Moderating Effects of Educational and Learning Capital on the Consequences of Performance Feedback

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Abstract:
Feedback is highly recommended in educational settings and can deliver valuable information to guide one's learning efforts. However, it can—but does not need to—lead to detrimental effects on learners' motivation and emotions. The response should be moderated by the individual's attitudes, experiences, abilities and many other aspects which can be subsumed in the concept of educational and learning capital. This study investigated the effects of random feedback on a reasoning test, measuring the participants' subsequent cognitive, metacognitive, motivational and emotional responses. Initially, we assessed their educational and learning capital to analyze direct and moderating effects on the responses. Results showed that feedback effects were not as strong as expected while educational and learning capital exerted strong direct effects. Moderating effects were verified for only some responses.

Keywords:
Educational and learning capital, feedback, performance, motivation, emotion

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Feedback is omnipresent in our educational system as well as in our workplaces; it can be summative or formative, mandatory or optional, delivered in various forms and at different frequencies. In the educational context, it often serves as a teaching tool that is anticipated to have an effect on the future performance of the learner. However, the effects can extend beyond changing performance, for example by influencing the learner's motivation, expectations, or emotional state (e.g., Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Kluger & DeNisi, 1996; O'Leary & O'Leary, 1977). The current study sought to determine the effects of feedback in a university learning context and how these effects could be moderated by the students' resources, namely their educational and learning capital.

Effects of Feedback

The body of evidence on the effects of feedback is inconsistent. On the one hand, feedback has been shown to improve learning performance (e.g., Jacobs, 2002; Krause & Stark, 2004) and, if given in an informative manner, it can increase the learner's intrinsic motivation (e.g., Deci, Koestner & Ryan, 2001; Sansone, 1986). Indeed, Hattie's (2009) meta-analysis of learning success in the school system concluded that feedback was one of the most important instruments to support learning processes (10^{th} of 100+). On the other hand, no effects or even negative effects of feedback on the learning process can be found (e.g., Jacobs, 2002; Kluger & DeNisi, 1996). For example, Kluger and DeNisi (1996) found that feedback that diverted the learner's attention to their self-concept—such as praise, verbal feedback and feedback that could threaten the self-concept—can lead to negative effects because the learner's cognitive resources no longer concentrated solely on the task, but also on themselves. Further, strong emotional reaction can hinder performance. In contrast to this, feedback that focuses on the task level should have more positive effects on performance.

According to learning theories, feedback can have cognitive (e.g., performance standards), metacognitive (e.g., validation of self-evaluation) and motivational effects (e.g., higher motivation; cf. Krause, 2007; London, 2002, 2003). These three effect groups (cognitive, metacognitive and motivational) are highly connected with each other in theory, so that an empirical differentiation may be challenging (Krause, 2007). Constructivist approaches also consider feedback effects on emotions (e.g., anxiety; cf. Kluger & DeNisi, 1996).

We will outline the different effects of feedback on (a) cognition, (b) metacognition, (c) motivation and (d) emotion in the following.

Feedback Effects on Cognition

Feedback has a diagnostic function, it helps one to clarify misunderstandings and to identify gaps in knowledge and skills, and it also indicates one's strengths and can emphasize the possible areas of improvement (Krause, 2007). In addition, if feedback is perceived as useful, it has a positive effect on achievement (Harks, Rakoczy, Hattie, Besser, & Klieme, 2014). For example, the study of Balzer, Doherty and O'Con-

nor (1989) shows that cognitive feedback improves the performance on judgment tasks. Further, the study of Vollmeyer and Rheinberg (2005) shows, that feedback improves cognitive performance: the feedback group had gained more knowledge than the no-feedback group.

Feedback Effects on Metacognition

Studies on feedback effects on metacognition have often considered metacognitive judgments (e.g., Geurten & Meulemans, 2016), self-regulated learning (e.g., Butler & Winne, 1995), and metacognitive skills (e.g., Molin, Haelermans, Cabus, & Groot, 2020). Consequently, feedback can validate judgements. Evaluations from others can stimulate the deliberate reflection of one's self (self-judgements) and of one's errors (error-judgments). In the context of teaching, error-judgements are particularly interesting, as coping with failure is relevant for self-regulated learning.

Coping with failure means not giving up after failure, but instead trying to regain control of the situation and to initiate new actions to attain the desired goal (Mantzicopoulos, 1990; Mietzel, 2005; Newton & Keenan, 1985). Dresel, Schober, Ziegler, Grassinger and Steuer (2013) differentiate two types in coping with failure: the affective-motivational adaptivity of error reactions (e.g., preservation of positive affects) and the action adaptivity of error reactions (e.g., adjusting learning activities in order to cope with the error). For both these error reactions, feedback is needed in order to handle errors and to be able to learn from errors.

Feedback Effects on Motivation

Based on previous findings, Vollmeyer and Rheinberg (2005) recommend teachers to use feedback, not only because it provides the learner with information, but also because feedback is beneficial for one's motivation. Many studies have investigated effects of (negative) feedback on intrinsic motivation (e.g., Fong, Patall, Vasquez, & Stautberg, 2018). However, effects of feedback on self-confidence and implicit personality theories are also of interest in the motivational context.

The self-concept of one's abilities comprises the assumptions of the level of one's abilities, which depend significantly on the attribution of learning outcomes (e.g., Weiner, 1986). Attribution can be steered by feedback, helping students to find the reasons for their positive or negative learning outcome. It is favorable for motivation to attribute successful learning outcomes to high abilities and personal effort, and in turn attribute failure to little effort (Dresel & Ziegler, 2006). Further, the attribution of failure to one's insufficient abilities is non-beneficial for motivation in general and the self-concept in particular (Dresel & Ziegler, 2006). The latter also plays a significant role for successful learning outcomes, and therefore many training concepts focused on fostering a positive self-concept, however, the outcomes were limited because beliefs about the modifiability of one's abilities were neglected by such trainings (Dresel & Ziegler, 2006).

Therefore, in addition to considering self-concept, it is important to assess and to provide feedback according to the different implicit personality beliefs, especially the beliefs about the modifiability of one's abilities that individuals might have (e.g.,

Dweck, 1999). According to this, individuals perceive their abilities and intelligence either as stable (entity view) or recognize them as adaptable (incremental view). For example, Mueller and Dweck (1998) found out that praising children for being smart would probably favor the development of a fixed mindset (entity view), which implies that these children would be less persistent after failure and their learning outcomes would worsen. In contrast, if children were praised for their hard work, this would promote the development of a growth mindset (incremental view), which entails the belief that they are able to improve after failure, thus leading to more persistence and better learning outcomes.

In contrast to Dweck's theory (e.g., 1999, 2006), Ziegler and Stoeger (2010) considered it necessary to refine the distinction between entity view and incremental view. They assume that the entity view only shows negative consequences if a person shows ability deficits, but has positive consequences if a person shows high abilities. Furthermore, Ziegler and Stoeger (2010) give an overview on the literature on self-theories pointing out the benefits of maintaining the stability of positively judged aspects of one's self. For instance, higher levels of self-confidence are not only associated with higher achievement, but also with better learning processes, and more adaptive behavior (e.g., Dweck, 1999; Gist & Mitchell, 1992; Pajares, 1996). Following this line of thought, Ziegler, Fidelman, Reutlinger, Vialle, and Stoeger (2010) proposed two beliefs about one's own learning: believing in the stability of one's abilities and believing in the modifiability of one's ability deficits. A stability belief refers to the conviction that one's learning reliably leads to success across a wide variety of situations and, thus, the result of one's learning is stable. Modifiability beliefs regarding one's ability deficits allow for improvement through learning and therefore make future success possible.

Feedback Effects on Emotion

Emotions also play an important role in the context of learning processes and their outcomes. Performance-related emotions should be considered in teaching (Pekrun, Elliot, & Maier, 2006) and therefore also in feedback situations. Yet, there has been little research on this topic (Värlander, 2008). Tennant (1997) draws attention to the fact, that once emotions are aroused, they cannot be turned off that easily, and they might hinder the learning process for days.

A perfect example is anxiety, possibly one of the strongest basic human emotions. According to the Yerkes-Dodson-law, performance increases with physiological or mental arousal, but only up to a certain point (e.g., Yerkes & Dodson, 1908). When anxious feelings overly dominate, especially in achievement situations, they can be dysfunctional towards learning outcomes. Kluger and DeNisi (1996) define anxiety as the "evaluation of a threat to the goals of the self, combined with a tendency to act to terminate the threat" (p. 267). Taking action to terminate the threat requires resources. Hence, feedback-induced emotion may influence the way the individual's available resources are used (Kluger & DeNisi, 1996).

According to self-enhancement theories, when faced with self-esteem relevant information, such as the case of feedback on one's performance, individuals tend to protect or increase their self-esteem (Peterson, Stahlberg, & Dauenheimer, 2000; Sedikides & Strube, 1995). When facing negative feedback, individuals tend to avoid

or reinterpret this information, in order to protect their self-esteem and to avoid negative emotions, such as anxiety. In contrast to self-enhancement theories, self-consistency theories (e.g., Swann, 2011) have a different explanatory approach whereby individuals tend to preserve the consistency of their self-attitudes. This implies that individuals with a positive self-esteem will prefer positive feedback, and that those with a negative self-esteem will prefer negative feedback. Empirical evidence for both approaches can be found, the effects depend on characteristics of the feedback (feedback design) and on personal characteristics of the learner (see section on moderating factors on feedback effects).

Our study focused on concepts from all four groups of feedback effects: (a) cognitive, that is, cognitive performance after feedback; (b) metacognitive, that is, coping with failure in two ways, namely adapting affective-motivationally to the failure and adapting one's actions after failure; (c) motivational, that is, self-confidence and stability/modifiability beliefs after feedback; and (d) emotional outcomes, that is, anxiety. This comprehensive overview of the feedback effects is the basis to determine possible moderating effects of resources which will be outlined next.

Moderating Factors on Feedback Effects

In the following sections, we will describe why the different effects of feedback on the learner and the learning outcomes can be explained by feedback design and through personal characteristics of the feedback recipient.

Feedback Design

Feedback design contains many different aspects, including form, content, timing, accuracy, reference norm and presentation mode of the feedback.

Feedback Forms

Some literature on feedback differentiates several forms of feedback (e.g., Jacobs, 2002; Kulhavy & Stock, 1989). Arguably, the most important differentiations are: knowledge of results (information about the achieved results), knowledge of correct results (information about the correctness of results), answering until correct (the learner has to try giving the answer until reaching the correct one), and elaborated feedback (additional information, for example, why the answer is correct or false). Elaborated feedback is more effective for subsequent performance than the other forms of feedback, particularly regarding complex tasks (Bangert-Drowns et al., 1991; Collins, Carnine & Gersten, 1987; Krause & Stark, 2004).

Feedback Content

Feedback information can refer to one's performance in a task or refer to oneself, such as personal development, or a combination of both. According to Kluger and DeNisi (1996), the effectiveness of feedback decreases as the feedback information becomes more self-orientated and through this, the attention of the feedback recipient moves away from task content towards themselves.

Feedback Timing

A further distinction can be made based on the timing of feedback. The terms "immediate" and "delayed" feedback are not precisely defined (Dempsey, Driscoll, & Swindell, 1993). Immediate feedback, for example, can be given after each item or after finishing the test, while delayed feedback can be given after a fixed time interval, such as a few seconds after finishing the test or after one week. According to the meta-analyses of Kulik and Kulik (1988), immediate feedback is on average slightly more effective for learning outcomes than delayed feedback. This positive effect of immediate feedback is stronger for simple tasks such as learning new words in a foreign language. When it comes to more complex tasks such as comprehending the content of a text, however, delayed feedback is more effective.

Feedback Accuracy

Feedback can be genuine, meaning the actual performance is fed back, or it can be fake, meaning a false performance is fed back. In cases of random feedback, which might be given to avoid performance levels confounding with feedback effects, special attention should be paid to accuracy so that the feedback can either match or mismatch the actual performance. Therefore, additional control variables are in order, such as assessing participants' awareness of the (in-)accuracy (e.g., Shibata, Yamagishi, Ishii, & Kawato, 2009) or asking for their performance judgements to assess their feedback expectation (e.g., Alloy & Abramson, 1979; Sedikides, Campbell, Reeder, & Elliot, 1998).

Feedback Reference Norm

When giving feedback, one can choose among (or also combine) the three different reference norms: criterial, individual and social reference norm (Krause, 2007). Many feedback studies use the criterial reference norm, where the content of feedback is orientated at the learning objective. When choosing the individual reference norm, feedback is orientated at the individual development in a learning domain. Using the social reference norm, students receive feedback on how good their individual performance was compared to other students. Findings show that, when using the criterial or the individual reference norm, feedback can be accepted more easily, than when using the social reference norm (Kopp & Mandl, 2014).

Feedback Presentation Mode

Feedback can be received face-to-face from others, such as teachers, other students, or researchers, or it can be received by non-person means, such as paper-pencil-based or computer-based feedback. Further, feedback can be presented in written, graphic or audible form. Findings suggest that, face-to-face feedback is easier to accept, because there is the possibility to request more information (Krause, 2007).

Personal Characteristics of the Feedback Recipient

As mentioned above, it is not only the feedback's design but also the personal characteristics of the feedback recipient that are important in order to explain the different effects of feedback on the learner and their learning outcomes. Several studies show

that feedback is often received sub-optimally (e.g., Anderson, Kulhavy, & Andre, 1971; Hancock, Thurman, & Hubbard, 1995; Jacobs, 2000; Jacoby, Troutman, Mazursky, & Kuss, 1984, Stark, 2001). These findings imply that conscious feedback reception is highly dependent on variables of the feedback recipient, like prior knowledge, cognitive resources, metacognitive control strategies, interest, motivation, feedback acceptance, negative emotions and personal preferences for a learning subject etc. Considering the large number of possible personal variables that can have an influence on the learner's feedback reception, we will discuss only some of these variables.

Learner's prior knowledge

The findings of Jacoby et al. (1984) show that students with a higher level of prior knowledge can implement the feedback more easily than students with lower levels of prior knowledge. Further, students with lower levels of prior knowledge need more complex forms of feedback (e.g., elaborated feedback), while for students with higher levels of prior knowledge simple forms of feedback (e.g., knowledge of result) are sufficient (Hanna, 1976).

Learner's motivation and feedback acceptance

Several studies show that in order for feedback to work, feedback information must be processed and used by the feedback recipient (Bangert-Drowns et al., 1991; Hancock, Thurman, & Hubbard, 1995). Bangert-Drowns and colleagues (1991), for example, refer to a mindful reception of feedback, whereby the individual consciously receives the feedback. This requires an adequate level of motivation (Kulhavy, 1977). Furthermore, the learner's feedback acceptance is important, meaning the credibility of feedback or to what extent the feedback is in accordance with the learner's own performance judgements or feedback expectations. For example, some studies have demonstrated that people tend to devalue feedback, when it is worse than they expected (Alloy & Abramson, 1979; Sedikides et al., 1998).

Considering the large number of possible influences on the learner's feedback reception, we will try to assess this comprehensively with the concept of educational and learning capital.

The Possible Role of Educational and Learning Capital

Before introducing the concept of educational and learning capital, we first have to describe the term 'actiotope'. Ziegler, Vialle and Wimmer (2013) define one's actiotope as comprising the individual and the material, social, and informational environment with which the individual interacts. Depending on the quality of this interplay between individual and environment, an individual delivers different performances. In order to attain any goal, resources are helpful and often necessary. In the case of learning goals or striving towards better performance levels, learning resources are required. Ziegler and Baker (2013) differentiate between exogenous and endogenous learning resources, depending on where in an actiotope the resources are situated: either in the environmental component of an actiotope (i.e., exogenous resources, also termed educational capital) or in the individual component of an actiotope (i.e., en-

dogenous resources, also termed learning capital). Furthermore, Ziegler and Baker (2013) distinguish five different forms of educational and five different forms of learning capital. For definitions, illustrations and examples of the ten capitals see Table 1.

Table 1 *Definitions, Illustrations and Sample Items of the Five Forms of Educational Capital and the Five Forms of Learning Capital*

Type of capital	Definition	Illustration	Sample item
Educational capital			
Economic educational capital	Economic educational capital is every kind of wealth, possession, money or valuables that can be invested in the initiation and maintenance of educational and learning processes. (p. 27)	Economic educational capital can be used as a targeted support for students, to pay for stimulating educational games, for appropriate tutors and mentors, or even for the higher public transportation fee to a good university in a distant area.	My family is willing to spend more money than others for learning.
Cultural educational capital	Cultural educational capital includes value systems, thinking patterns, models and the like, which can facilitate - or hinder - the attainment of learning and educational goals. (p. 27)	Are male students who want to become a primary school teacher seen in the same light as the female students who aspire the same position? What about professor for physics: what is the common gender issue about this topic in your country?	In my social environment learning is considered to be very important.
Social educational capital	Social educational capital includes all persons and social institutions that can directly or indirectly contribute to the success of learning and educational processes. (p. 28)	Social resources can be needed in order to gain access to specific learning environments (e.g., scholarships, networks) or in order to improve/establish learning conditions (e.g., supportive partner, supportive friends).	My friends and my family support me in my learning.
Infrastructural educational capital	Infrastructural educational capital relates to materially implemented possibilities for action that permit learning and education to take place. (p. 28)	Infrastructural capital implies the availability of libraries and learning-medias in schools and universities, which can support the development of interests and facilitate good learning conditions.	I have optimal learning opportunities.
Didactic educational capital	Didactic educational capital means the assembled expertise involved in the design and improvement of educational and learning processes. (p. 29)	Didactic educational capital has increased over the last decades, due for example to better organised teaching techniques and pedagogically improved learning feedback. This is shown in rises in performance levels in all domains. For example if the IQ-Test wouldn't be continually adjusted, then the average IQ would be much higher in the recent decades (e.g., Flynn, 2007).	I use suggestions and tips on how I learn best.

Table 1 (continued)

	Learning capital		
Organismic learning capital	Organismic learning capital consists of the physiological and constitutional resources of a person. (p. 29)	The availability of organismic learning capital is important not only for physiological activities, but also for cognitive activities needed for study achievements (Bellisle, 2004; Gottfredson, 2004).	My very good physical condition is a good basis for my continuous learning.
Actional learning capital	Actional learning capital means the action repertoire of a person - the totality of actions they are capable of performing. (p. 30)	The current available action repertoire is a good predictor for future performance (Ziegler, 2008).	I always know exactly what I can learn.
Telic learning capital	Telic learning capital comprises the totality of a person's anticipated goal states that offer possibilities for satisfying their needs. (p. 30)	Telic learning capital is the availability of functional goals for the learning process, like planning the next learning step under good physical conditions (the importance of rest periods).	I have set myself the learning goal to learn more and more.
Episodic learning capital	Episodic learning capital concerns the simultaneous goal- and situation-relevant action patterns that are accessible to a person. (p. 31)	If a student speaks fluently English as a foreign language, this does not imply, that this student will always say the "right" thing when asked questions by the professor in an English seminar.	Due to various experiences, I know how I can achieve outstanding success.
Attentional learning capital	Attentional learning capital denotes the quantitative and qualitative attentional resources that a person can apply to learning. (p. 31)	If students spend a lot of their time on leisure activities, such as chatting with friends then the quantitative attentional resources for learning can be diminished. The attentional quality can be reduced if students do not have a quiet work place for studying at home.	I can concentrate without distractions on my learning for university.

Note. All definitions are quotes from Ziegler & Baker (2013); all sample items are from the QELC (Vladut et al., 2013);

Educational and learning capital have already been shown to be associated with high performance levels and effective learning processes (Debatin, Hopp, Vialle, & Ziegler, 2015; Harder, O'Reilly, & Debatin, 2018; Harder, Trottler, Vialle, & Ziegler, 2015; Vladut, Liu, Leana-Taşcilar, Vialle, & Ziegler, 2013; Vladut, Vialle, & Ziegler, 2015; Ziegler & Baker, 2013; Ziegler, Debatin, & Stoeger, 2019; Ziegler & Phillipson, 2012). According to their positive role in an actiotope and in learning processes, resources should also help in dealing with feedback. Of particular interest is the case of negative feedback. For example, having a supportive environment and favorable dispositions should buffer the potentially crushing effect of negative feedback. A learner with a lot of educational and learning capital at their disposal should be able to maintain their motivation, adapt to the experience of failure affectively and through reorganizing their actions for upcoming performance situations; and, the learner should remain self-confident instead of becoming anxious because they trust their endogenous resources as well as the environment's support. By contrast, the lack of those resources

should make a learner susceptible to giving up after failure, developing anxieties, and so on. In the case of positive feedback, high levels of resources should help the learner to embrace their success and continue to perform successfully. However, this task should not be nearly as demanding as being confronted with a personal failure.

Given the width of the concept, we posit that educational and learning capital should be a valid conceptualization of the moderating circumstances, which either lead to positive or negative outcomes after feedback.

Current Study and Research Questions

The current study investigated feedback effects on (a) cognitive, (b) metacognitive, (c) motivational and (d) emotional outcomes. As not all potential variables could be examined, we focused on (a) cognitive performance after feedback, (b) coping with failure in two ways, namely adapting affective-motivationally to the failure and adapting one's actions after failure. Subsequently, we examined (c) self-confidence and stability/modifiability beliefs after feedback and (d) anxiety. We presented students with a piece of random feedback after a cognitive test they had taken one week before and also took into consideration their judgements on their pretest performance to account for the feedback's credibility. Finally, we wanted to determine the moderating role of educational and learning capital on the feedback effects as this concept captures not only characteristics of the learner that are known to moderate feedback effects, but also the resources within their environment comprehensively.

Our research questions were threefold. As the effects of feedback depend on multiple moderating variables, feedback does not necessarily lead to an improvement of performance or change motivation and emotion in a desired direction. Therefore, the first aim of our study was to analyze whether different feedback leads to different reactions in cognitive, metacognitive, motivational and emotional outcomes. In general, we assumed that the more negative the feedback experience (negative feedback combined with matching performance judgements), the more negative would be the effects on the outcome variables.

Second, given that resources are indispensable to learning processes we expected to find positive effects of high educational and learning capital on the outcome variables in general, while low capital should yield negative effects.

Third, assuming that resources play a major role in dealing with negative feedback compared to the much easier situation of accepting positive feedback, we wanted to investigate whether educational and learning capital moderate the effects of feedback on the cognitive, metacognitive, motivational, and emotional outcomes. We expected to find interaction effects stating that high educational and learning capital buffer the effects of negative feedback while in the case of positive feedback it should not appear that important.

Method

Study Design and Procedure

Our study design was an experimental field study with two measurement points and randomized assignment of participants to

one of three feedback conditions. At the first time of assessment, the participants (N = 140) were requested to provide some personal data and they completed a questionnaire on educational and learning capital. Finally, they took an abbreviated test of cognitive performance and gave their judgement on the test performance. One week later, at the second time of assessment, participants randomly received one type of feedback on their performance in the cognitive performance test, assigning them either to the *upper third* (N = 46), *middle third* (N = 51), or *lower third* (N = 43) of the participating group. Then the students were requested to complete questionnaire scales on self-confidence, coping with failure, anxiety, and implicit personality theories. Finally, the students took another cognitive performance test.

In our study we wanted to reach as many students as possible during the online semester due to the COVID-19 pandemic. Further, we wanted to eliminate person-based bias when giving feedback (e.g., unconscious non-verbal signals of the feedback giver). Thus, we chose computer-based data collection in the environment of an online lecture and a computer-based written presentation mode of the feedback.

Regarding feedback form, we chose the feedback form 'knowledge of results', because we wanted it to contain the minimum of information, in order to see how this minimal information affects the chosen variables. Regarding feedback accuracy, our given feedback was randomized, meaning the feedback could have been genuine (positive, mediocre or negative) or it could have been fake (positive, mediocre or negative). To control accuracy, we assessed students' judgements of their performance in the pretest (coded exactly as the feedback). Regarding the feedback reference norm, we chose the social reference norm, meaning the students received feedback on how good their individual performance was compared to other students. This could be seen more like an achievement situation, where anxious feelings following the feedback could arise.

Sample

Our sample consisted of N = 140 university students in teacher training, 26 male and 112 female, ranging from 19 to 38 years of age (M = 22.09, SD = 3.29) and 1 to 10 semesters of study. Most of them were in the first half of their studies (50.7 % in 2nd semester, 38.6 % in 4th semester). The mean grade of the students was calculated based on the last three grades that they had received in their studies (M = 2.38, SD = 0.57). This placed them in the upper-middle segment of the performance spectrum (the German grading system ranges from 1 *excellent* to 6 *insufficient*). Participants were recruited over a mandatory psychology lecture and gave their informed consent before participating in the study.

Measures

The measures taken comprised several questionnaire scales and two cognitive performance measures, namely intelligence tests. Questionnaire scales phrased for the school setting were adapted to the university context.

Educational and Learning Capital

Educational and learning capital was measured with the QELC (Questionnaire of Educational and Learning Capital; Vladut et al., 2013), which consists of ten subscales

measuring the ten forms of educational and learning capital with five items each. An example item would be "I have optimal learning opportunities" (infrastructural learning capital). Answers were given on a six-point Likert-scale ranging from 1 *I disagree completely* to 6 *I agree completely*. We used the comprehensive scales of educational and learning capital, each consisting of the mean value over the five subscales, which yielded acceptable reliabilities of Cronbach's α = .68 for educational capital and of α = .86 for learning capital.

Self-Confidence

We used the scale "Confidence in one's own competence" developed by Dweck and Henderson (1988), later adapted by Ziegler and Stoeger (2010). The scale consists of four bipolar items presenting two opposite statements. One corresponds to a negative self-evaluation (e.g., "I am not sure that I am good enough to be successful in in my university-studies") and the other pole corresponds to a positive self-evaluation (e.g., "I am sure that I am good enough to be successful in my university-studies"). Participants answered on the aforementioned six-point Likert-scale. Reliability of the self-confidence scale was satisfactory with α = .81.

Coping with Failure

Dresel et al. (2013) developed two scales that measure the degree to which a person copes adaptively with failure or errors. Two types of reactions on errors are distinguished: the *affective-motivational adaptivity* of error reactions (e.g., "If I get the answer wrong, it spoils my good mood for the entire seminar session") and their *action adaptivity* (e.g., "When I've made a mistake, I aim to improve myself"). Each subscale comprises seven items and uses the aforementioned six-point Likert scale answering format. Reliability of the subscale affective-motivational adaptivity was α = .86, and for the subscale action adaptivity the reliability was α = .83.

Anxiety

In order to assess anxiety, a six-item scale published by Ziegler, Dresel, Schober, and Stoeger (2005) was applied. A sample item reads "When I think of my university studies, I am afraid to get a bad mark". Answers were again given on the six-point Likert-scale with a higher scale value indicating a higher anxiety level. The reliability of the anxiety scale was good with α = .79.

Stability/Modifiability Beliefs

Dweck (e.g., 1999, 2006) proposed two different implicit personality theories, the fixed mindset assuming abilities are stable and the growth mindset assuming abilities can change. Ziegler and Stoeger (2010) refined the concept differentiating it further into stability beliefs regarding existing abilities and modifiability beliefs regarding ability deficits. They were measured with two subscales of six items each (Ziegler & Stoeger, 2010). A sample item for stability beliefs reads "After I have learned something, I don't forget how to apply it". A sample item for modifiability beliefs is "I can improve my skills". Answers were again given on the six-point Likert-scale. The reliability of the subscale stability beliefs was α = .87, and for the subscale modifiability beliefs the reliability was α = .80.

Performance

On the first measurement point, we assessed performance with a selection of 16 matrices from the RAVEM APM (Kratzmeier, 1980), which measure fluid intelligence. Due to shortening of the test (we used a selection of 16 out of the 36 matrices), no IQ scores were calculated; instead, we used raw-scores. The reliability was low with $\alpha = .60$.

On the second measurement point, we assessed performance with the BEFKI GK-C (Schipolowski, Wilhelm, & Schroeders, 2013), a test of crystalline intelligence or general knowledge. It consists of 12 multiple-choice items (one answer out of four options is correct) drawn from different domains, e.g., medicine, religion and history. Reliability of the test was lower than expected at $\alpha = .52$. We assume this was because each of the 12 questions was from a different knowledge domain.

Nevertheless, this is not highly problematic, neither for the measurement of the fluid intelligence nor for the measurement of the crystalline intelligence, because the measure of intelligence was not the objective of our current study. Hence, most scales that we used for the study showed acceptable reliabilities.

Data Analysis

To test the effects of feedback and judgements separately and combined (interaction effect) as well as the influence of educational and learning capital and its moderating effects on feedback and judgement, hierarchical regression analyses were performed with interaction terms consisting of the product term of the predictor and the moderator (see e.g., Cohen, Cohen, West, & Aiken, 2003). All models were performed by entering predictors step by step, always testing the new model against the previous version with fewer predictors (change in R^2). In a first step, the main effects of feedback and judgement were tested. Second, their interaction term was added (model 2). Both models served to evaluate our first research question. In model 3 educational and learning capital was entered into the equation to show its main effect (second research question). Finally, the interaction terms of educational and learning capital with feedback and judgement respectively were added in model 4, testing the moderating effects stated in research question number three. To obtain appropriate beta weights for the interaction terms, all variables were z-standardized beforehand and the interaction terms (cross products) were calculated with z-standardized values instead of using the z-standardized raw-variable product term (Cohen et al., 2003; LeBreton, Tonidandel, & Krasikova, 2013). All regression analyses were performed with SPSS 25 (IBM, 2017).

Moderator analysis demands hierarchically well-formulated models (Cohen et al., 2003; Hayes, 2018; Jaccard & Turrisi, 2003), i.e., all factors of a lower hierarchy order (the main effects) must be included when a higher order predictor (the interaction term) is to be analyzed. This demand can lead to collinearity among predictors which also happened in our analyses. Therefore, beta weights in regression analyses including interaction terms cannot be interpreted reliably and we will evaluate the significance of an additional predictor only by the produced change in R^2.

Unfortunately, beta weights represent the effect sizes and thereby are of great importance to interpret results (LeBreton, Hargis, Griepentrog, Oswald, & Ployhart, 2007). They allow for within model comparisons of

predictors' influence on the criterion, while the approach of interpreting changes in R^2 only allows for between model comparisons (LeBreton, Tonidandel, & Krasikova, 2013). Hence, to gain more insight into each predictor's true contribution to the total of explained variance, we also performed relative weight analyses (RWA; Johnson & LeBreton, 2004; Tonidandel & LeBreton, 2011). The relative weight (RW) refers to a predictor's true importance in explaining variance, i.e., taking into account shared variance between collinear predictors instead of neglecting those variance portions and thereby biasing the beta weights. To do so, RWA creates new orthogonal variables that are maximally related to the original predictors. Then, the dependent variable is regressed on the orthogonal variables to save their standardized regression *coefficients*. Next, the original predictors are regressed on the orthogonal variables to obtain the standardized regression *weights*. Last, the procedure multiplies each squared *weight* with each squared *coefficient*. The sum of all products an original predictor is involved in represents its RW and all RWs sum up to the total of explained variance (R^2). RWAs were carried out with the RWA-Web Tool (Tonidandel & LeBreton, 2015) which provides R Code (R Core Team, 2020). RWAs were run for each criterion on the regression model 4 including all predictors of interest to compare their relative contribution to the total explained variance. RWs were tested for significance using bias corrected and accelerated 95 % confidence intervals (equals an alpha error of 5 %) and 10,000 replications bootstrapping. In order to analyze interaction effects with RWA, LeBreton, Tonidandel and Krasikova (2013) recommend using residualized interaction terms, i.e., regressing the criterion on the predictors involved in the interaction effect (the main or lower order effects) and saving the residuals which represent the "clean" interaction effect. These residualized interaction terms represent only the higher order effect independent of the lower order effects (dependency represents an interpretation and collinearity problem in regular analyses techniques), allowing for easy interpretation and direct comparison with other effects.

Results

Descriptive Statistics and Correlations

Table 2 provides descriptive statistics for all scales as well as their bivariate correlations. Feedback and performance judgements were coded 0, 1, 2 for lower, middle and upper third of the sample respectively. Feedback was distributed about evenly across the sample as reported above (M = 1.02, SD = 0.80). Students judged their performance slightly lower and with less variance than the random feedback suggested (M = 0.95, SD = 0.60). The performance measures showed expected means: The mean pretest score was 11.22 points out of 16 (70 % correct) and for the posttest scores 8.20 points out of 12 (68 % correct). All other scales could range from 1 to 6 and most of them showed medium scores and normal standard deviations (anxiety scores were below, self-confidence, action adaptivity after failure and modifiability beliefs were above the scale center).

Correlations between all variables showed two unexpected findings. Feedback did not correlate with other variables while judgements did. Hence, the effects of random feedback alone seem to be weak, which supports the idea of additionally consider-

ing judgements to account for (in-)congruence or credibility effects. Second, the pre- and posttest performances did not correlate with other variables, which is surprising and will be discussed later. Aside from that, all variables correlated significantly in the expected direction with the exception of the non-significant relation between stability beliefs and anxiety ($r = -.15$).

Table 2 *Means, Standard Deviations, and Bivariate Correlations of All Scales*

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. ELC	3.62	0.56										
2. Pretest	11.22	2.11	.041									
3. Judgement	0.95	0.60	.334**	.450**								
4. Feedback	1.02	0.80	.081	.027	−.028							
5. Self-confidence	4.20	0.88	.429**	.068	.246**	.093						
6. Affective-motivational adaptivity a. f.	3.78	0.85	.174*	−.088	−.028	.024	.301**					
7. Action adaptivity a. f.	4.33	0.64	.422**	−.000	.189*	.105	.336**	.422**				
8. Anxiety	2.63	0.90	−.228**	.031	−.028	−.097	−.568**	−.507**	−.207*			
9. Stability beliefs	3.33	0.82	.227**	.065	.104	.061	.257**	.299**	.256**	−.150		
10. Modifiability beliefs	4.74	0.63	.316**	−.122	.154	.081	.546**	.483**	.522**	−.408**	.230**	
11. Posttest	8.20	2.09	.049	.138	.065	.023	.047	.025	.016	−.063	.115	−.009

Note. * $p < .05$, ** $p < .01$, ELC = educational and learning capital, a. f. = after failure;

Effects of Feedback and Performance Judgement

Models 1 and 2 tested the influence of feedback and performance judgements. As can be seen in table 3, feedback did not show any significant effects on response variables while students' judgements influenced their self-confidence and action adaptivity after failure, meaning higher judgements came with higher self-confidence and higher action adaptivity after failure.

The interaction term feedback x judgement raised the R^2 in models 2 slightly for action adaptivity ($\Delta R^2 = .025$, $p < .10$) and significantly for affective-motivational adaptivity after failure ($\Delta R^2 = .057$, $p < .01$). Figures 1 and 2 visualize the effects. For affective-motivational adaptivity we find a congruence effect, meaning that the highest adaptivity scores coincide with matching judgements and feedback. For mediocre judgements the differences appear to be very small, so all sorts of feedback seem to be easily acceptable, whereas high and low judgements combined with incongruent feedback lead to lower affective-motivational adaptivity. For action adaptivity (figure 2) we find the same pattern but less pronounced (as expected by the marginally significant effect). Hence, congruence played a role for adapting after failure but not for other outcomes.

Direct Effects of Educational and Learning Capital

Models 3 (see table 3) added educational and learning capital as a predictor to the regressions. We find significant gains in explained variance compared to model 2 without this predictor for all variables, except the posttest which remained unaffected by educational and learning capital. The signif-

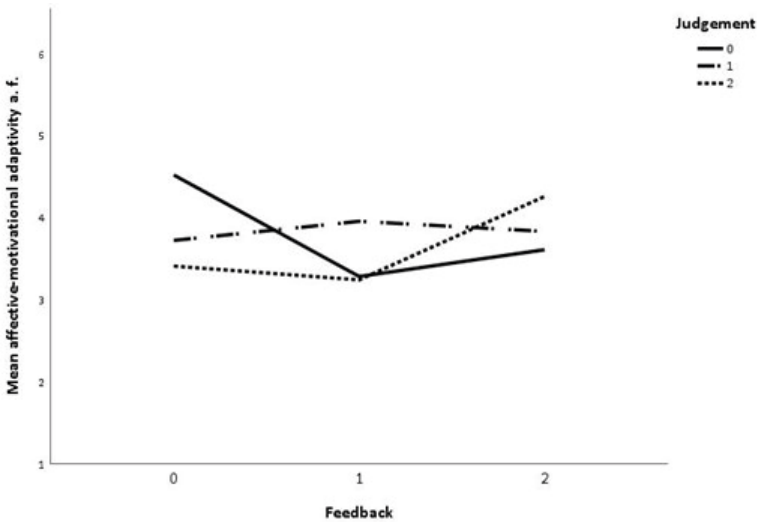

Figure 1 Interaction of feedback and performance judgement on students' affective-motivational adaptivity after failure.

icant changes in explained variance range from ΔR^2 = .027 for affective-motivational adaptivity after failure up to ΔR^2 = .123 and ΔR^2 = .125 for self-confidence and action adaptivity after failure. Relying on the signs of the beta weights these effects are all positive, i.e., higher capital coming with more favorable motivational and affective responses (also less anxiety, the negative sign here refers to the desired association).

Moderating Effects of Educational and Learning Capital

A moderating effect of educational and learning capital was found for anxiety and stability beliefs (ΔR^2 = .052, p < .05 and ΔR^2 = .068, p < .01). In the case of anxiety this is based on the interaction of educational and learning capital and judgement with a RW = .052 (equals the ΔR^2), in the case of stability beliefs on the other hand, the interaction of educational and learning capital with feedback contributes RW = .050 to the R^2.

In both cases, figures 3 and 4 indicate that the effect stems from students with low educational and learning capital. For anxiety (figure 3), only these students show different anxiety levels depending on their performance judgements. Thinking they have done well in the pretest led to more anxiety than judging their pretest performance as mediocre and they seemed to experience even less anxiety when having judged their performance as low. Hence, the higher their judgements, the higher their anxiety when they possessed low educational and learning capital.

For stability beliefs among students with low educational and learning capital, figure 4 indicates that more negative feedback led to lower stability beliefs, i.e., these students lost some faith in the stability of their competence after one piece of nega-

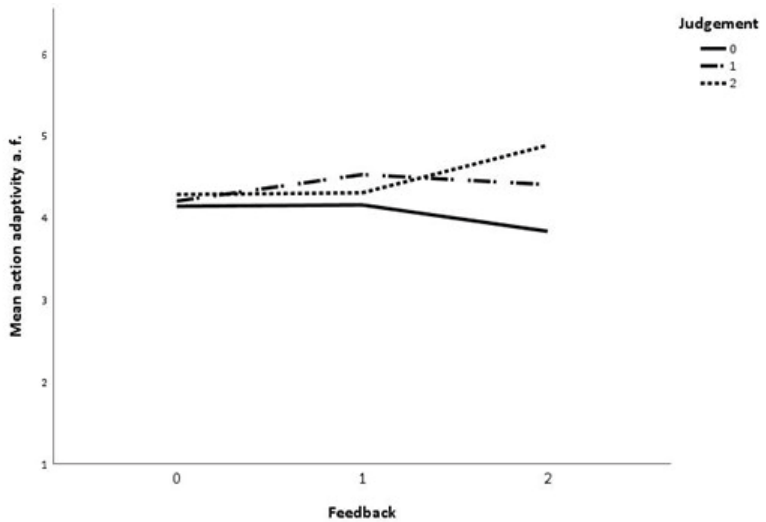

Figure 2 Interaction of feedback and performance judgement on students' action adaptivity after failure.

Table 3 *Results of Hierarchical Regression Analyses and Relative Weight Analyses for All Outcome Variables*

Predictor	Self–confidence					Action adaptivity a. f.					Affective–motivational adaptivity a. f.					Anxiety				
	β	ΔR^2	R^2	RW[b]	RS–RW (%)[c]	β	ΔR^2	R^2	RW[b]	RS–RW (%)	β	ΔR^2	R^2	RW[b]	RS–RW (%)	β	ΔR^2	R^2	RW[b]	RS–RW (%)
Model 1:		.070	.070**				.048*	.048*				.001	.001				.010	.010		
Feedback	.100					.111					.024					−.098				
Judgement	.249***					.192*					−.028					−.031				
Model 2:		.008	.079*				.025+	.073*				.057**	.059*				.008	.019		
Constant	.003					.005					.007					−.003				
Feedback	.092					.097					.003					−.090				
Judgement	.261***					.213*					.004					−.043				
Feedback x Judgement	.095					.166+					.251**					−.095				
Model 3:		.123***	.202***				.125***	.198***				.027*	.085*				.046*	.064+		
Constant	.001					.003					.006					−.002				
Feedback	.062					.067					−.011					−.072				
Judgement	.128					.078					−.058					.038				
Feedback x Judgement	.046					.116					.228**					−.065				
ELC	.377***					.381***					.175*					−.230*				
Model 4:		.012	.214***				.015	.214***				.025	.110*				.052*	.116*		
Constant	−.037					−.031					−.048					.077				
Feedback	.052			.006	2.6	.057			.007	3.2	−.025			.000	0.2	−.051			.006	4.9
Judgement	.116			.037	17.3	.078			.022	10.4	−.071			.003	2.9	.057			.002	1.4
Feedback x Judgement[a]	.018			.002	1.2	.133			.017	8.0	.204*			.045	40.5	−.035			.004	3.6
ELC	.388***			.155*	72.5	.400***			.152*	71.1	.195*			.030	27.0	−.259**			.050	43.0
ELC x Feedback[a]	.051			.003	1.4	−.055			.001	0.6	.035			.008	6.9	−.039			.003	2.1
ELC x Judgement[a]	.100			.011	5.0	.117			.014	6.7	.154+			.025	22.5	−.227**			.052	45.0

Note. Interaction terms represent the cross–product of the z–standardized variables instead of the standardization of the raw–variable cross–product (Cohen et al., 2003). In consequence, their mean will most likely deviate from zero which is why the constant/intercept is reintroduced in models including interaction terms (LeBreton et al., 2013). [a] Relative weight analysis used the residuals of the interaction terms regressed on their constituting variables, yielding a "clean" interaction effect (LeBreton et al., 2013). [b] RW = Relative Weight (they sum up to R^2), the RWA only tested for $p < .05$; [c] RS–RW (%) = Rescaled Relative Weight (RS divided by R^2, contribution of each predictor to the R^2 in percent). + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$, ELC = educational and learning capital, a. f = after failure.;

Table 3 (continued)

Predictor	Stability beliefs					Modifiability beliefs					Posttest				
	β	ΔR^2	R^2	RW[b]	RS−RW (%)[c]	β	ΔR^2	R^2	RW[b]	RS−RW (%)	β	ΔR^2	R^2	RW[b]	RS−RW(%)
Model 1:		.015	.015				.031	.031				.005	.005		
Feedback	.063					.085					.025				
Judgement	.106					.156+					.066				
Model 2:		.005	.020				.011	.042				.005	.010		
Constant	.002					.003					−.002				
Feedback	.057					.076					.031				
Judgement	.115					.170*					.056				
Feedback x Judgement	.075					.111					−.075				
Model 3:		.036*	.056+				.069*	.111**				.001	.011		
Constant	.001					.002					−.002				
Feedback	.041					.054					.028				
Judgement	.043					.071					.042				
Feedback x Judgement	.048					.074					−.080				
ELC	.205*					.282**					.039				
Model 4:		.068**	.125**				.028	.139**				.000	.012		
Constant	−.007					−.049					−.010				
Feedback	.036			.002	1.6	.040			.004	2.7	.026			.001	5.2
Judgement	.071			.008	6.8	.066			.015	10.7	.040			.003	23.8
Feedback x Judgement[a]	.162+			.013	10.1	.084			.007	5.2	−.083			.006	47.7
ELC	.235**			.042	33.4	.307**			.084*	60.8	.042			.002	16.2
ELC x Feedback[a]	−.279**			.050	40.4	−.046			.001	0.6	.003			.000	3.3
ELC x Judgement[a]	.102			.010	7.7	.166*			.028	20.0	.022			.000	3.8

tive feedback. For mediocre feedback the effect seems to be less pronounced and for positive feedback the students with low educational and learning capital seem to react similarly to their peers with higher educational and learning capital.

Seeing the Whole Picture: Comparing Effect Sizes of Predictors

Summarizing these results, we found scattered effects of feedback and judgements: main effects in two out of seven outcome variables (i.e., self-confidence and action adaptivity after failure), and interaction or congruence effects in two outcomes (action and affective-motivational adaptivity after failure). Main effects of educational and learning capital emerged in all outcome variables except the posttest and interaction or moderating effects of educational and learning capital on the effect of feedback/judgement emerged again in two of the outcomes (anxiety and stability beliefs). These seemingly inconsistent findings based on significant gains in R^2 should be viewed in the context of all predictors and their true effect sizes to see the whole picture. The RWAs performed on the complete regression models (model 4) provide us with each predictors' true importance for the total explained variance (see table 3).

First and foremost, for all but one outcome the total R^2 reached significance, ranging between 11.0 % (affective-motivational adaptivity after failure) and 21.4 % (self-confidence and action adaptivity after failure). The posttest score could not be predicted solidly (R^2 = 1.2 %).

Taking a look at the rescaled relative weights (RS-RWs) of the predictable outcomes we can identify two patterns: outcomes that heavily depend on educational and learning capital and outcomes that de-

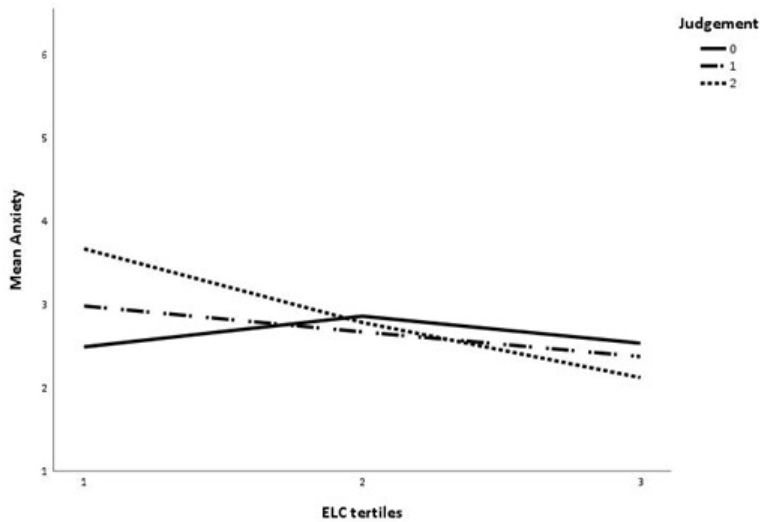

Figure 3 Interaction effect of educational and learning capital (ELC) and students' performance judgement on anxiety (to ensure the figure's readability ELC was classified into tertiles only for this visualization).

pend on several predictors, very often the interaction terms.

Self-confidence, action adaptivity after failure and modifiability beliefs depended strongly on educational and learning capital, which explained 60.8 % to 72.5 % of the respective total R^2. For Self-confidence the second best predictor was judgment (RS-RW = 17.3 %); for action adaptivity after failure, judgement and the congruence of judgement and feedback contributed 10.4 % and 8.0 % to the total R^2; and for modifiability beliefs the interaction of educational and learning capital with judgment (RS-RW = 20.0 %) and judgement alone (RS-RW = 10.7 %) contributed considerably to the total R^2.

The other three predictable outcomes did not show a clear main predictor. Affective-motivational adaptivity after failure was largely explained by the congruence of feedback and judgement (RS-RW = 40.5 %), by educational and learning capital (RS-RW = 27.0 %) and also by the interaction of educational and learning capital and judgment (RS-RW = 22.5 %).

Anxiety depended on two predictors equally, namely the interaction of educational and learning capital and judgment with RS-RW = 45.0 % and the educational and learning capital itself with RS-RW = 43.0 %.

Last, stability beliefs depended on almost all available predictors (only feedback fell behind the other predictors' contribution). Two predictors were more pronounced (interaction of educational and learning capital and feedback, RS-RW = 40.4 %, and educational and learning capital itself, RS-RW = 33.4 %), while the congruence of feedback and judgment (RS-RW = 10.1 %), the interaction of educational and learning capital and judgement (RS-RW = 7.7 %), and judgment (RS-RW = 6.8 %) contributed similar smaller amounts of explained variance.

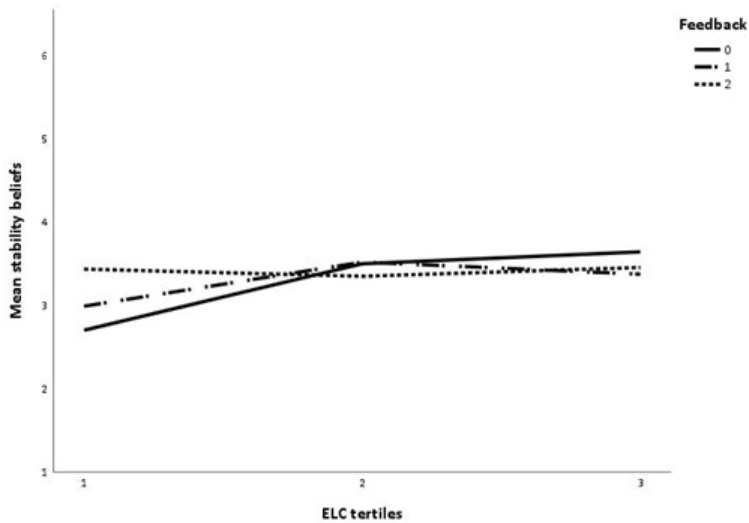

Figure 4 Interaction effect of educational and learning capital (ELC) and feedback on students' stability beliefs (to ensure the figure's readability ELC was classified into tertiles only for this visualization).

Discussion

This study investigated (a) the effects of random performance feedback and the learners' judgement of their performance on cognitive, metacognitive, motivational and emotional outcomes as well as (b) the supposedly positive effect of having educational and learning capital at one's disposal. In addition, we analyzed whether (c) educational and learning capital moderates the feedback and judgement effects, assuming that disposing over educational and learning capital would buffer negative consequences after experiences of failure (receiving negative feedback). We found that feedback and judgements had rather weak effects whereas educational and learning capital directly affected most responses. A moderating effect of educational and learning capital was found for some responses but not for all.

Overall, it is encouraging that almost all outcomes could be well predicted by feedback, judgements, educational and learning capital and their interaction effects bespeaking the selection of predictors, especially the validity of educational and learning capital. However, the combinations of relevant predictors also introduced new questions. We will discuss each research question in detail in the following.

Effects of Feedback and Performance Judgements

Our first research question treated the effects of feedback in general and, to account for the credibility of our random feedback, the effect of students' performance judgements and how they matched the received random feedback (interaction effect).

Surprisingly, we found no effects of feedback alone on any outcome. This can mean either that students were aware of the feedback but not affected by it or – more likely – that students did not effectively receive the feedback. Due to the available possibilities (online lectures during the COVID-19 pandemic), our study setting was not perfect in terms of guaranteeing feedback reception. In order for feedback to work, the learner must process the feedback information. We used computer-based feedback which we assume requires a higher motivation of the recipient to think about it intensively than a person-based feedback does (Krause, 2007). It was also delayed by one week while some studies indicate that immediate feedback works better (Bangert-Drowns et al., 1991; Kulik & Kulik, 1988). Furthermore, we only gave feedback based on the social reference norm (e.g., "Your answers place your performance in the upper third of the performance spectrum of this student group"). More performance information like adding the percentage or total number of correct solutions (criterial norm) or giving elaborative information might have lent more relevance to the feedback (Collins, Carnine, & Gersten, 1987; Kluger & DeNisi, 1996; Kopp & Mandl, 2014).

Performance judgements on the other hand displayed two effects, namely on self-confidence and action adaptivity after failure. Judging their own performance positively made students more self-confident, which concurs with theories and findings on the development of the academic self-concept through personal experience (Marsh & Shavelson, 1985; Shavelson, Hubner, & Stanton, 1976). They also estimated their action adaptivity after failure more positively after having a positive performance experience. Possibly, experiencing success made them optimistic dealing with future learning situations.

We did not explicitly expect direct judgement effects as we were mostly interested in the interaction effect of feedback and performance judgements representing the congruence between both, i.e., the credibility of the feedback. This credibility aspect showed effects on both coping with failure measures: one clear effect for affective-motivational adaptivity after failure (explaining 40.5 % of the total R^2 in the RWA) and a marginally significant effect for action adaptivity after failure. Congruent negative and positive feedback led to better affective-motivational adaptivity. For action adaptivity the effect seemed present only for congruent positive feedback. Obviously, credible feedback, even when negative, can enhance coping with failure. The question remains, why none of the other outcomes depended on the credibility of feedback. For example, Shibata et al. (2009) demonstrated that in the case of perceptual learning even fake feedback modulated learning (fake vs. genuine feedback condition). Here only a few students questioned the credibility of feedback (17 out of 84), and only five out of the 17 students were aware of the discrepancy between the received and their expected feedback (free report), but two of these five students were in the genuine feedback condition. Hence, participants seem to be rather unreliable when it comes to judge the accuracy of feedback which might explain the lack of effects on other responses in our study. However, a look at existing evidence shows that the credibility of feedback is rarely considered and more research could shed light on these effects.

Effects of Educational and Learning Capital on Feedback Responses

Our second research question treated the direct effects of having educational and learning capital at one's disposal. Our analyses confirmed the close relatedness of educational and learning capital with reactions in a learning process (e.g., Vladut et al., 2013; Vladut, Vialle, & Ziegler, 2015; Ziegler, Chandler, Vialle, & Stoeger, 2017; Ziegler, Debatin, & Stoeger, 2019). In all cases, the effect of educational and learning capital was positive, hence leading to desirable metacognitive, motivational, and affective responses (cognitive performance was not predictable by any predictors, see below).

This expected direct effect of educational and learning capital was especially pronounced in three outcomes. It predominantly predicted self-confidence, modifiability beliefs and action adaptivity after failure, contributing more than 60 % to the total explained variance. This is largely in line with the findings of Vladut, Vialle and Ziegler (2016) where educational and learning capital explained 9 to 34 % of the variances of self-confidence, stability/modifiability beliefs and coping with failure (combined scale of affective-motivational adaptivity and action adaptivity after failure). If we look at a failed learning process those three variables can be regarded as key elements to deal with failure: trusting their abilities helps learners to continue their efforts, modifiability beliefs also favor taking action to eliminate deficits and actually adapt their actions after failure to ensure more successful learning in the future (cf. Dweck, 1999). Educational and learning capital thus could be viewed as a booster of key elements for successful learning careers which inevitably will provide experiences of

failure at some point. At the same time, it means that educational and learning capital would not be that important for the emotional aspects of adapting after failure and anxiety in the learning context as well as for stability beliefs, which is harder to explain. As this is all speculation, future studies need to shed light on the explanation behind this finding.

Finally, the only outcome that could not be predicted by any predictor was cognitive performance in the posttest (R^2 = 1.2 %). As we already noticed in table 2 it did not correlate with any other variable which points to a problem with the test itself. It was a test on crystalline intelligence (BEFKI GC-K, Schipolowski, Wilhelm, & Schroeders, 2013) comprising questions on general knowledge in very diverse domains. According to the test manual, the BEFKI GC-K has been developed in order to economically measure crystalline intelligence. It correlates for example with self-reported knowledge (r = .52) and it is reliable (α = .81; Schipolowski, Wilhelm, & Schroeders, 2013). Unfortunately, this has not been the case in our study. Maybe students mainly aged 19 to 25 no longer deem these areas of knowledge relevant (sample item: "Families- and inheritance law are a subject matter of the a) Civil Code, b) Social Security Code, c) Basic Law, or d) Community Code"), or participants were no longer motivated to engage in this last assessment after having filled out the questionnaires beforehand.

Moderating Effects of Educational and Learning Capital

Our third research question was concerned with educational and learning capital as a moderator to the effects of feedback, especially in the case of (credible) negative feedback. We expected high educational and learning capital to buffer negative consequences of a failure experience. Conversely, low educational and learning capital should result in more detrimental consequences for the learner.

Indeed, we found two moderating effects pointing in this direction as they both originated from students with low educational and learning capital and showed negative consequences in terms of higher anxiety and lower stability beliefs. The first one was an interaction of educational and learning capital and judgements, suggesting that the higher the judgements, the higher students' anxiety when they possessed low educational and learning capital. Judging their performance as very good might lead to high expectations for future performance. At the same time, those students know that they possessed low educational and learning capital which might make them anxious to fail. Similar lines of thinking and feeling are known from students who identify a learning situation as threatening for their self-concept and self-esteem, and thereby experience high levels of anxiety. In consequence, these students are less likely to learn (Weiss, 2000). Getting hopes up by a positive self-judgement might exactly trigger this process. On the other hand, as soon as educational and learning capital was at a medium to high level, the detrimental effect disappeared or was indeed buffered.

The second moderating effect found, was educational and learning capital influencing how feedback affects stability beliefs. In particular, negative feedback in combination with low educational and learning capital led to lower stability beliefs. These students' beliefs in the stability of their competence seemed to be more fragile in the face of failure due to their unfavorable

levels of resources. If we replace 'resources' with examples subsumed under the concept of educational and learning capital this finding is not surprising. For example, the presence of social support is an important factor associated with student success (e.g., Dao, Lee, & Chang, 2007; Laurence, Williams, & Eiland, 2009). Again, having more educational and learning capital made the unfavorable consequences disappear, as we expected.

Hence, the question that remains is why we did not find moderating effects on other outcome variables. For example, why is their self-confidence not shaken while stability beliefs appear fragile? Why is their coping with failure unaffected by the moderator? Given the data we have at hand, the only explanation we can provide is that negative consequences seem to occur under extreme circumstances, i.e., when negative feedback or high hopes (judgments) coincide with low educational and learning capital; in the middle to positive spectrum of student characteristics we did not observe detrimental effects. As combinations of extreme conditions constitute only a small part of the sample, our study design might be unable to reveal the interaction effects. Instead, one would need to investigate only students with low educational capital or confront participants with only negative feedback, and so on.

Limitations and Outlook

One limitation of the current study is the lack of detectable feedback effects. We discussed possible reasons and suggest that future studies carefully select their feedback design to enhance its effect on students (e.g., person-based delivery, ensuring processing, not random feedback). Additionally, it is advisable to check students' awareness of feedback (in-)accuracy (e.g., Shibata et al., 2009) in case of working with random feedback. We assessed students' judgements, contrasted them with the random feedback received and assumed from the congruence or incongruence that students believed the feedback or may have found it incredible. In fact, we do not know if students believed or disbelieved incongruent feedback or even were aware of the possible inaccuracy. Therefore, it would be useful to control whether participants notice discrepancies between their expected and received feedback.

A second implication for future studies arises from the questions emerging from this study. We partly confirmed our moderating hypothesis but cannot tell for sure why other variables did not display the expected effects. It might help to expose interaction effects under extreme conditions by investigating participants with extreme characteristics (underprivileged learning environments, learning disorders, etc.) or creating extreme conditions through the study design (cf. negative feedback experiments by Mueller and Dweck, 1998).

In a similar vein, we can only speculate why the credibility of feedback only prove relevant for coping with failure and why educational and learning capital predominantly predicted three outcomes, while three other outcomes showed quite different patterns of predictor relevancy. As our combination of predictors was not used before on these outcomes we cannot draw any inferences from these findings but need clarification from further research.

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Conflicts of interests

The authors declare that there is not any conflict of interest.

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