

## ARTICLES

# Proximal Antecedents and Correlates of Adopted Error Approach: A Self-Regulatory Perspective

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**ABSTRACT.** The current study aims to further investigate earlier established advantages of an error mastery approach over an error aversion approach. The two main purposes of the study relate to (1) self-regulatory traits (i.e., goal orientation and action-state orientation) that may predict which error approach (mastery or aversion) is adopted, and (2) proximal, psychological processes (i.e., self-focused attention and failure attribution) that relate to adopted error approach. In the current study participants' goal orientation and action-state orientation were assessed, after which they worked on an error-prone task. Results show that learning goal orientation related to error mastery, while state orientation related to error aversion. Under a mastery approach, error occurrence did not result in cognitive resources "wasted" on self-consciousness. Rather, attention went to internal-unstable, thus controllable, improvement oriented causes of error. Participants that had adopted an aversion approach, in contrast, experienced heightened self-consciousness and attributed failure to internal-stable or external causes. These results imply that when working on an error-prone task, people should be stimulated to take on a mastery rather than an aversion approach towards errors.

**Keywords:** attribution of failure, error handling, self regulation

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TO ERR IS HUMAN. Indeed, everybody now and then makes an error. Errors may have negative consequences, such as delay in goal attainment, financial loss or safety threats, or positive consequences, such as learning something new (e.g., Edmondson, 1996; Sitkin, 1996). How we handle errors and their consequences can be of vital importance to ourselves and other individuals, as well as to organizations and society as a whole. In the literature on error handling (e.g., Frese, 1991; 1995; see also: Chillarege, Nordstrom, & Williams, 2003; Heimbeck, Frese, Sonnentag, & Keith, 2003; Rybowskiak, Garst, Frese, & Batinic, 1999; Van Dyck, Frese, Baer, & Sonnentag, 2005) generally a distinction between two error handling approaches is made. *Error mastery*, on the one hand, entails a positive approach of errors, optimally balancing the needs and possibilities for both prevention and management (e.g., correction and learning) of errors. *Error aversion*, on the other hand, entails a negative view on errors and a rigid focus on prevention of errors (Frese, 1991; Van Dyck et al., 2005). Error mastery has generally been found to result in better task, team, and organizational performance than error aversion (Edmondson, 1996; Frese, 1995; Hofmann & Mark, 2005; Van Dyck et al., 2005).

A large body of research on error handling has involved error management training (i.e., a training method that explicitly encourages errors for learning purposes; for a review, see Keith & Frese, 2008) and error management culture (Cannon & Edmondson, 2001; Hofmann & Mark, 2005; Sitkin, 1996; Van Dyck et al., 2005). These studies have demonstrated that environmental cues, such as training instruction, leadership style, and organizational culture, may influence individuals' error handling approach. Much less is known, however, on individual dispositions regarding preferred error handling approaches (for exceptions see Rybowskiak et al., 1999; Schell & Conte, 2008). That is, whether individuals differ—regardless of environmental cues—in their preference for a specific error handling approach and whether these preferences can be explained from theoretically related individual differences. As a first goal, the present study therefore investigates whether error handling approach is related to stable individual differences, specifically goal orientation (Dweck, 1986) and action-state orientation (Kuhl, 1994a).

Earlier research on error handling approaches has demonstrated that error mastery ultimately leads to better performance than error aversion. Much less is known, however, about other more proximal, psychological correlates of error handling. As a second goal, the present study is aimed at examining such correlates of error handling approach. In their influential information processing framework Kanfer and Ackerman (1989) identified task-related versus off-task cognitive processes as important mechanisms in challenging tasks. In the present study we specifically focus on two of these processes: (1) cognitive resource allocation to the self (i.e., self-focused attention), and (2) causal attributions of errors and failures (Weiner, 1985).

Both goals of the current study relate to a self-regulation perspective in the context of error handling. Self-regulation comprises (mental) activities and processes that are aimed at either starting or continuing working on the task (Kanfer & Ackerman, 1989). As such, self-regulation is the process that directs

resources (back) to the task: If resources are transferred from on-task to off-task, self-regulation is employed to redirect resources back to task pursuit. Error occurrence can function as a trigger that directs resources off-task. Relevant off-task processes include focus on the self and attribution of failure. In line with Zimmerman's (2000) model, cognitive resource allocation can thereby be seen as a cyclical process that is influenced by individual traits.

### *Self-Regulatory Traits as Predictors of Error Handling Approach*

Errors can be defined as unintended deviations from goals or standards (Gove, 1967). According to this definition, errors imply an unintended discrepancy between the current and the desired state (cf. Frese & Zapf, 1994; Reason, 1990). Discrepancies between current and desired states are a central aspect in the self-regulation literature (e.g., Bandura, 1991; Carver & Scheier, 1990; Kluger & DeNisi, 1996). As noted by Karoly (1993), self-regulatory processes are initiated when routinized activity is impeded—for example, when errors occur. The literature on self-regulation is extensive and diverse, and many studies have demonstrated that relatively stable individual differences exist in self-regulatory abilities (e.g., Mor & Winquist, 2002; Zimmerman, 2000). In the present study, we explicitly focus on such individual differences in goal orientation (Dweck, 1986) and action-state orientation (Kuhl, 1994a).

### *Goal Orientation*

In her motivational theory, Dweck (1986; Dweck & Leggett, 1988) introduced goal orientation as an individual difference variable related to the type of goals people tend to choose in achievement situations. Dweck distinguishes between two types of goals: learning goals and performance goals. Individuals with a *learning goal orientation* (LGO) tend to focus on increasing their competence and learning something new. Individuals with a *performance goal orientation* (PGO) tend to focus on gaining positive judgments and avoiding negative judgments of their competence. Dweck and Leggett (1988) posed that people's goal orientations depend on their implicit theories of ability, such that conceiving one's ability as fixed (entity theory) induces a performance goal orientation and conceiving one's ability as malleable (incremental theory) induces a learning goal orientation.

Based on these implicit theories of ability, goal orientation has been theorized to lead to different response patterns when facing failures. Individuals with a LGO interpret outcomes as feedback of their effort (Dweck & Leggett, 1988). When performance is poor, or when facing failure, LGO individuals tend to interpret this as useful feedback offering learning opportunities (Button, Mathieu, & Zajac, 1996). Consequently, LGO individuals tend to choose difficult and challenging tasks, which enable them to develop their competencies (Elliott & Dweck, 1988). They view obstacles, failures, and errors as part of the process

of acquiring new skills. Individuals with a PGO, in contrast, interpret outcomes of their behavior as diagnostic of their ability levels (Dweck & Leggett, 1988). When performance is poor, or when faced with obstacles or failures, they tend to attribute this to low ability (Button et al., 1996). Consequently, PGO individuals tend to avoid difficult and challenging tasks (Elliott & Dweck, 1988), and are motivated to prevent failures and errors as much as possible. Building on this rationale, individuals high on LGO can be expected to be more likely to adopt an error mastery approach when performing a difficult and error-prone task, whereas individuals high on PGO would be more likely to adopt an error aversion approach.

In more recent work on goal orientation, however, several authors have argued that PGO is multidimensional and should be separated in a prove dimension and an avoid dimension (Elliott & Harackiewicz, 1996; VandeWalle, 1997). Whereas a prove performance goal orientation (PPGO) is defined as the desire to prove one's competence and gain positive judgments, an avoid performance goal orientation (APGO) is defined as the desire to avoid unfavorable judgments about one's competence (VandeWalle, 1997). Based on the resulting goal orientation trichotomy (i.e., LGO, PPGO, and APGO), Payne, Youngcourt, and Beaubien (2007) conducted a meta-analysis of the goal orientation literature. They found LGO to be positively, APGO to be negatively, and PPGO to be unrelated to feedback seeking, learning, and performance. In other words, whereas individuals high on LGO demonstrated constructive task behavior, individuals high on APGO refrained from such constructive task behavior.

Based on this theoretical and empirical work, we expect differential relationships of LGO and especially the avoidant component of PGO (i.e., APGO) with error handling approaches. Specifically, we propose that in achievement situations with a high likelihood of errors and failures, individuals high on LGO are more likely to adopt an error mastery approach. Individuals high on APGO, in contrast, are more likely to adopt an error aversion approach.

*Hypothesis 1:* (a) Learning goal orientation is positively related to error mastery, and  
(b) avoid performance goal orientation is positively related to error aversion.

### *Action-State Orientation*

Action-state orientation was described by Kuhl (1994a) as a self-regulatory ability influencing the initiation and maintenance of goal-directed behavior. Individuals with a strong *action orientation* are characterized by an ability to enact intentions, devote cognitive resources to the task, and detach from distracting thoughts. Individuals with a strong *state orientation*, in contrast, have difficulties in initiating activities and are characterized by rumination and preoccupation with unpleasant experiences (Diefendorff, Hall, Lord, & Streat, 2000; Kuhl, 1994a; 1994b), such as errors and failures. Although originally action and state

orientations were described as mental states affected by the activation of a functional self-regulatory system (i.e., Motivational Maintenance System; Kuhl, 1994a), most empirical research has treated action-state orientation as a more or less stable individual difference variable (e.g., Diefendorff et al., 2000; Kuhl, 1994b).

Kuhl (1985; 1994b) distinguishes three dimensions of action-state orientation occurring at different stages of goal-directed behavior. The extent to which an individual has difficulty initiating goal-directed behavior is indicated by the *initiative versus hesitation* dimension. Individuals with an action orientation easily enact intentions and start activities, whereas state-oriented individuals have difficulties in initiating actions. The second dimension, *persistence versus volatility*, relates to continuing goal-directed behavior. Action orientation corresponds with persistence in continuing the behavior until the task is completed, whereas state orientation reflects volatility that causes distraction. The *disengagement versus preoccupation* dimension relates to behavioral tendencies when confronted with failure during goal-directed action. Action-oriented individuals are able to overcome the challenge posed by failure, disengage from ruminating thoughts, and stay task-focused, whereas state-oriented individuals are characterized tend to ruminate and focus on unpleasant experiences such as errors and failures during goal attainment.

Kuhl (1994b) developed a self-report questionnaire to assess these three dimensions of action-state orientation, with high scores indicating an action orientation and low scores indicating a state orientation. Supporting Kuhl's (1994a) theory, action-state orientation has been found to relate negatively to the occurrence of intrusive thoughts during task performance, the occurrence of cognitive failures, and aversive behavioral tendencies such as procrastination (Beswick & Mann, 1994; Diefendorff et al., 2000; Van Hooft, Born, Taris, Van der Flier, & Blonk, 2005), indicating that state-oriented individuals experience more intrusive thoughts and cognitive failures and demonstrate more aversive behaviors than action-oriented individuals.

Based on this theoretical and empirical work, we expect action-state orientation to relate to error handling approach. The disengagement-versus-preoccupation dimension, also described as *failure-related action-state orientation* (Kuhl, 1985), is particularly thought to be relevant in predicting whether individuals are inclined to adopt an error mastery or aversion approach during error-prone tasks. That is, in error-prone situations, action-oriented individuals are more likely to take an active and constructive approach, overcome failure, disengage from ruminating thoughts, and stay task-focused. State-oriented individuals, in contrast, are more likely to have a passive focus on the failure situation, ruminating about errors and failures. Therefore, action-state orientation is expected to relate positively to error mastery and negatively to error aversion, such that action-oriented individuals more than state-oriented individuals are likely to adopt an error mastery approach, whereas state-oriented individuals more than action-oriented individuals are likely to adopt an error aversion approach.

*Hypothesis 2:* Action-state orientation is (a) positively related to error mastery, and (b) negatively related to error aversion.

### *Psychological Correlates of Error Handling Approach*

Distinguishing between error mastery and error aversion as two different error handling approaches, the present study aims to investigate their psychological correlates. We specifically focus on the relationship of error handling with self-focused attention and causal attributions after error occurrence.

#### *Self-Focused Attention*

Kanfer and Ackerman (1989) argue that during task performance attentional resources are limited and can be allocated to either on-task, off-task, self-regulating activities, or any combination of these three. Upon error occurrence, the allocation of attentional resources becomes especially salient. We propose that such resource allocation depends on the adopted error approach.

In an error aversion approach, errors have a negative connotation and are likely to be interpreted as a sign of incompetence (Homsma, Van Dyck, De Gilder, Koopman, & Elfring, 2007). As such, error occurrence is likely to cause anxiety and redirect attention from the task to the self, increasing self-consciousness. As attentional resources are limited, such heightened levels of self-focused attention could interfere with task performance (Kanfer & Ackerman, 1989).

In an error mastery approach, errors are viewed as a challenge to be mastered, rather than as a sign of incompetence (Keith & Frese, 2008). Individuals adopting an error mastery approach focus on correction and learning from errors, rather than on blaming themselves (Van Dyck et al., 2005). Therefore, it seems less likely that errors would generate heightened levels of self-focused attention. Further, there are indications that an error mastery approach results in enhanced emotion control (Keith & Frese, 2005). Emotion control is a fundamental set of self-regulatory skills aimed at minimizing negative emotional thoughts, intrusive thoughts, and negative emotions (i.e., anxiety) during task engagement (Kanfer & Ackerman, 1996; Kuhl, 1985). Thus, when making an error while employing an error mastery approach, it is less likely to result in increased self-focused attention. Yet even if (some) self-focused attention is raised, this is more likely to be reduced by means of emotion control, redirecting attention away from the self back to the task.

In sum, we argue that an error mastery approach induces a non-threatening interpretation of errors, which is less likely to result in self-focused attention, allowing people to stay focused on the task. An error aversion approach, in contrast, implies a rigid focus on avoiding errors, which directs attention to the self in the case of making an error. The associated anxiety will have to be resolved before goal attainment can be resumed. Based on this reasoning, we expect the following:

*Hypothesis 3:* Error aversion is positively related to self-focused attention.

### *Causal Attributions*

In addition to self-focused attention, the present study focuses on causal attributions after error occurrence as a second important psychological correlate of error handling approach. In his attributional model of motivation and emotion, Weiner (1985) identified causal attributions (i.e., perceived causes of success and failure) as important predictors of future behavior. The causes that people perceive (e.g., after making errors) can be classified among two common dimensions: locus of causality and stability (Weiner, 1985). That is, causes can be attributed to factors within the person (internal locus) or to factors that lie within the environment (external locus). Furthermore, some causes are perceived as stable whilst other causes are perceived as unstable. A cause is defined as stable when it remains constant over time, and as unstable when it is likely to fluctuate.

In the present study we consider the relationship of error handling approach with causal attributions, using the internal-external and stable-unstable distinctions. This yields four attribution types: internal-unstable, internal-stable, external-unstable and external-stable. The general line of argument is that of these four, only internal-unstable attributions are functional in the context of task pursuit and are expected to be dominant under an error mastery approach. Both internal-stable and external (be they stable or unstable) attributions of failure are dysfunctional, but a likely byproduct of making errors while adopting an aversion approach. This line of reasoning is outlined below.

Research has shown that *internal-unstable attributions* after failure generally lead to more functional behavior than the other types of attributions (Abramson, Seligman, & Teasdale, 1978; Bandura, 1982; Weiner, 1985). If the cause is perceived to lie within the person, more responsibility is assumed. If the cause of an outcome is seen as unstable, the cause that led to the negative outcome is not necessarily expected to occur again and, therefore, the expectancy to perform well on that task would remain unaffected. Internal-unstable attributions then imply taking control and focus on what can be improved, and are considered constructive (Försterling, 1985). We expect that an error mastery approach promotes such internal-unstable attributions, because error mastery is focused at learning from errors and trying to change future task behavior. We therefore expect that error mastery is positively related to internal-unstable attributions.

*Hypothesis 4:* Error mastery is positively related to internal-unstable attributions.

Neither *internal-stable attributions*, such as intelligence, nor *external attributions* such as chance, are focused at future improvements. Neither type is indicative of experienced control over the outcome (failure)—in the one case (internal-stable),

because the cause for failure is stable and therefore not expected to change, and in the other case, (external) because the cause of failure may be absent in future task pursuit; but whether this is the case is not under one's own influence.

Attributing errors or failures to internal-stable attributions is generally associated with depression and helplessness (e.g., Metalsky, Abramson, Seligman, Semmel, & Peterson, 1982; Seligman, Abramson, Semmel, & Von Baeyer, 1979). Failure attribution to external causes is considered self-serving as all responsibility is averted. Such attributions are considered to be aimed at protection of the self (Leary & Forsyth, 1987; Weiner, 1985).

Both internal-stable and external attribution types are likely in the case of erring while employing an aversion approach. Under an aversion approach, error occurrence is a negatively framed event that holds the potential of ego-threat; erring may be perceived to be diagnostic of low ability levels. Whether making an error under error-aversive conditions is then attributed to internal-stable or external causes mainly depends on self-esteem and ability to avert self-esteem being threatened (Cannon & Edmondson, 2005; Taylor, 1989). High self-esteem persons are more likely to attribute error externally, whereas low self-esteem persons are more likely to attribute error to internal-stable causes. For the current purposes, the crucial aspect is that both internal-stable and external attribution types are dysfunctional in the context of task pursuit, as they prevent enhanced task effort.

*Hypothesis 5:* Error aversion is positively related to (a) internal-stable attributions, and (b) external attributions.

In summary, the goal of the present study is to apply a self-regulatory perspective in the context of error handling. Using this perspective, we address both traits that affect self-regulation (goal orientation, action-state orientation) and relevant off-task processes (focus on the self and attribution of failure). Specifically, we examine the relationship of goal orientation and action-state orientation with error handling approach (i.e., error mastery versus error aversion), and the relationship of error handling approach with self-focused attention and causal attributions (i.e., internal-unstable, internal-stable, and external). In line with previous research (e.g., Button et al., 1996; Diefendorff et al., 2000; Kuhl, 1994b; VandeWalle, 1997), goal orientation and action-state orientation are considered individual difference variables, operationalized using validated self-report questionnaires (Kuhl, 1994b; VandeWalle, 1997). Error handling approach, in contrast, is viewed as a specific behavioral tendency relevant in error-prone situations. In order to create such an error-prone situation, the present study uses a task in which errors and failures are likely to occur at a regular basis. Such a task makes error handling more salient and allows us to assess error handling, self-focused attention, and causal attributions very specifically as referring to the task that the participants performed.

## Method

### *Participants*

At the university, campus flyers were distributed in canteens, and study halls inviting students to participate in our study. Sixty students (39 women and 21 men, average age 23.38,  $SD=4.38$ ) participated. Students from all majors took part in the study with relatively high participation of students majoring in psychology and education (28.3%), social Sciences (13.3%), economics (8.3%), medicine (8.3%), and law (8.3%). About equal numbers of participants were in their first (20.0%), second (23.3%), third (30.0%), and fourth year (26.7%) of their studies. In return for their participation, students received 5 Euros.

### *Procedure*

The procedure was organized such that the following five requirements were met: First, self-regulatory traits (goal orientation, action-state orientation) were to be unaffected by any of the other aspects of the procedure. For this purpose, self-regulatory traits were measured first. Second, working on the task was not to be affected by the measurement of self-regulatory traits. For this purpose, a filler task was used between the measurement of the traits and the focal task. Third, self-regulatory processes (self-focused attention, failure attribution) had to be measured as temporally closely as possible to the experience of failure and error at the task. Finally, error approach was to be measured temporally separate from other measures.

Participants came to the lab individually, were seated in separate cubicles, and asked to follow the instructions provided on the computer screen. Participants started with filling in the self-regulatory trait measures (i.e., goal orientation and action-state orientation), followed by a filler task unrelated to the purposes of the present study. Next, to enhance perceived task relevance, we informed the participants that they would be carrying out a “spatial ability task” and that this task was a good measure of analytical ability, a predictor of future job success.

Participants started with a practice trial of the “spatial ability” task. After successful completion of the trial puzzle, participants started the performance task comprising eleven puzzles. After finishing the last item, they filled out an attribution measure and a measurement of self-focused attention. After eleven more puzzles, participants filled out part of the error approach measurement and some demographics. Participants were debriefed, thanked, and given their 5 euros.<sup>1</sup>

### *Task*

The task consisted of eleven Tangram puzzles, which we introduced to the participants as a “spatial ability” task supposedly predictive of job success. Tangram is an ancient Chinese game and consists of quite complicated puzzles.

The objective is to fit seven geometrical pieces (a square, a parallelogram, two large triangles, one medium triangle, and two small triangles) in a target shape. The Tangram task was custom made by Gallucci (2003) such that participants were presented with a blue target shape on the left of the screen and the seven geometrical pieces in yellow on the right. Participants had to solve the puzzles by fitting all seven pieces exactly in the target shape using the mouse. They were given a practice trial to get familiar with moving and rotating the pieces. After successful completion of the practice trail, the first puzzle was started.

The Tangram task was chosen with the following two explicit requirements in mind. As a first requirement, all participants would have to experience failures due to error. Measurement of error approach, self-focused attention, and attribution gains validity if the task provides actual failure for all. Related to this first requirement for the task, we made sure that participants would not be able to complete too many puzzles (i.e., ensuring errors). This was done by choosing difficult Tangram puzzles. As a second requirement, possible confounding effects of failure-related traits and error approach on the actual amount of errors encountered in the task had to be avoided. The reasoning is that people who have a learning goal orientation and/or employ an error mastery approach may likely make more errors but use these as learning opportunities. People who have an avoidance goal orientation and/or employ an error aversion approach, in contrast, might successfully reduce errors. Differences in the amount of encountered errors would undermine the validity of self-focused attention and attribution: if the number of errors varies across participants, interpretation of self-focused attention and attribution can not be compared. Thus, this second requirement implies that the task had to be designed such that all participants would (roughly) make about the same amount of errors. Therefore, participants had to perform the task under time pressure. While working on a puzzle, a stopwatch in the bottom left corner of the screen showed the remaining time. As soon as time ran out, a message indicating either successful completion of the puzzle or failure appeared. Piloting the task had shown that forty seconds proved to be too short a time to complete puzzles correctly. By setting the time limit at this critical value, we assured minimal variance in the actual amount of incorrectly solved puzzles.

To check whether the two requirements were met, we examined both the amount of errors and its variance. Averaged over the 22 puzzles, participants placed 2.46 ( $SD=0.63$ , minimum=0.45, maximum=4.23) of the seven pieces of the Tangram puzzle correctly. In terms of amount of incorrectly solved puzzles, 18.3 % of the participants failed on all 22 puzzles, 21.7% failed on 21, 16.7 % failed on 20, 16.7 % failed on 19, 16.7 % failed on 18, 5% failed on 17, 3.3 % failed on 16, and 1.7 % failed on 15 of the 22 puzzles. In other words, none of the participants were able to correctly solve one third or more of the puzzles offered. By meeting both requirements of high amount of errors and low variance in the amount of errors between participants, we were able to assess pure effects of error approach on self-focused attention and attribution.

## Measures

*Self-regulatory traits.* Consistent with our hypotheses, two self-regulatory traits were assessed: goal orientation and failure-related action-state orientation. Goal orientation was measured with VandeWalle's (1997) goal orientation instrument. This questionnaire has three subscales: *learning goal orientation* (five items;  $\alpha=.77$ ; e.g., "I am willing to select challenging tasks that I can learn a lot from"), *prove performance goal orientation* (four items;  $\alpha=.77$ ; e.g., "I prefer to work on tasks where I can prove my ability to others"), and *avoid performance goal orientation* (four items;  $\alpha=.73$ ; e.g., "I prefer to avoid situations where I might perform poorly"). All goal orientation items use 5-point scales with 1=strongly disagree to 5=strongly agree.

*Failure-related action-state orientation.* Failure-related action-state orientation was assessed with the Action Control Scale (ACS-90; Kuhl, 1994b). The failure-related subscale consists of 12 items ( $\alpha = .74$ ). Each item shows an incomplete sentence (e.g., 'If I've worked for weeks on one project and then everything goes completely wrong with the project . . .') and two possible endings, one indicating state orientation (e.g., '. . . It takes me a long time to adjust myself to it.') and one indicating action orientation (e.g., '. . . It bothers me for a while, but then I don't think about it anymore.'). Scores were compiled by adding all action-orientated answers per subscale. Lower scores indicate state orientation, and higher scores indicate action orientation.

*Error approach.* Six items of the Error Orientation Questionnaire (EOQ; Rybowski et al., 1999) were administered. This questionnaire is a measure for attitudes towards errors as well as actual error handling behavior. The administered items were selected on the basis of relevance to the content and context of the task, and were adjusted to the specific setting (i.e., several scales and items of the EOQ were not relevant in the present study as the participants worked individually rather than in a social setting). Four items referred to an active, constructive approach to errors (*error mastery*;  $\alpha=.64$ ; e.g., "My errors pointed me at what I could improve"). Two related to error aversion and strain (*error aversion*;  $\alpha=.61$ ; e.g., "When I made a mistake I felt stressed"). All error approach items use 5-point scales with 1=not at all applicable to 5=fully applicable.

*Self-focused attention.* Self-focused attention was measured with Bagozzi, Verbeke, and Gavino's (2003) questionnaire applied to the present study context. The questionnaire starts with a description of specific situational stimuli; that is, participants were made aware of the possibility that during the Tangram task they had been unable to fulfill the task (e.g., when they got a puzzle wrong / not done in time). Participants were then asked to indicate to what extent a total of 15 statements reflected how they felt in that situation. The questionnaire contains four

subscales: self-awareness or cognitions that others are looking at every detail ( $\alpha=.85$ ; e.g., “I think the researcher is watching my gestures and reactions.”); belief that the core self is threatened ( $\alpha=.74$ ;; e.g., “I believe that the researcher thinks I am a failure.”); physiological symptoms ( $\alpha=.78$ ; e.g., “I feel physically weak.”); and action tendencies ( $\alpha=.83$ ; e.g., “I want to hide.”). All items use 7-point scales with 1=strongly disagree to 7=strongly agree.

As the four scales cover different but related aspects of self-focused attention after failure, no separate hypotheses were formulated for each. In our analyses, both a composite score of self-focused attention ( $\alpha=.89$ ), as well as the four separate subscale scores, are included. Analyses including the composite self-focused attention measure offer simple, comprehensible insights and testing of hypotheses, while analyses on the subscales offers additional nuance.

*Attributions.* Attributions were measured in terms of possibilities for improvements as well as reasons for disappointing performance. In both cases specific possibilities/reasons were offered to participants (e.g., intelligence, effort, bad luck, time pressure) on 5-point scales (1=not at all applicable to 5=fully applicable). The items represent three subscales; (1) internal-unstable attributions, (2) internal-stable attributions and (3) external attributions.

The first subscale relates to internal-unstable possibilities for improvements on the second task and reasons for failure on the first task, including task behavior and effort. The scale consists of four items with an alpha of .77.

The second subscale to internal-stable possibilities for improvements on the second task and reasons for failure on the first task, including intelligence and experienced difficulty with the task. This scale has four items ( $\alpha=.70$ ).

The third subscale relates to external possibilities for improvements on the second task and reasons for failure on the first task, including bad luck and poor experimenter instructions. The scale consists of four items with an alpha of .68.

## Analyses and Results

Table 1 presents the means, standard deviations, and correlations among the study variables.

To test Hypotheses 1 and 2 concerning the relationships of goal orientation and action-state orientation with error handling approach, two multiple regression analyses were conducted. Table 2 demonstrates the results. In support of Hypothesis 1a, learning goal orientation was significantly positively related to error mastery. Furthermore, though not hypothesized, prove performance goal orientation was negatively related to error mastery. Consistent with Hypothesis 1b, avoid performance goal orientation was positively related to error aversion ( $r=.24, p < .10$ ; see Table 1). However, the regression analysis demonstrated that avoiding performance goal orientation did not explain any unique variance in error aversion (Hypothesis 1b not supported). In disagreement with Hypothesis

**TABLE 1. Means, Standard Deviations, and Intercorrelations for Self-Regulatory Traits, Error Handling Approach, Self-Consciousness, Failure Attributions, and Average Number of Correctly Placed Pieces**

Variables	M	SD	1	2	3	4	5	6	7	7a	7b	7c	7d	8	9	10
1 Learning GO	3.72	0.62														
2 Prove performance GO	2.90	0.82	.38**													
3 Avoid performance GO	2.61	0.78	-.16	.45**												
4 Failure-related action-state	5.97	3.02	.16	-.20	-.45**											
5 Error mastery	2.99	0.82	.24†	-.04	.09	-.22†										
6 Error aversion	2.42	0.94	-.04	.15	.24†	-.57**	.32*									
7 Self-focused attention	8.53	4.17	-.03	.24†	.33**	-.31*	.05	.47**								
a Self-awareness	2.37	1.38	-.01	.14	.29*	-.18	.07	.40**	.86**							
b Core self threat	2.02	1.08	.01	.14	.31*	-.28*	.10	.38**	.89**	.76**						
c Physiological symptoms	1.89	1.04	.04	.26*	.26*	-.25*	-.01	.37**	.85**	.62**	.64**					
d Action tendencies	2.26	1.31	-.12	.29*	.29*	-.36**	.01	.48**	.88**	.58**	.72**	.76**				
8 Internal-unstable attributions	2.90	0.89	.22†	-.03	-.13	-.02	.48**	.12	.17	.18	.19	.03	.16			
9 Internal-stable attributions	2.65	0.85	-.03	.09	-.03	-.26*	.14	.33*	.38**	.25†	.34**	.36**	.40**	.26*		
10 External attributions	1.71	0.69	-.11	.07	.37**	-.13	.14	.31*	.32*	.27*	.24†	.38**	.25†	-.08	.20	
11 Average number of correctly placed pieces	2.46	0.63	.07	-.23†	-.17	-.15	.07	.16	-.23†	-.33*	-.16	-.17	-.12	.07	-.04	.07

Note. *N* = 60, † *p* < .10; \* *p* < .05; \*\* *p* < .01 (2-tailed). All scales range from 1–5, the average number of correctly placed pieces ranges from 0–7. GO = Goal Orientation.

**TABLE 2. Regression Analyses of Error Mastery and Error Aversion on Goal Orientation and Failure-Related Action-State Orientation**

Predictor	Error mastery (beta)	Error aversion (beta)
Learning goal orientation	.45**	.04
Prove performance goal orientation	-.35*	.04
Avoid performance goal orientation	.20	-.03
Failure-related action-state orientation	-.27†	-.58**
Multiple <i>R</i>	.44	.57
<i>F</i> ( <i>df</i> <sub>1</sub> , <i>df</i> <sub>2</sub> )	3.35 (4, 55)*	6.60 (4, 55)**
Adjusted <i>R</i> -square	.14	.28

Note. *N* = 60, †  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$  (2-tailed).

2a, failure-related action-state orientation was negatively rather than positively related to error mastery. Supporting Hypothesis 2b, Table 2 demonstrates that failure-related action-state orientation was strongly negatively related to error aversion. Thus, individuals with an action orientation towards failures are less inclined to adopt an error aversion approach than those with a state orientation.

Hypothesis 3, stating that error aversion should relate positively to self-focused attention in error-prone situations, was supported. As demonstrated in Table 1, the correlation between our composite measure of self-focused attention and error aversion was significantly positive ( $r = .47, p < .01$ ), and this correlation was significantly larger than the self-focused attention – error mastery correlation,  $r = .05, p = .73, t(57) = 3.08, p < .01$ . Furthermore, the results in Table 1 demonstrate that the relationship holds for all four subscales of self-focused attention; that is, self-awareness, core self threat, physiological symptoms, and action tendencies. In addition to these results, we examined whether error aversion uniquely predicted self-focused attention over and above the self-regulatory traits. Hierarchical regression analysis of self-focused attention on the self-regulatory traits (see Table 3) in Step 1 and on the self-regulatory traits and the two error handling approaches in Step 2 demonstrated that the error handling approaches explained significant additional variance in self-focused attention beyond the self-regulatory traits. Consistent with our hypothesis, of the two error handling approaches, only error aversion related significantly to self-focused attention ( $\beta = .48, p < .01$ ).

Hypothesis 4 and 5 regarded the relationships between error handling approach and causal attributions. In support of Hypothesis 4, error mastery was strongly positively related to internal-unstable attributions ( $r = .48, p < .01$ ; see Table 1) and not significantly related to internal-stable attributions and external attributions (both  $r$ 's = .14,  $p = .30$ ). In addition to these results, we examined whether error mastery uniquely predicted internal-unstable attributions over and above the self-regulatory traits. Hierarchical regression analysis of internal-

**TABLE 3. Regression Analyses of Self-Focused Attention on the Self-Regulatory Traits and Error Handling Approaches**

Predictor	Self-focused attention (beta)	
	Step 1	Step 2
Step 1: Self-regulatory traits		
Learning goal orientation	-.01	.03
Prove performance goal orientation	.12	.06
Avoid performance goal orientation	.19	.23
Failure-related action-state orientation	-.20	.05
Step 2: Error handling approaches		
Error mastery		-.12
Error aversion		.48**
Multiple <i>R</i>	.39	.54
<i>F</i> ( $df_1, df_2$ )	2.46 (4, 55) †	3.69 (6, 53)**
Adjusted <i>R</i> -square	.09	.22
<i>R</i> -square change		.14
<i>F</i> -change ( $df_1, df_2$ )		5.38 (2, 53)**

Note.  $N = 60$ , †  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$  (2-tailed).

unstable attributions on the self-regulatory traits in Step 1 and on the self-regulatory traits and the two error handling approaches in Step 2 demonstrated that the error handling approaches explained significant additional variance in internal-unstable attributions beyond the self-regulatory traits (see Table 4). Consistent with our hypothesis, of the two error handling approaches, only error mastery related significantly to internal-unstable attributions ( $\beta = .49, p < .01$ ).

In support of Hypothesis 5, error aversion was positively related to internal-stable attributions ( $r = .33, p < .05$ ) and external attributions ( $r = .31, p < .05$ ), and not related to internal-unstable attributions ( $r = .12, p = .36$ ). In addition to these results, we examined whether error aversion uniquely predicted internal-stable and external attributions over and above the self-regulatory traits. Hierarchical regression analysis (see Table 4) demonstrated that the error handling approaches explained significant additional variance in external (but not internal-stable) attributions beyond the self-regulatory traits. Consistent with our hypothesis, of the two error handling approaches, only error aversion related significantly to external attributions ( $\beta = .36, p < .05$ ).

### Discussion

The goal of the present study was to apply a self-regulatory perspective in the context of error handling. Both traits that affect self-regulation and relevant

**TABLE 4. Regression Analyses of Causal Attributions on the Self-Regulatory Traits and Error Handling Approaches**

Predictor	Internal-unstable attributions (beta)		Internal-stable attributions (beta)		External attributions (beta)	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
<b>Step 1: Self-regulatory traits</b>						
Learning goal orientation	.27 <sup>†</sup>	.05	-.09	-.14	.00	-.03
Prove performance goal orientation	-.11	.06	.18	.20	-.12	-.13
Avoid performance goal orientation	-.10	-.20	-.28 <sup>†</sup>	-.29 <sup>†</sup>	.44**	.45**
Failure-related action-state orientation	-.13	.00	-.33*	-.17	.05	.27
<b>Step 2: Error handling approaches</b>						
Error mastery		.49**		.09		.04
Error aversion		.00		.23		.36*
Multiple <i>R</i>	.28	.52	.34	.41	.38	.49
<i>F</i> ( <i>df</i> <sub>1</sub> , <i>df</i> <sub>2</sub> )	1.19 (4, 55)	3.29 (6, 53)**	1.77 (4, 55)	1.17 (6, 53)	2.38 (4, 55) †	2.84 (6, 53)*
Adjusted <i>R</i> -square	.01	.19	.05	.07	.09	.16
<i>R</i> -square change		.19		.05		.10
<i>F</i> -change ( <i>df</i> <sub>1</sub> , <i>df</i> <sub>2</sub> )		6.97 (2, 53)**		1.62 (2, 53)		3.36 (2, 53)*

Note. *N*=60, † *p* < .10; \* *p* < .05; \*\* *p* < .01 (2-tailed).

off-task processes were studied. More specifically, we investigated (1) whether stable individual differences in self-regulatory traits (goal orientation, action-state orientation) predict employed error handling approach and (2) whether employed error approach is related to self-regulation relevant off-task processes (focus on the self and attribution of failure). As such, the current study adds to the literature by offering clarification in terms of individual tendencies to engage in either a mastery or an aversion approach in case of error occurrence as well as related process variables.

### *Error Mastery*

Results show that not all individuals are equally inclined to adopt an error mastery approach. Especially those scoring high on learning goal orientation are likely to adopt a mastery approach. This finding is consistent with theory on goal orientation and failure situations (e.g., Button et al., 1996; Dweck & Leggett, 1988) and recent empirical studies. Specifically, Arenas, Taberero, and Briones (2006) reported a positive relationship of LGO and error risk taking, and Schell and Conte (2008) found a positive relationship of LGO and error competence—that is, individuals with a strong LGO are generally more likely to risk errors and mistakes than to do nothing at all, and are more likely to feel competent in dealing with errors. Both error risk taking and error competence are aspects that align with an error mastery approach.

Contrary to our expectation, action-state orientation was not positively related to error mastery. In fact, we found a marginally significant negative correlation between action-state orientation and error mastery, suggesting that individuals with an action orientation are less likely to adopt an error mastery approach than those with a state orientation. This finding is in contrast with Kuhl's (1985; 1994a) action control theory. Previous empirical findings, however, have been inconsistent as well. Specifically, Rybowskiak and colleagues (1999) reported positive relations of action-state orientation with error mastery aspects such as error competence and error risk taking, but negative relationship with error anticipation. A possible explanation might relate to the measurement of error mastery, which focuses not only on actions after error occurrence but also on (constructive) thoughts. Future research is needed to further clarify these findings.

Regarding the psychological correlates of error mastery, individuals adopting a mastery approach were found to be likely to focus on internal-unstable causes when confronted with error and failure. Earlier research has shown that such causes offer most opportunity for strategy improvements in further task performance (Homsma et al., 2007). Internal-unstable causal attribution is most functional, it has been argued, because it does not dismiss the cause of failure to forces that cannot be altered or controlled (Abramson et al., 1978; Bandura, 1982; Weiner, 1985). When attributing failure to internal-unstable causes, a heightened degree of control is experienced (Homsma et al., 2007). This heightened experienced control more easily translates in optimized future task approach.

### *Error Aversion*

With regard to the adoption of an error aversion approach, the current study showed action-state orientation to be a stronger predictor than avoid performance goal orientation. That is, state-oriented individuals (i.e., low scores on the action-state measure) were found to be more likely to employ an error aversion approach when confronted with failure. Though positively related to error aversion as hypothesized, avoid performance goal orientation did not explain any additional variance in error aversion. The negative relationship between action-state orientation and error aversion aligns with action control theory (Kuhl, 1984; 1994a) and is consistent with previous empirical research. Specifically, Rybowskiak et al. (1999) reported negative relationships of action-state orientation with error strain and covering up errors, both aspects of an error aversion approach.

With regard to the psychological correlates, participants that had adopted an aversion approach experienced heightened self-focused attention when confronted with failure. Self-focused attention is dysfunctional in the context of task performance as it exhausts cognitive resources needed for further task pursuit (Kanfer & Ackerman, 1989).

Further, those individuals that used an aversion approach to error, tended to attribute failure to internal-stable and external causes. Both types of attributions are suboptimal in the context of future task performance as they offer no room for improvement (Homsma et al., 2007). If failure is attributed to internal-stable causes such as intelligence, one has no reason to expect to do better next time. Rethinking strategy or exerting more effort than would be perceived as a fruitless pursuit. If causes are perceived to be external, altering task strategy does not make sense either: If one cannot control outcomes, there is no point in trying.

In sum, the dominant approach to error was found to relate to individual differences in self-regulatory traits. Individuals with a learning goal orientation likely adopt a mastery approach, and individuals with a state orientation to failure likely adopt an aversion approach. Proximal correlates of error approach shed a light on the crucial advantages and disadvantages of error mastery and error aversion, respectively. Under a mastery approach, error occurrence does not result in cognitive resources “wasted” on the self. Rather, attention goes out to internal-unstable, and therefore controllable causes of error. When controllable causes are identified, future task pursuit can be optimized. Under an aversion approach self-focused attention is increased, and failure is attributed to internal-stable and external causes. Both decrease the likelihood of successful task pursuit. Self-focused attention decreases the likelihood of successful task pursuit because less cognitive resources are available for the task; internal-stable and external causal attribution of failure because both reflect a lack of experienced control over the outcome (failure), thereby reducing the motivation for finding and implementing improvements in task approach.

### *Implications, Limitations, and Future Research*

The current study contributes to the error handling literature in two ways. The first is by demonstrating the relevance of established functional and dysfunctional self-regulatory traits to the domain of error and failure. Goal orientation and action-state orientation are shown to differentially relate to the two error approaches. Although parts of these relationships have been established in previous research (Arenas et al., 2006; Rybowski et al 1999; Schell, & Conte, 2008), these studies examined error orientation as a general orientation that individuals have towards errors. The present study extends this research by investigating the relationships of self-regulatory traits with the error approach that individuals adopt in a specific error-prone situation, measured directly after the experience of errors and failures in a controlled setting. As such, we assessed people's actual reported error approach rather than their general orientation towards errors.

Second, the present study findings contribute to the error handling literature by demonstrating that psychological processes as related to self-focused attention and attribution processes are different for the two error handling approaches, such that error mastery relates to functional (e.g., internal-stable attributions) and error aversion to dysfunctional processes (e.g., self-focused attention and external attributions). Previous research has demonstrated that error mastery relates to better performance than error aversion (Edmondson, 1996; Frese, 1995; Hofmann & Mark, 2005; Van Dyck et al., 2005). Little research attention, however, has been directed to the more immediate psychological processes that may explain the performance benefits of an error mastery over an error aversion approach. Our findings suggest that self-focused attention and attributions of failure may be important mediating variables in the error approach—performance relationship. Consistent with this idea, correlations with the number of correctly placed puzzle pieces (see Table 1) suggest that heightened levels of self-focused attention may harm people's performance. As the present study was designed to investigate the direct psychological reactions after error occurrence rather than the effects of error approach on performance, future research is needed to further investigate these mechanisms.

A strength of the current study is that its design allowed for testing the relationships of individual differences in self-regulatory traits with task behavior in a controlled setting. The self-regulatory traits were assessed separate from task behavior. That is, possible effects of the measurement of these traits were averted by offering a filler task. Only after completing this filler task was the actual task presented. Error approach, self-focused attention, and failure attribution measures were made context specific. The task was such that all participants experienced about equal amounts of error, and error approach, self-focused attention, and failure attribution measures related to these specific failure experiences. In all, our study offers an integration and extension of highly relevant literatures in the specific context of error handling and task pursuit.

Limitations of the current study relate to the reliance on self-report data, the use of a correlational design, and the measurement of error approach. First, as all measures were obtained by self-report, common method variance might be a threat to the validity of our findings. In designing our study, however, we made an effort to reduce this threat by temporally separating the measurement of predictor and criterion variables (cf. Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Specifically, the measurement of goal orientation and action-state orientation was separated from the other measurements by a filler task, and the measurement of self-focused attention and attribution was separated from the measurement of error approach by 11 trials of the focal task.

Second, the use of a correlational design limits our possibilities to infer causal conclusions. For the tested relationships of goal orientation and action-state orientation with error approach, reverse causality seems unlikely because of the temporal order of the measurements (i.e., goal orientation and action-state orientation were measured *before* the task, and error approach was measured *after* the task). Nevertheless, causality can still only be assumed on theoretical rather than empirical grounds because of issues related to possible influences of third variables (spurious correlation). Regarding relationships between error approach, attribution, and self-focused attention, several causal models can be argued. Future research should therefore investigate causality by means of experimental research. Instead of using self-report measures, most of our study variables can be manipulated. For example, goal orientation can be manipulated using framing manipulations. Also, previous research has shown that error approach can be manipulated successfully in an experimental setting (for an overview see Keith & Frese, 2008). Similarly, failure attribution (Homsma et al., 2007) and self-focused attention can be manipulated (Mor & Winquist, 2002). Using such manipulations, future research can more thoroughly investigate causal and mediation effects as suggested by the present study findings. Furthermore, building on studies by Taberner and Wood (1999) and Schmidt and Ford (2003), future research should test whether the effects of error approach may depend on people's dispositions. For example, an error mastery instruction or training may possibly compensate for the negative effects of an avoid performance goal orientation. Lastly, an interesting avenue for future research relates to Zimmerman's (2000) conceptualization of self-regulation as a cyclical process, existing of a forethought phase, a performance phase, and a self-reflection phase. As applied to the present study, this model suggests a cyclical causal order such that goal orientation and action-state orientation (i.e., forethought) influence task strategies such as error handling and attention focus, which in turn affect self-reflection mechanisms (e.g., causal attributions). These self-reflections impact the forethought phase, completing the self-regulatory cycle. Future research, using dynamic designs, should empirically investigate this cyclical model in the context of error handling.

Third, our measures for error mastery and error aversion were rather short and had moderate reliabilities. Future research should further develop the

measurement of error approach and adapt existing error handling measures, such as the EOQ (Rybowiak et al., 1999) and the Error Culture Questionnaire (ECQ; Van Dyck et al., 2005), to individual error-prone task settings.

The current study tested relationships between error handling and crucial self-regulatory variables. Additional established traits and self-regulatory constructs could be included in future research. With regard to traits, individual differences in regulatory focus (Higgins, 1997) and neurobiological differences in the sensitivity of behavioral inhibition and approach systems (i.e., BIS/BAS; Carver & White, 1994) seem other possibly relevant predictors of error handling. With regard to the allocation of attentional resources, emotion control (see Keith & Frese, 2005) would be a relevant variable for inclusion in future research on psychological outcomes of error handling approach.

Although clearly further research is needed in the domain of both proximal antecedents and outcomes of error approach, the current study offers insight into the reasons why individuals differ in their responses to errors. Furthermore, the finding that error handling relates to self-focused attention and causal attributions may offer an explanation of the mechanisms by which error handling affects task, team, and organizational performance.

#### NOTE

1. For the original purpose of testing effects of error approach, we used an error approach manipulation, using the error approach items as a manipulation check. As our manipulation check, however, revealed no effects,  $F(2, 57) = .59, p = \text{n.s.}$  for error aversion items;  $F(2, 57) = .16, p = \text{n.s.}$  for error mastery items, we concluded that our error approach manipulation was not successful. Further, ANOVAs conducted on theoretically relevant variables and control variables did not reach significance. In addition, Box's test of equality of covariance matrices indicated that the covariance matrices did not differ significantly between the three conditions, Box's  $M = 193.39, F(132, 8716) = 1.05, p = .33$ . We therefore treated the dataset as a one-group cross-sectional survey, conducted in a controlled task setting.

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