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Effectual control orientation and innovation performance: clarifying implications in the corporate context

Sebastian Markus Szambelan · Yi Dragon Jiang

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Abstract This study aims to assess the relationship between effectual control orientation (ECO) and a firm's innovation performance, with entrepreneurial orientation (EO) as a mediator, in a corporate context. Based on data from 157 established corporations in Germany, the findings indicate that ECO has a positive effect on innovation performance. The study also shows that EO's behavioral dimension (i.e., innovation and proactiveness), rather than risk-taking, acts as a mediating mechanism between ECO and innovation performance. The empirical results provide theoretical and managerial implications for innovation, effectuation, and EO literatures.

Keywords Effectual control orientation · Entrepreneurial orientation · Innovation performance · Entrepreneurial behavior

JEL classification D22 · L25 · L26 · O32

1 Introduction

Innovation is key to a firm's competitive advantage (Alexander and van Knippenberg 2014; Arrow 2012; Thornhill 2006; Schumpeter 1934). It represents the creation of new products and services (Nijssen et al. 2006), which are subsequently commercialized through timely market introduction. Companies innovate in order to obtain a competitive advantage in price or value, and ultimately to accomplish superior economic outcomes (Chesbrough 2010; Gatignon and Xuereb 1997; Grinstein 2008; Song et al. 2015; Im and Workman 2004). A substantial amount of research on factors affecting innovation performance has been conducted. This vast literature can be organized along two major categories: the resources-based view (RBV; e.g., Ter et al. 2017), and the knowledge-based view (KBV; e.g., Laursen and Foss 2003; Fosfuri and Tribó 2008; Im and Workman Jr. 2004). According to the RBV, firms' resources, competences, and capabilities influence innovation performance. According to the KBV, on the other hand, different knowledge types that firms acquire influence innovation performance. Both views offer us insights into the factors that can affect a firm's propensity to innovate.

In addition to the aforementioned views, entrepreneurship has long been seen as a key source of innovation (Autio et al. 2014; Story et al. 2014; Arrow 2012; Barringer and Bluedorn 1999; Schumpeter 1934). In particular, entrepreneurial orientation (EO) has been studied as an explanatory variable for innovation performance (Bouncken et al. 2018; Baker et al. 2016; Alegre and Chiva 2013; Pérez-Luño et al. 2011; Maatoofi and Tajeddini 2011). However, the relationship between EO and innovation performance demands further clarification regarding the source of the innovations and the mechanisms linking them to innovation performance (Baker et al. 2016; Harms et al. 2010).

S. M. Szambelan (✉)
ESCP Europe, Heubnerweg 8-10, 14059 Berlin, Germany
e-mail: sszambelan@escpeurope.eu

Y. D. Jiang
ESCP Europe, 79 Avenue de la République, 75011 Paris, France

We argue that this need for further research stems from two key gaps. First, the mostly unidimensional use of EO does not distinguish between its behavioral and attitudinal dimensions (Anderson et al. 2015; Miller 2011). Second, without such a distinction, it is not possible to clearly position EO as a mechanism between the actual source of innovation and innovation performance. This, however, is important, as the distinction between found and created opportunities (i.e., innovation) is highly relevant for entrepreneurship research (Alvarez and Barney 2007). Research on EO, however, focuses only on the exploitation of already identified opportunities. The need for clarity identified here resonates with other calls for research to incorporate opportunity creation concepts, such as effectuation, into the existing EO literature (e.g., Randerson 2016; Welter et al. 2016). Therefore, this study aims to further the comprehension of how EO links effectual control orientation (ECO) as a strategic orientation (Werhahn et al. 2015; Welter et al. 2016) to innovation performance. ECO thereby reflects a firm's mindset toward proactively shaping and designing the external environment, and creating new market demand (Werhahn et al. 2015; Sarasvathy 2001).

To address the study's area of inquiry, we tested EO's behavioral dimension (i.e., innovation, proactiveness) as a mediator between ECO and innovation performance. The research model is assessed through a path analysis based on primary data from 157 established firms in Germany, obtained through online questionnaires. The results show a positive relationship between ECO and innovation performance. Moreover, the data support the hypothesis that EO's entrepreneurial behavior mediates the relationship between ECO and innovation performance. Finally, a management attitude toward risk (MATR) does not show any mediating effect, nor does the data support the positive link to innovation performance.

Our study promises several theoretical contributions to the entrepreneurship and innovation literature. First, based on our results, we build on effectuation theory by proposing ways to further specify the ECO construct in order to measure effectuation in a more parsimonious way (Fisher and Aguinis 2017; Shepherd and Suddaby 2017). In parallel, this is the first time ECO has been introduced as a novel entrepreneurial measure for enabling innovation performance. Second, we dive deeper into understanding the link between EO and innovation performance. Specifically, we show the positive effect of EO's entrepreneurial behavior dimension. Third, we offer new insights into how ECO relates to EO and discuss the theoretical implications for the innovation performance literature (Randerson 2016; Harms et al. 2010). In particular, we show how EO (through its behavioral and risk-taking dimensions) interacts between ECO and innovation performance. We therefore provide a more nuanced picture of the role of entrepreneurship within innovation performance literature. Lastly, by conducting our study in a corporate context, we identify and specify the boundary condition for effectuation theory (Jiang and Tornikoski 2019; Welter and Kim 2018; Arend et al. 2015).

2 Theoretical considerations and hypotheses

It has long been argued that entrepreneurially oriented firms are more likely to engage in new opportunities for innovation, are faster than their competitors, and take on more risk during new venture-creation processes (Pérez-Luño et al. 2011; Lumpkin and Dess 1996; Covin and Slevin 1989, 1991). More recently, researchers have introduced the EO concept to the innovation literature (Arzubiaga et al. 2018; Wang and Juan 2016; Wu et al. 2008). Specifically, studies have found support for a positive relationship between EO and innovation performance (e.g., Baker et al. 2016; Alegre and Chiva 2013). In this context, however, questions have been raised regarding the potential influence of different sources of innovation on that relationship (Baker et al. 2016; Harms et al. 2010). In particular, Baker et al. (2016) have called for further investigation of the influence of whether a firm creates or follows innovation. In a similar vein, Harms et al. (2010) have discussed the potential influence of different decision-making logics (i.e., means vs. goal orientation) on a firm's EO level and its innovation performance. These suggestions also reflect the recent debate in the entrepreneurship literature regarding the importance of the origin of entrepreneurial opportunities (Venkataraman et al. 2012; Alvarez and Barney 2007).

With regard to these suggestions for future research, we argue that the need for further clarification of the link between EO and innovation performance stems from two aspects. First, studies of the effect of EO on innovation performance refer to EO as a unidimensional behavioral construct (Alegre and Chiva 2013; Baker et al. 2016). Recently, however, scholars have raised

concerns about the interpretation of EO. They propose that the EO construct is composed of both behavioral and attitudinal dimensions (Anderson et al. 2015; Covin and Lumpkin 2011; Randerson 2016). Empirical evidence also shows that different dimensions of EO may yield different outcomes in terms of firms' innovativeness (Pérez-Luño et al. 2011). Consequently, in our paper, we take the strength of the two suggested dimensions, and propose that EO comprises two covaried and noninterchangeable dimensions, which are entrepreneurial behavior (i.e., innovation and proactiveness) and MATR (i.e., management attitude toward risk-taking; based on Anderson et al. 2015).

Second, although EO is an important factor for explaining innovation performance, studies do not distinguish where the innovation (i.e., entrepreneurial opportunity) originates. This is somewhat surprising, as recent entrepreneurship literature has argued that whether opportunities are seen as found or made, discovered or created, is important for various reasons, including innovation performance (Alvarez and Barney 2007). For example, in sustaining competitive advantages, effective entrepreneurial actions in a discovery context include "speed, secrecy, and erecting barriers to entry" (Alvarez and Barney 2007, p. 17). In a creation context, on the other hand, effective actions include "tacit learning in path dependent process" (Alvarez and Barney 2007). In fact, the strategic directions that firms take can be thought of as manifestations of the underlying assumption regarding discovering or creating opportunities. It is therefore important to also understand a firm's strategic mindset toward opportunities when assessing EO, which is considered reflective of the subsequent opportunity exploitation perspective (Shane and Venkataraman 2000; Alvarez et al. 2013).

Following this line of argumentation, we suggest incorporating effectuation, as the currently most operationalized opportunity-creation concept (Welter et al. 2016), into the assessment of the relationship between EO and innovation performance. Specifically, we focus on the recently developed concept of a firm's ECO (Werhahn et al. 2015). ECO is defined as a strategic direction that exerts a controlling and shaping influence on an external environment in a co-creative manner. This means, instead of trying to predict the future, ECO proactively shapes and designs the external environment and creates new market demand (Dew et al. 2015; Wiltbank et al. 2006). Moreover, it is considered to encompass the four remaining effectuation orientation dimensions: means orientation, partnership orientation, affordable loss orientation, and contingency orientation (Werhahn et al. 2015).

The inclusion of a firm mindset within the innovation performance literature also resonates well with the recent trend. Following the focus on RBV and KBV, researchers have recently incorporated various mindsets into the context of innovation performance. Such mindsets include, for example, managers' desire to innovate (Andries and Czarnitzki 2014), their commitment to receiving new knowledge (Bettencourt et al. 2017; Martínez-Noya and García-Canal 2016), and their motivation to use different incentives (Yanadori and Cui 2013). Each mindset played a decisive role in a firm's innovation performance. It is therefore reasonable for us to assume that ECO, representing a strategic mindset fostering entrepreneurial behavior (Werhahn et al. 2015), is an important enabler of innovation performance, especially because innovation is considered a key underlying element and outcome of entrepreneurial activities (Autio et al. 2014; Davidsson 2016) within start-ups and established organizations (Guth and Ginsberg 1990; Sharma and Chrisman 1999; Morris et al. 2008). Ultimately, this study argues that ECO is positively associated with innovation performance.

> H1: Effectual control orientation is positively related to a firm's innovation performance

ECO is a strategic mindset reflective of the opportunity-creation perspective (Welter et al. 2016). Firms with this mindset aim to control the external environment and co-create new entrepreneurial opportunities (Werhahn et al. 2015; Wiltbank et al. 2006). As ECO also fosters entrepreneurial behavior (Werhahn et al. 2015), it is reasonable to assume that it is positively associated with the timely introduction of new products or services ahead of competition (Covin and Slevin 1991). Consequently, we assume a positive relationship between ECO and EO's entrepreneurial behavior, which encompasses innovation and proactiveness (Anderson et al. 2015).

When it comes to EO's risk-taking dimension (i.e., MATR; based on Anderson et al. 2015), we hypothesize a reverse effect. Specifically, ECO builds on the notion of keeping risk under one's control. This notion can be best explained using the idea of "affordable loss," which is part of effectuation's original dimensions (Sarasvathy 2001). Affordable loss on a corporate level can be

understood through behaviors like limiting a firm's investment risks in order not to ruin the company, stopping projects early on to minimize losses, and considering worst-case scenarios (Werhahn et al. 2015). With such a mindset, firms would accept only certain levels of risk and focus more on shaping the environment, or the market, themselves (Blekman 2011). The control aspect of ECO, therefore, seems to oppose the risk-taking attitude dimension of EO, which reflects bold and high-risk endeavors (Covin and Slevin 1989).

Consequently, we hypothesize a positive relationship between ECO and EO's entrepreneurial behavior, and a negative relationship between ECO and EO's MATR.

> H2: Effectual control orientation is (a) positively related to EO's entrepreneurial behavior and (b) negatively related to EO's MATR

When looking at EO, abundant empirical research shows EO's positive impact on a firm's financial performance (Rauch et al. 2009), and more specifically innovation performance (Baker et al. 2016; Alegre and Chiva 2013; Madhoushi et al. 2011). Generally, innovation plays a central role in the definition of EO (Miller 1983), and therefore innovation performance should be considered a key outcome. Alegre and Chiva (2013), for instance, argue that innovation is a key indicator of entrepreneurial activities, and is therefore a more direct consequence of EO than is the overall firm performance. Consequently, this study hypothesizes that both underlying EO dimensions, entrepreneurial behavior and MATR (Anderson et al. 2015), have a positive impact on a firm's innovation performance.

> H3: Entrepreneurial orientation, through its two underlying dimensions, (a) entrepreneurial behavior and (b) MATR, is positively related to a firm's innovation performance

As the previous hypotheses have established separate theoretical links from ECO and EO to innovation performance, the fourth hypothesis aims to address the interrelation between those relationships. Specifically, it aims to assess EO's behavioral dimension as a mediating mechanism explaining how ECO links to innovation performance.

The ECO construct informs us about a specific mindset, adopted by a firm's management and employees, toward shaping the environment in which a firm operates (Werhahn et al. 2015; Wiltbank et al. 2006). EO's entrepreneurial behavior dimension, on the other hand, assesses self-reported past behavior (Anderson et al. 2015). It therefore informs us about how firms effectively interpret strategic directions and translate them into entrepreneurial behavior (i.e., proactive introduction of new products or services; Covin and Slevin 1991). Therefore, we expect EO to be an important mechanism mediating the relationship between ECO as a strategic direction and innovation performance as its ultimate outcome. Consequently, we hypothesize that EO's entrepreneurial behavior dimension positively mediates the link between ECO and innovation performance.

> H4: EO's entrepreneurial behavior dimension positively mediates the relationship between ECO and innovation performance

When it comes to EO's risk-taking dimension, it is not possible to theoretically derive a mediation effect. We argue that ECO should have a negative effect on EO's risk-taking dimension (hypothesis H2), but at the same time, previous studies have indicated a positive effect of EO's risk-taking dimension on innovation performance (hypothesis H3). As it is not possible to argue which effect outweighs the other, we cannot assume any mediation effect.

3 Data

3.1 Sample

Data were collected by means of an online questionnaire sent to German corporations, resulting in 164 complete responses. Firm contacts were sourced from the ORBIS database with a focus on relevant industries for innovation research according to the Organisation for Economic Co-operation and Development (OECD 2005). The survey was addressed to members of management, who were asked to answer all items from a firm-level perspective. The survey was active between August and November 2016 and two reminders were sent out. During data analysis, seven responses were removed because respondents' positions were not appropriate for assessing firm-level constructs. Responses were considered only if the respondent held one or more of the following positions: owner, supervisory board member,

Table 1 Industry distribution of the final sample

Industry aggregation (ISIC Rev.4/NACE Rev.2)		Final sample ($N = 157$)	Database sample ($N = 50{,}378$)
2	Manufacturing and other industry	25%	23%
3	Construction	7%	7%
4	Wholesale and retail trade, transportation and storage, Accommodation and food service activities	28%	37%
5	Information and communication	8%	5%
6	Financial and insurance activities	4%	5%
7	Real estate activities	0%	1%
8	Professional, scientific, technical, administration and support service activities services	20%	18%
10	Other services	7%	3%

Industry group 1 (Agriculture, Forestry, and Fishing) and group 9 (Public Administration and Social activities) were not considered in the sample

management team member, or key shareholder.[1] Moreover, the focus was set on established companies founded in 2010 or earlier, in line with thresholds used in previous research (Chandler et al. 2011; Cai et al. 2016). The focus was also on established corporations from industries with frequent innovations, as only those organizations experience the need to reinvent themselves within their already well-defined organizational boundaries. The final sample contained 157 responses, each from a different firm.

Firms were between 6 and 339 years of age with a mean of 52. In addition, the number of employees ranged from 1 to 150,000 with a mean of 1251. Annual revenues spanned from EUR0.1 million to EUR27 billion with a mean of EUR251 million. Overall, the sample showed an even distribution across small, medium, and large firms, and an industry distribution that is representative of the large population of the database (see Table 1). Respondents were mainly male (85%) and between 28 and 75 years of age with an average of 52. This is in line with the database gender distribution (82% male) and the average age of a management member in Germany (52 years; statista 2016). Finally, the positions represented in the sample were 56% CEOs, 33% management members, 8% owners, 2% key shareholders, and 1% supervisory board members.

[1] Shareholders only include respondents who were listed as management contacts in the firm database and who have a firm-specific email address. Therefore, it is considered that these shareholders are key shareholders with influence on the organization.

3.2 Measurements

Effectual control orientation The ECO scale was taken from the effectuation orientation construct developed by Werhahn et al. (2015) (see Appendix). Respondents were asked to assess four items on a seven-point Likert scale referring to the importance of certain beliefs based on the last 3 years. The exploratory factor analyses (EFA) resulted in a one-factor solution explaining 49% of the total variance (Kaiser 1974). The factor included all items with loadings between .57 and .87, a Cronbach's alpha of .78, and an acceptable Kaiser-Meyer-Olkin value (KMO) of .64. The confirmatory factor analyses (CFA) also showed an acceptable fit (χ^2 / df = 3.36; goodness-of-fit index [GFI] = .99; adjusted GFI [AGFI] = .90; comparative fit index [CFI] = .99; standardized root mean square residual [SRMR] = .03; root mean square error of approximation [RMSEA] = .12 with $p = .12$) (see Table 2). Consequently, the ECO factor was computed as the average of the four items.

Entrepreneurial orientation Each of the three original EO dimensions was measured through three items on a seven-point Likert scale and referred to the last 3 years. The items were taken from the commonly used scale developed by Covin and Slevin (1989) (see Appendix). To check for the reliability and validity of the scales, EFA and CFA were conducted, as suggested by Tang et al. (2007). The EFA resulted in a two-factor solution explaining 51% of the total variance (Kaiser 1974). The first factor included all innovation and proactiveness

Table 2 EFA and CFA results for constructs used

	EFA		CFA						
	Explained variance	Cron-bach α	χ2 / df	GFI	AGFI	CFI	SRMR	RMSEA	RMSEA*p* value
Effectual control orientation	.49	.78	3.36	.99	.90	.99	.03	.12	.12
Entrepreneurial behavior	.47	.84	2.03	.97	.92	.98	.04	.08	.17
MATR	.56	.78	.00	1.00	1.00	1.00	.00	.00	N/A
Innovation performance	.73	.89	.00	1.00	1.00	1.00	.00	.00	N/A
Uncertainty	.47	.77	2.52	.98	.92	.98	.03	.10	.16
Total model (5 factors)	.56	N/A	1.55	.88	.84	.93	.06	.06	.14

MATR, management attitude toward risk

items with loadings between .60 and .74, while the second factor included all risk-taking items with factor loadings between .55 and .82. Going forward, the first factor is called entrepreneurial behavior and the second factor MATR (Anderson et al. 2015). Both factors show acceptable Cronbach's alpha values of .84 and .78 as well as KMO values of .85 and .67, respectively (see Table 2). Moreover, the CFA of the two-factor solution shows a good fit (χ^2 / df = 1.65; GFI = .95; AGFI = .90; CFI = .97; SRMR = .05; RMSEA = .07). To validate the choice of a two-factor model, a unidimensional model was computed for comparison. One factor explains only 38% of the total variance with partially lower factor loadings between .40 and .74 and a Cronbach's alpha of .84. The CFA further indicates a worse model fit than the two-factor solution (χ^2 / df = 2.29; GFI = .93; AGFI = .86; CFI = .94; SRMR = .07; RMSEA = .09). Further analyses use entrepreneurial behavior and MATR as the average of their underlying items.

Innovation performance To measure innovation performance, the scale from Im and Workman (2004) was used (see Appendix). These authors assessed the success of newly developed products along the dimensions of market share, profitability, and sales. In order for the scale to match the requirements of the underlying analysis, the items were moved from a single product level to a general performance assessment of newly developed products and services within the past 3 years. Ultimately, firms were asked to assess their performance with newly developed products and compare it to their biggest competitor along three items (market share, sales, and profitability) on a seven-point Likert scale. Even though each item measures different financial indicators, they are strongly interlinked. This can be seen through the variable's high share of commonly explained variance (73%), its high Cronbach's alpha of .89, and a KMO value of .74. For the following analyses, the average of the three items is used as the innovation performance variable. The use of self-reported financial performance measures is common for the assessment of EO consequences (Rauch et al. 2009). However, instead of an overall firm performance indicator, this study applied a financial indicator more closely linked to innovation. As established firms' mature product lines often account for major proportions of their revenue, they might dilute the effect of EO in smaller revenue streams from innovations. Since effectuation and EO specifically address those innovations, the innovation performance measure is considered more relevant for assessing their direct effects. Since secondary data on such specific parts of a firm's performance were not available, relative self-reported performance measures were used, as suggested by Dess and Robinson (1984).

Control variables For better interpretation of results, several variables were controlled for. First, the level of perceived uncertainty was included, as it is acknowledged to be relevant for the application of effectuation (e.g., Sarasvathy and Kotha 2001; Sarasvathy 2001). To measure uncertainty, the scale from Chandler et al. (2011) was used. It is a four-item scale that reflects difficulties in decision-making due to the uncertainty of the external environment. Each item was assessed along a five-point Likert scale. This is in contrast to the originally used seven-point Likert scale, the aim being to counteract potential common method bias (see next section). Ultimately, the uncertainty variable was computed as the average of the four items, which shows an

acceptable fit (Table 2). Moreover, industry, firm age, and firm size (number of employees) were included as control variables based on prior EO research (e.g., Wiklund and Shepherd 2005). Firm size and age show a normal distribution according to the Shapiro-Wilk test ($p < .001$); one missing firm age value was replaced by the mean of the sample. However, some outliers in the sample make it difficult to interpret the firm size variable (mean = 1251; median = 50; s.d. = 11,980) and firm age variable (mean = 52; median = 34; s.d. = 48). In order to manage the outliers, both variables were transformed through a natural logarithmic function.[2]

Overall EFA and CFA In order to avoid any cross-loadings between factors, an additional EFA was conducted with all latent variables. The results show a five-factor solution (Kaiser 1974) in which all items load onto their respective constructs (see Table 3) and explain 56% of the total variance. Furthermore, interfactor correlations range from .02 to .40 (see Table 4), which is another indicator of the discriminant validity of the constructs. Finally, the KMO value (.76) and the CFA (χ^2 / df = 1.55; GFI = .88; AGFI = .84; CFI = .93; SRMR = .06; RMSEA = .06) show an acceptable fit.

3.3 Common method bias

As data collection was based on single respondents, several procedural remedies were put in place in order to counteract potential common method bias. These measures were taken from suggestions made by Podsakoff et al. (2003). First, the survey offered complete anonymity, which was clearly communicated to all participants. Second, different scales were used in order to reduce the level of response automation. Third, the independent and dependent variables were not presented in proximate consecutive order. Fourth, after each section in the online survey, there was no possibility of returning to previous sections for comparison or changes. Finally, several pretests were conducted with academics and practitioners to validate the ease and clarity of the survey and its underlying items.

As well as the ex-ante procedural measures, post hoc statistical remedies were used to assess potential common method bias, as proposed by Podsakoff et al. (2003). First, a Harman's single factor test was conducted through EFA. As uncertainty has a potentially inverse social desirability, tests were conducted once with and once without the inclusion of uncertainty. A single factor accounted for only 23% of the variance including the uncertainty construct and 28% of the variance excluding uncertainty. Second, a common latent factor was computed, which identified 4% common variance including the uncertainty construct and 44% excluding uncertainty. All values are below the suggested threshold of 50% (Fuller et al. 2016). Hence, common method bias does not seem to be an issue in this sample.

3.4 Descriptive statistics

The descriptive statistics and the correlation matrix are delineated in Table 4. The correlation matrix shows highly significant positive correlations between ECO and both EO factors ($p < .001$). Also, correlations among entrepreneurial behavior, ECO, and innovation performance indicate significant positive relationships ($p < .001$). MATR, however, does not show a significant correlation with innovation performance.

4 Empirical results

4.1 Data analysis

To test the model depicted in Fig. 1, a path analysis with SPSS AMOS 23 was conducted. To check for the applicability of the method, first a curve estimation for all paths was conducted. Most paths showed a sufficiently linear relationship. Only the path from MATR to innovation performance showed no significant linearity, as there is no significant relationship in the first place. Second, the independent and mediating variables were assessed for multicollinearity. As all VIF values are below 1.29, multicollinearity is not an issue.

The path analysis included several steps for the mediation assessment in accordance with Preacher and Hayes (2008). First, all direct effects of the research model were assessed separately. Second, the direct and indirect effects of the total model were computed. This was done through the recommended bootstrapping approach with 5000 samples and a bias-corrected confidence level of 95% (Preacher and Hayes 2008). Finally, the direct and specific indirect effects were assessed

[2] For validation purposes, all analyses were also conducted with a reduced data sample, which excluded companies with revenues above EUR500 million, more than 2000 employees, and a founding year more than 200 years ago. All results remained stable.

Table 3 Discriminant validity test (EFA)

	Factor loadings					
	1	2	3	4	5	Com.
Effectual control orientation	*.99*	− .17	− .01	.07	.06	.92
Effectual control orientation	*.71*	− .03	.03	− .03	.05	.49
Effectual control orientation	*.52*	.20	.09	− .08	− .13	.44
Effectual control orientation	*.44*	.34	− .07	.01	− .10	.41
Entrepreneurial behavior (EO Inno.)	− .09	*.74*	.10	− .03	.00	.55
Entrepreneurial behavior (EO Inno.)	− .01	*.60*	.15	− .03	− .02	.44
Entrepreneurial behavior (EO Inno.)	− .06	*.58*	.01	.10	− .07	.39
Entrepreneurial behavior (EO ProAct.)	.05	*.75*	− .19	.08	.03	.55
Entrepreneurial behavior (EO ProAct.)	.03	*.75*	.04	− .08	.05	.55
Entrepreneurial behavior (EO ProAct.)	− .01	*.69*	− .04	.04	.08	.48
MATR (EO RiskTak.)	.01	− .12	*.83*	.01	− .04	.64
MATR (EO RiskTak.)	.00	.07	*.81*	.05	− .01	.73
MATR (EO RiskTak.)	.04	.16	*.51*	− .04	.12	.37
Innovation performance	− .01	.00	.01	*.91*	.05	.81
Innovation performance	− .06	.04	− .01	*.84*	.01	.72
Innovation performance	.07	.01	.03	*.80*	− .07	.70
Uncertainty	.06	− .03	.01	.03	*.86*	.73
Uncertainty	− .04	.07	.10	.04	*.63*	.40
Uncertainty	.00	.12	− .12	− .02	*.63*	.41
Uncertainty	.00	− .09	.03	− .06	*.61*	.41

Italic: Highest factor loadings

Principal axis factoring with a promax rotation was used; Com., communalities; MATR, management attitude toward risk

separately for each mediator. This was done by computing the total model without one of the two mediators.

In all models, the control variables—firm age, firm size, industry classification, and level of uncertainty—were included and correlated with all endogenous variables. In addition, the error terms of the two mediators were covaried as they were modeled on the same level of analysis (i.e., mediators) and were based on items from the same scale (Preacher and Hayes 2008; Reddy 1992). The total model shows a good fit (χ^2 / df = 1.59; GFI = .96; AGFI = .87; CFI = .91; SRMR = .05; RMSEA = .06 with p = .26).

Table 4 Descriptive statistics and correlation matrix

		Mean	S.D.	1	2	3	4	5	6	7
1	Effectual control orientation	5.21	1.16	1						
2	Entrepreneurial behavior	3.75	1.32	.36***	1					
3	MATR	2.65	1.29	.29***	.40***	1				
4	Innovation performance	4.37	1.20	.25**	.40***	.09	1			
5	Uncertainty	2.70	.87	− .11	− .04	− .02	− .10	1		
6	Ln (firm age)	3.60	.87	.06	− .11	.02	− .09	.03	1	
7	Ln (firm size)	4.09	1.80	.15	.13	.08	.03	− .09	.39***	1

Pearson correlations are reported (two-tailed test); MATR, Mgmt. attitude toward risk

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

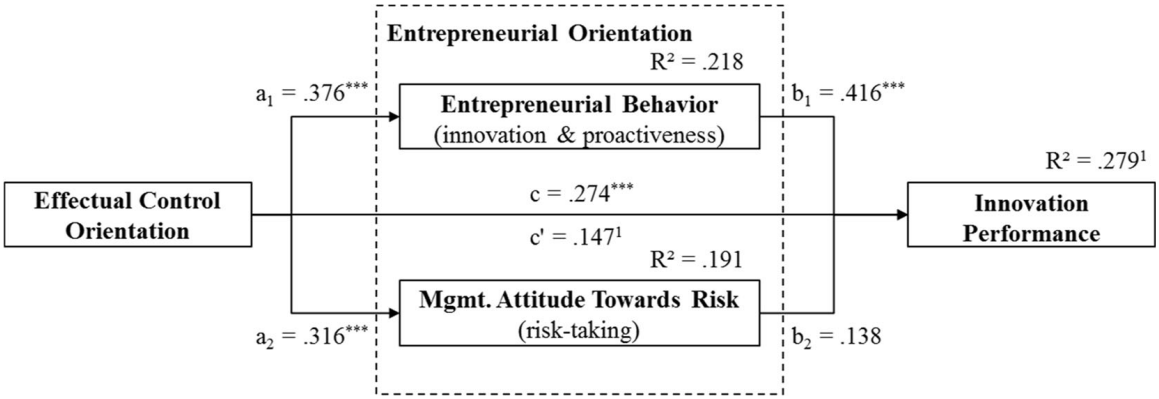

Fig. 1 Proposed research model. Controls: industry, LN (firm size), LN (firm age), Uncertainty. Standardized regression coefficients with $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$ (see detailed results in Table 5). [1]Based on the total model with both EO factors included as mediators

4.2 Results

ECO and innovation performance (H1) A significant positive link between ECO and innovation performance was found ($\beta = .274$, $p = .000$), and is described in Table 5. This means that ECO is positively related to the firm's innovation performance. The squared multiple correlation of innovation performance is .171. Therefore, 14.7% of the innovation performance variance can be explained through the underlying model. Overall, the data support hypothesis H1.

Effectual control orientation and EO (H2) Significant positive relationships were found between ECO and the entrepreneurial behavior dimension of EO (H2a $\beta = .376$, $p = .000$), as well as EO MATR (H2b $\beta = .316$, $p = .000$). ECO explained 21.8% and 19.1% of the variance, respectively. Therefore, the data support hypothesis H2a. Hypothesis H2b, on the other hand, is not supported as it shows a counterintuitive positive relationship between ECO and MATR.

EO and innovation performance (H3) A positive significant relationship between the entrepreneurial behavior and innovation performance dimensions of EO was found (H3a $\beta = .416$, $p = .000$), explaining 26.1% of the total variance. However, no significant relationship was found between EO MATR and innovation performance (H3b $\beta = .138$, $p = .066$). Analyses were also conducted for potential curvilinear relationships, which were also not significant. Therefore, the data support hypothesis H3a, but do not support hypothesis H3b.

Entrepreneurial behavior as a mediator (H4) The final analysis assessed EO's entrepreneurial behavior dimension as a mediator between ECO and innovation performance.[3] As the direct effect between ECO and innovation performance has already been tested as positive (see H1), the indirect effect through EO's behavioral dimension needed to be assessed to test for any mediation effect (Preacher and Hayes 2008). A significant positive mediation effect was found (H4a $\beta = .138$, $p = .000$) with the direct effect falling into insignificance ($\beta = .136$, $p = .101$). Therefore, the data support hypothesis H4 and indicate that the entrepreneurial behavior dimension of EO mediates the relationship between ECO and innovation performance.

Though not part of the hypothesis, we also tested the mediation effect of the second EO dimension (i.e., MATR). The data does not show any significant indirect effect (H4b $\beta = .018$, $p = .474$). The reason for the missing mediation effect seems to be the insignificant relationship between MATR and innovation performance (see hypothesis H3b).

5 Theoretical considerations

The findings above suggest that ECO might be an important construct in the study of innovation within firms. ECO is a new construct that we are the first to investigate empirically. Before discussing contributions

[3] Even though this study argues in favor of control orientation as the key effectual dimension, a total model with all five effectuation orientation dimensions was also computed. Results show that EO does not significantly mediate the relationship between the other four effectuation orientation dimensions and innovation performance.

Table 5 Results of the multiple mediator model analysis

	Direct effect	Indirect effect	Total effect	R^2
ECO ➔ IP	.274*** [.125;.426]	n/a	.274*** [.125;.426]	.171
ECO ➔ EB	.376*** [.226;.506]	n/a	.376*** [.226;.506]	.218
ECO ➔ MATR	.316*** [.186;.433]	n/a	.316*** [.186;.433]	.191
EB ➔ IP	.416*** [.272;.547]	n/a	.416*** [.272;.547]	.262
MATR ➔ IP	.138 [− .044;.310]	n/a	.138 [− .044;.310]	.118
ECO ➔ EB ➔ IP	.136 [− .029;.296]	.138*** [.071;.237]	.274** [.125;.426]	.277
ECO ➔ MATR ➔ IP	.255** [.089;.418]	.018 [−.034;.091]	.274** [.125;.426]	.174
ECO ➔ EB & MATR ➔ IP	.147 [− .023;.309]	.127** [.048;.230]	.274** [.125;.426]	.279

Standardized regression weights [biased corrected 95% confidence interval] reported

Bootstrapping (5000 samples and a 95% biased corrected (BC) confidence level)

ECO effectual control orientation, *EB* entrepreneurial behavior, *MATR* Mgmt. attitude toward risk, *IP* innovation performance, *SMC of DV* squared multiple correlation of the dependent variable

Control variables included: Industry, LN (firm age), LN (firm size), Uncertainty

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

to extant literature, we first present a theoretical extension that builds on the findings above and offers additional insights for deepening the ECO construct. We undertake this task based on guidelines from Shepherd and Suddaby (2017), Cornelissen and Durand (2014), and Fisher and Aguinis (2017). Specifically, we aim to sharpen the definition of ECO, while discussing potential extensions of the construct's items. Then, building on the elaborated definition, we derive propositions of potential relationships between ECO and other constructs for future research. In this section, we will discuss implications of both our empirical findings and the new theory extension.

We start with defining the term. Following Werhahn et al. (2015), we define ECO as a strategic direction that motivates the company and its employees to exert a controlling or shaping influence on their firm's environment. In the empirical study above, we measured ECO through a four-item construct focusing on a firm's willingness to shape the future environment, to proactively design the environment with others, to co-create future markets, and to influence trends. These items, loading on a single factor, reflect the firms' mindset and relate to how firms exert control to successfully cope with new or unknown challenges.

In many ways, the ECO construct advances our understanding about effectuation. First, instead of measuring effectuation through five dimensions, ECO captures the core of effectuation with one dimension. This one dimension covers the most important premises upon which effectuation is built. It captures the mindset of a firm attempting to control its external environment by co-creating and influencing the future (Read and Sarasvathy 2012) in a context of uncertainty (Sarasvathy and Kotha 2001). In doing so, ECO increases the level of complexity through abstraction (Shepherd and Suddaby 2017). Second, the orientation perspective in ECO translates effectuation from an individual-level into a firm-level construct. In other words, this is a rudimentary step toward achieving theoretical parsimony while empirically operationalizing effectuation at different levels of analysis (Eisenhardt 1989; Fisher and Aguinis 2017).

Although ECO allows measures to move up the ladder of complexity and extends the levels of analysis, the construct currently conflates mindset and action. Conceptual and empirical developments, however, show that mindset and action are both important aspects of effectuation. Building upon the seminal work of Sarasvathy (2001), under the umbrella of controlling instead of predicting the future mindset, entrepreneurs who use effectuation employ concrete actions such as, for instance, creating alliances, leveraging contingencies, or reformulating goals. Furthermore, empirical evidence has repeatedly shown that firms that have an effectual mindset can also take actions belonging to a causal logic, and vice versa. For instance, findings by Reymen et al. (2015) and Jiang and Rüling (2017) illustrate that firms attempting to shape and control the external environment through co-creation may also

Table 6 Effectual/causal mindset and action matrix

		Effectual action - *Create alliance* - *Embrace contingency* - *Use available means*	Causal action - *Competitive analysis* - *Avoid contingency* - *Predetermined goals*
Effectual mindset	- *Control future* - *Affordable loss*	e.g., partnering with self-selected stakeholders to create a new opportunity	e.g., using a business plan to communicate with others for creating a new opportunity
Causal mindset	- *Predict future* - *Expected return*	e.g., partnering with self-selected stakeholders to follow a goal derived from predictions	e.g., using a business plan to raise money to follow a goal derived from predictions

Italic: Exemplary mindsets and actions

employ competitive analyses, which are considered causal actions.

Consequently, by unpacking mindset and action, we can begin theorizing about measurable ways to mix and match causation and effectuation. In Table 6, we illustrate how mindset and action can lead to theoretically interesting yet empirically measurable combinations of causation and effectuation in entrepreneurship. It seems that we can provide a fuller understanding of the current measure of ECO if we add control-based action items to the current mindset items that comprise ECO. Doing so will also potentially enhance the validity of ECO and clarify of the scope of the construct (Bacharach 1989). We next propose concrete ways to refine it.

- First, we propose that the ECO mindset dimension should not only reflect the original effectual control aspect, but also include items embracing affordable loss, as the remaining mindset-based dimension not currently reflected in the set of ECO items. In doing so, the additional ECO item should be phrased from a control perspective. For example, "We attempt to control our downside by investing no more than we are willing and able to lose."
- Second, we propose that the remaining action-based effectuation principles can also be formulated with a control focus. Examples include: measuring means-driven action as seeking to separate what is within one's control from what is not; measuring partnerships in terms of commitments that bring new means within one's control and offer ways to co-create and shape the environment; and leveraging contingencies as ways to control the future in creative and resilient ways.
- Third, given a larger set of measures tightly wound around control, we can measure actions that are not only effectual, but can also mix and match causal and effectual actions in useful ways. For example, additional causal action items could be: we wrote business plans in order to co-create with investors or to enable key employees to self-select into the venture; we targeted particular suppliers/stakeholders who could help shape the market.

Developing a fuller theoretical model of ECO would take us beyond the scope of the current study. However, given our insights above, we envision multiple ways to deepen this construct in future research. We could begin by identifying specific relationships within the ECO construct and between ECO and other relevant constructs. More specifically, scholars might further examine multilevel interactions such as between individual- and firm-level ECO constructs. For example, it would be interesting to examine the relationship between managers' ECO mindset and the firm-level ECO actions over time. It is particularly interesting to look at the mechanisms through which firm-level mindset and action are shaped. This would enhance our theoretical understanding of effectuation theory at different levels of analysis, and consequently provide more accurate empirical explanations of effectuation.

Also, instead of looking at whether and how effectual and causal *behaviors* are complementary, future research could look at the circumstances under which firms explicitly or implicitly mix an effectual mindset

with effectual or causal actions. This can be done based on the extended conceptualization of the ECO construct. Future research can also focus on understanding whether effectual and causal *mindsets* can coexist or transit following temporal sequences. This would provide more nuanced insights into the discussion of the relationship between effectuation and causation as independent (Brettel et al. 2012; Corner and Ho 2010; Perry et al. 2012) or inclusive behaviors (Dew et al. 2009a; Fisher 2012; Sarasvathy and Dew 2008).

Lastly, we encourage future research to examine the relationship between ECO and uncertainty. Uncertainty is considered the boundary condition under which effectuation applies. Recently, however, some scholars have identified the need to broaden the boundary condition of effectuation theory (Welter and Kim 2018; Jiang and Tornikoski 2019). A way to further understand the boundary condition of the theory could be to look at how the mindset and action dimensions of the ECO constructs relate to uncertainty. For instance, uncertainty could be associated with the ECO's mindset dimension rather than the action dimension. Inductive qualitative research could also re-examine the boundary conditions for both mindset and action.

In sum, we believe that the clear separation of effectual control mindset and actions that implement that mindset will strengthen ECO's construct clarity, enabling future researchers to investigate more nuanced dynamics across different concepts (e.g., causation) and to position effectuation more prominently within the corporate entrepreneurship literature.

6 Discussion

Our study investigated how ECO and EO interact with innovation performance. Results show that ECO is highly relevant for studying innovation performance in a corporate context. The study further emphasizes that the behavioral dimension of EO plays a significant role in the relationship between ECO and innovation performance. EO's risk-taking dimension, on the other hand, does not have a mediating effect. In addition to contributions to effectuation research elaborated in the previous section, these results also offer four new insights into both entrepreneurship and innovation literatures.

First, our study dives deeper into the relationship between entrepreneurship and innovation. The results imply that innovation performance is explained not only by factors related to firms' resources (RBV) or knowledge (KBV), but also by firms' strategic mindsets. Anchoring with other papers that have incorporated mindsets into the innovation performance literature (e.g., Andries and Czarnitzki 2014; Yanadori and Cui 2013), our study aligns with the current development trend and provides a more nuanced picture of how and why firms can obtain a competitive advantage.

Second, we contribute to the literature around EO, which in the context of innovation performance has so far been treated as a unidimensional construct (Rauch et al. 2009). In our study, we measure EO through the entrepreneurial behavior dimension and also the MATR dimension (based on Anderson et al. 2015). Interestingly, our findings show that the two dimensions have different effects on a firm's innovation performance. While one of the EO dimensions, entrepreneurial behavior, is positively related to innovation performance, MATR has no significant relationship to innovation performance. This is in line with some of the extant studies, in which findings report weaker performance effects for the risk-taking dimension of EO (Kreiser et al. 2013; Anderson et al. 2015). Further, it raises the question of why risk-taking would lead to superior innovation performance. When placing high bets, there is always a good chance of being wrong. Consequently, our results provide evidence that treating EO as a unidimensional behavioral construct might dilute the different dynamics of EO's underlying dimensions (Anderson et al. 2015; Miller 2011), providing a more nuanced assessment of EO's mechanisms with regard to relevant dependent variables.

Third, we explicitly link ECO to EO by positioning EO's entrepreneurial behavior as a mediator between ECO and innovation performance. Results show that the hypothesis holds true for EO's entrepreneurial behavior dimension, as it significantly mediates the link between ECO and innovation performance. Therefore, this study suggests that firms that focus on effectual control achieve superior innovation performance via entrepreneurial behavior (i.e., innovation and proactiveness). EO's risk-taking dimension, however, does not show any mediating effect, as we have also suggested. However,

the separate direct effects between the three constructs reveal interesting aspects for discussion. Contrary to our initial hypothesis, results show a positive relationship between ECO and MATR. This means that although ECO firms focus on what is controllable rather than placing uncontrollable bets on potentially high returns (Kuechle et al. 2016; Dew et al. 2009b), managers nevertheless report taking higher risks. This raises the question of whether MATR reflects an actual attitude or is solely a subjective perception. Scholars have argued that the subjective contextualization of uncertainty indicates that risk and uncertainty may not be clearly differentiated by decision makers (Cohen et al. 1987). This implies that managers might generally understand decision-making as a matter of intuition, understanding, or gut feeling, and subsequently associate control under uncertainty with taking higher risk (Packard 2017). It would be interesting for future studies to compare the MATR measure with an objective behavioral measure of risk-taking. The aforementioned missing link between MATR and innovation performance further highlights the need for a more nuanced assessment of the benefits of risk-taking behavior.

Finally, overall, our research identifies and empirically specifies boundary conditions for effectuation. Over decades, uncertainty has been most commonly considered the boundary condition under which effectuation theory is applicable (e.g., Reymen et al. 2015; Fisher 2012). More recently, scholars have called for specifying and expanding the boundary conditions of effectuation theory from uncertainty to unexpected events (Jiang and Tornikoski 2019) and to risk-taking behavior (Welter and Kim 2018). By linking ECO to innovation literature through EO, we provide a more refined explanation of the implications of effectuation theory, and at the same time empirically specify the boundary conditions under which effectuation is applicable. Our empirical setting illustrates that effectuation theory can be applied beyond the context of new ventures and can also encompass more established organizations as long as the organizations adopt entrepreneurial behavior toward innovation and proactiveness.

Several practical implications can be derived. So far, EO has been discussed as being key to improved firm performance (Rauch et al. 2009). Practitioners have learned that they should create innovative products, be faster than competitors, and take risks. Such recommendations, however, are difficult to transfer into actionable measures. The inclusion of ECO allows for more fine-grained recommendations on how to foster innovation performance. For example, management members may aim not only to improve current product/service portfolios or to introduce new ways to cater for given market demands, but also to face an uncertain future by co-creating new markets and products in collaboration with other market players. Such a mindset should be clearly communicated to employees to enable them to adjust their behavior accordingly. Second, this paper considers the allowance for risky actions as distinct from entrepreneurial behavior. Although ECO is associated with such a risk-taking mindset, it has no positive effect on innovation performance. Management teams should therefore seek to distinguish entrepreneurial mindset and behavior from highly risk-taking mindset and behaviors. It is not the risk-taking that enables superior innovation performance, but the right mindset and subsequent actions.

7 Limitations

As with any research project, this paper is subject to certain limitations, which could be addressed by future research. First, the data were based on a sample of established firms in Germany. Due to potential cultural differences in the interpretation of innovation, risk, and control, these results might differ in other cultures. Even though EO has already been studied globally (Rauch et al. 2009), the new interpretation of its dimensions reflects a major shift that needs to be reproduced. Second, it would be interesting to validate the direction and strength of the tested causal links by leveraging panel data or experimental research designs. Moreover, a data set involving several informants from different levels might add further insights to the discussion and mitigate potential effects of the single respondent method. Third, the study could be reproduced with an even larger sample size, potentially serving to control for a larger number of firm characteristics. For instance, this study shows a high variance in control variables (e.g., firm size and revenue), which could be avoided with a larger sample size and the subsequent division in different firm-size categories (i.e., small, medium, large). Fourth, even though

subjective performance measures can be used in social science research, the inclusion of objective performance measures might strengthen the proposed and tested relationships. In particular, such measures would eliminate potential social desirability biases and provide clear reference periods. Fifth, as the sample size shows high variances in firm characteristics, such as firm size, age, and revenue, the implications should be generalized very carefully. Future research could attempt to assess different dynamics across different firms. For instance, ECO might impact larger corporations differently than smaller firms, which are easier to address holistically. Finally, we would like to reiterate the need to develop a richer and more nuanced understanding of ECO as a key construct in effectuation with deep implications for entrepreneurship and innovation.

8 Conclusion

This paper introduces ECO as a novel way to explain innovation performance. Based on a sample of 157 established organizations, we link ECO and innovation performance by positioning EO's behavioral dimension as a mediator of the two constructs. Results show that ECO is positively associated with innovation performance and that this relationship is mediated through EO's entrepreneurial behavior. Overall, this study contributes to the innovation as well as the entrepreneurship literature. It introduces ECO as a novel antecedent of innovation performance, identifies entrepreneurial behavior as the mechanism underlying that relationship, and simplifies the effectuation concept in a corporate context by positioning ECO as the key effectual notion.

Appendix

Variables	Items	Questions
		Please indicate the extent to which you agree or disagree with the following statements with regard to the last 3 years: As the managers of this company, we consider it important that both we ourselves and our employees…
Effectual control Orientation	Item 1	…attempt to shape the environment we operate in.
	Item 2	…attempt to proactively design our environment with others.
	Item 3	…attempt to co-create future markets.
	Item 4	…attempt to influence trends.
		Please evaluate the degree to which the following statements describe your firm over the last 3 years:
Entrepreneurial behavior (EO Innovation)	Item 1	In general, our top management team favors a strong emphasis on research & development, technological leadership, and innovations
	Item 2	In the past 3 years, our organization has marketed a wide variety of new lines of products or services.
	Item 3	In the past 3 years, changes in our products or service lines have been mostly of a major nature.
Entrepreneurial behavior (EO proactiveness)	Item 4	Our organization typically initiates actions to which our competitors have to respond.
	Item 5	Our organization typically adopts a very competitive posture aiming at overtaking the competitors.
	Item 6	Our organization is very often the first business to introduce new products/services, administrative techniques, operating technologies, etc.

Variables	Items	Questions
Mgmt. attitude toward risk (EO risk taking)	Item 1	Our top management team has a strong propensity for high-risk projects (with chances of very high return).
	Item 2	Our top management team believes that owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve our organization's objectives.
	Item 3	When there is uncertainty, our organization typically adopts a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities.
		Please evaluate your firm's success in developing new products or services in comparison to your biggest competitors over the last 3 years:
Innovation performance	Item 1	Sales development of newly developed products/services.
	Item 2	Profitability of newly developed products/services.
	Item 3	Market share of newly developed products/services.

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