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Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices

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Abstract

In support of theory, this study demonstrates that entrepreneurial experts frame decisions using an "effectual" logic (identify more potential markets, focus more on building the venture as a whole, pay less attention to predictive information, worry more about making do with resources on hand to invest only what they could afford to lose, and emphasize stitching together networks of partnerships); while novices use a "predictive frame" and tend to "go by the textbook." We asked 27 expert entrepreneurs and 37 MBA students to think aloud continuously as they solved typical decision-making problems in creating a new venture. Transcriptions were analyzed using methods from cognitive science. Results showed that expert entrepreneurs framed problems in a dramatically different way than MBA students. Published by Elsevier Inc.

Keywords: Entrepreneur; Framing; Expertise; Decision-making; Effectuation

1. Executive summary

More MBA programs offer courses in entrepreneurship than ever before. And most of them extrapolate their course content from research in core functional areas such as marketing and finance. Business planning takes center stage and large portions of course times are devoted to understanding market research techniques, competitive analyses based on received wisdom in strategic management and financial valuation methods based on calculations of risk-adjusted expected returns. Entrepreneurship research has contributed only indirectly to course development even as valuable insights begin to cumulate in directions different from current pedagogical frameworks.

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To redress this deficiency, and to improve the rationale for teaching entrepreneurship to MBAs, we set out to understand whether and how expert entrepreneurs — founders of multiple companies with over 15 years of experience and proven superior performance — think about typical decisions in starting a new venture. Cognitive scientists have studied expertise for over three decades. Recently, their work has come to the attention of researchers in entrepreneurship. Building upon this work, we used a well-reputed method called "protocol analysis" to compare 27 expert entrepreneurs with 37 MBA students, to see what expert entrepreneurs know that MBAs don't, and might be taught. We developed a research instrument which consisted of a detailed description of an imaginary product called *Venturing* and asked the subjects to think through several decisions in building a new venture around it. First, they were asked to think through the information required to do this and how they would gather that information; thereafter, they were provided with market research information and asked to make specific decisions in transforming this product into a profitable venture.

Both experts and students worked on exactly the same problems and information. They were asked to think aloud continuously as they solved these problems and made these decisions. Their think-aloud protocols were gathered on tapes, the tapes transcribed, and the transcriptions analyzed using both qualitative and quantitative techniques. Results showed dramatic differences in the way the two groups framed the decision problems contrasted by the underlying logic used: predictive versus effectual. Put simply, the MBA students picked target segments based on predictive information given to them and followed textbook procedures in arriving at decisions on how to capture the target segments. Expert entrepreneurs, however, under-weighted, ignored and even explicitly argued against taking predictions seriously, working instead with things within their control even if that meant effectuating, e.g., changing their initial goals and visions for the venture.

We call the expert frame "effectual" because it proceeded outward from means and causes to new effects and unanticipated ends. The MBA students, per their training proceeded in the opposite direction from pre-determined effects to striving for means and causal paths that would direct them toward the pre-selected goals. That the two groups were different is perhaps not so surprising to most researchers and practitioners in the entrepreneurial community. But that they were almost diametrically opposed and so *strongly and starkly* opposed was both surprising and important. It turns out, therefore, that not only had expert entrepreneurs gained a pronounced decision-making frame or logic presumable through years and years of entrepreneuring, but the MBA students exhibited an equally well-defined logical frame opposite to that of the experts.

Clearly, the study argues for rethinking what we teach MBA students about entrepreneurship and urges researchers to better understand how and why entrepreneurs develop an effectual frame through their experience. In addition, it tempts us to speculate whether we need to rethink the MBA curriculum in terms of the logical frame it generates to *hinder* entrepreneurial learning. Perhaps the interesting and creative way to go would be to develop a two toolboxes approach to grapple with contrasting logics of business decision-making.

2. Introduction

A growing literature on entrepreneurial cognition suggests that theories developed in expert–novice studies in cognitive psychology can potentially illuminate important aspects of the entrepreneurial process including how experienced entrepreneurs acquire useful cognitive frameworks and scripts that enable them to become experts over time (Mitchell et al., 2000; Baron and Ensley, 2006). In this paper we attempt to build on these pioneering studies and hope to make a contribution to the significant and expanding field of research on cognitive factors in entrepreneurship (Mitchell et al., 2004a,b, 2007).

This rising interest in expertise and cognition as useful lenses to study entrepreneurship is mirrored in developments within other disciplines. Note for example the recent award of the Nobel Prize in economics to Daniel Kahneman that signaled the potential profitability of this type of cross-disciplinary collaboration. In a recent paper forecasting the future of such collaborations, Thaler (2000) sets forth an exciting agenda including the following:

> There are an enormous number of exciting ways in which a better understanding of human cognition could help us do better economics. I'll suggest two here. First, there is a problem with prospect theory that cognitive psychology might help us fix, the theory is incomplete. Prospect theory tells us that choices depend on the framing of a problem, but does not tell us how people will spontaneously create their own frames.

At least one way people create/acquire frames is through the acquisition of expertise (Bettman and Sujan, 1987). Frames refer to "the decision-maker's conception of the acts, outcomes, and contingencies associated with a particular

choice." (Tversky and Kahneman, 1981). In general, framing matters because the particular frames people use influence how they formulate problems, what alternatives they perceive, generate and attend to, which constraints they accept, reject, and/or manipulate and how, and why they heed certain criteria rather than others in fabricating and implementing new (Gifford, 1992; Elliott et al., 1998). As Johnson and Lakoff (2002) put it,

> How a person frames a particular situation will determine what they experience as relevant phenomena, what they count as data, what inferences they make about the situation, and how they conceptualize it.

In this study we empirically investigate Sarasvathy's (2001) proposal that expert entrepreneurs frame decision problems using an *effectual* logic that inverts important principles in causal theories of entrepreneurship and strategic management. Effectual framing is about redrawing the problem space and reconstituting existing realities into new opportunities, whereas causal framing involves the discovery and exploitation of existing opportunities within a given problem space (Wiltbank et al., 2006). In the tradition of over three decades of research in expertise, we use think-aloud protocols gathered from expert entrepreneurs asked to complete a decision-making task in the new venture setting and compare them with novices. Our main motivation in this study is to isolate specific heuristics that differentiate the logical frames used by the two groups. In particular, we are interested in learnable and teachable elements that can feed into future research that directly impacts the content of entrepreneurship curricula in business schools. While we do not believe that any single study can accomplish this, we hope the results of the current study will serve to add a brick on the wall in the growing literature on what expert entrepreneurs know and how they acquire that knowledge.

The paper proceeds as follows. In the next section, we review literature on the nature and development of expertise in general and in the domain of entrepreneurship specifically. Section 4 summarizes the differences we expect to find between expert entrepreneurs and novices based on our chosen theoretical lens, namely effectuation. Section 5 describes the empirical study. Section 6 describes the results we found and outlines the limitations we need to keep in mind in interpreting those results. The final section discusses how our findings are related to the literature on entrepreneurial cognition and elsewhere, and outlines possibilities for future research.

3. Expertise and entrepreneurship

3.1. Expertise in general

Scientific investigation of expert performance using modern approaches began about 35 years ago, focusing on understanding the nature of chess masters (Chase and Simon, 1973; Simon and Chase, 1973).[4] In their early study of expert chess players, Chase and Simon quickly observed that simple intelligence had no correlation with chess mastery (Doll and Mayr, 1987). Instead, more complex factors were at work, revolving around how players stored information, perceived problems and generated solutions. On the foundation of their work, the field began to expand. Subsequent work validated and expanded expertise research beyond the domain of chess to more dynamic settings, such as taxi driving, medicine, fire fighting and consumer decision-making (for an overview of the professional domains in which expertise has been studied, see (Ericsson, 2006a,b,c). It is important to note that the majority of findings in less dynamic settings are robust in more dynamic settings as well (Klein, 1998).

There is little argument that expertise is contextual (Djakow et al., 1927; Ericsson and Smith, 1991). While a neurosurgeon's talents may be unsurpassed in the operating room, her abilities there predict nothing about her abilities in the grocery store, or on the computer. As such, expertise research examines experts in their own context. For the purposes of this paper, we define entrepreneurship as the creation of new ventures, new products and new markets. In keeping with traditions from expertise research, we define an expert as someone who has attained reliably superior performance in a particular domain ((Foley and Hart, 1992; Ericsson et al., 1993; Ericsson, 2006a,b,c). We restrict our discussions to "strong-form" expertise, associated with deep personal ability and knowledge derived from extensive practice and experience based on immersion in the relevant domain. We do not seek to investigate "weak-form" expertise, associated with forecasting that can be done through computer models and simulations or through private information (Mieg, 2001).

[4] de Groot began sporadic work on the topic as early as 1946.

3.2. The domain of entrepreneurial expertise

Mitchell (1994) first advocated studying entrepreneurship as a form of expertise (see also Mitchell and Seawright, 1995). Since then several studies have been published within the literature on entrepreneurial cognition that use expert–novice concepts (for example,(Mitchell et al., 2000; Gustafsson, 2004). Entrepreneurial expertise is both similar to and different from other domains of expertise. The content of domain knowledge required is one obvious source of difference. For example, although both music and scientific discovery have been extensively studied in the expertise literature, the domain of music is obviously very different from that of scientific discovery. Indeed, what makes the scientific study of any particular domain of expertise interesting is that the underlying cognitive processes that support expertise are common across domains (Mitchell et al., 2000; Feltovich et al., 2006) yet each individual domain exhibits a rather narrow set of heuristic principles that are typically very specific to a particular domain (Shepherd and Zacharakis, 2002; Feltovich et al., 2006). Researchers who study them can thereafter embody these heuristics either as expert systems or as testable and teachable techniques of decision-making and problem solving.

Studying entrepreneurship as a form of expertise allows us to do the same in the new venture domain (Sarasvathy et al., 1998). As Table 1 shows, both causal and effectual logics consist of heuristic principles that apply specifically to the creations of new organizations and markets, as opposed to heuristics used in the composition of a concerto or in the elimination of a hypothesis in scientific discovery. Our focus on these particular aspects of entrepreneurial expertise does not negate the importance and validity of other factors that predict and explain entrepreneurial performance, be it traits, or human and social capital of the entrepreneur, environmental constraints and opportunities, or any other random or systematic effects impacting the process. Instead, theories of entrepreneurial expertise should ultimately take these internal and external factors as either constraints or covariates in analyses of performance. Moreover, as we discuss later in the paper, several of the elements of entrepreneurial expertise that we study here cohere with findings reported in other empirical studies using expert–novice frameworks.

3.3. The development of domain-specific expertise

As Greeno and Simon (1988) put it, experts learn by doing and doing and doing. Expertise, however, is not merely experience: the acid test of expertise is reliably superior performance. When expertise is approached using the simple construct of experience, the connection with performance weakens considerably (Feltovich et al., 2006). According to a summary by Ericsson (2006a,b,c): "[I]ndividuals, identified by their reputation or their extensive experience, are not

Table 1
Differences between effectual and causal logics from Sarasvathy (2001).

Issue	Causal frame	Effectual frame
View of the future	Predictive. Causal logic frames the future as a continuation of the past. Hence accurate prediction is both necessary and useful.	Creative. Effectual logic frames the future as shaped (at least partially) by willful agents. Prediction is therefore neither easy nor useful.
Basis for taking action	Goal-oriented. In the causal frame, goals, even when constrained by limited means, determine sub-goals. Goals determine actions, including which individuals to bring on board.	Means-oriented. In the effectual frame, goals emerge by imagining courses of action based on given means. Similarly, who comes on board determines what can be and needs to be done. And not vice versa.
Predisposition toward risk and resources	Expected return. Causal logic frames the new venture creation problem as one of pursuing the (risk-adjusted) maximum opportunity and raising required resources to do so. The focus here is on the upside potential.	Affordable loss. Effectual logic frames the problem as one of pursuing adequately satisfactory opportunities without investing more resources than stakeholders can afford to lose. The focus here is on limiting downside potential.
Attitude toward outsiders	Competitive analysis. Causal frames promulgate a competitive attitude toward outsiders. Relationships are driven by competitive analyses and the desire to limit dilution of ownership as far as possible.	Partnerships. Effectual frames advocate stitching together partnerships to create new markets. Relationships, particularly equity partnerships drive the shape and trajectory of the new venture.
Attitudes toward unexpected contingencies	Avoiding. Accurate predictions, careful planning and unwavering focus on targets form hallmarks of causal frames. Contingencies, therefore, are seen as obstacles to be avoided.	Leveraging. Eschewing predictions, imaginative re-thinking of possibilities and continual transformations of targets characterize effectual frames. Contingencies, therefore, are seen as opportunities for novelty creation — and hence to be leveraged.

always able to exhibit reliably superior performance... [T]he number of years of work and leisure experience in a domain is a poor predictor of attained performance (Ericsson and Lehmann, 1996)." The key phrase here is "work and leisure": years of experience may include periods where individuals work to improve their performance, but may also include long periods where they were essentially at leisure when their skill levels stay stable, or may atrophy.

Furthermore, experience alone may make individuals subject to a variety of other decision-making errors. For example, experienced individuals are subject to the pitfall of inferring too much from too little information and misreading evidence that confirms prior beliefs; furthermore, those with significant experience are at particular risk because they may have become so mechanical they miss things (Rabin, 1998). This assertion has been empirically tested in numerous areas, including problems involving electronics circuits (Besnard and Bastien-Toniazzo, 1999). Experience can also cause individuals to inappropriately weight information cues, make errors combining them, and be overconfident in their judgments (Shanteau, 1992).

The weak relationship between experience and performance led researchers to develop the concept of "deliberate practice" (Ericsson and Simon, 1993). While consensus has yet to be reached on the exact scope of mechanisms that constitute deliberate practice, researchers agree that deliberate practice occurs when an individual exerts high effort on the performance of activities that are highly relevant to performance within a specific domain (Deakin et al., 2006). The deliberate practice perspective on expertise argues that simple experience is not sufficient for an individual to ascend into the ranks of expert performance, i.e. skills are not acquired automatically or casually. Systematic differences between experts and less proficient individuals within a domain nearly always reflect attributes acquired by experts during their lengthy period of sequentially mastering the performance of critical tasks in their domain (Ericsson, 2006a, b,c). In the domain of entrepreneurial cognition, researchers have pointed out that deliberate practice possibly has an important role to play in the development of entrepreneurial expertise (Englebrecht, 1995; Gustafsson, 2004). According to Mitchell et al. (2007): "Mounting evidence in recent entrepreneurship literature suggests that the path to becoming an entrepreneur is no elf special, but is in fact general — rooted in the cognitive systems created by deliberate practice." Papers by Baron and Ensley (2006), Baron and Henry (2006), Mitchell (2005) and Krueger (2007) all suggest entrepreneurs may become experts in starting new ventures through processes of deliberate practice.

Overall, we conclude that whether deliberate practice is an essential part of the development of entrepreneurial expertise or not would be a fascinating empirical question for future studies. But if deliberate practice plays any role at all in the development of entrepreneurial expertise, it is our contention that it would begin by being applied precisely to the kind of typical decision tasks that we use in the research instrument for the current study. These tasks involve identifying and defining markets for the new venture's products and services and also include decomposing the task into smaller elements such as channel choice and pricing details, very much in line with the most recent developments in the study of decision-making expertise as outlined in Yates and Tschirhart's (2006) process-decomposition perspective. But before we describe the instrument and other details of the design of the current study, we will outline key differences that we expect to find in comparing expert entrepreneurs with novices performing a typical decision task in the new venture creation setting.

4. Expected differences between experts and novices in entrepreneurial thinking

We expect to find two sets of differences between experts and novices in entrepreneurship. We derive one set from the literature on expertise in general and we derive a second set based on our chosen theoretical lens of effectuation. In sum, we expect that novices trained in traditional management techniques based on a causal logic would use a different logical frame in their decision-making and a different set of heuristics within that frame than expert entrepreneurs experienced in creating new ventures and new markets.

4.1. Differences due to expertise in general

4.1.1. Analogical reasoning

A vast body of empirical work has accumulated on the general association of superior knowledge storage and retrieval abilities of experts with quicker and more accurate problem-solving in a domain (Chase and Simon, 1973; Simon and Simon, 1978; Anderson, 1981; Camerer and Johnson, 1991; Bedard and Chi, 1992; Shanteau, 1992; VanLehn, 1996). Experts not only have a larger mental database of actual experiences to draw from, they also have better access to it than novices do. Feltovich et al. (2006) suggest that a major limitation of novices is their inability to access available, relevant knowledge because their short term memory is overloaded by the problem situation they face. By contrast, experts

subordinate many tasks to automatic processing, which increases their capacity for controlled memory recall. Because of their larger knowledge base and better retrieval abilities, experts tend to use analogical reasoning more than novices, who depend on analytical approaches to solve the problem. Analogical reasoning occurs when previously solved problems are stored in memory, a new problem is matched against stored problems, and these matches are used to suggest solutions for the new problem (Buchanan et al., 2006). One example of empirical evidence for this is provided by Isenberg (1986) who compared expert managers with novices and showed that analogical reasoning allowed experts to "reason more from small quantities of data." Faced with a complex decision, we would therefore expect expert entrepreneurs to talk more, theorize from their previous experiences more, and be more likely to go beyond the information given to them in a decision problem.

4.1.2. Holistic and conceptual thinking

Several studies in expertise attest to the fact that experts and novices differ not only in their access to knowledge but also in how they represent and organize knowledge (Feltovich et al., 2006). Chi (2006a) reviews several ways in which knowledge representation differs: here we focus on the consolidation and integration of knowledge, defined as, "the degree to which concepts and principles are related to one another in many meaningful ways." (Chi, 2006a). Gitomer (1988), for instance, found that when expert technicians were faced with troubleshooting tasks, they were more likely than novices to view the electronic device as a complete system of components. They tended to solve the problem holistically, unlike the novices who merely looked for a short circuit. In his work on firefighters, Klein (1998) suggests that expert firefighters represent the scene of a fire dynamically, in terms of its antecedents and likely evolution, i.e. they "observe" the whole history of the fire, not just the immediate scene. Similarly, Sonnentag et al. (2006) suggest that experts in software design develop not only superior knowledge of how to solve a narrow design task, but also develop "a more comprehensive representation of the entire work task, including necessary features of cooperation with coworkers." This suggests we should expect expert entrepreneurs not to solve functional problems in isolation, but to have a more integrative approach of building a venture as a whole (compared to novices).

4.1.3. Weighting of (predictive) information

The literature on expert decision-making shows us that trial-and-error experience in real, domain-relevant situations is the source from which experts develop much of their knowledge. In contrast, novices rehearse their skills in the context of "classroom" or practice problems, which are divorced from the actual domain of decision-making (Schenk et al., 1998). This distinction is critical, since it highlights the fact that novices lack the feedback mechanisms and post hoc analysis processes that enable experts to develop skills in automatically screening information. Therefore, we hypothesize that novices would take predictive information as seriously as they take any other information in a problem setting. Experts, however, evaluate and weight information in more subtle and complex ways. Experts have spent much more time trying to understand decision problems and have developed refined situation awareness based on intensive practice and familiarization in their domain ((Hutton and Klein, 1999; Ensley, 2006). As a result, they are more likely to carefully define the relevant features of decision problems and know how to adjust decision-making style accordingly (Baron and Ensley, 2006). On the other hand, experts also amass and organize significant bodies of knowledge (Glaser, 1996) which enables them to make good decisions with less reliance on processing external information inputs (Rikers et al., 2002). Therefore, we hypothesize that the ways in which experts use predictive information depends on their domain and on the specifics of the problem situation they face. That brings us to recent developments in entrepreneurship research to develop our ideas about how expert entrepreneurs are likely to weight predictive information.

4.2. Differences due to entrepreneurial expertise and effectuation

Expert entrepreneurs' use of predictive information is central to logical framing based on effectuation. An effectual logic consists of the following five elements in a static setting such as the task used in this study[5]:

4.2.1. Non-predictive as opposed to predictive control

Effectuation argues that expert entrepreneurs use a logic of non-predictive control to transform means at hand into new outcomes that they themselves may not have initially envisaged (Ericsson, 2006a,b,c; Yates and Tschirhart, 2006).

[5] For a dynamic model of effectual logic, see Sarasvathy and Dew (2005). Entrepreneurial logics for a technology of foolishness. Scandinavian Journal of Management **21**: 385–406.

Non-predictive control is defined as eschewing predictive information in favor of what the decision maker and her stakeholders can actually control at any given point in time (Wiltbank et al., 2006). Simplistically speaking, this is akin to a fashion designer who seeks to tie up large clothing distributors with exclusive contracts and then design the kind of apparel the joint contracts have negotiated (effectual) versus one who tries to predict next season's fashion through market research, invests in developing designs that match predicted tastes and then chases down appropriate distributors (causal). As Table 1 shows, this can be clearly contrasted with a predictive (causal) logic where the decision maker chooses between alternative means based on forecasts about pre-selected favorable outcomes.

4.2.2. Means-driven as opposed to goal-driven action

An effectual logic prescribes beginning with a given set of means and focusing on generating new ends. This may be contrasted with the causal logic of selecting a goal first and then choosing between given means or seeking to acquire the means necessary to achieve the selected end. A simple example of this is the chef who cooks from a recipe (causal) versus one who imagines possible meals from ingredients available at hand (effectual).

4.2.3. Affordable loss as opposed to expected return

Calculations of expected return do not drive the choice of projects in an effectual view; instead, the choice of projects depends upon the decision makers' assessments about what they are willing to lose. One example of this is the entrepreneur who refuses to leave a well-paying job until he finds an opportunity that he predicts will pay more (causal) versus one who decides to invest a small portion of her savings and two years of her life on a project that she believes is worth that amount of time and money — irrespective of whether it will pay more than what she currently earns (effectual).

4.2.4. Partnerships as opposed to competitive analysis

Effectual logic strongly favors building partnerships and bringing stakeholders on board even before clarifying what exactly the product-markets and other goals for the venture are going to be. The effectual entrepreneur therefore allows those on board to determine what goals to pursue, which in turn determines over time which markets the venture will end up in or end up creating. Causal approaches to new venture building, in contrast, prescribe first defining the market, then selecting segments within the market through detailed competitive analyses, and then using relevant specifications and needs of the target market to determine which stakeholders to pursue and acquire (Kotler 2000).

4.2.5. Leveraging as opposed to avoiding contingencies

Allowing one's means, acceptable levels of downside risk, and stakeholders to decide goals implies an ability to open oneself up to surprises of various sorts. In causal calculations, there is an explicit effort to avoid unpleasant surprises — even, as Denrell and March (2001) argued, to avoid *all* surprises, positive and negative. The effectual entrepreneur, in contrast, has to stand ready to make do with what comes her way and to learn to transform both positive and negative contingencies into useful components of new opportunities.

It can be seen from the foregoing exposition that all components of effectual logic are tied together through the human element — i.e. who is involved and what they do with the means available to them determine courses of actions and their outcomes. Not vice versa.

In sum, we can expect to find the following differences between an effectual as opposed to a causal frame. We can expect those from an effectual frame to fabricate more ends, pay more attention to and worry more about available resources, to envisage building more partnerships, to vary more in their interpretations of the data, and to eschew predictive information.

5. The study

5.1. Method: protocol analysis

Expertise in any area entails certain common cognitive processes among the experts who solve problems within the given area (Chi et al., 1982). The extraction of these processes has been the central goal of hundreds of protocol analysis studies in the past 30 to 40 years. Some examples from business include: decision-making (Montgomery and Svenson, 1989), accounting (Riahi-Belkaoui, 1989), argumentation in management consulting (Young, 1988), and software cost estimation (Mukhopadhyay et al., 1992). And the method has been used extensively in studying decision-

making processes of experts in areas other than business, such as chess (Charness, 1989), medical diagnosis (Johnson, 1988), mathematics (Webb, 1975) and scientific discovery (Qin and Simon, 1990).

In a detailed report on conceptual and methodological issues involving verbal protocols, Ericsson and Simon (1993) provide examples from over two hundred empirical studies that use protocol analysis. Ericsson (2006a,b,c) subsequently reviewed the literature again, adding to the list. These analyses emphasize the benefits of using think aloud protocols over other methods, particularly those calling for retrospective recall such as interviews or pure stimulus–response methods such as questionnaires. Think aloud protocols call for concurrent verbalization — i.e. subjects are required to think aloud continuously as they solve problems. Transcriptions of their tape-recorded verbalization form the basic data to be analyzed. The essential logic behind the use of protocol analysis can be summarized as follows: While retrospective recall allows subjects to make up good stories about how they believe they solve problems, and stimulus–response methods force us to deduce subjects' decision processes after the fact, concurrent verbalization allows the researcher to look directly inside the black box of cognitive processing, because of the structure of the short term memory system of the human brain (Ericsson and Simon, 1980). The validity of verbally reported thought sequences derives from its immediacy: the very short interval between the occurrence of thoughts and their verbalization. Therefore the concurrent verbalization technique suffers little from retrospection and introspection biases. These very constrained laboratory-style conditions were exactly what were used in the current study, thereby generating the most rigorously valid data possible in this line of research (Ericsson, 2006a,b,c).

5.2. Subjects

Protocols were collected from 27 experts and 37 novices. Table 2 provides descriptive data on the sample.

For the purposes of this study, expert entrepreneurs are persons who, either as individuals or as part of a team, have founded one or more companies, remained with at least one company that they founded for more than ten years and taken it public. Two sources were utilized to identify possible expert entrepreneurs for the study: (1) A list of the one hundred most successful entrepreneurs from 1960 to 1985, compiled by the venture capitalist, David Silver (Silver, 1985), and (2) The list of national winners of the Entrepreneurs of the Year awards, compiled by Ernst & Young. Together, the two sources drew their members from a pool that included virtually every enduring company created by an entrepreneur in the US from 1960 until 1996. As clearly outlined in their publications, both sources used several evaluation procedures and qualification criteria to select their lists from the complete population of entrepreneurial companies in their respective times. Thus the sample for this study was drawn indirectly from the complete population of entrepreneurs at large and directly from a complete population of *expert* entrepreneurs.

The characteristics of the final pool of expert entrepreneurs suggest that the sample is fairly representative of the population of expert entrepreneurs. Subjects from 17 states across the US were all male, 90% American, aged between 40 and 82, with two thirds having graduate degrees. While all subjects were male, there is no reason to believe that it would make the sample less representative since the percentage of female entrepreneurs who fulfilled the necessary

Table 2
Descriptive statistics of expert and novice samples.

Variable	Mean	S.D.	Minimum	Maximum
Expert entrepreneurs subjects (N=27)				
Year of birth	1943	8.8	1918	1953
Ventures started	7.3	7.4	3	40
Years worked for those ventures	21.6	9.3	12	43
Novice entrepreneurs subjects (N=37)				
Year of birth	1970	4.9	1959	1979
Ventures started	0.2	0.4	0	2
Years worked for those ventures	0.46	1.3	0	5
Years worked in a small organization (<100 employees)	1.87	2.34	0	10
Years worked in a medium organization (between 100 and 500 employees)	1.84	2.86	0	10
Years worked in a large organization (>500 employees)	11.03	6.22	0	21

criteria in the original population was less than one half of 1% to begin with. On average, subjects had founded seven new ventures, with the minimum number being three.

Protocols were collected from 27 experts and 37 novices. Based on precedents in the "deliberate practice" literature on expertise, we sought a control group of novices who would have enough experience in basic business knowledge so as to understand and tackle the problems in the research instrument, yet could be starkly contrasted with the expert entrepreneurs because (a) they were novices in entrepreneurial thinking as argued by Krueger (2007) and (b) they were trained in causal thinking embedded in MBA curricula as argued by Sarasvathy (2001). We chose 37 graduate students in business administration. The subjects in the novice group were 97% American, aged between 26 and 46, with primary experience in managerial roles in large and complex organizations. Their backgrounds spanned a wide range of occupations, including pilots, acquisitions and procurement, supply and logistics, human resources, operations, and medical services. Comparing this novice group with the expert entrepreneurs on key indicators of entrepreneurial expertise showed that the groups were dichotomous. Of the MBA students, 87% had never founded a firm and, of those that had, only one had started multiple ventures (in that case, two).

The choice of MBA students as a comparison group has both its advantages and limitations. We considered two specific issues in making this choice: (a) Why students in general and MBA students in particular? And (b) Why not a random sample of entrepreneurs or corporate managers? First, there is an established tradition of using students in expertise experiments in spite of the fact that their "novice-ness" may extend to dimensions not of interest to the study (Andersson, 2004; Lehmann and Norman, 2005). Furthermore, prior research on expertise in management and entrepreneurship has effectively utilized student samples. For example, Isenberg (1986) used 12 general managers and 3 college undergraduates in a think-aloud protocol study to develop and test a model of managerial decision-making. Another example is Mitchell et al.'s (2000) study, which used students as part of the sample. Moreover, Chi (2006b) explains that samples may be drawn according to *relative* rather than absolute criteria: "This relative approach assumes that expertise is a level of proficiency that novices can achieve. Because of this assumption, the definition of expertise for this contrasting approach can be more relative, in the sense that the more knowledgeable group can be considered the "experts" and the less knowledgeable group the "novices". Thus the term "novices" is used here in a generic sense, in that it can refer to a range of non-experts, from the naives to the journeyman." (Chi, 2006b).

Second, there are some specific advantages to using MBA students. The most important of these has to do with one of the main purposes of the study — namely to isolate and understand key elements of entrepreneurial expertise that might be teachable to MBA students. An additional advantage of the MBA sample is that it allows us to ensure a common baseline of knowledge in business fundamentals across the expert–novice groups. Without comparable knowledge across both our novice and expert samples, the findings from the business specific task used in our protocol might be confounded simply by lack of familiarity with business in general or inconsistent interpretations of terminology and concepts used in the decision task. For example, a random sample of people with a stated desire to become an entrepreneur, or even with a small amount of entrepreneurial experience will likely contain people who are unfamiliar with concepts such as market segments and channels. According to the Characteristics of Business Owners (CBO) Survey data from the US Census, even if we exclude firms with no employees and owned by people without a college degree, we will still find wide variation in terms of knowledge backgrounds with most having no prior business knowledge of the type that MBA students acquire in their first semester in business school.

In other words, a random sample of novice entrepreneurs in general would likely provide two sources of variation — one from the lack of basic business knowledge and another from the lack of entrepreneurial experience. Current data suggest that real world entrepreneuring, unlike chess or scientific discovery, appears to be a game anyone can play, a sort of opportunistic lottery that does not require even a rudiment of training in basic business concepts. In fact, both scholars and laypersons alike argue that entrepreneurship simple cannot be taught — more on that later. Therefore, in selecting the novice sample, we weighed the costs and benefits of the two sources of variation and found that the benefits of comparability across basic business knowledge outweighed limitations due to lack of "true" noviceness in entrepreneurial experience. This is because our findings in this study do not hinge on interest and/or genuine intention to start the business in the protocol, but around the knowledge structures and conceptual cues that drive the steps and processes of starting a business in its earliest stages when the market for the venture is still unknown.

Finally, while we decided not to use corporate managers for this particular study focused on identifying teachable and learnable elements of entrepreneurial expertise, we do not preclude the use of it in future work. In this connection, it may be useful to keep in mind recent results from entrepreneurship research (also using highly reliable CBO data) that show that whereas education and work experience significantly impact survival of new ventures, "prior managerial

experience has no systematic positive or negative effects on the survival prospects of either men's or women's new business ventures, however" (Boden and Nucci, 2000). All the same, we are cognizant of the limitations of using MBA students as our novice sample and will expressly include this in the discussion of limitations later in the current paper.

5.3. Procedures

A detailed description of an imaginary product called *Venturing* was given to the subjects. Since the expert sample varied (intentionally) in all aspects except entrepreneurial expertise, the decision problem used in the study had to be chosen so as not to technologically or otherwise bias some subjects against others. Therefore, entrepreneurship itself was made the product for which the subjects had to identify/create a market. *Venturing*, as described fully in Appendix A, is an imaginary game of entrepreneurship. Based on the description, subjects were asked to answer a set of questions pertaining to the development of an initial market for this product (Questions are also included in Appendix A). Subjects were asked to think aloud continuously during the task. Their protocols were collected on tape and transcribed for coding and analysis. Both during the experiment and afterwards, several subjects — both expert entrepreneurs and novices — mentioned they found the problems interesting, realistic and absorbing. All subjects were asked to set aside at least 30 min to complete the problems analyzed in this exposition, and all completed the task without time pressure. Several experts commented that the problems reminded them of actual decisions they had to make in their real life entrepreneurial experience. This lent credibility to the representative task used in this particular study. As argued by Ericsson (2006a,b,c): "[T]he study of expertise with laboratory rigor requires representative tasks that capture the essence of expert performance in a specific domain." Individuals at all different skill levels can then be compared in their performance of these representative tasks.

We developed the coding scheme (reproduced in Appendix B) to extract relevant variables and counts in three categories: (1) Expert–novice differences in general, (2) Domain-specific differences in issues related to marketing, and (3) Domain-specific differences in new venture creation (entrepreneurship). General differences were focused around information processing variables such as total numbers of words spoken, theorizing from previous experience (as in the case of pricing theories), etc. Marketing variables had to do with selecting segments, channels, prices and so on. And variables such as the amount of attention paid to resource constraints captured items relevant to new venture creation.

We used the helix process described in Ericsson and Simon (1993) to generate the coding scheme. This process calls for repeated circles of coding scheme items generated along a particular axis, such as the three axes of general expertise, marketing and new venture creation in our study. One member of the research team began listing specific items of the coding scheme from four randomly selected protocols, two from experts and two from novices. Thereafter, the same researcher added items to the list from other protocols and refined the list in an iterative fashion until the coding scheme converged into a complete and coherent instrument for analyzing all the protocols. Two other members of the research team then used the coding scheme to code the protocols independently. Three minor modifications to the phrasing of particular items emerged from this, leading to the final coding scheme presented in Appendix B.

After this, an independent coder, not involved in the study in any other way (i.e. blind to the hypotheses), coded all the protocols using the final coding scheme. The two sets of codings were compared to examine inter-rater agreement (James et al., 1993) and the results revealed a strong mean agreement of .82 across the variables used in this study, with no specific variable scoring lower than .67. The codings that consisted of frequency counts were analyzed with ANOVA and those that consisted of dichotomous variables were analyzed with chi-squared tests. A complete inventory of variable descriptions is included with results in Tables 3 and 4.

6. Results

Overall results show significant evidence of expert–novice differences as well as differences in logical framing. We initially report our findings related to expert–novice differences in general, and then discuss domain-specific differences.

6.1. Differences due to expertise in general

6.1.1. Analogical reasoning

At a fundamental level, we found several significant differences that support expectations based on existing research on expertise in general. Experts talked more ($p = .007$) than their novice peers. Additionally, experts consistently went

Table 3
Variable descriptions and analyses: differences due to expertise in general.

Construct	Variable description	Descriptive statistics	Significance of experts/novices	Summary of findings
Analogical reasoning	Total number of words the participant used to complete the scenario	Max: 2691 Min:135 S.D.: 608	$F=7.71$ $p=0.007$	Experts talked more than novices
Analogical reasoning	Number of new markets identified by each subject	Max: 8 Min: 0 S.D.: 1.38	$F=14.93$ $p=0.000$	Experts identified or created more new markets than novices
Analogical reasoning	Subject articulated an alternative segment during the scenario (Y/N)	Expert: 12Y, 15N Novice: 2Y, 35N	ChiSq∗=13.92 $p=0.000$	Experts were more likely to articulate a segment not included in the scenario
Holistic and conceptual thinking	Number of thoughts relating to the business but outside scenario questions	Max: 14 Min: 0 S.D.: 3.52	$F=39.81$ $p=0.000$	Experts were more likely to think holistically about the business
Weighting of (predictive) information	Subject believed and accepted the market research numbers in the scenario (Y/N)	Expert: 13Y, 14N Novice: 34Y, 3N	ChiSq∗=15.31 $p=0.000$	Novices are more likely to believe and accept market research than experts
Control variable	Count of times subject uses intuition or gut feel to make decisions	Max: 4 Min: 0 S.D.: 0.66	$F=1.05$ $p=0.310$	Experts and novices do not differ on their use of intuition or gut feel

* ChiSquared tests are two-tailed.

beyond the data specified in the research instrument as they worked through the problems. In Problem 1, experts identified 28 distinct potential markets while novices identified 12 ($p<.001$). In Problem 2, 45% of experts vs. only 5% of novices visualized alternative target segments beyond those identified in the problem ($p<.001$).

Table 4
Variable descriptions and analyses: differences due to entrepreneurial expertise.

Construct	Variable description	Descriptive statistics	Significance of experts/ novices	Summary of findings
Means-driven as opposed to goal-driven action	Number of times a subject drew on personal experience	Max: 4 Min: 0 S.D.: 0.96	$F=20.89$ $p=0.000$	Experts were more likely to draw on personal experience than novices
Affordable loss as opposed to expected return	Times a subject mentioned the availability of money or cost of an option	Max: 10 Min: 0 S.D.: 2.57	$F=41.52$ $p=0.000$	Experts are more concerned with project affordability than novices
Affordable loss as opposed to expected return	Total number of segments chosen by a subject (2nd priority segment counts as .5 of a choice)	Max: 4 Min: 0 S.D.: 1.02	$F=5.80$ $p=0.019$	Novices are more likely to chase greater expected value projects
Partnerships as opposed to competitive analysis	Times subject mentioned partnership activities	Max: 3 Min: 0 S.D.: 0.73	$F=13.24$ $p=0.001$	Compared with novices, experts prefer to build new ventures with partners
Control variable for: Partners hips as opposed to competitive analysis	Subject choice of direct sales as a channel	Expert: 6Y, 21N Novice: 8Y, 29N	ChiSq∗=.003 $p=0.954$	No significant difference in the choice of a direct sales channel between experts and novices
Partnerships as opposed to competitive analysis	Subjects choosing direct channel and personally approaching customers	Expert: 3Y, 3N Novice: 0Y, 8N	ChiSq∗=5.09 $p=0.024$	Experts that chose direct sales were more likely than novices to approach customers directly

* ChiSquared tests are two-tailed.

6.1.2. Holistic and conceptual thinking

Experts also focused on the problem tasks in a more holistic fashion, guiding decisions with an eye toward building the venture as a whole, rather than merely solving the marketing problem specified in the experimental task. Of the 27 experts, 21 explicitly dealt with the venture as a whole throughout the task, making 123 mentions of their thoughts in this area, while all but 4 novices (who made a total of only 5 comments in this vein) stayed within the parameters of the tasks called for at each step in the study ($p < .001$). All of these relationships reaffirm previous results found in the expertise literature on how experts differ from novices in storing, retrieving and processing complex information and in relating knowledge acquired through deliberate practice to new problems in their domain of expertise.

6.1.3. Weighting of (predictive) information

In addition to support for core principles in expertise, we found substantial evidence that experts significantly discount or ignore predictive information. During problem 1, subjects were asked how they would go about finding information about potential customers, competitors and the growth potential of the market. Expert entrepreneurs overwhelmingly rejected the use of traditional market research methods such as surveys, formal focus groups and systematic testing. In Table 5, we present a selection of actual quotes from the protocols in support of this claim. Furthermore, in Problem 2, when subjects were asked to deal with specific market research data, expert entrepreneurs again expressed reluctance to believe the forecasts provided in the problem task. Of the 27 experts, 15 stated explicitly that they did not believe the numbers, while only 2 of the 37 novices expressed disbelief in the numbers they were provided ($p < .001$).

Given expert rejection of predictive information, we investigated the use of intuitive rather than analytical decision-making approaches (Mitchell, 2005). There is some evidence that in the absence of external input people tend to rely on more "intuitive" rather than analytical decision-making ((Brunswick, 1956; Hammond, 1988; Dunwoody et al., 2000). While the expertise literature tends to equate intuition with a semi-automatic form of information processing arising out of deliberate practice (Ericsson and Smith, 1991; Ericsson and Charness, 1994), others have operationalized it as tacit knowledge that might have a variety of origins including socially and culturally instantiated knowledge structures (example: (Reber, 1989)).

Our results showed no significant differences between the novices and experts on several measures of intuitive decision-making. Instances where subjects worked through "gut feeling," "intuition," "personal choice" or "opinion" were in fact quite rare in either group (9 mentions for experts vs. 6 for novices). While many of our results support existing expertise principles, the finding that experts do not revert to gut feeling and intuition suggests a need to look more closely at the domain specific factors involved in decision-making under uncertainty.

6.2. Differences due to entrepreneurial expertise

6.2.1. Non-predictive as opposed to predictive control

As predictive and non-predictive control approaches are described by the set of strategies underlying each, our comparison of the two consists in the paired constructs below.

Table 5
Sample quotes from expert entrepreneurs.

"Traditional market research says, you do very broad based information gathering, possibly using mailings. I wouldn't do that. I would literally, target, as I said initially, key companies who I would call flagship, do a frontal lobotomy on them…. The challenge then is really to pick your partners, and package yourself early on before you have to put a lot of capital out" (E26)
"…I think I'd start by just... going... instead of asking all the questions I'd go and say... try and make some sale. I'd make some… just judgments about where I was going — get me and my buddies — or I would go out and start selling. I'd learn a lot you know… which people... what were the obstacles… what were the questions... which prices work better and just DO it. Just try to take it out and sell it. Even before I have the machine. I'd just go try to sell it. Even before I started production. So my market research would actually be hands on actual selling. Hard work, but I think much better than trying to do market research" (E1)
"Every product that potential customers are using, when critically examined, might give you insight on one aspect of your particular product. So you don't have to yourself go and do massive experiments. You can actually, by looking at half a dozen different products, you might actually learn about customer behavior, their need and their aspiration and… dynamics. So, without even going and building a product, you might want to get some understanding of the dynamics of that particular market" (E4)

6.2.2. Means-driven as opposed to goal-driven action

As expected, expert entrepreneurs were significantly more likely to draw on their means of personal experience ($p<.001$) in their decision-making. There was not sufficient data from this instrument to analyze whether experts were also likely to employ the other two types of means they might have at their disposal, those of network (whom I know), and resources (who I am).

6.2.3. Affordable loss as opposed to expected return

To examine whether there is a quantifiable difference between experts and novices in how they evaluate an opportunity, we counted how often each subject asked about how much money was available to the venture and how often they considered an option in light of what it would cost. Overwhelmingly, experts were more likely to talk about costs and making the most of limited resources available than novices. Of the 27 experts, 24 explicitly worried about it, making 108 mentions of their concern, while only 16 of the 37 novices made a total of 27 mentions. In addition to their significantly lower concern for project affordability ($p<.001$), novices also demonstrated a higher propensity to choose multiple market segments ($p=.019$), an approach we link to chasing the largest expected return. Taken together, these findings suggest that expertise makes a genuine difference in shaping the way individuals assess risks and opportunities.

6.2.4. Partnerships as opposed to competitive analysis

The preferred method of building the new venture for expert entrepreneurs consisted in stitching together a network of partnerships. Significantly more experts focused on partnerships than novices did ($p=.001$), with 55% of experts mentioning 21 partnership opportunities, while 10% of novices mentioned only a total of 5 partnerships. This finding was underscored when we focused on how the subjects planned to sell to the segments they chose. We counted the number of mentions subjects made about personally going out to sell to customers. Although expert entrepreneurs did not significantly differ from novices ($p=.755$) in whether they selected direct sales or not, experts that did select direct sales were much more likely to prefer selling personally than the novices that selected direct sales, who instead preferred to recruit a salesforce ($p=.024$). All 8 novices who selected direct sales also decided to use a recruited sales force, whereas 3 of the 6 experts who selected direct sales, specified that they would do it themselves rather than recruit a sales force. Of the remaining three, two did not specifically mention whether they would use a recruited sales force or not and only one planned to recruit a sales force. We take the emphasis on personal sales on the part of experts to signify a strategy of building integrative relationships with customers, further supporting the experts' predisposition to partnerships.

6.2.5. Leveraging as opposed to avoiding contingencies

In the interest of keeping the experiment constrained to a reasonable session time for our participants, our instrument design did not incorporate any unexpected event. Consequently, we were not able to measure whether our participants attempted to leverage or avoid contingences. We highlight this area as offering strong potential for future research.

6.2.6. Result summary: experts and novices differ in framing

After confirming that the two groups, experts and novices, differed in several elements related to entrepreneurial expertise, we combined all the significantly different items mentioned above (see details in Tables 3 and 4) to create a "framing score" for each subject as follows: For each variable the subject received a 1 if their response was associated with the overall expert response on that item (0 otherwise). For example, expertise was significantly associated with disbelief in the data; each subject who expressed disbelief in the data received a 1, the rest received 0 s. These items fit together well, with a Cronbach's alpha score of .694. When viewed graphically, as in Fig. 1, the subjects fall into two separable populations characterized by significantly different means ($p<.001$) and standard deviations that were not significantly different ($p=.210$). Overall, the framing scores and their distribution demonstrate consistency in each respondent's framing approach across the entire problem set, providing a useful overall measure of responses.

6.3. Limitations

In interpreting the results above, it is necessary to keep in mind limitations of the design. We already discussed in some length the use of MBA students as the comparison group. To that, we would like to add a few more concerns. First, the students were significantly younger than the expert entrepreneurs in the study (similar to the Mitchell et al.,

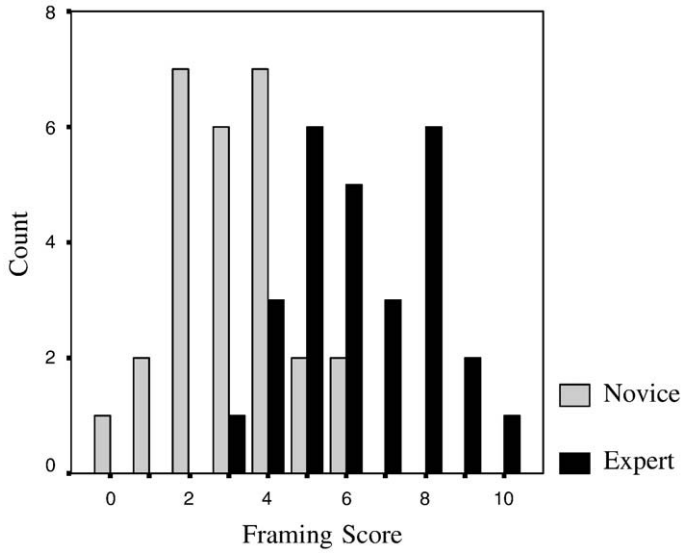

Fig. 1. Group differences.

2000; Baron and Ensley, 2006 studies). This is neither surprising nor easy to avoid considering the long period of deliberate practice required to attain levels of expert performance (Baron and Ensley, 2006 make a similar point about their study). Given the rule-of-thumb in operationalizing the very definition of expertise in subject selection, we would have to expect a minimum difference of ten years between the two groups. All the same, we acknowledge that we cannot entirely rule out age differences as a confounding explanatory factor in the study.

Second, though not small by comparison to many studies in the expertise literature, the samples used in this study are small by the standards of many entrepreneurship studies. In fact, one of the most important collections of (six) expertise studies reported in Zsambok and Klein (1996) consists in a median of only 20.5 participants, experts and otherwise. Whereas there is a practical reason for small samples in this stream of literature due to the difficulties in securing a sample of expert entrepreneurs, and the time-consuming nature of data collection and coding using the think aloud protocol method, it is the method itself that provides the remedy. The unit of analysis for protocol studies is the semantic chunk and not the subject. Each subject therefore provides a large number of analyzable units of data rich enough to make comparisons of decent statistical power. All the same, even when we believe that the sample sizes used in this study are adequate for its purposes and in line with its disciplinary traditions, we explicitly acknowledge the fact that external validity would be vastly improved with larger subject pools (as noted by (McMullen and Shepherd, 2006).

Taking the above limitations into explicit account here, we believe we should use caution in interpreting these results to mean that we have established the existence and content of entrepreneurial expertise merely because the MBA students did not use the same logical frame and heuristics as the expert entrepreneurs. The strength of claims about any relationship between effectual logic and entrepreneurial expertise has to come from the fact that we carefully selected *experts* and gave them decision tasks precisely within their domain of expertise. This strength is moderated by the *assumption* that the logical frame they used was acquired through their experience as entrepreneurs since we do not directly test this assumption. Our study is subject to the same limitation as a variety of studies that use naïve or non-expert groups in comparison with experts such as those defended by (Chi, 2006a,b).

The interesting issue, however, is the *difference* between the expert approach and that of the MBA students. Why are these two groups different? The standard argument would be that the MBA students have virtually no experience in entrepreneurship and therefore the differences are due to differences in entrepreneurial experience. But obviously, this claim would bring into the forefront the weakness of not using "true" novices as opposed to MBA students. And surely, a series of studies using entrepreneurs with different levels of experience would be necessary to make a strong claim in this regard. Yet there is a peculiar advantage to the fact that the comparison group consists of MBA students, especially in light of the *strength* of the differences in the contrasting results we obtained above. Fig. 1 can only be described as stark and striking in its contrast. Clearly such a strong difference could not simply be attributed to lack of entrepreneurial experience. It has to be related to the one fact that unifies this group — namely the very fact that they

are all MBA students. What is it about MBA students that leads them to choose a frame in stark contrast to expert entrepreneurs? Our conjecture in this regard is that it is their experience in the MBA program, i.e. the knowledge structures they have acquired through their education in courses within the MBA curriculum.

In evaluating the contribution of this finding, we need to ask ourselves whether this conjecture is already well known in the literature? Both anecdotal wisdom and the popular literature on entrepreneurship have claimed that the MBA program does not do a good job of educating entrepreneurs. But this claim has neither been systematically investigated nor have outlines of what might be missing been rigorously conceptualized. Lazear's (2004) work, although limited to certain areas of the new venture population, is a notable exception that argues *based on empirical evidence* for *business* as opposed to *technical* innovation as the key content for entrepreneurship curricula. Other works that speak to the content of entrepreneurship courses include empirical examinations of the efficacy of business planning. Two recent studies ((Delmar and Shane, 2003; Honig and Karlsson, 2004) argue in opposite directions in this regard and therefore the question awaits further investigations. The results from the current study suggest at least that the claim about the inadequacy of MBA curricula in educating entrepreneurs might be worth taking seriously as a topic for entrepreneurship research.

7. Discussion

To assist researchers in interpreting and integrating the results of this study with the work of Baron and Ensley (2006) and Mitchell et al. (2000), we have summarized the key features of these studies in Table 6.

This table may help highlight some of the differences in expert entrepreneurial cognitions reported here as well as some commonalities. The reason for the differences arises from the fact that even though studies of experience and expertise ultimately share a common research tradition, the literature has evolved into several different branches with their respective approaches, definitions, methods and interpretations. Readers will notice that the present study strongly reflects the traditions of Ericsson and Simon (1993). Mitchell et al. (2000) Leddo and Abelson (1986) as their foundation; Baron and Ensley draw substantially upon prototype theory inspired by Hahn and Chatter (1997) and Whittlesea (1997).

In spite of differences, these studies share a common root in research that examines the relationship between experience/expertise and cognition, a literature that the current paper aspires to join with. In their study, Baron and Ensley compared the business opportunity prototypes of novice and repeat entrepreneurs, finding that the prototypes of more experience entrepreneurs were both more sophisticated and more pragmatic than novices ((Baron and Ensley, 2006). The studies by Mitchell et al. (2002) used the script-cue approach and found that entrepreneurs and non-entrepreneurs differed in their ability to recognize appropriate cognitive script cues. Looking at our study in light of its predecessors, particular themes are evident. One important commonality that potentially has broad implications for research in entrepreneurship concerns risk-taking behavior. Baron and Ensley noted that the cognitive frameworks used by experienced entrepreneurs "tended to focus on factors pertaining to financial success, rejecting ideas for new products or services that did not appear to offer

Table 6
Comparison of studies.

	Mitchell et al. (2000)	Baron and Ensley (2006)	Present study
Definition of expertise	Possession of appropriate cognitive scripts	N/A	Someone who has attained reliably superior performance in a particular domain
Operationalization	Start >1 venture in existence >2 years; Years of business experience (6.5 mean)	Number of ventures started (2.6 mean); Years of entrepreneurial experience (>4.8 mean)	IPO at least 1 venture Number of ventures started (7.3 mean) Years of entrepreneurial experience (21.6 mean)
Method	Script-cue approach	Retrospective interview	Concurrent think-aloud solving a representative task
Instrument	Questionnaire of paired mastery and distracter cues and cultural values	4 open-ended questions about opportunities pursued and rejected	Commercialization of an imaginary product
Analytical techniques	Exploratory ANOVA, MANOVA and regression analyses	Computerized content analysis Coding, rating and counting by blind panel Regression analysis	Content analysis using coding scheme Multiple coders (blind coder/test inter-rater reliability) Exploratory ANOVA analysis

manageable risk, the capacity to generate positive cash flow, and so on." (2006). In our study, we found results congruent with this, in that experts were significantly more likely to emphasize affordable loss rather than expected returns, which may reduce the uncertainty of venturing. These results cumulate with Mitchell et al.'s conclusions that expert entrepreneurial cognitions may reduce perceived risk and that researchers might therefore consider that, "risk-taking behaviors may in reality be a manifestation of particular scripts." (2000). This cumulative evidence speaks to the ongoing debate in psychology on the risk-propensity of entrepreneurs. Note for example two recent meta-analytical studies that point in contrasting directions on this debate (Miner and Raju, 2004; Stewart and Roth, 2004).

Another important literature we hope the cumulation of the three studies on entrepreneurial expertise speak to is the one on behavioral decision-making. In this paper, we have found evidence that entrepreneurial expertise is related to a set of factors that frame decisions differently than novices or marketing textbooks do. There is some evidence that framing alters the problem space itself (Dunegan, 1993), i.e. that not only do individuals perceive different solutions to the same problem under different frames, they also perceive different problems and hence entirely different sets of alternatives or possible courses of action. In particular, all three studies listed in Table 6 found that expert entrepreneurs are focused on limiting the downside. Our study has also pointed to other factors such as stitching together partnerships to build the venture as a whole as opposed to predicting and pursuing forecasted upsides without regard to means at hand. This raises interesting theoretical possibilities for delineating decisions under uncertainty based on people's beliefs about the predictability and controllability of the future (Wiltbank et al., 2006). Traditionally, the literature on decision-making under uncertainty has focused on better prediction as the primary way to achieve control over future outcomes. Hence the emphasis on "correct" processing of probability estimates, for example (Bar-Hillel, 1980). However, as Kahneman and Lovallo (1993) and others have repeatedly shown, human beings are not good at probabilistic reasoning. Gigerenzer and his collaborators (Gigerenzer and Goldstein, 1996; Gigerenzer and Edwards, 2003) have proposed and tested one reason for this as resulting from the format in which information is presented — i.e. frequencies versus point estimates, the former being adaptive (in an evolutionary biological sense) and hence ecologically rational (Gigerenzer, 2000). The results in the current study provide another reason — particularly in contexts where human action is the dominant driver of outcomes — to think that it might be ecologically rational for entrepreneurs to limit their dependence on prediction, and instead favor forms of non-predictive control. We think that valuable synergies await future scholarship that seeks to connect notions of ecological rationality with entrepreneurial cognition.

Third, this paper is also related to the economics of entrepreneurship. The results of all three studies involving entrepreneurial expertise contain the seeds of an argument against the prevalent economists' contention that entrepreneurial performance is predominately due to luck (Denrell, 2004). The existence of a cognitive basis for domain-specific expertise, particularly one that can be contrasted with the logical drivers of novice decision-making, suggests strongly that entrepreneurial success may at least partly be a product of skill and not luck alone (Gompers et al., 2006). However, economic theory suggests that it is difficult and costly to observe and evaluate entrepreneurial ability (Amit et al., 1990). To the extent that the cumulative evidence from entrepreneurial expertise research enables lower cost evaluation of entrepreneurial skill levels, direct evaluation may substitute the indirect inferences stakeholders otherwise have to draw based on indirect data about the skills and abilities of individuals they are contemplating committing to (Mitchell et al., 2004a,b).

Finally, we wonder about the extent to which the deliberate practice concept applies to the domain of entrepreneurship. In this paper, we embraced Ericsson's position that deliberate practice is a key mechanism in the development of entrepreneurial expertise. It may be interesting to empirically examine which particular recurring tasks that entrepreneurs face in the course of developing their ventures that may constitute useful avenues to competence improvement. On balance, we suspect that the incentive to invest in competence improvement is fairly obvious to individuals who consider themselves career entrepreneurs, and is more plausible than the alternative claim that serial entrepreneurs do not practice (in the current venture) at becoming a better entrepreneur (for the next venture). Therefore, one task that awaits future research is collecting a body of longitudinal data about the everyday behavior of entrepreneurs, which explicitly helps us answer the question: how do entrepreneurs acquire expertise? Several methodologies are suggested for such investigations in Part IV of Ericsson et al. (2006): historiometric methods by Simonton (2006); laboratory methods by Proctor and Vu (2006); retrospective interview methods by Sosniak (2006) and dairying/time analysis by Deakin et al. (2006). Research using these methods might show us to what extent there are certain focused, critical activities that entrepreneurs engage in repeatedly. The expectation would be that they become very practiced at, for example, "pitching" their venture idea to potential stakeholders and negotiating details of means and ends shaping the new venture, business plan writing, evaluating commercialization opportunities, and the continual seeking, parsing, accepting and rejecting of feedback and advice from a variety of sources.

8. Conclusion

In this paper, we set out to investigate differences in logical framing between a group of expert entrepreneurs and a comparison group of novices. Expected differences were drawn both from theorizing in entrepreneurship research and empirical findings in the broader literature on cognitive expertise. Results showed stark differences that have implications for training potential entrepreneurs as well as for future research that builds upon the growing body of work in entrepreneurial cognition.

The starkness and strength of the results, however, suggests an intriguing new answer to the seminal question that Thaler proposed in quotation we cited at the beginning of this paper, namely "*How do people create the frames that so influence their choices?*" Cumulating the results of the current study with previous ones both from the expertise literature in general and entrepreneurial expertise in particular positions expertise as a compelling answer to this question. But it might very well turn out to be that focused professional education of the sort that MBA programs provide is another. If so, we need to be moving beyond the conventional question of "What should we be teaching potential entrepreneurs?" to the more cautionary one of "What should we *not* be teaching potential entrepreneurs?" For as a wise saying from Asia goes — it is far more difficult to unlearn something than to learn it — a thesis that in itself awaits examination by cognitive scientists.

Appendix A. Research instrument

Introduction

In the following experiment, you will solve two decision problems. These problems arise in the context of building a new company for an imaginary product. A detailed description of the product follows this introduction.

Although the product is imaginary, it is technically feasible and financially viable. The data for the problems have been obtained through realistic market research — the kind of market research used in developing a real world business plan.

Before you start on the product description and the problems, I do need one act of creative imagination on your part. I request you to put yourself in the role of the an entrepreneur building a company — i.e., you have a little money of your own to start this company, and whatever experience you have to date.

Throughout the experiment you should talk aloud the thoughts you are having. Please start by reading aloud the following instructions.

Description of the product

You have created a computer game of entrepreneurship. You believe you can combine this game with some educational material and profiles of successful entrepreneurs to make an excellent teaching tool for entrepreneurship. Your inspiration for the product came from several reports in the newspapers and magazines about increasing demand for entrepreneurship education; and the fact that a curriculum involving entrepreneurship even at the junior high or high school level induces students to learn not only business-related topics but math and science and communication skills as well.

The game part of the product consists of a simulated environment for starting and running a company. There are separate sub-simulations of markets, competitors, regulators, macroeconomic factors and a random factor for "luck". The game has a sophisticated multi-media interface — for example, a 3D office where phones ring with messages from the market, a TV that will provide macroeconomic information when switched on, and simulated managerial staff with whom the player (CEO) can consult in making decisions. At the beginning of the game, the player can choose from a variety of businesses the type of business he/she wants to start (For example: manufacturing, personal services, software etc.) and has to make decisions such as which market segment to sell to, how many people to hire, what type of financing to go for, etc. During the game, the player has to make production decisions such as how much to produce, whether to build new warehouses or negotiate with trucking companies, etc.; marketing decisions such as which channels of distribution to use, which media to advertise in and so on; management decisions involving hiring, training, promoting and firing of employees, and so on. There is an accounting subroutine that tracks and computes the implications of the various decisions for the bottom line. The simulation's responses to the player's decisions permit a range of possible final outcomes — from bankruptcy to a "hockey stick".

You have taken all possible precautions regarding intellectual property. The name of your company is *Entrepreneurship, Inc.* The name of the product is *Venturing*.

Problem 1: Identifying the market

Before we look at some market research data, please answer the following questions — one at a time: (Please continue thinking aloud as you arrive at your decisions)

1. Who could be your potential customers for this product?
2. Who could be your potential competitors for this product?
3. What information would you seek about potential customers and competitors — list questions you would want answered.
4. How will you find out this information — what kind of market research would you do?
5. What do you think are the growth possibilities for this company?

Problem 2: Defining the market

In this problem you have to make some marketing decisions. Based on *secondary market research* (published sources, etc.), you estimate that there are three major segments who are interested in the product:

Segment	Estimated total size
Young adults between the ages of 15 and 25	20 million
Adults over 25 who are curious about entrepreneurship	30 million
Educators	200,000 institutions

The estimated dollar value of the instructional technology market is $1.7 billion.
The estimated dollar value of the interactive simulation game market is $800 million.
Both are expected to grow at a minimum rate of 20% p.a. for the next 5 years.

The following are the results of the primary (direct) market research that you have completed

Survey #1 — Internet users were allowed to download a scaled down version (game stops after 15 min of playing) of the prototype and were asked to fill out a questionnaire

You get 600 hits per day. 300 actually download the product. You have 500 filled out questionnaires.

Willing to pay ($)	Young adults (%)	Adults (%)	Educators (%)
50–100	45	26	52
100–150	32	38	30
150–200	15	22	16
200–250	8	9	2
250–300	0	5	0
Total	100	100	100

Survey #2: The prototype was demonstrated at 2 Barnes & Noble and 3 Borders Bookstores

Willing to pay ($)	Young adults (%)	Adults (%)	Educators (%)
50–100	51	21	65
100–150	42	49	18
150–200	7	19	10
200–250	0	8	7
250–300	0	3	0
Total	100	100	100

Survey #3:Focus Group of educators (high school and community college teachers and administrators)

The educators who participated in the focus group find the product exciting and useful — but want several additions and modifications made before they would be willing to pay a price of over $150 for it. As it is, they would be willing to pay $50–80 and would demand a discount on that for site licenses or bulk orders.

Both at the bookstore demo and the focus group, participants are very positive and enthusiastic about the product. They provide you good feedback on specific features and also extend suggestions for improvement. But the educators are particularly keen on going beyond the "game" aspect; they make it clear that much more development and support would be required in trying to market the product to them. They also indicate that there are non-profit foundations and other funding sources interested in entrepreneurship that might be willing to promote the product and fund its purchase by educational institutions.

Based on your market research, you arrive at the following cost estimates for marketing your product.

Internet	$20,000 upfront+$500 per month thereafter
Retailers	$500,000 to 1 M upfront and support services and follow-up thereafter
Mail order catalogs	Relatively cheap — but ads and demos could cost $50,000 upfront
Direct selling to schools	Involves recruiting and training sales representatives except locally

Competition

None of the following four possible competitors combine a simulation game with substantial education materials — you are unique in this respect.

Company	Product	Description	Price per unit	Sales ($)
Maxis	Sim City	Urban planning simulation	29.95	30 M
Microprose	Civilization	Civilization building simulation	50.00	20 M
Sierra On-Line	Caesar	City building simulation	59.95	18 M
Future Endeavors (New Co. <1 yr. old)	Scholastic Treetop	CD-ROMs of Scholastic Books	n / a	1 M

The game companies are making a net return of 25% on sales.

At this point, please take your time and make the following decisions: (please continue thinking aloud as you arrive at your decisions)

1. Which market segment/segments will you sell your product to?
2. How will you price your product?
3. How will you sell to your selected market segment/segments?

Appendix B. Coding scheme

1. Overall
   - 1a. Total number of WORDS of text for each subject:
   - 1b. Did this person believe the numbers? Enter Yes or No
   - 1c. Did this person mention any of the following? Enter yes or no and the count of their mentions

Gut feeling	Intuition
My personal choice	In my opinion
Total "gut feeling" count:	

   - 1d. Did this person worry about how much money he or she has and what the costs of executing his or her marketing decisions will be? Enter yes or no
   - 1e. If yes, count how many times they mentioned their concern:

1f. Did this person go beyond making marketing decisions to talk about building the business as a whole? Enter yes or no
1g. If yes, count how many times they mentioned each of the following:

What it would take to put a sales force together:
Issues related to the long term:
Theorizing about entrepreneurial decisions/actions:
Insights from previous experience:
Insights from case studies/classes:

2. Partnerships/affiliations/relationships
   2a. Did this person visualize partnering or building a relationship with someone? Enter yes or no
   2b. If yes, count number of partnerships they visualized:
3. Segment decision
   3a. Did this person actually decide on one or more segments? Enter yes or no
   3b. Did this person decide to sell to all three segments? Enter yes or no
   3c. If this person chose more than one segment, was it simultaneous or prioritized? Enter S or P
4. Number of new markets
   4a. Who could be your potential customers for this product?
   4b. What do you think the growth opportunities are for this company?
   4c. Did this person visualize new segments other than the ones suggested? Enter yes or no
   4d. If yes, list the new segments:
5. Channel decision
   5a. Check off channels they used:

Internet Retail Mail order catalog Direct sales

   5b. Direct sales:
   I will personally contact:
   I will recruit salespeople:

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