‘Oops I did it again’:
How error management cultures can stimulate learning

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Abstract

Previous research has demonstrated that an error management culture in which errors are discussed and analysed, can stimulate learning from errors and many other positive consequences, such as a higher quality of service and better performance. But how do we create and stimulate an error management culture within financial organisations? Based on previous research, the current study examined the relations between leadership error management, tone at the top error management, error policy, error management culture, and learning from errors within the financial sector. In order to study this, an online survey was conducted by the AFM among employees from thirteen different financial organisations (N = 436). Results demonstrated that the behaviour of direct supervisors and the top regarding errors positively related to learning from errors, both directly and indirectly through error management cultures. As expected, if direct supervisors and the top focused on error management and set the right example, more errors were openly shared and discussed within financial organisations, and more was learned from errors. Other interesting findings showed that managerial staff on average scored higher on constructs than the non-managerial staff, and some organisations scored better than others. Although error policy could not be analysed due to insufficient reliability, this study gave organisations more insight into their error management. Moreover, this study offers opportunities for financial organisations to stimulate error management cultures and learning from errors by implementing error management among direct supervisors and higher management.

Keywords: error management culture, leadership error management, tone at the top, error policy, learning from errors

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Imagine that you are in a hurry when responding to a client’s email. Accidentally, you attach a document with personal information from another client in this email. How would you feel? Would you admit that you have made a mistake? Would you report this error to your supervisor or tell colleagues that you did something wrong? Humans make errors (Helmreich & Merritt, 2017). In this study, errors are defined as “unintended deviations from plans, goals, or adequate feedback processing as well as an incorrect action that results from lack of knowledge” (Van Dyck, Frese, Baer, & Sonnentag (2005, p.1229). Thus, errors occur unintentionally in contrast to intentional actions as fraud or misconduct.

Although everyone makes errors, not everyone feels comfortable to share one’s error with others at work. Employees are, for instance, afraid to get punished and blamed or it is perceived as normal to ignore errors that are made. Denial or blame and punishment are examples of ineffective error approaches (Scholten & Ellemers, 2016). These ineffective error approaches can result in strong negative emotions such as guilt, shame, or fear which increases the risk of counterproductive work behaviours (Cannon & Edmondson, 2005; Edmondson, 2000; Rybowiak, Garst, Frese, & Batinic, 1999). Besides, errors could reoccur, and therefore their negative consequences (Van Dyck et al., 2005).

Fortunately, *error management cultures* can prevent these negative effects of errors and can result in many positive effects (Van Dyck et al., 2005; Frese & Keith, 2015). Within an error management culture, errors are seen as only human, and people actively communicate about their errors. When errors are discussed and analysed, and the learning potential is shared within the organisation, improvements can be made. Acknowledging that errors are a natural part of work activities (and life in general) results in more learning (Bauer & Mulder, 2007; Edmondson, 1999; Homsma et al., 2009; Van Dyck et al., 2005; Lei, Naveh, Nivokov, 2016), a better quality of services (Hofmann & Mark, 2006), higher safety (Cigularov & Rosecrance, 2010), and a better organisational performance (Van Dyck et al., 2005).

In various fields, for instance in healthcare or aviation, an error management culture is found effective to prevent risks (Mark et al., 2008; Chang & Mark, 2011; Gronewold & Salterio, 2013). However, the question is “How do you create such an error management culture in an organisation?” Existing research and work practices suggest that *direct supervisors* (Dimitrova, 2014), *top management*, and *policy* about how to deal with errors can affect the way employees handle their errors (Chang & Lee, 2007), and therefore the error management culture. Unfortunately, in the financial sector where risks of ignoring errors

might be less obvious but still substantial, the topic of error management cultures is understudied. Not only for financial organisations themselves but also for the Authority for the Financial Markets (AFM), who supervises 11.000 financial organisations within the Netherlands, more insight into dealing with errors is important. This way, operational risks can be better managed and controlled. To manage the advantages of an error management culture and to identify factors that could stimulate this culture within financial organisations, the AFM initiated this research. The goal of this study is to examine how *leadership, tone at the top*, and *policy* relate to an *error management culture*, and how this culture is in turn related to *learning from errors* within the financial market.

Positive consequences of error management cultures

As previously stated, the presence of error management cultures has many positive consequences. The most important and most studied positive consequence is *learning from errors*. This positive consequence underlies many other positive consequences. Therefore, in this study learning from errors will be examined (Figure 1). Learning from errors can be considered a subcategory of non-formal experimental learning which consists of four steps (Van de Wiel, Szegedi, & Weggeman, 2004; Bauer & Mulder, 2007). First, people have a concrete example of an error. Second, they reflect and analyse the error. Third, a (new) strategy is developed to prevent the error next time. Finally, the strategy is tested and evaluated. These four steps are quite generic and have to be adjusted for specific working fields (Bauer & Mulder, 2007). Next, I will mention research about learning from errors in different working sectors.

The influence of an error management culture is studied within the medical field, especially the influence on learning from errors. Bauer and Mulder (2007) show in their qualitative study among nurses that especially non-formal learning activities result in more learning from errors. In particular, socially oriented learning activities such as informal discussions about errors with colleagues or supervisors, or discussions in formal team meetings, lead to more learning from errors among nurses. This result demonstrates that, through social interactions, learning from errors can support learning within teams and organisations (Edmondson, 2004; Van Dyck et al., 2005).

Also in other working fields, such as the chemical process industry, the influence of errors on learning is studied. Homsma and colleagues (2009) studied under which conditions learning from errors is expected. They found that the severity of consequences from errors and communication about errors are positively related to learning. The bigger the

consequences of an error, not on a personal but organisational and societal level, the more learning is visible. This does not mean that errors without clear negative consequences do not have a learning potential. These errors could play an indirect role in facilitating learning. The result that communication or social interaction regarding errors is important for learning, is consistent with results from the study mentioned above (Bauer & Mulder, 2007) and other studies (Edmondson, 2000; Edmondson, 2004; Van Dyck et al., 2005). All in all, learning from errors has proven to be an important consequence of an error management culture. Especially an error management culture in which people discuss their errors with others seems important to stimulate learning from errors.

As has been mentioned, learning could indirectly influence other positive consequences of error management cultures such as safety, the quality of services, and performance (Frese & Keith, 2015). First, learning within error management cultures could improve workplace safety to prevent workplace accidents, injuries, or damage. This is, among others, confirmed by research from Cigularov, Chen, and Rosecrance (2010). They prove that both safety communication (open communications and frequent interactions about safety) and an error management climate in which employees deal with and learn from errors, play an important role in improving workplace safety in the construction industry. Learning within error management cultures or climates thus seems important for stimulating workplace safety.

Second, open and constructive responses to errors predict a better quality of services. Hofmann & Mark (2006) found that safety climate (consisting of safety protocols and error management) predicts, besides less medication errors, also patient satisfaction, and patients' perceptions of nurse responsiveness in hospitals. Other healthcare studies show that when there is more psychological safety in teams, errors and current practices are discussed more, and more ideas are developed to improve service to customers and their interests (Edmondson, 1999; Nembhard & Edmondson, 2006). Thus, these results demonstrate that error management and learning cannot only predict the occurrence of errors, it also predicts (perceptions of) the service quality.

Finally, error management cultures and learning from errors relate positively to the performance of an organisation. Van Dyck and colleagues (2005) carried out an extensive study into the relationship between error management cultures and organisational performance. In two separate studies, conducted in two different countries, 112 commercial and advisory firms were selected to complete a survey. Results show that the error management culture of an organisation is positively related to organisational goal achievement and economic performance. Based on previous research, this relation was

expected to be mediated by factors as learning, innovativeness, experimentation, and improved quality of products, services, and work procedures. To sum up, an error management culture in which employees communicate, share, and analyse errors, positively relates to performance outcomes. Both financial organisations and the AFM will benefit from the implementation of error management cultures; error management cultures can improve safety and the quality of services, and at the same time, enhanced performances are more likely to occur.

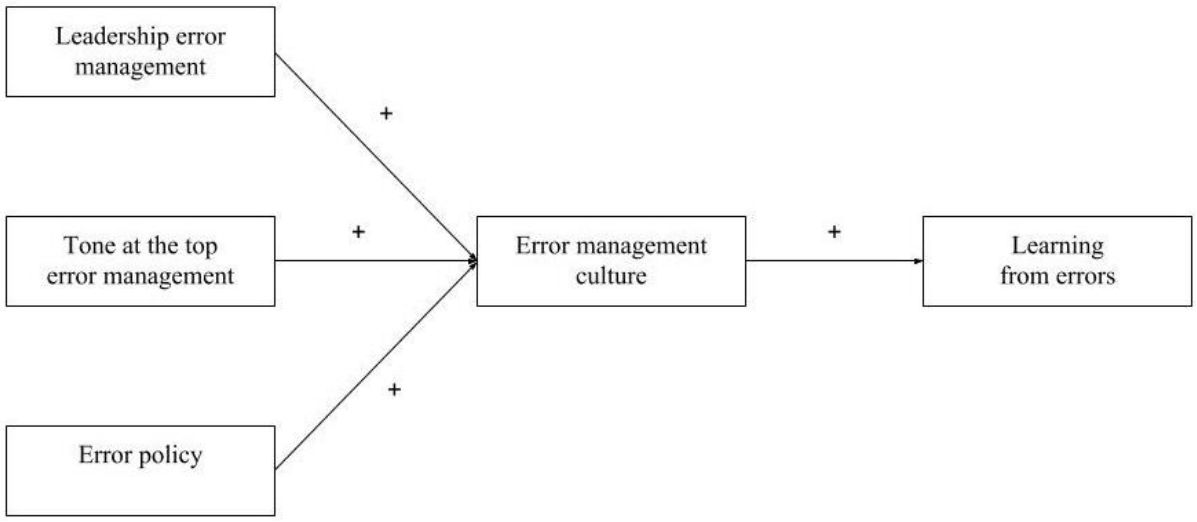

Figure 1. Hypothesized model

Stimulating error management cultures and learning from errors

Different factors could influence the error management culture and learning of an organisation. In this study, I examine how 'leadership error management', 'error management tone at the top', as well as 'error policy' relate to error management culture, and subsequently to learning from errors (Figure 1).

Leadership error management

Leaders, specified in this study as direct supervisors, play an important role in forming and maintaining an organisational culture (Chang & Lee, 2007). Different kinds of leadership styles, such as transformational leadership, participative leadership, and autocratic leadership are distinguished from each other to study how beliefs and attitudes of employees are changed in different leadership environments (Alonso Rodriguez & Griffin, 2009). In literature, little attention is paid to the way leaders handle errors within their organisation. This is unfortunate

because according to Cannon & Edmondson (2005), leaders play a key role in facilitating employees to learn from errors, through their role model position and error handling strategy.

Within the medical field, the influence of direct leadership from nurse managers on performance outcomes and shared beliefs about errors has been established. Edmondson (2000) studied the influence of different organisational factors on drug error rates across hospital units. Results show that unit leadership behaviour affects the way errors are managed, and this subsequently affects the shared perceptions of the error consequences. This means that both direction setting and coaching from unit managers influence outcomes as error rates, interpersonal relations, and performance. In turn, these outcomes affect the willingness to report errors, and the shared belief that employees are (not) blamed and punished for making mistakes. Recent research from Edmondson and Lei (2014) specifies what kind of behaviour leaders should demonstrate in order to stimulate learning from errors; leaders should create feelings of psychological safety through open reporting, active questioning, and sharing concerns.

Relevant for the current study, Dimitrova (2014) specifically studied the influence of leadership styles on employee perceptions about leaders, employee involvement, and organisational goal-fulfilment. She mentions in her article that there are two 'error-handling strategies' leaders can use: error management or error prevention. *Error prevention* suggests that errors can be prevented and thereby removed from organisations. On the other hand, *error management* entails that errors do occur, and they can be contained and managed, rather than removed completely. When leaders apply an error management strategy, they accept that errors are part of daily life and these errors are seen as opportunities to improve. Therefore, error management is a more realistic approach of dealing with errors (Dimitrova, 2014). Results show that leaders who apply an error management strategy, in contrast to an error prevention strategy, are seen as more sociable. Moreover, employees are more satisfied and motivated (Dimitrova, 2014). Nevertheless, error prevention is still a common practice among many organisations. This is why different studies emphasize the importance of switching from error prevention to error management in order to realize more learning and to prevent negative consequences of errors (Van Dyck et al., 2005; Alonso Rodriguez & Griffin, 2009; Frese & Keith, 2015).

Thus, in order to create an error management culture to accomplish positive effects of errors, leaders should apply an error management approach in which they accept and analyse errors, and see errors as opportunities to learn. Based on previous research about leadership error management, it is expected that in financial organisations, this style of leadership relates

positively to learning from errors, and that this relation will be mediated by an error management culture (H1).

Tone at the top error management

Besides influence from the direct supervisor, top management (in this study called *tone at the top*) can play an important role in affecting the culture of an organisation (Castellano & Lightle, 2005). There is not one general definition for the concept of tone at the top (Amernic, Craig, & Tourish, 2010). However, Cunningham (2005) defines the tone at the top as 'the shared set of values that an organisation has emanating from most senior executives' (p.6). It reflects actions; are managers "walking the talk"? The tone at the top thus focuses on visions and actions of senior managers.

Although the relation between tone at the top and an error management culture is not studied yet, the relation between tone at the top and ethical conduct is extensively studied (Schwarts, Dunfee, & Kline, 2005; Lamberton, Mihalek, & Smith, 2005; Mahadeo, 2006; Kaptein, 1998). For instance, interesting research from Lamberton and colleagues (2005) proves that less unethical behaviour was seen by employees in organisations where the tone at the top emphasizes ethical conduct. Likewise, Kaptein (1998) found that employees who behave unethically were, in many occasions, motivated by the unethical behaviour of the manager or board. Thus, employees often mirror behaviour of direct supervisors or the top, and this could influence (ethical) behaviour of employees (Brown, Trevinio, & Harrison, 2005).

In short, tone at the top influences the (ethical) perceptions and actions of employees within an organisation. In this study, an error management tone at the top will be studied which I define as "senior managers act according to and communicate a clear vision about how to deal with errors". Therefore, based on previous research, it is expected that an error management tone at the top relates positively to learning from errors, and this relation will be mediated by an error management culture (H2).

Error policy

Not only leadership from direct supervisors and tone at the top could influence the error management culture within an organisation, also procedures and *policy* written on paper (the structure) influence behaviour of employees. To my knowledge, research about error management cultures did not yet study the influence of policy. Nonetheless, error policy seems important for stimulating error management.

If you want employees to openly communicate errors and learn from them, culture and structure have to be well aligned (Miller & Friesen, 1984; Kish-Gephart, Harrison, & Treviño, 2010). When culture and structure are aligned, they can reinforce each other. For example, if the policy of an organisation states that employees should immediately report errors to their supervisor without being punished (the structure), and the supervisor really appreciates sharing errors because of the learning potential (the culture), it is expected that employees will share their errors more often and learn from them. Therefore, besides an error management culture, it is important for organisations to have a clear policy about how errors should be dealt with, and a user-friendly system that supports this error policy in order to stimulate learning from errors.

The theory of planned behaviour (Ajzen, 1991) supports the idea that both culture and policy affect intentions and behaviours of people. This commonly used theory emphasizes that behavioural attitudes, subjective norms and perceived behavioural control affect behavioural intentions and actions. A policy with clear procedures about how employees should handle errors, makes norms more explicit. This could increase the experienced behavioural control because people know what is expected from them. Thus, besides cultural norms and attitudes, policy could affect the actual and perceived behavioural control which indirectly and directly influence the behaviour of people (Ajzen, 1991). Besides leadership and a tone at the top, it is therefore expected that also error policy relates positively to learning from errors, and this relation will be mediated by an error management culture (H3).

Method

Context

This study was carried out by the AFM, a Dutch supervisor for the financial markets. The mission of the AFM is to promote fair and transparent financial markets in the Netherlands. The AFM is responsible for the supervision of activities within financial markets (savings, investments insurances and loans) in order to contribute to efficient and customer-friendly operations of these markets.

If organisations harm customer interests or violate laws, the AFM could correct these organisations by, for example, imposing fines. Besides this more regular form of supervision, the AFM has another side of supervision focused more on behaviour and culture, including this study on error management cultures. A corporate culture transformation within financial organisations is necessary to improve ethical behaviour, and the focus on customer interests. Within the AFM, the Behaviour & Culture (B&C) team tries to identify different cultural

elements, such as an error management culture, and make them more concrete and practical for organisations to work with. Therefore, the approach of this study is more practical than in most scientific research.

Although this form of supervision focused on behaviour and culture is more steering, sometimes, maybe even most of the time, organisations are still afraid for sanctions and increased supervision. Because of the practical nature of this and other cultural research, and the sensitivity of the data, certain choices had to be made to guarantee the relevance and anonymity of the results.

Procedure

The study was carried out by the AFM's B&C team. To collect data, the B&C team collaborated with another department called Efficient Capital Markets. This way, the same group of employees could be targeted with two different online questionnaires. Efficient Capital Markets selected thirteen organisations from four sectors: brokers, proprietary trading groups, trading platforms, and post-trading organisations. All organisations were selected from the Dutch trading platforms and post-trading organisations. From the brokers and proprietary trading groups, three organisations were selected. In most cases, all employees from an organisation were selected, or a representative selection.

All organisations received an email with the following information: the background and goal of the online survey, the way results would be presented, the study's aim, and the time load of the online survey. Results were used to generate an image of the market. To encourage collaboration from organisations, it was mentioned that results would be published anonymously. It was also explained to organisations that no supervisory measures would follow once the study was finished. The time to complete the survey was about 10 minutes.

Respondents within organisations received an email from their manager with the goal of the online survey and information about confidentiality. The same information was mentioned on the first screen from the online survey. It was explained that anonymity was guaranteed by mentioning that answers could not be retraced to specific persons, and results were only analysed on a company or sector level. Respondents received two emails: one with the link to the survey, and one with a password to log in.

After the results of the online survey were analysed, different employees were interviewed from five different organisations. The results from the interviews will not be discussed in this thesis because it exceeds the scope of this study. Afterwards, improvements

based on the survey and interviews were reported to and discussed with the participating organisations.

Participants

More than 400 employees completed the online survey (N = 436). The response rate differed between organisations from about 30% to 100%, with an average response of 71%. A representative picture could still be achieved, because the response rate at every cooperation was at least 1/3. Among the respondents, there were 81 managers (18%) and 355 non-managerial staff (82%). To maintain the anonymity of respondents, other demographic questions were not asked in the survey.

Measures

Five themes (constructs) were measured in the survey: error management culture, leadership error management, tone at the top, error policy, and learning from errors. The survey used in this study was based as much as possible on existing validated scales but developed by the AFM and researchers at Utrecht University. All constructs were measured on a 7-point scale (1 = does not apply at all to our organisation, 7 = applies completely to our organisation). For the reliability, Cronbach's Alpha (α) was used. Values of .70 or higher were interpreted as sufficiently reliable. The survey of this study cannot be shared due to the confidentiality of the instruments developed by the AFM. More items are available upon request.

Error management culture. To measure error management cultures within financial organisations, the scale developed by Van Dyck and colleagues (2005) consisting of seventeen items was used (e.g. "After making a mistake, people try to analyse what caused it.") (α = .96). Items were translated into Dutch.

Leadership error management. This construct was measured with the scale developed by Dimitrova (2014) to measure leadership error management, consisting of five items (e.g. "After an error, my supervisor takes the time to think it through"). Items were translated into Dutch. The scale was supplemented with four questions. Two questions were added about the behaviour of direct supervisors in cases of an error made by a colleague or when work pressure increases (e.g. "When the workload increases, my manager expects that the work is finished faster, even if it means skipping steps in procedures."). Also, two questions about the extent to which direct supervisors stimulate solution seeking, and share

the learning potential of errors were included (e.g. “I frequently notice that my manager does not address colleagues when an error has occurred.”) (α = .89).

Tone at the top error management. This scale was based on the scale from Kaptein (2008) to measure the organisational virtue of congruency. Three items were selected. Questions about unethical behaviour were transformed into questions about behaviour of the board regarding error management (e.g. “The board has a clear vision on how the company should manage errors.”). The reliability (α = .68) remained somewhat behind, but was still acceptable.

Error policy. Three items were developed to measure the extent to which organisations have a policy about errors. Because no existing scale was available, these items were self-developed. Unfortunately, the reliability of the scale was insufficient (α = .46). If one item (“Our procedures are too rigid on paper so that we cannot always follow them literally.”) was deleted, the reliability improved (α = .60) but was still insufficient. Officially, because there are only two items left, the reliability of two items could not be calculated. Therefore, this construct will not be included in further analyses.

Learning from errors. Likewise, there was no existing scale available to measure learning with regard to error management. The self-developed scale was based on theory mentioned in research from Edmondson (1999). Respondents were asked by nine questions (α = .90) the extent to which there were actions taken after errors to learn and improve from errors, other than reporting (e.g. “We discuss errors to prevent that these could repeat themselves”).

Plan for analyses

Survey data is analysed with SPSS and AMOS. All the hypotheses (H1 and H2) on relationships and mediation effects, can and will be analysed with model 4 in Process, and in AMOS. Indirect effects will be considered significant when 0 is not in the confidence interval (CI) or when $p < .05$. Factor analyses (not-forced and forced) will be carried out in SPSS to inspect the survey. The difference in scores between two organisations, and between managerial and non-managerial staff will be analysed with independent samples t-tests.

Results

Descriptives and correlations

The means and standard deviations, and correlations for all study variables are shown in Table 1. The overall means were all above 5 on a 7-point scale. Respondents scored

relatively high on error management culture (M = 5.85) and relatively low on learning from errors (M = 5.26). All the studied constructs (leadership error management, tone at the top error management, error management culture, and learning from errors) were positively related to each other (Table 1). The correlations were all above .50 and therefore categorized as strong.

Table 1

Correlations, means, and standard deviations variables

Variables	*M*	*SD*	1	2	3	4	5
1. Leadership error management	5.42	1.03	-				
2. Tone at the top error management	5.42	1.21	.62**	-			
3. Error management culture	5.85	0.93	.76**	.62**	-		
4. Learning from errors	5.26	1.11	.72**	.69**	.76**	-	
5. Managerial position (1=yes/2=no)	-	-	-.15**	-.22**	-.14*	-.21**	-

Note: *. Correlation significant at the .01 level. **. Correlation is significant at the .001 level. r = .10 (weak correlation), r = .30 (average correlation) and r = .50 (strong correlation).

To examine whether the constructs were, although strongly correlated, distinct from each other, a principal axis factor analysis was conducted on all the construct items with oblique rotation (direct oblimin). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analyses, KMO = .97 (‘marvellous’ according to Hutcheson & Sofroniou, 1999). An initial analysis was run to obtain eigenvalues for each factor in the data. Six factors had eigenvalues over Kaiser’s criterion of 1, and together they explained 65.98% of the variance. The scree plot showed inflexions that would justify retraining 1 factor (error management culture). Factor 1, the factor that measured an error management culture, explained more than half (50.1%) of the variance.

Thereafter, a factor analysis was run with a fixed amount of 4 factors that explained 63.29% of the variance together. Table 2 shows that the scale to measure error management culture was clearly distinguished as one factor. Leadership error management, learning from errors, and tone at the top were less easy to differentiate from each other, but with exception of a few questions[1], it is possible to distinguish them as separate factors.

[1] Leadership error management questions 6,7,8, and 9. Tone at the top 2. Learning from errors 8 and 9.

Table 2

Summary of principle axis factor analysis results with four factors (fixed)

	Rotated factor loadings			
Item	**1**	**2**	**3**	**4**
Error management culture 1	.59			
Error management culture 2	.84			
Error management culture 3	.86			
Error management culture 4	.74			
Error management culture 5	.87			
Error management culture 6	.82			
Error management culture 7	.81			
Error management culture 8	.81			
Error management culture 9	.69			
Error management culture 10	.63			
Error management culture 11	.59			
Error management culture 12	.62			
Error management culture 13	.75			
Error management culture 14	.77			
Error management culture 15	.76			
Error management culture 16	.63			
Error management culture 17	.72			
Leadership error management 1			-.73	
Leadership error management 2			-.74	
Leadership error management 3			-.72	
Leadership error management 4			-.66	
Leadership error management 5			-.57	
Leadership error management 6		.57		
Leadership error management 7		.69		
Leadership error management 8		.59		
Leadership error management 9			-.51	
Tone at the top error management 1		.56		
Tone at the top error management 2	-	-	-	-
Tone at the top error management 3		.62		

Learning from errors 1		.61
Learning from errors 2		.85
Learning from errors 3		.90
Learning from errors 4		.62
Learning from errors 5		.58
Learning from errors 6		.55
Learning from errors 7		.50
Learning from errors 8	.60	
Learning from errors 9	.51	

Note: Only items with rotated factor loadings higher than .40 are shown.

A principal axis factor analysis thus showed that statistically, study variables could be distinguished from each other. Furthermore, constructs did not measure exactly the same, since I did not find that all the constructs loaded on one and the same factor. Also, from a theoretical and practical perspective, constructs differ from each other.

Suggestions for improving the survey. Noticeable is that the four leadership questions that load on a different factor were the four self-developed questions. These questions were added for practical relevance. For example, respondents were asked if they had seen that their supervisor did not address colleagues when they made a mistake. Because of this practical relevance, these four questions will not be excluded from further analyses. The same applies to the last two learning questions. It is remarkable that these two questions had to be reversed, although statistically it would not be possible that reversed questions load on a different factor. Also for practical relevance, these questions will not be excluded in this study.

In this study, the practical and statistical reasons to include or exclude questions are taken into consideration, and decided is to focus more on the practical relevance of questions asked. If in the future, other researchers would like to focus more on statistical reasons such as more reliable scales and clearly distinguished constructs, I would recommend the following:

- Exclude the last four questions (6, 7, 8, and 9) from leadership error management.
- Exclude the last two questions (8 and 9) from learning from errors.

Furthermore, I would recommend the following to make scales more reliable:

- Add more questions to measure tone at the top error management. Make sure that these questions differ from the questions to measure leadership error management.

- Add more questions to measure error policy.

To check if constructs could be better distinguished from each other when suggestions above[2] are implemented, a principal axis factor analysis with adjusted scales was carried out with a fixed amount of 3 factors. The three factors explained 67.80% of the variance together. In Appendix 1 is demonstrated that error management culture, leadership error management, and learning from errors were easily differentiated from each other as separate constructs.

Noticeable mean differences

Noteworthy is that the managerial staff scores higher on all the constructs than the non-managerial staff (Figure 2). Especially the difference in scores on tone at the top and learning from errors is notable. Independent samples t-tests show that managerial staff scores significantly higher on leadership error management (M = 5.74, SE = 0.10) than non-managerial staff (M = 5.34, SE = 0.06), $t(137.6) = -3.59$, $p < .001$, d = 0.39. Managerial staff also scores significantly higher on tone at the top error management (M = 5.97, SE = 0.12) than non-managerial staff (M = 5.29, SE = 0.06), $t(134.3) = -5.08$, $p < .001$, d = 0.56. The same applies to error management culture and learning from errors. Managerial staff scores significantly higher on error management culture (M = 6.11, SE = 0.08) than non-managerial staff (M = 5.77, SE = 0.05), $t(148.5) = -3.46$, $p < .001$, d = 0.35. Finally, managerial staff scores significantly higher on learning from errors (M = 5.75, SE = 0.09) than non-managerial staff (M = 5.14, SE = 0.06), $t(167.0) = -5.75$, $p < .001$, d = 0.53. All effect sizes (d) can be categorized as small/medium or medium.[3]

[2] The last four questions of leadership error management are excluded, and the last two questions of learning from errors. Also, tone at the top is excluded because this construct could not be distinguished as one factor.

[3] *Cohen's d* = 0.2 (small), 0.5 (medium), 0.8 (large).

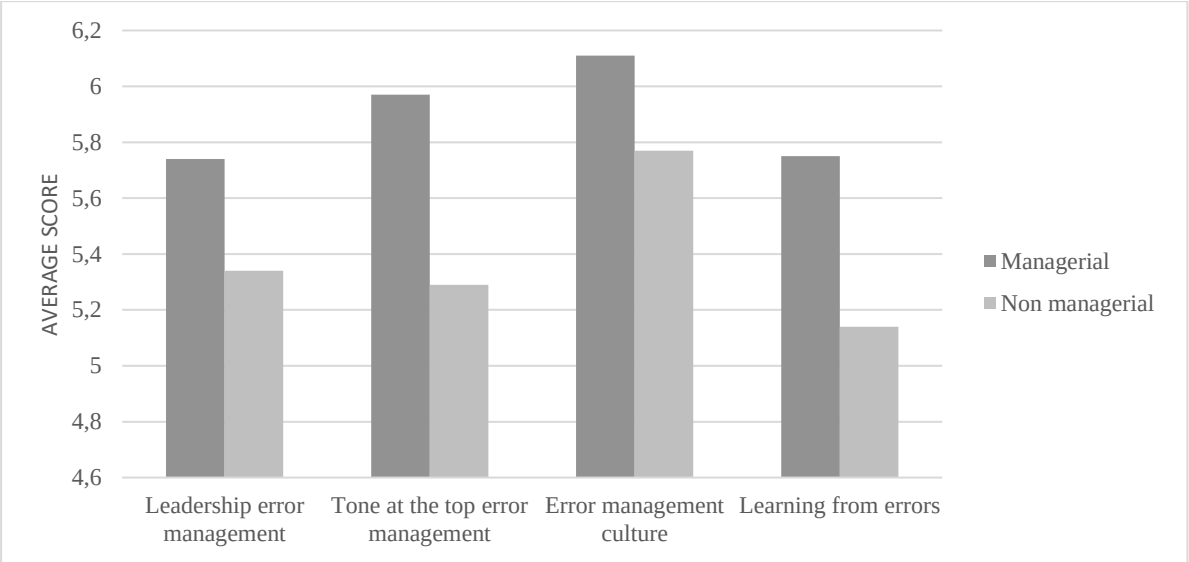

Figure 2. Managerial staff scores higher than non-managerial staff.

Note: All differences between managerial and non-managerial staff were significant at the .001 level ($p < .001$).

Another notable finding are the score differences between organisations. In Figure 3, the difference between the best (Organisation B) and worst scoring (Organisation H) organisation is visualized.[4] On average, respondents in organisation B score significantly higher on leadership error management ($M = 5.98$, $SE = 0.14$) than respondents in organisation H ($M = 4.75$, $SE = 0.16$), $t(74.7) = -5.58$, $p < .001$, $d = 1.15$. Respondents in organisation B also score significantly higher on tone at the top error management ($M = 6.19$, $SE = 0.15$) than respondents in organisation H ($M = 4.76$, $SE = 0.19$), $t(75) = -5.59$, $p < .001$, $d = 1.13$. The same applies to error management culture, and learning from errors. Respondents in organisation B score significantly higher on error management culture ($M = 6.52$, $SE = 0.08$) than respondents in organisation H ($M = 5.36$, $SE = 0.16$), $t(59.7) = -6.67$, $p < .001$, $d = 1.13$. Respondents in organisation B score significantly higher on learning from errors ($M = 6.22$, $SE = 0.12$) than respondents in organisation H ($M = 4.56$, $SE = 0.15$), $t(75) = -8.37$, $p < .001$, $d = 1.68$. All the effect sizes (d) can be categorized as large.[3]

[4] The best and worst scoring organisations were selected by calculating the mean scores per organisation on all constructs. Thereafter, the mean from all these means was calculated per organisation. In the ranking, only organisations with more than 15 respondents were included.

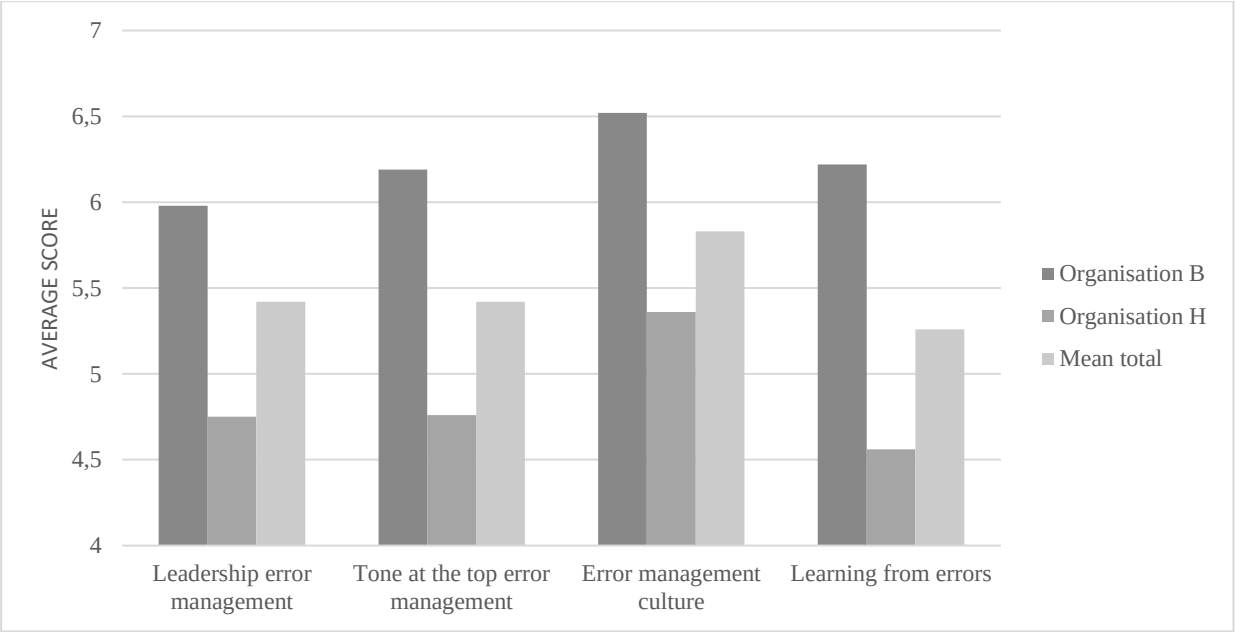

Figure 3. Organisation H scores lower than the total mean, whereas Organisation B scores higher.

Note: All differences between organisation B and H were significant at the .001 level ($p < .001$).

Mediation analyses

Error management culture as mediator. Hypotheses 1 was confirmed. There was a significant standardized indirect effect[5] of leadership error management on learning from errors via error management culture, $b = .24$, $p < .001$. This was a partial mediation, since the direct effect of leadership error management on learning from errors was also significant (Figure 4).

Hypothesis 2 was also confirmed. There was a significant standardized indirect effect of tone at the top error management on learning from errors via error management culture, $b = .09$, $p < .01$. This was also a partial mediation, since the direct effect of tone at the top error management on learning from errors was also significant (Figure 4).

Noticeable in Figure 4 was that leadership error management was stronger related to error management culture ($b = .61$) than tone at the top error management ($b = .24$). Hypothesis 3 could not be tested due to the insufficient reliability of the scale that measured error policy.

[5] Completely standardized indirect effects are reported as indications for effect sizes. These effects can be compared across different studies.

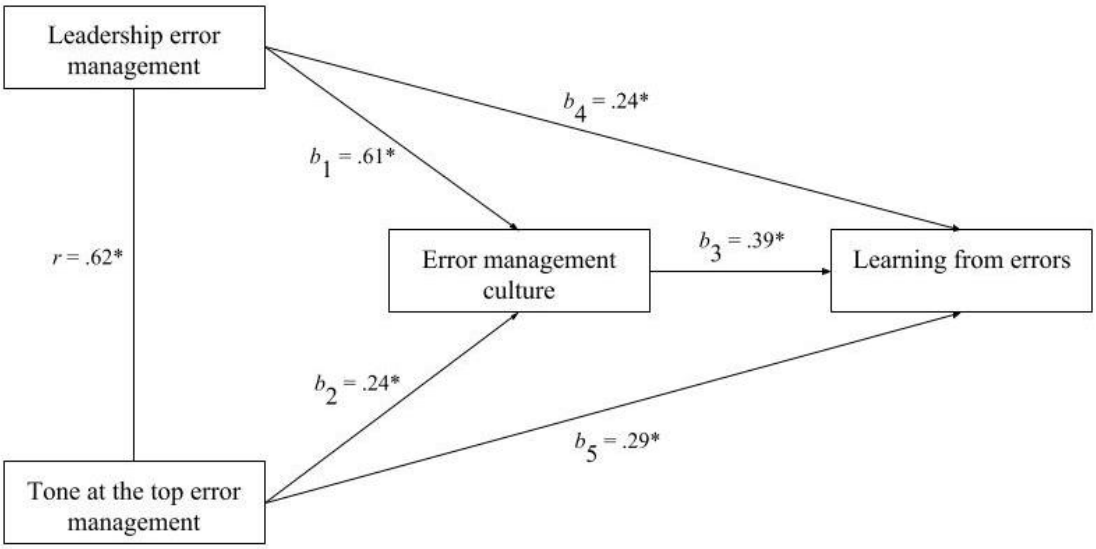

Figure 4. Relationship between leadership, tone at the top, and learning, partially mediated by error management culture.

Note: *. Relation is significant at the .001 level ($p < .001$).

The mediation/indirect effects (not standardized) of ERM are calculated by multiplying b_1 and b_3, and b_2 and b_3.

Discussion and conclusion

Up till now, the link between leadership, tone at the top, policy, and error management cultures was relatively unknown, especially within financial organisations. This study demonstrated that both leadership error management and tone at the top play an important role in stimulating learning from errors within financial organisations; when direct supervisors and the top embrace errors and stimulate sharing them, this relates to more learning from errors. Also, results show that the relation between leadership, tone at the top, and learning from errors is mediated by an error management culture; the more direct supervisors and the top focus on error management and set a right example, the more errors are openly shared and discussed within financial organisations, and more is learned from errors. Thus, both behaviours from direct supervisors and (senior) managers regarding error management relate to a more open culture in which employees dare to share their errors, and learn from them. These results are consistent with research in, for example, the medical or aviation sector, and with research in which other outcome measures are studied, such as satisfaction with leaders or ethical behaviour (Dimitrova, 2014, Edmondson, 2000; Edmondson & Lei, 2014; Kaptein, 1998; Lamberton et al., 2005).

Interestingly, managers scored higher on all constructs than the non-managerial staff. A possible explanation for this result is that managers are former employees who were (and are) more positive about the organisation, and who possibly put lots of energy in their work to become manager. Thus, it could be that managers were the former positive and hardworking employees, and that is why they scored more positive on all constructs. Another possible explanation could be that it is more in the interest of managers to score higher, since they want their own organisation to score well in comparison to other organisations. A competitive feeling among managers from different organisations could thus explain the score differences. Furthermore, self-serving biases can play a role. Hastorf, Schneider and Polefka (1970) said decades ago: "We are prone to alter our perception of causality so as to protect or enhance our self-esteem." (p. 73). Managers could identify themselves more with the organisation they work for, and to maintain their self-esteem, they scored more positive than the non-managerial staff, especially on the constructs concerning their behaviour.

Other interesting results show that two organisations score significantly different on all constructs. When looking at possible explanations, size and time can play a role. Organisation H (the lower scoring organisation) is a larger and more complex organisation compared with Organisation B, which can possibly cause reduced visibility or ownership of errors (Bovens, 1998). Also, the focus on success could be more important in large organisations, causing them to hide more errors. Another possible explanation is that organisation B (the best scoring organisation) is a relatively new organisation compared with Organisation H. For many organisations, error management is a relatively new concept. Recently established organisations can implement error management in their policy, management, and culture without making big changes. Longer existing organisations can find it more challenging to change and adapt to the newest insights (Lowndes, 2005). Further research in these organisations can confirm these possible explanations, or can verify other possible explanations.

Strengths and limitations

This study has contributed to research about error management. Many studies on error management have been carried out in the medical or aviation field but this is one of the first studies that examined error management within the financial sector. Also in the financial sector, an error management culture seems important to stimulate learning and other positive consequences. Furthermore, leadership, tone at the top, and policy were not yet studied in combination with error management cultures and learning. Finally, this study has a high

power due to the large sample of more than 400 respondents (N = 436) from thirteen different financial organisations. All in all, this study has contributed to emphasise the importance of an error management culture within financial organisations to stimulate learning and many other positive outcomes.

Although this study has its strengths, a few limitations should be mentioned. First, as already mentioned in the result section, all constructs are strongly correlated with each other. Factor analyses showed that the constructs do differ from each other but preferably, correlations would be lower to distinguish constructs more easily. The strong correlations can be explained by the fact that it is logical and expected that constructs are (strongly) related to each other, since they all focus on the management of errors. Also in previous studies, (safe) communication about errors and (team) learning behaviour (Homsma et al., 2009; Edmondson, 1999), or leadership behaviour and error management (Edmondson, 2000) are moderately to strongly correlated with each other. Thus, on one hand you would expect relatively high correlations between different constructs with the same focus on error management, on the other hand lower correlations would be more preferable to clearly distinguish different constructs. Another explanation for the strong correlations could be that respondents scored relatively high (higher than 5 on a 7-point scale) on all constructs. However, the standard deviation in many cases is higher than 1, so not all respondents and all organisations had a high score.

In order to prevent strong correlations between constructs in other studies, items can be more distinguished from each other by assuring that items from different constructs do not overlap too much content wise. With factor analyses and pilot tests it can be checked if items from the same construct load on one factor, and how many constructs can be differentiated from each other.

The second limitation is that the scale to measure error policy was insufficiently reliable. Also, the reliability of an error management tone at the top could be higher. In both cases, validated scales were not available. An explanation for the barely sufficient and insufficient reliability could be that both constructs were self-developed and measured with only three questions. In other research, an unreliable item can be replaced by more reliable items to increase the reliability. These new scales can be checked with pilot tests and reliability analyses. Fortunately, in contrast to the scales to measure error policy and tone at the top, other constructs were very reliable.

Finally, due to the small samples from some organisations, it was not possible to run analyses for every organisation separately. Therefore, for many organisations only overall

conclusions about all financial organisations together could be drawn. In further research, larger samples can result in more specific results for every organisation. This way, all organisations can be compared with each other, and more specific advice can be given.

Recommendations for future research

Next to the recommendations to improve measures and samples for further research, I will suggest some other recommendations. First, I recommend to replicate this study in more financial organisations and in other working sectors that have not yet been studied. This way, different relations can be studied in different organisations. Also, it can be checked if there are differences in error management between work sectors.

Second, not only learning from errors is important as dependent variable, also other outcomes such as ethical behaviour and client-oriented behaviour within financial organisations are important for the AFM and society to study (Schwarts, Dunfee, & Kline, 2005; Lamberton, Mihalek, & Smith, 2005; Mahadeo, 2006; Kaptein, 1998). For example, by including ethical and client-oriented behaviour in a survey, future research can analyse the influence or relation with leadership, a tone at the top, and policy. When significant positive relations are found, the AFM can stimulate organisations to implement error management in their policy and higher management levels in order to stimulate more ethical and client-oriented behaviour. Also, when more (positive) consequences of error management cultures are examined, the necessity to shift to an error management culture will be clearer for financial organisations.

Besides other outcomes, different stimulating factors of error management cultures can be tested. This study gives more insight in behaviour of direct supervisors, and (senior) managers. However, it would also be interesting to test, for example, how (team) psychological safety is related to error management and learning from errors. Team psychological safety is defined as ‘a shared belief that the team is safe for interpersonal risk taking’ (Edmondson, 1999, p.354). According to Edmondson (1999), team psychological safety should facilitate learning behaviour because it reduces concern about potentially negative reactions from others. Therefore, I am curious if (team) psychological safety is a necessary condition for employees to voice their errors and learn from them, or if (team) psychological safety functions as a moderator.

Finally, other research types can check the influence of direct supervisors and higher management even further. For example, with longitudinal research, it can be studied if on different time points, outcomes such as learning increase (or decrease) if an error management

culture is implemented within (financial) organisations. Additionally, an experiment should give more insight in causal relations between, for example, leadership, error management cultures, and learning. In an experiment, some leaders (chosen randomly) can be instructed to explicitly voice what they expect from employees when it comes to error management. For instance, they mention that employees can share and discuss errors with them and colleagues, and that employees would not be punished and blamed if they are honest and sincere. Other leaders are instructed to not explicitly mention their expectations about error management. Before and afterwards, error management and the degree of learning culture can be measured with a questionnaire. Based on the results from this study, I expect that when leaders voice their error management strategy, scores on error management culture and learning will be higher in comparison to leaders who do not voice their error management strategy. Also, it can be verified if there are any differences in the extent to which errors are reported.

Practical implications

For participating organisations of this study, the most important question is 'What can we do with the results from this study?' A financial organisation got different scores (means) on different constructs, and these results were compared with the overall means and means from the branch. For example, organisation X scored in comparison to the branch high on error management culture but a lot lower on learning from errors. An advice to this organisation could be to not only discuss errors within teams, but also to discuss what exactly went wrong, and how to prevent errors in the future. Only when organisations learn from errors, other positive outcomes such as better performance will arise.

Besides more specific results per organisation, an overall advice to all organisations can be given to improve their error management. First, it is important to study the overall culture or situation of an organisation, and not only focus on individuals. Because people influence each other, a culture transformation on organisational level is necessary if you really want to change how errors are managed and to stimulate learning. Second, as already mentioned in the theoretical part about error policy, it is important for organisations to align structure and culture so they can reinforce each other (Miller & Friesen, 1984; Kish-Gephart, Harrison, & Treviño, 2010). If procedures are clear and user-friendly systems are implemented to share errors (structure), and employees, managers and direct supervisors appreciate the added value of error management (culture), employees will share their errors more often and learn from them. Third, the behaviour of direct supervisors and managers is important for the management of errors on organisational level. Supervisors and managers

should not blame and punish employees who accidentally make an error, and they can set the right example by talking openly about their own mistakes. Start with sharing small errors; these can be perceived as less threatening, and are a good starting point to implement an error management culture. So all in all, organisations can be stimulated to implement error management in every aspect of their organisation, both in their systems and in their overall management.

Next to recommendations for organisations, the AFM can educate financial organisations to carry out this study by themselves. By teaching organisations how the questionnaire can be used to get more insight into their error management, more organisations will benefit from an error management culture. Also, different organisations asked for short scales to measure aspects of an organisational culture. This way, they can include these short scales into their annual survey among employees in order to get a better picture of the organisational culture. This study is a step in the right direction to make culture more concrete, and more studies from the AFM will follow.

Conclusion

The goal of this study was to examine the relations between leadership error management, tone at the top, error policy, error management culture, and learning from errors within the financial sector. Results demonstrated that when both managers and direct supervisors set a good example and focus on error management, more errors are shared and discussed which will stimulate learning from errors in financial organisations. These results offer opportunities for organisations to implement error management into their systems and overall management in order to stimulate learning from errors and possibly many more positive consequences, such as a better quality of services, higher safety, and a better organisational performance.

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Appendix 1: Principal axis factor analysis adjusted survey with a fixed amount of 3 factors.

Summary of principle axis factor analysis results with three factors (fixed)

	Rotated factor loadings		
Item	**1**	**2**	**3**
Error management culture 1	.60		
Error management culture 2	.85		
Error management culture 3	.88		
Error management culture 4	.72		
Error management culture 5	.91		
Error management culture 6	.84		
Error management culture 7	.80		
Error management culture 8	.78		
Error management culture 9	.61		
Error management culture 10	.60		
Error management culture 11	.53		
Error management culture 12	.57		
Error management culture 13	.77		
Error management culture 14	.78		
Error management culture 15	.80		
Error management culture 16	.69		
Error management culture 17	.76		
Leadership error management 1			-.91
Leadership error management 2			-.90
Leadership error management 3			-.88
Leadership error management 4			-.81
Leadership error management 5			-.71
Learning from errors 1		.63	
Learning from errors 2		.84	
Learning from errors 3		.90	
Learning from errors 4		.63	
Learning from errors 5		.58	
Learning from errors 6		.57	

Learning from errors	7	.48

Note: Only items with rotated factor loadings higher than .40 are shown.