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Learning and motivation

Which motivation is important and how to foster it

Both laypersons and experts widely regard motivation as a key determinant of academic performance, seeing it as both a prerequisite and an educational goal in its own right (Spinath, 2022). In a world characterized by rapid change, sustained motivation to acquire new knowledge is essential for active participation in society. Furthermore, motivation is thought to be relatively amenable to influence, making it a potentially powerful lever in educational settings. This raises an important empirical question: Does the commonly held belief in the importance of motivation for academic achievement hold up under scientific scrutiny?

1. The power of motivation in explaining interindividual differences in academic achievement

In academic literature, motivation refers to the entirety of processes that govern the initiation, direction, and intensity of behavior. It encompasses both internal states (such as needs or goals) and external influences that drive or guide behavior (Heckhausen & Heckhausen, 2018). Empirical evidence supports a relationship between motivation and academic achievement. Meta-analyses consistently demonstrate positive associations between these constructs (e.g., Cerasoli et al., 2014; Howard et al., 2021; Wirthwein et al., 2013). However, it is crucial to note that "motivation" is an umbrella term that encompasses a variety of constructs (for a detailed overview see Spinath, 2022). These constructs are typically categorized into three main groups: goal orientations, achievement motives, and expectancy-value variables (Elliot & Church, 1997; Murphy & Alexander, 2000; Pintrich et al., 2003). Of these, constructs within the expectancy-value category—such as ability self-concepts, self-efficacy, interest, and intrinsic motivation—show the strongest correlations with academic achievement, with medium to high effect sizes (Cerasoli et al., 2014; Howard et al., 2021; Möller et al., 2009; Multon et al., 1991; Schiefele et al., 1993; Stajkovic et al., 2018; Steinmayr et al., 2018). Achievement motives, generally conceptu-

alized as trait-like dispositions subdivided into "hope for success" and "fear of failure" are also associated with academic performance (Bjørnebekk et al., 2013; Steinmayr et al., 2019b; Steinmayr & Spinath, 2009). Hope for success correlates positively with academic outcomes, while fear of failure shows a negative correlation. Goal orientations, however, tend to exhibit only small correlations with academic achievement; specifically, work-avoidance goals are negatively associated with performance (particularly in mathematics), whereas approach-performance and learning goals have small positive correlations with achievement (Noordzij et al., 2021; van Yperen et al., 2015; Wirthwein et al., 2013). Figure 1 illustrates the varying correlations between different motivational constructs and academic achievement.

While these findings indicate that motivational constructs share a meaningful proportion of variance with academic performance, bivariate correlations alone provide an incomplete picture. Motivation is related to other powerful predictors such as intelligence (Bergold & Steinmayr, 2016) and personality (Steinmayr et al., 2011). These are also related to academic outcomes and the associations are sometimes even stronger (see Roth et al., 2015, for a meta-analysis on the association between intelligence and grades). Thus, some researchers even argue that motivation lacks predictive power for academic achievement beyond what is explained by intelligence (e.g. Gagné & St Père, 2002). Consequently, establishing the importance of motivation for academic success requires demonstrating its incremental validity—namely, the extent to which motivation contributes to the explanation of academic performance over and above other key predictors.

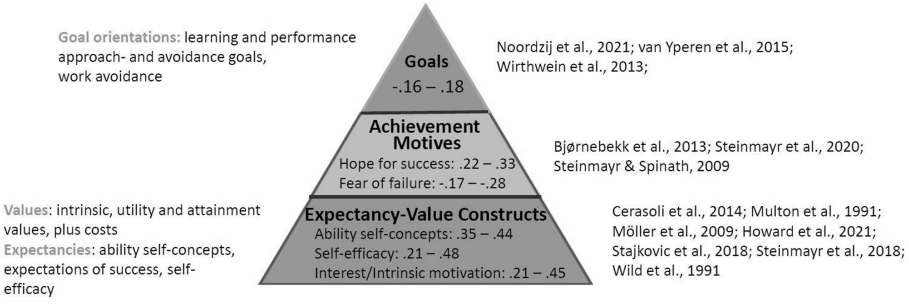

Figure 1: Correlations between different motivational constructs and academic achievement (goals: Noordzij et al., 2021; van Yperen et al., 2015; Wirthwein et al., 2013; achievement motives: Bjørnebekk et al., 2013; Steinmayr et al., 2019b; Steinmayr & Spinath, 2009; expectancy-value constructs: Cerasoli et al., 2014; Howard et al., 2021; Möller et al., 2009; Multon et al., 1991; Schiefele et al., 1993; Stajkovic et al., 2018; Steinmayr et al., 2018). Goals pertain to learning goals, performance-avoidance and -approach goals and work avoidance.

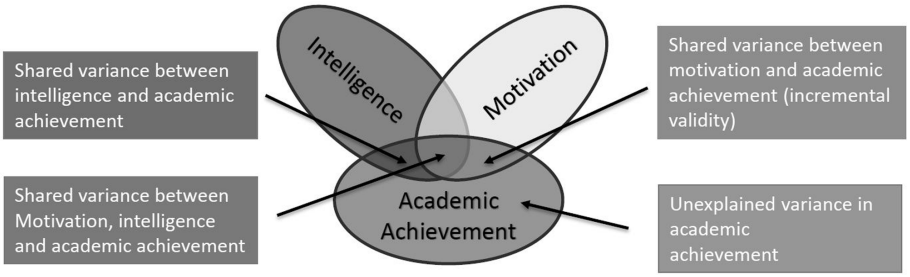

Figure 2: Graphical illustration of the incremental validity of motivation in predicting academic achievement above and beyond intelligence.

Figure 2 illustrates this critical concept in understanding the role of motivation in academic performance. As depicted, some variance in academic achievement is unaccounted for by both constructs. Some variance in academic achievement is only explained by interindividual differences in intelligence, some only by interindividual differences in motivation and some by both. In several studies, we explored the incremental validity of motivation beyond intelligence, personality, or a combination of both when predicting academic achievement (Lauermann et al., 2020; Steinmayr & Spinath, 2007, 2009; Steinmayr et al., 2011, 2018, 2019; Steinmayr & Meißner, 2013). One such study (Steinmayr & Spinath, 2009) exemplifies this relationship. Figure 3 displays the main results.

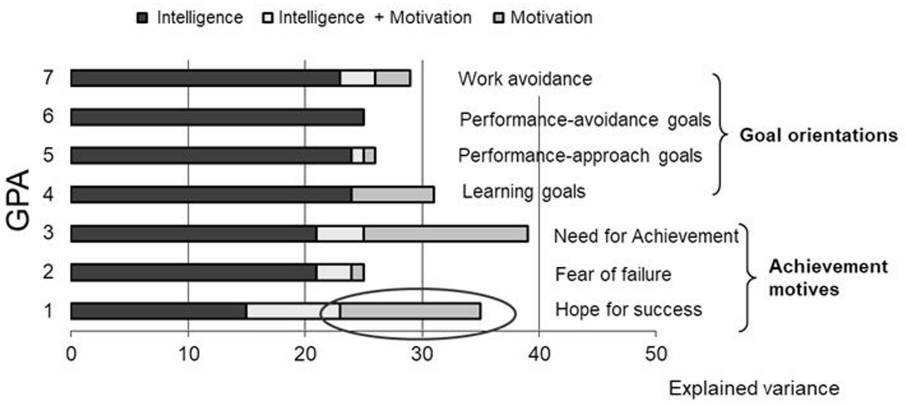

Figure 3: Graphical illustration of the commonality analysis results performed by Steinmayr and Spinath (2009).

In Figure 3, the medium grey portions of the bars in the results represent the unique variance in academic achievement attributed to motivation alone, even

after controlling for intelligence. Similar findings have been observed when controlling for personality alone or both intelligence and personality (Steinmayr & Spinath, 2007; Steinmayr et al., 2011). In all studies motivation accounted for variance in academic achievement which was not accounted for by the other constructs. As indicated by the light grey portions of the bars, some motivational constructs predict academic achievement in conjunction with intelligence. This shared variance—particularly strong for the construct "hope for success" in the displayed study—suggests an interaction effect between intelligence and achievement motives. Supporting this, other studies (Bergold & Steinmayr, 2018; Hufer-Thamm et al., 2023) demonstrated that intelligence was positively related to school grades only when accompanied by a certain level of achievement motivation, highlighting an interplay between these constructs in predicting academic success.

Besides its incremental validity in explaining variance in academic achievement, the importance of motivation is also underlined by its power to explain change in academic achievement. When asked about their child's academic struggles, many parents attribute it to a lack of motivation, believing that renewed motivation could lead to improved performance. Research supports this perception (see Lesperance et al., 2022). Across several studies, motivational constructs have been shown to predict changes in academic achievement, measured by both school grades and standardized achievement tests (Steinmayr et al., 2018, 2019; Steinmayr & Spinath, 2009). This is particularly noteworthy given that individual differences in academic performance tend to stabilize over time, limiting the potential for change. Remarkably, the effect of motivational constructs on changes in academic achievement was up to four times greater than the effect of intelligence, underscoring motivation's critical role in fostering academic growth (Steinmayr et al., 2019b; Steinmayr & Spinath, 2009).

2. Evaluating the relative importance of motivational constructs in academic achievement

Given the diverse array of motivational constructs it is crucial to empirically identify which are most predictive of academic success. Since the specific characteristics of a sample can influence the observed correlations, it is advisable to examine multiple motivational constructs within a single sample to rule out the possibility that differences in correlations are attributable to the sample's characteristics. Furthermore, expectancy-value constructs are often domain-specifically operationalized, while achievement motives are generally treated as more stable, trait-like characteristics assessed in a broader context. Since contextual-

ization affects the association between constructs (cf. Michel et al., 2022), it is essential to assess both motivational constructs and achievement outcomes at equivalent levels of specificity. To ensure the generalizability of findings across academic domains, it is also recommended to cross-validate results in multiple areas. Another challenge in motivational research is multicollinearity among constructs. Certain constructs, such as ability self-concepts, self-efficacy, and expectations for success, often overlap to the extent that they are nearly indistinguishable empirically (e.g., Marsh et al., 2019). Similarly, intrinsic values, intrinsic motivation, and interest are also closely related to each other but also to expectancy variables. Appropriate statistical techniques, such as commonality analysis and relative weight analysis, are therefore necessary to disentangle the specific contributions of these constructs (for specifics on relative weight analysis see Johnson & LeBreton, 2004; Tonidandel & LeBreton, 2011). Last but not least, to develop effective educational policies and implement meaningful school reforms, it is essential to gather strong empirical evidence on whether different motivational constructs can account for variations in school performance beyond the effects of other important variables, such as intelligence and prior achievement. Excluding these latter factors risks overstating the role of motivation in academic success.

Taking into account these thoughts, Steinmayr et al. (2019) sought to address these methodological considerations by examining various motivational constructs alongside prior performance and intelligence, with all variables assessed at comparable levels of specificity. We evaluated constructs from expectancy-value theory, including values and ability self-concepts, as well as achievement motives (hope for success and fear of failure), achievement goals (learning-approach, performance-approach, performance-avoidance), and work avoidance. Each variable was measured across different academic domains (general academic ability, math, and German), enabling cross-validation across subject areas and ensuring consistent specificity levels. A relative weight analysis, which quantifies the relative importance of each predictor in explaining variance in a criterion (LeBreton & Tonidandel, 2008), was employed due to the high intercorrelations among motivational constructs. The relative weight ε can be interpreted as an indicator of the relative importance of each motivational construct compared to other predictors and its thought to represent the share of explained variance in the specific grade by this specific motivational construct. In the study by Steinmayr et al. (2019), prior math grades emerged as the most significant predictor of subsequent math grades (explaining 45 % of the unique variance), followed by math self-concept (19 %). Students' math task values (9 %), learning goals (5 %), work avoidance (7 %), fear of failure, and hope for success (6 %) did not significantly differ in their contributions. Notably,

performance goals and intelligence did not significantly predict achievement when analyzed alongside prior grades. Similar patterns were observed for overall school achievement and language arts grades. Here again, among all motivational variables ability self-concepts and values were the strongest predictors (for more details see Steinmayr et al., 2019b). In a similar study, considering further variables such as grit – the consistency of interests and persistence in the pursuit of long-term goals (Duckworth et al., 2007) – and personality – operationalized as the Big Five of personality (Costa & McCrae, 1995) – Steinmayr et al. (2018) also found expectancy-value variables to be strongest predictors of academic achievement among all considered motivational variables. However, in both studies, expectancy-variables were more strongly associated with academic achievement than value variables. These findings held regardless of whether prior performance and intelligence were controlled (see also Steinmayr & Spinath, 2009; Steinmayr et al., 2011, 2018). Thus, regarding the question of which motivational constructs are particularly influential in shaping academic performance these studies demonstrated that domain-specific ability self-concepts, especially in math, are critical predictors of academic achievement. However, when it comes to achievement-related choices—such as vocational or academic pathways—values, particularly intrinsic values, become as significant as ability self-concepts (Steinmayr & Spinath, 2010). Consequently, in the following discussion, I will focus on expectancy-value constructs, which are both central to academic achievement-related criteria.

3. How to foster ideal expectancies and values

Before fostering expectancy constructs, it is essential to first determine the desired level of development. The question whether individuals should strive for a realistic or an optimistically biased self-view has especially been discussed with regard to ability self-concepts. Unlike intrinsic motivation, which is broadly beneficial if it is high, the optimal self-concept is less straightforward. Should one aim for a self-perception that aligns with actual abilities, or is a positively biased (overestimated) self-view more advantageous? If so, shall I overestimate myself just a little or greatly? The results of empirical research on self-estimation biases and academic performance are mixed, with some studies finding positive effects and others finding negative ones. These inconsistencies may arise from theoretical and statistical issues that often confound self-estimation bias with self-view effects (Humberg et al., 2018, 2019). Recent work by Paschke et al. (2020, 2023) clarifies that positively viewing one's competencies—irrespective of actual ability levels—can have a favorable impact on academic achievement.

If a positive self-concept (and intrinsic motivation) is beneficial, what fosters such an outlook? Several models explain the development of ability self-concepts across different domains, including the I/E model (Marsh, 1986), the big-fish-little-pond effect (e.g. Marsh et al., 2004), and the situated expectancy-value model (e.g. Eccles & Wigfield, 2020). According to the latter model, socializers' beliefs and behaviors—particularly those of teachers (cf. Steinmayr et al., 2019a)—affect students' self-concepts, which are empirically equivalent to expectations of success, and also values. However, the practical significance of teacher expectancy effects on students' development has occasionally been questioned due to their relatively small size (Jussim, 2017; Jussim & Harber, 2005). But most studies have concentrated on school performance, thus, this critique may overlook the possibility that teacher expectations influence numerous other important aspects of students' lives beyond academic achievement, for example ability self-concepts and values, as hypothesized by the situated expectancy-value model. The study by Bergold and Steinmayr (2023) investigated how teachers' expectations regarding students' abilities impact various student outcomes, including expectancy-value constructs. The longitudinal study involved 1,092 ninth-grade students from vocational track schools in Germany. Students completed assessments of their math and reading competencies, ability self-concepts, intrinsic motivation, academic and vocational aspirations, and subjective well-being. Teachers rated students' abilities in math and German using a seven-point scale based on national performance distributions. Our analysis revealed unique effects of math teachers' expectations on students' change in math performance, ability self-concepts, and educational aspirations. Though the effect of math teachers' expectations on intrinsic motivation was marginally insignificant ($p = .07$), intrinsic motivation at baseline predicted changes in math performance. German but not math teachers' expectancies affected students' life satisfaction. Teacher judgments thus affect many student outcomes at the same time, among them expectancy-value constructs, underscoring their practical importance for students' lives. Furthermore, they seem to be more important for expectancies than for intrinsic values. Thus, the question remains which variables additionally contribute to change of value variables.

The situated expectancy-value model (Eccles & Wigfield, 2020) does not only explain differences in intrinsic values but also in other values such as utility or attainment values and costs. Recently there has been a lot of research on interventions, especially minimal interventions to change values but also expectancies especially of disadvantaged groups (cf. Rosenzweig et al., 2020, 2022). Moreover, there is also increased interest in domain-specific beliefs about the nature of abilities, following research in implicit intelligence theories / mindsets.

Implicit beliefs about the nature of intelligence—whether viewed as fixed or malleable—are also pertinent to understanding motivational dynamics. Mindsets refer to an individual's subjective beliefs about whether specific attributes, such as intelligence or mathematical ability, are unchangeable or can be developed and improved (e.g., Dweck & Yeager, 2019). The belief that an attribute is fixed represents a fixed mindset, while the belief that it can be cultivated reflects a growth mindset. Unlike a fixed mindset, a growth mindset is theorized to enhance students' motivation and academic performance, especially among those facing challenges. Research indicates that when teachers view intelligence as unchangeable, their behavior tends to be more achievement-oriented, focusing on performance outcomes rather than the learning process (e.g., LaCosse et al., 2021; Park et al., 2016). However, such performance-oriented behavior has been linked to lower levels of student motivation, as it may create a high-pressure environment that prioritizes results over effort and improvement (e.g., Ames, 1992; Wirthwein et al., 2021). Furthermore, the nature of the learning environment significantly influences the way success is perceived and pursued. In achievement-oriented learning environments, the emphasis is on demonstrating one's competencies, with success often being defined in comparison to the accomplishments of peers (Ciani et al., 2010; Dweck & Leggett, 1988). This focus on relative performance strengthens the association between individual success and external validation. In contrast, learning-oriented environments prioritize the process of acquiring knowledge and improving personal competencies in those environments, success is measured by individual growth and mastery, leading to a weaker association with external comparisons or peer-relative outcomes (Dweck & Leggett, 1988; Meece et al., 2006). The self-determination theory explains individual differences in intrinsic motivation, among others, by different feeling of competences. Thus, in a learning-oriented environment, even students who receive performance feedback (in Germany mostly operationalized by grades) suggesting they are not performing as well as their peers can remain intrinsically motivated. Here, irrespective of a students' performance level, all students have the possibility to increase their competencies and thus perceive themselves as successful and competent learners which should weaken the association between grades and intrinsic values. In contrast, in a performance-oriented environment, only students outperforming their peer might be motivated which should strengthen the association between performance feedback and intrinsic motivation.

Following these rationales, Heyder et al. (2020) investigated whether math-specific implicit intelligence beliefs affected the association between students' intrinsic motivation and performance feedback (grades) in math in a large sample of German fourth graders and their 56 teachers. Findings revealed that

teachers were more likely to attribute success in math to innate ability compared to German language arts. Furthermore, the stronger a teacher held a belief in the necessity of innate ability for math success, the lower the intrinsic motivation of their low-achieving students. These results highlight that teachers' perceptions of math as requiring innate ability may hinder the creation of a classroom environment that promotes intrinsic motivation for all students and might be especially detrimental for low-achieving students.

These are just a few examples of factors that might influence expectancy-value variables. Beyond interventions and socializers' beliefs, numerous other factors impact these variables, including cultural norms, classroom characteristics, teaching styles, teacher attributes, environmental factors, and more (see Baumert et al., 2002; Eccles & Wigfield, 2020; Kunter et al., 2013). Recent research has focused on students' perceptions of socializers' beliefs (e.g., Reschke et al., 2023) and classroom characteristics (Wirthwein et al., 2021). Understanding the interplay between objective characteristics, students' perceptions of them, the factors influencing those perceptions, and their impact on key motivational constructs such as expectancy-value variables will significantly enhance our understanding of motivation.

4. Conclusion on the importance of motivation

Among the various motivational variables, expectations and values stand out as significant predictors of interindividual differences in career aspirations, academic achievement, and its progression over time (Nishen et al., 2024; Steinmayr & Spinath, 2009, 2010; Steinmayr et al., 2018, 2019). Thus, motivation holds considerable potential to enhance achievement-related outcomes across STEM fields and other domains. Importantly, it can be influenced by external factors beyond the individual, such as teachers' beliefs about ability, which can be modified to a certain extent. However, the role of motivation in academic achievement should not be overstated, as academic achievement is influenced by numerous factors as outlined by several models explaining interindividual differences in academic achievement (e.g., Eccles & Wigfield, 2020; Baumert et al., 2002, p. 16). Some of these factors are very hard to change and are thus relatively stable, such as social and educational family background, while others are more flexible, including the quality of teaching, for example due to a teacher change. Additionally, some factors interact with motivation, such as aptitude (Bergold & Steinmayr, 2018), while others are unrelated. Academic achievement is a highly complex phenomenon that cannot be fully explained by a single variable or even a set of related variables like motivation. This complexity underscores the need for a multidimensional approach to understanding

and fostering academic achievement which should consider motivation and its interplay with further achievement-related variables.

Furthermore, quite a lot of open questions remain concerning the role of motivation for academic achievement as motivation is a complex construct influenced by a variety of factors spanning individual, contextual, cultural, and biological domains. Recent research highlights the reciprocal effects between teacher characteristics and student motivation, emphasizing the dynamic interplay between educators' attitudes, behaviors, and students' motivational development (Kriegbaum et al., 2019). These findings underscore the importance of teacher-student interactions in shaping long-term educational outcomes. The effectiveness of motivational strategies and interventions has also garnered considerable attention, particularly regarding their sustainability over time. Minimal interventions, which require relatively low investment of time and resources, have been shown to yield significant benefits in certain contexts (Harackiewicz et al., 2023). However, understanding their long-term impact on student motivation and achievement is critical for informing evidence-based practices in education. Cultural differences further complicate the landscape of motivation. Cultural norms, values, and beliefs can shape motivational processes, influencing how individuals perceive success, effort, and failure (e.g., Chirkov et al., 2003; Heine et al., 2001). These variations highlight the necessity of culturally responsive motivational strategies to support diverse student populations which has rarely been investigated. On a more fundamental level, biological and neurophysiological foundations of motivation provide insights into the underlying mechanisms driving motivational behaviors. Advances in neuroscience have revealed how brain structures, neurotransmitter systems, and hormonal processes interact to influence motivation and goal-directed actions (Di Domenico & Ryan, 2017; Morris et al., 2022). However, there is still a need for a deeper understanding of how these biological and neurophysiological factors combine to produce unique motivational patterns, taking into account personal, environmental, and cultural influences. While significant progress has been made in identifying general mechanisms, much remains to be explored regarding their nuanced interplay and real-world applications. Another factor that needs more research is emotion. Motivation is also intricately linked with emotions. Emotional states can significantly enhance or undermine motivational processes, shaping individuals' goals (Chamani et al., 2023; Järvenoja et al., 2018), and performance in various activities. However, the process underlying these relations are not fully understood. The interplay between motivation and emotions is thus a critical area for further investigation. Lastly, sources of individual differences in motivation extend beyond frameworks like the situated expectancy-value model (Eccles & Wigfield, 2020). Factors such as

personality traits, prior experiences, and social influences contribute to these differences, underscoring the need for a more integrative understanding of the factors shaping motivation. By exploring these diverse dimensions, researchers and practitioners can develop more holistic approaches to fostering motivation in educational and other settings. Given its importance for academic achievement, the endeavor is worthwhile.

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