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Summary, Conclusions and Future Research

With the kick off at Mount Everest, I have tried to share with you my (non-active) fascination with high-altitude mountaineering. More importantly, though, the introductory chapter addressed, in an anecdotal manner, the major issues of this dissertation. In spite of the quote at the start of the introductory chapter, errors do appear, even in "environments so extreme that there is no room for them". People (expedition leaders) differ in their convictions on the best approach when it comes to errors (as well as violations and forces of nature): On the one hand there are the legalists who rely mainly on rules that should prevent disasters. On the other hand there are the situationalists who are convinced that dangerous situations cannot always be prevented by rules, and who are therefore more focussed on the best ways of dealing with a dangerous situation when it presents itself. Whatever convictions underlie an error approach, the occurrence of errors has to be taken into account. Certainly, in both expeditions, with their somewhat different convictions, plenty errors occurred.

What I tried to illustrate further, was that convictions of leaders are not just that. These convictions instill a shared approach among members of the expedition. An example of this is given when client Krakauer — an experienced mountaineer himself — neglected to recognize that guide Harris was hypoxic. Krakauer explains

that in another expedition he would not have been likely to overlook this. What his explanation comes down to, is that — in the Adventure Consultants' expedition — a culture was enforced in which clients were to rely on the judgement calls of their guides, where these judgements were not questioned, and where rules were to be obeyed. The 1996 summit bid tells a tale of shared beliefs, attitudes, norms and behavioral approaches: It tells a tale of error cultures. This Everest tale is an anecdotal one, in need of systematic empirical founding.

What exact questions need to be addressed in empirical research? First of all, whether there is such a thing as an error culture. That is, whether beliefs, attitudes, norms and behavioral approaches with respect to errors are shared in expeditions, teams and organizations. Chapter 2 described a pilot study, in which the ideas of an error culture were tested in teams that participated in a management game. The sufficiently high intra-group consensus values indicate that indeed 'error orientations' are shared within a team. Similarly, sufficiently high values were found on two of the three error culture dimensions in the survey described in Chapter 3. Additionally, the interview study of Chapter 3 revealed (high) positive correlations between managers from the same company. I conclude that beliefs, attitudes, norms and behavioral approaches with respect to errors can be shared: There is such a thing as error culture.

A second important question is whether one error culture is better than the other. That is, whether there are specific beliefs, attitudes, norms and behavioral approaches that are especially productive for dealing with errors. To address this question, I built on three broad lines of research. The first and most prominent one is concerned with the

error management ideas (Frese, 1991). In Chapters 2 and 3 I discussed empirical research on error orientation (Rybowiak, Garst, Frese & Batinic, 1999; Göbel, 1998; Göbel, and Frese, 1999), error training (e.g. Frese, 1995), and the independent research of Edmondson (1996) whose ideas can be linked to those of error management. The second line of research is discussed in Chapter 2 and relates to two general orientations related to overcoming failure (Dweck, & Legget, 1988). The third line of research is discussed in Chapter 3. It entails ideas developed in the literature on Total Quality Management (Sitkin, Sutcliffe & Schroeder, 1994), High Reliability Organizations (Rochlin, 1999), exploitation versus exploration (March, 1991), and the Learning Organization (Argyris, 1992). The argument made here relates to the goals of Control and Learning (Sitkin, et al., 1994). In all, I argue that errors cannot always be avoided, nor need they always be avoided. Most important is that error's negative consequences are avoided (goal of Control). Further, I argue that errors can also have positive consequences that should be fostered (goal of Learning).

The introductory chapter described anecdotal evidence that attests that errors can be managed even in an environment as extreme as Mount Everest. I suggested that an error management culture - which is best illustrated by Boukreev's 1997 expedition - is superior. In Chapters 2 and 3 this hypothesis was tested empirically. I chose to test the superiority of an error management culture by investigating its relationship with (team and organizational) performance. The pilot study described in Chapter 2 revealed a negative correlation between the Error Aversion dimension and team performance. The survey described in Chapter 3 revealed a positive correlation between the Mastery dimension and both subjective and objective measures of organizational performance. This effect was upheld when controlling for size and age

of the organization and the line of industry it is active in. Very encouraging in this respect are two recent replications of these effects, one in Germany (Baer, 1999), and one in China (Wang & Van Dyck, 1999). In Germany, a positive correlation was found between the Mastery dimension and organizational performance (in this study, the Awareness and Error Aversion dimensions were not measured).   In China, a positive correlation between the Mastery dimension and organizational performance, and a negative correlation between the Error Aversion dimension and organizational performance were found.

The qualitative study described in Chapter 3 supported the importance of the Mastery and Error Aversion dimensions. The interviews additionally focussed at a particular expression of organizational error culture; managers' reaction to subordinates' errors. Two dimensions surfaced; punishment and empathy.

A third question I addressed in this dissertation is whether error culture was optimally measured. The questionnaire used in Chapters 2 and 3 was directly adapted from the Error Orientation Questionnaire (Rybowiak, et al., 1999), which is aimed at the measurement of the error orientation of individuals. This direct adaptation may have resulted in an underestimation of social aspects of error culture. Chapter 4 describes a qualitative study in which interviews are conducted with the explicit goal of identifying lacunas in the original questionnaire.   Sixty-two new items were developed, which, together with the original thirty-seven items, were administered in a large sample (see also Chapter 4). This sample was divided into a calibration and confirmation sample. Items were selected, and sub-scales and underlying dimensions were formed with the use of structural equation modeling (LISREL).   The new

questionnaire comprises four main dimensions: Mastery orientation, Social orientation, Awareness and Error Aversion. Three new sub-scales need specific mentioning; helping as an aspect of the Social orientation, acceptance of errors as an aspect of the Awareness dimension, and error prevention as an aspect of the Error Aversion dimension.

A fourth question concerned the relationship between error culture and other — more general — aspects of organizational culture. To address this issue, I administered additional organizational culture questionnaires (Van Muijen, 1994; Van Muijen, Koopman, & De Witte, 1996; Van Vianen & Kmieciak, 1998; Van Vianen, in press) in a sub-sample of the survey described in Chapter 4. The four dimensions of the error culture questionnaire are placed in a nomological net with the 'competing values' of Quinn's (1988) model.

In a recent study - not described in this dissertation - data have been gathered on the four error culture dimensions and psychological safety (Edmondson, 1999), reflexivity (Schippers, 1999), group potency (Guzzo, Yost, Campbell, & Shea, 1993), communication, innovation, goals, and routines (Team Climate Inventory; Anderson & West, 1994; 1996). Thus, the nomological net will be further investigated.

The research I described in this dissertation addressed the four proposed questions. The following issues need to be investigated in future research. First, causality of the relationship between error culture and organizational performance. As has been argued in Chapter 3, there are, in the error training literature (Frese, 1995), indications that the way errors are dealt with influences performance. Currently, Luus Reijken, a

graduate student at the University of Amsterdam, is conducting an experiment in which group error culture is manipulated, and its causal effect on group performance will be tested. In addition, some possible mediators in the error culture – performance relationship will be investigated. So far, I have argued that error management culture has a positive effect on performance because it helps avoiding negative error consequences and fostering positive error consequences. The specifics, however, still have to be investigated. I propose that issues such as taking responsibility (e.g. Rochlin, 1999), attribution of failure (e.g. Leary & Forsyth, 1987) and psychological safety (Edmondson, 1999) deserve attention in future empirical research. Research on issues of causality and mediation must not be restricted to the artificiality of the laboratory. In time, new insights need to be tested in the field.

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