

Perceived Uncertainty and Behavioral Logic: Temporality and Unanticipated Consequences in the New Venture Creation Process

Abstract

In this study, drawing on effectuation theory, we combine analytical strategies for process data to examine inductively and theorize how founder teams' perceptions of uncertainty and behavioral logics develop during new venture creation processes. The results reveal four phases and suggest a possible evolution from a causal conditional relationship between perceived uncertainty and behavioral logics to an integrative relationship. We bring to light the notion of temporality and unanticipated consequences, discuss their central roles in perceived uncertainty, effectuation, and causation, and offer revelatory insights into why and when effectuation is used in relation to uncertainty and entrepreneurial action.

1. INTRODUCTION

The growing literature on effectuation theory proposes that entrepreneurs may engage in two decision making processes, which we call behavioral logic: causation, which emphasizes prediction, analysis and planning, and effectuation, which emphasizes collaboration and co-creating a future (Read, Sarasvathy, Dew, and Wiltbank, 2016; Sarasvathy, 2001). While effectuation theory has gained prevalence in the entrepreneurship field in the past decade, we know relatively little about when and why entrepreneurs employ effectuation (Arend, Sarooghi, and Burkemper, 2015; Read, et al., 2016), possibly because most studies have focused on explaining how to differentiate between effectuation and causation, but fall short of observing effectuation and causation as they unfold during venture creation processes (Gupta, Chiles, and McMullen, 2016).

In addition, it seems to be well established in the current literature that effectuation is associated with greater uncertainty across different entrepreneurial contexts¹ (e.g., Mainela and Puhakka, 2009; Read, Dew, Sarasvathy, Song, and Wiltbank, 2009; Sarasvathy, 2001). At the same time, suggestions are starting to emerge that the relationship between uncertainty and effectuation is a little more complex than previously thought. For example, recent empirical studies propose that a decreasing perception of uncertainty is a more likely driver for effectuation (McKelvie, Haynie, and Gustavsson, 2011), and that the mechanism governing uncertainty and effectuation includes other conditions (Reymen, Andries, Berends, Mauer, Stephan, and Burg, 2015). As a step towards understanding the current situation, we argue that there is a tendency to combine different types of uncertainties (Milliken, 1987) as the boundary conditions for different behavioral logics. Consequently, the mechanism for how different types of uncertainties are related to behavioral logic motivates our study.

¹ We thank the anonymous reviewer for this statement.

To fine-tune the relationship between uncertainty and effectuation and to enhance our understanding of entrepreneurial processes in general, our main objective in this study is to explore how perceived uncertainty and behavioral logics develop during new venture creation processes. We apply a process design (Langley, 1999) and a comparative case study design (Eisenhardt, 1989). The process approach allows researchers to address the evolution of both behavioral logic and uncertainty during new venture creation processes. We selected four new, technology-based ventures pursuing similar opportunities and followed their development over two years. We combined quantification (Van de Ven and Poole, 1990) and temporal bracket strategies (Denis, Langley, and Cazale, 1996) to observe how entrepreneurs' perceptions of uncertainties evolve and how these evolving perceptions of uncertainties are linked to the use of different behavioral logics.

Based on our process data, we inductively identify four phases in which perception and behavioral logics develop and evolve during the early stages of new venture creation. We find that in Phase 1, at the very beginning of new venture creation processes, entrepreneurs do not perceive uncertainty, and they all use causation. In Phase 2, we observe that planned actions from causation may result in unanticipated consequences that trigger two sequences through which entrepreneurs develop perceived uncertainty. These sequences set the conditions for different behavioral responses. In Phase 3, entrepreneurs all perceive state, effect and response uncertainty, and they actively combine causation and effectuation. Finally, our data show that entrepreneurs perceive less uncertainty in Phase 4 and use more causation.

Our findings allow us to contribute to the entrepreneurship literature in three ways. Firstly, on the basis of our fine-tuned process data, we propose a possible evolution from a causal conditional relationship between perceived uncertainty and behavioral logics to an integrative relationship. We therefore both challenge and complement the widely held assumption that perceived uncertainty sets the conditions for effectuation (e.g. Fisher, 2012;

Reymen et al., 2015; Sarasvathy, 2001). Secondly, based on this theorizing effort, we discuss different ontological understandings of processes and highlight the importance of incorporating temporality when studying behavioral logics (MacKay and Chia, 2013). Thirdly, we provide a more nuanced explanation of *why* and *when* effectuation is applied by introducing unanticipated consequences (Merton, 1936) as the boundary condition for effectuation theory, and by explaining how this construct relates to perceived uncertainty, effectuation and causation. We suggest future steps to embrace temporality and the unanticipated consequence construct when conducting empirical research on entrepreneurial perceptions and behaviors.

The remainder of this paper is divided into four sections. First, we first review the theoretical constructs related to behavioral logics and their links with uncertainty. We then present our cases and describe how we collected and analyzed the process data. The third section summarizes our empirical findings on how perceived uncertainty and behavioral logics develop during the different phases of the venture creation processes. The concluding section discusses the theoretical and practical implications of our study.

2. LITERATURE REVIEW

Effectuation theory proposes two logics for entrepreneurial action: causation and effectuation (Sarasvathy, 2001). Firstly, causation assumes entrepreneurs take rational actions to discover an opportunity, establish plans, and look for resources to pursue the opportunity to create revenue for their new venture (Shane, 2000; Shane and Venkataraman, 2000). Secondly, effectuation assumes a process where pursuing an opportunity depends more on entrepreneurs' resources, knowledge, and capabilities than on objective market conditions. Emphasizing collaboration, entrepreneurs crystallize new goals and / or means via effectuation (Sarasvathy, 2001).

Both causation and effectuation entail a series of entrepreneurial actions in four dimensions: relationship between goals and means, reaction to contingencies, feedback to external actors, and resource management (e.g., Brettel, Mauer, Engelen, and Küpper, 2012; Chandler, DeTienne, McKelvie, and Mumford, 2011; Fisher, 2012; Read et al., 2009; Sarasvathy, 2001). The first dimension covers the overall logic of how entrepreneurs reach the decision to act. Causation takes an outcome as given and focuses on selecting the means to achieve that outcome; effectuation takes a set of means as given and focuses on selecting outcomes which are possible with that set of means (Sarasvathy, 2001; 2008).

The remaining three dimensions describe situations in which entrepreneurs will act differently. When contingencies occur, causation focuses on carrying out the planned strategy to overcome or to avoid obstacles, while effectuation embraces unexpected events and exploits the opportunities they present (Sarasvathy, 2001). Moreover, entrepreneurs who adopt causation engage in competitive analysis when confronted with external actors. Entrepreneurs using effectuation engage in strategic alliances and negotiate pre-commitments with stakeholders (Brettel et al., 2012). Finally, entrepreneurs employing effectuation avoid risks when they cannot handle downside risks, while entrepreneurs adopting causation seek to maximize the expected returns (Berends, Jelinek, Reymen, and Stultiëns, 2014).

Although the literature explains how to differentiate between activities relating to causation and effectuation, the evidence for the relationship between effectuation and causation remains debatable. Specifically, the theory falls short of explaining the differences in how and when entrepreneurs adopt effectuation. While certain studies conceptualize causation and effectuation as opposites (Brettel et al., 2012), or as independent logics (Chandler et al., 2011; Perry, Chandler, and Markova, 2012), others argue that they are not mutually exclusive, but overlapping and intertwining depending on the contexts of the

decisions and actions (Sarasvathy, 2001). However, recent empirical studies seem to suggest that optimal decisions result from a combination of both (Reymen et al., 2015).

The aforementioned contexts under which effectuation and/ or causation may apply are characterized by uncertainty due to the novelty of the market or technology (Sarasvathy, 2008; Brettel et al., 2012), the initial founding conditions concerning the new venture, and entrepreneurial experiences from past events (e.g., Dew, Read, Sarasvathy, and Wiltbank, 2009; Politis, Winborg, and Dahlstrand, 2012). Among these factors, uncertainty remains the fundamental concept for the prediction of entrepreneurial action (McKelvie et al., 2011; McMullen and Shepherd, 2006; Read et al., 2009). Indeed, Fisher (2012) suggests that in a stable environment, causation is more favorable as it allows entrepreneurs to remain focused and efficient, while effectuation is more beneficial in uncertain environments because it allows entrepreneurs to act adaptively and flexibly.

More specifically, the extant studies suggest different forms of uncertainty as the antecedents of effectuation and causation. The literature generally distinguishes between objectively and subjectively measured uncertainties (McKelvie et al., 2011). Recent studies show that objective uncertainty has no systematic association with the use of effectuation and causation (Reymen et al., 2015) based on a comparison of effectuation and causation across companies that target an existing market or a new market. Other studies attempt to predict effectuation and causation by looking at subjective or perceived uncertainty (McKelvie et al., 2011; Reymen et al., 2015), which relates to entrepreneurs' cognition and measures uncertainty according to entrepreneurs' perceptions (Duncan, 1972; Milliken, 1987).

While scholars acknowledge the connections between perceived uncertainty and behavioral logics, it is still unclear how they are connected. Most studies suggest a positive association between an increasing perception of uncertainty about the market and technology, or resources and effectuation (e.g., Mainela and Puhakka, 2009; Read et al., 2009; Wiltbank,

Dew, Read, and Sarasvathy, 2006); others propose that a decreasing perception of uncertainty is a more likely driver for effectuation (McKelvie et al., 2011), or that the mechanism governing perceived uncertainty and effectuation includes conditions other than uncertainty, such as pressure from stakeholders, and resource constraints (Reymen et al., 2015). We propose two explanations for this dissonance.

A first possible explanation relates to the tendency for scholars to focus on different *types* of perceived uncertainty. Milliken (1987) identifies three types of perceived uncertainty: state, effect, and response uncertainty. State uncertainty refers to perceived market and technological uncertainties, and relates to perceptions of the environment as unpredictable (Milliken, 1987). When scholars (e.g., Fisher, 2012; Sarasvathy, 2001) suggest that a greater perception of uncertainty leads entrepreneurs to use effectuation, they are in fact referring to state uncertainty. Effect uncertainty is defined as, “an inability to predict what the nature of the impact of a future state of the environment or environmental change will be to the organization” (Milliken, 1987). Indeed, we argue that scholars who propose that a decreased perception of uncertainty is more likely to drive effectuation are referring to effect uncertainty. For example, McKelvie et al. (2011) suggest that as entrepreneurs gain experience and become more adept at predicting how the environment will influence the new venture, they are more likely to experiment with effectuation instead of causation. Finally, response uncertainty is an entrepreneur’s inability to predict the likely consequences of a response choice (Milliken, 1986). A recent study implies a relationship between response uncertainty and behavioral logic by suggesting that the use of effectuation and causation are likely to depend on conditions that widen the strategic scope of ventures (Reymen et al., 2015). For example, Reymen et al. (2015) used multiple examples to illustrate that when entrepreneurs do not know how a new venture may respond to a decreased resource situation, they will widen their strategic scope by exploring alternative income streams. In this sense, it is argued

that an increase in response uncertainty is a driver for more effectuation. Taken together, carrying out a deeper empirical investigation of the uncertainty construct and, in particular, unpacking the potential effects of different types of uncertainties, opens interesting avenues to explore with regard to how and when entrepreneurs use effectuation and causation.

A second possible explanation for this dissonance could be the lack of process studies on uncertainty, effectuation and causation (McMullen and Dimov, 2013). Although prior studies provide rich insights into how different forms of uncertainty may serve as antecedents to effectuation and/or causation, they often analyze such relationships at a single moment in time, or by treating the entire new venture creation process as a single observation (McKelvie et al., 2011; Reymen et al., 2015; Sarasvathy, 2008). Very few studies have looked at how entrepreneurs form different perceptions of uncertainty and how these perceptions develop with effectuation and causation during the venture creation process, which is somewhat surprising. Indeed, the literature on uncertainty suggests that the existence, sequence and order of the links between state, effect, and response uncertainty differ (Ashill and Jobber, 2009), which means that entrepreneurs may develop perceptions of uncertainty in different sequences other than from state to effect and then response. For example, entrepreneurs may not perceive uncertainty until they experience the effect of a competitor on their sales revenues.

Moreover, a new venture creation process is dynamic (McMullen and Dimov, 2013), consisting of different stages (pre-entry, nascent, infancy, and maturity), during which entrepreneurs develop different intentions and conduct different activities (Choi, Lévesque, and Shepherd, 2008; Choi and Shepherd, 2004; Katz and Gartner, 1988). Further, effectuation theory also highlights that both effectuation and causation are dynamic and interactive processes (Sarasvathy and Dew, 2005). Therefore, it is reasonable to assume that the relative weight and potential shifts of effectuation and causation might vary at different stages (Politis,

2005). For both effectuation and causation, a process approach may provide a more comprehensive explanation of behavioral logic without restricting the explanation of the drivers of different behavioral logics to only one type of uncertainty at a single point in time (e.g., McMullen and Dimov, 2013), and it may help to move beyond the conceptual discussions of the relationship between effectuation and causation (Read et al., 2016).

To summarize, although the extant studies make interesting suggestions about how the perception of uncertainty may predict the use of effectuation and causation, they fall short of describing the process that determines how both types of uncertainty evolve, and how this evolution influences the use of different behavioral logics. Because the relationship between uncertainty and behavioral logics is still unclear, it is difficult for scholars to explain when and why entrepreneurs use causation and effectuation. Therefore, to clarify this issue, we developed a finer-grained empirical study to explore how entrepreneurs perceive uncertainty at the nascent stage and to draw implications that contribute to improving our understanding of how entrepreneurs use causation and effectuation in response to perceived uncertainty. We addressed these issues by observing causation and effectuation in four new technology-based ventures.

3. METHOD

3.1 Research design and case selection

We investigated how types of uncertainty develop and influence behavioral logic through a comparative process study of four new technology-based ventures over a two-year period at the founding team level. We coded uncertainty perception, behavioral logics, and time occurrence to address the research question. Our data included interpretations, feelings and events. Because we had process data and were dealing with a nonlinear dynamic perspective on organizational processes, we applied both quantification and temporal bracket strategies to analyze and theorize the process data (Langley, 1999).

We used purposive sampling to select cases (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). The similarities and variations in cases enable more robust theory development (Eisenhardt and Graebner, 2007) and are more beneficial than using a random sample (Santos and Eisenhardt, 2009). Following Langley's (1999) advice that one or more cases may be sufficient to produce useful insights for internal replication when scholars are using a temporal bracket strategy, we selected four new ventures with similarities and differences based on several criteria.

We selected four new ventures based on two conditions of similarity. Firstly, in line with the recent empirical studies on effectuation (Berends et al., 2014; Kalinic, Sarasvahty, and Forza, 2014; Reymen et al., 2015), we aimed to identify ventures facing substantial uncertainty. Accordingly, we chose new technology-based ventures that use big data analytical technology as our empirical context. All of the selected ventures started by aiming to commercialize new products or services using big-data analytical skills. Because the outcomes of the technological activities, market selection, and commercialization processes of the chosen cases were, a priori, unpredictable and ambiguous, this context gave us the opportunity to observe entrepreneurs facing uncertainty. Secondly, we identified new ventures that were founded in Beijing and Shanghai because these two cities share a similar institutional context. Start-up firms benefit from similar government support and talent on the Chinese job market.

Next, we ensured variation in the selected cases since sampling variation allows researchers to identify significant shared patterns across cases (Patton, 2002), by including cases that differ in terms of the level of accumulated knowledge (represented by experience) as the main condition influencing the perception of uncertainty (Baron, 2008; Milliken, 1987; McKelvie et al., 2011). We confirmed that the selected entrepreneurs have some industrial and managerial experience, but differ in terms of their entrepreneurial start-up experience

(Gimeno, Folta, Cooper, and Woo, 1997). We identified two “low experience” ventures, in which none of the entrepreneurs had start-up experience, and two “high experience” ventures in which all entrepreneurs had previous start-up experience. Table 1 summarizes the cases, and Table 2 provides a brief description of each case’s main business.

Table 1
Case characteristics

Case*	Industry	Institutional context	Founding year	Entrepreneurial experience of founders
Data Ent	Information Technology & online data analysis	Beijing	2014	Low: one founder with industry and managerial experience
Education Ent	Information Technology & online education	Beijing	2012	Low: one founder with industry and managerial experience
Prevention Ent	Mobile health – Smart bracelet	Shanghai	2013	High: two founders with industry, managerial, and start-up experience
Virgin Ent	Mobile health - Smart watch	Beijing	2012	High: two founders with industry, managerial, and start-up experience

*All cases’ names remain anonymous

Table 2
Short case description

Short case description
Data Ent was founded in April 2014 and aimed at developing a big data platform. The company aggregated mobile users’ data from mobile operators. It cleaned and analyzed the data to provide advertisements agencies with information for advertising in various sectors, such as finance, travelling, etc.
Education Ent was created in August 2012. The company aimed at providing individual users with on-line personalized educational program. The company delivered various on-line courses targeted at people who would like to become entrepreneurs. It aimed at creating an ecosystem of on-line education in China.
Prevention Ent was founded in December 2013. Its overall aim was to develop an integrated health monitoring system focusing on physiological indicators such as blood pressure, blood lipids, body mass, breathing rates, etc. to predict and prevent chronic diseases. The firm offered to collect personal health data through electronic devices including two types of smart bracelets, and a smart scale, and to provide its clients with personal healthcare advice.
Virgin Ent was founded in 2012. The firm aimed at collection of personal physiological information (including body temperature, sleep cycles, etc.) through different devices including a smart ring, a smart watch, and a smart phone.

3.2 Data collection

We collected primary data through interviews with several founders and other key team members (see Table 3 for details). These key informants were chosen because they were active in the new venture creation processes when the key events took place. All four new ventures were started by teams of entrepreneurs. Our empirical study relied on three main data sources: (1) semi-structured interview data; (2) publicly available data (web articles, public interviews, press articles, etc.); (3) internal documents (business planning, annual reports, etc.).

Table 3

Data sources

Firm	Semi-structured interviews in 2013	Semi-structured interviews in 2014	Validation meeting in 2015	Internal documents	Publicly available documents
Data Ent	2 interviews with 1 founder	2 interviews with 2 founders	1 meeting with CEO	2	40
Education Ent	1 interview with 1 founder	4 interviews with 2 founders	1 meeting with CEO	5	15
Prevention Ent	3 interviews with 2 founders	4 interviews with 3 founders + 2 interviews with Vice President of Sales	1 meeting with CEO	13	59
Virgin Ent	1 interview with 1 founder	2 interviews with 1 founder + 2 interviews with Vice President of Sales	1 meeting with CEO	16	28

To address the retrospective problem, the research team conducted interviews at two points in time: between November and December 2013 and between November and December 2014. We visited the same venture several times during each visit whenever we had the opportunity. Finally, we presented our data analysis to the entrepreneurs of each new venture in December 2015. We used a similar validation strategy to alleviate any retrospective problem related to feelings or emotions (e.g., Vuori and Huy, 2015). Between the two sets of data collection, we analyzed the data to inform the subsequent interviews in 2014. We ensured that all interviewees were either the entrepreneurs or other key people involved in the strategic decision-making process.

During the first rounds of interviews, we mainly asked interviewees to talk about (1) the activities carried out during the development of the new venture and (2) why and under which contexts entrepreneurs carried out these activities. During the second round of interviews, in addition to using a similar interview guide to that used in the first interview rounds, we asked interviewees what had changed since 2013, and how these changes had occurred. Most interviews lasted between 40 and 70 minutes. They were all digitally recorded and transcribed.

3.3 Data coding and analysis

We used quantification (Van de Ven and Poole, 1990) and temporal brackets (Denis et al., 1996) for data coding and analysis as two strategies for analyzing and theorizing the

process data (Langley, 1999). Quantification strategy reduces complex process data to a set of analyzable quantitative time series, whereas a temporal bracket strategy allows scholars to observe continuity among variables over time. We coded and analyzed the data in an iterative process with Nvivo.

In line with our aim of observing how perceptions of uncertainty and venture behavior develop, our analysis followed four main analytical steps: (1) creating an event history listing, (2) coding based on theoretical constructs, (3) transforming qualitative codes into a bit-map data base, and (4) analyzing patterns of similarities and differences across cases.

3.3.1 Creating the event history listing

We began by creating an event history list for each case (Van de Ven and Poole, 1990), which helped us to arrange the extensive data set, familiarize ourselves with the data, and gain some preliminary insights into how perception and activity develop.

In this step, rather than code the data per theoretical lens, we simply arranged the raw data of each case into a list consisting of perceptions and actions. We identified all activities intentionally employed by the new ventures (McMullen and Shepherd, 2006). Following Reymen et al. (2015), we define events as actions carried out by the founding team members. The actions included decisions to create a new venture, explore opportunities, hire employees, analyze competitive forces, and so on. Simultaneously, we identified the founding team members' perceptions of the business context assessed via qualitative responses of how entrepreneurs talked about market needs, technology trends, resources, and/or other stakeholders prior to their decisions to act. Furthermore, we ordered each activity and the corresponding context according to its time of occurrence.

We relied primarily on interview data. The secondary data sources supported our data coding when triangulating events. However, written data rarely reveal entrepreneurs'

perceptions. In the case of Prevention Ent, for instance, the secondary data triangulated about 7 percent of entrepreneurs' perceptions.

3.3.2 Coding events into theoretical constructs

After establishing the event history listing, we used established criteria to understand the perceived uncertainty, differentiating state, effect, and response (McKelvie et al., 2011). We looked at how founding teams described the change in a particular component of the environment (state uncertainty), how environmental changes will impact the new venture (effect uncertainty), and the new venture's ability to sustain, innovate, and/or lead (response uncertainty). In addition, we coded whether or not the founding team perceived uncertainty. For example, we coded "The customers did not understand, nor did the investors. Everyone in the field, including the electronic device factories, had very little understanding of what a portable device is. (Prevention Ent, 2013)" as perceived state uncertainty. Table 4 provides the detailed code structure and examples of perceived uncertainty.

Table 4
Code structure and examples of perceived uncertainty

Key words and empirical indication of perceived uncertainty	Present/ absent of perceived uncertainty	Exemplary
State: perception of change in the environment: What is happening there?	Perceived	At that time (early 2013), nobody understands what we are doing. The customers did not understand, nor did the investors. Everyone in the field, including the electronic device factories, had very little understanding of what portable device is. (Prevention Ent, 2013)
	Not perceived	We know our competitors in the market are cross collaborating with partners in different industries. This is a very common phenomenon in China, a lot of our direct or indirect competitors are doing so. That is why we have applied the same strategy. (Virgin Ent, 2014)
Effect: prediction of how the change will influence the venture: How will the change influence me?	Perceived	At the beginning, we had to change the product forms so many times. This was because we were not sure how customers would react on our new concepts. (Prevention Ent, 2013)
	Not perceived	We think the system we are developing now uses a relatively stable technology, and therefore, we think we will not be affected by the technology instability. (Data Ent, 2014)
Response: perceptions of firm's ability to sustain innovative leadership and potential lead-time over competitors: How shall I reply?	Perceived	I am the Vice President of Strategy in this company, I am in charge of the company's strategy, but to be honest, I now have no idea of how to strategize this company. (Education Ent, 2014)
	Not perceived	When we first received the order from our customers, we did not have any experience of producing smart watch. But we thought at that time, we were sure that we could develop the leading smart watch within three months. We thought we were a black horse. (Virgin Ent, 2013)

We then coded entrepreneurial actions. We developed the coding themes according to recent studies by Berends et al. (2014) and Reymen et al. (2015). We coded whether an

activity was associated with effectuation and/or causation in four dimensions: (1) basis for action; (2) attitude toward unexpected events; (3) attitude toward outsiders; (4) view of risk and resources. We coded an action causation when a company had conducted a top-down survey to improve its understanding of the customers' need, for example. Table 5 presents the empirical indicators and the concepts used to code the data. On average, the coding identified around 40 effectuation and causation activities per new venture.

Table 5
Code structure and examples of actions of behavioral logics

Behavioral logics	Empirical indicators	Exemplary
Effectuation	Basis for action: means oriented	Founders of Virgin Ent knew that big data related business becomes very popular, but he had no idea what to develop as concrete product. One day, when the founders met one of their friends, they soon decided to develop a business around smart watches based completely on their personal preferences. (Virgin Ent, 2013)
	Attitude toward unexpected events: leverage	By coincidence, the main founder in Virgin Ent met an influential person in the portable device market. The founder soon asked the influential person to post their product idea on his personal web page. This resulted in sales recorded of 20,000 watches in less than 72 hours. (Virgin Ent, 2014)
	Attitude towards outsiders: partnerships	The founder of Education Ent decided to design the product together with the help of their users. The company moderated interactive exchanges between the internal product developer and external users. (Education Ent, 2013)
	View of risk and resources: affordable loss	Prevention Ent's top executive teams decided to not include any requirements for working hours. Because the executives consider they are willing to give up control on working hours so that employees will feel less pressed, and therefore, have more space for creativity. (Prevention, 2014)
Causation	Basis for action: goals oriented	Education Ent conducted top-down survey in order to understand customers' needs in online education. They insisted on first looking for all necessary resources and building all necessary analytical skills before developing and commercializing the product. (Education Ent, 2014)
	Attitude toward outsiders: competitive analysis	The founder of Data Ent analyzes the business model of more established players. This was done to facilitate the internal employees to copy the strategies of other players. (Data Ent, 2014)
	Attitude toward unexpected events: avoid	Data Ent decided to drop out from collaborating with other stakeholders soon after they encountered some difficulties. (Data Ent, 2015)
	View of risk and resources: expected return	The executive team in Prevention Ent has written very detailed business plans and have planned to acquire multiple rounds of funding from multiple stakeholders. (Prevention Ent, 2014)

Lastly, we noted the timing of all codes of perception and behavior by coding perceptions and actions from the pre-entry stage (Katz and Gartner, 1988) through to the time when the ventures began receiving payments from their main clients for their products or services (Tornikoski and Newbert, 2007) or stopped their efforts. We subsequently matched the temporal order in a detailed timeline based on the event history list to gain a much finer-grained view of the sequences of perceived uncertainty and activities.

3.3.3 Transforming qualitative codes into a bit-map database

In the third step, we quantified the qualitative data to visualize the sequence of events. We transformed qualitative codes into dichotomous variables in order to adopt comparative methods for examining sequences and patterns among the coded variables (Van de Ven and Poole, 1990).

In transforming coded uncertainty types, we used the dichotomous indicator “2” to represent perceived uncertainty, “1” to represent the absence of perceived uncertainty, and left the row empty when respondents did not mention uncertainty. We applied the same process to code behavioral logic, using the dichotomous indicator “2” to represent the presence of a behavior, “1” to represent the absence of a behavior, and left the row empty when respondents did not mention any type of effectuation or causation action. At the end of the transformation, we mapped all rows into a bit-map of 2s, 1s, or empties. Table 6 illustrates the extraction of the overall bit-map data file for Virgin Ent. The order of the rows represents the chronological listing of qualitative codes.

Table 6
Extract of bit-map database on perceived uncertainty and action of Virgin Ent

Event	State	Effect	Response	Effectuation	Causation
1			1	1	2
2			1	2	2
3	1	1	1	1	2
4			1	1	2
6	1			1	2
7	2		1	2	1
8				2	1
9				2	1
10	2			2	1
11		2		1	2
12			2		
13			2	2	1
14			1	2	2
15		1	1	1	2
16			2	1	2
17			2	1	2
18				2	1
19

3.3.4 Analyzing patterns and relationships

In the final step, we analyzed how the overall perceived uncertainty and behavior develop over time by applying a temporal bracket strategy (Barley, 1986; Denis et al., 1996)

and using the bit-map database (Van de Ven and Poole, 1990) to transform the process data into a series of more discrete but connected blocks.

We started by identifying breakpoints to define “phases” of perceived uncertainty and behavior for each case. These phases do not have any particular theoretical significance; they are not “phases” in the sense of a predictable sequential process, but as a way to structure the description of events (Barley, 1986; Denis et al., 1996; Langley, 1999; Langley and Truax, 1997). The idea was to identify phases in which data described the processes as a relatively stable or a linearly evolving pattern (Langley, 1999).

To define the breakpoints, we used our bit-map data to plot sequentially the distributions of entrepreneurs’ perceived state, effect and response uncertainty, and their behavioral logic. We set the breakpoints for different phases based on the shifts in perceived uncertainty types. Each breakpoint represents a discontinuity in perception. We applied the same strategy of setting the breakpoints to all selected cases. Consequently, we broke down the overall process change in the selected cases into four phases. Phase 1 represents a period when entrepreneurs do not perceive uncertainty. The breakpoint from phase 1 to phase 2 occurred when any type of perceived uncertainty arose. The breakpoint from phase 2 to phase 3 occurred when ventures perceived all three types of uncertainties. Finally, the breakpoint from phase 3 to phase 4 occurred when there was a drop in perceived uncertainty.

In the second step, we carefully examined the patterns of how perception developed over time as well as the patterns of corresponding behavioral logic, effectuation and causation. At the same time, we closely analyzed the interview data to further develop the qualitative evidence with a view to describing how different types of perceived uncertainty changed and how they influenced behavioral logic. This step was highly iterative and we revisited all cases to check how our data explained the breakpoints, the evolution of perceptions and actions across the four phases, and the relationship between them.

In the final step of our analysis, we compared the similarities and differences per phase across the four cases. In particular, we focused on comparing the developmental process of perceived uncertainty, and its relationship with patterns observed in behavioral logic (Miles and Huberman, 1994). We developed a series of tables to map out the differences of how ventures evolve in all four phases. We compared our observations with the existing entrepreneurship literature to interpret the findings and refine the mechanisms during the analytical process.

4. FINDINGS

In this section, we report on similarities and differences in how perceived uncertainty and behavioral logic develop according to four phases identified from our process data (see Figures 1 to 4). Phase 1 (Optimism) indicates that the new venture creation process is marked by the absence of perceived uncertainty, coupled with causation behavior. The data show that this pattern remains stable until unanticipated consequences of actions occur in Phase 2 (Struggling). The struggling phase consists of two different developmental sequences of perceived uncertainty, each of which has implications for the use of different behavioral logics. Empirical observation in this phase allows us to refine how specific combinations of types of uncertainty are associated with effectuation behavior. The data in phase 3 (Turbulence) show patterns of behavioral logic when all three types of uncertainty are perceived. Surprisingly, in the turbulence phase, instead of using more effectuation, entrepreneurs actively strive to combine causation and effectuation. Finally, phase 4 (Optimistic but realistic) reveals the use of behavioral logic when entrepreneurs start to perceive less uncertainty as the new venture creation continues. We shall now develop our findings in detail for each of the four phases.

Figure 1 Data Ent

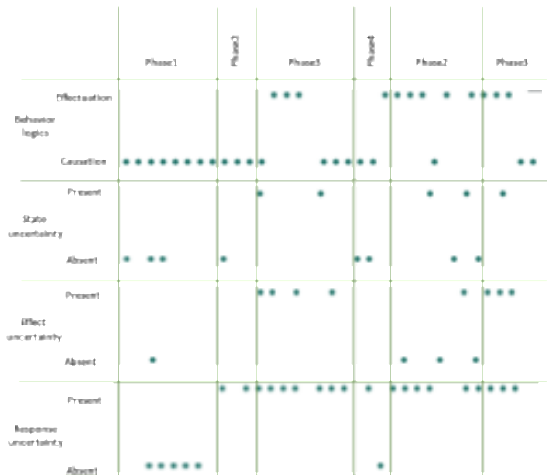


Figure 2 Education Ent

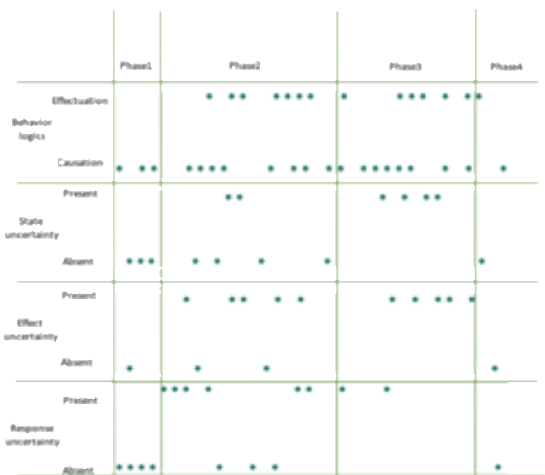


Figure 3 Prevention Ent

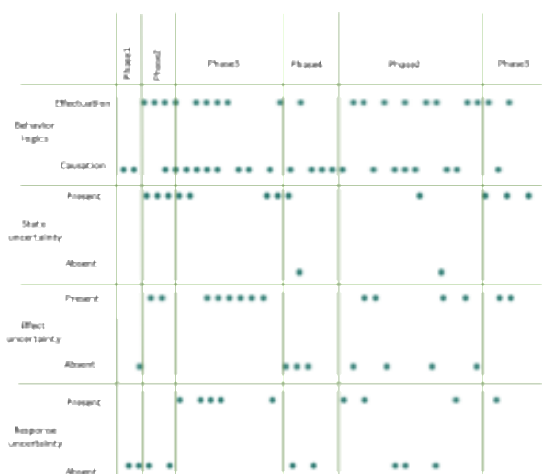
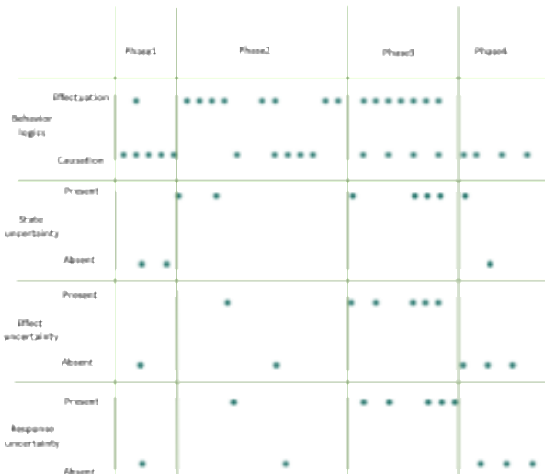


Figure 4 Virgin Ent



4.1 Phase 1: Optimism – absence of uncertainties

Optimism represents a phase in which entrepreneurs were positive and enthusiastic about the opportunities they identified, believing that these opportunities are meaningful and salient and can resolve customers’ problems or satisfy their needs. The entrepreneurs were confident about the market need, the market effect, and their own ability to respond.

During this phase, none of the entrepreneurs perceived state, effect or response uncertainty, illustrated by following quote from Data Ent’s CEO: *“I think people will need some healthcare-related solutions. I personally really care about healthcare-related issues. Look, I monitor the level of air pollution all the time. If I think it is important, then I believe it*

is important for everybody. So there must be a huge market potential for data mining in the healthcare sector.” (Data Ent)

Causation logic dominates the behavioral response to this perception, reflected in activities such as gathering and analyzing survey data, drafting several business plans, and attracting funding from venture capitalists, as stated by the CTO of Education Ent: *“We collected a lot of information from various channels and concluded that on-line businesses have a great future, from news to speeches, etc. I also analyzed the market trends, looked at other players, and thought about how the business would generate revenue... Our VP of Strategy also evaluated the opportunity from the capital point of view...” (Education Ent)*

Although our overall analysis did not show a systematic association between initial entrepreneurial experience and the overall use of effectuation and causation, data in phase 1 suggest that more experienced entrepreneurs switch from causation to effectuation more quickly. This implies that the differences between cases emerged more from what happened during the new venture creation processes than from entrepreneurial experience. Similar patterns across for all four cases taken together from phase 1 show that in the absence of perceived uncertainty, entrepreneurs are more likely to respond with causation.

4.2 Phase 2: Struggling – mixed perception of certainty and uncertainty

The struggling phase started when entrepreneurs faced unanticipated consequences from their actions in phase 1. Generally, these positive or negative unanticipated consequences may correspond to the stakeholders’ high or low acceptance of the ventures’ products or services. The entrepreneurs in all new ventures started to recognize similar unanticipated problems as consequences of their actions, which caused their perception of uncertainty to develop. More precisely, although the entrepreneurs in each case started to perceive uncertainty, founding team members alternated between the presence and/or absence of different types of uncertainty. Moreover, we identified variations in the sequences in which

entrepreneurs perceived different types of uncertainty as well as in how they reacted. Conceptually, the first sequence starts with entrepreneurs perceiving state, effect, and then response uncertainty. The second sequence starts with entrepreneurs perceiving response, effect, and then state uncertainty. We shall now describe the sequences in greater detail.

4.2.1 Sequence A- Response uncertainty as an impetus

Entrepreneurs in two firms, Data Ent and Education Ent, seemed to perceive response uncertainty first. In fact, when these entrepreneurs sensed that stakeholders did not acknowledge or accept their products, they started to doubt their own capacities to develop the right product for the market, or abilities to respond to the competition. For instance, the first perceived uncertainty expressed by one of the Data Ent entrepreneurs was, *“We know there are markets and needs, but I don’t think we know how to turn what we have as data into valuable services to meet those needs.” (Data Ent)*

The Data Ent entrepreneurs did not perceive any state or effect uncertainties during phase 2. In response to the perceived response uncertainty, the entrepreneurs continued to use causation. For instance, after identifying an established firm with similar processes to those they wished to implement in their own venture, the entrepreneurs then benchmarked how that firm conducted business to help them understand how to deal with the perceived response uncertainty. The Data Ent entrepreneurs considered that mimicking successful players was a viable way to react to response uncertainty.

Similarly, the Education Ent entrepreneurs perceived response uncertainty due to their actions in phase 1. The Vice President of Strategy of Education Ent illustrated this point: *“I am the VP of Strategy of Education Ent, but now, I actually have no idea how to create a strategy to respond to the huge potential market for on-line education.” (Education Ent).*

This perceived response uncertainty was soon followed by effect uncertainty. One of Education Ent’s entrepreneurs illustrated this point by stating that the executives were not

sure how the explorative style of managing the venture and the general business environment would influence its performance. In response to the effect uncertainty, Education Ent's entrepreneurs shifted to effectuation. For example, instead of developing products themselves, they tried developing on-line educational programs by interacting with users. This activity helped them develop diversified programs for online education. However, the entrepreneurs soon realized that users were not willing to continue interacting with them, which impeded the development of their various online programs. It was only after the entrepreneurs experienced the unanticipated consequences of their ambiguous approach to the venture's product development and sales record that they perceived other types of uncertainty.

In short, as with Data Ent, Education Ent's entrepreneurs began to formulate their perceptions of uncertainty by questioning their own ability to respond. Data from both ventures show that entrepreneurs who perceive only response uncertainty are less likely to shift from causation to effectuation; and that entrepreneurs who perceive effect uncertainty and response uncertainty are more likely to shift from causation to effectuation, as in the case of Education Ent.

4.2.2 Sequence B – State uncertainty as an impetus

Contrary to Data Ent and Education Ent, the Virgin Ent and Prevention Ent entrepreneurs began the “struggling” phase by perceiving state uncertainty and then developed perceptions of effect/response uncertainty during phase 2. In other words, when unanticipated consequences of actions occurred, entrepreneurs in these ventures first perceived uncertainty related to the external market rather than that concerning their own ability to respond.

To illustrate, when one of Prevention Ent's entrepreneurs realized that stakeholders were not receptive to their initial product idea, their first reaction was to reach out to the external business environment. Prevention Ent's entrepreneurs perceived uncertainty from

investors, suppliers, and customers; Virgin Ent's entrepreneurs perceived uncertainty from both investors and customers, as stated by one of their entrepreneurs: *"I don't think anyone knows what we are doing. I can't get much feedback from customers because portable devices are a new concept for everybody. Investors don't talk to me either; they don't understand what I am doing. I think all I can do is make a product and see what happens next."* (Virgin Ent). In both ventures, the entrepreneurs' perceived state uncertainty soon developed to include effect uncertainty. The founding teams expressed their concern about their inability to predict how the (perceived) state uncertainty may affect the future development of their ventures.

In response to both state and effect uncertainty, the entrepreneurs in both ventures engaged in more effectuation, reflected in actions such as interacting with multiple stakeholders of interest without particular goals, entering into negotiations with stakeholders regarding what to develop or how to deliver the product prior to product prototyping, adapting the resources at hand to deal with unexpected events, and so on. For example, Virgin Ent's entrepreneurs developed links with different investors and agreed to establish a sales channel with one of them prior to developing a new product protocol. Prevention Ent's entrepreneurs also interacted with suppliers and decided to modify the product concept and change the product form. As one founder explained: *"Our current product form was crystallized by talking with my friends, who were our suppliers. We sat together in a meeting room. There were four of us. We had a full table of products."* (Prevention Ent)

By carrying out more effectuation activities, the entrepreneurs in Virgin Ent and Prevention Ent established new goals (new products) and developed new means with the help of different stakeholders in their networks. By observing the pattern in Figures 3 and 4, we inferred that these entrepreneurs used both causation and effectuation during phase 2. Causation dictated planning to help the ventures pursue their goals or identify the means

through effectuation activities. For example, in the case of Virgin Ent, effectuation led entrepreneurs to establish new goals in the form of a new sales channel. This was a positive unanticipated consequence of effectuation. To pursue this new goal, entrepreneurs established an online payment center, contracted a manufacturer, and recruited more people to activate the sales channel. Therefore, data showed that entrepreneurs who perceive state uncertainty and response uncertainty are more likely to shift from causation to effectuation.

Taken together, the main findings for phase 2 indicate that it is the unanticipated consequence that trigger the psychological response mechanisms through which entrepreneurs seek to better direct future consequences with different behavioral logics. Secondly, to cope with unanticipated consequences, entrepreneurs can either question their own (i) ability to respond to the perceived uncertainty or (ii) understanding and knowledge of the external environment, forming two distinctive sequences through which entrepreneurs' perceptions of uncertainties develop. Thirdly, when entrepreneurs perceive response uncertainty, they are more likely to continue with causation. When entrepreneurs perceive both effect and state uncertainties, or effect and response uncertainties, they are more likely to shift their behavior from causation to effectuation.

4.3 Phase 3: Turbulence – perception of all types of uncertainty

Turbulence corresponded to a phase in which entrepreneurs took multiple steps to advance the new venture creation process. During this “turbulence” phase, the entrepreneurs acknowledged and collectively perceived the three types of uncertainties. We observed that entrepreneurs in all four ventures responded by actively adopting a combination of effectuation and causation.

We can use Data Ent and Virgin Ent to illustrate this pattern. In phase 3, Data Ent's entrepreneurs perceived effect and state uncertainties in addition to response uncertainty, perceiving effect and state uncertainties after observing negative results at the firm they were

benchmarking during phase 2. The entrepreneurs were concerned that their own venture could end in the same state as the benchmark firm if they continued to follow it due to the market (effect uncertainty), and wondered what they should focus on in the business environment to avoid similar consequences (state uncertainty).

In reaction to the response, effect, and state uncertainties, Data Ent's entrepreneurs adopted effectuation, as shown by their commitment of limited resources, identification of new opportunities based on entrepreneurs' networks, and avoidance of actions that would restrict their venture's flexibility. For example, one of the Data Ent entrepreneurs stated that: *"We tried to talk to as many people as possible about our business. We even initiated conversations with people who we once considered competitors. We tried to be their partners. We tried to talk to everybody in the ecosystem. We intended to collaborate with them, we could open our data sources to them, and they could help us to think about how to transform that data into money."* (Data Ent)

Although the ventures responded to uncertainty with effectuation and thereby developed new goals, Data Ent's entrepreneurs subsequently shifted to causation in phase 3. The entrepreneurs analyzed the feasibility of the new goals, and tried to identify, analyze and benchmark firms in the market that were pursuing similar goals. Such behavior patterns were repeated until the entrepreneurs decided that the new goals were too far from those of any existing firm. The entrepreneurs sold their venture at the end of the second phase 3. It seems that the adoption of a particular behavioral logic was a source of dissatisfaction, thus setting the stage for a shift to another behavioral logic.

In addition to the example of Data Ent, firms can use both effectuation and causation during one event. Virgin Ent entered phase 3 with a new idea (to develop a smart watch), which was defined in phase 2, because the entrepreneurs' previous idea (to develop electronic gadgets for mobile phones) was challenged. The entrepreneurs started to perceive response

uncertainty in addition to state and effect uncertainty. The entrepreneurs doubted their venture's ability to develop the right product to meet the customers' needs, and perceived response uncertainty by questioning whether their venture's resources would be sufficient to develop a smart watch in time to meet customers' expectations. The resources included previous experience of developing electronic gadgets, the investment fund, internal talent, and so on.

A typical mechanism of the Virgin Ent entrepreneurs' reaction that used both behavioral logics during the same phase was to begin by interacting with stakeholders in their networks with a specific goal. During this interaction, the entrepreneurs remained willing to respond to unplanned opportunities as they arose. The interaction process often resulted in attaining a specific goal, and/or establishing new goals and means at the same time. Taken together, our empirical observation in the turbulence phase shows that when entrepreneurs perceive all types of uncertainty, they actively strive to employ a mix of causation and effectuation.

4.4 Phase 4: Optimistic but realistic – Perceived uncertainties reduced

After the “struggle” and “turbulence” phases, phase 4 represented a period in which the entrepreneurs found some stability in their new ventures. The entrepreneurs stopped perceiving all types of uncertainty and responded with more causation than in phase 3. We use Prevention Ent to illustrate the process since this venture had two experiences in phase 4 during our observation period.

In phase 4, all entrepreneurs started to perceive some degree of certainty. For example, one of Prevention Ent's entrepreneurs expressed that: *“Although I still think there is so much uncertainty in the business environment, we feel lucky that we've always been able to respond to the environment in an efficient way. We've made so many mistakes, but we have not done*

anything fatal. So if I think about what the venture has been through, I think at least we did very well on things we could control” (Prevention Ent)

The behavior in response to this perception was similar to that in phase 3: a combination of causation and effectuation, but often dominated by causation. The entrepreneurs’ reliance on both was reflected in the activities described by one of Prevention Ent’s entrepreneurs: *“We started the customer service department to serve customers. But people in the customer service team ended up doing sales. We never thought this would happen... The steps taken in Internet business are very fast. We have to adapt and be very flexible. We’ve learned to react to the market without any plan. Actually, our plan is to react without a plan.” (Prevention Ent)*

To summarize, our process data point toward the important role of temporality and unanticipated consequences and provide much finer-grained insights into how perceived uncertainty and behavioral logics develop as new venture creation processes continue. We shall now theorize the relationship between these constructs, i.e. temporality, unanticipated consequence, perceived uncertainty, effectuation, and causation, and discuss the new insights of our observations in relation to the extant entrepreneurship literature.

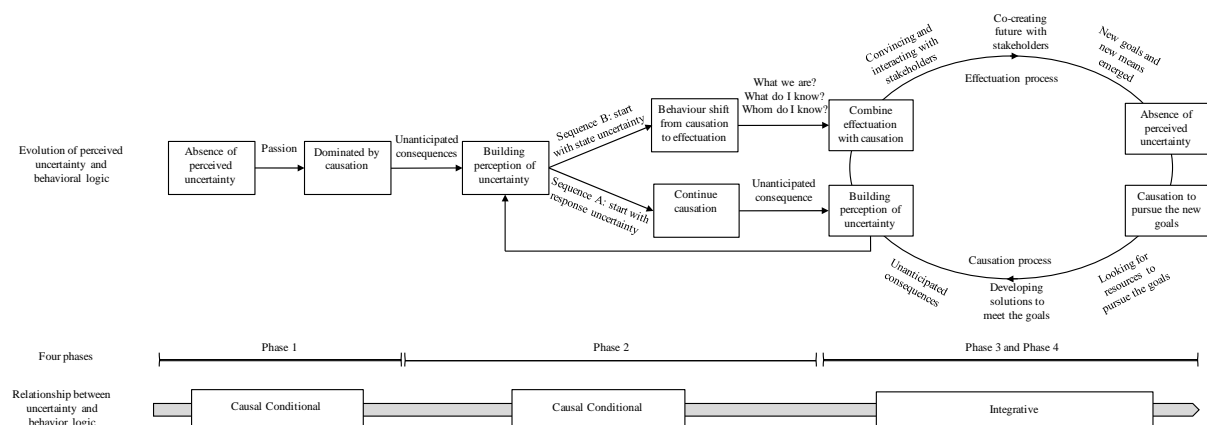
5. DISCUSSION

Recent dissonance, discussed in the literature review, concerning the relationship between uncertainty and behavioral logics raises the research question of *how perceived uncertainty develops and evolves with the behavioral logics* under investigation. Based on a longitudinal process study of four new ventures, we further effectuation theory and the debate on uncertainty and behavioral logics. By taking temporality into consideration, we refine the relationship between uncertainty, effectuation, and causation constructs, propose unanticipated consequences as the boundary condition for effectuation theory, and present revelatory scientific and practical insights for entrepreneurship scholars and practitioners alike.

5.1 Underlying dynamics of uncertainty, effectuation, and causation

Our empirical observations, which are based on fine-grained process data, divided into four phases, reveal the evolution of perceived uncertainty and behavioral logics in nascent ventures. These observations broaden our current understanding of the underlying dynamics of uncertainty, effectuation and causation. As revealed in figure 5, as the venture creation process continues, the relationship between uncertainty and behavioral logics evolves from a causal conditional to an integrative relationship (Van de Ven, 2007). In a causal conditional relationship, scholars assume “*if* perceived certainty – *then* causation” and “*if* perceived uncertainty – *then* effectuation” relationships. Perceived uncertainty is considered to be an antecedent or a boundary condition for effectuation (e.g. Brettel et al., 2012; Fisher, 2012; McKelvie et al., 2011; Reymen et al., 2015; Sarasvathy, 2001). In an integrative relationship, perceived uncertainty, effectuation and causation *interact* with each other. Constructs are not separated from one another; instead, one is a component of the other to which a response is subsequently made.

Figure 5
Perceived uncertainty and behavioral logic, evolution, phase, and relationship



In line with the existing literature, data from Phase 1 suggest that entrepreneurs use causation when they do not perceive uncertainty (Sarasvathy, 2001). Entrepreneurs start creating new ventures with passion, which is a consciously accessible, intensely positive feeling (Cardon, Wincent, Singh, and Drnvssek, 2009). They have a belief in their

opportunities (Mullins and Komisar, 2009) that leads them to have positive market perceptions, to carry out causation in the form of fundraising, and to engage in problem-solving in order to exploit the opportunities. Acting under causation, entrepreneurs choose actions based on how well they help to achieve pre-determined goals. An entrepreneur needs to choose correct actions when, for example, evaluating and choosing the most attractive opportunity, acquiring the required resources, and using those resources efficiently (Fisher, 2012; Mullins, 2013; Sarasvathy and Dew, 2005; Wiltbank et al., 2006). In causation, entrepreneurs implement purposive planned actions that are positively aligned with the pre-determined goals. These planned actions may have unanticipated consequences, thus establishing the conditions for uncertainty perception and variations in behavioral logics in Phase 2.

Analysis of data from Phase 2 yields two interesting insights. Firstly, observations based on rich qualitative data show that unanticipated consequences trigger perceived uncertainty. An unanticipated consequence corresponds to the incorrect anticipation of outcomes of purposive actions (Merton, 1936). The limitation to a correct anticipation of the consequences of an action is determined by the state of knowledge (Merton, 1936). The outcomes of an action may or may not correspond to our expectations, because we act on the basis of incomplete knowledge, and cannot correctly anticipate all possible consequences of an action. In this sense, perceived uncertainty (state, effect, response) is the cognitive response mechanism through which entrepreneurs interpret the occurrence of unanticipated consequences and redirect future actions. Without unanticipated consequences, entrepreneurs do not perceive uncertainty or experience doubts that prevent or delay future actions (Lipshitz and Strauss, 1997), and they continue to use causation.

Secondly, in line with our current understanding of uncertainty as an antecedent and/or a boundary condition for effectuation theory (e.g. Fisher, 2012; McKelvie et al., 2011;

Reymen et al., 2015; Sarasvathy, 2001), analysis in Phase 2 shows two sequences through which entrepreneurs develop their uncertainty perceptions, associated with distinctive cognitive control systems (Skinner, 1996; Thompson, 1981), each of which has different implications for entrepreneurial behavioral logics. On the one hand, entrepreneurs who start by perceiving response uncertainty, i.e. lack knowledge of response options (Milliken 1987), cognitively attribute the cause of unanticipated consequences to their lack of internal ability or skills to provide a suitable solution for the market. This reduces the entrepreneurs' feeling of internal control over their ventures' ability to respond. It has been argued that when people perceive uncertainty as internally and skill-determined (Levenson, 1973; Skinner, 1996), they are more likely to reinforce or repeat previous attempts (Abramson, Seligman, Teasdale, 1978). This is because in skill-driven situations, people tend to engage in behaviors designed to maximize the probability of success: choosing which responses to make, familiarizing themselves with the responses, spending time thinking about tasks in order to develop possible strategies, and striving to increase the chances of success (Langer, 1975, 1982). Therefore, entrepreneurs who only perceive response uncertainty are less likely to shift their behavioral logics from causation to effectuation, as they focus on improving their ventures' skills and ability to respond in order to cope with unanticipated consequences.

On the other hand, entrepreneurs who perceive state uncertainty, i.e. lack knowledge of the business environment (Milliken 1987), consider unanticipated consequences to be caused by their insufficient knowledge of the outside world (Weisz, Rothbaum, Blackburn, 1984, Kahneman and Tversky, 1982). External causes may include the market, business environment, institution, customers, competitors, other powerful players, and factors beyond human control (e.g. chance, luck or fate) (Levenson, 1973, Abramson et al., 1978). These causes reduce the entrepreneurs' feeling of control over external events (Kahneman and Tversky, 1982). It has been argued that when people attribute uncertainty to external realities,

they strive for control by attempting to influence externalities via actions involving more personal agencies and dominance (Weisz et al., 1984). Following this line of argumentation, entrepreneurs who perceive state uncertainty are more likely to involve other agents in the decision-making processes (i.e. stakeholder interactions and engagements). We argue that entrepreneurs who perceive state uncertainty are subsequently more likely to shift their behavioral logics from causation to effectuation in order to gain more control over external causes of unanticipated consequences.

Data taken together from Phase 1 and Phase 2 show that as the venture creation process progresses, actions planned on the basis of causation may result in unanticipated consequences that trigger the development of perceived uncertainty, associated with distinctive cognitive control systems that, in turn, set the conditions for different behavioral responses. The evidence that certain entrepreneurs start by developing state uncertainty, whereas others start by developing response uncertainty as a cognitive response mechanism in response to unanticipated consequences, not only shows systematic variations in the developmental phase of uncertainty (Kahneman and Tversky, 1982), but also adds to the current uncertainty literature by suggesting that response uncertainty, in addition to state uncertainty, may also be a primary impetus for perceived uncertainty (Ashill and Jobber, 2009; Gerloff, Muir, and Bodensteiner, 1991).

Although our process data in Phase 1 and Phase 2 are consistent with existing discussions concerning uncertainty and effectuation, which suggests that perceived uncertainty causes behavioral logic variations, anomalies identified in Phase 3 and 4 give us further information. To our surprise, as discussed in the findings, data patterns in Phase 3 and 4 consistently show that when there is a high level of perceived uncertainty, instead of using more effectuation, as is conventionally considered in the entrepreneurship literature (Alvarez and Barney, 2005; Fisher, 2012; Sarasvathy, 2001; 2008), all entrepreneurs actively combine

both causation and effectuation. Moreover, the consistent evolution from Phase 3 to Phase 4 in each of our selected cases implies that by actively combining causation and effectuation, entrepreneurs perceive less uncertainty and eventually switch back to causation as the dominant behavioral logic. These findings suggest that if we take temporality into consideration, there may be an integrative rather than a causal conditional relationship between perception, causation and effectuation constructs.

The theoretical explanation (see figure 5) for the anomalies in Phase 3 and 4 is that, as entrepreneurs start to use effectuation in Phase 2, they carry out actions based on their existing means, knowledge, and personal networks, and co-create the future with selected stakeholders (Sarasvathy, 2001). According to effectuation theory, the future, represented by what to do (new goals) and how to do it (new means), is the outcome of an effectuation process (Sarasvathy and Dew, 2005; Wiltbank et al., 2006). This implies that the future is not considered to be unknown in effectuation. As such, actions are not inherently uncertain, as argued by McMullen and Shepherd (2006). Subsequently, in order to pursue the new goals and the new means emerging from an effectuation process, entrepreneurs switch to causation in order to exploit contingencies and quickly test the potential returns (Jiang and Ruling, forthcoming). Because in effectuation, the environmental situation is created by the entrepreneurs themselves, causation actions in Phase 3 and Phase 4, are not therefore directly undertaken in response to an existing environmental situation. Rather, the environment arises from a decision relating to it (Whitehead, 1929; MacKay and Chia, 2013). The misalignments between causation actions and goals that are set on the basis of effectuation processes then trigger unintended consequences that undermine the actions undertaken.

In line with this reasoning, we argue that the perceived uncertainty in Phase 3 becomes the cumulative, unintended effect of decisions previously made in both effectuation and causation. It seems that as the venture creation process progresses, the presupposed causal

link between uncertainty, effectuation, and causation is transformed into an integrative relationship, as shown in figure 5: effectuation actions are undertaken in order to generate new goals and new means of coping with unintended consequences. As the future is considered certain, causation actions are undertaken in order to pursue the new goals and the new means, which in turn generate new unintended consequences. As a result, planned actions in Phase 3 and 4 are not implemented in response to an external environmental situation, but rather, are undertaken in response to an environment created by the ventures' previous effectuation actions. Our analysis suggests that perceptions are part of the entrepreneurial actions, and that unanticipated consequences do not always arise from environmental forces, but from the interaction of deliberate causation or effectuation actions undertaken by entrepreneurs.

5.2 Temporality, boundary condition, and theoretical implication

Our process study informs both effectuation theory and the debate on perceived uncertainty and behavioral logics. By explicitly delineating patterns from our empirical observation (Hambrick, 2007), we show that the relationship between uncertainty, causation, and effectuation evolves from a causal conditional to an integrative relationship. Therefore, this evolution provides a plausible explanation for the dissonance concerning the central role of uncertainty in explaining behavior variations. It also implies that uncertainty might not be the most appropriate construct to explain *why* and *when* effectuation is applied (Whetten, 1989). We propose unanticipated consequences as the boundary condition for effectuation theory. On the basis of control theory (Skinner, 1996; Thompson, 1981), we also theorize entrepreneurs' underlying cognitive dynamics to determine *why* unanticipated consequences trigger perceived uncertainty, which prompts entrepreneurs to target consequences more efficiently using different behavioral logics. In doing so, we incorporate existing constructs in effectuation theory into this new construct by explaining *how* an unanticipated consequence

relates to uncertainty, effectuation, and causation constructs. The above theorizing efforts yield two important implications for entrepreneurship scholars at both theoretical and operational levels (Corley and Gioia, 2011).

Firstly, we strongly urge entrepreneurship scholars to take temporality into consideration. This is because our data suggest that the new venture creation process might incorporate different understandings of relationships between constructs. A distinctive feature in much of the current theorizing about effectuation is the central role of the uncertainty construct in explanations of effectuation and/ or causation logic. Research has implicitly assumed that the process by which uncertainty is perceived has no impact on entrepreneurial behavioral logics (e.g., McKelvie et al., 2011; McMullen and Shepherd, 2006; Song and Montaya-Weiss, 2001). One major outcome of this predisposition is that entrepreneurial perceptions and behavioral logics are ontologically favored over amorphous and disparate processes. It discounts the fact that the in situ responses of entrepreneurs themselves may generate unanticipated consequences and state, effect, and response uncertainty, without interacting with external environment (MacKay and Chia, 2013). Taking temporality into consideration, we observe that as venture creation progresses, it is therefore the organizations' very act of choosing a particular course of action that generates the unanticipated consequences they subsequently face. More specifically, causation actions are more likely to be associated with unanticipated consequences than effectuation actions.

In order to take temporality into consideration, we suggest that in addition to observing distal outcomes (success or failure in new venture creation), as most researchers in the field are trained to do, much more attention should be devoted to the attainment of more proximal milestones, or approximate outcomes (Van de Ven, 2007). This is because actions chosen to address perceived immediate concerns may create longer-term ramifications (Merton, 1936). Approximate outcomes can be achieved by observing how sequences of

activities and critical events unfold over time (McMullen and Dimov, 2013). By conducting event-based process studies, and observing venture creation processes through holistic sets of actions, process studies will help us improve our understanding of how unanticipated consequences occur and how entrepreneurs face and cope with them.

Secondly, from the outset of effectuation theory in 2001, uncertainty has been considered the most important boundary condition within which effectuation applies (e.g. Berends et al., 2014; Fisher, 2012; Reymen et al., 2015; Sarasvathy, 2001; 2008). Our study furthers effectuation theory by proposing the notion of unanticipated consequences of actions as the boundary condition within which effectuation theory applies. In other words, the boundary condition for effectuation corresponds to how entrepreneurs predict the consequences of the subjects' actions. This notion enables scholars to apply effectuation theory from contexts of uncertainty (Sarasvathy, 2001) to situations in which actions yield unanticipated consequences, broadening the applicability of effectuation theory.

The refinement of the boundary condition suggests that for scholars studying *why* and *when* effectuation is used (Arend et al., 2015; Perry et al., 2012; Read et al., 2016), how unanticipated consequences occur and their relationships with systematic variations in the development of perceived uncertainty, associated with distinctive control systems, should be considered to be central elements. For example, scholars could consider perceived uncertainty to be a mediator in the relationship between unanticipated consequences and effectuation. Specifically, the entrepreneurial ability to acknowledge, face and cope with unanticipated consequences (Minniti and Bygrave, 2001) is an important consideration when investigating entrepreneurial actions during new venture creation, because an unanticipated consequence represents a plausible condition for the occurrence of perceived uncertainty and behavioral logic shifts.

5.4 Practical implications

Our research has important practical implications for both entrepreneurs and investors. Entrepreneurs commonly combine and shift between different behavioral logics. During the actual venture creation process, entrepreneurs often need to find people who adopt complementary behavior, value similar ideas, or follow similar paths. Our study of the antecedents of different behavioral logics helps entrepreneurs to identify their optimal early-stage collaborators. Entrepreneurs can benefit from considering their collaborators' ability to acknowledge and cope with unanticipated consequences in order to decide whether a particular person is suitable to work with. This advice is also beneficial for venture capitalists and other types of investors, especially those investing in new ventures in high-velocity industries. For example, venture capitalists can select entrepreneurs by considering how they react to situations with unanticipated consequences. We urge entrepreneurship educators in general to provide more training on how to react in response to unanticipated consequences. With future research on how each behavioral logic may lead to different entrepreneurial outcomes, we could develop guidelines for how and when to employ either behavioral logic or a combination of logics.

5.5 Limitations and future research

This study is subject to certain limitations that provide opportunities for future research. Firstly, our study excludes information other than types of uncertainty and the two types of behavioral logic. Other forms of uncertainty (e.g., sources of uncertainty, technology, and market) were not taken into consideration in this study. In addition, we did not consider other behavioral logics, such as experiential learning (Gavetti and Levinthal, 2000) and bricolage (Baker and Nelson, 2005). Therefore, we were unable to observe how entrepreneurs behave when other forms of uncertainty are present; nor can we say much about what entrepreneurs do when causation and effectuation are absent. We hope that future scholarly work, while attempting to confirm or refute our key findings, could also complement and

expand on the role of unanticipated consequences in explaining entrepreneurial action by including a broader set of behavioral logics and sources of uncertainty.

Secondly, in this study, we did not determine whether the use of effectuation or causation is a deliberate, habitual, or created practice. To further effectuation theory, researchers could consider how and when entrepreneurs learn to effectuate and how habituated effectuation responses occur in different contexts of the venture creation process (Reuber et al., 2016). Effectuation theory consists of a set of heuristics that are learnable and teachable (Read et al., 2016). Therefore, by studying how individuals, entrepreneurial teams, and organizations learn to make effectuation a habitual practice, we could further effectuation theory by showing how habit and creativity are intertwined in effectuation activities.

Despite these limitations, we believe that our findings challenge the scholarly knowledge of uncertainty as an antecedent of entrepreneurial behavior, and hope that both academics and practitioners will benefit from them. Indeed, because new ventures drive the economies of most nations, including on emerging markets, we believe that it is essential to develop a better understanding of the perceived uncertainty and behavioral dynamics that occur during the early stages.

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