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# Dimensional comparisons in the formation of faculty members' research and teaching self-concepts?

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**Abstract**
Dimensional comparisons—i.e., comparisons between achievements in different domains—have to date been examined particularly between students' achievements in different school subjects. Numerous studies have documented that dimensional comparisons between mathematical and verbal achievements significantly affect students' mathematical and verbal self-concepts. However, dimensional comparisons also take place and affect self-evaluations in other contexts. The present study is the first to examine indications of dimensional comparisons between faculty members' research and teaching achievements. For this purpose, we extended the reciprocal I/E model, which describes the relations between mathematical and verbal achievements and self-concepts over time, to the domains of research and teaching. We examined our generalized reciprocal I/E model in a sample of 681 faculty members from German universities by considering their research and teaching achievements and self-concepts at four measurement points over two years. Results of cross-lagged analyses indicated positive dimensional comparison effects: The participating faculty members reported higher (lower) research and teaching self-concepts after high (low) achievement not only in the same domain, but also in the other domain. This core finding has important implications for our knowledge of the impact of dimensional comparisons in the formation of domain-specific self-concepts, as well as for the debate about the research–teaching nexus, as it suggests a strong link between research and teaching in terms of self-assessments.

**Keywords** Achievement · Dimensional comparisons · Higher education · Reciprocal I/E model · Research–teaching nexus · Self-concept

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## Introduction

Are your strengths in research or teaching? You may have already asked yourself this question. Research and teaching are the two major responsibilities of many faculty members. Although their nexus is often considered a defining element of universities, they represent clearly separable aspects of faculty members' professional activities (Daumiller & Dresel, 2018). Accordingly, it is reasonable that faculty members evaluate their abilities to do research and teach separately and have specific self-concepts in both domains (e.g., Marsh & Hattie, 2002).

But how exactly do research and teaching self-concepts develop? Given that academic self-concepts represent evaluations of one's academic achievements, it would be reasonable to assume that faculty members consider their research achievement to assess their research self-concept, and their teaching achievement to assess their teaching self-concept. However, previous research has shown that self-concepts are not merely reflections of actual achievements in individual domains. Rather, self-concepts can be influenced, especially by achievements in other domains and by comparisons with these achievements (Möller & Marsh, 2013). So far, these *dimensional comparisons* have mainly been studied in the school context, where researchers have shown in numerous studies that students' mathematical and verbal self-concepts are significantly affected by comparisons of their mathematical and verbal achievements (e.g., Möller et al., 2020).

On the basis of such research, in this study we address the question as to whether dimensional comparisons also affect the formation of faculty members' research and teaching self-concepts. Our theoretical section begins with an overview of the research–teaching nexus debate, which provides arguments both for dimensional *assimilation effects* (i.e., positive effects of achievement in one domain on self-concept in the other) and *contrast effects* (i.e., negative effects of achievement in one domain on self-concept in the other) in the formation of faculty members' research and teaching self-concepts. Subsequently, we present the reciprocal I/E model, which describes the reciprocal relations between mathematical and verbal achievements and self-concepts. Finally, we extend this model to a generalized reciprocal I/E model for the domains of research and teaching, which allows us to examine the reciprocal relations between achievements and self-concepts in these domains and to test for the occurrence of dimensional comparison effects in the formation of faculty members' research and teaching self-concepts.

## Theoretical section

### The research–teaching nexus

In recent decades, researchers have discussed various perspectives on the research–teaching nexus. These discussions have yielded various arguments for and against a strong linkage between research and teaching (e.g., Hattie & Marsh, 1996; Malcolm, 2014; Marsh & Hattie, 2002).

On the one hand, it has been argued in the Humboldtian spirit that researchers are also teachers and teachers are also researchers, which is why research and teaching should support and encourage each other. On the basis of this conception, Daumiller and Dresel (2018)

distinguished between integration (perceived overlap between research and teaching) and synergy (mutual enrichment of research and teaching) to describe the research–teaching nexus. In terms of integration, they noted that both research and teaching focus on the pursuit of knowledge accumulation. Furthermore, they pointed out that the dialectical connection between these two domains is typically a defining element of universities. In terms of the synergy, they argued that active researchers should be particularly well-positioned to provide students with a critical perspective on empirical findings and to inspire and motivate them through their own research activities. Simultaneous research and teaching activities in turn help ensure that faculty members are aware of the most current knowledge and methodologies, even those not yet published in textbooks. Moreover, teaching encourages researchers to situate their own research questions in the perspective of a larger whole. The preparation of specific learning content can help to identify and close one's own knowledge gaps. Presenting and discussing one's own research findings can further motivate researchers in their research activities and help them formulate research findings precisely, refine their own research ideas, and develop new ideas for future research (see also Marsh & Hattie, 2002).

On the other hand, however, it must be noted that research and teaching are often quite different fields of work that do not necessarily overlap or enrich each other. In fact, the multitude of different tasks and expectations that faculty members have to fulfill in research and teaching can lead to increased occupational stress and foster perceptions of the incompatibility of the two domains (Daumiller & Dresel, 2018). For example, research and teaching differ in terms of types of activity, objectives, preparations, reward systems, and financing logistics (e.g., Hattie & Marsh, 1996; Marsh & Hattie, 2002; Ramsden & Moses, 1992). Often there are only few opportunities for connecting research and teaching in practice, since in many cases highly specialized research cannot be the subject of broad teaching. Rather, research and teaching are usually in competition for faculty members' time resources, as the time available to faculty members for research is usually negatively related to time available for teaching. Moreover, research and teaching may appeal to different personality types. Along with this, especially on an international level there is also the increased trend of faculty positions in which either teaching or research is the primary or sole responsibility (Hüther & Krücken, 2018).

Given these diverging arguments for and against a strong linkage between research and teaching activities, it is an intriguing question whether and how dimensional comparisons are involved in the formation of faculty members' research and teaching self-concepts. Assuming that faculty members perceive research and teaching to be rather synergistic, it would be plausible to assume that achievement in one domain positively affects self-concept in the other. However, if faculty members perceive research and teaching to be rather antagonistic, it would be conceivable that achievement in one domain negatively affects self-concept in the other. In the present research, we address this question by testing the generalized reciprocal I/E model for research and teaching, which is developed in the following subsections.

## The reciprocal I/E model

The reciprocal I/E model (Marsh & Köller, 2004; Möller et al., 2011) describes the mutual relations between students' mathematical and verbal achievements and self-concepts (see

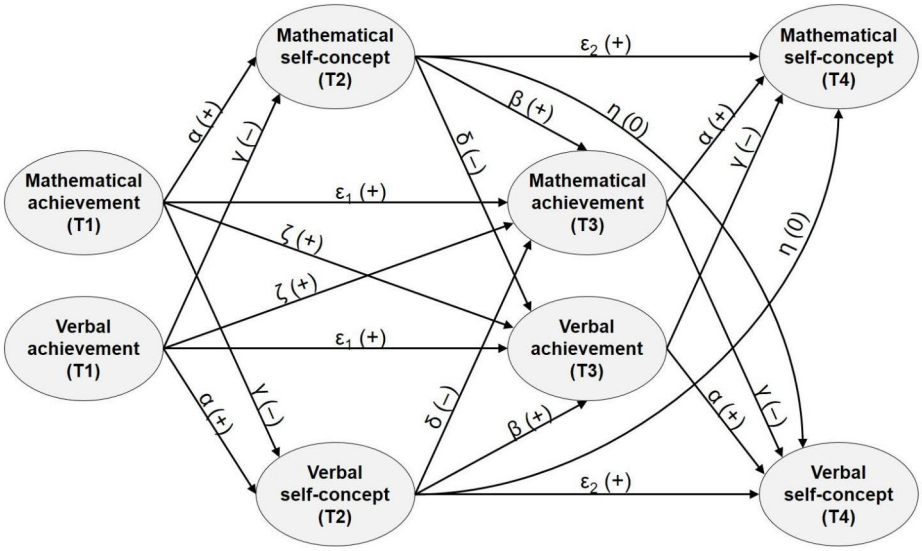


**Fig. 1** The Reciprocal Internal/External Frame of Reference (I/E) Model. (*Note*. The path labels are adapted from Niepel et al. (2014): α = skill-development effects within domains; β = self-enhancement effects within domains; γ = skill-development effects between domains; δ = self-enhancement effects between domains; $\varepsilon_1$, $\varepsilon_2$ = autoregressive effects; ζ = cross-domain effects between achievements; η = cross-domain effects between self-concepts. The assumed direction of the effects is shown in parentheses (+ = positive; – = negative; 0 = close to zero))

Fig. 1). It integrates the reciprocal effects model (REM; Marsh, 1990; Marsh & Craven, 2006), which describes the reciprocal relations between achievements and self-concepts within one domain, with the internal/external frame of reference model (I/E model; Marsh, 1986), which describes the effects of mathematical and verbal achievements on mathematical and verbal self-concepts. In this way, it overcomes the specific limitations of both the REM (being confined to one domain) and the I/E model (being restricted to the effects of achievements on self-concepts).

Specifically, the reciprocal I/E model makes seven assumptions (see also Niepel et al., 2014). In line with the REM, it assumes (1) positive effects of achievements on subsequent self-concepts within domains (α), which may result from the fact that high-performing (low-performing) students develop higher (lower) self-concepts because they have many opportunities to experience their achievement as above (below) average, (2) positive effects of self-concepts on subsequent achievements within domains (β), which may be because a high (low) self-concept encourages (discourages) students from engaging in domain-specific activities with high effort and persistence, resulting in a higher (lower) achievement, and (3) positive effects of achievements on subsequent achievements and of self-concepts on subsequent self-concepts within domains ($\varepsilon_1$ and $\varepsilon_2$), which may reflect the stability of these constructs across time. In line with the I/E model, the reciprocal I/E model further assumes (4) positive effects of achievements on subsequent achievements between domains (ζ), which may be due to the fact that students' mathematical and verbal achievements usually show strong positive correlations, (5) near-zero effects of self-concepts on subsequent self-concepts between domains (η), which may be because students' mathematical and

verbal achievements usually show correlations close to zero, and (6) negative effects of achievements on subsequent self-concepts between domains, which are assumed to represent the effects of dimensional comparisons between mathematical and verbal achievements, leading students to increase (decrease) their self-concept in the domain in which they show intra-individual higher (lower) achievement. Finally, the reciprocal I/E model assumes (7) negative effects of self-concepts on subsequent achievements between domains (δ). This assumption is based on the idea that students compare not only their mathematical and verbal achievements but also their mathematical and verbal self-concepts dimensionally. Given that an intra-individual higher (lower) self-concept should result in higher (lower) motivation to engage with domain-specific contents, students' achievement in this domain should improve (worsen).

Empirically, several studies so far have tested the reciprocal I/E model (see Wolff et al., 2021, for an overview). Overall, these studies, especially those with secondary school students, have largely supported most of the above assumptions. However, the effects of self-concepts on achievements between domains were often close to zero, rather than significantly negative.

It is noteworthy that the reciprocal I/E model has been labelled and specified somewhat divergently in the past. For example, Marsh and Köller (2004), who were probably the first to present this model explicitly (but also see Marsh & Yeung, 1997, 1998), spoke of a "unification" of the REM and the I/E model (later also called REM/IE), and conceptualized it as a cross-lagged panel model (CLPM), in which students' achievements and self-concepts were measured at the same point of time. In contrast, Möller et al. (2011), who introduced the label "reciprocal I/E model", conceptualized their model as including achievements and self-concepts from different measurement points. In our study, we use the term "reciprocal I/E model" for two reasons: First, this label seems more appropriate, given that our measures of faculty members' research and teaching achievements and self-concepts also stem from different time points. Second, the label reciprocal I/E model can be found in dimensional comparison theory (DCT; Möller & Marsh, 2013), which provides a comprehensive theoretical basis for the phenomenon of dimensional comparisons, and which has substantially advanced the development of various models for studying dimensional comparison effects.

### The generalized I/E model

In DCT, Möller and Marsh (2013) also assumed that dimensional comparisons occur in a wide variety of life areas. On the basis of this assumption, which is supported by findings from diary studies in particular (e.g., Möller & Husemann, 2006), Möller et al. (2016) extended the I/E model to the generalized I/E model to provide a framework to examine effects of dimensional comparisons between virtually all domain-specific constructs. Similarly to the I/E model, the generalized I/E model, applied to the relations of achievements and self-concepts, assumes that the effects of achievements in one domain on self-concepts in another domain result from dimensional comparisons. However, the model makes no specific assumptions regarding the direction of these between-domain effects. Rather, it allows these effects to be negative (contrastive), positive (assimilative), or close to zero, depending on the domains that are considered. Thus, the generalized I/E model no longer necessarily presumes the antagonism between domains being compared that is implicit in the I/E model.

On the basis of the generalized I/E model, researchers have conducted many studies in recent years to investigate the effects of dimensional comparisons between achievements in different school subjects. Taken together, these studies showed that effects of dimensional comparisons between two subjects from either the mathematical or the verbal domain are usually less contrastive than the effects of dimensional comparisons between one mathematical and one verbal subject (Möller et al., 2020). Moreover, in some studies, the effects of dimensional comparisons between two subjects from the mathematical domain (e.g., math and physics) even turned into positive assimilation effects (e.g., Jansen et al., 2015). In line with the Marsh/Shavelson model (Marsh et al., 1988), which describes the similarity of school subjects on a math-verbal continuum, these findings were explained by the greater similarity of subjects from the same domain compared to subjects from different domains (e.g., Marsh et al., 2014; Wolff et al., 2019).

In addition to examining the effects of dimensional comparisons between different school subjects, researchers have used the generalized I/E model to study dimensional comparisons in other contexts (see Wolff, 2022, for an overview). For example, the generalized I/E model has been used to examine dimensional comparison effects between the personality traits of agency and communion (Helm et al., 2017) or between engagement in vigorous exercises and abstinence from alcohol (Edmonds & Rose, 2022). Moreover, the model has been applied to higher education. In these studies, researchers have found evidence for dimensional comparison effects in the formation of subject-specific self-concepts in different sports among physical education students (e.g., Lohbeck et al., 2021), in different areas of professional knowledge among pre-service teachers (Paulick et al., 2017), and in different disciplines of psychology among psychology students (Wolff et al., 2018). The significant dimensional comparison effects were usually contrastive. However, Wolff et al. (2018) also found some significant assimilation effects between similar subjects in the psychology curriculum, implying that a high (low) achievement in one subject can increase (decrease) students' self-concept in another similar subject.

## The generalized reciprocal I/E model for research and teaching

In the present study, we aim to investigate dimensional comparison effects, for the first time, among faculty members with respect to the domains of research and teaching. However, we are interested not only in the effects of dimensional comparisons between achievement in research and teaching on self-concepts in these domains. Rather, our goal is to examine the complex interplay between achievements and self-concepts in research and teaching over time. To this end, we transfer the rationale of the generalized I/E model to the reciprocal I/E model, which we extend to a generalized reciprocal I/E model for research and teaching (see Fig. 2).

Consistent with the reciprocal I/E model, we postulate that achievement and self-concept positively influence each other within domains: If faculty members show a high (low) achievement in research or teaching, they should also perceive their abilities in the respective domain as high (low). Furthermore, a high (low) research or teaching self-concept should motivate (demotivate) faculty members to engage themselves in the particular domain with high effort and persistence, and consequently enhance (decrease) their achievement in this domain. Accordingly, in our generalized reciprocal I/E model, we expect to find (1) positive effects of achievements on subsequent self-concepts within domains (α) and

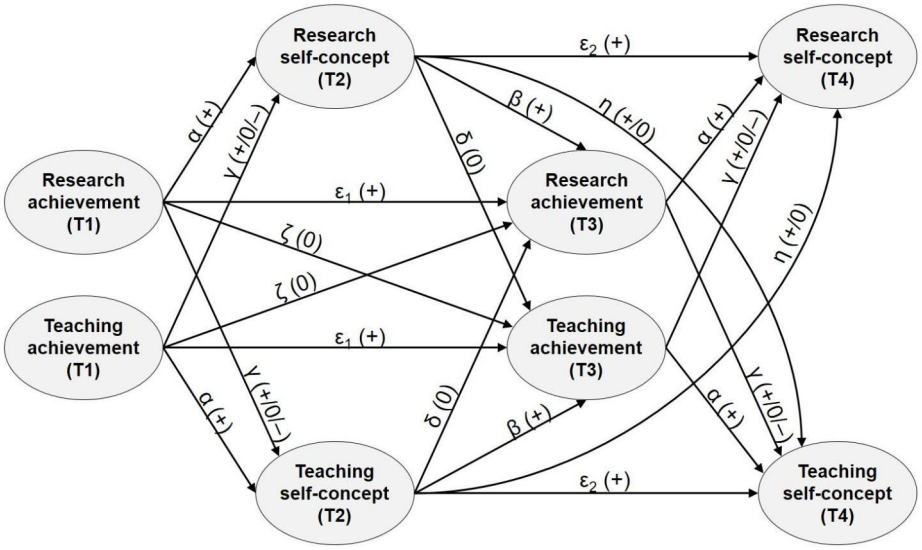


**Fig. 2** The Generalized Reciprocal Internal/External Frame of Reference (I/E) Model for Research and Teaching. (*Note*. The path labels are adapted from Niepel et al. (2014): α = skill-development effects within domains; β = self-enhancement effects within domains; γ = skill-development effects between domains; δ = self-enhancement effects between domains; $\varepsilon_1$, $\varepsilon_2$ = autoregressive effects; ζ = cross-domain effects between achievements; η = cross-domain effects between self-concepts. The assumed direction of the effects is shown in parentheses (+ = positive; – = negative; 0 = close to zero; +/0 = positive or close to zero; +/0/– = positive, close to zero, or negative))

(2) positive effects of self-concepts on subsequent achievements within domains (β). These assumptions are also supported by empirical findings that have revealed moderate to strong positive correlations between achievement and self-concept within the domains of research and teaching (Marsh & Hattie, 2002; see also Marsh, 1984, 1987, for an overview of the relations between teaching achievement and self-concept).

Also in line with the reciprocal I/E model, we assume (3) positive effects of achievements on subsequent achievements ($\varepsilon_1$) and of self-concepts on subsequent self-concepts ($\varepsilon_2$) within domains. As shown in previous research, both achievements and self-concepts in research and teaching exhibit high stability over time (see Daumiller et al., 2020, for an overview). However, in contrast to the reciprocal I/E model, we expect to find (4) near-zero effects of achievements on subsequent achievements between domains in our model (ζ). Unlike mathematical and verbal achievements, which are usually strongly positively correlated (Möller et al., 2020), previous research suggests that research and teaching achievements are more or less independent of each other. For example, in a meta-analysis of 58 studies, Hattie and Marsh (1996) found a mean correlation of $r = .06$ between achievement in research and teaching (see also Marsh, 1984, 1987). The authors speculated that this finding may result from the trade-off of time available for research and teaching, which counterbalances the otherwise positive relationship between research and teaching achievement.

As for achievement in research and teaching, Marsh and Hattie (2002) also found a close-to-zero correlation between research and teaching self-concepts. In contrast, Daumiller (2018) found moderate to strong positive correlations between research and teaching self-

efficacy. Theoretically, we would consider it plausible that self-concepts in research and teaching would have at least a small positive correlation—assuming that both self-concepts are influenced by a general self-concept for academic activities (see Brunner et al., 2010; Marsh et al., 1988) and that faculty members' achievement in one domain could positively influence their self-concepts in both domains. Nevertheless, given the inconsistent findings of Marsh and Hattie (2002) and Daumiller (2018), we assume (5) either near-zero or positive effects of self-concepts on subsequent self-concepts between domains (η).

A particularly intriguing question concerns the effects of dimensional comparisons between achievements in research and teaching. To the best of our knowledge, these effects have not yet been studied empirically. Assuming that the domains of research and teaching are at least as central to faculty members as are the mathematical and verbal domains for high school students, we believe that dimensional comparisons between research and teaching achievements could play a significant role in the formation of faculty members' research and teaching self-concepts. However, given the contrasting arguments for and against a strong linkage between research and teaching activities, it is difficult to predict how these effects may affect faculty members' research and teaching self-concepts. As discussed above, and considering the findings of the generalized I/E model with different school subjects, it would be plausible to expect contrastive dimensional comparison effects if faculty members perceived the domains of research and teaching to be rather dissimilar and unrelated, whereas the dimensional comparison effects could be close to zero, or even assimilative, if faculty members perceived the domains of research and teaching to be rather similar and intertwined. Moreover, positive effects of achievement in one domain on self-concept in the other could occur when faculty members' achievement in one domain becomes relevant to their work in the other domain (e.g., in the case of strongly research-based teaching or the scientific evaluation of one's own teaching concepts). That is, faculty members' achievement in one domain could also affect their self-concept in the other without direct comparisons being made of achievement in both domains. In our generalized reciprocal I/E model therefore we abstain from making specific assumptions concerning the dimensional comparison effects and predict (6) positive, negative, or near-zero effects of achievements on subsequent self-concepts between domains (γ).

The last effects to be discussed in our generalized reciprocal I/E model concern those of research self-concept on teaching achievement and of teaching self-concept on research achievement. Consistent with the theory of the reciprocal I/E model, we find it (theoretically) plausible that these effects will be negative, as a higher self-concept in one domain might relate to increased engagement in the same domain but to decreased engagement in the other domain. In consequence, faculty members' achievement should increase (decrease) in the domain in which their engagement has increased (decreased). However, as noted above, contrary to the model's assumptions, studies testing the reciprocal I/E model usually showed near-zero effects of mathematical (verbal) self-concepts on subsequent verbal (mathematical) achievements. Furthermore, Marsh and Hattie (2002) found no significant effects of research (teaching) self-concept on teaching (research) achievement. On the basis of these findings, we also expect to find (7) near-zero effects of self-concepts on subsequent achievements between domains in the generalized reciprocal I/E model for research and teaching (δ).

## The present study

In the present study, we tested the generalized reciprocal I/E model developed in the previous section to examine the interplay between achievements and self-concepts in research and teaching, including the potential effects of dimensional comparisons. For this purpose, we analyzed data from a larger project, in which faculty members were asked about their achievements and self-concepts in research and teaching at four measurement points. This dataset has already been used to examine research questions concerning the relationships of achievement goals with achievement, burnout experiences and professional learning (Daumiller & Dresel, 2020, 2022; Hein et al., 2019), as well as linkages between subjective perceptions of the research–teaching nexus and burnout experiences (Daumiller & Dresel, 2018). However, none of these prior studies analyzed the data measuring faculty members' research and teaching self-concepts and only one study (Daumiller & Dresel, 2022) analyzed the data measuring faculty members' research and teaching achievements.

## Method

### Sample and procedure

The sample consisted of $N = 681$ faculty members from various disciplines in German universities. Of these, 168 participated in two measurement points, 217 in three measurement points, and 296 in all four measurement points. The number of participants was 632 at T1, 576 at T2, 576 at T3, and 459 at T4. At T1, 51% reported being male, 67% were academic faculty members with PhDs and 25.3% were full professors. The average age was 38.7 ($SD = 11.0$) years. At each of the four measurement points, the faculty members filled out paper-and-pencil questionnaires that were sent to them by mail in the middle of four consecutive semesters. More details on the sample and the recruitment procedure can be found in Daumiller and Dresel (2022).

### Measurements

**Achievements.** We measured research achievement using three items from Daumiller et al. (2019), in which the faculty members indicated whether they had published more publications, published higher-quality publications, or obtained more external funding during the last six months compared to faculty members in the same field and with the same academic status. The faculty members answered these items on a visual analog scale with sliders from 0 to 99 (e.g., "In the last six months, I have published more publications than ___% of the other researchers of my status in my community"). The internal consistency of the three items was good at both measurement points (T1: $\alpha = .80$; T3: $\alpha = .81$). To measure teaching achievement, we used a single-item question asking the faculty members to indicate their students' overall rating of their teaching on a scale from 1 = *very bad* to 8 = *very good*. The items were chosen as, unlike the items measuring research and teaching self-concept, they related to objectively measurable criteria of performance in research and teaching. In contrast to rather subjective aspects of research achievement (e.g., knowledge of the relevant literature) and teaching achievement (e.g., activation of students), these items also provided

the advantage of referring to achievement aspects that are relatively suitable for making comparisons and that are often used for feedback in the academic context (e.g., in application procedures or on platforms such as ResearchGate).

**Self-concepts.** We used scales developed by Daumiller (2018) to measure faculty members' research and teaching self-concepts. The scale measuring research self-concept consisted of eight items asking faculty members to assess their competence in the areas of data collection and interpretation (e.g., "In your research, how well do you succeed in developing specific research questions or hypotheses?") and understanding and presenting research findings (e.g., "In your research, how well do you succeed in understanding the current state of research?"). The scale measuring teaching self-concept was composed of nine items asking faculty members to indicate how competent they felt about their teaching in terms of instruction (e.g., "In your teaching, how well do you succeed in using varied teaching methods in your teaching?"), classroom management (e.g., "In your teaching, how well do you succeed in stopping unrest and disruption?"), and motivation (e.g., "In your teaching, how well do you succeed in communicating to students where the meaning and benefits of the course content lie?"). The faculty members responded to each item of both scales on a Likert scale ranging from 1 = *not at all well* to 8 = *exceptionally well*. At both measurement points, the internal consistencies were good for the research self-concept scale (T2: $\alpha = .90$; T4: $\alpha = .89$) and the teaching self-concept scale (T2: $\alpha = .80$; T4: $\alpha = .82$). A list of all items can be found in Table S1 in the Supplemental.

## Statistical analyses

We conducted our analyses by means of structural equation modeling in Mplus 8.4. For model estimation, we used the robust maximum likelihood estimator. All variables were specified as latent constructs with variances fixed to 1. Except for teaching achievement, which we specified as a latent single indicator, we allowed correlations between the same indicators across time, to account for residual effects that could not be ascribed to the latent factors. Furthermore, we assumed and specified strict factorial invariance. Thus, we set equal the factor loadings, the intercepts, and the residual variances of the same indicators from different measurement points. In addition, we allowed the indicators of the self-concept constructs that measured the same self-concept facet at one measurement point to covariate, and set equal the covariances between the same indicators across time. Detailed analyses showed that these assumptions of invariance were justified (see Table S2 in the Supplemental). To test our generalized reciprocal I/E model, we regressed both constructs measured at one measurement point on all constructs measured at a prior measurement point. Moreover, we allowed correlations between (the residuals of) the latent constructs assessed at the same measurement point. To deal with missing values (on average, 21.8% of the values on the achievement variables and 24.7% of the values on the self-concept variables), we used the full information maximum likelihood (FIML) procedure. All data and the syntax are available at https://osf.io/j5r8c/?view_only=52f77c73ee334a13a541e99774dca5b3.

## Results

### Preliminary analyses

Table 1 depicts the bivariate correlations of the latent variables. As shown, there were strong positive correlations between the same constructs measured at different points of time ($.42 \leq r \leq .66$). Moreover, there were moderate to strong positive correlations between research achievement and research self-concept and between teaching achievement and teaching self-concept ($.30 \leq r \leq .50$). In accord with prior studies, the correlation between research achievement and teaching achievement was only small positive (at T1; $r = .07$) or nonsignificant (at T3). In contrast, research self-concept and teaching self-concept showed strong positive correlations ($.43 \leq r \leq .48$).

### Testing the generalized reciprocal I/E model

Table 2 presents the results of the generalized reciprocal I/E model. The model showed a good fit to the data; $\chi^2(815) = 1{,}527$, $p < .001$; CFI = 0.93; TLI = 0.93; RMSEA = 0.03. All of our hypotheses were supported, with one exception.

First, we found strong positive effects of research achievement at T1 on research self-concept at T2 ($\beta = 0.46$) and of teaching achievement at T1 on teaching self-concept at T2 ($\beta = 0.49$). The effect of teaching achievement at T3 on teaching self-concept at T4 was also positive and small ($\beta = 0.17$). However, in contrast to our expectations, the effect of research achievement at T3 on research self-concept at T4 was nonsignificant. Instead, we found a small positive effect of research achievement at T1 on research self-concept at T4 ($\beta = 0.11$). Second, we found a small positive effect of research self-concept at T2 on research achievement at T3 ($\beta = 0.08$) and a moderate effect of teaching self-concept at T2 on teaching achievement at T3 ($\beta = 0.22$). Third, we found moderate to strong positive autoregressive effects of research achievement at T1 on research achievement at T3 ($\beta = 0.55$), of teaching achievement at T1 on teaching achievement at T3 ($\beta = 0.31$), of research self-concept at T2 on research self-concept at T4 ($\beta = 0.61$), and of teaching self-concept at T2 on teaching self-concept at T4 ($\beta = 0.50$). Fourth, the effects of research achievement at T1 on teaching achievement at T3 and of teaching achievement at T1 on research achievement at T3 were nonsignificant. Fifth, the effect of research self-concept at T2 on teaching self-concept at T4 was small positive ($\beta = 0.13$), whereas the effect of teaching self-concept at T2 on research self-concept at T4 was nonsignificant. Sixth, there were small positive effects of research achievement at T1 on teaching self-concept at T2 ($\beta = 0.13$) and of teaching achievement at T1 on research self-concept at T2 ($\beta = 0.15$). In contrast, the effects of research achievement at T3 on teaching self-concept at T4 and of teaching achievement at T3 on research self-concept at T4 were nonsignificant. Seventh, the effects of research self-concept at T2 on teaching achievement at T3 and of teaching self-concept at T2 on research achievement at T3 were nonsignificant.

**Table 1** Bivariate Correlations With 95% Confidence Intervals of the Latent Constructs

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Research achievement T1 | — | | | | | | | |
| 2. Teaching achievement T1 | **.07 [.00; .14]** | — | | | | | | |
| 3. Research self-concept T2 | **.48 [.39; .56]** | **.18 [.08; .28]** | — | | | | | |
| 4. Teaching self-concept T2 | **.17 [.05; .28]** | **.50 [.40; .60]** | **.43 [.33; .54]** | — | | | | |
| 5. Research achievement T3 | **.59 [.55; .63]** | .06 [–.01; .13] | **.35 [.28; .41]** | **.14 [.05; .22]** | — | | | |
| 6. Teaching achievement T3 | **.10 [.03; .18]** | **.42 [.34; .50]** | **.14 [.06; .21]** | **.37 [.28; .45]** | .07 [–.06; .21] | — | | |
| 7. Research self-concept T4 | **.41 [.35; .48]** | **.15 [.07; .22]** | **.66 [.61; .71]** | **.26 [.16; .35]** | **.30 [.22; .38]** | **.09 [.01; .17]** | — | |
| 8. Teaching self-concept T4 | **.12 [.02; .22]** | **.39 [.30; .48]** | **.36 [.25; .46]** | **.63 [.56; .70]** | .09 [–.02; .20] | **.39 [.29; .49]** | **.48 [.36; .61]** | — |

*Note*. $N = 681$. Correlations highlighted in bold are statistically significant at the 5% alpha level

**Table 2** Standardized Path Coefficients With 95% Confidence Intervals in the Generalized Reciprocal Internal/External Frame of Reference (I/E) Model

| Predictors | Research self-concept T2 | Teaching self-concept T2 | Research achievement T3 | Teaching achievement T3 | Research self-concept T4 | Teaching self-concept T4 |
|---|---|---|---|---|---|---|
| Research achievement T1 | **0.46 [0.38; 0.55]** | **0.13 [0.02; 0.24]** | **0.55 [0.50; 0.61]** | 0.07 [–0.02; 0.15] | **0.11 [0.03; 0.20]** | –0.03 [–0.14; 0.08] |
| Teaching achievement T1 | **0.15 [0.05; 0.24]** | **0.49 [0.39; 0.59]** | –0.01 [–0.08; 0.07] | **0.31 [0.23; 0.40]** | 0.06 [–0.01; 0.14] | 0.05 [–0.05; 0.15] |
| Research self-concept T2 | — | — | **0.08 [0.00; 0.15]** | –0.05 [–0.16; 0.06] | **0.61 [0.53; 0.69]** | **0.13 [0.01; 0.25]** |
| Teaching self-concept T2 | — | — | 0.01 [–0.07; 0.10] | **0.22 [0.11; 0.33]** | –0.06 [–0.15; 0.03] | **0.50 [0.38; 0.61]** |
| Research achievement T3 | — | — | — | — | 0.03 [–0.06; 0.12] | –0.02 [–0.15; 0.10] |
| Teaching achievement T3 | — | — | — | — | –0.01 [–0.10; 0.07] | **0.17 [0.05; 0.29]** |

*Note*. $N$=681. Effects highlighted in bold are statistically significant at the 5% alpha level. The correlations between the (residuals of the) constructs measured at the same time point are $r$=.07 [.00; .14] at T1, $r$=.38 [.27; .49] at T2, $r$=.00 [–.18; .19] at T3, and $r$=.48 [.25; .72] at T4

## Discussion

The present study aimed to enhance our knowledge of the complex interplay between achievements and self-concepts in research and teaching. For the first time, we have examined dimensional comparison effects in the development of faculty members' research and teaching self-concepts. In particular, we found positive effects of faculty members' research achievement on their teaching self-concept, after controlling for teaching achievement, and of their teaching achievement on their research self-concept, after controlling for research achievement. According to DCT and the generalized I/E model, these effects can be interpreted as dimensional assimilation effects, suggesting that faculty members' self-concept in one domain benefits from high and suffers from low achievement in the same and the other domain. Moreover, it is possible that these effects result from the linkage of research and teaching; for example, when faculty members incorporate research into their teaching or consider their teaching as the subject of their research.

Controlling for prior achievements and self-concepts, the dimensional comparison effects of research achievement on teaching self-concept and of teaching achievement on research self-concept were not statistically significant. However, it should be considered that the self-concepts, showing autoregressive effects, had already been affected by prior achievements in both domains and thus included some dimensional comparison information. Furthermore, there was a positive effect of faculty members' research self-concept on their teaching self-concept, after controlling for prior achievements and self-concepts, which could be cautiously interpreted in terms of a dimensional comparison effect.

The effects of research self-concept on teaching achievement and of teaching self-concept on research achievement were not significant. This finding is in line with the results of Marsh and Hattie (2002), as well as prior studies testing the reciprocal I/E model with mathematical and verbal school subjects. It suggests that dimensional comparisons between perceived abilities in research and teaching do not have a substantial impact on subsequent achievements in these domains.

Concerning the relations between achievements and self-concepts within domains, consistently with previous research we mostly found significant positive effects (Marsh & Hattie, 2002). Only faculty members' research self-concept at T4 was affected not by the most recently measured research achievement (at T3), but by the research achievement measured beforehand (at T1). In this regard, it should be noted that faculty members' research achievement at T3 also showed no significant dimensional comparison effect on their teaching self-concept at T4. Instead, as discussed above, we found a significant effect of research self-concept at T2 on teaching self-concept at T4. Nevertheless, overall our findings demonstrate that research and teaching achievement and self-concept are reciprocally related within domains. It is plausible that these relations are due to the same processes that are thought to explain the reciprocal relations between domain-specific achievements and self-concepts at school. That is, on the one hand, faculty members may base their research and teaching self-concepts on achievement feedback in these domains. On the other hand, their self-concepts in research and teaching may affect their achievements in the respective domain due to more or less intensive domain-specific engagement.

In accord with prior research (see Daumiller et al., 2019, for an overview), we found strong autoregressive effects for the examined constructs. This finding underpins the high stability of achievement and self-concept in research and teaching over time. Furthermore,

our findings concerning the correlation between research and teaching achievement were consistent with prior findings: Both at T1 and at T3, this correlation ($r = .07$) was very similar to the correlation found in Hattie and Marsh's (1996) meta-analysis ($r = .06$). In line with the close-to-zero correlation between research and teaching achievement, we also found no significant effect of research achievement on teaching achievement, or of teaching achievement on research achievement in our generalized reciprocal I/E model.

In contrast to the near-zero correlations between research and teaching achievement, the correlations between research and teaching self-concepts were moderately to strongly positive. This finding, which is in line with findings of Daumiller (2018), but contradicts those of Marsh and Hattie (2002), suggests that there may be a general self-concept for academic activities that influences both faculty members' research self-concept and teaching self-concept. Also, this aligns well with the idea of research and teaching activities overlapping within the research–teaching nexus. However, it should also be noted that the scales used in our study to measure faculty members' research and teaching self-concepts were originally developed to measure self-efficacy in research and teaching. Because both scales measure self-perceptions of rather broad competences in research and teaching, based primarily on assessments of prior experiences in these domains, we consider it appropriate to interpret the constructs measured as self-concepts. Nevertheless, research has shown that task-specific self-efficacy measures in different domains tend to be more strongly correlated than corresponding measures of domain-specific self-concepts. Furthermore, task-specific self-efficacy measures are relatively less influenced by comparison effects (e.g., Marsh et al., 1991, 2019). Thus, it is possible that the positive self-concept correlations in our study, as well as the positive dimensional comparison effects, can be attributed in part to self-efficacy effects. Accordingly, it would be interesting for future research to examine the relations between faculty members' research and teaching achievements and self-concepts with more generalized self-concept measures (e.g., "How would you rate your ability as a researcher/teacher?"), such as those used by Marsh and Hattie (2002).

## Limitations

The present study has some limitations that should be discussed. First, it should be noted that our study does not allow us to draw causal conclusions. Although the analysis of longitudinal data makes causal interpretations more plausible than would be the case with cross-sectional data, additional studies are necessary to validate our conclusions. Ideally, these studies should be experimental. However, it might be difficult to apply the research methodology from those experiments in which effects of dimensional comparisons between mathematical and verbal achievements were examined by providing students with manipulated feedback in corresponding achievement tests (e.g., Möller & Köller, 2001) to the domains of research and teaching. Therefore, a perhaps more appropriate approach to providing stronger evidence of causal effects in the interplay of achievements and self-concepts in research and teaching might be the analysis of longitudinal data in which achievements and self-concepts were measured at the same time point, using traditional CLPMs or RI-CLPMs (e.g., Marsh et al., 2022).

Second, it is important to point out that our study does not allow us to verify the psychological mechanisms assumed to underlie the effects we found in the generalized reciprocal I/E model. Because we analyzed secondary data, we could not ask the faculty members of

our sample, for example, whether they really compared their research and teaching achievements dimensionally, or whether an increase in their self-concept in research or teaching resulted in increased engagement in this domain. Moreover, as discussed above, we cannot rule out the possibility that the dimensional comparison effects found in our research do not (in part or in the whole) represent "real" influences of faculty members' achievement in one domain on their self-concept in the other, rather than consequences of dimensional comparisons. Therefore, future research should aim to uncover the psychological processes that explain the interplay between achievements and self-concepts in research and teaching. To this end interviews or diary studies in which faculty members note dimensional comparisons in their everyday life (see Möller & Husemann, 2006) could be helpful.

Finally, a limitation of our study can also be seen in the fact that we analyzed self-reported achievements. As faculty members of our sample were from different universities and disciplines, in which research and teaching achievement was measured using different instruments and against different standards (if measured at all), it is reasonable that their achievements were based on self-reports. The items that we used to measure research and teaching achievements stemmed from validated scales that have been found to correlate substantially with objective achievement data in prior studies (Daumiller et al., 2019, 2022). Nevertheless, it would be important for future studies to supplement the relations between achievements and self-concepts in research and teaching with more-objectively measured achievement indicators (e.g., *h*-indices and actual student evaluations of teaching effectiveness).

## Implications

In theoretical terms, the results of this study significantly expand our knowledge of the interplay between achievements and self-concepts in different domains. So far, these relations have been studied mainly in the school context. In contrast, in this study we have applied the reciprocal I/E model to the domains of research and teaching for the first time, and examined how research and teaching achievements and self-concepts influence each other over time. Accordingly, our study also provides an important contribution to validating DCT, which assumes that dimensional comparisons take place in various areas of life.

Although we were able to replicate several findings from the reciprocal I/E model for mathematical and verbal achievements and self-concepts, we also found significant differences. In particular, this concerns the dimensional comparison effects, which were at the heart of our investigation and turned out to be positive, rather than negative. Moreover, our study revealed moderate to strong positive correlations between research and teaching self-concepts, but near-zero correlations between research and teaching achievements, whereas for the mathematical and verbal domains there are mostly strong positive correlations between achievements, but near-zero correlations between self-concepts. This difference in the pattern of achievement and self-concept correlations between the mathematical and verbal domains and the research and teaching domains could also explain why we found positive dimensional comparison effects in our study, although the effects of dimensional comparisons between mathematical and verbal achievements are usually negative. Thus, it is conceivable that the assimilation effects found in our study resulted from the fact that research and teaching self-concepts show stronger correlations than do research and teaching achievements—possibly because faculty members' research and teaching self-concepts

are influenced by a general self-concept for academic activities, while a lack of time makes it difficult for them to show high achievement in both domains. More broadly, one could speculate that the dimensional comparison effects in the generalized I/E model are positive when the correlation between the criteria (self-concepts) is stronger than that between the predictors (achievements), but negative when the correlation between the criteria is weaker.

The positive dimensional comparison effects found in our study are also of high practical relevance. As discussed in the theoretical section, the research–teaching nexus has long been the subject of debate. In light of this debate, our findings are promising in that they suggest a substantial linkage between research and teaching, at least in terms of self-assessment. A lack of time often makes it difficult or impossible for faculty members to devote as much time as they would like to researching and teaching. However, we found no indications that high achievement in one of these two domains lowers the self-concept in the other domain. Rather, a high achievement in one domain seems to be advantageous for both domain-specific self-concepts. Thus, faculty members neither have to fear a decrease in their teaching self-concept due to a particularly high research achievement nor a decrease in their research self-concept due to a particularly high teaching achievement. Nonetheless, self-concepts in research and teaching can suffer from low performance in both domains. Accordingly, faculty members should be encouraged to focus not just on one domain of their work. However, if faculty members should on occasion perform weakly in either research or teaching, considering their stronger achievement in the other domain could help them to maintain a positive self-concept.

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**Data availability** All data, analysis code, and research materials are available at https://osf.io/j5r8c/?view_only=52f77c73ee334a13a541e99774dca5b3.

## Declarations

**Conflict of interest** We have no known conflict of interest to disclose.



## References

Brunner, M., Keller, U., Dierendonck, C., Reichert, M., Ugen, S., Fischbach, A., & Martin, R. (2010). The structure of academic self-concepts revisited: the nested Marsh/Shavelson model. *Journal of Educational Psychology*, *102*, 964–981. https://doi.org/10.1037/a0019644.

Daumiller, M. (2018). Motivation von Wissenschaftlern in Lehre und Forschung: Struktur, Eigenschaften, Bedingungen und Auswirkungen selbstbezogener Ziele. Springer. https://doi.org/10.1007/978-3-658-21182-0.

Daumiller, M., & Dresel, M. (2018). Subjective perceptions of the teaching–research nexus and occupational stress at universities. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, *50*, 126–138. https://doi.org/10.1026/0049-8637/a000194.

Daumiller, M., & Dresel, M. (2020). Researchers' achievement goals: prevalence, structure, and associations with job burnout/engagement and professional learning. *Contemporary Educational Psychology*, *61*, 101843. https://doi.org/10.1016/j.cedpsych.2020.101843.

Daumiller, M., & Dresel, M. (2022). Temporal dynamics between faculty goals, burnout/engagement, and performance in teaching and research: a latent change score approach. *Contemporary Educational Psychology*, *72*, 102124. https://doi.org/10.1016/j.cedpsych.2022.102124.

Daumiller, M., Janke, S., Hein, J., Rinas, R., Dickhäuser, O., & Dresel, M. (2022). Teaching quality in higher education: agreement between teacher self-reports and student evaluations. *European Journal of Psychological Assessment Advanced online publication*. https://doi.org/10.1027/1015-5759/a000700.

Daumiller, M., Siegel, S., & Dresel, M. (2019). Construction and validation of a short Multidisciplinary Research Performance Questionnaire (SMRPQ). *Research Evaluation*, *28*, 241–252. https://doi.org/10.1093/reseval/rvz009.

Daumiller, M., Stupnisky, R., & Janke, S. (2020). Motivation of higher education faculty: theoretical approaches, empirical evidence, and future directions. *International Journal of Educational Research*, *99*, 101502. https://doi.org/10.1016/j.ijer.2019.101502.

Edmonds, K. A., & Rose, J. P. (2022). Exploring the impact of dimensional comparisons in health contexts. *Social and Personality Psychology Compass*, *16*, e12669. https://doi.org/10.1111/spc3.12669.

Hattie, J., & Marsh, H. W. (1996). The relationship between research and teaching: a meta-analysis. *Review of Educational Research*, *66*, 507–542. https://doi.org/10.3102/00346543066004507.

Hein, J., Daumiller, M., Janke, S., Dresel, M., & Dickhäuser, O. (2019). How learning time mediates the impact of university scholars' learning goals on professional learning in research and teaching. *Learning and Individual Differences*, *72*, 15–25. https://doi.org/10.1016/j.lindif.2019.04.002.

Helm, F., Abele, A. E., Müller-Kalthoff, H., & Möller, J. (2017). Applying dimensional comparison theory to the fundamental dimensions of social judgment—agency and communion. *Learning and Individual Differences*, *54*, 116–125. https://doi.org/10.1016/j.lindif.2017.01.011.

Hüther, O., & Krücken, G. (2018). *Higher education in Germany—recent developments in an international perspective* (49 vol.). Springer.

Jansen, M., Schroeders, U., Lüdtke, O., & Marsh, H. W. (2015). Contrast and assimilation effects of dimensional comparisons in five subjects: an extension of the I/E model. *Journal of Educational Psychology*, *107*, 1086–1101. https://doi.org/10.1037/edu0000021.

Lohbeck, A., Tietjens, M., & Möller, J. (2021). An extension of the internal/external frame of reference model to the physical domain: are there contrasting and assimilating achievement-self-concept relations in specific sports? *Learning and Individual Differences*, *90*, 102048. https://doi.org/10.1016/j.lindif.2021.102048.

Malcolm, M. (2014). A critical evaluation of recent progress in understanding the role of the research-teaching link in higher education. *Higher Education*, *67*, 289–301. https://doi.org/10.1007/s10734-013-9650-8.

Marsh, H. W. (1984). Students' evaluations of university teaching: dimensionality, reliability, validity, potential biases, and utility. *Journal of Educational Psychology*, *76*, 707–754. https://doi.org/10.1037/0022-0663.76.5.707.

Marsh, H. W. (1986). Verbal and math self-concepts: an internal/external frame of reference model. *American Educational Research Journal*, *23*, 129–149. https://doi.org/10.3102/00028312023001129.

Marsh, H. W. (1987). Students' evaluations of university teaching: Research findings, methodological issues, and directions for future research. *International Journal of Educational Research*, *11*, 253–388. https://doi.org/10.1016/0883-0355(87)90001-2.

Marsh, H. W. (1990). A multidimensional, hierarchical model of self-concept: theoretical and empirical justification. *Educational Psychological Review*, *2*, 77–172. https://doi.org/10.1007/BF01322177.

Marsh, H. W., Byrne, B. M., & Shavelson, R. J. (1988). A multifaceted academic self-concept: its hierarchical structure and its relation to academic achievement. *Journal of Educational Psychology*, *80*, 366–380. https://doi.org/10.1037/0022-0663.80.3.366.

Marsh, H. W., & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: beyond seductive pleasure and unidimensional perspectives. *Perspectives on Psychological Science*, *1*, 133–163. https://doi.org/10.1111/j.1745-6916.2006.00010.x.

Marsh, H. W., & Hattie, J. (2002). The relation between research productivity and teaching effectiveness: complementary, antagonistic, or independent constructs? *The Journal of Higher Education*, *73*, 603–641. https://doi.org/10.1353/jhe.2002.0047.

Marsh, H. W., & Köller, O. (2004). Unification of theoretical models of academic self-concept/achievement relations: Reunification of East and west german school systems after the fall of the Berlin Wall. *Contemporary Educational Psychology*, *29*, 264–282. https://doi.org/10.1016/S0361-476X(03)00034-1.

Marsh, H. W., Kuyper, H., Seaton, M., Parker, P. D., Morin, A. J. S., Möller, J., & Abduljabbar, A. S. (2014). Dimensional comparison theory: an extension of the internal/external frame of reference effect on academic self-concept formation. *Contemporary Educational Psychology*, *39*, 326–341. https://doi.org/10.1016/j.cedpsych.2014.08.003.

Marsh, H. W., Pekrun, R., & Lüdtke, O. (2022). Directional ordering of self–concept, school grades, and standardized tests over five years: new tripartite models juxtaposing within– and between–person perspectives. *Educational Psychology Review*, *34*, 2697–2744. https://doi.org/10.1007/s10648-022-09662-9.

Marsh, H. W., Pekrun, R., Parker, P. D., Murayama, K., Guo, J., Dicke, T., & Arens, A. K. (2019). The murky distinction between self-concept and self-efficacy: beware of lurking jingle-jangle fallacies. *Journal of Educational Psychology*, *111*, 331–353. https://doi.org/10.1037/edu0000281.

Marsh, H. W., Walker, R., & Debus, R. (1991). Subject-specific components of academic self-concept and self-efficacy. *Contemporary Educational Psychology*, *16*, 331–345. https://doi.org/10.1016/0361-476X(91)90013-B.

Marsh, H. W., & Yeung, A. S. (1997). Coursework selection: relations to academic self-concept and achievement. *American Educational Research Journal*, *34*, 691–720. https://doi.org/10.2307/1163354.

Marsh, H. W., & Yeung, A. S. (1998). Longitudinal structural equation models of academic self-concept and achievement: gender differences in the development of math and English constructs. *American Educational Research Journal*, *35*, 705–738. https://doi.org/10.3102/00028312035004705.

Möller, J., & Husemann, N. (2006). Internal comparisons in everyday life. *Journal of Educational Psychology*, *98*, 342–353. https://doi.org/10.1037/0022-0663.98.2.342.

Möller, J., & Köller, O. (2001). Dimensional comparisons: an experimental approach to the internal/external frame of reference model. *Journal of Educational Psychology*, *93*, 826–835. https://doi.org/10.1037//O022-O663.93.4.826.

Möller, J., & Marsh, H. W. (2013). Dimensional comparison theory. *Psychological Review*, *120*, 544–560. https://doi.org/10.1037/a0032459.

Möller, J., Müller-Kalthoff, H., Helm, F., Nagy, N., & Marsh, H. W. (2016). The generalized internal/external frame of reference model: an extension to dimensional comparison theory. *Frontline Learning Research*, *4*(2), 1–11. https://doi.org/10.14786/flr.v4i2.169.

Möller, J., Retelsdorf, J., Köller, O., & Marsh, H. W. (2011). The reciprocal internal/external frame of reference model: an integration of models of relations between academic achievement and self-concept. *American Educational Research Journal*, *48*, 1315–1346. https://doi.org/10.3102/0002831211419649.

Möller, J., Zitzmann, S., Helm, F., Machts, N., & Wolff, F. (2020). A meta-analysis of relations between achievement and self-concept. *Review of Educational Research*, *90*, 376–419. https://doi.org/10.3102/0034654320919354.

Niepel, C., Brunner, M., & Preckel, F. (2014). The longitudinal interplay of students' academic self-concepts and achievements within and across domains: replicating and extending the reciprocal internal/external frame of reference model. *Journal of Educational Psychology*, *106*, 1170–1191. https://doi.org/10.1037/a0036307.

Paulick, I., Großschedl, J., Harms, U., & Möller, J. (2017). How teachers perceive their expertise: the role of dimensional and social comparisons. *Contemporary Educational Psychology*, *51*, 114–122. https://doi.org/10.1016/j.cedpsych.2017.06.007.

Ramsden, P., & Moses, I. (1992). Associations between research and teaching in australian higher education. *Higher Education*, *23*, 273–295. https://doi.org/10.1007/bf00145017.

Wolff, F. (2022). Dimensional comparisons: much is known about the effects, less about the processes. *Social and Personality Psychology Compass*, *16*, e12664. https://doi.org/10.1111/spc3.12664.

Wolff, F., Helm, F., & Möller, J. (2019). Integrating the 2I/E model into dimensional comparison theory: towards a comprehensive comparison theory of academic self-concept formation. *Learning and Instruction*, *62*, 64–75. https://doi.org/10.1016/j.learninstruc.2019.05.007.

Wolff, F., Helm, F., Preckel, F., & Möller, J. (2018). Dimensionale Vergleiche im Studium? Ein generalisiertes I/E-Modell zur Ausbildung fachbezogener Selbstkonzepte im Studium der Psychologie. *Zeitschrift für Pädagogische Psychologie*, *32*, 207–220. https://doi.org/10.1024/1010-0652/a000227.

Wolff, F., Sticca, F., Niepel, C., Götz, T., Van Damme, J., & Möller, J. (2021). The reciprocal 2I/E model: an investigation of mutual relations between achievement and self-concept levels and changes in the math and verbal domain across three countries. *Journal of Educational Psychology*, *113*, 1529–1549. https://doi.org/10.1037/edu0000632.