As mentioned above there is a theoretical foundation for associations between intrinsic motivation and academic achievement in both directions. Additionally, there is mixed evidence regarding these associations. To identify which of these variables has a stronger impact on dropout and to identify the processes underlying the associations, it is important to gain a deeper understanding of the longitudinal associations. Therefore, one goal of this dissertation is to understand this process in more detail. This is also helpful for the implementation of services to help students to successfully finish their studies as those services need to know on which aspects they should focus on.

A further limitation of existing research on the process of study success and dropout is that usually models only list predictors of study success and dropout without a more detailed explanation of the question at which time point during the studies certain aspects are more or less important. As studying at university is a process during which students develop a lot, it makes sense to assume that not all phases of studying contain the same challenges (Bettinger et al., 2022; Clark, 2005; Hunter et al., 2010; Larsen et al., 2013; Webb & Cotton, 2019). Therefore, it is questionable if it can be expected that all factors that contribute to dropout have the same impact in all study phases. Previous research has, e.g., taken a closer look at the freshman year and found that students are challenged to adjust to their new environment during this period of time (Holmegaard et al., 2014). This is a challenge that many universities have recognized and often there is some kind of support system in place to help the new students to fit in (Larsen et al., 2013). In the sophomore year students often struggle with a decrease in academic achievement and persistence (Webb & Cotton, 2019). In this phase, the support given in the freshman year is often not existent anymore. Also, in the final year of the studies, students are usually expected to study more independent and overcome possible difficulties of studying on their own (Bettinger et al., 2022). Despite this first insights in the study process, a holistic view on the whole study process and how students

manage to stay motivated, attain good grades and not drop out of the studies is missing. Further, data covering the entire time span of a bachelor's degree is rare – especially integrating objective data regarding academic achievement and dropout. This is important to develop a more detailed model of dropout which can account for temporal differences of the process.

#### Testing the Associations Using Advanced Statistical Analyses

Following the theoretical considerations, I would now like to address the methodological challenges of the present research and how I have solved them. For Manuscript 1 and Manuscript 2, latent structural equation models and regression analyses were sufficient. As the third manuscript included a longitudinal study with six measurement points and as I wanted to gain a deeper understanding of the processes and temporal associations, it was necessary to find an appropriate way to deal with the data to be able to account for both within-person effects and between-person effects. Therefore, a Random-Intercept Cross-Lagged Panel Model (Hamaker et al., 2015) seemed the right choice, as it has several advantages, for example over a Cross-Lagged Panel Model. A Random-Intercept Cross-Lagged Panel Model decomposes the effects of between-person factors (stable traits) and within-person factors (temporal deviation from the trait). Further, Random-Intercept Cross-Lagged Panel Models are suited to deal with covariates that are time-invariant (Hamaker et al., 2015; Mulder & Hamaker, 2021) as those covariates impact the between-person effects (Random Intercepts) only. Statistically speaking, the between-person factors are independent from the within-person factors (autoregressive and cross-lagged effects) which are used to examine the directional ordering (Hamaker et al., 2015). This characteristic of the Random-Intercept Cross-Lagged Panel Model was used to account for the temporal direction of the effects.

Further, as dropout from a major also meant that subsequent data on other study success measures could not be obtained and would not make sense as the respective students quit their studies, it was also necessary to find an appropriate way to deal with that. Using a *Survival Analysis* (Muthén & Masyn, 2005), it was further possible to include the point of time when students dropped out from their studies. One result of the Survival Analysis are hazards of dropping out – in case of Manuscript 3 the thresholds (hazards in logit scale) were used to indicate the probability of dropping out. This allows to learn more about which study success prerequisite or study success outcome is related to dropout at a certain time point and building on that developing a temporal model of dropout from a major in higher education.

# **Goals of This Dissertation**

Overall, this dissertation aims to explain the associations between prerequisites and outcomes of study success and develop a temporal process model of study success and dropout from higher education. This overarching goal can be divided into four subgoals: First, to *establish the connection* between an interest-based major choice and study success (Goal 1). Second, to *clarify which assessment* of Interest-Major Fit is better suited to predict study success (Goal 2). Third, to *understand* how study success outcomes are related longitudinally over the course of studies (Goal 3) and fourth, to *explore boundary conditions* of dropout by identifying which study success outcomes and study entry criteria contribute to dropout in different study phases (Goal 4).

For Goal 1, I hypothesize that an interest-based major choice is associated with subsequent study success. This is in line with the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) which postulates that an environment that fits the person, in the context of studying at university a major that fits the interest of the students, leads to more motivation, less intentions to leave the major, less dropout, better performance, and more satisfaction. As the findings of Study 1a and Study 1b confirmed associations between an interest-based major choice and study success the next logical step is to investigate how to assess whether a major choice is interest-based.

Therefore, the second goal is the comparison between two assessments of Interest-Major Fit regarding the impact on study success. I hypothesize that a concrete operationalization of the construct facilitates the predictive power of Interest-Major Fit (Edwards et al., 1998; Edwards & Shipp, 2007; Kristof-Brown et al., 2005). The congruence can be assessed more accurately if a commensurate and more concrete assessment is used. Therefore, the major-specific approach should be more closely associated with study success than the general assessment.

After having established that an interest-based major choice is beneficial, the next step is the understanding of the longitudinal relationship between study success outcomes (Goal 3). The longitudinal relationship between study success outcomes – especially intrinsic learning motivation and academic achievement at the university – is investigated in Study 3 and partly in Study 1b. Based on the Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2000, 2020), I hypothesize a positive bidirectional association between intrinsic learning motivation and academic achievement.

The fourth goal of this dissertation is to explore boundary conditions of dropout taking the different study phases into account. For this, Study 3 and to some extent Study 1b aimed to identify study success outcomes and prerequisites that contribute to dropout and categorize them by the phase of the studies (freshman, sophomore, or final year) in which they contribute to dropout. Despite a few insights on the challenges in different study phases already exist (Bettinger et al., 2022; Clark, 2005; Hunter et al., 2010; Larsen et al., 2013; Webb & Cotton, 2019), this is not enough to formulate concrete directed hypotheses about which variables have the greatest influence in which study phase. Therefore, the fourth goal is exploratory research of phases in which certain study success variables are particularly relevant. From the results of all manuscripts a temporal process model of study success and study dropout was developed.

To sum up, the goals were to establish the connection between an interest-based major choice and study success (Goal 1). Building on this, Goal 2 was to clarify which constructs and assessments are commensurate to measure Interest-Major Fit in a way that predicts study success. Further, Goal 3 was the understanding of the process underlying the association between the study success outcomes intrinsic motivation and academic achievement. Goal 4 was to explore boundary conditions of how and when dropout is associated with study success prerequisites and outcomes. The overall goal was to develop a longitudinal process model of dropout from a major in higher education which takes different study phases into account.

The next three chapters comprise the three manuscripts that are the basis for this dissertation. Subsequently, the overarching discussion of the findings of my dissertation is presented in chapter 5.

# Manuscript 1 – Choose Wisely: Intrinsic Motivation for Enrollment is Associated With Ongoing Intrinsic Learning Motivation, Study Success and Dropout

#### Abstract

Student dropout is a frequent phenomenon in higher education institutions that entails high costs for individuals, institutions, and society as a whole. Thus, it is crucial to identify protective factors regarding dropout in cases in which it could have been prevented. In line with Person-Environment Fit Theory, we assume that intrinsic motivation for enrollment (i.e., choice of major based on personal interests) is an important protective factor that facilitates intrinsic learning motivation over time, which should in turn be positively associated with performance at university and negatively associated with dropout (intentions). We tested these assumptions in two longitudinal studies using structural equation modeling. In Study 1a, we found that intrinsic motivation for enrollment was associated with a positive development of intrinsic learning motivation (N = 774 students, two time points during the first two semesters). In Study 1b, we investigated whether intrinsic learning motivation mediated the association between intrinsic motivation for enrollment and study success variables (N = 1185 students, three time points during the first academic year). Intrinsic motivation for enrollment was only slightly positively associated with university GPA, but negatively with students' dropout intention measured one year later - mediated via intrinsic learning motivation. We did not find an association between intrinsic motivation for enrollment and actual dropout. The presented research provides the foundation for a process model linking the quality of motivation for enrollment to study success, which has strong implications for counseling of prospective students as well as for the identification of students at risk.

*Keywords*: Intrinsic motivation for enrollment; study success; motivation for learning; university dropout; motivated educational decisions

#### Introduction

About one third of university students leave their major without the degree they initially aspired (see Heublein & Schmelzer, 2018 for Germany; OECD, 2018 for OECD countries), mostly during their first academic year (Heublein et al., 2017). Dropping out from a major or from university entails

high costs for the state, society and the affected individuals (Behr et al., 2020; Sarcletti & Müller, 2011; Schiefele et al., 2007). While dropout and change of major may be unproblematic in some higher education systems that explicitly integrate orientation phases into study programs, it represents higher costs for the state, society and the affected individuals in higher education systems that lack such structures. The German higher education system (among others) usually lacks an orientation or introductory phase in which students can freely explore various majors. Students typically choose a major before entering university and are expected to complete it. Dropout (from a major) is commonly associated with significant opportunity costs for the individual and considered a public cost for society due to a lack of permeability between study programs, which is why it is often regarded as an event that should be avoided (Heublein, 2014; Sarcletti & Müller, 2011). Accordingly, it is an important task for educational research to identify protective factors that can prevent dropout meaning students from changing their major or dropping out from university completely. Motivational variables are particularly important predictors of dropout from a major (Allen et al., 2008 for the US; Heublein et al., 2017 for Germany). According to Person-Environment Fit Theory, individuals are more likely to develop optimal motivation when choosing environments that suit their interest profile (Le et al., 2014). Thus, we assume that the degree to which individuals base their choice of major on their personal interest (in the following labeled as intrinsic motivation for enrollment; Janke et al., 2021; Ramm et al., 2014) impacts whether they can uphold interest for this subject (i.e., intrinsic learning motivation) over time. In the present studies, we investigate whether intrinsic motivation for enrollment can indeed serve as a protective factor against dropout from a major while also ensuring performance through the facilitation of optimal learning motivation.

#### A Process Model on Motivated Dropout From a Major in Higher Education

In order to understand why dropout from a major occurs, it is necessary to take a closer look at the preceding processes. There are different models of student dropout from higher education focusing on various aspects that could lead to dropout (Bean & Metzner, 1985; Heublein, 2014; Kember, 1989; Tinto, 1975). Here we focus on some parts of the dropout from higher education process model (Heublein, 2014). We assume that the foundation for persistence in the major is already laid, at least in part, when student aspirants decide in which major they want to enroll themselves (*phase of major decision*; Heublein, 2014). Identifying majors that align well with one's interest profile can help prospective students in facilitating an optimal fit between their personal characteristics and their learning environment – or in other words ensure an optimal Interest-Major Fit, which is a subcategory of Person-Environment Fit (Allen & Robbins, 2010; Tracey & Robbins, 2006). We assume that intrinsic motivation for enrollment is a factor that evokes Interest-Major Fit as it guides prospective students towards considering their interest profile while choosing between majors. As such, intrinsic motivation for enrollment should help to ensure optimal Interest-Major Fit in the later study situation.

Students who succeed in facilitating a good Interest-Major Fit are supposedly more likely to develop joy and interest for the learning subject (Bretz & Judge, 1994) and therefore intrinsic learning motivation (Deci & Ryan, 2010). Consequently, intrinsic motivation for enrollment should impact intrinsic learning motivation. Through this, performance should be indirectly (via intrinsic learning motivation) impacted by intrinsic motivation for enrollment because performance depends as much on optimal motivation as it depends on optimal abilities (Edwards & Shipp, 2007; Kriegbaum et al., 2018). This means that if students fail to facilitate intrinsic learning motivation, they also become more likely to underperform at university.

# Figure 2.1





Additionally, the experience of low intrinsic learning motivation could trigger complex processes that will eventually make students consider dropping out of their major. In the first stage of forming such dropout intentions, students may develop the impression that there is an incongruence between their personal interests and the study content (also labeled non-fit perception; Bäulke et al., 2021). We think that intrinsic learning motivation plays an important role during this stage, which will eventually lead to further rumination about dropout and eventually to students acting on festered dropout intentions. We can assume that students who develop intrinsic learning motivation while studying, are a) less likely to think that the major does not suit them and b) more likely to do well in their courses. In turn, students have fewer reasons to doubt their fit, which could prevent them from thinking about dropping out of their major. These assumptions align well with empirical evidence that has shown that intrinsic learning motivation is an important predictor for persistence (Hardre & Reeve, 2003; Vansteenkiste et al., 2004) and performance alike (Hattie, 2009; Liu & Hou, 2017).

This would also mean that intrinsic motivation for enrollment can indirectly reduce students' dropout intentions as it provides the foundation for intrinsic learning motivation. Additionally, we assume that intrinsic motivation for enrollment impacts dropout intentions even more directly because a high intrinsic motivation for enrollment may positively influence the development of a sense of Interest-Major Fit - which should lead to less thoughts about non-fit to the major. Taken together, this would make intrinsic motivation for enrollment an important protective factor reducing the risk of both the emergence of perception of non-fit and shielding students from dropping out of their study program. Such a notion aligns well with current theoretical frameworks that consider dropout as long-term decision-making which is influenced by factors that already impact students' choice of major (Bäulke et al., 2021; Heublein, 2014). According to such dropout models, factors impacting students' decision for a certain major (e.g., interest, personal preferences) supposedly also impact their later perspective on their major and the learning content (i.e., the Interest-Major Fit and intrinsic learning motivation).

Empirical evidence suggests that intrinsic motivation for enrollment is indeed associated with persistence at university (Dresel & Grassinger, 2013; Heublein et al., 2017). Moreover, comparisons of dropouts with graduates show that the latter retrospectively report a higher intrinsic motivation for enrollment (Heublein et al., 2017). A limitation of the existing studies on motivational factors impacting dropout is, however, that they are mostly cross-sectional in nature, lack objective measures for outcome variables (such as dropout or performance) and did not investigate mechanisms that could explain the uncovered associations. We consider intrinsic learning motivation to be a variable that is particularly important for the facilitation of the association between intrinsic motivation for enrollment and study success. In this regard, it is noteworthy that a lack of (intrinsic) learning motivation and the resulting performance problems are among the most prevalent self-ascribed reasons for university dropout (Hardre & Reeve, 2003; Heublein, 2014).

#### **Research Questions**

In the presented research, we aim to provide empirical evidence for the proposed process model of motivated dropout that explains the supposed impact of intrinsic motivation for enrollment on intrinsic learning motivation and study success. First, we want to show that intrinsic motivation for enrollment is associated with a positive development of intrinsic learning motivation over the course of the first semester (Study 1a). Second, we want to investigate how intrinsic motivation for enrollment is associated with other measures of study success, namely dropout intention, dropout and university grade point average (GPA) as a measure of performance (Study 1b). We propose that the assumed positive association of intrinsic motivation for enrollment with university GPA is mediated through intrinsic learning motivation (intrinsic motivation for enrollment should positively predict intrinsic learning motivation, which should predict better university GPA; indirect effect). Moreover, we hypothesize that intrinsic motivation for enrollment is negatively predictive for dropout intention - both directly and indirectly via intrinsic learning motivation. Intrinsic motivation for enrollment should positively predict intrinsic learning motivation, which should negatively predict dropout intentions. The same is expected for actual dropout (direct and indirect effect). The proposed model as well as the aims of both conducted studies are visualized in Figure 2.1.

#### Study 1a

This study investigates the temporal effects of intrinsic motivation for enrollment on intrinsic learning motivation. Particularly, we assumed that higher values in intrinsic motivation for enrollment at T1 are associated with higher values of intrinsic learning motivation at T2 – even when controlled for intrinsic learning motivation at T1.

# Method

We examined our research questions using data from an existing longitudinal study of university students that was conducted at a public German university which has a focus on social and economic sciences. With around 12,000 students the university was medium sized for an institution of higher education in Germany. In Germany, university education is usually divided into three subsequent stages (bachelor, master, doctorate). The major has to be chosen before entering university and is usually not to be chanced in the course of study. The investigated sample only consisted of students at the beginning of the first stage of their education (bachelor level).

The original study included four time points, but we only used the first two time points as we wanted to investigate the importance of motivation for enrollment during the transition to university. The first survey took place when the experiences of the decision process were still fresh during the entry phase at university in the students (first two months after enrollment; T1). The second survey was conducted at the beginning of the subsequent semester (T2). The participating students filled in an online survey that was distributed by the university administration among all students of one cohort. Participation in the study was voluntary and informed consent was obtained.

Subsamples of the dataset have already been used to examine research questions concerning the challenges first-generation students experience at university (Janke et al., 2017) and the associations between motivation for enrollment, study satisfaction and achievement goal orientations over time (Janke, 2020). The data set has not yet been used to investigate how motivation for enrollment relates to shifts in intrinsic learning motivation.

As Study 1a did not contain the variables dropout (intention) and GPA, we could not account for those variables. However, our first goal was to establish a temporal order of intrinsic motivation for enrollment and intrinsic learning motivation.

# Sample

A sample of 536 students ( $M_{age} = 20.0$  years, SD = 2.6; 65.3 % female) completed the first online survey at the beginning of the first semester (21.7 % of all freshmen in this semester), which was the fall semester 2013. At the second time point, a sample of 564 students ( $M_{age} = 20.2$  years, SD = 2.6; 62.8 %

female) completed the survey (26.6 % of all students in this semester). Due to the nested cross-sectional design this resulted in a net sample of 774 students out of which 326 participants answered both the questionnaire at time point one and time point two. The participating students were enrolled in 19 different subjects, see Supplemental Table 2.1

(<u>https://osf.io/qn8ex/?view\_only=982e2430c2104ba4a6d3dcff2b938f54</u>) for more details about major distribution.

#### Measures

Intrinsic Motivation for Enrollment. Intrinsic motivation for enrollment was measured with a German questionnaire inspired by items used in a nation-wide survey about the study situation (Ramm et al., 2014). It consisted of 3 items: "I chose to enroll myself because" "... of my interest in the major", "... my major corresponds with my abilities and talents" and "... I believe I will enjoy my studies." Items were measured on a 7-point Likert scale with responses ranging from 1 (not at all) to 7 (completely true). The subscale acquired an acceptable reliability ( $\alpha_{T1} = .71$ ). In the subsequent analyses, all three items loaded well on a latent factor ( $\lambda \ge .58$ , p < .001).

**Intrinsic Learning Motivation.** We used adapted Items of the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 2013) that had been translated to German. Intrinsic learning motivation was measured with 6 Items at both time points. This scale was adapted to the context of studying; sample item: "I think studying is really interesting." It was measured on a 7-point Likert scale with responses ranging from 1 (not at all) to 7 (completely true). The internal consistency was excellent ( $\alpha_{T1} = .91$ ,  $\alpha_{T2} = .92$ ). In the subsequent analyses, all six items loaded well on a latent factor at both measurement points ( $\lambda \ge .69$ , p < .001).

#### Analyses

We computed a structural equation model with Mplus version 8.5 (Muthén & Muthén, 1998-2017) to investigate our research questions. Intrinsic motivation for enrollment at T1 as well as intrinsic learning motivation at T1 and at T2 were modeled as latent factors to estimate associations between variables free of measurement errors. Regarding the structural model, we investigated whether intrinsic motivation for enrollment predicting intrinsic learning motivation one semester later, controlling for intrinsic learning motivation at the first time point. Additionally, we compared this model with another model that only contained intrinsic learning motivation at time point one as predictor for intrinsic learning motivation one semester later, to estimate the incremental predictive power of intrinsic motivation of enrollment beyond initial learning motivation. We allowed for residual correlations within the intrinsic learning motivation scales between measurement points for items with the same wording (indicators for intrinsic learning motivation at T1 and T2). Factor indicators were treated as categorical. We used the weighted least squares means and variance adjusted estimator (WLSMV) to estimate model parameters and relied on the recommendations of Schermelleh-Engel et al. (2003) to evaluate the model fit. Therefore, we differentiated between an acceptable model fit (RMSEA  $\leq$  .08, SRMR  $\leq$  .10, CFI  $\geq$  .95, TLI  $\geq$  .95) and a good model fit (RMSEA  $\leq$  .05, SRMR  $\leq$  .05, CFI  $\geq$  .97, TLI  $\geq$  .97). We used the Full-Information-Maximum-Likelihood-method (FIML) to handle missing data, so every student who participated at least once was included in the analysis. For the directed hypotheses we used one-tailed tests.

#### Results

## **Descriptives and Zero-order Correlations**

The zero-order correlations reveal associations between intrinsic motivation for enrollment (T1) and intrinsic learning motivation at both time points (see Table 2.1). The strongest association was found between both measurement points of intrinsic learning motivation.

# Table 2.1

Descriptive Statistics and Correlations of Study 1a.

1	5	-			
Scale	М	SD	Scale	(1)	(2)
			Range		
T1 = First semester					
(1) Intrinsic motivation for	5.91	0.76	1–7		
enrollment					
(2) intrinsic learning motivation	5.29	0.96	1–7	.54**	
T2 = Second semester					
(3) intrinsic learning motivation	5.28	1.07	1–7	.45**	.58**

*Note.* Range refers to the theoretical minimum and maximum of the scale and not to the observed scale range. \*\*p < .01

# Structural Equation Model

The fit indices of the conducted structural equation model showed a good to acceptable fit,  $\chi^2(81) = 402.53$ , p < .001, CFI = .988, TLI = .984,
RMSEA = .072, SRMR = .034, which shows that the model fits our data. Intrinsic motivation for enrollment measured at T1 predicted intrinsic learning motivation measured at T2 ( $\beta$  = .31, *p* < .001), even when controlling for intrinsic learning motivation measured at T1 ( $\beta$  = .41, *p* < .001). Overall, 45% of the variance of intrinsic learning motivation (T2) could be attributed to the predictor set (*p* < .001). Compared to a model that only included intrinsic learning motivation (T1) to predict intrinsic learning motivation (T2),  $\chi^2(43) =$ 165.31, *p* < .001, CFI = .995, TLI = .993, RMSEA = .061, SRMR = .025, 3% more variance could be explained when including intrinsic motivation for enrollment in the model. This means that the amount of intrinsic motivation, even though intrinsic learning motivation is to some extent stable between the beginning of the first and second semester.

## Discussion

In Study 1a, we found that intrinsic motivation for enrollment was positively associated with later intrinsic learning motivation even when controlling for initial intrinsic learning motivation. This indicates that intrinsic motivation for enrollment facilitates a positive development of learning motivation over time. Building on this finding, the next step in investigating the lasting prospective effects of intrinsic motivation for enrollment was to answer the question of whether intrinsic motivation for enrollment is also associated with further measures of study success.

#### Study 1b

In Study 1b, we investigated whether intrinsic learning motivation acted as a mediator for long-term associations of intrinsic motivation for enrollment with further outcomes, namely dropout intention, dropout and university GPA. We assumed that intrinsic motivation for enrollment is positively related to later intrinsic learning motivation, which in turn should positively predict university GPA and negatively dropout intentions and dropout (see Figure 2.1). **Method** 

We used data from a longitudinal study that was conducted at the same university as in Study 1a. This data was collected six years later than the data for Study 1a. Once again, we started questioning the students when entering higher education. Students were assessed at the very beginning of their first semester in their bachelor program (T1), half a year later at the beginning of their second semester (T2) and another half year later at the beginning of their third semester (T3). The university administration contacted the full cohort at each time point and we also advertised the survey study via social media and in lectures that targeted freshmen. As compensation, the students either received 5€ or course credits for participating in psychological studies (only students of psychology or education). We asked the participants for permission to access their university GPA and status of enrollment (still enrolled in the same major vs. dropped out from the major) through student services at a later point in time. We assessed this additional data at the beginning of the participating students' third semester (T3). The IRB of the University (EK Mannheim 17/2019) approved the assessment and pseudonymized matching of additional personal data (GPA and status of enrollment).

### Sample

In total about half of the students of the cohort participated at least once  $(N = 1185 \text{ students}, M_{age} = 19.6 \text{ years}, SD = 3.3 \text{ years}, 57.5 \%$  female, 1 nonbinary). A sample of 706 students answered the first online survey at the beginning of the first semester. At the second time point 642 students answered the survey. In total, 369 participants answered the survey at time point one and time point two. At the third time point 690 students answered the survey. In total, 338 participants answered the survey at time point three. Overall, 222 participants answered the survey at all three time points. The participating students were enrolled in 21 different subjects, see Supplemental Table 2.1

(<u>https://osf.io/qn8ex/?view\_only=982e2430c2104ba4a6d3dcff2b938f54</u>) for more details about major distribution.

## Measures

We measured motivation for enrollment at time point one and intrinsic learning motivation was measured at time point two. Dropout intention, GPA of semester 2 and actual dropout were measured at time point three.

**Motivation for Enrollment.** We assessed intrinsic motivation for enrollment with a corresponding subscale of a German multi-factorial inventory to measure motivation for enrollment (STUWA; Janke et al., 2021) with 3 items: "I chose my major because..." "...of my interest in the major.", "...my major corresponds with my abilities and talents" and "...I like to engage with the contents of my major." The items were assessed with a Likert scale ranging from 1 (not at all) to 7 (completely true). The subscale acquired an acceptable reliability ( $\alpha_{T1} = .77$ ) and all items loaded sufficiently on one latent factor in subsequent analyses ( $\lambda \ge .58$ , p < .001). The wording of the items was slightly different from the ones used in Study 1a. This is because this scale was further developed and improved between the first and the second study.

**Intrinsic Learning Motivation.** We used the same scale to measure intrinsic learning motivation as in Study 1a. The internal consistency was excellent ( $\alpha_{T2} = .93$ ), and the items achieved sufficient loadings on one latent factor in subsequent analyses ( $\lambda \ge .72$ , p < .001).

**Dropout Intention.** To assess dropout intention, we used one subscale of the German version of the scales to assess study dropout intentions and intentions to change a major (Bäulke et al., 2021). The subscale *non-fit perception* consisted of three items (e.g., "At the moment ... it occurs to me that my degree program does not suit me well."). Items were answered on a seven-point Likert scale ranging from 1 (disagree completely) to 7 (agree completely). The subscale acquired an excellent reliability and all items reached acceptable factor loadings ( $\alpha_{T3} = .87, \lambda \ge .77, p < .001$ ).

University GPA and Dropout From the Major. We derived the GPA of semester 2 and actual drop-out/persistence (as information about status of enrollment) directly from the university services. All participating students consented that this data could be collected. The data was matched to the questionnaire data using pseudonyms. We operationalized dropout as leaving a major without finishing it (changing major, leaving university, dropping out after failing an exam definitely, etc.). Changing university but remaining in the same major was not considered as dropout. In total, 60 of the participating students in our sample had dropped out of their major within their first year at university (5.1% of the sample). For the distribution of reasons to drop out see Supplemental Table 2.2

(<u>https://osf.io/qn8ex/?view\_only=982e2430c2104ba4a6d3dcff2b938f54)</u>. The most prominent reason was "dropping out completely". It has to be noted that we could only include those students in our sample who participated in our survey, even though we obtained the information about the enrollment status directly from the student administration. Therefore, the amount of dropout in our sample was lower than in the overall population in this cohort (about 11% after the second semester).

The GPA reflected the average grade achieved in the exams of the second semester. We recoded the GPA for easier interpretation – higher values now mean better GPA – and z-standardized to the mean performance level of the different majors. This ensured that differences between GPAs did not reflect different grading standards between "easier" and "more difficult" majors. *Analyses* 

We conducted a mediation analysis to investigate if the effect of intrinsic motivation for enrollment on dropout intentions, dropout and GPA of semester 2 was mediated through intrinsic learning motivation. Similar to Study 1a, we used Mplus version 8.5 (Muthén & Muthén, 1998-2017), factor loadings were treated as categorical, we used FIML to handle missings, the same criteria to evaluate the model fit (Schermelleh-Engel et al., 2003), and the WLSMV estimator which is robust to the inclusion of dichotomous model variables (dropout) as well as the use of non-normal distributed variables. Intrinsic motivation for enrollment, intrinsic learning motivation and dropout intention were included as latent factors into the model. We tested all possible direct and indirect effects of intrinsic motivation for enrollment, regardless whether we hypothesized that there was an effect, to investigate whether any meaningful unexpected associations emerged in our data. We tested one full structural equation model and the indirect effects were estimated using the standard settings of MPlus (command *ind*). Associations between dropout and dropout intentions as well as dropout and GPA of semester 2 were not specified, as we had no data for these variables of the students who dropped out. For the directed hypotheses we used one-tailed tests.

## Results

## **Descriptives and Zero-order Correlations**

Means, standard deviations and zero-order correlations between all measures are displayed in Table 2.2. Zero-order correlations showed that intrinsic motivation for enrollment was positively associated with intrinsic learning motivation and negatively associated with dropout intention and dropout – but not with GPA of semester 2. Intrinsic learning motivation was correlated with all study success outcomes (performance, dropout intentions and dropout) in the expected direction. Additionally, dropout intentions were negatively associated with performance.

# Table 2.2

Descriptive Statistics and Correlations of Study 1b.

-			•				
Scale	М	SD	Scale	(1)	(2)	(3)	(4)
			Range				
T1 = First semester							
(1) Intrinsic motivation for	5.00	0.95	1 7				
enrollment	5.98	0.85	1-/				
T2 = Second semester							
(2) intrinsic learning	5 22	1 10	17	27**			
motivation	5.22	1.18	1-/	.57			
T3 = Third semester							
(3) dropout intention	2.12	1.4	1–7	29**	34***		
(4) GPA of semester 2 <sup>a</sup>	0.12	0.74	-2.5-1.7 <sup>b</sup>	.06	.14**	16**	
(5) actual dropout	0.52	0.22	0.1	11**	00*	с	с
[0 = No; 1 = Yes]	0.52	0.22	0–1	11**	09*	_	_•

*Note.* Range refers to the theoretical minimum and maximum of the scale and not to the observed scale range; <sup>b</sup>exception for GPA of semester 2 which is <sup>a</sup>z-standardized for each major. <sup>c</sup>no data for those who dropped out. <sup>\*</sup>p < .05, <sup>\*\*</sup>p < .01, <sup>\*\*\*</sup>p < .001.

## Structural Equation Model

The structural equation model showed a good fit,  $\chi^2(71) = 168.48$ , CFI = .995, TLI = .994, RMSEA = .034, SRMR = .037. Intrinsic motivation for enrollment predicted intrinsic learning motivation at time point two (see Figure 2.2).

# Figure 2.2

Intrinsic Learning Motivation Mediates the Effect of Intrinsic Motivation for Enrollment on Dropout Intention and University Grade Point Average (GPA; Study 1b).



*Note.* Direct effects only shown if significant. Total N = 1185.

The more students reported to have chosen their major out of personal interest the more intrinsic learning motivation they experienced half a year later. Moreover, the effect of intrinsic motivation for enrollment on dropout intention was mediated by intrinsic learning motivation (indirect effect:  $\beta = -.16$ , p < -.16.001). Additionally, there was a direct effect of intrinsic motivation for enrollment on dropout intention ( $\beta = -.23$ , p = .002). This indicates that intrinsic motivation for enrollment predicts dropout intentions one year after starting the studies both directly, but also indirectly via the association with intrinsic learning motivation. Intrinsic learning motivation mediated the effect of intrinsic motivation for enrollment on GPA of semester 2 (indirect effect:  $\beta = .12$ , p =.002). However, the explained variance of performance was not significant ( $R^2 =$ .04, p = .135). The link between intrinsic learning motivation and dropout intention is descriptively stronger ( $\beta = -.34$ , p < .001) than the link to GPA of semester 2 ( $\beta = .23$ , p < .001). While we observed a significant total effect of intrinsic motivation for enrollment on actual dropout, this effect was neither qualified by indirect nor direct effects of the variable (lowest p = .057), nor did any variables explain a significant proportion of variance in the variable in question ( $R^2 = .05$ , p = .088). As such, we have to conclude that the exploratory power of the variable set is limited regarding actual dropout. All direct and

indirect effects can be found in Supplemental Table 2.3 (https://osf.io/qn8ex/?view\_only=982e2430c2104ba4a6d3dcff2b938f54).

## **General Discussion**

The main aim of our studies was to investigate whether and how intrinsic motivation for enrollment is associated with intrinsic learning motivation and study success over time. The findings of Study 1a indicate that motivation for enrollment facilitates a positive development of intrinsic learning motivation over the course of one semester. This positive association may yield further long-term consequences as the findings derived from Study 1b suggest. Here, we found that intrinsic learning motivation mediated prospective associations between intrinsic motivation for enrollment and study success outcomes over the time span of a whole year. This was especially true for dropout intentions, whereas effects on performance were less substantial (nonsignificant explained variance). While we found a significant indirect effect via intrinsic learning, we also want to clarify that this effect was not suitable to explain a significant portion of the variance in the outcome variable. Our results suggest that intrinsic motivation for enrollment could lay the foundation for later performance but also the impact on this aspect of study success seems small. The expected effect on intrinsic motivation for enrollment and intrinsic learning motivation on actual dropout was not found in our study. While we found some indications for small associations, these associations were not sufficiently qualified through direct or indirect effects. It has to be noted, though, that our power for detecting associations was rather weak regarding actual dropout. This is due to the fact that the dropout rate in our sample was not as high as in the general student population of the corresponding semester. In our sample only few students had dropped out from their major, which might be due to the fact that students who take part in voluntary surveys are largely more inclined in finishing their major. Further research could try to reveal differences between students who take part in surveys like ours and students who do not.

# **Theoretical Implications**

Our results provide empirical support for associations with motivational variables with study success in higher education. The proposed process model on motivated dropout in higher education (derived from Heublein, 2014) describes the development of dropout intentions through motivational variables. The core of this model is that students' motivation for enrollment impacts later

study success. The more students consider personal interests when choosing their major, the more they will enjoy learning and develop the feeling of fitting into their learning environment. We expand this model further by providing clear mechanisms that explain why intrinsic motivation for enrollment has a long-lasting beneficial impact. In this regard, we find both evidence for a direct pathway (facilitation of optimal fit) as well as an indirect pathway (facilitation of optimal learning motivation) linking intrinsic motivation to study success in terms of lower dropout intentions.

As predicted, study success in terms of performance was indirectly associated with intrinsic motivation for enrollment. However, the effect was small in magnitude and as such, we think that we should remain cautious when judging the importance of motivation for enrollment regarding later performance. One might even argue that intrinsic motivation for enrollment is more central regarding the development of an optimal fit than regarding the later development of competencies.

Our process model strongly highlights that the development of dropout intentions depends on motivational factors and that those factors should be considered when trying to explain what drives students to quit their major. Even more importantly, our findings align well with the notion that the decision to drop out is a complex process with several phases, which can start even before students have finished their first semester or even earlier (Bäulke et al., 2021; Heublein, 2014). Accordingly, research aiming to explain study success and dropout from a major should consider aspects of students' motivation that relate to early phases of decision making as well as initial experiences of (mis-)fit that can be present already when choosing the major. Our process model is a starting point for such research and provides a much-needed process-oriented perspective on the impact of motivation on students' persistence in higher education institutions.

## **Practical Implications**

Although dropout from a major can be an adaptive behavior under some conditions (meaning that in some cases it makes sense to change the major or quit university completely), there are situations in which it indicates a failed adaption to a non-fitting major that could have been prevented through a better choice of major. This is especially problematic in higher education systems in which a change of major is associated with high opportunity costs such as a substantial loss of time or financial resources (e.g., loss of applicability for student grants) when starting fresh in a new major. Our process model provides valuable information regarding factors that could be helpful when searching for new ways to avert such unwanted dropout. Particularly, our results suggest that intrinsic motivation for enrollment is an important predictor for (the absence) of later doubts about personal fit. As such, this factor should be considered by student aspirants when choosing a major. One challenge in doing so could be that even students who want to consider their interests might not know which major suits them best – especially when the range of offered majors is becoming more and more diverse. Therefore, tools are needed to acquire more knowledge about the content of the different majors that can give students access to their interest profiles and matching majors (e.g., online-self assessments; Stoll, 2018).

Practically speaking, intrinsic motivation for enrollment can be established using Online-Self Assessments which can guide prospective students in their major choice (Stoll, 2018). This is especially important as fostering motivation while studying is a great challenge. It is therefore more beneficial if students select their major based on their interest. Instead of thinking about interventions to foster motivation during studies (which is of course also possible), students can also be encouraged to select a major for which they are motivated. If students did so - e.g., using an Online-Self Assessment - they are more likely to be motivated during their studies (Karst et al., 2017; Nye et al., 2012; Stoll, 2018; Stoll & Spinath, 2015).

## **Limitations and Future Research**

We would like to note that we used a self-report measure on how much students took their interest into account when choosing their major which we administered in a freshmen population shortly after enrollment. Thus, our measure may already reflect a biased perspective on the actual decision process – albeit first evidence indicating that the time of measurement does not substantially impact students' perspective on their motivation for enrollment (Janke et al., 2021). However, we think that these issues are less critical as we find substantial prospective associations between intrinsic motivation for enrollment and (non-)fit perception of the students over long time spans. This speaks for close ties between self-reported intrinsic motivation for enrollment and the development of Interest-Major Fit and intrinsic learning motivation.

Nevertheless, we think that an even more accurate investigation into the decision process (and its consequences) would be possible with student samples that have been tracked from the end of secondary school onwards. As it is

difficult to predict which students will eventually enroll themselves, we think that this endeavor calls for specifically tailored large-scale studies. Furthermore, the scale to assess intrinsic motivation for enrollment was developed further between Study 1a and Study 1b meaning that the wording was different in both studies. Still, both studies showed the effect of intrinsic motivation for enrollment on intrinsic learning motivation.

Additionally, we measured intrinsic learning motivation only at the second time point in Study 1b. However, as intrinsic learning motivation can change (e.g., due to study content), it would be interesting to investigate the relationship between intrinsic learning motivation and study success outcomes with a longitudinal design measuring all variables at different time points. Moreover, our analysis only allows us a temporal order of our findings and not a causal interpretation. Future research could further investigate causation.

We did not have the data to differentiate between students who dropped out from their major to start a completely new major and students who dropped out from their major to start a similar and maybe even more specialized major. High levels of intrinsic motivation for the major might encourage students to change to a similar but more specialized major which fits theirs interests even better. Accounting for those different kinds of dropout could possibly reveal that the effects of intrinsic motivation are underestimated in our study.

Moreover, we focused on whether intrinsic learning motivation predicted performance and did not investigate patterns of reversed causation. While some research speaks strongly for motivation being an antecedent of achievement (Liu & Hou, 2017), other research indicates that those variables mutually influence each other in reinforcement cycles (Marsh & Craven, 2006; Möller et al., 2009; Schaffner et al., 2016; Toste et al., 2020; Vu et al., 2022). The unidirectional association we tested in this model should not be understood as sole possible causal gateway that links motivation and achievement, but as one possible explanation on how intrinsic motivation for enrollment may facilitate performance.

Also, the direction of the association with other outcomes (e.g., study satisfaction) should be investigated. This could be done through systematic intervention studies, e.g., utility value interventions to promote students' interest in their major (see Hulleman et al., 2010). This could reveal the causal effects of interest in the major on intrinsic learning motivation and other study success outcomes.

In our theoretical model and analyses, we focused on intrinsic motivation rather than other kinds of motivation as intrinsic motivation is claimed to be one of the main reasons for study success (Allen et al., 2008; Heublein, 2014). Therefore, this seemed the most promising variable in explaining the dropout process to us. However, it stands to reason that other motivation variables such as extrinsic motivational forces (Janke, 2020) or personal goals (Bardach et al., 2020) could also contribute to students' likelihood to succeed in higher education. As such, we do not claim that our model represents all potential motivated processes that could impact dropout. However, we see particular value in focusing on variables such as intrinsic motivation for enrollment that could be impacted through practical measures such as effective counseling.

There was a gap of six years between the two studies which might lead to a difference in the student population and study environment. However, our finding – that intrinsic motivation for enrollment at the beginning of the first semester is positively associated with subsequent intrinsic learning motivation – is robust in both samples. This is an indicator that the same results will be found also in further research and are not subject to small changes in the student population or the study environment, which most likely will occur over time.

## Conclusion

Our findings indicate that the reason on which people base their decision for a study program might affect their ongoing intrinsic learning motivation in this program and in turn their dropout intentions. Our findings were generally in line with the proposed process model of motivated dropout in higher education – even though we did not find all hypothesized effects. The empirical evidence on parts of the process model is an important contribution to the literature as it informs us about the relative importance of intrinsic motivation for enrollment as a factor for ongoing study success. As a result, studies on study success should consider not only the actual study situation, but also the major decision-making process prior to the start of studies. Through advising students accordingly to their interests, foreseeable difficulties with the major could be avoided and students can finish their studies successfully and feeling motivated.

# Manuscript 2 – Interest-Major Fit Predicts Study Success? Comparing Different Ways of Assessment

#### Abstract

Ensuring a personal fit between students' interests and their study program is meant to facilitate long-term study satisfaction, and optimal performance in higher education institutions. However, a challenge in identifying such well-fitting students, is that the optimal way to assess personal fit is a debated topic. While some have argued that general vocational interests are well suited to indicate fit (Interest-Vocation Fit), we argue that more specific measures tailored to the respective major (Interest-Major Fit) have more predictive power. Here, we compare these two operationalizations of Interest-Major-Fit as predictors of performance and study satisfaction in a sample of 455 German university students who participated in a longitudinal survey study. We found that the different measures of personal fit were associated with subsequent university GPA and study satisfaction. Moreover, we found that Interest-Major Fit was more closely associated with these outcome measures compared to Interest-Vocation Fit. We also found that Interest-Major Fit has incremental predictive power for study satisfaction beyond high school GPA. These findings indicate that the assessment of Interest-Major Fit as operationalization of personal fit might be helpful to university practitioners when selecting future students. Feedback on Interest-Major Fit may also assist prospective students in finding the ideal major.

*Keywords*: Interest-Major Fit, academic performance, academic wellbeing, study success, higher education

# Introduction

When selecting future students, universities usually aim to identify individuals that are most likely to perform well and develop a positive perspective on their respective study program. To achieve this, university administrations apply a variety of entry criteria, which are meant to be predictive for later study success. Most commonly these criteria include some sort of assessment of prior academic performance such as high school GPA (Gold & Souvignier, 2005; Naumann zu Grünberg, 2011; Noble & Sawyer, 2004). While such criteria are especially helpful for the university as an organization to select ideal students and to predict later performance (Janke & Dickhäuser, 2018; Schuler & Hell, 2008; Trapmann, 2006; Troche et al., 2014), they are possibly more limited in guiding students towards finding ideal study programs. This makes additional measures necessary that are particularly sensitive in predicting students' well-being. According to the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007), a strong congruence between a person and the environment facilitates performance and well-being. For higher education, this means that the fit between a student's interests and the content of the chosen major (Interest-Major Fit) should be predictive for later study success (Allen & Robbins, 2010; Nye et al., 2012; Tracey & Robbins, 2006). However, Person-Environment Fit Theory proposes that whether measures of the Interest-Major Fit facilitate predictive power for these outcome variables likely depends on the concrete operationalization of the construct (Kristof-Brown et al., 2005). Most research uses rather broad operationalizations of Interest-Major Fit (e.g., Allen & Robbins, 2010; Etzel & Nagy, 2016) that do not take the specifics of the respective study programs into account and focus more on the demands of a potential subsequent work position. In this article, we address a research gap and compare the predictive power of such broad measures (Interest-Vocation Fit) with more specific operationalizations of Interest-Major Fit. We also aim to investigate whether Interest-Major Fit can predict later study success beyond performance measures. In doing so, our research is an important contribution for a more nuanced understanding of Interest-Major Fit as a potential facilitator of a beneficial study choice.

## Person-Environment Fit as a Predictor of Study Success

According to the Person-Environment Fit Theory (Edwards & Shipp, 2007), a strong congruence between a person and his/her environment leads to higher well-being (Bretz & Judge, 1994) and better performance (Etzel & Nagy,

2016). The effect of Person-Environment Fit on well-being can be explained through the evaluation of the environment in relation to the values (in case of Interest-Major Fit: interests) of the person (Edwards & Shipp, 2007). Individuals aim to experience that their personal values align with their current environment. If this alignment – or Person-Environment Fit – comes to pass, they will feel that they belong in the respective environment and subsequently develop feelings of well-being (Edwards & Rothbard, 1999; Schmitt et al., 2008). Additionally, if people get the impression that they fit into the environment they are currently in, they are more motivated to engage in tasks connected to the environment and therefore perform better (Edwards & Shipp, 2007).

In the context of higher education, Person-Environment Fit is often conceptualized as the fit between students' interests and their respective major, which is consequently termed Interest-Major Fit (Allen & Robbins, 2010). As a consequence of Interest-Major Fit, students are more satisfied with their studies (Allen et al., 2008) and perform better (Etzel & Nagy, 2016; Tracey & Robbins, 2006). In line with Person-Environment Fit Theory, empirical studies show that higher Interest-Major Fit results in higher study satisfaction (Allen et al., 2008) and better performance (Etzel & Nagy, 2016; Messerer et al., 2023; Tracey & Robbins, 2006).

Particularly during the first years at university, students that experience a low Interest-Major Fit are more likely to drop out from university (Heublein et al., 2017). If a strong Interest-Major Fit is established early on, this may prevent students from detaching themselves from their study program and dropping out of university (Bäulke et al., 2022). In sum, the assessment of student applicants' Interest-Major Fit could be of high importance in guiding their decision towards choosing a major which is a better fit, thereby fostering study success.

Even though the effect of Interest-Major Fit on both study satisfaction and performance at university has been found in other studies, research that simultaneously takes other prerequisites of study success (e.g., high school GPA) into account is rare. Moreover, different studies assess the fit of the students' interests with a vocation rather than with a major. This is common practice in research as the major choice can be seen as a first step to choosing a vocation. However, the content of a major (environment) is not necessarily the same as a possible further vocation – especially since most majors can lead to different vocations. Therefore, we want to differentiate between Interest-Major Fit (congruence between interests and content of the major) and InterestVocation Fit (congruence between interests and content of the vocation) to investigate if the assessment makes a difference here. The predictive power of Interest-Vocation Fit and Interest-Major Fit for study success has not been assessed together before. We want to close this gap in the research as it has practical implications: If Person-Environment Fit is included in major choices, it makes sense to operationalize it in the best possible way. Moreover, if Interest-Major Fit cannot explain any variance in study success measures beyond high school GPA, the assessment of Interest-Major Fit can be considered as negligible given that information on the GPA is often more easily attainable. However, if the impact of Interest-Major Fit on study success goes beyond the impact of prior performance, the consideration of this measure in guiding students in their study choice process might be helpful to increase overall study success.

A first pioneer study highlights the distinct importance of Interest-Major Fit beyond performance measures as it showed that both standardized performance test results and Interest-Major Fit independently contributed to the prediction of performance at university (Tracey & Robbins, 2006). It is our goal to expand this research by providing additional evidence on study success measures beyond performance (here: study satisfaction). Additionally, the joint analysis of Interest-Vocation Fit and Interest-Major Fit helps to answer the question if and to what extent those different fit measures should guide prospective students' decision process.

# **Assessment of Person-Environment Fit**

Person-Environment Fit in the context of interest for a major is often operationalized using vocational interests of Holland's (1997) RIASEC model (Allen & Robbins, 2010; Tracey & Robbins, 2006; Usslepp et al., 2020). The RIASEC model suggests that vocational interests can be divided into six interest types (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). Based on this model, interest-major congruence is determined by comparing the three interests that dominate the interest profile of prospective students with the three-letter code that is meant to characterize the respective major (Brown & Gore, 1994; Camp & Chartrand, 1992). Comparing the personal code (three most prominent interests) with the code for the study program (three-letter-code) should help prospective students to find environments that suit them best.

However, the RIASEC interest dimensions are general vocational interests, which are not specifically designed for measuring interests regarding

study content and may therefore be better referred to as *Interest-Vocation Fit*. Because the degree of fit between the students' interests and the major can be assessed more accurately if both refer to the same content dimension (e.g., study content) and can be quantified on the same metric, appropriate dimensions are necessary for the conceptualization and assessment of Interest-Major Fit (Edwards et al., 1998). Thus, the fit between one's vocational interests and potential vocations that are attainable through a certain major does not sufficiently cover Interest-Major Fit. Therefore, Interest-Major Fit is potentially better suited than Interest-Vocation Fit to predict study success outcomes while studying, like university GPA and study satisfaction. This is due to the fact that Interest-Major Fit is a more congruent operationalization regarding the time during studying.

This does not imply that Interest-Vocation Fit is not of interest to prospective students when choosing their major. In terms of Expectancy-Value Theory (Wigfield & Eccles, 1992, 2000), actions such as the choice of a study program can be motivated both through intrinsic value (e.g., the anticipation of pleasure bound to an activity) and utility value (e.g., the anticipation of extrinsic rewards). In this terminology, ensuring an Interest-Major Fit reflects the maximization of intrinsic value, whereas ensuring Interest-Vocation Fit reflects the maximization of utility value. It stands to reason that ensuring intrinsic value is more likely to ensure positive outcomes in the here-and-now as it directly enhances the possibility to derive joy from the current situation (see also Janke, 2020; Janke et al., 2021 in the context of choice of major). This is in line with the theoretical reasoning that Interest-Major Fit in terms of a match between study-related interests and content of the major is more predictive for study success than Interest-Vocation Fit (see Edwards et al., 1998).

#### **Research Questions**

As outlined above it makes sense to choose a commensurate dimension (interests regarding study content not interests regarding vocational content) when assessing the Person-Environment Fit (Edwards et al., 1998) to predict study success outcomes in the current study situation. However, most previous research on Interest-Major Fit and study success outcomes was conducted using a dimension of Interest-Major Fit, which is based on the vocational interests of the RIASEC model (Holland, 1997) and should potentially be called Interest-Vocation Fit instead. Even though this research found evidence that there is an association between Interest-Vocation Fit measured in such a way and study success (Allen & Robbins, 2010), it can be assumed that the association is even closer when Interest-Major Fit is measured on a dimension that is more commensurate, including study content related interest dimensions. This could be the case if Interest-Major Fit was measured in a way that aligns better with the content of a major. Accordingly, this study aims to answer the following questions: (1) Which kind of Person-Environment Fit (Interest-Major Fit vs. Interest-Vocation Fit) is better suited to predict (1a) achievement at university and (1b) study satisfaction? We hypothesize that Interest-Major Fit is better suited to predict both university GPA and study satisfaction than Interest-Vocation Fit.

The second research question is whether (2) Interest-Major Fit can predict university GPA and study satisfaction beyond high school GPA. Here we hypothesize (2a) that high school GPA is closely positively associated with university GPA while Interest-Major Fit has a rather smaller effect. This is due to underlying personal variables, that influence both high school GPA and university GPA, e.g., intelligence, conscientiousness and learning strategies (Chamorro-Premuzic & Furnham, 2008). We take high school GPA into account because many majors have some kind of entry criteria that are connected to prior performance (usually high school GPA). This makes sense as high school GPA is a very good predictor for grades at university (Janke & Dickhäuser, 2018; Schuler & Hell, 2008; Trapmann et al., 2007; Troche et al., 2014).

Regarding (2b) study satisfaction (especially satisfaction with the study content), we hypothesize that high school GPA has a weaker effect here than Interest-Major Fit, as students who hold interests that fit the content of the major, are likely to be satisfied with the content of the major. It makes sense to also assume an association between high school GPA and study satisfaction because high school GPA should predict performance at university (Janke & Dickhäuser, 2018; Schuler & Hell, 2008; Trapmann et al., 2007; Troche et al., 2014) which in turn should satisfy students' need for competence. Based on the basic needs theory (Deci & Ryan, 2000) the need for competence resembles one of three inherent basic needs whose satisfaction should foster subjective wellbeing. However, as the relationship between GPA and study satisfaction would be an indirect relationship mediated by performance and perceived competence, it is supposedly not as strong.

## Method

We used data from an existing longitudinal study conducted at a public German university with an emphasis on social and economic sciences to investigate our research objectives. The university was a medium-sized institution, with roughly 12,000 students. University education in Germany is traditionally separated into three levels (bachelor, master, doctorate). The major must be chosen before enrolling in a bachelor program and is not meant to be changed over the course of one's studies. Only students at the start of the first stage of their studies were included in the study (bachelor level).

Student data was assessed at the very beginning of students' first semester in their bachelor program (T1) and at the beginning of their second semester (T2). The overall longitudinal study consisted of six time points in total, also assessing student data after the third, fourth, fifth and sixth semester. This study only utilizes measures from the first two time points as it aims to provide a deeper understanding of how entry criteria such as GPA and Interest-Major Fit predict a successful transition into higher education.

The university administration contacted the full cohort at each time point, and we also advertised the survey study via social media and in lectures that targeted freshmen. As compensation, the students either received 5€ or course credits for participating in psychological studies (only students of psychology or education). We asked the participants for permission to access their university GPA through student services at a later point in time. We assessed this additional data at the beginning of the participating students' second semester (T2). The IRB of the University (EK Mannheim 17/2019) approved the assessment and pseudonymized matching of additional personal data (university GPA).

## Sample

The sample consisted of university students, who participated at least once within the first and second semester (N = 455 students,  $M_{age} = 19.5$  years, SD = 1.9 years, 54.1 % female, 1 non-binary). However, we could only use the data of those students who were enrolled in a major for which a questionnaire to assess the specific Interest-Major Fit existed. The assessment of the specific Interest-Major Fit requires a questionnaire tailored for the specific major at the university and was therefore developed for this purpose. At the time of data collection, the questionnaire was only developed for the nine majors with the greatest number of students. Therefore, the sample consisted only of students

enrolled in one of the following nine subjects: Business Administration (30.3 %), Law (11.9 %), Economic and Business Education (9.5 %), Economics (10.1 %), Psychology (9.7 %), Political Sciences (9.7 %), Sociology (7.0 %), Business Informatics (6.8 %), Business Mathematics (5.1 %).

## Measures

For our analyses, we used data on the predictor variables (Interest-Major Fit, Interest-Vocation Fit, and high school GPA) that was collected at T1 to predict criteria (university GPA, study satisfaction) measured at T2. *Interest-Vocation Fit* 

To assess Interest-Vocation Fit we used a well-validated German scale to measure vocational interests (Allgemeiner Interessens-Struktur-Test; Bergmann & Eder, 2019). This scale assesses six aspects of vocational interests according to the Holland model (Holland, 1997): Realistic, Investigative, Artistic, Social, Enterprising and Conventional with 10 items per subscale. The items were assessed with a Likert scale ranging from 1 (I'm not interested in that at all; I don't like to do that) to 5 (I'm very interested in that; I'm very happy to do that). Sample items are: "Running a business or enterprise." (Enterprising) or "look after or care for other persons." (Social; Bergmann & Eder, 2019). The subscales acquired an acceptable reliability (.83 <  $\alpha$  < .86; mean  $\alpha$  = .85).

To assess the congruence between Interests and Vocation, we calculated the congruence index (C index; Brown & Gore, 1994). This represents an extension of Holland's Congruence to three-digit codes with weights, which makes it more accurate and is therefore used often (Brown & Gore, 1994). Three distance values are used which refer to three pairs of letters: the first, second, and the third letters of both codes. The three distance values are weighted and added up (following Brown & Gore, 1994, p. 322).

 $C = 3^*X_1 + 2^*X_2 + 1^*X_3$ 

The variables  $X_1$ ,  $X_2$ ,  $X_3$  in the formula represent the three distance values of the three examined letter pairs ( $X_1$ , for example, corresponds to the distance between the 1<sup>st</sup> letter of each of the respective 1<sup>st</sup> letters of the Interest code and the major code). The distances within the pairs are each represented from "0" (opposite, e.g., C and A) to "3" (congruent, e.g., A and A). The weighted sum (C) can take all values from 0 to 18. Higher values stand for higher congruence.

# Interest-Major Fit

We assessed study content related Interest-Major Fit using items that were designed for nine specific majors. To generate the items, experts of each major were involved as well as experienced and successful students of the respective majors. Those items were also answered by current university students who were asked to what extent the content occurs in their studies (to have a measure for the environment). The result was six to 20 items per major. For details about the item development see Messerer et al. (2020). Sample items are: 'I am interested in how people make purchasing decisions' (Business Administration) and 'I am interested in how the nervous system and brain are structured and what functions they perform' (Psychology). Students answered these items on a Likert scale ranging from 1 (not at all) to 7 (very much). The subscales for each major acquired an acceptable reliability (mean  $\alpha = .80$ ). *Study Satisfaction* 

We used a well-validated German self-report scale to measure study satisfaction (Fragebogen zur Studienzufriedenheit; Westermann et al., 1996, 2002). This questionnaire has often been used in previous studies (Heise et al., 1997; Hiemisch et al., 2005; Schiefele & Jacob-Ebbinghaus, 2006; Wach et al., 2016). The scale consists of three subscales. As this is the dimension of study satisfaction, which is most likely dependent on the major choice, we focus solely on *satisfaction with the study content* in this study. This dimension assesses the student's feelings of joy and satisfaction with the chosen major. The subscale consisted of three items. A sample item for the subscale measuring satisfaction with study content is 'Overall, I am pleased with my academic experiences.' The items were measured on a Likert scale ranging from 1 (not true at all) to 7 (completely true). The internal consistency of the subscale satisfaction with study content was excellent ( $\alpha = .85$ ).

#### University GPA

We derived the university GPA directly from the university services. All participating students consented that this data could be collected. The data was matched to the questionnaire data using pseudonyms. The university GPA reflected the average grade achieved in the exams of the first semester. We recoded the grades as in the German system usually 1 is the best and 4 is the worst grade. Now better grades mean higher values.

# High school GPA

We asked the participants to report their high school GPA. Note that also for high school GPA higher values reflecting better grades. While self-reported grades may be biased estimates of actual grades, past research has found high correlations between reported and actual grades for German students (Dickhäuser & Plenter, 2005).

## Analyses

To test the first hypothesis, that university specific Interest-Major Fit can predict the study success outcomes better than the Interest-Vocation Fit, we conducted hierarchic regression analyses: to predict (1a) university GPA with Interest-Vocation Fit in the first model; in the second model Interest Major Fit was added. Another hierarchical regression analysis was conducted to predict (1b) study satisfaction with Interest-Vocation Fit in the first model and in the second model with Interest-Major Fit added.

To answer the second research question, whether Interest-Major Fit can predict study success outcomes beyond high school GPA, we conducted (2a) a hierarchical regression analysis in which high school GPA predicted university GPA (model 1). This regression analysis was compared to another analysis which contained the high school GPA and additionally Interest-Major Fit as predictors for university GPA (model 2). The same was done for the study success measure study satisfaction (2b). All analyses were conducted with R version 4.0.3 (R Core Team, 2020). Missing data was handled with the Full Information Maximum Likelihood method.

#### Results

Descriptive statistics and zero-order correlations are depicted in Table 3.1. A first look shows that the C Index (Interest-Vocation Fit) was neither correlated with any of the outcomes (study satisfaction and university GPA) nor with the Interest-Major Fit – only with high school GPA ( $r = .21^{***}$ ). In contrast, the Interest-Major Fit was correlated with study satisfaction ( $r = .27^{***}$ ) and university GPA ( $r = .18^{**}$ ). Interest-Major Fit was also correlated with high school GPA ( $r = .15^{***}$ ). Moreover, study satisfaction and university GPA were not significantly correlated.

# Table 3.1

Descriptive Statistics and Zero-Order Correlations.

Scale	М	SD	Range	(1)	(2)	(3)	(4)
T1 = First semester							
(1) Interest-Major Fit	5.14	0.92	1–7				
(2) Interest-Vocation Fit	11.54	4.12	0–18	08			
(3) high school GPA	3.19	0.61	1–4	.15***	.21***		
T2 = Second semester							
(4) Satisfaction with study content	5.65	1.04	1–7	.27***	.10	.04	
(5) university GPA	2.85	0.62	1–4	.18**	.12	.55***	.13

*Notes.* \*\* p < .01, \*\*\* p < .001. The depicted scale values are based on manifest mean scores. Range indicates the potential range.

## Hypothesis 1: Different Measurements of Interest-Major/Vocation Fit

The conducted hierarchical regression analyses showed that only the Interest-Vocation Fit was not significantly predictive for study satisfaction (see Table 3.2). Interest-Major Fit was significantly predictive for both study success measures in the models with both predictors. The model with Interest-Vocation and Interest-Major Fit explained 6.3% of the variance of university GPA and 8.8% of the variance of study satisfaction. For both study success measures, Interest-Vocation Fit alone explained only around 1% of the variance, so a considerable amount of explained variance was added when taking Interest-Major Fit into account as well.

# Table 3.2

Results of Regression Analyses for Hypothesis 1.								
		beta	SE	R²	AIC	BIC		
University GPA								
Model 1				.014	416.92	429.29		
	Interest-Vocation Fit	.12*	.009					
Model 2				.063	409.06	425.54		

		beta	SE	R²	AIC	BIC
	Interest-Vocation Fit	.16**	.009			
	Interest-Major Fit	.21**	.044			
Study satisfaction						
Model 1				.010	734.05	746.41
	Interest-Vocation Fit	.10, n.s.	.018			
Model 2				.088	715.80	732.28
	Interest-Vocation Fit	.12, n.s.	.017			
	Interest-Major Fit	.28***	.071			

Chapter 3: Interest-Major Fit Predicts Study Success?

*Notes.* n.s. = not significant, \*\* p < .01, \*\*\* p < .001.

# Hypothesis 2: Incremental Effect of Interest-Major Fit Beyond High School GPA

The second research objective was to test the effect that Interest-Major Fit has beyond high school GPA. As expected, high school GPA predicted university GPA with about 40% variance explained (see Table 3.3). The model with added Interest-Major Fit as a predictor could not even explain 1% more variance of university GPA and Interest-Major Fit was not a significant predictor in this regression.

For study satisfaction, high school GPA alone could not explain any of the variance in study satisfaction. The model with added Interest-Major Fit could explain 10% of the variance of study satisfaction. This is the same amount of explained variance as Interest-Major Fit can explain alone.

#### Table 3.3

Results of Regres	ssion Analyses jor	пуроте	515 2.			
		beta	SE	R²	AIC	BIC
University GPA						
Model 1				.398	339.61	351.97
	High school GPA	.63***	.064			
Model 2				.400	339.54	356.02
	High school GPA	.62***	.065			

Results of Regression Analyses for Hypothesis 2.

		beta	SE	R²	AIC	BIC
	Interest-Major Fit	.08, n.s.	.036			
Study satisfaction						
Model 1				.002	736.01	748.38
	High school GPA	.05, n.s.	.111			
Model 2				.100	619.65	636.13
	High school GPA	.06, n.s.	.128			
	Interest-Major Fit	.32***	.090			
<b>X</b> 7	· · · · · · · · · · · · · · · · · · ·	** 01	***	. 001		

*Notes.* n.s. = not significant,  ${}^{*}p < .05$ ,  ${}^{**}p < .01$ ,  ${}^{***}p < .001$ .

## Discussion

The aim of the conducted research was to compare different approaches of measuring Interest-Major Fit and to test whether Interest-Major Fit could contribute to the explanation of variance in study success (academic performance and study satisfaction) – beyond high school GPA. To this end we compared two different measures of Interest-Major Fit - general vocational interests (hereinafter Interest-Vocation Fit) in comparison to specific universityrelated interests (hereinafter Interest-Major Fit) - in their predictive power. Interest-Major Fit was measured with items especially tailored to the interest in content of studying, while Interest-Vocation Fit was measured with items indicating vocational interests in terms of the RIASEC-Model (Holland, 1997). Interest-Major Fit explained more variance than Interest-Vocation Fit of university GPA as well as of study satisfaction. That means that Interest-Major Fit was better suited to predict study success in the first semester. The Interest-Vocation Fit alone was not predictive of study satisfaction and explained only a small amount of variance of university GPA. Furthermore, the specific Interest-Major Fit emerged as a relevant predictor of study satisfaction even under consideration of high school GPA. However, the measure did not significantly explain university GPA when also considering high school GPA. This indicates that Interest-Major Fit is a relevant predictor for student well-being but not particularly for performance.

## **Theoretical Implications**

The present research illustrates that the predictive power of Interest-Major Fit for study success depends on the respective operationalization of the construct. In the terminology of the Expectancy-Value Theory of motivated action (Wigfield & Eccles, 1992, 2000), we find that particularly operationalizations of Interest-Major Fit that focus on the intrinsic value of the study content are predictive for study success. In contrast, operationalizations that focus on the utility value of a study program for latter occupations (Interest-Vocation Fit) were not (highly) predictive for study success. This makes sense, given the core tenet of Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) that commensurate and more concrete dimensions are better suited to assess the congruence, and therefore ensure higher predictivity.

Our findings, thus, illustrate a strong limitation of prior investigations into Interest-Major Fit that often used Holland's (1959) RIASEC model of vocational interests to operationalize the fit between the interests of a student and his/her major. To our understanding, past research more strongly echoes Interest-Vocation Fit or the utility value of a study program than it echoes Interest-Major Fit operationalized in line with the Person-Environment Fit Theory (Edwards & Shipp, 2007) as the congruence between personal interests and the curriculum of a major. This is especially important as an incommensurate operationalization of Interest-Major Fit supposedly leads to an underestimation of the meaningfulness of this factor. As most other research takes broader measures of Interest-Major Fit into account as used in the present study, it can be assumed that the effect of Interest-Major Fit on study success outcomes has been underestimated in the past. This is critical, as it not only leads to an incorrect process model of study success, but also inhibits the use of adequate ways to give advice to prospective students. It could be argued that those different ways of assessing congruence are not just different operationalizations of Interest-Major Fit, but actually two distinct constructs. That also makes sense, considering that we find no correlation between those two factors. Moreover, we do find differential results of what we call Interest-Major Fit and Interest-Vocation Fit. This divergent validity could hint that those are in fact different constructs and not merely different operationalizations of the same construct.

Regarding the joint influence of different predictors of study success – namely Interest-Major Fit and high school GPA – we could not find that Interest-Major Fit predicts the university GPA beyond high school GPA. However, it is possible that the effect of Interest-Major Fit on performance becomes more pronounced over time. As high school GPA and Interest-Major

Fit are correlated it could also be the case that individuals who achieve better grades are better at identifying their strengths and interests. In addition, in the German higher education system, some majors are restricted to individuals with a very good high school GPA. As such, the assurance of a high Interest-Major Fit at least partly depends on students' high school GPA. Therefore, it would be interesting to see whether effects of students' Interest-Major Fit on performance are more pronounced and go beyond the effects of high school GPA in education systems that do not use high school GPA as a strict entrance criterion.

Study satisfaction was only associated with Interest-Major Fit and not with high school GPA if both variables were included in one model. Taken together with the fact that both study success outcomes were uncorrelated, this indicates differential psychological processes behind the development of different dimensions of study success. This strongly highlights that study success is not a homogeneous construct. While prior performance (i.e., high school GPA) may act as an important indicator for students' ability to perform well at university, this does not mean that high-performing students will also be satisfied with their major. When aiming to project whether students are going to like the content of their studies, Interest-Major Fit seems to be a more important factor. Comprehensive models of study success, thus, require in-depth analysis and thorough theorizing for each potential dimension of study success (e.g., motivation, performance, persistence, well-being).

In the context of the Expectancy-Value Theory (Wigfield & Eccles, 1992, 2000) it makes sense that the intrinsic value (Interest-Major Fit) is more closely associated with the study satisfaction than the utility value (Interest-Vocation Fit). However, it needs to be tested if an intrinsic value during the studies can also translate to satisfaction in a subsequent vocation or whether this is the time when Interest-Vocation Fit becomes more important.

It could be argued that a higher Interest-Vocation Fit (utility value of a major) is connected to retrospective satisfaction with the studies, if the result of the studies was an extrinsically motivated job (e.g., good working hours, high pay). Additionally, the satisfaction with the subsequent job could be higher when the interests of the person suit the vocation. This long-term view (which was not included in the current study) could potentially highlight the impact of Interest-Vocation Fit measured with Holland's RIASEC-model. Further studies could investigate this question by conducting a longitudinal study which also covers the transition into the job.

# **Practical Implications**

According to our findings, measures of Interest-Major Fit – in terms of a congruence between personal interests and study content – are well suited to predict study success. This means that the use of such measures could benefit educational practitioners that aim to increase students' likelihood to develop well-being and perform well in their respective study program. Particularly, it seems important to promote that students choose their major based on individual interests. This in turn makes it necessary to provide information to prospective students about why an interest-based major choice is important and subsequently give them an opportunity to learn more about their personal interests and the content of different majors. For this purpose, practitioners may want to rely on Online Self-Assessments, which have proven to be reliable tools in providing student aspirants with important information regarding their choice of major and to assist them in self-reflection (Stoll, 2019; Stoll et al., 2017).

Questionnaires that assess Interest-Major Fit could be implemented in such Online Self-Assessments to provide students with optimal information on their likelihood to fit in certain study programs. However, the development of specific questionnaires tailored to a unique major at a certain university entails costs in terms of time and finances for test development and validation. Given the benefit of helping students to find a good fit, it may be advantageous to develop broader measures of Interest-Major Fit that are more strongly tailored to the university context (in comparison to measures of Interest-Vocation Fit) but are less costly than university-tailored tests (as used in this study). It stands to reason that the predictive power of such measures lies between very specific measures and measures of Interest-Vocation Fit (in line with Edwards & Shipp, 2007). As such, these measures might be a good compromise between implementation costs and predictive validity for educational practice.

## **Limitations and Future Research**

The present research only took the first semester of university into account. During this time span, we did not find effects of Interest-Major Fit on university GPA if high school GPA was considered as well. However, a fit between the interests of students and their majors might still have long-term effects on university GPA (even beyond high school GPA). This could be the case as Interest-Major Fit is usually connected to other variables that impact study success like motivation (Edwards & Shipp, 2007). Delayed effects of Interest-Major Fit may come to pass because students who perceive that they belong in a certain major could be less likely to experience a decline in learning motivation and consequently maintain high performance over time. These effects may become particularly prominent over time as students develop a better understanding of their major and its content. Future studies may take such potential indirect long-term effects of Interest-Major Fit via learning motivation into account to provide an even deeper understanding of psychological processes behind the development of study success.

Another limitation is that the study was conducted at only one university, located in Germany, which may limit the transferability of the results to other universities. This is a limitation because there are several majors at this university that do not directly lead to a certain job but offer a rather broad variety of possibilities. Additionally, in the German higher education system, some majors can only be studied if students have a good enough high school GPA. This means that in some majors there are many students with a rather similar high school GPA. This lack of variance limits the predictive power of high school GPA on further performance. Thus, future research could test our findings within a different education system and with a larger sample of universities that offer a broader set of majors.

## Conclusion

While Person-Environment Fit Theory suggests that assessing the congruence between students' interest and their major may be helpful in projecting study success, the presented study suggests that it is important how this congruence is operationalized. Particularly, past research often relied on measures of Interest-Vocation Fit rather than assessing Interest-Major Fit tailored to the study content of the respective study program. Our results show that the latter operationalization of the congruence between students' interests and their study program is better suited to predict students' study success. In practice, this means that prospective students should be encouraged to choose a major according to their interests regarding the specific major (not only regarding the subsequent vocation) when making their study choice.

Manuscript 3 – Is Every Semester the Same? The Interplay Between Intrinsic Motivation and Grades and How They Relate to Dropout Over the Course of University Studies

#### Abstract

Dropout from higher education carries high costs for individuals, institutions, and society. Intrinsic motivation and academic achievement are among the most prominent predictors for dropout. While these variables are deemed to be intertwined, competing explanations exist on how this connection comes to pass. We examine how the association between intrinsic learning motivation and achievement develops over time and how strongly these variables predict dropout at different time points. To investigate our research questions, we conducted a longitudinal survey that covered the whole duration of six-semester-programs at a German university with measurement points at the beginning of each semester (N = 1349 students). The survey data on intrinsic learning motivation and high school GPA was matched with information on university grades (obtained from the student administration). A Random-Intercept Cross-Lagged Panel Model revealed stable associations between intrinsic learning motivation and university GPA and cross-lagged effects from intrinsic learning motivation on university GPA in later semesters. When it comes to dropout, survival analyses showed that university GPA was the main predictor during the first and fifth semester, whereas intrinsic learning motivation and high school GPA played an important role during the second semester. None of the variables had any impact during the sophomore year. Our findings highlight that the association of achievement and motivation on dropout differs largely during different phases of one's studies. We use this information to develop a temporal process model on (motivated) dropout from higher education, which has implications both for educational theory and practical interventions to reduce dropout.

*Keywords:* Intrinsic motivation, academic achievement, study success, higher education, Random-Intercept Cross-Lagged Panel Model

# **Educational Impact and Implications Statement**

In different study phases, different (motivational) processes relate to dropout. On a practical level, it implies that distinct interventions are needed to be effective in the different study phases. On the one hand, early fostering of motivation is important since intrinsic motivation is a dropout reason in the freshman year. In addition, intrinsic motivation has a long-term effect on performance. On the other hand, it is important to offer students help in the event of early failures (poor grades in the first semester) to recognize whether this indicates that they are not suitable for the study program or whether only adaption processes to the requirements of the university are the reason for lower short-term performance.

## Introduction

When enrolling at a university, a lot of students are highly motivated to perform well in their major and attain the aspired academic degree. Unfortunately, about 30% of all bachelor students drop out of their study program (see Heublein et al., 2007 for Germany; OECD, 2018 for OECD countries) and for those who remain, the initial interest in the study content often fades away with motivation generally decreasing over time (Musu-Gillette et al., 2015). Particularly dropout from higher education (Sarcletti & Müller, 2011) entails high costs such as financial losses for the individual (e.g., tuition fees, book costs, relocation costs) as well as for society (e.g., inefficient allocation of money for learning material, learning facilities and teaching personnel). Besides these sunk financial costs, society also loses its ability to qualify needed professionals if a critical number of spots in study programs are distributed to individuals that eventually drop out of the program. Taken together with the impact on individuals' lifetime and well-being, it is possibly worthwhile to find ways to reduce the risk of dropout. While existing theoretical models on university dropout (Bean & Metzner, 1985; Blüthmann et al., 2008; Heublein, 2014; Tinto, 1975) classify a plethora of factors that may ultimately lead to dropout, survey data collected from students who preliminarily quit their study program revealed that lack of intrinsic motivation and poor grades are the most dominant proximal reasons for dropping out (Heublein, 2014). The interplay of those two factors has, to our knowledge, not been investigated in a longitudinal setting that covers the whole course of studies. This is necessary to identify starting points for interventions to prevent students from dropping out.

The aim of the present research is twofold: First, we investigate the interplay between intrinsic learning motivation and university GPA during the course of the bachelor's (six semesters of regular study time), which could help find a starting point for interventions to enhance study success. Second, we investigate how intrinsic learning motivation and university GPA contribute to dropout from higher education to provide further evidence about the time at which each of these variables has the largest impact on dropout from higher education. Importantly, we use objective data (i.e., academic achievement scores and dropout information directly collected from the student administration) to overcome the limitations of prior research that mostly relied on self-report data (Bardach et al., 2020; Höhne & Zander, 2019; Respondek et al., 2017; Sarcletti & Müller, 2011; Suhlmann et al., 2018).

# Critical Connections Between Motivation, Academic Achievement, and Dropout

To achieve those aims, it is necessary to take a closer look at the theories that could explain the longitudinal interplay of intrinsic learning motivation and achievement and how they contribute to dropout from higher education over time. We want to specifically focus on the longitudinal perspective. **The Interplay Between Intrinsic Learning Motivation and Achievement** 

# The interplay between intrinsic learning motivation and achievement can be explained through different theoretical approaches. According to *Person-Environment Fit Theory*, the fit between students' interests and the study content (i.e., their Interest-Major Fit) is central to their psycho-social development at university (Allen & Robbins, 2010; Tracey & Robbins, 2006). Interest-Major Fit is positively associated with intrinsic motivation, satisfaction, feeling of fit, and achievement and negatively with dropping out (Allen & Robbins, 2010; Tracey & Robbins, 2006). While the theory does not specify the exact mechanism linking intrinsic learning motivation and achievement, its central postulate that fitting interests facilitate optimal performance at least hints at a possible temporal direction of the association. This seems particularly true for the development of performance within freshmen who may lack the necessary intrinsic learning motivation to invest enough time and energy in learning if they chose an unfitting major. This lack of motivation might then directly translate into impaired performance.

In contrast to this assumption, *Self-Determination Theory* (Ryan & Deci, 2019, 2020) can explain why performance might also fuel the development of intrinsic motivation. Particularly, the theory states that developing a sense of competence is beneficial to developing intrinsic motivation (Niemiec & Ryan, 2009; Pintrich, 2004; Ryan & Deci, 2020; Ryan & Moller, 2017). Attaining good grades is directly associated with the experience of competence (Leondari & Gialamas, 2002) – and as a result likely with intrinsic motivation. In contrast, experiencing failures repeatedly may reduce students' intrinsic motivation. Nevertheless, Self-Determination Theory also leaves room for the hypothesis that intrinsic motivated, they are supposedly also more likely to enjoy their studies and will therefore try harder and invest more time (Ryan & Deci, 2020; Wang & Guthrie, 2004). Accordingly, they are likely to perform better in later exams (Hebbecker et al., 2019; Taylor et al., 2014).

# Chapter 4: Is Every Semester the Same?

Taken together, theoretical considerations based on Person-Environment Fit Theory and Self-Determination Theory make it possible to consider intrinsic motivation impacting achievement and vice versa. This is also echoed in empirical findings on the subject matter: On the one hand, studies have demonstrated unidirectional associations both from intrinsic motivation on academic achievement (Froiland & Worrell, 2016; Liu & Hou, 2017), or in the opposite direction (Garon-Carrier et al., 2016). On the other hand, other studies find associations in both directions and underline that intrinsic motivation and performance are connected in circles of reinforcement (Hebbecker et al., 2019; Schaffner et al., 2016; Taylor et al., 2014; Toste et al., 2020). Nevertheless, the existing studies are mostly limited to the context of primary and secondary education, which makes it difficult to draw direct inferences about the development of motivation and performance in higher education. Here, longitudinal studies are especially lacking with the few existing research works mainly pointing to the assumption that intrinsic learning motivation facilitates performance/better grades (e.g., Augustyniak et al., 2016; Messerer et al., 2023; Taylor et al., 2014).

While longitudinal studies in higher education are scarce, studies that investigated the relationship in a long-term longitudinal setting (more than only two measurement points) covering the period of a full study program are virtually non-existent. Most existing studies merely use either rather random time points or focus on the entry phase of higher education learning (Bargmann et al., 2022; Casanova et al., 2018; e.g., Messerer et al., 2023). This is a major shortcoming as different time points during one's studies are associated with different demands, which are not sufficiently accounted for in existing research. As such, the diverging empirical pattern between empirical studies such as finding mutual versus unilateral patterns of influence could be a direct result of researchers covering different study phases.

# Meaning of Motivation and Achievement for Dropout in Different Study Phases

The phases describing study progress are bound to different challenges, which may resonate differentially in the association between motivation and achievement. However, it should be noted that longitudinal research considering the challenges of the different phases at university is rare and models explaining dropout do not usually consider dropout at different time points.

#### Chapter 4: Is Every Semester the Same?

As mentioned above there is a rather large number of people dropping out of higher education (about 30%, see Heublein, 2014 for Germany; OECD, 2018 for OECD countries). This a severe problem, due to the above-mentioned costs for the individuals as well as for society (Sarcletti & Müller, 2011). In Germany and most European countries, the major has to be chosen before entering university, and changing the major often means starting over completely; this, of course, depends on whether students switch to a related major (e.g., from chemistry to biochemistry) or if they switch to a rather unrelated major (e.g., from chemistry to English studies). But regardless of this, if students change their major, there are nearly always courses that they attended that they do not need for the new major.

As empirical findings show, the main variables that are associated with dropout from higher education are intrinsic motivation and achievement (Heublein, 2014; Robbins et al., 2004). But how are they associated? Derived from the Person-Environment Fit Theory (Edwards & Shipp, 2007), we can assume that students who have the impression that their interests match the requirements of the major and therefore experience intrinsic learning motivation and show better performance, which makes it more likely to stay in the major.

In the first phase of studying at a university (entry phase/freshman year) students face the challenge to fit into their new environment (Holmegaard et al., 2014). During this time students have to cope with a lot of challenges for the very first time: many students live away from their family for the first time ever, students need to find new friends among their peers, time management skills and self-regulated learning are much more important at university than at school, while students are free to choose between different seminars and have to manage their own studying time. Additionally, in the first semester(s), students have to compare their interests and expectations about the major with the content of that major (Allen & Robbins, 2008). In other words, the assumptions of Person-Environment Fit Theory on the association between motivation and achievement is particularly fitting for this period.

Furthermore, it can be assumed that in the freshman year, more students drop out voluntarily (Larsen et al., 2013). This is because it is unlikely that students already failed an exam so many times that they are not allowed to retake it. However, it may be the case that students fail an exam in the first semester and therefore conclude that they are not able to cope with the coursework of their major. This conclusion does not necessarily have to be

correct but still leads to voluntary dropout (Larsen et al., 2013). It is also likely that the studies do not meet the students' expectations and they do not see a fit between their interests and the major (Allen & Robbins, 2010). Because of this, they could conclude that they enrolled themselves in the wrong major or that they do not want to continue higher education at all. In this case, it probably makes sense to switch to another major or leave higher education completely.

In the sophomore year, it becomes more important to be able to maintain achievement and intrinsic learning motivation. This is the period that has often been characterized under the label "sophomore slump" as students often struggle with declining performance and persistence (Webb & Cotton, 2019). Students in the sophomore year have generally adapted to the study context but need to find a way to motivate themselves even if they still have a large part of their studies ahead of them and the initial enthusiasm about university starts to weaken. Students in this phase already had time to build routines for studying but need to make sure that those routines do not bore them. Further, students in the sophomore year face the challenge of cognitive development, they need academic guidance and social connections (Hunter et al., 2010). Additionally, they are required to work more independently and therefore deliberately find support if needed (Clark, 2005). So far, there exists more research on the study entry phase than on the sophomore year (Schaller, 2010).

In the final phase of the studies, students need to take the last hurdles to finish their studies. As universities typically focus their supportive efforts on students in earlier study phases (Larsen et al., 2013), final year students are typically expected to be ever more self-reliant (see Bettinger et al., 2022). Whether students succeed in finishing their degree likely depends on whether they were able to develop good strategies for self-regulation and on how well they did in their previous studies, e.g., if they managed to pass all exams from the previous semesters or if they still have to retake (sometimes even the most difficult) exams. Additionally, students still have to maintain their motivation for their studies and push themselves to keep going. This long-term process can be explained by the Self-Determination Theory (Deci & Ryan, 2008) as both positive and negative reinforcement cycles are possible.

Considering those various challenges in the different study phases (freshman year, sophomore year, and final year), it can be assumed that the interplay between intrinsic learning motivation and academic achievement differs in the different phases. Moreover, this could also mean that intrinsic learning motivation and academic achievement contribute differently to dropout from higher education in the different phases of the studies. However, as existing models of dropout do not take different study phases into account, it is of great importance to provide further data on how intrinsic learning motivation and academic achievement are related to each other and particularly dropout over the course of studies. Although there has been some research and theoretical assumptions, it is yet unclear how the interplay of intrinsic motivation and achievement affects dropout – given the various challenges during studying. Both lack of intrinsic motivation and insufficient achievement can lead students to drop out over time. However, as motivation and achievement are also associated with each other, we aim to provide a deeper understanding of the process. For this, data that covers the different phases of undergraduate studies is needed to give meaning to the different associations and disentangle the different effects that might occur.

## The Present Study

To address existing research gaps regarding the interplay between intrinsic learning motivation and academic achievement, we examine the extent to which the two variables are related across the whole duration of students' undergraduate studies and whether there are study phases in which the further development of either variable is significantly related to the other variable. We hypothesized that intrinsic motivation and achievement are positively mutually associated over time (cross-lagged effects). In more detail, we hypothesize that intrinsic motivation is positively associated with subsequent academic achievement due to investing more time and effort in an activity they enjoy (see theoretical explanations above). Moreover, we hypothesize that academic achievement is positively associated with subsequent intrinsic motivation, due to an increased experience of competence. Our research questions (RQs) on the relations between motivation and achievement were:

RQ1a. To what extent are intrinsic motivation and achievement related over the course of studies and in the different study phases? RQ1b. To what extent are the associations between intrinsic learning motivation and achievement stable and can be generalized across study phases?
Concerning dropout from higher education, we aimed at identifying in which study phases intrinsic learning motivation and university GPA had an impact on students' decision to leave their studies. Our explorative RQs concerning study dropout were as follows:

*RQ2a.* In which study phase(s) is intrinsic learning motivation related to dropout from higher education?

*RQ2b.* In which study phase(s) is academic achievement related to dropout from higher education?

#### Method

#### **Data Collection**

To investigate our research objectives, we used data from an existing longitudinal study which was conducted at a public German university. With approximately 12,000 students, this university is a medium-sized university. Our study only included students who were in the first stage of their education (bachelor level): Student data was assessed at the beginning of each semester, starting with the students' first semester  $(T_1)$  and each subsequent semester until the sixth semester ( $T_6$ ). At each time point, the university administration contacted the entire student cohort, and we also advertised the survey study on social media and in lectures. Students either received 5€ or gained course credits for participating in our study (only students of psychology or education) as compensation. We requested permission from the participants to retrieve their university GPA and enrollment status through the student administration and obtained the data at the start of each semester. The assessment and pseudonymized matching of extra personal data (i.e., university GPA and enrollment status) was approved by the University's IRB (EK Mannheim 17/2019).

#### Sample

Our final sample consisted of university students who participated in our study at least once within their first to sixth semester. Before we conducted the analyses, we excluded those students who participated in the study but were not in the cohort we aimed to investigate (n = 8). We did so by comparing the self-reported semester with the data we obtained from the study administration and making sure that it (a) corresponded and (b) that the students were in the semester we wanted to examine. In total, more than half of the students of the cohort participated at least once (N = 1349 students,  $M_{ageTI} = 19.7$  years, SD =

2.0 years, 61.8% female, 1 participant identified as non-binary). A sample of 655 students answered the first online survey at the beginning of the first semester. At the subsequent time points, the sample sizes were as follows:  $n(T_2) = 635$ ,  $n(T_3) = 541$ ,  $n(T_4) = 515$ ,  $n(T_5) = 437$ ,  $n(T_6) = 285$ . The participating students were enrolled in 24 different subjects, mostly from the fields of Social Sciences and Economics (for more details, please see the Supplemental Table 4.1 at hhttps://osf.io/h2rjs/?view\_only=b6b3af380cdd42cfa37dff8784c393a9).

#### Measures

## Intrinsic Learning Motivation

To assess intrinsic learning motivation, we used items from the Intrinsic Motivation Inventory (IMI, Deci & Ryan, 2013) that had been adapted to the context of university studies and translated into German. Intrinsic learning motivation was measured with the same six items at all time points (T<sub>1</sub> to T<sub>6</sub>). Sample item: "I think studying is really interesting." Students were asked to indicate their agreement with the items using a 7-point Likert scale that ranged from 1 (not at all) to 7 (completely true). The internal consistencies over time were high ( $\alpha_{T1-T6} = .92-.94$ ). In the subsequent analyses, all six items loaded well on a latent variable at all measurement points ( $\lambda \ge .72$ , p < .001).

# High School GPA

The students' general qualification for admission to an institution of higher education (which we refer to as "high school GPA" for the ease of reading) was obtained as a self-report. In Germany, passed exams are graded from 1 to 4, with 1 being the best, and 4 the worst grade. We recoded the grades for better comprehensibility, so that higher values indicated better performance. *University GPA* 

As noted earlier, we retrieved students' university GPAs from the university service to avoid assessing them via self-reports. The university GPA reflected the average grade achieved in the exams of each semester. Consequently,  $GPA_{T2}$  is the GPA of the exam period after the first semester,  $GPA_{T3}$  is the GPA of the exam period after the second semester, and so forth. As such, the GPA captures the momentary performance level, which is not confounded with earlier performance (as it would be for a summative GPA that also includes predating exams). Like for high school GPA, we recoded the grades, so that higher grades reflected better university performance. *Dropout from the Major*  In Germany, before enrolling in a bachelor's program, students must choose a major, and as there is no orientation phase, changing the major means starting over. Therefore, we defined dropout as quitting a major before completing it (i.e., including leaving university, changing major, dropping out after conclusively failing an exam, etc.). Changing universities but maintaining a major was not considered dropping out. Following this definition, 121 of the students who took part in our survey dropped out between the first and the sixth semester (9.7% of the sample).

#### **Statistical Analyses**

#### Random Intercept Cross-Lagged Panel Model

To address RQ1a and RQ1b, we estimated a Random-Intercept Cross-Lagged Panel Model (RI-CLPM) and accounted for both within- and betweenperson effects (Hamaker et al., 2015), using the robust maximum likelihood estimator (MLR). We applied one-tailed testing for our directed hypothesis on the associations between intrinsic learning motivation and achievement. To ensure that a RI-CLPM can be applied to latent variables that are indicated by multiple indicators (i.e., intrinsic learning motivation), weak factorial invariance needs to hold (Hamaker, 2018; Mulder & Hamaker, 2021). Weak invariance means that the factor loadings do not significantly differ from each other for the different time points. Strong factorial invariance is only important if we would want to compare the means over time. We applied the following criteria to determine if measurement invariance holds:  $\Delta CFI > .01$ ,  $\Delta RMSEA > .01$ (Putnick & Bornstein, 2016). Additionally, we did a  $\chi^2$  difference test which needs to be nonsignificant to assume that measurement invariance holds (Hamaker, 2018).

RI-CLPMs have several advantages over CLPMs: RI-CLPMs contain a stable trait factor (RIGPA and RIMot in Figure 4.1), which is not included in CLPMs (Marsh et al., 2022). Consequently, a RI-CLPM decomposes the effects of within-person (i.e., momentarily divergence from a general trait) and the between-person (i.e., stable trait) factors. However, between-person effects in CLPMs are a mix of both factors. Furthermore, RI-CLPMs provide better protection for time-invariant covariates (between-person) and unmeasured covariates (Hamaker et al., 2015; Mulder & Hamaker, 2021). This is because covariates that are truly time-invariant for each person only affect the trait factors (RIGPA and RIMot). Those trait factors are statistically independent

from the autoregressive factors (within-person) which test the directional ordering (Hamaker et al., 2015).

In our RI-CLPM (see Figure 4.1), we included intrinsic learning motivation at all six time points as a latent variable. University GPA was included at time points T<sub>2</sub> to T<sub>6</sub>. We also allowed covariances among the residuals in the measurement models of intrinsic learning motivation to account for possible time dependencies among the same items over time (Little, 2013). High school GPA was included in the model to allow prior school achievement to predict subsequent university achievement and, through high school GPA, to explain possible differences in university GPA. This was also done to rule out the possibility that associations between intrinsic learning motivation and university GPA reflect selection effects (i.e., better performance conditions admission to the desired field of study), the model controlled for influences of high school GPA. Moreover, we included the different majors as a cluster variable to account for possible between-major differences (e.g., there are majors in which the grades are usually better than in other majors) and for the fact that the students are not distributed equally between the majors (e.g., some majors have entry criteria while others have not). In Mplus, we used the TYPE=COMPLEX option with majors as clusters to obtain cluster-robust standard errors and test statistics.

To address RQ1a, we examined the cross-lagged effects which tested whether students are more or less likely to experience a subsequent higher than usual intrinsic learning motivation (compared to their long-term average intrinsic learning motivation over the course of their studies) when they exhibit a greater than usual GPA (compared to their long-term average GPA over the duration of their studies). We also tested whether students are more or less likely to have a subsequent better than usual GPA when their intrinsic learning motivation exceeds their typical levels (relative to their long-term average GPA). To address RQ1b, we modeled the reciprocal associations between the random intercepts of intrinsic learning motivation and university GPA while controlling for the stable, trait-like parts of these constructs.

We conducted all analyses using M*plus* Version 8 with the fullinformation maximum-likelihood procedure to handle missing data (Muthén & Muthén, 1998-2017). To evaluate the model fit, we used the following criteria:  $CFI \ge .95$ ,  $TLI \ge .95$ ,  $RMSEA \le .08$ ,  $SRMR \le .10$  was considered an acceptable model fit and CFI  $\geq$  .97, TLI  $\geq$  .97, RMSEA  $\leq$  .05, SRMR  $\leq$  .05 was considered a good model fit (Schermelleh-Engel et al., 2003).

# Survival Analysis

To investigate the effects of intrinsic learning motivation and GPA on dropout from higher education (RQ2a & RQ2b), we extended the RI-CLPM by the dropout variables at T<sub>2</sub>-T<sub>6</sub>. Hence, our approach combined the RI-CLPM with a survival analysis. In the survival part of our model, we used the random intercepts (RI<sub>Mot</sub> and RI<sub>GPA</sub>) and the high school GPA as predictors of dropout from higher education. Dropout was included as a binary variable (dropout yes = 1 or no = 0). As we measured dropout at the end of each semester, there are five possible time points at which students could have dropped out from their major: at the end of the first semester (T<sub>2</sub>), at the end of the second semester (T<sub>3</sub>), and so on. To estimate the model, we used the MLR estimator and inserted the parameters of the RI-CLPM as starting values. Notably, a model estimating all parameters without the given starting values did not converge. Thresholds, which were hazards in a logit scale, indicated the probability of dropping out over time (Muthén & Masyn, 2005).

#### **Transparency and Open Science Practices**

We report how we collected our data and all data exclusions. The analysis code and output as well as the questionnaire we used to measure intrinsic learning motivation (Supplemental Table 4.4) is available online via <u>https://osf.io/h2rjs/?view\_only=b6b3af380cdd42cfa37dff8784c393a9</u>. Data were analyzed using M*plus*, Version 8 (Muthén & Muthén, 1998-2017). We did not pre-register the study design and its analysis.

Table 4.1

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Scale	W	SD	Range	β	(1)	(2)	(3)	(4)	(2)	(9)	6	(8)	(6)	(10)	(11)
(1) high school GPA	1.95	0.63	4												
T <sub>1</sub> = First semester (2) Intrinsic Learning Motivation	5.31	1.18	1–7	.93	*80.										
T <sub>2</sub> = Second semester (3) university GPA (4) Intrinsic Learning Motivation	2.57 5.22	0.68 1.18	1-4 1-7	.92	.50** .09*	*60. **69.	.20**								
T <sub>3</sub> = Third semester (5) university GPA (6) Intrinsic Learning Motivation	2.79 5.05	0.66 1.23	1-4 1-7	.92	.35** .03	.07 .61**	.63** .17**	.14** .67**	.16**						
T <sub>4</sub> = Fourth semester (7) university GPA (8) Intrinsic Learning Motivation	2.80 4.97	0.64 1.26	1-4 1-7	.93	.40** .02	.10* .57**	.61** .10*	.17** .67**	.59** .16**	.21** .74**	.21**				
T <sub>5</sub> = Fifth semester (9) university GPA (10) Intrinsic Learning Motivation	3.01 5.02	$0.60 \\ 1.30$	1-4 1-7	.93	.23** .04	.12** .54**	.48** .13**	.12** .60**	.52** .15**	.23** .65**	.58** .13**	.19** .77**	.17**		
T <sub>6</sub> = Sixth semester (11) university GPA (12) Intrinsic Learning Motivation	3.22 5.02	0.64 1.32	1-4 1-7	.94	.44** .16**	.17** .51**	.53** .22**	.17** .50**	.44** .15*	.17** .63**	.46** .25**	.15** .65**	.46** .18**	.17** .73**	.19**
Note. * $p < .05$ , ** $p < .0$ GPA measures that 4 is the	1. The d	depicted and 1 is	d scale vi	alues aré st grade.	based o	n manife	sst mean	scores.	Range i	ndicates	the pote	ential rar	nge. Not	e for	

#### Results

Descriptive statistics and zero-order correlations are shown in Table 4.1. The means reveal that intrinsic learning motivation decreases slightly – especially towards the second year. University GPA however increases over the course of studies. Intrinsic learning motivation was positively correlated with intrinsic learning motivation among all time points ( $T_1$  to  $T_6$ ). Furthermore, university GPA was positively correlated among all time points ( $T_2$  to  $T_6$ ). In most cases (except Motivation  $T_1$  and university GPA  $T_3$ ), motivation was positively correlated with grades. High school GPA was positively correlated with university GPA at all time points and positively correlated with intrinsic learning motivation at time points  $T_1$ ,  $T_2$ , and  $T_6$ .

The number of students dropping out from their major in our sample is depicted in Table 4.2. The actual percentage of students dropping out within the respective cohort (about 30% until the beginning of the 6<sup>th</sup> semester) is higher than in our sample which is probably because our sample consists of students who participated voluntarily in the survey(s).

Time points	Dropout	%	No dropout	%
$T_2$	29	2.4	1200	97.6
$T_3$	44	3.7	1142	96.3
$T_4$	19	1.7	1091	98.3
$T_5$	17	1.6	1049	98.4
$T_6$	11	1.1	1033	98.9

# Table 4.2 Numbers of Students Dropping Out.

We tested measurement invariance by comparing the configural model and the weak factorial invariance model using a chi-square test, which was not significant,  $\Delta \chi^2 = 27.03$ ,  $\Delta df = 25$ , p = .380,  $\Delta CFI = .000$ ,  $\Delta RMSEA = .000$  (see Supplemental Table 4.2,

<u>https://osf.io/h2rjs/?view\_only=b6b3af380cdd42cfa37dff8784c393a9</u>). Hence, there is evidence supporting the assumption of weak factorial invariance. All subsequent models with a RI-CLPM part were based on this assumption. We

further tested strong factorial invariance and found that  $\Delta$ CFI and  $\Delta$ RMSEA meet the criteria. However, the model comparison was significant, which should not be the case to establish strong invariance. As weak invariance is the necessary prerequisite for a RI-CLPM, this is not further discussed.

# Random-Intercept Cross-Lagged Panel Model (RQ1a & RQ1b)

The RI-CLPM is displayed in Figure 4.1. The model showed a good fit,  $\chi^2(730) = 1128.28$ , p < .001, CFI = .977, TLI = .973, RMSEA = .021, SRMR = .048.

The model shows significant autoregressive associations between university GPA from T<sub>2</sub> to T<sub>5</sub> and for intrinsic learning motivation from T<sub>1</sub> to T<sub>2</sub> and T<sub>3</sub> to T<sub>6</sub>. Significant cross-lagged effects existed from intrinsic learning motivation to university GPA from T<sub>4</sub> to T<sub>5</sub>, and T<sub>5</sub> to T<sub>6</sub>. The random intercepts of university GPA and intrinsic learning motivation were correlated with r =.298, p < .001. The residual variances of the random intercepts were .988 for RI<sub>GPA</sub> and .776 for RI<sub>Mot</sub>, respectively. High school GPA was associated with the latent variable of GPA at T<sub>2</sub>, RI<sub>GPA</sub>, and RI<sub>Mot</sub>. Table 4.3 shows the relevant model parameters.

Random-Intercept Cross-Lagged Panel Model.



# Table 4.3

Unstandardized and Standardized Parameter Estimates for the RI-CLPM.

Paths	b	β	SE	<i>p</i>	95% CI
Motivation $T_1 \rightarrow$ Motivation $T_2$	.214	.226	.117	.028	[-0.005; 0.456]
Motivation $T_1 \rightarrow \text{GPA} T_2$	064	112	.068	.051	[-0.246; 0.022]
Motivation $T_2 \rightarrow$ Motivation $T_3$	.239	.211	.162	.097	[-0.107; 0.529]
Motivation $T_2 \rightarrow GPA T_3$	031	048	.067	.239	[-0.180; 0.084]
$GPA T_2 \rightarrow GPA T_3$	.260	.240	.083	.002	[0.077; 0.402]
GPA $T_2 \rightarrow$ Motivation $T_3$	028	015	.065	.409	[-0.143; 0.113]
Motivation $T_3 \rightarrow$ Motivation $T_4$	.516	.485	.101	.000	[0.288; 0.683]
Motivation $T_3 \rightarrow GPA T_4$	.035	.065	.051	.103	[-0.036; 0.165]
$GPA \ T_3 \rightarrow GPA \ T_4$	.181	.196	.066	.002	[0.066; 0.326]
GPA $T_3 \rightarrow$ Motivation $T_4$	.120	.065	.089	.233	[-0.110; 0.240]
Motivation $T_4 \rightarrow$ Motivation $T_5$	.656	.583	.072	.000	[0.442; 0.723]
Motivation $T_4 \rightarrow GPA T_5$	.075	.150	.080	.030	[0.006; 0.307]
$GPA T_4 \rightarrow GPA T_5$	.162	.163	.052	.001	[0.061; 0.265]
GPA $T_4 \rightarrow$ Motivation $T_5$	077	034	.034	.155	[-0.100; 0.032]
Motivation $T_5 \rightarrow$ Motivation $T_6$	.612	.569	.083	.000	[0.406; 0.732]
Motivation $T_5 \rightarrow GPA T_6$	.054	.114	.053	.016	[0.010; 0.218]
$GPA \ T_5 \rightarrow GPA \ T_6$	040	037	.127	.386	[-0.285; 0.211]
GPA $T_5 \rightarrow$ Motivation $T_6$	256	105	.074	.078	[-0.250; 0.040]
Paths	b	β	SE	р	95% CI
High school GPA $\rightarrow$ Motivation T <sub>1</sub>	041	033	.078	.337	[-0.187; 0.121]
$\text{High school GPA} \to \text{GPA} \ T_2$	.194	.276	.068	.000	[0.143; 0.408]
High school GPA $\rightarrow$ RI GPA	.336	.475	.089	.000	[0.301; 0.649]
High school GPA $\rightarrow$ RI Motivation	.175	.111	.057	.025	[0.000; 0.223]
Between-person correlation RI Motivation WITH RI GPA	.117	.298	.066	.000	[0.169; 0.427]

Residual Variance RI Motivation	.980	.988	.013	.000	[0.963; 1.012]
Residual Variance RI GPA	.156	.775	.084	.000	[0.609; 0.940]
Note. GPA = Grade Point Average	, RI = F	Random	Interc	ept. Mo	odel fit: $\chi^2(730) =$

1128.28, *p* < .001, CFI = .977, TLI = .973, RMSEA = .021, SRMR = .048.

# RI-CLPM and Survival Analysis Combined (RQ2a & RQ2b)

The combination of the survival analysis and the RI-CLPM showed that we can explain dropout by intrinsic learning motivation, university GPA, and high school GPA at the beginning and the end of the studies (see Table 4.4). Particularly after the first semester ( $T_2$ ), dropout was associated with university GPA ( $RI_{GPA}$ ). After the second semester ( $T_3$ ) both intrinsic learning motivation ( $RI_{Mot}$ ) and high school GPA were associated with dropout. For  $T_4$  and  $T_5$ , there were no significant associations; yet, at  $T_6$ , the university GPA ( $RI_{GPA}$ ) was associated with dropout. In all cases, the significant associations were negative and thus indicated that better (poorer) grades and higher (lower) intrinsic learning motivation were associated with a decreased (increased) probability of dropping out.

#### Table 4.4

Paths	b	β	SE	р	95% CI
$RI_{Motivation} \rightarrow Dropout \ T_2$	269	119	.111	.284	[-0.336; 0.099]
$RI_{GPA} \rightarrow Dropout \ T_2$	-2.071	415	.177	.019	[-0.762; -0.068]
$RI_{Motivation} \rightarrow Dropout \ T_3$	062	308	.047	.000	[-0.400; -0.216]
$RI_{GPA} \rightarrow Dropout \ T_3$	.697	.157	.248	.526	[-0.328; 0.643]
$RI_{Motivation} \rightarrow Dropout \ T_4$	.088	.043	.119	.717	[-0.191; 0.277]
$RI_{GPA} \rightarrow Dropout \ T_4$	-1.674	374	.213	.079	[-0.790; 0.043]
$RI_{Motivation} \rightarrow Dropout \ T_5$	325	170	.128	.182	[-0.420; 0.080]
$RI_{GPA} \rightarrow Dropout \ T_5$	377	090	.395	.821	[-0.864; 0.685]
$RI_{Motivation} \rightarrow Dropout \ T_6$	.234	.107	.250	.668	[-0.383; 0.597]
$RI_{GPA} \rightarrow Dropout \ T_6$	-3.142	652	.136	.000	[-0.920; -0.385]
$High \ school \ GPA \rightarrow Dropout \ T_2$	776	218	.137	.112	[-0.486; 0.051]

Unstandardized and Standardized Parameter Estimates for the Survival Analysis.

Chapter 4: Is Every Semester the Same?

High school GPA $\rightarrow$ Dropout T <sub>3</sub>	-1.119	353	.134	.008	[-0.615; -0.091]
$High \ school \ GPA \rightarrow Dropout \ T_4$	453	142	.164	.387	[-0.462; 0.179]
$High \ school \ GPA \rightarrow Dropout \ T_5$	498	166	.285	.561	[-0.725; 0.393]
High school GPA $\rightarrow$ Dropout T <sub>6</sub>	.802	.233	.189	.218	[-0.138; 0.604]

*Note*. RI = Random Intercept.

Additionally, the probability of dropout decreased with time, as indicated by the thresholds (see Table 4.5).

#### Table 4.5

Thresholds for the Survival Analysis.

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Thresholds	b	β	SE	р	95% CI
Dropout T <sub>2</sub>	049	022	.383	.955	[-0.773; 0.730]
Dropout T <sub>3</sub>	.568	.282	.357	.428	[-0.416; 0.981]
Dropout T <sub>4</sub>	1.359	.670	.577	.246	[-0.461; 1.801]
Dropout T <sub>5</sub>	2.162	1.134	.636	.075	[-0.112; 2.380]
Dropout T <sub>6</sub>	4.549	2.085	.653	.001	[0.806; 3.364]

*Note*. RI = Random Intercept.

Our model could significantly explain the variance of dropout, especially for time points at which we found significant associations with one of our variables. Those time points were the freshman year,  $T_2$  with  $R^2 = .356$  and  $T_3$  with  $R^2 = .186$ , and the final year,  $T_6$  with  $R^2 = .309$ . For dropout during the sophomore year, that is  $T_4$  and  $T_5$ , we could not explain a significant variation in dropout (for details on the variance explanation, please see Supplemental Table 4.3, <u>https://osf.io/h2rjs/?view\_only=b6b3af380cdd42cfa37dff8784c393a9</u>).

#### Discussion

The conducted research aimed to disentangle the associations of intrinsic learning motivation and university GPA during undergraduate studies (six semesters of bachelor's degree) and the association of those variables with dropout from higher education. To foster our understanding of these associations, we used a Random-Intercept Cross-Lagged Panel Model in combination with a Survival Analysis. We found that associations between intrinsic learning motivation and university GPA differed between different time points over the course of students' time at university. This was mirrored by our findings on associations with dropout, which suggest that achievement and (intrinsic) motivation play very different roles for students' likelihood to dropout during different phases of their studies.

### **Theoretical Implications**

Processes that are in place during a 3-year bachelors' degree are not the same as processes in contexts in which individuals engage for longer time frames such as work and school contexts. As individuals often spend over a decade at school and years to decades in a work environment, it is more difficult to differentiate time phases in a normative way (besides the entry phase). This is remarkably different within undergraduate programs in higher education, which are defined by an overall shorter duration that makes it easy to judge whether an individual is in the freshmen, sophomore, or final year (both for the researcher and the individual in question).

The RI-CLPM showed cross-lagged effects only from intrinsic learning motivation on academic achievement. This indicates that even though there are existing stable associations between intrinsic learning motivation and achievement (indicated through the association of the Random Intercepts), only changes in intrinsic learning motivation can lead to an increase (decrease) in university GPA in the subsequent semester. This is especially true for the end phase of the studies as we did not find these cross-lagged effects in the freshman year. This indicates that different phases of studying are characterized by unique challenges, which limits the exploratory power of simplified models of dropout that generalize the importance of motivation and achievement over different phases. Rather, it seems appropriate to develop temporal process models of dropout, which are sensitive to changing characteristics of study demands. In this discussion, we want to present such a temporal process model inspired by our empirical results and further theoretical considerations (see Figure 4.2).

#### Figure 4.2

Temporal Process Model of Dropout From Higher Education.

#### Chapter 4: Is Every Semester the Same?



The adaption phase is often considered as a time period when questions about personal fit are central to newly enrolled students. The fit with the major is put to test during the freshman year. According to the Person-Environment Fit Theory (Allen & Robbins, 2010; Edwards & Shipp, 2007; Tracey & Robbins, 2006) the fit between the students and their majors is important as it leads to an increase in intrinsic learning motivation, better academic achievement and less dropout. Empirical studies found that fit with the major was connected to these variables (Bäulke et al., 2022; Messerer et al., 2023). The importance of fit seems to be especially important in the adaption phase of the studies. This also resonates with our findings as the probability of dropout decreases with time (see Table 4.5), which fits previous findings that half of the dropouts happen in the first academic year (Heublein et al., 2017).

We do find that different variables are associated with dropout in different semesters. University GPA is associated with dropout during the first semester – even though we can assume that this is still voluntary dropout. However, it is probable that students who have rather bad grades in the first exams of their studies or even fail one or several exams in the first semester, might conclude that they chose the wrong major or that they are not suited to studying at all. During the second semester, intrinsic learning motivation and high school GPA are associated with dropout. This means that students drop out because on the one hand they experience a lack of intrinsic learning motivation. Intrinsic learning motivation could be helpful to overcome the challenge of selfregulation of the learning activities in this phase (Klingsieck, 2013; Sitzmann & Ely, 2011; Steel, 2007; Zimmerman & Schunk, 2011). Also, intrinsic learning motivation is needed in order for students to spend their time learning rather than on other activities which are more appealing to them (e.g., meeting friends, watching TV), overcoming the challenges of self-regulation and time management (Ryan & Deci, 2020; Wang & Guthrie, 2004). On the other hand, high school GPA is also connected with dropout in this semester. This could be a hint that students who have a higher capacity of performance are more immune to the challenges in this phase. For example, less self-regulation or time management skills are needed if students need less time to prepare for exams and for university courses in general because of a greater capacity of performance.

During the sophomore year, neither academic achievement nor intrinsic learning motivation could explain why dropout occurs. In the sophomore year, some aspects of the studies certainly stabilize since adaption to the university context is over. However, other variables could be responsible for dropout in this phase. More research is needed here (see section on limitations and future research).

In the final year, dropout was associated with university GPA. Dropout just before finishing a degree could be regarded as the worst kind of dropout since most resources have been invested without attaining an academic degree. Dropout might be a result of improper motivational development over the entire course of the studies. Additionally, exams which were postponed to the next semester could finally get back at the students. Also, a chronically reduced level of achievement could be a reason for why university GPA is associated with dropout in the final year. The cross-paths of the RI-CLPM indicate that even though we only found that university GPA was associated with dropout in the fifth semester, it seems at least indirectly influenced by intrinsic learning motivation. Therefore, we conclude that dropout in this phase of the studies is the result of both poorly sustained intrinsic learning motivation and academic achievement. According to the Self-Determination Theory (Deci & Ryan, 1985, 2008) we would assume that cross-paths in both directions (from motivation on achievement and from achievement on motivation) were possible. However, we only found cross-paths from intrinsic learning motivation on academic achievement. In the specific context of undergraduate studies, it seems like the associations are only unidirectional.

The findings of our study highlight that it is important to focus on meaningful moments during the course of study when making statements about relationships about different variables. Additionally, if future or existing research does/did not find certain associations between variables, a closer look should be taken at the time points of the analysis as at least our results highlight the possibility that motivation is less impactful for achievement in the freshman year than in the final phase of one's studies.

Taken together, our findings contribute to a more nuanced view of the interplay between intrinsic learning motivation and university grades. It seems to matter immensely which phase of the studies is investigated as the effects differ strongly. The model presented in this work (see Figure 4.2) can be a starting point for a real process model of the study process which takes a stronger temporal perspective than existing models on dropout and study success. Time points during the duration of a study program are not arbitrary as different study phases are characterized by different challenges and demands. This also has strong implications for interventions targeting study success and dropout.

# **Practical Implications** Foundations for an optimal development of motivation and academic

achievement should already be laid at the beginning of the studies as long-term neglect can lead to late dropout. Regarding the practical implications our findings suggest that motivational interventions to reduce dropout can be immediately effective – especially during the second semester. One example could be the provision of a need-supportive learning environment (Haakma et al., 2017; Mohamedhoesein & Crul, 2018). This includes lecturers at universities receiving specific training to provide a need-supportive learning environment (Aelterman et al., 2013). Additionally, socializing agents that help the students in an autonomy-supportive way could be used (Su & Reeve, 2011).

Another approach to foster intrinsic learning motivation is the choice of a commensurate major (Allen & Robbins, 2010; Janke et al., 2021; Messerer et al., 2023; Stoll, 2019; Tracey & Robbins, 2006). This means finding a major that fits the interests of the prospective students. Since there is no orientation phase at German universities, this choice needs to be made before enrolling in a major. Research has shown that Online Self-Assessments are a good way to provide prospective students with information about their potential major (Stoll, 2019). Consequently, Online Self-Assessments lead to an Interest-Major Fit which results in higher intrinsic learning motivation, better grades and also higher persistence (less dropout) in university students (Allen & Robbins, 2010; Messerer et al., 2023). Chapter 4: Is Every Semester the Same?

As research has shown that in the sophomore year, students usually receive less academic guidance than in the freshman year (Clark, 2005; Hunter et al., 2010), it could be worthwhile to implement a low-threshold service for students where they can get help regarding their studies. Additionally, students who still require assistance in self-regulated learning should get this help, e.g., through courses about how to structure themselves and lecturers setting tasks in smaller sub-tasks.

However, motivational interventions might also have a delayed effect on reducing dropout – especially when the effect is mediated by academic achievement. This is because in the final year, university GPA is the reason for dropping out rather than motivation. Nevertheless, as there are cross-lagged effects of intrinsic learning motivation on university GPA towards the end of a student's studies, motivation might also still be associated with dropout in this late phase of the studies – mediated by university GPA. As we especially want to prevent dropout this late because of high costs, it is important to build a strong foundation of both motivation and academic achievement from early on in the studies.

Further, universities should offer help to students adjusting to the university environment and the adaption process to the requirements at university. For example, when students struggle with their first exams at university, it may simply be that they did not sufficiently know how to prepare themselves for the exams – and not that they are not suited for studying. Instead training programs to enhance self-regulated learning can foster students' academic performance as well as their motivation (see meta-analysis by Theobald, 2021).

#### **Limitations and Future Research**

We weighted all grades the same, even though there could be exams which are more important for the students because they are the core of their major and other exams that only cover an optional course. Accounting for this could make it more probable to find associations between our constructs because weighting the grades would give a more accurate picture of students' academic achievement. If possible, future research should take that into account.

The number of students dropping out in our sample was smaller than in the total student population at this university. A reason for this could be that students who are already thinking about leaving their major/the university are probably less motivated to take part in a survey by the university. Still, most students in our sample drop out within the first academic year, which is in line with the literature (Heublein et al., 2017). However, this does not mean that the effects we found are less credible – on the contrary: Effects that we find despite the limited number of students are even more meaningful. This is because we probably underestimate the effects in our study due to lower power bound to positive selection. Future research should aim to avoid this self-selection of study participants to overcome this.

Especially the sophomore year of the bachelors' degree needs more research as we could not explain the variance of the dropout in this phase with grades and intrinsic learning motivation. It seems like in the sophomore year, there are other variables that contribute to dropout and this phase is the blind spot of our presented temporal process model (see Figure 4.2). According to the literature on the "sophomore slump" (Hunter et al., 2010; Webb & Cotton, 2019), it would be interesting to take a closer look at the social connections and evaluate how well students are able to work independently (Clark, 2005). To complete the processes that are in place when regarding dropout, these factors could be included in future studies.

It should be noted that the way in which we measured our variables (once per semester) might also influence the findings. Intrinsic learning motivation, in particular, may not stay the same over the course of each semester (Darby et al., 2013; Dresel & Grassinger, 2013; Mac Iver et al., 1991). If learning motivation is measured several times during the semester, it would be possible to investigate at which time point during the semester intrinsic learning motivation is most predictive of academic achievement or dropout. Further research should take that into account and might have shorter intervals between the measurement points.

#### Conclusion

To sum up, the present study is a first approximation of a temporal process model of dropout and how intrinsic learning motivation, and university GPA are related. Our temporal process model shows that the time span of an undergraduate program is characterized by distinct periods that are subject to different challenges reflected in the associations between intrinsic motivation, achievement, and dropout. Here we found that motivation and grades can predict dropout especially in the freshmen and final year of the bachelor's degree but not in the sophomore year. Our findings might help to explain why some studies find effects while others do not as prior studies have often neglected the inherent meaning of different phases within higher education.

#### **Overarching Discussion**

In this overarching discussion, I consolidate evidence from all three manuscripts to provide answers to the research questions and goals raised in chapter 1. In the following I will provide a summary of the findings of the three dissertation manuscripts, which were presented in the last three chapters. Then I provide an integrated discussion of the theoretical implications of the dissertation results based on the considerations outlined in chapter 1. I then derive practical implications from the findings of the studies. Thereafter, I discuss the strengths and limitations of this dissertation and provide directions for future research. Lastly, I draw conclusions from the theoretical consideration.

#### **Overall Summary of the Findings**

An overview of the findings can be found in Table 5.1. Study 1a examined if intrinsic motivation for enrollment is associated with a positive development of intrinsic learning motivation during the first semester. We found that even if controlling for intrinsic learning motivation at the beginning of the first semester there was a positive development of intrinsic learning motivation associated with intrinsic motivation for enrollment. That means that an interestbased major choice is beneficial for the long-term development of intrinsic learning motivation in higher education.

Building on this findings, Study 1b aimed to investigate the associations between intrinsic motivation for enrollment and a broader set of study success outcomes (intrinsic learning motivation, dropout intention, dropout, and academic achievement). We did this to gain a deeper understanding if the assumed associations between intrinsic motivation for enrollment and study success were direct or mediated by intrinsic learning motivation. We found that the prospective associations between intrinsic motivation for enrollment and study success outcomes over the time span of a whole year were (partly) mediated by intrinsic learning motivation measured at the beginning of the second semester. In more detail we found indirect effects from intrinsic motivation for enrollment via intrinsic learning motivation on academic achievement and dropout intentions. Further, intrinsic motivation for enrollment was also directly associated with dropout intention. Contrary to our expectation, an effect from intrinsic motivation for enrollment and intrinsic learning motivation on actual dropout was not found in Study 1b. This could be explained by the rather low number of dropouts in the sample of Study 1b, which consisted of students voluntarily taking part in the survey.

Study 2 aimed to compare two ways of assessment of Interest-Major Fit regarding their ability to predict study success, namely study satisfaction and academic achievement. The findings showed that the university- and majorspecific way of assessment of Interest-Major Fit was more predictive for both, study satisfaction and academic achievement - compared to the vocational assessment of fit. In the next step we investigated whether the more universityand major-specific way of assessment of Interest-Major Fit was still predictive for study satisfaction and academic achievement if high school GPA - which is a good predictor for study success – was included as well. The findings showed that if included in the same regression model, only high school GPA was predictive for academic achievement (at university) and Interest-Major Fit was nonsignificant. This is not surprising since previous achievement is often a good predictor for subsequent achievement (Janke & Dickhäuser, 2018; Schuler & Hell, 2008; Trapmann et al., 2007; Troche et al., 2014). However, regarding the subjective study success outcome study satisfaction, only Interest-Major Fit was predictive while high school GPA was not. This shows that even though high school GPA is surely a very important predictor of study success, it might not be able to predict all aspects of study success. But also vice versa: Even if an interestbased major choice seems to be associated with some aspects of study success, it is not related with all aspects. This indicates that objective predictors (high school GPA) are more closely associated with objective outcomes (university GPA) and subjective predictors (Interest-Major Fit) are more closely associated with subjective outcomes (study satisfaction).

# Table 5.1

Overview of the Findings of Study 1a, Study 1b, Study 2, and Study 3.

			Study su	ccess outcom	nes	
		Intrinsic learning motivation	Study satisfaction	University GPA	Dropout intention	dropout
Intrinsic motivation for enrollment	$\rightarrow$	+		(+)	_	(–) <sup>b</sup>
Interest- Major Fit	$\rightarrow$		+	$+^{a}$		
High school GPA	$\rightarrow$	Х	Х	+		_
Intrinsic learning motivation	$\rightarrow$			+	_	b
University GPA	$\rightarrow$	Х				_

*Notes.*  $\rightarrow$  indicates a temporal association. Pluses indicate positive temporal associations; minuses indicate negative temporal associations; x indicates that the association was investigated but not found. Brackets indicate an indirect temporal association via intrinsic learning motivation. <sup>a</sup>association only appears when not controlled for high school GPA. <sup>b</sup>association is not significant at *p* = .057.

The aims of Study 3 were to understand the longitudinal associations between academic achievement and intrinsic learning motivation. For this we conducted a longitudinal study with six measurement points covering the time span of a bachelor's degree. We analyzed it using a Random Intercept Cross-Lagged Panel Model. We found a stable association between intrinsic learning motivation and academic achievement (random intercepts), meaning that the trait values of these two variables are correlated. Interestingly, there were only crosslagged effects from intrinsic learning motivation on academic achievement and only towards the end of the bachelor's degree. This means that in the end of the studies, temporary changes in intrinsic learning motivation had an effect on academic achievement – but not vice versa. This is an important insight into this association, especially regarding the mixed findings about relations between motivation and achievement (Froiland & Worrell, 2016; Garon-Carrier et al., 2016; Hebbecker et al., 2019; Liu & Hou, 2017; Schaffner et al., 2016; Taylor et al., 2014; Toste et al., 2020). Additionally, we explored the temporal process of dropout combining the before mentioned Random Intercept Cross-Lagged Panel Model with a Survival Analysis. We found that in the first semester, mainly university GPA contributed to dropout. In the second semester, intrinsic learning motivation and high school GPA were associated with dropout. For the third and fourth semester the variables we used (intrinsic learning motivation, university GPA, and high school GPA) could not explain dropout. Dropout in the fifth semester was associated with university GPA. Building on these findings a temporal process model of dropout from a major in higher education was developed.

#### Theoretical Implications and Contribution to the Field

The goals of this dissertation were fourfold: First, establish the connection between an interest-based major choice and study success. Second, clarify which assessment of Interest-Major Fit is commensurate to predict study success. Third, understand how study success outcomes – especially intrinsic motivation and academic achievement – are related longitudinally. And forth, exploring boundary conditions for when and how dropout occurs. The overall goal was to develop a temporal process model of dropout from a major in higher education integrating the theoretical considerations and evidence from the findings of the studies of this dissertation. The longitudinal process model of motivated dropout from a major in higher education accounting for different study phases integrating the theoretical considerations and findings of all manuscripts can be found in Figure 5.1.



Longitudinal Process Model of Study Success and Dropout From a Major in Higher Education Accounting for Different Study



evidence-based paths depicted

# Connection Between an Interest-Based Major Choice and Study Success

Existing models of study success (Heublein, 2014) mention choice of major as an important predictor of subsequent study success. Additionally previous research has shown that an interest-based major choice is beneficial for study success (Allen & Robbins, 2010, 2008; Tracey & Robbins, 2006). However, those findings do not explain how and why an interest-based major choice is beneficial. The findings of Study 1a, Study 1b and Study 2 illustrate the process between an interest-based major choice and study success in accordance with the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007). According to the Person-Environment Fit Theory, the congruence between a person and his/her environment has several positive outcomes. In the context of university there seems to be a direct prospective connection between an interest-based major choice and intrinsic learning motivation (Study 1a and Study 1b). Mediated by this, there are indirect associations between an interest-based major choice and the intention to leave the major and academic achievement (Study 1b). However, the associations between an interest-based major choice and academic achievement vanish if previous academic achievement (high school GPA) is taken into account as well (Study 2). Further, there is a direct association between an interest-based major choice and dropout intention (Study 1b) as well as study satisfaction (Study 2).

Overall, the findings reveal that there are direct as well as indirect associations between an interest-based major choice and study success outcomes. This may indicate that there are lagged effects and associations that can only be uncovered through longitudinal research designs. In addition, it is important to include mediating variables to explain associations. The findings indicate that the Person-Environment Fit Theory (Edwards et al., 1998; Edwards & Shipp, 2007) is applicable in the university context and provides information that congruence between a person's interests and the demands of the environment has a positive impact on the person's success and persistence in the environment. The findings of the presented studies extend the previous findings in the university context and show that the longitudinal perspective is particularly important to uncover effects.

#### Commensurate Assessment of Interest-Major Fit

Another tenet of the Person-Environment Fit Theory is that more concrete dimensions and commensurate assessment are important when assessing the congruence, and to ensure the predictivity of fit (Edwards et al., 1998; Edwards & Shipp, 2007). In Study 2 we wanted to test whether this also applies to major choices in higher education. Therefore, we examined if a more concrete and specific assessment of Interest-Major Fit would lead to a closer association with study success outcomes. The findings revealed that a more concrete assessment of Interest-Major Fit was indeed more closely associated with study success in terms of academic achievement and study satisfaction. This means that the tenet of the Person-Environment Fit Theory that concrete and commensurate assessment is beneficial is applicable to the context of major choices in higher education.

Further, this implies that incommensurate assessment of Interest-Major Fit could lead to an underestimation of effects. This is alarming because it not only prevents identifying key variables that are prerequisites of study success, but also results in an inaccurate picture of the study success process. As the more unspecific method of assessment of Interest-Major Fit does in fact measure the fit between a persons' interests and demands of the subsequent vocation, it may even be argued that it is a distinct construct (Interest-Vocation Fit) and not another assessment of Interest-Major Fit. This idea is further strengthened by the fact that in our study we did not find an association between the two kinds of assessment and the results regarding the study success outcomes were different as well. This might be due to the broad and general assessment of vocational interests compared to the major-specific approach. The importance of a commensurate assessment of Interest-Major Fit is further underlined by this divergent validity. This means that interest in the major seems to be something different than interest in the content of a subsequent job. It might be the case that Interest-Major Fit predicts study success while Interest-Vocation Fit predicts success in the job. It is however remarkable that this should be different as the content of the major and the job should be the same to some extent. Future research could aim to answer the question if Interest-Vocation Fit is better suited to predict success in the job than Interest-Major Fit.

#### Longitudinal Process of Study Success Outcomes

As study success and dropout from a major in higher education is a process, it makes sense to gain a deeper understanding of the different factors in play. The Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2019, 2020) explains how intrinsic motivation and academic achievement could be mutually associated with each other. However, given the mixed evidence in various contexts and different time intervals of the measurement, one goal of this dissertation was to gain a deeper understanding of the longitudinal relation between intrinsic motivation and academic achievement. According to the Self-Determination Theory intrinsic motivation can be fostered by an enhanced feeling of competence in the own abilities (Niemiec & Ryan, 2009; Pintrich, 2004; Ryan & Deci, 2020; Ryan & Moller, 2017). This feeling of competence can be evoked by receiving good grades (Leondari & Gialamas, 2002). This explains how good grades could enhance the intrinsic motivation for studying and learning more about the contents of the major. The flip side of this is that students' intrinsic motivation may be reduced if they repeatedly receive low grades. The other direction of the association can also be explained by the Self-Determination Theory: Intrinsically motivated students are likely to work harder and invest more time in studying, leading to better performance and better grades in subsequent exams (Hebbecker et al., 2019; Ryan & Deci, 2020; Taylor et al., 2014). The findings of Study 1b indicate that intrinsic motivation is associated with subsequent academic achievement. In Study 3 we found that there was a trait-like association between intrinsic learning motivation and academic achievement. That means that students who have a higher intrinsic motivation also have a better GPA in general. So far, the findings are in line with the previous considerations. However, regarding the momentarily divergence (within-person carry-over effects), we only found that students who experience temporarily higher (or lower) intrinsic motivation than expected for them are likely to receive a higher (or lower) university GPA than their average at the subsequent time point. Those effects only appeared towards the end of the studies and were only found from intrinsic motivation on academic achievement. Looking at these findings in light of Self-Determination Theory, the question arises whether the effects hypothesized in the theory are present only under certain conditions or in certain contexts and environments. In the university context we could only find that intrinsic motivation impacted subsequent academic achievement and even this finding was not consistent during the whole duration of the studies. This does not necessarily mean that the claim of the Self-Determination Theory about a mutual association between intrinsic motivation and academic achievement is false, but certain conditions need to be in place for the theoretical assumptions to be found in a field study. One condition could be the time interval between the measurements. It could be the case that intrinsic motivation needs to be assessed right after receiving the grades and not half a year later. Another context factor could be that towards the end of the studies

students have more term papers to write (rather than exams) for which the amount of time invested can be quite different. Future research could aim to explain the context factors that need to be present for the associations between intrinsic motivation and academic achievement to be present.

# Boundary Conditions for Dropout and Temporal Process Model of Study Success

To develop a theoretically sound and evidence-based process model of motivated dropout from a major in higher education that has a longitudinal approach and takes the different study phases into account, I integrated the findings of all three manuscripts of this dissertation. With this model I strive to overcome the shortcomings of existing models which lack psychological explanations of the proposed associations, are not based on empirical evidence, and do not account for different phases of the study process and the longitudinal perspective therefore required (Sarcletti & Müller, 2011).

In general, the findings of all studies included in this dissertation reveal associations between prerequisites of study success and study success outcomes. Additionally, the study success outcomes are associated longitudinally. The findings revealed further that it is important to take the different phases of studying into account as variables indicating the study success can change over time. Each study phase has different challenges and therefore it makes sense that associations between study success outcomes change over the course of studies. In the freshman year students have to overcome the hurdle to fit into their new environment, cope with the different styles of instruction and exams at university including the requirement of more self-regulation and time management skills, and have to face many challenges (e.g., living apart from their parents) for the first time (Holmegaard et al., 2014). Additionally, the students have to evaluate their fit with the major they chose (i.e., Person-Environment Fit Theory; Allen & Robbins, 2008). The findings of Study 1a, Study 1b and Study 2 reveal that an interest-based major choice is beneficial regarding the better fit with the major and therefore an easier adaption to the new environment and higher study success. Further, the findings of Study 1b and Study 3 imply that a positive start into the new environment enhances a positive long-term development of study success outcomes as study success outcomes are associated over time and higher study success at a previous time point leads to higher study success at a subsequent time point.

#### Chapter 5: Overarching Discussion

Moreover, university GPA, intrinsic motivation and high school GPA contribute to dropout from a major in the freshman year. It can be assumed that intrinsic motivation is needed to master the challenge of self-regulated engagement in learning activities and to successfully manage to spend enough time on learning (Klingsieck, 2013; Ryan & Deci, 2020; Sitzmann & Ely, 2011; Steel, 2007; Wang & Guthrie, 2004; Zimmerman & Schunk, 2011). Further, academic achievement (in terms of university GPA and previous high school GPA) is important to prevent dropout in the freshman year. That could indicate that students with a higher ability to perform well in exams and study effectively have a higher resistance to the challenges, as less time needs to be spent on learning activities if students need less time to understand the content of the exams well enough to perform well in the exams. Building on these considerations the freshman year could be called *adaption phase* as the students need to adapt to the new environment and this adaption is crucial for further positive or negative development and reinforcement cycles.

The sophomore year is also called 'sophomore slump' in the literature as students often struggle with a decline in academic achievement (Hunter et al., 2010; Schaller, 2010). It is important that students maintain their intrinsic motivation and achievement in this phase even if a potential initial enthusiasm about their major is weaker than at the beginning of the studies. Additionally, there is less academic guidance in this phase, students are required to work more independently, and students are dependent on social connections (Clark, 2005; Hunter et al., 2010). The findings of Study 3 revealed that neither intrinsic motivation nor academic achievement could explain dropout in the sophomore year. Further, the number of dropouts in this phase was lower than in the freshman year. This is in line with, numbers documenting dropout which show that most dropout occurs within the first academic year (Heublein et al., 2017). This indicates that (a) more research is needed regarding the variables that are related to dropout in this phase (see section on directions for future research) and (b) that the sophomore year seems to be a *stability phase* as less dropout occurs. These findings of a rather stable sophomore year are contrary to the assumption of a sophomore slump as the U.S. literature describes. This could be due to the German university context, which is different, for example in the regard that there is no orientation phase at the beginning of the studies. This could be one reason why the processes in the German system are somewhat different from those in the United States. Further research should clarify this.

In the final year of the studies students are usually expected to learn more independently (Bettinger et al., 2022) and require less guidance (Larsen et al., 2013). In this phase the results of long-term positive or negative reinforcement cycles regarding the study success (i.e., Self-Determination Theory: Deci & Ryan, 2008) are revealed as students must have learned to push themselves to keep going and to maintain their intrinsic motivation. Additionally, having studied properly and having passed the exams of the previous semester is beneficial in contrast to having to retake difficult exams which students failed in one of the previous semesters. The findings of Study 3 reveal that carry-over effects from intrinsic motivation on academic achievement only appear in the end of the studies. Intrinsic motivation and academic achievement do in fact have a trait-like association but temporary changes in intrinsic motivation affect academic achievement only towards the end of the studies. This indicates that students who manage to increase their intrinsic motivation relative to previous semesters show better performance in subsequent exams. This is especially interesting as university GPA is associated with dropout in the final year. Following these considerations, it might seem that only university GPA is responsible for dropout in the final year when in fact – as university GPA towards the end of the studies depends on intrinsic motivation intrinsic motivation also plays a role.

Taken together the findings of this dissertation reveal that time points during the course of the studies are not arbitrary. There are different effects in play at different time points as students face different challenges in the freshman, sophomore and final year. If one aims to predict the students' actions (e.g., dropout from the major) it needs to be considered in which phase of the studies the students are. To achieve this a general model merely listing and describing aspects that contribute to dropout is not sufficient, as not all study phases involve the same challenges. The temporal process model of motivated dropout from a major in higher education developed in this dissertation gives insight into certain study success aspects that contribute to dropout and additionally explains why and when different variables contribute to dropout (see Figure 5.1). Moreover, this is not merely a theoretical model, but this model is evidence-based on real field data even including objective outcomes. This model is an important contribution to explaining study success and dropout. **Practical Implications** 

#### Chapter 5: Overarching Discussion

This dissertation offers some implications for practice, e.g., for advisors of prospective students in their major choice, for prospective students themselves and for people in charge in higher education institutions who plan interventions to foster study success. The dissertation studies (1) suggest that an interest-based major choice is beneficial for longitudinal study success, (2) give insight into what can be gained from a major-specific assessment of interests, (3) investigate the associations between intrinsic motivation and academic achievement over the course of the studies, and (4) give insight into when which study success outcomes predict dropout in different phases of studying. Building of these results a longitudinal process model of study success is developed. I will discuss these aspects in more detail in the following sections.

# Importance of an Interest-Based Major Choice

The findings of Study 1a, Study 1b and Study 2 suggest that an interestbased major choice is beneficial for study success. That includes particularly intrinsic learning motivation, dropout intention, academic achievement, and study satisfaction – but mediated by those variables also dropout as Study 3 reveals. This means that prospective students should be aware of the importance of interest-based major choices and be encouraged to choose a major in which they are actually interested. That also means that students should be helped in exploring their interests. Further, the students should be aware what other competing motivators influence their major decision. This should be done to sensitize students to other influences and to make a self-determined and reflected decision. Those competing motivators could be extrinsic reasons like a better salary in a subsequent job or advice by parents and peers (Janke et al., 2021). While not all other motivators for a major choice might be faulty, not being interested in the content of the major at all seems a poor decision regarding the findings of the presented studies. Therefore, it makes sense to inform prospective students about the importance of interest-based major choices as those have proved to be important for study success (see Study 1a, Study 1b, and Study 2). An interest-based major choice can be achieved using Online Self-Assessments (Stoll, 2019) to help the prospective students to figure out which major consists of learning content that they are actually interested in. This is also important to help prospective students reveal misconceptions they might have about the contents of a major to prevent unfulfilled expectations, which in turn could damper study success (Hasenberg & Schmidt-Atzert, 2013; Merkle et al.,

2021). A great advantage of Online Self-Assessments are the relatively low costs compared to the high societal and individual costs of dropout from a major. *Benefits and Challenges of a Major-Specific Assessment of Interests* 

For more details about how congruence of the interests of the students and the demands of the major can be achieved, the findings of Study 2 suggest that assessing the Interest-Major Fit with a more university- and major-specific approach is superior to the approach of assessing the congruence with a more general and vocation-orientated tool. That means that a university- and majorspecific tool should be used preferably and if available. However, it needs to be noted that the development of such a tool is associated with costs, as it is more difficult to develop a tool which is adapted to a specific university and several steps need to be taken for the development of such a tool (for an example of the development of a university- and major-specific Online Self-Assessment see Messerer et al., 2020). Therefore, a consideration of the costs and benefits of such a tool is necessary. It could be argued that this Online Self-Assessment does not necessarily have to be university specific and that it is enough to develop a major-specific Online Self-Assessment. For an example of a majorspecific and inter-university Online Self-Assessment see OSA-psych (Merkle et al., 2021). The applicability of such tools surely also depends on whether majors are somewhat similar across different universities or if universities offer very specific majors that are more or less unique regarding the curriculum. But if the content of a major at different universities is similar enough, it is probably most beneficial (due to the ecological efficiency) to use an inter-university and majorspecific approach. Moreover, for majors with limited places in the study program, it makes more sense to generally know if the major fits the prospective students, as they might not be able to choose freely at which university they want to study.

#### Approaches to Prevent Dropout in Different Phases of Studying

As intrinsic motivation and academic achievement are the most often mentioned self-ascribed reasons for dropout from higher education, it is worthwhile to investigate their association. This helps to gain a deeper understanding of on which of those variables interventions should focus on if aiming to prevent dropout. The findings of Study 3 suggest that there is some kind of stable association between intrinsic motivation and academic achievement. However, as there are also temporal spill-over effects meaning that a change (increase/decrease) in intrinsic motivation is associated with a subsequent change (increase/decrease) in academic achievement especially towards the end of the bachelor's degree, it could be argued that it is worthwhile to implement interventions that increase the intrinsic motivation. Through this both academic achievement and intrinsic motivation could be targeted as academic achievement depends to some extent on intrinsic motivation. This double effect of those interventions is likely to be especially strong in the middle and final phase of the studies. Fostering of intrinsic motivation is further important as intrinsic motivation is also associated with other study success outcomes like dropout intention as the findings of Study 1b reveal. Additionally, dropout during the second semester is also associated with intrinsic motivation as Study 3 uncovers. To foster intrinsic learning motivation, there is a variety of motivation interventions available (Hulleman et al., 2010). Those interventions could for example illustrate for what purpose students need to know theoretical constructs they learn at university to demonstrate their practical relevance. This could increase the utility value of what students learn at university and therefore motivate them to study (i.e., Expectancy-Value Theory; Wigfield & Eccles, 1992, 2000). Additionally, the seminars and lectures should be interactive and should incorporate the students' world of experience.

Further, the findings of Study 3 revealed that university GPA is associated with dropout in the first semester. This could indicate that at the beginning of the studies students struggle with their performance. Therefore, it makes sense to introduce or improve measures that help students to cope with the challenges in this first study phase. This could mean that students get input on how to organize themselves as well as on self-regulation strategies. As such, the importance of distributed practice in contrast to massed practice should be explained for example. That means that students should be encouraged to study during the whole course of the semester and from the beginning on to learn more and gain more knowledge (massed vs. distributed learning; see Arnold & Linder-Müller, 2018; Steiner, 2006).

Moreover, Study 2 and Study 3 revealed that previous achievement (high school GPA) is associated with achievement at university (university GPA). That means that success at university can be influenced even before starting university while students are still in high school. As those previous grades are also a reflection of the general ability of the students to engage in learning activities and to self-regulate their learning, it makes sense to foster these skills even before prospective students enroll themselves at university and while they are still in school. This could give freshmen a head start in their studies and help them cope with the challenges of the university entry phase.

To sum up, the temporal process model of motivated dropout from a major in higher education provides approaches to start interventions to foster study success. The longitudinal perspective is beneficial as it gives hints to at what time point the application of an intervention might be most beneficial. What is more, the longitudinal associations of the different study success outcomes illustrate that a positive reinforcement cycle should be initiated from the very beginning of the studies – or even before as the associations between the prerequisites of study success and the study success outcomes indicate. **Limitations and Strengths of the Conducted Studies** 

The conducted studies of this dissertation have limitations and strengths. In the following, I am going to elaborate on the topics of ways of measurement, causality, generalizability, if intrinsic motivation for enrollment necessarily leads to an interest-based major choice, and longitudinal perspective on study success.

#### Ways of Measurement

The manuscripts include studies which use both, self-report, and objective measures. For subjective outcomes like study satisfaction, dropout intention, and intrinsic motivation, self-report measures were used. For those subjective outcomes, one could argue that it would be desirable to rather assess behavioral outcomes which could be assessed objectively, e.g., learning time as a behavioral outcome of intrinsic learning motivation. However, this is only a distal approximate value of intrinsic learning motivation, as learning time depends on intrinsic learning motivation but also on other factors like time to exam, time available for learning, and other competing tasks (Zimmerman & Schunk, 2011).

A great strength of our data is that university GPA as well as dropout were assessed with objective data. Moreover, as we obtained the data directly from the student administration, the number of missings in this part of the data was almost non-existent. This objective data directly from the student administration is extremely rare among studies investigating study success and dropout. What is more, this form of data collection made it possible to make a reliable statement as to whether the students had dropped out of their studies or merely no longer participated in the survey. Studies actually working with objective data when it comes to university grades and dropout from university are very rare (Sarcletti & Müller, 2011).

Further the combination of subjective and objective predictors and outcomes allows to investigate associations between the variables more closely. Especially Study 2 revealed that subjective predictors are better suited to predict subjective outcomes of study success, and objective predictors are better suited to predict objective outcomes of study success – even though also objective predictors can predict subjective outcomes to some extent and vice versa. This means that subjective and objective measures do overlap to some extent, but a holistic perspective is only possible if a combination of subjective and objective measures is used. This is possible in the studies of this dissertation which include subjective and objective variables.

#### Causality

Another limitation of this dissertation is that as all four studies were survey studies and not experiments, we cannot draw conclusions about the causality of the results. What could be done to test causality and the claim that an interest-based major choice is beneficial is to conduct an experiment in which prospective students are either randomly assigned to a condition in which they have to answer an Online Self-Assessment (experimental group) or to another condition in which they do not complete the Online Self-Assessment (control group). In this experiment it could be evaluated if the students who are in the experimental group have a higher study success than in the control group. Based on previous studies (e.g., Stoll & Spinath, 2015) and on my findings, it would be expected that prospective students who have participated in the Online Self-Assessment would have higher study success.

However, a strength of the conducted studies is that all of them are longitudinal studies. Therefore, temporal order of the associations is given, which is a prerequisite of causality.

#### Generalizability

Regarding the generalizability, all studies are limited to one university and therefore also to the majors this university offers. In the case of the four studies included in this dissertation the sample mainly consisted of students studying a major in social and economic sciences. This means that future research needs to test if the findings of the studies are replicable at other universities and other majors. This is especially true for majors in the domain of natural science which include a lot of laboratory work and laboratory experiments at the beginning of the studies; or for medical studies in which students must take a key exam after four semesters and which is not divided into a bachelor and a master phase (in Germany). Therefore, medical students and other students that study in majors that are differently structured might have a different development of study success outcomes. Further research is needed regarding this.

A strength regarding the sample composition is however, that students from all bachelor programs that the university offers took part in the studies (more than 20 different majors). Even though the university does not cover all majors, there is still diversity in our sample regarding the majors, which is a strength of the presented studies. Additionally, more than half of the students of the full cohort took part in the surveys and the sample for all studies was substantial. The smallest sample was Study 2 with N = 455, and the largest Study 3 with N = 1349.

# Interest-Based Major Choice

Certain associations have not fully been tested in the manuscripts, e.g., the implicit assumption that intrinsic motivation for enrollment leads to a major choice that is actually interest-based. This is because merely having the goal of making an interest-based major choice may not be sufficient to actually choose a major that matches one's interests. This is due to the fact that there are often misconceptions about the contents of the major (Hasenberg & Schmidt-Atzert, 2013; Hasenberg & Stoll, 2015). In the studies of this dissertation, the assumption was made that students who aimed to make an interest-based choice of major were successful in doing so. However, there is a possibility that this is not always the case. This could be for example due to the constraint that prospective students do not always have the required high school GPA to enroll themselves in the major that most closely matches their interests. Alternatively, it could also happen that prospective students assume that a certain major matches their interests. However, if they have not informed themselves sufficiently about the content of the major, it could happen that the assumption of the congruence between their interests and their chosen major is incorrect. Therefore, one direction for future research could be to examine whether intrinsic motivation for enrollment is positively associated with Interest-Major Fit.

#### Longitudinal Perspective on Study Success
Another strength of the studies of this dissertation is that all studies were longitudinal. That means it was possible to draw conclusions on temporal associations and gain a deeper understanding of the temporal processes regarding the associations of study success outcomes during the bachelor's degree.

However, a limitation of the data is that it only covers students during their bachelor's degree and the time span of six semesters. This does not allow conclusions about how the prerequisites of study success and the study success outcomes during the bachelor's degree are associated with study success during a potential master's degree and even more important, a successful transition into a subsequent job and success in this job. Future research should take this even longer perspective to investigate if the prerequisites of a successful bachelor's degree can also be applied to predict success in the future career. This would include the market-based perspective on study success (Heinze, 2018; Sarcletti, 2020).

Another limitation is that the prerequisites of study success, particularly intrinsic motivation for enrollment and Interest-Major Fit, were not assessed before entering the university and before taking the decision which major the students want to enroll themselves. By assessing intrinsic motivation for enrollment and Interest-Major Fit at the very beginning of the studies (beginning of the first semester) we aimed to measure them as unbiased as possible. Nevertheless, we cannot rule out the possibility that the measurement is distorted, e.g., because the students ignore information that are likely to increase their cognitive dissonance (i.e., Cognitive Dissonance Theory; Festinger, 1962; Harmon-Jones & Mills, 2019; McGrath, 2017). Future research should aim to assess motivation for enrollment and Interest-Major Fit even before the students take their major decision. This requires a large sample as a severe disadvantage of this procedure is that matching data from prospective students with students enrolled at a university usually leads to great numbers of missings in the data. Still, approaches doing that are exceedingly valuable for research on educational transitions (for an example see Merkle et al., 2023).

Like most longitudinal studies, we had missings in our data because students did not answer all surveys. However, a great strength of our data is, that the objective outcomes (university GPA and dropout) were provided by the student administration which led to very few missings regarding those variables. Additionally, this enabled us to retrieve this information even if students did not answer the subsequent survey. Through this, it was possible to differentiate between not answering the survey and having dropped out from studying. This is an advantage over other field studies which cannot account for this.

## **Directions for Future Research**

The findings of this dissertation reveal various directions for future research. Some of them have already been mentioned in the previous section to overcome the limitations of the studies and do therefore mainly address methodological and practical aspects. In the following paragraphs I illustrate the future directions for research which might help to gain an even deeper understanding of processes regarding the associations between study success outcomes and contextualize the findings in a broader perspective.

I will focus on directions of future research that can be derived from my findings, namely (a) additional aspects of study success, (b) longitudinal prediction before and after the university, and (c) evaluate the possibility of integrating different perspectives on the process of dropout from higher education.

#### Additional Aspects of Study Success

For my dissertation project I had to choose from a variety of aspects of study success. However, there are other indicators of study success that could be interesting for future research. Especially as the findings of the studies of this dissertation could not explain dropout during the sophomore year, other variables need to be taken into account when aiming to explain dropout in this phase. Following the considerations of the literature on the sophomore year (Hunter et al., 2010; Webb & Cotton, 2019) which states that one challenge of this phase is self-regulated learning, this could be one example of a variable worth investigating. For a holistic model of study success and dropout, it is important to fully explain the associations and take all phases of studying into account as so far, the existing research mostly covers the university entry phase (Schaller, 2010).

Moreover, the findings of Study 3 reveal that for some students their intrinsic motivation changes relative to the previous semesters which is associated with changes in the academic achievement. Future research could investigate variables that could explain those changes in intrinsic motivation. One possible explanation could be that the utility value of good grades becomes more salient towards the end of the studies (following the Expectancy-Value Theory; Wigfield & Cambria, 2010; Wigfield & Eccles, 2000).

## Longitudinal Prediction

Further, examining an even longer time span and including success in the subsequent job could be another possible direction for future research. Ultimate academic success can also be understood as successful transition into the labor market and success in subsequent careers. For this, longitudinal studies that cover an even longer period of time would be needed. Those studies could investigate whether an interest-based study choice has positive long-term effects, such as on for example career paths, wage, employment status, or job satisfaction. As the findings of Study 2 revealed the divergent validity of Interest-Major Fit and Interest-Vocation Fit, it could be further investigated if Interest-Vocation Fit is indeed more predictive for success in a subsequent job.

Related to this is the question about the career prospects if students choose their major purely out of interest. Ideally all degrees qualify to find a job, but it cannot be denied that in some fields of work, more jobs are open than in others. Therefore, it could be argued that prospective students should also take the situation at the labor market into account when choosing a major. This does not contradict the claim, that an interest-based major and career choice is important. While other motivators for a major choice might be important as well, not being interested in the content of the major at all seems a poor decision regarding the findings of the presented studies. Future research could investigate if there is an optimal combination of different motivations for enrollment (for a classification see Janke et al., 2021). This could mean that intrinsic motivation for enrollment could be supplemented by other motivations for enrollment and this combination could eventually lead to an even higher study success or be closer associated with other aspects of study success. This could be investigated in future research.

### Different Perspectives on the Process of Dropout From Higher Education

In this dissertation I aimed to develop a temporal process model of study success and dropout from higher education. But as mentioned before, dropout from higher education also is a process in itself for which it is proposed that it is starting with first perceptions of misfit and ends with the final decision to drop out (Bäulke et al., 2022). However, this consideration of the different phases of forming the decision to drop out does not take into account in what phase of the studies the students are. Following the claim that each study phase has different challenges, it might make sense to assume that a misfit with the studies is more relevant for a development of a dropout intention in the freshman year than in

the final year of the studies when adaption processes should be completed. This contextualization of the dropout process is not included when only the process of forming a dropout intention is described. Then again, the model that I have developed does not incorporate the complex process of forming a dropout intention with all the different stages of making a decision (illustrated by Bäulke et al., 2022). Both models give different but equally important perspectives on the development of dropout. It would therefore be interesting to evaluate how those two approaches could be integrated in a model that especially describes dropout and the process that leads to dropout in a more holistic way. Future research could aim to integrate those perspectives and investigate which other study success outcomes are related to the different stages of forming a dropout intention and how that eventually results in dropout.

#### Conclusion

Research regarding study success is a current issue and highly relevant as impaired study success is very prevalent (Heublein, 2014; Heublein et al., 2022; OECD, 2018). This is problematic for both the individuals due to e.g., lower mental health and risk of unemployment (Ajjawi et al., 2020; Davies & Elias, 2003; Faas et al., 2018), and the society, because government money is invested without people graduating (Voelkle & Sander, 2008) and skilled workers are needed in the labor marked (Grunschel & Dresel, 2021; Neugebauer et al., 2019; Sarcletti & Müller, 2011).

This dissertation provides evidence and theoretical explanations for a process-orientated perspective on study success and dropout taking different phases of studying into account. Choosing the major based on interest in the contents of the major is beneficial for study success. Building on this, it was clarified that a major-specific assessment of Interest-Major Fit is more commensurate when aiming to predict study success than a vocation-orientated approach. For a complete perspective on study success, not only the transition to university is important, but also the processes during the studies. The findings could deepen the understanding of the longitudinal association between intrinsic motivation and academic achievement during the studies. It was revealed that there is a stable association, but only temporary changes in intrinsic motivation affect subsequent academic achievement and not vice versa. Those temporary effects were only found in certain study phases, which could explain the

heterogeneity in previous studies (Froiland & Worrell, 2016; Garon-Carrier et al., 2016; Taylor et al., 2014). Another important contribution of this dissertation is the exploration of boundary conditions of dropout. The results showed that different variables were associated with dropout in different study phases. This can be explained by the different challenges present in different study phases (Bettinger et al., 2022; Holmegaard et al., 2014; Schaller, 2010). The findings give insights into how those challenges are relevant for the associations between study success outcomes over the course of studies.

From a practitioner's point of view, this highlights the importance of tools that help prospective students to identify majors that are congruent with their interests (e.g., Online Self-Assessments; see Stoll, 2019). These tools should assess the fit of prospective students and their major if the prediction of study success is targeted. Further, during the course of studying, interventions that aim to foster study success need to be tailored to the study phase as the complex psychological processes underlying study success are different among study phases. This is a new perspective on study success and the process of dropout from a major in higher education.

The developed theoretical and evidence-based model goes beyond existing models by taking the different phases of the study process into account and differentiating between those phases. Investigating the whole course of the bachelor's degree gives insights in associations that have been rarely researched. The psychological processes that influence study success vary in the different phases of studying, as different challenges are present. Study success can be tremendously enhanced, and dropout prevented if those underlying processes in the different phases are considered.

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#### Appendix

This appendix contains all Supplemental Tables of the manuscripts included in this dissertation (Appendix A) and the personal statements by the co-authors (Appendix B).

## **Appendix A – Supplemental Tables**

Supplemental Tables of the manuscripts. Appendix A1 includes three supplemental tables of Manuscript 1, and Appendix A2 includes four supplemental tables of Manuscript 3. For the published manuscript the Supplemental Tables are also available online via OSF using the following link. Manuscript 1: <u>https://osf.io/qn8ex/</u> *Appendix A1 – Supplemental Tables Manuscript 1* 

#### Supplemental Table 2.1

Sample Composition Regarding Majors.

Major	% in sample	% in
	of Study 1a	sample
		of Study
		1b
Business Administration	14.4	21.3
Psychology	10.8	6.1
Economics	10.1	6.9
Law	9.1	7.8
Sociology	7.6	4.9
Political Sciences	7.5	7.2
Economic and Business Education	5.6	6.9
Media and Communication Studies	5.0	2.5
Culture and Economics: Romance studies	5.0	1.3
Business Informatics	4.5	4.9
Culture and Economics: English Studies	4.5	3.0
Business Mathematics	3.9	3.4
Culture and Economics: German Studies	2.8	0.9
German Studies	2.1	1.3
English Studies	1.9	1.2
Culture and Economics: Philosophy	1.7	0.7
Culture and Economics: History	1.3	2.2
Culture and Economics: Media and Communication	1.2	15
Studies	1.5	1.5
History	0.9	0.9
Teacher Education	-	14.6
Romance Studies	-	0.3

## Appendix

## Supplemental Table 2.2

Reasons for Dropping Out.

Reason		Amount of students in	% of students in
		sample	sample
dropout	Missing re-registration	13	1.1
	Dropping out completely	33	2.9
	Failing an exam definitely	8	0.7
	Other reasons	6	0.5
No dropout	Still enrolled	1056	91.3
	Changing university but same major	41	3.5

## **Supplemental Table 2.3**

Direct and Indirect Effects of the Full Model of Study 1b.

Paths	b	SE	β	SE	р	
	[95% CI]		[95% CI]			
Intrinsic motivation for enrollment						
Intrinsic learning motivation	.511	.056	.473	.050	.000	
	[0.402; 0.620]		[0.376; 0.571]			
dropout intention	245	084	233	070	002	
	[-0.409; -	.064	[-0.388; -	.079	.002	
	0.081]		0.077]			
GPA semester 2 <sup>a</sup>	084	.086	074	.075	.165	
	[-0.253; 0.085]		[-0.221; 0.074]			
actual dropout $[0 = No;$	071	.120	062	.105	.279	
1 = Yes]	[-0.307; 0.165]		[-0.269; 0.145]			
Intrinsic learning motivation						
dropout intention	328	065	337	066	000	
	[-0.456; -	.005	[-0.467; -	.000	.000	
	0.201]		0.208]			
GPA semester 2 <sup>a</sup>	.239	.075	.226	.071	.001	
	[0.092; 0.385]		[0.087; 0.365]			
actual dropout $[0 = No;$	.208	.132	197	.125	.057	
1 = Yes]	[-0.467; 0.050]		[-0.442; 0.048]			
Indirect effects						
Intrinsic motivation for enrollment $\rightarrow$ Intrinsic learning motivation $\rightarrow$						
dropout intention16		026	160	024	000	
	[-0.239; -	.030	[-0.226; -	.034	.000	
	0.097]		0.093]			
GPA semester 2 <sup>a</sup>	.122	.042	.107	.037	.002	
	[0.040; 0.204]		[0.035; 0.179]			
actual dropout $[0 = No;$	106	.069	093	.061	.063	
1 = Yes]	[-0.243; 0.030]		[-0.212; 0.026]			

*Notes.* <sup>a</sup>GPA semester 2 is z-standardized for each major. [95% CI] = 95% Confidence Interval. One-sided *p*-values.

			1.	
Λ1	nn	on	dı	$\mathbf{v}$
$\mathbf{\Lambda}$	υu	υn	uı	Λ

# Appendix A2 – Supplemental Tables Manuscript 3 Supplemental Table 4.1

Sample Composition Regarding Majors.

Major	% in sample
Business Administration	19.5
Teacher Education	11.6
Law	11.2
Economic and Business Education	8.2
Economics	7.1
Psychology	6.3
Political Sciences	5.9
Sociology	4.8
Business Informatics	4.5
Mathematics in Business and Economics	3.5
Culture and Economy: English and American Studies	3.3
Media and Communication Studies	2.6
German Studies: Language, Literature, Media	2.2
Culture and Economy: Media and Communication Studies	2.1
Culture and Economy: Romance Studies	1.5
Current English Linguistics and Literary Studies	1.5
Culture and Economy: History	1.2
Culture and Economy: German Studies	1.0
Culture and Economy: Philosophy	1.0
Culture and Economy: Spanish Studies	1.0
History	0.8
Romance Languages, Literatures and Media	0.4
Culture and Economy: Italian Studies	0.3
Culture and Economy: French Studies	0.2

*Note*. *N* = 1297.

Measurement Invariance.												
Model	$\chi^2$	df	CFI	RMSEA	SRMR	Model	$\Delta \chi^2$	Δdf	ΔCFI	ARMSEA	ASRMR	d
						comp						Model
												comp
Model 1: Configural	1101.25***	705	<i>TT</i> 0.	.021	.047	I	I	I	I	I	I	
invariance												
Model 2: Weak	1128.28***	730	776.	.021	.048	Model 1	27.03	25	000	000.	.001	.380
factorial invariance												
Model 3: Strong	1266.74***	755	970.	.023	.050	Model 2	138.46	25	007	.002	.002	<.001
factorial invariance												
<i>Note.</i> $^{***} p < .001$												

# Supplemental Table 4.2

## Appendix

## Supplemental Table 4.3

R <sup>2</sup> for the Survival Analysis.					
	R <sup>2</sup>	SE	р		
Dropout T <sub>2</sub>	.356	.132	.007		
Dropout T <sub>3</sub>	.186	.033	.000		
Dropout T <sub>4</sub>	.200	.114	.078		
Dropout T <sub>5</sub>	.095	.078	.223		
Dropout T <sub>6</sub>	.309	.130	.017		

## Supplemental Table 4.4

Scale to Measure Intrinsic Learning Motivation.

German version used in this study	English translation
Es macht mir Spaß zu studieren.	Studying is fun to do.
Zu studieren empfinde ich als unterhaltsame Tätigkeit.	I find studying an enjoyable activity.
Es bereitet mir Freude zu studieren.	I enjoy studying vey much.
Mir gefällt es zu studieren.	I like studying.
Ich denke häufig daran, wie viel Spaß es mir bereitet, zu studieren.	I often think about how much I enjoy studying.
Ich finde es sehr interessant zu studieren.	I would describe studying as very interesting.