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LINKING EXPERIENCE TO INTUITION AND COGNITIVE VERSATILITY IN NEW VENTURE IDEATION: A DUAL-PROCESS PERSPECTIVE

Leonie Baldacchino*
University of Malta
Msida, MSD 2080, Malta
leonie.baldacchino@um.edu.mt

Deniz Ucbasaran
Warwick Business School
University of Warwick
Coventry, CV4 7AL, England, UK
deniz.ucbasaran@wbs.ac.uk

Laure Cabantous
Bayes Business School (formerly Cass)
City, University of London
London, EC1Y 8TZ, England, UK
laure.cabantous.1@city.ac.uk

* Corresponding author

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ABSTRACT

As many high-profile business leaders purport to make decisions based on gut feelings, a growing number of management scholars are seeking to explain how leaders use intuition in organizational settings. In line with dual-process theories, management scholars argue that the most effective decision makers are cognitively versatile, which means that they are able to 'switch cognitive gears' between intuition and analysis and, more importantly, that they are able to use both types of processing at high levels. Although this has important implications, the actual use of intuition as well as cognitive versatility have received limited scholarly attention. Motivated by the desire to address this gap, we pose the following research question: *To what extent is experience associated with a) intuition and b) cognitive versatility, and with what effects?* We consider the influence of domain-specific experience because this is considered to be a prerequisite for intuition, and we explore the effects in the context of new venture ideation which is a precursor to and the lifeblood of entrepreneurial action, not only for founders of new ventures but also for managers of existing organizations who seek to drive innovation and be entrepreneurial. We build on insights from the dual-process Cognitive-Experiential Self-Theory, as well as the literature on managerial and entrepreneurial intuition, to develop a conceptual model, which we test on data collected from 74 technology-entrepreneurs via think-aloud protocol analysis and an online survey. We find that experienced entrepreneurs are able to use both intuition and analysis extensively during new venture ideation, and that the use of intuition is most effective for new venture ideation when used together with analysis – both at high levels – in a cognitively versatile strategy.

Keywords: Cognitive Versatility
Dual-Process Theories of Cognition
Entrepreneurship
Intuition
New Venture Ideation

INTRODUCTION

Management scholarship has a rich tradition of drawing on psychology to generate insights into the behavioural foundations of business decision making (Foss and Weber, 2016; Hambrick and Crossland, 2018; Hodgkinson and Healey, 2011; Powell et al., 2011). In recent years, management researchers have followed the lead of psychology scholars in studying cognition from the perspective of dual-process theories (e.g., Calabretta et al., 2017; Hodgkinson and Clarke, 2007; Hodgkinson and Sadler-Smith, 2018; Luoma and Martela, 2021), which hold that individuals process information by means of two independent but interactive types of processing: A rapid, automatic type that is beyond conscious awareness and control, and gives rise to various non-conscious processes including heuristics and intuition (Type 1); and a slower, deliberate type that is conscious and controlled, and gives rise to processes such as rational analysis (Type 2) (Evans, 2008; Evans and Stanovich, 2013).

As many high-profile business leaders like Jeff Bezos and Steve Jobs have claimed to make decisions based on their hunches or gut feelings, a growing number of scholars are seeking to explain how leaders use intuition in organizational settings (e.g., Akinci and Sadler-Smith, 2019; Meziani and Cabantous, 2020; Samba et al., in press; Sukhov et al., 2021). Intuition, defined as "affectively-charged judgments that arise through rapid, nonconscious, and holistic associations" (Dane and Pratt, 2007, p. 40) is often confused with heuristics since both are Type 1 processes that enable quick and seemingly effortless information processing. However, they are not the same thing (Hodgkinson and Sadler-Smith, 2018; Samba et al., in press), for heuristics are rules of thumb that enable conscious judgements (Kahneman and Frederick, 2002), while intuition is a form of direct knowing that occurs outside conscious awareness (Sinclair and Ashkanasy, 2005).

Furthermore, while heuristics often lead to biases or errors in thinking (Kahneman and Frederick, 2002), dual-process theories of cognition and the literature on intuitive expertise (Salas et al., 2010) posit that, although intuition is rapid, automatic, and often hard to justify or explain, it does not necessarily lead to biases in decision making. In fact, they argue that, under certain conditions, intuition can yield even better decisions than those arrived at through analysis, which refers to "the process of trying to understand a problem by breaking it down into its components and then performing logical and/or mathematical operations on these components" (Klein, 2004, p. 74).

Accordingly, management scholars have started to develop a more nuanced understanding of how, when, and under which conditions intuition is deployed, and with what effects. In line with dual-process theories, one important message that emerges from management scholarship on intuition is that the most effective decision makers are able to 'switch cognitive gears' between intuition and analysis as required (Louis and Sutton, 1991) and, more importantly, that they are able to use both types of processing at high levels. This ability to extensively use both intuition and analysis and to switch between them as needed has been referred to in various ways, including cognitive versatility (Hodgkinson and Clarke, 2007) and cognitive flexibility (Laureiro-Martínez and Brusoni, 2018).

The notion that cognitive versatility may be more effective than a dominant use of just one type of processing has important implications for management scholars. However, at least partly due to the methodological challenges in studying intuition, which is difficult to capture through self-report due to its non-conscious nature (Sadler Smith et al., 2008), actual use of intuition as well as cognitive versatility have received limited scholarly attention beyond research on cognitive style (preference for – rather than actual use – of intuition) (Baldacchino et al., 2015; Hodgkinson and Sadler-Smith, 2018).

Motivated by the desire to address this research gap, our aim in this paper is to advance management research by developing knowledge about the nature and effectiveness of intuition and cognitive versatility. Specifically, we draw upon the dual-process Cognitive-Experiential Self-Theory (CEST: Epstein, 2003, 2010; Pacini and Epstein, 1999) to address the following research question: *To what extent is experience associated with a) intuition and b) cognitive versatility, and with what effects?*

We consider the influence of domain-specific experience because this is considered by various scholars to be a prerequisite for intuition (e.g., Akinci and Sadler-Smith, 2019; Hodgkinson et al., 2009; Klein, 2004; Miller and Ireland, 2005; Sadler-Smith and Shefy, 2004; Simon, 1987), such that only experienced actors would be capable of effectively using intuition. However, this has been debated by other scholars who argue that novices could also be intuitive by means of *entrepreneurial intuition* (Dutta and Crossan, 2005) or *creative intuition* (Dane and Pratt, 2007), which are distinct from *expert intuition* in that they rely on creative capacity rather than experience. Moreover, it is not clear whether experience enables cognitive versatility.

We explore the effects of experience, intuition and cognitive versatility in the context of new venture ideation. Ideation refers to the generation of ideas, especially novel ideas, for creating, sourcing, or deriving new products, services, or business models (Flynn et al., 2003), and is just as relevant within existing organizations as it is within new ventures (Kier and McMullen, 2018). We focus on *new venture* ideation (i.e., ideas relating to "imagined future ventures": Davidsson, 2015, p. 676), as a precursor to and the lifeblood of entrepreneurial action in line with recent research (Canavati et al., 2021; Frederiks et al., 2019; Kier and McMullen, 2018). In dynamic business environments where competitive advantage is often transient (McGrath, 2013), an important task for entrepreneurial leaders is to generate novel venture ideas and fit them within a competitive landscape (Lingo, 2020). It

is, therefore, not just founders of new ventures who are searching for new ways to drive innovation and be entrepreneurial, but also managers of existing organizations (Pollack et al., 2020).

We build on insights from CEST, as well as the literature on managerial and entrepreneurial intuition, to develop a conceptual model. We then test this model on data collected from 74 technology-entrepreneurs via a think-aloud protocol analysis exercise (Ericsson and Simon, 1993) to capture the use of intuition and analysis during a series of new venture ideation tasks, together with an online survey which measured dispositional cognitive style, experience and other relevant background data. It is worth noting that we approach cognitive versatility as a specific cognitive strategy – i.e., a way of processing information in the context of a task and in response to the circumstantial demands of the task, rather than a cognitive style – i.e., a dispositional, enduring preference in information processing approach (Hodgkinson and Clarke, 2007; Sadler-Smith, 2009).

We conduct regression and bootstrapped mediation analyses (Hayes, 2012) to test for direct and indirect effects of experience, intuition and cognitive versatility on two aspects of new venture ideation in line with prior literature (DeTienne and Chandler, 2004; Shepherd and DeTienne, 2005; Ucbasaran et al., 2009), namely: quantity (i.e., the number of new venture ideas generated) and quality (in our case the innovativeness of the new venture ideas). We find that entrepreneurs with domain-relevant experience are both more intuitive and more cognitively versatile, and that this enables them to generate more and better quality (i.e., innovative) new venture ideas than novices. Moreover, we find that both intuition and cognitive versatility mediate the relationship between experience and new venture ideation in terms of quantity and moderate innovativeness, but it is only cognitive versatility that is a mediator where the generation of highly innovative venture ideas are concerned.

Our contributions are threefold: First, by focusing on cognitive strategy rather than cognitive style, we provide robust empirical evidence on the actual use of intuition rather than inferring it from self-report measures that have been criticised as potentially unreliable (Blume and Covin, 2011). Second, we contribute to dual-process theory in management and entrepreneurship literature by being the first to demonstrate that (experienced) entrepreneurs are able to use both intuition and analysis extensively during new venture ideation, and that the use of intuition is most effective for new venture ideation when used together with analysis – both at high levels – in a cognitively versatile strategy. Third, we contribute to the debate amongst scholars on whether or not intuition is experience-based, and which form of experience supports the use of intuition, cognitive versatility, and new venture ideation.

THEORETICAL BACKGROUND AND HYPOTHESES

Dual-process theories, including CEST, share one key assumption, namely that information is processed by means of two independent but interactive types of cognitive processes or systems: Type 1 processes (labelled 'experiential' in CEST) are rapid, automatic and beyond conscious awareness and control, and they give rise to intuition; Type 2 processes (termed 'rational' in CEST) are slower, controlled and volitional, and they give rise to analysis. CEST conceptualises intuition as being experientially-derived and holistically-oriented (Epstein, 2003, 2010), which suggests that entrepreneurs' use of intuition is linked to both entrepreneurial experience and new venture ideation. Moreover, CEST's view is that Type 1 operates independently from, yet in parallel with, Type 2, which allows the conceptualisation of both intuition and analysis as being activated at the same time (Hodgkinson and Clarke, 2007).

In line with several authors (e.g., Hodgkinson and Clarke, 2007; Sadler-Smith, 2009), we use the term 'cognitive versatility' to refer to a specific cognitive strategy that consists of

using extensively both intuition and analysis (see our method section for more details). This cognitive strategy captures a central idea within CEST: that Type 1 (intuition) and Type 2 (analysis) processes can operate in parallel. Accordingly, when performing a particular task, an individual can rely on both intuition and analysis. Specifically, while intuition and analysis can compete, they often operate in harmony, enabling us to process information in detail, and to cut through such details (Hodgkinson and Sadler-Smith, 2018). Indeed, proponents of CEST argue that a high level of functioning in both experiential (intuitive) and rational (analytical) processing represents "an ideal state" (Hodgkinson and Sadler-Smith, 2018, p. 481; see also Epstein and Pacini, 1999; Hodgkinson and Clarke, 2007).

Deploying these theoretical principles, in our conceptual model (illustrated in Figure 1) we propose that experience allows entrepreneurs to be more intuitive as well as more cognitively versatile. This, in turn, enables experienced entrepreneurs to be more adept at new venture ideation than their inexperienced counterparts. Hence, intuition and cognitive versatility are proposed as mediators of the relationship between experience and new venture ideation. [1]

INSERT FIGURE 1 ABOUT HERE

Entrepreneurial Experience and Intuition

A key feature of the intuitive system according to CEST is that it is inherently linked to experience, to the extent that Epstein (2010) named it the 'experiential system' as its "very essence" is to learn from experience (p. 307). This is in line with the widely accepted notion that "the ability to intuit in particular domains is acquired through experience and learning ...

[1] While CEST provides the theoretical links necessary to hypothesise about the relationship between experience, intuition, and new venture ideation, it specifies no similar connections for analysis. We therefore do not derive hypotheses related to the use of analysis by itself. Instead, we draw on management and expertise literature which indicates that analysis may play a role in new venture ideation when it is used *alongside intuition* in a cognitively versatile strategy.

and relies upon pattern recognition processes" (Hodgkinson et al., 2008, p. 7). Miller and Ireland (2005) describe intuition as "automated expertise" which involves the "recognition of a familiar situation and the straightforward but partially subconscious application of previous learning related to that situation" (p. 21), while Sadler-Smith and Shefy (2004) speak of "intuition-as-expertise" which is based on "experience and analysis frozen over time into familiar routines and habitual responses" (p. 81).

Further support for this experience-based pattern-recognition view of intuition derives from Klein's work in naturalistic settings (e.g., fire-fighting and intensive care nursing), which portrays expert decision making as based on instant intuitive awareness of a situation by means of pattern recognition, which in turn depends on experience. Within the context of entrepreneurship, the more extensive the entrepreneurial experience, the larger the pool of relevant knowledge (e.g., regarding markets, customer needs, emerging technologies, etc.) (Shepherd and DeTienne, 2005; Ucbasaran et al., 2009) that can be intuitively drawn upon to generate new venture ideas. In view of the above, entrepreneurs with prior experience are expected to engage in a greater amount of intuitive processing than novices during new venture ideation. This leads to the following hypothesis:

H1a: Higher levels of entrepreneurial experience are associated with greater use of intuition in new venture ideation.

Entrepreneurial Experience and Cognitive Versatility

While CEST provides the theoretical links necessary to hypothesise about the relationship between experience and intuition, it specifies no similar connection with respect to experience and analysis. Furthermore, there are indications in the literature that novice entrepreneurs are more likely to engage in analytical processing than any other type of

cognition (Gustafsson, 2006), while expert processing is characterised by automaticity (Salas et al., 2010). Does this imply that experience stifles analysis?

The expertise literature (Dreyfus and Dreyfus, 2005; Ericsson et al., 2007; Prietula and Simon, 1989; Salas et al., 2010) offers some insight into this issue. Novices are highly analytical because they have not yet accumulated sufficient knowledge, internalised the appropriate rules, or developed the rich cognitive structures necessary to process information and carry out tasks automatically. Their performance is typically slow, deliberate and rule-based, as they attempt to understand the nature of the task and devise an appropriate response strategy (Dreyfus and Dreyfus, 2005). As individuals gain experience in a given domain, they become increasingly capable of responding intuitively. This, however, does not replace analytical processing (Prietula and Simon, 1989). On the contrary, automaticity enables experts to engage in a level of analysis that is more sophisticated and focused on the task at hand by freeing up valuable cognitive resources (Salas et al., 2010). Therefore, although experts typically generate an immediate intuitive response to a given situation, they also engage in analysis and reflection (if time permits) prior to making a decision or taking action (Dreyfus and Dreyfus, 2005).

While not the same as expertise, some studies suggest that experience may facilitate cognitive versatility. Experienced executives reportedly combine intuition with analysis (Burke and Miller, 1999; Sukhov et al., 2021), while experienced entrepreneurs were found to be better able than novices at adapting their cognitive processing to suit the task at hand (Evans, 2019; Gustafsson, 2006). We therefore suggest the following hypothesis:

H1b: Higher levels of entrepreneurial experience are associated with cognitive versatility in new venture ideation.

Intuition and New Venture Ideation

According to CEST, the experiential (intuitive) system is holistic and operates by making associative connections between stimuli, responses and outcomes (Epstein, 2010). Such holistic associations arise from an automatic process of pattern recognition in which "environmental stimuli are matched with some deeply held (nonconscious) category, pattern or feature" (Dane and Pratt, 2007, p. 37). Intuitive processing may therefore facilitate new venture ideation by rapidly accessing the entrepreneur's complex structures of non-consciously held knowledge (e.g., about markets, industries and technologies) and triggering the perception of novel patterns. Indeed, Baron (2006) draws parallels between pattern recognition and the ability to identify opportunities, and suggests that the latter involves connecting the dots between seemingly unrelated events and changes.

Although empirical research on the link between intuition and new venture ideation is scant, Crossan et al. (1999) view intuition as a critical part of learning about opportunities, such that every business opportunity originates from an intuition about an unmet need, accompanied by an initial notion about how it could be met. Dimov (2007a) extends this argument to entrepreneurial opportunities and maintains that the "early gestation and transition of opportunities" is rooted in a process of "*intuiting* that generates ideas with perceived potential" (p. 562).

Besides facilitating the generation of a larger number of new venture ideas, intuition may also play a role in enhancing their innovativeness. New venture ideation involves the application of mental operations to existing knowledge structures in order to generate creative (novel and useful) ideas which can potentially be developed into appealing goods or services (Ward, 2004). Generating ideas for innovative new ventures likely requires breaking out of established patterns and forming new ones (Gaglio, 2004), which is enhanced by the holistic and associative nature of the intuitive system (Epstein, 2003, 2010). This type of

processing provides a big-picture view of the business landscape encompassing a wide range of stimuli. As a result, intuition is likely to increase not only the quantity of ideas generated, but also their degree of novelty, because the subconscious and associative nature of intuition allows distant content areas to be connected (Raidl and Lubart, 2000-2001). In other words, an intuitive approach increases the likelihood both of more gaps and trends being recognised, and of increasingly novel connections being made among distant and disparate elements, thus leading to the generation of more innovative new venture ideas. For simplicity, we use the term new venture ideation proficiency to capture two important dimensions of new venture ideation: the quantity of new venture ideas generated, and their quality as characterised by their degree of innovativeness. Based on the above, we present the following hypothesis:
H2a: Greater use of intuition is associated with higher proficiency in new venture ideation.

Cognitive Versatility and New Venture Ideation

Although the extant literature suggests that analysis is not the ideal type of processing in ambiguous, uncertain tasks such as those involved in entrepreneurship (Allinson et al., 2000), Hodgkinson and Healey (2011) highlight the importance of combining intuition and analysis to develop the firm dynamic capabilities of sensing (and shaping) opportunities and threats. In the 4I Organizational Learning Framework (Crossan et al., 1999), which has been used to explain how entrepreneurial opportunities are identified and developed (Dimov, 2007a, 2007b; Dutta and Crossan, 2005) and how expert intuition and analysis influence team decision making and learning in organisations (Akinci and Sadler-Smith, 2019), the initial *intuiting* stage which triggers the generation of business ideas is followed by a process of *interpreting*, which involves explaining the idea to oneself and others. Similarly, Gaglio (2004) suggests that opportunity identification entails a process of *mental simulation*, where entrepreneurs "mull over what will happen" or "mentally rehearse" what might take place if a

business idea is pursued (p. 537). This aligns with Klein's (2004) work which maintains that once a course of action has been intuitively identified, individuals then evaluate its appropriateness by "*imagining* what would happen when they carried it out" (p. 26).

We suggest that interpreting and mental simulation are crucial in new venture ideation as they help entrepreneurs make sense of their initial "fuzzy" ideas and form a more coherent view – prior to any formal evaluation – about whether or not they may constitute ideas for new ventures. Indeed, as a sub-class of ideation, new venture ideation represents one end of the continuum that becomes increasingly complex as the individual starts to imagine how others might respond to their initial ideas and the hypothetical actions they might take to progress the idea (Gemmell et al., 2012; Kier and McMullen, 2018). These processes take place at a conscious level and involve analysis and reasoning (Akinci and Sadler-Smith, 2019; Crossan et al., 1999; Klein, 2004) and are therefore classified as rational (analytical) processes according to CEST (Epstein, 2003, 2010). The above implies that new venture ideation involves analysis *as well as* intuition. Entrepreneurs who are cognitively versatile and employ both intuition and analysis extensively are therefore expected to generate a larger number of venture ideas than those who do not.

Moreover, although we argued that the holistic and associative nature of intuition allows entrepreneurs to generate more innovative new venture ideas by establishing novel connections among disparate elements, work on structural alignment (Grégoire et al., 2010; Grégoire and Shepherd, 2012) suggests that analytical processing may also play an important role in this respect. Grégoire and colleagues suggest that the identification of "superficially obvious" (2010, p. 425) opportunities may take place at an automatic level with minimal cognitive effort. In such cases, individuals are likely to focus on superficial similarity, where the basic features of the product or technology resemble those of the market, but such an emphasis is unlikely to lead to unexpected applications or breakthrough ideas, as connections

would only be made between elements that are similar at face value. In contrast, the generation of more innovative venture ideas likely requires a cognitively demanding process of aligning the intrinsic elements of products, technologies and markets to detect their latent or concealed potential. Structural features of a technology would include its underlying scientific or functional mechanisms and how they work together, while those of a market would include latent demand which do not only represent consumer needs but also the reasons why gaps in the market prevail (Grégoire and Shepherd, 2012).

Following this logic, entrepreneurs who rely extensively on both intuition and analysis (i.e., adopt a cognitively versatile strategy) may have the upper hand when it comes to generating not only more new venture ideas but also more innovative ones. On the basis of the above, we present the following hypothesis:

H2b: Cognitive versatility is associated with higher proficiency in new venture ideation.

Entrepreneurial Experience, Intuition and New Venture Ideation

Recent research indicates that experienced entrepreneurs are more adept than novices at new venture ideation (Ucbasaran et al., 2009; Gruber et al., 2008, 2012, 2013), as they are able to "construct a larger choice set" prior to launching their ventures (Gruber et al., 2008, p. 1653) and are therefore able to "look before they leap" (p. 1663); by identifying multiple opportunities, they are able to select the most promising ones. Prior knowledge of customer needs (Shepherd and DeTienne, 2005) and business ownership experience (Ucbasaran et al., 2009) are also positively associated with the innovativeness of opportunities identified. As noted by Short et al. (2010), "although the image of the novice who devises a path-breaking opportunity is a romantic one … experts are far more likely to be novel" (p. 56). Scholars have proposed various theories to explain these differences in new venture ideation, arguing that experience leads to the accumulation of knowledge (Shepherd and DeTienne, 2005;

Gruber et al., 2008) and to the formation of complex cognitive structures (Baron and Ensley, 2006; Gaglio and Katz, 2001) which enable entrepreneurs to detect gaps, trends and patterns in the environment.

In view of the above, experienced entrepreneurs are expected to be more proficient in new venture ideation than their less experienced counterparts, by generating not only more new venture ideas, but also ideas that are more innovative. Drawing on CEST (Epstein, 2003, 2010) and the literature on intuition (Hodgkinson et al., 2008; Miller and Ireland, 2005), we propose that the increase in proficiency that takes place as entrepreneurs gain experience in the field may be attributed, at least in part, to their growing ability to make use of intuitive processing. On the basis of the above, we present the following hypothesis:

H3a: Intuition mediates the relationship between entrepreneurial experience and new venture ideation proficiency.

Entrepreneurial Experience, Cognitive Versatility and New Venture Ideation

The expertise literature (Dreyfus and Dreyfus, 2005; Ericsson et al., 2007; Prietula and Simon, 1989; Salas et al., 2010; Sukhov et al., 2021) suggests that experienced entrepreneurs are better equipped (and therefore more likely) than novices to engage in high levels of both intuitive and analytical processing, and that they are more able to switch readily between these two types of processing. In other words, it suggests that experienced entrepreneurs are more able and likely to adopt a cognitively versatile strategy. The management and entrepreneurship literature (Dimov, 2007a, 2007b, Dutta and Crossan, 2005; Gaglio, 2004; Grégoire et al., 2010; Grégoire and Shepherd, 2012), suggests that cognitive versatility may, in turn, facilitate new venture ideation proficiency. The volume and innovativeness of ideas generated by experienced entrepreneurs may be attributed to “deeper and richer connections”

(Shepherd and DeTienne, 2005, p. 94) of cognitive frameworks, which are utilised to guide the application of an extensive base of relevant knowledge.

It is possible that at least part of the increase in new venture ideation proficiency that occurs as entrepreneurs obtain experience may be due to the use of high levels of both intuition and analysis in a cognitively versatile strategy. We therefore propose the following hypothesis:

H3b: Cognitive versatility mediates the relationship between entrepreneurial experience and new venture ideation proficiency.

METHODS

Sample

We identified 289 entrepreneurs operating in the ICT industry in Malta through the Malta Enterprise ICT Business Directory, the National Statistics Office Business Register, and the Yellow Pages, and we invited them via email to participate in our study. Of these, 99 accepted our invitation, and 74 of them completed the whole study. This represents a response rate of 25.6%, which is similar to those obtained in other studies using entrepreneur samples (e.g., Chaston and Sadler-Smith, 2012: 27.4%; Gruber et al., 2013: 23%). We tested for non-response bias by dividing our sample into early responders (those who responded to their invitation in month 1: $n = 35$) and late responders (those who responded during months 2 and 3: $n = 38$). We then ran Mann-Whitney U tests on all our independent and dependent variables, and found no significant differences between the two sub-groups.

Entrepreneurs were defined in this study as owner-managers of one or more businesses, in line with previous research (e.g., Gruber et al., 2008, 2012, 2013; Ucbasaran et al., 2009). The ICT industry was taken to include: 1) ICT Manufacturing Industries (manufacture of computers, electronic components and boards, peripheral equipment, communication

equipment, consumer electronics, and magnetic and optical media; 2) ICT Trade Industries (wholesale and retail sale of electronic and telecommunications equipment, computers, computer peripheral equipment and software); and 3) ICT Services Industries (software publishing, telecommunications, computer programming, consultancy, data processing, hosting of web portals, and repair of computers and communication equipment), in line with the International Standard Industrial Classification (United Nations, 2008) and the Statistical Classification of Economic Activities in the European Community (European Commission, 2008). Entrepreneurs had to be operating in at least one of the above-mentioned ICT categories to be included in this study. The ICT sector is a relatively new player in Malta's economy, but it is rapidly growing and highly competitive (Malta Enterprise, n.d.). This was therefore appropriate to test our research question as the literature indicates that intuition is more prevalent and effective in such dynamic and competitive environments (Covin et al., 1999; Khatri and Ng, 2000).

The minimum age for participation was set at 18 years to ensure that all recruited entrepreneurs were legally able to consent to participate. There was no upper age limit for participation in this study. Gender and nationality were not inclusion or exclusion criteria. However, descriptive statistics showed that this was a highly gender-biased sample (93.2% were males – which reflects the reality of the male-dominated ICT industry), and all participants were living and operating a business in Malta at the time of the study.

Although quantitative research generally utilises larger samples, protocol analysis studies published in leading management journals have made use of substantially smaller samples than ours (e.g., Grégoire et al., 2010: 9 participants; Sukhov et al., 2021: 14 participants; Sarasvathy, 2008: 27 participants). This is due to the time-consuming and labour-intensive nature of this method, which generates large quantities of data (Green, 2009; Witteman and van Geenen, 2010) and is therefore prohibitive in terms of the number of

participants that can feasibly be involved. Moreover, we applied bootstrapping during our statistical analyses, which compensates for smaller samples (details below). Our sample size of 74 entrepreneurs is therefore deemed sufficient to test our model.

Data Collection

Data were collected through two sources, namely a think-aloud scenario-based concurrent protocol analysis exercise, and an online survey, as detailed below.

Data on cognitive strategy (mediator variables) and new venture ideation (dependent variables) were collected via concurrent verbal protocols whereby participants carried out a scenario-based new venture ideation exercise, allowing researchers to gain insight into their cognitive processes during task performance (i.e., cognitive strategy) (Ericsson and Simon, 1993). In concurrent protocol analysis, research participants are asked to think aloud while they work on a task, thereby providing "a real-time insight into the knowledge that a subject uses and the mental processes applied while performing a process of interest" (Hughes and Parkes, 2003, p. 127). Ericsson and Simon (1993) found that concurrently thinking aloud does not lead to any change in cognitive processing during task performance, except that this is likely to be slower due to the additional time needed to verbalise one's thoughts. This method has therefore been recommended for measuring intuition in use (Hodgkinson and Sadler-Smith, 2011, 2018).

We presented each participant with three scenarios (in a random order to minimise order effects), which were developed and piloted with six technology-entrepreneurs and industry experts to ensure ecological validity (Green, 2009; Witteman and van Geenen, 2010). Participants were first told "*Imagine you are thinking of starting up a new company in the ICT industry and are looking around for new business ideas. You are attending a*

technology fair with an eye for identifying opportunities for your new venture". They were then presented with a one-page description of the three scenarios, asked to read them out aloud, and to "*think of what business opportunities could be possible for the described technology*". In keeping with concurrent protocol analysis methodology (Ericsson and Simon, 1993; Green, 2009), neither did we interrupt the participants as they were completing the task, nor did we probe or ask them to elaborate (as we would have done if we adopted an in-depth interview methodology) when they had completed the task (i.e., ceased thinking aloud). We audio recorded the participants' verbalisations for subsequent transcription and analysis.

Additionally, participants completed an online survey (time = 20min) to capture data on their entrepreneurial experience (independent variable), as well as their cognitive style (one's preferred manner of gathering, processing and evaluating information) and other background information (control variables).

Measures: Intuition, Analysis and Cognitive Versatility (Mediator Variables)

To measure *intuition* and *analysis* (i.e., intuitive and analytical processing, respectively), we were guided by the literature on protocol analysis (Chi, 1997; Ericsson and Simon, 1993; Green, 2009; Trickett and Trafton, 2009), and research employing this method to study cognitive processes in entrepreneurship (Dew et al., 2009; Grégoire et al., 2010; Gustafsson, 2006; Sarasvathy, 2008). Accordingly, we transcribed, segmented and coded the think-aloud data in compliance with the general principles of this method. Specifically, we adopted the protocol analysis approach that is concerned with the typology and frequency of processes, which in turn enables statistical analysis to ascertain whether skilled research participants use particular processes to a greater or lesser extent than their less skilled counterparts (Ericsson and Simon, 1993). This approach stipulates that protocols must be broken down into segments, that each segment represents a single instance of a process, and

that segments must be coded by matching each one with the appropriate category in a coding scheme (Green, 2009).

In line with the above, we segmented all the think-aloud data into 'complete thoughts' (Trickett and Trafton, 2009) or 'thought units' (Hensman and Sadler-Smith, 2011), which can be defined as phrases, sentences or clauses that convey only one idea or thought (Butterfield et al., 1996). This is illustrated in the following example (segments are divided by //):

> // Ok, so this would be one thing I would want to play with. // Would they be able to display on it? // Two Dimensional. Soo, that's a bit limiting // why don't they have a slight 3-dimension? // Aha! So this is something you put on top of your screen. // Mmm, that's a bit of a killer though, cause there are already touch sensitive screens. // Ok, but I'd like to see why. // Ok, so you don't need to push basically is what they're saying. // So maybe this could be good maybe for the elderly who sometimes cannot press properly but they could poke or pass their hands through something. //

We deemed this grain size as appropriate as it allowed us to detect underlying cognitive processing. A more 'microscopic' approach would not have given us sufficient indication about the kind of processing (intuition / analysis) adopted, while a more 'macroscopic' approach would have resulted in segments encompassing more than one cognitive process (Green, 2009). This approach also has the advantage of evening out individual differences in verbosity (see Baldacchino et al., 2014). Some individuals may use more words than others to convey a single thought or idea. This likely reflects that they are more or less articulate or talkative rather than implying the individual is more analytical or intuitive. Segmenting the protocols according to thought units (as opposed to counting the number of words or time taken to solve a problem) therefore allows us to control for differences in verbosity, thus increasing confidence that the variance in the number of segments across participants was a true reflection of their underlying cognitive processing rather than superficial differences in verbosity (Chi, 1997).

Following segmentation, the first author coded each segment as intuitive or analytical, using the coding scheme developed by Baldacchino et al. (2014) (reproduced in Appendices A1 and A2), guided by traditional protocol analysis principles (Ericsson and Simon, 1993; Green, 2009) and by the literature on intuition and analysis. Segments were coded as intuitive if the cognitive processing involved had at least one of the following characteristics: i) was emotionally laden; ii) occurred rapidly, automatically and non-consciously; iii) was holistic (i.e., pattern-recognition, big-picture oriented); iv) was a spontaneous idea or solution; v) was an intuitive projection (i.e., future oriented); vi) explicitly referred to intuition (or gut feelings); and vii) represented a willingness to commit to a specific course of action even though only limited information was available. Segments were coded as analytical when they referred to processing that had at least one of the following characteristics: i) the process was carried out in a logical way; ii) involved a deliberate effort at reasoning; iii) showed due attention to the relevant information; iv) referred to a lack of objective data; v) showed that mental simulation was at play; vi) pointed to a rational justification; vii) showed that a conscious search for solution is ongoing; viii) included a comparison of alternatives; and ix) represented a delay in making a commitment to a specific course of action due to lack of information. A total of 4,008 segments were identified, all of which were coded as *intuition* (n = 2,158; 53.8%) or *analysis* (n = 1,850; 46.2%).

In order to ensure reliability in coding, and in line with requirements stipulated for large studies (Trickett and Trafton, 2009), a second researcher (a qualified psychologist with a PhD and entrepreneurial experience) independently coded 15 protocols and a total of 890 segments (i.e., 20% of the protocols and 22% of the total number of segments). Inter-coder reliability was high, with a Cohen's Kappa of 0.802 overall, ranging from 0.745 to 0.855 for the three scenarios.

To measure *cognitive versatility*, we next counted the intuition and analysis segments in each of the transcribed protocols and created frequency-based intuition and analysis variables for each participant. As explained above, a cognitively versatile strategy consists of using both intuitive and analytical processing at high levels (e.g., Hodgkinson and Clarke, 2007, Aggarwal, 2013). In order to operationalize this concept, we therefore considered that extensive use of both types of information processing reflects an individual's cognitive versatility. Specifically, we compared the number of intuition and analysis segments generated by each participant during the think-aloud tasks with the respective sample means. We considered those who were above the sample mean in their number of both intuition and analysis segments to have employed high levels of both intuition and analysis, and to therefore be cognitively versatile (operationalised as a dichotomous Yes/No-type dummy variable). This may be better understood by referring to the examples from the dataset in Table I.

INSERT TABLE I ABOUT HERE

This operationalization of cognitive versatility enabled us to differentiate individuals who use both intuition and analysis extensively (cognitively versatile) from those who predominantly use one type of information processing (i.e., higher than average use of analysis but lower than average use of intuition; or lower than average use of intuition but higher than average use of analysis). Importantly, it also differentiates individuals who are cognitively versatile from those who use neither type of processing at high levels (i.e., lower than average use of intuition and lower than average use of analysis) - what Hodgkinson and Clarke (2007) refer to as a 'non-discerning'. Distinguishing between cognitively versatile and non-discerning participants is of utmost importance, since cognitive versatility is not just

about switching gears, or even about the equal use of the two types of information processing. Instead, it is about using both intuition and analysis in abundance (Hodgkinson and Clarke, 2007).

Measures: New Venture Ideation (Dependent Variables)

In line with past research (e.g., DeTienne and Chandler, 2004; Shepherd and DeTienne, 2005; Ucbasaran et al., 2009), we operationalised proficiency in new venture ideation in terms of both the number and the innovativeness of new venture ideas generated. The first author content-analysed the transcribed protocols and counted the number of new venture ideas for each participant. This author also rated the ideas on their novelty and feasibility on 7-point Likert scales, in line with the notion that innovation involves the successful implementation of creative ideas, and that creative ideas are those which are novel and useful (Amabile et al., 1996) as well as different and appropriate in terms of commercial application (Cook, 1998). The novelty and feasibility ratings were averaged to generate innovativeness ratings ranging from 'not very innovative' (1) to 'very innovative' (7) (Shepherd and DeTienne, 2005). A total of 204 new venture ideas were generated, with an average of 2.76 ideas per participant, and a mean innovativeness score of 4.4.

Once all ideas were rated for innovativeness, we classified them according to the framework illustrated in Figure 2. Considering that a rating of 4 represents the mid-point on the 7-point Likert scale, we distinguished between ideas that were not innovative (rated below 4) and those that were at least moderately innovative (rated ≥ 4). Moreover, out of the latter category, we extracted a further sub-category comprising the highly innovative ideas (rated ≥ 6).

INSERT FIGURE 2 ABOUT HERE

Reliability in coding at this stage was also checked. After the full set of protocols had been content analysed by the first author and a list of ideas generated was extracted, two additional coders with a background in entrepreneurship and innovation analysed a subset of 15 protocols (equivalent to approximately 20% of the data: Trickett and Trafton, 2009; Austin and Delaney, 1998) to confirm the number of ideas generated. This led to high levels of inter-coder agreement, with a Cohen's kappa of 0.831 overall (ranging from 0.752 to 0.896 for the three separate scenarios). Next, after the full list of ideas had been rated for innovativeness (as described above) by the first author, a third coder with an ICT background rated the degree of innovativeness of all the ideas in the dataset on the same 7-point Likert scale. High levels of inter-rater agreement were again achieved, with a Cohen's kappa of 0.803 overall (ranging from 0.745 to 0.820 for the three scenarios) for the innovativeness of the ideas. In line with past research (e.g., Shepherd and DeTienne, 2005), the last step in this process was for the coders to discuss their points of disagreement, all of which were successfully resolved.

Measures: Entrepreneurial Experience (Independent Variable)

In line with previous studies (e.g., Gruber et al., 2008, 2012, 2013; Robson et al., 2012), we measured *entrepreneurial experience* using data from our online survey on participants' business ownership experience. However, we delineated between domain-specific and non-domain specific business ownership experience and used the former (in our case the *number of ICT businesses owned*) as our measure of entrepreneurial experience, since the literature on intuition highlights the significance of domain-specific experience. In view of the so-called 'ten-year rule', which proposes that a minimum of 10 years of

experience are required for the acquisition of expertise in a given domain (e.g., Sadler-Smith 2008, 2010), we considered using the duration of business ownership experience as our measure of entrepreneurial experience. However, because an individual might simply own the same business for 10 years, they may not have been through the entrepreneurial process several times to accumulate experience. Nonetheless, we did control for the duration of business ownership experience (see below).

Measures: Control Variables

Our online survey also allowed us to measure cognitive style via the 40-item Rational-Experiential Inventory (REI) (Pacini and Epstein, 1999). Half of the REI items represent *experientiality* or an intuitive approach (e.g., "I believe in trusting my hunches"), while the other 20 items represent *rationality* or an analytical approach (e.g., "I have a logical mind"). All the items were rated on a 5-point Likert scale anchored by "definitely not true of myself" and "definitely true of myself". Although it has been argued that one's dispositional preference does not necessarily determine cognitive strategy, as various other factors such as task characteristics may come into play (Blume and Covin, 2011; Hodgkinson and Sadler-Smith, 2011), a holistic cognitive style has been found to enhance intuition (Sinclair, 2003), suggesting that cognitive style should be included as a control variable in this study.

We also included *risk perception* and *risk propensity* as control variables because they may be associated with one's reliance on intuition and are expected to influence one's attraction or aversion to innovative technologies and new venture ideas (Keh et al., 2002; Simon et al., 2003). We used the scales developed by Forlani and Mullins (2000) as they operationalised risk perception in terms of new venture creation, and risk propensity in terms of financial risk, as opposed to other forms of risk associated with situations or behaviours which are unrelated to entrepreneurship.

We recognize that entrepreneurial experience is broad and therefore controlled for other aspects including the *number of businesses owned in the non-ICT industry*, *years of ICT business ownership experience* and *years of non-ICT business ownership experience*. The latter two measures capture the duration of business ownership in light of the 'ten-year rule' for expertise discussed earlier. Further, since scholars delineate between experience and expertise and argue that building entrepreneurial expertise requires deliberate practice (i.e., intense, effortful, prolonged, and highly focused efforts to improve current performance) rather than merely owning one or more businesses for a number of years (e.g., Baron and Henry, 2010), we sought to measure and control for *deliberate practice*. As no established instrument was available in the literature to measure deliberate practice in entrepreneurship, we constructed a scale composed of ten activities (see Appendix B) that past research (Sonnentag and Kleine, 2000; Unger et al., 2009) suggested may be suitable for this purpose. Each activity was scored according to participants' frequency of engagement and perceived extent of effectiveness in enhancing domain-relevant knowledge, skills and performance. In line with Unger et al. (2009), activities would qualify as deliberate practice if they were performed regularly (at least once a week) and if they were carried out for a goal related to competence improvement (as opposed to an unrelated goal, or with no goal).

Finally, we also controlled for various background characteristics such as *years of work experience* and years of education. Our survey also measured our participants' gender and age, but we did not control for their effects in the hypothesis testing, as a correlation analysis showed that they were not associated with any of the dependent variables. However, our education and experience measures may be considered to be proxies of age.

Data Analysis

We integrated the variables from the protocols with those from the online survey and used them to run a series of statistical analyses. We generated descriptive statistics and Spearman's correlations, and performed regressions and mediation analyses to test our hypotheses.

For mediation, we used the bootstrapping technique suggested by Preacher and Hayes (2004), which is the recommended method of choice (Hayes, 2009) where small samples are involved. We ran the 'PROCESS' macro which was developed by Hayes (2012) for SPSS to test the mediation effects of intuition (operationalised as the number of intuition segments) in the relationship between entrepreneurial experience and new venture ideation. The bootstrapping mediation technique involves the estimation of indirect effects of an independent variable on a dependent variable through a mediator.

The PROCESS Macro does not accommodate categorical mediators so it could not be used where cognitive versatility (operationalised as a dichotomous Yes/No-type dummy variable) was the hypothesised mediator. For this purpose, we used a code command provided by Hayes to test for bootstrapped mediation in the path analysis software M-Plus.

To test the hypotheses concerning new venture ideation, we made use of the total number of new venture ideas, the number of innovative ideas (rated ≥ 4), and the number of highly innovative ideas (rated ≥ 6) as the dependent variables in the regression and mediation models.

RESULTS

Descriptive and Correlation Analyses

All the 74 entrepreneurs (69 males, mean age = 42) had owned at least one technology-related business at the time of the study. They reported an average of 2.32 businesses owned and almost two-thirds held an undergraduate or postgraduate degree. Sixty-eight participants (91.9%) had some work experience (mean = 11.3 years) before starting their own business. The majority had gained some industry-specific work experience, with 51 of them (68.9%) reporting that they had worked in the ICT industry before becoming business owners. The participants scored significantly higher on rationality (mean = 4.04) than experientiality (mean = 3.37) in the survey ($t(73) = 6.83$, $p < .001$), which suggests that their dispositional preference is to process information analytically rather than intuitively. Descriptive statistics of all the variables are presented in Table II.

INSERT TABLE II ABOUT HERE

Table III shows that most correlations among the control and independent variables are relatively low and non-significant, indicating the absence of collinearity concerns. There are significant correlations between hypothesised independent and dependent variables.

INSERT TABLE III ABOUT HERE

Hypothesis Testing

Table IV presents the results of the regression and mediation analyses that we performed to test the hypotheses related to the use of intuition (H1a, H2a, H3a). A baseline model of controls was first estimated for each of the dependent variables in the analyses, after which the main independent variables (the total number of intuition segments, and the number of ICT business owned) were added to estimate the full models, in order to

demonstrate the incremental explanatory power of our main variables of interest. The full models are significant and were improved as a result of adding each independent variable (see *R* Squares and *F* values in Table IV).

INSERT TABLE IV ABOUT HERE

With regards to the full model for the effects of experience on intuition, the number of ICT businesses owned was positively associated with the number of intuitive segments (B = 3.868, $p < .001$). Significant effects were also detected for work experience on intuition (B = 0.539, $p < .01$), indicating that this may play a role in determining the extent of intuitive processing. Moreover, deliberate practice was positively related to intuition, although the coefficient was smaller and less significant (B = 1.336, $p < .1$) than that of ICT business ownership and work experience. These results indicate that intuition is experience-based, and provide support for H1a. The most relevant experience for intuition appears to derive from owning multiple businesses in one's own industry, although intuition may also be enhanced by work experience and (to a lesser extent) by engaging in deliberate practice.

No significant relationship was detected between experientiality and the use of intuition, which suggest that dispositional preference for this type of processing did not determine its use in this study.

Table V presents the results of the regression and mediation analyses that we performed to test the hypotheses related to cognitive versatility (H1b, H2b, H3b). We followed the same procedure as above to estimate baseline and full models. This time, the main independent variables were cognitive versatility and the number of ICT businesses owned. The full models are significant and were improved as a result of adding each independent variable (see *R* Squares and *F* values in Table V).

INSERT TABLE V ABOUT HERE

With respect to the full model for the effects of experience on cognitive versatility, the number of ICT businesses owned was positively associated with the deployment of a cognitively versatile strategy during new venture ideation ($B = 0.089$, $p < .01$). Deliberate practice was also positively related to cognitive versatility, but its effect was weaker ($B = 0.046$, $p < .05$) than that of ICT business ownership. The effect detected for work experience on cognitive versatility was at the $p < .1$ level ($B = 0.011$). These results indicate that cognitive versatility too is experience-based, and provide support for H1b. The number of businesses owned in one's own industry was confirmed as the most relevant form of experience, not only for enhancing intuition, but also for developing a cognitively versatile strategy. Cognitive style (i.e., rationality and experientiality) was unrelated to cognitive versatility.

As shown in Table IV, positive effects were detected for intuition on the number ($B = 0.039$, $p < .05$) and innovativeness of new venture ideas ($B = 0.052$, $p < .001$ for those rated ≥ 4; and $B = 0.018$, $p < .05$ for those rated ≥ 6). Therefore, H2a was supported. Table V shows that a positive and significant relationship was also detected between a cognitively versatile strategy and new venture ideation in all three models ($B = 1.481$, $p < .05$ for the number of new venture ideas; $B = 1.733$, $p < .001$ for ideas rated ≥ 4; and $B = 0.785$, $p < .05$ for those rated ≥ 6). This provides support for H2b.

Results of the bootstrapped mediation analyses that we carried out using the 'PROCESS' Macro for SPSS to test H3a are presented in Table IV. In contrast to traditional mediation techniques (e.g., Baron and Kenny, 1986), mediation effects are reported if the bootstrapped lower level and upper level confidence intervals (LLCI and ULCI) at 95%

levels of confidence exclude the possibility of the indirect effect being zero (Hayes, 2009, 2012).

Zero falls outside the LLCI and ULCI range in two of the three models reported in Table IV, which indicates the following: Intuition mediates the relationship between entrepreneurial experience (number of ICT businesses owned) and new venture ideation with respect to the number of new venture ideas generated (effect = 0.150, $CI_{.95}$ = 0.002, 0.404), and the generation of innovative new venture ideas (rated ≥ 4) (effect = 0.203, $CI_{.95}$ = 0.079, 0.445). However, no mediation was detected where the generation of highly innovative ideas (rated ≥ 6) is concerned (effect = 0.071, $CI_{.95}$ = -0.005, 0.215). These results offer partial support for H3a, as the mediation effects of intuition between experience and higher proficiency in new venture ideation do not apply to highly innovative ideas (rated ≥ 6).

The results of the mediation analyses that we conducted on M-Plus to test H3b are presented in Table V. The LLCI and ULCI of all three models indicate that their bootstrapped estimates of indirect effects are significantly different from zero, offering full support for H3b. In other words, cognitive versatility mediates the relationship between entrepreneurial experience (number of ICT businesses owned) and new venture ideation, both in terms of the number of ideas generated (effect = 0.132, $CI_{.95}$ = 0.035, 0.351), and in terms of the innovativeness of ideas at each of the two levels of innovation specified in this study (effect = 0.154, $CI_{.95}$ = 0.058, 0.348 for those rated ≥ 4; and effect = 0.070, $CI_{.95}$ = 0.022, 0.179 for those rated ≥ 6).

Robustness Checks

In order to test the robustness of our findings, we ran further statistical tests as follows: First, we ran separate Poisson and Negative Binomial regressions for our new venture ideation (number and innovativeness) dependent variables, which were composed of count data (Cameron and Trivedi, 1998). These further tests produced consistent results with the

conventional OLS models that are used by the PROCESS and MPlus models reported in this paper.

Next, besides using the total number of new venture ideas, the number of innovative ideas (rated ≥ 4), and the number of highly innovative ideas (rated ≥ 6) as the dependent variables, we also performed tests with the mean innovativeness of all ideas generated by each participant, as well as with the innovativeness rating of each participant's most innovative idea, as dependent variables. These too produced results that are consistent with the models reported in this paper.

To check the robustness of our cognitive versatility measure, we repeated the categorisation of participants as cognitively versatile using the sample medians rather than the sample means. Our results using the mean-based and median-based categorisations produced consistent results. Moreover, we investigated whether a non-discerning cognitive strategy would have opposite effects to cognitive versatility on our dependent variables. To do so, we re-categorised our participants as non-discerning or otherwise by comparing the number of intuition and analysis segments with the respective sample means. Those who were below the sample mean in both their number of intuition segments and their number of analysis segments were considered non-discerning. We then ran our analyses using the non-discerning category as a mediator and found opposite effects to the cognitive versatility models: experience is negatively associated with a non-discerning cognitive strategy, and this in turn is negatively associated with the number and innovativeness of new venture ideas (rated both ≥ 4 and ≥ 6). Moreover, a non-discerning cognitive strategy negatively mediates the relationship between experience and new venture ideation.

Finally, although we ran the main analyses with the aggregated data from all the three scenarios, we also analysed each scenario independently. All these models were consistent with their respective main models that are reported in the previous sections.

The full results of these robustness tests are not presented in this paper due to space limitations but are available from the first author upon request.

DISCUSSION

Motivated by several gaps and debates in the literature, and by calls for more academic research on the use of intuition and its interplay with analysis in business settings (e.g., Blume and Covin, 2011; Hodgkinson et al., 2008), we set out in this paper to address the following research question: *To what extent is experience associated with a) intuition and b) cognitive versatility, and with what effects?* We developed a conceptual model based on the dual-process theory CEST (Epstein, 2003, 2010) and tested our hypotheses using a mixed methods approach that tapped into both actual use of, and dispositional preference for, intuitive (and analytical) processing.

Our results offered full support for all our hypotheses, with the exception of H3a which was partially supported. Experienced entrepreneurs were more intuitive and more cognitively versatile than their less experienced counterparts and, as a result, they were more proficient at new venture ideation; that is, they generated more new venture ideas and more of these were innovative. Specifically, domain-relevant experience – identified in this study as the number of businesses owned in one's own industry – was strongly associated with the extent of intuitive processing as well as with the deployment of a cognitively versatile strategy during new venture ideation. Moreover, intuition and cognitive versatility were both found to be enablers of new venture ideation, and they appear to bridge the gap between relevant entrepreneurial experience and the ability to generate more and better quality (innovative) ideas.

These results suggest that the superior new venture ideation proficiency of experienced entrepreneurs may be attributed, at least in part, to their greater ability to make extensive use of intuitive processing while also being able to draw heavily on analysis. Indeed, cognitive

versatility was found to be the 'better' mediator because, unlike intuition, it mediated all three models including the one with highly innovative ideas (rated ≥ 6) as the dependent variable. This implies that the positive association between entrepreneurial experience and innovative new venture ideas was stronger when both intuition and analysis were used extensively in a cognitively versatile strategy.

Our findings can be explained as follows: As entrepreneurs gain relevant experience, they develop complex mental structures stocked with masses of knowledge about their particular business context (Baron and Ensley, 2006; Gaglio and Katz, 2001; Shane and Venkataraman, 2000; Shepherd and DeTienne, 2005). This enhances their ability to process information intuitively, and to "connect the dots" between subtle changes and emerging trends within that context (Baron, 2006). This is a vital process for entrepreneurship as it generates ideas with perceived potential (Dimov, 2007a) which are the seed of all opportunities (Dutta and Crossan, 2005). As this intuiting process takes place at a non-conscious, automatic level (Crossan et al., 1999), it frees up scarce cognitive resources (Salas et al., 2010) which can be allocated to other cognitive processes that facilitate new venture ideation. These include the conscious-level processes of interpreting (Crossan et al., 1999; Dutta and Crossan, 2005) and mental simulation (Gaglio, 2004; Klein, 2004) (i.e., analytical processing), both of which help entrepreneurs assess their ideas' worth as potential opportunities. Further, the ability to deploy a cognitively versatile strategy allows entrepreneurs to deal with the demanding process of structurally aligning the intrinsic elements of products, technologies and markets (Grégoire et al, 2010, Grégoire and Shepherd, 2012), which may lead to the detection of latent or concealed potential, and thus to the identification of highly innovative ideas. Experience teaches entrepreneurs to make extensive use of both intuition and analysis, and to 'switch cognitive gears' (Louis and Sutton, 1991), in order to derive maximum benefit from both modes of processing, thereby

increasing the likelihood that additional innovative new venture ideas are generated. We now explain how our study contributes to the literature on intuition, dual-process theories, management and entrepreneurship.

Contributions

Our first contribution is to provide robust, empirical evidence on the actual use of intuition. Past research on intuition in management and entrepreneurship has been criticised on various grounds, including that many researchers have relied on simplistic and potentially unreliable self-report measures (e.g., Khatri and Ng, 2000) and that the use of intuition has largely been inferred from dispositional cognitive style (e.g., Kickul et al., 2009). Self-report data is questionable since people's beliefs that their decisions are driven by intuition may be mistaken (Blume and Covin, 2011), and intuitive preference does not necessarily determine whether or not intuition is used in situations where other factors, including experience and task characteristics, may come into play (e.g., Gustafsson, 2006; Sinclair and Ashkanasy, 2005). In adopting a multi-method approach which recorded entrepreneurs' intuitive (and analytical) processing in real time while controlling for cognitive style and other factors, our study answers calls for the adoption of multiple approaches to investigate intuition (Blume and Covin, 2011; Hodgkinson et al., 2008; Hodgkinson and Sadler-Smith, 2018), thereby overcoming some of the above-mentioned shortcomings of past research.

In doing so, we make a second contribution, which is to dual-process theory in management and entrepreneurship literature by being the first to demonstrate that (experienced) entrepreneurs are able to use both intuition and analysis extensively when engaged in new venture ideation; lending support for the hitherto untested claim that intuition and analysis are most effective when used together at high levels in a cognitively versatile strategy (Hodgkinson and Clarke, 2007). Specifically, our finding that extensive use of intuition enhances new venture ideation suggests that this is a valuable cognitive strategy

when performing ill-structured tasks under conditions of uncertainty. However, our finding that extensive use of intuition is most valuable for generating highly innovative new venture ideas when used in conjunction with extensive use of analysis, points to the limits of intuition alone when performing tasks involving high levels of novelty. These findings also contribute to the growing body of recent entrepreneurship literature that has examined the cognitive foundations of new venture ideation (cf. Canavati et al., 2021; Frederiks et al., 2019; Grégoire et al., 2010; Grégoire and Shepherd, 2012; Kier and McMullen, 2018) by highlighting the role of intuition and cognitive versatility as important cognitive strategies that can be deployed to facilitate new venture ideation.

As a result of the above, we advance dual-process theory in management and entrepreneurship literature by demonstrating that cognitive style is not analogous to cognitive strategy. Although our participants held a preference for a rational rather than experiential cognitive style (as indicated by the mean REI survey scores), the intuitive segments significantly outnumbered the analytical ones in the protocol analysis tasks. Moreover, no significant relationships were found between the REI scores and the number of intuitive and analytical segments in the protocol analysis tasks. Although individuals may have a preference for one or the other type of processing, the entrepreneurs in this study were able to override this preference and employ the cognitive strategy that they believed was most appropriate for the tasks at hand. This suggests that cognitive style does not determine cognitive strategy as has often been indicated in the literature (Evans, 2010; Sinclair and Ashkanasy, 2005).

Third, we contribute to knowledge on intuition by providing clarity on the debate regarding the experiential origins of intuition and cognitive versatility. Our finding that experienced entrepreneurs make greater use of intuition and are more likely to combine this with analysis in a cognitively versatile strategy, points to domain-specific experience as being

a key antecedent of both intuition and cognitive versatility. This supports scholars who associate intuition with experience (e.g., Miller and Ireland, 2005; Sadler-Smith and Shefy, 2004; Simon, 1987) but provides no evidence for the *entrepreneurial* or *creative* intuition proposed in the conceptual work of Dutta and Crossan (2005) and Dane and Pratt (2007).

Our study therefore sheds light on which form of experience is most relevant for the development of intuition, cognitive versatility and new venture ideation. Although past research has posited that a minimum of 10 years' experience is required for the acquisition of expertise in a given domain (e.g., Sadler-Smith 2008, 2010), this 'ten-year rule' was not upheld in our study. Instead, owning multiple businesses in the same industry seems to constitute the most useful form of experience. It is therefore the nature of entrepreneurial experience, rather than the duration of such experience, that is associated with the use of intuition, cognitive versatility and higher proficiency in new venture ideation.

Limitations and Future Research

Our study used a hypothetical scenario for the think-aloud new venture ideation exercise (protocol analysis). The extent to which entrepreneurs can be expected to engage the same cognitive processes during new venture ideation in natural settings is unclear. To address concerns surrounding predictive validity, future researchers could use concurrent protocol analysis in natural settings, where the researcher would 'shadow' entrepreneurs to observe their use of intuition and analysis in real life scenarios. However, this method would be associated with significant challenges, not least because new venture ideation may not be a regular occurrence for many entrepreneurs in natural settings, therefore an intervention may be required to trigger the process. Further, it is worth noting that we took extensive measures to ensure that the tasks in this study were as ecologically valid as possible by consulting industry experts in their design, and by extensively piloting our scenarios during the planning and preparation stage. All those involved confirmed that the 'technology fair' scenarios were

realistic and familiar to the participants, all of whom were technology-entrepreneurs. We therefore argue that our research setting closely resembled the entrepreneurs' natural new venture ideation settings, and that the cognitive processes which would be utilised would therefore be very similar or the same.

We also recognise that while new venture ideation is a pre-cursor to entrepreneurial action (Kier and McMullen, 2018), new venture ideas must be subsequently evaluated and then implemented (through opportunity exploitation) for entrepreneurship to take place. Although Hodgkinson and Healey (2011) argue that the firm dynamic capabilities of sensing and shaping opportunities and threats require a combination of intuition and analysis, the later stages of the entrepreneurial process were not assessed in our study. Future studies could therefore investigate the role of intuition and cognitive versatility in the evaluation and exploitation of opportunities to further knowledge about the core processes involved in entrepreneurship. A related salient yet underexplored area that could be addressed by future research concerns the possible link that intuition, analysis and cognitive versatility might have with effectuation and causation (Sarasvathy, 2001; 2008). The means-based effectual approach is associated with expertise and, by extension, with intuition (Welter et al., 2016). However, researchers have not yet explored whether intuition and effectual thinking are indeed related (Kickul and Gundry, 2011).

Our participants were selected by means of a purposive sampling technique because we needed to ensure that they were all competent to perform technology-related new venture ideation, and that the task context would be relevant to their domain-specific knowledge and experience (Green, 2009). While this ensured the selection of a theoretically relevant sample that was well-suited for the purpose of this study (Davidsson, 2005), it led to a sample that was made up exclusively of entrepreneurs from the ICT industry in Malta. This may have led to a 'corridor principle' (Ronstadt, 1988) effect, which states that the act of starting a venture

enables entrepreneurs to recognise other venture opportunities. By extension one could argue that starting a venture in a particular industry may enhance entrepreneurs' ability to see opportunities within that industry. This could explain why business ownership in the ICT industry was found to be so strongly associated with new venture ideation, and may limit the generalisability of the findings to other sectors. Although we would argue that new venture ideation involves similar cognitive processes – such as "connecting the dots" (Baron, 2006) – irrespective of setting, future researchers concerned about the 'corridor principle' effect and the generalisability of our findings might usefully extend this line of research into different sectors and countries. In doing so, however, we encourage scholars to pay attention to ecological validity (Green, 2009).

It is worth noting concerns surrounding the nature of the think-aloud protocol analysis technique, which has been criticised for potentially disrupting the underlying cognitive processing that occurs under silent conditions (see Ericsson and Simon, 1993, for a critical review of studies that found this effect). However, there is no evidence showing that thinking aloud has an effect on cognitive processing, as long as the researcher adheres closely to the recommended procedures, such as avoiding social interaction and intrusive prompts during task performance (Ericsson and Simon, 1993). We adhered to all of these procedures in our study. Future research could, however, deploy other techniques to capture cognitive strategy which have been developed in recent years, such as those which make use of cognitive mapping, eye-tracking tools and physiological measures (see, e.g., Glöckner and Witteman, 2010; Hodgkinson and Sadler-Smith, 2011; Maule et al., 2003; and Sinclair, 2014).

The Cognitive-Experiential Self-Theory that we adopted to underpin this study was appropriate to derive hypotheses about the experience-intuition-new venture ideation links, but not about any relationships between experience, analysis and ideation. We therefore did not explore the use of analysis by itself in our regression and mediation analyses, but only

considered it as an element of cognitive versatility. It could be interesting for future research to adopt a different theoretical underpinning to explore the role of analysis in new venture ideation, particularly as the number of analysis segments was significantly correlated with the new venture ideation variables in this study (Table III).

As intuition and cognitive versatility were found to be positively associated with new venture ideation, an important question to be addressed by future researchers concerns whether it is possible for these cognitive strategies to be actively developed and, if so, what methods are most effective. The expertise literature suggests that most individuals – including novice entrepreneurs – are able to engage in analytical processing (Dreyfus and Dreyfus, 2005), as this is the predominant type of thinking developed in formal education (Sadler-Smith, 2010) and entrepreneurship training (Kickul and Gundry, 2011). The same, however, cannot be said for intuition, which is generally acquired through domain-relevant experience and is largely absent from entrepreneurship curricula. It is therefore intuition that will most likely need to be enhanced for entrepreneurs seeking to develop the ability to deploy cognitive versatility. While acknowledging that the most salient form of experience for developing intuition derives from real-life events, various authors (e.g., Baldacchino, 2019; Hogarth, 2001; Kickul and Gundry, 2011; Klein, 2004; Sadler-Smith, 2010; Sadler-Smith and Shefy, 2004, 2007) suggest that intuition is a skill that may be enhanced through appropriate methods and practice. These authors have proposed various principles, guidelines and programmes to 'educate' or strengthen intuition, based on the notion that along with feedback (Hogarth, 2001), "the more we exercise – the more repetitions – the stronger we get" (Klein, 2004, p. 8), and the better able and more confident we become to use alternative types of processing. However, empirical evidence to support these claims is limited (Sadler-Smith and Shefy, 2007), and further research is required to shed light on the prospect of developing intuition and cognitive versatility in the absence of real-life experience.

Moreover, in relation to expertise, we acknowledge that our deliberate practice scale is a new measure and warrants further scrutiny. Future researchers could assess its discriminant validity in relation to other measures of expertise.

Another important issue relates to the emerging but unresolved debate about on the relative merits of Type 1 vis-à-vis Type 2 processes, and the nature of the relationship between them. Default-interventionist theories, to a large extent popularised by Kahneman's (2011) work, assume that the default is to rely on the less costly Type 1 processes, deploying Type 2 processes only when essential. This has resulted in a somewhat sceptical view of intuition since an over reliance on Type 1 processing is seen as leading to cognitive errors and biases. In contrast, Parallel-Competitive theories (such as CEST: Epstein, 2003, 2010) assume that Type 1 and Type 2 processes operate in parallel and do not associate intuition with heuristic thinking and the negative connotations that might bring. Having evaluated both theories, Hodgkinson and Sadler-Smith (2018) conclude that "the jury is still out" regarding their relative merits for managerial cognition scholars (p. 485). Although our study is amongst the first to demonstrate that intuition and analysis can be effectively used extensively together – in a cognitively versatile strategy – without undermining one another, future researchers could build on our research to further develop knowledge on the nature and effects of cognitive versatility.

Practical Implications and Recommendations

Recent research has indicated that prosperous entrepreneurship – in terms of superior venture outcomes, such as higher early-stage sales revenues and market diversification – is linked to the ability of entrepreneurs to identify and explore multiple new venture ideas prior to launching new ventures (Gruber et al., 2008, 2013). Our findings that highlight the value of domain specific business ownership experience in enhancing new venture ideation

proficiency through intuition and cognitive versatility have important implications for entrepreneurs.

We recommend that entrepreneurs who are thinking of starting up additional businesses should seek to generate new venture ideas within their current sector. The stock of domain-specific knowledge that they would have accumulated from their prior start-up experience will enhance their ability to generate more (innovative) new venture ideas, while the new knowledge they attain as they start up additional businesses will further enhance this ability for future endeavours. Moreover, entrepreneurs who have chosen to focus their energies on a single business may need to get out of their comfort zone and 'shake the apple tree', so to speak. This also applies to managers who are seeking new ways of driving innovation because, as noted by Ward (2004), "novel and useful ideas are the lifeblood of entrepreneurship" (p. 174), and new venture ideation is crucial not only for the purpose of starting up new businesses but also to breathe new life into existing ones. It is therefore important for all entrepreneurs and managers – including those who run a thriving, established business – to shape up their new venture ideation skills.

Considering that entrepreneurs and managers often lead or work in teams, or may have boards or investors to answer to, we also recommend that they learn how to effectively communicate their intuition to others. This involves, for instance, displaying the various facets of intuition – affect, confidence, expertise in particular – by using various modes of verbal (e.g., metaphors) and non-verbal communication (e.g., body language) (Clarke et al., 2019; Meziani, 2020; Meziani and Cabantous, 2020).

Our final recommendation is for entrepreneurs and managers to bear in mind that new venture ideation depends very much on both intuition and analysis. There are some who may be led to naively believe the tales that abound in the popular literature of famous business leaders who claim that they make all their important decisions based on intuition and gut

feeling. Intuition is certainly important as we show in our study, but analysis is also required – for engaging in mental simulation (Gaglio, 2004; Klein, 2004) and for interpreting to oneself (Dutta and Crossan, 2005), in order to avoid the unfounded acceptance of poor ideas or the premature rejection of promising ones, and to perform the cognitively demanding task of structural alignment (Grégoire et al., 2010; Grégoire and Shepherd, 2012), which may facilitate the generation of truly innovative new venture ideas.

CONCLUSION

In this study we have shown that relevant experience is positively associated with intuition and cognitive versatility, and that these in turn explain why experienced entrepreneurs are more proficient than novices at new venture ideation; a crucial micro-foundation of entrepreneurial action. Specifically, the experience of owning multiple business in the same domain enhances the ability of entrepreneurs to make effective use of both intuition and analysis, and this in turn enables them to generate more and better quality (i.e., innovative) new venture ideas than novices.

While we find intuition to be a key mediator of the relationship between experience and new venture ideation, intuition is most effective when used together with analysis – both at high levels – in a cognitively versatile strategy. Overall, these results suggest that scholars need to think about cognitive versatility, rather than simply looking at intuition or analysis in isolation, and about how this can be shaped to benefit new venture ideation.

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FIGURES AND TABLES

Figure 1 Conceptual Framework

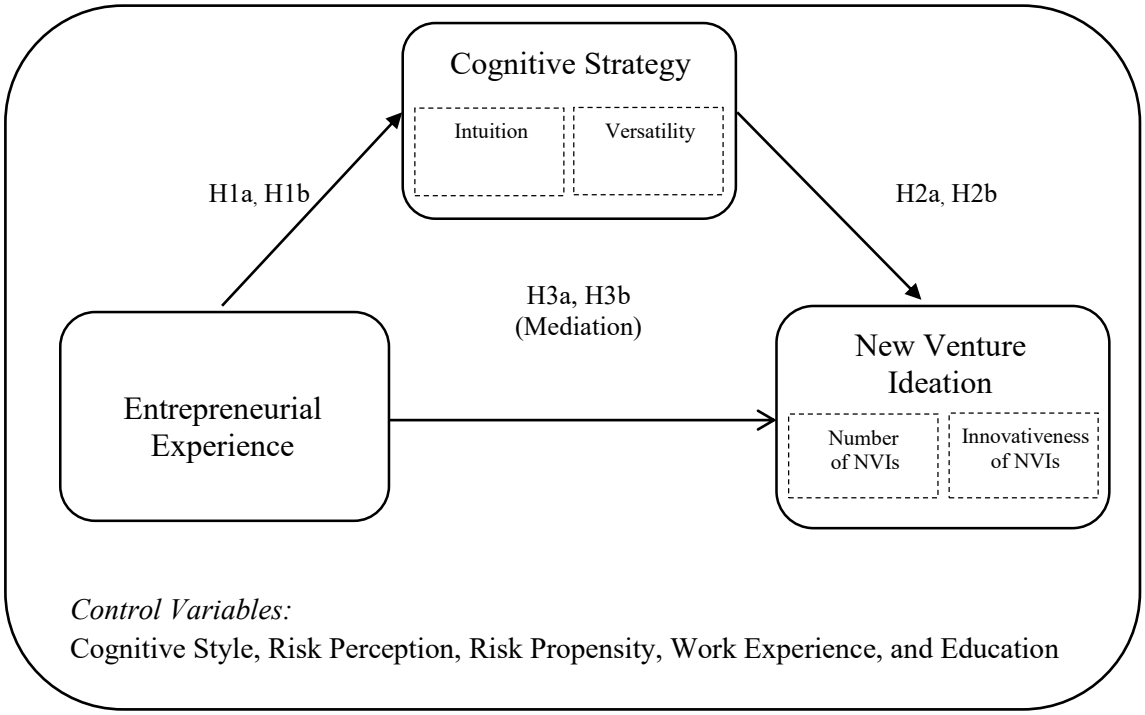

Figure 2 Classification of New Venture Ideas (NVIs) According to their Innovativeness Rating

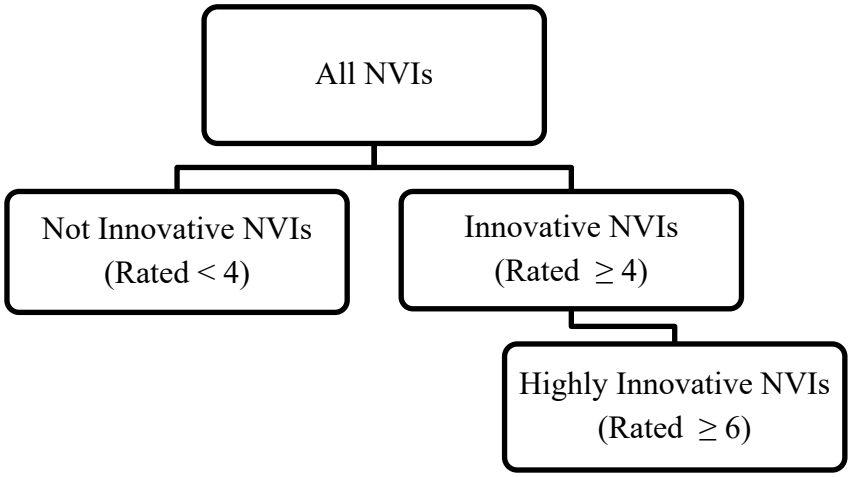

Table I Categorisation of a Sub-Sample of Participants as Cognitively Versatile or Not

Participant Code	Number of Intuition Segments	Is Participant's Number of Intuition Segments ≥ Sample Mean (29.16)?	Number of Analysis Segments	Is Participant's Number of Analysis Segments ≥ Sample Mean (25.00)?	Is Participant Cognitively Versatile?
E01	33	Yes	12	No	No
E06	26	No	26	Yes	No
E28	67	Yes	60	Yes	Yes
E30	14	No	11	No	No

Table II Descriptive Statistics

Survey Data	Mean	Median	SD	Min	Max	Skewness	Kurtosis
Rationality*	4.04	4.05	0.52	2.70	4.95	-0.392	-0.572
Experientiality*	3.37	3.35	0.56	1.95	4.70	-0.088	0.037
Risk Propensity*	1.58	1.00	0.99	0.00	5.00	0.761	0.901
Risk Perception*	3.47	3.50	1.03	1.50	6.25	0.319	-0.311
Deliberate Practice*	3.86	4.00	2.37	0.00	9.00	0.311	-0.562
Years Education	15.69	16.00	2.38	10	21	-0.546	0.071
Years Work Experience	11.32	10.00	8.52	0	36	0.873	0.382
Years ICT Business Ownership	10.46	9.00	7.71	1	32	0.773	0.003
Years Non-ICT Business Ownership	1.05	0.00	3.60	0	19	4.067	16.363
No. of ICT Businesses Owned	1.88	1.00	1.60	1	8	2.474	6.160
No. of Non-ICT Businesses Owned	0.45	0.00	1.09	0	7	3.890	18.950
Verbal Protocol Data	**Mean**	**Median**	**SD**	**Min**	**Max**	**Skewness**	**Kurtosis**
No. of Intuition Segments	29.16	26.00	15.95	6	78	1.041	0.980
No. of Analysis Segments	25.00	21.00	18.30	1	78	1.244	1.027
Cognitive Versatility	0.24	0.00	0.43	0	1	1.222	-0.522
No. of NVIs	2.76	2.00	2.12	0	9	1.244	1.561
No. of NVIs Rated ≥ 4	1.77	1.00	1.99	0	9	1.485	2.499
No. of NVIs Rated ≥ 6	0.68	0.00	1.16	0	6	2.292	6.246

*Cronbach's alphas for these scales are: Rationality 0.868; Experientiality 0.875; Risk Propensity 0.388; Risk Perception 0.937; Deliberate Practice 0.804.
We acknowledge that the Cronbach's alpha for Risk Propensity is on the low side. We also ran our analysis without this variable and found all our results to hold.

Table III Spearman's Correlation Matrix: Survey Data with Protocol Analysis Data

Survey Data		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Rationality																	
2	Experientiality	-.292*																
3	Risk Propensity	-.110	-.068															
4	Risk Perception	.063	.007	-.002														
5	Deliberate Practice	.118	-.111	.229*	.129													
6	Years Education	.292*	-.189	.017	.094	-.072												
7	Years Work Experience	.191	-.067	-.117	-.127	-.110	.064											
8	Years ICT Business Ownership	.001	.084	-.212†	.109	.061	.101	-.157										
9	Years Non-ICT Business Ownership	-.097	.159	.117	-.116	-.091	.056	.029	-.287*									
10	No. of ICT Businesses Owned	.278*	.074	-.034	-.003	-.030	.220†	-.081	.353**	-.030								
11	No. of Non-ICT Businesses Owned	.078	.078	.056	-.133	-.215†	.123	.018	-.142	.682***	.160							
Verbal Protocol Data: Overall		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
12	No. of Intuition Segments	.216†	-.081	.113	.052	.176	.299**	.204†	.198†	.062	.334**	.101						
13	No. of Analysis Segments	.087	-.126	.156	.134	.174	.305**	.103	.016	.110	.380***	.168	.668***					
14	Cognitive Versatility	.069	-.050	-.031	.031	.208†	.227	.179	.186	.034	.216†	.106	.683***	.669***				
15	No. of NVIs	.222†	.041	.114	-.112	.025	.264*	.256*	.047	.027	.370***	.098	.454***	.360**	.425***			
16	No. of NVIs Rated ≥ 4	.247*	.036	.063	-.045	-.037	.190	.137	.090	.087	.481***	.251*	.540***	.474***	.453***	.810***		
17	No. of NVIs Rated ≥ 6	.164	.155	.026	-.107	-.079	.149	-.001	.042	.191	.536***	.380***	.347**	.407***	.314**	.562***	.726***	

†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$, two-tailed.

Table IV Regression and Mediation Analyses for Experience, Intuition and New Venture Ideation

	Effect of Experience on Intuition		**Effect of Experience and Intuition on No. of NVIs**				**Effect of Experience and Intuition on Innov. of NVIs (≥ 4)**				**Effect of Experience and Intuition on Innov. of NVIs (≥ 6)**			
	Coeff [SE]	Coeff [SE]	Coeff [SE]	Coeff [SE]	Direct Coeff [SE]	Indirect (Boot) Effect [SE] LLCI ULCI	Coeff [SE]	Coeff [SE]	Direct Coeff [SE]	Indirect (Boot) Effect [SE] LLCI ULCI	Coeff [SE]	Coeff [SE]	Direct Coeff [SE]	Indirect (Boot) Effect [SE] LLCI ULCI
Control Variables:														
Rationality	4.337	1.726	0.349	0.076	-0.181		0.823†	0.483	0.207		0.426	0.270	0.084	
	[3.555]	[3.335]	[0.517]	[0.475]	[0.445]		[0.491]	[0.413]	[0.367]		[0.286]	[0.261]	[0.227]	
Experientiality	3.591	0.962	0.692	0.466	0.189		0.552	0.271	-0.027		0.291	0.163	-0.038	
	[3.161]	[2.984]	[0.459]	[0.421]	[0.398]		[0.437]	[0.367]	[0.328]		[0.254]	[0.232]	[0.203]	
Risk Propensity	4.380*	4.163*	0.425	0.149	0.225		0.359	0.016	0.097		0.130	-0.027	0.028	
	[1.756]	[1.609]	[0.225]	[0.243]	[0.225]		[0.243]	[0.211]	[0.186]		[0.141]	[0.134]	[0.115]	
Risk Perception	0.723	0.797	-0.316	-0.361	-0.333		-0.233	-0.290	0.260		-0.131	-0.157	-0.137	
	[1.692]	[1.549]	[0.246]	[0.224]	[0.207]		[0.234]	[0.194]	[0.170]		[0.136]	[0.123]	[0.105]	
Years Education	1.571*	1.105	0.207†	0.108	0.082		0.081	-0.042	-0.070		0.026	-0.030	-0.049	
	[0.774]	[0.720]	[0.112]	[0.105]	[0.098]		[0.107]	[0.092]	[0.081]		[0.062]	[0.058]	[0.049]	
Years Work Experience	0.515*	0.539**	0.049	0.016	0.032		0.019	-0.022	-0.005		0.000	-0.018	-0.007	
	[0.206]	[0.189]	[0.030]	[0.029]	[0.027]		[0.028]	[0.025]	[0.022]		[0.017]	[0.016]	[0.014]	
Years ICT Business Ownership	0.383	0.239	0.021	-0.003	-0.014		0.037	0.007	-0.005		0.028	0.015	0.007	
	[0.235]	[0.219]	[0.034]	[0.032]	[0.029]		[0.032]	[0.028]	[0.024]		[0.019]	[0.017]	[0.015]	
Years Non-ICT Business Ownership	-0.568	-0.135	-0.068	-0.032	0.014		-0.105	-0.061	-0.011		-0.031	-0.011	0.023	
	[0.695]	[0.647]	[0.101]	[0.092]	[0.086]		[0.096]	[0.080]	[0.071]		[0.056]	[0.051]	[0.044]	
No. of Non-ICT Businesses Owned	1.220	-0.350	0.144	0.068	-0.120		0.426	0.331	0.129		0.338†	0.294†	0.158	
	[2.285]	[2.037]	[0.332]	[0.302]	[0.285]		[0.316]	[0.263]	[0.235]		[0.184]	[0.166]	[0.145]	
Deliberate Practice	1.412†	1.336†	0.051	-0.038	-0.015		-0.001	-0.112	-0.086		-0.014	-0.065	-0.048	
	[0.739]	[0.677]	[0.107]	[0.100]	[0.093]		[0.102]	[0.087]	[0.077]		[0.059]	[0.055]	0.047	
Independent Variables:														
No. of Intuition Segments				0.063***	0.039*			0.078***	0.052***			0.036***	0.018*	
				[0.017]	[0.017]			[0.014]	[0.014]			[0.009]	[0.009]	
No. of ICT Businesses Owned		3.868***			0.535***	0.150			0.575***	0.203			0.388***	0.071
		[1.068]			[0.157]	[0.098]			[0.129]	[0.086]			[0.080]	[0.052]
						0.002 0.404				0.079 0.445				-0.005 0.215
Constant	-49.785*	-28.469	-4.771	-1.639	0.109		-5.118	-1.218	0.660		-2.557	-0.771	0.493	
	[22.501]	[21.433]	[3.269]	[3.084]	[2.893]		[3.110]	[2.682]	[2.386]		[1.811]	[1.696]	[1.476]	
R Square	0.322**	0.440**	0.189	0.341**	0.447***		0.168	0.435***	0.574***		0.170	0.335**	0.520***	
F	2.990**	4.433***	1.464	2.914**	4.106***		1.270	4.340***	6.844***		1.287	2.834**	5.506***	

Notes: Coefficients are shown, with standard errors in parentheses; $N = 74$; Bootstrap re-sampling = 5000; †$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$, two-tailed.

Table V Regression and Mediation Analyses for Experience, Cognitive Versatility and New Venture Ideation

	Effect of Experience on Cog. Versatility		**Effect of Experience and Cog. Versatility on No. of NVIs**				**Effect of Experience and Cog. Versatility on Innov. of NVIs (≥ 4)**				**Effect of Experience and Cog. Versatility on Innov. of NVIs (≥ 6)**			
					Direct	Indirect (Boot)			Direct	Indirect (Boot)			Direct	Indirect (Boot)
	Coeff [SE]	Coeff [SE]	Coeff [SE]	Coeff [SE]	Coeff [SE]	Effect [SE] LLCI ULCI	Coeff [SE]	Coeff [SE]	Coeff [SE]	Effect [SE] LLCI ULCI	Coeff [SE]	Coeff [SE]	Coeff [SE]	Effect [SE] LLCI ULCI
Control Variables:														
Rationality	-0.070	-0.130	0.349	0.497	0.078		0.823†	0.994*	0.522		0.426	0.512†	0.218	
	[0.106]	[0.099]	[0.517]	[0.470]	[0.545]		[0.491]	[0.421]	[0.417]		[0.286]	[0.257]	[0.234]	
Experientiality	0.050	-0.011	0.692	0.587	0.242		0.552	0.430	0.042		0.291	0.230	-0.012	
	[0.094]	[0.105]	[0.459]	[0.417]	[0.352]		[0.437]	[0.374]	[0.306]		[0.254]	[0.228]	[0.201]	
Risk Propensity	0.028	0.023	0.425	0.365	0.352		0.359	0.290	0.275		0.130	0.095	0.086	
	[0.052]	[0.068]	[0.225]	[0.232]	[0.225]		[0.243]	[0.208]	[0.192]		[0.141]	[0.127]	[0.151]	
Risk Perception	-0.004	-0.002	-0.316	-0.308	-0.300		-0.233	-0.224	-0.215		-0.131	-0.126	-0.121	
	[0.050]	[0.047]	[0.246]	[0.223]	[0.210]		[0.234]	[0.200]	[0.172]		[0.136]	[0.122]	[0.104]	
Years Education	0.045†	0.034	0.207†	0.112	0.075		0.081	-0.029	-0.071		0.026	-0.029	-0.055	
	[0.023]	[0.026]	[0.112]	[0.105]	[0.117]		[0.107]	[0.094]	[0.090]		[0.062]	[0.057]	[0.060]	
Years Work Experience	0.011†	0.011†	0.049	0.026	0.036		0.019	-0.007	0.004		0.000	-0.013	-0.006	
	[0.006]	[0.007]	[0.030]	[0.028]	[0.030]		[0.028]	[0.025]	[0.026]		[0.017]	[0.015]	[0.016]	
Years ICT Business Ownership	0.007	0.004	0.021	0.005	-0.011		0.037	0.019	0.001		0.028	0.019	0.008	
	[0.007]	[0.007]	[0.034]	[0.031]	[0.029]		[0.032]	[0.028]	[0.027]		[0.019]	[0.017]	[0.014]	
Years Non-ICT Business Ownership	-0.016	-0.006	-0.068	-0.033	0.018		-0.105	-0.065	-0.007		-0.031	-0.011	0.025	
	[0.021]	[0.024]	[0.101]	[0.092]	[0.109]		[0.096]	[0.082]	[0.086]		[0.056]	[0.050]	[0.066]	
No. of Non-ICT Businesses Owned	0.044	0.008	0.144	0.051	-0.146		0.426	0.318	0.097		0.338†	0.283†	0.146	
	[0.068]	[0.080]	[0.332]	[0.302]	[0.361]		[0.316]	[0.271]	[0.307]		[0.184]	[0.165]	[0.244]	
Deliberate Practice	0.048*	0.046*	0.051	-0.051	-0.031		-0.001	-0.119	-0.096		-0.014	-0.074	-0.060	
	[0.022]	[0.024]	[0.107]	[0.101]	[0.089]		[0.102]	[0.090]	[0.071]		[0.059]	[0.055]	[0.040]	
Independent Variables:														
Cog. Versatility				2.128***	1.481**			2.462***	1.733***			1.239***	0.785**	
				[0.557]	[0.716]			[0.500]	[0.543]			[0.305]	[0.311]	
No. of ICT Businesses Owned		0.089**			0.554***	0.132			0.624***	0.154			0.389***	0.070
		[0.037]			[0.202]	[0.083]			[0.174]	[0.080]			[0.124]	[0.041]
						0.035 0.351				0.058 0.348				0.022 0.179
Constant	-0.755	-0.266	-4.771	-3.164	-0.602		-5.118	-3.258	-0.371		-2.557	-1.621	0.178	
	[0.670]	[0.665]	[3.269]	[2.995]	[2.806]		[3.110]	[2.684]	[2.341]		[1.811]	[1.638]	[1.416]	
R Square	0.180	0.265*	0.189	0.343**	0.466***		0.168	0.402***	0.579***		0.170	0.344**	0.547***	
F	1.381	2.032*	1.464	2.943**	4.439***		1.270	3.788***	6.995***		1.287	2.959**	6.136***	

Notes: Coefficients are shown, with standard errors in parentheses; $N = 74$; Bootstrap re-sampling = 5000; †$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$, two-tailed.

Appendix A1: Criteria for coding segments as intuitive (rapid, non-conscious, holistic, automatic)[2]

Coding Criteria	Sources	Examples from protocol
It is an initial reaction or automatic response	Epstein (2011)	"Hmm I like this" "Interesting!"
It represents recognition of patterns (largely based on experience, expertise and knowledge):	Dutta and Crossan (2005) Hodgkinson et al., (2008) Klein (2004)	
✓ The technology seems familiar, similar to others the participant has seen (despite the fact that all three technologies were breaking news at the time of the study)	Miller and Ireland (2005) Simon (1995)	"I've seen this somewhere" "This is old technology"
✓ Detection of problems, anomalies	Witteman and van Geenen (2010)	"This is not particularly new but anyway"
✓ Detection of links between technology and changing market trends		"Connected with a USB cable? No, that won't work" "People are realizing that plastic is a more convenient way to pay"
It is a spontaneous generation of an idea, alternative or solution, or what Sadler-Smith would call "divergent" (2004, p. 161)	Sadler-Smith (2004)	"So for example the first thing that came to mind when I saw this was ee for example menus and people select the food that they want to eat..."
It is an intuitive projection, or what Crossan et al. would call "future possibility oriented" (1999, p. 526)	Crossan et al., (1999)	"This is going to be huge" "I can see this happening in a few year's time"
It is emotionally-laden	Dane and Pratt (2007) Sinclair and Ashkanasy (2005)	"This is very exciting technology" "Ahh yesss!" (spoken in an excited voice)
It represents an instant judgment or a rapid, confident decision to exploit or reject the technology (despite the lack of information available)	Dane and Pratt (2007) Simon (1995)	"This is definitely something I would go for" "No. From what I see I wouldn't invest in this"
It represents an inability to give a rational justification for why the decision was made, or it makes reference to intuition, gut feeling, etc.	Epstein (2011) Simon (1995)	"I don't know why" "I can just see it"
BUT "if participants immediately mention their decision and only then continue to give reasons pro (and con) they may be assumed to have reached their (initial) decision intuitively, and their reasons could be called post-hoc justifications" (Witteman and van Geenen, 2010, p. 56)	Simon (1987) Witteman and van Geenen (2010)	"My gut feeling is that right now em you can do away with an add-on technology like this" "Somehow it's more intuition, something is telling me that e this technology em might not work in all scenarios, in all conditions"

Once all segments have been coded, protocols are examined in a holistic manner in order to obtain supporting evidence for the above coding. The following additional indicators suggest intuitive processing:

- Rapid reading of the text and quick scanning of the task scenario (Dane and Pratt, 2007; Klein, 2004; Simon, 1995)
- High confidence in decision (Dane and Pratt, 2007; Simon, 1987; Witteman and van Geenen, 2010)
- Other observations noted during the data collection (excitement, etc.)

[2] Reproduced from Baldacchino et al. (2014, p. 169-170)

Appendix A2: Criteria for coding segments as analytical (conscious, logical, detail-focused, deliberate)[3]

Coding Criteria	Sources	Examples from protocol
It represents what Klein describes as "the process of trying to understand a problem by breaking it down into its components and then performing logical and/or mathematical operations on these components" (2004, p. 74)	Klein (2004)	"Ok so if I'm understanding this correctly..." "I'm still, I'm trying to understand what it's all about, and what it can be used for"
It involves a deliberate effort at what Sadler-Smith describes as "reasoning the decision through by a process of analysis" (2008, p. 35)	Sadler-Smith (2008)	"We're talking here about entrepreneurship, so so we really have to think about the objectives in this case… normally the first objective that an entrepreneur tries to hit is the commercial objective…"
It is characterised by attention to objective data such as market trends and statistics, prices, and other information that is relevant to the task at hand	Dane and Pratt (2007) Dean and Sharfman (1993) Gustafsson (2006) Sadler-Smith (2008)	"And also even the investment, it's something that needs investment in the hardware itself, em it's something that needs investment in the technology" "There is penetration of mobiles in practically more than one phone in every pocket"
Reference is made to the lack of information available, or respondent seeks more information (including re-reading / closer examination of the text provided)	Dean and Sharfman (1993)	"My only concern is that still repeatedly I have absolutely no idea what type of investment is required" "Bear with me I'm going to read quickly through it again"
It represents mental simulation, which Klein describes as "evaluating a course of action by consciously *imagining* what would happen when they carried it out" and "simulating and envisioning a scenario – playing out in their heads what they expect would happen if they implemented the decision in a particular case" (2004, p. 26)	Klein (2004)	"What we are saying here is that I can use this on a monitor, nowhere did the CEO tell me that I can use it on any other device and I'm trying to think if I could actually use it on another device, maybe a fixed picture, and a fixed picture and you press one to the other…"
It represents a rational justification for a choice or decision. As explained by Witteman and van Geenen, "the more reasons, the more deliberation is used in the process", especially if participants "mention their decision only after their reasoning" (2010, pp. 56-57)	Simon (1987) Witteman and van Geenen (2010)	"Well em first of all as I said I'm not into retailing because retailing doesn't create anything for myself, just buying and selling, don't do that boring stuff. And especially there's nothing you can do on a product, you have to buy it as it is and sell it as it is, so few things you might eventually change. And you have no control over the product so if there's something wrong you still have to go back to the producer"
It is a conscious search for alternatives, ideas, solutions	Coget (2011)	"Ok, what can this do for me? I'm not so much interested in in this technology per se, what does it do for the end user?" "I'm just seeing what possibilities there might be"
There is a comparison of alternatives	Coget (2011) Klein (2004)	"So whereas in the first case we were looking at developing applications for special needs where the market could be slightly a little bit more restricted, now we're looking into something which is on the opposite side of the scale where the market is huge, the way I see it"
It represents a delay in making a commitment to exploit or reject the technology until more information is gathered (search for more information)	Dean and Sharfman (1993)	"I need to look into this further" "It's an opportunity I would explore... Because unfortunately although it's very interesting I don't have enough information here..."

Once all segments have been coded, protocols are examined in a holistic manner in order to obtain supporting evidence for the above coding. The following additional indicators suggest analytical processing:

- Slower reading of the text and careful inspection of the task scenario (Dane and Pratt, 2007)
- Other observations noted during data collection (e.g., closely examining the text / attention to detail, etc.

[3] Reproduced from Baldacchino et al. (2014, pp. 171-172)

Appendix B: Deliberate Practice Scale (adapted from Unger et al., 2009)

The following questions will help us better understand the ways in which you enhance your entrepreneurial knowledge, skills and performance. For each of the ten activities listed below, kindly indicate: a) how often you engage in that activity (every day / every week / every month / every 3 months / every 6 months / every year / less than once a year / never), and b) to what extent you would say that activity enhances your knowledge, skills and performance as an ICT entrepreneur (to a great extent / to a large extent / to some extent / to a minor extent / to no extent / N/A). For the activities which you answer question a) with 'never', kindly select the 'n/a' option from the drop-down menu of question b). There are no right or wrong answers, we only ask that you are open and truthful in your responses.

1. **Mental Simulation** (e.g., viewing / testing your website / products through the eyes of a customer, envisaging different uses for your products)
2. **Exploring new strategies** (e.g., trying out new products or services, trying out new designs and observing people's reaction)
3. **Consulting colleagues or experts** (e.g., seeking advice from and networking with other like-minded entrepreneurs to share knowledge and experiences)
4. **Asking customers for feedback** (e.g., having a feedback function on your website, asking existing clients about their needs)
5. **Firm / staff meetings** (e.g., brainstorming with employees to see where improvements are necessary)
6. **Private conversation** (e.g., talking to family members, friends, and acquaintances to pick up ideas for new or improved products)
7. **Professional reading** (e.g., reading business and ICT related journals and magazines, books, brochures, scanning the internet, watching domain related videos)
8. **Workshops / training / courses** (locally, overseas or online)
9. **Observing others** (e.g., keeping an eye on the competition to see what they are offering in terms of products, prices, etc.)
10. **Monitoring** (e.g., keeping track of which of your products are selling the most, keeping records of statistics related to your website's traffic such as number of clicks, duration of visits, etc.)