A longitudinal analysis of the reciprocal relationship between academic procrastination, study satisfaction, and dropout intentions in higher education

Anne Scheunemann, et al. *[full author details at the end of the article]*

Received: 11 September 2020 / Revised: 28 June 2021 / Accepted: 29 June 2021 /

Published online: 21 September 2021

© The Author(s) 2021

Abstract

Student dropout is a multi-causal process. Different theoretical models on student dropout consider dysfunctional study behavior (e.g., academic procrastination) and low study satisfaction as possible determinants of students' dropout intentions during their university studies. However, these models neglect contemporary conceptualizations that assume reverse relationships between dropout intentions and other determinants of the dropout process. Until now, empirical evidence on these assumptions is scant. The present three-wave longitudinal study explored the reciprocal relationships between academic procrastination, study satisfaction, and dropout intentions over one semester. To this end, we used data of $N = 326$ undergraduate students enrolled in mathematics and law. Our latent cross-lagged panel model replicated existing empirical cross-sectional findings between the variables (i.e., academic procrastination, study satisfaction, and dropout intentions). Regarding the longitudinal relations, as expected, the cross-lagged effects showed that higher dropout intentions significantly related to subsequent higher academic procrastination and lower study satisfaction. Unexpectedly, academic procrastination did not significantly relate to subsequent dropout intentions. Additionally, higher study satisfaction significantly associated with subsequent higher dropout intentions—possibly due to unfulfilled expectations. Further, higher study satisfaction significantly related to subsequent higher procrastination—possibly due to more confidence among satisfied students. Our results broaden the view on dropout intentions as part of the dynamic interplay of student dropout determinants and the need to refine dropout models' assumptions accordingly. Practically, realistic expectations seem important to reduce dropout intentions. Further, student counselors should have a closer look at the reasons for academic procrastination to develop individual solutions for this dysfunctional behavior.

Keywords Academic procrastination · Study satisfaction · Dropout intentions · Longitudinal study · Latent cross-lagged panel model

Student dropout is a challenging and prevalent phenomenon in higher education (OECD, 2007) with adverse consequences for individuals, institutions, and society (Faas et al., 2018; Hagedorn, 2012). For many decades, different dropout models have emphasized dropout as a

long multi-causal process of decision-making and consideration (e.g., Bäumke et al., 2021; Bean & Metzner, 1985; Heublein, 2014; Tinto, 1975). Thereby, they distinguish external and internal individual factors, as well as determinants of the pre-university phase of studying and during university studies.

In the present study, we focused on analyzing the interplay of three internal individual determinants for student dropout that play a key role for student dropout during university studies (Bean, 1982; Bean & Metzner, 1985; Heublein, 2014; Mashburn, 2000). First, we investigated dropout intentions as one of the most important predictors for student dropout that is often seen as a mediator between other determinants of student dropout and actual dropout (e.g., Bean, 1982). Second, we analyzed dysfunctional study behavior and focused on academic procrastination (Schneider & Preckel, 2017). Third, we examined the role of study satisfaction as a cognitive component of students' subjective well-being (Diener et al., 2018; Grunschel et al., 2016). Academic procrastination and study satisfaction can be modified by interventions for individuals or by changes made by the university itself (e.g., in study conditions) and, thus, deliver starting points regarding dropout intentions for counseling services, as well as prevention and intervention programs.

Empirically, initial studies identified academic procrastination (Bäumke et al., 2018) and a low study satisfaction (e.g., Mashburn, 2000) as predictors of dropout intentions. Yet, on the basis of researchers' assumptions regarding reverse or reciprocal relationships between determinants of student dropout and dropout intentions (e.g., Perez et al., 2014; Respondek et al., 2017), it also seems conceivable that dropout intentions precede academic procrastination and reduce study satisfaction. Similarly, indications for a reciprocal relationship between academic procrastination and study satisfaction exist (e.g., Balkis & Duru, 2016; Grunschel et al., 2013a). To date, empirical investigations on the reciprocal relationships between dropout intentions, academic procrastination, and study satisfaction are nonexistent.

Based on the theoretical considerations and empirical findings, we conducted a longitudinal study to explore the interplay between academic procrastination, study satisfaction, and dropout intentions over one semester. Linking different aspects of students' lives (i.e., study behavior, cognitive well-being, and study decisions) enabled us to take a holistic perspective on students' situations in higher education. We followed recommendations to investigate the student dropout process longitudinally (Tinto, 1975), and considered the possibility of reciprocal relations of academic procrastination and study satisfaction with dropout intentions, which is generally neglected in dropout models.

Student dropout, the dropout process, and dropout intentions

Student dropout means leaving the university without obtaining a degree (Hagedorn, 2012). For some students, dropping out of university may be an appropriate choice (Rummel et al., 1999) as dropout decisions do not always result in adverse consequences (Faas et al., 2018). Yet, researchers have indicated that in most cases dropout decisions result in costs for individuals, institution, and society. Students that dropped out tended to have a higher risk of unemployment, lower income, lower subjective socioeconomic status (SES), and lower mental health compared to graduates (Davies & Elias, 2003; Faas et al., 2018). From a more systemic perspective, student dropout can cause unfavorable reputations and costs for institutions concerning the recruitment of new students, loss of tuitions, and unlikely donations from dropouts to their former institution (Hagedorn, 2012; Schuh & Gansemer-Topf, 2012).

Additionally, it is considered a squander of educational resources, or a sign of inefficacy in the tertiary education system (Schnepf, 2017).

Despite the negative consequences, student dropout is a prevalent phenomenon. The average dropout rate for 18 OECD countries was 30% (OECD, 2007). For example, on average, students in Germany dropped out after 2.3 semesters (Heublein, 2014) and at Catalan universities after 1.5 years (Gairín et al., 2014). Moreover, student dropout is a long process of decision-making (Heublein, 2014). Ghassemi et al. (2017) described dropout as a gradual process of goal disengagement (i.e., action crisis). Students are in a conflict with their previous goal (i.e., to obtain a university degree) and the goal disengagement, which can end up in the abandonment of the goal (i.e., student dropout). Its intensity can be operationalized with reported levels of doubts or goal-related rumination (i.e., dropout intentions). Previous research focused mainly on dropout intentions as a mediator between other determinants of student dropout and actual dropout (e.g., Fleischer et al., 2019; Mashburn, 2000). However, to adequately describe the dropout process and the formation of dropout intentions, a repeated measure of dropout intentions and its determinants (e.g., Schnettler et al., 2020a; 2020b; Perez et al., 2014) is particularly important. This also enables the investigation of reciprocal relations with dropout intentions, which are theoretically and empirically neglected so far.

Study behavior and study satisfaction as predictors of dropout intentions

Various student dropout models describe dropout as a multi-causal process (e.g., Bean & Metzner, 1985; Heublein, 2014). The determinants of dropout and dropout intentions include internal individual factors (e.g., academic performance, study behavior, and study satisfaction) and external factors (e.g., living and study conditions). The dropout models also divide these variables into factors that refer to the pre-university phase of study (e.g., background information) and factors that refer to the phase during studies at university (e.g., commitment, study motivation, study behavior, study satisfaction, and study conditions).

In the present study, we were interested in the reciprocal relations of student dropout determinants. In accordance with the assumptions of several dropout models (e.g., Bean & Metzner, 1985; Heublein, 2014; Mashburn, 2000; Tinto, 1975) and our psychological perspective on student dropout, we took a closer look at internal individual determinants for forming dropout intentions that refer to the phase during university studies, namely academic procrastination as a dysfunctional study behavior and study satisfaction.

Study behavior is central to student dropout. Bean and Metzner (1985) argued that students who dropped out reported problems with dysfunctional study habits. In Tinto's model (1975). In Tinto's model (1975), dysfunctional study behavior could hinder academic integration, which reduce commitment and could lead to student dropout. Previous research on dropout has dealt with different forms of study behavior. Positive engagement and effort for study activity negatively related to student dropout and major change (Fleischer et al., 2019; Hovdhaugen, 2009), whereas negative engagement negatively predicted degree completion (Holliman et al., 2018). Another example of a dysfunctional study behavior is academic procrastination (Patrzek et al., 2012; Schneider & Preckel, 2017), which is the focus of the present research.

With reference to Steel's (2007) definition of procrastination, academic procrastination is the voluntary delay of an intended study-related course of action despite expecting to be worse off for the delay. In the following, we use the term procrastination when referring to academic procrastination. Several studies linked procrastination to negative consequences in higher education, such as poor affective well-being (e.g., Balkis & Duru, 2016; Krause & Freund,

2014), stress and lower health (e.g., Tice & Baumeister, 1997), cheating behavior (e.g., Patrzek et al., 2015), accumulation of study tasks, or the need to repeat study requirements (e.g., Grunschel et al., 2013b), and a lower academic achievement (e.g., Kim & Seo, 2015). Given this abundance of negative consequences of procrastination, a relationship with dropout intentions seems plausible. Indeed, interview studies with study counselors (Patrzek et al., 2012 et al., 2012) and students of different semesters (Grunschel et al., 2013b) identified procrastination as a possible reason for forming dropout intentions. Two cross-sectional studies with students of different semesters also found a positive relationship between procrastination and dropout intentions (Bäulke et al., 2018, 2021). However, it lacks longitudinal studies allowing conclusions on the temporal relations between procrastination and dropout intentions.

Another variable that is central to student dropout during studies at university is study satisfaction (Bean & Metzner, 1985; Mashburn, 2000). It can be classified as cognitive well-being (Diener et al., 2018; Grunschel et al., 2016) and expresses the extent to which students evaluate different aspects of their studies positively or negatively (Westermann & Heise, 2018). According to Schiefele and Jacob-Ebbinghaus (2006), students can be satisfied with their major, the conditions of studies, and their coping with study-related stress. Researchers have assumed study satisfaction to prevent or buffer the formation of dropout intentions (Bean & Metzner, 1985; Tinto, 1975). Initial studies have identified low study satisfaction as a risk factor for dropout. For example, Starr et al. (1972) found that students who dropped out had reported lower study satisfaction one year before than students who persisted. Similarly, low study satisfaction predicted dropout intentions and student dropout in cross-sectional and longitudinal studies with a sample of freshman students (Fleischer et al., 2019), with freshman and sophomore students (Mashburn, 2000), and students of different semesters (Freeman et al., 2007). Nevertheless, longitudinal studies on the relationship between study satisfaction and dropout intentions are scarce.

Effects of dropout intentions on study satisfaction and procrastination

Recently, researchers have assumed reverse or reciprocal relationships between dropout intentions and other constructs that were originally introduced as determinants of dropout intentions. Theoretically, for example, researchers considered dropout intentions as determinants of low achievement (Respondek et al., 2017) and effort–reward imbalance (Williams et al., 2018), as well as reciprocal relations between study satisfaction and retention (Green et al., 2015). Empirically, initial studies investigated the reciprocal relationship of academic satisfaction and intention to persist in engineering (Navarro et al., 2014) as well as of motivation and dropout intentions (Ghassemi et al., 2017) or the intention to leave a STEM major (Perez et al., 2014).

Reverse relationships are also conceivable for dropout intentions, procrastination, and study satisfaction and therefore require empirical exploration. For instance, dropout intentions indicate increasing doubt about the goal of obtaining a university degree (Ghassemi et al., 2017). An individual may not invest time and energy in behavior (e.g., learning) to achieve this uncertain goal, but instead postpone study-related tasks (i.e., procrastination). Regarding study satisfaction, students thinking about dropping out might begin to see more negative aspects of their studies (i.e., mind-shift; Brandstätter et al., 2013; see also Bäulke et al., 2021). This can affect their study satisfaction negatively.

The direction of the relationship between procrastination and study satisfaction

Procrastination is considered to decrease satisfaction (e.g., Balkis & Duru, 2016; Fritzsche et al., 2003). Similarly, the social cognitive career theory (SCCT; Lent & Brown, 2008) states that the perception of not making progress with one's goals leads to dissatisfaction. As procrastinators seemed to have difficulties in maintaining goal-driven behavior (Dewitte & Schouwenburg, 2002) and procrastination hindered goal achievement (Wäschle et al., 2014), procrastination could lead to lower study satisfaction. Empirically, procrastination negatively predicted study satisfaction (e.g., Balkis & Duru, 2016; Grunschel et al., 2016).

Contrarily, Chow (2011) suggested that lower study satisfaction leads to procrastination. This is in line with the theory that negative attitudes toward an object should lead to behavior that hinders the object (Eagly & Chaiken, 1993). Procrastination hinders studying through the accumulation of study tasks or the need to repeat study requirements, which could result in a prolonged duration of studies (Grunschel et al., 2013b; Patrzek et al., 2012). Therefore, low study satisfaction could lead to procrastinating behavior that hinders studying. In addition, Grunschel et al. (2013a) identified a specific type of academic procrastinator who is discontent with studies, indicating that study dissatisfaction could relate to subsequent procrastination. However, most of the studies on the relationship between procrastination and study satisfaction were cross-sectional and referred to correlative findings. Longitudinal results to answer the question of temporal directions are missing.

The present study

Among others, the dysfunctional study behavior of procrastination (e.g., Bülke et al., 2018; Bean & Metzner, 1985) and students' low cognitive well-being in the form of low study satisfaction (e.g., Fleischer et al., 2019; Mashburn, 2000) are predictors of dropout intentions. Though, the mutual influence of student dropout determinants is feasible (Heublein, 2014). Yet, dropout models neglect reciprocal relationships with dropout intentions. In recent years, researchers have started to test reciprocal relationships between dropout intentions and study motivation as one predictor of student dropout (Ghassemi et al., 2017; Perez et al., 2014). Dropout intentions might also relate to subsequent procrastination due to doubts about the goal of obtaining a university degree (Ghassemi et al., 2017) or study satisfaction by drawing attention to negative aspects of studies (Brandstätter et al., 2013). Further, theoretical considerations and initial empirical evidence exist for reciprocal relationships between procrastination and study satisfaction (e.g., Eagly & Chaiken, 1993; Grunschel et al., 2013a; 2016; Lent & Brown, 2008).

Thus far, empirical studies investigating whether dropout intentions relate to subsequent procrastination and/or study satisfaction do not exist. Besides, most of the studies on the bivariate relationships between procrastination, study satisfaction, and dropout intentions were cross-sectional. However, longitudinal studies are more suitable to adequately describe the dropout process (Tinto, 1975) and to explore reciprocal relationships. Thus, we conducted a longitudinal study with three measurement points across one semester to explore the interplay between procrastination, study satisfaction, and dropout intentions. We decided on investigating the variables over one semester because it is a definable period with three central phases for the students in higher education that we covered by our measurement points. The beginning of the semester is a phase of arriving after the semester break. In the middle of the semester, the students are back in full-time studies, and at the end of the semester is the examination phase.

Overall, we assessed three research questions. First, are procrastination and study satisfaction associated with subsequent dropout intentions as assumed by dropout models (Bean & Metzner, 1985; Heublein, 2014)? Second, concerning newer conceptualizations of reciprocal relationships between dropout intentions and other determinants of the dropout process (e.g., Ghassemi et al., 2017; Perez et al., 2014), are dropout intentions associated with subsequent procrastination and/or study satisfaction? Third, what is the temporal direction of the relationship between procrastination and study satisfaction? To this end, we used a latent cross-lagged panel design that allows the simultaneous examination of all research questions (Geiser, 2013).

In sum, our study contributes to a better understanding of the interplay between central variables (i.e., procrastination, study satisfaction, and dropout intentions) in the dynamic dropout process during university studies. In considering reciprocal relations with dropout intentions, the present study builds on recent empirical findings (Ghassemi et al., 2017; Perez et al., 2014) and draws attention to an important aspect that is neglected in student dropout models so far (e.g., Bean & Metzner, 1985; Heublein, 2014). By shedding light on the temporal relationships of procrastination, study satisfaction, and dropout intentions, we also deliver starting points for counseling services, prevention and intervention programs that aim to reduce procrastination and student dropout, as well as foster study satisfaction.

Method

Procedure and participants

Data collection took place at a mid-sized German university. The target sample were undergraduate students—freshmen and more experienced students—enrolled in mathematics or law. Both majors have particular high dropout rates in Germany (Heublein, 2014). No admissions rules applied to mathematics, whereas the following rules applied to law. Up to 20% of applicants with the best GPA of diploma (German Abitur) and 80% of applicants with the best GPA of diploma with waiting semesters being credited to GPA were selected. Our study focused on the period of one semester. During the semester, students typically attend lectures and seminars with extra assignments. In mathematics, students also complete weekly exercises. Only enough credits in these exercise sheets allow them to attend the final exam at the end of the semester. As a peculiarity, the involved university allows its students to take and improve exams as many times as they want, thus, no students are forced to drop out due to poor performances.

Prior to data collection, the ethics committee of the department of psychology at the involved university approved the study. Recruitment took place in central lectures of undergraduate students of mathematics and law of different semesters. Two of the co-authors briefly introduced the study, its goals, and the reward for participation. Then, interested students voluntarily filled in a contact form and were invited by e-mail to the online surveys. We informed students prior to their participation about the purpose of the study and data privacy issues. The three measurement points spread over the fall semester 2017/2018 (T1: end of October/beginning of November; T2: middle of December; T3: beginning of February).

In the online surveys, participants provided, among other things, information about their study behavior (e.g., procrastination), study motivation, dropout intentions, their lives at university (e.g., integration and challenges), their cognitive and affective well-being, and personality traits. At T1, they also provided demographic information that are relevant in the

educational context, namely age, gender, migration background (0 = *participant and both parents born in Germany*, 1 = *participant or at least one parent not born in Germany*; Aldrup et al., 2020), academic background operationalized with parents' academic background (0 = *both parents without an academic degree*, 1 = *one parent with an academic degree*, 2 = *both parents with an academic degree*; Hovdhaugen, 2009), GPA of their diploma (German Abitur; lower values indicate better achievement), major, and semester. On average, it took participants $M = 28.43$ ($SD = 18.58$) minutes to answer the questionnaire at T1, $M = 29.21$ ($SD = 16.50$) at T2 and $M = 30.11$ ($SD = 108.80$) at T3. The high standard deviation resulted due to participants who started the survey and then paused for a longer time.

We excluded students from the analyses who did not study mathematics or law ($n = 6$) or who did not participate at T1 ($n = 4$). At T1, $N = 326$ ($n = 218$ women, $n = 104$ with migration background, $n = 170$ both parents without an academic degree, and $n = 225$ students of law) students participated. On average, they were 20.50 ($SD = 2.52$) years old, had a GPA of 2.27 ($SD = 0.57$), and were in their 2.85 ($SD = 2.33$) semester. At T2, $n = 266$ students and at T3, $n = 236$ students participated. Overall, $n = 224$ students participated at all measurement points. The attrition rate between T1 and T3 was 27.61%. Participants received up to 20€, depending on how many measurement points they had partaken.

Measures

The study was part of the project procrastination as risk-factor for student dropout (in German: Prokrastination als Risikofaktor für den Abbruch des Studiums; ProkRASt) and covered a number of different variables. However, we solely report those variables that are relevant to the research questions of this contribution. For each of the described measures, a higher value indicates a higher expression in the construct.

Dropout intentions

Five items on a seven-point Likert scale (1 = *absolutely inapplicable* to 7 = *absolutely applicable*) measured dropout intentions or intentions to change major (e.g., "I often think about changing my course of studies or dropping out of college"; Dresel & Grassinger, 2013). The reliability was good at all three measurement points ($\omega_{T1} = .90$, $\omega_{T2} = .87$, $\omega_{T3} = .91$). Dresel and Grassinger (2013) reported a comparable value of Cronbach's $\alpha = .91$. An adapted version of this scale correlated positively with academic performance (lower values indicated a better performance; $r = .30$) and negatively with academic effort ($r = -.26$; Kryshko et al., 2020).

Academic procrastination

We assessed academic procrastination with the German version of the Tuckman Procrastination Scale (TPS-d; Tuckman, 1991; Stöber & Joormann, 2001) adapted to the academic context (Grunschel et al., 2013a). It consists of 16 items (e.g., "I get stuck in neutral even though I know how important it is to get started with my study-related tasks"), which participants answered on a five-point Likert scale (1 = *is not true at all* to 5 = *is perfectly true*). The reliability was good at all three measurement points ($\omega_{T1} = .95$, $\omega_{T2} = .95$, $\omega_{T3} = .96$) and is comparable to the reported values of Tuckman (1991; $\alpha = .86$), and Stöber and Joormann (2001; $\alpha = .92$). A previous study showed negative correlations between the TPS-

d and academic performance (higher values indicated a better performance; $-.25 \leq r \leq -.31$), study satisfaction ($r = -.35$), and life satisfaction ($r = -.32$; Grunschel et al., 2016).

Study satisfaction

Participants answered 10 items on a six-point Likert scale (1 = *is not true at all* to 6 = *is absolutely right*) about their satisfaction with their major (e.g., “I am satisfied with my subject to the extent that I would choose it again”), their satisfaction with the conditions of studies (e.g., “At my university, there is not sufficient attention paid to students’ concerns”), and their satisfaction with coping with study-related stress (e.g., “I often feel tired and exhausted due to my studies”; Schiefele & Jacob-Ebbinghaus, 2006). As in previous studies (Grunschel et al., 2016), the total score of all subscales were used for our analyses with study satisfaction. The reliability of the measure of study satisfaction was acceptable to good at all three measurement points ($\omega_{T1} = .82$, $\omega_{T2} = .78$, $\omega_{T3} = .73$). Schiefele and Jacob-Ebbinghaus (2006) reported comparable Cronbach’s α for the subscales of study satisfaction ($\alpha_{\text{major}} = .89$; $\alpha_{\text{conditions}} = .74$; $\alpha_{\text{stress}} = .67$). Grunschel et al. (2016) reported a comparable Cronbach’s $\alpha = .85$ for the total scale and positive correlations with academic performance (high values indicated a better performance; $r = .26$) and life satisfaction ($r = .44$).

Data analysis

First, we checked for systematic missingness using SPSS Version 25. ANOVAs and chi-square-tests checked for differences between three groups—(1) students participating at all measurement points, (2) students participating at two measurement points, and (3) students participating only at T1—for procrastination, study satisfaction, dropout intentions, and sample socio-demographics at T1. Significant differences between the groups point to variables that correlate with missingness (so-called auxiliary variables; Enders, 2010). Implementing auxiliary variables in the analyses, fine-tune the missing data analysis and increase the probability of the assumption of missing at random (MAR). Second, we conducted descriptive and correlation analyses with SPSS Version 25. Third, we explored the longitudinal relationships between procrastination, study satisfaction, and dropout intentions using a latent cross-lagged panel model with autocorrelated error variables (Geiser, 2013) in (Mplus Version 8.4 Muthén & Muthén, 1998–2017). Figure 1 displays the model. Advantages of latent models include the ability to control for measurement errors and test for model fit and measurement invariance (Coffman & MacCallum, 2005; Geiser, 2013). Every latent model consists of a measurement model and a structural model (Geiser, 2013).

The measurement model defines how the latent variables are measured by observed variables (i.e., indicators; Geiser, 2013). We used both parcels and single items as indicators (Coffman & MacCallum, 2005). For procrastination, we built four parcels with the item-to-construct method (Little et al., 2002). We matched the highest loading items with the lowest loading items and continued this approach until we achieved four parcels consisting of four items with balanced loadings. To take the multidimensionality of study satisfaction into account, we built three parcels consisting of three to four items with the domain-representative approach (Little et al., 2002). Each parcel contained at least one item from the three subscales of study satisfaction (i.e., satisfaction with the major, with the conditions of studies, and with coping with study-related stress). Again, we balanced loadings in each parcel. Based on Kline’s (2005) general recommendation to model a latent variable by using at least

Fig. 1 Latent cross-lagged panel model with three measurement points for academic procrastination, study satisfaction, and dropout intentions. *Note.* T1/T2/T3, first/second/third measurement time point. Ellipses illustrate latent variables. Arrows illustrate the direction of the relationship; double arrows illustrate correlations. We refrained from presenting the measurement model in favor of clarity; error variables were autocorrelated

three indicators, we refrained from parceling and modeled dropout intentions with the five items as indicators. In addition, we correlated the errors of the same parcels over time to account for indicator-specific effects (Geiser, 2013).

An important precondition for cross-lagged panel analyses is measurement invariance of the measurement models. Measurement invariance can be tested across groups (e.g., gender) and across time (i.e., different measurement points; Little, 2013). We tested measurement invariance across time because we were interested in comparing data across different measurement points. It indicates whether latent variables represent the same constructs at different points in time (Geiser, 2013). We tested three forms of measurement invariance across time. First, we compared a model without constrained factor loadings and intercepts of our indicators (configural invariance) with a model with constrained factor loadings of the same indicators over time and no constraints on the intercepts (weak invariance). Then, we compared the model with weak invariance with a model with both constrained factor loadings and intercepts of the same indicators over time (strong invariance). Chen (2007) proposed the following cut-offs for CFI, RMSEA, and SRMR to identify possible noninvariance: $\Delta CFI \geq -.010$, supplemented by $\Delta RMSEA \geq .015$ or $\Delta SRMR \geq .030$ for weak invariance and $\Delta CFI \geq -.010$, supplemented by $\Delta RMSEA \geq .015$ or $\Delta SRMR \geq .010$ for strong invariance. We found strong invariance across time for all constructs and the full cross-lagged panel model (see Table 1).

The structural model of a cross-lagged panel model specifies the relationships of the latent variables in terms of path analyses (Geiser, 2013). First, the autoregressive effects provide information about the stability of a construct by representing the relation of the same construct between subsequent points in time. We allowed first and second-order autoregressive paths to improve the model fit. We did not constrain the autoregressive effects from T1 to T2 and from T2 to T3 for each construct because we considered these periods to be too different within a semester. Second, we considered within-time correlations to account for situation-specific effects by either correlating the residuals of the latent variables at the same time points and the latent variables at T1. Third, to explain further variance not yet explained by the autoregressive

Table 1 Test statistics for measurement invariance across time for academic procrastination, study satisfaction, dropout intentions, and full model

Variable	Fit indices				Model comparison		
	$\chi^2(df)$	CFI	RMSEA	SRMR	ΔCFI	$\Delta RMSEA$	$\Delta SRMR$
Academic procrastination							
Configural	38.09 (39)	1.000	.000	.013			
Weak	39.67 (45)	1.000	.000	.016	.000 ^a	.000 ^a	.003 ^a
Strong	50.64 (51)	1.000	.000	.020	.000 ^b	.000 ^b	.004 ^b
Study satisfaction							
Configural	30.68 (15)	0.993	.057	.035			
Weak	37.94 (19)	0.991	.055	.043	-.002 ^a	-.002 ^a	.008 ^a
Strong	47.20 (23)	0.989	.057	.045	-.002 ^b	.002 ^b	.002 ^b
Dropout intentions							
Configural	212.68 (72)	0.954	.077	.043			
Weak	244.70 (80)	0.946	.079	.051	-.008 ^a	.002 ^a	.008 ^a
Strong	267.88 (88)	0.941	.079	.053	-.005 ^b	.000 ^b	.002 ^b
Full model							
Configural	748.94 (528)	0.977	.036	.042			
Weak	790.41 (546)	0.975	.037	.045	-.002 ^a	.001 ^a	.003 ^a
Strong	833.59 (564)	0.972	.038	.045	-.003 ^b	.001 ^b	.000 ^b

Note. CFI= comparative fit index; RMSEA= root mean squared error of approximation; SRMR= standardized root mean square residual.

^aComparison of configural invariance model with weak invariance model. ^bComparison of weak invariance model with strong invariance model.

effects, we modeled the cross-lagged effects, that are, effects of temporally preceding variables on subsequent variables.

To evaluate our model fit, we used goodness-of-fit indices recommended by Weston et al. (2008). These include the comparative fit index (CFI) $\geq .95$, root mean squared error of approximation (RMSEA) ≤ 0.06 , and standardized root mean residual (SRMR) ≤ 0.08 . We added information about the chi-square test of model fit (χ^2) though it is sensitive to large sample sizes and tests for exact model fit that rarely occurs (Weston et al., 2008). Alpha level was set at .05, two-tailed in all analyses.

Results

Panel attrition

We conducted one-way ANOVAs for procrastination, study satisfaction, dropout intentions, age, GPA, and semester as well as chi-square-tests for gender, migration and academic background, and major at T1 to check for differences among (1) participants who completed all three measurement points ($n = 224$, 68.71%), (2) participants who completed only two measurement points ($n = 54$, 16.56%), and (3) participants who completed only T1 ($n = 48$, 14.72%). These analyses revealed significant differences for migration background, $\chi^2(2) = 6.78$, $p = .03$, and no significant differences for procrastination, $F(2, 323) = 1.73$, $p = .18$, study satisfaction, $F(2, 323) = 0.36$, $p = .70$, dropout intentions, $F(2, 323) = 0.62$, $p = .54$, age $F(2, 323) = 0.87$, $p = .42$, GPA $F(2, 322) = 0.82$, $p = .44$, semester $F(2, 323) = 1.45$, $p = .24$, gender $\chi^2(2) = 1.85$, $p = .40$, academic background $\chi^2(4) = 4.12$, $p = .39$, and major $\chi^2(2) = 3.61$, $p =$

.17. We added migration background as auxiliary variable in our model to improve the estimation of missing data using the full information maximum likelihood (FIML; Enders, 2010).

Descriptive statistics and bivariate correlations

Table 2 displays the descriptive statistics and bivariate correlations between procrastination, study satisfaction, and dropout intentions from T1 to T3. An examination of the mean values showed that procrastination and dropout intentions increased during the semester, whereas study satisfaction decreased.

All correlations were significant and moderate to high (Cohen, 1988). Procrastination correlated negatively with study satisfaction and positively with dropout intentions. Study satisfaction correlated negatively with dropout intentions. The correlations within the same construct were higher than between different constructs, indicating a relatively high stability of the three constructs (Geiser, 2013). In addition, adjacent measuring points of the same construct (e.g., procrastination at T1 and T2) correlated more strongly than between non-adjacent measuring points (e.g., procrastination at T1 and T3), which already indicated an autoregressive structure between the variables (Geiser, 2013).

Table 3 displays the bivariate correlations between the sociodemographic characteristics of our sample and procrastination, study satisfaction, and dropout intentions from T1 to T3. Age and semester correlated positively with procrastination and negatively with study satisfaction at T1 as well as negatively with dropout intentions at T2 and T3. Semester additionally correlated negatively with study satisfaction at T3. Gender correlated significantly with procrastination at T1 and T3 as well as with study satisfaction and dropout intentions at T1 and T2. Migration and academic background did not significantly correlate with any of the three constructs at any point in time. Students' GPA correlated positively with procrastination at all measurement points and positively with dropout intentions at T1 and T3. Major correlated significantly with study satisfaction at T2 and T3.

Table 2 Descriptive statistics and intercorrelations of academic procrastination, study satisfaction, and dropout intentions at all measurement points

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9
1. Procrastination T1	2.57	0.86	—	.79*	.73*	-.34*	-.20*	-.29*	.27*	.24*	.14*
2. Procrastination T2	2.72	0.91		—	.84*	-.23*	-.29*	-.31*	.19*	.28*	.23*
3. Procrastination T3	2.76	0.94			—	-.20*	-.19*	-.34*	.26*	.30*	.32*
4. Study satisfaction T1	3.85	0.79				—	.66*	.68*	-.54*	-.34*	-.27*
5. Study satisfaction T2	3.73	0.81					—	.78*	-.44*	-.54*	-.40*
6. Study satisfaction T3	3.70	0.79						—	-.43*	-.44*	-.47*
7. Dropout intentions T1	2.28	1.23							—	.72*	.61*
8. Dropout intentions T2	2.50	1.32								—	.74*
9. Dropout intentions T3	2.63	1.50									—

Notes. $N_{T1} = 326$, $n_{T2} = 266$, $n_{T3} = 236$. T1/T2/T3, first/second/third measurement time point. The scale of procrastination ranges from 1 to 5, of study satisfaction from 1 to 6, and of dropout intentions from 1 to 7.

* $p \leq .05$.

Table 3 Bivariate correlations of sociodemographic characteristics with academic procrastination, study satisfaction, and dropout intentions at all measurement points

Variable	Age	Semester	Gender ^a	Migration background ^b	Academic background ^c	GPA ^d	Major ^e
Procrastination T1	.24*	.22*	.11*	-.01	-.02	.15*	.09
Procrastination T2	.11	.09	.10	.10	-.03	.15*	.07
Procrastination T3	.11	.05	.17*	.04	-.06	.19*	.04
Study satisfaction T1	-.16*	-.30*	.13*	-.05	.00	-.02	.02
Study satisfaction T2	-.02	-.11	.14*	.00	.05	-.01	-.16*
Study satisfaction T3	-.09	-.20*	.07	.07	.08	-.08	-.16*
Dropout intentions T1	-.04	-.01	-.14*	-.07	-.01	.21*	.02
Dropout intentions T2	-.14*	-.14*	-.13*	-.08	-.05	.08	.10
Dropout intentions T3	-.15*	-.15*	-.02	-.08	.00	.19*	.11

Notes. $N_{T1} = 326$, $n_{T2} = 266$, $n_{T3} = 236$. T1/T2/T3, first/second/third measurement time point.

^a 0 = female, 1 = male. ^b 0 = participant and both parents born in Germany, 1 = participant or at least one parent not born in Germany. ^c 0 = no parent with an academic degree, 1 = one parent with an academic degree, 2 = both parents with an academic degree; $n = 44$ missing because of missing information about at least one parents' degree. ^d Lower values indicate a better achievement. ^e 0 = law, 1 = mathematics.

* $p \leq .05$.

Cross-lagged panel model

Figure 2 provides an overview of the significant standardized effects of the cross-lagged panel model. Table 4 shows the significant and the non-significant standardized effects of the model. The model test was significant ($\chi^2 = 833.59$, $df = 564$, $p < .001$). However, all other fit indices indicated a good model fit for our model (CFI = .97, RMSEA [90% CI] = .04 [.03, .04], SRMR = .05).

Fig. 2 Results of the latent cross-lagged panel model for academic procrastination, study satisfaction, and dropout intentions. Note. Standardized coefficients of the latent cross-lagged panel model. T1/T2/T3, first/second/third measurement time point. Dotted lines illustrate non-significant paths. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 4 Standardized autoregressive and cross-lagged effects between academic procrastination, study satisfaction, and dropout intentions for the cross-lagged panel model with strong measurement invariance

Effect	T1 → T2			T2 → T3			T1 → T3		
	β	<i>SE</i>	<i>p</i>	β	<i>SE</i>	<i>p</i>	β	<i>SE</i>	<i>p</i>
Autoregressive effects									
Ap	0.83	0.03	<.001	0.75	0.06	<.001	0.14	0.07	.03
Sa	0.60	0.06	<.001	0.55	0.07	<.001	0.30	0.06	<.001
Di	0.87	0.05	<.001	0.67	0.09	<.001	0.17	0.09	.04
Cross-lagged effects									
Ap → Di	0.08	0.05	.11	−0.01	0.05	.87	—	—	—
Sa → Di	0.16	0.06	.01	0.01	0.06	.90	—	—	—
Di → Ap	−0.01	0.05	.93	0.13	0.05	.01	—	—	—
Di → Sa	−0.14	0.07	.04	−0.07	0.06	.26	—	—	—
Ap → Sa	0.01	0.05	.81	−0.08	0.04	.06	—	—	—
Sa → Ap	0.01	0.05	.92	0.10	0.05	.04	—	—	—

Note. *N* = 326. T1/T2/T3= first/second/third measurement time point; Ap= Academic procrastination; Sa= Study satisfaction; Di, dropout intentions. Explained variance of academic procrastination: $R^2_{T2} = 68.1\%$, $R^2_{T3} = 77.6\%$; study satisfaction: $R^2_{T2} = 47.7\%$, $R^2_{T3} = 73.7\%$; dropout intentions: $R^2_{T2} = 64.7\%$, $R^2_{T3} = 64.2\%$.

Autoregressive effects

In our cross-lagged panel model, all autoregressive effects were positive, significant, and strong. This illustrates the high temporal stability of the three constructs. The first-order autoregressive effects were stronger than the second-order autoregressive effects.

Within-time correlations

To take situation-specific effects into account, we correlated the latent variables at T1 and the residuals of the latent variables at the other time points each (within-time correlations; Geiser, 2013). All within-time correlations were significant on a moderate to high level (Cohen, 1988), indicating additional influences on all three variables at the same measurement point beyond the autoregressive and cross-lagged effects (Geiser, 2013). All within-time correlations of study satisfaction with procrastination and dropout intentions were negative, whereas all within-time correlations between procrastination and dropout intentions were positive.

Cross-lagged effects and results to our three research questions

Turning to our first research question, we examined the association of procrastination and study satisfaction with subsequent dropout intentions. In our model, procrastination did not significantly relate to subsequent higher dropout intentions at any time. But, unexpectedly, high study satisfaction at T1 significantly related to subsequent higher dropout intentions at T2.

Based on our second research question, we analyzed the association of dropout intentions with subsequent procrastination or study satisfaction. Higher dropout intentions at T2 significantly related to subsequent higher procrastination at T3. Additionally, higher dropout intentions at T1 significantly linked with subsequent lower study satisfaction at T2.

Our third research question focused on the reciprocal relationship between procrastination and study satisfaction. We found no significant reciprocal relationship between procrastination and study satisfaction because procrastination did not significantly relate to subsequent lower

study satisfaction at any time. However, unexpectedly, a higher study satisfaction at T2 significantly related to higher procrastination at T3.

Discussion

Student dropout is prevalent in higher education, and both theoretical models and empirical evidence have indicated that procrastination and study satisfaction are associated with dropout intentions (e.g., Baulke et al., 2018; Bean & Metzner, 1985; Mashburn, 2000). Although most models presume procrastination and study satisfaction as predictors of dropout intentions, reverse relationships seem also plausible (e.g., Navarro et al., 2014) and require empirical investigation. Similarly, the direction of the relationship between procrastination and study satisfaction is unclear. We aimed to shed light on the dynamic interplay between procrastination, study satisfaction, and dropout intentions, and, thus, different central aspects of students' lives (i.e., study behavior, cognitive well-being, and study decisions). More specifically, we conducted a three-wave longitudinal study over one semester and analyzed the reciprocal relationships between these three variables beyond the stability of the constructs by using a latent cross-lagged panel model.

Stability and cross-sectional relationships of procrastination, study satisfaction, and dropout intentions

Our statistical model offered different insights. First, the autoregressive effects indicated that procrastination, study satisfaction, and dropout intentions were highly stable constructs over one semester (Cohen, 1988). These results are consistent with findings on the stability of procrastination (Eckert et al., 2016; Rice et al., 2012) and study satisfaction (Ng & Ye, 2016). We found dropout intentions to be more stable than in a previous study (Perez et al., 2014), possibly because our time interval was shorter compared to that study.

Besides, we replicated the cross-sectional results concerning the bivariate relationships between the three variables at all measurement points. All manifest bivariate correlations as well as the within-time correlations in our latent cross-lagged panel model were significant and pointed in the same direction as previous cross-sectional results. That is, procrastination correlated negatively with study satisfaction (Balkis & Duru, 2016; Grunschel et al., 2016) and positively with dropout intentions (Baulke et al., 2018; 2021). In addition, study satisfaction and dropout intentions correlated negatively (Mashburn, 2000).

The longitudinal relationships between procrastination, study satisfaction, and dropout intentions

Considering the high stability of the constructs, the finding of significant cross-lagged effects between the variables is noteworthy (Adachi & Willoughby, 2015). With our first research question, we explored whether procrastination and study satisfaction related to subsequent dropout intentions. First, we did not identify procrastination significantly relating to subsequent higher dropout intentions beyond the autoregressive effects at any time point. Therefore, we can neither support theoretical assumptions of dropout models (e.g., Bean & Metzner, 1985) nor replicate previous empirical findings (e.g., Baulke et al., 2018) with longitudinal findings. The reasons why procrastination was not associated to subsequent dropout intentions

could be manifold. Future studies could examine whether procrastination is linked to dropout intentions indirectly via its negative influence, for example, on performance (e.g., Kim & Seo, 2015) or stress (Tice & Baumeister, 1997).

Contrary to procrastination, students reporting higher study satisfaction at T1 tended to report higher dropout intentions at T2. This contradicts the theoretical assumption that low study satisfaction reflects a predictor for dropout intentions (e.g., Bean & Metzner, 1985) and respective longitudinal results (Fleischer et al., 2019). Comparing our results with the findings of Fleischer et al. (2019), we stress two important differences between the studies. On the one hand, Fleischer et al. only examined students' satisfaction with the major that could have led to different results. On the other hand, the data collection based on different periods in the semester. Our cross-lagged effect referred to the period from the beginning (T1) to the middle of the semester (T2). At T1, returning from the semester break, students might have started the semester with optimism and high expectations. At T2, they might have gathered a more realistic impression of the semester by, for example, being aware of course requirements, succeeding or failing in using learning strategies, and receiving performance feedback. Unfulfilled or disappointed expectations from T1 might have resulted in higher dropout intentions at T2 (Heublein et al., 2017; Pleitz et al., 2015)—especially if students had inadequate prior information about studying or the chosen major (e.g., Pleitz et al., 2015) or were overly confident about their academic abilities and performances (Hall & Sverdluk, 2016). Thus, to generate realistic expectations beforehand, searching for information on tasks and challenges of the semester, and a reflection, for example, of prior learning experiences and students' past academic achievement would be beneficial. In contrast to our study, Fleischer et al. observed the period between the middle and the end of the semester and found a negative relationship between study satisfaction and dropout intentions. In the middle of the semester, students' more realistic view on their studies (maybe linked to unfulfilled expectations) might result in higher dropout intentions at the end of the semester, which would be in line with dropout models (e.g., Bean & Metzner, 1985; Mashburn, 2000). However, we did not detect a negative relationship between study satisfaction at T2 and dropout intentions at T3. Consequently, future studies should further clarify the relationship between the variables.

Subsequently, we explored whether dropout intentions related to subsequent procrastination and study satisfaction (Research Question 2). First, students who reported higher dropout intentions at T2 tended to report higher procrastination at T3. Dropout intentions could decrease study motivation (e.g., Ghassemi et al., 2017) and discourage a student from investing time and energy into a now uncertain goal. This might result in higher reported procrastination. Second, students who reported higher dropout intentions at T1 tended to report lower study satisfaction at T2. Students with dropout intentions become more aware of the negative aspects of their studies and weigh the costs and benefits of studying (i.e., mind-shift; Brandstätter et al., 2013), which results in lower study satisfaction.

The reciprocal relationship between procrastination and study satisfaction

Lastly, we explored the reciprocal relationship between procrastination and study satisfaction (Research Question 3). We did not identify a reciprocal relationship between procrastination and study satisfaction. First, procrastination did not significantly relate to subsequent study satisfaction beyond the autoregressive effects at any time point. This contradicted the pre-suppositions of SCCT (Lent & Brown, 2008) as well as corresponding assumptions and cross-sectional results (e.g., Grunschel et al., 2016). Second, students who reported higher study

satisfaction at T2 tended to report more procrastination at T3. This contradicted the theoretical assumptions (Eagly & Chaiken, 1993) and cross-sectional results (Chow, 2011; Grunschel et al., 2013a). At a second glance, however, this finding is perhaps not surprising. Satisfied students may feel more confident and may have to do less to achieve results in their satisfactory studies. Thus, they lean back more in their studies, which could result in higher procrastination. Our longitudinal findings indicated a more complex relationship between procrastination and study satisfaction than often assumed or shown in cross-sectional studies. Therefore, researchers should use longitudinal data to adequately identify determinants and consequences of procrastination.

Theoretical implications

To our knowledge, this longitudinal study is the first to show a meaningful association between dropout intentions, subsequent procrastination, and lower study satisfaction. Considering our results, some student dropout models need to be revised (e.g., Bean & Metzner, 1985). They should not view dropout intentions only as a mediator to actual dropout, but also consider dropout intentions to precede other determinants of student dropout (e.g., procrastination and low study satisfaction). Taking a broader theoretical view beyond models of student dropout, we encourage researchers to reconsider whether a more dynamic or processual perspective of relations between variables might be conceivable for other theoretical models in the field of educational psychology as well. Recently, Eccles and Wigfield (2020), for example, explicitly re-emphasized the dynamic interplay between different components of motivation within the situated expectancy-value theory.

Given our findings, it further seems too early to reject the theoretical assumptions on the influence of procrastination on study satisfaction and vice versa (Eagly & Chaiken, 1993; Lent & Brown, 2008). In the future, researchers should investigate not only between-person relations among variables but also within-person relations as these might reveal an interesting interplay between variables—not only with regard to procrastination and study satisfaction (Orth et al., 2021).

Lastly, some authors consider study satisfaction as a multidimensional construct of three subscales (Schiefele & Jacob-Ebbinghaus, 2006). In line with past research (e.g., Grunschel et al., 2016), we used the composite score of study satisfaction. However, not examining the different subscales of study satisfaction could be a reason for the unexpected relations between study satisfaction and dropout intentions and procrastination in our study. To gain more insights in the relations, future research should consider the subscales of study satisfaction. A clarification of the internal structure of the construct would be informative as well.

Practical implications

Our study also provides several practical implications. First, regarding the positive association between study satisfaction and subsequent dropout intentions, prospective students should form realistic expectations about studying and their target major. Career orientation days with opportunities to visit universities and lectures before enrolment or to participate in relevant courses could be useful strategies. Second, given that higher dropout intentions related to subsequent lower study satisfaction and higher procrastination, we recommend to explore the reasons for dropout intentions, strive for changes of these reasons, and acknowledge that a final dropout or major change could also be a reasonable step for some students. Third, the

association between higher dropout intentions and subsequent procrastination indicates that attempts to reduce procrastination (van Eerde & Klingsieck, 2018) should be supplemented. While for one, increasing self-regulation is the right solution, for another it might be considering alternatives to the current major. Fourth, turning to the positive association between study satisfaction and subsequent procrastination, it could be fruitful to inform students about the negative consequences of procrastination (e.g., Grunschel et al., 2013b).

Limitations and future research

Our results should be interpreted in the context of its limitations. The first part of our limitations relates to the explanatory power of our model. Although our cross-lagged panel model provides valuable information on the dropout process, we cannot claim causality (Selig & Little, 2012). The longitudinal design allows us to approach the temporal precedence, but we lack information about the time before the first measurement point and we cannot rule out further alternative explanations. Moreover, we cannot completely rule out the possibility of a violation of the assumption for MAR, although we tried to increase the likelihood of MAR through several attrition analyses and by including migration background as an auxiliary variable in our model (Enders, 2010).

The second part of our limitations relates to our research methodology and provides ideas for further research. Study dropout is a long process (Heublein, 2014; Mashburn, 2000). Additionally, procrastination could lead to a prolonged study course Patrzek et al., 2012). Maybe, one semester was not enough or the time intervals between our measurement points were too short to reveal all influences of procrastination and study satisfaction on dropout intentions. Thus, future studies should investigate a longer time interval. Furthermore, our analyses were limited by sample size and sample composition. The generalizability of our results is limited to students of law and mathematics in Germany. Moreover, our sample consisted more of female than male students. Future studies with higher sample size and a more equal distribution of sample characteristics should investigate whether the longitudinal relations between procrastination, study satisfaction, and dropout intentions differ between groups of students (e.g., gender, major, different semesters) or consider other important determinants of student dropout (e.g., past GPA, family background, financial situation, or academic achievement; Bean & Metzner, 1985; Heublein, 2014; Tinto, 1975) in their main analyses as well. Lastly, our measure of dropout intentions mixed dropout intentions and intentions to change major. Recent studies indicated to distinguish these two phenomena (Bäulke et al., 2021) and that they could be attributable to different reasons (Rosenzweig et al. 2021). Future studies could investigate whether the relationships with procrastination and study satisfaction are different for dropout intentions and intentions to change major.

Conclusion

The present longitudinal study investigated the relationship between students' dysfunctional study behavior (i.e., academic procrastination), cognitive well-being (i.e., study satisfaction), and study decisions (i.e., dropout intentions) by conducting a cross-lagged panel model. In

sum, the latent cross-sectional results on the associations between the variables (i.e., procrastination, study satisfaction, and dropout intentions) in the model were in line with theoretical assumptions and past empirical findings. Yet, the longitudinal results of the cross-lagged effects did not align with theoretical postulations and, thus, yielded a more complex picture of the relations among the variables. First, a higher study satisfaction related to subsequent higher dropout intentions between the beginning and middle of the semester, possibly due to unfulfilled expectations. Second, higher dropout intentions related to both subsequent lower study satisfaction at the middle of the semester and subsequent higher academic procrastination at the end of the semester. Third, higher study satisfaction at the middle of the semester related to subsequent higher procrastination at the end of the semester, possibly due to more confidence among satisfied students. These results strengthen the relevance of longitudinal research that investigates the dynamic interplay of variables. Regarding theoretical implications, we advocate to attribute dropout intentions a more dynamic role in the dropout process than just the mediating role to actual dropout, and that other theoretical models in the field of educational psychology might also consider a more dynamic perspective among variables. Regarding practical implications, we suggest a realistic expectation management as well as the exploration of reasons for procrastination and low study satisfaction to help individuals draw the right conclusions for their further educational careers—for example, improving self-regulation or considering alternatives to their current major.

The authors' current themes of research and relevant publications in the field of psychology of education

Anne Scheunemann. Institute of Educational Research Ruhr-University Bochum, Universitätsstraße 150, 44801 Bochum, Germany. E-mail: Anne.Scheunemann@ruhr-uni-bochum.de

Current themes of research:

Student success and student dropout intention

Academic Procrastination

Motivation

Most relevant publications in the field of psychology of education:

Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44, 491–507. doi:10.1007/s11031-020-09822-w

Theresa Schnettler. Department of Psychology, University of Muenster, Fliednerstr. 21, 48149 Münster, Germany. E-mail: theresa.schnettler@uni-muenster.de

Current themes of research:

Student success and student dropout intention

Student's academic motivation (situated expectancy-value theory)

Academic procrastination

Ambulatory assessment

Most relevant publications in the field of psychology of education:

Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44, 491–507. doi:10.1007/s11031-020-09822-w

Julia Bobe. Department of Psychology, Paderborn University, Warburger Straße 100, 33098 Paderborn, Germany. E-mail: julia.bobe@uni-paderborn.de

Current themes of research:

Academic procrastination

Motivation

Academic emotions

Most relevant publications in the field of psychology of education:

Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44, 491–507. doi:10.1007/s11031-020-09822-w

Stefan Fries. Department of Psychology, Bielefeld University, Universitätsstraße 25, 33615 Bielefeld, Germany. E-mail: stefan.fries@uni-bielefeld.de

Current themes of research:

Motivation to learn

Motivational conflicts

Academic procrastination

Self-regulation in everyday life

Ambulatory assessment

Most relevant publications in the field of psychology of education:

Fries, S., Dietz, F., & Schmid, S. (2008). Motivational interference in learning: The impact of leisure alternatives on subsequent self-regulation. *Contemporary Educational Psychology*, 33(2), 119–133.

Grund, A., Brassler, N. K., & Fries, S. (2014). Torn between study and leisure: How motivational conflicts relate to students' academic and social adaptation. *Journal of Educational Psychology*, 106, 242–257. doi:10.1037/a0034400

Grund, A., Fries, S., & Rheinberg, F. (2018). Know your preferences: Self-regulation as need-congruent goal-selection. *Review of General Psychology*, 22, 437–451. doi: 10.1037/gpr0000159

Grunschel, C., Schwinger, M., Steinmayr, R., & Fries, S. (2016). Effects of using motivational regulation strategies on students' academic procrastination, academic performance, and well-being. *Learning and Individual Differences*, 49, 162–170. doi:10.1016/j.lindif.2016.06.008

Stojanovic, M., Grund, A. & Fries, S. (2020). App-Based Habit Building Reduces Motivational Impairments During Studying—An Event Sampling Study. *Frontiers in Psychology*, 11, 167. doi:10.3389/fpsyg.2020.00167

Carola Grunschel. Department of Psychology, University of Muenster, Fliednerstr. 21, 48149 Münster, Germany. E-mail: carola.grunschel@uni-muenster.de

Current themes of research:

Self-regulated learning

Procrastination

Motivation and motivational regulation

Learning success and study dropout

Most relevant publications in the field of psychology of education:

Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44, 491–507. doi:10.1007/s11031-020-09822-w

Grunschel, C., Patrzek, J., Klingsieck, K. B., Fries, S. (2018). “I’ll stop procrastinating now!” Fostering specific processes of self-regulated learning to reduce academic procrastination. *Journal*

of Prevention & Intervention in the Community, 46(2), 143–157. <https://doi.org/10.1080/10852352.2016.1198166>.

Grunschel, C., Schwinger, M., Steinmayr, R., Fries, S. (2016). Effects of using motivational regulation strategies on students' academic procrastination, academic performance, and well-being. *Learning and Individual Differences*, 49, 162–170. <https://doi.org/10.1016/j.lindif.2016.06.008>.

Grunschel, C., Patrzek, J., & Fries, S. (2013). Exploring reasons and consequences of academic procrastination: An interview study. *European Journal of Psychology of Education*, 28(3), 841–861.

Grunschel, C., Patrzek, J., & Fries, S. (2013). Exploring different types of academic delays: A latent profile analysis. *Learning and Individual Differences*, 23, 225–233.

Availability of data and material The data on which our analyses are based can be provided on request.

Code availability The Mplus code of our analyses can be provided on request.

Author contribution All authors have contributed significantly to the manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. The data are taken from a study of the project ProkRASt (Prokrastination als Risikofaktor für den Abbruch des Studiums; procrastination as risk-factor for student dropout), funded by the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF). Award Number: 01PX16011A

Declarations

Conflict of interests The authors declare no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Adachi, P., & Willoughby, T. (2015). Interpreting effect sizes when controlling for stability effects in longitudinal autoregressive models: Implications for psychological science. *European Journal of Developmental Psychology*, 12(1), 116–128. <https://doi.org/10.1080/17405629.2014.963549>.
- Aldrup, K., Klusmann, U., & Lüdtke, O. (2020). Reciprocal associations between students' mathematics anxiety and achievement: Can teacher sensitivity make a difference? *Journal of Educational Psychology*, 112(4), 735. <https://doi.org/10.1037/edu0000398>.
- Bäulke, L., Grunschel, C., & Dresel, M. (2021). Student dropout at university: a phase-orientated view on quitting studies and changing majors. *European Journal of Psychology of Education*, 1–24. <https://doi.org/10.1007/s10212-021-00557-x>.
- Balkis, M., & Duru, E. (2016). Procrastination, self-regulation failure, academic life satisfaction, and affective well-being: Underregulation or misregulation form. *European Journal of Psychology of Education*, 31(3), 439–459. <https://doi.org/10.1007/s10212-015-0266-5>.
- Bäulke, L., Eckerlein, N., & Dresel, M. (2018). Interrelations between motivational regulation, procrastination and college dropout intentions. *Unterrichtswissenschaft*, 46(4), 461–479. <https://doi.org/10.1007/s42010-018-0029-5>.

- Bean, J. P. (1982). Student attrition, intentions, and confidence: Interaction effects in a path model. *Research in Higher Education*, 17(4), 291–320. <https://doi.org/10.1007/BF00977899>.
- Bean, J. P., & Metzner, B. S. (1985). A conceptual model of nontraditional undergraduate student attrition. *Review of Educational Research*, 55(4), 485–540. <https://doi.org/10.3102/00346543055004485>.
- Brandstätter, V., Herrmann, M., & Schöler, J. (2013). The struggle of giving up personal goals: Affective, physiological, and cognitive consequences of an action crisis. *Personality and Social Psychology Bulletin*, 39(12), 1668–1682. <https://doi.org/10.1177/0146167213500151>.
- Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, 14(3), 464–504. <https://doi.org/10.1080/10705510701301834>.
- Chow, H. P. H. (2011). Procrastination among undergraduate students: Effects of emotional intelligence, school life, self-evaluation, and self-efficacy. *Alberta Journal of Educational Research*, 57(2), 234–240.
- Coffman, D. L., & MacCallum, R. C. (2005). Using parcels to convert path analysis models into latent variable models. *Multivariate Behavioral Research*, 40(2), 235–259. https://doi.org/10.1207/s15327906mbr4002_4.
- Cohen, J. (1988). *Statistical power analysis for the social sciences* (2nd ed.). Lawrence Erlbaum.
- Davies, R., & Elias, P. (2003). *Dropping out: A study of early leavers from higher education*. DfES Publications.
- Dewitte, S., & Schouwenburg, H. C. (2002). Procrastination, temptations, and incentives: The struggle between the present and the future in procrastinators and the punctual. *European Journal of Personality*, 16(6), 469–489. <https://doi.org/10.1002/per.461>.
- Diener, E., Oishi, S., & Tay, L. (2018). Advances in subjective well-being research. *Nature Human Behaviour*, 2(4), 253–260. <https://doi.org/10.1038/s41562-018-0307-6>.
- Dresel, M., & Grassinger, R. (2013). Changes in achievement motivation among University Freshmen. *Journal of Education and Training Studies*, 1(2), 159–173.
- Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt Brace Jovanovich.
- Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, 61, 101859. <https://doi.org/10.1016/j.cedpsych.2020.101859>.
- Eckert, M., Ebert, D. D., Lehr, D., Sieland, B., & Berking, M. (2016). Overcome procrastination: Enhancing emotion regulation skills reduce procrastination. *Learning and Individual Differences*, 52, 10–18. <https://doi.org/10.1016/j.lindif.2016.10.001>.
- Enders, C. K. (2010). *Applied missing data analysis*. Guilford Press.
- Faas, C., Benson, M. J., Kaestle, C. E., & Savla, J. (2018). Socioeconomic success and mental health profiles of young adults who drop out of college. *Journal of Youth Studies*, 21(5), 669–686. <https://doi.org/10.1080/13676261.2017.1406598>.
- Fleischer, J., Leutner, D., Brand, M., Fischer, H., Lang, M., Schmiemann, P., & Sumfleth, E. (2019). Vorhersage des Studienabbruchs in naturwissenschaftlich-technischen Studiengängen [Prediction of student dropout in scientific and technical courses of study]. *Zeitschrift für Erziehungswissenschaft*, 22(5), 1077–1097. <https://doi.org/10.1007/s11618-019-00909-w>.
- Freeman, J. P., Hall, E. E., Bresciani, M., & J. (2007). What leads students to have thoughts, talk to someone about, and take steps to leave their institution? *College Student Journal*, 41(4), 755–771.
- Fritzsche, B. A., Young, B. R., & Hickson, K. C. (2003). Individual differences in academic procrastination tendency and writing success. *Personality and Individual Differences*, 35(7), 1549–1557. [https://doi.org/10.1016/S0191-8869\(02\)00369-0](https://doi.org/10.1016/S0191-8869(02)00369-0).
- Gairín, J., Triado, X. M., Feixas, M., Figuera, P., Aparicio-Chueca, P., & Torrado, M. (2014). Student dropout rates in Catalan universities: profile and motives for disengagement. *Quality in Higher Education*, 20(2), 165–182. <https://doi.org/10.1080/13538322.2014.925230>.
- Geiser, C. (2013). *Data analysis with Mplus. Methodology in the social sciences*. The Guilford Press.
- Ghassemi, M., Bernecker, K., Herrmann, M., & Brandstätter, V. (2017). The process of disengagement from personal goals: Reciprocal influences between the experience of action crisis and appraisals of goal desirability and attainability. *Personality and Social Psychology Bulletin*, 43(4), 524–537. <https://doi.org/10.1177/0146167216689052>.
- Green, H. J., Hood, M., & Neumann, D. L. (2015). Predictors of student satisfaction with university psychology courses: A review. *Psychology Learning and Teaching*, 14(2), 131–146. <https://doi.org/10.1177/1475725715590959>.
- Grunschel, C., Patrzek, J., & Fries, S. (2013a). Exploring different types of academic delayers: A latent profile analysis. *Learning and Individual Differences*, 23, 225–233. <https://doi.org/10.1016/j.lindif.2012.09.014>.
- Grunschel, C., Patrzek, J., & Fries, S. (2013b). Exploring reasons and consequences of academic procrastination: An interview study. *European Journal of Psychology of Education*, 28(3), 841–861. <https://doi.org/10.1007/s10212-012-0143-4>.
- Grunschel, C., Schwinger, M., Steinmayr, R., & Fries, S. (2016). Effects of using motivational regulation strategies on students' academic procrastination, academic performance, and well-being. *Learning and Individual Differences*, 49, 162–170. <https://doi.org/10.1016/j.lindif.2016.06.008>.

- Hagedorn, L. S. (2012). *How to define retention*. In A. Seidman (Ed.), *College student retention* (pp. 81–100). Rowman & Littlefield.
- Hall, N. C., & Sverdlid, A. (2016). Encouraging realistic expectations in STEM students: Paradoxical effects of a motivational intervention. *Frontiers in Psychology*, 7, 1109. <https://doi.org/10.3389/fpsyg.2016.01109>.
- Heublein, U. (2014). Student drop-out from German higher education institutions. *European Journal of Education*, 49(4), 497–513. <https://doi.org/10.1111/ejed.12097>.
- Heublein, U., Ebert, J., Hutzsch, C., Isleib, S., König, R., Richter, J., & Woisch, A. (2017). *Zwischen Studierenerwartungen und Studienwirklichkeit: Ursachen des Studienabbruchs, beruflicher Verbleib der Studienabbrecherinnen und Studienabbrecher und Entwicklung der Studienabbruchquote an deutschen Hochschulen [Between study expectations and the reality of studies: Causes of study dropout, career paths of dropouts and the development of the drop-out rate at German universities]*. Deutsches Zentrum für Hochschul- und Wissenschaftsforschung (DZHW), Hannover.
- Holliman, A. J., Martin, A. J., & Collie, R. J. (2018). Adaptability, engagement, and degree completion: A longitudinal investigation of university students. *Educational Psychology*, 38(6), 785–799. <https://doi.org/10.1080/01443410.2018.1426835>.
- Hovdhaugen, E. (2009). Transfer and dropout: Different forms of student departure in Norway. *Studies in Higher Education*, 34(1), 1–17. <https://doi.org/10.1080/03075070802457009>.
- Kim, K. R., & Seo, E. H. (2015). The relationship between procrastination and academic performance: A meta-analysis. *Personality and Individual Differences*, 82, 26–33. <https://doi.org/10.1016/j.paid.2015.02.038>.
- Kline, R. B. (2005). *Principles and practice of structural equation modeling*. Guilford Press.
- Krause, K., & Freund, A. M. (2014). Delay or procrastination—A comparison of self-report and behavioral measures of procrastination and their impact on affective well-being. *Personality and Individual Differences*, 63, 75–80. <https://doi.org/10.1016/j.paid.2014.01.050>.
- Kryshko, O., Fleischer, J., Waldeyer, J., Wirth, J., & Leutner, D. (2020). Do motivational regulation strategies contribute to university students' academic success? *Learning and Individual Differences*, 82, 101912. <https://doi.org/10.1016/j.lindif.2020.101912>.
- Lent, R. W., & Brown, S. D. (2008). Social cognitive career theory and subjective well-being in the context of work. *Journal of Career Assessment*, 16(1), 6–21. <https://doi.org/10.1177/1069072707305769>.
- Little, T. D. (2013). *Longitudinal structural equation modeling*. Guilford press.
- Little, T. D., Cunningham, W. A., Shahar, G., & Widaman, K. F. (2002). To parcel or not to parcel: Exploring the question, weighing the merits. *Structural Equation Modeling: A Multidisciplinary Journal*, 9(2), 151–173. https://doi.org/10.1207/S15328007SEM0902_1.
- Mashburn, A. J. (2000). A psychological process of college student dropout. *Journal of College Student Retention: Research, Theory & Practice*, 2(3), 173–190. <https://doi.org/10.2190/U2QB-52J9-GHGP-6LEE>.
- Muthén, L. K., & Muthén, B. O. (1998–2017) *Mplus user's guide* (8th ed.). Muthén & Muthén, Los Angeles.
- Navarro, R. L., Flores, L. Y., Lee, H. S., & Gonzalez, R. (2014). Testing a longitudinal social cognitive model of intended persistence with engineering students across gender and race/ethnicity. *Journal of Vocational Behavior*, 85(1), 146–155. <https://doi.org/10.1016/j.jvb.2014.05.007>.
- Ng, T. K., & Ye, S. (2016). Human values and university life satisfaction among Hong Kong Chinese university students: A cross-lagged panel analysis. *The Asia-Pacific Education Researcher*, 25(3), 453–461. <https://doi.org/10.1007/s40299-015-0255-0>.
- OECD. (2007). *Education at a glance: OECD indicators*. OECD.
- Orth, U., Clark, D. A., Donnellan, M. B., & Robins, R. W. (2021). Testing prospective effects in longitudinal research: Comparing seven competing cross-lagged models. *Journal of Personality and Social Psychology*, 120(4), 1013. <https://doi.org/10.1037/pspp0000358>.
- Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology*, 106(1), 315–329. <https://doi.org/10.1037/a0034027>.
- Pleitz, J. D., MacDougall, A. E., Terry, R. A., Buckley, M. R., & Campbell, N. J. (2015). Great expectations. *Journal of College Student Retention: Research, Theory & Practice*, 17(1), 88–104. <https://doi.org/10.1177/1521025115571252>.
- Patrzek, J., Sattler, S., van Veen, F., Grunschel, C., & Fries, S. (2015). Investigating the effect of academic procrastination on the frequency and variety of academic misconduct: a panel study. *Studies in Higher Education*, 40(6), 1014–1029. <https://doi.org/10.1080/03075079.2013.854765>.
- Respondenk, L., Seufert, T., Stupnisky, R., & Nett, U. E. (2017). Perceived academic control and academic emotions predict undergraduate university student success: Examining effects on dropout intention and achievement. *Frontiers in Psychology*, 8, 243. <https://doi.org/10.3389/fpsyg.2017.00243>.
- Rice, K. G., Richardson, C. M. E., & Clark, D. (2012). Perfectionism, procrastination, and psychological distress. *Journal of Counseling Psychology*, 59(2), 288–302. <https://doi.org/10.1037/a0026643>.
- Rosenzweig, E. Q., Harackiewicz, J. M., Hecht, C. A., Priniski, S. J., Canning, E. A., Tibbetts, Y., Asher, M. W., & Hyde, J. S. (2020). College students' reasons for leaving biomedical fields: Disenchantment with

- biomedicine or attraction to other fields? *Journal of Educational Psychology*. Advance online publication. <https://doi.org/10.1037/edu0000456>.
- Rummel, A. M. Y., Acton, D. A. N., Costello, S., & Pielow, G. (1999). Is all retention good? An empirical study. *College Student Journal*, 33(2), 241–241.
- Schiefele, U., & Jacob-Ebbinghaus, L. (2006). Lernermerkmale und Lehrqualität als Bedingungen der Studienzufriedenheit [Learner characteristics and teaching quality as conditions for study satisfaction]. *Zeitschrift für Pädagogische Psychologie*, 20(3), 199–212. <https://doi.org/10.1024/1010-0652.20.3.199>.
- Schneider, M., & Preckel, F. (2017). Variables associated with achievement in higher education: A systematic review of meta-analyses. *Psychological Bulletin*, 143(6), 565. <https://doi.org/10.1037/bul0000098>.
- Schnepf, S. V. (2017). How do tertiary dropouts fare in the labour market? A comparison between EU countries. *Higher Education Quarterly*, 71(1), 75–96. <https://doi.org/10.1111/hequ.12112>.
- Schuh, J. H., & Gansemer-Topf, A. (2012). *Finances and retention: Trends and potential implications*. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 101–118). Rowman & Littlefield Publishers.
- Selig, J. P., & Little, T. D. (2012). *Autoregressive and cross-lagged panel analysis for longitudinal data*. In B. Laursen, T. D. Little, & N. A. Card (Eds.), *Handbook of developmental research methods* (pp. 265–278). The Guilford Press.
- Starr, A., Betz, E. L., & Menne, J. (1972). Differences in college student satisfaction: Academic dropouts, nonacademic dropouts, and nondropouts. *Journal of Counseling Psychology*, 19(4), 318–322. <https://doi.org/10.1037/h0033083>.
- Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychological Bulletin*, 133(1), 65–94. <https://doi.org/10.1037/0033-2909.133.1.65>.
- Stöber, J., & Joormann, J. (2001). Worry, procrastination, and perfectionism: Differentiating amount of worry, pathological worry, anxiety, and depression. *Cognitive Therapy and Research*, 25(1), 49–60. <https://doi.org/10.1023/A:1026474715384>.
- Schnettler, T., Bobe, J., Scheunemann, A., Fries, S., & Grunschel, C. (2020a). Is it still worth it? Applying expectancy-value theory to investigate the intraindividual motivational process of forming intentions to drop out from university. *Motivation and Emotion*, 44(4). <https://doi.org/10.1007/s11031-020-09822-w>.
- Tice, D. M., & Baumeister, R. F. (1997). Longitudinal study of procrastination, performance, stress, and health. *Psychological Science*, 8(6), 454–458. <https://doi.org/10.1111/j.1467-9280.1997.tb00460.x>.
- Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, 45(1), 89–125. <https://doi.org/10.3102/00346543045001089>.
- Tuckman, B. W. (1991). The development and concurrent validity of the procrastination scale. *Educational and Psychological Measurement*, 51(2), 473–480. <https://doi.org/10.1177/0013164491512022>.
- van Eerde, W., & Klingsieck, K. B. (2018). Overcoming procrastination? A meta-analysis of intervention studies. *Educational Research Review*, 25, 73–85.
- Wäschle, K., Allgaier, A., Lachner, A., Fink, S., & Nückles, M. (2014). Procrastination and self-efficacy: Tracing vicious and virtuous circles in self-regulated learning. *Learning and Instruction*, 29, 103–114. <https://doi.org/10.1016/j.learninstruc.2013.09.005>.
- Westermann, R., & Heise, E. (2018). *Studienzufriedenheit [Study satisfaction]*. In D. H. Rost, J. R. Sparfeldt, & S. Buch (Eds.), *Handwörterbuch Pädagogische Psychologie [Handbook of educational psychology]* (pp. 818–825). Weinheim; Basel: Beltz.
- Weston, R., Gore Jr., P. A., Chan, F., & Catalano, D. (2008). An introduction to using structural equation models in rehabilitation psychology. *Rehabilitation Psychology*, 53(3), 340. <https://doi.org/10.1037/a0013039>.
- Williams, C. J., Dziurawiec, S., & Heritage, B. (2018). More pain than gain: Effort–reward imbalance, burnout, and withdrawal intentions within a university student population. *Journal of Educational Psychology*, 110(3), 378–394. <https://doi.org/10.1037/edu0000212>.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Affiliations

Anne Scheunemann^{1,2} · Theresa Schnettler³ · Julia Bobe⁴ · Stefan Fries¹ · Carola Grunschel³

✉ Anne Scheunemann
Anne.Scheunemann@ruhr-uni-bochum.de

¹ Department of Psychology Bielefeld University, Bielefeld, Germany

² Institute of Educational Research, Universitätsstraße 150, 44801 Bochum, Germany

³ Department of Psychology University of Muenster, Münster, Germany

⁴ Department of Psychology Paderborn University, Paderborn, Germany