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Positive Error Orientation as a Promoter of the Learning Process in Organizations

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ABSTRACT

Objective: through the recognition of how important a procedural approach is to the study of individual learning from errors, in this article, we propose and test a model of orientation to individual learning from one's own error. **Methods:** by means of a survey questionnaire involving 298 Brazilian workers, we analyzed the data using partial least squares structural equation modeling (PLS-SEM). **Results:** we contribute to academic knowledge, first, by modeling and empirically identifying the relationships of positive influence between positive error orientation and error detection, and between error correction and individual learning from error; and second, by the identification of the significant practical importance of positive error orientation for error detection. **Conclusions:** we point out implications for investigations concerned with measuring more accurately the individual positive error orientation phenomenon, as well as those that seek to deepen the understanding of the influence of the organizational context on the direction of individual error orientation. As implications for managerial practice, we highlight positive error orientation as a promoter of learning in individuals, which means that managers should include, in the training programs, learning activities about situations of error in the workplace.

INTRODUCTION

After Edmondson's (1996) and Rybowiak et al.'s (1999) papers, investigations about learning from errors have been directed toward a deeper understanding of the nature encompassing the phenomenon in its diverse dimensions. There have been studies that explore the individual dimension of learning from errors (e.g., Zhao & Olivera, 2006), in terms of teams (e.g., Tjosvold et al., 2004) and organizations (e.g., Dyck et al., 2005), as well as those in which the integration of these dimensions of analysis was sought (e.g., Dahlin et al., 2018).

Regarding individual learning, the phenomenon has also been analyzed through the relationship with several contextual and individual antecedent factors, which act as facilitators or barriers to learning from errors. We note the focus on factors as leadership styles and behavior (Ye et al., 2019), psychological safety (Lee et al., 2020), organizational climate for learning from errors (Grohnert et al., 2017), emotional reactions to error (Zhao et al., 2018), and work motivation (Zhou et al., 2020). Moreover, there are those researchers that have investigated the influence of error attributes — as in who committed the error and its severity — in learning from errors (Horvath et al., 2021).

However, empirical studies have not covered the theme through an integrative perspective of individual learning from errors, in which it is analyzed as a result of a process made up of error detection and correction stages and which is influenced by individual characteristics and resources, as well as the work context. In the literature, the lack of measuring scales for error detection is noted, even though this represents the first crucial step toward initiating the process of learning from errors (Frese & Keith, 2015). In addition, previous literature does not deepen the understanding of the relationship between the stages of error correction and learning derived from the error, except for a few studies that point in this direction (Bauer & Mulder, 2007; Leicher & Mulder, 2016).

Besides, the approaches and models proposed for the study of individual learning from errors do not make any distinction between one's own errors and those committed by others. Horvath et al. (2021) show that workers tend to learn more from errors made by themselves than those committed by peers. A possible explanation for this could be the occurrence of more intense emotional and cognitive reactions to their own errors than those related to the errors of others. This could force individuals to adopt an attitude of greater attention and involvement toward errors committed by themselves.

Through recognition of the importance of the procedural approach to the study and understanding of individual learning from error, we propose and test a model of orientation to individual learning from one's own error (OILOE model). We define orientation to individual learning from one's own error as the propensity of the individual to behave in a favorable way to acquire new learning, under error situations at the workplace.

The OILOE model is based on a processual perspective. It is the integrator of the distinct stages of the approach to the error, and it brings together individual and contextual elements that influence positively this process and facilitate learning from errors. According to the model, the individual learning from error — the endogenous variable — is a result of a process that begins with the error detection (Frese & Keith, 2015; Zhao & Olivera, 2006), which, in turn, leads to error correction (Bauer & Mulder, 2007).

Nevertheless, how the error detection stage occurs is influenced by individual elements we call positive error orientation (Rybowiak et al., 1999), while the way the error correction stage is carried out is influenced by organizational factors that facilitate learning from error (Putz et al., 2013). In addition, the existence of organizational factors that facilitate learning strengthens the individual positive error orientation.

Our intention is to contribute to the literature by the proposition of a model that enables the analysis of individual learning from errors in diverse contexts. By applying the same model, it may be possible to generate the widening of the understanding into this type of learning and its relationship to main antecedents. From the practical point of view, the model may contribute to the understanding of heads of people and culture about the organizational members' perceptions on their own willingness and conditions offered through the organizational context to engage in learning from errors. Thereby, managers can identify actions that lead to an increase in this type of learning.

This article is structured as follows: first, the theoretical foundation and the development of hypotheses are put forward; next, the methodological procedures and results are described; finally, a discussion of the results is delivered.

THEORETICAL BACKGROUND AND HYPOTHESES

The error and learning from errors

Errors are inherent to human action, and as such refer to "... inappropriate actions committed while performing a task" (Ohlsson, 1996, p. 242). Such actions concern unintentional or avoidable deviations from goals, standards, or any unexpected result (Cannon & Edmondson, 2001; Dyck et al., 2005), that are the result of individual decisions and behaviors (Zhao & Olivera, 2006).

Despite the emphasis placed on conceptual definitions of the phenomenon on the association between human error and negative results (Bauer & Mulder, 2007; Cannon & Edmondson, 2001; Goodman et al., 2011), we understand that errors will not always lead to negative consequences (Lei et al., 2016). Naturally, in some specific work contexts, such as transportation industries, hospitals, or engineering and construction companies, errors can lead to negative consequences both for the client and user, as well as for organizational reputation and results (Ibrion et al., 2021; Tucker & Edmondson, 2003). For these reasons, errors should be ostensibly avoided.

In other environments, on the contrary, such as those of startups that insert new solutions into the market, errors are shown as an inherent element of work processes. Through experimentation, organizations gain improvements in products and services, and process stability (Bledow et al., 2009; Cannon & Edmondson, 2005; Lei et al., 2016). In both situations, however, when errors occur, it is necessary to learn how to avoid their repetition.

Learning from an error involves directing the individual cognition at two main activities: error detection and error correction (Ohlsson, 1996). The learning results from the adequate approach and handling of the error situation, in which the individuals employ their knowledge and ability for reflective analysis to understand the situation, and generate and implement actions required to correct the error (Bauer & Mulder, 2007; Zhao, 2011).

Adopting this approach, one may be required to build new knowledge bases, which improve the work process (efficiency and quality of process outputs), which are necessary for error correction activities. However, we emphasize that learning from one's own errors is not restricted to specific knowledge to block error repetition. In addition to improving the ability to handle errors, learning from errors can have a positive influence on the individual's self-development, i.e., the way in which the individuals seek and acquire relevant information to increase their performance (Zhou et al., 2020).

Therefore, we define the individual learning from error variable as the acquisition of new information or experiences from an error situation, which lead to changes in attitude, behaviors, and/or knowledge, within the work context. Such learning can be acquired both by individual error correction processes and by collective ones. In the latter, there is the involvement of colleagues, managers, or even individuals outside the organization, such as clients and suppliers.

Individual learning from error is the endogenous (dependent) variable of the OILOE model. Next, we provide the theoretical background for the remaining model constructs, as explained in the introduction.

Organizational factors that facilitate learning from errors

The productive approach to an error is a process influenced by not only individual attitudes and behaviors, but also by organizational factors, relevant to the work context (Harteis et al., 2008; Zhao & Olivera, 2006). Putz et al. (2013) identified four categories of organizational factors that can influence learning from errors: supervisor's behavior, colleagues' behavior, task structures and operating procedures, and organizational principles and values.

The supervisor's and colleagues' behavior factors refer to ways that managers and colleagues act as facilitators of learning from errors. Edmondson (1999) shows that psychological safety — that is a "... shared belief that the team is safe for interpersonal risk taking" (p. 354) — influences one's individual willingness to admit, reveal, and discuss one's own errors. The establishment of psychological safety, in turn, is dependent on the supportive behavior of leaders, and through which they help individuals deal with and talk about errors (Cannon & Edmondson, 2001). Zhao (2011) verified that an attitude toward intolerance to errors, noted in managers, is related both positively and significantly to the negative emotions experienced by employees in relation to their own errors.

The task structures and operating procedures factor addresses adequate conditions and opportunities toward errors, through an organizational support context that guarantees resources, information, expert assistance, and training necessary to perform tasks. This perspective is related to the notion proposed by Harteis et al. (2008) of workplace culture of learning from mistakes.

In such organizations, people have access to opportunities to search for sufficient information about the error situation and its causes, to define new work processes, and to establish new strategies for monitoring and supervising the job. Naturally, it is necessary that the work context provide people with the necessary time to carry out such tasks, which involve reflection and analysis of the error event (Dahlin et al., 2018).

Finally, the organizational principles and values factor includes elements that stimulate, among the organizational members, the assessment of the error as important to learning at the workplace.

Putz et al. (2013) consider the four factors mentioned as dimensions of the error-related learning climate, understood as shared perceptions of the extent to which organizational elements help learning from errors. They found that error-related learning climate is positively correlated with constructive handling of errors (relative to reflection on the causes and error correction) and with the individual appraisal of effectively learning from errors. In addition, Grohnert et al. (2017) identified that the organizational factors pointed out by Putz et al. (2013) are positively correlated with individual learning from errors.

On this line, based on Putz et al. (2013), we define organizational factors that facilitate learning from errors as the support and resource elements, which are present in the work context and facilitate the approach to error situation, as well as learning through this experience.

In the structural model, organizational factors are a second-order emergent construct formed by three first-order latent variables. The first, manager and colleagues support, is defined as the recognition by the individual that the manager and colleagues present openness and readiness to cooperate with them, in dealing with an error situation. The second, organizational principles and values, deals with the individual understanding that, in the workplace, the addressing of the error is guided toward a conduct for the positive handling of the error situation and toward learning. The third variable, support resources for error correction, is defined as the evaluation that, in the work context, there are available and accessible material resources and necessary information for dealing with an error situation.

Positive error orientation

Rybowiak et al. (1999), the first to operationalize the concept of error orientation, did so from the theoretical perspective of coping strategies (cf. Lazarus & Folkman, 1984), adopted by individuals in the face of adverse or psychologically stressful situations that occur in everyday life. Considering that adaptation responses to a situation may be in the form of avoidance or confrontational behavior, Rybowiak et al. (1999) defined error orientation of an individual in two dimensions.

Firstly, error orientation refers to the degree to which people believe that errors can occur and the degree to which these are evaluated negatively. Secondly, it refers to the way people tend to deal with the error situation, i.e., if they can regulate the tension generated by the error, resolve the situation, and learn with it; or, otherwise, if they act toward covering up the error occurrence, and do not deal with the situation.

The error orientation questionnaire (EOQ), developed by Rybowiak et al. (1999), is comprised of subscales of constructs of attitude and confrontational behaviors related to workplace errors. These subscales have been replicated or adapted, wholly or partially, in empirical studies that investigate both the orientation to errors and specific attitudes and behaviors toward them (e.g., Casey et al., 2015; Chughtai & Buckley, 2010; KC et al., 2013).

In the OILOE model, we define positive error orientation as the individual willingness to handling error situations in a productive way. The construct is formed of three dimensions that arise from the EOQ, these are error competence, error strain, and error communication, which are aligned with the operational definition given herein.

Through revision of the infrequent studies based on structural equation modeling, we noted that the EOQ dimensions tend to be modeled as reflective first-order latent variables (Amini & Mortazavi, 2013; Gronewold & Donle, 2011). Nevertheless, we modeled positive error orientation as a second-order emergent construct, in alignment with the theoretical criteria indicated by Coltman et. al. (2008) for formative models: about the direction of causality, the variation in the first-order latent variables of the model causes variation in the positive orientation to error construct; also, the first-order latent variables do not share a common theme.

Next, a brief theoretical discussion is made about each of the formative variables of the positive error orientation construct.

Error competence

The individual perception of the errors importance at work can vary from the view that they are negative events — and as such should be avoided — to the understanding that errors can constitute an opportunity to apprehend the complexity of work and learning (Harteis et al., 2008). Nevertheless, the adoption of responses to cope with the error may require the mobilization of personal resources and behaviors such as self-efficacy, action-orientation after failure, need for achievement, and initiative, constructs that Rybowiak et al. (1999) identify as being positively correlated with error competence.

Thereby, based on Rybowiak et al. (1999), we define error competence as the individual understanding that one has mastered the knowledge necessary to immediately deal with the error situation and contain its effects; and despite the error, is able to adopt the initiative, oriented toward achievement and action. Highlighted here is that error competence does not cover the actions necessary for error correction, i.e., reflection on the errors causes, and the development and implementation of corrective actions. However, error competence is a predictor of reflexive activity (Hetzner et al., 2011).

Error strain

Errors can be a detrimental indicator to individual performance and to work results, since their consequences can impact both people and organizations (Homsma et al., 2009). Therefore, after making a mistake, the person may experience emotions or negative affective states such as fear, embarrassment, and guilt (Rybowiak et al., 1999).

We could say that negative emotional states can reduce personal motivation to engage in new learning. However, the effect of negative emotions on learning appears to be modulated by the intensity of the negative state experienced. The results from the study by Zhao (2011) suggest that low levels of negative emotions, such as sadness, guilt, anger at oneself, and nervousness, may enhance motivation to learn. On the other hand, only moderate or strong levels of negative emotions could negatively affect motivation to learn — including situations of learning from errors.

In this study, negative emotions are addressed by the error strain construct, which is defined as "... generalized fear of committing errors and by negative emotional reaction" (Rybowiak et al., 1999, p. 543). Therefore, the intensity of the stress related to the error experienced by people and the way in which they deal with it can have adverse effects on the error approach, in the form of blocks or delay in taking actions necessary to handle the error (Frese & Keith, 2015; Zhao & Olivera, 2006).

Error communication

In some situations, in order to correct an error and block its negative effects, the person who made the error needs to report it; to Zhao and Olivera (2006), individuals are supposed to communicate their errors to their supervisors. However, we consider that the assessment of the work context circumstances is useful for decision-making on who to report the error situation to.

Regarding low complexity job positions, the person who erred is expected to share the error with their manager. For those that hold managerial positions or act in more complex work environments, error communication does not necessarily reach the manager. This can occur when the error correction involves other actors, internal and external to the organization, as colleagues, customers, or suppliers (Rodrigues & Bido, 2019).

Thereby, we define error communication as the individual attitude of sharing one's own errors, be that with the immediate manager or with any other actor within the workplace context. These actors can be colleagues, subordinates, partners, and agents external to the organization (as clients, suppliers, or business partners), which are important to the process of correction and containment of eventual negative effects from the error.

However, it is important to consider that, on some occasions, the individual may act to cover up or ignore the error, thus removing the opportunity to gain learning from the situation (Rybowiak et al., 1999). This happens due to their understanding that error reporting can have potential negative consequences, such as punishment or damage to professional image (Zhao & Olivera, 2006).

Hence, we establish the following hypothesis:

H1: Organizational factors that facilitate learning from errors positively influence positive error orientation.

Error detection

Error detection represents the inducing factor of the process for error addressing. When people are unable to identify their own errors or take responsibility for them, they will not recognize the need to actively deal with the error situation. These individuals may even refuse to participate in error correction activities (Frese & Keith, 2015; Tjosvold et al., 2004; Zhao & Olivera, 2006).

There are errors that can be detected the moment they occur through observation of the very actions themselves (Sellen, 1994) — such as when making a telephone call, and one presses one or more numbers incorrectly. In more complex situations, the error identification depends on the person verifying the consequences of their own actions, by comparing the result obtained with the one expected (Ohlsson, 1996; Sellen, 1994) — as in those cases in which a management decision made incorrectly does not generate the predicted positive effects (Rodrigues & Bido, 2019).

In these situations, error detection can be made by the individual who erred or by others who are involved with the situation (Love & Josephson, 2004). Therefore, being open to feedback and opinions expressed by other people, as well as having the capacity to reflect on the content of such evaluations, are valuable elements in the error identification. Feedback from others, for example, has the potential to show the non-fulfilment of goals or expectations of the internal and external customers, or to the occurrence of misunderstandings (Cannon & Edmondson, 2001).

Based on Zhao and Olivera (2006) and Frese and Keith (2015), we define the error detection variable as the individual behavior aimed at identifying and recognizing one's own errors, even though, at that moment, the causes of the error are not understood. In the structural model, error detection was modeled as an emergent construct, once its "indicators are defining characteristics of the construct" (Jarvis et al., 2003, p. 203), i.e., its items represent a set of actions that constitute the behavior aimed at the error detection.

Thus, we propose the following hypothesis:

H2: Positive error orientation positively influences error detection.

Error correction

Error correction is the action of acquiring knowledge and information that is necessary for improving individual future actions (Ohlsson, 1996). Error correction occurs by identifying and understanding the causes behind the error, along with the development and implementation of solutions that prevent its repetition — or, at least, that lead to the reduction of negative consequences in case of error repetition (Bauer & Mulder, 2007; Dahlin et al., 2018; Zhao, 2011).

Such a process requires a posture based on reflective analysis, whereby the individual that erred reaches a deeper understanding of the situation, which leads to the development of effective action strategies to avoid error repetition (Putz et al., 2013). This perspective is relevant to situations where the nature and causes of the error are not evidently clear (Gartmeier et al., 2008).

Bauer and Mulder (2007) propose that actions taken for correcting an error be considered as a process of engaging in learning activities. After error detection, the first activity consists of individual reflection on the possible error causes, which may occur by interactions and exchanges with colleagues or the immediate manager. The next activity is the identification of ways to act on the causes and the planning of implementation of changes that impede the recurrence of the error, for which it may be necessary to search for information and allocate resources. Finally, it becomes necessary to implement the actions for improvement and monitoring results.

Thus, based on Bauer and Mulder (2007), we define error correction as the performance of activities necessary to understand the situation and its causes, and to identify, plan, and implement actions that prevent the error recurrence.

In the structural model, error correction is a second-order construct consisting of three first-order latent variables. The first, reflection, is defined as the activity of "... performing a root-cause analysis in order to identify probable causes of an error" (Bauer & Mulder, 2007, p. 124). The second, development of a new action strategy, involves the execution of "... processes of considering strategies to change the cause, alternatives for future acting, allocation of information and resources, and planning of the implementation" (Bauer & Mulder, 2007, p. 124). Finally, implementation of the new strategy is defined as the activity of "... experimenting with the new behavior and evaluating it after experiences in similar situations" (Bauer & Mulder, 2007, pp. 124-125).

Therefore, we establish the following hypotheses:

H3: Error detection positively influences error correction.

H4: Organizational factors that facilitate learning from errors positively influence error correction.

H5: Error correction positively influences learning from errors.

Figure 1 presents the structural model, in accordance with the previous hypotheses.

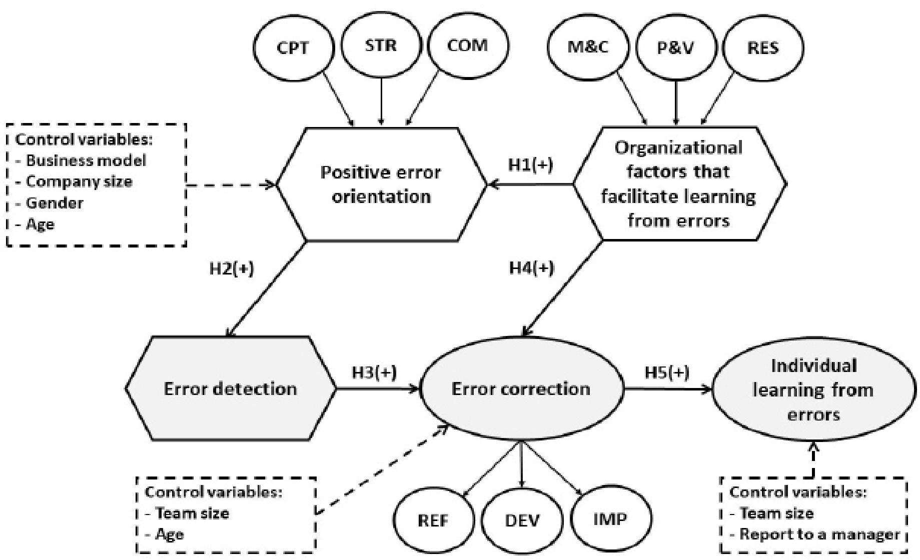

Figure 1. Research structural model — OILOE
CPT: error competence; STR: error strain; COM: error communication; M&C: manager and colleagues support; P&V: organizational principles and values; RES: support resources for error correction; REF: reflection; DEV: development of a new action strategy; IMP: implementation of the new strategy.
The process of error detection to individual learning from error has been highlighted in gray.
Constructs represented as ellipses are reflective and hexagons are formative (Henseler, J. (2021). Composite-based structural equation modeling: Analyzing latent and emergent variables. The Guilford Press.).

METHOD

Participants and procedure

The target population of the study were workers from organizations operating in Brazil. The participation of workers from specific sectors was not delimited, as we aimed to propose a model applicable to the analysis of individual learning from errors in diverse contexts. It was defined as an inclusion criterion that participants were 18 years or older, working or having previous work experience.

For data collection, carried out from June to August 2020, we used an online survey platform, Google Forms. The questionnaire link was disclosed via social digital networks (Facebook and LinkedIn) and instantaneous message applications (WhatsApp), to potential participants accessed for convenience. Prior to answering the questionnaire, the participants had access to the informed consent form, and they had to register a formal acceptance of participation, according to the information available in the form.

As we adopted the PLS-SEM analysis method, an examination of statistical power was performed (Hair et al., 2013). The software G*Power 3.1.9 was used, which determined the minimum sample of 270 cases, with the following parameters: significance level of 5%, average effect size (f^2) – according to the classification of Cohen (1988) – of 0.15, and statistical power of 80%. All returned questionnaires were validated (checking for missing data or other problems) and the non-probabilistic sample was composed of 298 Brazilian workers.

The descriptive statistics of the final sample characteristics are presented in Table 1.

Most of the sample consisted of men (54.4%). As for age, no significantly dominant age group was observed among the respondents, with the most frequent age range being 31-40 years old (26.5%). Approximately 45% of them held postgraduate degrees, and the majority were either regular or temporary employees (51.7%). In terms of hierarchical position, 43.6% worked at the operational/technical level, while 19.1% worked at the supervisory/team leadership level.

Table 1. Descriptive statistics of sample characteristics (N = 298).

Category	n	%	Category	n	%
Gender			Report to a manager		
Female	136	45.6	Yes	258	86.6
Male	162	54.4	No	40	13.4
Age range			Team size		
25 or less	73	24.5	Work alone	18	6.0
26-30	61	20.5	2-5 people	89	29.9
31-40	79	26.5	6-9 people	54	18.1
41-50	41	13.8	10-19 people	56	18.8
50 or more	44	14.7	20 or more people	41	13.8
			Uninformed	40	13.4
Educational level					
High school	55	18.5	Company sector		
Higher education	108	36.2	Human health	18	6.0
Postgraduate degree	135	45.3	Retail	38	12.8
			Public sector	39	13.1
Professional relationship			Education	46	15.4
Employee	154	51.7	Manufacturing	53	17.8
Civil servant	60	20.1	Service	84	28.2
Entrepreneur	25	8.4	Others	20	6.7
Others	59	19.8			
			Company size*		
Hierarchical position			Micro	64	21.5
Operation/Technical operation	130	43.6	Small	54	18.1
Supervision/Team leadership	57	19.1	Medium	26	8.7
Analyst	59	19.8	Large	154	51.7
Middle management	25	8.4			
Top management	27	9.1	Business model		
			Technology-based company	61	20.5
			Traditional-based company	237	79.5

Note. *Company size defined according to the Brazilian Institute of Geography and Statistics.

A significant majority of respondents reported to a manager (86.6%). Regarding the size of their work teams, the most common range was 2-5 people (29.9%). Respondents represented various economic sectors, with services (28.2%) and manufacturing (17.8%) being the most prevalent. Most of the respondents worked in large companies (51.7%), and a significant majority of them was employed in traditional-based organizations (79.5%).

Measures

Positive error orientation dimension: To measure the formative variables of this dimension, we mostly used replicated or adapted items from subscales of the EOQ (Rybowiak et al., 1999). For error competence, we included three items from the subscale of error competence (cpt1, cpt2, and cpt3 on the original scale) and one item was developed. For error tension, we modified the five items from the subscale error strain. For error communication, we did the replication of one item (com1) from the subscale error communication and the adaptation of three items (cov3, cov4, and cov5) from the subscale covering up errors.

Organizational factors that facilitate learning from errors: To measure the formative variables of this dimension, we adapted most of the items from the organizational learning scale from the error (Putz et al., 2013). For manager and colleagues support, two items were adapted; for organizational principles and values, three items were adapted; and for support resources for error correction, one item was adapted and another two were developed from Harteis et al. (2008).

Error detection: To measure the variable, we developed four items based on the literature review (Cannon & Edmondson, 2001; Ohlsson, 1996; Rodrigues & Bido, 2019).

Error correction: To measure the reflexive variables of this dimension, we developed some items from the model for learning from error proposed by Bauer and Mulder (2007). For reflection, four items were developed; for development of an action strategy, three items; and for implementation of the new strategy, three items.

Individual learning from error: To measure the variable, we adapted two items (ape1 and ape2 on the original scale) and replicated two (ape3 and ape4) from the subscale learning from errors of the EOQ (Rybowiak et al., 1999).

Control variables: We included the following control variable: age (1 = up to 25 years old, 2 = from 26 to 30, 3 = from 31 to 40, 4 = 41 to 50, 5 = above 50), gender (0 = feminine, 1 = masculine), report to a manager (0 = reports to a manager, 2 = does not report to a manager), work team size (1 = only the participant, 2 = from 2 to 5 individuals, 3 = from 6 to 9, 4 = from 10 to 19, 5 = 20 or more), business model (0 = traditional-based organization, 1 = technology-based organization), organization size (1 = micro, 2 = small, 3 = medium, 4 = large).

We included age as a control variable due the suggestion that older people benefit more from instructions received in management training of errors than younger colleagues (Carter & Beier, 2010). Regarding gender, we considered the results showed by Ye et al. (2018), who found that gender moderates the indirect relationship between inclusive leadership and learning from errors, being stronger for women than for men.

Respondents rated all items on a seven-point scale from 1 (never) to 7 (always). In Appendices A and B, there are the lists of scale items.

Validation and pilot study

For content validation, we submitted the questionnaire to an evaluation by five experts —professors and researchers in organizational learning, psychology, and human behavior areas. Based on the analysis of recommendations made by them, we did the necessary improvements in the instrument. For semantic validation, we applied the questionnaire to six people, the research target audience. Then, we performed adjustments to elements that could present some type of difficulty in the understanding of the instructions and items.

For final verification of the instrument's adequacy, we performed a pretest using 41 individuals, the research target audience. The measurement model evaluation was done through PLS-SEM, using the software SmartPLS 3.

Regarding convergent validity, discriminant validity, and reliability, at the level of reflective latent variables, the values were adequate, that is, average variance extracted (AVE) above or close to 50% and composite reliability $\geq$ 0.7. We verified low factor loadings for one item of the learning from errors variable (maintained in the scale); two items from manager and colleagues support (excluded from the scale); one item from implementation of the new strategy (reformulated and kept in the scale); and one item from competency in error handling (kept in the scale).

Data analysis

In data treatment, we conducted the pattern analysis of the answers across the individual answers to identify whether any atypical cases occurred, i.e., when a respondent gives the same answer at a rate higher than 80% over the items, according to the criteria indicated by Schwartz (2016), within the scope of European Social Survey Education Net. Only one atypical case was identified (88% of the items with the same answer), which represents only 0.34% of the sample. For this, we maintained it.

The structural model contains one second-order latent variable in endogenous position (organizational factors that facilitate learning from errors). The repeated indicator approach (repetition of items of first-order variables on the second-order variable) makes the structural coefficients of the relationships of this variable always equal to zero. Thus, we adopted a two-step approach.

Initially, we performed the analysis of the principal components for each first-order reflective latent variable, and through such, the factor scores were generated for each of the variables, using the mean of their composite items. Then, we added the scores to the data set and used them as indicators of the second-order latent variables, in substitution of the first-order variables.

ANALYSIS AND DISCUSSION

Evaluation of the measurement model

Reflective latent variables

Table 2 presents the results for the measurement model evaluation, at the reflective latent variables level. Convergent validity is adequate since the values for the average variance extracted (AVE) are greater than 0.5. Regarding the discriminant validity, the values for the square root of AVE (in bold) are higher than the correlations for the latent variables. In terms of reliability, the results are also suitable, above 0.8 (Hair et al., 2010).

Table 2. Matrix of correlations between latent variables (*N* = 298).

Variables	1	2	3	4	5	6	7	8	9	10	11
1 Org_factors	*E*										
2 Pos_err_orientation	0.392	*E*									
3 Err_detection	0.339	0.518	*E*								
4 Err_correction	0.342	0.480	0.520	***0.845***							
5 Indiv_learn_error	0.280	0.444	0.456	0.501	***0.713***						
6 Business_model	0.054	0.067	0.061	-0.008	-0.015	*S*					
7 Company_size	-0.001	0.042	0.046	-0.026	-0.047	0.132	*S*				
8 Gender	0.061	0.079	0.040	0.016	0.047	0.047	0.045	*S*			
9 Age	-0.009	0.095	-0.076	0.115	0.014	-0.159	0.058	0.068	*S*		
10 Team_size	0.090	-0.074	0.052	0.077	0.141	0.047	0.079	0.066	-0.095	*S*	
11 Report_manager	-0.106	-0.072	-0.055	-0.031	0.119	-0.029	-0.453	-0.034	0.087	-0.078	*S*
Composite reliability	E	E	E	0.882	0.805	S	S	S	S	S	S
AVE	E	E	E	0.714	0.509	S	S	S	S	S	S

Notes. Org_factors: organizational factors that facilitate learning from errors; Pos_err_orientation: positive error orientation; Err_detection: error detection; Err_correction: error correction; Indiv_learn_error: individual learning from error; Report_manager: report to a manager; E: emergent construct; S: single indicator. The values in bold along the diagonal (columns 4 and 5) are the square root of AVE; as their values are higher than the values outside of the diagonal (correlations), there exists discriminant validity (Hair, J. F., Jr., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2016). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) (2nd ed.). Sage Publications.).
Correlations higher or equal to |0.119| are significant at 5%.

When checking the cross-loading matrix, at the item level, we did not identify problems of discriminant validity. In Appendix A, there is a list of scale items and their factor loadings.

Emergent constructs

Table 3 shows the results for the measurement model assessment, in relation to emergent constructs. In these cases, reliability and convergent validity are not considered, as no correlation between the indicators is expected (Hair et al., 2020). Based on the results, there are no problems regarding multicollinearity, given that the variance inflation factor (VIF) for the indicators is < 3.0.

In the assessment of the relative contribution of the indicators for constructs formation, as indicated by Hair et al. (2020), the weight factors are significant (p-value < 0.05), except for ED1, STR, and P&V. The analysis of the absolute contribution of these indicators to constructs formation indicates that the factor loading is ≥ 0.50 only for P&V, situation where it is recommended to maintain the indicator in the model (Hair et al., 2020).

In reference to ED1 and STR, they show factor loads < 0.50 and do not demonstrate significance. However, from the theoretical point of view, these are considered relevant to the construct's operational definition and, as such, we maintained them in the model.

In Appendix B, there is a list of the error detection variable items, the factorial scores generated for the latent variables, and the respective factorial weights.

Table 3. Measurement assessment of the formative constructs (*N* = 298)

Indicator	Factor weights	p-value	VIF	Factor loads	p-value
Organizational factors that facilitate learning from error					
M&C	0.313	0.034	1.193	0.621	0.000
P&V	0.084	0.733	1.286	0.533	0.006
RES	0.802	0.000	1.304	0.948	0.000
Positive error orientation					
REF	0.824	0.000	1.016	0.882	0.000
STR	-0.042	0.777	1.022	0.055	0.757
COM	0.478	0.001	1.037	0.575	0.000
Error detection					
ED1	-0.006	0.946	1.022	0.122	0.218
ED2	0.598	0.000	1.060	0.755	0.000
ED3	0.458	0.000	1.028	0.568	0.000
ED4	0.484	0.000	1.045	0.597	0.000

Note. ED1 to ED4: indicators of the formative error detection construct.

Structural model assessment

The results of the structural model assessment are presented in Table 4. It was performed in three stages (Models 1, 2, and 3). In Model 1, only the control variables were included along with their respective endogenous variables, where all the control variables present significant effects. In Model 2, there are no control variables, as this was used only to assess the variation of the structural coefficient of each hypothesis, after the inclusion of the control variables. In Model 3, there is the complete or final model; since all the control variables present significant effects, these were maintained.

When comparing the adjusted R^2 of the hypotheses, of Model 1 with those of Model 3, we note that the model explains 4.1% of the positive error orientation variance (ΔR^2 = 15.6% – 11.5%), thus highlighting that all control variables are significant in Model 1 and not significant in Model 3. About this result, we understand that organizational factors that facilitate learning possess a shared variance with organizational characteristics (business model and company size), along with the individual characteristics (gender and age).

Table 4. Structural model assessment (*N* = 298).

Model 1	Hypotheses	f^2	Path coefficient	Standard error	t-value	p-value	R^2 adj.
Business_model → Pos_err_orientation	Control	0.030	0.165	0.061	2.70	0.007	0.115
Company_size → Pos_err_orientation	Control	0.022	-0.140	0.065	2.16	0.031	
Gender → Pos_err_orientation	Control	0.045	0.199	0.057	3.50	0.000	
Age → Pos_err_orientation	Control	0.062	0.237	0.059	3.99	0.000	
Age → Err_correction	Control	0.026	0.160	0.056	2.86	0.004	0.029
Team_size → Err_correction	Control	0.013	0.115	0.052	2.21	0.027	
Team_size → Indiv_learn_error	Control	0.029	0.168	0.045	3.76	0.000	0.038
Report_manager → Indiv_learn_error	Control	0.021	0.142	0.050	2.84	0.004	
Model 2							
Org_factors → Pos_err_orientation	H1(+)	0.176	0.387	0.057	6.79	0.000	0.147
Pos_err_orientation → Err_detection	H2(+)	0.383	0.526	0.046	11.5	0.000	0.274
Err_detection → Err_correction	H3(+)	0.265	0.459	0.063	7.24	0.000	0.295
Org_factors → Err_correction	H4(+)	0.041	0.181	0.066	2.73	0.006	
Err_correction → Indiv_learn_error	H5(+)	0.339	0.503	0.050	10.0	0.000	0.251
Model 3							
Org_factors → Pos_err_orientation	H1(+)	0.179	0.387	0.056	6.90	0.000	0.156
Business_model → Pos_err_orientation	Control	0.004	0.056	0.060	0.95	0.345	
Company_size → Pos_err_orientation	Control	0.001	0.027	0.060	0.44	0.658	
Gender → Pos_err_orientation	Control	0.002	0.045	0.068	0.66	0.511	
Age → Pos_err_orientation	Control	0.012	0.102	0.066	1.55	0.122	
Pos_err_orientation → detec_erro	H2(+)	0.366	0.518	0.065	7.92	0.000	0.265
Err_detection → Err_correction	H3(+)	0.287	0.469	0.061	7.69	0.000	0.318
Org_factors → Err_correction	H4(+)	0.042	0.179	0.065	2.78	0.005	
Age → Err_correction	Control	0.036	0.157	0.050	3.11	0.002	
Team_size → Err_correction	Control	0.004	0.051	0.047	1.09	0.278	
Err_correction → Indiv_learn_error	H5(+)	0.341	0.497	0.052	9.62	0.000	0.275
Team_size → Indiv_learn_error	Control	0.018	0.114	0.040	2.84	0.005	
Report_manager → Indiv_learn_error	Control	0.029	0.144	0.046	3.11	0.002	

In relation to remaining constructs, after disregarding the control variables effect, the model explains around 27% of the variance for error detection (27.4% in Model 2 and 26.5% in Model 3), 28.1% of the variance for error correction ($\Delta R^2 = 31.8\% - 2.9\%$), and 23.7% of the variance for learning from error ($\Delta R^2 = 27.5\% - 3.8\%$).

Furthermore, when comparing the structural coefficients of Model 2 with Model 3, we note the variation of approximately 0.01 or lower, which indicates that even the model without the control variables presents unbiased (beta) results. Next, we present the hypotheses analysis.

Hypothesis 1, organizational factors that facilitate learning from error positively influences positive error orientation, is supported ($\beta = 0.387$, $p < 0.00$), in alignment with previous studies (Edmondson, 1999; Gronewold & Donle, 2011). According to Cohen (1988), the effect size is average ($f^2 = 0.179$).

Hypothesis 2, positive error orientation positively influences error detection, is supported ($\beta = 0.518$, $p < 0.00$). Despite the previous literature highlighting the error identification as necessary to the individual's involvement in addressing the error situation (Frese & Keith, 2015; Zhao & Olivera, 2006), no model is identified that contemplates the association between individual error orientation and error detection. The effect is large ($f^2 = 0.366$), which strengthens the understanding that individual disposition when dealing with error stimulates the adoption of favorable behaviors toward the identification and recognition of one's own errors.

Hypothesis 3, error detection positively influences error correction, is supported ($\beta = 0.469$, $p < 0.00$), with an effect from medium to large ($f^2 = 0.287$). This result is aligned to existing literature, which stresses the necessary error detection as a condition for dealing with the error situation, by means of executing the activities for its correction (Frese & Keith, 2015; Tjosvold et al., 2004; Zhao & Olivera, 2006).

Hypothesis 4, organizational factors that facilitate learning from error positively influence error correction, is supported ($\beta = 0.179$, $p < 0.01$). Previous literature points to the relationship between organizational elements and activities related to error correction, at the level of work teams (Cannon & Edmondson, 2001; Edmondson, 1999), whereas, in this study, this relationship is evidenced at its individual level. However, the effect is small ($f^2 = 0.042$), which indicates an importance of organizational factors toward error correction less than expected.

Hypothesis 5, error correction positively influences learning from error, is supported ($\beta = 0.497$, $p < 0.00$), with a large effect ($f^2 = 0.341$). Existing literature emphasizes that it is through means of error correction activities that learning takes place (Bauer & Mulder, 2007; Dahlin et al., 2018; Ohlsson, 1996; Zhao, 2011). Yet, a model that includes and measures the relationship between error correction and individual learning from error is not identified.

Regarding the control variables, organization business model, gender, and organization size did not demonstrate significant effects. On the other hand, age ($\beta = 0.179$, $p < 0.036$) presented a significant relationship with error correction. Additionally, team size ($\beta = 0.114$, $p < 0.005$), and reporting to a manager ($\beta = 0.144$, $p < 0.0002$), showed significant relationships with individual learning from error.

Such results, supported by hypotheses analysis, bring theoretical and practical implications, which are discussed in the following section.

Theoretical implications

The research findings confirm that organizational factors contribute to the formation of the individual positive error orientation. The results also evidence the relevance of the positive error orientation to error detection, on the individual level. However, the level of explanation given by the model for positive error orientation variance is low. We consider two reasons for this.

First, organizational factors that facilitate learning are seen as possessing a shared variance with organizational and individual characteristics, measured by the control variables. About business model, for example, technology-based organizations have their operations based on new processes and technologies, which requires people to be open to more experimentation and, therefore, to tolerate more frequent errors (Cannon & Edmondson, 2001). So, these organizations — as well as the traditional-based — may possess other characteristic elements of the management model and of work processes influencing individual error orientation, besides the indicators covered by organizational factors that facilitate learning dimensions.

Secondly, error orientation is a multifaceted construct. Considering just the EOQ (Rybowiak et al., 1999), different combinations of its subscales are found in the literature, to measure error orientation (e.g., Arenas et al., 2006; Hetzner et al., 2011; Schell & Conte, 2008). This implies that it is necessary to consider other positive error orientation dimensions, in addition to those included in the structural model. We specifically point out error anticipation and error risk taking.

Error anticipation deals with the expectation that errors may occur, even in areas of professional dominance (Rybowiak et al., 1999). Therefore, the adoption of behaviors based on error anticipation collaborates on the development of cognitive and emotional strategies favorable for dealing with error situations (Seckler et al., 2017).

In turn, error risk taking concerns the attitude of openness toward the possibility of erring, according to the nature of the objective one desires to achieve (Rybowiak et al., 1999). When considering the error risk and its negative consequences, the individual tends to assume a posture of flexibility and adaptation, which proves to be useful for both identifying errors and dealing with them.

The behavior adopted by the individuals in situations where they should be able to identify and recognize their own errors is dependent on their conceptions in relation to this type of event. As it was identified by Harteis et al. (2008), except in more serious situations, people tend to differ in relation to the same situation whether it is an error or not. If people reject the possibility that the problem they are facing may have originated from their own error, such a situation will not be perceived — and effectively approached — as an opportunity to learn more about the work and the environment that surrounds it.

As previously mentioned, if individuals hold the belief that errors can occur during the execution of their work, it is possible that they are more likely to identify their own errors than those that hold an excessively optimistic attitude or one of avoidance in terms of errors. This occurs, as suggested by Zhao and Olivera (2006), through the understanding that error anticipation makes people direct their attention at the monitoring of their own action and performance. Such understanding would favor the immediate identification of errors or the willingness to assess the possibility of these having occurred.

The research findings also show the positive influence of organizational factors on error correction, on the individual level of analysis. Nevertheless, organizational factors presented a low practical importance for error correction, which we assume to be associated with the complexity level of the errors considered by the respondents. As Homsma et al. (2009) corroborated, the intensity of effort employed in dealing with the error depends on the severity of its consequences: the more severe the apparent consequences are, the greater the involvement will be of individuals in error correction activities.

Hence, a possible explanation is that part of the errors experienced by the respondents present a low complexity level, so that when correcting errors, individuals did not find it necessary to seek organizational support resources, such as information or supervisor support. This implies that more attention should be given to capturing the individual perception of the level of error severity, as a way for researchers to better understand the influence of the error correction actions on learning.

Finally, by modeling and measuring the relationship between error correction and individual learning from error, we empirically verify the significant practical importance of the error correction stage for learning. Bearing in mind the need for conceptual clarity as a condition for the proper understanding of learning from one's own error, it is considered relevant to make a tangible delimitation of the stages of the error treatment process (such as detection and correction) and of the learning generated from this process.

In view of the necessary theoretical development of the phenomenon, we conceive as essential that learning from errors is not defined in such a way as to be confused with the error treatment process (cf. Bauer & Mulder, 2007; Rybowiak et al., 1999; Zhao, 2011). Learning from errors concerns the process of acquiring new information and experiences from the appropriate approach to an error situation, which can lead to new ways of thinking and acting.

Practical implications

Based on the research findings, we emphasize some aspects of organizational context that, if actively managed, can favor the learning of individuals.

Positive error orientation is highlighted as a promoter of learning in individuals. This means that organizational managers should include, within the training programs of corporate universities, learning and development activities related to situations of error in the workplace. To help people develop a positive error orientation, such programs could cover learning activities that allow them to understand their beliefs regarding errors and how they tend to manage them. In addition, instrumental training activities can be carried out, in which individuals learn problem-solving methods based on errors.

Individuals have the necessity to act in a psychologically safe environment (Edmondson, 1999) where they can approach, share, and confront their own errors, and which is favorable to the acquisition of new learning. Likewise, the formation of positive error orientation depends on the individual understanding that, when faced with an error, it is feasible and productive to seek manager and colleagues support to correct it. In other words, it is necessary that organizational managers seek to establish a culture of learning from errors (Harteis et al., 2008).

Moreover, the OILOE model can be used by managers to capture and understand the perceptions of people in relation to their own readiness and the conditions offered by the organizational context to engage in learning processes from errors. The results of a survey like this may indicate areas that need more attention concerning management effort, aimed at increasing learning from errors and avoiding their repetition.

CONCLUDING REMARKS

In this study, we aimed to propose and test a model of orientation to individual learning from one's own error. The results confirm relationships of effect between model constructs, according to which organizational factors that facilitate learning from error strengthen positive error orientation and this promotes error detection. Additionally, the results evidence and empirically confirm the predictive relationships of organizational factors that facilitate learning from errors with error correction, as well as of error correction with individual learning from error.

We contribute to the research field of learning from error through modeling and measuring of the association between individual positive error orientation and error detection — given that, in the existing literature, no model is identified that contemplates this relationship. The effect of positive error orientation on error correction is large, which suggests that the individual disposition favorable to approaching error situations in a productive way facilitates the identification and recognition of one's own errors.

Another contribution comes from the empirical verification of the association between error correction and individual learning: it is a relationship of positive influence and significant practical importance. Despite previous literature establishing the importance of error correction activities for individual learning from error, the OILOE model is the first to model and measure the relationship between the two constructs.

Finally, we consider some theoretical implications. To deepen the understanding of the influence of the organizational context on the direction of individual error orientation, it is important to consider specific elements of the business model (technology-based or traditional-based). In addition, to measure more accurately the individual positive error orientation construct, its operationalization should be more comprehensive in its dimensions: individual attitudes toward error such as error anticipation and error risk taking seem to be some of these essential dimensions.

Limitations and future research

One of the limitations of this study concerns the fact that we did not collect and analyze data related to the error level complexity considered by the respondents when they answered the questionnaire. Previous literature suggests that the perceived severity level for error consequences can influence both the individuals' willingness to communicate their own mistakes and learning from them (Homsma et al., 2009; Horvath et al., 2021). Therefore, for future studies, we suggest considering the analysis of how the level of severity perceived for the error influences the individual's engagement in error correction activities.

One of the main strengths of this study, the investigation of one's own error as learning opportunities, is precisely what exposes another of its limitations: the research results do not apply to situations in which someone engages in the detection and correction of errors made by others.

As proposed by Horvath et al. (2021), "... people may learn more from errors made by themselves as opposed to errors made by someone else" (p. 111), depending on the cognitive and affective outcomes of higher learning rates observed for one's own errors. So, we suggest that future studies explore how the agent of the error impacts on learning, for example, comparing individual engagement in situations of errors made by themselves with engagement in situations of errors made by others.

The third limitation of the study relates to the previously commented restricted capacity of the model to explain the variance of positive error orientation. We consider that future investigations may seek to broaden the understanding of the formation of individual positive error orientation. For this, it is suggested that other formative dimensions of the positive error orientation construct be included in the OILOE model, such as error anticipation and error risk taking.

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APPENDIX A.

Table A1. Scale items (N = 298)

Item	Content	Mean	S.D.	F.L.
Construct/Formative variable: error competence				
CPT1	When I have made a mistake, I know immediately how to correct it (a)	4.829	1.170	0.796
CPT2	When I do something wrong at work, I correct it immediately (a)	6.265	0.971	0.542
CPT3	When it's possible to correct a mistake, I know how to do it (a)	5.547	1.025	0.807
CPT4	In my work, errors occur that I don't know how to solve right away (d) (R.I.)	3.547	1.461	X
Construct/Formative variable: error strain				
STR1	I feel stressed when I make mistakes at work (a)	2.292	1.481	0.744
STR2	I fear making mistakes at work (a)	2.909	1.783	0.816
STR3	I feel embarrassed when I make mistakes at work (a)	3.111	1.912	0.809
STR4	I get irritated when I make mistakes at work (a)	2.742	1.671	0.733
STR5	I get concerned that I might do something wrong at work (a)	2.463	1.520	0.721
Construct/Formative variable: error communication				
COM1	When I make a mistake at work, I tell others about it in order that they do not make the same mistake (a)	4.960	1.554	0.797
COM2	It is to my advantage to discuss my mistakes with others in my work (a)	4.896	1.760	0.758
COM3	Hiding my mistakes at work can be helpful (a) (R.I.)	6.040	1.284	X
COM4	I prefer to keep my mistakes at work to myself (a) (R.I.)	4.762	1.660	0.780
Construct/Formative variable: manager and colleagues support				
M&C1	When I make a mistake at work, I can enlist the help of my manager to correct the mistake (a)	4.500	2.196	0.851
M&C2	When I make a mistake at work, I can enlist the help of my colleagues to correct the mistake (a)	4.876	1.779	0.851
Construct/Formative variable: organizational principles and values				
P&V1	In my work, people consider mistakes to be useful for acquiring new learning (a)	4.329	1.788	0.787
P&V2	When an error occurs in my work, people consider it more important to determine the causes of the error, not who made the mistake (a)	4.376	1.719	0.857
P&V3	In my work, those who make mistakes suffer negative consequences, such as dismissal or damage to their professional image (a) (R.I.)	4.856	1.755	0.689
Construct/Formative variable: support resources for error correction				
RES1	In my work, I have access to the information or knowledge necessary to correct a mistake (a)	4.383	1.341	0.828
RES2	In my work, I have access to the material and technological resources necessary to correct a mistake (a)	5.292	1.414	0.868
RES3	When I make a mistake at work, I take the time to correct the mistake (a)	5.144	1.538	0.530
Construct/Reflexive variable: reflection				
REF1	Before correcting my mistakes at work, I reflect on what happened (d)	5.930	1.180	0.782
REF2	After detecting that I made a mistake, I think about why the error occurred (d)	6.191	1.038	0.802
REF3	Before correcting my mistakes at work, I analyze their possible causes (d)	5.755	1.275	0.725
Construct/Reflexive variable: development of a new action strategy				
DEV1	If I am correcting a mistake of mine at work, I think about how to act on the cause of the mistake (d)	5.886	1.137	0.737
DEV2	If I'm correcting a mistake of mine at work, I don't spend time evaluating different solution alternatives (d) (R.I.)	4.745	1.716	0.737
DEV3	If I'm correcting a mistake I made at work, I plan the solution first, then take action (d)	5.430	1.372	X
Construct/Reflexive variable: implementation of the new strategy				
IMP1	Even though I've planned how to correct a mistake I made at work, I don't implement corrective actions (d) (R.I.)	5.383	1.668	0.724
IMP2	After taking corrective actions for a mistake at work, I verify that they were effective in preventing the mistake from recurring (d)	5.671	1.305	0.724
IMP3	If I find that the actions taken to correct a mistake at work have not been effective, I look for new alternative solutions (d)	6.007	1.025	X
Construct/Latent variable: individual learning from errors				
ILE1	Mistakes made by other people help me improve my work (a)	5.601	1.454	0.700
ILE2	The mistakes I observe provide me with useful information to do my job (a)	5.883	1.071	0.663
ILE3	My mistakes help me improve my work (a)	6.134	1.123	0.733
ILE4	My mistakes have helped me improve my work (a)	6.154	1.043	0.770

Notes. (a) the item was replicated or adapted (original scales are listed in the method section); (d) the item was developed from the literature review; R.I.: reversed item; S.D.: standard deviation; F.L.: factor loading obtained in the analysis of principal components carried out in Jamovi software; X: indicator removed from the measurement model because of presenting low factor loading.
Answer options: seven-point Likert scale type from 'never' to 'always.'

APPENDIX B.

Table B1. Items of the formative variable error detection and the factorial scores generated for the latent variables (N = 298)

Item	Content	Mean	S.D.	F.W.
Construct/Formative variable: error detection				
ERR1	In my work, I notice when I perform a procedure differently than I should have (d)	5.389	1.377	-0.049
ERR2	In my work, when I get a result different from what was expected, I analyze the situation to identify if I made a mistake (d)	6.107	1.106	0.410
ERR3	When a problem occurs in my work, the opinions and advice I receive from others help me identify if I have made a mistake (d)	5.664	1.240	0.491
ERR4	When I make a mistake at work, I'm the first to notice (d)	4.997	1.252	0.655
Factorial scores generated for the latent variables				
CPT_score	Factorial score obtained by the average of the items CPT1, CPT2, and CPT3	5.547	0.763	0.840
COM_score	Factorial score obtained by the average of the items COM1, COM2, and COM4	4.872	1.292	0.456
STR_score	Factorial score obtained by the average of the items STR1, STR2, STR3, STR4, and STR5	2.703	1.282	-0.106
M&C_score	Factorial score obtained by the average of the items M&C1 and M&C2	4.688	1.692	0.311
P&V_score	Factorial score obtained by the average of the items P&V1, P&V2, and P&V3	4.520	1.363	0.047
RES_score	Factorial score obtained by the average of the items RES1, RES2, and RES3	5.273	1.066	0.824
REF_score	Factorial score obtained by the average of the items REF1, REF2, and REF3	5.959	0.894	0.838*
DEV_score	Factorial score obtained by the average of the items DEV1 and DEV2	5.658	1.049	0.855*
IMP_score	Factorial score obtained by the average of the items IMP1 and IMP2	5.839	0.990	0.840*

Notes. (d) the item was developed from the literature review (sources are listed in the method section); S.D.: standard deviation; F.W.: factor weight (formative construct) obtained in the estimation of the structural model in SmartPLS 3.
* Factor loading obtained in the estimation of the structural model in SmartPLS 3.
Answer options: seven-point Likert scale type from 'never' to 'always.'