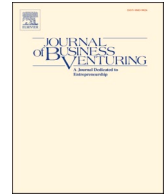




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Ecological rationality and entrepreneurship: How entrepreneurs fit decision logics to decision content and structure

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ABSTRACT

During new venture creation, entrepreneurs make decisions in a variety of areas from seeking funding to hiring employees. When and why entrepreneurs use effectual or causal logics to make such decisions is poorly understood. In this study, we integrate ecological rationality theory and effectuation theory to examine how the nature of decisions influences entrepreneurs' use of decision logics. In a qualitative study with 41 entrepreneurs across 290 decisions, we explore how decision content (what the decision is about) and decision structure (what information about a decision is represented in the decision-maker's mind) influence entrepreneurs' use of effectual or causal logics. We extend our findings in an experiment with 224 entrepreneurs where we manipulate decision structure. Our results suggest that decision content influences entrepreneurs' mental representations of decision structure. In turn, the combination of two elements of decision structure — decision complexity and the perceived costs of implementing different options — drives entrepreneurs' use of decision logics. We contribute to the effectuation literature by integrating it with ecological rationality theory, introducing the concept of *decision fit* as a driver of decision logics, and developing our understanding of hybrid decision-making (the simultaneous use of effectuation and causation).

1. Introduction

New venture creation requires entrepreneurs to make decisions in all firm areas, from recruiting co-founders and first employees, to funding their ventures (Shepherd et al., 2015). How entrepreneurs make these decisions has been explored using many approaches and theoretical frameworks (Mitchell et al., 2007, 2004), one of the most widely used being effectuation theory (Perry et al., 2012; Sarasvathy, 2001a, 2008). Effectuation is a non-predictive decision logic whereby entrepreneurs use existing means to create new effects (Sarasvathy, 2001a; Sarasvathy and Dew, 2005). It contrasts with causation, a decision logic wherein entrepreneurs seek to predict the future and plan actions accordingly (Dew et al., 2009a). Effectuation and causation are seen as alternative decision logics relying on different principles with regard to the decision-maker's approach to *organizing means, investing resources, and dealing with contingencies and stakeholders* (Brettel et al., 2012; Fisher, 2012; Sarasvathy, 2001a, 2001b).

Effectuation research has grown considerably (Grégoire and Cherchem, 2020), and started to investigate the antecedents underpinning entrepreneurs' use of effectual and causal decision logics. Studies connect the increased use of effectuation with individual

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characteristics, such as entrepreneurial expertise (e.g. Dew et al., 2009b) and founder identity (e.g. Alsos et al., 2016). Other research finds effectuation relates to venture characteristics such as high uncertainty (Jiang and Tornikoski, 2019; Wiltbank et al., 2006), resource constraints (Karami et al., 2020), and constraints arising from stakeholder pressure (Reymen et al., 2015) and changes in key personnel (Nummela et al., 2014). These venture characteristics co-vary with the venture's stage of development (e.g. Berends et al., 2014): for instance, uncertainty is typically high in the early stages of new venture creation and tends to reduce as the venture becomes more mature (Sarvasvathy, 2008).

Several studies provide evidence for heterogeneity in the use of effectuation, even given the effects of individual and venture characteristics. For instance, although effectuation is often attributed to expert entrepreneurs, novice entrepreneurs also use effectual logics (Politis et al., 2010). Similarly, while effectuation is typically associated with early-stage venture development, entrepreneurs also use causation in the start-up phase (Jiang and Tornikoski, 2019) as well as effectuation in later stages (Reymen et al., 2015). Aligned with such observations of heterogeneity is an increasing recognition that effectuation and causation may be 'mixed and matched' (Read et al., 2016; Reymen et al., 2015; Smolka et al., 2018); however, when and why entrepreneurs rely on one or the other, or both logics, to make decisions remains poorly understood (Read et al., 2016, p. 531–532).

How then can this heterogeneity be further understood and explained? One potential source of such heterogeneity may be heterogeneity in the *nature* of the very decisions that entrepreneurs encounter at various venture-development stages, or in different venture circumstances. There may be heterogeneity in the content of the decisions (i.e. what the decisions are about) that entrepreneurs encounter within the same venture stage: e.g. in the early stages of venture creation, entrepreneurs may face decisions about the value of different opportunities, where and how to invest resources, or stakeholder selection. Evaluating different opportunities and options may leverage a more causal logic (as entrepreneurs use prediction to help them compare the potential of different opportunities), while, according to Sarvasvathy (2008, 2001a), entrepreneurs may be more likely to use effectuation for the two latter decisions (by leveraging the affordable loss and co-creation principles). Furthermore, there may be heterogeneity in the structure of the decisions (i.e. what information is represented in decision-makers' minds) that different entrepreneurs encounter within the same stage. For instance, certain entrepreneurs may have more information on product design, because it leverages a technology they are already familiar with through their previous industry work experience. By contrast, when hiring an early employee, they rely on limited information from a CV and interview. We can expect that entrepreneurs are more likely to use effectuation for the hiring decision because they are relying on limited, uncertain information (cf. Milliken, 1987), and causation for the product-design decision where they can leverage information with more certainty (Wiltbank et al., 2006). In summary, both the content and structure of the decisions that entrepreneurs encounter may influence their use of effectuation and causation. Thus, in this paper, we ask: Could some of the decision content entrepreneurs face lend itself better to effectual logics, and other decision content to causal logics, irrespective of individual differences and venture development stage? If so, what is the structure or defining characteristics of these decisions that may help future research to predict when and why entrepreneurs use particular decision logics? Thus, we propose exploring *decision fit* — the alignment between decision logics and the nature of decisions — as an important, hitherto overlooked, explanation and driver of entrepreneurs' use of effectual and causal logics.

To explore the nature of decisions and decision fit, we draw on a prominent theory from the cognitive sciences — ecological rationality theory (Todd et al., 2012), which is concerned with understanding the nature of decisions and, in turn, how different decision-making strategies fit different types of decisions (Gigerenzer and Gaissmaier, 2011). It differs from logical rationality, i.e. the idea of optimal decision-making (i.e. optimizing) that considers all the information that is available to the decision-maker, is logically coherent, and conforms to probability theories (Tversky and Kahneman, 1986). Instead, ecological rationality highlights how other decision-making strategies, such as fast-and-frugal heuristics (i.e. strategies that ignore part of the information available) are widely used (including by managers, see Luan and Reb, 2017), because they provide a better fit with particular types of decisions and outperform logically rational strategies for these decisions (Luan et al., 2019; Todd et al., 2012). Ecological rationality typically investigates domain-general decision-making strategies (e.g. heuristics such as take-the-best; Gigerenzer et al., 1999), rather than domain-specific decision-making strategies, such as effectuation.

In this study, we integrate insights from ecological rationality theory (Todd et al., 2012) with effectuation theory to investigate when and why entrepreneurs use effectual or causal logics to make particular decisions. Ecological rationality provides a framework for understanding the nature of the decisions entrepreneurs face, and to explore how entrepreneurs adapt the decision logics they use to fit with the *decision content* and *decision structure* of these decisions. We are interested in answering the following research question: *In what ways do decision content and structure drive entrepreneurs' use of effectual and causal logics?* We first conduct a qualitative study with 41 entrepreneurs in the United Kingdom and analyze 290 new venture decisions. In a supplemental experiment with 224 entrepreneurs, we manipulate decision structure to corroborate and extend our qualitative findings. We find that decision content drives entrepreneurs' use of effectual and causal decision logics and principles. Furthermore, the combination of two elements of decision structure — decision complexity (i.e. the number of options considered) and perceived costs (i.e. the anticipated costs of implementing an option) — explains *why* entrepreneurs use distinct logics for decisions differing in content.

The current study contributes to the entrepreneurship literature in two main ways. First, by integrating effectuation and ecological rationality theory (Gigerenzer and Gaissmaier, 2011; Todd et al., 2012), we draw attention to a new important concept: decision fit. Thus, we offer new insights into the micro-foundations (Shepherd, 2015) of effectual and causal decision logics. This enables us to better predict and understand when and why entrepreneurs use effectual and causal logics in response to particular decisions (Read et al., 2016). By showing that decision content, through structure, drives the use of effectual and causal logics, we complement research emphasizing individual and venture-related antecedents (Berends et al., 2014; Dew et al., 2009a; Grégoire and Cherchem, 2020). This enables us to explain *why*, even within the same level of expertise or venture development stage, entrepreneurs switch between differing logics. In line with ecological rationality theory, the decision logic entrepreneurs use is a function of its fit with the

nature of the decision they face (i.e. its content and structure).

Second, by focusing on decision fit, we extend our understanding of ‘hybrid’ decision-making beyond outlining sequential switches between logics (Reymen et al., 2015). Specifically, we pinpoint the *simultaneous* use of effectual and causal principles for the same decision. Again, ecological rationality allows us to explain how and why certain characteristics of the decision are a good fit with such hybrid logics (whereas other decisions are a good fit for causation or effectuation). This insight is important and extends past research which points at the co-occurrence of effectuation and causation, for example during the same venture development phase (cf. Reymen et al., 2015), but which has not been able to uncover the underlying reasons. In brief, understanding the nature of decisions extends our understanding of entrepreneurs’ (hybrid) decision-making.

2. Theoretical background

2.1. Effectuation theory

Effectuation theory offers an account of entrepreneurial decision-making under uncertainty (Saravathy, 2001a, 2008). Effectuation has become a widely adopted theoretical framework for studying entrepreneurial decision-making, and one of the most researched constructs in the entrepreneurship literature (Grégoire and Cherchem, 2020; McKelvie et al., 2020; Perry et al., 2012). Effectual and causal logics consist of four contrasting principles (summarized in Table 1) that capture how entrepreneurs make decisions on distinct issues they encounter during new venture creation: organizing means, investing resources, dealing with contingencies, and dealing with stakeholders (Brettel et al., 2012; Fisher, 2012; Saravathy, 2001a).

Conceptually, effectual and causal logics are not opposite approaches, and, as such, can be combined (Saravathy, 2001a, 2008). Accumulating empirical evidence attests to the prevalence and advantages of such a hybrid approach to new venture creation, where entrepreneurs shift between effectuation and causation at different stages of venture development (Reymen et al., 2015; Smolka et al., 2018).

Effectuation research has started investigating factors associated with entrepreneurs’ use of effectual and causal logics. Early effectuation research has focused on expertise as a key individual variable associated with increased use of effectual logics (Dew et al., 2009b; Read et al., 2009a; Saravathy, 2001b). Nevertheless, recent studies show that novice and student entrepreneurs also rely on effectuation, casting doubt on expertise being a necessary precondition for the usage of effectual logics (e.g. Politis et al., 2010). Subsequently, founder identity has been explored as a potential individual characteristic related to effectuation, with particular social identities linked to increased use of effectual logics (Alsos et al., 2016). However, research finds diverging result patterns in relation to entrepreneurs’ identities and their use of effectuation and causation (e.g. Sieger et al., 2016). It becomes apparent that research findings on individual antecedents of effectual logics are mixed, with a recent review of the effectuation literature concluding that “evidence about possible relationships between individual characteristics and one’s mobilization of/preference towards effectuation remains inconclusive” (Grégoire and Cherchem, 2020, p. 627).

Research has also considered venture-related antecedents of entrepreneurs’ use of effectual and causal logics. In particular, uncertainty is proposed as a key environmental antecedent to entrepreneurs’ use of effectuation (Perry et al., 2012; Saravathy, 2001a; Wiltbank et al., 2006). Uncertainty tends to co-vary with the venture’s development stage, in that uncertainty is high in the early stages of creation of a venture and tends to reduce as the venture reaches a more mature development stage (Saravathy, 2008). Berends et al. (2014) find that entrepreneurs in small firms tend to use effectuation logics in the early stages of their product innovation efforts when uncertainty levels are high, and gradually shift toward causation logics in later stages as uncertainty reduces. Resource constraints have also been related to entrepreneurs’ increased use of effectual logics (Karami et al., 2020), as well as constraints arising from changes in key personnel (Nummela et al., 2014) or regulations (Maine et al., 2015).

At the same time, several studies reveal heterogeneity in entrepreneurs’ use of effectuation that we do not fully understand. For instance, recent studies show that entrepreneurs use causal rather than effectual logics at the start of the venture creation process, when uncertainty is typically high (Jiang and Tornikoski, 2019). Furthermore, a longitudinal process study suggests that entrepreneurs also use effectual logics in the later stages of development of a venture, for instance in crisis situations when they respond by widening their venture’s scope (Reymen et al., 2015). This is in line with increasing recognition that effectuation and causation tend to co-occur,

Table 1
Effectual and causal principles.

Issue	Causal principles	Effectual principles
Organizing means	<i>Predict the future</i> and plan actions to acquire means accordingly.	<i>Focus on means</i> already within control, direct actions toward creating new effects using these existing means.
Investing resources	<i>Maximize returns</i> : use predictions of future returns to establish size of investment; focus on the upsides of entrepreneurial investments.	<i>Affordable loss</i> : estimate what you would be willing and could afford to lose in a worst-case scenario; focus on the downsides of investment.
Dealing with contingencies	<i>Avoid contingencies</i> : view contingencies as endangering the effective and accurate execution of the business plan.	<i>Leverage contingencies</i> : keep decision-making approach flexible to adapt and gather information through unexpected events.
Dealing with stakeholders	<i>Competitiveness</i> : stakeholders must be carefully selected and enrolled once a clear business plan has been established.	<i>Co-creation</i> : co-opt stakeholders early through <i>partnerships</i> , allowing other actors (e.g. customers, suppliers, other strategic partners) to shape the new venture strategy.

Sources: Chandler et al. (2011); Dew et al. (2009a, 2009b); Martina (2020); Perry et al. (2012); Saravathy and Dew (2005).

and that entrepreneurs mix both approaches in their decision-making (Reymen et al., 2015; Smolka et al., 2018). However, specifically when and why entrepreneurs rely on effectual or causal logics to make decisions is poorly understood (Read et al., 2016). Although the literature has focused on broad venture characteristics, with most attention devoted to uncertainty, it has rarely clarified what type of uncertainty researchers are referring to (Jiang and Tornikoski, 2019). Importantly, the mechanisms through which uncertainty affects entrepreneurs' decision-making, and thus drives their use of effectual or causal logics, are unexplained (Grégoire and Cherchem, 2020). In summary, the antecedents of effectuation remain vague, underspecified, and not as well understood as they should be.

Instead, we propose exploring *decision fit* — the alignment between decision logics and the nature of decisions — as an important, hitherto overlooked, explanation and driver of entrepreneurs' usage of effectual and causal logics. Analyzing effectuation through the lens of decision fit involves exploring the decision logics and principles that entrepreneurs use when making particular decisions (e.g. hiring, creating a marketing strategy). A micro-foundations approach (Shepherd, 2015) is applied to effectuation by exploring individual cognitions and actions. Throughout new venture creation, entrepreneurs make many different decisions, from selecting co-founders or hiring first employees, to creating marketing strategies, or seeking funding for their ventures. Unpacking the nature of the different decisions entrepreneurs face may elucidate the heterogeneity in entrepreneurs' use of effectual and causal logics even within the same venture development stage or for individuals with similar characteristics. To this end, we turn to cognitive science and the theory of ecological rationality, which offer a deeper understanding of how individuals make decisions and the nature of their decisions.

2.2. Ecological rationality

To explore decision fit, we turn our attention to ecological rationality (Gigerenzer and Gaissmaier, 2011; Todd et al., 2012), a prominent theory in the cognitive sciences that emphasizes the fit between decisions and the decision-making strategies individuals use. Other cognitive theories and concepts in psychology also explain how individuals select strategies for thinking and decision-making, such as metacognition (Flavell, 1987, 1979). These frameworks have been successfully integrated with entrepreneurship theory (e.g. Haynie et al., 2012, 2010). However, whereas metacognition explains the cognitive process underpinning thinking about thinking (i.e. how decision-makers select strategies for decision-making), ecological rationality provides an explanation for *why* decision-makers select one strategy over another for particular decisions, making it particularly suitable for investigating the construct of decision fit in relation to effectuation.

Extending Simon's (1955, 1990) work on bounded rationality, ecological rationality theory highlights the importance of understanding both the decision-making strategies individuals use, the decisions in which these strategies are used, as well as how the two fit with each other (Gigerenzer and Gaissmaier, 2011; Todd and Gigerenzer, 2012). It departs from decision-making research focusing on logical rationality, which specifies that optimal decision-making (i.e. optimizing) takes into consideration all the information available to the decision-maker, is logically coherent, and conforms to probability theories (Tversky and Kahneman, 1986). Ecological rationality argues that in "large worlds" (i.e. when the future is uncertain and not all information is known; Savage (1954)), achieving logical rationality is impossible; instead, the decision-maker needs to use decision-making strategies that adapt to the decisions encountered. Put differently, similarly to Simon's (1990, 1955) bounded rationality concept, ecological rationality theory recognizes the limitations of human cognition, specifically that it is impossible for humans to attend to and process all available information, which means that optimizing and logical rationality are often simply unrealistic for real-life decisions. Instead, ecological rationality emphasizes the *fit* between decision-making strategies and the nature of decisions an individual faces (Gigerenzer and Gaissmaier, 2011).

Ecological rationality theory acknowledges that individuals have evolved, through evolution and learning mechanisms, a so-called adaptive toolbox containing a variety of different decision-making strategies. These strategies range from optimizing, to so-called fast-and-frugal heuristics that ignore part of the information available to the decision-maker (Gigerenzer, 2008; Gigerenzer et al., 1999). Rather than certain decision-making strategies being intrinsically best ("optimal") or worst, ecological rationality considers certain strategies *better* suited to some decisions than others (Gigerenzer et al., 1999; Todd and Gigerenzer, 2012).

Thus, ecological rationality theory highlights that in order to understand decision-making, we need to understand the nature of the decisions that individuals encounter. Specifically, a decision can be decomposed into its content, or what the decision is about (Gigerenzer, 1995; Goldstein and Weber, 1995), and its structure (what information about the decision and its elements is represented in the decision-maker's mind) (Pleskac et al., 2020). These two aspects of a decision are related in that individuals transform an input (i.e. the content of the decision they encounter) into a mental representation (i.e. decision structure) based on which they make a decision (Rettinger and Hastie, 2001). These mental representations, like all attention and cognition, are selective rather than accurate and complete one-to-one representations of a particular decision. This is because humans are limited in their cognitive capacity (Johnston and Dark, 1986).

Research examining individuals' decision-making strategies on the same basic decision across different contents (e.g. choosing a spouse, an electronic device, or whether to plagiarize on an academic essay) suggests that individuals use decision-making strategies that fit the specific content of the decisions they encounter. For instance, individuals tend to use narrative-based decision-making strategies for decisions involving choosing a spouse, wherein they imagine how their life would unfold should they choose different options; or additive strategies for decisions involving choosing objects (e.g. CD players), wherein they compare features additively (Goldstein and Weber, 1995). This demonstrates the importance of investigating how decision content (what a decision is about) impacts decision-making strategies (how individuals make decisions).

The effects of decision content on decision strategy are explained by changes in the mental representations (i.e. decision structure) that individuals form of the contents of these decisions. Research shows that the type of information individuals encode as part of

decision structure varies across different decision contents. For instance, the structure of financial and legal decisions contains more numerical information relative to academic and gambling decisions (Rettinger and Hastie, 2001). In turn, in line with predictions of ecological rationality theory, past research has shown that individuals use decision-making strategies adaptively, by selecting strategies that show good fit with the structure of the decisions they encounter (Luan and Reb, 2017; Payne et al., 1993; Todd and Gigerenzer, 2012). For example, fast-and-frugal heuristics have been found to outperform optimizing for decision structures that present higher levels of uncertainty and fewer data (Gigerenzer and Gaissmaier, 2011).

2.3. Integrating effectuation and ecological rationality theory

In this study, we integrate insight from ecological rationality theory with effectuation theory to deepen our understanding of when and why entrepreneurs rely on effectual and causal logics. Effectuation provides an account of the decision-making strategies entrepreneurs use during new venture creation (Sarasvathy, 2001a). On one hand, causal logics can be seen as examples of optimization strategies that seek to use all the information available to the entrepreneur to predict the optimal course of action for achieving a long-term goal. Causation may be seen as overlapping with the logical rationality approach whereby the entrepreneur is seeking to make optimal decisions. On the other hand, effectual logics can be conceived as domain-specific heuristics whereby entrepreneurs limit their search for information by focusing on simple principles and approximations of their environment. For instance, the affordable loss principle acts as a heuristic specifying the size of the investments that entrepreneurs make depending on what they can afford and are willing to lose in a worst-case scenario (Martina, 2020). A causal logic would entail calculating the necessary investment for maximizing the potential returns for the entrepreneur.

However, from an ecological rationality perspective, effectuation theory is incomplete because it does not specify for what *kinds* of decisions entrepreneurs use effectuation and/or causation. Ecological rationality theory argues that in order to understand decision-making, we also need to understand the nature of the decision — i.e. the content and structure of the decision — that the decision-maker approaches, as well as how the decision-maker adapts the strategy they use to decision content and structure (Pleskac et al., 2020; Todd and Gigerenzer, 2012). Thus, by integrating effectuation and ecological rationality theories, several new questions arise: how do entrepreneurs transform decision content into mental representations of decision structure; how do entrepreneurs cognitively represent decision structure; and, finally, how do decision content and structure drive entrepreneurs' use of distinct decision logics?

3. Method

Due to the lack of previous research investigating how entrepreneurs adapt their use of effectuation and causation in response to the various decisions they encounter in the new venture creation process, we conducted a primary qualitative study (Shepherd and Sutcliffe, 2011) and a supplemental experiment (Grégoire et al., 2019), wherein we manipulate decision structure, in order to corroborate, triangulate, and extend our inducted findings.

3.1. Sample

The primary sample of our qualitative study comprised 41 owner-managers of companies between two and seven years old, who had firsthand experience in making decisions related to new venture creation (Bird et al., 2012). We recruited entrepreneurs through a mix of personal contacts, cold calls, and the snowball technique, as is common in qualitative research (e.g. Ashforth et al., 2007). We used a combination of theoretical sampling (Eisenhardt and Graebner, 2007) and maximizing variability in our data in order to enable theory development (Bluhm et al., 2011). In line with previous research on the antecedents of effectual and causal logics (e.g. Berends et al., 2014; Dew et al., 2009a; Reymen et al., 2015), we sought high heterogeneity among participants with regards to several key variables that influence entrepreneurs' reliance on effectuation in previous research: entrepreneurial experience, firm size, firm age, and industry. Overall, 65% of participants were male, and were diverse in terms of education (22% had no university degree, 37% undergraduate degree, 41% postgraduate degree); 54% of participants co-founded their businesses, and 61% were first-time business-founders. Participants had, on average, 5 years of managerial experience ($SD = 5.66$, $min = 0$, $max = 27$). The ventures included in the sample were, on average, 3.51 years old ($SD = 1.37$, $min = 2$, $max = 7$), had a mean of 14 employees ($SD = 23.11$, $min = 0$, $max = 110$), and operated in 14 different industries, including Construction, Finance, Arts, and Technology. Nineteen ventures offered products (46%), 21 ventures offered services (51%), and one offered a combination of both (2%).

3.2. Data collection

We used several entrepreneurial decision-making data sources to triangulate our findings: interviews with entrepreneurs, social media data, and archival sources.

As our primary data source, we conducted in-depth, semi-structured interviews which lasted an hour on average. The interview guides were developed from a review of previous effectuation literature and contained elements of the critical decision method, an adaptation of the critical incident technique used to study decision-making processes during non-routine/significant events (Flanagan, 1954; Klein et al., 1989). Interviewees provided a brief description of their venture and a timeline of the main events shaping the development of their venture since its creation (i.e. the moment when the entrepreneur started working on exploiting the idea for the venture) until the time of the interview, using a visual prompt, and were asked to date these events, a technique intended to minimize recall biases (Kahneman et al., 2004). An example of such a visual prompt completed by one of our research participants can be found

in [Appendix A](#). Based on the timeline they provided, participants were asked to note the most significant decisions they made over the course of venture development. The interviewees were prompted to provide examples of both successful and unsuccessful decisions, as well as decisions where no particular action was decided. On average, each interviewee talked about four to five decision events. Importantly, focusing on these critical decisions ensured that recall biases were minimized, considering past research has shown that individuals recall significant decision events accurately ([Chell, 2004](#)). Finally, the interviewer probed each decision mentioned by the participant using a series of questions designed to elicit discussion of decision-making processes (e.g. “Walk me through the thought process you went through when you made this decision.”; “Can you tell me more about the options you considered as part of your decision-making?”; “What were the factors that weighed in on this decision?”). The interviewer focused on entrepreneurs’ *perceptions* of the decision, and, in particular, what information about the decision and its elements was represented in the decision-maker’s mind (i.e. decision structure). Each interview was recorded and transcribed.

As already detailed, several measures were implemented to minimize potential biases related to the use of the retrospective recall data collection methodology. In addition, to check validity and triangulate our interview findings, we collected data from social-media forums for entrepreneurs as a more concurrent and unobtrusive data collection method. Our interviewees suggested that social-media forums are a resource they frequently employ when seeking advice outside of their existing professional and social network on important decisions. Indeed, data collected through social media has been employed in a variety of research fields, including entrepreneurship (e.g. [Fischer and Reuber, 2011](#)). We collected 343 posts and associated comments posted across 10 open groups for business founders and entrepreneurs, across two social-media platforms (Facebook and LinkedIn). Data were anonymized and used to validate whether the types of decisions participants mentioned in their interviews matched the types of decisions entrepreneurs posted about on these groups. We found substantial overlap in the content as well as structure of the decisions described by entrepreneurs in their social-media posts and those mentioned by entrepreneurs during the interviews (89% agreement), which provided further evidence of the validity of our primary data source and helped triangulate our findings.

Lastly, we used archival sources (e.g. firm websites, firm information from Companies House¹) and firm documents (e.g. business plans, marketing materials) provided by participants to supplement and cross-check the interview data.

3.3. Data coding and analysis

We coded data in three main stages. First, we coded each decision in terms of content, using [Shepherd et al.’s \(2015\)](#) broad taxonomy of entrepreneurial decision-making content to guide our coding. We then used a more granular set of content categories (see [Table 2](#)) to capture subtler differences in content between decisions and add new content categories that were present in our data.

To do this, each decision event was decomposed into individual decisions, and each decision was coded according to the content category it represented. For instance, one of the interviewees talked about an event where they made a decision related to selecting a product idea to turn into a prototype, and how to implement and market the product; this event would be decomposed into three individual decisions, each coded in terms of content. This step enabled later analysis of between-content category heterogeneity in the logics that entrepreneurs reported. [Table 2](#) provides the detailed code structure and exemplary quotes for each decision content category.

In stage two, we inductively coded the elements of decision structure mentioned in the entrepreneurs’ accounts, i.e. any information about the decision and its elements and how it was represented in the decision-maker’s mind. The decision structure elements that we identified in the data included the different options or alternatives entrepreneurs considered for each decision, the type and source of information the entrepreneurs gathered about the decision, their expected consequences, and the likelihood that these different consequences materialize, informational costs related to acquiring more information, and time pressure. We were particularly interested in elements of decision structure that related to entrepreneurs’ use of specific decision logics. Two elements of decision structure — decision complexity (the number of options) and the costs of implementing different options — emerged as key drivers of entrepreneurs’ decision-making.

Regarding decision complexity, the median number of options that entrepreneurs mentioned in their reports was six, with a standard deviation of two. We coded decisions where entrepreneurs considered fewer than four options (median number of options minus one standard deviation) as decisions low in complexity, between four and eight options as medium, and more than eight options (median plus one standard deviation) as high in complexity. We performed sensitivity analysis with different cut-offs for categorizing decision complexity and replicated our findings (results available upon request).

Costs were defined loosely in terms of expenditure of resources, and this included financial and non-financial costs (e.g. time, as per [Lévesque and Stephan \(2020\)](#)). Because we were interested in elements of decision structure as perceived by the entrepreneurs, we qualified costs based on participants’ subjective perceptions. Decisions where entrepreneurs used qualifiers such as “reasonable”, “cheap”, or “quick and easy to do” to describe these costs were coded as low, qualifiers such as “it wasn’t easy, but it could be done” were coded as medium, and qualifiers such as “it was quite a significant investment” were coded as high.

To facilitate interpretation of our findings relating to decision structure, we introduce four archetypes of decision structure based on combinations of the two decision structure elements that emerged from our data, namely complexity and costs. The four archetypes are presented in [Fig. 1](#), and depict routine decisions (low complexity, low costs), testing-the-waters (high complexity, low costs), committing (low complexity, high costs), and direction-setting (high complexity, high costs) decisions. We note that although we did

¹ Companies House is an executive agency that registers, and makes publicly available, information on all businesses incorporated in the UK, including the nature of business (SIC), company status (e.g., live, dissolved), directorship, and accounts filed.

Table 2
Coding structure for decision content (coding of content categories and coding of their issue focus) and exemplary quotes.

Decision content category	Coding of issue focus				Exemplary quote
	M	I	C	S	
Human resources - hiring	X			X	"I think everything comes down to having a good team involved, right? So I think it needs to be something, there's no way you can do this with an average team. If you have an average team, you get an average company. There's no way you get an average team and a super company, I think." [E1]
Human resources - firing	X	X			"[...] the person who is not the right person for your company, it's a sort of poisonous injection in your daily work where all the interactions are somehow altered by the disposition of this person [...]. If you know already that it's not going to work, somehow it's more unfair to prolong this agony, even for the person who doesn't like at all the outcome of this process. And we had an incredible improvement on the quality of our work since this person left." [E6]
Human resources - management	X		X	X	"Human management is always the most difficult thing in the world in terms of managing a company and businesses. It's not about your product, the product is important, but the human is more important. If you get the right people to do the right thing, your business no matter what will still be fine." [E3]
Financial resources - funding	X	X		X	"I think the first step is actually identifying how you're raising investment? So either raising funding with business angels, or with VC funds. [...] And then identifying the right partners, that's really important." [E22]
Financial resources - investment			X		"Raising a bit of money can be a double-edged sword, because on the one hand you suddenly have the firepower to do more things and you want to spend it because you should spend it. But there's a very real risk that you... either you have contractors trying to take advantage of you or people see you have money, and they try to... you just bring on the wrong people." [E26]
Product or service ideas	X	X	X		"I was looking at a lot of finance ideas, but I didn't really love anything that I sort of came up with, and then [...] I came up with this idea that intrigued me because it includes a few things, psychology, [...], software and gamification" [E1]
Implementation	X	X			"another critical decision was to actually build an app. So that is the technology decision, because in my last company we were used to building websites... so that didn't make the decision to build an actual app that easy." [E37]
Marketing	X	X			"The problem I have isn't the idea, isn't the concept, isn't even really the website [...], it's more the marketing. So definitely marketing is a big problem because, so I've restricted it largely to digital methods at the moment, [...] there aren't that many channels for me to find that quality organic traffic" [E10]
Branding	X			X	"I suppose our brand strategy, how do we present that and we have a real problem actually, which is a lot of students in the UK, because they've never had a B2C supplier before, they say well I need to go to my university's official supplier. So we have to kind of convey some authority and legitimacy, whilst at the same time, saying that we are fun, and interesting, and student-focused. [...] So we have a really difficult balance." [E5]
Sales strategy	X	X	X	X	"that really specific early stage hustle that every entrepreneur goes through, which I think is really important for the journey because that's when you literally get the coldface, every day, in a very simplistic sense. If you've got a product, call it what you like, but you're out holding your product around hustling." [E23]
Business development	X		X	X	"When we got going we started basically going out talking to clients, trying to bring clients on board. We started to think of how do we raise awareness for the product, how do we start to market?" [E21]
Business model	X		X	X	"Whether it's consultancy where you charge a day rate for a certain number of days to go and advise and do some work for the company, or it's a product where you are selling to multiple customers and they are consuming it... you need to understand what customers are willing to pay for those things... but also what it costs you to deliver it to them. [...] it's just the fundamental of understanding if you've got a profitable business or not." [E22]
Pricing	X	X	X	X	"I think it is really basic stuff like setting up rates for different types of work, which is quite important. So like covering overheads and how many hours of work... especially when I am doing my degree, I have to figure all of that out." [E38]
Production	X	X			"What are we going to do, we need to do something, because otherwise I don't feel comfortable going out there to someone, and then asking me for 30 pieces or whatever it is, and not having 100% certainty that I can deliver that." [E7]
Cash flow management	X	X			"I think cash flow management is such a daily thing to be involved with and we definitely had to go down routes that were not ideal but it kind of forced us to make some decisions." [E31]
Internationalization	X	X	X	X	"So we are in the process of taking it out, very much the way it happens now is that we are still trading online the way we used to do initially in Brazil, because there's still many things we need to adapt. There's just too many things to reverse." [E7]
Expanding offering / verticals	X	X	X		"We probably need to diversify and we need more revenue streams. We had a very serious meeting to decide what other revenue stream we could venture into." [E41]

Note. M = organizing means; I = resource investment; C = dealing with contingencies; S = dealing with stakeholders. This coding reflects the issues that each decision content related to (e.g. hiring decisions relate to organizing means and dealing with stakeholders).

not find any occurrences of the routine decision archetype in our qualitative data, we include this archetype in our figure for completeness. We believe this is an artefact of the methodology used to elicit data in this study, in particular our focus on decisions considered as significant by the decision-maker. Given that high complexity levels and/or high costs posed additional challenges to the decision-maker, these decisions may be more salient and thus more readily available for recall to interviewees as well as to entrepreneurs seeking advice on social media.

Finally, in stage three, we coded each of the individual decisions previously identified in terms of the participants' decision principles and logics. We identified specific descriptors for each of the principles typically associated with effectual and causal decision

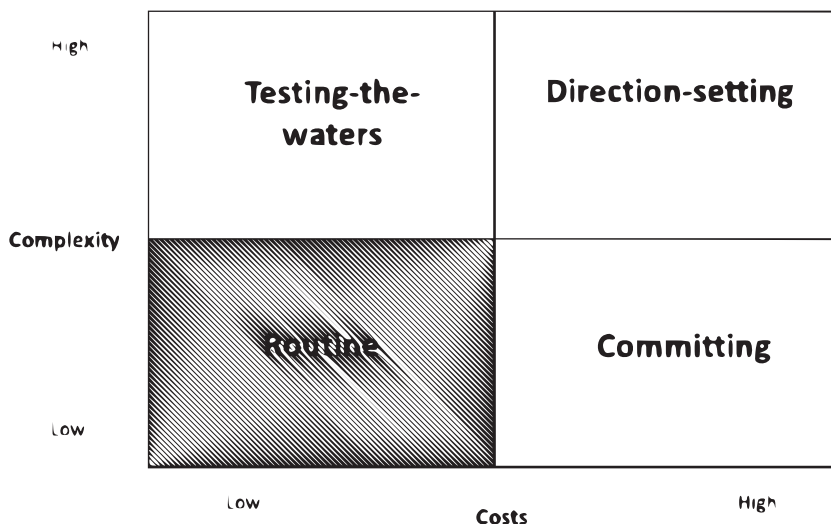


Fig. 1. Decision structure archetypes emerging from our data, reflecting combinations of decision complexity and costs as key elements of decision structure (Qualitative study).

logics, based on past effectuation research (e.g. Dew et al., 2009a; Reymen et al., 2015). Once all the principles used by entrepreneurs during decision-making were coded, we also coded the overall logic that the entrepreneur used for each decision: effectual if they only used effectual principles, causal if they only used causal principles, and hybrid if they used both effectual and causal principles for that decision. Table 3 provides the detailed code structure and exemplary quotes for each principle. Three coders independently coded principles and logics for each decision (290 decisions overall). Differences between coders were resolved through discussion.

As an additional robustness check, given the significant proportion of entrepreneurs in the sample who were part of a team of founders where decisions were likely to also involve co-founders, we checked for any systematic differences between solo and co-founders' accounts of their decision-making. The distribution of usage of different logics across the different decision content categories was similar across the two groups.

Our analysis strategy consisted of a mix of qualitative and quantitative research procedures (Van de Ven, 2007), and allowed us to examine relationships between our three main constructs of interest: decision content, decision structure, and decision logics.

Table 3
Coding structure and exemplary quotes of decision logics.

Logic	Principles	Exemplary quote
Causation	Basis for action: Prediction	"I estimated the size of the market to be around £90 million annually [...] so I thought this was worth giving it a go as a business" [E5]
	View of risk and resources: Maximize returns	"I did business plans and projections and I thought I need to... in order to play, you have to pay, right? So you need to invest in order to get growth." [E1]
	Attitude toward contingencies: Avoid	"I do not think this is the right time for us to take up management space, when we really should be focusing on doing our original product, making actual productions and going on tour" [E37]
	Attitude toward outsiders: Competitiveness	"We thought that to compete with the incumbent supplier who is so well established, we had to differentiate ourselves, and price alone was not a differentiator. And also for the long term of the business, it is not inconceivable that they will drop their prices [...] and then as soon as they do that, we become less competitive." [E5]
Effectuation	Basis for action: Focus on means	"I believe I am probably the person in London that knows most about female entrepreneurship, knows most about what those women want. So this is basically what I've been doing: starting a community, running events, launching a space, and taking things from there." [E11]
	View of risk and resources: Affordable loss	"we needed less of an investment to bring it here [UK] than to extend the range of what we do, so... I think it was the right step, both financially and in terms of developing the business" [E7]
	Attitude toward contingencies: Leverage	"I can tell you retrospectively what each quarter looked like for the past 3 years... but if I had sat back and started off here at 2016, it would look nothing like this. [...] That arrow you've got there, we've been all over the place. [...] So it's not linear." [E30]
	Attitude toward outsiders: Co-creation	"the first big thing for us would be to have a commitment to actually use whatever we produce, so to have someone to be the first user of the platform. What we want is a partnership in the sense of helping us improve it, getting feedback, getting more data" [E6]

Table 4

Prevalence of decision logics and principles for each decision content category mapped onto decision structure and decision archetypes (41 participants, 290 decisions).

Decision content (number of instances coded)	Decision logics and principles									Decision structure		Decision archetypes
	Effectuation				Causation				Hybrid	Complexity	Costs	
Human resources – Hiring (31)	55%				32%				13%	High	Low to Medium	Testing-the-waters
	FoM	AL	LC	CC	P	MR	AC	Co				
	32%	6%	13%	48%	23%	35%	6%	13%				
Human resources – Management (16)	63%				25%				12%	Medium to High	Low to Medium	
	FoM	AL	LC	CC	P	MR	AC	Co				
	25%	6%	38%	44%	25%	19%	0%	0%				
Product or service ideas (37)	46%				19%				35%	High	Variable	
	FoM	AL	LC	CC	P	MR	AC	Co				
	30%	8%	51%	22%	32%	19%	11%	11%				
Business model (11)	45%				36%				19%	Medium to High	Low to Medium	
	FoM	AL	LC	CC	P	MR	AC	Co				
	45%	9%	36%	36%	9%	18%	0%	18%				
Human resources – Firing (5)	0%				100%				0%	Low	High	Committing
	FoM	AL	LC	CC	P	MR	AC	Co				
	0%	0%	0%	0%	80%	80%	0%	0%				
Financial resources – Funding (24)	29%				50%				21%	Low to Medium	High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	17%	17%	4%	29%	25%	38%	4%	29%				
Financial resources – Investment (10)	40%				60%				0%	Low to Medium	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	0%	40%	20%	20%	20%	50%	0%	10%				
Implementation (e.g. technology to leverage) (19)	21%				53%				26%	Low to Medium	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	21%	11%	21%	16%	37%	32%	21%	16%				
Branding (15)	33%				47%				20%	Low to Medium	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	27%	7%	13%	33%	27%	20%	20%	33%				
Sales strategy (23)	30%				48%				22%	Medium to High	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	9%	13%	30%	17%	26%	26%	39%	30%				
Pricing (8)	25%				75%				0%	Medium	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	25%	0%	13%	13%	63%	38%	38%	25%				
Production (8)	37%				63%				0%	Low	High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	25%	13%	0%	0%	38%	38%	13%	0%				
Cash flow management (7)	14%				71%				14%	Low	High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	0%	28%	0%	0%	85%	0%	0%	0%				
Marketing (24)	38%				33%				29%	Medium to High	Medium to High	Direction-setting
	FoM	AL	LC	CC	P	MR	AC	Co				
	38%	8%	21%	13%	33%	33%	13%	17%				
Business development (20)	40%				20%				40%	Medium to High	Medium to High	
	FoM	AL	LC	CC	P	MR	AC	Co				
	45%	10%	15%	30%	15%	20%	35%	15%				
Internationalization (13)	30%				40%				30%	High	Low to Medium	
	FoM	AL	LC	CC	P	MR	AC	Co				
	31%	15%	23%	23%	23%	31%	23%	15%				
Expanding offering / verticals (19)	42%				32%				26%	High	Variable	
	FoM	AL	LC	CC	P	MR	AC	Co				
	32%	21%	37%	11%	21%	26%	26%	11%				

Note. 1. Abbreviation of decision principles: FoM = focus on means; AL = affordable loss; LC = leverage contingencies; CC = co-creation; P = prediction; MR = maximize returns; AC = avoid contingencies; Co = competitiveness.

We calculate prevalence as the percentage of decisions within a decision content category where entrepreneurs used a particular logic/principle (e.g.

55% of all hiring decisions ($n = 31$), i.e. 17 decisions, were made using an effectual logic). Bold marks the dominant logics and principles for each decision content category. For *decision logics*, we coded as the dominant logic those which occurred with over 45% prevalence. This indicates that rounded up, at least half of decisions were made using this logic. We chose this more conservative cut-off rather than 33% (if there was no preference for one of the logics, we would expect that 33% of decisions would be made using each of the three logics, i.e. effectuation, causation, hybrid logics), to account for potential error given the relatively low number of decisions for some content categories. For *decision principles*, we consider as dominant any principles with over 25% prevalence (if there was no preference between the principles, we would expect that 25% of decisions would be made using each of the four principles).

4. Findings

4.1. Decision-content-fit: decision content drives entrepreneurs' use of distinct logics and principles

We analyze entrepreneurs' reports in terms of the decision logics and principles they used for decisions varying in their content. Table 4 (left-hand side and middle) shows the prevalence of effectual, causal, and hybrid *logics* for each decision content category identified. Overall, entrepreneurs used different logics when making decisions varying in their content: effectual logics dominated decision-making processes for decisions related to hiring, human resource management, selecting between potential product or service ideas to exploit, and choice of business model; causal logics for decisions related to firing employees, choosing financing sources for their venture, investment of financial resources, implementation, branding, sales strategy, pricing, production, and cash flow management.

Lastly, a higher proportion of participants reported using a hybrid logic combining effectual and causal principles, in decisions related to marketing, business development, internationalization, and expansion of the range of products or services offered.

We also conducted a more granular analysis of the heterogeneity in entrepreneurs' use of specific effectual and causal *principles* when making decisions differing in content. Table 4 (middle) presents the prevalence of effectual and causal principles (labelled as focus on means (FoM), affordable loss (AL), etc.) within each decision content category, respectively. As can be seen, content category heterogeneity is observed also in relation to the principles used by entrepreneurs. For instance, focus on means was predominantly used for hiring and business development decisions, affordable loss in investment and cash flow management decisions, leverage contingencies for selecting between product or service ideas, and co-creation for human resource management decisions. Moreover, prediction was prevalent in decisions related to firing and cash flow management, maximize returns in investment, avoid contingencies in pricing and sales strategy choice, and competitiveness in branding. Notably, for each decision content category, there was no single principle that dominated entrepreneurs' decision-making; rather, entrepreneurs used a combination of principles. For instance, for human resource management decisions, entrepreneurs used a combination of the focus on means, leverage contingencies, and co-creation principles.

To further unpack this heterogeneity, we sought to understand *why* entrepreneurs used specific effectual and causal principles for some decision content categories but not others. To do this, we leveraged the issues that each of the effectual-causal principles focus on: organizing means, investing resources, dealing with stakeholders, and dealing with contingencies (see Table 1, left). In participants' reports of each decision's content, we also coded whether each decision content tapped into one (or multiple) of these aforementioned issues that effectual and causal principles dealt with. The results of this coding are summarized in Table 2, second column (codes labelled M, I, C, S).

We observed a close match between the content of a decision (i.e. whether it related to means, investment, contingencies, and stakeholders; as shown in Table 2 second column) and entrepreneurs' use of specific effectual or causal principles (Table 4 middle). For instance, hiring decisions relate to means (e.g. how to source potential candidates) and stakeholders (e.g. future employees), and this can explain why entrepreneurs used the focus on means and co-creation principles for these decisions. Similarly, funding decisions relate to means (e.g. financial resources), investment (e.g. the investment of financial resources), and other related actors (e.g. competitors and how the venture can outgrow them), and this could explain why entrepreneurs predominantly use the prediction, maximize returns, and competitiveness principles for funding decisions. Thus, we observe preliminary evidence of *decision-content-fit for effectual and causal principles*: specific principles fit particular decision content categories better than others. Nevertheless, to unpack the concept of decision fit in more detail, we next explored *decision-structure-fit — or how effectuation and causation may fit particular decision structures* better than others. Before considering decision-structure fit, we explore the relationship between decision content and decision structure.

4.2. The relationship between decision content and structure

In our data, decision content also related to entrepreneurs' perceptions of decision structures. Specifically, decisions about hiring, human resource management, product or service ideas, and the business model were perceived by entrepreneurs as being more open-ended and involving many different options and alternatives. This decision structure corresponds to that of 'creation problems' described by Sarasvathy (2001a) in her seminal work, where a large number of possible effects or options can be imagined or created. These decisions shape and construct the narrative of the future venture, with many potential directions that can be taken at each step, thus resulting in many possible ventures and development trajectories (see Goldstein and Weber (1995) for a similar argument made for decisions that involve endeavors or that are defined by story-like processes, such as choosing a profession or a spouse). Entrepreneurs perceived these decisions as having more options, and hence a more complex structure. For instance, E1 talks about the process of selecting an idea for a product to start prototyping: "I had a lot of ideas [...] it's not always systematic this process, it depends

on your background, I think. For example, my background is in finance so I was looking at a lot of finance ideas". Furthermore, entrepreneurs perceived these decisions as lower in costs, given the possibility of course-correcting and changing course of action to alter the consequences of different options. E28 talked about experimenting with different business models (such as working with governments), and commented that "it's quite quick and it's free, so we can do one tender per month".

In contrast, decisions such as firing employees, acquiring funding, investment, pricing, or cash flow management have more concrete outcomes that can either be quantified or easily imagined. As such, entrepreneurs perceived these decisions as having fewer alternatives (i.e. lower complexity; for example, E2 considered two options when it came to the technology used to implement her product idea) and higher costs, as these were easy to calculate based on the imagined outcomes (e.g. E5 talking about an investment decision: "we could potentially lose a lot of money"). As such, costs became more salient in entrepreneurs' mental representations of these decisions. Furthermore, these decisions are perceived as requiring legitimation and justification vis-à-vis investors and other stakeholders (e.g. the fired employee; Zott and Huy, 2007), thus also incurring potential social costs. We further discuss these different decision structures, as well as how they influence entrepreneurs' use of effectual, causal, and hybrid logics, in the following section.

4.3. Decision-structure-fit: decision structure drives the use of effectual and causal decision logics

4.3.1. Testing-the-waters decisions: high complexity, low perceived costs

The first type of decision structure that entrepreneurs reported was the testing-the-waters decision archetype: high complexity and low perceived costs to implementing options. Most entrepreneurs used effectual logics (over causal logics) when making testing-the-waters decisions (see Table 4, middle and right-hand side). These decisions posed significant cognitive demands due to the complexity incurred by the high number of options. Thus, entrepreneurs were first concerned with reducing complexity by focusing on a more limited set of options. They then proceeded to implement options through experimentation, permitted through the relatively low costs of trying out alternatives. The focus on means and co-creation principles helped entrepreneurs reduce complexity, and the leverage contingencies principle guided entrepreneurs in their cycles of experimentation. In the following paragraphs, we illustrate the ecological rationalities of these three principles.

Due to the high complexity associated with testing-the-waters decisions, entrepreneurs first attempted to control and reduce the number of options they were considering at a given time. The focus on means principle was employed by entrepreneurs to narrow down the number of options, and can be seen as a satisficing strategy (Gigerenzer and Gaissmaier, 2011; Simon, 1955), or a way to ignore part of the information. For instance, E39 makes an inventory of her means, by referring to her identity, knowledge, and social capital to help her decide which countries to expand her venture to next: "So many places I would like to expand to, but I speak French, I am a fluent speaker. So I am thinking, once I have more traction in the UK to go to Paris. Because [...] I speak the language and I know the culture quite well, so the next step would be to go to Paris. And then the next step, I have a good set of connections in the Middle East as well. So my husband and I are thinking once we have taken quite a control of European market, we would go into the Middle East". E12 emphasized in his account that narrowing down the options under consideration was the first step he took in the process: "you can't just try everything at once, you've got to narrow things down, you need some structure to help you get started".

Alongside focusing on existing means, co-creation was another principle through which entrepreneurs attempted to reduce complexity at this stage (see Table 4, middle). Entrepreneurs used the feedback obtained through interacting with self-selected stakeholders as validation or endorsement for particular options available to them, rather than conducting a systematic search. As E6 noted when recounting how they made a series of key decisions related to their product idea: "I would say the first big thing for us was to have a commitment [from customers] to actually use whatever we produce, so to have someone, not only us, to be the first users of the platform. [...] What we wanted was a partnership in the sense of helping us, improving, getting feedback. We needed their involvement, otherwise it would have been a wild shot in the dark."

Once the number of options had been reduced, the principle of leveraging contingencies allowed entrepreneurs to implement potential options (given the low perceived costs) and to engage in cycles of experimentation to gather more data on the (subset of) option(s) they were considering (E10: "once you know your options, you have to do lots of testing, because you just don't know what is going to work"). Experimentation was used rather than more indirect ways of gathering feedback on the suitability of different options (e.g. market research). This is an excerpt from E10's account of settling on a business model for her start-up offering expert advice on career changes: "The other thing that I'm testing now is B2B, because what I'm finding through doing all of this is that actually it [the B2C model] is quite labor-intensive, trying to reassure and speak to each individual person who this expert is, and how it would help them whereas actually if I can go to a larger corporate, they may just be making 100 people redundant, then I can actually offer a more interesting proposition potentially. So, I have two meetings this week where I can pitch, and trying doesn't cost anything".

In some cases, however, entrepreneurs struggled to interpret the results of these experiments because it was not always clear from the data gathered whether the experiment had been a success. At this stage, some entrepreneurs were tempted to start experimenting again with a new option, given the low costs of doing so, in the hope that a more successful option would be identified. As such, entrepreneurs would start reconsidering new options and the experimentation process would continue, sometimes for long periods of time, leading to what previous research has termed effectual churn (Fischer and Reuber, 2011). E12's account of the process they went through when trying to discern which business development opportunities were worth investing in is a good example of entrepreneurs' efforts to limit these cycles of effectual churn and thus control costs: "And what I found was, coming back to this thing of initially meeting lots of people and lots of possibilities to work together, there's only so much time you've got, therefore which relationships are you going to invest into [...] There's lots of 'who are you' conversations going on, 'really nice to meet you', but am I going to willingly invest to build that relationship? So, I've invested a lot of time in [1], [2], and [3] because I like the people, I like the work, we've done stuff together, and I want to be part of those organizations."

4.3.2. Committing decisions: low complexity, high perceived costs

The second type of decision structure reported corresponded to committing decisions, characterized by low levels of complexity and high perceived costs. Most entrepreneurs used causal logics (over effectual logics) for making committing decisions (see Table 4, middle and right-hand side). Given the lower number of options under consideration, entrepreneurs invested more time and effort defining each option more clearly to start with. However, entrepreneurs had to mitigate the cognitive demands posed by the high costs of trying out options. Thus, entrepreneurs sought alternative ways of gathering information on each of them. In particular, prediction and the maximize returns principles allowed them to gather information about the available options without performing costly experiments, whereas affordable loss, avoid contingencies, and the competitiveness principles allowed them to further minimize the costs related to implementing the chosen option later on in the decision-making process. We illustrate how these five principles fit the structure of committing decisions.

Given the low level of complexity experienced, the entrepreneurs spent time defining each option more clearly and seeking information by conducting systematic research at first. Furthermore, perceptions of high costs motivated entrepreneurs to avoid testing out different options, and instead use more indirect information-gathering methods. Specifically, prediction and the maximize returns principles were used to gather information on the different options first. Prediction enabled entrepreneurs to better understand the potential consequences of the different options, information they could use in decision-making. The maximize returns principle was often coupled with prediction (see Table 4, middle) to quantify these expected outcomes. E15 describes the process they went through for selecting a vertical to focus their marketing strategy on; earlier in the interview, the participant mentioned that three different verticals had been considered as options: “I think for any entrepreneur, or for anybody, it’s first looking at what are your options? [...] We did work around, what is the size of the market, what does the market look like in the UK and what it looks like globally [...] We looked at the different verticals where we thought the product could basically fit, and we did market research [...] We always knew whatever it was that we were doing, to start off we really need to be very focused, we couldn’t afford to lose too much time and money. [...] You want clients that can afford the service, and so we have gone after UK financial services to start off with.”

While gathering information and making investment decisions, a minority of entrepreneurs employed the affordable loss principle to limit their resource commitments to levels that were uncritical to them, in order to avoid loss of resources that would endanger venture survival. Interestingly, affordable loss was the least prevalent principle in entrepreneurs’ accounts of their decision-making; however, it was mostly used for committing decisions, where the downsides of a project were relatively easy to estimate. Some entrepreneurs preferred affordable loss as an alternative to predictive strategies. For instance, E14 describes his early investment strategy as minimizing potential losses in case things went wrong, by focusing on low-cost facilities and small-scale projects: “So when we started this venture, we invested a very small amount [of money]. We had a facility that was not as good as other companies’, we thought this would be our starting point. We had a lot of customers, but again very local and very low price.”

Later on, during implementation, the high perceived costs led entrepreneurs to use the avoid contingencies principle and stick to their chosen course of action. Feelings of confidence were often mentioned by entrepreneurs as accompanying their predictions and used as a reason for remaining inflexible in the face of information that went against their predictions once a particular option had been selected. For instance, E22 discusses their decision to stick to their initial marketing strategy consisting of targeting customers in a specific industry, despite indications disconfirming that their selected course of action was the right one: “I think once you made a decision, and you’re confident in your analyses, you got to move on. In bigger businesses, you sit there and you might go right let’s cut our losses and try this, but we haven’t got the resources available to start from scratch again in a different vertical, so there’s no point even looking at it at this stage. We’ve made a decision, we’re going to commit to it and we are going to go and keep focused on that.”

As a complement to the avoid contingencies principle, the competitiveness principle also enabled entrepreneurs to be selective about the involvement of external stakeholders and allowed them to stay on track with their selected course of action during implementation. Its use was content-dependent, the domains where competitiveness was most often used being branding, choice of sales strategy, and financing (see Table 4). In these contexts, saying no to potential partnerships or customers enabled entrepreneurs to focus their limited resources on actions that were most likely to be successful, whilst deterring potential distractions. As E39 notes: “I think saying no is something that I have perfected over the years, as I found myself wasting a lot of my time and money. Saying no to clients, saying no to partners that I don’t think add value to what I am doing. And saying no to clients who [...] ask me to do a lot of random things but without an end goal in mind.”

4.3.3. Direction-setting decisions: high complexity, high perceived costs

The third type of decision structure that the entrepreneurs reported was the direction-setting decision archetype: high complexity, and high perceived costs of implementing options. Thus, entrepreneurs were confronted with cognitive demands posed by both complexity and high perceived costs. For direction-setting decisions, a larger proportion of entrepreneurs used a hybrid logic combining both effectual and causal principles as part of the same process. We show how entrepreneurs mix principles pertaining to different logics to solve the cognitive demands posed by direction-setting decisions.

Similar to their approach to testing-the-waters decisions, entrepreneurs first employed effectual principles to reduce complexity. For instance, the focus-on-means principle allowed entrepreneurs to prioritize certain options over others. However, instead of experimenting with these options, entrepreneurs used causal principles, such as prediction and maximize returns, to gather data on these options subsequently. For instance, E13 talks about selecting a marketing strategy for their services, mentions three potential target customer personas, and, for each, about two to three different ways of marketing to these customers (seven options overall). Finally, he decides to create a book to distribute to CEOs of large corporates, based on a strategy combining the focus on means and maximize returns principles: “So I’ve originally thought about going into advertising, which I did and then I sold with two other people later on [...] So I’ve always kind of believed that appearances are very important, so that’s why I made that book, and obviously it’s

relatively expensive, right? And it's 20 pages of very carefully written stuff and it took months to do, [...] with the whole purpose of knowing you could give that to the CEO of [1]."

Interestingly, different from their approach for committing decisions and despite the high perceived costs of trying out different options, for direction-setting decisions, entrepreneurs remained flexible once a particular option had been selected and implemented. As such, entrepreneurs combined causal prediction principles, exemplified through market research and competitive landscape analysis, with the effectual leverage contingencies principle that allowed them to change course of action as they went along, even during implementation. E30 noted, as part of their decision on a product that would expand their existing range: "We were also doing user testing and we were surveying the market and we realized that it wasn't the right time to penetrate the market with the investment app. At the same time, there were lot of investment apps out there and we were just looking at our idea that we were working on for two-three months and we realized we are not better than any of them. [...] We had already spent a lot of money, but we decided to pivot something that was a little bit like a lower hanging fruit. So that is why we moved to education. [...] and actually now we may go back to our options again, because we definitely want to eventually accomplish our mission to deliver an investment service for the masses". This quote also illustrates how entrepreneurs making direction-setting decisions sometimes went back to reconsidering their options and re-starting the decision-making process.

4.3.3.1. Exploratory analysis of co-occurring principles. We additionally conducted exploratory analysis at the level of effectual and causal principles to understand whether particular principles were more likely to co-occur as part of a hybrid logic. Thus, we examined co-occurrences of effectual with causal principles as part of hybrid logics across the 290 decisions. These co-occurrences are shown in [Table 5](#) (also see [Appendix B](#) for a full matrix considering co-occurrences of all principles). We tested which pairings of principles were statistically most likely to co-occur. The only pair of effectual-causal principles that was significantly more likely to co-occur than other hybrid pairs was the prediction-leverage contingencies pair, $\chi^2 = 8.25$, $df = 1$, $p = .004$.

4.4. Ecological rationality of entrepreneurial decision logics

In summary, we find that decision content influences entrepreneurs' mental representations of decision structure ([Section 4.2](#)), which, in turn, drives entrepreneurs' use of effectual, causal, and hybrid decision logics through decision fit ([Section 4.3](#)). We highlight how both decision-content-fit and decision-structure-fit drive entrepreneurs' use of decision logics. We find that specific effectual and causal principles fit particular decision-content categories better than others. Furthermore, we find that for testing-the-waters decisions (high complexity, low costs), entrepreneurs predominantly used effectual logics, whereas they used causal logics for committing decisions (low complexity, high costs). Finally, entrepreneurs used a hybrid logic combining effectual and causal principles for direction-setting decisions (high in both complexity and costs). For routine decisions (low in both complexity and costs), we were unable to determine entrepreneurs' dominant logics based on our data.

Through our analyses, we ascertained how entrepreneurs use effectual and causal principles to adapt to decision structure throughout the decision-making process, specifically to perceived complexity and costs ([Fig. 2](#)). Entrepreneurs used specific decision-making principles to adapt to particular cognitive demands associated with decision structure. Entrepreneurs first assessed the complexity of the decisions they approached by considering the options available to them. When complexity was perceived as high, entrepreneurs used the focus on means and co-creation principles to try and reduce it. Once the cognitive-computational issue of complexity was resolved, entrepreneurs moved on to making an assessment of the costs of implementing different options. When costs were assessed as high, entrepreneurs first attempted to collect more information on the options under consideration using prediction and maximize returns, before attempting costly implementation of options. Finally, when it came to implementing options, entrepreneurs remained flexible for testing-the-waters and direction-setting decisions by using the leverage contingencies principle. For committing decisions, entrepreneurs further attempted to reduce the costs associated with implementing an option by leveraging the affordable loss, avoid contingencies, and competitiveness principles. Whereas entrepreneurs in our sample making committing decisions typically exited the decision-making process once a particular option had been implemented, some entrepreneurs making testing-the-waters and direction-setting decisions entered an experimentation cycle (termed "effectual churn" in previous research, ([Fischer and Reuber, 2011](#)) where they went back, reconsidered their options, and started the process anew.

5. Supplemental study

Given the exploratory nature of the main study, we sought to further validate our findings using an alternative methodology. Also, a weakness of our qualitative methodology was that we could not ascertain entrepreneurs' dominant logics for routine decisions (low in both complexity and costs). We conducted an additional experimental study to corroborate our qualitative findings and extend our understanding of the ecological rationality of effectuation for routine decisions.

5.1. Method

We conducted a 2×2 within-subjects experiment where we manipulated the two elements of decisions structure — decision complexity and costs of implementation of options — and assessed entrepreneurs' preference for causal and effectual decision logics in response.

Table 5
Frequency of co-occurrence of principles (41 participants, 290 decisions).

	C: Prediction	C: Maximize returns	C: Avoid contingencies	C: Competitiveness
1. E: Focus on means	5	5	3	3
2. E: Affordable loss	3	4	2	2
3. E: Leverage contingencies	11**	8	2	1
4. E: Co-creation	2	5	3	2

Note. E = effectuation; C = causation. N = 61 hybrid co-occurrences. We performed chi-square tests to test whether certain pairs of principles were more likely to co-occur than the other pairs. Significant differences are marked as ** $p < .01$.

5.1.1. Instrument

Following a format similar to the scenario-based instrument in Wiltbank et al. (2009), we devised a scenario about a fictitious venture in the technology industry, with eight different initial decisions (two for each decision archetype). Each of the decision descriptions contained an indication of that decision's complexity, i.e. the number of options under consideration, and the corresponding costs. We ran a first pilot study with 30 entrepreneurs (i.e. owner-managers of businesses) in the United Kingdom to validate the decision scenarios, given this was a new instrument. We included a manipulation check asking participants to report on the perceived complexity and costs of each decision. Furthermore, we asked participants to rate their amount of experience making similar decisions, the perceived typicality of the decision for the new venture creation process, and the perceived importance of each decision. The data from this study indicated that participants' perceptions of decision structure matched the structure that we attempted to manipulate for the four archetypes. Most participants also indicated they had some experience with each of the decisions described in the scenario. Based on the data from this first pilot study, we chose the one-decision scenario per archetype that entrepreneurs had perceived as more typical of their experience and as more important for a venture. The final instrument is available in Appendix C. The full data of this pilot study are available upon request.

For each decision, we wrote two response options, one representing an effectual decision logic, and the other one representing a causal decision logic. In order to test the content validity of the options, we asked two independent researchers familiar with effectuation theory to categorize the responses into effectual and causal logics, or indicate when they could not categorize the options into these two logics. The results confirmed the suitability of our options. We asked participants to rate how likely they would be to use each logic on a 7-point Likert-type scale, from 1 = Very Unlikely to 7 = Very Likely.

5.1.2. Sample

The sample consisted of 224 owner-managers of businesses in the United Kingdom, meeting the definition of "everyday entrepreneurs" (Welter et al., 2017). We used Prolific² (Palan and Schitter, 2018) for recruiting participants and offered financial incentives. The sample was 62% female (139 females), had a mean age of 39.42 years (SD = 12.31), 77% had university-level education, on average had 17.64 years (SD = 12.01) of work experience, and had 6.83 years (SD = 7.33, min = 0, max = 30) of entrepreneurial experience; 64% of businesses in the sample were less than 5 years old, with annual business revenues of between 0 and £3,670,000 and employing, on average, 3.59 employees (SD = 1.19, min = 0, max = 45).

5.2. Results

To test the effects of the two decision structure elements — complexity and costs — on entrepreneurs' use of effectuation and causation, we performed two 2×2 repeated-measures ANOVAs, where complexity and costs were within-subjects factors, with two levels (low and high) each. Based on the findings of our main (qualitative) study, we expected a significant interaction between decision complexity and costs in driving entrepreneurs' use of effectuation and causation: specifically, we expected that entrepreneurs use more effectuation for testing-the-waters relative to committing decisions, whereas they should use more causation for committing relative to testing-the-waters decisions. For direction-setting decisions, we would expect that entrepreneurs use effectuation and causation jointly (hybrid logic), so there should be no significant differences in entrepreneurs' use of effectuation versus causation for this archetype.

First, we investigated the effects of decision complexity and costs on entrepreneurs' use of *effectuation*. We found a significant main effect of costs ($F(1,223) = 3.97, p = .047, \eta_p^2 = 0.018$) and a significant interaction effect between complexity and costs ($F(1,223) = 32.33, p < .001, \eta_p^2 = 0.127$). The main effect of complexity was not statistically significant ($F(1,223) = 0.74, p = .39, \eta_p^2 = 0.003$). We performed post-hoc contrast tests to compare entrepreneurs' use of effectuation across the four decision archetypes (Fig. 3). Overall, we replicate our qualitative findings: entrepreneurs use more effectuation for testing-the-waters decisions ($M = 5.45$) compared with committing decisions ($M = 5.26$). Furthermore, entrepreneurs use more effectuation for routine decisions ($M = 5.80$), compared with testing-the-waters and committing decisions. Also, entrepreneurs use more effectuation for direction-setting decisions ($M = 5.73$), compared with testing-the-waters and committing decisions. We do not find a significant difference between entrepreneurs' use of

² Prolific is a crowd-sourced data collection platform that enables detailed and rigorous pre-screening criteria of research participants. Requirements for fair compensation enhance response quality (Peer et al., 2017). Previous research has used Prolific samples to experimentally study entrepreneurial decision-making (e.g. Collewaert et al., 2021; Engel et al., 2020).

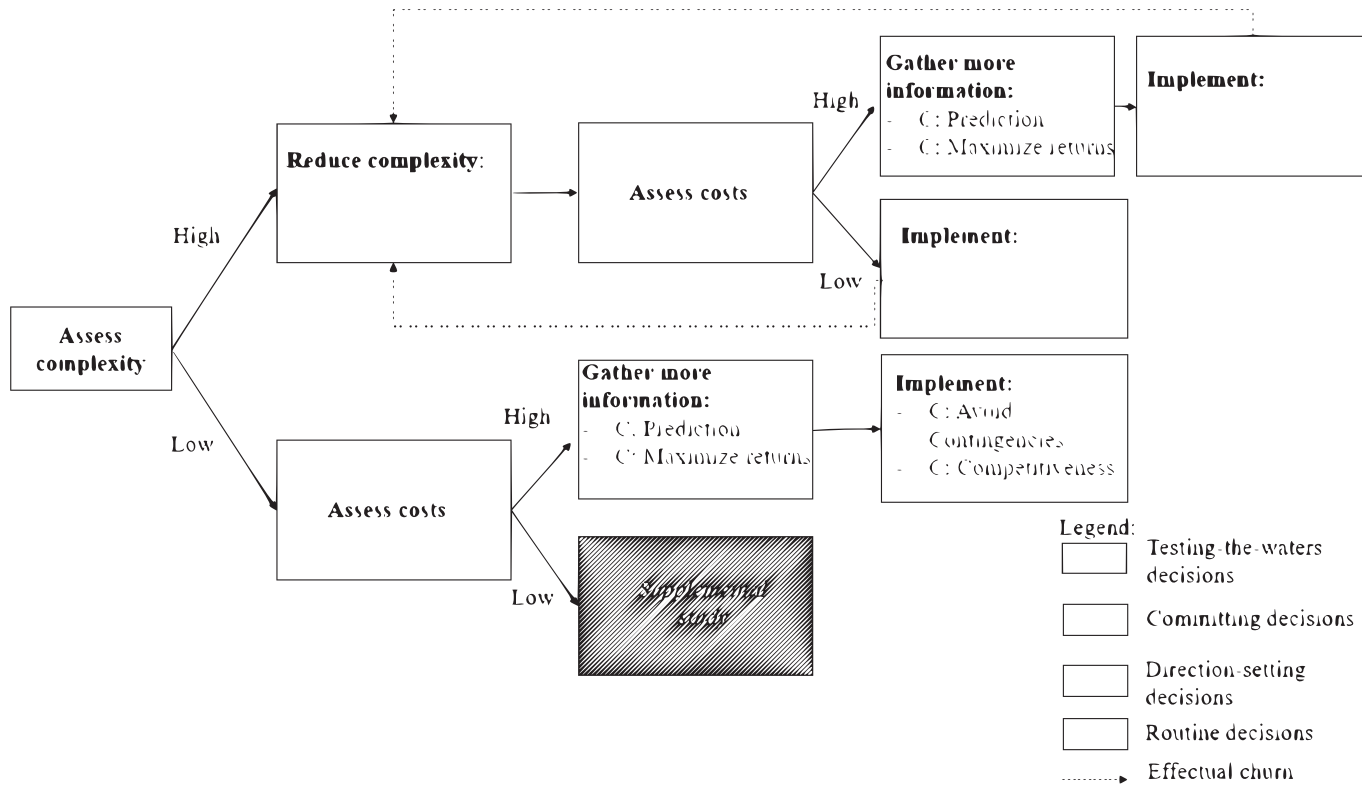


Fig. 2. The link between decision structure and decision principles (unpacking the decision structure configurations shown in Fig. 1). E (orange) = effectual principles; C (blue) = causal principles. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

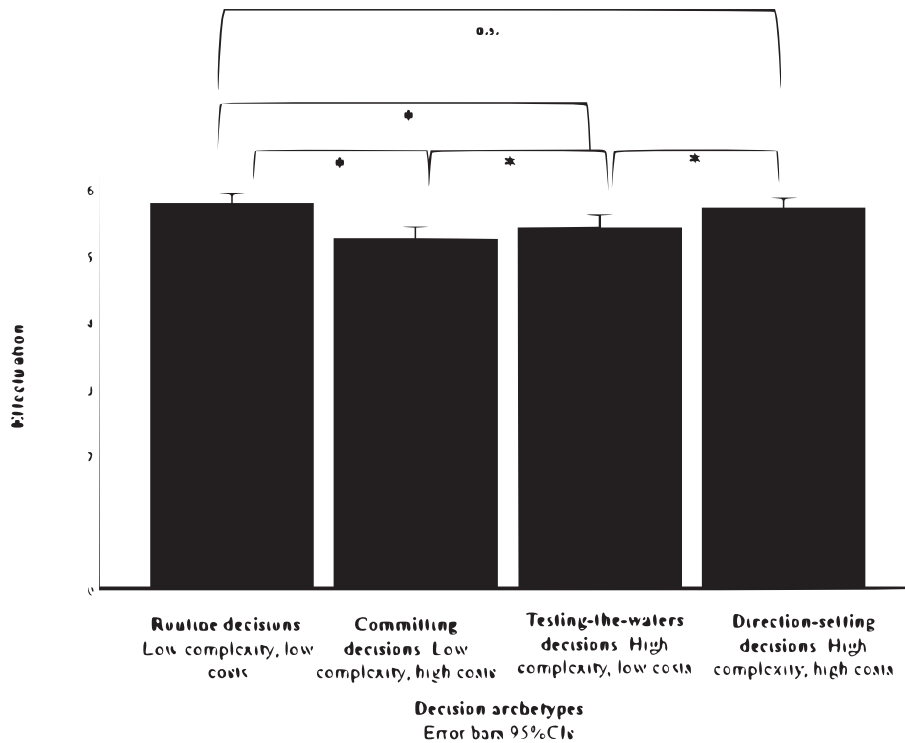


Fig. 3. Differences in entrepreneurs' use of effectuation between the four conditions (* denotes a contrast test significant at $p < .05$; n.s. = non-significant).

effectuation for routine and direction-setting decisions.

Second, we investigated the effects of decision complexity and costs on entrepreneurs' use of *causation*. We found a significant main effect of complexity ($F(1,223) = 49.94, p < .001, \eta_p^2 = 0.183$) and a significant main effect of costs ($F(1,223) = 24.92, p < .001, \eta_p^2 = 0.101$). Entrepreneurs use more causation for complex and costly decisions than for decisions low in complexity and cost. The interaction effect was non-significant ($F(1,223) = 1.924, p = .27, \eta_p^2 = 0.006$). Thus, we cannot replicate the qualitative findings for entrepreneurs' increased use of causation for committing decisions ($M = 5.39$ in the experiment) compared with testing-the-waters decisions ($M = 5.54$).

Finally, considering the findings for effectuation and causation together reveals that entrepreneurs use causation to the largest extent for direction-setting decisions ($M = 5.84$). Coupled with the observation that entrepreneurs also use high levels of effectuation for these decisions ($M = 5.73$), we replicate our qualitative finding showing that entrepreneurs use a hybrid logic (combining effectual and causal logics) for direction-setting decisions. Lastly, entrepreneurs used the highest levels of effectuation ($M = 5.80$) and the lowest levels of causation ($M = 4.92$) for routine decisions (low in complexity and costs). Thus, we extend our previous qualitative findings by showing that entrepreneurs predominantly use effectual logics for routine decisions. Comparing entrepreneurs' use of effectuation and causation across the four archetypes, we only find a significant difference between entrepreneurs' use of these two logics for routine decisions, where entrepreneurs used significantly more effectuation ($t(223) = 6.59, p < .001$).

6. Discussion

6.1. Extending effectuation by considering entrepreneurs' ecological rationality

By integrating effectuation and ecological rationality theories (Gigerenzer and Gaissmaier, 2011; Todd et al., 2012), we draw attention to a new construct — decision fit — and introduce this to research on effectual and causal decision logics. We find that the very nature of the decisions that entrepreneurs are faced with influences whether they use effectual, causal, or hybrid decision logics. We complement past research that identifies individual and venture-related characteristics driving the use of effectual or causal logics (e.g. Jiang and Tornikoski, 2019; Reymen et al., 2015). By unpacking how decision fit 'triggers' different decision logics, our study offers new insights into the micro-foundations (Shepherd, 2015) of effectual and causal decision-making. This addresses a key critique of effectuation theory: not being able to predict and fully understand when and why entrepreneurs use effectual and causal logics to make specific decisions (Arend et al., 2015; Read et al., 2016). We first consider the specific implications of our findings in terms of decision-content-fit, and then turn to decision-structure-fit.

Decision-content-fit explains why, even within the same venture development stage, entrepreneurs use distinct logics. For instance,

selecting a new product idea, choosing a mode of implementation, and devising a marketing strategy were all associated with different decision logics even though these decisions typically co-occur within the same venture-development stage. Whereas past research links effectuation predominantly to early venture-development stages (e.g. Berends et al., 2014), our findings highlight that it is decision-content-fit rather than development stages per se that drives the use of effectual decision logics. This helps explain why entrepreneurs use effectuation also in later venture-development phases (cf. Reymen et al., 2015) and predicts with greater precision *when* (for what decisions) entrepreneurs will use effectual logics. Furthermore, our findings contribute to our understanding of effectual and causal decision principles. By introducing the concept of decision-content-fit, we help explain why entrepreneurs tend to use some principles more than others for particular decision contents. We find that entrepreneurs adapt their use of principles based on the principles' fit with decision content — specifically, whether the decision relates to organizing means, investing resources, dealing with stakeholders or contingencies (Sarvasvathy and Dew, 2005). We believe this framework may be helpful for future research on effectual and causal principles (cf. Smolka et al., 2018), as it offers a more nuanced understanding of when and why specific principles are used.

In turn, by linking decision content and structure, we explain *how and why* decision content influences entrepreneurs' use of distinct decision logics. We introduce a systematic way of relating decision content to four archetypes of decision structure, which allows us to move beyond describing differences in decision content to conceptualize *what* underlying elements of decision structure (i.e. complexity and cost) drive particular logics (through decision-structure-fit). These decision archetypes and structure may prove a useful analytical framework for decision-making research beyond effectuation and venture creation, for instance, to understand traditional (e.g. Sanchez-Ruiz et al., 2021) and crowdfunding (e.g. Rose et al., n.d) investment decisions and strategies as driven by investors' mental representations of decision structure.

Decision structure offers a new and precise way of conceptualizing uncertainty for research on entrepreneurs' decision-making. Our study answers a call to unpack entrepreneurs' perceptions of uncertainty in effectuation research (Welter et al., 2016). Past research on the antecedents of effectuation has either tended to use venture development stage as a proxy for uncertainty (e.g. Berends et al., 2014; Nummela et al., 2014) or has more explicitly related uncertainty to decision logics (Jiang and Tornikoski, 2019; Wiltbank et al., 2006). However, even though uncertainty is often invoked, it is rarely clear what exactly is uncertain. We find that entrepreneurs' perceptions of uncertainty can be broken down into the dimensions of decision complexity and costs (which can be aggregated into our decision archetypes). Higher levels of complexity mean that the options under consideration are less clearly defined — due to entrepreneurs' cognitive constraints, only a limited amount of information about these options can be mentally represented. This results in more uncertainty perceived by the entrepreneur. Higher perceived costs of implementing options also mean that it is harder to gather information through direct methods (e.g. experimentation), resulting in more uncertainty.³ In summary, considering decision structure opens new avenues for research on the role of uncertainty in entrepreneurs' decision-making.

Lastly, considering decision structure also enables us to explain previously documented switches between logics with more precision. Entrepreneurs may switch back to effectuation, even in later venture-development stages, for instance, in times of crisis (Reymen et al., 2015). In crisis situations, as unexpected events unfold, entrepreneurs are faced with new options, thus increasing decision complexity, and there is more uncertainty about decision options, their consequences, and the likelihood of these consequences (Pearson and Clair, 1998). At the same time, implementation costs of new options reduce as the alternative option — staying on the same course — becomes more costly. Thus, the structure of the decisions entrepreneurs encounter in crisis situations is a better fit to effectual rather than causal logics.

6.2. Hybrid decision logics —combining effectual and causal principles for individual decisions

By focusing on the micro-foundational level of decisions, we advance the understanding of 'hybrid' decision-making (combining effectual and causal principles) for entrepreneurship research. Although entrepreneurs can switch between effectual and causal logics at different venture stages (cf. Reymen et al., 2015), in past research, a hybrid approach meant using effectuation and causation sequentially rather than simultaneously (e.g. Berends et al., 2014; Jiang and Tornikoski, 2019). Our findings depart from this conception and instead suggest that entrepreneurs can also *simultaneously* combine effectual and causal principles as part of a hybrid decision logic for the *same* decision. Thus, our findings refine our conceptual understanding of the relationship and synergies between effectual and causal principles (Galkina et al., n.d).

We also go beyond research that simply investigates entrepreneurs' dominant decision logics, by introducing a more nuanced understanding of *how* entrepreneurs use specific principles within their hybrid decision-making; in doing, we offer first insights into the temporal sequencing of decision principles in entrepreneurs' decision-making process (recall Fig. 2). By exploring decision-structure-fit, we explain how distinct decision principles help entrepreneurs adapt to the cognitive demands of decision structures they encounter. Complexity poses significant challenges for entrepreneurs' limited cognitive capacity, and effectual principles such as focus on means and co-creation enable entrepreneurs to reduce complexity by focusing on a more limited number of options. By contrast, causal principles, such as prediction and maximize returns, enable entrepreneurs to gather more information (thus reducing

³ We note that this new conceptualization of uncertainty complements other typologies already explored in entrepreneurship research, such as Milliken's (1987) typology of state, effect, and response uncertainty (e.g., Jiang and Tornikoski, 2019; McKelvie et al., 2011). Whereas some of these uncertainty types seem to map to our suggested conceptualization (state uncertainty may be linked to perceived lack of information due to complexity in options, effect uncertainty may refer to uncertainty about the consequences of these options due to high perceived costs of implementation), we believe the proposed conceptualization provides a sharper and more focused operationalization of how uncertainty manifests itself in entrepreneurs' perceptions of the decisions that they encounter during new venture creation.

uncertainty) when implementing decisions perceived as costly. Later, entrepreneurs switch again to effectuation by using the leverage contingencies principle, allowing them to gather more data on their implemented options and reconsider their options. This illustrates the “planning effectuator” approach (Smolka et al., 2018, p. 21) at the micro-foundational level of the decision, and shows that entrepreneurs adaptively combine principles pertaining to different logics to help them address cognitive-computational challenges they encounter during new venture creation. Thus, we highlight decision-structure-fit as a mechanism for explaining how and why entrepreneurs use specific principles in hybrid decision-making. This answers calls for investigating effectuation as a process (Gupta et al., 2016).

Furthermore, our exploratory analysis of hybrid logics highlights that not all effectual and causal *principles* are equally suited for use within a hybrid logic,⁴ suggesting that some principles (e.g. avoid contingencies) may be more representative of a purely effectual or causal logic, whereas others (e.g. leverage contingencies, prediction) are seemingly combined by entrepreneurs within their decision-making. Thus, a promising avenue for future research on hybrid decision-making would be to investigate entrepreneurs’ joint use of effectuation and causation principles, rather than investigating overall logics. In summary, our findings reveal important nuance in how entrepreneurs deploy effectual decision-making and combine different principles, rather than using one logic or the other. This opens up several new avenues for research on hybrid decision-making, e.g. future research could explore whether entrepreneurs use other temporal sequences of principles within their ‘hybrid’ decision-making beyond the one highlighted in our qualitative findings (see Fig. 2). Furthermore, we highlighted two antecedents (complexity and costs) that jointly influenced entrepreneurs’ use of hybrid decision-making: future research could explore other antecedents of entrepreneurs’ use of hybrid logics.

6.3. Practical implications

Our research draws attention to the fact that the nature of the many decisions that entrepreneurs face (Shepherd et al., 2015) differs, and in turn, these decisions pose different cognitive demands for entrepreneurs as decision-makers. Thus, different decision-making strategies will be better fitted to specific decisions. Rather than relying on the same decision-making strategy throughout new venture creation or in particular stages, entrepreneurs can benefit from using decision-making strategies that fit the content and structure of the specific decision they face. Our model of decision-making, based on ecological rationality, can be used to encourage entrepreneurs to reflect about the structure of the decisions they approach — in particular, the complexity and costs incurred — and subsequently enable them to choose decision logics that fit this structure.

Furthermore, our findings suggest that entrepreneurship education should train the whole range of effectual and causal principles for decision-making. Entrepreneurs should be aware of the importance of combining effectual and causal principles to deal with the cognitive demands of direction-setting decisions.

6.4. Limitations and future research

The limitations of our research open opportunities for future research. To strengthen the validity of our results, we used a mixed-methods design to test our propositions using two distinct paradigms: a qualitative study exploring entrepreneurs’ reports of their decision-making process, and a quantitative, experimental study manipulating the two decision structure elements inducted from the qualitative findings. Although in the experiment we confirm that the two elements of decision structure we identified in the qualitative study (i.e. complexity and costs) drive entrepreneurs’ use of effectuation and causation, we do not fully replicate our qualitative findings. In hindsight, one potential limitation of our experimental design was to investigate frequencies of entrepreneurs’ use of *overall* effectual or causal logics, which likely obscured the more nuanced patterns of ‘mixing and matching’ logics at the level of principles observed in our qualitative data. Future experimental research should assess effectuation and causation in a more nuanced manner at the level of principles and investigate the temporal dynamic in the sequencing of principles that our qualitative study suggested.

A possible limitation of our main (qualitative) study’s methodology is that interviews can trigger post-hoc rationalization processes, and thus lead to accounts reflecting causal decision logics. We took several steps to mitigate such concerns. The high prevalence of effectual decision logics suggests that we were successful in mitigating against such rationalization. In an ideal world, a longitudinal observational study could be conducted where researchers work-shadow entrepreneurs and note decision-making as it happens.

An important question that we did not investigate is which meta-cognitive processes underpin entrepreneurs’ decision-making strategy choices. We focus on understanding *why* entrepreneurs use effectual and causal logics for particular decisions; however, a complementary research question is *how* do they select one logic over the other? This could be fruitfully linked to the entrepreneurial metacognition literature (Haynie et al., 2012, 2010). Furthermore, we did not investigate potential individual differences between entrepreneurs’ ability to select the decision logic that fits with the structure of the decisions they face. Future research could investigate whether metacognitive ability (Haynie and Shepherd, 2009) plays a role in explaining why some entrepreneurs are better able to apply decision fit to their decision-making than others.

We identified two elements of decision structure — decision complexity and costs — that drive entrepreneurs’ use of certain logics. These decision structure elements were derived inductively, and as such could be related to the nature of the data collected. First, although we conceptualized decision complexity as number of options, decision complexity may also be operationalized in other ways,

⁴ For instance, the avoid contingencies principle was less likely to be used by entrepreneurs within a hybrid logic than other principles, suggesting that this principle is more representative of a purely causal logic. See Appendix B for details of this analysis.

including the number of attributes considered for each alternative, as well as uncertainty about options or their consequences, and interrelationships between options (Campbell, 1988). Future research should explore these different conceptualizations of decision complexity and their role in driving entrepreneurs' use of decision logics. Furthermore, there may be other potential decision structure elements that are not as easy to verbalize as complexity and costs that could influence entrepreneurs' use of decision logics. For instance, redundancy between decision-related cues (Gigerenzer and Gaissmaier, 2011) and a skewed distribution of their importance (Luan et al., 2019) have been found to influence the logics that decision-makers use for different decisions. We encourage future research on the ecological rationality of decision logics to investigate these potential factors using experimental approaches, where these more implicit influences on entrepreneurs' decision logics can be more readily observed than via methods relying on introspection. This would enable further theorizing on the nature of entrepreneurial decision-making structure.

While this study focuses on identifying the decision logics entrepreneurs use across decisions differing in content and structure, we do not investigate the relative effectiveness of these logics for venture performance or other outcomes, such as wellbeing. Previous research on effectuation outcomes has tried to unveil direct relationships between effectuation and new venture performance (e.g. Read et al., 2009b; Smolka et al., 2018). However, from an ecological rationality perspective, the effectiveness of a decision-making strategy depends on its fit to the decision being approached (Todd et al., 2012). Such a perspective suggests that there is no single best or 'optimal' decision logic to use throughout the process of new venture creation, but rather that entrepreneurs should adapt their use of effectual and causal logics to the different decisions they face. Thus, we urge future research to investigate for what types of decision structure effectual and causal decision logics perform better in terms of firm performance, and why. This will help address a key criticism of effectuation theory in relation to underspecified boundary conditions and mechanisms underpinning the effectiveness of effectual and causal logics (Arend et al., 2015). Methodologies typically used in ecological rationality research, such as comparative model testing using simulation (e.g. Luan et al., 2019), may be particularly useful for further testing relationships with performance.

In this study, we observed that entrepreneurs adapt their use of decision logics to the content and structure of the decisions faced. However, the effect of entrepreneurial learning on preferred logics is unclear, especially when these decisions are re-conducted. For instance, how do entrepreneurs develop their knowledge of decision fit? Is this an entrepreneurial ability that develops through experience or expertise? In other words, are expert entrepreneurs more adept at achieving decision fit? What happens when decisions do not necessarily result in positive outcomes for the entrepreneur and/or the venture?

Lastly, our findings about entrepreneurs' use of decision logics also have implications for the measurement of effectual and causal decision logics in future research. Our findings suggest that much explanatory power might be gained if we measure effectuation and causation in relation to specific decisions, rather than in relation to the entire venture (Chandler et al., 2011; Werhahn et al., 2015). Our findings suggest that when effectuation is assessed at the venture level, it risks masking important heterogeneity in entrepreneurs' use of logics across different decisions. In line with recent calls for more attention to the level of analysis in the measurement of effectuation and causation (McKelvie et al., 2020), we encourage researchers to assess their usage at the micro-foundational level of the decision. Given we observe significant heterogeneity in entrepreneurs' use of logics (as well as principles) across different decisions, this also makes a case for reflective (rather than composite) measures of effectuation. Furthermore, to appropriately capture entrepreneurs' use of hybrid logics, effectuation and causation should be measured independently, both as overall logics and at the level of principles. Such independent measurement allows investigation of correlation between the logics and, thus, their joint use.

7. Conclusion

We integrate ecological rationality theory and effectuation theories to explore how the nature of decisions influences entrepreneurs' use of decision logics. Through a main qualitative study and supplemental experiment, we show how entrepreneurs fit their use of effectual and causal logics to the content and structure of the decisions they encounter. Our findings extend previous research on the individual and venture characteristics driving entrepreneurs' use of effectuation, introduce decision fit as an overlooked antecedent of effectuation, and extend our understanding of hybrid decision-making for the same decision.

CRedit authorship contribution statement

Sonia Koller: Conceptualization, Methodology, Formal Analysis, Investigation, Writing -Original Draft, Writing – Review and Editing, Project administration, Funding acquisition.

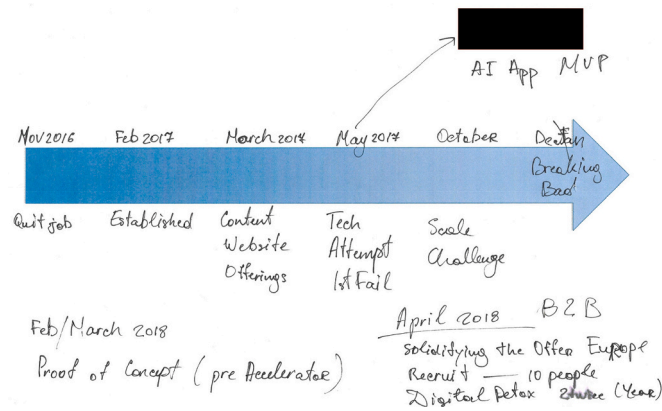
Ute Stephan: Conceptualization, Methodology, Writing -Original Draft, Writing – Review and Editing.

Gorkan Ahmetoglu: Conceptualization, Methodology, Writing -Original Draft, Writing – Review and Editing.

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Appendix A. Example completed timeline of events from the main study



Appendix B. Frequency of co-occurrence of effectual and causal principles within our qualitative data (Study 1, 41 participants, 290 decisions)

Below, we present a table showing the frequency of co-occurrence of all effectual and causal principles in our qualitative data. We also explored whether some principles were more likely to co-occur as part of a hybrid logic, compared to a purely effectual or causal logic. Overall, between 17% (competitiveness and co-creation) and 32% (affordable loss and leverage contingencies) of principle occurrences were as part of a hybrid logic – indicating the prevalence of hybrid logics in entrepreneurs’ decision-making. Furthermore, out of all eight principles, only the avoid contingencies ($\chi^2 = 4.05, df = 1, p = .04$) principle was less likely to occur within a hybrid logic than within a purely effectual or causal logic.

	1 (E)	2 (E)	3 (E)	4 (E)	5 (C)	6 (C)	7 (C)	8 (C)
1. E: Focus on means	–	3	13	18	5	5	3	3
2. E: Affordable loss	–	–	10*	2	3	4	2	2
3. E: Leverage contingencies	–	–	–	12	11**	8	2	1
4. E: Co-creation	–	–	–	–	2	5	3	2
5. C: Prediction	–	–	–	–	–	17	14	7
6. C: Maximize returns	–	–	–	–	–	–	5	4
7. C: Avoid contingencies	–	–	–	–	–	–	–	14
8. C: Competitiveness	–	–	–	–	–	–	–	–

Note. E = effectuation; C = causation. N = 180 co-occurrences. We performed Chi-square tests to test whether certain pairs of principles were more likely to co-occur than the other pairs. Significant differences are marked as: * $p < .05$; ** $p < .01$.

Appendix C. Decision-making scenario task developed and used in the supplemental study

Welcome! Please read the following short scenario:

You are the founder and CEO of a start-up building wearable technology intended to work in tandem with Virtual Reality (VR) environments. Your idea is to create products that enhance user experience and engagement by enabling users to have real-time, two-way interactions with the VR.

You have previously worked in the tech industry, and have some limited resources to invest in the start-up from personal savings. You quit your current job to further develop this idea.

Please use your imagination, put yourself in the context of the scenario you just read, and answer each question as if you are the CEO.

- For each decision, indicate **how likely you are to use** each decision-making approach described from 1 – Very Unlikely to 7 – Very Likely.
- If you **do not agree with the full statement but only part of it**, you can reflect this in your rating (e.g., indicate “Quite Likely” rather than “Very Likely”).
- **You do not have to choose between the two approaches presented, you can use both approaches** (i.e. combine them) should you wish to.

Decision 1 - direction-setting (high complexity, high costs)

Now that you’ve quit your job and decided to take the plunge, you need to decide what is the first product you will develop.

However, you have many different options in terms of both the type of product you could build (from a headset, to a full-body device integrating different senses and responding to real-time movement), as well as its primary application (gaming, medicine, military, real estate, etc.). Furthermore, development of any of these ideas is costly. How do you decide?

For each decision, indicate how likely you are to use each decision-making approach described from 1 – Very Unlikely to 7 – Very Likely.

	1 – Very Unlikely	2	3	4	5	6	7 – Very Likely
Use your expertise, past experience, and network to gather ideas and think of creative ways in which you can leverage them; search for partners willing to co-create, and remain open to emerging possibilities and opportunities							
Produce a detailed analysis of where the market is heading, how consumer preferences are evolving, and what existing players in the market are already doing; analyze this data to help you predict the areas with the highest potential for growth and future returns							

Decision 2 – testing-the-waters (high complexity, low costs)

Since you quit your job, you have been working long hours trying to get a prototype ready to show to potential partners and buyers. However, progress is slow and you start considering whether it may be time to get some help. You have a number of different options in terms of how to go about this, whether it's hiring contractors to help you with some of the development work for the product software, getting an accountant to help with the management of your finances, finding a co-founder to share day-to-day responsibilities for the venture, or hiring employees who could help take the pressure off and allow you to focus on business development. You reckon that implementing any of these options wouldn't be too costly for the venture. How do you decide?

For each decision, indicate how likely you are to use each decision-making approach described from 1 – Very Unlikely to 7 – Very Likely.

	1 – Very Unlikely	2	3	4	5	6	7 – Very Likely
Start by considering your network, asking people for recommendations, consider the skillsets and experiences you already have, and explore different partnership opportunities							
Start by considering your venture goals, compare the different options available to you based on their likelihood of helping you achieve these goals, and choose the best option							

Decision 3 – committing (low complexity, high costs)

As you have an early prototype, you start talking to potential retailers. These conversations are successful in securing a number of orders from several consumer technology retailers in the country. You need to somehow fund these orders, and you have two options – (1) engage with a venture capitalist or angel investor who would be able to offer you the money necessary to fund the orders in exchange for equity in your venture, or (2) bootstrap these orders by trying to reduce production costs, gradually selling existing inventory and using these sales to fund further inventory acquisition. Given the nature of your venture and the high costs of manufacturing your products, both of these options are costly to implement. How do you decide?

For each decision, indicate how likely you are to use each decision-making approach described from 1 – Very Unlikely to 7 – Very Likely.

	1 – Very Unlikely	2	3	4	5	6	7 – Very Likely
Assess available resources, as well as what you would be willing and could afford to lose in case things go wrong; attempt to partner with a stakeholder who would be willing to share the risks							
Calculate financial projections based on different scenarios and choose the option with the highest expected returns, thus allowing you to maximize your revenues and get ahead of your competitors							

Decision 4 - routine (low complexity, low costs)

You are attending your first industry conference, where you secured a booth to attract potential industry partners. You have to choose what promotional objects to offer attendees, and within your budget you have a choice between either branded notebooks or mugs. The costs associated with ordering either of these two options are modest. How do you decide?

For each decision, indicate how likely you are to use each decision-making approach described from 1 – Very Unlikely to 7 – Very Likely.

	1 – Very Unlikely	2	3	4	5	6	7 – Very Likely
Figure out which of these options best represent your brand and ethos, and are likely to attract potential partners that are willing to co-create with you							
Figure out which of these options are most likely to impress big players in the industry and high-value partners who could help you achieve your goals in terms of future growth							

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