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The Generalized Internal/External Frame of Reference Model: An Extension to Dimensional Comparison Theory

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Abstract

The dimensional comparison theory (DCT) focuses on the effects of internal, dimensional comparisons (e.g., "How good am I in math compared to English?") on academic self-concepts with widespread consequences for students' self-evaluation, motivation, and behavioral choices. DCT is based on the internal/external frame of reference model (I/E model) which integrates dimensional and external, social comparisons (e.g., "How good am I in math compared to my classmates?"). This article presents an extension, the generalized I/E model, which describes effects of dimensional and social comparisons in various areas. Firstly, it proposes that such comparisons are carried out not only within the academic area but also within other areas. Secondly, it proposes effects of social and dimensional comparison for other variables besides self-concepts, i.e. for motivational constructs, learning behaviors, or personality characteristics. The present article closes with an examination and discussion of the contributions of the DCT by applying standards of good theories to it.

Keywords: dimensional comparison; social comparison; self-concept; domain-specificity

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1. Introduction to the dimensional comparison theory and the I/E model

This paper deals with a recently developed theory in the field of educational psychology, the dimensional comparison theory (DCT; Möller & Marsh, 2013). First we will present the central ideas of the DCT and the empirical support for its assumptions with regard to the antecedents of dimensional comparisons and the psychological processes carried out while dimensionally comparing aspects of different domains. Then we will present a recent extension derived from the DCT, the generalized internal/external frame of reference model (GI/E model). Whereas the internal/external frame of reference model (I/E model; Marsh, 1986) deals with the relations between math and verbal achievements and self-concepts and proposes positive effects from math and verbal achievements to corresponding self-concepts and negative effects on non-corresponding self-concepts, its generalization allows the application of the relations and effects described therein to other domains as well. The DCT and the GI/E model both are presented with reference to their motivational implications. In the discussion, DCT's gains with regard to the criteria of good theories developed by Van Lange (2013) will be summarized.

1.1 The dimensional comparison theory

Like social comparison theory (Festinger, 1954) or the temporal comparison theory (Albert, 1977), the dimensional comparison theory (Möller & Marsh, 2013) details the cognitive process of evaluating a certain target by comparing it to a certain standard. This cognitive process comprises four stages: The selection of a certain target for evaluation, the selection of a certain standard, the comparison of the target with the standard, and finally the evaluation of the target (Biernat & Eidelman, 2007; Mussweiler, 2003). Whereas social comparisons use information on others as the standard (Festinger, 1954), and temporal comparisons use prior information on oneself as the standard (Albert, 1977), dimensional comparisons use information on other attributes of the same person as a standard (Möller & Köller, 2001a, b). More precisely, dimensional comparisons (like temporal comparisons) are intra-individual comparisons, for example comparing one's own mathematical achievement with one's own verbal achievement affecting both mathematical and verbal self-evaluations.

In the DCT, dimensional comparisons are defined as taking place when people compare their achievement in one domain (the target domain) with their achievement in another domain (the standard domain). Most of the research on DCT is quantitative in nature and data come from field studies. However, there are some experimental studies clearly demonstrating effects of dimensional comparisons on self-concepts. In Möller and Köller (2001a) as well as in Pohlmann and Möller (2009), participants received dimensional comparison information indicating that their performance on the domain A is ranked worse (better) than their performance on the domain B. Participants felt better about their performance in their better-off domain and worse in their worse-off domain, controlled for the presence of social comparison information (see also Strickhouser & Zell, 2015). Research on dimensional comparison has also shown that these comparisons happen in everyday life situations. For example, in a diary study Möller and Husemann (2006) examined spontaneous dimensional comparisons using qualitative data. Their participants were told to note and describe any dimensional comparison that came to their mind during a period of 14 days. University students (Study 1) and high school students (Study 2) recorded an average of more than six dimensional comparisons during the two weeks, clearly supporting the assumption that dimensional comparisons occur in everyday life. Students were asked to mark which domain served as target and which domain served as the comparison standard. Results showed that academic matters were most commonly used as target domains (i.e., "We were given our school reports and I compared my grade in religion with my grade in mathematics"). Personal relationships with friends, partners, and family as well as the general well-being, physical appearance, and personality characteristics were also used

as targets ("Although I am not that thin, I am not touchy"), yet less frequently. Additionally, target and standard often belonged to the same domain. It was also shown that people often carry out dimensional comparisons when they are motivated to enhance themselves or to improve their mood. Particularly in situations of failure, upward dimensional comparisons with a better-off standard (Möller & Husemann, 2006) serve compensational needs: When I fail at math, it is more pleasurable to concentrate on my verbal abilities. If self-enhancement is the major motivation for dimensional comparison, it is beneficial to use a better-off domain as a comparison standard. Such an upward comparison often leads to a higher self-esteem and a more positive mood state in the better-off domain (despite some costs in self-concepts in the worse-off domain). The gains in the better-off domain following downward dimensional comparison (from this perspective) should be stronger than the losses in the worse-off domain following upward dimensional comparison (from this perspective): The net effect of dimensional comparison on self-evaluations empirically seems to be slightly positive (Pohlmann & Möller, 2009).

In the diary study by Möller and Husemann (2006), upward dimensional comparisons were more frequent than downward comparisons. In Study 1, the majority of dimensional comparisons were upward (70.5%). Participants reported 20.9 % downward comparisons and 8.7% horizontal comparisons. In Study 2, 52.3% of all comparisons were upward, 34.9% downward, and 12.8% horizontal. However, the need for self-enhancement is not the only motivation for dimensional comparisons. Following Möller, Helm, Müller-Kalthoff, Nagy, & Marsh (2015), motivations for domain-specific self-evaluation and for self-improvement may also lead to dimensional comparisons. For example, someone trying to self-evaluate how verbally talented he or she is may choose his/her math ability as a comparison standard even if choosing math as a (worse-off) standard may not be beneficial to the actual self. Dickhäuser, Reuter, and Hilling (2005) and Nagy et al. (2006) showed that the probability of choosing a particular course in school is positively affected by high achievement in corresponding subjects and negatively affected by high achievement in non-corresponding subjects (i.e., influenced by dimensional comparisons). Imagine a student who has to decide whether he/she wants to concentrate on language or on science courses. One criterion for his/her decision will be his/her achievement in these domains; he/she may ask him/herself: "Am I better at science or in language arts?". Then again, self-improvement motivation may also trigger dimensional comparisons: To become better in math, a student might analyze his/her motivation and learning behavior in his/her better-off verbal subjects and transfer them to math. Here, the comparison might lead to a behavioral assimilation. One might think that verbal and math achievements both are based on motivation, intelligence, and adequate learning behavior so that the more positive achievement in verbal subjects could be transferred to math. This would lead to a more positive learning behavior in math as well. In addition, some hints on the antecedents of dimensional comparisons could be found: Dimensional comparisons (like social comparisons) were shown to be triggered by motivational needs and/or by external forces (Möller et al., 2015).

The DCT is inspired by the I/E model (Marsh, 1986, Figure 1), which posits the joint operation of both social comparisons and dimensional comparisons to construct domain-specific academic self-concepts. Students conduct social comparisons by comparing their achievement with the achievement of their classmates (external frame of reference). For example, if a student's verbal achievement is lower than that of his/her classmates, likely his/her verbal self-concept will also be lower. In addition, students conduct dimensional comparisons by comparing their achievement in a given subject with their achievements in another subject (internal frame of reference). For example, if a student's verbal achievement is lower than his/her math achievement, his/her verbal self-concept will suffer and his/her math self-concept will benefit from dimensional comparisons.

Möller, Pohlmann, Köller, and Marsh (2009) meta-analyzed 69 studies with N = 125,308 students on the relations between academic achievements and self-concepts (see Figure 1). The average correlation between math and verbal achievements was strongly positive (r = .67), and much higher than the average correlation between math and verbal self-concepts (r = .10), indicating a strong domain-specificity of academic self-

concepts. Moreover, the effects of external comparisons, i.e. the effects of math achievement on math self-concept (β = .61) and of verbal achievement on verbal self-concept (β =.49), were substantial and positive (see the horizontal paths in Figure 1). However, the effects of dimensional comparisons, i.e. the effects from verbal achievement to mathematical self-concept (β = −.27) and of mathematics achievement on verbal self-concept (β = −.21), were negative (see the cross-dimensional paths in Figure 1). Integrating the results leads to the central assumption of the I/E model: The strong positive correlation between subjects-specific achievements does not lead to strong positive correlations between subject-specific self-concepts. The reason for this is the negative effect of dimensional comparisons between subject-specific achievements. The results of the meta-analysis indicate the effects of social and dimensional comparisons described in the classic I/E model to be valid for different achievement measures (grades as well as standardized achievement test scores), for different grades, gender groups, and countries (Möller et al., 2009).

Despite the various studies supporting the I/E model, the actual psychological processes behind dimensional comparisons remain rather unexplored. A central assumption of the DCT is that dimensional comparison effects are moderated by the perceived similarity of the compared school subjects. According to the DCT, different school subjects form a similarity continuum (Marsh, Byrne, & Shavelson, 1988; Marsh, Lüdtke et al., 2015) that explains the different outcomes of dimensional comparisons. The DCT predicts that for dissimilar subjects (so-called far comparisons) like math and English, dimensional comparisons lead to contrast effects, whereas smaller contrast effects or even assimilation effects result between similar subjects (so-called near comparisons). For example, Möller, Streblow, Pohlmann, and Köller (2006) found positive path coefficients from achievements to non-corresponding self-concepts between relatively similar subjects like English and German or math and physics. Möller, Streblow, and Pohlmann (2006) asked students directly for their belief in a negative interdependence of math and verbal abilities, that is, whether they thought of math and verbal abilities as negatively correlated or not. Stronger beliefs in a negative interdependence of math and verbal ability were accompanied by more negative path coefficients from grades in one subject to academic self-concepts in the other subject. If students considered abilities in two subjects to be positively correlated, the impact of dimensional comparisons even showed a positive assimilation effect. Therefore, similarity perceptions regarding different school subjects seem to be composed to a great amount of interdependence beliefs students hold about underlying abilities.

We propose that the similarity of school subjects influence dimensional comparisons in a manner that is described for social comparisons by the selective accessibility model (SAM) designed by Mussweiler (2003). According to SAM, the comparison of a certain target to a given standard is influenced by perceptions of the general similarity of the target and the standard. We assume that when two subjects like math and English are selected as target and standard for dimensional comparison, the comparison process is driven by dissimilarity assumptions. When two more similar subjects like math and physics are dimensionally compared, the comparison process is driven by similarity assumptions instead. The similarity assumption will make commonalities between math and physics more accessible, which will result in lower contrast or even assimilation effects in self-concepts. The dissimilar perception will make differences between subjects more accessible and lead to contrast effects as described in the original I/E model.

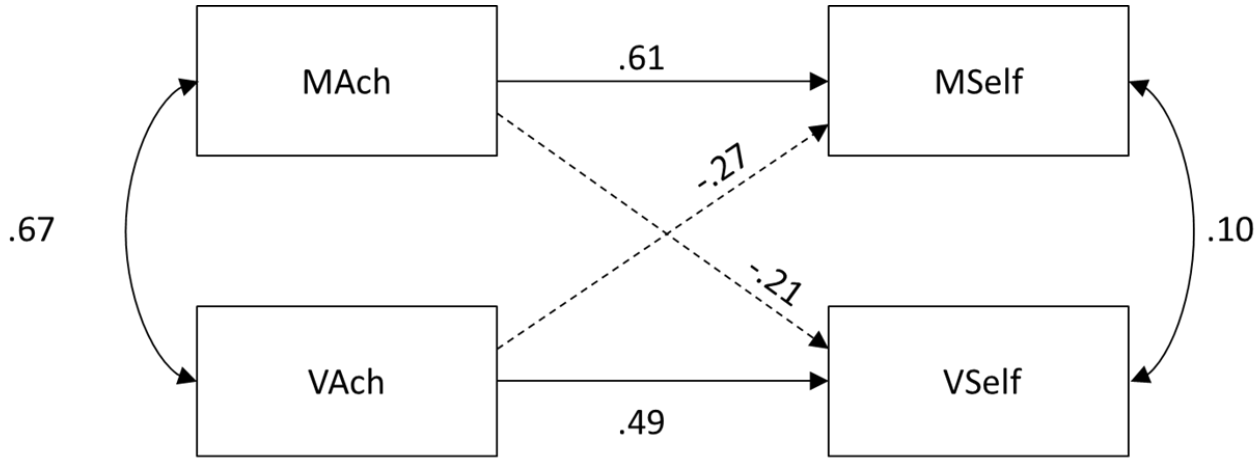

Figure 1. The I/E model: Results of a meta-analytic path-analysis on the relations between math and verbal achievement and math and verbal self-concept (from Möller et al., 2009). MAch = math achievement; MSelf = math self-concept; VAch = verbal achievement; VSelf = verbal self-concept.

1.2 The Generalized Internal/External Frame of Reference Model (GI/E model)

Whereas the I/E model is originally restricted to math and verbal achievements and math and verbal self-concepts, its logic is extended in the DCT to a variety of other variables. Therefore, we introduce a generalized I/E model (see Figure 2) which may serve as a kind of a guide to look for more I/E like relations between independent and dependent variables. In this model, a person carries out social and dimensional comparisons. For example a student compares his/her own standing or perception in a certain domain with someone else's standing, and as a result the student is able to form an opinion on his/her own standing in that particular domain. The student also carries out a dimensional comparison when comparing his/her perception of aspects of a particular domain A with his/her perception of aspects of a particular domain B coming to a conclusion about his/her standing in domain A in comparison to his/her standing domain B. Both comparisons may have consequences for any kind of domain-specific thought and learning behavior. If a student perceives him/herself as being better than most of his/her classmates in a domain, the effects of social comparisons are positive for self-evaluations. However, the effects of dimensional comparisons are often negative for a particular domain. If someone perceives that he/she is better in sports than in music he/she might neglect his/her musical activities because he/she prefers sports.

In extension to the original I/E model, the GI/E model allows an integration of each domain-specific aspect that students tend to compare externally and internally as a predictor or an independent variable. It also integrates the consequences of self-evaluation, motivation, and learning behavior as criteria or dependent variables.

At the moment our assumptions on the generalizability of the I/E model and effects to different constructs are rather hypothetical. However there are already some empirical studies that provide preliminary evidence of the validity of our extensions. We will present the description of these studies with regard to the question whether they extended the I/E model on the side of the predictors (i.e., examining the effects of different independent variables on the academic self-concept), on the side of the criteria (i.e., examining the effects of academic achievements on different dependent variables) or on both (i.e., examining I/E-like effects in completely different domains).

Changing predictors. Most recent extensions on the side of the predictors integrate more or other school subjects than merely the native language and math (e.g. Chiu, 2012; Marsh, Lüdtke et al., 2015; Jansen, Schroeders, Lüdtke & Marsh, 2015; Möller, Streblow, Pohlmann, & Köller, 2006; Nagy, Trautwein, Baumert, Köller, & Garrett, 2006), i.e., multiple academic subjects (native and foreign language, history, biology, physics, and math). As already outlined, the application of the I/E model to two similar subjects does not typically lead to contrast effects in subject-specific self-concepts. It rather leads to no significant effect from subject-specific achievement to self-concept in the other subject or even to assimilative effects, i.e., positive effects from achievement to self-concept in the other subject. A study by Marsh, Lüdtke et al. (2015) offers an illustration of the distinction of between-domain comparisons and within-domain comparisons, showing significant contrast effects for so-called far comparisons (between dissimilar subjects) and significantly less contrast or even assimilation effects for so-called near comparisons (for similar subjects). Jansen et al. (2015) analyzed dimensional comparison effects for five domains and found support for the hypotheses which derived from the DCT. Both contrast and assimilation effects can result from dimensional comparisons: Mathematics, physics, and chemistry showed contrast effects to German self-concept, whereas more assimilative effects were found from achievements in the three subjects to mathematics, physics, and chemistry self-concepts.

Furthermore, Tietjens, Möller, and Pohlmann (2005) successfully replicated the I/E model using sports achievement as predictors. Performance in track and field negatively affected the self-concept in swimming and basketball and swimming performance negatively influenced the self-concept in soccer (see also Chanal, Sarrazin, Guay, & Boiché, 2009). In the diary study mentioned above (Möller & Husemann, 2006), participants were found to compare a vast variety of different domains intra-individually, like personality characteristics and physical attractiveness.

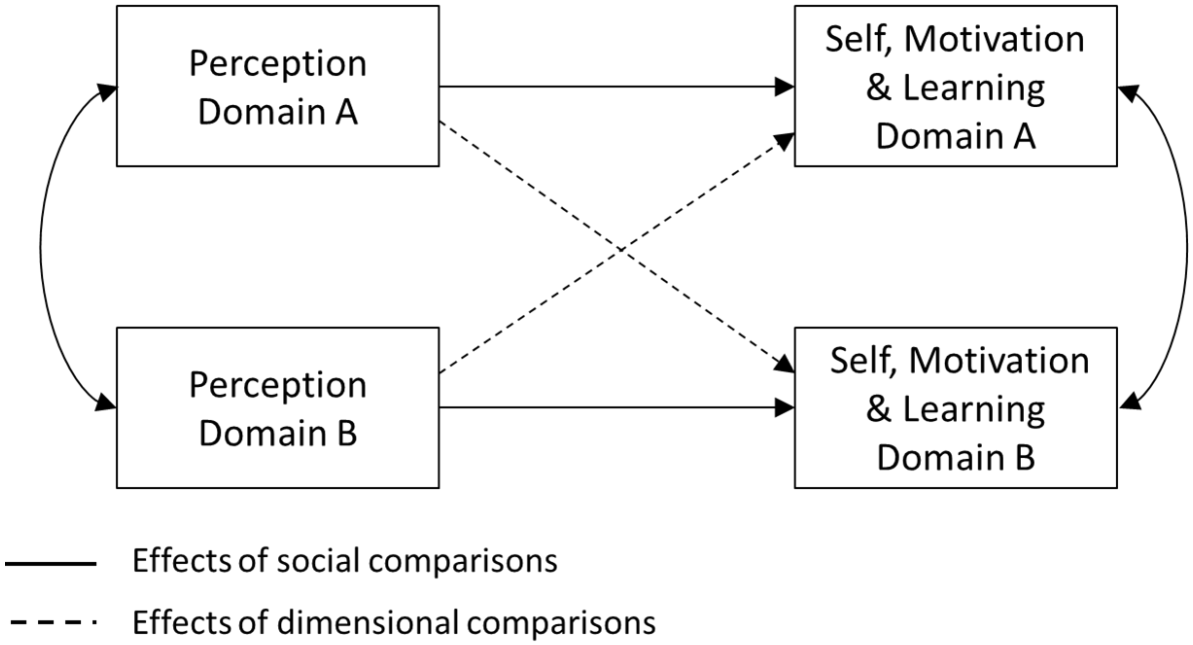

Figure 2. The generalized I/E model. An extension of the I/E model to other domains and consequences.

Changing criteria. Some studies in the tradition of the I/E model used math and verbal achievements as comparison target and standard, but then used different dependent variables analyzing effects on variables other

than self-concepts, i.e. self-regulated learning (Miller, 2000), emotions (Goetz, Frenzel, Hall, & Pekrun, 2008), intrinsic motivation (Marsh, Abduljabbar, Parker, Morin, Abdelfattah, Nagengast, Möller, & Abu-Hilal, 2015), and interest (Schurtz, Pfost, Nagengast, & Artelt, 2014).

With regard to motivation we refer to the corpus of motivation terms relevant to academic achievement Murphy and Alexander (2000) discussed. They differentiated between self-schema (including self-efficacy and attribution), interest (situational and individual), intrinsic and extrinsic motivation, and goal orientation (including learning, performance, and work avoidance goals). Our general answer to the question which constructs fit into I/E relations as criteria is based on the domain-specificity of the motivational constructs: Whereas self-schema, interest, and intrinsic/extrinsic motivation in most research studies are domain-specific constructs, goal orientation is often conceptualized as more domain-general (Bong, 2013). The more a motivational construct is specific to a domain, the more we will assume effects of dimensional comparisons. Motivational constructs that are less specific to a domain are rarely able to be the subject of dimensional comparisons. There is one important exception to this rule: In the Möller et al. (2009) meta-analysis, the most important moderator was the type of self-schema measure. When measures of self-efficacy served as self-concept indicators that included the target in the item, analyses revealed larger relations between math and verbal self-evaluations and the I/E model did not fit the data well. The most important difference between such self-efficacy beliefs and self-concept with regard to comparison processes may be that self-efficacy beliefs, when including the target in the item beliefs, are much more driven by former experiences with similar types of tasks.

So far, there is a lack of studies that analyze the effects of dimensional comparisons on other criteria than students' self-reported self-concepts. Although there is already evidence for I/E like relations between students' verbal and math grades and other-ratings of students' ability beliefs (e.g., Dickhäuser, 2005; Möller, 2005), it would be interesting to analyze the effects of social and dimensional comparisons using a broader variety of domain-specific criteria (observed and self-reported) such as time spent on homework, teacher-ratings of students' classroom behavior, or students' perceptions of instructional quality of classes (see Arens & Möller, 2016).

In one of the first studies directly referring to the GI/E model, Arens and Möller (2016) asked students for their grades in math and German and for their perceptions of the learning environment in each their math and German classes from two perspectives: First, the students were asked to rate their relationships to their math teacher and their German teacher. Second, the students were asked to judge the perceived quality of the instruction they received in math and German classes. Analyses revealed positive paths from grades to corresponding student-teacher relationships and qualities of instruction. More importantly for the DCT, negative paths occurred from grades to non-corresponding perceptions of the quality of instruction and positive paths occurred from grades to non-corresponding student-teacher relationships, indicating dimensional comparison processes.

Changing predictors and criteria. Very few studies replaced both independent and dependent variables. However Dietrich, Dicke, Kracke, & Noack (2015) found dimensional comparison effects when analyzing cross-domain relations of teacher support and motivation: Higher levels of perceived teacher support in one subject were negatively related to students' intrinsic value and effort in another subject. Möller and Savyon (2003) analyzed dimensional comparison effects between intelligence and honesty. They gave their participants success or failure feedback on anagram tasks. People in the failure condition rated themselves as being more honest than did students who received positive feedback in the anagram task, indicating that processes of dimensional comparison were carried out between intelligence and honesty.

Möller and Marsh (2013) suggested a transfer of the I/E model to basic personality characteristics. They viewed the "Big Two" personality dimensions agency (competence) and communion (warmth; Abele &

Wojciszke, 2014) as ideal candidates for an extension of the DCT since both dimensions are independent of each other in self-perception, as are math and verbal self-concepts. A first re-analysis of the data of Abele, Rohe, and Hauke (2013, merged from Studies I and II) revealed some support for a "Big Two I/E model". Helm et al. (under review) revealed typical I/E patterns between other-rated agency and communion as predictors and self-rated agency and communion as criteria, i.e. positive effects on corresponding self-ratings and negative effects on non-corresponding self-ratings. Such extensions to personality variables like agency and communion widen the opportunities delivered by the generalized I/E model.

To sum up, the generalized I/E model may serve as a matrix for other juxtapositions of domain-characteristics with consequences for domain-specific beliefs and learning behaviors. The successful transfer of our assumptions to agency and communion may serve as an example for the research possibilities that arise from these extensions, within and outside of learning and motivation research.

1.3 Discussion

The aim of the present article was to give an overview on a new theory in motivation research, the dimensional comparison theory, as well as to devise a critical extension to the core assumption of the theory. Namely, we introduced a generalized I/E model assuming external and in particular internal, dimensional comparisons to be rather general comparison processes not only limited to the formation of academic self-concepts alone, but to apply to evaluations of different constructs as well. The GI/E model may enable future research to go beyond the relations between verbal and math self-concepts and apply the rationale underlying external and dimensional comparisons in different fields and disciplines as well. In conclusion, we would like to evaluate the DCT in regard to its usefulness in terms of a good theory. We will try to evaluate DCT from our (subjective) perspective. According to Van Lange (2013) truth, abstraction, progress, and applicability as standards (TAPAS) may serve as ideals for theories in psychology. In the following section, we would like to apply TAPAS to DCT:

Truth. The ideal of truth is met when a theory allows hypothesizing testable relations between the constructs that the theory deals with. Although according to Popper (1959) truth remains an unreachable ideal, empirical studies allow researchers, who are testing hypotheses derived from theories, to evaluate what aspects of a theory are more or less adequate descriptions of the data. With regard to motivation and learning research, such a theory has to describe or explain data on motivational constructs, e.g. relations between two motivational constructs or between motivation and achievement. In the case of the DCT, we have shown that there is strong evidence (a) for the occurrence of dimensional comparisons inside and outside of schools and (b) for cross-domain effects between achievements and academic self-concepts. The empirical support is smaller with regard to other motivational constructs.

Abstraction. The second ideal of abstraction asks theories to go beyond single empirical studies, generalize findings, and verbalize relations between constructs. In our opinion, the DCT is abstract enough while still exposing the causal relations between aspects of domains and corresponding self-evaluations as well as non-corresponding self-evaluations of these aspects, and grounding them on psychological principles. The DCT overcomes the limitations of the I/E model, which is a more descriptive approach.

Progress. Thirdly, ideal theories strive for progress. They should add some new insights to the prior knowledge or provide a new and intriguing perspective on a phenomenon. The DCT emphasizes a comparison process rather neglected in research outside of educational psychological self-concept research. A first visible sign of progress may be that research on the DCT is published in a major social psychology journal (Strickhouser & Zell, 2015). From our perspective and concerning the DCT, it is essential to generalize the I/E model and to initiate more (and more experimental) research on the psychological phenomena associated with

dimensional comparisons. Derived from DCT, the GI/E model allows the application of the relations and effects described in the I/E model to other domains and person characteristics as well. This would offer a new theoretical perspective on the formation of self-concepts and on the emergence of motivational tendencies in different areas of life.

Applicability. Fourthly, a theory should be applicable to real-world concerns, an ideal that is in particular important in an applied field of research like motivation and learning research. The DCT does not only claim to be applicable to the well-known and practically important relations between academic achievement and academic self-concept, but has the potential of explaining several real world phenomena that may benefit from considering dimensional comparisons as an underlying psychological process. The DCT is applicable in each situation, which forces people to choose between alternatives. In particular, when students have to choose between courses, select careers and academic majors, dimensional comparisons will be at work.

To sum up, the GI/E model was introduced overcoming the I/E model's limitations with regard to math and verbal affairs. First empirical support was presented underlining the fruitfulness of the model to initiate further research activities. The GI/E model is a consequence of the formulation of the DCT and enriches the theories' purpose. Further research is needed that adds new domains as comparison targets and standards as well as new motivational and learning outcomes as consequences of external and internal comparisons.

Keypoints

- The internal/external frame of reference model (I/E model) describes the relations between math and verbal achievements and self-concepts.
- The dimensional comparison theory (DCT) focuses on the internal frame of reference and extends the I/E model.
- Instead of being limited to math and verbal achievements, it deals with other domains as well. Instead of being limited to math and verbal self-concepts, it deals with motivational constructs, learning behaviors, and personality characteristics.
- Therefore, a generalized I/E model is proposed that allows the application of previous findings and will initiate further research.
- DCT is discussed by applying standards of good theories to it.

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