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Open for business: The impact of creative team environment and innovative behaviour in technology-based start-ups

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Abstract
Rather than the view of the entrepreneur as a 'lone ranger', recent work has focused on the importance of teams in bringing a start-up to growth and success. Here, we aim to bridge the gap between the individual characteristics of entrepreneurs and the characteristics of their teams by examining openness of founders in relation to creative team environment (CTE), innovative work behaviour (IWB) and performance. On the basis of upper echelon theory and integrating other complementary theories such as the attention-based view, we develop a theoretical framework and test this using a survey of 322 high-tech entrepreneurs. Our findings suggest a mediating role of CTE and IWB in the relation between openness of entrepreneurs and performance. The implications of the results for managerial practices and future research directions are discussed.

Keywords
creative team environment, entrepreneurship, innovative work behaviour, openness to experience, technology-based start-ups

Introduction

The impact of entrepreneurs on venture performance has been a prevailing topic in entrepreneurial studies for decades. Through the lens of upper echelon theory, previous work identified many features of the entrepreneur and examined their impact on the entrepreneurial process. In comparison with CEOs of more established firms, entrepreneurs with new ventures have more managerial

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discretion so their behaviour has important effects upon how the organisation develops and grows over time (Klotz et al., 2014). Entrepreneurial characteristics that have been analysed include demographic characteristics such as age, gender, education, career experience, as well as psychological factors including cognitive base and value. Studies show that such characteristics are crucial for explaining the behaviour of entrepreneurs in relation to the performance of their new ventures (Smith et al., 2018; Zhao et al., 2010).

In addition to the importance of the characteristics of the entrepreneur for explaining venture success, other researchers argue that the ability to innovate and the creation of new knowledge are the keys to the success of high-technology firms (Beckman et al., 2012; Collins and Smith, 2006; Garud and Karnøe, 2003; Shane and Venkataraman, 2003). In effect, such activities support the process of translating technology into business within such ventures. To achieve innovation goals, individual employees often work together in teams for the further development of new products, services or business models (Gilson et al., 2005). A growing number of studies are therefore, dedicated to the impact of team processes on creativity and innovation (Hu and Randel, 2014; Rodríguez-Sánchez et al., 2017; Sung and Choi, 2012; Talke et al., 2011). Although these efforts have advanced our understanding of the impact of both entrepreneurial features and new venture teams on performance, much less attention has been paid to uncovering the mechanisms that explain how founders of technology-based start-ups guide their teams to favourable outcomes (Ali et al., 2019; Boies et al., 2015). Studies either focus strongly on the characteristics of entrepreneurs (see Zhao et al., 2010, for an extensive overview), or highlight the role of the 'new venture team' as a whole (Klotz et al., 2014), but less is known about the way entrepreneurs may shape their entrepreneurial teams to become more creative and to gain success.

In this study, we address the question of how founders of technology-based ventures shape their teams to influence venture performance. Specifically, we bridge the gap between the individual characteristics of entrepreneurs and those of their teams by examining the mediating role of creative team environment (CTE) and innovative work behaviour (IWB) in the relationship between openness of founders and venture success. Reflecting the work of Shane and Venkataraman (2000), we define an entrepreneur as an individual who initiates and engages in an activity that involves the discovery, evaluation and exploitation of opportunities with the goal to introduce new goods, services, ways of organising, markets, processes and/or raw materials through organising efforts that previously had not existed. Following Klotz et al. (2014), we define a new venture team as '. . . the group of individuals that is chiefly responsible for the strategic decision making and ongoing operations of a new venture . . .' (p. 227).

We focus on technology-based start-ups rather than on small businesses in general. Such technology-based start-ups are characterised by an iterative process of technological innovation and entrepreneurship (Beckman et al., 2012). In this context, entrepreneurs concurrently interact with both the internal and the external environment to test ideas and to gain support for further development. This is undertaken through several iterations until a 'minimum viable product or service' is achieved (Blank, 2013; Chiesa and Frattini, 2011); regular adaption to change is required due to the inherent processes of continuous testing and revising. To deal with such ambiguities, it helps to be open to different ideas and experiences where change is part of daily operations (Zhao et al., 2010). It has been demonstrated that openness to experience relates significantly to several key parts of the entrepreneurship process regarding the sensing and the adaptation of business opportunities (Shane et al., 2010). As such, this dimension differs from other dimensions of the big five personality traits by having this strong link to technology entrepreneurship. Therefore, rather than study the full array of personality traits, we focus upon 'openness to experience' of entrepreneurs in practice and how this relates to the team climate, employee behaviour and performance of new ventures.

We predict that an entrepreneur high on openness will have a positive impact on team creativity and performance; thus, openness to experience is an important predictor of team creativity and we explain the mechanism through which this leads to firm performance. Rather than assuming a direct relationship between openness and performance, we expect that this relationship is mediated by the creation of a CTE and by stimulating innovative behaviour of other members in a technology-based start-up.

This article offers two contributions. The first is the development of upper echelon theory in entrepreneurship research by elaborating upon the individual-team nexus in the context of technology-based new ventures (Klotz et al., 2014). We link the impact of openness and venture performance with team creativity, rather than directly assessing the impact on venture performance, in response to the call to pay attention to innovation-related mediators (Ibeh et al., 2018). We offer two alternative mechanisms through which entrepreneur's openness exerts influences on venture performance (i.e. CTE and IWB). Second, we show that openness of entrepreneurs is strongly linked to IWB as well as a CTE within high-tech start-ups. Rather than focusing on the team-level construct, this finding adds to the discussion on the antecedents of team creativity by specifying entrepreneur's openness to experience is an important antecedent for team creativity.

Theoretical background and hypotheses

Technology-based entrepreneurship

Technology entrepreneurship highlights the critical role of technology in the entrepreneurship process (Beckman et al., 2012); technical innovation constitutes a core element in creating and capturing market value in the process of entrepreneurship. The way a technical element presents itself could be found in the development of a totally new product or invention, in the manufacturing process itself, or in the distribution channel. Founders of technology-based ventures experience a diverse range of uncertainties such as market and competitive uncertainty as is common in any new venture. However, in addition, technology entrepreneurs also need to consider how their firm can develop new technologies, that is, technological uncertainty (Lazonick, 2010). An important task of technology-based entrepreneurs is, therefore, to create or to apply technologies that bring new products or services into the market to achieve competitive advantage and capture value. For such technology-based ventures, innovation, especially technological innovation, is an important driver of such value creation. Here, we define innovation as 'a process of turning opportunity into new ideas and of putting these into widely used practice' (Tidd et al., 2005: 66). Although this process is complex and uncertain, we assume that such processes are at the heart of technology-based firms and new ventures. We argue that founders not only depend on their teams but are also likely to be instrumental in driving innovation outcomes. Particularly at the early stages of development, new start-ups largely depend on the individual characteristics of entrepreneurs, such as personality traits, skills and prior experience (Penrose, 1959). Therefore, we argue that technology-based entrepreneurship is an appropriate context to examine the question of how founders build their teams to influence venture performance.

Openness to experience and creative team environment

Personality predicts a wide range of individual behaviours, including the decision to become an entrepreneur (Konon and Kritickos, 2019) as well as a determinant entrepreneurial performance

such as income (Levine and Rubinstein, 2017). Openness to experience, as one of the dimensions of the big five personality constructs, refers to those who are intellectually curious, imaginative and creative; this dimension is regarded as an important trait of entrepreneurs (Antoncic et al., 2015). Individuals, who score high on openness, tend to be more open to external information and new ideas and more amenable to unconventional perspectives. As such, openness to experience plays a crucial role in sensing entrepreneurial opportunities (Shane et al., 2010). In their meta-analysis, Zhao et al. (2010) show that openness is indeed linked to several characteristics of entrepreneurship, such as intelligence related to creativity and divergent thinking (McCrae, 1987). Openness to experience also implies a range of different interests and a strong attraction to novelty. Extremely open people are often creative, inquisitive and artistic, whereas less open people tend to be more conservative, less adventurous and more predictable. For example, being self-employed is a nontraditional mode of employment that appeals to entrepreneurs. Entrepreneurs are also likely to rely on their creativity to solve everyday problems and make decisions on the basis of limited resources (Zhao et al., 2010). Accordingly, in our study we expect that openness to experience could also serve as an important predictor of team creativity in technology-based start-ups.

According to upper echelon theory, the characteristics of founders are critical to the continuity and the overall management of start-ups (Hambrick, 2007). Entrepreneurs and the new venture team have considerable managerial power whilst their behaviour has important imprinting effects on how the organisation grows and develops (Klotz et al., 2014). In other words, the differences in openness to the experiences for founders not only cause differences in creativity and alertness, labelled as individual characteristics, but also the management of new ventures.

We suggest that entrepreneurs who are more open to experience are likely to stimulate creativity and innovation among their workforce through the creation of an innovative team environment where members encourage each other to engage in creative activities (Gilson et al., 2005). On the one hand, as evidence from studies in the area of similarity–attraction and categorisation shows, individuals tend to work and interact with others who share similar characteristics such as personality traits and background (Burt and Reagans, 1997; Byrne, 1971). Therefore, we argue that entrepreneurs who are open to experience are more likely to team up with individuals who are also open to experience. Evidence pertaining to entrepreneurial team formation suggest that founders prefer to work with those who reflect their own qualities and and share their preferred working routines. (Forbes et al., 2006).

On the other hand, the behaviours of the founders constitute an important part of the organisational culture which influences the behaviours of other team members. Hsu (2006) suggests that a strong commitment to innovation by a leader is a strong predictor of knowledge sharing among employees in the firm. Entrepreneurs open to new ideas and receptive to external information therefore, tend to rely strongly on inputs from others. Equally, as entrepreneur who direct their attention upon innovative solutions also expect this of their employees (Boies et al., 2015). Both the expectations and behaviours of the entrepreneur will encourage others to share their information, ideas and knowledge with the team (Ali et al., 2019). Also, the behaviour of entrepreneurs may improve the likelihood that employees feel comfortable to voice new ideas and to take initiatives rather than to rely on the ideas of their leaders. Therefore, we predict the following hypothesis:

Hypothesis 1. Openness to experience of entrepreneurs will be positively related to a creative team environment (CTE) within their new technology-based ventures.

Openness to experience and innovative work behavior

Janssen (2000) defines IWB 'as the intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization' (p. 228). IWB includes behaviour related to the generation of ideas, idea promotion and the realisation or implementation of ideas (De Jong and Den Hartog, 2010; Janssen, 2000). It involves sensing and implementing as well as adapting opportunities. We expect that entrepreneurs who are open to experience will be more likely to stimulate IWB among the members of their start-ups at least in three ways. First, following the logic of psychological needs, founders tend to recruit and prefer to work with those who share their approach to problem-solving (Forbes et al., 2006). As such, we argue that entrepreneurs of innovation-driven firms are more likely to select team members who show IWB. The literature on imprinting also suggests that the founding conditions influence the structure and processes of start-ups (Leung et al., 2013). In other words, the behaviour of founders as well as their traits are important conditions and will have an impact on other team members in the new venture and are important for the generation of new ideas. Second, the openness of an entrepreneur would increase the IWB by encouraging experiential learning. Experiential learning among team members plays an important role in the process of idea generation, promotion and the implementation and reflection on experience, which helps firms to identify those ideas that do not work and those suitable for adaption (Karami and Tang, 2019). Entrepreneurs who are high on openness are likely to encourage both knowledge and experience sharing among their employees, as they will be able to push them to reflect on their own experience as well as on the experience of other team members. In such teams, individuals are exposed to different perspectives and diverse information and this helps new venture teams to generate novel ideas more easily. Third, according to the attention-based perspective, managerial attention will influence the outcomes of teams by allocating more attentional capacity to receive, interpret and make sense of information (Fiske and Taylor, 2008) and economic resources (Li et al., 2013). Cho and Hambrick (2006) argue that the attention-based view is complementary to upper echelon theory; they found that the characteristics of the top management team are reflected in their management attention. In the context of entrepreneurship, we expect innovation-oriented entrepreneurs will tend to allocate limited economic resources to idea generation activities as well as the implementation of ideas. On the basis of these considerations, we propose the following hypothesis:

> *Hypothesis 2.* Openness to experience of entrepreneurs will be positively related to innovative work behavior of employees within their new technology-based ventures.

The mediating effects of creative team environment and innovative work behavior

Creativity and the ability to generate novel solutions to problems are crucial for innovative firms in the early stages of development (Greiner, 1998). Entrepreneurs simultaneously interact with both the internal and the external environment to test ideas and gain support for further development. This is attained through several iterations until a 'minimum viable product or service' is achieved (Blank, 2013; Chiesa and Frattini, 2011). Particularly in the case of new technology-based ventures, the entrepreneur and the team are expected to learn and to acquire new knowledge in response to different inputs from changing markets and technological developments (Ciavarella et al., 2004). Although technological innovations commonly relate to product and process innovation, this does not imply that technological innovations are more important than non-technological innovations for improving venture performance (Exposito and Sanchis-Llopis, 2018). For

example, managerial innovations such as changing the organisational structure or altering administrative procedures may also affect business performance (Madrid-Guijarro et al., 2013). Different types of innovation, together with complementary resources and managerial capabilities, will enable technology-based entrepreneurs to outperform competitors and inform better financial performance. In such environments, we expect that higher levels of entrepreneur openness will increase the likelihood of venture success in terms of both finance and operations.

Drawing from research following the upper echelon perspective in entrepreneurship studies, the performance of a venture is largely achieved by teams, rather than by lone entrepreneurs (Klotz et al., 2014; Talke et al., 2011). This is not to say that every team member has an identical impact on the venture performance; rather, as a result of the characteristics, behaviours and creativity of entrepreneurs and innovative behaviours among other team members. These become key drivers for venture performance. CTE is an organisational climate that facilitates team creative processes, generating radical as well as incremental innovations (Gilson et al., 2005). Here, we argue that such an environment is necessary for the performance of technology-driven start-ups. Rather than a direct relationship between openness of entrepreneurs and performance, we predict that this relationship is mediated by the CTE within their ventures.

Hypothesis 3. A creative team environment within new technology-based ventures mediates the relationship between openness of entrepreneurs and venture outcomes, such as (a) innovation, (b) competitiveness and (c) profit.

We also predict that openness influences firm performance by fostering IWB; as such IWB mediates the relationship between openness and performance. IWB, as discussed above, involves sensing new business ideas as well as providing support to get the ideas implemented (Janssen, 2000).

Previous empirical research has found that sensing new business opportunities and seizing opportunities often leads to better venture performance particularly in turbulent and fast-changing markets (Ma et al., 2015). This occurs as entrepreneurship, by its nature, is a process of iterative sensing, testing and adapting actions until the entrepreneur ultimately finds a way to achieve a configuration (Wood and McKinley, 2010). Constant adaptations in the forms of changing entrepreneurial strategy, reconfiguring resources and creating resources to support the implementation of adapted strategies, the direct results of IWBs, are crucial for technology-based start-ups, given the infamously high levels of uncertainty and ambiguity coupled with the technology-based entrepreneurship process (Hill and Levenhagen, 1995). Both improvisation and bricolage are integral elements of new ventures (Garud and Karnøe, 2003; Gulati and DeSantola, 2016). In addition to the direct impacts of generating innovations on business performance, the innovations generated from IWBs will shape the development of future team cohesion and team effectiveness (Rodríguez-Sánchez et al., 2017). Thus, we hypothesise:

Hypothesis 4. innovative work behavior of employees within new technology-based ventures mediates the relationship between openness of entrepreneurs and venture outcomes, such as (a) innovation, (b) competitiveness and (c) profit.

Our proposed conceptual model is depicted in Figure 1.

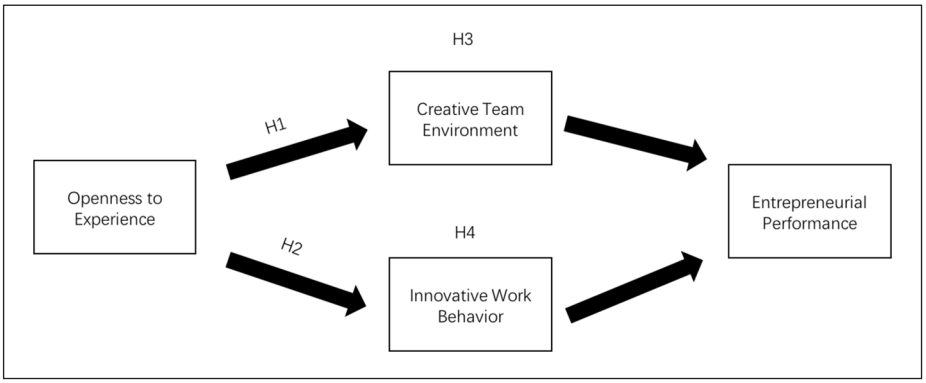

Figure 1. The conceptual model.

Method

Sample and procedures

The data were collected through a survey among founders of technology-based start-ups, who applied for the Innovation Fund (Innofund) grant in Shanghai, 2016. Innofund may be compared with the Small Business Innovation Research (SBIR) programme in the United States. It is specifically designed to support innovative ventures at their early stages of development. According to the funding procedure, all applicants were invited to pitch their ventures in the year of 2016. As part of this visit, we asked them to complete a questionnaire about openness, team creativity, IWB and the performance of their venture. Most of the entrepreneurs contributed to the questionnaire. A total of 623 founders were asked to participate; 591 completed questionnaires (94.8% response rate). A number of questionnaires were not readable so were discarded. Four hundred and ninety-two remained. We established this relatively high response rate by targeting the respondents at an appropriate time; questionnaires were distributed during attendance at Innofund. A high response was also facilitated by developing a concise questionnaire with the minimal number of scales and items possible. To rule out the influence of a co-founder, we matched the founder information from the government held database. After the matching process, the information of founders of 170 firms were not available leading to our final sample to 322 founders of start-ups. All the sample firms in this study are relatively young (⩽five years) with number of employees ranging from three to 215.

Measures

All measures were originally constructed in English. In the case where there was no Chinese version of the scale available, we created a Chinese version following the commonly used translation–back translation procedure (Brislin, 1980).

Openness to experience. We measured openness to experience through the 4-item scale developed by Donnellan et al. (2006) (see Appendix), as part of the Mini-IPIP. We used the available Chinese translation by Li et al. (2012). Response options ranged from 1 (‘strongly disagree’) to 5 (‘strongly agree’). Sample items included: ‘Have a vivid imagination’ and ‘am not interested in abstract idea’. Reliability analysis showed that Cronbach’s alpha was .73 for openness to experience.

Creative team environment. We used the 3-item scale developed by Gilson et al. (2005) to measure team creativity. Response options ranged from 1 ('strongly disagree') to 5 ('strongly agree'). Sample items included 'Team members welcome change' and 'Team members encourage each other to try new things, even though they might not work'. Reliability analysis showed that Cronbach's alpha for CTE was .75.

Innovative work behaviour. This was measured by 9-item scale developed by Janssen (2000) (see Appendix). Response options ranged from 1 ('never') to 5 ('always'). Sample items included 'new venture team members create new ideas for difficult issues (idea generation)', 'new venture team members mobilize support for innovative ideas (idea promotion)' and 'new venture team members transform innovative ideas into useful applications (idea realisation)'. Cronbach's alpha of the summative scale was .89.

Firm performance. In relation to entrepreneurial performance, Baron (2007) suggests 'that different metrics are required during different phases of new venture development' (p. 28). In the early periods of the venture, the identification, quality and quantity of opportunities are suitable measures for success. More traditional financial measures of success are appropriate in later stages. As a result, scholars examining early stage technology-based firms often go beyond the traditional financial indicators and focus on both innovation performance (e.g. patenting activities) and market performance, such as the introduction of new products or services (Vandenbroucke et al., 2016). This is consistent with the findings of Gans and Stern (2003), who argue that technology-based companies operate either in a market for ideas or a market for products in the early stages of their development. Our focus is on these early stages of technology-based start-ups. As we discussed above, entrepreneurs with technology-based ventures face three types of uncertainties: technical, market and competitive. Such technology-based ventures are legally established and are already active in launching their activities and we concentrate on three main outcomes of the new venture, that is, innovation, market competitiveness and profit.

Previous studies show that the implications of different innovation types on new venture performance vary. For example, Exposito and Sanchis-Llopis (2018) in their field study among Spanish small and medium-sized enterprises (SMEs) suggest measuring innovation on the basis of a combination of organisation features (i.e. specific resources and organisational capabilities). In this study, we focus on technology-driven entrepreneurship in which the technical elements can be found in the development of a new product or service, or in the manufacturing process itself, or in the distribution channels. Given the importance of technological innovation for predicting venture performance, some have tried different approaches to capture innovation in new ventures (Foreman-Peck, 2013), including R&D expenditures (Lev, 2001), counting patents (Griliches, 1990) and the number of significant innovations (Tether et al., 1997). In this study, we measured innovation performance on the basis of the objective number of invention patent applications. We used the database from the State Intellectual Property Office (SIPO) for the period ending in 2016; doing so for two main reasons. First, patent count is highly correlated with R&D expenditure and financial performance in the Chinese context (see Dang and Motohashi, 2015). Second, innovation data are scarce in the case of new ventures. Although, we were planning to collect the number of (product, services) innovations, it emerged that most new ventures focus on only one novel product or service. Therefore, we could not use this as a complementary measure.

Rather than using an objective measure for innovation, we gathered data on both profit and competitiveness on the basis of a set of questions to the founders. We asked respondents to compare their venture with its direct competitors in the firm's industry as suggested by Wang, Tsui, and Zhang (2003) (see Appendix). Specifically, we asked the founder to indicate these two aspects on

a scale ranging from 1 ('very low') to 5 ('very high'). A sample item is: 'In comparison to other companies in my industry, the overall profit level of my venture is . . .' Despite the disadvantages of such measures, we decided to use this type of question because the new ventures were from different industries. Although all ventures are technology-based start-ups, they operate in different industries and are likely to have diverse goals and different perceptions of firm performance. According to Baer and Frese (2003), subjective performance measures are particularly appropriate for situations in which firms have diverse goals (see also Fey and Beamish, 2001). Several studies (Frishammar and Hörte, 2005; Ketokivi and Schroeder, 2004; Ling and Kellermanns, 2010; Madrid-Guijarro et al., 2013) illustrated that self-reported venture performance compared with competitors demonstrates convergent validity with actual performance. These results suggest subjective measures, such as the perception of entrepreneurs were highly correlated with objective performance and could be compared with other firms.

Control variables. Following the recommendations by Hmieleski and Baron (2009), we controlled for gender, age and education to rule out possible extraneous effects. Gender was dummy coded by '0' (female) and '1' (male). Age was coded as '1' for entrepreneur's age below 25, '2' for age between 25 and 34, '3' for age between 35 and 44, '4' for age between 45 and 54 and '5' for entrepreneur's age over 55. Education attainment was coded as '1' for middle school, '2' for high school, '3' for associate's degree, '4' for bachelor's degree and '5' for master's and doctoral degrees. Moreover, we also include firm-level variables as control variable including the number of co-founders, employee size and firm age. These three firm-level control variables applied to the year in which the survey data were collected. We define co-founders as individuals who have equity within the new ventures. To detect the potential multicollinearity issues, we ran the multicollinearity diagnostics for all the models in these studies with SPSS; the results show that all the variance inflation factor (VIF) values are less than five and do not suggest multicollinearity problems for our research model.

Results

Confirmatory factor analyses

Since openness to experience, CTE and IWB were measured at the same time and through the same source (i.e. founders of technology-based start-ups), we conducted confirmatory factor analyses (CFAs) to evaluate the distinctiveness of these variables. We examined a three-factor model, in which openness, CTE and IWB were included. The model yields an acceptable fit to the data: χ^2 (322) = 318.2, comparative fit index (CFI) = 0.89; incremental fit index (IFI) = 0.89; standardised root mean square residual (RMR) = 0.04; root mean square error of approximation (RMSEA) = 0.08. In addition, all the factor loadings were significant, demonstrating evidence of convergent validity.

The discriminant validity of the three constructs was tested by contrasting the three-factor model against alternative models. Model comparison results (see Table 1) revealed that the three-factor model was considerably better than any of the alternative models (Bentler and Bonett, 1980; Cheung and Rensvold, 2002). Thus, the distinctiveness of the three constructs in this study was supported. Given the results, all three constructs were applied to further analyses.

Table 2 presents the means, standard deviations, Cronbach's alpha values and zero-order Pearson correlations of all key variables. As shown in Table 1, openness to experience ($r = .23$, $p < .01$) was positively correlated with CTE and IWBs ($r = .25$, $p < .01$). CTE was positively correlated with competitiveness in the firm's industry ($r = .16$, $p < .01$) as well as profit ($r = .16$, $p < .01$). Likewise, IWB was also positively correlated with competitiveness in the firm's industry ($r = .26$, $p < .01$) and

Table 1. Results of confirmatory factor analysis for the measures of the variables studied.

Model	χ^2	df	χ^2/df	RMSEA	CFI
Three-factor model					
Openness to experience, innovative work behaviour and creative team environment	319.22	101	3.16	0.08	0.89
Two-factor model 1					
Innovative work behaviour and creative team environment combined	219.7	53	4.15	0.10	0.90
Two-factor model 2					
Openness to experience and creative team environment combined	66.3	13	5.10	0.11	0.91
Two-factor model 3					
Innovative work behaviour and openness to experience combined	260.6	64	4.07	0.10	0.88

CFI: comparative fit index; RMSEA: root mean square error of approximation.
$n = 322$.

profit ($r = .26$, $p < .01$). Openness to experience was positively correlated with competitiveness in the firm's industry ($r = .13$, $p < .05$), but not correlated with profit. Unfortunately, we could not find any significant correlations between innovation performance and the other variables. Therefore, we decided to exclude innovation performance from our regression analyses.

Main and mediating effects

Hierarchical regression analysis was conducted to test Hypotheses 1, 2, 3(b), 3(c), 4(b) and 4(c). This approach involves entering variables into the regression analysis for both performance measures in separate steps: the control variables (entrepreneur's gender, age, education, employee size, firm age and the number of co-founders) were entered first, followed by the independent variables (openness to experience), and then the mediator (CTE and IWB). Table 3 shows the results.

Hypothesis 1 predicted a positive relationship between openness to experience of entrepreneurs and CTE. The hierarchical regression analysis results support our hypothesis that openness is indeed positively related to creative environment ($\beta = .24$, $p \leqslant .01$; M2). Hypothesis 2 predicted that openness is positively related to IWB, and we found support for this relationship ($\beta = .24$, $p \leqslant .01$; M4) as well.

In Hypothesis 3(a)–(c), we argue that a CTE would mediate the effect of openness to experience on venture performance. We follow the mediation testing procedures as recommended by Baron and Kenney (1986). Perfect mediation holds if openness to experience has no effect on venture performance when controlled for CTE. Our results show that CTE was positively related to competitiveness ($\beta = .17$, $p \leqslant .01$; M7). After entering CTE into the equation, the co-efficiency relationship of openness to experience ($\beta = .12$, $p \leqslant .05$; M8) with competitiveness becomes less significant, while CTE is still positively related to competitiveness ($\beta = .14$, $p \leqslant .01$), thus providing proof for mediation in support of Hypothesis 3(b). In relation to Hypothesis 3(c), we did not find any significant relationship between openness and profit (M10), although CTE does have a positive relationship with profit ($\beta = .17$, $p \leqslant .01$; M11).

Hypothesis 4(b) predicted that IWB mediates the relationship between openness and competitiveness. In the regression analysis, after entering IWB into the equation, the relationship of

Table 2. Means, standard deviations and correlations.

Variable	Min	Max	*M*	SD	1	2	3	4	5	6	7	8	9	10	11
1. Openness to experience	8	20	15.63	3.10	(.73)										
2. Creative team environment	7	15	11.84	1.80	.23**	(.75)									
3. Innovative work behaviour	18	45	36.79	4.95	.25**	.50**	(.89)								
4. Innovation	0	18	1.15	2.67	−.05	−.08	.02								
5. Competitiveness	2	5	3.94	0.78	.13*	.16**	.26**	.11**							
6. Profit	1	5	3.52	0.78	.03	.16**	.26**	.10	.34**						
7. Gender	0	1	0.81	0.39	.11*	.01	−.01	.03	−.01	−.01					
8. Age	1	5	2.57	0.69	.02	−.05	.03	.09	. 10	.06	.14**				
9. Education	2	5	4.27	0.57	.07	−.02	.06	.03	. 10	.01	.06	.13*			
10. Firm age	0	5	2.00	1.39	.05	−.01	.01	.10	−.04	.00	.08	.06	−.08		
11. Employee size	3	215	24.99	27.45	−.01	.11	.01	−.02	.03	.02	−.08	−.14*	−.03	.16**	
12. Co-founders	1	11	2.74	1.55	.07	.02	.05	−.08	−.08	−.06	.07	.06	−.01	−.02	.05

SD: standard deviation.
N = 322. Cronbach's alpha values appear in parentheses on the diagonal for variables composed of multi-item scales. *$p < .05$; **$p < .01$.

Table 3. Results of hierarchical regression analysis.

	CTE		IWB		Competitiveness				Profit				Competitiveness		Profit	
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
Control variables																
Gender	.03	.00	.00	−.03	−.03	−.04	−.03	−.04	−.01	−.01	−.01	−.01	−.03	−.04	.00	.00
Age	−.03	−.03	.04	.04	.10	.11	.11	.11	.09	.09	.09	.09	.09	.09	.08	.08
Education	−.03	−.05	.05	.03	.09	.08	.09	.08	−.01	−.01	.00	.00	.07	.07	−.02	−.02
Employee size	.09	.09	.01	.02	.06	.06	.05	.05	.06	.06	.04	.04	_06	.06	.06	.06
Co-founders	.01	−.01	.05	.04	−.08	−.09	−.08	−.09	−.09	−.09	−.09	−.08	−.10	−.10	−.10	−.10
Firm age	−.03	−.05	.01	−.01	−.06	−.07	−.06	−.07	−.02	−.02	−.01	−.01	−.06	−.07	−.02	−.02
The independent variable																
Openness to experience		.24**		.24**		.16**		.12*		.05		.01		.09		−.01
Mediator																
Creative team environment							.17**	.14**			.17**	.17**				
Innovative work behaviour													.28**	.26**	.26**	.26**
Adj. R^2	.00	.05	−.01	_04	.01	.03	.04	.05	.00	.00	.02	.02	.09	.09	.06	.06
ΔR^2	.01	.07	.01	_06	.03	.06	.06	.07	.02	.02	.04	.04	.11	.12	.08	.08
F	0.54	3.05**	0.39	2.82**	1.63	2.48**	2.72**	2.95**	0.77	0.77	1.99*	1.74*	5.20**	4.92**	3.87**	3.38**

CTE: creative team environment; IWB: innovative work behaviour.
$N = 322$; **$p < .01$; *$p < .05$.

openness to experience with competitiveness becomes insignificant (M14), while IWB remains positively related to competitiveness (β = .26, $p \leqslant .01$; M14). Therefore, the mediation effect of IWB is supported. In relation to Hypothesis 4(c), we did not find any significant relationship between openness with profit (M10), although IWB is suggested to have a positive relationship (β = .26, $p \leqslant .01$; M15).

In addition, we tested for the significance of indirect effects (MacKinnon et al., 2007). In terms of Hypothesis 3(b), CTE mediates the relationship between openness and competitiveness, for $\hat{a} = 0.47$ (SE = 0.14) and $\hat{b} = 0.28$ (SE = 0.11). The indirect effect estimate is 0.13 (SE = 0.08), with a 95% CI under bias-corrected percentile method to be [0.02, 0.34], indicating significant indirect effect between openness and competitiveness. The direct estimate is 0.16 (SE = 0.19), with a 95% CI [–0.21, 0.52] under bias-corrected percentile method, showing insignificant direct effect between openness and competitiveness. Therefore, CTE is a full mediator. In relation to Hypothesis 4(b), we also find support for mediation as IWB mediates the relationship between openness and competitiveness, for $\hat{a} = 0.46$ (SE = 0.13) and $\hat{b} = 0.42$ (SE = 0.1). The indirect effect estimate is 0.19 (SE = 0.08) with a 95% CI under bias-corrected percentile method to be [0.09, 0.41] and the direct effect estimate is 0.10 (SE = 0.17) with a 95% CI under bias-corrected percentile method to be [–0.27, 0.41]. In both models, the mediators are full mediators because of significant indirect effect and insignificant direct effect between openness and competitiveness.

With regard to Hypothesis 3(c) CTE mediates the relationship between openness and profit, for $\hat{a} = 0.48$ (SE = 0.15) and $\hat{b} = 0.34$ (SE = 0.11). The indirect effect estimate is 0.16 (SE = 0.08), with a 95% CI under bias-corrected percentile method to be [0.04, 0.38], indicating significant indirect effect between openness and profit. The direct estimate is −0.14 (SE = 0.21), with a 95% CI [–0.63, 0.21] under bias-corrected percentile method, showing insignificant direct effect between openness and profit. Therefore, CTE is a full mediator. In relation to Hypothesis (c), we also find support for mediation as IWB mediates the relationship between openness and profit. For $\hat{a} = 0.46$ (SE = 0.13) and $\hat{b} = 0.46$ (SE = 0.10). The indirect effect estimate is 0.21 (SE = 0.08) with a 95% CI under bias-corrected percentile method to be [0.10, 0.45] and the direct effect estimate is −0.19 (SE = 0.20) with a 95% CI under bias-corrected percentile method to be [–0.71, 0.15]. In this model, we also find IWB a full mediator because of a significant indirect effect and insignificant direct effect between openness and profit.

Discussion

There is a growing need for more knowledge on the link between the role of entrepreneurs, new venture teams and entrepreneurial success (Klotz et al., 2014). In this article, we sought to address the question of how founders of technology-based ventures build their teams to influence venture performance. Specifically, we utilise a mediation model which examines the relationship between openness to experience, CTE, IWB and venture performance, such as innovation, profit and competitive position in market. A strength of our study being that we were able to investigate our hypotheses using a relatively large sample of 322 young technology-based start-ups in a specific geographic area. This improves the generalisability of our results.

The results suggest that openness of entrepreneurs in technology-based start-ups is positively related to a CTE as well as IWBs in the new ventures. Reflecting our expectations, we find support for the mediating role of this CTE and IWB in the relation between openness and firm performance. Through stimulating a CTE, technology-based start-ups are more likely to achieve competitiveness in their markets. Although, we also expected a link with technological innovation, we only found support for this mediation in relation to competitiveness and profit.

Our findings offer a number of theoretical contributions. First, we joined the entrepreneurship research debate regarding the upper echelon perspective that examines the influence of entrepreneur characteristics on venture performance. This differs from previous studies following upper echelon perspective which typically examine the direct links between the traits of entrepreneurs and entrepreneurial propensity (Antoncic et al., 2015) or venture success (Zhao et al., 2010), our study illustrates how CTE and IWBs mediate between entrepreneur openness to experiences and venture performance. As a result, we now have a better understanding of how different entrepreneurs have diverse influences on venture performance. This is, in part, because they differ in building new venture teams, in creating as well as maintaining a favourable organisational climate. These behavioural differences create variances in venture performance.

Second, we demonstrate that the openness of the entrepreneur is strongly linked to IWB as well as a CTE within high-tech start-ups. This evidence adds to research on new venture teams by illustrating that openness of the entrepreneur is an important antecedent for team creativity. This differs from previous studies which focus on the team-level construct, such as diversity, to predict team effectiveness (Jin et al., 2017). Third, our empirical results open the discussion on the relationship between innovation and business performance. We use multiple indicators to measure business performance (i.e. technological innovation, competitiveness and profit), and the overall results reaffirm the argument that the relationship between innovation outcomes and other business performance indicators should be analysed from a multi-dimensional approach (see also Exposito and Sanchis-Llopis, 2018).

As a growing number of start-up businesses aim to be innovative, our findings have important implications for practice. As such, entrepreneurs involved with high-tech start-up firms would benefit from more awareness of the impact of their teams on the development and performance of the venture. In addition to personal traits, human capital and social capital suggested by other studies, our results suggest that entrepreneurs might also consider instilling a CTE, confirming that the development of new ventures depends on team effectiveness rather than the creativity of entrepreneurs. Entrepreneurs should pay attention to behaviour rather than creativity in driving team effectiveness.

For those funding new high-tech ventures (e.g. public policymaker and venture capitalists), it could be beneficial to pay attention to the openness to experience of the entrepreneur as well as the team formation process in new ventures. It is generally accepted that entrepreneurs and the new venture team are key to venture success; thus, policymakers and venture capitalists should favour entrepreneurs and new venture teams with specific features which increase venture success. The extant evidence shows the importance of openness to experience for opportunity recognition and for maintaining awareness of market changes and new technologies. Our study indicates that openness to experience may also be associated with a greater CTE. As such, openness seems to be an important predictor of new venture success and could be used as a mechanism for the selection of entrepreneurs by venture capitalists or other funding bodies. Given the mediating role of the creative team environment and innovative work behaviour, policymakers and investors should also pay attention to the external environment which facilitates the formation the new venture teams. Equally, training for team management, especially for managing creative teams, is suggested for entrepreneurs with high openness to experience.

Limitations and future studies

The inconsistency between our results in relation to profit and competitiveness is probably related to the context of technology-based new ventures. Although profit is accepted as an indicator of venture performance, it may not be such a good indicator for the success of technology-based

ventures in the early stages of development. It might be too early for such firms to expect profits as their focus might be on further development and refinement of new products, services or business models rather than on driving the business. We were surprised about the lack of support in relation to our hypotheses on innovation performance; this could be explained by an inappropriate measure of innovation performance. We measured innovation performance on the basis of an objective measure using the number of patent applications; despite our aim to use an objective measure, this may not have been the best indicator as can take up to 18 months for SIPO to release the patent information after the application. More recent data would probably show a more favourable number of patent applications to serve as a measure of innovation performance. Moreover, although filing patents can be assumed as an indicator of technological capability (Zhou et al., 2016), it can be costly, time-consuming and increase exposure to IP infringement (Chung et al., 2019).

Another limitation of our study is that the data were collected at one point in time; hence, it is impossible to draw causal conclusion or rule out the possibility of reverse causality. Since the results are based on single source survey data, this may cause common method and causal ordering concerns. It proved difficult to avoid the use of perceptual measures as we aimed to study many different organisations simultaneously however, we are aware of the drawbacks of these measures.

Uncovering the underlying mechanisms through which entrepreneurs influence firm performance warrant further research. Our study supports the growing evidence suggesting that in addition to the efforts of the founders, it is their teams that play a pivotal role in the development and performance of start-up firms. This may be particularly pertinent for technology-based firms aiming to create novel products, services or business models where a creative team environment is important for the development of the firm. Future research could refine the conditions under which such creative team activity occurs. For instance, by involving both team members and entrepreneurs in multisource studies over time and by including more objective performance measures related to start-up firms. In addition to these outcomes, future work could also include the use of outcomes in relation to innovation, such as patents or IWB.

Conclusion

The impact of entrepreneurs, and the nature of their new venture teams, on performance are important research areas in entrepreneurship studies. Attention has been afforded to the characteristics of entrepreneurs or on the composition of new venture teams, but less attention has been paid to uncovering the mechanisms that explain how founders guide their teams to achieve favourable business performance. In this study, we hypothesised and found support for the impact of the openness of entrepreneurs on the performance of technology-based new ventures in terms of both profit and competitiveness. Rather than a direct relationship between openness and performance, we show that two team-level outcomes, a creative team environment and innovative work behaviour of employees serve as core-mediating mechanisms through which entrepreneurs shape the performance of technology-based new ventures.

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Appendix

Measure used in the study

Openness to experience (Donnellan et al., 2006).

1. Am the life of the party.
2. Does not talk a lot (R).
3. Talk to a lot of different people at parties.
4. Keep in the background (R).

Creative team environment (Gilson et al., 2005)

1. Team members welcome change.
2. Team members encourage each other to try new things, even though they might not work.
3. Team members are willing to try creative solutions to solve difficult problems.

Innovative work behavior (Janssen, 2000)

1. Creates new ideas for difficult issues.
2. Searches out new working methods, techniques or instruments.
3. Generates original solutions for problems.
4. Mobilizes support for innovative ideas.
5. Acquires approval for innovative ideas.
6. Makes important organizational members enthusiastic for innovative ideas.
7. Transforms innovative ideas into useful applications.
8. Introduces innovative ideas into the work environment in a systematic way.
9. Evaluates the utility of innovative ideas.

Performance (Wang et al., 2003).

1. In comparison to other companies in my industry, the overall profit level of my venture is . . .
2. In comparison to other companies in my industry, the overall competitiveness level of my venture is . . .