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The Error-Oriented Motivation Scale: An examination of structural and convergent validity

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ABSTRACT

The current paper describes an analysis of the factor structure and convergent validity of the Error-Oriented Motivation Scale (EOMS). The EOMS is an attempt to validate a context-general and brief measure of error orientations theoretically similar to the Error Orientation Questionnaire (EOQ) written by (Rybowiak, Garst, Frese, and Batinic (1999)). Motivation theory, particularly approach/avoidance motives and goal theory, was chosen as a foundational model for the new EOMS measure, arguing that errors take on properties of goals when they occur by creating a discrepancy, which generates arousal and direction toward a solution. In this article, the factor structure of the EOMS is examined, as well as expected correlations with subscales of the EOQ. The discussion focuses on the advantages of the EOMS measure and suggestions for its further validation and use in applied settings.

1. Introduction

Research in human error suggests that persons vary with respect to their perceptions and behaviors vis-à-vis errors that they make themselves. This is evidenced by differences in error reporting among employees that can be observed in a variety of industries (Armitage, Newell, & Wright, 2010; Weant, Humphries, Hite, & Armitstead, 2010). Since the first person to "catch" an error is often the person who generated it, those perceptions, reactions and behavioral responses becomes an important area of inquiry. In this vein, Rybowiak, Garst, Frese, and Batinic (1999) developed a 37-item scale called the Error Orientation Questionnaire (EOQ) encompassing eight factors. The scale has been used since that time sparingly in other research (e.g., Hofmann & Mark, 2006; Schell, Costa, Thomas, & Etchegaray, 2007), sometimes in a piecemeal manner (e.g., Carter & Beier, 2010). Further research into error orientations is needed, because the construct of error orientations has the potential to provide important information about motivational antecedents to error-related behaviors and, ultimately, could be useful for selection and training in jobs where a failure to handle errors appropriately could be damaging. This paper describes internal and convergent validation of a self-report instrument called the Error-Oriented Motivation Scale (EOMS). The EOMS is designed to tap into the motivational roots of reactions to self-produced errors.

1.1. Error-oriented motivations and goal theory

The theoretical premise of the EOMS is that errors create a secondary transient goal state, such that the actor must divert attention from the task at hand to address the situation that the error created. While it may seem that an error will always be aversive and always elicit similar reactions, research suggests that some may see errors as valuable tools for learning (e.g., Keith & Frese, 2008). As a result, theory relevant to goal pursuit such as goal orientations (Dweck & Leggett, 1988; Elliot & Harackiewicz, 1996; Elliot & McGregor, 2001; VandeWalle, 1997, 2003) should be germane to the error orientation construct. Fortunately, the goal orientation literature provides a fairly well-developed structure onto which error orientations can be mapped.

Generally, a potential goal will be evaluated on a basic approach/avoidance continuum (Elliot, 1999; Weiner, 1972) to determine the possibility of positive or negative outcomes. Second, the actor must consider what standard(s) will be used to assess goal attainment. Goal orientation theory suggests that these standards fall along a mastery-performance dimension (Elliot & McGregor, 2001; Elliot & Sheldon, 1997; VandeWalle, 1997). Mastery orientations are concerned with skill and competence development, internal satisfaction and growth, independent of externally-imposed benchmarks. In contrast, performance orientations are concerned with external standards that are usually measured in outcomes rather than conceptual learning (Elliot & Dweck, 2005). Goal orientation measures must account for both of these dimensions, as a popular scale in the organizational sciences does (VandeWalle, 1997, 2003). This scale measures three orientations:

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Mastery-Approach, Performance-Approach, and Performance-Avoidance (but see Elliot and McGregor (2001) for a 2 × 2 model that includes Mastery-Avoidance). Error orientation theory as measured by the EOMS is related to goal orientation theory, paralleling its basic structure. In the next section, the specifics of this structure are outlined.

1.1.1. The avoidant error orientation

The perception of an error as something to be avoided is likely to be rooted in strong, negative affective reactions, as well as the ramifications of that error for self-perceptions and self-evaluations. Research suggests that aversive self-referent events create disaffection and disengagement, but that they inhibit our desire to self-verify (e.g., Seyle & Swann, 2007). While the avoidance of an error usually involves negative affect, it should be noted that there are several (usually passive) behavioral options that can stem from avoidance as well (i.e., ignore the error, deny the error, rationalize the error, redefine the error as actually correct, etc.). Therefore, an avoidant error orientation should reflect the immediate negative reactions to the error which would likely be experienced as stress, worry and anxiety, similar to avoidance-based goal orientations (Elliot, 1999; Elliot & Dweck, 2005).

1.1.2. The covering errors and learning from errors orientations

If the actor's intention is to actively engage the error and the situation it has created, then there are multiple behavioral options available that can be organized into two broad categories: behaviors that are active and approach-oriented, and behaviors that are active but are avoidant at their cores. The intent to cover or hide errors falls into the latter category. Individuals that "cover" errors take active steps to make the error less visible from others. Someone with an orientation toward covering errors sees errors as weaknesses that should be hidden in the name of impression management. A successfully covered error is also theoretically invisible to performance evaluations by supervisors, making covering a potentially attractive strategy. In this way, the Covering Errors orientation is conceptually similar to the Performance-Prove dimension of goal orientation theory (VandeWalle, 1997, 2003), because the error is thought to signal incompetence to observers.

By contrast, an individual may have the tendency to approach errors in the interest of learning. The error is perceived to be an opportunity for improvement of both one's knowledge about the aspects of the task and also the skills necessary to successfully engage it. While those oriented toward learning probably do feel badly about the error, negative reactions are well-controlled and not given much weight (Keith & Frese, 2005). Therefore, the learning from errors orientation should lead the actor to engage the error assertively, learn what can be learned from it, and move forward beyond it, all while accepting the responsibility for the error's production. In this way, it bears remarkable similarity to the mastery goal orientation, which describes a tendency to develop mastery on tasks regardless of external performance standards. Research shows that a mastery orientation is associated with several beneficial outcomes, such as deeper metacognition, greater effort and persistence on tasks, and higher self-efficacy (see Gully & Chen, 2010, for a brief review), and a learning orientation toward errors is also likely to correlated with it.

It should be clarified at this point that, while error orientations are expected to be key distal influences on error-oriented behavior, they are most likely not completely explanatory. Several other sources of influence come into play when an individual decided how to approach the error (or not). For instance, the difficulty involved in correcting or learning from the error may prohibit the actor from acting out of a learning orientation, similar to the way in which task difficulty affects mastery orientations in goal-setting (e.g., Elliot & Dweck, 2005). Second, cultural and climactic factors in the organization help to define what errors mean and how they should be viewed. These norms could influence the expression of error orientations, especially if they are strictly communicated to employees and strongly enforced. Third, the closeness of the supervisor to the task, the employee and the error itself may influence error-based behavior in either a positive or a negative manner, as leadership theory would suggest (e.g., Bezuijen, van den Berg, van Dam, & Thierry, 2009; Hofmann, Morgeson, & Gerras, 2003). These are just examples of possible determinants of error-oriented behaviors; the extant literature contains even more (e.g., Edmondson, 1996; Tucker & Edmondson, 2003; Zhao & Olivera, 2006). Nevertheless, error remediation must begin from some psychological foundation when an error is noticed, and error orientations can help to define that foundation and what behavioral tendencies may be built into it.

1.2. A brief history of the creation of the EOMS

The EOMS began as a large database of original items, developed by examining (Rybowiak et al., 1999) EOQ measure for thematic elements and organizing them into a motivationally-informed factor structure. Specifically, appropriate item stems had to meet two criteria: they seemed to fit well within the definitional structures outlined above, and they referenced immediate, reactive kinds of behaviors and attitudes rather than behaviors that require some deliberation. As an example, the EOQ includes an "Error Communication" scale, measuring the tendency to tell others (i.e., supervisors) about what happened. Obviously, this decision in most cases would suggest a slower, more thoughtful decision process, and would not fit well in a theory of error orientations grounded in immediate reactions.

Following the construction and categorization of 58 items, a research team of graduate students sorted the items according to construct definitions of the three orientations. These students were unaware of the purpose of the task to avoid experimenter effects, and their sorts were correlated to assess agreement. The data showed that the item sorts correlated very well (average Spearman $r = 0.80$ within factor). Therefore, the items were judged to have acceptable face validity. However, four items were identified by the majority of raters as having confusing language, so these items were removed from further study, leaving 54 items going forward.

Next, a sample of 144 undergraduate students completed the 54-item instrument. Items were randomized for each participant to avoid order effects. An unrotated principal-components EFA was conducted for each of the three factors separately to identify underperforming items. Only items with factor loadings above 0.50 were considered to have acceptable relationships to the latent factor and were retained. After this stage, 29 items remained (10 of 18 items for the Learning factor, 9 of 17 items for the worry factor, and 10 of 17 items for the Covering factor). Next, an internal consistency analysis further identified three items each from the Learning and Covering scales and one item from the Worry scale that possessed low squared item-total correlations (defined as $R^2 = 0.16$). Alpha coefficients for each scale were sufficient (ranging from 0.82 to 0.93). At this point in the process, the EOMS contained 22 items.

The factors were named "Error-Oriented Learning" (representing a mastery orientation towards errors), "Error-Oriented Covering" (representing a performance-approach orientation toward errors), and "Error-Oriented Worry" (representing an avoidant orientation toward errors). While the title "Error-Oriented Covering" may connote to some an avoidance of errors, covering errors is more of an active behavior and requires that one approach the error, even if it is only for the purpose of covering it up. This also parallels language used for a similar factor in the original error orientation model (Rybowiak et al., 1999), so it seemed appropriate as a conceptual description.

As a next validation step, the EOMS was administered to a large (>600) sample of students. The form presented the items in a consistent sequence and required respondents to type in the number of their response next to each item, and it was built so that improper answers (i.e., blank spaces, numbers outside the range of the instrument's scale) were not allowed. An obliquely-rotated exploratory factor analysis was used to examine the factor loadings for this second sample for two reasons. First, in the original study of the EOQ instrument (Rybowiak et al., 1999), "Error Covering" and "Error Strain" were positively correlated, suggesting that Error-Oriented Covering and Error-Oriented Worry in the EOMS would be as well. Second, the goal orientation literature shows that performance-approach and avoidance orientations are distinct but correlated. This EFA revealed no problems with excessively low factor loadings, but one item did load with equal strength on both the Error-Oriented Worry (its expected factor) and Error-Oriented Covering. A review of the item ("When I make an error, I tend to avoid contact with others who might know about it") suggested that its language may have invoked a covering mindset in addition to the affective (embarrassment, shame) motive originally targeted. Thus, the item was removed from the EOMS, leaving a total of 21 items (7 per factor).

1.3. Hypotheses

The factor structure of the EOMS will be assessed using structural modeling, followed by an investigation of convergent validity. First, it is expected that a three-factor structure for the EOMS will be the best-fitting model, compared to a one-factor and a two-factor model (H1). Second, it is expected that relationships between the EOMS and the EOQ will be supportive of the validity of the EOMS. Specifically, it is expected that Learning from Errors orientation (EOMS-L) will be associated with the Learning, Thinking, and Competence factors from the EOQ (−), the Covering Errors orientation (EOMS-C) will be associated with the Covering and Communication factors from the EOQ (H3a–H3b), and the Worrying About Errors orientation (EOMS-W) will be associated with the Strain and Anticipation factors from the EOQ (H4a–H4b). Finally, it is expected that the EOMS-L factor will be negatively correlated with EOQ-Covering (H5a), that the EOMS-W factor will be positively correlated with EOQ-Covering (H5b), and that the EOMS-C factor will be positively correlated with EOQ-Strain (H5c).

2. Method

2.1. Participants

Three hundred and thirty-six undergraduate students at a southwestern university in the US were sampled for this study. The sample was composed of 231 women and 105 men with an average age of 19.9 years (SD = 3.92). Course credit was offered as compensation for participation.

2.2. Materials

2.2.1. The Error-Oriented Motivation Scale (EOMS)

The EOMS is a self-report instrument assessing error-oriented motivations. The items are grouped into three factors, each comprised of seven items: Error-Oriented Learning (EOMS-L) describes a mastery approach orientation that leads to perceiving errors as valuable sources of information for self-improvement and learning, Error-Oriented Covering (EOMS-C) describes a performance approach orientation that leads to hiding or rationalizing errors in order to maintain the appearance (both introspective and external) of competency, and Error-Oriented Worry (EOMS-W) describes an avoidant orientation that leads to strong negative affect and experienced stress. All items are scored on a 5-point scale (1 = not at all like me; 5 = very much like me), and no items are reverse-scored.

2.2.2. The Error Orientation Questionnaire (EOQ)

The EOQ is a 37-item self-report instrument assessing eight orientations that describe a wide variety of error-related attitudes, behaviors and cognitions. Each item requires a response from 1 (not at all) to 5 (completely) and the instrument does not incorporate reverse scoring procedures. More detail on the EOQ can be found in Rybowiak et al. (1999).

2.3. Procedures

All instruments were administered using Web forms customized by the author in a controlled laboratory. Controls were built into the forms so that all items required a response and so that all responses had to be within the defined item range. Between administrations of the two instruments, participants were distracted with a simple computer game for 8 min. This was an attempt to control for possible common method variance in the study's design (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

3. Results

3.1. Descriptives and model evaluation

Data on all variables in the study were screened for normality and outliers before proceeding with the assessment of the hypotheses. All subscales of both the EOMS and EOQ were distributed normally. Critical descriptive statistics are shown in Table 1.

The factor structure of the EOMS was analyzed using structural modeling. The best-fitting model included three factors ($\chi^2(186) = 676.81$, CFI = 0.88, RMSEA = 0.088, RMSEA CI = 0.109–0.062) compared to the two-factor ($\chi^2(188) = 1109.74$) and the one-factor ($\chi^2(190) = 2195.98$) alternatives. The low CFI statistic was likely caused by correlations observed between error terms within each latent factor, one of which was very high. After accounting for that correlation (between Item 20 and Item 21), model fit improved significantly ($\chi^2(185) = 522.54$, CFI = 0.92, RMSEA = 0.074, RMSEA CI = 0.092–0.060). If all correlated error terms within each factor that significantly reduced chi-squared were specified in the model, fit reached very good levels ($\chi^2(176) = 291.86$, CFI = 0.97, RMSEA = 0.044, RMSEA CI = 0.031–0.058); however, these modifications were *post hoc* (see Section 4

Table 1
Descriptive statistics for EOMS and EOQ subscales.

Measure/factor		M	SD	Skew
EOMS				
	Learning from Errors	26.10	4.71	−0.16
	Worrying about Errors	19.70	6.60	0.20
	Covering Errors	16.02	5.98	0.41
EOQ				
	Error Competence	13.83	2.50	−0.21
	Error Learning	14.78	3.01	−0.13
	Thinking about Errors	18.09	3.75	−0.28
	Error Strain	14.08	4.31	0.14
	Error Anticipation	16.00	3.39	−0.01
	Covering Errors	13.01	4.32	0.49
	Error Communication	13.08	3.16	−0.01
	Error Risk-Taking	14.53	2.99	−0.26

Note: N = 336. Standard error of skew = 0.133 for all variables.

for more on this issue). Thus, a three-factor model was better-fitting than the one-factor and two-factor alternatives, supporting H1.

3.2. Correlations with the EOQ

Correlations needed to examine the relationships between the EOMS and the EOQ are displayed in Table 2. Internal consistencies are listed in parentheses and ranged from marginal to excellent in quality ($0.61 < \alpha < 0.91$). The marginal reliabilities were all subscales from the EOQ. For clarity, the correlations are organized according to the specific hypotheses to be tested.

First, the Error-Oriented Learning (EOMS-L) factor was expected to be correlated with three EOQ subscales: Error Competence, Learning from Errors and Thinking about Errors. Table 2 shows that this hypothesis was supported by these data by significant correlations ($0.48 < r < 0.52$; all $ps < .01$). Therefore, Hypotheses H2a–H2c were all supported. Also, EOMS-L was negatively associated with EOQ-Covering as hypothesized ($r(336) = -0.23$, $p < .01$), supporting H5a.

Next, the Error-Oriented Worry (EOMS-W) factor was expected to be correlated with two EOQ subscales: Error Strain and Error Anticipation. Table 2 indicates that these correlations were significant in the expected direction (for EOQ-Strain, $r(336) = 0.74$; for EOQ-Anticipation, $r(336) = 0.25$; all $ps < .01$), supporting Hypotheses H3a and H3b. Also, a significant positive correlation with EOQ-Covering was observed ($r(336) = 0.44$, $p < .01$), supporting Hypothesis H5b.

Finally, the Error-Oriented Covering (EOMS-C) factor was expected to be correlated with two EOQ subscales: Covering Errors and Communicating about Errors. Table 2 shows that these correlations were significant in the expected direction (for EOQ-Covering, $r(336) = 0.69$; for EOQ-Communication, $r(336) = -0.35$; all $ps < .01$), supporting Hypotheses H4a and H4b. Further, a significant and positive correlation with EOQ-Strain was observed ($r(336) = 0.47$, $p < .01$), supporting Hypothesis H5c.

4. Discussion

This study described an initial investigation into the construct validity of the Error-Oriented Motivation Scale (EOMS) by assessing its factor structure and then correlating it with appropriate subscales from the Error Orientation Questionnaire. This study assessed the validity of a smaller, more focused measure of error orientations (compared to the EOQ) rooted in motivation theory and applicable to a variety of contexts. In general, the EOMS demonstrated adequate model fit, showed strong internal consistency and correlated with the EOQ subscales as expected in every case.

Table 2
Correlations among Error-Oriented Motivation Scales and other factors.

Variable	EOMS-Learn	EOMS-Worry	EOMS-Cover
	(0.88)	(0.91)	(0.88)
EOMS-Worry	0.07		
EOMS-Cover	−0.16**	0.59**	
EOQ-Competence (0.61)	**0.48****	−0.01	−0.10
EOQ-Learning (0.85)	**0.50****	−0.04	−0.21**
EOQ-Thinking (0.80)	**0.52****	0.23**	−0.06
EOQ-Strain (0.78)	−0.03	**0.74****	0.47**
EOQ-Anticipation (0.66)	0.13*	**0.25****	0.04
EOQ-Cover (0.76)	−0.23**	0.44**	**0.69****
EOQ-Communication (0.64)	0.20**	−0.06	**−0.35****
EOQ-Risk Taking (0.68)	0.36**	−0.12*	−0.23**

Bolded values correspond to the hypotheses tested in this study.
Note: Reliabilities for all scales are in parentheses. EOMS = Error Orientation Motivations Scale. EOQ = Error Orientation Questionnaire. $N = 336$.
* $p < .05$.
** $p < .01$.

The EOMS is not intended to be a replacement for the Error Orientation Questionnaire (EOQ). Instead, the intent is to provide a measure that is briefer, more general, and grounded in specific motivational theory. The EOQ is written in language that is predominantly work-focused and is difficult to generalize outside of organizational settings. Also, the EOQ includes eight factors across 37 items which were derived empirically, and some researchers have used the subscales individually instead of the entire scale (Carter & Beier, 2010; Hofmann & Mark, 2006). There is literature to suggest that this piecemeal approach to data collection may adversely affect the psychometric properties of the subscales themselves (Franke, 1997). Therefore, a shorter scale of error orientations is needed, focusing on core approach-avoidance attitudes.

The EOMS instrument is still in need of further psychometric validation, despite the promising data from this study. First, it was encouraging to find that the hypothesized three-factor structure of the EOMS was confirmed in these data, despite the correlated error terms. All of the individual items loaded unequivocally on their hypothesized latent factor with no troubling cross-loadings, and the most problematic correlated error is probably due to too much similarity in item content between Items 20 and 21 (see Appendix A). Future research should examine the EOMS factor structure after removing Item 21.

Second, it was also encouraging to see that the factors making up the EOMS were related to their theoretical counterparts on the EOQ, but more convergent evidence is required. For example, a study that correlates the EOMS with goal orientations and other approach/avoidance constructs (i.e., the BAS/BIS system; Gray & McNaughton, 2000) would be one logical "next step" in its validation. Future studies could also set up careful laboratory scenarios where individuals can make mistakes and then attempt to recover from them so that error orientations can be connected to behavioral reactions. While this may be difficult due to the typical artificiality and transparency of laboratory work, error orientations cannot be fully explored without such data.

The data reported here are limited by factors typical of this sort of research. The sample size was a little smaller than what would be ideal, but the consistency of the data with hypothesized relationships means that the sample size issue may not be a significant problem. Also, the sample was a sample of convenience, which could affect the ability of these data to generalize to other populations. This is not likely to be a great concern, given that the variables measured are not expected to vary among populations systematically, but since the EOMS instrument could be very useful to business and industry, it should be transported to and validated in that domain. Second, the study's design is correlational and therefore causative links between error orientation subscales cannot be established. This is an important point going forward, because it is unclear whether error orientations form out of values and beliefs intrinsic to the individual, or whether they form because certain behavioral responses to errors in the past were rewarded (or punished). Future research might look at error orientations from a values perspective to add some clarity to this issue.

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Appendix A

A.1. The Error-Oriented Motivations Scale (EOMS)

1. I try to learn something from every error I commit.

2. When I make an error, I make it my goal to understand completely why it happened.
3. I deliberately try to find information in my mistakes so I can improve my work.
4. I believe that most errors can be used to improve my performance on a particular task.
5. I apply the information that I learn from my mistakes to my future work.
6. When I make an error, I make sure that I learn something from it.
7. Every time that I mess something up, I think about what I could learn from the situation.
8. I often worry about making mistakes when I am engaged in some task.
9. I believe that errors are definitely things to be worried about.
10. After I mess something up, it is hard to stop thinking about how embarrassing it is to make mistakes.
11. I usually feel embarrassed and foolish when I realize I have made an error.
12. Mistakes make me think about how much I hate messing things up.
13. Most of the time I feel really frustrated and angry when I make an error.
14. I tend to feel a strong sense of concern about making mistakes no matter what I am working on.
15. I do what I can to make sure that no one knows when I make mistakes.
16. I believe that errors can do more harm than good to your reputation when others know about them.
17. I usually try to avoid discussions about my mistakes with my peers.
18. I would rather think about my errors by myself than talk about them with others.
19. I believe that discussing my mistakes usually isn't worth the time it takes.
20. When I make an error, I find ways to cover it so I don't suffer any consequences.
21. Covering the mistakes I make helps me avoid potential consequences.

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