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Who learns from errors on a class test? Antecedents and profiles of adaptive reactions to errors in a failure situation

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ABSTRACT

Situations in which pupils experience failure on a class test have the potential to become learning opportunities on the basis of the feedback on errors, which lead to the failure. This paper explores with a sample of 479 German high school students in the domain of Mathematics to what extent, and when, pupils take advantage of this opportunity. Consistent with previous findings, it was shown that a distinction can be made between affective-motivational adaptive and action adaptive reactions to errors on a class exam. Latent profile analyses yielded three characteristic response patterns and illustrated that about 47% ninth graders responded adaptively and about 44% maladaptively to errors in terms of both dimensions. There were further about 9% who only showed strong affective-motivational and weak action adaptive reactions to errors. Structural equation modelling revealed that a positive ability self-concept, a strong pursuit of mastery goals, and internal-variable attributions to failure corresponded with adaptive reactions to errors and a strong pursuit of performance avoidance goals correspond with maladaptive reactions to errors.

1. Introduction

In learning and performance contexts, errors provide informative feedback on knowledge gaps or misconceptions, and thus exhibit a high potential to be engaged as a learning tool (Cannon & Edmondson, 2001; Steuer, Rosentritt-Brunn, & Dresel, 2013). Particularly when students make errors on a class test, a suitable opportunity may be generated to help them learn from the errors that were made. However, it is well documented that many students are demotivated by errors and make little out of the immanent learning opportunities (Weinert, 1999). Previous studies on the antecedents of the adaptivity of affective, motivational, cognitive, and behavioral reactions to errors demonstrated that this particularly is the case when students have a negative ability self-concept, pursue mastery goals only to a small degree, and are more inclined to pursue performance-avoidance goals (Dresel, Schober, Ziegler, Grassinger, & Steuer, 2013; Heimbeck, Frese, Sonnentag, & Keith, 2003).

However, the specific situation, in which errors get salient, is frequently disregarded in these studies (e.g., failure experiences, obtainment of negative feedback in a class test)—instead, reactions to errors were assessed in a more generalized manner in terms of habitualized reaction styles. Less is known about different patterns of more or less adaptive reactions to errors in specific situations. Moreover, it is unclear whether the above-mentioned characteristics also function as determinants of adaptive reactions to errors in the critical situation. Beyond their hypothesized impact, one may additionally assume that adaptive reactions to errors depend on attributional processes in the specific situation (Graham & Williams, 2009; Stiensmeier-Pelster, 1994; Weiner, 1986, 2005).

The current paper focusses on the specific situation when secondary school students receive the results of a class test in the subject of Mathematics and experience failure. It analyzes (1) the extent to which there are different profiles of adaptive responses to errors made on this class test and (2) the individual antecedents under which students can learn from these errors.

1.1. Definitions of errors and failure

An error can be defined as an individuals' decision or behavior that unintentionally deviates from a certain norm, prevents the attainment of a specific goal, and is judged to be incorrect (cf. Zhao & Olivera, 2006). In the process of self-regulated learning an error occurs in the actional phase and is then salient in this phase, or in the post-actional phase, through a comparison of the target with the actual result attained, whereby the target state is established through existing standards or objectives (see Kreutzmann, Zander, & Hannover, 2014; Perels, Otto, Landmann, Hertel, & Schmitz, 2007; Winne & Hadwin, 1998; Zhao & Olivera, 2006; Zimmerman, 1986, 1989). Existing differences in the target-actual comparison can be determined by the individual him/herself or by a third party (e.g., a teacher). The former option

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refers to the process of monitoring that is prevalent in self-regulated learning and can be conceptualized as observation of the learning process and its outcomes and as evaluations whether the learning activities correspond with the learning strategies planned, and whether their outcomes correspond with the learning goals (Winne & Hadwin, 1998; Wirth & Leutner, 2008).

In contrast, failure is defined as a more global non-attainment of self-set goals, which is exclusively post-actional and subjectively perceived, dependent on the individual's level of aspirations (cf. Zhao & Olivera, 2006). The evaluation of performance on a class test by awarding it with a grade provides a pupil with feedback over the quality of his/her performance on the test. Should this grade lie beneath a specific aspiration level, the student experiences failure.

1.2. Receiving the results of a class test as a situation in which errors become salient

The situation of receiving the results of a class test seems to be particularly significant for two reasons: (1) The assessment of an impending performance becomes salient and initiates potential performance comparisons among classmates; thus, it becomes a situation which is particularly emotionally charged (Weiner, 1985, 1986). Especially for students who experience failure, this situation may pose a threat to self-worth. (2) In no other scholastic situation do pupils receive such a compact form of feedback with regard to their state of knowledge. Unless all of the exercises on the test were answered correctly, students in this situation will become aware of the errors they made. In particular for those students who do experience failure, this situation actually embodies a high potential to function as a learning opportunity.

1.3. Adaptive reactions to errors

Errors can induce the regulation of one's own behavior. Boekaerts (1996) and Boekaerts and Niemivirta (2000), in their model of adaptive learning, differentiate between the regulation of one's self with the over-riding goal of reducing threats to self-esteem, and the regulation of knowledge and competences with the over-riding goal of expanding on these two qualities. By analogy, one can distinguish affective-motivational and action-related reactions to errors, which are considered to be more or less adaptive (Dresel et al., 2013; Steuer et al., 2013; for an overview see also Tulis, Steuer, & Dresel, 2016). The affective-motivational adaptivity of error reactions is defined as the degree to which a learner maintains positive affect and motivation to learn in the face of errors. This is crucial because errors can induce outcome achievement emotions like shame or anger due to attributional processes (Pekrun, 2006; Reisenzein, 2014). The regulation of these outcome emotions seems to be important for forthcoming learning motivation and learning behavior (Baker & Berenbaum, 2007; Krohne, Pieper, Knoll, & Breimer, 2002). On the other hand, action adaptivity of error reactions is defined as the degree to which a learner initiates cognitive processes and behaviors aimed to specifically overcome a possible misconception underlying the present error. These cognitive processes are reflexive ones, so that the experience of an error leads to changed conceptions (Boyd & Fales, 1983; Moon, 1999, 2004).

1.4. Interindividual differences in adaptive reactions

Schoolchildren show different reactions to errors and failure. For example, Tulis and Ainley (2011) found four profiles of emotional experience following failure: One group of students primarily experienced anger and boredom, another group expressed inward-looking emotions such as shame or sadness, a third group reported increased positive emotion, and a fourth group showed themselves to be predominantly unemotional. Also early investigations on learned helplessness have reported large inter-individual differences in the patterns following failure (Abramson, Seligman, & Teasdale, 1978; Stiensmeier-Pelster & Schürmann, 1990; Ziegler, Schober, & Dresel, 2005).

Specifically pertaining to affective-motivational adaptive and action adaptive reactions to errors, Steuer et al. (2013) found large differences between secondary school students in the subject of Mathematics (aside from mild differences between classrooms).

1.5. Motivational tendencies and beliefs as antecedents of adaptive reactions to errors

In previous work on antecedents of adaptive reactions to errors self-related motivational tendencies and beliefs (notably ability self-concept and performance-avoidance goals) proved to be significant for affective-motivational adaptive reactions to errors. Motivational tendencies and beliefs, which predominantly allude to the task or activity at hand (notably mastery goals), were associated with action adaptive reactions to errors (Dresel et al., 2013; Grassinger et al., 2015).

Students with a positive ability self-concept—defined as the individual perception of one's own abilities (Spinath & Stiensmeier-Pelster, 2003)—perceive errors as less threatening to their self-worth and are more likely to demonstrate affective-motivational adaptive reactions to errors (Steuer et al., 2013). Students who pursue performance-avoidance goals are motivated to avoid demonstrating what they consider to be low skills or lack of knowledge (Ames, 1992; Dweck, 1986; Maehr & Zusho, 2009). Characteristic here is the avoidance of negative effects on one's self in social learning and achievement situations (Elliot, 1999; Hulleman, Schrager, Bodmann, & Harackiewicz, 2010). For these students, errors entail a threat to these goals, which is associated with an affective-motivational maladaptive reaction to errors (Dresel et al., 2013; Heimbeck et al., 2003; Tulis & Ainley, 2011).

Students with mastery goals pursue the goal of expanding their competences (Elliot & Dweck, 1988). This type of achievement goals enables them to perceive errors as an indication of what exactly still needs to be learned in order for subsequent learning steps to be attained, or which learning strategies need to be improved (see Elliot & Dweck, 1988, cf. Maehr & Zusho, 2009). Accordingly, mastery goals are related with action adaptive reactions to errors (Dresel et al., 2013; Dickhäuser & Buch, 2009; Grassinger et al., 2015; Heimbeck et al., 2003; Steuer et al., 2013).

1.6. Failure attributions as antecedents to adaptive reactions to errors

Errors, by definition, are unintentional and have a negative valence for many students. They likely trigger explicit attributional processes (Köller & Möller, 1996; Möller & Köller, 1997) and as a consequence have impact on outcome emotions, further motivation, and learning behavior. To explain the consequences of specific causal factors to which errors or failure are attributed, it is decisive to consider individuals' perceptions of the degree to which these causal factors are variable, internal, and controllable (Weiner, 1985, 1986). Variable attributions of negative achievement outcomes are usually associated with small or no decrease of self-efficacy (Meyer, 1973) and ability self-concept (Skaalvik, 1994). Controllable attributions are related with less anger (Försterling, 1984), and internal and stable failure attributions are seen as precursors of learned helplessness (Abramson et al., 1978; Seligman, 1986; Stiensmeier-Pelster, 1994).

1.7. Research questions and hypotheses

The present study aims to understand who demonstrates adaptive reactions to errors in a class test and why. Specifically, dimensions, profiles, and antecedents of adaptive reactions in this concrete error situation were investigated.

When receiving the results of a class test students are, in effect, being given feedback on their performance on the test. In particular, when students experience failure under these circumstances, errors made on the test become salient. In order to better understand when students will take advantage of this learning opportunity, we are first of all interested