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Academic Self-Efficacy and Value Beliefs of International STEM and Non-STEM University Students in Germany from an Intersectional Perspective

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Abstract: The expectancy–value theory (EVT) positions expectations and value beliefs as important predictors of academic success. We, thus, investigated the prevalence of academic self-efficacy and intrinsic, attainment, utility, and cost values amongst international STEM students in Germany, as well as their associations with gender, parental academic background, cultural characteristics, and their interplay. We also compared STEM to non-STEM students. Analyses with hierarchical multi-group regression models using data from 1590 international bachelor students (n_{STEM} = 882, $n_{non\text{-}STEM}$ = 708) revealed high levels of academic self-efficacy, attainment, intrinsic, and utility values but also high costs. International STEM students indicated lower levels of academic self-efficacy than non-STEM students; all other results were similar in both subject-groups. There were no direct associations between gender and the expectancy–value components but continuous-generation students showed higher academic self-efficacy than first-generation students. Significant associations between cultural background and all expectancy–value components were identified, most of them applied to costs. In some cases, the associations differed by gender. Study-related language skills were related to all expectancy–value components whereas host- and home-culture orientations were distinctly associated with attainment, intrinsic, and utility values. Implications of the results for interventions supporting the academic success of international STEM students and future research needs are discussed.

Keywords: international students; academic self-efficacy and value beliefs; (situated) expectancy–value theory (SEVT); STEM students; intersectionality; multi-group regression analyses

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1. Introduction

A comprehensive answer to the Special Issue's leading question of who is sticking with STEM requires the consideration of many aspects. For example, it is important to consider who comes to study STEM subjects at German universities and to explore these students' (psychological) prerequisites for study success that may influence who stays and who goes in due course.

An important group amongst the STEM students at German universities constitutes international students. These are foreign students who obtained their university entrance qualification outside of their study country [1,2]. In 2020, approximately 4.4 million international students were enrolled in the OECD which represents about 7% of the higher education students in these states [3]. About 369,000 international students studied at German universities, i.e., 11% of the student body [3]. Nearly 52% of the international students in Germany were enrolled in STEM subjects [4]. Hence, international students could help mitigate the shortage of skilled workers in STEM fields (e.g., in Germany; see Hoffmeyer-Zlotnik and Grote [5]). Yet, unfortunately, many international students struggle with their studies as the high dropout rates of 41% in the bachelor's and 28% in master's programs (compared to 28% and 21% among domestic students) show [6]. Against

this background, understanding the (psychological) prerequisites of international STEM students' academic success is essential.

A prominent psychological approach to explain interindividual differences in academic choices and success is the (*situated*) *expectancy–value theory* (EVT [7]; SEVT [8]). It suggests that study-related expectations and value beliefs are building blocks in explaining why some individuals succeed whilst others struggle or drop out of their studies. Yet, previous meta-analytic research showed that learners differ in their expressions of these psychological constructs by their demographic characteristics such as gender, parental academic background, cultural background, and their interplay [9]. Accordingly, a thorough assessment of individual differences in international STEM students' study-related expectations and value beliefs at the beginning of their studies in Germany is an important endeavor in order to identify student groups who might be at risk for (academic) struggles throughout the further study course.

In the present study, we addressed the manifestation of expectations and value beliefs amongst international STEM students. In doing so, we assessed how demographic (gender and parental academic background) and cultural characteristics (cultural background, study-related language skills, previous residence in Germany, and acculturation orientations), as well as the intersectional interplay (e.g., [10,11]) between gender and parental academic and cultural background, relate to these motivational constructs at the beginning of the students' degree courses in Germany. In doing so, we aim to contribute to a better understanding of the heterogeneity within the (international) student body with regard to their (psychological) prerequisites for STEM success. This may help to identify target groups for tailored interventions to prevent study dropout and, thus, shed light on the question "Sticking with STEM: Who comes, who stays, who goes, and why?".

1.1. Expectancy and Value Beliefs

The EVT [7] explains behavior and behavioral intentions using expectancy and value components which are influenced by one's own experiences, cultural norms, and the environment, e.g., family and peers [12]. The expectancies (for success) and subjective task values of individuals are postulated as the most relevant psychological predictors of task choice, performance, and effort in the chosen tasks [7]. The EVT was extended to the situated expectancy–value theory (SEVT) [8]. Eccles and Wigfield [8] described this extension as a situated and cultural view on the EVT model, pointing to the relevance of the specific situation, i.e., environmental conditions and the cultural background, for the development of expectancy and value hierarchies.

The first central factor of the EVT, expectancy, incorporates different theoretical conceptions of self-belief such as (academic) self-concepts [13,14] and self-efficacy [15,16]. For both constructs. there is evidence that they adequately represent the expectancy factor (i.e., Eccles and Wigfield [17]). In the present study, we focused on self-efficacy. Bandura [15,18] defined general self-efficacy within the social cognitive learning theory as a person's assessment of the extent to which he or she expects to be able to master tasks and challenges or to achieve goals. Self-efficacy can be understood as a generalized construct, but can also refer to specific domains, e.g., academic self-efficacy.

Academic self-efficacy describes students' beliefs that they can control and reflect their study behaviors, understand and successfully process learning material, and meet academic requirements [19]. The *Social Cognitive Career Theory* (SCCT) [20] drew on this social cognitive framework to explain three closely related aspects of education and career development: (a) development of career-relevant interests, (b) selection of study and career choices, and (c) performance and persistence in education and occupation. According to the SCCT, the development of STEM interests before the study starts, the choice of a STEM subject, and the academic success in STEM are predicted by individuals' self-efficacy beliefs in their interplay with the environment [19,20].

Pertaining to the second factor of EVT, value beliefs, four value components are differentiated: attainment value (importance of success for self-image, identification with

the subject and school in general), intrinsic value (interest and enjoyment of the task), utility value (utility for short- and long-term personal goals), and cost value (potential costs of investing time in this activity rather than another).

Both expectations and value beliefs guide individuals, their educational achievements, and related decisions both consciously and unconsciously [21–23]. Wigfield and Eccles [23] reported accumulated findings from more than 35 years of research which support these assumptions. Results from the secondary school context revealed that expectations and value beliefs, as well as their interaction, predicted (math) achievement [24,25]. Former studies corroborated that individuals are more likely to choose STEM studies if they show higher STEM-related self-efficacy and ability self-concepts [26] (for a general review, see [27]). Furthermore, positive value beliefs with regard to mathematics and science among adolescents at the beginning of high school were associated with STEM achievement, as well as STEM subject choices, not only in high school, but also 7 years later in college [28].

Yet, even if the decision to study a STEM subject has already been made, differences in STEM students' self-efficacy and value beliefs, e.g., due to their perceived minority status as a female or first-generation student, occur and should not be neglected, as they were shown to be relevant for study success [9,29,30]. For example, a study with a sample of first-year engineering undergraduates showed that higher levels of engineering self-efficacy and highly valuing engineering were related to higher engineering persistence [31].

To conclude, empirical findings corroborate the importance of expectations and value beliefs (as well as their interplay) in the prediction of academic choices and success in STEM fields and beyond. As a consequence, investigating both the level of and the interindividual differences in these constructs amongst international STEM students at the beginning of their studies is important to identify student groups who might be at risk of struggling in or dropping out of their degree programs.

1.2. Differences in Expectations and Value Beliefs by Gender and Parental Academic Background

Gender. One of the purposes of the EVT [7] is to explain gender differences in STEM-related academic attitudes and decisions such as subject choices.

Indeed, in the university context, female students remain to be underrepresented in many STEM subjects. In the US—despite differences between subjects (e.g., 19% female students in engineering-technology and computer science vs. 39% in physics)—the overall proportion of 35% female students in STEM corroborates the gender imbalance [2]. Similarly, in Germany, female students remain to be underrepresented in STEM subjects [32] with, for example, only 16% females in engineering and 21% in computer science [32,33]. We may, thus, assume that the female international STEM students in Germany represent a selective sample who chose to study STEM despite the unpopularity of these subjects amongst their same gender fellows. This may have implications with regard to gender differences in their study-related expectations and value beliefs. Yet, to the best of our knowledge, there is no systematic research on gender differences in expectations and value beliefs amongst international STEM students in Germany and beyond, although many studies addressed these issues in different stages of the educational career. For example, a meta-analysis of 187 studies by Huang [29] identified gender differences in academic self-efficacy that were moderated by subject area. Males showed higher levels of self-efficacy in mathematics, computer science, and science than females. Importantly, gender differences in academic self-efficacy also varied with age. The largest effect size occurred for respondents who were over 23 years old, which supports their importance in higher education.

A more recent meta-analysis (n = 176) revealed gender differences in all expectancy–value components but costs (mostly because there were not enough studies available) across different subject fields [9]. In particular, males showed higher levels of expectancy for success in math, science, computing, engineering, and physical sciences (small to medium effect sizes). In biological sciences, there were no gender differences in expectancy for success. With regard to the value components, the results showed higher levels of intrinsic value for males in math, science, computing, physical sciences, and engineering (medium

effect sizes), whereas females reported higher intrinsic values with regard to biological sciences. Yet, for utility and attainment value, gender differences were less obvious; males only indicated higher levels of utility value in computing. Moreover, males showed higher overall task value in computing and math, whereas girls showed higher overall task value in physical sciences (all small effect sizes). All other gender differences were negligible. With regard to the cost component, the low number of studies and effect sizes limited the results. The only substantial effect sizes were observed for physical science, where females reported higher costs (medium effect size). Overall, gender differences were weaker for general science expectancy/value than they were in more precisely defined areas of STEM (e.g., physical or biological sciences). With regard to the interaction of gender and other demographic characteristics, only one significant interaction, for gender and age (categorized into elementary school, middle school, high school, and (young) adult samples) was observed, i.e., the gender gap in expectancy for success was larger for older samples in more advanced stages of the educational career [9].

To conclude, both meta-analyses [9,29] suggested that gender differences in STEM-related expectancies and values in the favor of males are prevalent in all educational stages. Surprisingly, the findings suggest that gender differences gain importance in more advanced stages of the educational career despite potential self-selection mechanisms with regard to university subject choices. These considerations led to our investigation of the relationship between gender and expectancy–value components at the beginning of international STEM students study time abroad.

Parental academic background. Previous research on the role of the parental academic background with regard to academic decisions and success suggested that students' generational status, i.e., being a first-generation or continuous-generation student, was decisive [34,35]. Being the first in the family who is studying at a higher education institution contains several barriers with regard to academic success, e.g., due to missing role models, knowledge about the campus life, or a lack of university belonging. Several studies substantiated advantages of being a continuous-generation student with regard to the academic success of students with and without an immigrant background in Germany [36–38].

Yet, few studies considered the association between parental academic background and study-related expectancies and values. Findings from the school context by Gaspard et al. [39] showed associations of parental academic background with ability self-concept and task value (attainment) in math; high school students with at least one parent who holds an academic degree reported a higher academic self-concept and higher task (attainment) values. Former research using a sample of secondary education students in Germany showed significant correlations between socioeconomic status (which included parental academic background) and all expectancy and value components. In particular, positive associations for expectancy, attainment, intrinsic, and utility value (r = .15 to .11) and a negative one for cost value (r = −.09) were identified [40]. Accordingly, Goldman et al. [41] revealed that first-generation college students indicated higher levels of cost value and that these more strongly increased during the semester as compared to continuous-generation students.

Overall, these few findings suggest that coming from a non-academic household may have negative consequences with regard to international students' (STEM) expectations and values. Yet, further empirical research to evaluate these tentative assumptions is needed.

1.3. Expectations and Value Beliefs and Cultural Characteristics

The (S)EVT and related research postulated that cultural norms, such as individualism and collectivism, influence expectations and value beliefs [8,12,21,42,43]. Accordingly, previous studies showed that gender differences in STEM attitudes and success varied between European countries [44,45]. The authors explained these differences with references to cultural norms. Furthermore, Donohue [46] showed that cultural norms predicted the intrinsic value of undergraduate university students in the United States. Mok et al. [47] reported associations between cultural norms and the utility value of study programs amongst

a sample of international students in Germany. Hence, we deemed it was important to consider students' cultural background as an external predictor of the EVT factors and included students' countries of origin (summarized to country groups) into our analyses. Former studies also showed a strong relation between language skills and international students' study success and emphasized their importance for the academic (and social) integration (e.g., Wisniewski et al. [48]). Language skills may help students to feel more confident to succeed in the study program, thereby increasing their task enjoyment and motivation to persist. Likewise, as language skills may reduce (cultural) barriers and facilitate participation in campus life, psychological costs such as the experience of loneliness and stress may decrease. Therefore, a measure of self-perceived study-related language skills was included in the analyses to analyze potential effects of these skills on international students' expectancies and value beliefs. Previous experiences in the host country were shown to have an impact on cultural transition experiences [49,50]. In particular, previous experiences in Germany might influence expectations of students to be able to handle (academic) challenges and thereby increase their academic self-efficacy. Furthermore, knowing what to expect in Germany may reduce fear and stress during the acculturation process, thus increasing enjoyment and decreasing psychological costs. Hence, we additionally considered previous residence in Germany.

Beyond the general importance of cultural norms and differences, the EVT also emphasizes that individual differences in approaching a culture may influence the formation of expectancy and value beliefs [8,42]. In addition, acculturation theory suggests that, for international students, differences in their approaches to both their host- and their home-culture are essential. According to Berry [51], such differences are captured in individuals' acculturation attitudes, i.e., their attitudes toward and interest in the involvement with the home- and the host-culture. Importantly, home- and host-culture orientation are considered to reflect two independent constructs [51,52]. Home- and host-culture orientations correlated positively with sociocultural adaption in the school context and beyond (e.g., Berry [51]). This suggests its relevance with regard to the formation of education-related expectancies and values.

However, a recent meta-analysis by Bierwiaczonek and Kunst [53] indicated that the relationship between host- and home-culture acculturation and adaptation might be weaker and less consistent than assumed. The only relationship that was consistently maintained even in longitudinal designs was the positive association between host-culture orientation and sociocultural adaptation. Yet, the authors concluded that the heterogeneity and instability of effects might be due to the heterogeneity in samples, e.g., with regard to the duration of their stay abroad. For example, it could be that acculturation orientations are more relevant regarding the sociocultural adaptation in the early stages of migration (e.g., at the beginning of a study program abroad) and become less relevant at later stages. The authors, thus, called for further studies on the relationship between acculturation orientations and sociocultural outcomes which—in the present case—are captured by students' study-related expectancies and values [53]. In line with previous findings, we speculated that a higher host-culture orientation could probably serve as a kind of resource during the adaption process and reduce the perceived costs of studying abroad during the adaption of international students in Germany.

1.4. Intersectionality

Intersectionality is defined as the interaction of multiple characteristics on diverse dimensions, which could build the base for discrimination or the experience of disadvantages [54,55]. Hence, the effects of these dimensions are developed in interaction/intersection, not just added up [10,11]. Results of studies in the US revealed that the confluence of multiple minority status-generating characteristics (e.g., gender, ethnicity, and parental academic background) conditioned lower levels of academic achievement in the school and higher education sector [56,57]. Most current studies on the interaction of gender, educational background, and ethnic/cultural background characteristics were

conducted in the US. Most studies based on European data primarily examine the school sector [44,45]. With regard to higher education in Germany, intersectionality has mainly been considered at a descriptive level [38].

This unequal distribution of intersectional research between the US and Europe was also noted by Parker et al. [9]. Their meta-analysis provides the most comprehensive research work to date that considered an intersectional perspective on students' expectancy and value beliefs in different academic domains. Parker et al. [9] pointed out that gender influences the expectancy–value components not only alone, but also in interaction with multiple characteristics. In particular, their analysis revealed interactions of gender and social class (operationalized by socioeconomic status) in the math domain for expectancy, intrinsic value, and (by trend) for utility value. In all cases, the gender effect sizes were highest in high-socioeconomic status samples. Similar patterns were found for science expectancy. Yet, in view of the limited data on these interactions, the results need to be interpreted with caution and require further research.

Beyond these meta-analytic findings, a study that considered samples from 65 universities in the US revealed that female first-generation students reported significantly lower levels of self-efficacy than female continuous-generation students and male students, regardless of their academic family background [58]. In contrast, Else-Quest et al. [59] reported that, although gender gaps in self-beliefs and value beliefs in science and math slightly varied among Latin, Asian American, and Caucasian 10th grade high school students in the US, these differences tended not to be statistically significant. Seo et al. [60] used a similar but nationally representative sample of US 10th graders and showed that male adolescents' math self-concept was more positive than females among Whites and Latinxs but not among Blacks and Asians.

Given the heterogeneity and small number of previous findings, the current research considered intersectional effects between gender and students' academic and cultural background from an intersectional perspective to allow for a more specific consideration of potential disadvantage and dropout risks of specific student groups.

2. Purposes of the Present Study

The (S)EVT and previous findings emphasize that expectancy and value beliefs are important determinants of academic success [21–23]. However, to the best of our knowledge, there are no studies that specifically addressed expectations and value beliefs of international STEM students. In order to close this research gap, we examined how gender, parental academic background, and cultural characteristics (i.e., cultural background, study-related language skills, previous residence in Germany, and acculturation orientations) are related to the academic self-efficacy and value beliefs of a large sample of international STEM students. Moreover, despite our focus on students in STEM subjects, the design allows us to compare the pattern of results between STEM and non-STEM subjects; we can, thus, infer if any findings are indeed specific to the situation of international students in STEM or reflect a more general pattern.

On the basis of previous findings, we formulated the hypotheses below.

2.1. Relations with Gender

H1a. *Female international STEM students show lower levels of academic self-efficacy than male international STEM students.*

H1b. *Female international STEM students show higher levels of cost value than male international STEM students, but lower levels of intrinsic, attainment and utility values.*

2.2. Relations with Parental Academic Background

H2a. *International STEM students who are first-generation students report lower levels of academic self-efficacy than international STEM students who are continuous-generation students.*

H2b. *International STEM students who are first-generation students report higher levels of costs than international STEM students who are continuous-generation students. We did not assume differences in intrinsic, attainment and utility values, but assessed these for explorative reasons.*

2.3. Interactions of Gender and Parental Academic Background

H3a. *Female international STEM students who are first-generation students report lower levels of academic self-efficacy than female international STEM students who are continuous-generation students and than male STEM students.*

H3b. *Female international STEM students who are first-generation students report higher levels of cost values than female international STEM students are continuous-generation students and than male international STEM students.*

No interaction effects between gender and parental academic background were expected for intrinsic, attainment, and utility values, yet we assessed these for explorative reasons. We further pursued some exploratory questions on the associations of cultural background and its interaction with gender, as well as acculturation orientations. In particular, we assessed if academic self-efficacy and value beliefs of international STEM students differed by country groups and if these associations were moderated by students' gender.

Additionally, we examined how study-related language skills, previous stays in Germany, host-culture orientation, and home-culture orientation were related to academic self-efficacy and value beliefs of international STEM students.

In order to address these questions, we used data on bachelor students from a large and diverse panel sample of international students in Germany that provided information from students of different cultural and parental academic backgrounds, studying all over Germany in an extensive range of subject groups and at different higher education institutions. Notably, this dataset provided us with the great advantage of a large control group of international non-STEM students.

3. Method

3.1. Sample

The data come from the first wave of the 3 year German panel study on international students (*International Student Survey* [61]), which was conducted in the interdisciplinary research project *Academic Success and Withdrawal Among International Students in Germany in Bachelor's and Master's Programs (SeSaBa)*. The online survey (presented in German and English language) addressed international students, i.e., students who held a foreign citizenship and obtained their university entrance qualification outside of Germany or at a preparatory college (German: *Studienkolleg*) [1]. Further inclusion criteria were that international students had to study in the first semester of a bachelor's or master's degree program in winter term 2017/2018 and intended to obtain their degree in Germany [61]. The participants registered for the study by answering a short questionnaire (t0) to confirm they content the inclusion criteria. They also received information on data protection standards provided their informed consent here and at the beginning of each questionnaire. The first wave took place at the end of the first semester between January and April 2018.

The analysis sample included data from 1590 international bachelor students (n_{STEM} = 882, $n_{\text{non-STEM}}$ = 708). They were studying at 123 universities (with the exception of music and art universities [61]) in all 16 federal states of Germany and in 34 subject groups. The participants came from 120 different countries. The largest group was from Syria (8.6%, n = 136), followed by China (6.5%, n = 104), Russia (5.6%, n = 89), Luxembourg (4.0%, n = 63), Bulgaria (3.8%, n = 60), and the United States and Ukraine (each 3.7%, n = 59). At t1, their mean age was 23.5 years (SD = 4.25); 48.3% (n = 768) were female and 457 (32.7%) were first-generation students. Further information on the demographic characteristics of the sample is shown in Table 1.

Table 1. Descriptive statistics of sample characteristics and control variables.

Variables	STEM		Non-STEM	
Mean age in years (*SD*)	22.95	(3.58)	24.18	(4.87)
Female (%)	283	(32.1%)	485	(68.5%)
Parental academic background (continuous-generation students) (%)	542	(67.2%)	445	(67.4%)
Country groups (%)				
Western Europe (Reference category)	95	(10.8%)	148	(20.9%)
Central and South Eastern Europe	117	(13.3%)	116	(16.4%)
Eastern Europe and Central Asia	74	(8.4%)	133	(18.8%)
North America	21	(2.4%)	43	(6.1%)
Latin America	67	(7.6%)	53	(7.5%)
North Africa and Middle East	269	(30.5%)	62	(8.8%)
Sub-Saharan Africa	45	(5.1%)	33	(4.7%)
Asia and Pacific	194	(22.0%)	120	(16.9%)
Previous residence in Germany (yes) (%)	253	(29.1%)	300	(43.0%)

Note. $N = 1590$, $n_{\text{STEM}} = 882$, $n_{\text{non-STEM}} = 708$ (in the descriptive statistics, listwise deletion was used).

3.2. Instruments and Scales

Academic self-efficacy. Academic self-efficacy was measured using a three-item short scale on general self-efficacy expectations (ASKU) [62] that participants were instructed to answer with regard to their studies. An example item is "In difficult situations, I can rely on my abilities.". The participants indicated their level of agreement on a five-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale revealed a high internal consistency [63] with $\alpha = .78$.

Study-related value beliefs. Intrinsic value was measured with two items from a scale by Westermann et al. [64] (German translation by Heise and Thies [65]). A sample item was "I find my studies really interesting." ($\rho = .73$). The study-related attainment value, utility value, and costs were measured with items based on Gaspard et al. [66]. There were two items each on attainment value (e.g., "My studies are very important to me personally."; the Spearman–Brown reliability coefficient was $\rho = .69$), utility value (e.g., "My studies will positively influence my future."; $\rho = .72$), and costs (e.g., "I have to make many personal sacrifices for my studies."; $\rho = .57$). Students indicated their level of agreement using a five-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

STEM versus non-STEM-subjects. The categorization of the study subject groups into STEM and non-STEM subjects was based on the specification of the Federal Statistical Office of Germany for the winter semester 2017/2018 [32] and the statistics of the Federal Employment Agency [33]. In this categorization, for example, human medicine and health science, agricultural science, forestry, nutritional science and veterinary medicine, business engineering specializing in economics, and social science were considered as non-STEM subjects, whereas, e.g., pharmacy, business engineering specializing in engineering sciences, architecture, interior design, and spatial planning were considered as STEM subjects, in addition to the more familiar STEM subjects [32,33].

Gender. Participants specified their gender using the categories 0 = *male*, 1 = *female*, and 2 = *diverse*. Because of the small number of students who chose the category "diverse" (< 0.1%) it was not possible to separately analyze this gender category. As a consequence, participants who indicated their gender as "diverse" ($n = 6$) were omitted from the sample.

Parental academic background. Students were categorized as first-generation students if they reported that *none* of their parents held a bachelor's, master's, or doctorate degree; otherwise, they were categorized as continuous-generation students (0 = *first-generation students*, 1 = *continuous-generation students*).

Cultural background. We operationalized the participants' cultural background by the country of students' university entrance qualification. These countries were categorized into eight regions according to the German Academic Exchange Service's (DAAD) regional coding system [4,67], i.e., Western Europe (which served as the reference category), Central

and South Eastern Europe, Eastern Europe and Central Asia, North America, Latin America, North Africa and Middle East, Sub-Saharan Africa, and Asia-Pacific.

Study-related language skills. The participants indicated their study-related language skills by answering the self-formulated item "My language skills are sufficient to cope with my academic studies." on a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

Previous residence in Germany. Students responded to the question "Before your current stay in Germany, had you ever lived in Germany for at least 1 month?" with 0 = *no* or 1 = *yes* to provide information about a potential previous residence in Germany.

Acculturation orientations. Host-culture orientation (α = .81) and home-culture orientation (α = .81) were measured with four items each that were adapted from Demes and Geeraert [68]. The participants rated the statements on a five-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Sample items were "It is important to me to have friends from my country of origin." for the home-culture orientation and "It is important to me to get to know and maintain German customs and traditions." for the host-culture orientation.

Age. Participants age at the first measurement was calculated from their year of birth.

3.3. Analytical Strategy

All analyses were calculated with IBM SPSS Statistics version 28 [69] and Mplus Version 7 [70]. Missing data were handled with the full information maximum likelihood (FIML) method as implemented in Mplus although missing rates of all constructs were very low (< 1%). Preliminary analyses confirmed that all conditions for linear regression analyses were met. To assess potential dependencies in the data due to the clustering of participants in country groups, we first inspected intraclass correlations (ICC's). Yet, all ICCs were low (< .01) which suggests that the independence of observations can be assumed. Thus, multi-group regression analyses were performed to evaluate significant differences between STEM and non-STEM subjects. All continuous predictors were grand-mean-centered as part of the analyses. In a first step, the predictor variables were inserted, and a Wald-test was run to test the appropriateness of equality constraints between the subject groups. According to non-significant Wald-tests (at $p > .05$), the respective model paths were restricted to be equal. In the next step, the interaction terms (interactions between gender and parental academic background and between gender and the country groups) were inserted, and it was tested if these paths could be equated across subject groups. If the interaction terms did not yield statistical significance in both subject groups, they were removed from the model. In the last step, the intercepts were tested and set equal if the Wald-test was not significant. In all analyses, effects of age were controlled.

3.4. Power Analyses

A post-hoc power analyses using G*Power Version 3.1.9.7 [71,72] revealed that, with a significance level of α = .05 and N = 1590, even small (interaction) effects of (f^2 = .02) could be detected with a probability of $1 - \beta$ = .96. Accordingly, a target power of at least .80 according to Cohen [73] was achieved.

4. Results

4.1. Descriptive Analyses

The international students showed high means of academic self-efficacy and all value components (see Table 2). Despite slightly different means, the overall pattern was the same in both subject groups. The highest values were observed for attainment value, intrinsic value, and utility value, which all clearly exceeded the scale mean of three. The means of academic self-efficacy and cost value were lower, but also exceeded the scale means. T-Tests revealed significant difference between STEM and non-STEM students in academic self-efficacy whilst all other differences were negligible (see Table 2). The bivariate correlations between the study variables in the STEM and non-STEM sample are

presented in Table 3. Overall, the correlation pattern was similar in both subject groups and yielded small to moderate sizes associations.

Table 2. Descriptive statistics of main scale study variables.

Variables	STEM		Non-STEM		*t*-Tests		
	M	*SD*	*M*	*SD*	*t(df)*	*p*	*d*
Study-related language skills	3.98	0.92	4.03	0.96	0.96(1561)	.335	.05
Home-culture orientation	2.92	0.90	3.00	0.90	1.64(1518)	.102	.08
Host-culture orientation	3.51	0.84	3.54	0.78	0.68(1519)	.498	.04
Dependent variables							
Academic self-efficacy	3.71	0.71	3.81	0.69	2.72(1553)	.007	.14
Value beliefs							
Attainment value	4.49	0.68	4.48	0.60	−0.33(1559)	.745	−.02
Intrinsic value	3.99	0.82	4.06	0.80	1.78(1559)	.075	.09
Utility value	4.53	0.67	4.51	0.61	−0.53(1559)	.598	−.03
Cost value	3.45	0.89	3.39	0.91	−1.30(1559)	.193	−.07

Note. n_{STEM} = 882, $n_{non\text{-}STEM}$ = 708 (in the descriptive statistics, listwise deletion was used).

4.2. Multi-Group Analyses

All models explained substantial variance in academic self-efficacy (12% STEM; 15% non-STEM), attainment value (8% STEM; 11% non-STEM), intrinsic value (12% both subject groups), utility value (8% STEM; 12% non-STEM), and cost (7% STEM; 9% non-STEM). Overall, the multi-group analyses yielded very few differences between STEM- and non-STEM students (Table 4). That is, most of the reported results represent generalized patterns that apply to international students in STEM subjects and beyond. As a consequence, the below description of results is focused on the results for the STEM sample; findings from the comparison group of non-STEM students are only considered in cases of significant differences between the subject groups. In line with the results from the t-tests, differences in the adjusted intercepts were only identified for academic self-efficacy (adjusted $M = 3.55$, $SE = 0.11$, $p < .001$ for STEM students; $M = 3.63$, $SE = 0.12$, $p < .001$ for non-STEM; Wald $\chi^2 = 5.83$, $p = .016$). All other Wald-tests on the adjusted intercepts—for attainment ($M = 4.43$, $SE = 0.07$), intrinsic ($M = 4.13$, $SE = 0.06$), utility ($M = 4.48$, $SE = 0.07$), and cost value ($M = 3.12$, $SE = 0.07$)—did not yield significance (all p-values > .136).

Contrary to our assumptions, we did not find associations between gender and any expectancy or value components (Table 4). That is, the hypotheses H1a and H1b had to be rejected.

Parental academic background showed a significant association with academic self-efficacy ($b = .08$, $SE = .04$, $\beta = .12$, $p = .027$) which implies that, in line with hypothesis 2a, continuous-generation STEM students showed higher levels of academic self-efficacy than first-generation STEM students.

Parental academic background showed no statistical significance in relation with cost value. Hence, hypothesis 2b was not supported.

Contrary to our assumptions, no significant interaction of parental academic background and gender in relation with academic self-efficacy (H3a) and cost values (H3b) could be identified which implies the rejection of both hypotheses.

Table 3. Correlations between the study variables.

Correlations	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. Academic self-efficacy	-	.15 **	.30 **	.20 **	−.10 **	.39 **	.00	.01	.07	.03	.05	.15 **	−.02	−.06	−.04	−.17 **	.01	.02	.04
Value beliefs																			
2. Attainment value	.21 **	-	.36 **	.49 **	.10 **	.11 **	.07	−.01	−.09 *	.04	.00	−.17 **	.08 *	.05	.11 **	−.02	.04	−.02	.19 **
3. Intrinsic value	.34 **	.40 **	-	.30 **	−.22 **	.31 **	−.01	.06	−.05	−.01	.01	−.01	.03	.04	.04	−.17 **	.01	−.07	.10 *
4. Utility value	.21 **	.62 **	.38 **	-	.08 *	.16 **	.07	.01	−.00	.09 *	.10 **	−.13 **	.12 **	.07	.02	−.15 **	.10 *	−.04	.18 **
5. Cost value	−.07 *	.21 **	−.11 **	.17 **	-	−.22 **	−.01	.14 **	−.02	.03	−.00	.12 **	.03	.08 *	.02	.06	.03	.07	.13 **
6. Study-related language skills	.27 **	.11 **	.27 **	.13 **	−.15 **	-	−.05	−.11 **	.01	.08 *	.02	−.00	−.03	−.11 **	.06	−.41 **	.04	.01	−.02
7. Previous residence Germany	.00	−.06	−.05	−.03	.02	−.04	-	.12 **	−.01	.02	.21 **	−.07	.16 **	−.14 **	−.03	−.06	.12 **	−.13 **	.02
8. Age	−.04	.01	.01	−.05	.06	−.07	.08 *	-	−.12 **	−.15 **	.08 *	.15 **	.06	.14 **	.09 *	.02	−.03	−.07	.03
9. Parental academic background	.07 *	.02	.07	−.00	.03	.02	.08 *	−.24 **	-	−.05	.12 **	.14 **	.11 **	−.05	.01	−.06	−.08	.04	.02
Country groups																			
10. Central and South Eastern Europe	.05	−.06	.04	.04	.00	.09 **	.08 *	−.22 **	.01	-	−.21 **	−.11 **	−.13 **	−.14 **	−.01 **	−.20 **	.05	−.06	−.01
11. Eastern Europe and Central Asia	.04	.00	.04	.09 *	−.04	.07 *	.22 **	.03	.11 **	−.12 **	-	−.12 **	−.14 **	−.15 **	−.11 **	−.22 **	.16 **	−.08 *	.02
12. North America	.04	−.09 *	−.04	−.11 *	.04	.02	.02	.13 **	.06	−.06	−.05	-	−.07	−.08 *	−.06	−.12 **	−.02	.13 **	.08 *
13. Latin America	.07	.03	.05	.07 *	.10 **	.04	.13 **	.01	.11 **	−.11 **	−.09 **	−.05	-	−.09 *	−.06	−.13 **	−.03	−.02	.12 *
14. North Africa and Middle East	−.04	.12 **	−.10 **	.03	.07	−.10 **	−.15 **	.21 **	−.07 *	−.26 **	−.20 **	−.10 **	−.19 **	-	−.07	−.14 **	−.25 **	−.07	−.03
15. Sub-Sahara Africa	−.03	.13 **	.08 *	.12 **	.00	.04	−.12 **	.07	−.08 *	−.09 **	−.07 *	−.04	−.07 *	−.15 **	-	−.10 **	−.02	−.03	−.00
16. Asia and Pacific	−.07	−.09 *	−.09 **	−.18 **	−.05	−.26 **	−.02	−.01	−.01	−.21 **	−.16 **	−.08 *	−.15 **	−.35 **	−.12 **	-	−.00	.06	.03
17. Gender	−.04	−.03	−.00	.07 *	.00	.02	.07 *	−.03	.07 *	.08 *	.17 **	.00	.05	−.21 **	−.02	.04	-	−.01	−.01
18. Home-culture orientation	−.05	−.04	−.06	−.05	−.00	−.03	−.11 **	−.20 **	.07	−.04	−.11 **	.04	−.03	−.06	−.00	.12 **	−.02	-	.16 **
19. Host-culture orientation	.03	.12 **	.14 **	.09 *	.01	−.02	.01	.05	−.03	−.10 **	.03	.06	.05	.03	−.04	.04	.03	.08 *	-

Note. Correlations for the non-STEM group are above the diagonal. Correlations for the STEM group are below the diagonal. For categorial variables, Spearman's rho is presented. n_{STEM} = 882, $n_{non\text{-}STEM}$ = 708. Listwise deletion was used. Country groups: Reference category, Western Europe. ** Correlation is significant at the level of $p < .01$. * Correlation is significant at the level of $p < .05$.

Table 4. Results of the multi-group models for STEM students.

Predictors	Academic Self-Efficacy			Attainment Value			Intrinsic Value			Utility Values			Cost Value		
Final Model	***b***	***SE***	***p***	***b***	***SE***	***p***	***b***	***SE***	***p***	***b***	***SE***	***p***	***b***	***SE***	***p***
Age	.00	.00	.468	−.00	.00	.830	.01	.01	.013	−.00	.00	.566	.01	.01	.017
Previous residence in Germany	−.02	.04	.634	.02	.04	.501	−.05	.05	.271	−.03	.04	.480	−.00	.05	.971
Study-related language skills	.27	.02	< .001	.09	.02	< .001	.23	.02	< .001	.08	.02	< .001	−.17	.03	< .001
Country groups[a]															
Central and South Eastern Europe	.14	.06	.027	−.13	.09	.160	−.11	.07	.147	.08	.09	.348	.35	.08	< .001
Eastern Europe and Central Asia	.10	.07	.122	.06	.11	.557	−.10	.08	.222	.17	.11	.110	.24	.09	.007
North America	.30	.10	.002	−.63	.13	< .001	−.25	.11	.027	−.61	.13	< .001	.56	.13	< .001
Latin America	.12	.08	.137	.05	.10	.606	−.05	.09	.561	.15	.10	.143	.50	.10	< .001
North Africa and Middle East	.06	.06	.335	.17	.08	.024	−.21	.07	.004	.11	.07	.135	.39	.08	< .001
Sub-Saharan Africa	−.03	.09	.759	.41	.12	< .001	.05	.11	.666	.21	.12	.063	.33	.12	.006
Asia and Pacific	.12	.06	.073	.11	.08	.194	−.15	.07	.047	−.09	.08	.292	.17	.09	.045
Gender	−.05	.04	.160	−.04	.09	.625	−.01	.04	.829	−.06	.09	.529	.05	.05	.303
Parental academic background	.08	.04	.027	−.04	.05	.459	.06	.04	.180	−.04	.05	.434	.00	.05	.998
Home-culture orientation	−.02	.02	.439	−.02	.02	.393	−.07	.02	.002	−.02	.02	.333	.05	.03	.055
Host-culture orientation	.03	.02	.151	.12	.02	< .001	.14	.03	< .001	.10	.02	< .001	.04	.03	.169
Gender × parental academic background				−.01	.07	.873				.03	.07	.618			
Central and South Eastern Europe × gender				.34	.12	.003				.19	.12	.096			
Eastern Europe and Central Asia × gender				.09	.13	.475				.11	.13	.400			
North America × gender				.47	.17	.006				.60	.17	< .001			
Latin America × gender				.26	.14	.066				.25	.14	.072			
North Africa and Middle East × gender				−.00	.12	.987				.11	.12	.347			
Sub-Saharan Africa × gender				−.14	.17	.397				.05	.17	.746			
Asia-Pacific × gender				.00	.11	.999				.12	.11	.263			

Note. n_{STEM} = 803. [a] Country groups used Western Europe as the reference category. The final model of each dependent variable is presented here.

With regard to cultural background, some country groups yielded statistically significant associations with academic self-efficacy: students from Central and South Eastern Europe (b = .14, SE = .06, β = .37, p = .027) and North America (b = .30, SE = .10, β = .41, p = .002) showed higher levels of study-related self-efficacy as compared to the reference group Western Europe. Beyond this, students' cultural background played a role with regard to all investigated value outcomes, with most associations being substantiated between cultural background and cost value, as presented in Table 4. In particular, students from all other country groups indicated higher cost value than their fellows from Western Europe (β's ranged from .19 to .63). Furthermore, students from North America (b = −.25, SE = .11, β = −.31, p = .027), from North Africa and Middle East (b = −.21, SE = .07, β = −.26, p = .004), and from Asia-Pacific (b = −.15, SE = .07, β = −.18, p = .047) showed lower levels of intrinsic value in comparison to the students from Western Europe.

No significant interactions of country groups and gender in relation with academic self-efficacy could be observed. Yet, some instances of interactions between country groups and gender were detected for attainment and utility value (Figures 1 and 2, Table 4), pointing toward differences between male and female students that only occurred amongst students from these country groups. In particular, female students from Central and South Eastern Europe (b = .34, SE = .12, β = .58, p = .003) and North America (b = .47, SE = .17, β = .80, p = .006) reported higher attainment values than their male fellows. The same applied to female students from North America with regard to their perceptions of utility values (b = .60, SE = .17, β = .92, p < .001). Regarding cost and intrinsic value, no intersections of country groups and gender showed statistical significance (all p-values > .060).

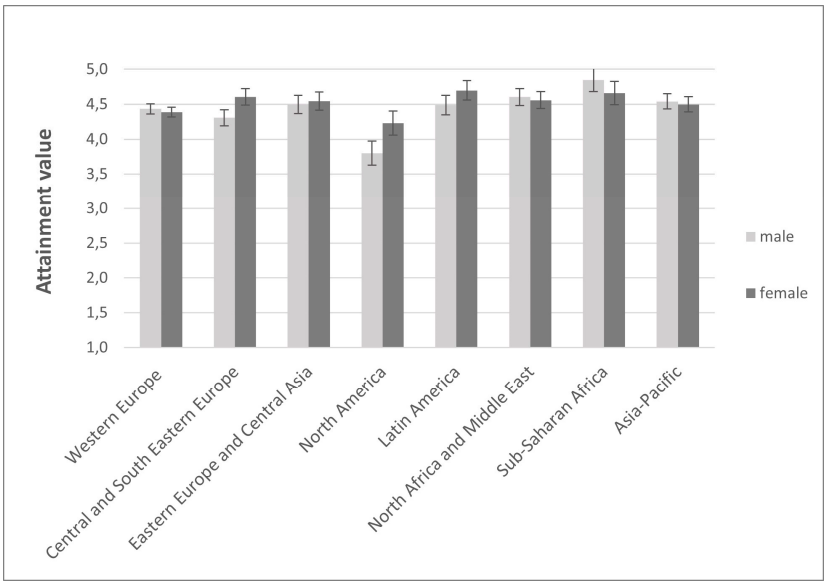

Figure 1. The interaction of country groups and gender in the prediction of attainment value. n_{STEM} = 803. Error bars represent the standard errors. Reference category: Western Europe.

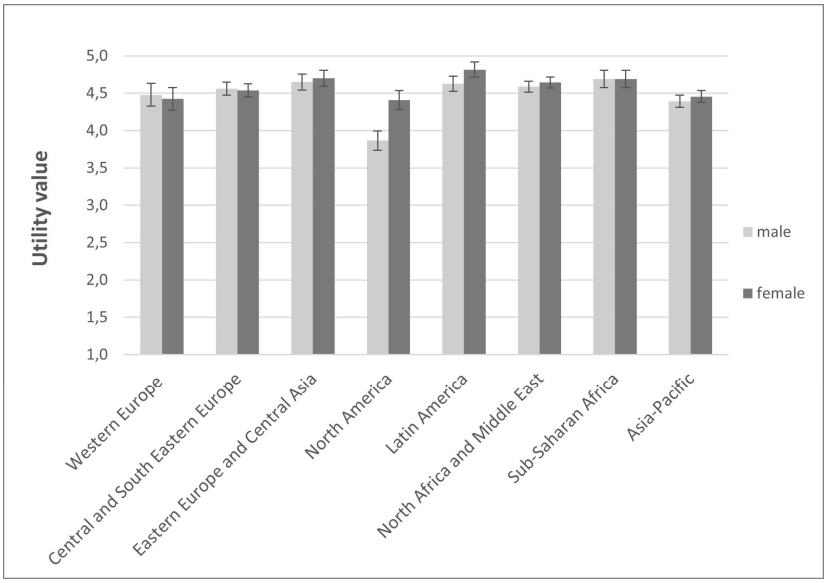

Figure 2. The interaction of country groups and gender in the prediction of utility value. n_{STEM} = 803. Error bars represent the standard errors. Reference category: Western Europe.

Study-related language skills showed a positive significant relation with academic self-efficacy (b = .27, SE = .02, β = .34, p < .001), attainment value (b = .09, SE = .02, β = .12, p < .001), intrinsic value (b = .23, SE = .02, β = .26, p < .001), and utility value (b = .08, SE = .02, β = .11, p < .001), whereas a negative association with cost value (b = −.17, SE = .03, β = −.17, p < .001) could be identified. By contrast, previous residence in Germany showed no significant association with the dependent variables (all p-values > .270).

Moreover, acculturation orientations showed no significant relation with academic self-efficacy. However, acculturation orientations were positively related with attainment value (b = .12, SE = .02, β = .15, p < .001), intrinsic value (b = .14, SE = .03, β = .15, p < .001), and utility value (b = .10, SE = .02, β = .13, p < .001), i.e., a higher host-culture orientation was associated with higher levels in the three value components, whereas a higher home-culture orientation was only related to lower levels of intrinsic value (b = −.07, SE = .02, β = −0.08, p = .002).

With regard to age, a small positive relation with intrinsic value (b = .01, SE = .01, β = .06, p = .013), as well as cost (b = .01, SE = .01, β = .05, p = .017), showed statistical significance.

5. Discussion

Despite increasing numbers of international students in OECD countries such as Germany [3,67,74], little is known about their (psychological) prerequisites for study success. Given the relevance of expectations and value beliefs for a successful completion of the academic track [21–23], we explored their manifestation amongst international STEM students in Germany and investigated if former findings on differences in these variables by gender, parental academic background, and cultural background that were identified amongst school students or in US student samples were transferable to our sample. Beyond this, we also investigated associations with study-related language skills, previous residence in Germany, and the international students' acculturation orientations. To support our findings, we compared the associations between STEM and a non-STEM comparison group as a kind of robustness check and to explore potential differences between subject groups.

In general, the international students showed high levels of expectations and value beliefs. Yet, only the means of academic self-efficacy differed significantly between the subject groups, i.e., international STEM students showed significantly lower levels of academic self-efficacy than international non-STEM students. All other results (regression paths in the multi-group model, unadjusted and adjusted means) did not significantly differ between the subject groups. Against our expectations, there were no direct associations between gender and the expectancy–value components. Yet, the parental academic background was related to academic self-efficacy as continuous-generation students showed higher academic self-efficacy than first-generation students. By contrast, the relation between parental academic background and cost value was not significant, and there were no interactions between gender and parental academic background.

Furthermore, significant associations between cultural background and all expectancy–value components were identified, most of them referring to cost. In some cases, the associations differed by gender. Study-related language skills were positively related to academic self-efficacy and attainment, intrinsic, and utility value but negatively to costs. By contrast, no significant associations between previous residence in Germany and the outcome variables were substantiated. With regard to the acculturation orientations, host-culture orientation was positively related with attainment value, intrinsic value, and utility value, whereas home-culture orientation was negatively associated with intrinsic value. Below, we discuss the outlined results in more detail.

5.1. High Levels of Expectations and Value Beliefs Amongst International STEM Students

With regard to the manifestation of expectancies and values amongst international students, the analyses revealed high levels of all expectancy and value components. That is, at the beginning of their studies, international students in Germany seemed to be quite optimistic about their potential to meet the requirements of their degree courses and value their studies for several reasons, such as intrinsic joy, personal importance, and utility for their future. Yet, despite the rather high levels of academic self-efficacy being rather high, comparisons between the subject groups revealed that international STEM students scored lower than their fellows in non-STEM subjects. This applied to both the unadjusted means (that were compared via t-tests) and the intercepts in the final multi-group regression model that included all main predictors and, thus, controlled for potential differences between the subject groups in these variables. These results were in line with the findings by Lee et al. [75] who reported similar differences between the subject groups. This might be reasoned in the high reputation of STEM subjects as being particularly demanding and prestigious, which might decrease students' expectations to be able to master the upcoming academic challenges [76,77]. Furthermore, the international students also reported high levels of costs, i.e., they feel that their studies in Germany require great personal sacrifices and cause many worries. Interestingly, in opposition to the common finding that higher

intrinsic, attainment, and utility values are accompanied by reduced costs [78], attainment and utility values were positively correlated with costs in the present sample. That is, international students who indicated that their studies are very important and useful to them also experienced substantial strain. This pattern might be specific to international students who have to master additional challenges beyond the academic context such as the cultural transition. It might also reflect an incident of introjected regulation, i.e., motivation from partially internalized values such as seeking approval and protecting the ego [79]. In the present case, the students' high levels of attainment and utility values might be influenced by the values and expectations of significant others. As a consequence, the students do not benefit from these elevating motivations but still suffer from increased costs. In the future, person-centered analyses that investigate if there are distinct motivational profiles amongst international (STEM) students and how these are linked to values and expectations of significant others might help to better understand the observed pattern. Furthermore, future research may also investigate the development of the expectancy and value components over the study course and how they interact in the prediction of study outcomes. Maybe the high costs decrease the positive effects of the other value components. This may provide further insights into the question why so many international students are dropping out of their degree courses [6] despite their rather high levels of self-efficacy, as well as intrinsic, attainment, and utility values at the beginning of their studies.

5.2. Differences in Expectations and Value Beliefs by Gender and Parental Academic Background

Against our expectations, no direct associations between gender and any expectancy or value components could be found. This points to an important difference between previous findings from school and general student samples where females revealed less favorable STEM expectations and value beliefs than males [9,29]. This pattern might be reasoned in the sample selectivity of international degree-seeking STEM students in Germany. International students have already accomplished several challenges before starting their studies abroad (e.g., getting visa and study permissions, dealing with expectations and potential stereotypes of family, teachers and peers [80], and obtaining all relevant (language) qualifications). They decided for a STEM degree abroad despite potential (gender) stereotypes and possible cultural barriers [22,25,28,80,81]. Hence, this sample can be assumed to be highly selective (which is corroborated by the high levels of expectancies and value beliefs). In this highly selective sample, gender might not play the same role as in general student samples. Yet, further longitudinal studies are needed to investigate if gender differences may unfold during later stages of the study programs.

Consistent with our hypothesis, continuous-generation students indicated higher levels of academic self-efficacy; that is, they were more optimistic to fulfil all necessary study requirements than their first-generation fellows. This is in line with the results of Wille et al. [25], who identified a significant positive correlation between socioeconomic status and math expectancy in a school sample. One explanation could be that parents with an academic background may be able to provide more (financial) support and helpful role models to their children. On the one hand, this may let them feel that their parents trust in their persistence and that they fit into their study environment. On the other hand, the parents' potential to provide financial support may reduce their fear of having to drop out of their studies due to a lack of financial means. Contrary to our hypotheses, no significant relations between parental academic background costs could be identified. Hence, our results did not support the findings of Goldman et al. [41], Meyer et al. [40], and Wille et al. [25] who showed that first-generation college students indicated higher levels of costs as compared to continuous-generation students, and that this effect even increased across the semester [41].

Lastly, and also contrary to our hypotheses, no interactions of parental academic background and gender in the prediction of academic self-efficacy and cost values yielded significance. That is, earlier findings which showed that female first-generation students are particularly disadvantaged in terms of lower self-efficacy [58] and increased cost

value [9,82] could not be substantiated for international STEM students. Although the present findings may be interpreted as good news as (female) first-generation international STEM students do not seem to be more challenged by their studies than their fellows from academic households, further research may investigate the persistence of this pattern over the study course.

5.3. Differences in Expectations and Value Beliefs by Cultural Characteristics

The results of this study also indicate that students' cultural background played a role with regard to all investigated outcomes, with most effects being identified for costs. Beyond the rather high mean levels, substantial differences between the country groups were substantiated as students from all country groups indicated higher cost values than their fellows from the reference category Western Europe. One explanation could be that coping with cultural distance is a relevant factor. Students from more culturally distant countries may experience greater challenges [83,84] which makes them experience higher study costs. Yet, the relations between costs and further factors of adaptation abroad poses an important question that could be addressed in future explorational research. In particular, with regard to the (psychosocial) counselling of international students, it might be helpful to further explore if international students who perceive higher costs are more likely to suffer from burnout or reduced psychological wellbeing.

Some further associations between single country groups and expectancy and value components were observed, as well as some interactions between country groups and gender. The latter corroborate the findings of previous studies which suggested heterogeneous associations between gender and expectancy–value components in different ethnic groups in the US [59,85–87]. Overall, our results on cultural differences and their interplay with gender in the prediction of expectancy–value components enhance the knowledge on these contingencies amongst international students in Germany. Yet, in order to validate these findings and to explore the mechanisms that account for the observed effects, further research that more closely considers (cultural) differences between and within these country groups is deemed essential.

A previous residence in Germany showed no significant association with expectations and value beliefs. This might be reasoned in the rather unspecific measure that did not distinguish between different types of previous residence (e.g., holidays, school exchange, and family stay abroad) and the duration of these stays. Further research may thus benefit from considering such information. Contrary, study-related language skills were positively related with academic self-efficacy, attainment values, intrinsic value, and utility value, but negatively with cost value. This corroborates the importance of language skills with regard to academic success and its (psychological) prerequisites [48,88]. Further research might differentiate between skills in study program language (as assessed in our study) and host country language (which are not necessarily the same as, for example, students may be enrolled degree courses that are taught in English at German universities) and consider more extensive and objective measures of language competencies such as test scores.

Lastly, the analyses showed that acculturation orientations were not significantly related with academic self-efficacy, but were associated with attainment, intrinsic, and utility values; that is, a higher host-culture orientation was associated with higher levels in all three value components whereas a higher home-culture orientation was related to lower levels of the intrinsic component. These results partly support evidence from Berry [51] who pointed to the positive associations of host-culture orientations with adjustment and productive adaption in the school context and beyond. They are also in line with findings from a meta-analysis by Bierwiaczonek and Kunst [53], which suggested that the host-culture orientation was particularly relevant in the early stages of migration. Yet, whilst a higher host-culture orientation was approved as a valuable resource for international students, the results on the home-culture orientation showed a contrary pattern as a higher home-culture orientation was related to lower intrinsic value. That is, students who are very engaged with their home-culture seem to be less prone to enjoy their studies abroad.

5.4. Implications for Practice

Of course, it is important to mention that all reported results reflect small effect sizes. Yet, even small effect sizes matter, because these small effects may influence the whole academic career and, thus, gain practical relevance. Against this background, some practical implications that may be inferred from the present results are considered.

In line with former research, international first-generation students showed lower levels of self-efficacy than continuous-generation students in both subject groups. That implies that interventions promoting academic self-efficacy should particularly consider the encouragement of international first-generation students, e.g., by directly addressing them with teaser-texts such as "You are the first in the family who studies (abroad)? Meet others and find information regarding. . .".

One further important finding with regard to practical implications was the overall high levels of perceived costs amongst the international students that were increased for students from countries outside of Western Europe. These findings suggest that it will be most helpful to integrate interventions that address the reduction in psychological costs into the counselling programs for international students. Even though some promising examples of interventions that directly address psychological costs were described in previous studies [89,90], future research is needed to further elaborate and evaluate these interventions and to adapt them to the specific needs of international (STEM) students. In the meantime, interventions that address related topics and conditions of psychological costs may be usefully employed. On the one hand, interventions may address general study management skills such as time management (e.g., Middendorff [91]). On the other hand, our findings suggest that it might be beneficial to complement cost interventions for international students with elements of intercultural trainings as information on cultural differences and hands-on practices on how to handle these effectively as this may also contribute to the reduction of perceived costs. This suggestion is corroborated by findings from Poort et al. [81] who showed that the engagement in intercultural group work reduced perceived costs. With regard to higher education policy, establishing part-time study programs and blended learning models may also help to decrease perceived study burdens and, thus, psychological costs (e.g., Middendorff [91]). To conclude, addressing psychological costs is deemed particularly important as recent studies suggested that cost value moderate the effect of the other (S)EVT components on academic outcomes [78]. This also suggests that interventions which increase academic self-efficacy or attainment, intrinsic, and utility values may pay off in terms of reduced psychological costs. For example, previous studies suggested that the use of cooperative learning strategies, setting specific, short-term goals and encouraging goal reflection would be helpful to support students' academic self-efficacy [15,92], which in turn may also reduce the psychological costs.

Lastly, our findings on acculturation orientations suggest that it will be advantageous for the adaptation process to support international students' host-culture orientation. For example, promoting contact to the campus community may help in this regard [93]. Likewise, a deliberate approach toward the own home-culture orientation may help students to maintain their study motivation and enjoyment.

All implications need to consider the relations of study-related language skills and the expectancy–value components regardless of subject group. The more the students feel they can master study-related communication, the higher their study-related expectancy and the more adaptive their value beliefs will be. Wisniewski et al. [48,88] described language skills (particularly reading skills) to be highly predictive of academic success in the study entry phase of international students. Our findings support Wisniewski's [48,88] results and suggest that one mechanism by which language skills affect the academic success might be via international students' more adaptive study-related expectations and value constellations.

Importantly, as there were almost no differences between the subject groups, all of the suggested interventions may be equally beneficial for all international students in STEM and non-STEM subjects. Furthermore, in contrast to previous studies, almost no direct

relations for gender and parental academic background with the value components were detected; that is, in this highly selected sample of international university students, it is probably not necessary to make targeted offers for female or for first-generation students.

5.5. General Limitations

First, it is important to consider that we investigated a specific sample, i.e., international students in Germany. The (international) student body in other countries might differ from this sample, e.g., with regard to their demographic and cultural characteristics. Likewise, the study conditions and environment will be different and, thus, present students with other chances and challenges that might influence their study-related expectations and value beliefs. Hence, caution is warranted with regard to the transferability of the present results to other samples. Likewise, our sample was limited to bachelor students. As master's students may have different and more heterogeneous (study) experiences in their subjects and beyond, their expectancies and value beliefs may be different and require further research.

Moreover, the distribution of country groups showed a small number of cases in some of the investigated country groups. This might be a reason why some effects may not have been identified for these groups or may have been inflated by few extreme cases. Furthermore, differences between the countries within the country groups were not investigated. As a consequence, it is questionable to what extent the results can be applied to each and every single country, particularly due to the small number of cases in some countries.

We examined the associations of gender, parental academic background, and cultural characteristics with the expectancy–value components in a cross-sectional design to explore contingencies between these variables at the beginning of the study time abroad. This was deemed important to get an understanding of which student groups might have increased risks of facing challenges in their studies or dropping out of university due to their maladaptive expectancy–value constellations. Further longitudinal analyses are needed to explore the differential trajectories of the expectancy–value components amongst STEM students over the study course and the longitudinal relations between study-related expectancy and value beliefs and academic success of international STEM students. Additionally, the interplay of acculturation orientations and study-related expectancy and value beliefs needs to be focused on future research, to more precisely understand their longitudinal interdependencies and the role of the duration of the stay abroad [53]. Furthermore, due to the non-experimental cross-sectional design of the present study, no causal interpretation of the results is possible.

Additionally, there were some limitations with regard to the used measurement instruments. First, only self-report measures were used which might imply some bias due to socially desirable responding [94,95]. Second, some of the subscales (particularly in value beliefs) were measured with only two items which may have restricted their content validity. Although this is a common approach in large panel studies, further research may benefit from enclosing more detailed measures of the investigated constructs.

6. Conclusions

Despite these limitations, the present study provided important insights with regard to the manifestation of and differences in study-related expectations and value beliefs as (psychological) prerequisites for study success amongst international STEM students (and non-STEM students) in Germany.

Importantly, without an intersectional perspective, some of the contingencies between demographic characteristics and the expectancy–value components would not have been detected. Hence, the intersectional perspective can be helpful in differentiating effects of belonging to multiple potentially disadvantaged groups [54,96]. We hope that the present results may encourage further research on the heterogeneity amongst internationals stu-

dents in Germany and its implications with regard to their specific strengths and potential support needs.

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