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The organizational climate for psychological safety: associations with SMEs' innovation capabilities and innovation performance

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Abstract

This paper conceptualizes psychological safety as an organizational level phenomenon, and proposes that an organizational climate for psychological safety is positively related to SMEs' innovation performance and innovation capabilities. These hypotheses are tested on data from Norwegian SMEs. The results demonstrate that psychological safety is positively associated with SMEs' innovation performance, and positively related to product-, process-, service-, and business model innovation capabilities. Furthermore, an organizational climate for psychological safety is particularly important for enhancing a firm's radical innovative capability, while environmental dynamism is found to moderate the effect of psychological safety. The results support the relevance of psychological safety at the firm level of analysis.

Keywords: organizational climate for psychological safety; innovation performance; innovation capabilities; radical innovation; environmental dynamism.

1. Introduction

Innovation – broadly defined as the invention, development and implementation of new ideas – is widely acknowledged as an essential driver of the vitality and long term survival of firms (Garud, Tuertscher, & Van de Ven, 2013). Hence, understanding its antecedents is an important and continuing research endeavour (Bertrand & Mol, 2013; Cheng, Chang, & Li, 2013; Crossan & Apaydin, 2010; Curado, Muñoz-Pascual, & Galende, 2018; Damanpour, 1991; de Jong & Vermeulen, 2006; Futterer, Schmidt, & Heidenreich, 2018; Romijn & Albaladejo, 2002; Rothaermel & Hess, 2007; Scott & Bruce, 1994; Yang, 2012). Organizational learning and the creation and utilization of knowledge have long been recognized as fundamental determinants of firms' ability to innovate (Choo, Linderman, & Schroeder, 2007; Cohen & Levinthal, 1990; Hitt, Ireland, & Lee, 2000; Nonaka & Takeuchi, 1995). Subramaniam and Youndt (2005), who state, "in recent years scholars have seen a blurring of the boundaries between these areas" (p. 450), emphasize this intrinsically close link between innovation and knowledge. Learning behaviours within organizations may therefore be considered essential for innovation, which is inherently about creating and seizing opportunities to develop new products, services or work practices (Van de Ven, 1986). Although the new ideas triggering innovative efforts may originate from individuals, innovation is fundamentally a collective endeavour calling for integration of different strands of knowledge (Subramaniam & Youndt, 2005), and coordination between interdependent actors (Thompson, 1967). This assertion is accentuated by Van de Ven (1986), who argues that while the "*conception* of innovative ideas may be an individual activity, innovation […] is *a collective achievement"* [italics added] (p. 591). Thus, in order to foster innovation, firms need to facilitate the collective learning behaviours necessary for realizing innovations. To this end, we argue in this paper that cultivating an organizational climate for psychological safety is key.

A basic premise for this assertion is that engaging in the collective learning behaviours associated with innovation efforts (e.g. *experimenting* and *talking about errors*) inherently implies interpersonal risks (e.g. *threat to face*) (Edmondson, 1999). Thus, whenever the level of interpersonal risk is perceived to be high, individuals will be reluctant to engage in such learning behaviours (Edmondson, 1999), ultimately hampering firms' innovative capabilities. Importantly, however, extant research has demonstrated that psychological safety effectively reduces these interpersonal barriers and enables learning behaviours to take place in organizations (Edmondson, 1999; Edmondson & Lei, 2014; Newman, Donohue, & Eva, 2017).

More specifically, research has reported positive associations between psychological safety and learning behaviour at the individual (Liu, Hu, Li, Wang, & Lin, 2014) as well as the team level of analysis (Bstieler & Hemmert, 2010; Edmondson, 1999), and provided empirical support for the notion that psychological safety positively influences innovation (Lee, Swink, & Pandejpong, 2011; Post, 2012) and knowledge creation (Choo et al., 2007). Given that in Edmondson's (1999) seminal paper, psychological safety is conceptualized as a team level construct denoting "a shared belief that the team is safe for interpersonal risk taking" (p. 354), it is not surprising that the majority of research has employed a team-level analytical lens (Bstieler & Hemmert, 2010; Choo et al., 2007; Edmondson, Bohmer, & Pisano, 2001; Edmondson & Lei, 2014; Edmondson & Nembhard, 2009; Lee et al., 2011; Newman et al., 2017; Post, 2012). Consequently, there is a relative paucity of research concerning psychological safety at the organizational level (Edmondson & Lei, 2014; Newman et al., 2017), with the studies by Baer and Frese (2003), Carmeli (2007), and Carmeli and Gittell (2009) serving as prominent exceptions. Although Newman et al. (2017) advocate for the potency of psychological safety as a team-level construct, they recognize that "a climate of psychological safety might exist in smaller organizations" (p. 524) and call explicitly for further empirical research to confirm this assertion. In line with their call, we follow Baer and Frese's (2003) conceptualization of psychological safety at the organizational level, and employ this in a context of SMEs in order to investigate the extent to which such an organizational climate influences firms' innovative capabilities and innovation performance. While previous research has demonstrated the existence of a positive link between psychological safety and learning behaviours, and alluded to its potential impact for firms' ability to innovate, less is known as to whether psychological safety influences distinct innovative capabilities differently. This study addresses this gap in the literature by explicitly delineating between different innovative capabilities and testing the extent to which each are affected by an organizational climate for psychological safety.

It has been suggested that psychological safety is becoming increasingly important for facilitating firms' success in today's business environment (Edmondson & Lei, 2014; Newman et al., 2017), where the pressures on organizational members to engage in explorative endeavours are escalating along with the growing requirements for firms to continuously innovate to create new advantages (Dess & Picken, 2000; March, 1991; Tushman & O'Reilly III, 1996). Prior research has indicated that particular organizational climates may be conducive to innovation (Baer & Frese, 2003; Crossan & Apaydin, 2010; Yang, 2012). In line with these

notions, we propose in this paper that an organizational climate for psychological safety will enable employees to engage in the explorative learning behaviours underpinning radical innovations, thus enhancing the firm's radical innovative capability. Furthermore, we assess the impact of external contingencies in terms of environmental dynamism on the proposed relationship between an organizational climate for psychological safety and a firm's radical innovative capability, thus contributing to the literature by responding to recent calls for "further research on the boundary conditions of psychological safety's effects" (Edmondson & Lei, 2014, p. 27).

This paper's contribution to the innovation literature is therefore threefold. Firstly, by investigating the association of psychological safety as an organizational level construct with firms' innovation performance we provide further justification for conceptualizing a climate for psychological safety at the organizational level of analysis, and accentuate the concept's importance in understanding the antecedents to innovation. Secondly, we conduct the first empirical examination of the extent to which an organizational climate for psychological safety is differentially associated with distinct types of innovative capabilities, by differentiating these explicitly. Thirdly, we investigate how the level of dynamism in firms' external environment moderates the association between psychological safety and radical innovative capability, hence advancing the understanding of the concept's boundary conditions.

The remaining parts of this paper are structured as follows. First, hypotheses are developed based on a review of relevant theory. Secondly, the methods used for performing analyses and the operationalization of concepts are described. Thirdly, the results from the performed analyses are presented. Finally, the results are discussed and conclusions are presented, in addition to comments on possible research limitations and suggestions for future research.

2. Theoretical background and hypotheses development

The idea that learning and innovation are two closely interrelated concepts seems to be both intuitively appealing and generally supported by extant literature (Calantone, Cavusgil, & Zhao, 2002; Choo et al., 2007; Cohen & Levinthal, 1990; Subramaniam & Youndt, 2005). In this paper, we adopt the view that innovation within firms is fundamentally about organizational learning and new knowledge creation (Cohen & Levinthal, 1990; Grant, 1996; Hitt et al., 2000;

Nonaka & Takeuchi, 1995; Subramaniam & Youndt, 2005), and that learning behaviours may therefore reasonably be considered the key drivers for realizing innovations in organizations. Consistent with the notion that innovation is essentially a collective endeavour (Van de Ven, 1986), requiring the integration of different strands of knowledge (Subramaniam & Youndt, 2005) and thus extensive coordination between interdependent organizational actors (Edmondson & Lei, 2014), we assert that collective learning behaviours within organizations are the fundamental underpinnings for firms' successful realization of innovations. Building on this premise, and the fact that previous research has shown that psychological safety fosters learning behaviours within organizations (Bstieler & Hemmert, 2010; Edmondson, 1999; Edmondson, 2002; Edmondson & Lei, 2014; Liu et al., 2014; Newman et al., 2017), our baseline expectation is that there exists a positive relationship between psychological safety and innovation in firms.

In essence, the concept of psychological safety concerns individuals' shared perceptions of the consequences of taking interpersonal risks in a particular context (Edmondson, 1999; Edmondson & Lei, 2014). More specifically, a psychologically safe environment describes a setting in which individuals hold a shared perception that they are safe from the potentially negative consequences of engaging in behaviours that are generally thought to entail interpersonal risks (Newman et al., 2017). Psychological safety, in other words, "alleviates excessive concern about others' reactions to actions that have the potential for embarrassment or threat, which learning behaviours often have" (Edmondson, 1999, p. 355). Such learning behaviours include "seeking feedback, sharing information, asking for help, talking about errors, and experimenting" (Edmondson, 1999, p. 351). These and other learning behaviours are arguably key in overcoming some of the basic organizational barriers to innovation, such as internal inertia and resistance to change (Dess & Picken, 2000). Through enabling these behaviours, psychological safety ultimately enhances the quality of innovation efforts. This assertion is consistent with the notion that individuals must feel psychologically safe in order to engage in the searching and experimenting activities associated with innovation processes (Un, 2010). Moreover, this appears to be substantiated by extant research reporting that psychological safety is conducive to innovation, essentially because it enables individuals to speak freely (enhancing the quality of shared information), ask questions, and proffer dissenting perspectives (Lee et al., 2011; Post, 2012), i.e. behaviours that are known to be inherently psychologically threatening (Argyris & Schön, 1978; Edmondson, 2002).

Importantly, however, the advantageous effects of psychological safety identified in the received literature are almost exclusively concerned with the individual- or team level of analysis (Newman et al., 2017), implying that less is known about whether these mechanisms also apply at the organizational level. Edmondson and Lei (2014) conclude that psychological safety is particularly relevant for understanding organizational learning, and that this will hold true "across levels of analysis (individual, group, and organization)" (p. 36). Accordingly, it seems reasonable to assert that psychological safety *at the organizational level* will be of substantial importance for explaining firm level outcomes and phenomena (Baer & Frese, 2003; Carmeli, 2007), such as firm innovation performance (Curado et al., 2018) and innovative capabilities (Subramaniam & Youndt, 2005; Yang, 2012). Consequently, we follow Baer and Frese (2003), who "extend the construct of team psychological safety to an organizational climate for psychological safety" (p. 50), and thus conceptualize psychological safety as an organizational level phenomenon. That such a conceptualization is in fact meaningful is supported by Baer and Frese (2003), who report that their empirical findings provide "justification for thinking of a climate for psychological safety not only as a team-level construct, but also as an organizational-level construct" (p. 57).

The appropriateness of conceptualizing an organizational climate for psychological safety depends on the extent to which it is reasonable to assume the existence of a unitary organizational climate (Baer & Frese, 2003), given that shared perceptions is a prerequisite for psychological safety (Edmondson, 1999). Such an assumption is plausible for relatively small firms, and less so for larger ones (Baer & Frese, 2003). Hence, it is appropriate to assume the existence of a unitary organizational climate in small and medium sized enterprises (SMEs), which provide the context for the present study. Moreover, in SMEs, successfully realizing innovations may depend more heavily on drawing from all the available human resources within the firm, thus requiring psychological safety to exist at an organizational level, rather than merely at the level of individual teams. Given that innovation is inherently a collective effort (Van de Ven, 1986), it implies strong interdependencies between the actors involved within the organization (Edmondson & Lei, 2014). These interdependencies will be relatively more salient for the individuals in SMEs compared to those in large firms, as the former will likely hold a more complete overview of a focal firm's employees and their actions. Such highly salient interdependencies imply that the potential for perceived interpersonal threat is greater (i.e. more

all-encompassing) in SMEs than in large firms, because, for example, talking openly about errors (or other potentially face-threatening learning behaviours) in the former will be noticed by – and potentially affect – a relatively larger proportion of the people in the organization. Thus, given this assertion that the potential for perceived interpersonal threat is higher in SMEs – consequently posing greater barriers to the learning behaviours key to innovation – the need for psychological safety is more important for innovation in SMEs than in large firms. This explanation seems consistent with anecdotal evidence from large organizations, in which high risk innovation projects have been found to sometimes 'fly under the radar' of management awareness, which is arguably a less feasible approach for high-risk projects in SMEs (i.e. failures cannot be easily hidden in SMEs, implying a greater need for psychological safety). Thus, we adopt the construct of an organizational level climate for psychological safety, which Baer and Frese (2003) define as "formal and informal organizational practices and procedures [which guide and support] open and trustful interactions within the work environment" (p. 50).

Building on the insights elaborated above, we advance the following argument. In an organizational climate characterized by a high level of psychological safety, employees will readily engage in the learning behaviours associated with innovation, such as sharing information, experimenting, asking for help, and evaluating failures. A climate for psychological safety enhances the quality of work and the richness of information exchange among organizational members (Baer & Frese, 2003; Edmondson, 1999), and enables them to overcome barriers to innovation, such as a 'fear of failure' (Carmeli, 2007; Edmondson, 2011). In short, psychological safety is epitomized in how it facilitates learning behaviour by reducing perceived interpersonal threats. This enhances organizational members' willingness and ability to challenge the status quo (Edmondson & Lei, 2014), which is fundamental to innovation in firms (Dess & Picken, 2000; Hitt et al., 2000; Tushman & Anderson, 1986; Van de Ven, 1986). Thus, an organizational climate for psychological safety will likely assist in the generative process of innovation by enabling individuals to question and refine existing practices, voice new ideas, and experiment and develop new products, services, and 'ways of doing things'. In summary, given that "a psychologically safe environment enables divergent thinking, creativity, and risk taking and motivates engagement in exploratory and exploitative learning" (Edmondson & Lei, 2014, p. 31), it seems reasonable to assert that these behaviours positively influence innovation within firms. Expectedly, an organizational climate facilitating such learning behaviours is crucial for enhancing the quality of all the aspects of the innovation process – encompassing the invention,

development and implementation of new ideas (Garud et al., 2013) – thus ultimately leading to increased innovation performance. Consequently, our first hypothesis reads:

H1. An organizational climate for psychological safety is positively associated with SMEs' innovation performance.

In the innovation management literature, a central distinction is made between incremental and radical innovations (Crossan & Apaydin, 2010; Koberg, Detienne, & Heppard, 2003; McDermott & O'Connor, 2002; Popadiuk & Choo, 2006; Tushman & Anderson, 1986; Tushman & O'Reilly III, 1996; Un, 2010), and it has long been recognized that these "require quite different organizational capabilities" (Henderson & Clark, 1990, p. 9). Seminal research has thus differentiated between radical and incremental innovative capabilities (Abernathy & Clark, 1985). Essential to the delineation between these two types of innovative capabilities is that they vary in the nature by which knowledge is drawn upon (Cardinal, 2001; Henderson & Clark, 1990; Subramaniam & Youndt, 2005), and that they are differentially underpinned by the distinct organizational learning activities of exploration and exploitation (March, 1991; Popadiuk & Choo, 2006). More specifically, while an incremental innovative capability requires the *reinforcing* of prevailing knowledge, a radical innovative capability is dependent on *transforming* prevailing knowledge (Subramaniam & Youndt, 2005). Similarly, a radical innovative capability is fundamentally underpinned by *explorative* learning behaviours, while incremental innovative capabilities are more closely associated with exploitation (Popadiuk & Choo, 2006), and thus less explorative in nature (Crossan & Apaydin, 2010). This assertion is supported by the empirical study performed by Koberg et al. (2003), which reported that experimentation (an exploration process activity) had a stronger positive influence on radical innovation than on incremental innovation. Hence, an incremental innovative capability reflects an organization's capacity to realize innovations that refine and reinforce existing products and/or services, while a *radical innovative capability* is defined as "the capability to generate innovations that significantly transform existing products and [or] services" (Subramaniam & Youndt, 2005, p. 452). Building on this distinction, we argue in the following that an organizational climate for psychological safety is particularly beneficial for a firm's radical innovative capability.

Given that radical and incremental innovative capabilities rests on such different foundations, it seems reasonable to assert that fostering the former inherently entails higher levels of interpersonal risk-taking (Edmondson, 1999). As *transforming knowledge* and *experimenting* must reasonably be categorized as high-risk learning behaviours that are inherently psychologically threatening (Argyris & Schön, 1978; Edmondson, 2002), these underpinnings of a radical innovative capability are likely better cultivated in a psychologically safe environment. Moreover, considering one of March's (1991) key points, namely that "The essence of exploration is experimentation with new alternatives. Its returns are uncertain, distant, and often negative." (p. 85), it seems less likely that individuals will engage in explorative learning behaviours if they perceive that the organizational climate is not psychologically safe (e.g., that one expects to be punished for mistakes or negative outcomes). Conversely, in an organizational climate for psychological safety, experimentation is among the learning behaviours that are likely to be fostered (Baer & Frese, 2003; Edmondson, 1999; Edmondson & Lei, 2014), thus expectedly enhancing the firm's radical innovative capability.

Furthermore, we contend that the tasks involved in developing a radical innovative capability are substantially complex, significantly more so than for an incremental innovative capability, and that the former therefore implies higher risks (Alexander & Van Knippenberg, 2014; McDermott & O'Connor, 2002; O'Connor & McDermott, 2004). As task complexity increases (Campbell, 1988), so does the risk of failure (Alexander & Van Knippenberg, 2014), which is of course a fundamental barrier to engaging in innovation efforts, particularly in organizational contexts characterized by a high degree of 'fear of failure' (Edmondson, 2011), i.e. low psychological safety (Edmondson, 1999). Therefore, assuming that a high level of complexity is involved in *transforming prevailing knowledge* (Subramaniam & Youndt, 2005), and that *exploration* is inherently complex given its high degree of uncertainty and distant returns (March, 1991), it can be expected that these fundamental elements of a radical innovative capability are positively affected by an organizational climate for psychological safety, because it alleviates the interpersonal risks involved in these radical innovation enhancing behaviours. In other words, because the complexities underlying a radical innovative capability are significantly greater than for an incremental innovative capability – implying that the former's associated risk of failure is greater – an organizational climate for psychological safety should be more important for the former. This assertion seems to be in accordance with Un's (2010) empirical findings, suggesting that (in the case of product innovation) psychological safety has a stronger impact on radical

innovations than on incremental innovations. Moreover, Sanner and Bunderson (2015) find that the positive effect of psychological safety on learning and performance is dependent on the level of task-complexity. Our basic argument is thus in accordance with research demonstrating that the positive influence of psychological safety on learning behaviour is stronger when the nature of the work entails greater uncertainty and complexity (Edmondson & Lei, 2014; Sanner & Bunderson, 2015), key characteristics of the essential elements underpinning a radical innovative capability (March, 1991; Subramaniam & Youndt, 2005). Thus, we advance the following hypothesis:

H2. An organizational climate for psychological safety is positively associated with SMEs' radical innovative capability.

The overarching positive effects that we argue for in this paper, of an organizational climate for psychological safety on SMEs' radical innovative capability, may be affected by contingencies external to the organization. Understanding the possible boundary conditions for the effects of psychological safety has been identified as a fruitful research endeavour (Edmondson & Lei, 2014). In this particular context, we expect that the level of dynamism in a firm's task environment affect the proposed relationship between the firm's organizational climate for psychological safety and its radical innovative capability. Environmental dynamism is related to the degree of changes in the environment of the firm, as described by Zahra and Bogner (2000) and may be an external factor influencing firm level innovation activity. Rapid changes in customer preferences or technology shifts may result in outdated or uncompetitive products and services (Jansen, Van Den Bosch, & Volberda, 2006). Research seems to provide some evidence that environmental dynamism has a stronger influence on radical innovation than on incremental innovation (see e.g. Koberg et al., 2003, p. 37). Furthermore, the literature suggests that psychological safety will be of particular importance in settings where exploration activities are essential (Kostopoulos & Bozionelos, 2011). This is because engaging in the learning behaviours associated with exploration inherently involves high levels of uncertainty, something that is obviously enhanced by an uncertain external environment, which implies a high risk of failure (Edmondson & Nembhard, 2009). An external environment characterized by a high level of dynamism (including threats from competitors, changing customer preferences, short product life cycles etc.) provides an incentive for an organization to pursue radical innovations. Thus, a high level of environmental dynamism could be expected to qualify as such a setting "where exploration activities are vital" (Kostopoulos

and Bozionelos, 2011, p. 391).

Given the complexities and high levels of uncertainty linked with the core elements of a radical innovation capability discussed above (March, 1991; Popadiuk & Choo, 2006; Subramaniam & Youndt, 2005), and their associated high risks of failure (Alexander & Van Knippenberg, 2014; McDermott & O'Connor, 2002), it seems reasonable to assert that these uncertainties and complexities will be amplified in a highly dynamic environment. Thus, it can be expected that the already proposed advantageous impact of an organizational climate for psychological safety on a firm's radical innovative capability will be enhanced, as the collective learning behaviours entailing high interpersonal risks underpinning a radical innovative capability are required to address the demands from the external environment. Therefore, it is proposed:

H3. An organizational climate for psychological safety has a stronger positive association with radical innovation capabilities in a highly dynamic environment than in a stable environment.

In addition to its expected association with innovation performance, an organizational climate for psychological safety arguably also affects the organization's general ability to innovate, namely its innovation capability. Given that there is a lack of consensus on a definition of the widely used concept of "innovation capability" (Zawislak, Cherubini Alves, Tello-Gamarra, Barbieux, & Reichert, 2012), there is some freedom in how to operationalize the construct. Building on the definition purposed by Zawislak et al. (2012), we conceptualize innovation capability as the organization's ability to realize product, service, process and business model developments that can "lead [the organization] to Schumpeterian profits, i.e., innovation" (Zawislak et al., 2012 p. 15).

Malhotra, Ahire, and Shang (2017) distinguish between three dimensions of psychological safety, namely openness to others' opinions, willingness to speak up and capacity to foster collaboration. We expect psychological safety to have a positive impact on all types of innovation capabilities, as exemplified by the advantages of openness, willingness to speak up and collaboration. Following this reasoning, Calantone et al. (2002) focus the importance of learning behaviour for "enhancing [an organization's] innovation capability" (p. 517), and we expect that an organizational climate for psychological safety facilitate such learning behaviour. Our expectations are formulated in H4:

H4. An organizational climate for psychological safety is positively associated with SMEs' a) product innovation capability, b) process innovation capability, c) service innovation capability and d) business model innovation capability

Although "business model innovation" is not explicitly accounted for in the innovation frameworks examined in Popadiuk and Choo's (2006) theoretical review, it has been firmly established by subsequent literature as a distinct innovation category (Chesbrough, 2010; Teece, 2010; Zott, Amit, & Massa, 2011). According to Zott et al. (2011), an organization's business model can be considered "a vehicle *for* innovation as well as a subject *of* innovation" (p. 1034). Precisely because a business model is so closely related to an organization's way of doing business, changing it implies overcoming significant barriers. This is illustrated by Chesbrough's (2010) account of how Xerox failed to take advantage of technological innovations because of their poor fit with the company's existing business model, which eventually resulted in the technologies becoming "'orphans' within the company" (p. 356). As noted by Teece (2010), inertia is likely to be considerable when attempting to change an organization's business model because it "literally involves changing the paradigm by which it goes to market" (p. 187). Consequently, business model innovation implies a high level of interpersonal risk-taking within the organization. Therefore, an organizational climate for psychological safety is needed in order for business model innovation to be realized.

Both Chesbrough (2010) and Teece (2010) argue that in order for an organization to overcome the barriers to business model innovation, a commitment to *extensive experimentation* is necessary. Hence, the process of business model innovation is closely associated with *exploration* activities, which implies high levels of interpersonal risk (as discussed above). Furthermore, they advocate that significant trial-and-error is required (Chesbrough, 2010; Sosna, Trevinyo-Rodríguez, & Velamuri, 2010; Teece, 2010), which implies that the organization's ability to learn from failure is essential to succeed with business model innovation. Since also effectively learning from failure requires a climate for psychological safety (Edmondson, 2011), such a climate should have a positive influence on an organization's business model innovation capability. Moreover, business model innovation is clearly a high-complexity task (Teece, 2010), which arguably implies the greater influence of psychological safety (Edmondson & Lei, 2014; Sanner & Bunderson, 2015).

This forms the basis for the following reasoning. Given that business model innovation is

associated with greater cognitive inertia and resistance to change compared to other types of innovation, business model innovation requires a greater level of psychological safety than that which is the case for product, process and service innovation. This is because challenging the current business model of an organization, in effect questioning the very essence of a business, arguably entails a greater level of interpersonal risk than most other conceivable behaviours in an organization. In summary, the above account appears to indicate that:

H5. An organizational climate for psychological safety has a stronger positive association with the organization's capability for business model innovation than for product-, process-, and service innovation capability.

3. Method

3.1 The data

The data material analysed in this paper was collected from a sample of Norwegian business-to-business SMEs involved in exporting activities. Only firms involved in exporting, with fewer than 250 employees, were selected for the study, resulting in a population of 2262 firms. We focus exporting SMEs, as these are important with regard to employment, export revenues and represent an important growth potential as have been described by Eurofound (2012), OECD (2012) and WTO (2016). The firms in the sample belong to different industries, and operate in both service and manufacturing sectors. Identification of firms was done using the Kompass Norway database.

After a pilot study was performed in order to fine-tune the survey-items, questionnaires were distributed to the relevant recipients by both paper and e-mail. The survey was addressed to the CEO. When the collection of data was finished in September 2014, answers to the survey questions were received from 380 respondents, resulting in a response rate of 16.8%. As is evident from the descriptive statistics presented in Table 1, the sample is rather heterogeneous. However, considering the mean values, the average values are firm establishment year 1971, 37 employees and 45.1% export share. All items were measured on 7-point Likert type scales. In order to perform the statistical analyses, SPSS software version 24.0 was used.

Table 1: Sample characteristics

	Mean	Std dev.	N
Year of establishment	1971	29.02	371
Share of foreign sales	45.1	34.52	268
Number of employees	37.0	48.49	377

3.2 Variables and measures

3.2.1 Independent variables

The organizational climate for psychological safety was measured using a combination of six questions regarding the organizations' internal working environment (negatively phrased questions have been reverse-scored). These questions are based on Edmondson's (1999) seven-item construct (see Table 2 for detailed information). The minor alterations made to Edmondson's (1999) original questions are because in the present survey there was only one respondent from each SME, and that psychological safety is conceptualized at the organizational level. Hence, the items referred to the organization rather than the 'team' as in Edmondson's (1999) original questionnaire. This approach is in line with previous research concerned with psychological safety at the organizational level (Baer & Frese, 2003; Carmeli, 2007). Reliability analysis of this construct gives a Cronbach's alpha value equal to 0.66. Edmondson (1999) reports a Cronbach's alpha of 0.82 for her measure of team level psychological safety, while Kostopoulos and Bozionelos (2011) find that α=0.98 when using Edmondson's seven-item construct. Moreover, Choo et al. (2007) adopt three of the mentioned seven items in their study, which gave α=0.74. Baer and Frese (2003) also find α=0.82 for their six-item construct of psychological safety, which has been adjusted to the organizational level. Although the α=0.66 is somewhat lower than the commonly recommended threshold of α=0.7, it is possible to argue for using constructs with slightly lower values (Bryman, 2016). We consider the described measure of an organizational climate for psychological safety appropriate, as a number of studies have been based on similar items.

Moreover, the construct is based on the assumption that the survey respondents, being members of the organizations' top management teams, are well positioned to provide an accurate indication of the level of the organizational climate for psychological safety. This assumption

seems reasonable, given that the organizations are all SMEs, and thus expectedly characterized by a unitary climate, as described by Baer and Frese (2003).

Table 2: Measures of EnvDyn and PsySaf

	N	Mean	Std dev.
Environmental dynamism (EnvDyn) (0.74)	**363**	**4.23**	**1.49**
New entrants are a constant threat to the firm	365	3.99	1.73
Competitors' products are a constant threat to the Firm	364	4.48	1.65
Organizational climate for psychological safety (PS) (0.66)	**331**	**5.30**	**0.87**
Employees value and respect each other's contributions	341	5.36	1.13
In this firm, it is safe for employees to undertake risky projects which may have a high probability of failure	338	4.84	1.55
If an employee makes a mistake, it is often held against him/her (reverse-scored)	341	5.89	1.25
In this firm, it is easy to discuss difficult topics and problems	342	4.67	1.67
In this firm, it is difficult to ask other employees for help (reverse-scored)	339	5.80	1.56
Employees actively engage in sharing their knowledge and competence with each other	338	5.20	1.41

Environmental dynamism (EnvDyn) was operationalized using a construct consisting of two items describing the level of external threats and dynamism in the firms' environments. These items have been used in a large innovation survey organized by Statistics Canada (2002) (Kafouros, Buckley, Sharp, & Wang, 2008) (Kafouros, Buckley, Sharp, & Wang, 2008). The first item (EnvDyn1) measures the level of competitive threats from new entrants into the firms' markets, while the second item (EnvDyn2) measures the level of threat from competitors' products and services. Reliability analysis gives α=0.74 for this construct, which satisfy the normal requirements.

3.2.2 Dependent variables

Taking the view that innovation performance is a multidimensional concept, seven items from the Innovation Canada survey were combined into a single construct (InnPerf) in order to provide a reliable measure of the phenomenon (table 3). This procedure yielded a Cronbach's alpha of 0.84, indicating good reliability. The applied questions tap into different aspects of

innovation performance by measuring the effect of innovation activities on the profitability, productivity, domestic market share, international market share, profit margin and competitiveness of the SMEs. The InnPerf construct also includes a question concerning the management's overall satisfaction with the firm's innovation level. The combination of items used here therefore seems to provide the most appropriate measure of innovation performance available, given that it is expected that the top management consider the complex nature of evaluating innovation when assessing the firm's innovation performance.

Table 3: Radical innovation capability and innovation performance.

	N	Mean	Std.dev.
Radical innovative capability (RadInnCap) (0.80)	**308**	**4.12**	**1.70**
Product/service new in home market	312	4.34	2.05
Product/service new in international market	312	4.02	2.12
Radical compared to existing solutions	310	4.01	1.90
Innovation performance (InnPerf) (0.84)	**299**	**4.73**	**1.11**
To what degree has the firm's innovation activity increased the firms:			
- Profitability	315	5.00	1.54
- Productivity	316	4.61	1.54
- Domestic market share	312	4.47	1.72
- International market share	311	3.97	1.95
- Competitiveness	310	5.25	1.36
- Ability to maintain profit margins	313	4.97	1.43
Rate managers general satisfaction with innovation level	311	4.68	1.43

Three items were used in order to measure the radical innovative capability, a high value on the 7-point Likert scale implies radical innovation. These items were inspired by the Innovation Canada survey as well as Henderson and Clark (1990) and Gatignon, Tushman, Smith, and Anderson (2002). The respondents were asked to focus on the most important product or service developed in the past five years, and rate if it was new to the home market, the international market and if it could be described as a radical solution within the industry. The 'product/service' formulation used in the items is consistent with extant research concerned with degrees of radicalness (Cheng, Yang, & Sheu, 2016; Subramaniam & Youndt, 2005). The Cronbach alpha was 0.80 for this radical innovative capability (RadInnCap) scale.

The different innovation capabilities investigated in this study were operationalized using three survey items per capability (Table 4). We developed these based on previous work by Little (2012), Thuriaux-Alemán, Eagar, and Johansson (2013), Weerawardena (2003a) and Weerawardena (2003b). The questions rated the SMEs' ability to innovate and their emphasis on different innovation activities, thus providing reliable measures of product innovation capability (α=0.73), service innovation capability (α=0.86), process innovation capability (α=0.831) and business model innovation capability (α=0.74).

Table 4: Measures of Innovation Capabilities

	N	Mean	Std dev.
Product innovation capability (ProdC) (0.73)	**312**	**5.16**	**1.24**
Ability to realize product innovations	315	5.09	1.49
Focus on improving current products	317	5.47	1.47
Focus on developing new products	315	4.90	1.65
Service innovation capability (SerC)(0.86)	**304**	**4.47**	**1.45**
Ability to realize service innovations	309	4.48	1.58
Focus on improving current services	314	4.77	1.66
Focus on developing new services	313	4.18	1.71
Process innovation capability (ProcC)(0.83)	**304**	**4.48**	**1.41**
Ability to realize process innovations	313	4.45	1.55
Focus on improving current processes	313	4.80	1.61
Focus on developing new processes	309	4.22	1.76
Business model innovation capability (BuMoC)(0.74)	**309**	**4.33**	**1.20**
Ability to realize business model innovations	313	4.33	1.36
Focus on improving current business models	315	4.62	1.50
Focus on developing new business models	314	4.02	1.63

Table 5 present the correlation between the constructs used.

Table 5: Pearson correlations between the constructs

	PsySaf	EnvDyn	ProdC	SerC	ProcC	BuMoC	InnPerf
PsySaf							
EnvDyn	-0.032						
ProdC	0.157**	-0.083					
SerC	0.224**	-0.122*	0.224**				
ProcC	0.139*	-0.041	0.422**	0.266**			
BuMoC	0.175**	-0.008	0.397**	0.470**	0.353**		
InnPerf	0.330**	-0.097	0.531**	0.257**	0.349**	0.296**	
RadInnCap	0.176**	-0.117*	0.429***	0.176**	0.159**	0.209***	0.417***

*p<0.05; **p<0.01; ***p<0.001

3.2.3 Control variables

We included four control variables: the year of establishment, number of employees, operating profit and R&D intensity. Following the reasoning presented by Zahra & Garvis (2000), we included company size and company age as control variables, as size may influence available resources while age may influence development focus and activities. Operating profit was also included as a measure of available resources. Finally, R&D intensity have been identified as a fundamental driver of SME development and performance as described by Booltink & Saka-Helmhout (2018) and may influence other innovation related effects. We include it as a control variable, measuring it as the ratio of R&D expenditure to total revenues. This measure is in line with previous studies as exemplified by Lome, Heggeseth & Moen (2016), Garciá-Manjón & Romero-Merino (2012) as well as Wang & Tsai (2004).

4. Analyses

We use linear regression analysis in order to test the different hypotheses, we present results both with and without use of control variables. When testing H1, we noted differences with regard to higher versus lower levels of PsySaf that could influence the results. We then included a regression calculation only if PsySaf was lower than five with and without control variables. Similarly, a regression calculation with PsySaf equal to five or higher with and without control variables was included. H3 suggested that PsySaf has a stronger positive association with radical

innovation capabilities in highly dynamic environments compared to stable environments. We split the companies into two groups, one group with lower and one with higher than average environmental dynamism scores when testing this hypothesis. We used the standard option in SPSS regression analysis with listwise deletion of cases with missing values, none of the results would have changed if pairwise deletion or replacement with mean had been used.

5. Results

H1 suggests that the organizational climate for psychological safety is positively associated with innovation performance. Table 6 presents the linear regression results both with and without the control variables. The results demonstrate that excluding the control variables does not change the results related to psychological safety.

Table 6: Regression analysis, psychological safety versus innovation performance

Dep: InnPerf	**All cases**		**If PsySaf < 5**		**If PsySaf > 5**	
Constant (Unstand. B)	-2.673	2.513	7.640	3.624	-8.360	1.508
PsySaf	0.350***	0.330***	0.117	0.092	0.324***	0.275***
Operating margin	0.003		-0.046		-0.003	
Number of employees	0.039		0.207		-0.058	
Year of establishment	0.064		-0.061		0.116	
Percentage R&D	-0.144*		-0.093		-0.193**	
R^2	0.145	0.330	0.061	0.092	0.145	0.275
Adjusted R^2	0.127	0.106	-0.004	-0.002	0.119	0.071
ANOVA (F)	8.188***	35.150***	0.935	0.781	5.544***	15.920***

*p<0.05; **p<0.01; ***p<0.001, standardized coefficients

These results suggest general support for H1 when including all levels of PsySaf and when including high levels of PsySaf. However, within the group of firms with low or medium levels of PsySaf (score less than 5), we observed no significant relation to innovation performance. This is an interesting observation and is further commented on in the discussion section.

H2 suggested that psychological safety is positively associated with radical innovation capability (RadInnCap). Table 7 presents results, with and without control variables.

Table 7: Regression analysis, psychological safety versus radical innovative capability

Dependent: RadInnCap	**With control variables**	**Without control variables**
Constant (Unstand. B)	-11.237	2.367
Psychological Safety	0.222***	0.176**
Operating margin	-0.111	
Number of employees	0.025	
Year of establishment	0.108	
Percentage R&D	-0.005	
R^2	0.079	0.176
Adjusted R^2	0.060	0.028
ANOVA (F)	4.180**	9.142**

*p<0.05; **p<0.01; ***p<0.001, standardized coefficients

The results demonstrate a significant relationship as expected, and so we choose initially to evaluate hypothesis H2 as supported.

The third hypothesis suggested that PsySaf has a stronger positive association with radical innovation capabilities in highly dynamic environments compared to stable environments. We split the companies into two groups, one group with lower and one with higher than average environmental dynamism scores. Table 8 illustrates the results: EnvDyn Low with and without control variables as well as EnvDyn High with and without control variables.

Table 8: Regression analysis, the effect of PsySaf on radical innovative capability when differentiating environmental dynamism

Dependent: RadInnCap	**Low EnvDyn**		**High EnvDyn**	
Constant (Unstand. B)	-7.575	3.535	-17.444	1.077
PsySaf	0.125	0.084	0.295**	0.262**
Operating margin	-0.131		-0.018	
Number of employees	-0.037		0.152	
Year of establishment	0.091		0.143	
Percentage R&D	0.000		0.099	
R^2	0.058	0.084	0.139	0.262**
Adjusted R^2	0.015	0.000	0.105	0.062
ANOVA (F)	1.348	0.999	3.933**	10.826**

*p<0.05; **p<0.01; ***p<0.001, standardized coefficients

The results presented in Table 8 support H3; in a highly dynamic environment, psychological safety contributes to higher radical innovation capabilities, but this is not true if the environment is considered less dynamic. Although we stated that H2 was initially supported, when assessed in combination with the H3 it seems that PsySaf is related to radical innovation capabilities only if the firms operate in a dynamic environment. In the discussion, we further elaborate on this issue.

In order to test H4, the four constructs measuring the distinct innovation capabilities (ProdC, SerC, ProcC, BuMoC) were used as dependent variables in the regression analysis. The results in Table 9 suggest, as expected in H4, that psychological safety does have a positive impact on all the four included innovation capabilities types; thus, the hypothesis is supported.

Table 9: Regression analysis, psychological safety versus different innovation types

Dependent variable	Product innovation		Process innovation		Service innovation		Business model innovation	
Constant (Unstand. B)	7.081	3.992	10.521	3.308	-2.984	2.572	-5.016	3.056
PsySaf	0.182**	0.157*	0.130*	0.139*	0.182**	0.224***	0.141*	0.175**
Operating margin	-0.091		0.130*		0.121		-0.047	
Number of employees	0.007		-0.135*		0.046		0.021	
Year of establishment	-0.038		-0.073		0.057		0.100	
Percentage R&D	0.027		0.048		0.060		0.022	
R^2	0.040	0.025	0.062	0.019	0.061	0.050	0.037	0.031
Adjusted R^2	0.021	0.021	0.043	0.016	0.042	0.047	0.018	0.027
ANOVA (F)	2.177*	7.535**	5.795**	5.728*	3.194**	15.412***	1.906	9.360**

*p<0.05; **p<0.01; ***p<0.001, standardized coefficients

H5 predicts that an organizational climate for psychological safety has the strongest positive association with business model innovation. The results demonstrate that PsySaf has the greatest positive correlation with service innovation capabilities, and based on the results, we find no reason to evaluate the effect as most strongly linked to business model innovation. Therefore, H5 is rejected.

Four of the hypotheses were supported, while one was rejected, as summarized in Table 10.

Table 10: Results of the hypotheses testing

Hypotheses	Result
H1. An organizational climate for psychological safety is positively associated with SMEs' *innovation performance.*	Supported
H2. An organizational climate for psychological safety has a positive association with radical innovation capabilities.	Supported
H3. An organizational climate for psychological safety has a stronger positive association with radical innovation capabilities in a highly dynamic environment than in a stable environment.	Supported
H4. An organizational climate for psychological safety is positively associated with a) product innovation capability, b) process innovation capability, c) service innovation capability and d) business model capability.	Supported
H5. An organizational climate for psychological safety has a stronger positive association with the organization's capability for business model innovation than for any other type of innovation capability	Rejected

6. Discussion

6.1 A climate for psychological safety is positively associated with innovation performance

The results reported above provide support for H1, indicating that an organizational climate for psychological safety does in fact have a positive association with SMEs' innovation performance. This is an interesting finding because it supports the intuitively appealing notion that a climate for psychological safety is an effective means for facilitating enhanced innovation performance in firms. The importance of psychological safety as a phenomenon is thus strengthened by the empirical findings in this article. Furthermore, these results suggest that psychological safety does not only influence innovation performance at the team-level, as indicated by Edmondson (1999), but also positively affects innovation performance at the firm level in SMEs. This finding is in accordance with Baer and Frese (2003), who report similar results for mid-sized companies (between 100 and 900 employees) in Germany. Thus, the idea of viewing psychological safety as an organizational construct seems further legitimized.

Overall, our empirical findings provide strong support for the basic premise that an organizational climate for psychological safety is conducive to innovation in SMEs. The results indicate that by reducing the perceived interpersonal threats experienced by actors in a firm, an organizational climate for psychological safety seems to enable the collective learning behaviours and generative process of innovation and, consequently, augment its innovation performance. In fact, such an organizational climate appears to enhance all facets of the multidimensional innovation performance construct, suggesting that its impact is of a fundamental nature. Notably, its positive effect appears to be significant only above some minimum level threshold of psychological safety, which indicates that below this minimum level the concept is inconsequential in relation to innovation performance. One possible implication of this observation is that fostering an organizational climate for psychological safety does not provide any beneficial outcomes in terms of innovation performance unless the level of perceived psychological safety within the organization is sufficiently high. This could be a key insight for managers attempting to develop a psychologically safe environment within their firms. In order to reap the innovation-related benefits of an organizational climate for

psychological safety, a high level of psychological safety seems to be required.

6.2 Psychological safety enhances firms' radical innovative capability

The analysis provided support for the hypothesis suggesting that a high level of psychological safety is associated with a high degree of radical innovative capability. This finding seems to be in accordance with Un's (2010) conclusion that, in the case of product innovation, psychological safety is more strongly associated with radical innovation than with incremental innovation. This is also consistent with the empirical results of Koberg et al. (2003), as well as Sanner and Bunderson's (2015) findings regarding task-complexity. A reasonable implication of these consistent results is that psychological safety is particularly important for firms engaged in the inherently risky and complex efforts aimed at developing radical innovations. Extending Un's (2010) finding, this study demonstrates that the advantageous effect of psychological safety on radical innovative capability need not be considered exclusive to product innovation, but may be equally relevant for service innovation.

6.3 The moderating effect of environmental dynamism

Focusing radical innovation capabilities, we also found that the advantageous effects of high levels of psychological safety is particularly pronounced in contexts characterized by high environmental dynamism. This is an interesting finding pointing to the level of environmental dynamism as a contextual contingency that moderates one of the positive effects of an organizational climate for psychological safety. Our study thus contributes towards an increased understanding of the boundary conditions for psychological safety's advantageous influence on organizational outcomes. A key implication of the demonstrated positive influence of an organizational climate for psychological safety on radical innovative capability is that the highly complex and risk-associated learning behaviours of *exploration* and *knowledge transformation* that underpin radical innovations seem to be more effectively cultivated in such a climate. Our results seem consistent with the findings of Kostopoluos and Bozionelos (2011), suggesting that psychological safety is an effective means for enhancing the explorative learning behaviours essential for achieving radical innovations when facing high levels of external dynamism.

6.4 A climate for psychological safety enhances SMEs' all types of innovation capabilities

The analysis has shown that an organizational climate for psychological safety was positively associated with firms' innovation capabilities. Specifically, product innovation capability, process innovation capability, service innovation capability and business model innovation capability were all found to be positively associated with the level of psychological safety within SMEs.

The empirical findings also imply that H5, which predicted that an organizational climate for psychological safety is especially strongly associated with business model innovation capability, is rejected. Although business model innovation capability showed a significant positive association with psychological safety, its magnitude was not greater than that for service or product innovation capability. Interestingly, it is evident from the descriptive statistics that business model innovation capability has the lowest mean value (4.33) of all the capabilities. Either this may imply that business model innovation is something that the SMEs consider to be of relatively less importance, or that it is the capability they experience the most difficulty in developing.

6.5 The results related to R&D intensity is difficult to explain

Previous studies have identified R&D intensity as an important factor when analysing SME development and performance (Booltink & Ska-Helmhout, 2018; Lome, Heggeseth & Moen, 2016). In table 6, innovation performance is focused. We notice that when examining all cases, there is a significant negative effect between R&D intensity and innovation performance. We also notice that this is non-significant when considering firms with low levels of psychological safety but high when focusing the firms with the highest levels of psychological safety. One possible explanation may be related to a time lag dynamism between R&D investments and innovation results influencing the analyses. However, it is difficult to understand why such effects is most notable in an environment of high psychological safety. We are not able to explain these results, and future research should attempt to investigate these interactions.

7. Implications and limitations

7.1 Implications

First, it seems reasonable to conclude that the results suggest that SMEs' managers should aim to foster an organizational climate for psychological safety in order to increase innovation capabilities and innovation performance. Examining the specific elements, managers should in particular allocate efforts towards establishing an organizational climate where employees value and respect each other's contributions, and be aware that a blame-free culture is essential for fostering an organizational climate for psychological safety (Edmondson, 2011). We note considerable variation in the psychological safety scores between firms, standard deviation ranging from 1.13 to 1.67 when we examine the different items in the scale. Many companies perform employee satisfaction evaluations; this may be combined with other measures of firm/manager performance. Based on our results, evaluation of organizational level psychological safety levels may also be used in order to design and implement improvement activities.

Second, if a firm aims to realize radical innovations, management should take particular care to foster an organizational climate for psychological safety, because this appears to be especially important for successfully developing a radical innovative capability. Third, considering that an organizational climate for psychological safety is determined by firm internal mechanisms, it should be regarded a management responsibility, and consequently a factor that managers may deliberately work to improve in order to increase innovation performance.

7.2 Limitations and suggestions for further research

We included a broad set of heterogeneous firms and industries in order to increase variation of the variables as well as enhance the generalizability of our findings. However, a limitation of this study is that the sample only contains Norwegian SMEs. In addition, it may not be possible to generalize the results to larger companies, because a unitary organizational climate is assumed. Longitudinal studies should investigate whether the positive associations between concepts that have been uncovered can be made into causal inferences. In addition, we suggest that to develop

even more fine-grained measures of different types of innovations would be a fruitful endeavour for future research.

Although our findings indicate that an organizational climate for psychological safety is conducive for all of the innovation capabilities investigated in this paper, we find it interesting to speculate that the distinct innovation capabilities may be differentially linked with psychological safety due to differences in the learning behaviours underpinning the capabilities. Unfortunately, our research design does not permit us to tease out or test such underlying mechanisms empirically. Future research could attempt to go further in explicating the presumably different learning behaviour mechanisms associated with the distinct innovation capabilities discussed in this paper, and investigate their potentially unique links with psychological safety. For example, it seems reasonable to assert that service and product innovation have different behavioural foundations, and that the mechanisms through which psychological safety enables these may be distinct. In-depth qualitative studies should be fruitful for such inquires, and for further theory development.

Moreover, the subjective assessment of our results indicated a non-linear pattern where the effect of psychological safety was first evident above a certain level. The statistical tests did not support this assessment, but confirmed a linear pattern. Nevertheless, further research should also include the search for a possible non-linear relationship between psychological safety, and innovation capabilities and innovation performance.

To the best of our knowledge, our study is the first to delineate between different innovation capabilities for investigating their potentially differing relationships with psychological safety. This paper thus contributes to the literature a more nuanced perspective on the link between innovation and psychological safety, which may prove fruitful for future research endeavours.

Most prior studies focusing on psychological safety have used this concept with data collection at the team level. One notable exception is Baer and Frese (2003) who demonstrated that Edmondson's (1999) construct of psychological safety might be meaningfully conceptualized at the organizational level. An important contribution of our study is that it provides further justification for the notion that it is possible and relevant to use the psychological safety construct not only at the team level but also at the organizational level, at least when studying

SMEs. We encourage future studies to also employ an organizational level perspective on psychological safety, and to further investigate the conditions under which such a unitary organizational climate can exist.

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