

**The conception of New Venture Ideas by novice entrepreneurs: A question of nature or nurture?**

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## **Abstract**

This research aims to further understanding around the cognitive mechanisms lying behind the generation of entrepreneurial New Venture Ideas (NVIs). It assesses the extent to which this competency is innate or one which is capable of being proactively developed. This has particular salience in the context of novice entrepreneurs, a group lacking the knowledge corridors and cognitive frameworks of their serial or portfolio counterparts.

Innovative in nature, NVIs represent the first candidate concepts for new means-end relationships. Existing as cognitive products at the very start of the entrepreneurial journey, significant academic attention has focused on the cognitive micro-foundations that influence their conception. Nonetheless, notable gaps in this body of work remain, not least in how different cognitive antecedents impact upon NVI quality.

This thesis looks at these issues through three independent but inter-related studies.

The first undertakes a systematic literature review of the existing empirical research to elucidate the extent, and associated transmission methods, through which entrepreneurship education and training (EET) supports opportunity identification.

The second takes a quantitative approach to observe how an individual's innate cognitive capabilities, notably those aspects of intelligence related to executive functioning, explain significant inter-person performance differences when it comes to entrepreneurial ideation.

The third adopts an experimental methodology, to assess the extent to which the use of cognitive heuristics, in this case analogical reasoning, impacts on performance outcomes in the conception of NVIs, and the extent to which it can be supported.

Collectively this study finds that EET interventions, innate cognitive capabilities, and cognitive heuristics all contribute to NVI quality. It highlights the potency of nurturing interventions but simultaneously illustrates their limitations. With different cognitive antecedents shown to exude varying degrees of malleability, this research has relevance to both the structure, and expectations, of EET programmes dedicated to the ‘fuzzy front’ end of entrepreneurship.

## Acknowledgements

Work on this PhD began on holiday in the shadows of the Matterhorn, and finished a number of years later overlooking the face of the Jungfrau. Both Swiss mountains are apt metaphors for completing a PhD thesis. Just as challenging as they appear, conquering them requires determination, hard work, and in the face of repeated and considerable doubts, a huge dollop of blind faith that the summit can eventually be scaled. Having finished the attached text, I have a new found respect for those across all fields, who have undertaken the same task.

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# 1. Introduction

“When you ask creative people how they did something, they feel a little guilty, because they didn’t really do it, they just saw something. It seemed obvious to them after a while” - Steve Jobs<sup>1</sup>

## 1.1 Research background

In discussions around the emergence of entrepreneurial ideas, there is a dichotomy between the public and academic conceptions of entrepreneurship. Amongst popular consciousness, the ‘aha’ moment, complete with its ‘Eureka’ style flash of inspiration, is positioned as being front and central to subsequent entrepreneurial success<sup>2</sup>. By contrast, entrepreneurship academe cautions against this kind of single point and singular person depiction of the entrepreneurial journey (Dimov, 2007). Given the numerous junctions that exist en route before a moment of imagination can morph into a revenue generating reality, entrepreneurship scholarship has often exuded an understandable desire to downplay the significance of the initial burst of insight.

Yet for the many miles that there are still to travel, all the work required to refine an initial concept, the plethora of different validations needing to be secured, and the sheer number of trap doors that there are to circumvent in the enactment of a successful and functioning business, there is still a need to understand how rudimentary entrepreneurial ideas first emerge. Every

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<sup>1</sup> Steve Jobs, Interview with *Wired*: Gary Wolf. Steve Jobs: The Next Insanely Great Thing. 1996. ([http://archive.wired.com/wired/archive/4.02/jobs\\_pr.html](http://archive.wired.com/wired/archive/4.02/jobs_pr.html)).

<sup>2</sup> <https://www.theguardian.com/news/2022/jul/10/uber-files-timeline-parisian-eureka-moment-global-domination>

entrepreneurial opportunity has an idea as its progeny, such that someone needs to have first thought of it for it to ever become the subject of subsequent human discussion (Dimov, 2007). Indeed entrepreneurial opportunities can only ever be brought into existence with the formation of an initial candidate idea (Hayton and Cholakova, 2012). This ensures that fresh ideas are the lifeblood of entrepreneurship (Ward, 2004), with the most prolific entrepreneurs shown to be those most skilled in ideational behaviour (Ames and Runco, 2005). How entrepreneurial concepts are first triggered in a person's mind therefore remains a topic that is of central interest to the field (Baron, 2006, Short *et al*, 2010; Davidsson, 2015).

The motivation behind the ensuing research is partly personal, the corollary to the researcher's own fostering long term interest in how business ideas come to pass. During the last 25 years, the researcher has founded or co-founded 12 different entrepreneurial ventures, as well as musing over scores of different concepts that have never escaped the drawing board. Amongst the 12 new ventures that drew breath, some have grown into quite large concerns, with one featuring as high as 61<sup>st</sup> on the Inc 5000 list of fastest growing companies in the United States of America, and another being successfully sold to a FTSE 100 company in the United Kingdom. At the opposite end of the spectrum, testament to the great leveller that exists in entrepreneurship, other ventures have closed having either never made it to profitability or even to having established a meaningful revenue stream. In the researcher's case, what has united these ventures is that they have all involved an innovative New Venture Idea (NVI). In different ways, they have sought to forge a new 'means-end' relationship.

Each of these entrepreneurial journeys has started with an initial concept thought appearing in the researcher's consciousness, often if not always, in a specific moment that the researcher can still recall. As the researcher has accumulated an ever larger inventory of such ideas, each with their own different back stories, the focus has moved to detect patterns for how such candidate concepts come to emerge, not just within his own mind, but also within the minds of others who have had their own enterprising thoughts. Moving beyond anecdotal observations, this is a puzzle that the researcher has therefore long wanted to investigate in a more structured and scientific fashion.

Within this starting corner of entrepreneurship, academic scholarship currently convalesces around the notion that, when presented with similar circumstances, differing individuals will exude significant variances in the ideas that they identify (Gaglio and Katz, 2001). This has led the ability to be able to identify potential entrepreneurial opportunities, as being portrayed as a core element of the person-entrepreneurship fit (Markman and Baron, 2003). The capacity to generate ideas having relevance both before any venture is created, but also as an enterprise develops. In seeking to explain the diversity in ideational performance that exists between disparate individuals, attention has focused on the different cognitive micro-foundations that lie behind the generation of quality NVIs. Varying in their precise composition, these micro-foundations involve elements related to both nature and nurture. Overhanging this research area, is therefore suspended the more generic question, as to whether entrepreneurial ideation is the preserve of a select cohort of uniquely talented individuals, or something accessible to all, particularly in tandem with the appropriate training.

This is the playing pitch upon which the following PhD looks to stride out.

In approaching this central question, this PhD incorporates three conceptually separate papers, each of which seeks to contribute new knowledge upon different aspects of the central theme: (i) firstly around the extent to which current empirical studies observe entrepreneurship education and training to support the identification of entrepreneurial opportunities, (ii) secondly on the importance of an innate cognitive capability in executive functioning as an important, person centric, variable in entrepreneurial ideation, and (iii) thirdly on the extent to which the use of particular cognitive heuristics, in this case of analogical reasoning, can both impact on performance outcomes in the conception of New Venture Ideas (NVIs), and itself then be supported.

The background and purpose of this inter-linking research is laid out in the ensuing Introduction chapter. This Introduction chapter begins by providing an overview of the New Venture Idea construct, before reviewing the existing literature and discussing the core themes that already exist in this particular district of entrepreneurship research. Identifying the area in which it looks to make a contribution, it then spells out this research's objectives and outlines the research questions that it seeks to answer. Finally it details the methodology that it deploys and the resulting structure of the study.

## 1.2 The New Venture Idea (NVI) construct

### Definition

The principle unit under consideration within this study is the New Venture Idea (NVI). Whether it be a world famous digital start up, a medical device company harnessing the latest technology, or a restaurant offering a whole new genre of cuisine in the nearest town, there will always be a first candidate NVI from which subsequent action flows. Existing at the very start of the process of entrepreneurial opportunity recognition, an NVI has been defined as the first candidate thought for a potential new product or service, a new market, a new source of supply, a new way to organise production, a new distribution channel, new internal processes, or a new business model (Birkinshaw and Hill, 2007).

New Venture Ideas (NVIs) are not well rounded, fully developed, or positively assessed business propositions. Rather they refer to that initial flash of insight which encompasses the emergence of new possibility within consciousness (Long and McMullan, 1984). Fragile and ephemeral in nature (Dimov, 2007), an NVI is a preliminary, mostly incomplete, and not well articulated mental representation of the 'concept' for a possible future venture (Frederiks *et al*, 2019). Despite their fledgling nature, NVIs do though contain qualitative dimensions, ones that will impact on their subsequent strategic and financial potential (Kavanagh and Hisrich, 2010). Within entrepreneurship scholarship, NVI quality has typically been measured in terms of an idea's novelty, alongside an assessment of its utility, desirability or feasibility (Kier and McMullen 2018; Warnick et al, 2021).

Regularly described as having a value proposition which is unique relative to incumbents (Dyer *et al*, 2008), the NVI resides firmly in the Schumpeterian neighbourhood of innovative entrepreneurship. Whether they are conceived by profit driven entrepreneurs, or by their socially motivated contemporaries, NVIs dismantle equilibrium and create change. They forge fresh social possibilities or new sources of economic gain (Hill and Birkinshaw, 2010). Whether it was Billy Butlin and his holiday camp proposition in inter war Britain, or Sean Rad's twenty first century Tinder dating app, NVIs present fresh customer possibilities. At extremis, they have the potential to spawn whole new markets, leading in time, to a host of newly competing firms and associated supply chains. Such that when Fred Smith conceived an air-ground delivery postal service in 1973, he didn't just build Federal Express, he developed a whole distribution industry in his wake.

By focusing specifically on NVIs as innovative ideas, the ensuing study does not intend to somehow diminish or undermine the importance of imitative entrepreneurship. Mirroring the core routines and competencies on offer, imitative ventures account for the overwhelming proportion of business start ups (Hunter, 2013). Indeed, according to the most recent Global Entrepreneurship Monitor report (2021/22), the proportion of new business creations drawing on genuinely new ideas, only marginally surpassed 1% in just 5 global economies (Uruguay, the United Arab Emirates, Chile, the United States and Luxembourg)<sup>3</sup>. Whether it be at the level of the large corporate or the sole trader, imitative entrepreneurship sees what is working for others and looks to 'get in on the act'. Generating wealth by expanding existing markets or assisting in the rapid diffusion of technology, imitative enterprises are the engine room of the economy

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<sup>3</sup> Global Monitor Entrepreneurship Report. Global Entrepreneurship Research Association (2021/2022). Babson College. <https://gemconsortium.org/file/open?fileId=50900>.

(Baumol, 1987). Successful imitative businesses add value, not least because they take an existing concept and deliver it more effectively, in new locations, or at better value to others in the market.

Yet just as the experienced entrepreneur starts as a novice entrepreneur, the imitative idea has to start with an innovative forefather. Opening up new routines and competencies, it is the exceptional and elusive nature of New Venture Ideas, which makes understanding how they are conceived all the more important. As a target for research, it is the rarity, as well as the potency, of the innovative idea that marks it out as a particularly interesting area to study. In much the same way that an astronomer is drawn to a rare constellation event, that a soccer fan is drawn to watch an once in a generation global talent, or that a bird watcher is drawn to seek out an endangered species, the rarity of the innovative idea imbues the construct with the same feeling of magnetism in the early stages of entrepreneurship.

### **New Venture Ideas and the entrepreneurial journey**

Conceived as an initial candidate idea, the NVI feeds into those wider characterisations which perceive entrepreneurship, not as an act, but as a journey or a process of emergence (Wiklund *et al.*, 2011; McMullen and Dimov, 2013). After the point of initial conception - the focus of this particular study - an NVI will need to pass through a whole range of behavioural steps before it can come close to any material reality (Reynolds and Miller 1992).

In what has previously been likened to a period of gestation involving a human biological embryo (Gartner and Katz, 1988), the initial entrepreneurial concept will be further explored in



the mind of its originator, before being researched and elaborated in tandem with others (Ardichvili *et al.*, 2003). The more refined idea will then be evaluated, with the majority of initial ideas soon relegated to the status of a passing redundant thought. Even if the refined idea is deemed a suitable ‘first person’ opportunity for someone (Shepherd *et al.*, 2007), there will be much to do before a concept can become a practical reality. With a whole chain of subsequent events needing to go well for the refined venture idea to successfully make it to market, subsequent entrepreneurial success still remains dependent on the ‘exceptional execution’ of the idea (Bhide, 2000).

This depiction of the entrepreneurial journey helps to demarcate an NVI from the wider notion of an entrepreneurial opportunity. Despite the regularity with which the terms have previously been inter-changed, particularly in early years entrepreneurship scholarship (Kornish and Ulrich, 2011; Short *et al.*, 2010), the concept of an NVI is now increasingly being delineated from that of the entrepreneurial opportunity (Vogel, 2017). Following Davidsson’s 2015 re-conceptualisation of the term ‘entrepreneurial opportunity’, an NVI is now better understood as the cognitive product first emerging in the mind. As such, the NVI is distinguished from the external and often temporary circumstances which create the room for new economic activities (External Enablers), and from the forces (Opportunity Confidence) that apply a subsequent favorability to an idea and determine its attractiveness as the basis for future entrepreneurial action (Davidsson, 2015).

With the ‘New Venture Idea’ presented as a particular person’s varying interpretation of external forces, the differentiation between External Enablers and New Venture Ideas has worked to

transcend some of the previous ontological debates around opportunity discovery or opportunity creation. This is not to diminish the importance of disequilibrating forces such as regulatory changes, technological breakthroughs, or demographic shifts. External circumstances matter. In 1995, an era when web surfing was reliant on slow speed dial ups and flash software was in its infancy, it would have been highly inconceivable that someone would have hit on the idea for the video sharing website YouTube, one that emerged in very different circumstances, a decade later. Nonetheless, external enablers do not on their own generate fresh venture insights. Those insights come in the form of New Venture Ideas, cognitive products that reflect the cognitive reaction within an individual's mind to the external circumstances that they observe. This is something which makes it possible for the same broad characteristics of a particular NVI to be identified by multiple actors at largely the same point in time (Verstraete and Jouison-Laffitte, 2011).

Similarly the differentiation between the notion of a NVI, and the subsequent and later concept of Opportunity Confidence, confines the study of NVIs to the process of idea conception, rather than any subsequent act of evaluation. As such, the reservoir relating to NVIs will always be significantly larger than the subsequent pool of more refined opportunities, let alone that of actual business formations that is so often historically used as the proxy measure for entrepreneurial opportunities. Indeed it has been suggested that less than a tenth of initial ideas are said to reach the point where their business model is validated (Dimov, 2017).

With the NVI relating to the initial fragile idea that first appears within consciousness, the focus of the ensuing study is thus very much dedicated to how candidate entrepreneurial concepts first emerge. In essence, what the individual actor first sees, and of how they come to see it.

### **1.3 Literature review – The cognitive conception of NVIs**

Extant entrepreneurial research into the conception of New Venture Ideas has drawn heavily on the *theory of entrepreneurial cognition* (Mitchell et al, 2002). Through this theoretical lens, entrepreneurial behavior is seen to be driven by mental processes, namely that what an individual thinks, says, and does, is heavily influenced by the mechanisms through which that person acquires, stores, transforms, and uses information (Baron, 2004).

Contrasting with personality trait theories of entrepreneurship (Coulton & Udell, 1976; McClelland, 1965), economic theories of entrepreneurship (Bauoml, 1993, Bull and Willard, 1993), or categorisation theories of entrepreneurship (Dutton and Jackson, 1987), the *theory of entrepreneurial cognition* has increasingly become the dominant framework through which researchers have assessed why some people, and not others, conceive ideas for new business ventures. Assigning agency to the individual, the theory of entrepreneurial cognition explores how a person's cognitive framework develops, alongside how they then use these frameworks to make sense of the environments and contexts in which they are integrated. In this way, it is people's fragmented knowledge and diverse perceptions, allied to their differing uses of cognitive heuristics and mechanisms, which explain how different individuals make contrasting sense of the world (Baron, 2004).

The *theory of entrepreneurial cognition* further opens up the possibility that the conception of NVIs is a capability that can be developed. In contrast to the personality trait approach, where traits are portrayed as inherited, stable, and enduring over time, the theory of entrepreneurial cognition is based on the principle that individuals are able to develop their mental frameworks through significant experiences that they transform into knowledge. Rather than installing entrepreneurs as ‘uber’ individuals high up on a plinth, such that entrepreneurship is portrayed as activity beyond the reach of mere mortals below, the *theory of entrepreneurial cognition* leaves the door open to the possibility that the mental frameworks required to generate New Venture Ideas can be both learnt and taught.

Amongst the existing studies that ground themselves in the *theory of entrepreneurial cognition* in the generation of New Venture Ideas, two themes are dominant. The extant literature has simultaneously considered the future orientated cognitive processes that lie behind the emergence of these candidate ideas, and the cognitive micro-foundations which, both individually and in aggregate, are tendered to lie behind the effective operation of those processes.

### **Future oriented cognition**

Given that NVIs are described as “imagined future ventures” (Davidsson, 2015), entrepreneurship scholarship around NVIs has concentrated on mechanisms of ‘future oriented cognition’ (Frederiks *et al*, 2019). Requiring a departure from existing norms (Amabile, 1997) such thought processes are pictured as creative, although in a business context, they need not always be complex (Fillis and Rentschler, 2006). Within entrepreneurship, these main thought

processes can be grouped into three broad types: those relating to the making of fresh associations, those placing individuals in the shoes of others, and those undertaking simulations around both past and future outcomes. Although during the first moment of insight, these mechanisms are considered to operate in isolation (Frederiks *et al*, 2019), many of these thought processes do then co-exist in the later nourishment and refinement of an initial candidate venture concept.

As the name suggests, the first grouping of these studies, that labeled associative thinking, focusses variously on a range of thought processes that drive the association of knowledge. These include the use of pattern recognition (Baron and Ensley, 2006), whereby individuals draw on cognitive prototypes and exemplars to ‘connect the dots’ between seemingly unrelated events or trends to detect patterns which are suggestive of new products or services. Referencing the incorporation of structural knowledge from outside the domain of consideration, others point to the potency of reasoning through structural alignment (Grégoire *et al*, 2010) or analogy (Cornelissen and Clarke, 2010), such that new insights emerge through the comparison of a particular target situation with similar structural circumstances existing in an alternate source domain. Going further than simply borrowing concepts from alternative domains, other entrepreneurial researchers highlight the potential of conceptual combination (Bruni, 2017) and bi-sociation (Ko, 2004) whereby information from wholly unconnected knowledge bases is fused together to create new concepts.

By contrast the second grouping of studies, falling under the label of ‘perspective taking’, draws heavily on processes involving social imagination, and empathy to generate new ideas.

Sometimes described as placing oneself in the user's shoes (Prandelli *et al*, 2016), perspective taking considers the world from another individual's viewpoint (Galinsky *et al*, 2008). Incorporating studies that look at salesperson led opportunity recognition (Booney and Williams, 2009) and the role of 'lead users' (Lettl and Gemuenden, 2005), perspective taking is said to minimise cognitive biases and lead to a deeper understanding of customer needs. In doing so, it is suggested that the novelty which results from potential customer responses, frequently also contains an in-built plausibility.

The third broad grouping of studies considered within the literature congregates around processes which use mental simulation, in order to consider alternative outcomes. Looking forward, through prospective thinking, individuals are said to be able to generate ideas by simulating the way in which future possibilities may unfold (Worthy *et al*, 2014). Less bounded by the facts, generating imagined futures opens up pathways to situations where things that were not possible in either the past or in the present, become plausible. By contrast, through counterfactual thinking, mental simulation instead looks back to consider alternative representations of the past (Roese, 1997). Reflecting upon 'what might have been' is said to lead to a greater understanding of 'causal' inferences and relationships (Epstude and Roese, 2008), thereby generating new concepts by adding to the set of information that individuals already possess (Gaglio, 2004).

### **Cognitive micro foundations**

Underpinning the operation of these different mechanisms of future cognition, either collectively or individually, entrepreneurship scholarship has further looked to identify the particular

cognitive micro-foundations that may explain why it is that one particular individual identifies a particular venture concept (Mitchell *et al*, 2007). Where formative entrepreneurship research downplayed the role of individual differences in early stage entrepreneurial activities (Gartner, 1989; Shaver and Scott, 1991), these varying micro foundations are now considered to lie at the heart of the *theory of entrepreneurial cognition*. They can be broadly grouped into four categories: prior knowledge, environmental conditions, emotions and affect, and a person's intrinsic cognitive capabilities.

Firstly, a person's stock of prior knowledge is seen as central to why individuals with similar cognitive abilities, may nevertheless conceive a variety of different venture concepts (Shane, 2000; Casson, 2005). Although prior knowledge is sometimes said to cause cognitive fixedness (Ward, 2004), it has nonetheless been described as the fundamental cognitive resource (Grégoire *et al*, 2010). What someone already knows, allows them to better understand the value of fresh stimuli (Vaghely and Julien, 2010), to direct their gaze to a relevant field (Arentz *et al*, 2013), to facilitate causal maps that link means-end relationship (Smith and Di Gregario, 2002), and to frame the perceptions of a marketplace or industry (Gaglio, 1997). Moreover the breadth and depth of existing knowledge drives entrepreneurial creativity by widening a problem solver's network of possible wanderings (Amabile, 1997), feeding through into the diversity of ideas produced by associational thinking (Dyer *et al*, 2008).

Given the potency of prior knowledge in the ideation process, scholars have pointed to the benefit of individuals searching for NVIs within the areas, or 'consideration sets', in which they have the greatest experience (Fiet, 2007). Elsewhere the literature has considered the

circumstances that lead to this diversity of knowledge. This incorporates the examination of the impact of prior education (Ardichvili *et al*, 2003); of exposure to social networks (Singh, 2000); or of cross cultural experiences away from one's normal point of reference (Vandor and Franke, 2016). Others have pointed to the value of accumulated work experience (Gabrielson and Politis, 2012), and of the appreciation of markets, customer problems, and technology (Shane, 2000; Marvel and Lumpkin, 2017), all garnered from the idiosyncratic professional and social contexts in which people live and operate (Cooper and Park, 2008).

In terms of cognitive micro-foundations, the second pillar investigated by the extant literature covers environmental factors. Drawing on social cognitive theory (Bandura, 1986), scholars have point to the importance of an individual's wider context, and the way in which they interact with that environment. This has included the study of the societal and macro context in which the individual is embedded, such that the existence of a munificent or dynamic entrepreneurial environment has been said to turn on people's alertness to ideas (Tang *et al*, 2010) and support scanning behaviour (Wiklund and Shepherd, 2003). Variations in higher education systems and the associated research and development ecosystems (Koellinger, 2008), differences in consumer economics, distinctions between metropolitan and rural areas (Arenius and Clercq, 2005), and disparities across social and political systems are all said to stimulate individuals to identify opportunities (Stevenson and Gumpert, 1985). This has even led studies to explore whether in certain countries, such as Finland, respondents are more likely to perceive opportunities, than they are in others, such as Belgium (Arenius and Clercq, 2005).



Amongst these environmental influences, scholars have further drawn on social capital theory to emphasise the importance of an individual's social networks, such that an associated network of both strong and weak ties expose people to more ideas (Singh, 2000). Studies have highlighted the micro environment surrounding a particular individual, notably the significance of being embedded in a family business environment (Aldrich, 2003), or the potency for moments of personal turbulence to enhance a person's creativity (Tang, 2010). Such person centric environmental influences also incorporate an individual's past entrepreneurial experience. Experienced entrepreneurs are said to possess cognitive heuristics that promote creativity, allowing them to tap into more complex and interlinking schema from prior industry experience (Dimov 2010; Ucbasaran *et al*, 2009), and in the case of past entrepreneurial failure, to benefit from honed expert prototypes and a repertoire of mapped mental structures (Mueller and Shepherd, 2016; Mitchell *et al*, 2008).

The third pillar of micro-foundations relates to those studies that consider the role played by emotions, motivation, and affect in empowering the subjective insights and energised behaviour needed to identify new entrepreneurial possibilities (Campos, 2016; Fernandez De Arroyabe Fernandez *et al.*, 2019). Tapping into Ajzen's theory of planned behavior (1987), intentions are said to act as motivational factors such that they influence how much effort someone is prepared to exert in order to perform a task, such as opportunity search (Zhao and Seibert, 2006). Intrinsic motivation ensures people persist with creative activities (Amabile, 1997). Entrepreneurial passion is said to increase cognitive flexibility, drive creativity, and support the retrieval of information from working memory (Baron, 2008). Conversely creative idea generation capacity, such as the capability of working memory to undertake the cognitively

demanding task of aligning structural relationships, can also be negatively impacted by emotional pressures. This has been shown to come in the form of time pressure (Oldham and Cummings, 1996), or from the existence of stress and a lack of sleep (Weinberger *et al.*, 2018; Gish *et al.*, 2019).

Within this vein, it has further been suggested that individuals who possess high levels of self-efficacy are more likely to proactively engage in the search for opportunities (Ozgen and Baron, 2007). Scholars highlight how an individual's beliefs about their own ability will influence their subsequent actions. The extent to which particular individuals believe that they have the skills to identify opportunities, in particular when it comes to their creative self-efficacy, has been found to be an influential predictor of opportunity recognition perceptions and behaviours (Gibbs, 2009).

Finally, amongst the varying cognitive micro-foundations that have been considered, a fourth pillar of studies concentrates on the cognitive abilities of the relevant individual (Alvarez and Busenitz, 2001). Interlinking with Human Capital Theory (Becker, 1964), it is suggested that greater levels of human capital feed through into the ability to perceive new entrepreneurial ideas (Davidsson and Hong, 2003). This particular avenue of study has considered the possession of behaviours such as the tendency to question, observe and experiment (Dyer *et al.*, 2008), alongside how individuals exude different levels of imaginativeness (Kier and McMullen, 2018) and empathy (Sekiguchi and Khalid, 2018). Touching on the concept of entrepreneurial alertness (Gaglio and Katz, 2001), scholars have highlighted how those with an intuitive cognitive style will be more likely to observe signals (Olsen, 1985), and reflected upon the

notion that some people possess mental schemas that make them more sensitive to emerging information such as market and user problems (Valliere, 2013).

Within the context of early stage entrepreneurial ideation, a ‘twins’ survey has been used to suggest that biological factors account for 66% of the correlation between a creative personality and the recognition of opportunities (Nicolaou *et al*, 2009). In doing so it has been intimated that those with the DRD4 gene are disproportionately more sensitive to the stimuli of information about potential business opportunities. More recently, one study has even looked at how artificial stimulants, such as cannabis, can stimulate creative capabilities and engender NVI novelty (Warnick *et al*, 2021).

Developing on this range of individual cognitive differences, other researchers have looked fleetingly at the role of intelligence. It has been conceptually suggested that individuals with higher levels of intellectual capital should be able to make superior use of the information that they possess (Archdichvilli *et al*, 2003; Casson, 2005, Baum and Bird, 2010), and to generate more profitable business ideas (Shane, 2003; Davidsson and Honig, 2003; Baron and Ensley, 2006; Koellinger, 2008). Those laying down a neuro-cognitive perspective on entrepreneurial opportunity recognition have conjectured around the activation of brain structures, allied to cognitive abilities such as working memory, sustained attention and cognitive flexibility (Beugre, 2016).

### **Gaps in the extant research**

Although research convalescing around the *theory of entrepreneurial cognition* has steadily lifted the lid on many of the mental operations lying behind the identification of entrepreneurial opportunities (Wigger and Shepherd, 2020), research seeking to explain the font of inter person differences in this area is still regularly described as sparse (Kier and McMullen, 2018). Indeed it has recently been remarked how entrepreneurship theorists struggle to describe the ‘fuzzy front-end’ at the start of the entrepreneurial journey (Packard and Burnham, 2021), such that a lack of understanding persists as to where NVIs originate from (Davidsson, 2015). Accordingly there remain a number of gaps in the extant body of knowledge.

The first of these gaps relates to the range of aspects that, as yet, are still simply unexplored. When it comes to the knowledge jigsaw relating to the cognitive micro-foundations of NVI generation, there remain a number of prominent pieces still to be fitted in. Despite the focus of entrepreneurial cognition being on the means through which people store, process, and access information, only a handful of cognitive mechanisms (eg: perspective taking - Prandelli *et al*, 2016; and empathy - Sekiguchi and Khalid, 2018) have had their relative contributions empirically assessed. Although other cognitive heuristics, from pattern recognition to analogical reasoning, have been conceptually discussed, their relevance has not yet been subject to empirical investigation. Similarly, where entrepreneurship researchers have mused at length as to the role played by prior knowledge as a cognitive resource, there has been less of a focus on how cognitive capabilities power the way in which idiosyncratic knowledge is accessed or deployed by a particular person.

Secondly, when examining early stage entrepreneurial ideation, there has historically been only limited focus on how different antecedents impact upon the quality of the NVIs that are produced. Given how the quality of an idea will influence its eventual chance of success, these qualitative aspects remain an important area of consideration. During the period that this particular PhD has itself been being researched and written, there has been an increase in academic scholarship focussing on the qualitative antecedents of NVI conception (Kier and McMullen, 2018; Frederiks *et al*, 2019, Warnick *et al*, 2021). Yet research considering how different cognitive micro-foundations impact upon an NVI's innovativeness, strategic potency and potential profitability, remains in its infancy.

Thirdly, there remains a lingering lack of research clarity on the overarching issue of whether the generation of high quality New Venture Ideas is an activity that can be proactively developed. For whilst some researchers point to how the conception of New Venture Ideas as a skill that can be nurtured, for example through educational interventions (DeTienne and Chandler, 2004; Munoz *et al*, 2011; Cohen *et al*, 2021), this is not an uncontested assumption. Others argue that entrepreneurial ideation lies some distance away from the deductive science that typifies the functional and business skills in which management education is said to specialise. Instead it is argued, that the generation of NVIs reflects art, an activity that is inductive and creative. Similarly it is suggested that creativity and alertness skills are not universally distributed in the population, such that they are in part natural skills which are hard to teach (Dimov, 2017, Saks and Gaglio, 2002).

Accordingly, in spite of all the research streams identified within this literature review, when it comes to understanding the cognitive mechanisms and antecedents that lie behind the generation of NVIs, there remains more still to know.

## **1.4 The objectives of this research**

### **Research focus**

Developing on the *theory of entrepreneurial cognition*, such that the generation of NVIs is related to the cognitive mechanisms through which people acquire, store, transform and use information, this study looks to fill some of the knowledge gaps that exist in terms of the related cognitive micro-foundations.

In doing so, this research focusses on novice entrepreneurs. In the realm of entrepreneurial opportunity recognition, distinctions are regularly made between first time company founders and their more experienced compatriots (Ucbasaran *et al*, 2009). Lacking the cognitive imprints (Mathias *et al*, 2015), or the knowledge corridors (Shane, 2000) of more experienced entrepreneurs, it is arguably even more important for novice entrepreneurs to possess strong ideation skills. Moreover, the experienced entrepreneur will have at some point themselves, once been a novice entrepreneur. As such the conception of NVIs by novice entrepreneurs remains a necessary and important first stepping stone in any individual's entrepreneurial journey (Fillis and Rentschler, 2010).

The decision to concentrate this study's focus on novice entrepreneurs is also deliberate for another reason. Aspirant novice entrepreneurs, particularly those engaged in what has been

described as intentional idea generation (Vogel, 2017), frequently cite difficulties in generating their first idea (Sieger *et al*, 2014). For this group, the possession of a rich supply of ideas has been directly correlated with their level of entrepreneurial intent (Bhave, 1994), such that filling the ‘tank’ with quality ideas has been attributed as one of the most important factors lying behind the rate of new business creation (Molaei *et al*, 2014). Against this background, it is therefore doubly important to understand how novice entrepreneurs might be supported in the generation of NVIs.

### **Research questions and structure**

In developing knowledge upon the cognitive antecedents that support the generation of quality NVIs by novice entrepreneurs, this research undertook three separate studies. These studies considered cognitive micro-foundations that are notably distinct, both in their form and their focus of attention, with each academic investigation answering its own specific research question. Together the three studies contribute to an overarching research question, around the extent to which the generation of NVIs remains a matter of ‘nature’ or ‘nurture’.

Contained in Chapter (2), the first of these studies is a systematic literature review seeking to understand the degree to which extant entrepreneurship scholarship perceives Entrepreneurship Education and Training (EET) programmes to support entrepreneurial ideation. In doing so, it constitutes the first systematic literature review to analyse the empirical evidence that exists within this area. It gauges the extent through which EET interventions are seen to have an effect on opportunity identification, before elucidating on the mechanisms and boundary conditions surrounding that effect, and making recommendations as to how empirical research in this area

might be advanced in the future. The focus of that particular study therefore centres on the following research question:

*Specific Research Question 1:*

According to existing empirical studies, what is the effectiveness of Entrepreneurship Education and Training in supporting the identification of entrepreneurial opportunities?

Detailed in Chapter (3), the second study develops entrepreneurship knowledge by seeking, for the first time, to understand the extent to which cognitive capabilities around executive functioning, manifested in intellectual fluidity and memory retrieval abilities, impact upon a novice entrepreneur's ability to conceive New Venture Ideas that are high in quality. Where the role of intelligence has previously been given a conceptual billing, its potential impact has never been measured empirically in terms of its impact on NVI quality. In taking up that challenge, this study seeks to delve below a singular measure of general intelligence, to consider the impact played by different sub-aspects of intelligence. Drawing on recent insights from wider creativity research, it considers the role that differences in executive functioning capabilities have upon ideational quality within entrepreneurship. The focus of that particular study therefore centres on the following research question:

*Specific Research Question 2:*

How important are high levels of cognitive capabilities, notably those aspects of intelligence that relate to executive functioning, in the conception of high quality New Venture Ideas by novice entrepreneurs?



Expanded upon in Chapter (4), the third study looks to understand the impact that the use of a particular cognitive heuristic, in this case analogical reasoning, can have on the conception of high quality NVIs. Rather than viewing the use of analogy as a tool for the legitimisation or evaluation of ideas that have already emerged, this study develops entrepreneurial knowledge by exploring the potential for analogical reasoning to act as a creative engine in the conception of high quality NVIs. The study goes on to consider the potency of nurturing people in how to undertake analogical retrieval, and of the existence of prior market knowledge, in moderating the efficacious operation of this cognitive mechanism in the generation of high quality NVIs. The focus of that particular study therefore centres on the following research question:

*Specific Research Question 3:*

What impact does the use of analogical reasoning have on the ability of novice entrepreneurs to generate high quality New Venture Ideas, and to what extent is this relationship moderated by analogical training or prior market knowledge?

Each of these studies concentrates on very different cognitive antecedents, firstly around the impact of entrepreneurship training, secondly upon the power of innate cognitive capabilities, and thirdly on the role played by particular cognitive heuristics. Yet when viewed in unison, these different pieces of research talk to each other, most notably in the context of whether entrepreneurial ideation is an activity that can be proactively developed. They therefore contribute to the wider and un-resolved question around the extent to which entrepreneurial ideation is a matter of nature or nurture. This is the overarching focus of this research, one that leads to the collective research question assessed by this study:

*Overarching research question:*

To what extent is the conception of high quality New Venture Ideas by novice entrepreneurs a product of nature, or something capable of being developed through nurture?

### **Intended contribution**

In tackling both the generic, and more specific, research questions listed above, this study seeks to make both a theoretical and practical contribution to the existing body of entrepreneurial knowledge.

On a theoretical level, this research strives to build fresh understanding in a number of hitherto uncharted territories within the wider cognitive landscape relating to the generation of NVIs. In doing so it seeks to locate reasons for why one particular individual may be more likely to come up with a higher quality NVI than another. In assessing the contribution of previously un-researched micro-foundations upon both the novelty and usefulness of the ideas that are generated, this research also responds to recent calls for entrepreneurship research to consider the impact of its proposed antecedents on different aspects of NVI quality (Frederiks *et al*, 2019).

Collectively by focussing on cognitive antecedents which are both innate, and which also involve different aspects of training and development, this research further aims to augment the debate as to whether entrepreneurial ideation skills are a matter of ‘nature’ or ‘nurture’. By considering cognitive micro-foundations that very much differ in their form (from education, to innate powers of intelligence, to a reliance on different ways of thinking), this study looks to contribute

to wider theoretical discussions as to the extent to which entrepreneurial ideation can be proactively developed.

Specifically, the three different pieces of research contained within this study look to make their own stand alone contributions. Chapter (2) seeks to clarify understanding as to the impact that Entrepreneurship Education and Training programmes have on Opportunity Identification Capabilities, on the means through which their impact is transmitted, and the boundary conditions that surround these interventions. Chapter (3) looks to develop knowledge of the role played by intelligence, and in particular by the different component aspects of general intelligence relating to executive functioning, as sources of inter-person differences in the ability to undertake high quality entrepreneurial ideation. Whilst in considering the quality of ideas that emerge through the use of analogy, Chapter (4) looks to understand the extent to which analogical reasoning can lead to the generation of NVIs that are disproportionately high in quality, before exploring the extent through which analogical training and the existence of prior market knowledge can positively moderate that relationship.

On a practical level, this research has relevance for the burgeoning global infrastructure in entrepreneurship education and training (EET). Its findings have the potential to feed through into discussions about both the overall *raison d'être* of those EET programmes directed upon the 'fuzzy front' end of new venture idea generation, as well as on the specific approach which they take. Moreover should the ideational capabilities of novice entrepreneurs be shown to be capable of being proactively developed, such that this can lead to improvements in both the

fluency and quality of the ideas that are engendered, this will point a further signpost down the road to subsequent entrepreneurial success.

## **1.5 Methodology**

In answering the first of its three specific sub research questions (Chaper 2), this study deployed a systematic literature review methodology (Palmatier *et al*, 2018) in order to analyse how previous empirical research has interpreted the relationship between Entrepreneurship Education and Training and the initial identification of entrepreneurial opportunities. Systematic reviews were first developed in medical science as a way of synthesising research findings in a transparent and reproducible way (Davis *et al*, 2014). It thereby follows a transparent and replicable method to garner a pool of academic studies related to the research question, before using a narrative synthesis methodology involving thematic analysis to collate and analyse the existing empirical evidence (Snyder, 2019).

In answering the specific sub research questions relating to a person's innate cognitive capabilities with executive functioning (Chapter 3), and to the use of analogical reasoning (Chapter 4), this study harvested its own fresh empirical data. In garnering that empirical data, this study tapped into a cohort of undergraduate and post graduate students from Essex Business School in England. Given the stated strong future entrepreneurial intent of this cohort, this participant pool was considered a sound proxy for novice entrepreneurs (McGee *et al.*, 2009). It also had control benefits given the participant's broad similarity in age, educational backgrounds, and the comparative level of past entrepreneurial experience.

Scoped out in late 2019, the plan for this research initially anticipated commencing data collection during the spring of 2020 by using the 'Essex Lab' laboratory facility at Essex University in Colchester. However the dramatic emergence of the global coronavirus pandemic soon thwarted this approach. Dominating everyday life for much of the ensuing two years, there followed the sustained closure of the laboratory facility and a prolonged exodus of students from the campus.

In order to progress with this study, the approach to data collection was adjusted accordingly. Rather than collect the data for Papers 2 and 3 separately, one single data collection exercise was undertaken. This still involved working with business undergraduate and post graduate students from Essex Business School, with the study advertised to this cohort, and people voluntarily participating in return for £20 for an hour of their time. However, with the participants working from, and in periods, actually confined to, their own homes, the data collection was now undertaken through one to one sessions conducted through the 'Zoom' technology platform. In total a 110 of these 'one to one' Zoom sessions were subsequently undertaken by the researcher.

During each session, a participant first undertook a series of online and spoken tests designed to measure their cognitive capabilities as per the research questions in Paper 2. To assess their aptitudes with the ideation of New Venture Ideas, each participant next undertook ideation exercises relating to four different business vignettes. The output from these ideation exercises was later transcribed and coded, with the results used for both Papers 2 and 3. During the ideation segment of the research session, the order in which the ideation exercises were presented was alternated. The odd numbered participants began the ideation exercise by first

considering vignettes 1 and 2 first, with the even numbered participants ideating vignettes 3 and 4 first. After undertaking their first two ideation exercises, each participant watched an online video that imparted analogical training such that it constituted the experimental intervention required for the research question in Paper 3. Finally at the end of each research session, the participant answered a number of control questions.

Following this template based approach to data collection ensured that each individual research session was run in a fully systematic and identikit fashion. Conducted individually there was no danger of any cross contamination from participants communicating with others participants in the study. Moreover conducted remotely through a computer interface, rather than face to face, the researcher instinctively came to feel that this approach actually made it more comfortable for the participants to speak their thoughts aloud as they engaged in the ideation exercises.

At the end of this extensive data collection exercise which ran from the spring of 2020 through to late 2021, the harvested data was reviewed and analysed. In Paper 2 the subsequent focus of the data analysis was on the individual participant and their ideational performance, whilst in Paper 3 the focus was on the individual NVIs that were generated and their subsequent relationship to a participant's use of analogy. As the core dependent variable in this research, NVIs were assessed in terms of their quality: the novelty of each idea, and its appropriability in terms of the probability of it making a return. The qualitative grading relating to novelty and appropriability was attributed by three judges, whose experience as multiple company founders ensured that they were qualified to undertake the task.

Undoubtedly this coronavirus induced approach to data collection ended up being more time consuming and difficult than the original plan of running group laboratory sessions. Nonetheless the exercise managed to secure a total participant pool of 110. That level is comparable, or indeed in excess of, many other empirical studies in this area: DeTienne and Chandler (2004) - 130 participants; Breslin and Jones (2014) - 70 participants; Fiet and Patel(2008) - 52 participants; Cohen *et al* (2020) - 149 participants. Had the data collection approach been focussed solely on the objectives of Paper 2, the procedure would not have introduced an experimental intervention in the midst of the four ideation exercises. However the fact that it did so consistently across ‘all’ participants was not considered to have impacted on the findings of this Paper 2.

## **1.6 Structure of this study**

This study is laid out across five separate chapters. The current chapter, the Introduction, has started by providing the background for this research, outlining the construct under consideration (the NVI), and reviewing how the extant academic scholarship has approached the conception of NVIs. Detailing a number of research gaps that still exist in terms of the cognitive micro-foundations that lay behind the conception of high quality NVIs, it then detailed the research questions under consideration. From there it explained the methodology being deployed, alongside the structure and contributions of each aspect of the study.

The ensuing three chapters look to investigate each of the three specific research questions in turn. Chapter (2) is a Systematic Literature Review that looks at how capabilities in opportunity identification are developed through entrepreneurship education and training. Chapter (3) is a

quantitative study that assesses the contribution of cognitive capabilities around executive functioning to the conception of high quality NVIs. Chapter (4) undertakes experimental research to observe the potential for analogical reasoning to support the ideation of high quality NVIs.

The final concluding chapter, Chapter (5), then looks to review the key findings from these different avenues of research, highlighting the potential interactions and connections that exist between the studies, and assessing their relevance to the overarching research question. It then seeks to draw out any further recommendations that emerge from this work, alongside recognising its weaknesses and identifying the areas in which potential further research would prove beneficial.



## **2. Teaching the un-teachable? Developing capabilities in opportunity identification through entrepreneurship education and training: A systematic literature review and research agenda**

### **Abstract**

The global growth in entrepreneurship education and training programmes (EET) has spawned an associated boom in academic scholarship assessing the merits of such interventions. This systematic literature review is the first to synthesise the growing number of empirical studies that consider the impact of EET on opportunity identification capabilities (OIC). In doing so, it reviews the extent to which EET has been observed to support entrepreneurial ideation, before elucidating on the mechanisms and boundary conditions surrounding how such an effect is transmitted. Amongst recommendations for future research, it highlights the need for greater empirical rigour, calls for more empirical studies to measure the impact from training specific cognitive techniques, and urges more attention to be focussed on the boundary conditions of ‘who’ is most suited to attend these programmes and ‘how’ they are best delivered.

### **Keywords**

Entrepreneurship education, opportunity recognition, New Venture Ideas, opportunity identification.

### **2.1. Introduction**

Opportunity identification has been described as the capability to identify a good idea and transform it into it a business concept that adds value to the customer or society and generates revenues for the entrepreneur (Lumpkin and Lichtenstein 2005). It is the first cognitive

conception by an individual of the ostensive nature of an entrepreneurial idea (Cluasen, 2020). Such ideas have been described as the ‘lifeblood’ of entrepreneurship (Ward, 2004). Indeed the UK’s Quality Assurance Agency Guidance on Enterprise and Entrepreneurship Education (2018) previously defined enterprise itself as ‘the generation and application of ideas’.

In practice, the distance between the initial identification of an entrepreneurial opportunity, and the subsequent establishment of that idea into a wealth creating business, is vast. To successfully take an idea to market, entrepreneurs and their teams, require skill-sets that extend far beyond the identification of opportunities. Subsequent success requires competencies with relationship building, organising, commitment and strategy (Man *et al*, 2002). Yet, with all new ventures requiring a starting point, entrepreneurial opportunities could not be brought into existence without the emergence of that first candidate idea (Hayton and Cholakova 2012).

Opportunity identification therefore remains a key talent for entrepreneurs, something that discriminates between those who are more and less successful (Ames, 2005). Fluidity in idea generation is important, precisely because such a small proportion of initial ideas will ever be funded, let alone be sold to a customer (Timmons 1994). Moreover, with longitudinal studies positing a link between the quality of the initial opportunity concept and the strategic potential of the ensuing venture (Kavanagh and Hisrich, 2010), the ability to undertake high quality ideation matters. Having a tank ‘full with ideas’ supports entrepreneurial intentions (Molai *et al*, 2014), and at the very least, removes a significant barrier to embarking on the process. For although entrepreneurship is frequently cited as a desirable career for many individuals, aspirant entrepreneurs frequently cite difficulties in generating that first idea (Sieger *et al*, 2014).

Against this background, modules focussing on opportunity identification now constitute an important component within many entrepreneurship education and training courses (EET). EET has been defined as ‘any pedagogical programme or process of education for entrepreneurial attitudes and skills’ (Fayolle *et al*, 2006, p. 702). An educational endeavour that began in 1947 with Harvard University offering ‘new enterprise’ courses for returning war veterans, EET has now become something of a global industry in its own right. As public and private institutions continue to make large investments into the field, the Department for Business, Innovation and Skills (2016) recently detailed how 196,300 undergraduate students were taking entrepreneurship modules in the UK alone.

As an educational discipline, the legitimacy of EET hinges on the very considerable body of academic scholarship that strives to assess, and potentially reaffirm, its positive impact (Kuratko, 2005). This body of academic work has been described as both overwhelming (Fellnhofter, 2019) and contentious (Hahn *et al*, 2017). As such it has provided fertile ground for systematic literature reviews seeking to make collective sense of the field. These reviews have previously considered the broader efficacy of EET (Pittaway and Cope, 2007; Rideout and Gray, 2013; Nabi *et al*, 2017; Carpenter and Wilson, 2022), as well as more specific aspects of the EET intervention, such as the potency of experiential learning (Morland *et al*, 2021), or the impact of EET on entrepreneurial intent (Fayolle and Benoît, 2013). To date though, no such review has been undertaken of the academic evidence that exists around the question of whether, and how, EET positively supports Opportunity Identification Capabilities (OIC). This is the gap into which this study looks to stride.

In doing so, this review makes two primary contributions. Firstly by mapping the empirical terrain in this area, it seeks to clarify understanding as to the impact that EET has on OIC, on the means through which that impact is transmitted, and upon the related boundary conditions. Secondly, and in order to move research in this field forward, it then proposes a research agenda for future investigations in this area. In doing so, it highlights the need for greater empirical rigour and definitional clarity in future studies. Suggesting a number of possibilities for worthwhile further research, it identifies empirical gaps around the impact of training students in particular cognitive techniques, and in understanding how the ‘to whom’ and ‘what’ in terms of course delivery, flow through to the benefits in OIC that are extracted from these programmes.

This paper is structured as follows. It starts by detailing the scope and process methodology that it utilises within its systematic appraisal of the entrepreneurial literature (Section 2). Having done so, it then describes the characteristics of the empirical studies contained within the review (Section 3). Next it presents the thematic findings found within these studies, identifying contentions and competing observations (Section 4). Finally, it strives to use that analysis to highlight potential omissions and develop an agenda for future research in this area (Section 5).

## **2.2. Methodology**

This literature review centres on the research question of whether entrepreneurship scholarship foresees EET programmes to contribute positively to opportunity identification capabilities. Using a systematic literature review methodology, it seeks to identify and synthesise the extant literature related to that research question, such that it can provide the reader with a

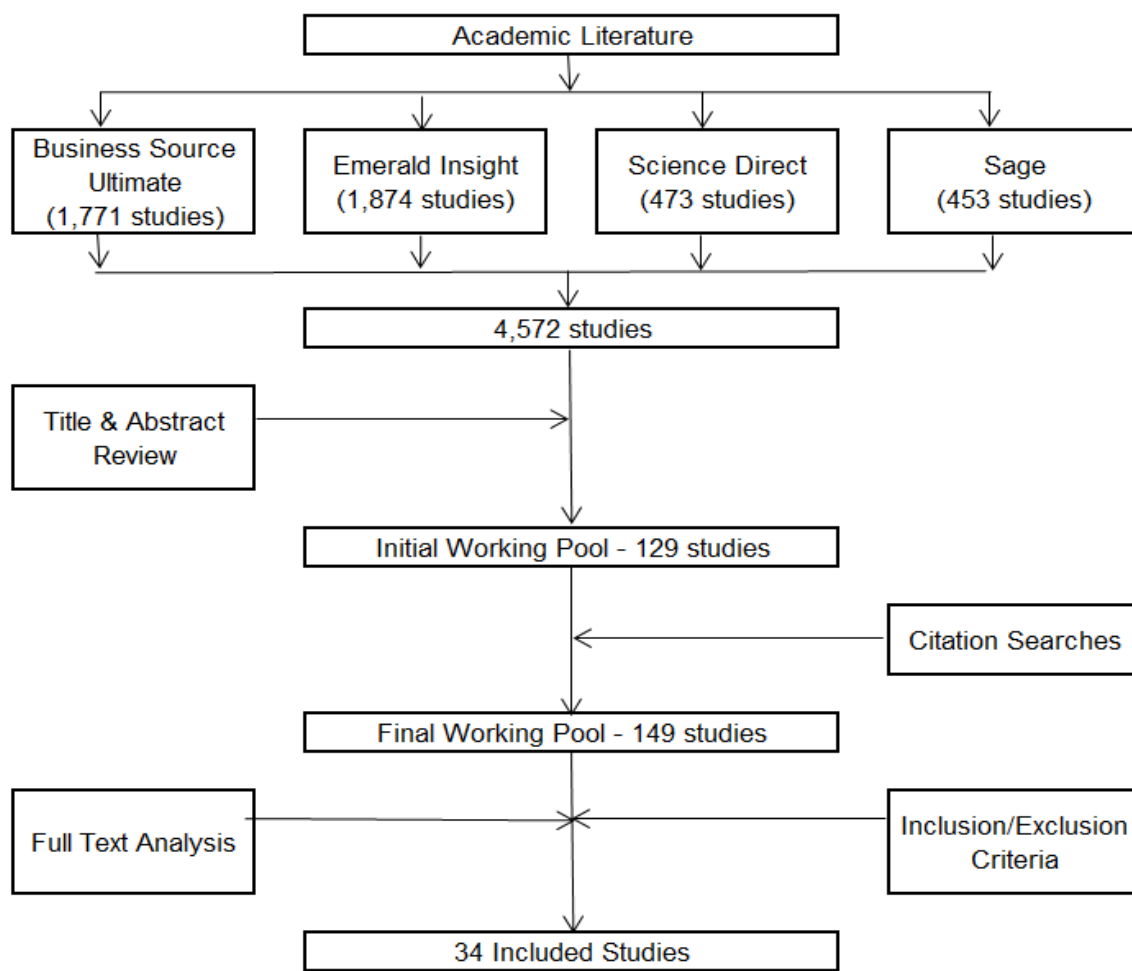
comprehensive understanding of the empirical evidence (Palmatier *et al*, 2018). Having undertaken that analysis, it is then positioned to identify areas in which future research might be next advanced.

Systematic reviews were first developed in medical science as a way of synthesising research findings in a transparent and reproducible way (Davis *et al*, 2014). In explicitly using systematic methods to garner and review the academic studies related to a particular question, bias is minimised, such that reliable and trustworthy findings can be drawn (Moher *et al*, 2009). Consistent with that approach, this study has sought to undertake a transparent and replicable multi-stage review (Tranfield *et al*, 2003; Littell *et al*, 2008). These stages are illustrated in Figure 1.

Firstly, a systematic search was performed on content within the electronic databases Business Source Ultimate, Science Direct, Sage and Emerald Insight to identify relevant research. In doing so this systematic search focussed on ‘article’ and ‘book’ content within these databases, directing its search terms to query the ‘full text field’ of material within the databases. Given how EET programmes have predominately developed within the last quarter of a century, the temporal timeframe of this search focussed on material published since 1998. This systematic search used the Boolean terms “entrepreneurship education” or “entrepreneurship education” or “enterprise training” or “enterprise education” or “entrepreneurship course” or “enterprise course” AND “opportunity recognition” or “opportunity identification” or “entrepreneurial alertness” or “business idea” or “new venture idea” within the ‘full text’ fields of the database.

Operationalising these searches returned 4,572 separate publications across the four databases. The abstract of these publications was then read so to filter down this initial list of sources. In doing so, initial exclusion criteria was used, such that this study first screened out those results whose focus was evidently not primarily on the relationship between higher education programmes and entrepreneurial opportunities or entrepreneurial ideation. Duplicate items were also eliminated. This led to the establishment of an initial working pool of 129 papers. This pool increased to 149 articles after the citations at the end of each article revealed a further 20 papers with potential relevance.

**Figure 1 – The SLR Review Process**



Secondly, a number of inclusion and exclusion criteria were then deployed to ensure that the finalised pool of studies was directly relevant to the research question under consideration. The full text of each paper within the working pool was reviewed in line with this exclusion and inclusion criteria, before the population of relevant papers was finalised. The inclusion criteria stipulated that to be incorporated in this research, studies must, (i) contain a focus, either directly or indirectly on an output variable that related to capabilities in identifying entrepreneurial opportunities, and (ii) must observe that output variable in the context of entrepreneurial education and training delivered by a higher educational institution. Given that the focus of this study was to assess for evidence of an effect, the exclusion criteria was set to ensure that the final body of studies was evidence based. As such the exclusion criteria explicitly disregarded studies that, (i) failed to contain empirical research, and (ii) didn't themselves contribute primary data, for example excluding literature reviews on EET.

In following this methodology, a final cohort of 34 empirical based studies was identified. Although three of these studies specifically measure the impact of EET on entrepreneurial alertness (Saeed et al, 2021, Zulfiqar *et al*, 2019, Cui *et al*, 2021), these studies are included because their specific measures of entrepreneurial alertness are considered to equate to opportunity identification. 33 of the 34 studies emanated from peer reviewed journals, with 1 further study (Albornoz and Amoros, 2017) drawn from a chapter within the 'Research handbook on entrepreneurial opportunities' (2017). It is contended that within the databases that were queried, these 34 studies amount to the core population of peer reviewed empirical research assessing the effectiveness of EET on OIC.

Across the 34 studies, both the diversity of empirical methodologies, and the range of different measures being assessed, contributed to the pool of studies being unsuitable to meta-analysis (Tranfield *et al*, 2003). Instead, the body of empirical literature was examined using a narrative synthesis methodology, one which involved collating the studies and amalgamating them into a wider mosaic (Hammersley, 2001). This thematic analysis was structured such that it effectively answered the research question (Synder, 2019). In the context of this study, that has involved the use of three first order themes, (i) the nature and extent of the measured impact, (ii) the mechanisms through which such effects were said to be transmitted, and (iii) the contingency factors which were seen to influence the strength of that impact.

### **Methodological limitations**

The limited nature of the current sample reflects the extent to which entrepreneurship researchers have hitherto addressed this important question. At 34 studies, the size of this literature pool constitutes something of a limitation with this systematic review. It restricts the ability to undertake bibliographic coupling analysis and to construct and visualise bibliometric networks. The fact that so much literature within the review has emanated from the last 5 years suggests that the question, of how EET programmes can support OIC, is one to which entrepreneurship researchers are increasingly turning. As they do so, and the pool of relevant papers grows, it is envisaged that there will become greater opportunities to utilize these additional forms of analysis in the future.

The narrow focus of this paper in specifically assessing the relationship between EET and OIC within the empirical literature constitutes the specific contribution of the study. In spite of contesting claims being made as to the potency of EET programmes in enhancing OIC, academic

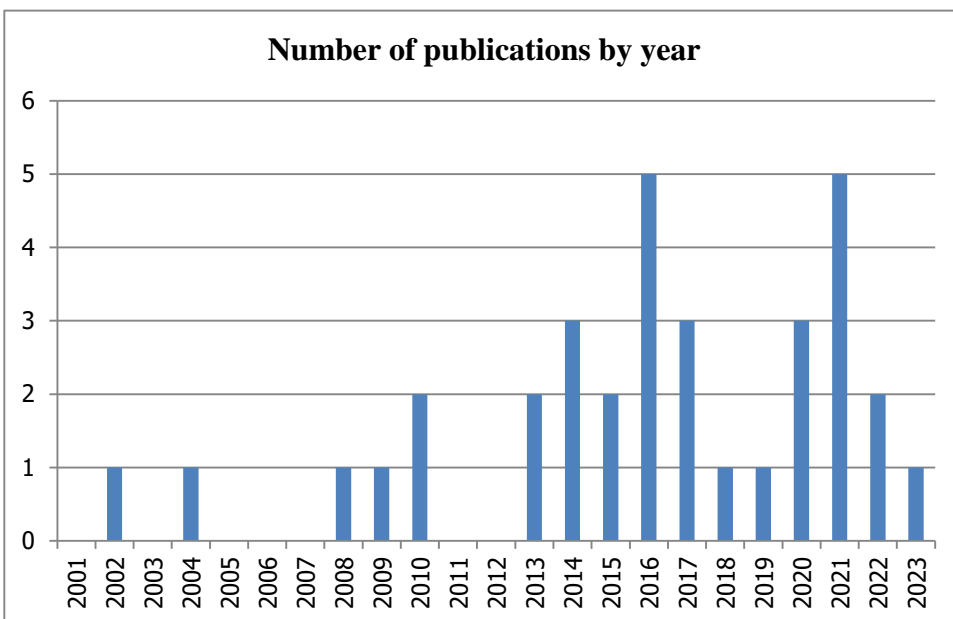


research in this area has not previously been subject to any systematic review. Although the pool of studies under review is comparatively low, the value of this particular research emanates from its assessment of those empirical studies within the context of the specific research question under consideration. Broadening the search criteria to include either conceptual papers, or research which examined the impacts of EET programmes on subsequent opportunity evaluation and development, would undoubtedly have brought more papers into the body under review. However doing so would only have undermined and compromised this research's focus on the research question being posited.

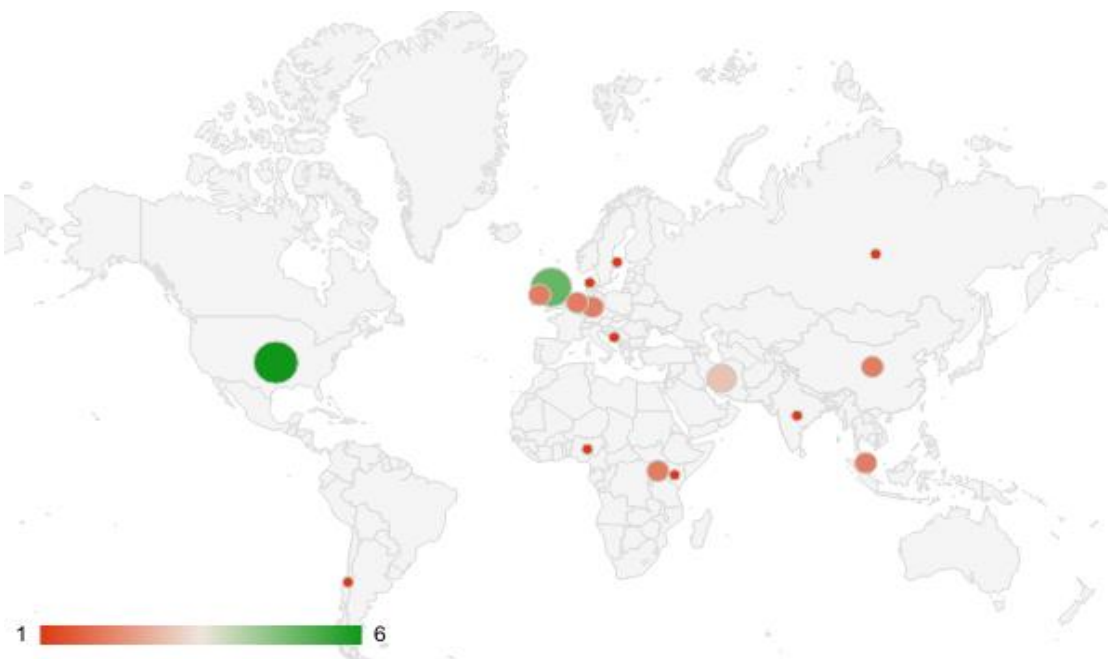
### **2.3. The studies in this review**

A full list of the 34 empirical studies included in this review is contained within Table 1. As detailed in Figure (2), research activity around the question of the impact of EET on OIC is one that has grown in interest in recent years. Some 28 of the 34 articles (82.3%) have been published within the last decade, with 13 (38.2%) emanating from the last 5 years alone. As detailed in Figure (3), this cohort of research studies is also drawn evenly from across the world. Although the greatest number of studies emanate from the United States (6 studies) and the United Kingdom (5 studies), the literature pool under review contains a broad range of studies from across the rest of Europe, Asia, Africa, and South America.

*Figure 2 –Publications by date period*



*Figure 3 –Research by country*



**Table 1 – Summary of publications included within the Systematic Review**

No.	Lead author	Date	Paper title	Journal	Grading	Relevance to study of EET and OIC
1	Saks, Naomi	2002	Can Opportunity Identification be taught?	Journal of Enterprising Culture	1	Semi structured interview study looking at how entrepreneurship programmes teach opportunity identification, drawing on the insights of leading educators.
2	DeTienne, Dawn	2004	Opportunity identification and its role in the entrepreneurial classroom: A pedagogical approach and empirical test	Academy of Management and Learning	4*	Experimental study that shows opportunity identification to be a competency that can be developed in the classroom through an SEEC creativity training programme. Highlights how both the number and innovativeness of venture ideas increased after SEEC.
3	Fiet, James	2008	Entrepreneurial discovery as constrained systematic search	Small Business Economics	3	Experimental survey, founded upon a systematic search approach through which students are trained in idea sets. Using an experimental approach, it shows how training students in active search, led to more ideas being identified than through an alertness perspective.
4	Levie, Jonathan	2009	The effect of business or enterprise training on opportunity recognition and entrepreneurial skills of graduates and non graduates in the UK	Frontiers or Entrepreneurship Research	n/a	Telephone based questionnaire assessing participant's perceived propensity to recognise business opportunities, in relation to 4 different types of EET intervention.
5	Lourenco, Fernando	2010	Enterprise education: the effect of creativity on training outcomes	International Journal of Entrepreneurial Behaviour and Research	3	Self report survey study that shows how students with higher perceptions of creativity tend to have higher tendencies to learn.
6	von Graevenitz, Georg	2010	The effects of entrepreneurship education	Journal of Economic Behavior & Organisation	n/a	Self report study that looks at the impact of EET on entrepreneurial intent, but which also contains measures of students self assessed capabilities including opportunity recognition
7	Nab, Jan	2013	Fostering the competency of social science students in identifying business opportunities: A design research approach	International Journal of Entrepreneurial Venturing	1	Mixed method study that relies on survey data, interviews, and a comparison of ideational outputs. It looks to see if students are better able to discover opportunities following a course in which design principles are implemented
8	Karlsson, Tomas	2013	Improving perceived entrepreneurial abilities through education: Exploratory testing of an entrepreneurial self-efficacy scale in a pre-post setting.	The International Journal of Management Education	1	Survey based approach that measures impact of a course of EE on entrepreneurial self-efficacy, including confidence in searching and identifying business opportunities. Uses a pre and post test design, as well as a control group of innovation students.

9	Breslin, Dermot	2014	Developing an evolutionary/ecological approach in enterprise education	International Journal of Management Education	1	Investigates the impact of an evolutionary approach within EET, whereby students develop practice based heuristics to make sense of their lived experiences. Measures results through ideational outcomes.
10	Gundry, Lisa	2014	Seeing around corners: How creativity skills in entrepreneurship education influence innovation in business	International Journal of Management Education	1	Self report survey study showing how key innovative behaviours emerge when students are taught the appropriate tools and creative methods for idea generation.
11	Nab, Jan	2014	Strategies of expert teachers for teaching identification of business opportunities	Industry and Higher Education	1	Semi structured interview study that uses the experiences of expert teachers to look at strategies that work to teach opportunity identification.
12	Bell, Robin	2015	Developing the next generation of entrepreneurs: Giving students the opportunity to gain experience and thrive	International Journal of Management Education	1	Self report study which uses a series of reflective essays written by students post a course of experiential learning. Observes how an experiential approach develops entrepreneurial traits, including the generation of ideas.
13	Gielnik, Michael	2015	Action and Action regulation in entrepreneurship: Evaluating a student training for promoting entrepreneurship	Academy of Management Learning and Education	4*	Experimental study that involves a control and treatment group, which assesses the impact through surveys and transcribed interviews before, immediately after, and 12 months after, the course of treatment or control.
14	Gielnik, Michael	2016	Positive impact of entrepreneurship training on entrepreneurial behaviour in a vocational training setting	African Journal of Management	2	Study on how a STEP training programme based around action learning supports entrepreneurship, and opens up avenues the identification of new opportunities. Measures the results in terms of ideational outcomes.
15	Barucic, Ajka	2016	Entrepreneurship education as a factor of entrepreneurial opportunity recognition for starting a new business	Management	1	Self report survey study that explores the correlation between entrepreneurship education and entrepreneurial opportunity recognition.
16	Karimi, S	2014	The impact of entrepreneurship education: A study of Iranian Students Entrepreneurial Intentions and Opportunity Identification	Journal of Small Business Management	3	Self report study whereby participants measured their opportunity identification capability before and after a course of entrepreneurial training, alongside their entrepreneurial intention.
17	Lindberg, Erik	2016	Methods to enhance student's entrepreneurial mindset: a Swedish example	European Journal of Training and Development	1	Self report survey study that shows how applied intervention methods have a positive impact on how participants perceive their opportunity identification and creative capabilities, which in turn impacts on an entrepreneurial mindset

18	Karimi, Saeid	2016	Fostering student's competence in identifying business opportunities in entrepreneurship education	Innovations in Education and Teaching International	n/a	A pre and post test study, and a control and experimental group study of Iranian agricultural science students. Found there to be a positive impact of creative exercises on the number of business ideas generated, with a smaller impact on the innovativeness of the ideas generated.
19	Gielnik, Michael	2017	Boosting and sustaining passion: A long term perspective on the effects of entrepreneurship training	Journal of Business Venturing	4	A self report study that suggests that processes post training are dynamic, and that entrepreneurial self efficacy is needed to maintain passion. This in turn leads to greater experimentation and the creation of new ideas.
20	Albornoz, Carlos	2017	The effect of entrepreneurship education on opportunity recognition self-efficacy	Research handbook on entrepreneurial opportunities	n/a	A pre and post test study of Chilean students taking a mandatory entrepreneurship course. Measuring their self assessed opportunity recognition capabilities before and after the course.
21	Olugbola, Seun Azeez	2017	Exploring entrepreneurial readiness of youth and start up success components: Entrepreneurship training as a moderator	Journal of Innovation and Knowledge	1	Self report survey study suggesting that entrepreneurial training can develop entrepreneurial abilities, and strengthen opportunity recognition capabilities
22	Costa, Silvia	2018	Recognising Opportunities across Campus: The effects of cognitive training and entrepreneurial passion on the business opportunity prototype	Journal of Small Business Management	3	Self report survey study that tests the causal relationship between training and opportunity recognition by means of a cognitive and experiential learning approach. Finds a moderating role for entrepreneurial passion.
23	Zulfiqar, Salman	2019	Opportunity Recognition Behaviour and Readiness of Youth for Social Entrepreneurship	Entrepreneurship Research Journal	2	Self report survey study that looks at how formal education and training can enhance opportunity recognition behaviour within the context of social entrepreneurship.
24	Cohen, Dan	2021	Identifying innovative opportunities in the entrepreneurship classroom: a new approach and empirical test	Small Business Economics	3	Study looking at the IDEATE teaching method. Measuring ideational outcomes, it finds ideas discovered through active search are more innovative than those identified through passive search.
25	Hulten, Peter	2020	Building students' entrepreneurial mindsets: Results from an interview at a Russian university	International Journal of Management Education	1	Study as to how an entrepreneurial course focused on developing the entrepreneurial mindset made a difference, such that engaging students in creative cognitive processes supported opportunity identification

26	Othman, Nor	2020	The mediating effect of emotion on entrepreneurship education and business opportunity recognition	International Journal of Business and Society	3	Self report survey study showing that entrepreneurial emotion has a strong effect on the relationship between EET and business opportunity recognition. Highlights the importance of stable emotions.
27	Mathews, Robert	2021	An examination of the effect of new venture ideation exercises on entrepreneurial intentions	Entrepreneurship. Education and Pedagogy	n/a	Self report survey study that shows how entrepreneurial intent significantly increased after new venture training exercises, showing a link with self efficacy of ideation skills.
28	Saadat, Soroush	2022	The effect of entrepreneurship education on graduate students' entrepreneurial alertness and the mediating role of the entrepreneurial mindset	Education and Training	1	Self report study which assesses the impact of EE alertness, and finds the relationship to be mediated by an entrepreneurial mindset.
29	Munoz, Christian	2021	Developing opportunity - Identification capabilities in the class room: Visual evidence for changing mental frames	Academy of Management and Learning	4*	A study that shows how the development of a student's ability to identify business opportunities is underpinned by a change in their mental frames.
30	Cui, Jun	2021	The impact of entrepreneurship education on the entrepreneurial mindset of college students in China: The mediating role of inspiration and the role of educational attributes	International Journal of Management Education	1	Self report survey that considers the impact of extra-curricular activity, and curriculum attendance on an entrepreneurial mindset, including being alert to opportunities. Found that EE did not positively impact entrepreneurial mindsets.
31	Okolie, Chinonso	2021	Entrepreneurial competencies of undergraduate students: The case of universities in Nigeria.	International Journal of Management Education	1	Self report study which finds that EE has a significant effect in opportunity identification, considering in particular the effect of compulsory EET participation.
32	Costin, Yvonne	2022	Entrepreneurial Education: Maker or breaker in developing student's entrepreneurial confidence, aptitude and self-efficacy	Industry and Higher Education	1	Self report survey study that measures the impact of entrepreneurship education on confidence, self-efficacy and entrepreneurial aptitudes. Finds areas of improvements, but not in terms of idea generation.
33	Hou, Fei	2022	Entrepreneurial learning acts as a moderator impacting impact of entrepreneurial education on opportunity recognition	Frontiers in Psychology	1	Self report survey that measures a participant's level of entrepreneurial learning, suggesting this is a moderating factor influencing the extent to which opportunity recognition is a capability that can be fostered through EET programmes.

34	Tynan, Margaret	2023	The creative catalyst: Developing student competency in opportunity recognition	Industry and Higher Education	1	Structured qualitative interviews with 10 design educators in the Republic of Ireland. Found the educators to believe that programmes based on design thinking did develop students thinking and technical skills which they wouldn't then be able to move back from.
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As detailed in Table (2), the papers reviewed in this study emanate broadly evenly from the entrepreneurship literature (16 out of 34, 47%) and the management education literature (17 out of 34, 50%), with 1 publication from the psychology literature (1 out of 34, 3%). Although both the specificity of this research, and the scarcity of relevant material, required a wide ranging search of publication sources that extended beyond purely the highest ranking journals, 10 of the 34 articles (29%) were published in journals graded by the Chartered Association of Business Schools 'Academic Journal Guide (2021)' at Grades of 4\*, 4, or 3.

**Table 2 – Publications used within this Systematic Review**

<b>Entrepreneurship and Management Literature</b>	<b>Education</b>
African Journal of Management (1 article)	Academy of Management Learning and Education (3 articles)
Entrepreneurship Research Journal (1 article)	Entrepreneurship Education and Pedagogy (1 article)
Frontiers of Entrepreneurship Research (1 article)	European Journal of Training and Development (1 article)
International Journal of Entrepreneurial Behaviour and Research (1 article)	Industry and Higher Education (3 articles)
International Journal of Entrepreneurial Venturing (1 article)	Education and Training (1 article)
International Journal of Business and Society (1 article)	International Journal of Management Education (7 articles)
Journal of Business Venturing (1 article)	Innovations in Education and Teaching International (1 article)
Journal of Economic Behaviour & Organisation (1 article)	<b>Psychology</b>
Journal of Enterprising Culture (1 article)	Frontiers in psychology (1 article)
Journal of Innovation and Knowledge (1 article)	
Journal of Small Business Management (2 articles)	
Management (1 article)	
Research Handbook on entrepreneurial opportunities (1 article)	
Small Business Economics (2 articles)	

## 2.4. Thematic analysis

### Theme 1 - Does EET support entrepreneurial ideation?

At an aggregate level, the majority of the empirical studies contained within this review find a positive relationship between EET programmes and the enhancement of capabilities in opportunity identification. As detailed in Table (3), 27 of the 34 empirical studies (79%) highlight a positive impact, 2 of the 34 studies (6%) suggest a partial or mixed effect, with 5 of the 34 (15%) failing to find support for such a relationship.

Separate to the lack of uniformity in the findings, the variety of empirical approaches deployed within the study pool, also make it more difficult to draw definitive singular conclusions. As illustrated in Table (3), the studies vary significantly in: (i) the methodology they deploy, (ii) the nature of the educational intervention being assessed, (iii) the sample size with which they are engaged, and (iv) the precise independent variable that they are using in order to measure an effect. Accordingly, it would be a mistake to assume that each of the 34 empirical studies under consideration carries equal weight. In considering their empirical findings, the 34 studies are considered within three separate categories that best characterise their methodological approach: those assessing ideational outcomes, those drawing on semi-structured interviews, and those utilising self report surveys.

Within the first grouping, there are 10 studies that look to measure ideational outcomes, through either counting or grading the venture concepts that students produce post a course of EET. To this extent their findings are based on tangible outputs. With the exception of the study by Munoz *et al* (2011), which purely considers a pre and post test responses, these studies harness



experimental designs utilising separate treatment and control groups. Three studies (Costa *et al*, 2018; Karimi *et al*, 2016; DeTienne and Chandler, 2004) combine both pre and post test observations with the use of a control and treatment group. In measuring ideational outcomes, normally with the use of external raters, these studies exude a degree of collective consistency. Although this approach is not without its limitations, with opportunity identification often being observed within a narrow time period and away from a fully natural environment, the degree of methodological homogeneity of these 10 studies, allied to their focus on actual ideational outputs, allows this cohort to stake a claim to be the grouping carrying the greatest empirical weight.

Amongst this grouping, the evidence of EET interventions positively supporting OIC is strong. In their study, Munoz *et al* (2011) found that the ideational output from 12 of their 15 participants improved in studies before and after the EET intervention. Post their particular course of EET, Fiet and Patel (2008) found that those in their treatment group identified nine-fold more opportunities than those in their control group. Cohen *et al* (2021) found that 10% of the idea innovativeness in their study could be attributed directly to their educational intervention. DeTienne and Chandler (2004) recorded how the response in terms of idea production increased from a mean of 2.17 to 2.87 ( $p < 0.05$ ) post EET training, with the innovativeness score of those ideas rising from 1.46 to 2.16 ( $p < 0.01$ ). Based on their action learning intervention, Gielnik *et al* (2015) also found a significant effect from their action training programme on business opportunity identification ( $B = 0.25, P < 0.01$ ).

**Table 3 – Empirical approach within this Systematic Review**

Lead Author	Study Size	Intervention	Relevant measurement variable in this context	Effect
<b>1. Ideational outcomes</b>				
Costa, Silvia (2018)	283	Cognitive entrepreneurial training in Germany/Portugal	Assessment of business prototype viability	Positive
Cohen, Dan (2021)	149	IDEATE EE programme, ten 75 minute courses in the US.	Number and level of innovative opportunities identified	Positive
DeTienne, Dawn (2004)	130	SEEC training intervention in a western US university	Number of ideas generated, innovativeness of the ideas	Positive
Fiet, James (2008)	52	8 week course in systematic search training	Number and wealth generating potential of ideas recorded in an idea log.	Positive
Gielnik, Michael (2015)	374	12 week training programme based on action learning in two Ugandan universities	Number of ideas, number considered profitable, number pursued	Positive
Gielnik, Michael (2016)	389	STEP training programme for vocational trainees at a Uganda university	Number of ideas generated, and the self perceived quality of those ideas	Positive
Munoz, Christian (2011)	15	Students on a module at Nottingham University business school.	Number and quality of the ideas generated	Positive
Karimi, Saeid	68	Entrepreneurship courses with specific creativity exercises	Number of ideas generated, and innovativeness of ideas	Positive
Nab, Jan (2013)	23	Mandatory entrepreneurship course at Utrecht university.	Number of business opportunities, level of divergent thinking	Partial
Breslin, Dermot (2014)	70	Evolutionary education approach tested on students at Sheffield university	Number of ideas generated, and quality of the ideas generated	Negative
<b>2. Semi Structured Interviews</b>				
Nab, Jan (2014)	9	n/a	Educators perception of ability to teach opportunity identification	Positive
Tynan, Margaret (2023)	10	n/a	Educators perception of the impact of design based education	Positive
Saks, Naomi (2002)	14	n/a	Educators perception of ability to teach opportunity identification	Negative
<b>3. Self Report Measures</b>				
Levie, Jonathan (2009)	5,000	Different forms of entrepreneurship training in the UK	Assessment of whether good opportunities exist for starting a business in their area	Positive
Von Graevenitz, Georg (2010)	196	Compulsory entrepreneurship course at a German university	Students assessment of whether their opportunity recognition skills improved	Positive
Karlsson, Tomas (2013)	105	Year long entrepreneurship masters programme in Denmark.	Students assessment of 3 measures relating to their confidence in searching for ideas	Positive
Gundry, Lisa (2014)	137	Part time MBA programme in the US.	Perception of own creativity skills	Positive
Barucic, Ajka (2016)	48	University entrepreneurship education course in Bosnia/Herzegovina	4 part measure of perceived opportunity recognition capability	Positive
Lindberg, Erik (2016)	103	COPSS intervention in a Swedish university	3 part measure of perceived opportunity recognition capability.	Positive
Gielnik, Michael (2017)	27	Entrepreneurship training at a Kenya university.	A measure of entrepreneurial self-efficacy, including opportunity perception	Positive
Karimi, Saeid (2014)	205	Fundamentals of entrepreneurship at Iranian Universities	Self report scale to reflect participants opportunity identification perception	Negative
Olugbola , Seun Azeez (2017)	490	Participants on a second year entrepreneurship course in Malaysia	4 part measure of perceived opportunity recognition capability	Positive

Zulfiqar, Salman (2019)	555	Social empathy, education and training in China, India, Pakistan	3 part scale relating to opportunity alertness	Positive
Albornoz, Carlos (2017)	1,532	Mandatory entrepreneurship courses in Chile. Not just to business students.	5 part scale measuring opportunity recognition skills	Positive
Hulten, Peter (2020)	70	COPSS intervention in a Russian university management course	3 part scale relating to opportunity identification capabilities	Positive
Othman, Nor (2020)	152	152 students on a university education course in Malaysia	7 statements around opportunity recognition	Positive
Mathews, Robert (2021)	376	150 minute divergent thinking training programme in the US.	Measure of openness to experience, in response to undertaking ideation exercises.	Positive
Okolie, Chinonso (2021)	1,192	Compulsory university wide EE course in Nigeria	5 item opportunity recognition scale.	Positive
Saadat, Soroush (2022)	91	Entrepreneurship course delivered at a Iranian university	Scale of entrepreneurial alertness developed by Tang et al (2012)	Positive
Bell, Robin (2015)	27	Higher education module at a UK university	Reflective essays on how EET impacted a participant's entrepreneurial outlook.	Positive
Hou , Fei (2022)	1,150	Students who had taken entrepreneurship course at 55 Chinese universities	Likert scale measuring students assessment of their ability to identify opportunities	Positive
Lourenco, Fernando (2010)	384	Six month training course at a university in North West England	Creativity measure including perception of idea generating capability	Partial
Costin, Yvonne (2022)	23	Dedicated EE postgraduate EE programme in Ireland.	Response to the statement, ideas always come to me.	Negative
Cui, Jun (2021)	1,428	Entrepreneurship courses across 15 Chinese universities	6 part scale relating to alertness to opportunity.	Negative

Moreover, the findings from the two studies within this group that failed to show the same positive effect may also be capable of explanation. Nab *et al* (2013) found only partial support for the contention that teaching ideational heuristics flowed through to ideational outcomes, but their participant pool of 23 was far lower than the mean of 155 in this cohort of studies as a whole. Similarly where Breslin and Jones (2014) failed to find an improvement in idea production and quality, it is noteworthy that their intervention in the form of ‘evolutionary learning’ pedagogy, delivered to one treatment group in a 30 minute session, was narrower and less directly comparable to the nature of the interventions in this wider group of studies.

The second subset of studies, accounting for just 3 out of the 34 the papers in this review, concerns those whose research design involved semi-structured interviews with entrepreneurial educators. In assessing whether opportunity identification could be taught, this group of studies came to directly contradictory results. Saks and Gaglio (2002) found that 12 out the 14 educators that they interviewed, believed opportunity identification to be un-teachable. By contrast, Nab *et al* (2014) found 6 of the 8 educators in their study believed that such capabilities could be developed. Tynan (2023) similarly found the 10 educators interviewed in her research to believe that design education pedagogies can develop the attributes, behaviours and skills associated with opportunity recognition. Although these three studies contained a low number of participants, the wider context of the studies is different. The Saks and Gaglio (2002) study which failed to advance the prospect of an EET impact was conducted some 12 years before the later Nab *et al* (2014) study and 21 years before the Tynan (2023) study. It is worth noting that during this time intervening period, EET scholarship and techniques, notably those involving cognitive training and experiential learning, developed considerably.

The third and final batch of 21 studies under review relate to those who draw their findings from a student's perception of their own capabilities, typically graded on a Likert scale in response to a series of statements. The strength of this cohort lies in the population sizes, which at a mean of 633 participants, approaches four times more than the grouping which considered ideational outcomes. However, the weakness of this evidence pool remains the way in which these studies equate an effect to a person's temporal reading of their own ideational abilities, rather than any independently evaluated assessment of that actual capability.

Within these 21 self report studies, a wide range of methodologies are also in play. These differences extend beyond the scale of the population samples, or the diversity in the dependent variables being measured, as already laid out in Table (3). Some of the studies confine themselves to assessing the relationship between attendance on an EET course and a person's perceived capabilities with opportunity identification (Barucic and Umihanic, 2016; Cui *et al*, 2021; Zulfiqar *et al*, 2019; Olugbola, 2017, Hou *et al*, 2022). Others go further, using pre and post test surveys to measure the extent to which the participants believe their OIC improved post an EET intervention (Albornoz and Amoros, 2017; Costin *et al*, 2022; Nab *et al*, 2013; von Graevenitz *et al*, 2010). Some take a quasi-experimental approach, comparing the self report responses of those who have and have not undertaken a particular EET course (Karlsson and Moburg, 2013; Gielnik *et al*, 2016; Hulten and Tumunbayarova, 2020). Whilst Gielnik *et al* (2015) and Gielnik *et al* (2017) take a longitudinal approach, observing the impact of EET a participant's self reported opportunity identification capabilities over a 12 month and 32 month period respectively.

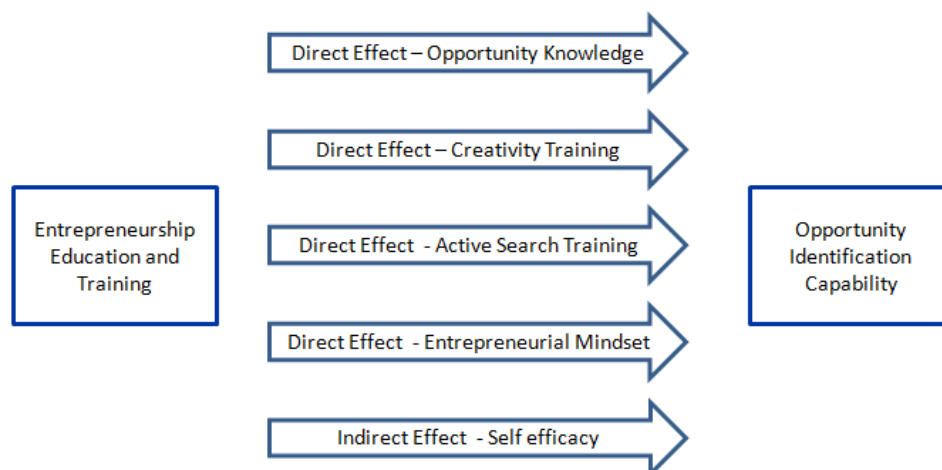
Notwithstanding the methodological differences that exist within this grouping, 17 out of the 21 studies (81%) report empirical findings which support the contention that EET advances OIC, with a further study (Lourenco and Jayawarna, 2011) concluding that a positive relationship is conditional on a person's self perception of creativity. Amongst the 3 self report studies that fail to find supporting evidence of an effect, there may again be reasons for the contrasting findings. The first of these studies (Costin *et al*, 2022) had the smallest number of participants, which at 23, was significantly below the mean of 633 mean found amongst these self report studies as a whole. The second of these studies (Karimi *et al*, 2014), itself questioned the effectiveness of the opportunity identification intervention within the EET programme experienced by its participants, suggesting that teachers may not have paid the necessary attention to fostering this competency in their classes. The other (Cui *et al*, 2021) found that compulsory curricula attendance on a Chinese entrepreneurship course did not impact upon a participant's opportunity alertness. However, the same study found that extracurricular activities, such as use of entrepreneurial games and interactions with entrepreneurs, did have a positive effect. Given that many EET courses are actually increasingly founded around these types of extracurricular activities, in a different study, it might thus be inferred that the same findings could have been used to provide support for an effect from an EET intervention.

When viewed in concert, the studies within these three groupings can largely be seen to support the contention that EET can impact positively upon opportunity identification capabilities. However, as Section 5 will develop, future research in this area would benefit from greater empirical standardisation and rigour.

## Theme 2 – How does EET support entrepreneurial ideation?

Although the majority of the empirical studies within this review evidence a supportive effect from EET on OIC, there is no common agreement as to the transmission mechanism through which that effect occurs. As detailed in Figure (4), a number of transmission mechanisms are propagated, comprised of four direct training effects, alongside a potential indirect effect that is said to emanate from enhancements in self-efficacy.

**Figure 4 – Transmission mechanisms**



The first transmission mechanism described by the studies in this review revolves around the benefits that emerge from students garnering greater knowledge around the entrepreneurial opportunity concept. Drawing on human capital theory (Becker, 1962), EET is presented as imparting specific gains in knowledge that feed into higher levels of task performance (Olugbola, 2017; Othman *et al*, 2020). Amongst these knowledge gains, Gienik *et al* (2016) point to how EET can improve understanding of the sequences involved in opportunity identification, and the importance in thinking outside the box (Gielnik *et al*, 2015). Others emphasise the benefits that flow from being able to identify a good opportunity as a result of EET delivering a better

understanding of the opportunity prototype (Nab *et al*, 2013; Costa *et al*, 2018). Whilst in a study on social entrepreneurs, EET is likened to a formal analytical tool, such that the provision of structural and experience based knowledge, allows the competitive interpretation of information and the creative location of gaps in the market (Zulfiqar *et al*, 2019).

Secondly, it is suggested that a transmission mechanism from EET to OIC emanates from the way in which EET programmes enhance the creative capacities of their learners by imparting knowledge of creative techniques and heuristics (DeTienne and Chandler, 2004; Munoz *et al*, 2011; Gundry *et al*, 2014; Karimi *et al*, 2016). For others, these benefits emanate as a consequence of students actively engaging with those creative activities, particularly through courses whose pedagogy is weighted towards action learning or experiential learning (Bell, 2015; Lindberg *et al*, 2016). Through active participation, creativity techniques are seen to transform from theoretical notions to a fresh way through which an individual perceives reality. Augmenting the validity of the educational intervention, practising these techniques is said to establish mental models that are apt for opportunity identification (Gielnik *et al*, 2016; Hulten and Tumunbayarova, 2020; Costa *et al*, 2018). Munoz *et al* (2011) use mind maps to illustrate how the development of these mental frames goes hand in hand with the development of OIC, likening these improvements to the building of an entrepreneurial asset. Tynan (2023) argues that the use of design education pedagogies can develop opportunity identification competencies by moving students from dependency to independence over time.



Thirdly, some studies tender that a direct effect arises as a consequence of EET programmes pointing students to where best to search for new opportunities (Fiet and Patel, 2008; Cohen *et al*, 2021). Conjecturing that calls just to ‘stay alert’ offer little practical guidance, these studies portray creativity training as an approach akin to ‘passive search’. Instead they proffer that novice entrepreneurs, often bereft of more specific work experience, will have greater success identifying potential opportunities when they are trained to undertake proactive search in just a few constrained areas, notably those in which they are most passionate. Proponents of this approach even intimate that the positive OIC results observed from studies considering creativity training, such as that of DeTienne and Chandler (2004), may in part be attributed to the seniority and greater work experience of that participant pool (Cohen *et al*, 2021). Stressing how opportunity discovery can’t happen without the right information, they attribute the principal training effect to come from teaching students to search for ideas in the areas where they possess the most detailed prior knowledge.

Fourthly, Saadat *et al* (2022), make the case that the relationship between EET and improvements in entrepreneurial alertness capabilities being mediated through developments in the entrepreneurial mindset. They argue that entrepreneurship education can positively change a student’s way of thinking. Rooting the entrepreneurial mindset in cognitive adjustment, they argue that this mental habit needs to be learned to take shape, such that when this is fostered through education it has a positive effect on entrepreneurial alertness.

Separate to the contentions put forward in these four direct training effects, a fifth group of studies point to OIC enhancements that develop indirectly, notably from improvements that EET

programmes can imbue in an individual's perception of their own self-efficacy (Karlsson and Moburg, 2013; Albornoz and Amoros, 2017; Gielnik *et al*, 2017). Referencing the Theory of Planned Behaviour (Ajzen, 1985), it is suggested that one of the most significant contributions from EET programmes comes from the way in which they foster positive attitudes towards the identification of entrepreneurial opportunities (Lourenco and Jayawarna, 2011). In this way, EET programmes are seen to support entrepreneurial emotion, which in turn leads people to think more proactively, flexibly, and creatively, thereby improving their OIC (Othman *et al*, 2020).

Studies advancing the case for the indirect effect of self-efficacy, argue that by enhancing a student's confidence in their own intellectual ability to identify entrepreneurial opportunities, EET programmes create a state of worthiness (Bell, 2015). Feeding through into task motivation, this makes it more likely that a student will engage actively in opportunity identification post training (Hulten and Tumunbayarova, 2020). Referencing social cognitive theory (Bandura, 1986), it is further suggested that these gains in self-efficacy act as a cognitive-motivation resource that sustains passion over time post training (Gielnik *et al*, 2017).

Between them, these five groupings illustrate a range of different conduits through which EET interventions are shown to empirically feed through into improvements in OIC. These findings should be seen as complimentary rather than competitive forms of analysis. This is acknowledged within the studies themselves. Those highlighting the potency of creativity techniques also reference the impact that these techniques simultaneously have on entrepreneurial self-efficacy (Lindberg *et al*, 2016; Gielnik *et al*, 2017). Whilst even those

advocating the merits of active search techniques, acknowledge that this approach can work as a supplement to other initiatives designed to support entrepreneurial alertness and creative discovery (Cohen *et al*, 2021).

### **Theme 3 – What contingency factors influence the impact of EET on opportunity identification?**

Having elucidated how the academic literature within this review is largely supportive of an effect between EET and entrepreneurial ideation, and tendered how that effect is transmitted, the final aspect of this thematic analysis considers those contingency factors which the extant literature suggests moderate the relationship. From the studies under review, these moderating factors can be split into two silos, those relating to the actual recipient of the training (the student), and those connected to the nature of the intervention (the course of EET).

Focussing on who is attending an EET course, a number of scholars identify how person centric factors impinge upon training outcomes. Chief amongst these are a student's affective and motivational tendencies. Costa *et al* (2018) find that the effect of EET on opportunity recognition is significantly moderated by entrepreneurial passion, such that EET has a significantly higher effect on individuals who embark on a course already possessing intense positive feelings towards entrepreneurial activities. Lourenco and Jayawarna (2011) demonstrate that those individuals who have a perception of being creative find entrepreneurship training to be easier to comprehend and use. This in turn leads them to better exploit their learning. This relationship is potentially inadvertently supported by Nab *et al* (2013), who finding only partial

evidence of a positive effect in OIC, simultaneously note how in their study, the participant's perceptions of their own creativity didn't rise post the EET intervention.

Considering other moderating factors which are specific to the participant, Hou *et al* (2022) evidence the importance of entrepreneurial learning as a boundary condition that influences the link between the fluctuating effectiveness of EET programmes and the subsequent effective engagement in opportunity recognition. They suggest that those with higher experience of entrepreneurial learning, either experiential or vivacious, will be more sensitive to changes in situations. With more cognitive resources available, it is contended that they will respond more actively to the training intervention. By contrast, research by Albornoz and Amoros (2017), suggest that the greatest gains from mandatory courses of EET come from those with less prior exposure to business. It finds the gains to be greater from those students not studying a business degree rather than those who were, from those without entrepreneurial parents or a family business background, and from those emanating from low income households.

Further filling the silo of evidence around the moderating impact of inter person variations, Gielnik *et al* (2016) suggest that a person's starting level of opportunity identification capabilities pre training, acts as a significant predictor of business opportunity identification after the training ( $B=0.33$ ,  $\beta = 0.31$ ,  $p < 0.01$ ). Nab *et al* (2014) even suggest that students for entrepreneurial courses might be selected based on starting the quality of their business ideas. Yet, even here the findings are not universal. In their earlier study, DeTienne and Chandler (2004) found that an individual's disposition to be innovative did not moderate the impact of EET training, such that those with a lesser predisposition for innovation derived the same

benefits from the training as those with a greater disposition. Meanwhile, Karlsson and Moberg (2013) found that those students entering a course of training with low levels of Entrepreneurial Self-Efficacy (ESE) gained more for the intervention than those doing so with higher levels of ESE.

The second silo within the literature pool under review points to how the impact of EET on OIC is moderated by the nature of the educational intervention itself. Research from Levie *et al* (2009) highlighted how university EET programmes had a far greater impact on opportunity recognition propensities than college or school based programmes. Although they vary in the extent to which they pursue pedagogical comparisons empirically, the majority of the 34 studies highlight the tacit benefits that emanate from education pedagogies that encourage action learning and learning by doing (Munoz *et al*, 2011, Gielnik *et al*, 2015). Thereafter the impact of EET is said to further hinge on the different ways in which these programmes are delivered, with Tynan (2023) pointing to the importance of the scaffolding used in teaching programmes, the repetition of exercises, and the use of peer challenge, in supporting structured reflection

Reiterating the live debate that exists surrounding how EET courses are precisely delivered, the studies in this review point to how positive impacts can derive from a variety of course designs. Lindberg *et al* (2016) point to the benefit of self directed learning assignments. Barucic and Umihanic (2016) reference the importance of the structure and comprehensiveness of teaching material. Tynan (2023) details how the physical layout and visual aesthetic of the learning environment support experimentation and creative freedom. Munoz *et al* (2011) guard against course designs that rely on formal written evaluations to assess their student's work. Focussing

on the person delivering the training, others suggest that the educator should take on the role of a ‘coach’ (Nab *et al*, 2014; Hulten and Tumunbayarova, 2020; Tynan, 2023), with one paper highlighting the benefits of those with previous entrepreneurial experience performing that role (Okolie *et al*, 2021).

## 2.5. Recommendations for future research

Although the number of papers focussing on EET and OIC has risen in the last five years, this remains an area of study in which the overall body of literature remains relatively light. Within the wider and deeper realm of academic research on EET programmes in general, contrasting findings around their potential efficacy, have been attributed to both empirical and conceptual inaccuracies (Nabi *et al*, 2017), and to a failure to understand the boundary conditions under which entrepreneurship education is effective (Bae *et al*, 2014; Martin *et al*, 2013). As detailed in Table (4), both of these concerns, allied to the benefit of conducting empirical investigations into the merits of individual cognitive techniques, feature in this paper’s recommendations for future research around EET and OIC.

**Table 4 – Recommendations for future research**

<b>Future empirical designs</b>
1 Greater emphasis on experimental designs
2 Increased clarity and definition around EET interventions
3 Longitudinal approaches
4 Emphasis on the study of unfolding effects
<b>The potency of particular cognitive techniques</b>
5 Measuring the impact of individual cognitive techniques
<b>Boundary conditions</b>
6 Understanding the personal features of those who benefit most from EET
7 Exploring the effectiveness of different modes of EET delivery

### 2.5.1 Future empirical designs

As detailed in Section (4), existing empirical research on EET and OIC exudes a diversity of empirical rigour. Research into EET and OIC, just as with EET research in general (Von Graevenitz *et al*, 2010), also fails to consolidate around any singular defined methodology or build upon one conceptual model. Echoing the calls made in the wider EET literature (Carpenter, 2022), empirical studies on OIC would benefit from a qualitative grading so to highlight the strongest sources of evidence. Allied to the benefits of such a grading, this study further makes four recommendations in relation to the design of future empirical research in this area.

Firstly, when looking to measure the impact of EET interventions, it is recommended that future research prioritises the measurement of changes that occur in tangible ideational outputs, either through pre or post test designs, or by the use of experimental treatment and control groups. This approach avoids methodological strength being compromised by subjective measures (Nabi *et al*, 2017). Moreover, by moving towards a greater focus on ideational outputs, the field would then gravitate towards a narrower portfolio of independent variables, allowing for greater comparisons in the unfolding research. Within that context, future research should also ensure that it selects the measures that are most apt for the aims of the study in question. For example, the volume of ideas being generated is apt for research into capabilities with ideational fluency (Ames and Runco, 2005). Measures of idea innovativeness are the most relevant to research considering the spawning of high growth entities (Angulo-Guerrero *et al*, 2017). Whilst for those reflecting on what best constitutes an achievable and meaningful outcome for many EET

participants, the perceived usefulness and achievability of an idea may be the most relevant indicator (Suroso *et al*, 2010).

Secondly, there is a case for future empirical designs to be more explicit about the nature of the educational intervention whose effects they are investigating. A primary challenge within the extant research is the notion that educational intervention is monolithic (Piperlous, 2012). Yet as the 34 studies within this review show, EET interventions range considerably in terms of their pedagogical philosophy, techniques, and even basic duration. Too often a course in entrepreneurship can be whatever an instructor wants it to be (Morris, 2013). Through the use of a shared lexicon, future studies should more adequately describe the pedagogies that they are testing such that it becomes easier to compare effects from like for like interventions (Pittaway and Edwards, 2012; Rideout and Gray, 2013). These distinctions would also help elucidate those EET interventions that have the greatest effect.

The need for empirical studies in this area to better define the variables under consideration also extends to the make-up of both the population pool in receipt of the educational intervention, and the educational institutions involved in delivering it. Findings from elite private colleges in America may well differ from large public institutions in Europe (Lüthje and Franke, 2002), or entrepreneurship courses delivered in China through a more didactic learning based approach (Cui *et al*, 2019). With EET programmes becoming ever more diffused across a range of different campuses, the recipients are themselves ever more diverse in terms of their demographics, prior entrepreneurial exposure, and commitment (Hahn *et al*, 2017). Being clear as to who is receiving the training would once again allow better like for like comparisons to be



drawn, in turn shedding light on the participant groupings that would most benefit from EET intervention. Without such clarity, the heterogeneous profiles of the students may only otherwise continue to explain a pattern of heterogeneous results (Martin *et al*, 2013; Naia *et al*, 2014).

Thirdly, future empirical designs should focus more explicitly on the long term sustainability of EET interventions, not least as there remain questions as to the durability of idea generating exercises (Assenza and Western, 2017). Given that many students may not embark on venture creation activities for a number of years after their university education ends, these longitudinal assessments matter. A previous wider meta-analysis into EET research noted that only 4 out of 42 studies measured the effects of EET programmes beyond short term outcomes (Martin *et al*, 2013). Amongst the 34 studies reviewed within this research on OIC, only two (Gielnik *et al*, 2015; Gielnik *et al*, 2017) looked at the associated impact of the effect over time.

Avoiding the problems with short term time frames that transpire from studies measuring outcomes purely at the end of a particular ideational exercise, future empirical studies could compare the number of viable ideas that an individual student had at the start, and then the end, of a full course of entrepreneurship education. Alternatively, giving educational theory the chance to blend further with real life business experience, future empirical studies might choose to track ideational performance some six months or twelve months after a course had finished. Once again using treatment and control groups, this form of longitudinal analysis would further advance understanding as to the extent to which entrepreneurship education is causal and beneficial to the subsequent entrepreneurship practice.

Finally in terms of future empirical designs, the field would benefit from studies that are able to illuminate how enhancements in opportunity identification capabilities are actually manifested. Amongst the 34 studies covered in this review, only one took a turning down this particular highway, as it deployed the use of mind-maps (Munoz *et al*, 2011). Going forward there is the potential for a broadening in research designs such that they include in depth interviews and verbal protocol analysis to elucidate changes occurring real time in the mindset of the student. Such an approach may also shed light on how opportunity identification capabilities develop at different points during an EET intervention, and in the context of a group learning environment, demonstrate the extent to which that capability is influenced through interactions with other participants.

### **2.5.2 The potency of particular cognitive techniques**

The empirical studies considered in this review highlight a number of different transmission mechanisms between EET and OIC. However, within that extant body of research, there is a notable absence of empirical investigations into the merits of training entrepreneurship students in one particular cognitive technique or heuristic. Indeed, within the 34 studies under review, active search is really the only technique that is subjected to singular statistical analysis.

Although opportunity identification has been likened to a domain-specific form of creativity, one whose core competencies are interlinked with the application of creativity heuristics (Amabile, 1996), there is a dearth of EET studies investigating the impact of teaching particular creative techniques on OIC. This is again something of a surprise, not least given that creative self

efficacy is suggested as being more potent in opportunity identification than wider entrepreneurial self-efficacy (Sobakinova *et al*, 2019).

The lack of empirical studies investigating the impact of EET interventions that focus upon particular cognitive techniques, contrasts with the conceptual approach taken in the literature. It has previously been advanced that novice entrepreneurs could be trained to be more successful in recognising opportunities through pattern recognition (Baron, 2004). It was propagated that such training was feasible, first by developing prototypes which illustrated how to search for connections in changing situations (such as demographic changes and the restaurant industry), and second by mirroring an experienced entrepreneur's knowledge of exemplars by using EET to provide students with exposure to a wide range of business opportunities. Yet in the two decades since Baron's original contention, it remains empirically untested.

More recently scholars have suggested that the ill-defined nature of entrepreneurial problems lies at odds with more traditional educational expectations that involve well defined processes, geared to reaching a single answer with guidance from instructors. Instead they suggest that design thinking techniques represent a better paradigm through which EET can enhance OIC. Conceptually, it has therefore been advanced that students would benefit from being instructed in a whole range of specific cognitive skills, such as abductive reasoning, analogical reasoning, framing, and mental simulation (Garbuio *et al*, 2018). Yet once again, the individual potency of each of these individual cognitive approaches through EET remains empirically unproven.

That same lack of empirical investigation extends to the exploration of meta-cognition, another aspect of the entrepreneurial mindset considered central to opportunity recognition (Hulten and Tumunbayarova, 2020). The development of meta-cognitive mechanisms is said to aid the transfer of knowledge across domains (Flavell, 1987), such that meta-cognitive awareness can facilitate opportunity recognition within an uncertain and dynamic context (Haynie *et al*, 2010). Meta-cognition is presented, not as a dispositional trait, but as a learned process, which can be enhanced through training (Schmidt and Ford, 2003). In the past, empirical analysis has reflected on the extent to which meta-cognitive training in an EET course supports the effective evaluation of profitable opportunities (Haynie *et al*, 2004), but as yet, no such analysis has been undertaken to consider its impact on the proceeding act of opportunity identification.

With opportunity identification being portrayed as an inherently creative activity (Hansen *et al*, 2011), future academic scholarship would benefit from empirical research to understand the extent to which training students in many of these respective techniques feeds through into medium term outcomes in terms of entrepreneurial ideation. Where such effects are proven, it would strengthen the case for these techniques to be put at the heart of future programme designs.

### **2.5.3 Boundary conditions**

As detailed in Section (4), empirical studies have already explored some of the boundary conditions that moderate the potential efficacy of EET interventions on OIC. This has included studies considering the role of entrepreneurial passion (Costa *et al*, 2018, Gielnik *et al*, 2017) and on a student's perception of their own creative capabilities (Lourenco and Jayawarna, 2011). Yet

when it comes to OIC, there remains much to still understand in relation to the questions first posed by Rideout and Gray (2013) in terms of who EET is best delivered by, in what type of university, to what type of student, with what type of goal, and in what set of circumstances. Developing empirical answers to these questions would seem directly relevant to how and to whom courses on opportunity identification are offered in the future (Pittaway and Cope, 2007).

With the success of EET programmes said to be largely dependent on the nature of the learner (Béchar and Grégoire 2005), future empirical research needs to understand who benefits most from training in OIC. This goes further than exploring affective tendencies. Innate characteristics, whether in the form of a genetic openness to experience (Nicolaou *et al*, 2009) or a person's level of different cognitive capabilities, also impact on OIC. Yet, there remains little clarity on whether it is those with the highest or lowest starting levels of these capabilities, that are the ones who benefit most from training in opportunity identification, and who arguably therefore represent the cohort upon whom such courses should be focussed.

Taking this one step further, conceptually it has been suggested that every individual has their own learning style (Dutta and Crossan 2005), with this style said to impact on a person's ability to respond to training in the identification of opportunities (Corbett, 2007). It has been tendered that entrepreneurship courses looking at entrepreneurial opportunity recognition should be tailored differently for those whose cognitive styles are either intuitive or analytical (Molaei *et al*, 2014). Yet once again, there remains a dearth of empirical investigations to illustrate this contention, one that if proven, could again have a notable impact in the way that EET programmes are best personalised and delivered in the future.

Developing on that theme, it would be beneficial for future empirical research to understand the extent to which the actual delivery of EET courses impacts on OIC. Outside those studies referencing overarching pedagogies, or those considering the design of actual physical spaces in business schools (Pittaway *et al*, 2019), there is only limited empirical research into the impact of different educational techniques or educators. Various it has been suggested that the innovativeness and risk taking nature of the teacher (Peltonen, 2015), their passion (Wu and Jung, 2008), and their ability to act as a role model for their students (Ruskovaara and Pihkala, 2013), can all have a material impact on learning outcomes. Yet the extent to which the individual educator moderates a student's ability to benefit from EET in the context of opportunity identification appears statistically untested. To gauge such an impact, future research should look to observe the results in OIC that are obtained from different individuals, delivering the same course content to a similar cohort of students.

Beyond the moderating impact of the educator his or herself, there would also be merit in understanding the extent to which different educational environments moderate the effectiveness of EET on OIC. With digital technology characterised as an external enabler (Nambissan and Shaker, 2017) and a tool to help students research and create more ideas (Ozgen, 2022), it would be informative to understand the comparative differences that emanate from courses which more fully engage with digital infrastructure. Similarly, where the involvement in business and university based incubators is said to provide students with a 'community of practice' (Lave and Wenger, 1991) and support 'learning by doing' (Refai and Klapper, 2016), it would again be instructive to observe the extent to which this exposure moderates the impact of EET on OIC. In

considering the nature of the education intervention, future empirical research could also extend to consider variables such as the number of students on a course, if a programme was elective or mandatory, and whether a student's enjoyment rating of their learning experience, moderated its impact.

## **2.6. Conclusion**

The aim of this systematic review has been to contribute to the literature by identifying and synthesising past empirical research into the impact of EET interventions on OIC. Having done so, it has considered ways through which future empirical study could both be enhanced and beneficially extended. Given that so many of the publications within this review are weighted to the last few years, the potential impact of EET programmes upon opportunity identification capabilities appears to be a matter of growing interest to the field. Accordingly, the timing of these recommendations is becoming more apt.

The focus of this study has not extended to consider the potential by-products of ideational training. As such, it has not diversified into the auxiliary debate as to whether ideational training, supports entrepreneurial ambitions (Molaei *et al*, 2014; Mathews *et al*, 2021; Seun and Kalsom, 2015), or suppresses them (Piperopoulos, 2012, Oosterbeck *et al*, 2010). Instead the focus has been on the extent to which this particular subset of entrepreneurial capabilities can be developed by education and training. This focus has implications for two of entrepreneurship scholarship's most central questions, firstly why some individuals perform better at opportunity recognition than others (Shane and Venkatramam, 2000), and secondly on the extent to which future entrepreneurs can be actively developed (Drucker, 1985).

In the past it has been suggested that individuals interested in becoming entrepreneurs should be trained in opportunity recognition, before they are taught other technical competencies (Pittaway and Cope 2007). The empirical data reviewed in this study points to the efficacy of EET interventions in supporting OIC. This applies in particular to the cohort of studies that specifically measure the impact of EET on actual ideational outcomes. Concentrating on the fuzzy front end of entrepreneurial ideas, this review reaffirms the legitimacy of entrepreneurship education as a discipline (Katz 2008; Kuratko, 2005). Set against the two aforementioned central questions in entrepreneurship research, those empirical studies considering EET and OIC, suggest that entrepreneurs can both be taught this capability, and that the possession of knowledge and confidence in how to undertake this particular task, can act as a differentiator between people. However, as has been detailed, the current results are also somewhat fledgling and ill defined, with a number of aspects in need of further confirmation.

Against this background, and with the successful ideas described as the ‘lifeblood of entrepreneurship’ (Ward, 2004), further empirical exploration around the question of EET and OIC, would certainly appear to constitute a worthwhile undertaking.



### **3. Paper 2 - What has intelligence got to do with it? – The importance of executive functioning capabilities to the conception of high quality New Venture Ideas.**

#### **Abstract**

Extant entrepreneurship research focusses heavily on how different sources of prior knowledge constitute important antecedents in the generation of New Venture Ideas (NVIs). Yet as people engage in creative cognition at the start of the entrepreneurial journey, rather less consideration has been directed onto how potent pieces of prior knowledge actually become the focus of internal cognitive attention. In the last decade, creativity researchers have attributed greater weight to those aspects of intelligence relating to executive functioning. Drawing on these developing interdisciplinary insights, this paper develops entrepreneurship theory by highlighting how cognitive capabilities that facilitate the control of attention constitute an important source of inter person differences when undertaking entrepreneurial ideation. Its empirical study measured the cognitive capabilities of 110 novice entrepreneurs in tandem with their ability to generate high quality NVIs. It found there to be a notable relationship between aptitudes in intellectual fluidity and memory retrieval with the subsequent ability to generate New Venture Ideas that were high in quality.

#### **Keywords**

New Venture Ideas, opportunity recognition, entrepreneurial cognition, creativity, fluid intelligence, memory retrieval.

#### **3.1. Introduction**

High quality New Venture Ideas (NVIs) lead to tangible outcomes that improve the conditions and convenience of everyday life. With a New Venture Idea (NVI) representing the first candidate idea for a new product, a fresh service, or an alternative means of production

(Birkinshaw and Hill, 2007), conceiving an NVI sits at the start of the process of entrepreneurial opportunity recognition. Although this first moment of ideation is just a fleeting component of a far longer entrepreneurial journey, the quality of the initial conception inevitably has a bearing on what follows. Those possessing ideas that are higher in quality are more likely to launch ventures that possess greater strategic and financial potential (Kavanagh and Hisrich, 2010), a differentiated competitive advantage (Shepherd and DeTienne, 2005), and a first mover advantage (Dahlqvist and Wikland 2012). Accordingly, research into how New Venture Ideas first transpire, and what impacts upon their quality, is central to the wider study of entrepreneurship (Baron, 2004).

One of the most sustained findings from extant entrepreneurship research is that some people perform better at identifying entrepreneurial opportunities than others (Alvarez and Busenitz, 2001). This body of work has drawn heavily on the theory of entrepreneurial cognition, such that entrepreneurial behaviour is seen to be influenced by mental processes (Mitchell *et al*, 2002). What an individual thinks, says, and does, is said to flow from the mechanisms through which that person acquires, stores, transforms, and uses information (Baron, 2004). Nonetheless, entrepreneurship theorists still struggle to describe the ‘fuzzy front-end’ at the start of the entrepreneurial journey (Packard and Burnham, 2021), with research into the cognitive antecedents of high quality entrepreneurial ideation regularly characterised as sparse (Kier and McMullen, 2018).

Previous entrepreneurship research has majored heavily on the importance of prior knowledge as the core cognitive resource in the identification of entrepreneurial opportunities (Grégoire *et al*,

2010), one that provides entrepreneurs with the insights to synthesise information in a way that facilitates opportunity recognition (Casson, 2005; Vaghely and Julien 2010). In garnering that information, entrepreneurship scholarship has focussed on the way in which people obtain prior knowledge, its various formats (Shane, 2000), and the importance of behavioural traits such as the tendency to question, observe and experiment (Dyer *et al.*, 2008). Similarly, it has mused upon the contribution of varying emotions and affect, whether that be sleep (Gish *et al.*, 2019), entrepreneurial intent (Zhao and Seibert, 2006), or passion (Cardon *et al.*, 2009), in empowering the subjective insights and energised behaviour that support the use of that knowledge to identify opportunities.

To date though, rather less scholarly attention has been directed upon the actual cognitive capabilities that facilitate people in identifying, connecting and utilising the prior knowledge that they have at their disposal. In particular, there is a dearth of entrepreneurship research considering how the most potent aspects of prior knowledge become the focus of attention during the course of entrepreneurial ideation. Scholars looking to outline a conceptual framework for a neuro-cognitive perspective on entrepreneurial opportunity recognition have stressed the importance of the workings of the brain as the foundation of human decision making (de Holan, 2014, Beugre 2017). It has been conceptually suggested that intelligence lies behind the identification of entrepreneurial opportunities (Shane, 2003; Baron and Ensley, 2006; Koellinger, 2008; de Wit and Winden, 1989), such that it allows people to make superior use of the information that they possess (Archdichvilli *et al.*, 2003; Casson, 2005; Grégoire *et al.*, 2011). Yet in general, the impact that cognitive capabilities have on controlling attention during the creative process remains a theoretically uncharted chamber within the wider cave structure of

entrepreneurial cognition. Indeed the only previous empirical foray into this territory, found a person's level of general mental awareness not to influence the quantity of entrepreneurial opportunities being generated (Gielnik *et al.*, 2014).

Peering into this largely empty cavern, this paper draws on the *theory of controlled attention* that has recently emerged from cognitive science (Gilhooly *et al.*, 2007; Nusbaum and Silvia, 2011). This developing theory proffers that the quality of creative ideas is influenced by levels of cognitive capabilities, particularly those capabilities in executive functioning which allow the top down control over attention and cognition. Executive functioning capabilities have been characterised as the mental processes which it make it possible to play with ideas and to meet novel and unanticipated challenges (Diamond, 2013). It is a theoretical lens that has particular salience for those entrepreneurship scholars seeking to identify the antecedents of quality entrepreneurial ideation, because rather than simply deliberating on the number of ideas generated, its focus is very much on the qualitative aspect of the creative output.

Seeking to extend understanding on the cognitive micro-foundations that lie behind the generation of high quality NVIs, this study makes three main contributions to entrepreneurship research. Firstly, it offers fresh theoretical insights which highlight the importance of understanding not just the sources of prior knowledge, but of the mind's ability to cognitively access potent knowledge, when conceiving NVIs. In this way it contends that an individual's capabilities in executive functioning constitute an important cognitive antecedent of entrepreneurial ideation. Secondly, in separately investigating the impact that these cognitive capabilities have on different elements of NVI quality, such as novelty and appropriability, this

research picks up on the recent call to observe the impact on NVI quality at a more granular level. It therefore adds to the emerging body of literature exploring the qualitative aspects of NVIs. Thirdly, in empirically assessing its contentions, this study contributes to our wider understanding of the role played by intelligence, and in particular by the different component aspects of general intelligence, as sources of inter-person differences during the first stages of the entrepreneurial journey.

This paper develops as follows. It begins by developing its theoretical contention as to how cognitive aptitudes with executive functioning support entrepreneurial ideation, thereby feeding through into the generation of ideational outputs that are higher in quality. It then outlines the methodology that it uses to test these related hypotheses, before detailing its findings and reviewing their significance. It concludes by considering the potential limitations of its investigation and making some recommendations for further research.

### **3.2. Theoretical background**

In the identification of entrepreneurial opportunities, individuals typically respond to problems that they encounter (Amabile, 1997). Whether it be in response to a set of particular customer needs, or in reaction to the operating pains of a market or business process, entrepreneurs deploy creative cognition in the search for possible solutions to these identified problems (Karimi *et al*, 2014). In generating potential candidate solutions, a person's creative thinking is regularly characterised as divergent, such that rather than involving a single and obvious solution, it is open ended (Amabile and Mueller, 2008). The product of that ideation is a New Venture Idea, one whose quality is typically characterised by its novelty, and its appropriability, namely the

chance that someone would be able to capture returns from their idea (Davidsson and Tonelli, 2013).

Within the current body of entrepreneurship scholarship, considerable weight has been attributed to the way in which prior knowledge forms the building blocks that empower creative thinking (Shane, 2000). As entrepreneurs ideate to bridge a customer or market problem, with the subsequent identification of a potential high quality entrepreneurial solution, prior knowledge has been described as the core cognitive resource in the process (Grégoire *et al*, 2010). Academic columns have hitherto mused at length as to how stocks of valuable prior knowledge develop, whether that be through social networks (Singh, 2000), education (Ardichvili *et al*, 2003), cross cultural travel (Vandor and Franke, 2016), accumulated work experience (Gabrielson and Politis, 2012), or simply the idiosyncratic professional and social contexts in which people live and operate (Cooper and Park, 2008). Yet although potent knowledge can sometimes be accessed inadvertently through uncontrolled mind wandering (Tang *et al*, 2012 ), or encountered serendipitously in the environment (Dew, 2009), far less column ink has been dedicated to the particular cognitive capabilities that support potent knowledge in becoming the focus of attention as someone looks to generate a New Venture Idea.

During the last decade, cognitive research has increased its focus on the mechanisms of internally driven cognition. Distinct from cognition that is not specifically goal directed such as unintentional day dreaming, cognition that requires constant external attention like reading, or cognition that involves a constructive memory process such as with mental arithmetic (Benedek and Fink, 2019), creative cognition has its own specific cognitive antecedents. Within this

context, the newly emerging *theory of controlled-attention* has paired the attainment of creative quality with a person's executive functioning capabilities (Beaty et al., 2016; Benedek and Jauk, 2019; Chrysikou, 2018). Facilitating top-down attentional control, executive functioning has been described as the control processes which regulate and empower goal directed thought as someone undertakes a novel task (Eslinger, 1996; Zelazo et al., 2004).

Building on these emerging cognitive insights, this current study draws on the *theory of controlled attention* to develop entrepreneurship theory around the identification of entrepreneurial opportunities. It proffers that innate individual level differences in executive functioning capabilities directly influence the efficacy of creative cognition, and thereby constitute an important inter person differentiator in the capability to identify NVIs that are high in quality.

Historically within wider creative scholarship, only limited attention was directed to the potential for executive functioning capabilities to influence the quality of creative ideation. Creative differences between individuals were instead related to the general organisation of memory and differing structures of knowledge (Weisberg, 2006). Even at the start of the twenty first century, empirical studies continued to suggest that there was only a modest overlap between creativity and intelligence (Kim, 2005). The dominant view of creativity was of an associative process in which one idea cued into a series of further connected ideas (Wallach and Kogan, 1965). *Associative theory* suggested that creative ideas arose spontaneously through a series of associative processes unfolding in semantic memory (Bowden et al, 2005). Creativity was seen as being derived from associative hierarchies that were flat, ones that afforded quick access to a

range of loose conceptual connections (Mednick, 1962). As associations spread out to reach more distal concepts, higher quality creative solutions were perceived to emerge.

Within the last decade, that prevailing cognitive view about the distance between intelligence and creativity has though come under challenge (Benedek *et al.*, 2013). Early research designs were accused of confounding fluency, in terms of the volume of creative responses that were returned, with the quality and originality of what was engendered (Nusbaum and Silvia, 2011). The notion of a ‘serial order effect’, one whereby the creative quality of ideas was said to increase over time, and which had previously buttressed associative theories, also came into question. New studies highlighted how the quality of ideas conceived early in the creative process, remained on a par with those generated later in the piece (Gilhooly *et al.*, 2007; Beaty and Silvia, 2012). The notion of a ‘threshold effect’ was instead put forward, one in which a basic level of IQ was considered a necessary condition to facilitate creativity (Jauk *et al.*, 2013). Those aspects of intelligence associated with executive functioning skills were shown to be directly predictive of ideational novelty (Benedek *et al.*, 2012).

Where creativity had previously been presented as something more passive, the theory of ‘*controlled-attention*’ now linked creative quality to those executive functions that supported top down control over attention and cognition (Gilhooly *et al.*, 2007; Nusbaum and Silvia 2011). During the last decade, these contentions have been further bolstered by neuro-imaging studies that have connected creativity to strong levels of activation in those prefrontal brain regions known to be implicated in executive functions and inhibitory control (Dietrich and Kanso, 2010; Houde *et al.*, 2010; Benedek *et al.*, 2014; Xu *et al.*, 2015; Beaty *et al.*, 2016; Frith *et al.*, 2020).



In the ideation of NVIs that are high in quality, it is theoretically contended that there are two primary means through which executive functioning capabilities, manifest themselves as important person-centric cognitive antecedents behind the generation of quality entrepreneurial ideas.

Firstly, executive functioning capabilities allow the mind to direct and maintain attention towards the creative purpose at hand (Benedek *et al.*, 2020), to suppress knowledge which is unoriginal (Dietrich and Kanso, 2010), and to challenge the stability of existing cognitive structures or cause-effect relationships. When an impasse is reached in trying to solve the customer or market problem at hand, these executive functioning capabilities support the mind in switching between semantic categories in memory (Unsworth, Spillers and Brewer, 2011) and in beneficially determining what is brought into the creative process (Nusbaum and Silvia, 2011; Beaty and Silvia, 2012; Benedek *et al.*, 2012).

Secondly, these executive functioning capabilities drive internal cognition such that they support the strategic search of memory through the generation and maintenance of retrieval cues. In the ideation of entrepreneurial opportunities, past scholarship has pointed to the value of having an aptitude for cognitive search (Hsieh *et al.*, 2007), and on the importance of being able to trigger apposite knowledge activation from long term memory (Baron, 2014; Althuisen and Wirenga, 2014). Given that the creation of fresh knowledge is said to be a function of new information brought into consideration (Schilling and Green, 2011; Acar and Van den Ende, 2016), simply exploring familiar bodies of knowledge soon exhausts itself as a source of novel NVIs. In this

way, a person's executive functioning capabilities influence the number of re-combinatorial possibilities and quality associations that they arrive upon (Hennessey and Amabile, 2010), simultaneously activating a mindset that allows people to avoid people becoming entrapped in inefficient local optima (Gavetti and Levinthal, 2000).

In operationalising the contention that executive functioning capabilities are overlooked cognitive antecedents in the generation of high quality NVIs, this study focusses on the dual variables of intellectual fluidity (gf) and memory retrieval (gr). Located as broad abilities or second level stratum within the Cattell–Horn–Carroll (CHC) theory on the structure of human cognitive abilities (Cattell, 1963; Horn and Cattell, 1966; Schneider and McGrew, 2012), intellectual fluidity and memory retrieval have both been classified as domain independent components of general intelligence. Within recent creative writings, these are the two components of general intelligence that are most regularly used to measure a person's executive functioning capabilities, with both being considered central to the *theory of controlled attention* (Beaty and Silvia, 2012).

*Fluid intelligence* (gf) is the capability that allows the mind to deliberately control attention, to think flexibly, and to draw inferences that are independent of prior knowledge or previously learned habits, schemas and scripts. Cognitive studies have shown the significance of the effect from fluid intelligence on creative quality to remain large even when the Big 5 factors of personality are added to the model (Beaty and Silvia, 2012). Where in the interests of efficiency, the brain is tuned to focus on common associations, fluid intelligence is what allows people to exert cognitive control over their attention and thought (Vartanian *et al*, 2018), to keep the

creative goal in mind (Beatty and Silvia, 2012), to direct thought processes away from the most obvious connections (Cassotti, et al, 2016), and to reject that which is inapt (Zabelina and Robinson, 2010).

*Hypothesis 1 – Those with higher levels of fluid intelligence capabilities will prove more successful in conceiving high quality New Venture Ideas, than those with lower levels of fluid intelligence.*

*Memory retrieval* (gr) represents the capacity to extract knowledge from long term memory. Rather than simply relating to information that is present in working memory, memory retrieval capabilities allow a person to recall information which has existed out of immediate awareness for such a length of time, that its contents have been completely displaced (Schneider and McGrew, 2012). Memory retrieval capabilities provoke breakthrough idea generation by igniting remote associations and utilising connections that are atypical (Schilling, 2005). Introducing otherwise hidden, but highly relevant, candidate knowledge into cognitive deliberations, it is advanced that an aptitude in memory retrieval underpins access to potent knowledge, leading to the generation of NVIs that are disproportionately high in novelty and appropriateness.

*Hypothesis 2 – Those with higher levels of memory retrieval capabilities will prove more successful in conceiving high quality New Venture Ideas than those with lower capabilities in memory retrieval.*

Although they are categorised as separate aspects of general intelligence (g), it is further suggested that there will be a symbiotic, and mutually beneficial, relationship between the joint existence of high capabilities in intellectual fluidity (gf) and memory retrieval (gr) in the

generation of high quality NVIs. Through the effective setting of strategies, intellectual fluidity helps to guide the initial act of memory retrieval. At the same time, strong capabilities in memory retrieval, allow the mind to better identify sources of information that are hidden beyond immediate awareness in long term memory. In doing so they feed in more potent pieces of knowledge, resources from which a capability in intellectual fluidity can subsequently draw upon when generating enhanced inferences. This inter-relationship has been shown to be particularly powerful with thought processes that generate original associations and bi-associations (Benendek *et al*, 2020). Accordingly, it is advanced that there will be an interaction effect between these different aspects of intelligence, such that there is a potential synergetic effect on NVI quality, when high levels of the two separate capabilities (gr, and gf) are present in tandem.

*Hypothesis 3 – Those with higher levels of both intellectual fluidity and memory retrieval capabilities will prove more successful in conceiving high quality New Venture Ideas than those with lower capabilities in both intellectual fluidity and memory retrieval.*

### **3.3. Methodology**

#### **3.3.1. Research sample**

In testing its hypotheses, this study garnered its participant pool, totalling some 110 individuals, from a mixture of undergraduate and masters students at the University of Essex Business School in England. In this sense, the size of the study is broadly comparable to other entrepreneurship studies measuring ideational outcomes (Fiet and Patel (2008) – 52 participants; Breslin and Jones (2014) – 70 participants; Gielnik *et al* (2014) – 100 participants; Cohen *et al* (2021) – 149 participants). The study was advertised to students and they were voluntarily invited to participate. Those who did so were paid £20 for an hour of their time. Participating individuals

were on average 24.0 years old (sd of 5.55); 52% were male and 48 % female; 34% were studying for a first degree, 41% had obtained a Bachelors degree, and 25% had already obtained a Masters degree.

In the past, some entrepreneurship scholars have expressed caution as to the merits of using recent graduates and undergraduates within business research. It is argued that a participant body comprised of students differs too significantly from that of practising entrepreneurs, and thereby undermines the external validity of an associated study (Stevens, 2011). Yet in the context of this particular research, it is tendered that such concerns are not authenticated.

The act of conceiving NVIs is not an activity that is simply confined to practising entrepreneurs. It is available to anyone within the general population, and in particular incorporates first time company founders and novice entrepreneurs, a population to which university entrepreneurship students are adequately said to reflect (McGee *et al.*, 2009). Indeed, within this particular study, the median participant score in response to the question, “I am determined to create a firm and set up a business in the future”, measured on a Likert scale of 1 to 7 (with 7 being ‘Strongly Agree’, and 1 being ‘Strongly Disagree’) was 6.0. Although the fact that one participant (0.9%) rated themselves as a 2 (ie: that they disagreed with the idea that they were determined to create a firm in the future), and seven participants (6.3%) rated themselves as 3 (ie: that they slightly disagreed with the idea that they were determined to create a firm in the future), could be considered as a limitation with this study, it is tendered that the overall entrepreneurial intent of the research sample as a whole was nonetheless particularly high. Moreover, in terms of the objectives of this research, using a student cohort also had very deliberate advantages. It served

to diminish individual level variations such as age and education. With the students lacking previous professional experience it minimised the effect of familiarity with past business failure or success (Arentz *et al.*, 2013)

### **3.3.2 Data collection processes**

Undertaken during the course of 2020 and 2021, the timing of this study coincided with the global Coronavirus pandemic. Data research sessions were executed on a one to one basis with the researcher, but reflective of the societal desire to minimize face to face interaction during this period, they were conducted remotely using the Zoom technology platform.

During the course of each session, participants undertook two separate tests to assess their capabilities in terms of intellectual fluidity and memory retrieval. They were then each presented with vignettes of the same four business opportunity situations, and asked to ideate for potential new venture ideas in each case. The participants were finally asked a small number of control questions. The individual session with each of the 110 participants lasted approximately 60 minutes.

### **3.3.3 Measures**

#### **3.3.3.1 Fluid intelligence**

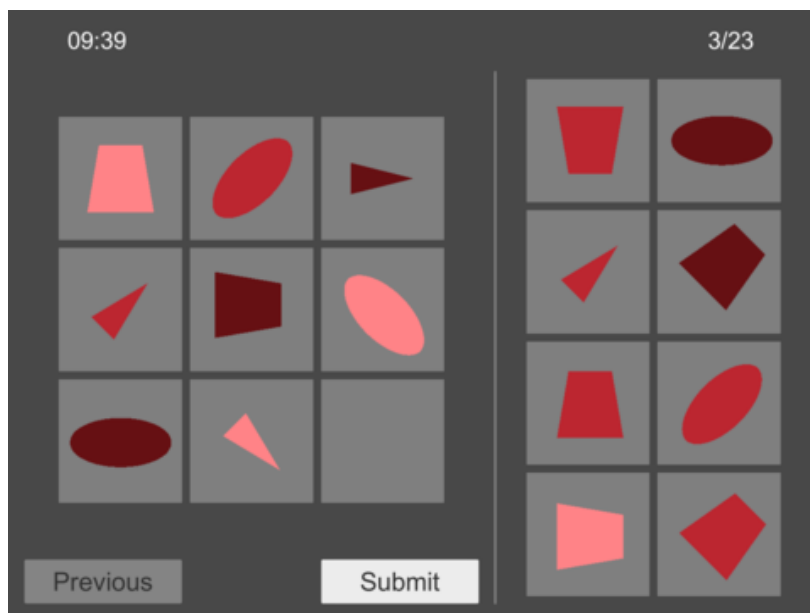
During the course of each research session, participants were assessed for their capabilities in terms of fluid intelligence (gf). Fluid intelligence is not dependent on pre-existing knowledge and is linked to reasoning and problem solving capabilities (Cattell, 1963). For the purposes of this enquiry, intellectual fluidity was measured through the 'University of California Matrix

Reasoning Task' (UCMRT), a non verbal and abstract problem-solving test designed to specifically measure fluid intelligence.

Levels of intellectual fluidity have traditionally been measured through the Ravens Advanced Matrices Test (Carpenter, Just, and Shell, 1990). However, with the Ravens Advanced Matrices Test often requiring an hour to complete in its own right, that method of appraisal was considered problematic within the confines of this study. With the wider results from UCMRT tests having shown themselves to be comparable with the Ravens Advanced Matrices Test (Pahor *et al.*, 2019), the decision to utilise the UCMRT system lay in its shorter overall administration time of 12-15 minutes, and the fact that it was self-administrable online, thereby allowing for remote testing during the coronavirus pandemic.

Accordingly through the Zoom chat functionality, participants were provided with a link to a website hosted by the University of California Riverside. Each person was conferred a unique participant ID number, which they entered into UCMRT system, thereby enabling their performance to be linked to other components in this study. At the start of UCMRT assessment, participants spent a few minutes engaging with a number of practice questions imparted through the system. In the timed test that followed, participants had ten minutes to complete 23 multiple choice questions. As per the example question showed in Figure (1), the format of this test required participants to select from a series of shapes that best fitted the gap in a particular pattern grid. A high score represented strong capabilities in terms of intellectual fluidity. The participant scores ranged from 2 to 18, with a mean of 10.42 (sd of 3.51).

*Figure 5 – UCMRT ScreenShot*



[Image credit - UCR Brain Game Center]

### 3.3.3.2 Memory retrieval

This research study also separately tested the participant's respective capabilities in terms of memory retrieval (gr). In doing so it followed the approach taken in the cognitive literature by Silvia *et al* (2013) in their work on memory retrieval. Given that there are different aspects of memory, this research individually assessed four memory areas sitting under the broader memory retrieval domain: word fluency, associational fluency, associational flexibility, and ideational fluency. The research asked two questions designed to test each of these four marker areas of memory retrieval. These questions are detailed in Table (1) below, and again directly mimicked those that have been repeatedly used to assess memory retrieval within the cognitive literature (Benedek *et al.*, 2012; Silvia *et al.*, 2013; Beaty and Silvia, 2013).

### **Table 5 – Questions used to measure memory retrieval**



No.	Relevant gr marker areas	Question
1	Ideational Fluency	Tell me a list of people's first names
2	Ideational Fluency	Tell me a list of people's occupations
3	Word Fluency	Tell me a list of words that end in 'TION'
4	Word Fluency	Tell me a list of words that start with 'CON'
5	Associational Fluency	Tell me as many alternative words for 'good' as you can think of
6	Associational Fluency	Tell me as many alternative words for 'hot' as you can think of
7	Associative Flexibility	Tell me a series of linked words, in which each word is related to the prior word, starting with the word 'cold'
8	Associative Flexibility	Tell me a series of linked words, in which each word is related to the prior word, starting with the word 'music'

Participants were presented with each of these eight questions, one at a time, on a screen shared with the researcher. Respondents then spoke out their responses, thereby avoiding the need to control for their respective typing speed. Given that the participants were all enrolled on a UK university course, for which in most cases English was their first language, and where not, the participant had passed an English language test in order to be enrolled on the course, the study did not explicitly control for proficiency in spoken English. Each person was given sixty seconds to provide as many valid answers as they could think of. The results were subsequently transcribed, totalled up by the researcher, and then averaged between the two questions for each of the four marker areas.

In the memory area of Ideational Fluency the participant's scores ranged from 6.5 to 26.5 with a mean of 16.39 (sd of 4.43). In the memory area of Word Fluency the scores ranged from 3.0 to 15.0 with a mean of 7.87 (sd of 2.54). In the memory area of Associational Fluency the scores ranged from 2 to 12 with a mean of 5.50 (sd of 2.08). In the memory area of Associational Flexibility the scores ranged from 2.5 to 30.5 with a mean of 12.04 (sd of 5.37).

Using these scores, each participant was then categorised as to where their respective memory score in each of the four memory areas. Participants were given a grade for each memory area between 1 and 7 (1 being very low, 7 being very high). This grading was attributed based on the band that their respective score fell in, within each memory area. Within each memory area, these bands were created by taking the range of scores in each memory area, and dividing by 7 to create the score bands within each range. The different grading scores that a participant obtained in each of the four areas were then averaged out to create a single overall memory banding. This provided a singular measure of each participant's overall memory capabilities in a way that circumvented the different scales otherwise occurring within each memory area. These overall memory scores ranged from 1.5 to 6.0 with a mean of 3.36 (sd of 1.05).

### **3.3.3.3 NVI Quality**

In assessing their ability to ideate for New Venture Ideas, participants were separately presented with four vignettes summarising the challenges being faced by people in a range of demand led opportunity situations. Two of these related to Business to Consumer situations (concerning the challenges faced by those purchasing car tyres, and by older people in taking medication), and two related to Business to Business situations (concerning the challenges in managing lone workers, and in recruiting suitable staff).

The choice of research material provided through these vignettes was governed by the need for the opportunity situations to be easily comprehensible to the respondents, without the need for an advanced understanding of the market in question. For consistency, each vignette related to a 'demand-led' opportunity situation rather than any which involved a technology transfer proposition. To ensure that the task reflected everyday life, the validity of the experiment was

augmented by utilising vignettes that drew from real life opportunity situations, elements of which had been capitalised upon by companies found in the Inc 5000 List of fastest growing companies in the United States. The choice of the United States being deliberate, as it represented a geography from which these participants were not directly exposed.

Having read through each opportunity vignette, participants were asked, 'What opportunities for potential new business ventures spring to mind from this situation'? The participants continued to talk through each opportunity situation until they felt that they had exhausted all possibilities. During this exercise, care was taken by the researcher to minimise interaction with each participant, so to avoid the risk that the respondent's attention might be shifted intrusively to comments made by others (Green, 1998).

After each research session, the participant's ideation was transcribed and then evaluated, such that each of the participant's distinct ideas were identified and numbered. Across all the sessions, the 110 participants generated 411 ideas, at a mean of 3.73 per person. Over the course of the entire research project, different participants sometimes separately came up with the same broad idea. Where there were sufficient variations in the idea in question, each notable variation was considered as a stand-alone idea. The aggregate ideation output from the research pool resulted in the generation of 118 distinct NVIs across the 4 vignette areas. This comprised of 24 ideas relating to the lone worker vignette, 32 ideas relating to the tyre purchasing vignette, 34 ideas relating to the elderly person medication vignette, and 28 relating to the recruitment vignette.

In assessing the impact of executive functioning capabilities on creative entrepreneurial ideation, this research went further than just merely apportioning a single grading to the quality of those ideas. Considering different aspects of NVI quality, it drew on the findings of two systematic literature reviews which separately concluded novelty and usefulness to be the two most central measures used within scholarship to assess the quality of creative products (Plucker *et al.*, 2004; Dean *et al.*, 2006). Specifically within the context of NVIs, novelty was judged by the extent to which each idea differed from that of existing market or industry norms, whilst usefulness was judged through the entrepreneurship concept of appropriability. Appropriability has been defined as the likelihood that someone would be able to capture returns from the exploitation of an idea (Davidsson and Tonelli, 2013). It has been portrayed as the key reference point considered by entrepreneurs in evaluating whether to pursue an entrepreneurial opportunity (Promsiri and Kunte, 2019).

The job of attributing quality scores to each of the 118 distinct ideas generated in this study was performed by three independent judges whose backgrounds as multiple company founders were deemed to qualify them to pass appropriate judgements. Faced with the practical impossibility of testing out an idea in practice, the use of qualified judges in rating the different aspects of an NVI was considered the best possible proxy of its qualitative aspects.

The three judges graded each idea on a scale between 1 and 7 to reflect their assessment of each NVI's overall quality, novelty and appropriability. Using a consensual assessment technique (Amabile *et al.*, 1997), the three scores given by each judge were then averaged together to yield a final score for each NVI across the three areas (overall quality, novelty, and appropriability).

These idea scores were then separately mapped back to the various participant, or participants, who had thought of that particular idea.

Across the 4 vignette areas, the 110 participants undertook a total of 440 ideation sessions. In 78 of these 440 ideation sessions, a participant failed to identify an NVI. In these instances, he or she was awarded a zero score for that opportunity situation. On 49 occasions, a participant generated more than one potential distinct NVI. Given that the focus of this research was on idea quality, and that there were likely practical restrictions in terms of an entrepreneur being able to develop more than one idea at a time, in these situations research into NVI quality drew on the participant's idea for that vignette which had the highest respective score.

The highest NVI score that each participant achieved across each of the four vignette situations were then totalled together to generate a singular aggregate overall NVI quality score per person, alongside a similar separate score per participant for NVI novelty and NVI appropriability. Across the four vignette areas, a participant's mean overall NVI quality score was 11.84 (sd of 4.32, range of 1.0 to 22.3); the mean NVI novelty score was 10.98 (sd of 3.83; range of 1.0 to 18.66), and the mean NVI appropriability score was 11.97 (sd of 3.88; range of 3.0 to 19.34).

#### **3.3.3.4 Control Variables**

This study also collected a range of control data from the participants so to ensure that the focal independent variables were behaving as hypothesized in relation to the dependent variables under consideration. Drawing on the control measures utilised by previous studies into entrepreneurial opportunity recognition, these control questions asked the participant's age

(Ucbasaran *et al.*, 2009) and gender (DeTienne and Chandelers, 2007) to account for the way in which these differences impacted on an individual's ability to ideate for NVIs. It further controlled for education level (Davidsson and Honig, 2003) to account for the effect that different levels of formal education may have upon the thought processes used in entrepreneurial ideation. The participants entered this data online as part of their work in undertaking the UCMRT fluid reasoning assessment.

At the end of each research session, participants were then presented with two further control questions on a screen shared with the researcher. Given how prior knowledge has been described as a core cognitive resource in entrepreneurial opportunity recognition (Grégoire *et al.*, 2010; Shane, 2000), this study first gauged the prior knowledge that a participant felt that they had across each particular opportunity situation, in turn providing an average prior knowledge score for each participant. Second the study questioned the participants as to their entrepreneurial intention, itself another factor previously shown to correlate with the successful perception of entrepreneurial opportunities (Krueger and Dickson, 1994). In measuring levels of both entrepreneurial intent and prior knowledge, the study used a 7 point Likert Scale response (7 being 'Very High' and 1 being 'Very Low') to the statements: 'indicate the level of prior knowledge you have of each of the opportunity situations that we considered' and 'I am determined to create a firm and set up a business in the future'.

### **3.3.4 Data Analysis**

The hypotheses in this study were tested through linear regression analysis, with the complementary use of artificial neural network analysis further used to test the robustness of the

findings. This approach ensured the research assessed both the direct effect and the interaction effect of different cognitive capabilities on aspects of NVI quality.

The use of linear regression measured the impact of each independent variable on the dependent NVI quality variables, thereby verifying potential relationships. In performing this analysis, robustness checks were undertaken on the data. Measuring the correlation among the independent variables in relation to overall NVI quality, the Variance Inflation Factors were all between 1.0 and 2.0 (1.05 for intellectual fluidity, and 1.05 for overall memory retrieval). A Durbin-Watson test for autocorrelation was further undertaken. Sitting comfortably between the range of 1.5 and 2.5, it recorded 1.81 for overall NVI quality, 1.95 for NVI novelty, and 2.02 for NVI appropriability.

The complementary use of artificial neural network analysis (ANNs) subsequently measured the interaction effect of the independent variables upon aspects of NVI quality in a way that highlighted their relative importance. Artificial neural networks have proven an informative lens of analysis because of their ability to track how multiple variables work together (Yang and Wang, 2020). ANNs deploy parallel information-processing structures to interpret outcomes, determining interactions among the predictor and output variables through the use of multiple training algorithms. Highly relevant for cognitive studies, this statistical approach imitates the biological neural networks of the human brain, doing so in way that allows for the analysis of complex relationships in causal studies with relatively small data sets (Pasini, 2015).

In undertaking neural network analysis, this study portioned the data in a ratio of 7 for training (establishing the initial mathematical relationship between input and output), 3 for testing (validation), and 1 for holdout (cross validation). It deployed a Multilayer Perceptron (ANN - MLP) approach, involving the architecture of 5 input layers (reflecting the input variables of intellectual fluidity, and the 4 memory areas of associational flexibility, associational fluency, word fluency and ideational fluency), 1 hidden layer, and 1 output layer (relating to the particular output variable being measured at that point, whether that be NVI quality, NVI novelty, or NVI appropriability). In the training stage for overall NVI quality the relative error was 0.774 for training, compared to 0.84 in the testing stage. The relative errors were similarly 0.667 (training) and 0.853 (testing) for NVI novelty, and 0.775 (training) and 0.81 (testing) for NVI appropriability.

### **3.4. Results**

Table 2 displays the descriptive statistics of the variables deployed in this study, and illustrates their pair-wise Pearson correlations. As referenced in Appendix (D6), the reliability of the data was confirmed by a Cronbach's Alpha coefficient of 0.95 on the three main dependent variables (overall NVI Quality, NVI Novelty, and NVI appropriability).

To estimate the results and to assess the significance of the various hypotheses, linear regression analysis was first employed. The related estimations are reported in Tables 3, 4 and 5, in terms of the results on overall NVI quality, NVI novelty and NVI appropriability respectively. Within each table, Model 1 displays the results of the baseline model with the control variables only.



Model 2, then introduces the independent variable of intellectual fluidity. The coefficient of intellectual fluidity was shown to have a positive and statistically significant influence upon NVI quality ( $\beta = 0.28$ ,  $p < 0.05$ ), as well as upon both NVI novelty ( $\beta = 0.39$ ,  $p < 0.01$ ) and NVI appropriability ( $\beta = 0.39$ ,  $p < 0.01$ ). This supports Hypothesis 1, suggesting that a person with higher capabilities in fluid intelligence is more successful in conceiving high quality NVIs than someone with lower capabilities in fluid intelligence.

Model 3 considers the impact of capabilities with overall memory retrieval. The results of Model 3 found that overall capabilities with memory retrieval had a statistically significant impact upon overall NVI quality ( $\beta = 0.81$ ,  $p < 0.05$ ), on NVI novelty ( $\beta = 0.93$ ,  $p < 0.01$ ) and NVI appropriability ( $\beta = 0.93$ ,  $p < 0.05$ ). This supports Hypothesis 2, suggesting that a person with higher capabilities in memory retrieval is more successful in conceiving high quality NVIs than someone with lower capabilities in memory retrieval.

Models 4 to 7 then separately examined the separate impact of four different components of memory retrieval, with Model 4 looking at associational fluency, Model 5 at ideational fluency, Model 6 at word fluency, and Model 7 at associational flexibility. In terms of the sub component aspects of memory, the greatest effect was observed with Model 5 relating to ideational fluency ( $\beta = 0.26$ ,  $p < 0.001$  on NVI Overall Quality,  $\beta = 0.30$ ,  $p < 0.01$  on NVI Novelty,  $\beta = 0.15$ ,  $p < 0.01$  on NVI Appropriability). Model 7 also revealed a statistically significant effect involving the sub memory area of associational flexibility on NVI Novelty ( $\beta = 0.15$ ,  $p < 0.05$ ) and on NVI Appropriability ( $\beta = 0.15$ ,  $p < 0.05$ ). There was no statistically significant impact from the sub

memory areas of associational fluency in Model 4 or word fluency in Model 6 on any of NVI Overall Quality, NVI Novelty, or NVI appropriability.

Model 8 then observed the results when the two studied components of executive attention, intellectual fluidity and overall memory retrieval, were combined as a single interaction variable. The results in Model 8 led to an increase in R-Squared, showing there to be complementary and statistically significant effects from the combination of intellectual fluidity and overall memory retrieval on overall NVI quality ( $\beta = 0.07$ ,  $p < 0.01\%$ ), as well as on NVI novelty ( $\beta = 0.09$ ,  $p < 0.01\%$ ) and NVI appropriability ( $\beta = 0.09$ ,  $p < 0.01\%$ ). The impact was even more significant when intellectual fluidity and the specific sub component of ideational fluency on its own were combined as a single interaction variable in Model 9. The results in Model 9 led to a further increase in R-Squared, again showing statistically significant effects from the combination of intellectual fluidity and ideational fluency on overall NVI quality ( $\beta = 0.02$ ,  $p < 0.01\%$ ), as well as on NVI novelty ( $\beta = 0.02$ ,  $p < 0.01\%$ ) and NVI appropriability ( $\beta = 0.02$ ,  $p < 0.01\%$ ). When combined, Model 8 and Model 9 provided support for the synergetic effect of intellectual fluidity and memory retrieval working together, as contended in Hypothesis 3.

The robustness of these findings was further supported by the study's use of artificial neural network analysis (ANN), such that the interaction effects of the respective cognitive variables could be assessed. The findings of this artificial neural network analysis are laid out in Tables 6.1, 6.2, and 6.3 in relation to overall NVI quality, in Tables 7.1, 7.2, and 7.3 in relation to NVI novelty, and in Tables 8.1, 8.2, and 8.3 in relation to NVI appropriability.

**Table 6 – Descriptive Statistics: cognitive capabilities****Correlations**

N o.	Variable	Me an	S D	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Y - NVI Overall Quality	11.84	4.32														
2	Y - NVI Novelty	10.98	3.83	***													
3	Y - NVI Appropriability	11.97	3.88	***	***												
4	X - Intellectual Fluidity	10.42	3.51	*	***	***											
5	X - Associational Fluency	5.50	2.08	0.08	0.10	0.07	-	0.04									
6	X - Ideational Fluency	16.39	4.43	***	***	***	0.07	***									
7	X - Word Fluency	7.87	2.54	0.10	0.11	0.15	0.02	***	***								
8	X - Association Flexibility	12.04	5.37	*	**	**	0.18	***	***	***							
9	X - Total Memory	3.36	1.05	0.22	0.24	0.28	0.07	***	***	***	***						
10	C - Intent	5.84	1.25	0.11	0.23	0.20	0.02	0.06	-0.06	0.08	0.08	0.07					
11	C - Knowledge	4.02	1.32	-0.11	-0.02	-0.05	0.00	-0.14	-0.06	0.07	-0.13	0.10	**				
12	C - Age	24.02	5.56	0.05	0.06	0.14	0.01	-0.01	0.09	0.03	-0.13	0.00	**	**			
13	C - Gender	1.55	0.57	0.09	0.11	0.10	0.05	0.14	-0.03	-0.07	0.07	0.04	***	**			
14	C - Education	1.91	0.77	-0.03	-0.01	0.02	0.01	-0.08	-0.14	0.03	0.26	***	**	**	***	0.01	

\*\*\*. Correlation is significant at the 0.01 level (2-tailed). \*\*. Correlation is significant at the 0.05 level (2-tailed). \*. Correlation is significant at the 0.1 level (2-tailed).

**Table 7 – Regression results: Overall NVI Quality**

<b>NVI QUALITY</b>									
<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intellectual Fluidity		** 0.28							
		0.12							
Overall Memory			** 0.81						
			0.40						
Associational Fluency				0.09					
				0.21					
Ideational Fluency					*** 0.26				
					0.09				
Word Fluency						0.19			
						0.17			
Associational Flexibility							0.11		
							0.08		
Intellectual Fluidity & Overall Memory								*** 0.07	
								0.02	
Intellectual Fluidity & Ideational Fluency									*** 0.02
									0.01
<b>Control Variables</b>									
Age	0.07	0.07	0.06	0.07	0.03	0.07	0.07	0.06	0.05
	0.09	0.08	0.08	0.09	0.08	0.09	0.09	0.08	0.08
Entrepreneurial Intent	0.43	0.47	0.36	0.43	0.47	0.40	0.35	0.38	0.48
	0.37	0.36	0.36	0.37	0.35	0.37	0.37	0.35	0.35
Prior Knowledge	-0.54	-0.54	-0.48	-0.52	-0.51	* -0.57	-0.49	-0.46	*-0.49
	0.33	0.33	0.33	0.34	0.32	0.33	0.34	0.32	0.32
Gender	0.59	0.47	0.56	0.55	0.62	0.69	0.55	0.46	0.49
	0.78	0.76	0.77	0.79	0.76	0.78	0.78	0.75	0.75
Education	-0.32	-0.36	-0.11	-0.31	-0.01	-0.32	-0.13	-0.19	-0.19
	0.62	0.61	0.62	0.62	0.61	0.62	0.63	0.60	0.60
F-Statistics	1.01	* 1.89	1.56	0.87	* 2.18	1.07	1.17	** 2.37	** 2.70
R-square	0.05	0.10	0.08	0.05	0.11	0.06	0.06	0.12	0.14
Adjusted R-square	0.01	0.05	0.03	-0.01	0.06	0.04	0.01	0.07	0.09
Observations	110	110	110	110	110	110	110	110	110

Note: The coefficient estimates of independent variables are beta coefficient; the standard error is documented in the row below..

\* P<0.1; \*\* p<0.05; \*\*\* P<0.01

**Table 8 – Regressions results: Overall NVI Novelty**

<b>NVI NOVELTY</b>									
<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intellectual Fluidity		*** 0.39							
		0.10							
Overall Memory			** 0.93						
			0.35						
Associational Fluency				0.05					
				0.18					
Ideational Fluency					*** 0.23				
					0.08				
Word Fluency						0.22			
						0.15			
Associational Flexibility							** 0.14		
							0.07		
Intellectual Fluidity & Overall Memory								*** 0.09	
								0.02	
Intellectual Fluidity & Ideational Fluency									*** 0.02
									0.00
<b>Control Variables</b>									
Age	0.05	0.05	0.09	0.10	0.06	0.11	0.11	0.10	0.08
	0.08	0.07	0.07	0.08	0.07	0.08	0.07	0.07	0.07
Entrepreneurial Intent	** 0.72	** 0.78	* 0.53	* 0.62	** 0.66	* 0.58	0.52	* 0.56	** 0.70
	0.32	0.30	0.32	0.33	0.31	0.32	0.32	0.30	0.29
Prior Knowledge	-0.23	-0.23	-0.29	-0.35	-0.32	-0.39	-0.29	-0.25	-0.30
	0.33	0.28	0.29	0.30	0.28	0.30	0.29	0.27	0.27
Gender	0.33	0.14	0.33	0.33	0.39	0.48	0.30	0.19	0.23
	0.68	0.64	0.67	0.70	0.65	0.69	0.68	0.64	0.62
Education	-0.35	-0.41	-0.08	-0.31	-0.04	-0.31	-0.07	-0.15	-0.15
	0.55	0.51	0.54	0.56	0.53	0.55	0.56	0.51	0.50
F-Statistics	1.44	*** 4.11	** 2.60	1.32	*** 3.82	1.71	* 2.08	*** 5.00	*** 5.93
R-square	0.07	0.19	0.13	0.07	0.18	0.09	0.11	0.23	0.26
Adjusted R-square	0.02	0.15	0.08	0.02	0.13	0.04	0.06	0.18	0.21
Observations	110	110	110	110	110	110	110	110	110

Note: The coefficient estimates of independent variables are beta coefficient; the standard error is documented in the row below..

\* P<0.01; \*\* p<0.05; \*\*\* P<0.01

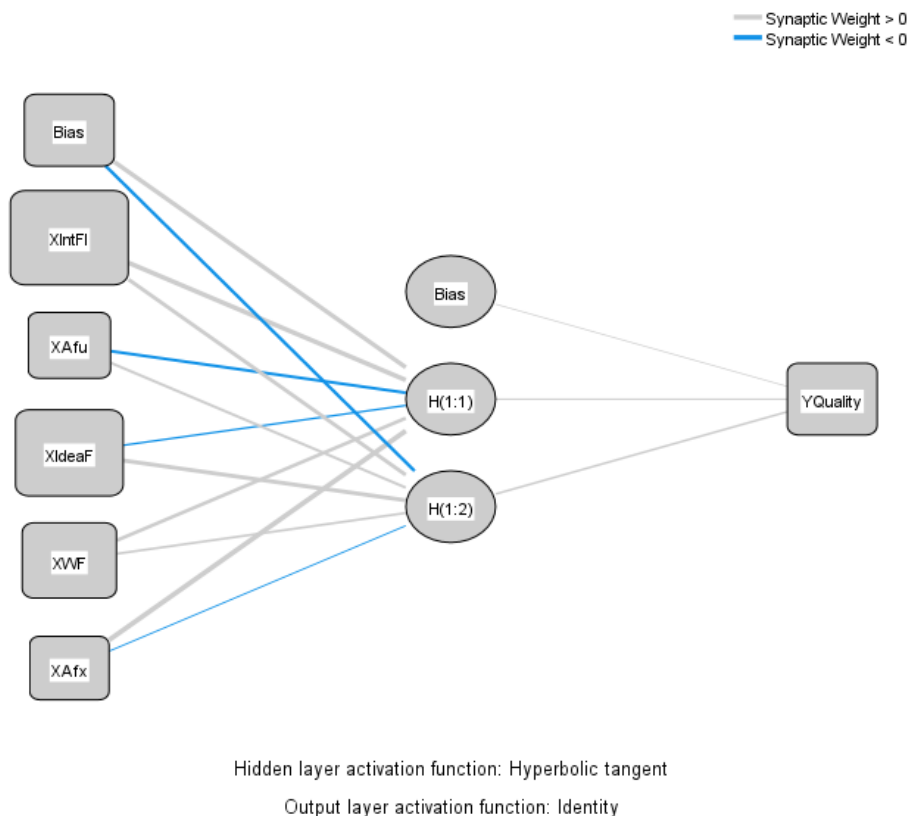
**Table 9 – Regression results: Overall NVI Appropriability**

<b>NVI APPROPRIABILITY</b>									
<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intellectual Fluidity		*** 0.39							
		0.10							
Overall Memory			** 0.93						
			0.35						
Associational Fluency				0.04					
				0.18					
Ideational Fluency					*** 0.30				
					0.08				
Word Fluency						0.22			
						0.15			
Associational Flexibility							** 0.15		
							0.07		
Intellectual Fluidity & Overall Memory								*** 0.09	
								0.02	
Intellectual Fluidity & Ideational Fluency									*** 0.02
									0.00
<b>Control Variables</b>									
Age	0.11	0.11	0.95	0.11	0.01	0.06	0.11	0.10	0.08
	0.08	0.07	0.07	0.08	0.07	0.08	0.07	0.07	0.07
Entrepreneurial Intent	* 0.62	** 0.68	* 0.54	* 0.63	* 0.67	* 0.58	0.53	* 0.57	** 0.69
	0.32	0.30	0.32	0.33	0.31	0.32	0.32	0.30	0.29
Prior Knowledge	-0.36	-0.36	0.37	0.43	0.39	0.48	0.38	0.32	0.36
	0.30	0.28	0.31	0.32	0.30	0.31	0.31	0.29	0.28
Gender	0.36	0.19	0.35	0.36	0.41	0.51	0.33	0.22	0.25
	0.69	0.65	0.67	0.70	0.65	0.69	0.68	0.64	0.62
Education	-0.33	-0.38	-0.07	-0.31	0.05	-0.30	-0.06	-0.14	-0.15
	0.55	0.52	0.54	0.55	0.53	0.55	0.56	0.51	0.50
F-Statistics	1.58	*** 4.04	** 2.68	1.41	*** 3.90	1.82	* 2.16	*** 5.06	*** 6.01
R-square	0.07	0.19	0.14	0.08	0.19	0.10	0.11	0.23	0.26
Adjusted R-square	0.03	0.14	0.09	0.02	0.14	0.04	0.06	0.18	0.22
Observations	110	110	110	110	110	110	110	110	110

Note: The coefficient estimates of independent variables are beta coefficient; the standard error is documented in the row below.

\* P<0.01; \*\* p<0.05; \*\*\* P<0.01

**Figure 6 – ANN - NVI Quality – Network Information**

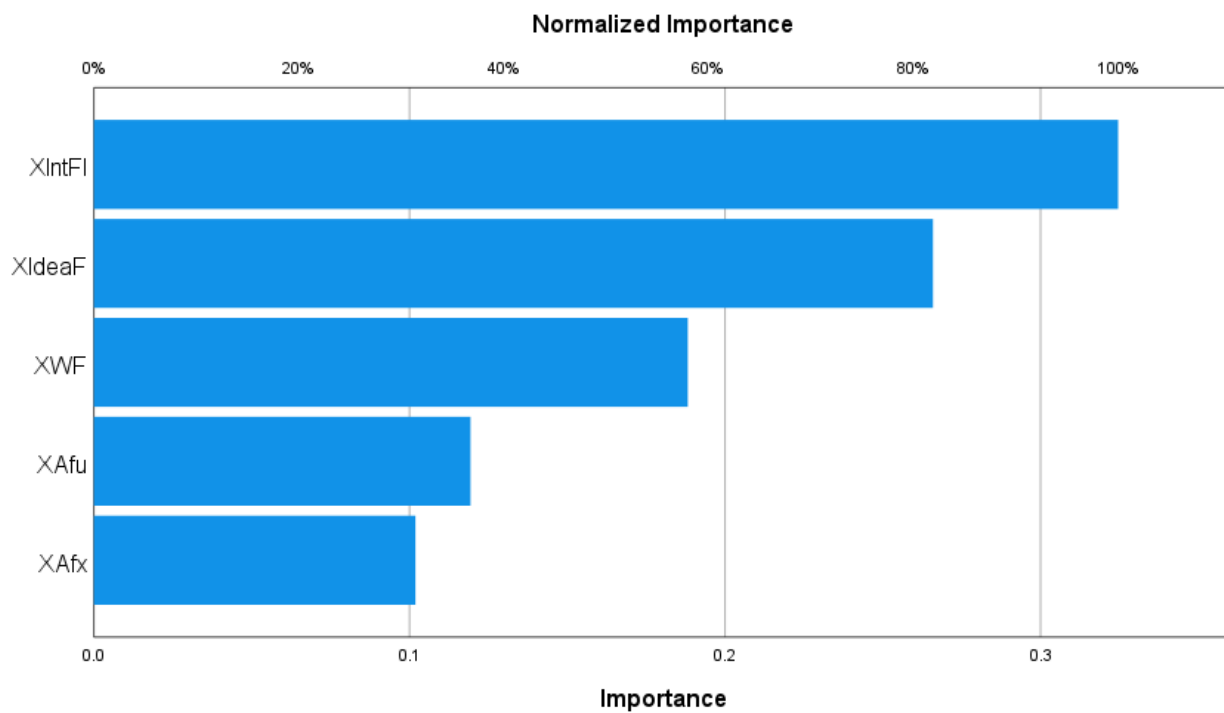


Variable Key: XinFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, Yquality = Overall NVI Quality

**Table 10 – ANN - NVI Quality – Independent Variable Importance**

	Importance	Normalised Importance
XIntFl	.325	100.0%
XAfu	.119	36.8%
XIdeaF	.266	81.9%
X WF	.188	58.0%
X Afx	.102	31.4%

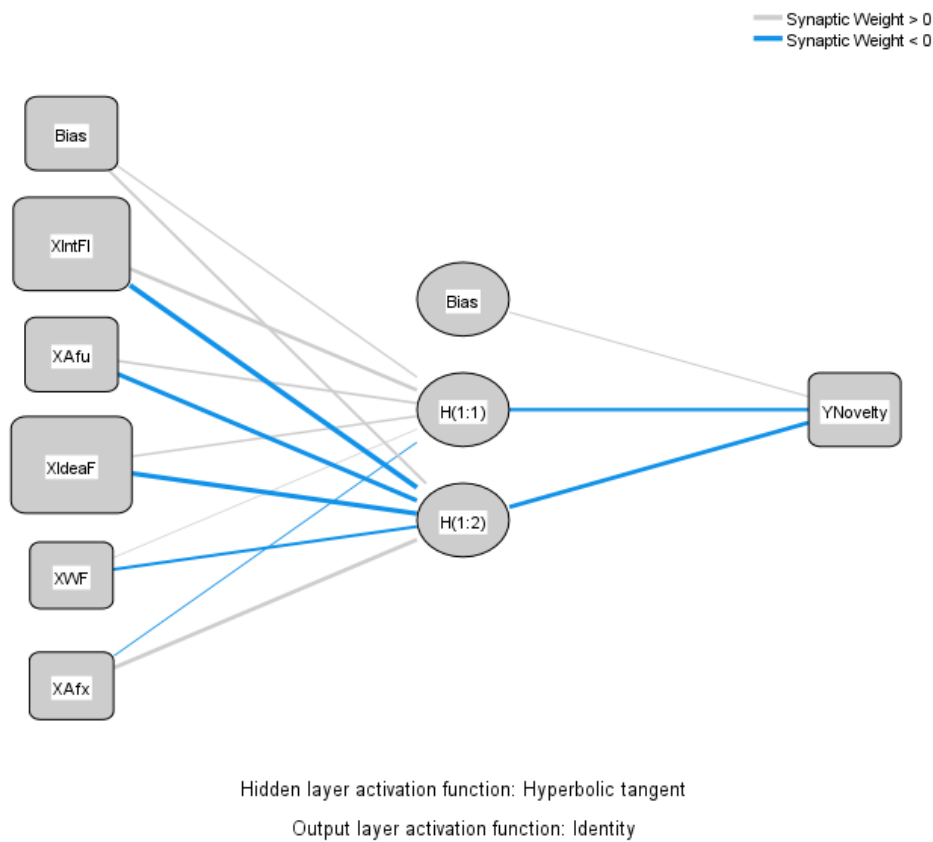
Variable Key: XinFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, Yquality = Overall NVI Quality

**Figure 7 – ANN - NVI Quality – Independent Variable Importance**

Variable Key: XIntFl = Intellectual fluidity, XIdeaF = Ideational Fluency, XWF = Word Fluency XAfu = Association Fluency, , , XAfx = Associational Flexibility.



**Figure 8 – ANN - NVI Novelty - Network Information**



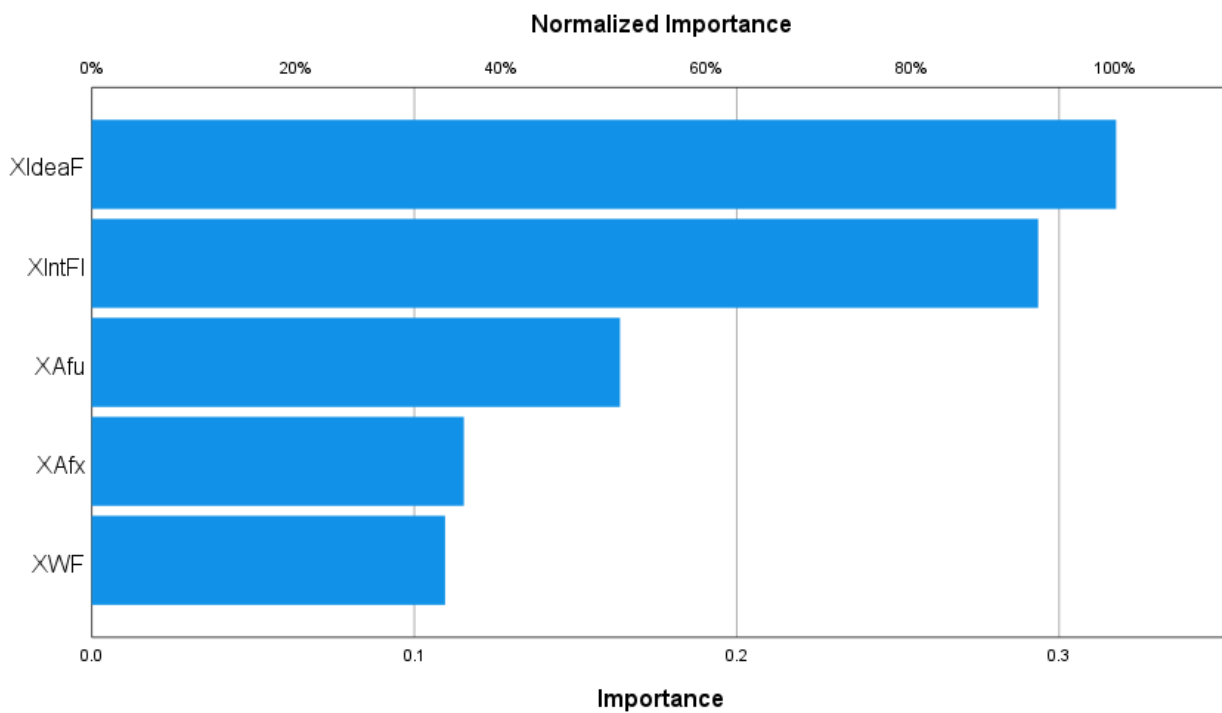
Variable Key: XInFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, YNovelty = NVI Novelty

**Table 11 – ANN - NVI Novelty – Independent Variable Importance**

	Importance	Normalised Importance
XIntFl	.294	92.4%
XAfu	.164	51.6%
XIdeaF	.318	100.0%
X WF	.110	34.5%
X Afx	.115	36.3%

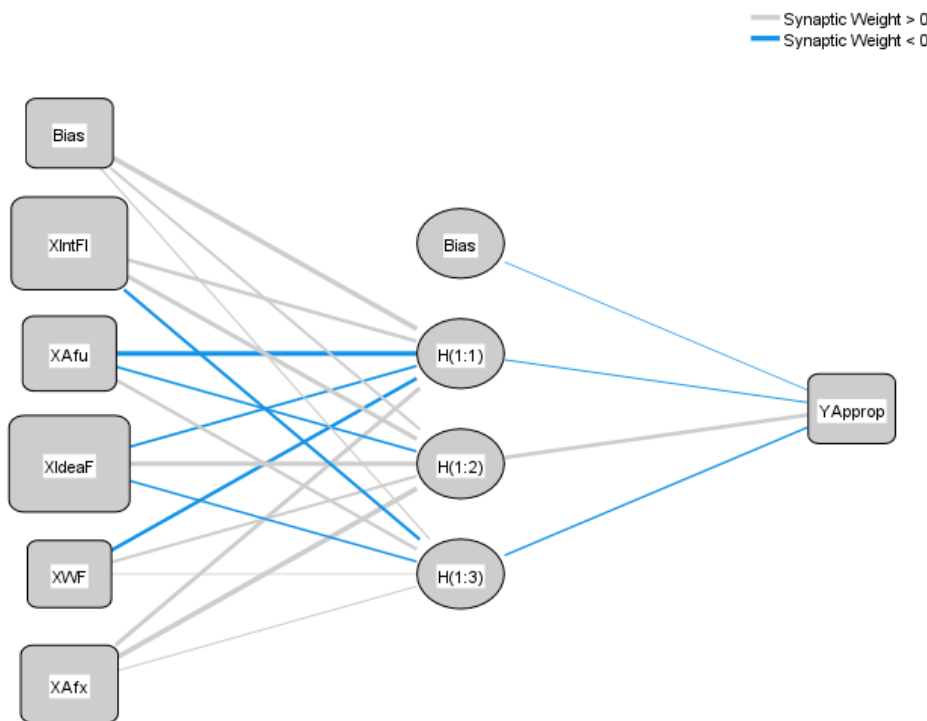
Variable Key: XInFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, YApprop = NVI Appropriability

**Figure 9 – ANN - NVI Novelty – Independent Variable Importance**



Variable Key: XIdeaF = Ideational Fluency, XInFlu = Intellectual fluidity, XAfu = Association Fluency, , XWF = Word Fluency, XAfx = Associational Flexibility, YApprop = NVI Appropriability

**Figure 10 – ANN - NVI Appropriability - Network Information**



Hidden layer activation function: Hyperbolic tangent  
 Output layer activation function: Identity

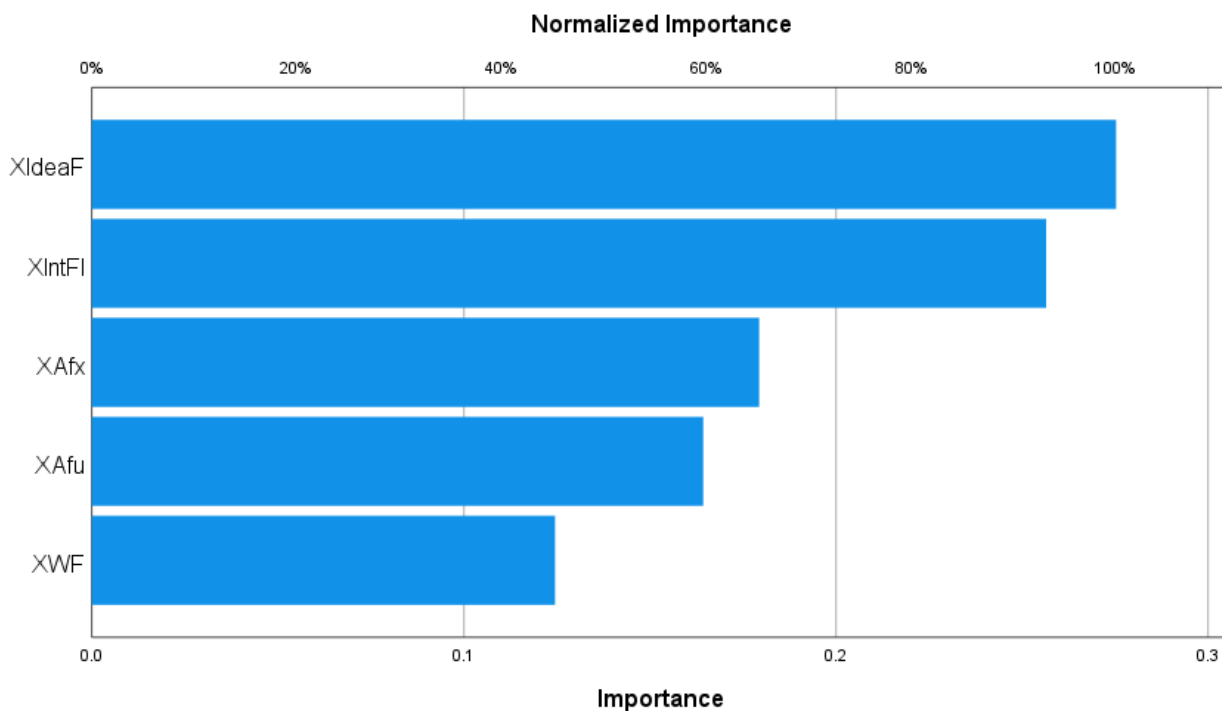
Variable Key: XinFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, YApprop = NVI Appropriability

**Table 12 – ANN - NVI Appropriability – Independent Variable Importance**

	Importance	Normalised Importance
XIntFl	.256	93.2%
XAfu	.164	59.7%
XIdeaF	.275	100.0%
X WF	.125	45.2%
X Afx	.179	65.2%

Variable Key: XinFlu = Intellectual fluidity, XAfu = Association Fluency, XIdeaF = Ideational Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, YApprop = NVI Appropriability

**Figure 11 – ANN - NVI Appropriability – Independent Variable Importance**



Variable Key: XIdeaF = Ideational Fluency, XInFlu = Intellectual fluidity, XAfu = Association Fluency, XWF = Word Fluency, XAfx = Associational Flexibility, YApprop = NVI Appropriability

The results of the complementary ANN analysis provided robustness to the findings of the earlier regression analysis in so far as they confirmed the primacy of the same primary independent variables on NVI quality, NVI novelty, and NVI appropriability. Intellectual fluidity was once again shown to have the greatest relative importance in terms of its contribution to the overall quality of the NVIs generated (importance 0.325, 100% normalised value), followed again by memory capabilities with Ideational Fluency (importance 0.266, 81.9% normalised value). The same two variables were also dominant when ANN analysis was conducted on NVI novelty (Ideational Fluidity: importance 0.318, 100% normalised value; Intellectual Fluidity: importance 0.294, 92.4% normalised value), and on NVI appropriability novelty (Ideational Fluidity:

importance 0.275, 100% normalised value; Intellectual Fluidity: importance 0.256, 93.2% normalised value).

### **3.5. Discussion**

The introduction of the ‘venture concept’ as a focal unit of analysis for those studying the initial stages of entrepreneurial opportunity recognition has allowed greater research clarity to be directed onto the way in which ideas for new business ventures first emerge (Davidsson, 2015; Vogel, 2017). In an attempt to further advance understanding within this area, this study has primarily sought to shine a spotlight on the way in which a person’s ability to internally control attention during the ideation process impacts on the quality of the NVIs that they subsequently generate.

This study has argued that when considering the importance of prior knowledge as a cognitive resource behind the identification of fresh entrepreneurial opportunities, the ability to cognitively access the most potent knowledge, should be further considered, alongside the sources through which that knowledge was originally acquired. In doing so, it has sought to develop entrepreneurship theory, by propagating the case that inter person cognitive differences in executive functioning capabilities represent an important cognitive micro-foundation behind the generation of high quality NVIs. Dovetailing with those contentions from the management literature which highlight how high quality business ideation involves knowledge activation, through which existing knowledge is activated from long term memory, and idea production, in which that knowledge is effectively applied (Althuzen and Wirenga, 2014), this study tested its

theoretical contentions by measuring the impact of intellectual fluidity (gf) and memory retrieval (gr) on the quality of the NVIs being generated.

Highlighting the importance of being able to internally control cognition, this study found there to be a strong link between intellectual fluidity (gf) and memory retrieval (gr) with the overall quality of entrepreneurial ideation. Within the specific area of memory retrieval, the study found a particularly positive effect to emanate from a person's innate capabilities with ideational fluency. Ideational fluency, characterised as the particular ability to retrieve ideas (Vannorsdall *et al*, 2012), has previously been shown in the cognitive literature to have particular prominence when it comes to creative quality (Avita and Kaufman, 2014). A complementary effect was further observed on NVI quality when a person had strong capabilities in intellectual fluidity in combination with high levels of overall memory retrieval, and in particular when capabilities in intellectual fluidity existing alongside capabilities in ideational fluency.

In illustrating how a person's executive functioning capabilities impact on the quality of NVIs that they generate, the results of this study contribute to the wider evidence pool that reaches out beyond purely environmental influences. They add to the body of entrepreneurship scholarship that highlights the importance of innate inter-person differences during the early stages of the opportunity recognition (Markman and Baron, 2003). Previous studies looking at genetic influences have suggested substantial heritability for opportunity recognition with no influence of the shared environment (Nicolaou *et al*, 2009). Accordingly, there have been calls for further research into what the sources of these individual differences might be. This research makes the

case for executive functioning capabilities, to complement personality traits (Palladan and Ahmed, 2021) and cognitive biases (De Carolis and Saporito, 2006), as a font of such difference.

In evidencing a relationship between person-centric capabilities around executive functioning and the quality of NVIs that are generated, the findings of this study show the cognitive *theory of controlled attention* to have relevance to the early stages of entrepreneurial opportunity recognition. Within the wider creativity literature, there has been a sustained call, to investigate the impacts of cognitive capabilities on ideational quality across a wider range of domains (Avita and Kaufman, 2014). Some have suggested that the impact of cognitive capabilities is domain specific (Baer, 1991), for example with intelligence shown to have a far greater impact in creative drawing tasks than in poetry for example (Avita and Kaufman, 2014), and yet others have made the case for a domain generic effect (Qian *et al*, 2019; Silvia *et al*, 2012). The findings of this entrepreneurship study would seem to add a further notch to the body of evidence highlighting the impact that executive functioning capabilities have on the quality of creative ideation across a wide range of domains.

In undertaking its research, this study further built on recent entrepreneurship studies that have focussed on the quality, rather than the quantity, of venture concepts that are generated (Kier and McMullen, 2018; Warnick *et al*, 2021). Indeed it has gone further. Taking up the call to explore how cognitive antecedents interact upon different aspects of NVI quality (Frederiks *et al*, 2019), it observed how the impact of intellectual fluidity and ideational quality were separately found to have a significant impact on both the novelty and the appropriability of the entrepreneurial ideas that were generated.

Finally, the empirical results of this study somewhat push up against previous empirical research from entrepreneurship which suggested that intelligence, encapsulated in a measure of General Mental Awareness, exerted a smaller impact on opportunity recognition than was expected (Gielnik *et al*, 2014). The differences between that earlier study, and the findings of this research, may be partly explicable in terms of their primary focus. Gielnik *et al* (2014) assessed ideational output in terms of the volume of ideas being produced, whilst this study has majored on the qualitative aspects of what was being generated. The ensuing difference in results mirrors that seen in the creativity literature, where studies measuring the quality of ideation (Nusbaum and Silvia, 2011) have similarly observed a greater impact for capabilities related to intelligence, than those studies assessing just the quantity of creative ideation (Kim, 2005).

In practical terms, the evidence suggesting that there is a causal relationship between the possession of executive functioning capabilities with the subsequent generation of high quality NVIs, would appear to have implications for entrepreneurship education programmes that seek to bolster ideational competency. Yet, to the extent that differences in cognitive aptitudes are innate, this research may also tender some caution as to the extent to which training can be expected to overcome this particular aspect of difference. It may further suggest that those looking to recruit for entrepreneurial teams, particularly those where they deem idea generation to be an important component of the work, might be well served in considering the innate intellectual fluidity and memory retrieval aptitudes of their applicants.



### **3.6. Limitations and recommendations for future research**

It is hard, if not impossible to replicate entrepreneurial ideation in a test environment, and the design framework used in this study intrinsically encounters certain limitations. There are though, additional approaches through which the contentions from this research could be assessed, alongside avenues through which their findings might be further developed.

In choosing to select university students for its participant pool, this study focussed on the thought processes of first time company founders. Such an approach recognises the importance of novice entrepreneurs to replenishing entrepreneurial churn across economies (Disney *et al*, 2003). Indeed, some of the world's current most successful companies, such as Amazon and Facebook, were themselves once established by first time company founders. However, the confines of this sample mean that this study has not captured the full range of those conceiving NVIs. Entrepreneurial ideation also occurs at the hands of experienced entrepreneurs, a cohort with greater ideational tendency (Ames and Runco, 2005) and who are known to frame information differently from first time founders (Dew *et al*, 2009). Similarly by focussing on lone individuals, this study ignores the potential for collaborative or team based quality ideation (Chen, 2007). Accordingly, it would be informative to replicate the parameters of this study with either a sample of more experienced entrepreneurs, or by observing the overall intelligence profile and ideational output that came from a series of entrepreneurial teams.

A further limitation relates to the context of this study's ideation exercises, in particular their potential distance from the natural environment. With its opportunity vignettes openly presented

to the participants, the research did not test their skills in discovering or noticing the entrepreneurial problem under consideration. By focussing solely on ‘intention led’ idea generation (Vogel, 2017), this study also just examined one type of scenario in which ideas might emerge. In the future it may also be informative to observe the role of intelligence in alternate situations such as a legacy situation where someone was picking up on the unfinished ideational efforts of someone else. The range of opportunity vignettes could also be expanded beyond those which are demand-led, to also include other situations such as technology transfer.

Given the time constraints involved in each participant session, this research charged people with ideating a potential idea ‘on the spot’. It did not therefore consider the role that can be played by sub conscious incubation (Wallas, 1926) or allow for the iteration of ideas to occur over a longer period of time. Accordingly, using longitudinal designs to assess the impact of intelligence over a greater time period would undoubtedly constitute a valuable avenue for additional research.

In selecting parameters to investigate, this research focussed on the two broad components of general intelligence (intellectual fluidity and memory retrieval), that have been most linked in the creativity literature to the *theory of controlled attention* and to aptitudes with executive functioning. Extending this study, there would be merit in measuring the impact of other types of general intelligence on NVI quality. Tapping into the Cattell-Horn-Carroll Theory of Cognitive Abilities (Cattell, 1963; Horn and Cattell, 1963; Schneider and McGrew, 2012), this might include research around crystallised intelligence (gc), short term memory (gsm), and processing speed (gs). Similarly, it may be informative to observe the wider impact of other

measures of intelligence on idea quality, such as practical intelligence (Baum *et al.*, 2017), emotional intelligence (Hadia, 2017), or social intelligence (Baron & Markman, 2003).

There is also the potential for future research to examine the impact of intellectual fluidity and ideational fluency across different cognitive mechanisms. It is known that when ideating for new business concepts, entrepreneurs deploy different ways of thinking, including perspective taking, analogical reasoning, conceptual combination, and pattern recognition. Different cognitive approaches have been shown to vary in the quality of the ideas that they generate (Frederiks *et al.*, 2019). Accordingly, there may be fertile ground for future studies to consider the potential impact of different cognitive capabilities across different modes of entrepreneurial thinking.

Finally, this study was designed to isolate and measure the contribution of particular cognitive capabilities. However, there is a large body of literature which points to the holistic nature of entrepreneurial creativity, involving the interplay between multitudes of different variables. The freshness of the entrepreneur (Gish *et al.*, 2019), their personality (DeTienne and Chandler, 2007), behavioural traits (Dyer *et al.*, 2008), and the conditions in any given environment (Tang, 2008), have all previously been deemed as important. Going forward it would thus be informative to understand how other measures interact with the antecedents relating to the cognitive abilities that were identified in this study.

### **3.7. Concluding thoughts**

Venture concepts are refined considerably after the initial moment of conception (Dimov, 2007). Yet subsequent entrepreneurial opportunities could not be brought into existence without the

emergence of a first candidate idea (Hayton and Cholakova 2012). With the quality of conceptual ideas inevitably having a bearing on what follows, the ability to develop novel and useful ideas is part of the lifeblood of entrepreneurship (Ward, 2004). It is among the most important skills that a successful entrepreneur can possess (Ardichvili *et al.* 2003).

Drawing on developments from the last decade in the literature on cognitive creativity, this study explored the relationship between a person's ability to control attention during an act of entrepreneurial ideation, with the subsequent ability to generate high quality entrepreneurial concepts. It observed that two particular sub-components of intelligence relating to aptitudes in executive functioning - intellectual fluidity and the memory retrieval - constitute notable, if not singularly sufficient, cognitive micro-foundations of quality entrepreneurial ideation. This paper therefore plants a stake in the ground, one that is potentially further refined and honed, for the broader contention that intelligence positively impacts upon NVI quality.

## **4. Paper 3 - A key to the door of entrepreneurial creativity: The potential for analogical reasoning to support the ideation of high quality New Venture Ideas.**

### **Abstract**

Entrepreneurship research has previously considered the role of different cognitive mechanisms in the conception of New Venture Ideas (NVIs). This study contributes to that work by deliberating on the creative potential of analogical reasoning. Using verbal protocol analysis involving 110 participants across 440 different ideation sessions, it first explores the extent to which the use of analogy leads to the generation of new venture concepts that are disproportionately high in quality. It then considers the extent to which NVI quality emanating from analogical reasoning is positively moderated through analogical training and prior market knowledge. Its results found there to be a direct link between analogical reasoning and NVI quality, but that the potential moderators of this relationship, were far more elusive than in the case of many other mechanisms of entrepreneurial cognition.

### **Keywords**

New Venture Ideas, analogy, analogical reasoning, opportunity recognition, entrepreneurship education, prior knowledge.

### **4.1. Introduction**

Culminating in the pioneering endeavours and competitive pressures that power economic development, hundreds of thousands of new companies are created globally every year. Presented as a critical starting point for entrepreneurship, innovation, and strategic change (Kier

and McMullen, 2018), one important subset of these freshly created entities, are those that are innovative. Rather than merely imitating an existing organisation or optimising within a prevailing framework, these are the ventures that forge fresh possibilities and form novel ‘means-ends’ relationships (Shane and Venkataraman, 2000).

The emergence of these innovative firms begins with the generation of a New Venture Idea (NVI) (Vogel, 2017), the first candidate thought for a potential new product or service, a new market, a new source of supply, a new way to organise production, a new distribution channel, or a new business model (Birkinshaw and Hill 2007). Although this moment of initial ideation is just a fleeting component in a far longer entrepreneurial journey, the nature of the initial conception inevitably has a bearing on what follows. Accordingly, the consideration of how New Venture Ideas (NVIs) arise, and what impacts upon their quality, is an important area for entrepreneurship research (Daviddson, 2015).

Entrepreneurship researchers have previously studied how particular cognitive mechanisms can play a crucial role in how potential entrepreneurs interact with the environment and generate high quality concepts for new business ventures (Frederiks *et al*, 2019). Given that NVIs by definition revolve around routines and competencies that are sufficiently different from those which already exist in a particular market, entrepreneurship researchers have gravitated towards those cognitive processes that involve a ‘break-away’ from previous behaviours (Koellinger, 2008).

Entrepreneurship theory has previously suggested that analogical reasoning (henceforth AR) is one ‘break-away’ cognitive mechanism that can support the conceptualisation of entrepreneurial opportunities (Burnell, 2021; Cornelissen and Clarke, 2010). Yet compared to the theoretical examination of analogy that has been undertaken in many other creative fields, the potential for analogy to engender creativity in the conception of NVIs remains comparatively underexplored. In particular, there has neither been consideration as to the extent to which AR may support the generation of NVIs that are disproportionately high in quality, nor to the potential conditions within the early stages of entrepreneurship that support the efficacy with which analogies are deployed.

This study deduces a number of hypotheses that elucidate the use of AR in the ideation of NVIs. Firstly, in hypothesising how AR works to identify insights that are camouflaged, but useful, this research furthers understanding by measuring how the use of AR leads to NVIs that are disproportionately high in quality. Secondly, in considering the role of two potential moderators in the form of analogical training and access to prior market knowledge, this study looks to understand the conditions in which that relationship holds particularly true.

In doing so, this study makes two primary contributions to the field of entrepreneurship. Firstly, in specifically considering the quality of ideas that emerge through the use of analogy, it builds on recent research that has focussed on the qualitative aspect of NVIs (Frederiks *et al*, 2019). In this regard, its empirical findings are significant because they demonstrate that when ideating for NVIs, AR should be an integral part of the cognitive toolkit for entrepreneurial ideation. Secondly, in considering moderating factors through which the use of analogy may beneficially

impact on the generation of NVIs that are high in quality, this study looks to shine light on the conditions whereby, and the extent to which, AR is positively moderated. Highlighting the challenges in supporting AR, its findings reaffirm that within the early stages of entrepreneurship, cognitive mechanisms are far from homogenous, and that modes of thinking react differently to particular cognitive antecedents.

The paper begins by briefly outlining the core construct of AR (Section 2), before providing some context as to how reasoning through analogy has hitherto been considered within the milieu of scholarship on the ideation of fresh entrepreneurial ventures (Section 3). Presenting its theoretical model, the paper then explores the potential for AR to generate high quality NVIs, potentially buffeted by the moderating impact of analogical training and prior market knowledge (Section 4). After laying out the methodology used (Section 5), it presents the results (Section 6), discusses their implications for literature and practice (Section 7), before referencing the study's potential limitations, and making suggestions for further research (Section 8).

## **4.2. Analogical reasoning (AR)**

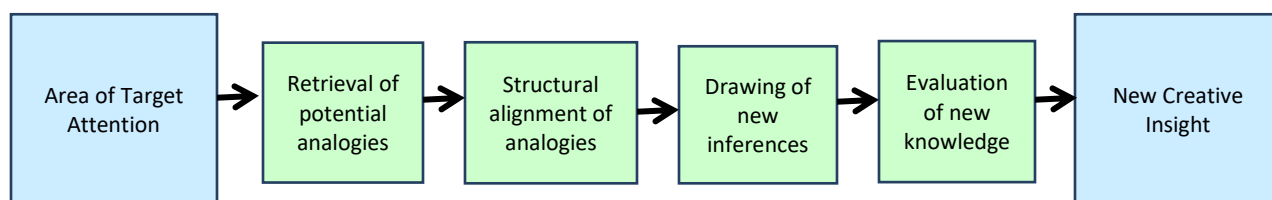
AR is the thought process whereby the human mind identifies relationship structures that exist in one domain, and then subsequently transfers and applies those relational commonalities to an entirely different domain (Holyoak *et al.* 1984). These relationship structures may involve functional (one to one) relationships, or higher-order (abstract) relationships such as causal chains, objectives and dependencies (Gentner *et al.*, 1989). Overcoming a lack of superficial similarity, analogy allows a lion taking cover from the midday sun under a tree in the African savannah, to be compared with a loving couple sitting beneath a beachfront parasol on the



Mediterranean. Connecting knowledge from disparate environments, AR enables fresh inferences to be drawn from structural commonalities (Gentner and Markman 1997).

Although the role of analogy had long been recognised in human cognition (Spearman, 1923; Piaget, 1950), scholarly understanding of analogy advanced significantly with Gentner's (1983) *structural mapping theory*. As laid out in Figure (6), analogical reasoning is generally regarded as having four component phases. Firstly, existing knowledge is identified, either as a consequence of being retrieved from memory, or serendipitously, by being stumbled upon as the focus of attention in the environment (Gick and Holyoak, 1980). Secondly, through a process of structural alignment, that knowledge is then prioritised according to its structural features and mapped across to the target situation under consideration (Gentner, 1983). Thirdly, fresh inferences are drawn from the structural similarities that exist between the different situations, serving to enhance understanding and open up fresh possibilities (Hofstadter and Sander 2013). And fourthly, the new knowledge which has been created is then evaluated in relation to its impact on the target situation or the task at hand (Gick and Holyoak 1983).

*Figure 12 – The creative process of analogical reasoning*



Although AR is commonly portrayed as a tool for explanation, legitimisation, and problem solving, the use of analogy is also recognised as an important means of cognitive creativity (Cushen, 2018). By harnessing distant and otherwise unrelated information from a ‘source’ domain, and bringing it to bear on the construction of a new idea in a ‘target’ domain (Ward and

Smith, 1995), analogy supports creative ideation by acting as a heuristic into the heart of what has been described as a problem solver's network of 'possible wanderings' (Amabile, 1997). Analogous examples have been shown to be far more readily accessible than abstract domain-general principles (Reed, 1987; Doumas and Hummell, 2008). When an appropriate analogy is identified, the concrete and familiar nature of the example supports people in focussing on the underlying principle which it illustrates (Ross, 1984; Ross and Kilbane 1997).

Accordingly, reasoning through analogy has been cited as a key creative engine in fields ranging from architecture (Casakin, 2019), to music (Moore, 1990), literature and poetry (Simecek and Rumbold, 2016), and management strategy (Gavetti *et al*, 2005). Within the history of science the creative use of analogy has been shown to lie behind scientific discovery (Oppenheimer 1958), including Darwin's theory of natural selection, Kekulé's unveiling of the ringed molecular structure of benzene, and Salvador Luria's Nobel Prize winning model into the resistant cultures of bacteria. Creative analogising has further been shown to inspire product innovation (Dahl and Moreau, 2002), variously attributed as lying behind Guttenberg's invention of the printing press, Bell's development of the telephone, and more recently with Brin and Page's conception of the Google search engine.

The inventive power that emerges from the incorporation of structural knowledge from more disparate fields can further generate insights for new entrepreneurial ventures (Ward, 2004). In 1985, having spent a fraught weekend trying to buy printer ink, Thomas Stemberg founded the stationery company, Staples, by applying the food retail model to the office supply market. In 2003, the online photo business, Shutterstock, was conceived by the application of the

subscription marketplace principle to problems within the stock photography industry. In the same year, the idea for the Skyscanner flight comparison site emerged through the transferral of search engine algorithms to what are now some seven trillion travel combinations a year. Subsequently developing into full blown entrepreneurial opportunities, and hugely successful global businesses, these examples provide anecdotal support for the role that creative analogy can play in the initial conception of NVIs.

### **4.3. Analogical reasoning and the generation of NVIs**

New venture ideation is the activity of creating, sourcing, or deriving ideas for new products, services, or business models (Flynn *et al*, 2011). It has been likened to that of ‘filling in’ the gaps of information between specific customer needs and a mental image of matching products or services that are not immediately visible (Dimov, 2007). Existing as cognitive products at the very first stage of entrepreneurial opportunity recognition, recent entrepreneurship literature has sharpened its focus on the origins of NVIs (Davidson, 2015). It has sought to delineate how these embryonic ideas first emerge, from their subsequent development into fuller venture opportunities (Vogel, 2017).

In the study of entrepreneurial cognition (Shaver *et al*, 1991; Mitchell *et al*, 2002; Grégoire *et al*, 2011), extant research has considered how different cognitive micro-foundations support the ideation of new entrepreneurial ideas. Past studies have looked variously at the role of prior knowledge (Shane, 2000), entrepreneurial experience (Ucbasaran *et al*, 2009); meta-cognition (Haynie *et al*, 2010), emotions (Campos, 2016), and behaviours (Dyer *et al*, 2008; Nicolaou *et al*, 2010).

Entrepreneurship researchers have also explored how particular cognitive mechanisms support entrepreneurial ideation. The power of cognitive mechanisms is said to be at its greatest in relation to those opportunities when demand is not given, and where a situation exists, that entrepreneurs should try and ‘do something about’ (Alvarez and Barney, 2007). Amongst others this has included the study of counterfactual thinking (Gaglio, 2004); user perspective taking (Wu, 2007; Prandelli *et al*, 2016); pattern recognition (Baron, 2006); conceptual combination (Ward, 2004), and bisociation (Ko, 2004). With creative success in entrepreneurship often attributed to the juxtapositioning of ideas from diverse and often unrelated domains (Fillis and Rentschler, 2010), Analogical Reasoning (AR) has been further referenced as a cognitive mechanism through which novel ventures can be created and commercialised (Cornelissen and Clarke, 2010).

Within entrepreneurship, AR has been described as an act of ‘creative imitation’ (Johanisson 2011), the cognitive act of adopting knowledge from a sphere that is familiar and using it in the construction of a new idea in a target domain (Phiri and Barnard 2018; Martins *et al*, 2015). As evidenced in past research on structural alignment, verbal protocol studies have observed the predilection for experienced entrepreneurs to reason through structural comparisons when contemplating potential new venture ideas (Grégorie *et al*, 2010), and when using analogy to strategically position their proposed ventures (Burnell, 2021). Nonetheless compared to the weight of attention given to analogy in other creative fields, AR still remains relatively underdeveloped as a creative mechanism that can power the ideation of first insights for new entrepreneurial ventures. Although scholars have previously considered how specific factors,

such as entrepreneurial intent (Grégoire and Shepherd 2012), experience of past business failure (Mueller and Shepherd, 2016), or a lack of sleep (Gish *et al*, 2019), impact upon an entrepreneur's ability to align structural relationships, notable research gaps remain.

As far as the author is aware, there has been no assessment of the potential qualitative benefits that AR can bring to the ideation of new entrepreneurial ventures. Where the cognitive mechanisms of counterfactual thinking, perspective taking and prospective thinking have all been empirically assessed in relation to the quality of New Venture Ideas that they generate (Frederiks *et al*, 2019), no such comparative analysis has yet been undertaken in relation to AR. Moreover, when it comes to the quality of the NVIs that are generated, there has been limited focus on what moderates the initial act of analogical retrieval.

Although past academic research on structural alignment has been weighted towards the behaviour of experienced rather than novice entrepreneurs, there have been calls for entrepreneurship students to be trained in the use of analogy when envisaging potential entrepreneurial opportunities (Garbuio *et al*. 2018; Ling and Chen, 2023). The impact of analogical training (alongside meta-cognition) has previously been explored in supporting the evaluation of profitable opportunities (Haynie *et al*, 2004). Yet when it comes to the preceding act of new venture ideation, there has been limited theoretical discussion around what form such analogical training might take, nor any empirical measurement of its actual efficacy. Accordingly, in relation to the use of AR to ideate for new NVIs, both in terms of the mechanism's potency, and in terms of the conditions which best support its efficacy, there would

appear to remain something of a research gap at the heart of town. This is the plot of land on which this study now looks to build.

## **4.4 A model of analogical reasoning in the generation of NVIs**

### **4.4.1 AR and the quality of NVIs**

In this section, this paper outlines the main effect of its model by highlighting how analogical reasoning enhances the quality of NVI generation. Although an NVI will likely be heavily refined post its initial conception, initial venture concepts all exude different characteristics, ones which in turn feed through into a range of, actor-independent, probabilistic effects (Davidsson, 2015). In this way, the quality of the initial conception inevitably has a bearing on what follows.

Across the extant entrepreneurship and innovation literature, the quality of a new venture concept has most commonly been assessed in terms of its novelty and usefulness (Gielnik *et al.*, 2012; Poetz & Schreier, 2012, Kier and McMullen, 2018). This in turn reflects two broader systematic literature reviews concluding that novelty and usefulness are the two most central measures used within academic scholarship to assess the quality of creative products (Plucker *et al.*, 2004; Dean *et al.*, 2006). In the context of this paper, it is contended that there are theoretical underpinnings to believe that AR generates NVIs that are high in both these characteristics. AR (a) engenders novelty by bringing additional non related information into consideration, and AR (b) supports usefulness by bringing information into contention which is often already proven in an alternative domain.

Opening up access to a far more diverse range of knowledge, particularly structural knowledge from a different context, drawing upon analogies provides fresh inferences and provokes (a) novelty. *Structural mapping theory* (Gentner, 1983) has been shown to cue people to think beyond the superficial situation that confronts them, thereby support the mind in accessing insights which are useful yet highly concealed (Schilling and Green, 2011). Where some cognitive techniques advanced as being relevant to entrepreneurship, such as ‘user perspective taking’, are constrained to the original domain under consideration, reasoning through analogy imports knowledge from alternate domains. Constituting a mental leap (Holyoak and Thargard, 1995), the use of analogy enables the mind to escape the process of linear thinking (De Bono, 1990).

Moreover, with analogical reasoning previously referred to in entrepreneurship as an act of ‘creative imitation’ (Johanisson 2011), ideas generated through AR demonstrate a preponderance of being (b) useful. By importing structural knowledge from other fields, ideas spawned through analogy, utilise systems of relations that are already operational and proven within a different context. So where entrepreneurial thought processes involving conceptual combination or bi-sociation involve the fusion of random knowledge in a process which might be more akin to a lottery, the use of analogy reduces uncertainty by drawing on knowledge from a distant yet similar problem setting (De Bono, 1990). By anchoring the creative process in something that is already known, and which often can be seen to work in an alternate context, ideas germinated through analogy frequently start with an inbuilt advantage in terms of their prospective viability.

As detailed in the earlier section, there is anecdotal evidence as to how a number of leading business ideas have emanated from the use of analogy. With the theoretical advantages offered by AR also appearing to be grounded in entrepreneurial practice, this study advances the following main effects in relation to the impact of reasoning through analogy in the initial conception of concepts for future entrepreneurial ventures:

*Hypothesis (1a) – The use of analogical reasoning results in the generation of NVIs that are higher in overall quality.*

*Hypothesis (1b) – The use of analogical reasoning results in the generation of NVIs that are higher in novelty.*

*Hypothesis (1c) – The use of analogical reasoning results in the generation of NVIs that are higher in appropriability.*

#### **4.4.2 The impact of analogical training on NVI quality**

The second aspect of this study's model looks to explore the conditions through which AR supports the ideation of high quality new venture concepts. In doing so, this study first considers how the use of AR might be positively moderated by the provision of analogical training. Generalising across criteria, settings, and target populations, a previous meta-analytic review of 70 studies has shown that creative training programmes can result in notable performance gains, particularly when those exercises focussed on the development of heuristics that supported their application (Scott *et al*, 2009). In the context of this study, it is contended that analogical training can work to make an individual more familiar with the practices that best support the use of AR, an activity which is regularly cited as being difficult to undertake.



Within the creativity literature, AR has shown the capacity to trigger considerable insights, yet the initial act of analogical retrieval, is said to typically fail to occur (Gentner, and Maravilla, 2018). To effectively reason through analogy, problems encountered in working memory must be linked to potent knowledge in long term memory (Ripoll, 1998). That knowledge resides beneath the level of conscious awareness (Hurst, 2019), such that anything within a person's memory pool might have potential relevance (Holyoak and Thagard, 1995). Remote or distant analogies, ones that may possess the most valuable structural similarity with the target situation under consideration, but which lack many of its superficial attributes, are rarely retrieved based on overlapping content (Goldwater and Jamrozik, 2019). Frustrating the identification of relationally potent comparisons, and the ensuing generation of creative solutions (Langley and Jones, 1998), there is an 'analogical paradox' in which there is disassociation between what is most accessible in memory and what is more useful in reasoning (Dunbar, 2001).

Labelled as a problem of 'inert knowledge' (Lancaster and Kolodner, 1987), these challenges in accessing relevant structural or relational information can be seen to play out in the public parlance around NVIs. For when encountering a new product or service for the first time, people can frequently be heard lamenting 'that is a good idea, why didn't I think of that'. Going beyond mere mental flagellation, such comments reaffirm how a multitude of different people possessed the very knowledge sources that were required to generate the same potent new idea. Yet without the appropriate recall and deployment of that knowledge from memory, they clearly failed to do so.

With these challenges in analogical retrieval constituting the primary cognitive bottleneck in the ability to effectively reason through analogy (Gentner *et al*, 2003), the theory of *late analogical abstraction* (Gentner *et al*, 2009) has advocated that the focus of attention should be on the ‘target’ situation under consideration. This has spawned a burgeoning number of potential cognitive interventions such as comparing two analogous cases (Gentner *et al*, 2009); creating secondary analogous problems or situations (Minervino *et al*, 2017); and fostering a ‘relational’ mindset (Goldwater and Jamrozik, 2019). In the context of creative ideation, as per the focus of this study, two target centred strategies are advanced as having particular salience in supporting analogical retrieval, namely (a) taking steps to abstract the underlying principles that exist in a target situation (Goldwater and Jamrozik, 2019), and then (b) consciously searching out for analogies (Trench *et al*, 2016).

Training people to abstract the underlying principles that exist in the target situation (a) can help people search memory for alternative knowledge which might have relevance to the target situation under consideration (Goldwater and Jamrozik, 2019). Within the literature on design thinking, previous studies have shown that abstracting a target situation according to its structural foundations, supports the subsequent search for analogies based on structural knowledge (Gassman and Zeschky, 2008). Abstracting the underlying schema of a ‘target’ situation, serves to diminish the primacy role of surface features, and act as a more effective probe to identify relational matches in memory (Trench *et al*, 2017). Meanwhile the action of deliberately searching out for analogies (b) has been shown to significantly increase the number of analogies retrieved. Indeed, one experimental study revealed that those in a control group who had been specifically prompted towards searching out for analogies, recalled ten times more analogies, than those in a similar but unprompted group (Trench *et al*, 2017).

Building on these theoretical insights, this research advances the proposition that an analogical training programme specifically designed to support analogical retrieval, is likely to improve the efficacy of AR in the early stages of entrepreneurial opportunity recognition. In response to a particular market or customer problem, it tenders that pro-actively encouraging individuals to abstract the underlying functional and operational characteristics of that situation, and then training them to deliberately search for these characteristics in an alternate domain, is a portable strategy that will enhance the quality of NVI undertaken through AR.

*Hypothesis (2a) - The relationship between analogical reasoning and the overall quality of NVIs is positively moderated by the receipt of training in analogical retrieval.*

*Hypothesis (2b) - The relationship between analogical reasoning and the novelty of NVIs is positively moderated by the receipt of training in analogical retrieval.*

*Hypothesis (2c) - The relationship between analogical reasoning and the appropriability of NVIs is positively moderated by the receipt of training in analogical retrieval.*

#### **4.4.3 The impact of prior market knowledge on NVI quality**

Finally this study seeks to observe the extent to which there is a moderating effect from the existence of prior market knowledge in the use of AR to generate high quality NVIs. Studies considering the entrepreneurial antecedents that support other cognitive mechanisms in the identification of entrepreneurial opportunities, whether that be pattern recognition (Baron, 2006) or user perspective taking (Prandelli *et al*, 2016), have all pointed to how prior market

knowledge amplifies the efficacy of a particular way of thinking (Rerup, 2005; Vaghley and Julien, 2010; Khin and Lim, 2018).

Although some scholars have suggested that prior knowledge can work to inhibit creativity (Ward, 2004), leave people in ‘mental ruts’ (Shepherd and DeTienne, 2005), and cause a cognitive fixedness which prevents people departing from existing paradigms or patterns (Dane, 2017, Gielnik et al, 2012), empirical studies have shown prior knowledge to act as a significant and positive predictor of the subsequent opportunities that are recognised (Siegel *et al*, 2012). When it comes to prior market knowledge in particular, studies have likened its existence to the wearing of ‘glasses’ that sharpen an entrepreneur’s vision (Arentz *et al*, 2012), suggesting it moulds the interpretative framework (Hajizadeh and Reza Zali, 2015), shapes mental schemas which set the perception of a market (Baron, 2006), and triggers recognition around the value of new information (Shane, 2000). Prior knowledge of customer problems has also been said to affect the innovativeness of ideas being identified (Shepherd and DeTienne, 2005), allowing people to know how to obtain or combine resources in ways which will best satisfy customer needs (Dew *et al*, 2009).

Within the context of AR, there are good reasons to presuppose that prior market knowledge could exude the same positive moderating relationship as seen with other cognitive mechanisms in entrepreneurship. Wider creativity studies into the operation of AR, point to how knowledgeable experts are more readily able to identify the most relevant structural comparisons, solving problems with low superficial similarity but high structural similarity (Gick and Holyoak 1983, Keane 1988). When it comes to the use of AR in entrepreneurship, it is

tendered that prior market knowledge will thereby improve understanding of the target domain in question, and in turn would characterise the entrepreneur as the aforementioned knowledgeable expert. Those with a higher knowledge of a particular domain will find it easier to access new structures because they have richer mental representations with which to work (Chi *et al*, 1981), something which in turn will lead to higher quality creative ideation.

In their earlier conceptual paper around the use of AR in opportunity recognition, Corneliesen and Clarke (2010) tendered the proposition that the degree to which an entrepreneur would use analogies when speaking about a new venture would be associated with the depth of their experience in the target market industry. Similarly, in two technology transfer opportunity situations, Grégoire *et al* (2010) found experienced entrepreneurs were more likely to work to align structural relationships when their prior market knowledge was higher. Echoing the findings observed across other cognitive mechanisms, there would thus seem good reason to expect prior market knowledge to have the same positive moderating effect on NVI quality in the context of AR.

*Hypothesis (3a) - The relationship between analogical reasoning and the overall quality of NVIs is positively moderated by prior market knowledge.*

*Hypothesis (3b) - The relationship between analogical reasoning and the novelty of NVIs is positively moderated by prior market knowledge.*

*Hypothesis (3c) - The relationship between analogical reasoning and the appropriability of NVIs is positively moderated by prior market knowledge.*

## 4.5. Methodology

### 4.5.1. Research Sample

This study garnered its participant pool, totalling some 110 individuals, from a mixture of undergraduate and master's students at Essex University Business School in England. The size of this cohort was comparable with a number of past experimental studies that have used MBA and business undergraduate students to study entrepreneurial opportunity recognition: Dimov (2007): 95 participants, Arentz *et al* (2012): 64 participants, Shepherd and DeTienne (2005): 78 participants. The study was advertised to students and they were invited to voluntarily participate. Those who did so were paid £20 for an hour of their time. Participating individuals were on average 24 years old (sd of 5.55); 52% were male and 48 % female; 34% were studying for a first degree, 41% had obtained a Bachelor's degree, and 25% had already obtained a Master's degree.

The act of conceiving New Venture Ideas is available to anyone within the general population. In particular, it is open to motivated first time Company founders and novice entrepreneurs, a population to which university entrepreneurship students are adequately said to reflect (McGee *et al.*, 2009). To confirm the validity of the research sample in this regard, at the end of the study, participants rated their 'determination to create a firm and set up a business in the future' on a 1 to 7 Likert Scale. The median response was found to be 6.0, (with 7 being 'Strongly agree', 6 being 'Agree', down to 2 being 'Disagree', and 1 being 'Strongly disagree'). With the students lacking previous professional experience, the use of this cohort also controlled for experience, including of past business failure and success (Arentz *et al.*, 2013).

### 4.5.2 Research procedure

In assessing its hypotheses, this research deployed verbal protocol analysis asking the 110 participants to ‘talk aloud’ during a series of business ideation exercises (Ericsson and Simon, 1993). Prevalent in psychological investigations, this methodology provides a window into the workings of the mind, and allows researchers to infer ‘a priori’ as to the cognitive processes being undertaken. It is less susceptible to failures in memory or contamination from additional information or emotions that might otherwise afflict post hoc inquiries. With the collection of rich contemporaneous data said to be one of the biggest challenges facing those looking at the origination of entrepreneurial ideas (Dimov, 2010), verbal protocol analysis was considered well suited to the focus of this research. As a research technique, it has previously been deployed in studies considering the use of analogy in design (Dahl & Moreau, 2002), as well as in past entrepreneurial studies on both AR (Burnell, 2021) and reasoning through structural alignment (Grégoire *et al.*, 2010; Mueller and Shepherd, 2016).

Prior to commencing the ideation task, the nature of a verbal protocol study was explained to the participants. Participants were walked through a practice verbal protocol exercise so as to establish greater familiarity with the notion of talking aloud (Ericsson and Simon, 1993). With the validity of verbal protocol analysis and its ability to effectively reflect a person’s stream of thoughts said to be heavily influenced by the rigour with which they are conducted (Green, 1998), care was taken by the interviewer to minimise interaction with each participant as they were talking aloud, thereby ensuring that the participants ‘do’ the thinking. In line with the recommendations of Ericsson and Simon (1993), each participant’s stream of thoughts was transcribed within 24 hours of the research session. Undertaken during the course of 2020 and

2021, this study was conducted in the midst of the global Coronavirus pandemic, and as such all verbal protocol studies were conducted over the Zoom technology platform. Without physical face to face contact, this approach anecdotally actually seemed to support the freedom with which people felt able to talk aloud.

In assessing a participant's ability to ideate for new venture possibilities, all participants were presented with four separate demand-led opportunity vignettes. Vignette 1 related to the problems faced by organisations employing lone workers. Vignette 2 related to the challenges faced by people in the process of buying replacement car tyres. Vignette 3 related to the difficulties faced by organisations in recruiting staff. Vignette 4 related to the burden faced by elderly people in taking their medication. The choice of research material provided through these vignettes was governed by a realisation that the opportunity situation needed to be readily understandable to the respondents, without the need for an advanced technical knowledge of each market in question. To ensure that the task reflected everyday life, the validity of the experiment was augmented by utilising vignettes that drew from real life opportunity situations, elements of which had been capitalised upon by companies found in the Inc 5000 List of fastest growing companies in the United States. The choice of the United States being deliberate, as it represented a geography from which the participants were not directly exposed.

Having read through each opportunity vignette, participants were asked, 'What opportunities for potential new business ventures sprung to mind from this situation'? Such an approach thus encouraged people to ideate for potential ventures based on their own pools of personal knowledge, knowledge that had been encoded naturally in everyday life. It is advanced that this



naturalistic approach, one in which participants generate analogies themselves, is the most conducive to analogical research (Dunbar, 2001). The participants continued to talk through each opportunity situation until they felt they had exhausted all possibilities.

### **4.5.3 Experimental manipulation**

Alongside assessing the respective quality of ideas that were generated with and without the use of analogy, and measuring the use of analogy in relation to the participant's levels of prior market knowledge, this study also sought to observe the impact of analogical training on people's ability to generate high quality NVIs. As such the participants' ideation activities were observed both prior and post a course of analogical training.

Analogical training was delivered through a single four minute video which the researcher shared with all the participants online. This training video involved a presenter talking over intermittent graphics that outlined two techniques drawn from the body of literature relating to *late analogical abstraction*, namely the merits in first abstracting a target situation, and then of proactively searching for relevant examples from other fields. Having talked through the principles involved, the video presenter demonstrated the benefits of using this approach with two concrete opportunity situations, one involving the problems with stained teeth, and the other with challenges in booking entertainment talent. To ensure sufficient professionalism in this course of training, the researcher commissioned the services of a local television reporter to present and produce the video. The fact that the training was delivered to all participants through the same standard video, ensured there was consistency in the intervention used within this experiment.

Similar to the approach used by Dahl and Moreau (2002) in their study on the use of analogy in product innovation, the course of training employed in this research, was explicit in its focus around analogy. The intervention did not therefore take the form of a conventional prime where the priming paradigm is unintended and can occur without awareness (Janiszewski and Wyer, 2013). The participants were not directly instructed to use the principles laid out in the video, nor did the researcher make any comment directly on the contents of the video. As per the approach of Dahl and Moreau (2002), participants were simply told that the intervention, in this case the video, was a useful guide to support creativity.

The course of analogical training was deployed after each participant had undertaken two ideation exercises, and prior to them then undertaking the remaining two ideation exercises. Participants in this study were split into two equally sized groups (Batch A and Batch B). Those in Batch A were first presented with Vignettes 1 and 2, before watching the video imparting the training in analogical retrieval, and then being presented with Vignettes 3 and 4. For those in Batch B, the procedure was inverted, such that they were first presented with Vignettes 3 and 4, before then watching the training video, and subsequently being presented with Vignettes 1 and 2. By splitting the participants into two equal batches and introducing this course of analogical training mid way through the four ideation exercises, it was possible for the research to control the impacts of the training across different vignettes.

At the end of each research session, the participants were asked to rate their response on a Likert Scale as to how much they had found themselves drawing on the training video in their ideation

of the subsequent third and fourth opportunity situations with which they were presented. This question was designed to assess the impact of the training video and thus augment the validity of the experimental intervention. The responses showed a mean response of 5.36 (sd of 1.22) in terms of the participants describing the use that they felt they had made of the video (with 7 being 'Strongly agree', 6 being 'Agree', 5 being 'Somewhat agree', 4 being 'Neither agree nor disagree', 3 being 'Somewhat disagree', 2 being 'Disagree', and 1 being 'Strongly disagree').

#### **4.5.4 Research measures**

##### **4.5.4.1 NVI Quality**

This study garnered a substantial amount of information around new venture ideation activity. With 110 participants each considering 4 separate opportunity situations (2 which were Business to Consumer, and 2 which were Business to Business), this generated verbal protocol transcripts that reflected cognitive activity across some 440 separate ideation sittings. 362 sessions generated one or more New Venture Ideas, with 78 sessions resulting in no ideas being generated. With other participants generating more than one NVI for each vignette situation, a total of 411 NVIs (Ideational Outputs) emerged from the 440 sessions. Sometimes, broadly the same NVI was referenced by multiple participants, such that the total output of this study resulted in 118 variant ideas. This comprised of 24 ideas relating to the lone worker vignette, 32 ideas relating to the tyre purchasing vignette, 34 ideas relating to the elderly person medication vignette, and 28 relating to the recruitment vignette. Each of the 118 new venture idea variants was given a unique idea code.

Given that the quality of a NVI will influence its later chances of success, this research assessed efficacy in ideating for new ventures by then measuring the quality of the 118 variant ideas that were conceived as part of the 411 Ideational Outputs. Given this study focussed on the relative quality of NVIs that were conceived, those 78 sessions that did not generate any NVIs were excluded from the data analysis. In assessing the quality of the NVIs that were generated, this research went further than just measuring the overall quality of an idea. It also sought to examine different characteristics of NVI quality, notably in terms of an NVI's novelty and its usefulness. Within the entrepreneurship and design literature, novelty is regularly perceived as being central to the quality of an idea (Baron, 2006, Davidsson and Tonelli, 2013, Gielnik et al, 2012), with an emphasis on value propositions that are unique relative to incumbents (Dyer *et al.* 2008). Novelty was judged by the extent to which each idea differed from that of existing market or industry norm. Usefulness on the other hand was observed through an idea's appropriability. Defined as the likelihood that someone would be able to capture returns from the exploitation of an idea (Davidsson and Tonelli, 2013), appropriability has been portrayed as the key reference point used by entrepreneurs in evaluating whether to pursue an entrepreneurial opportunity (Promsiri and Kunte, 2019).

Drawing from previous entrepreneurship research (Keir and McMullen, 2018), this study used three judges to rate the quality of each of the 118 New Ventures Ideas. Faced with the practical impossibility of testing out each idea, the use of qualified judges was considered the best possible proxy of its qualitative aspects. The background of the three judges, as multiple company founders, was deemed to qualify each judge to pass appropriate judgements. The three judges graded each idea on a scale between 1 and 7 (7 being Very High, and 1 being Very Low)

to reflect their assessment of each NVI's overall quality, novelty and appropriability. Using a consensual assessment technique (Amabile *et al*, 1996), the three scores given by each judge were then averaged together to yield a final score for each NVI across the three areas (overall quality, novelty, and appropriability). Across the 411 ideational outputs that resulted in an NVI being generated, the mean overall quality score of the NVIs generated was 3.27 (sd of 1.36, range of 1 to 6); the mean NVI novelty score was 3.20 (sd of 1.30; range of 1.0 to 6.0), and the mean NVI appropriability score was 3.45 (sd of 1.29; range of 1.0 to 6.66).

#### **4.5.4.2 Use made of analogy**

The extent to which a participant engaged in reasoning through analogy was measured by reviewing the transcripts of each participant. This approach was one previously used in studies that assessed the use of analogy in politics and laboratory experimentation (Blanchette and Dunbar, 2000). By using verbal protocol analysis to identify each participant's underlying cognitive processing, this research separated each person's transcript into segments, and then used a coding scheme to assess whether an analogy was present (Ericsson and Simon, 1993).

Within this study, a segment was deemed to represent a thought unit such that it involved a sentence or clause that conveyed a single idea or thought (Hensman and Sadler-Smith, 2011). To ensure that the use of analogy was in the context of creative ideation, rather than something drawn upon later to aid legitimacy, or provide understanding to an idea that had already been generated, the segments that were analysed only related to the parts of each transcript that ran up to the point where a relevant NVI idea was first identified by the participant. Each segment was

given a distinct number, and mapped to the code of the particular ideation output concerned. From the 411 ideational outputs reviewed, some 1,771 segments were put forward for analysis.

In terms of the coding scheme used to assess the existence of an analogy, coders were asked to consider whether an analogy was present with a simple Yes or No categorisation. In doing so, the coders were asked to look for statements that involved a comparison of two things. An analogy was deemed to be present when the segment of text, “used one thing in terms of another” to highlight the ways in which they are alike. This coding exercise was undertaken by two coders, both of whom had careers as journalists with well known news outlets in the United Kingdom. As such their familiarity with language and analysis was considered to make them suitable for the task. High levels of inter-rater agreement were achieved, with a weighted Cohen’s kappa of 0.879. In line with previous research (Shepherd and De Tienne, 2005), the two coders then met in person alongside the researcher, to discuss their points of difference in the coding. This led to them reaching a final decision as to whether an analogy was present in each segment.

In total, amongst the 411 ideation outputs, 100 were coded as including a segment that involved the use of an analogy (24.3%), whereas 311 (75.7%) were coded as not involving any segments that contained an analogy. Where an analogy was not used, the ideational output was coded (0), where analogy was used the ideational output was coded (1).

#### **4.5.4.3 Training in analogical retrieval**

Participants were then categorised according to whether each of their ideation outputs occurred prior or post the experimental intervention, namely them watching the analogical training video ('Without Training' (0), and 'With Training' (1)). For those in Batch A, the ideation sessions and ideas generated from Vignettes 3 and 4 were marked 'With Training', and the ideas generated from Vignettes 1 and 2 were marked 'Without Training'. The opposite categorisation applied to those in Batch B.

#### **4.5.4.4 Level of Prior Market Knowledge**

In each of the four vignette areas that they considered, the participants were asked to self report their level of prior market knowledge. In doing so they were asked to characterise their level of prior market knowledge on a scale between 1 and 7 (whereby 7 was 'Very High', 6 was 'High', 5 was 'Somewhat High', 4 was 'Neither High nor Low', 3 was 'Somewhat Low', 2 was 'Low', and 1 was 'Very Low'). The accompanying score of prior market knowledge was then applied to each of the related 411 ideation outputs. Across the vignette areas, the mean knowledge score of the participants was 4.11 (sd of 1.94).

#### **4.5.4.5 Control Variables**

At the conclusion of each one hour research session, the participants were asked a number of questions that sought to collect a range of control data to help support the validity of the study's findings. This control data sought to rule out the potential role played by other relevant inferences such that the study could determine that the focal independent variables were behaving as hypothesized in relation to the dependent variables being tested. Drawing on the control measures utilised by previous studies into entrepreneurial opportunity recognition, this

study controlled for the participant's age (Ucbasaran *et al.*, 2008) and gender (DeTienne and Chandelier, 2007) to account for the way in which differences in age and gender impacted on how individuals may ideate for NVIs. It further controlled for education level (Davidsson and Honig, 2003) to account for the effect that different levels of education may have upon the thought processes used in entrepreneurial ideation. Finally, given how motivation has been shown to correlate with the successful perception of entrepreneurial opportunities (Krueger and Dickson, 1994) such that it may be a primary factor in successful entrepreneurial ideation, this study further used a 7 point Likert Scale response (7 being 'Very High' and 1 being 'Very Low') to the statement 'I am determined to create a firm and set up a business in the future', to assess a participant's entrepreneurial intentions (Linan and Chen, 2009). Each of these control measurements were then married up to an individual ideation output.

## 4.6. Results

Table 13 displays descriptive statistics of the variables deployed in this study, and illustrates their pair-wise Pearson correlations. To estimate the results and to assess the significance of the hypotheses, hierarchical regression analysis was then performed. The estimations of this hierarchical linear regression model are reported in Table 2 for overall NVI Quality, Table 3 for NVI Novelty, and Table 4 for NVI Appropriability.

In the first model (Model 1), the study regressed the respective NVI dependent variables on the control variables, with the following results in terms of overall NVI quality ( $R^2 = 0.01$ ,  $F(4,406) = 0.55$ ,  $p=0.70$ ), NVI novelty ( $R^2 = 0.01$ ,  $F(4,406) = 0.76$ ,  $p=0.55$ ), and NVI appropriability ( $R^2 = 0.03$ ,  $F(4,406) = 0.26$ ,  $p=0.91$ ).



In the second model (Model 2), the study introduced the independent variable of reasoning through analogy in terms of its impact on overall NVI quality ( $R^2 = 0.11$ ,  $F(4, 406) = 10.19$ ,  $p < 0.01$ ), on NVI novelty ( $R^2 = 0.14$ ,  $F(5, 405) = 12.81$ ,  $p < 0.01$ ), and on NVI appropriability ( $R^2 = 0.10$ ,  $F(5, 405) = 8.84$ ,  $p < 0.01$ ). Undertaking Mann Whitney analysis, the study further compared the extent to which the use of analogy increased the overall quality of NVIs (Mean Rank without analogy = 183.76, Mean Rank with analogy = 275.17,  $p < 0.01$ ). The same was performed for NVI novelty (Mean Rank without analogy = 182.02, Mean Rank with analogy = 280.58,  $p < 0.01$ ), and NVI appropriability novelty (Mean Rank without analogy = 184.85, Mean Rank with analogy = 271.78,  $p < 0.01$ ). Put together, these results supported Hypothesis (1a), (1b) and (1c) such that NVIs generated through the use of analogy were shown to be disproportionately higher in NVI quality, in NVI novelty, and in NVI appropriability.

Secondly, the study tested for interaction effects between the receipt of training in analogical retrieval, and the quality of NVIs that were subsequently generated (*analogical training x analogy use* = -0.10,  $p = 0.45$ ), alongside that of NVI novelty (*analogical training x analogy use* = -0.18,  $p = 0.14$ ), and NVI appropriability (*analogical training x analogy use* = -0.10,  $p = 0.42$ ). It found that the receipt of analogical training had no significant interaction effect on the relation between the use of analogical reasoning and NVI quality. Although the quantity of analogies generated by the participants post the course of analogical training rose from 40 to 61, the experimental intervention failed to impact the quality of the NVIs being generated. It therefore failed to find support for the qualitative improvements hypothesised in Hypothesis (2a), (2b), or (2c).

Finally, the research next tested for the interaction effects between prior market knowledge, and the use of analogical reasoning in generating high quality NVIs. It found that prior market knowledge had no significant interaction effect on the relation between the use of analogical reasoning and overall NVI quality ( $bknowledge \times analogy \ use = 0.01, p=0.81$ ), NVI novelty ( $bknowledge \times analogy \ use = 0.03, p= 0.44$ ), or NVI appropriability ( $bknowledge \times analogy \ use = 0.03, p=.0.023$ ). Where prior market knowledge has been shown to be a potent moderator in relation to other cognitive mechanisms in the generation of NVIs, this was not the case with analogical reasoning. It therefore did not find support for Hypotheses (3a), (3b), or (3c).

In summary, the results of this research showed that the use of AR led to the generation of NVIs that were disproportionately higher in overall NVI quality, NVI novelty and NVI appropriability, thereby supporting Hypothesis (1a), (1b) and (1c). However despite the theoretical contentions, it did not find support for any positive moderating effect from the receipt of training in analogical retrieval, or the existence of prior market knowledge. This highlights a notable difference existing between the operation of AR, and that of other cognitive mechanisms reviewed in previous entrepreneurial studies around the ideation of NVIs. There was thus no support for hypotheses (2a), (2b), (2c) and (3a), (3b) or (3c).

## **4.7. Discussion**

The introduction of the ‘venture concept’ as a focal unit of analysis in the first stages of entrepreneurial opportunity recognition has allowed greater research clarity to be directed onto the way in which venture ideas first emerge (Vogel, 2017). To understand why some people

generate high quality NVIs, whereas others fail to do so, extant research has regularly turned to entrepreneurial cognition (Mitchell *et al*, 2002; Grégoire *et al*, 2011). Different cognitive mechanisms have previously been shown to influence the quality of the venture concepts that are generated (Frederiks *et al*, 2019). Hitherto though, there has been no qualitative assessment of the merits of reasoning through analogy.

Although entrepreneurship research has previously touched more widely upon the use of AR (Cornelissen and Clarke, 2010), this is the first study to directly assess the qualitative benefits of using analogy in the ideation of new venture concepts. Where earlier research has pointed to the preponderance for experienced entrepreneurs to reason through structural alignment (Grégoire *et al*, 2010), this study shows that when novice entrepreneurs deploy structural comparisons by drawing on analogies, this has a positive effect on the quality of their creative output.

Academic research in other domains, whether it be in poetry (Simecek and Rumbold, 2016) or architecture (Casakin, 2019), has shown AR to constitute a cognitive mechanism that can lead to powerful creative outcomes. This study now shows the same to hold true in the early stages of entrepreneurial opportunity recognition. Compared to the control condition, it found there to be a notable positive effect between the use of analogical reasoning and the quality of the NVIs that were generated. These findings further illustrate how cognitive differences between individuals, in this case the choice of cognitive mechanism that is deployed, influence the effectiveness of NVI generation (Davidsson, 2015).

**Table 13 - Descriptive Statistics analogical reasoning**

		<b>Correlations</b>											
		Mean	SD	1	2	3	4	5	6	7	8	9	10
1	X - NVI Quality	3.27	1.36										
2	X - NVI Novelty	3.20	1.30	*** 0.82									
3	X - NVI Approp	3.45	1.29	*** 0.92	*** 0.68								
4	Y - Used Analogy	0.24	0.43	*** 0.33	*** 0.37	*** 0.31							
5	Z - Analogical Training	0.5	0.5	0.00	-0.03	0.00	** 0.12						
6	Z - Knowledge	4.11	1.94	0.01	0.03	0.05	-0.04	0.03					
7	C - Intent	5.9	1.18	0.050	0.065266	0.02	0.04	-0.05	*** 0.18				
8	C - Age	24.26	5.92	0.02	-0.02	0.039	-0.02	0.00	*** 0.13	*** 0.22			
9	C - Gender	1.57	0.57	0.061	0.063	0.02	* 0.09	0.01	** 0.13	*** 0.29	0.05		
10	C - Education	1.88	0.78	0.03	0.01	0.04	0.02	0.01	*** 0.15	*** 0.25	*** 0.44	0.03	

\*\*\*. Correlation is significant at the 0.01 level (2-tailed). \*\*. Correlation is significant at the 0.05 level (2-tailed). \*. Correlation is significant at the 0.1 level (2-tailed).

**Table 14 – Regression results – Overall NVI Quality**

<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4
Analogy Use		*** 1.04	*** 1.05	*** 1.04
		0.15	0.15	0.15
Receipt of Analogical Training			-0.10	
			0.13	
Prior Market Knowledge				0.01
				0.03
<b>Control Variables</b>				
Age	0.00	0.00	0.00	0.00
	0.01	0.01	0.01	0.01
Entrepreneurial Intent	0.03	0.03	0.02	0.02
	0.06	0.06	0.06	0.06
Gender	0.12	0.06	0.06	0.06
	0.12	0.11	0.12	0.12
Education	0.04	0.03	0.03	0.02
	0.01	0.09	0.09	0.09
F-Statistics	0.55	*** 10.19	*** 8.58	*** 8.48
R-Squared	0.01	0.11	0.11	0.11
Adjusted R-Squared	0.00	0.10	0.10	0.10
Observations	411	411	411	411

Note: The coefficient estimates of independent variables are beta coefficient, and the standard error is documented in the row below. \*p <0.1, \*\* p<0.05, \*\*\* P<0.01

**Table 15 – Regression results – NVI Novelty**

<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4
Analogy Use		*** 1.09	*** 1.12	*** 1.10
		0.14	0.14	0.14
Receipt of Analogical Training			-0.18	
			0.12	
Prior Market Knowledge				0.03
				0.03
<b>Control Variables</b>				
Age	-0.01	-0.01	-0.01	-0.01
	0.01	0.01	0.01	0.01
Entrepreneurial Intent	0.06	0.06	0.05	0.05
	0.06	0.06	0.06	0.06
Gender	0.11	0.00	0.04	0.03
	0.12	0.11	0.11	0.11
Education	0.02	0.00	0.00	-0.01
	0.10	0.01	0.09	0.09
F-Statistics	0.76	*** 12.81	*** 11.06	** 10.76
R-Squared	0.01	0.14	0.14	0.14
Adjusted R-Squared	0.00	0.13	0.13	0.13
Observations	411	411	411	411

Note: The coefficient estimates of independent variables are beta coefficient, and the standard error is documented in the row below. \*p <0.1, \*\* p<0.05, \*\*\* P<0.01

**Table 16 – Regression results – NVI Appropriability**

<b>Predictors</b>	Model 1	Model 2	Model 3	Model 4
Analogy Use		*** 0.94	*** 0.95	*** 0.95
		0.14	0.14	0.14
Receipt of Analogical Training			-0.10	
			0.12	
Prior Market Knowledge				0.04
				0.03
<b>Control Variables</b>				
Age	0.01	0.01	0.01	0.01
	0.01	0.01	0.01	0.01
Entrepreneurial Intent	0.00	-0.01	-0.01	-0.01
	0.06	0.06	0.06	0.06
Gender	0.05	-0.01	-0.01	-0.02
	0.12	0.11	0.11	0.11
Education	0.04	0.03	0.03	0.02
	0.09	0.09	0.09	0.09
F-Statistics	0.26	*** 8.84	*** 7.47	*** 7.62
R-Squared	0.03	0.10	0.10	0.10
Adjusted R-Squared	-0.01	0.09	0.09	0.09
Observations	411	411	411	411

Note: The coefficient estimates of independent variables are beta coefficient, and the standard error is documented in the row below. \*p <0.1, \*\* p<0.05, \*\*\* P<0.01

This research study is also amongst the first to take up a recent entrepreneurial call to observe the impact of particular modes of thinking on different characteristics of NVI quality (Frederiks *et al*, 2019). In separately studying the effects of AR not just on overall NVI quality, but also on more specific components such as NVI novelty and appropriability, this research showed the impact of analogy to be multi-faceted. It reaffirmed the conceptual contention that the use of analogy separately imbues entrepreneurial ideation with both novelty and usefulness. This has obvious practical implications. For although an initial NVI will be heavily adjusted and refined in the course of any subsequent development, the stand alone quality of the initial conception inevitably has some impact on what will ensue. Representing a new means-ends relationships (Shane and Venkataraman, 2000), the qualitative aspects of NVIs are thus of clear interest to the field (Hayton and Cholakova 2012). Accordingly, entrepreneurs, business developers, and new product development teams, would all be well advised to consider utilising AR as they strive to come up with concepts for potential high quality new products and services.

Nonetheless, when it comes to the entrepreneurial conditions that might best support the use of analogy in generating high quality NVIs, the findings of this study are less clear-cut.

It was hypothesised that there were theoretical reasons to believe that analogical training, particularly that focussing on analogical retrieval, may support access to valuable analogies (Hypothesis 2a, 2b, 2c). To the extent that the number of times that analogies were deployed rose from 40 instances to 61 instances post the experimental intervention, there was partial support for the potency of training people in analogical retrieval. Yet in terms of the qualitative nature of these ideational outcomes, the results of this study failed to indicate an impact from



analogical training. Instead the findings appear to mirror those cognitive experiments which have suggested that without an appropriate cue, people struggle to retrieve 'relevant' relational knowledge at apposite times (Ross, 1984; Sternberg and Nigro, 1980).

Within the wider cognitive literature, the seminal demonstration of these difficulties with AR is most commonly illustrated through an experimental design which considers the challenges in treating a tumour through radiation (with the dangers posed by excessive rays), and the potential relationship between that problem, and the analogy of how a well defended military fort might be attacked from multiple angles (Gick and Holyoak, 1983). Even when the two problems are presented within the same experimental session, it has been shown that over two thirds of the subjects fail to retrieve the analogy from the military problem (Finlayson and Winston, 2006). Indeed, in the face of extreme manipulation, where people's thought processes are interrupted and they are directly questioned about the military problem, there were not found to be notable improvements in analogical retrieval compared to the control condition (Anolli *et al*, 2001).

Although the possibility remains that the disproval of hypotheses (2a, 2b, 2c) may be a function of the format of the analogical training provided in this study, the findings suggest that within an entrepreneurial context, any expectation that training people in analogical retrieval will yield higher quality results, may be problematic. This has implications for the wider debate around the merits of entrepreneurship education programmes that seek to provide creativity training, notably that around design cognition. Conceptually it has been tendered that analogical training could form part of entrepreneurship training programmes around the early stages of opportunity recognition (Garbuoi *et al*, 2018, Ling and Chen, 2023). However, the results of the training

intervention deployed in this study, would seem to proffer some caution around this approach. In this case, providing brief training in analogical retrieval, failed to show itself as a silver bullet to support NVI quality through the use of AR.

Finally in terms of the moderating potency of prior market knowledge to the use of AR and the generation of high quality NVIs, the results of this study contrast with recent theoretical conceptions about the potential moderating role for prior market knowledge in the conception of NVIs (Khin and Lim, 2018), one that has previously been empirically observed by people studying the entrepreneurial antecedents lying behind user perspective taking (Prandelli *et al*, 2016). On first glance, the 118 different venture concepts generated by the 110 participants, might appear to illustrate how idiosyncratic knowledge profiles manifest themselves in a wide range of possibilities in the early stages of opportunity recognition. Yet when differences in prior knowledge profiles relating specifically to the market area under consideration were observed (Hypothesis 3a, 3b, 3c), there was no positive moderating effect with the quality of ideation undertaken through the use of analogy.

The lack of a qualitative impact for 'prior market knowledge' found in the ideation of NVIs through AR is instead likely to be attributed to the way in which this particular cognitive mechanism operates. Previously, prior market knowledge has shown itself to be significant in those entrepreneurial opportunity recognition situations where the direction of information search is known, particularly in discovery or arbitrage situations (Arentz *et al*, 2013). In comparison, AR is an altogether more creative activity, one where the sources of structural knowledge brought into consideration are unexpected, and regularly spreads far beyond the domain in

question. To this extent, the findings of this study reaffirm those suggestions from cognitive science which argue that to be effective in the use of AR, someone just requires working knowledge rather than a more detailed expertise of the target situation (in this case, the market area) on which they are focussing (Dunbar, 2001).

Mirroring extant research from the innovation literature (Franke *et al*, 2014), the lack of impact from prior market knowledge seen in this study, would appear to add weight to the suggestion that the use of near analogies (typically more related to the domain in question) have far less creative potential than the use of far analogies (from further afield domains). In the context of analogical reasoning at least, this provides support for those who have previously argued that the breadth and depth of an entrepreneur's knowledge structure are conceptually independent (Hitt, 2002). Pointing to the specific characteristics involved in the use of analogy, the findings of this study illustrates the heterogeneity of the antecedents that exist between different cognitive modes of thinking in the early stages of entrepreneurial journey.

When put together, the findings of this study are somewhat paradoxical. On one hand they suggest that the use of an analogy has a notable positive impact on NVI quality. However, in contrast to what has been observed across some other cognitive mechanisms, in the case of AR, that relationship is not positively impacted by the depth of prior market knowledge. Although training in analogical retrieval can lead to an increase in the number of analogies being generated, its findings point to the difficulties incumbent in expecting training to impact upon the qualitative efficacy of analogical reasoning. This suggests that the qualitative gains from

analogy are likely to be more reliant on chance connections or natural reasoning ability, than anything that can be formally taught.

#### **4.8. Limitations and recommendations for future research**

There are challenges in replicating entrepreneurial ideation in a mass test environment, and whilst the design framework in this study does yield ample comparable data, it intrinsically encounters certain limitations.

Unlike the assessment of people's own idea sets (Hill and Birkinshaw, 2015), the use of standardised vignettes proactively directs the participants to the area in which they are expected to ideate. Downplaying the potential interaction with environmental effects, this approach fails to account for the potential 'alertness' of the participant in reacting to chance encounters or unexpected events (Archdivilli and Cardozo, 2000). Similarly, the requirement for the participant to ideate, immediately after being presented with a particular customer challenge, ignores the role played by so called 'slow hunches', ones in which thoughts incubate and ideas emerge after a longer period of reflection. For its validity to be extended, the findings of this study would benefit from being assessed within a longitudinal design. Future research should also incorporate opportunity situations that move beyond those which are demand led, so to compare the effect in opportunity situations which are supply driven, most notably considering the application of different technologies.

The findings of this study have also been drawn exclusively from a pool of business undergraduate and postgraduate students, one considered to suitably replicate a population of

nascent entrepreneurs. Reflecting new entrants into entrepreneurship, how nascent entrepreneurs conceive new ideas, is itself a relevant area of investigation. Yet when it comes to the ideation of new venture concepts, it has previously been suggested that there is a marked contrast between nascent entrepreneurs and experienced entrepreneurs, the latter of whom are said to possess more refined cognitive frameworks (Baron, 2006) and developed expert schemas (Valliere, 2013, Ucbasaran *et al*, 2009). This distinction may have particular salience in the context of analogy, where cognitive science has also suggested that experts (ie: experienced entrepreneurs) may have advantages in structural recall (Finlayson and Winston, 2006). Going forward, there would thus seem particular merits in observing the impacts of AR on NVI quality in tandem with a population of experienced entrepreneurs.

Moreover, where this study has measured the broader impact of analogy on the subsequent quality of entrepreneurial ideation, no empirical analysis has been undertaken around the type of analogies being deployed. Analogies are regularly described by their position on a continuum ranging from ‘near’ at one ‘extreme’ to far at the other (Gentner and Markman, 1997). Future research into the use of analogy within new venture ideation would benefit from measuring the qualitative impact in relation to the analogical distance involved. In particular, it would be interesting to observe whether those NVIs generated through AR with the highest quality scores, drew upon analogies that were furthest away from the target domain in question. Accordingly, rather than measuring prior knowledge as encapsulated in the depth of knowledge around the target market area, in the future it may be more beneficial to measure and observe the impact of prior knowledge in terms of its breadth (Lettl and Gemuenden, 2005).

The analogical training programme in this research was based upon recent cognitive scholarship highlighting the aptness of interventions focussing on the target domain. However, the time constraints involved in each individual research session, meant that this study was inevitably constrained by the thoroughness through which that training intervention could be delivered. Given how the AR training deployed in this study didn't result in the kind of pronounced effects that were expected, it may be interesting to test these findings with courses of analogical training that were structured differently. With previous entrepreneurship research pointing to the benefits of experiential learning (Corbett, 2007), it would be interesting to see if alternative and longer forms of analogical training altered the findings of the study.

Finally, any future research agenda around the conditions that most positively support the impact of AR on NVI quality may be advised to look further than the two (disproved) moderators considered in this study. Although it was not shown to have any effect as a control variable in this study, the role of 'entrepreneurial intention' may warrant more explicit investigation. As has been previously suggested with bisociative thinking (Adcroft, 2004), entrepreneurial intent may have a bearing on the extent to which a nascent entrepreneur may be prepared to exert the cognitive effort required to effectively perform AR. Similarly, meta-cognitive experience, potentially allied to experience of a dynamic environment, may have an influence on the mapping of analogy, something that could again feed through into qualitative effects. And with previous research showing how person centric cognitive aptitudes such as intellectual fluidity and ideational fluency impact on the quality of NVI ideation (Chapter 3), it would be informative to understand how variances in cognitive aptitudes might interact with the qualitative output of using AR.

## 4.9. Conclusion

With every entrepreneurial opportunity having an initial idea as its progeny (Dimov 2007), successful ideas have been described as the ‘lifeblood of entrepreneurship’ (Ward 2004). Research into how NVIs emerge in people’s minds, and upon the cognitive mechanisms that impact upon their quality, is therefore central to the wider study of entrepreneurship (Baron, 2004). Analogical reasoning has previously shown itself to be a powerful cognitive engine across a range of wider creative domains. This study, focussing on the use of AR at the creative beginnings of entrepreneurship, adds to that wider body of literature. In the very first phase of entrepreneurship, it finds there to be a similar positive effect between the use of AR and the generation of NVIs that are high in quality.

Yet when exploring the conditions that support that aforementioned relationship, this research found the use of analogy to be somewhat elusive. The quality of the NVIs that were generated through analogy, neither benefited from the possession of high levels of prior market knowledge, nor from the ideating individual being trained in techniques with the potential to support analogical retrieval. As such, even if the bundle of keys marked analogy has direct relevance to the ideation of high quality new ventures, retrieving the specific key which unlocks the door, would appear to remain altogether more challenging.

## **5. Conclusion**

### **5.1 The debate around nature or nurture**

Whether the focus of attention is on elite sport or criminology, tensions between the role of nature and nurture pervade most aspects of everyday life. Frequently characterised as offering competing visions for the determinants of fate, there is said to be a jostling between forces that stress the importance of biological pre-wiring, and those which emphasise the significance of environmental exposure, experience, and learning. Evidenced as far back as 209 BC in the Qin dynasty's ponderings around what led to the emergence of a great military commander, and again in Shakespeare's Elizabethan era writings about the devil in 'The Tempest', this is not a new debate.

Since the start of the twenty first century, leading biologists have sought to push back against the conventional nature versus nurture squabbles, arguing that a person's characteristics are influenced by both biological and experiential factors (Robert, 2004; Jablonka and Lamb, 2005; Lickliter, 2008; Bateson and Gluckman, 2011; Lewkowicz, 2011). In doing so, an analogy has been drawn with the internal combustion engine. Given that a combustion engine requires the existence of both fuel and an ignition spark to actually function, there is said to be little point in debating which of the two has the strongest effect on the function. Playing down the oppositional character of the forces, debates between nature and nurture have therefore been characterised as false competitions for supremacy (Moore, 2011). Instead, the emphasis has switched to how genetic and environmental factors collaborate to build traits and skills (Lewkowicz, 2011). Biologists have increasingly highlighted how genes only express their



products in specific contexts, such that the genome is reactive to a particular set of circumstances (Gilbert, 2003). They have also pointed to how hormones and chemical messengers, such as testosterone, serve as further non-genetic influencing factors.

Nonetheless, despite these recent advances in biological scholarship, in many wider fields, the headline debate around ‘nature’ and ‘nurture’ persists as a proxy for discussions as to the extent to which a person’s characteristics and skills can be trained. In the field of entrepreneurship, this is most typically encapsulated by the question as to whether entrepreneurs are ‘born’ or ‘made’. It is a colloquialism that strikes at the heart of the extent to which a person’s entrepreneurial ability is a function of their inborn characteristics. Past surveys have suggested that this is not a matter upon which the general population itself has formed a definitive view. In 2014, an Amway report<sup>4</sup> asked over 43,000 people in 38 countries whether they thought entrepreneurs were ‘born’ or if their entrepreneurial skills could be acquired. Some 37% of respondents, rising to 39% in the UK and 60% in Japan, believed that entrepreneurs were simply born. Moreover, when the expert eyes of entrepreneurial scholars have been applied to the same question, the answer has not come back as any more clear-cut.

Boxing out of one corner of the entrepreneurship scholarship ring, there has been long standing support for the notion that entrepreneurial skills are innate (Gartner, 1988; Shook et al, 2003). A number of scholars have stressed the importance of an entrepreneurial personality (Chell, 2008), and used heritability studies to emphasise the genetic basis of entrepreneurial behavior (e.g.,Shane and Nicolauo, 2013). In the opposite corner, an alternative party of protagonists have

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<sup>4</sup> Amway Global Entrepreneurship Report, 2014: [https://www.amwayglobal.com/wp-content/uploads/2017/09/141016\\_ager\\_2014\\_publication\\_final.pdf](https://www.amwayglobal.com/wp-content/uploads/2017/09/141016_ager_2014_publication_final.pdf)

played down the role of genetic influences. These researchers muse how once successful companies have often been run into the ground by the genetic descendents of the original founders. They suggest that in a field as complex as entrepreneurship, the causal chains through which genes influence human behavior, are far too long for genetic variations to account for anything but a small proportion of behavioral variability (Chabris et al., 2015). Where certain disciplines like sport may well require an inherent physical talent, entrepreneurship it is claimed, relies more on taking good decisions, the possession of passion, a willingness to work hard work, and the use of knowledge that develops from experience (Baron and Henry, 2010, Sarasvathy, 2008). Drawing attention to the fact that entrepreneurs are not simply one homogenous social group, scholars also warn about the dangers of confounding what leads people into entrepreneurship, from an assessment of what makes a particular individual an effective entrepreneur (Forbes, 2017).

These ‘nature’ or ‘nurture’ tensions afflict deliberations across the entrepreneurial process. They integrate themselves into discussions around what impacts upon a particular person’s attitude to risk (Bernat et al, 2016), or someone’s ability to inspire and lead and inspire an entrepreneurial team (Shane, 2010). As has been the focus of this particular study, they also spill over into the question of whether certain people have a ‘special talent’ which uniquely allows them to succeed in generating high quality New Venture Ideas (NVIs).

## 5.2 The findings of this research

Through its three separate investigations, this study has sought to build evidence around the overarching research question as to whether the generation of NVIs by novice entrepreneurs is a question of nurture, something that develops and which can be proactively and beneficially supported, or one of nature, reflecting a person's intrinsic capabilities or talents. Concentrating on novice entrepreneurs, a group bereft of those benefits of nurture that come from past entrepreneurial experience, this research has inevitably concentrated on the extent to which opportunity identification skills can be proactively taught and developed.

Within entrepreneurship this remains a disputed question, with some claiming such skills to be un-teachable (Saks and Gaglio, 2002; Dimov, 2017), and others believing that they can be actively enhanced (Munoz *et al*, 2011; Breslin and Jones, 2014; Hou *et al*, 2022).

In looking to answer this question, the findings presented in Chapter (2), themselves a function of the actual empirical studies previously conducted in this area, point heavily to entrepreneurial ideation being a skill that can be cultivated. Although it is fair to argue that the longitudinal benefits emanating from entrepreneurial education programmes remain under-assessed, Chapter (2) confirms the potency of 'nurture' in supporting novice entrepreneurs as they seek out ideas at the fuzzy front end of their entrepreneurial journey. Whether emanating from the positive impact engendered from passion and creative self-efficacy (Gielnik *et al*, 2017), through the development of knowledge around the characteristics of the 'opportunity prototype' (Costa *et al*, 2018), or the way in which people are directed to ideate in areas where they can most fruitfully deploy their prior expertise (Fiet and Patel, 2008; Cohen *et al*, 2021), Chapter (2) further

provides an indication of how the positive impact of EET is manifested. As suggested by the *theory of entrepreneurial cognition*, the research findings from Chapter (2) confirm that many of the mental frameworks considered to lie behind the successful generation of Venture Ideas (as per the literature review in Chapter (1)), can indeed be nurtured.

Building from the same literature review contained within Chapter (1), this study next considered two separate knowledge gaps within the wider cognitive landscape surrounding the generation of NVIs by novice entrepreneurs. Dovetailing with the recommendations for future research made in Chapter (2), both of these investigations also related to aspects that have been largely unexplored in discussions around the wider potency of EET programmes in supporting entrepreneurial ideation. Chapter (3) considered the importance of person level aptitudes with executive functioning, whilst Chapter (4) considered the impact on qualitative impacts that emanate from the use of a particular cognitive heuristic, analogical reasoning (AR), and the extent to which the efficacious use of that mechanism was moderated. In their own right, the empirical data spawned by these fresh studies makes a contribution by further adding to the existing knowledge pool on the cognitive micro-foundations influencing NVI quality, and the reasons why one particular individual may be more likely to come up with a higher quality NVI than another.

Moreover, findings from this study's subsequent research into these two previously unexplored cognitive micro-foundations feed through into the wider debate on the role of nature and nurture at the start of the entrepreneurial journey. Indeed they provide a somewhat conflicting narrative to that advanced in Chapter (2). Highlighting the importance of cognitive capabilities with

executive functioning, innate aspects of general intelligence that are regarded beyond the reach of specific training (Chen *et al*, 2020), Chapter (3) evidenced one area in which ‘nature’ still remains very much relevant to discussions around opportunity identification. Whilst focussing on the use of analogy in the generation of high quality NVIs, Chapter (4) separately demonstrated the importance of the individual cognitive mechanism being deployed. Indeed, where recent conceptual analysis has championed the potential of training entrepreneurship students in the use of design cognition, including the application of analogy when identifying opportunities (Garbuio *et al*, 2018; Ling and Chen, 2023), these contentions were not supported by the empirical examination within Chapter (4). Demonstrating the potential elusiveness of effective analogising (Gentner, and Maravilla, 2018), the findings of this research caution expectations around the extent to which ‘nurture’ can impact qualitative outcomes in the creative use of this powerful cognitive heuristic within entrepreneurship.

In the wider nature versus nurture debate, the scholarly writings of biologists over the last two decades have become increasingly accepting of the notion that given characteristics are influenced by the circumstances in which a person develops (Moore, 2013). Nonetheless they also observe how there are always certain factors that are far more likely to be influenced by nurture than others. For example in matters of obesity, it is clearly easier to influence a particular person’s diet or exercise regime, than it is to change their possession of the FTO gene which has also been linked to weight gain. This has led to calls for the nature-nurture question to be rephrased as one that considers the malleability of particular traits (Keller, 2010).

Developing upon this stream of thought within the context of entrepreneurial ideation, Chapter (2) first showcased how a range of previously identified cognitive antecedents are capable of being nurtured. Yet the micro-foundations freshly explored in Chapters (3) and (4) evidence that not all cognitive antecedents are quite so susceptible of being proactively developed. Highlighting how quality entrepreneurial ideation is also contingent on the potency of the information brought into a particular creative cognitive deliberation, it illustrates that accessing the most potent prior knowledge at the most apposite time, is not an activity which can so easily be taught and developed.

Mirroring the recent biological discussions around ‘nature’ or ‘nurture’, these contrasting findings within entrepreneurship, lead to the overall theoretical contribution of this study.

The findings from this particular thesis, suggest that in the context of entrepreneurial ideation, debates around the competing roles of nature and nurture are misplaced. Rather than being mutually exclusive, influences from both nature and nurture are shown here to support high quality entrepreneurial ideation. Instead the findings of this study point to the appropriateness of a more nuanced approach. Going forward, entrepreneurship researchers should consider the malleability of individual cognitive micro-foundations, such that in this regard, different cognitive micro-foundations can be seen to be far from equal. Despite the positive technical, motivational, and even behavioural impact that EET programmes can offer at the ‘fuzzy front end’ of entrepreneurial journey’, this study reaffirms how there are still boundary limitations to the impact of such nurturing interventions. In the generation of high quality NVIs, it reaffirms

how the cognitive ability to access the most potent prior knowledge during the creative process, is something that is altogether harder to train.

### **5.3 Limitations and future research**

In taking this study forward, future research has the opportunity to develop upon the individual findings and structure of the three respective individual papers in this study, as well as advance the overall observations emanating from its research.

Firstly, as detailed in each of the studies found in Chapters (2), (3), and (4), there are certain methodological limitations in the approaches that have been used. The systematic literature review in Chapter (2) is a prisoner of the relatively compact volume of empirical studies that have previously been produced. Whilst the research showcased in both Chapters (3) and (4) involved ideational exercises that required the participants to generate ideas within a confined timeframe, and in response to situations (vignettes) that were already pre-identified for the participants. The course of training in analogical retrieval provided to the participants in Chapter (4), also related to an intervention that was time constrained and failed to give the participants the chance to practice through experiential learning.

Against the background of these methodological limitations, the findings would benefit from further validation through empirical designs that look to address these aforementioned constraints. In observing the impact on ideational behaviour, this would in particular involve the use of studies that take a longitudinal approach, assessing idea generation and the effects of cognitive interventions over a longer time period. Similarly, where this research has majored on

the quality of ideas produced, it would be instrumental to observe the effects of the different interventions on the quantity of ideas being generated. In order to reaffirm the findings garnered from assessing the impact of training people in design cognition, future research should also observe the impact of analogical training interventions that are potentially more extensive than the (Covid induced) approach deployed within this study. Should data collection have been undertaken simultaneously from a larger number of participants in a laboratory setting, the time would have existed to provide a longer overview of analogical reasoning, and to allow the participants to engage experientially in techniques relating to the creative use of analogy, before applying it to entrepreneurial ideation.

In the future, there would also be merits in observing the effects of this study across a wider research sample. Although business students have been considered an apt proxy for a population of novice entrepreneurs (McGee et al, 2009), it would be informative to undertake the same research with those who express entrepreneurial intent, but who are outside the remit of business education programmes. This could involve a participant pool from the general population or students on other university courses. With ideational differences having previously been shown to exist between novice and experience entrepreneurs (Ucbasaran et al, 2009), it would also be interesting to compare the cognitive capabilities around executive functioning possessed by experienced and successful entrepreneurs with those of the aspirant novices. Similarly it would be informative to explore the relative extent to which experienced and novice entrepreneurs deployed analogical reasoning in their ideational approach.



Secondly, in terms of taking this research forward, this study provokes new questions that now sit alongside the specific sub research questions that it has sought to answer. Chapter (3) has moved the field forward by considering different sub components of general intelligence, namely memory retrieval and intellectual fluidity. The fact that this approach finds evidence of an effect on NVI quality suggests that there is a case for observing whether there are other person centric cognitive capabilities, such as working memory or processing speed, which may also constitute relevant micro-foundations in the generation of New Venture Ideas. In a similar vein, the evidence produced by this study has added analogical reasoning, to the likes of perspective taking (Prandelli et al, 2016) and empathy (Sekiguchi and Khalid, 2018), as a cognitive mechanism now subject to empirical scrutiny in the generation of NVIs by novice entrepreneurs. Complementing this repertoire, future empirical studies could beneficially further assess the individual impact of other cognitive techniques such as abductive reasoning, pattern recognition, and mental simulation.

Thirdly, in the context of this study's wider focus on the extent to which novice entrepreneurs can be supported in the ideation of quality NVIs, future research has the potential to build on the collective findings. Rather than considering the more generic and potentially false question concerning the varying contribution of nature and nurture, those looking to consider the extent to which entrepreneurial ideation can be developed, should instead focus on the malleability of individual cognitive micro-foundations. Future research into individual cognitive antecedents of quality NVI generation should therefore explicitly consider both how, and the extent to which, that antecedent can be trained. Whilst collectively, knowledge would be advanced by some

further assessments of the relative extent to which each different cognitive micro-foundation can indeed be developed.

## **5.4 Concluding thoughts**

As was laid out in Chapter (1), the ability to generate high quality NVIs is an important first step in the entrepreneurial process. Those excelling in entrepreneurial ideation are more likely to establish their own business (Feldman and Bolino, 2000) and be more successful in doing so (Ames and Runco, 2005). Those coming up with ideas that are high in originality are more likely to start ventures that possess greater strategic and financial potential (Kavanagh and Hisrich, 2010), a differentiated competitive advantage (Shepherd and DeTienne, 2005), and a first mover advantage (Dahlqvist and Wikland, 2012). To this extent, understanding how innovative ideas emerge and how they lead to commercialisable opportunities is central to the field of entrepreneurship (Baron, 2006, Short et al, 2010).

The origination of entrepreneurial ideas, with the interaction between a candidate thought and the individual progenitor, has been compared to the conception of a human embryo (Gartner and Katz, 1988). Whether it involves active search, an ongoing courtship, or a serendipitous encounter, academic research had sought to explain the ‘fleeting circumstances’ that bring the two together at the start of the entrepreneurial journey (Dimov, 2010). Whichever of these routes is followed, the question remains as to what can be done to increase a novice entrepreneur’s chance of success in the endeavour. This question has obvious personal relevance to the aspirant entrepreneur involved, as well as to the network of educational institutions that exist to support

this cohort, and indeed to any society seeking to support those looking to break out and create new 'means-ends' relationships.

Historically the academic literature suggested that there was a lack of consensus around the extent to which entrepreneurial ideation capabilities can be developed (Carrier, 2007). However the review of the related empirical evidence conducted in Chapter (2), now points to a larger body of thought suggesting that the entrepreneurial ideation capabilities of novice entrepreneurs can be proactively nurtured. Nonetheless, mastering the art of generating a NVI remains far from a linear skill. It is not one that progresses from one stage to another, akin to learning how to bake a cake or improve a golf swing. Each burst of imagination that lies behind the conception of a New Venture Idea is highly contextual, such that generating NVIs that are high in potency remains a relatively rare occurrence.

In the discussion around whether the generation of a New Venture Idea is an innate skill or an aptitude that can be proactively trained, this study has illustrated how it is wrong to view the influences of nature or nurture as competing extremes. Cognitive micro-foundations that are grounded in 'nature' and 'nurture' have both been shown to contribute to ideational outcomes. Accordingly, this study calls for a reframing of the current debate on whether entrepreneurs are born or made, such that future research should instead focus on the malleability of individual cognitive micro-foundations. Transferring this approach to education and training programmes considering entrepreneurial ideation would ensure that such 'nurturing' interventions focus upon those cognitive antecedents evidenced to be the most susceptible to improvement. To the extent to which the 'Eureka' moment is indeed trainable, this very much looks like the rubric to follow.

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# Appendices

# A. Research Project Paperwork

## A1. Ethical approval form

### Application for Ethical Approval of Research Involving Human Participants

This application form must be completed for any research involving human participants conducted in or by the University. 'Human participants' are defined as including living human beings, human beings who have recently died (cadavers, human remains and body parts), embryos and foetuses, human tissue and bodily fluids, and human data and records (such as, but not restricted to medical, genetic, financial, personnel, criminal or administrative records and test results including scholastic achievements). Research must not commence until written approval has been received (from departmental Director of Research/Ethics Officer, Faculty Ethics Sub-Committee (ESC) or the University's Ethics Committee). This should be borne in mind when setting a start date for the project. Ethical approval cannot be granted retrospectively and failure to obtain ethical approval prior to data collection will mean that these data cannot be used.

Applications must be made on this form, and submitted electronically, to your departmental Director of Research/Ethics Officer. A signed copy of the form should also be submitted. Applications will be assessed by the Director of Research/Ethics Officer in the first instance, and may then passed to the ESC, and then to the University's Ethics Committee. A copy of your research proposal and any necessary supporting documentation (e.g. consent form, recruiting materials, etc) should also be attached to this form.

A full copy of the signed application will be retained by the department/school for 6 years following completion of the project. The signed application form cover sheet (three pages) will be sent to the Research Governance and Planning Manager in the REO as Secretary of the University's Ethics Committee.

1. Title of project:

The cognitive formation of New Venture Ideas - The role of moderators in supporting processes of analogical reasoning.

2. The title of your project will be published in the minutes of the University Ethics Committee. If you object, then a reference number will be used in place of the title.  
Do you object to the title of your project being published? Yes  / No

3. This Project is:  Staff Research Project  Student Project

4. Principal Investigator(s) (students should also include the name of their supervisor):

Name:	Department:
William Bracken PhD Research Student	Management Science and Entrepreneurship Group Essex University Business School
Dr Jun Li (Supervisor)	Management Science and Entrepreneurship Group Essex University Business School

5. Proposed start date: May 2019

6. Probable duration: 3-4 Months

7. Will this project be externally funded? Yes  / No   
If Yes,

8. What is the source of the funding?

8. Is external approval required for this project? Yes  No

9. Has the required external approval already been obtained? Yes  No  N/A

If the answer is yes, please attach evidence of approval.

If the answer is no, please confirm that it is being sought Yes

**NB: Final authorisation of a project will not be granted until all approvals are in place.**

Projects which have received approval from one of the following listed external ethics committees do not require a further ethics review by the University: (i) HRA NHS REC; (ii) MoDREC; (iii) Social Care REC; (iv) another UK university REC. If this is the case, applicants should complete this cover sheet and attach confirmation of approval from the external review body. You may also be asked to provide a copy of the full application for the University's records. If you have approval from a body that is not listed, please check with the Research Governance and Planning Manager to see whether a full application will be required.

#### Declaration of Principal Investigator:

The information contained in this application, including any accompanying information, is, to the best of my knowledge, complete and correct. I/we have read the University's *Guidelines for Ethical Approval of Research Involving Human Participants* and accept responsibility for the conduct of the procedures set out in this application in accordance with the guidelines, the University's *Statement on Safeguarding Good Scientific Practice* and any other conditions laid down by the University's Ethics Committee. I/we have attempted to identify all risks related to the research that may arise in conducting this research and acknowledge my/our obligations and the rights of the participants.


Signature(s):  .....

Name(s) in block capitals: WILLIAM BRACKEN .....

Date: 27/3/19 .....

#### Supervisor's recommendation (Student Projects only):

I have read and approved the quality of both the research proposal and this application.

Supervisor's signature:  .....

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**Outcome:**

The departmental Director of Research (DoR) / Ethics Officer (EO) has reviewed this project and considers the methodological/technical aspects of the proposal to be appropriate to the tasks proposed. The DoR / EO considers that the investigator(s) has/have the necessary qualifications, experience and facilities to conduct the research set out in this application, and to deal with any emergencies and contingencies that may arise.

- This application falls under Annex B and is approved on behalf of the ESC
- This application is referred to the ESC because it does not fall under Annex B
- This application is referred to the ESC because it requires independent scrutiny

Signature(s): ..... *M Hudson* .....

Name(s) in block capitals: ..... DR MARIA HUDSON .....

Department: ..... ESSEX BUSINESS SCHOOL .....

Date: ..... 3 MAY 2019 .....

- 
- The application has been approved by the ESC
- The application has not been approved by the ESC
- The application is referred to the University Ethics Committee

Signature(s): .....

Name(s) in block capitals: .....

Faculty: .....

Date: .....

## **A2. Participant information sheet**

### **Examining the thought processes used by nascent entrepreneurs in identifying business opportunities**

#### **Research Project - Participant Information Sheet**

This research is being undertaken by William Bracken from Essex University. It examines the thought processes used by nascent entrepreneurs when generating ideas for new business ventures. This information sheet provides you with information about the study and the rights of those participating in it.

#### **Do I have to take part?**

You will be asked to confirm that you are happy to take part in this research. You are able to withdraw at any time.

#### **What does taking part in the research involve?**

Participation in this research involves two principle activities. Firstly you will undertake a couple of quick exercises that gauge thinking aptitudes and strengths. Secondly, you will be presented with a selection of short summaries about particular business situations along with some training materials. You will be asked to ‘talk aloud’ to describe what business opportunities come to mind in each situation. These thoughts will be transcribed verbatim, anonymised, and analysed alongside the other verbal protocols obtained from other participants in the course of this research.

#### **What the disadvantages of taking part in this study?**

The study will take approximately 50-55 minutes to complete, but there should be no other disadvantages. You will be paid for your time.

#### **What the advantages of taking part in this study?**

The benefits to a participant of taking part in this study include being paid £20 for their time. Participants also get to practice the activity of entrepreneurial opportunity identification. The answers provided through this study, will on aggregate contribute to an academic paper designed to further collective understanding of the kinds of thought processes used by people when ideating ideas for new business ventures.

#### **What will happen to the results of this research study?**

Data collected through this information experiment will be aggregated and anonymised by the researcher. No participant will be individually identified, either by name, or any other way that could give cause to disclose their identity. The aggregate findings of this research will be included in a final PhD research thesis, and form the basis of an academic journal article into the cognitive thought processes used in the ideation of New Venture Ideas. Anyone interested in receiving an aggregated copy of the finished research findings, can contact the researcher direct at [william.bracken@essex.ac.uk](mailto:william.bracken@essex.ac.uk).



**Will my taking part in this study be kept confidential?**

This research forms part of PhD research programme at the University of Essex, England. All information collected will be kept securely. It will only be accessible by William Bracken. The transcriptions and exercise answers provided will be stored with a participant number. They will not contain details of the participant's name.

**What happens if something goes wrong?**

If you are harmed by taking part in this research project, there are no special compensation arrangements. If you wish to complain, or have any concerns about any aspect of the way you have been treated during the course of this study then, you should inform the researcher. If you are not satisfied with the response, you may contact the Essex Business School Research Ethics Officer, Dr Maria Hudson ([mhudson@essex.ac.uk](mailto:mhudson@essex.ac.uk)) or the University of Essex Research Governance and Planning Manager, Sarah Manning-Press ([sarahm@essex.ac.uk](mailto:sarahm@essex.ac.uk)) who will advise you further.

**What is the legal basis for using the data and who is the Data Controller?**

The legal basis for processing the data collected from this project is informed consent. The Data Controller for this project is the University of Essex and the contact is Sara Stock, University Information Assurance Manager ([dpo@essex.ac.uk](mailto:dpo@essex.ac.uk)).

**What should I do if I want to take part?**

If you wish to take part in this survey, please confirm your interest in participating to [william.bracken@essex.ac.uk](mailto:william.bracken@essex.ac.uk). William will then contact you to arrange a mutually convenient time.

**Who has reviewed this study?**

I have applied for ethical approval to undertake this study. My application was reviewed and approved by the Social Sciences Ethics Sub-Committee at the University of Essex.

I am very grateful for your participation in this study. If you need to contact me (William Bracken) in the future, please do so at [william.bracken@essex.ac.uk](mailto:william.bracken@essex.ac.uk). You can also contact me in writing at: Essex Business School, University of Essex, 10 Elmer Approach, Southend on Sea, Essex. SS11LW. England.

You are welcome to ask any questions at any point,

Yours,

William Bracken ([william.bracken@essex.ac.uk](mailto:william.bracken@essex.ac.uk))

## **B. Research material**

### **B1. Opportunity vignettes**

#### **Opportunity Scenario 1 - Supporting Lone Workers**

Many organisations employ workers who work alone, out and about in the field.

Example of lone workers include : delivery drivers, farm workers, parole officers, sales reps, home health and social care staff, engineers, real estate agents, auditors, and security guards.

Lone workers are now said to account for 20% of the workforce.

Lone workers lack the immediate support of co-workers or managers. Studies have suggested that the nature of lone working impacts upon staff retention, motivation and task execution.

Facing dangerous or difficult situations alone is stated as the prime worry of lone workers. Lone workers are known to experience significantly more work place accidents than other employees.

The question is:

What opportunities for potential new business ventures sprung to mind from this situation?

#### **Opportunity Scenario 2 – The provision of replacement car tyres**

Car owners regularly have to replace the tyres on their cars. Tyres may experience a puncture from a nail or pot hole, or simply get worn, and are thus no longer safe or legal.

Buying replacement tyres for cars can be a hit and miss experience:

- There are hundreds of different types of tyre, and it is often unclear to the driver what type of tyre a car needs.
- Fitting a new tyre requires a mechanic. As such car owners typically have to fit around the availability of a garage to get the work done.
- There seems to be a massive price differential between different garages.

The question is:

What opportunities for potential new business ventures sprung to mind from this situation?

### **Opportunity Scenario 3 – Hiring the right employees**

The success of most organisations is dependent on the quality of the people they recruit.

Yet for many small and medium sized firms, the process of recruiting new employees is time consuming, expensive, and fraught with difficulty.

There are time consuming bottlenecks in the recruitment process: placing ads, filtering applications, notifying interviewees, rejecting candidates, taking on new hires.

There is also a challenge in finding the applicants that are best suited to the role, and fit well with the organisation's culture.

The question is:

What opportunities for potential new business ventures sprung to mind from this situation?

### **Opportunity Scenario 4 – The challenges of taking medicines in old age**

In the UK, 1 in 2 people aged 65 or over take more than 5 medicines a day. This figure has risen markedly from a level of just 1 in 10 back in the year 2000.

Failing to take medicines properly is something that can have clinical consequences.

Yet, a study from Utrecht University has suggested that as many as 9 in 10 older people experience practical problems in taking their medicines. These problems include:

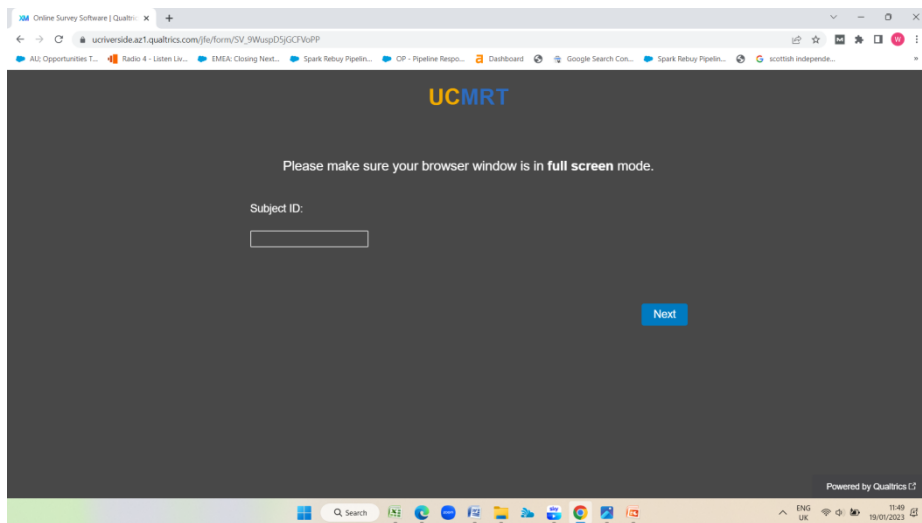
- Difficulties reading and understanding the instructions for use.
- Challenges in remembering to take the right medicines at the right time.
- Struggling to handle the packaging surrounding the medication
- Complications in getting hold of the medication to ensure continuous supply.

The question is:

What opportunities for potential new business ventures sprung to mind from this situation?

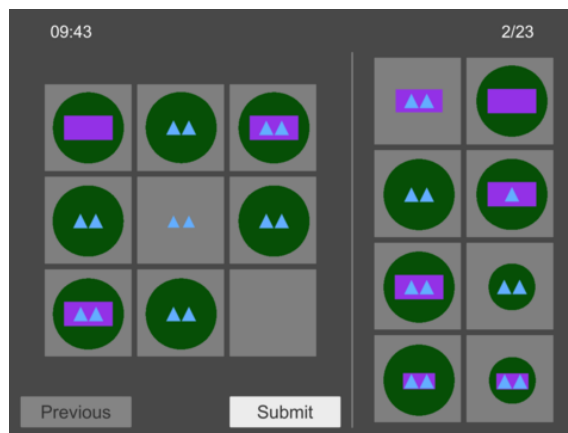
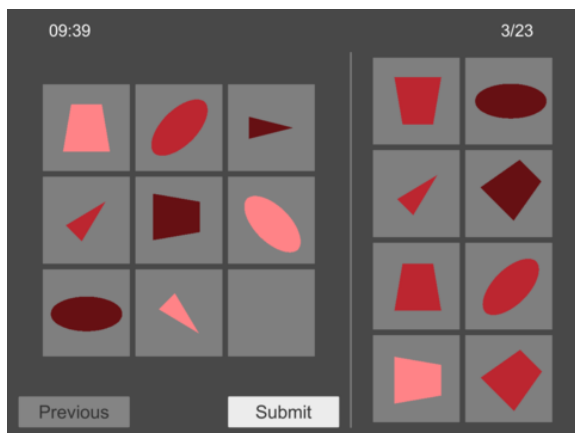
## B2. Intellectual fluidity test

Intellectual Fluidity was measured using the University of California Matrix Reasoning Task. Each participant was given a unique Subject ID by the researcher at the start of the test. As per the below screenshot, this ID was entered at the commencement of the task such that the results could later be mapped back to the individual participant.



The test involved 23 questions which the participants had to work through in a 10 minute time frame.

Although it is not appropriate to put otherwise unpublished aspects of the test into the public domain, I have included below two screen shots that are [contained](#) on the University of California Riverside's own website, which give an indication of the format that the test takes.




### B3. Memory retrieval tests

A participant's aptitude for different aspects of memory retrieval was measured through a spoken test.

The participants viewed 8 questions on a shared screen, and then had 60 seconds to speak out their answers.

The 8 question slides relating to this memory retrieval exercise are contained below:


Part 1 – Memory Retrieval 

The research study first involves a memory retrieval exercise.

You will be presented with 8 basic questions on the screen.

You then have 60 seconds to speak out as many answers as you can.


4

Part 1 – Memory Retrieval 

Question 1:

Tell me as many alternative words for 'good' as you can think of?


5

Part 1 – Memory Retrieval 

Question 2:

Tell me as many alternative words for 'hot' as you can think of?


6

Part 1 – Memory Retrieval 

Question 3:

Tell me as many words that you can think of, that end in 'TION'?


7

Part 1 – Memory Retrieval 

Question 4:

Tell me as many words that you can think of, that begin with 'CON'?

8

Part 1 – Memory Retrieval 

Question 5:

Tell me as many different first names of people that you can think of?

9

## Part 1 – Memory Retrieval



Question 6:

Tell me as many different jobs or occupations that you can think of?

10

## Part 1 – Memory Retrieval



Word Chains:

A word chain is a chain of words in which each word is somehow linked to a previous word.

So for example starting with 'Beach', it could go:

Beach -> Sand -> Castle -> Knight -> Horse -> Jockey -> Short -> Dwarf  
-> Red -> Traffic Light -> Car etc...

11

## Part 1 – Memory Retrieval



Question 7:

Create a word chain starting with the word 'Cold'.

12

## Part 1 – Memory Retrieval



Question 8:

Create a word chain starting with the word 'Music'.

13

## **B4. Analogical training video**

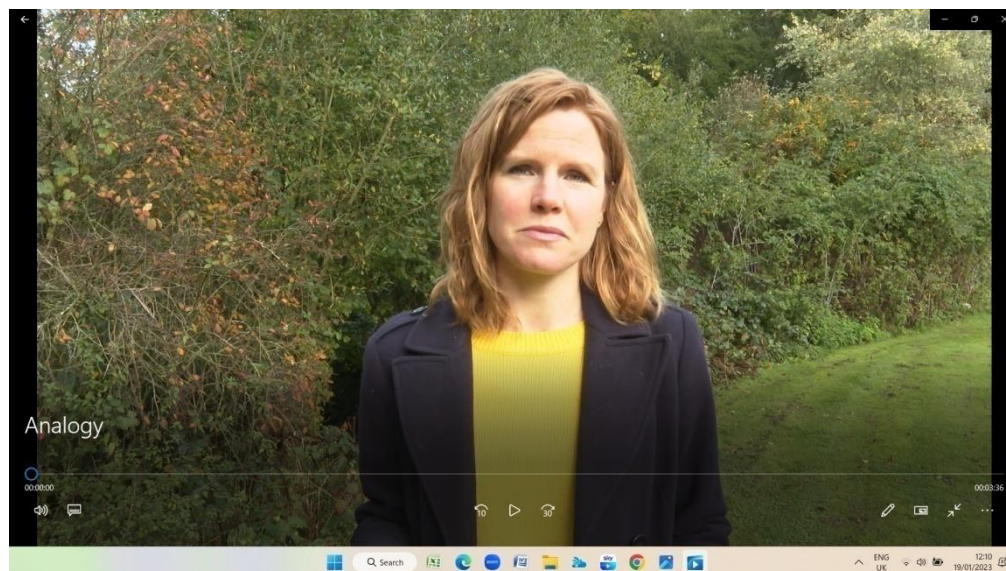
All participants watched the same 3 mins 40 seconds training video around analogical retrieval.

The course of training was delivered by a practising television reporter to ensure sufficient professionalism in presentation. It was shared to the participant through the same shared Powerpoint presentation through which they were walking through the research exercise with the researcher.

Screen shots from the video are attached below to give a feel to the flow and content within the training video.

### **1. Introduction (30 Seconds):**

The presenter initially provided an overview of analogical reasoning, and went through an overview of steps that can be used to help in the identification of analogies (identifying the underlying problems in the target area concerned, and then proactively searching/thinking of other areas tackling the same problem).

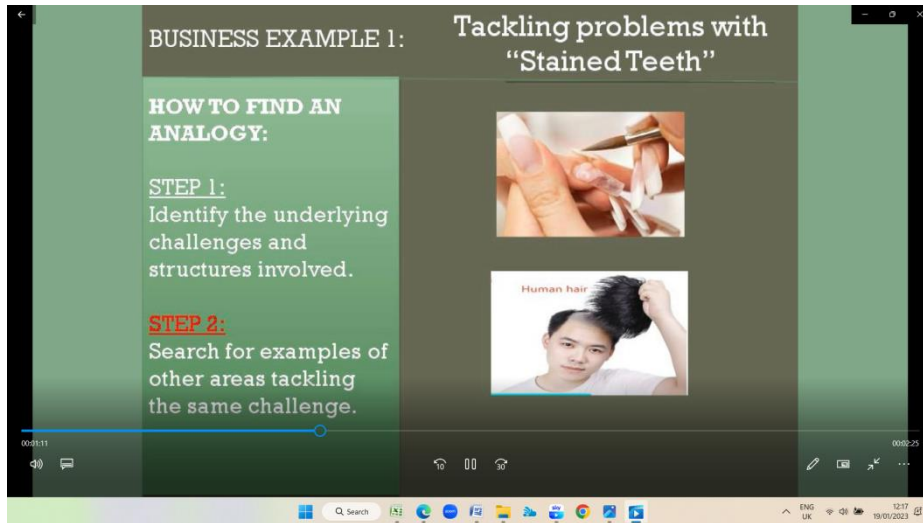


### **2. Case Study 1 (1 min 20 seconds)**

The presenter next showcased those two practical steps through which someone could improve their capability in retrieving analogy, by showcasing how they operated through a first practical example. This focussed on the problems that people face with stained teeth.

The presenter highlighted the underlying challenge (in this case - changing the appearance of a body part), before highlighting how people currently deal with these challenges. This might be through the use of an artificial component such as with nail extensions or with whigs for hair

loss. Alternatively it may be through painting such as with fake tanning. Highlighting how such ideas could be borrowed for the case of stained teeth, the presenter pointed to the possibility of using artificial clip on solutions on top of teeth, or using a paint to change the appearance of teeth.



### **3. Recap (30 Seconds)**

As part of this training programme, the presenter once again reaffirmed the two practical steps that have been shown to assist with analogical retrieval (identifying the underlying problem, and proactively searching for similar examples).





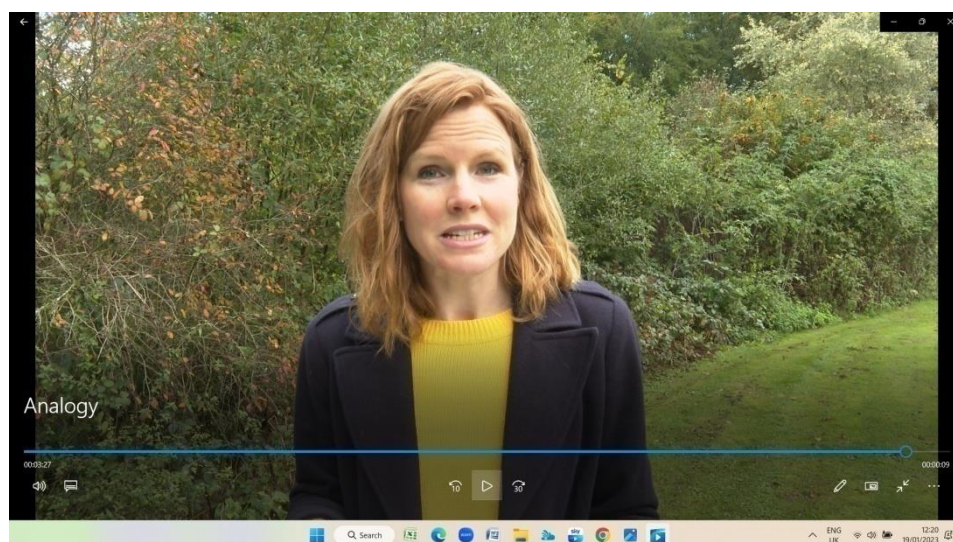
#### **4. Case Study 2 (1 minute)**

The presenter then showcased a further practical example, this time relating to the difficulties that people encountered in booking ‘creative talent’ for an event or party. The same steps were followed as in Case Study 1 by looking at the underlying problems and then identifying alternative solutions founder in alternate domains.



#### **5. Final summary (20 seconds)**

Concluding, the presenter again returned to the two practical steps that someone can use to assist them in analogical retrieval.



## B5. Analogical training video use

Through a question introduced at the end of the study, the research garnered information as to the extent to which the participants felt they had made use of the training video around analogical retrieval. This was designed to confirm the validity of the experimental intervention.


### Part 4 – Debrief

The study ends with 3 simple questions:

Q1. Please rate the following statement, according to the number below:

“After watching the earlier training video, and when considering the 3<sup>rd</sup> and 4<sup>th</sup> opportunity scenarios, I found myself using techniques involving the use of analogy, namely I considered the underlying principles of the situation and proactively searched for analogies as a source of potential ideas”.

1. Strongly Disagree
2. Disagree
3. Somewhat disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree



22

The mean response from the participants was 5.36 (sd: 1.22), as outlined in the participant responses to this question below:

Participant ID	Video Use
101	6
102	6
103	5
104	5
105	7
106	7
107	6
108	5
109	6
110	5
111	5
112	5
113	6
114	7
115	6

116	6
117	5
118	6
119	6
120	5
121	6
122	7
123	1
124	5
125	5
126	5
127	5
128	7
129	6
130	5
131	6
132	5
133	6
134	5
135	3
136	5
137	7
138	6
139	6
140	3
141	7
142	7
143	6
144	5
145	5
146	3
147	3
148	5
149	6
150	5
151	6
152	5
153	5
154	6
155	5

156	5
157	3
158	3
159	5
160	4
161	5
162	4
163	5
164	6
165	5
166	2
167	5
168	7
169	5
170	7
171	6
172	5
173	5
174	6
175	6
176	6
177	4
178	6
179	5
180	7
181	5
182	5
183	3
184	7
185	4
186	6
187	7
188	3
189	5
190	7
191	6
192	6
193	5
194	7
195	7

196	6
197	6
198	6
199	7
200	4
201	5
202	6
203	5
204	5
205	6
206	2
207	7
208	6
209	6
210	5


## B6. Control questions

This research garnered further data in relation to each participant ID in order to garner a range of background control data. Information as to the participant's age, gender, and educational background was helpfully collected through an online questionnaire at the start of the UCMRT fluid reasoning test (as part of its own standard checks), and then provided to the researcher alongside the results of that test.

Additional control data was garnered through the following three questions put up on the shared screen at the end of the study. Question (2) had four components, where the participant was asked for their prior knowledge of each of the market areas relating to the 4 vignettes, one by one.

The extracts from this final debrief relating to these control questions are contained below:

### Part 4 – Debrief



---

The study ends with 3 simple questions:


Q1. Please rate the following statement, according to the number below:

“After watching the earlier training video, and when considering the 3<sup>rd</sup> and 4<sup>th</sup> opportunity scenarios, I found myself using techniques involving the use of analogy, namely I considered the underlying principles of the situation and proactively searched for analogies as a source of potential ideas”.

1. Strongly Disagree
2. Disagree
3. Somewhat disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

23

### Part 4 – Debrief



---

Q2. For the numbered list below, please indicate the level of prior knowledge you have of each of the opportunity situations that we considered:

1. Very Low
2. Low
3. Somewhat Low
4. Neither High nor Low
5. Somewhat High
6. High
7. Very High

24

## Part 4 – Debrief

Q3. From the numbered list, how would you rate your response to the following statement:

"I am determined to create a firm and set up a business in the future",

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

## C. Research Participants

### C1. Session list

The following table details the background information garnered about each participant, alongside the date that the research session occurred. The location relates to whether they were at the Southend or Colchester EBS campus at the time of the study, or whether they not on the university campus at the time of the study.

<b>Subject ID</b>	<b>Session Date</b>	<b>Age</b>	<b>Gender</b>	<b>Education</b>	<b>Location</b>
101	05/11/2020	22	Male	Bachelors Degree	Southend
102	06/11/2020	24	Female	Masters Degree	Southend
103	06/11/2020	25	Male	Bachelor's Degree	Sofuthend
104	08/11/2020	20	Female	No Degree Yet	Southend
105	09/11/2020	20	Male	No Degree Yet	Southend
106	09/11/2020	20	Male	No Degree Yet	Southend
107	10/11/2020	21	Male	No Degree Yet	Off Campus
108	09/11/2020	28	Female	Bachelor's Degree	Off Campus
109	10/11/2020	19	Male	No Degree Yet	Off Campus
110	11/11/2020	20	Male	No Degree Yet	Off Campus
111	11/11/2020	22	Female	No Degree Yet	Southend
112	12/11/2020	40	Female	Masters Degree	Southend
113	13/11/2020	22	Male	Bachelor's Degree	Off Campus
114	13/11/2020	25	Female	Masters Degree	Southend
115	16/11/2020	20	Female	Bachelor's Degree	Southend
116	17/11/2020	21	Female	Bachelor's Degree	Off Campus
117	17/11/2020	20	Female	No Degree Yet	Off Campus
118	19/11/2020	24	Male	Bachelor's Degree	Southend
119	20/11/2020	25	Male	Bachelor's Degree	Southend
120	20/11/2020	23	Female	Bachelor's Degree	Southend
121	25/11/2020	22	Female	Bachelor's Degree	Off Campus
122	25/11/2020	26	Male	Masters Degree	Off Campus
123	25/11/2020	41	Male	Bachelor's Degree	Off Campus
124	27/11/2020	22	Female	Bachelor's Degree	Off Campus
125	27/11/2020	23	Male	Masters Degree	Off Campus
126	30/11/2020	20	Male	No Degree Yet	Off Campus
127	03/12/2020	26	Male	Masters Degree	Off Campus
128	03/12/2020	24	Male	Masters Degree	Off Campus
129	15/12/2020	20	Male	No Degree Yet	Southend
130	08/12/2020	23	Female	Bachelor's Degree	Off Campus
131	21/12/2020	20	Male	No Degree Yet	Off Campus



132	25/01/2021	20	Female	Bachelor's Degree	Colchester
133	26/01/2021	26	Female	No Degree Yet	Colchester
134	27/01/2021	51	Female	No Degree Yet	Colchester
135	27/01/2021	24	Male	Bachelor's Degree	Colchester
136	28/01/2021	25	Female	Bachelor's Degree	Colchester
137	28/01/2021	23	Male	Bachelor's Degree	Southend
138	28/01/2021	21	Female	Bachelor's Degree	Southend
139	28/01/2021	22	Female	No Degree Yet	Colchester
140	29/01/2021	22	Female	Bachelor's Degree	Off Campus
141	29/01/2021	22	Female	No Degree Yet	Southend
142	29/01/2021	21	Male	Bachelor's Degree	Off Campus
143	01/02/2021	21	Male	Bachelor's Degree	Off Campus
144	02/02/2021	23	Male	Bachelor's Degree	Off Campus
145	03/02/2021	23	Female	Bachelor's Degree	Off Campus
146	15/02/2021	22	Male	Bachelor's Degree	Colchester
147	15/02/2021	21	Male	No Degree Yet	Off Campus
148	12/02/2021	28	Female	Masters Degree	Colchester
149	15/02/2021	22	Female	No Degree Yet	Off Campus
150	16/02/2021	21	Male	No Degree Yet	Off Campus
151	16/02/2021	21	Female	Bachelor's Degree	Colchester
152	16/02/2021	20	Female	No Degree Yet	Colchester
153	17/02/2021	22	Male	No Degree Yet	Colchester
154	17/02/2021	22	Female	No Degree Yet	Colchester
155	17/02/2021	21	Female	Bachelor's Degree	Off Campus
156	17/02/2021	20	Female	No Degree Yet	Off Campus
157	18/02/2021	21	Female	No Degree Yet	Off Campus
158	18/02/2021	22	Female	Bachelor's Degree	Colchester
159	18/02/2021	22	Female	Bachelor's Degree	Colchester
160	19/02/2021	21	Male	Bachelor's Degree	Off Campus
161	19/02/2021	20	Female	No Degree Yet	Off Campus
162	19/02/2021	19	Male	No Degree Yet	Off Campus
163	20/02/2021	22	Male	Bachelor's Degree	Colchester
164	15/02/2022	22	Male	Bachelor's Degree	Colchester
165	01/03/2022	20	Female	Bachelor's Degree	Colchester
166	12/03/2022	23	Male	No Degree Yet	Off Campus
167	23/03/2022	29	Male	Masters Degree	Off Campus
168	25/03/2021	31	Male	Bachelor's Degree	Off Campus
169	26/03/2021	20	Male	Bachelor's Degree	Off Campus
170	30/03/2021	23	Male	Bachelor's Degree	Off Campus
171	30/03/2021	18	Female	No Degree Yet	Off Campus
172	01/04/2021	19	Male	Bachelor's Degree	Colchester
173	01/04/2021	27	Female	Masters Degree	Southend
174	06/04/2021	20	Female	No Degree Yet	Off Campus

175	06/04/2021	24	Male	Masters Degree	Off Campus
176	07/04/2021	18	Male	No Degree Yet	Southend
177	12/05/2021	18	Male	No Degree Yet	Off Campus
178	08/04/2021	22	Female	Masters Degree	Off Campus
179	22/02/2022	22	Male	No Degree Yet	Colchester
180	22/02/2022	27	Female	Masters Degree	Off Campus
181	25/02/2022	42	Male	Masters Degree	Colchester
182	25/02/2022	21	Male	No Degree Yet	Colchester
183	28/02/2022	35	Male	Masters Degree	Colchester
184	01/03/2022	25	Male	Masters Degree	Colchester
185	01/03/2022	30	Female	Masters Degree	Colchester
186	02/03/2022	27	Female	Masters Degree	Off Campus
187	03/03/2022	21	Male	No Degree Yet	Off Campus
188	03/03/2022	22	Female	Bachelor's Degree	Off Campus
189	04/03/2022	23	Male	No Degree Yet	Colchester
190	07/03/2022	20	Male	Bachelor's Degree	Off Campus
191	18/03/2022	21	Female	No Degree Yet	Off Campus
192	16/03/2022	21	Female	Bachelor's Degree	Off Campus
193	11/03/2022	29	Female	Bachelor's Degree	Off Campus
194	21/03/2022	25	Female	Masters Degree	Colchester
195	11/03/2022	20	Male	No Degree Yet	Off Campus
196	17/03/2022	20	Female	No Degree Yet	Off Campus
197	18/03/2022	23	Female	Masters Degree	Off Campus
198	22/03/2022	22	Female	Bachelor's Degree	Colchester
199	23/03/2022	26	Female	Masters Degree	Colchester
200	23/03/2022	28	Female	Bachelor's Degree	Off Campus
201	23/03/2022	20	Female	No Degree Yet	Off Campus
202	23/03/2022	30	Male	Bachelor's Degree	Southend
203	23/03/2022	24	Female	Masters Degree	Off Campus
204	23/03/2022	37	Male	Masters Degree	Colchester
205	24/03/2022	36	Male	Bachelor's Degree	Colchester
206	24/03/2022	32	Male	Masters Degree	Colchester
207	25/03/2022	39	Male	Masters Degree	Off Campus
208	30/03/2022	27	Male	Masters Degree	Off Campus
209	30/03/2022	28	Male	Masters Degree	Off Campus
210	07/04/2022	27	Male	Masters Degree	Off Campus

## D. Research results – Venture ideation

### D1. Sample transcripts

It would be too extensive to contain a full list of every transcript below, but to give a feel, some examples of the transcripts garnered from the different participants during the ideation process are included below:

#### Sample Transcript – Lone Workers – Participant 34

“The question is what opportunities for potential new business ventures sprung to mind from this situation.

The thing that comes to my mind, is the issue of Susie Lamplough, you know from years ago and the loan estate agent lady.

Um I guess it is somehow having personal alarms for people and. does that form part of their package for work that they get given a personal alarm.

You could have it as part of your booking system where you're booking jobs for these people .

I was thinking about people working on their own, but in a building and so, for example, like, I was thinking of beauty therapists working on their own, maybe they're working late shift and they're on their own, whereas the other therapists are enjoying the day.

You'd have to have a booking system that would not allow you to book in, for example, a man that wasn't known to the Salon that night when she was in on her own, just as a safety thing.

Maybe you know they're obviously lonely there.

Maybe some kind of, if their out driving on their own, a lot, something for them to listen to, while they're driving if they're driving lorries can there be more kind of podcast things, is that an educational thing, or could it be that you know that you're walking and that could be a mindful walking app, to listen to, something to keep them entertained.

Lonely, what's going to increase their motivation.

Maybe if they are a delivery driver, Amazon or DFD, they're always running to the door and they've got certain things that they have to do.

Maybe there is a kind of a target thing that they can get given at the beginning of the day, maybe they have that anyway, don't know, and maybe at the end of the day, if you deliver so many parcels you're going to get 20 quid bonus”.

**Sample Transcript – Recruitment – Participant 106**

“One thing I can think of is building an automated recruitment tool using a machine learning algorithm, which is kind of a spider, which goes through the web, scanning profiles.

So most likely LinkedIn doesn't allow spiders to go through their website, but maybe we can find an integration, or a tool.

What we can do, is go through the profiles, the algorithm has to be fed with data, so if for example, they are hiring for an operations manager, then all the keywords, and the kind of profile that they are looking for, and the experiences that are needed are built in initially, and then crawling through the web to find these profiles, and then to learn on it and build on it.

In the first 3 months we can improve the engine, maybe have manual intervention to do supervised learning and after that, the engine can be a prototype and then a product, and then given to start ups actually.

They pay a small fee to identify key talent in the local region.

I am applying for jobs at the moment and in terms of what Indeed and LinkedIn are showing me there doesn't seem to be that kind of direct correlation, between what is in my profile and what is available.

Maybe we charge by hiring session. You may use our product for 3 months, and you will have a certain number of hours, or you can charge by the number of profiles that the engine returns.

So it can have some flexibility depending on who is using it”.

**Sample Transcript – Tyres – Participant 7**

“Hmm, this is interesting. I think possibly maybe, I was going to say an application. I think maybe I'm thinking a Directory website, which allows people to input the make and model of their car, and be suggested to them what tyres work on this car, and what tyres suit this car and direct them to the nearest garage that offers that tyre in particular.

I think that also that'd be something that would need to be, you know, cross checked and speaking to the different garages around which again may take a lot of time, work, and effort.

But I'm sure I hope, I believe there could be an easier way just getting these garages around to be involved.

I think that I think we, I think the company who builds his website would work off a commission basis, maybe, maybe because a garage is already functioning. He's already getting the business from, you know, just a hit and miss experience that has been going on for so long.

Garages are already so used to that, that they may not want to change what it is that they're doing because you know it's a longer process or whatever.

But I think by explaining to them how this makes more sense. And what it is, are they doing with the hit and miss experience, because it may bring a car that they may not have the resources for, because that is a waste of their time and their resources. They're having to fit or even I mean, time is a resource, but they're having to allocate a person or something to try and sort out the car that they may not have the resources.

And not only that, I think they would agree to having a website which they can be listed on as in, that they work with these specific cars, that they have tyres for these specific cars because a booking system that could that could be generated from this website allocated to that specific garage definitely make the process very like more smooth, easier, and just more time efficient to smooth resource efficiency. It just would make the whole process less hit and miss and more direct.

It obviously will be based on location. So if you're in Kent, you have to type in your, your postcode, you'd have a different you'd have many different garages in your area, the ones that are specific to your car. And you'd be able to book, based on your availability and their availability..

And then you can go from there. I know some garages do offer after hours sort of appointments so that would come an extra fee on the website.

Some people don't actually get their car fixed in that moment, and some people do, but some people go there for information. And because you know, garages are not the best with phone calls and I mean the garages, in my area and I try and call them and you know you're not getting through to them until a couple days later.

I think for both the customer and the business, this will make the whole process a lot more simple, smooth, and easy to work round”.

### **Sample Transcript – Medication - Participant 50**

“Right. So the first thing I thought of when I read that they couldn't take their medication, is that there could be maybe like an App, maybe like a simple App as old people can't use their smart phones, but a simple app where maybe every day it would send them a simple reminder, with like lets say a picture of their medication so that they could be reminded to take it.

Maybe like a reminder with like an alarm, with the pictures it will be easier to see which particular medication they need to take, and how to take it.

Maybe, it could be like a smart box or something with a QR code or something, so that every time you have to take the medication, you have to scan the QR code or something, so that the App can recognise that you have taken your medication. And therefore you won't miss taking your pills.

Maybe with this smart box, or whatever it is with the QR code, maybe somehow it can measure how many pills you have got left. So once it comes to a certain amount, it can notify your GP so that they can send you a new prescription, and the NHS can send you a refill, so that you can refill your smart box with your smart App.

Maybe the smart box can have on top, M for Monday, T for Tuesday, and then on the App the same thing, so it has letters for the week, to make it easier for the people.

It says that there is difficulty understanding the instructions, maybe with that smart box, if you scan the QR code, it can show you how to take the medication. If it is a pill it will show you a picture, or a quick video of how to take it. If it is a syrup it will show you how many spoons to take in and so on. It could be a video showing you how to do it easily”.

## **D2. NVI list**

A full list of the different NVI concepts suggested by the participants during this research study is detailed below, broken down by the vignette area concerned:

### **A. Challenges in supporting lone workers**

#### **A1. Company specific phone Apps**

- The NVI revolves around selling Apps (potentially tailored on top of basic features) to companies to help them manage their own workers.
- The features these apps may include are:
  - Benchmarking (see how one lone worker is doing vs a vs another)
  - Geolocation tracking (where nearby staff are)
  - Communication channels between staff (providing support, answering questions, harnessing motivation). A chat room concept in effect.
  - Potential for some entertainment functionality (company games even)
  - Conduit for company communications – possibility for company messaging and training.

#### **A2. Connected network of screens**

- The NVI revolves around the provision of ‘always on’ screens that connect remote staff.
- This NVI is particularly targeted to those working remotely (rather than office workers), particularly for drivers.
- This permanently links lone workers to other staff, and also to their managers back in an office environment.

#### **A3. Earpieces that are permanently worn**

- The NVI revolves around the provision of earpieces that staff can wear at work. These form part of a communication network, to keep them in constant contact with colleagues and managers.
- These earpieces support a number of objectives such as safety, motivation, and the provision of advice.

#### **A4. Networking apps for lone workers in different fields (non company specific)**

- The NVI involves the creation of an app (or equivalent online product) focussed on people working in particular fields (that are normally lone working).
- The product is a community for people to use in their spare time to discuss work matters. The idea is to try and create a community feel for people in the same remote working line of work genre. People can thus talk about their experiences, detail problems, provide solutions (ie: if they have had an accident what to do etc., what seeds may work best for farmers etc.)
- There could be such networks created for drivers, famers etc..(ie: people in the same line of work, but not in the same company).
- The community could also have potential to run training events, or other virtual events.

- The community could be paid by subscription from the members, or funded by advertising (solicitors, relevant sector support firms etc..).

#### **A5. A Buddy network**

- The NVI revolves around the setting up of a buddy network, where people can be connected to others, who they can then keep in touch with during the day (rent a friend...).
- As such, the system would match lone workers up with other lone workers, so that they can speak to in the course of their day to keep them company, offer advice.
- The match up would be done on the basis of personality, similar interest, work.

#### **A6. Wearable cameras just recording**

- The NVI revolves around the supply of recordable cameras for lone workers to wear.
- The recordable camera doesn't transmit, but is there for piece of mind, and to provide safety.

#### **A7 . Wearable cameras with panic button to support recording**

- The NVI revolves around a wearable camera, but this time with a panic button, such that when the button is pressed, someone in a call centre can see the location (GPA) and what the situation is.
- It records, but only transmits at that point the button is pressed, potentially so help can be called.

#### **A8. Wearable cameras that constantly transmits with audio**

- The NVI again involves a wearable device, one that records and is at least capable of transmitting and interacting back with a head office or call centre situation.
- This offers the possibility of providing specific advice to lone workers in certain situations. It could also support socialisation and morale. Could operate similar to 'google glasses'.
- Potential to use Artificial Intelligence (noise, blood pressure – potentially via a watch) to track real situations, and then transmits that, when it sensitive, to the call centre.

#### **A9. Just a panic button**

- The NVI focuses around a system where staff all have panic buttons (possibly wearable) that connects the lone worker to the company (or a call centre), with the location and an ability to speak if there was ever any issues. It does not include a camera.
- Most relevant for those situations where urgent help may be required (care staff, parole staff etc..).

#### **A10. Personal alarms**

- The NVI is to provide lone workers with personal alarms. These are safety alarms that emit a large sound, to act as a deterrent in dangerous situations.

#### **A11. Safety location tracking service**

- The NVI is a location tracking service that checks where staff are at any point. It alerts if they do not dial in/connect in within a set time period (say every hour).



- The product is sold to companies on subscription.
- This is a safety mechanism, which can be followed up by a call, if the person does not respond or is not in a known place etc..
- Possibly could also be used by the companies to check where their staff are working, they are where they supposed to be etc..

#### **A12. Hotline for Counselling**

- The NVI is the provision of a third party counselling service (or hotline) for lone workers. It is staffed by therapists and psychologists.
- The service is designed to provide counselling and support mental health.
- In this sense it reacts to the fact that lone workers may have anxiety, and loneliness that comes with the nature of the work.
- In that sense it is a third party 'lone worker support' product.

#### **A13. Meet up centres**

- The NVI is the concept of operating physical spaces (locations) where lone and geographically remote workers can go during the course of their day.
- These would be places where the lone workers can access break out facilities, refreshments, and desk space (sockets). They are social environments, replenishing the 'rest room' concept that exists in offices or factories.
- These physical locations (service station feel) may also be places where managers can meet remote staff, or they can meet up with other remote workers.

#### **A14. Staff rewards business for lone workers**

- The NVI is a business that focuses on providing staff rewards/incentives for lone workers.
- The business co-ordinates and provides a series of rewards (whether that be food options, manicures etc..) for its customer with local suppliers. The driver being to support motivation of lone working staff.

#### **A15. Event meet up business for lone workers**

- The NVI is an events company, which provides third party services to employers, in relation to co-ordinating staff events.
- The idea is that the company would organise social events (weekly or monthly) for a particular company's lone working staff within a particular geography, thereby saving the company the stress of doing that themselves.

#### **A16. Artificial Intelligence Companions**

- The NVI is the provision of software (on the computer or phone) that automatically and remotely interacts with the lone worker.
- The software may provide jokes, songs, anecdotes, or stories. It is tailored to the personality and interest of the person concerned.
- In that sense the product is designed to keep up motivation and make the lone worker feel less isolated.

**A17. A support App**

- The NVI is for an app to which the individual employee or lone worker subscribes themselves.
- It is something whereby someone through an App checks in on them at set intervals, say every hour, in order to provide them company and give them a boost. It is presented as a paid personal trainer at work service, one that aids the lone worker's motivation.

**A18. Break match up service**

- The NVI is geolocation software that matches different lone workers in a particular area who are on a break and looking for people to pair up with for lunch etc.
- So it could connect 2 delivery drivers who are on their lunch break so they can spend the time together and not feel lonely.

**A19. Pet renting business**

- The NVI here is for a business that rents lone workers pets for the day so to provide them with company at work. It could be a dog, but also a fish or a hamster.

**A20. Health and Safety consultancy visiting workplaces - 103a.**

- The NVI relates to a service sold to businesses, where a health and safety team/person comes in and checks the workplaces of remote workers and which looks for hazards.
- Trained health and safety people do inspections of the workplaces/typical environments in which the lone workers are operating and provide advice.

**A21. Insurance for lone workers**

- The NVI revolves around the provision of dedicated accident insurance packages that are sold to companies employing lone workers, and which cover accidents etc...
- So the idea is in essence a tailored insurance product for this space.

**A22. Training business**

- The NVI involves the creation of a consultancy business that offers training to companies employing lone workers.
- This would range from things like first aid, health and safety, to more generic aspects like how to maintain morale. Employers would pick from the suite of options that best suited their needs.
- These one off training sessions could be offered to remote staff, or to the managers who specifically look after remote/lone working staff.

**A23. Training and monitoring business**

- The NVI involves an ongoing partnership between the training agency, and the corporate/organisational client.
- The agency provides ongoing training courses, but then also works with the client on an ongoing basis (including through technology) to track results (retention, motivation, accidents, communications etc..), and then adjusts the training programme on the back of the results.

**A24. Pooling staff service**

- The NVI is a marketplace concept, whereby different firms can lend each other their surplus staff (often lone workers) to do jobs they need in a certain area.
- It could work in particular for delivery drivers, but also could apply to other roles (eg: security guards, engineers).
- The providing firm gets paid by the other firm for the days that they borrow staff on a day rate through the marketplace. The marketplace takes a small commission.

## **B. Challenges in buying replacement tyres**

### **B1. New Garage Opening Time Model**

- The NVI is to open a new garage (or chain of garages) that work on a better out of hours hours (6 to 9pm to be more convenient) with an online booking site that allows clients to reserve their own space.

### **B2. A 'garage offered' warranty on tyres**

- The NVI is to open a garage (or chain of garages) that offers customers a warranty on the tyres that are replaced.
- As such if something goes wrong in a year, the client can come back and get a replacement tyre from the same garage, with also the offer of being towed back to the garage if something goes wrong.
- This service is offered direct by an individual garage (not by a third party tyre insurance business).

### **B3. Self service garages**

- The NVI is to open up premises, where members of the public can change the tyres themselves, using the kit that is there.
- The premises have service points and instructions.
- People just pay to use the facility.

### **B4. Tyre vending machine**

- The NVI is the creation and rolling out of self service tyre vending machines (of some form).
- They provide you with the tyre that you need according to the correct specification. Clients then fit the tyre themselves. They just key in the details and the tyre appears.

### **B5. Automatic tyre changing machines**

- The NVI is to create an actual machine that changes your tyre. Drive in, and it swaps it out all automatically (automatic garage).
- So this is a full service machine that does whole process automatically. It takes off the old tyre, adds the new tyre (like a car wash).

### **B6. Convenient Garages in car parks**

- The NVI is to set up garages in spots where people go. As such the equipment is hosted in a series of parking spots.

- So potentially in a town centre or shopping centre car park. This has appeal to people without drives, where a mobile tyre replacement van cannot visit.
- People drive in, and garage staff then change the required tyre. This happens as the vehicle owner goes shopping/does other things. Makes it a lot more convenient for people.

#### **B7. Online Tyre retailer**

- The NVI is to set up a website that is an online shop for tyres, so like an online tyre retailer.
- The website provides guidance on what your car is and what type of tyre you need. You then buy it from them, it is delivered, or you pick it up from a collection point, and you then take care of the installation separately (or that could be arranged).
- This approach ensures price transparency and certainty on the tyre for the customer.

#### **B8. Independent tyre call out business**

- The NVI is to set up a small business with trucks that go around and replace/fix people's tyres at the location where they are. It is a tyre call out service.
- This is the mobile garage principle, know what you need, and brings it to you.

#### **B9. Networked call out business with storage**

- The NVI is a mobile tyre call out service, albeit on a larger scale such that it can operate effectively.
- This is working on the principle that many tyre problems can and need to be fixed remotely and that a remote operation (like windscreen repair) is the way to go, rather than making clients come in.
- However the idea envisages a network of local vans that go out to customers, tapping into a central distribution centre where they tyres are warehoused and then provided to the local drivers. This makes it practical at scale.

#### **B10. Forum focussing on local garages**

- The NVI is to set up a local forum site focussed on garages.
- Here locals make recommendations of good local garages. Site designed just for this purpose. It would have ratings and reviews on it.
- Funded by advertising (from tyre firms or garages).

#### **B11. Forum focussing on actual tyre types.**

- The NVI is a forum site where people discuss what type of tyres have worked for them, based on their location, type of car etc. This leads to information symmetry.
- It is thus a review site looking at tyre performance and effectiveness, rather than the service offering of local garages.
- It is funded by advertising, in terms of garages or tyre companies

#### **B12. Tyre choosing App**

- The NVI is for a mobile phone App, that helps you choose a tyre.

- It takes the details of your car (or possibly scans the tyre in), and then gives you a range of tyres that are relevant, featuring information on their grip, quality, length, road mileages, luxury etc..
- Clients pre-select the criteria that they are looking for, and decide what tyre they want from there.

### **B13. Tyre choosing consultancy**

- The NVI is to set up a consultancy business, where people pay to receive advice on what tyres they need.
- This is an agency service that operates between the car owner and the garage.
- This is provided over the phone typically, once the details of the car have been provided.
- The advice is based on what you do, where you live, or what you are looking for.

### **B14. Tyre databases**

- The NVI revolves around the creation of a tyre database. The database is a website front end that simply aggregates all the types of tyres and cars available. It is regularly updated for new types of tyres.
- It is potentially something for use by car owners, or by garages. It has all the data in it, and marries up which tyre goes with which car etc..

### **B15. Garage Booking site on web**

- The NVI is either a website or an App whereby people enter the model and make of car, and which then points them to what is available and allows them to book a slot.
- It does not contain any price comparison aspects.
- The Website/app draws heavily on geo-location functionality to find garages nearby.
- It does though only include certified local garages, with the potential for client reviews.
- It is possible to schedule garage appointments through this app.
- The revenue model is commission from local garages.

### **B16. Booking site on phone**

- The NVI revolves around the idea of a phone service (hotline). This is akin to something like a tyre breakdown service that becomes well known.
- There is a number that you ring up. It gives guidance on what to do, and advises nearest place to go for assistance, or for someone to come to you.
- Is a 24/7 service.
- Premium rate or commission revenue model.

### **B17. Comparison site**

- The NVI is for a garage comparison site.
- Customers put in their details (car make and model) and it works out what tyres they need.
- It then proceeds to show availability in the local area, alongside reviews, and prices.
- Clients then are able to book an appointment through the comparison site, which is funded on a commission model through the garage.

**B18. Comparison site using a photo**

- The NVI is for a comparison site (as described in Idea 17), but with the twist that the user only has to take a photo of their current tyre, in terms of putting in the details.
- This image recognition functionality then specifies what is needed before giving the customer options of nearby garages.

**B19. Comparison site (user pays)**

- The NVI is the provision of a garage locator and comparison service which provides information on what is available in terms of local garages and the charges they offer.
- This website is though funded by the user. Rather than drawing on a commission model, it charges the user to visit the website and extract the information from it.

**B20. A mobile call out comparison site**

- The NVI is an app which basically offers call outs for your tyre problems and shows you the different prices involved.
- It is thus a combination of the comparison site principle (need, location, availability), with the mobile call out service where people come to you (mobile garage) to fix your tyre.
- It thus connects you to local garages, who are able to come to you. It gives the time and price options for each suppliers. The client then books the service that works best for you from the options.

**B21. Better material**

- The NVI is to set up a tyre business that manufactures tyres from different material. This is material that is more resilient and longer lasting, potentially less likely to require air.
- This tyre would be far less likely to puncture.

**B22. Recycled tyres**

- This NVI focusses on the idea of recycled tyres that are then made available for sale.
- It is an environmentally friendly play.
- Tyres are potentially manufactured or indeed repaired, using rubber from alternative tyres. It potentially draws on a 3D printing style approach to repair or refurbish the old tyres with existent rubber.

**B23. Tyre breakdown/call out service**

- The NVI is focussed around a breakdown service for tyres in effect. It is a 24/7 offering.
- This is a service where people subscribe for a year (like breakdown cover), and then if their tyres go it covers the call out to fix on the spot, and provide the new tyre.
- Clients pay an annual fee and it covers the replacement tyres and the cost of the call out.
- This breakdown service further provides customers with certainty that they not getting ripped off.

**B24. Replacement tyre insurance**

- The NVI here is for specific tyre insurance. So in this sense it is not all in breakdown cover (as per B23), but just covers the cost of tyre problems for your car.

- It is an annual subscription. It links to a network of garages who potentially do the work (for a discounted rate), re: the tyre insurance provider.
- The price of the insurance is tailored to what car the person drives (which relates to the price of the tyres), and it potentially also considers mileage and other factors.

**B25. Manufacturer's warranty fulfilment**

- The NVI here is that the car manufacturer (ie: BMW, Ford etc.) provides a warranty alongside the car, which also covers the tyres if they go wrong within a certain period.
- Under this warranty, the customer is directed to a garage who repairs the tyres for them, and who then bill the manufacturer.
- The potential business then facilitates this warranty, re: overseeing relations with relevant manufacturers and local garages.

**B26. Testing machine**

- The NVI revolves around rolling out a machine that tells you the age of your car tyres and their state. Tells you the future life cycle of the tyre.
- If plausible, the same machine could have the possibility to repair tyres (rubber patches etc..).

**B27. Tyre tracker**

- The NVI is some kind of tracker device that is fitted to a tyre. It can then scan the tyre, and from there alerts the driver, and also the local garage when the tyre is wearing down or when the alignment is off.
- Reassuring for the consumer, and allows garage to track tyre, get replacement ordered in advance of any issues etc.

**B28. Tyre regulation monitoring**

- The NVI is a regulatory consultancy business, or a consumer champion style business (like 'Which') that collects data over tyre lengths and performance, and which audits that data.
- This provides information on tyre longevity and safety. Ideally government funded.

**B29. Garage that focusses on recycling tyres**

- The NVI is to open a garage, or a chain of garages, that are dedicated to recycling tyres. As such you know when you dispose of your old tyres, they are not going to landfill or equivalent, but are going to the construction of new things (swings/furniture etc..)
- It is possible that the car owner is charged a lower price as well for using this garage, because there is this secondary proactive revenue stream from the garage in recycling the tyres.

**B30. Tyre recycling business**

- The NVI is a business (not a garage) that focusses on collecting old tyres and recycling them into new materials.
- This gives the tyre a further life which is friendly for the environment, and also sees things (playground equipment) produced from the material.

**B31. Training service on tyre changes**

- The NVI is an online platform that has videos on how to change tyres, and which contains everything you need to know about tyres, without having to visit the garage.
- It could offer to sell the equipment needed to change tyres, or be monetised by ads of those providing this hardware.

**B32. Automatic Jack**

- The NVI is to create and market an automatic jack, one that you put under the car and it automatically increases it to the right level for the car in question (helpful for those lacking the know or physical ability to do it).
- Potentially the portable machine can also help to automatically/mechanically loosen and tighten the wheel nuts with an associated device that comes with the automatic jack.

**C. Challenges in hiring the right employees****C1. Standard Recruitment Agency**

- The NVI revolves around a recruitment service play.
- This is very much in the model of a recruitment agency, performing the advertising, filtering, pre-screening and interview organising work, on behalf of the customer.

**C2. Recruitment agency that does simulations**

- The NVI here is a tweak on the recruitment agency principle.
- As part of the pre-screening work, the recruitment agency is seen to run a number of tests. These are real life simulations where the candidates are assessed in relation to the job roles that they would be performing (possibly over 1-2 days).

**C3. Recruitment agency that trains people to an accredited standard**

- The NVI here is a recruitment agency, that operating in certain sectors, trains people (like a boot camp), for the role involved.
- As such the agency is able to guarantee the quality of the candidates that they provide (in terms of accreditation), and the company knows they have been through a rigorous practical training regime.
- This could apply for a range of jobs, from waiters to drivers.
- The recruitment agency is then able to provide a bank of ready to go staff in various categories.
- In certain circumstances, some public money may be available for this training work.

**C4. Recruitment agency that trains post hiring**

- The NVI here is a recruitment agency that hires people with the organisational culture of its customer heavily in mind.
- The recruitment agency thus works with the client to find the right candidates, but then after they have been hired, it offers training on behalf of the organisation for the new hires (in areas where they have been seen to be deficient), potentially also educating them in the client's company culture.



**C5. Recruitment agency that works on the volunteer principle**

- The NVI here is a recruitment agency but with a twist.
- This recruitment agency works to place volunteers who work at an organisation for free.
- If the volunteers work out well, then after a set period they are hired, and if that happens the agency then earns a commission.

**C6. Automatic Ad placer**

- The NVI here is a recruitment ad fulfilment system.
- It would be targeted at larger companies.
- The system would tap into organisational information in relation staff leavers/staff turnover. It would then automatically place ads in relation to the staff turnover and recruitment needs in question. It would do this placement automatically once the system was pre-populated with the ads.

**C7. Interview booking app**

- The NVI here is app software (or an online website plugin) whereby applicants book slots when they can come in for interview. It is something potentially sold to large companies with lots of interviewees/interviewing staff, and automates this part of the process.
- It then automatically sends out details/reminders of the interview.

**C8. Basic filtering software**

- The NVI is filtering software that organisations use to read and filter CVs.
- The client puts in their filtering criteria which then flag the CVs from the incoming application pile (possibly set against the application reference number) which are worth looking at in more detail.

**C9. Filtering software the books interviews**

- The NVI is filtering software that screens the applicants, but then goes further and automatically books interviews with those that it likes, and automatically rejects those that do not meet the criteria.
- The service is thus a one stop digital HR service.
- It is possible that internal teams could register new recruiting needs through this platform, and that the same platform could also handle the contract paperwork post offers being made.

**C10. Testing and gaming screening website**

- The NVI here is a website solution that is run for companies doing recruitment.
- On the website, applicants take tests, answers questions, and fill in an application form, all of which automatically filters out and rejects candidates automatically at the time at which they take the tests. This saves admin as well as improving the results.
- These tests variously can include personality and aptitude tests, as well as tests that relate to the actual job role involved, and even the company culture.
- These tests can take the form of a game or series of games if that helped increase engagement.
- Companies would tailor the website/input to what they need and pay a subscription for it.

**C11. Chat bot driven by Artificial Intelligence**

- The NVI is a chat bot that is deployed during the application process, drawing on Artificial Intelligence, to ask questions and screen applicants.
- It takes the form of a website plug in, that asks a series of questions, assesses candidate attitudes, and poses a series of scenarios.
- It is sold on subscription by the software company to the client, and then adjusts to client needs.
- The chat box automatically rejects people on the back of their answers. It would help find the best candidates and saves human time/work.

**C12. Automatic Interview that listened back**

- The NVI is software that potentially does the filtering of CVs, and then the handing of tests to the candidates, before then conducting automatic interviews.
- Those candidates who pass the initial screening are presented with interviews by an 'alexa' style machine (automatic questions). Through a video they then record their answers onto the software.
- The answers of the screened candidates are then reviewed by the company's HR staff in a process which saves a lot of time (arranging, facilitating, conducting the initial interviews).
- The possibility might exist for the AI software to even screen out some candidates from further answers given to the recorded software.
- All this cuts the time of creating a final short list considerably.

**C13. Video Submission sites**

- The NVI revolves around a video CV.
- There is an application which assists/templates candidates applying through a video recording where they present themselves, talk about themselves, and answer set questions.
- The video CV makes it much easier and more effective to pick out the right candidates at the selection stage. This application is sold to companies to use.

**C14. Quick Swipe recruitment application**

- The NVI is a recruitment application.
- In the application companies upload profiles of their jobs in a very quick easy to view format (one screen). Those interested in applying swipe through the profiles.
- When the candidate is interested in an application, they mark it, and it provides the recruiting company with details of their profile. In essence a 1 page screen with a picture and some core details, possibly even a sneak peak of them doing a task (if sector specific).
- This 'tinder style' principle makes it far quicker for applicants, and makes it more efficient and potentially effective for companies in the initial CV filtering stage.

**C15. Fast paced recruitment fayre**

- The NVI is a series of recruitment fayres, with a difference.

- The recruitment fayres are arranged and those looking are encouraged to attend. People then register for the areas they are interested in (the fayre is segmented by area, waiters, chefs etc.), and then they have interviews at the event with the companies that are there.
- These interviews are fast though (speed dating principle) to allow employers (and candidates) to apply to as many places/see as many candidates in a short period of time. It is thus a very efficient way for companies to do mass recruitment.
- Companies pay to attend the event, signing up for a booth in effect.

#### **C16. Competitions**

- The NVI relates to specialist fields (engineering etc..),
- The company would organise and market a competition on behalf of the recruiting company.
- Applicants would be encouraged to enter the competition to solve a particular problem.
- Given the specific nature of the competition (related to the job role involved), this approach would find good matches (interested people) and pre-screen out the highest quality candidates. The prize relates to a job offer.

#### **C17. Scanning API**

- The NVI relates to the creation of some scanning software that would be marketed to companies for them to use to identify potential candidates from CVs that are out there on the internet (people's own websites, FB etc..).
- Companies would pay for either a set number of campaigns, or a monthly time period.
- Companies would pre-populate what they are looking for into this scanning software, and some kind of API would then go through the internet looking for CVs that meet criteria.
- The API could be based on intelligent learning, adjusting to feedback from the company in terms of how they rate the CVs that are returned.
- This product would then reduce the need to advertise extensively for a role, or indeed to filter CVs (as only good matches would be returned). It would thus yield relevant potential candidates with limited work.
- The service needn't work on LinkedIn/Indeed etc.., but could be offered to them/people could pay to access their databases on top.

#### **C18. Recruitment consultancy**

- The NVI is akin to a recruitment consultancy, for recruiters.
- So it is a business that trains HR staff/those doing recruiting in what to look for, how to identify people certain skills (teamworking etc..)
- Including role specific consultancy, part of this service could also extend to working with the client to identify the right profile for the role in question, where to advertise, what tests to use in the specific recruitment process for that role.
- It would be charged on a day rate, and could work for SMEs/those without established recruitment experienced.

#### **C19. Leavers profiling test**

- The NVI here is in effect a data analytics service, sold to companies, that looks at the profiles of staff who have left the company (particularly a large company).

- It would combine a range of data on those leaving, including their psychometric profile.
- It would then tell the client what kind of features/profiles tend not to work in terms of profiles that do not work with staff retention.
- This would then feed through into the client's hiring process, such that they could adjust their criteria/look for certain things, and thus become more effective at recruiting going forward.

**C20. AI that looks at performance to create perfect profile**

- The NVI is to create a profiling service using data analytics to identify what is the absolute best criteria/fit that work with a particular role in a company.
- This consultancy is potentially sold on a role by role basis.
- The service would therefore collate data on the backgrounds of all staff (from their CV, education, physical attributes even), and use machine learning to add all this information to an algorithm. This would then be matched with information about what has worked best in the role/past performance.
- The result of this machine learning is that future applicants would then be filtered out/selected based on the known criteria that work with that company and that role.
- It is possible that this information could be extended to those at the application phase, so that it specifically encourages some (and discourages others) with certain backgrounds from applying.

**C21. CV Database where people upload their details**

- The NVI here is a website where candidates put up details about themselves (CV, work history etc..) and what they are looking for.
- Companies then enter details of the jobs that they have available, and from there the service then screens the database of people who are looking, and provides the company with potential matches.
- It provides those details over to the company for a fee for each job that is posted, and avoids the need for recruitment agencies to do the searching on behalf of a company.

**C22. Recruitment database tied to a university**

- This NVI is student focussed database, with the objective of marrying university students with SMEs. It would thus help SMEs recruit from universities, where the hiring is normally the preserve of larger companies.
- Students would upload their details into this database, and at the same time SMEs would then pay to access that database, to try and find matches that suit their needs.
- It would make for a more targeted and cost effective way for SMEs to recruit from universities.
- The company would either charge a subscription for SMEs to access the database, or if it could be arranged, charge a commission for every hire that went through the service.

**C23. Job board (paid for by those hunting jobs)**

- This NVI is a job board in effect, where people would pay a membership fee to upload their CVs.

- This membership fee would also provide the individual potential applicant with background information on jobs that are free/vacant.
- Companies would then go to the website/database and access the candidates that had uploaded their CVs onto the platform and which they liked.
- The revenue is model is though exclusively paid for by the applicant.

**C24. Facial recognition software**

- The NVI revolves around facial recognition software that is sold to companies, and which profiles people as they come in for interview, or as their CV are sent through (and which requires a photo).
- It then scrolls through a database of un-desirables, and does background checks.
- The principle it is suggested could be extended by taking blood from applicants.

**C25. Selling personality tests**

- The NVI here is a business that markets and sells personality tests to those engaged in recruiting.
- There could be different types of these physical recruitment tests depending on what they client is looking for.
- These could either be done a log in, given to the client, to then give to an applicant, or a physical test. In effect the business revolves around the marketing and distribution of tests (neat). The tests are not integrated into any wider recruitment workflow.

**C26. Sandwich board recruitment advertising business**

- This NVI is a service offering, where the company uses a network of sandwich board style people to advertise a client's vacancies and attract applicants.
- The client tells the company of the vacancy that they have, and then the company's network of staff walk around town centres with sandwich boards which contain details of that particular vacancy.
- This is presented as a low cost/high volume way to garner potential interest/applicants for specific types of job role.

**C27. Reference Review service**

- The NVI here is a database that reviews previous employees, so it is in effect a staff rating or reference service into which employers add details.
- This service thereby provides recruiters with information about a person's integrity, honesty, past capability etc.. It could be on a starred basis for simplicity.
- Companies then pay to access this secure database, potentially linking with other employers to garner ratings and reviews.

**C28. Employee bidding system**

- The NVI here is a website where people anonymously upload details of their role, experience, location, and what they are currently earning. It is then a potential bidding platform, through which companies looking to hire staff, can bid/make offers to those people for higher money.

- The revenue model would involve companies having to pay to access the service, and possibly the employees paying on that side as well.
- It is in effect taking the marketplace principle to recruitment, bidding up salaries for the benefit of those working, but also providing an easy/straight forward way for companies to hire/poach fresh staff.

## **D. Challenges of taking medicines in old age**

### **D1. Live Doctor Platform**

- The NVI is a platform where patients can chat with a doctor. The platform provides information about the particular medication, and then there is the option to message a medical practitioner or do a live chat with them.
- It is virtual medicine, in terms of the home help aspect at least. The revenue model of this idea is not specified.

### **D2. Robotic hologram doctor**

- The NVI is to build a hologram that is in effect a remote doctor that sits in people's living rooms.
- It has a whole library of medicines and information about medical conditions and the older person can then select what they need to know, and the hologram would impart useful medical information and information about the specific medicine.

### **D3. Master medicine directory**

- The NVI is to create a website that in effect serves as online drug directory.
- The website has all major medicines on it, and details what the medicine is for, how you take the medicine, with potential dosage guidance.
- This is a service that is open to both patients, with potentially a higher even version available for pharmacists which they pay to access.

### **D4. Medicine Community Group**

- The NVI is to create a support group for those who have the same medical condition and who are taking the same medication.
- The support group would serve as a valuable community for people with that condition, helping them to share good practice, experiences and provide each other with support. The support group would also become a central information destination for people with different conditions.
- Once the community (whether on an app/website) was established it would be possible to create/offer a whole host of value add services (including medical consultations) around it.

### **D5. Larger fonts on medicines**

- The NVI involves around an alternative packaging offering, whereby the information and small print on medicine bottles/packs and the associated insets are provided in a much larger font.
- The instructions would also prioritise what is important first.

- The business and revenue model for this ‘larger instructions’ proposal is unspecified.

#### **D6. Instructions Reader**

- Here the NVI involves the ability to scan a QR code on a medicine package or bottle, which then relates to an app/reader which then verbally (or through a video) provides you with the core information.
- This could be useful for older people who struggle with vision and memory.

#### **D7. A personalised App that has your medicine on there**

- The NVI here is to create a personalised App which people download, and into which they can easily enter all their current medication requirements.
- In doing so it could potentially draw information about each medicine from a list, so it has full details of what the medicine does, side effects, and how and when it should be taken.

#### **D8. A medicine advice platform**

- The NVI here is to create a website that provides guidance and tutorials on how to take specific medications.
- The service is presented as a ‘teaching place’ that educates old people inn how to take medicine.
- The platform can have people (chat room style principle) who can provide one to one guidance as required. The revenue model is not specified.

#### **D9. Basic Alarm on an App**

- The NVI here is a basic medicine taking app,that sits on people’s phones.
- Customers download the app from the app store (or equivalent), enter the medicine they take, what the dosage is and when they are supposed to take it.
- The App then schedules a series of basic alarms that vibrate/ring each time (until they are cancelled/paused) reminding the customer to take the relevant medication.
- The App could potentially have a picture of the bottle/pill to be taken at that time (generated from a list automatically, along with other potential background information) so to aid the identification of right medication at that time.

#### **D10. Alarm App and medicine scanner**

- The NVI is a phone app that combines the two functions of alerting the customer to take the medicine and providing them with functionality to understand the medication.
- The App alerts you at the time you need to take the medication.
- It also has the ability to scan the medicine bottle or package (name or code) and to give them (reading aloud) the details at the time of what the medicine is for, and what dosage needs to be taken. This would help with older people who maybe cognitively impaired.

#### **D11. Text message reminder service**

- The NVI is a reminder service on the need to take medications, but which operates through text message (rather than alarms).

- The messaging service, to which people sign up to, can provide details of dosages and instructions in how to take the medication.

**D12. Alerting service tied to smart TVs**

- The NVI is an alerting service that is tied to the customer's smart television.
- The smart television has functionality where it can be programmed either by the elderly person concerned, or their friends or relatives, such that it provides alerts and reminders on the screen at the apt time, that the older person now needs to take their particular medication.

**D13. Automatic phone alerting service**

- The NVI is an automated phone service that rings the older person at home, at the appropriate pre-programmed time for the medicine concerned, and tells them that it is now time to take the specific medication (alongside the appropriate dosage).
- The service is fully automated (is a pre-recorded message that is played).
- Customers would subscribe to this service for a few pounds a month.

**D14. A talking medicine reminder device**

- The NVI involves the creation of an actual physical device that has alarm functionality and which is related just to medicine.
- Rather than being housed on the customer's phone (which might not work for many old people), at the appropriate time, the device that sits in the old person's home, plays music or talks at them telling them to take the medication concerned.
- The device can also provide information as to the dosage required, instructions on how to take the medicine, and background information as to what it is for.
- This device operates on a subscription service, and could potentially be marketed through pharmacies.

**D15. Talking medicine reminder device with interactivity**

- The NVI here is talking medicine device, tailored as per (idea 14) to the older person's medication needs, and which comes with alarms, and instructions.
- The further twist with this idea is that the medical device also has some connectivity functionality. This might allow the older person to potentially speak to someone (in a call centre) if they had any further questions.
- The device could include an emergency button/panic button. The customer would then press this if they were having a medical emergency so to summon help (it could potentially alert both relatives and medical professionals).

**D16. Wearable watch that prompts**

- The NVI here centres around wearable technology (focussed mainly around a watch, or it could be a band/ring).
- The technology then vibrates when the time has come to take specific medication. In this sense it is more full proof (as it is wearable) than a phone or other device.



- The wearable technology would keep reminding you until it was reset. If it is not reset it could always prompt a relative (so doubles up as a safety feature) on more sophisticated versions.

#### **D17. Wearable watch also measure medical state**

- The NVI here is focussed around wearable technology (logically a watch) which alerts and alarms older people to take their medication.
- However with an added aspect of sophistication, the wearable technology also doubles up as a health monitoring solution, one that can read, monitor, and record blood pressure/pulse and other indicators.
- In response to what it finds, it would also be possible for the wearable technology to suggest adjustments to the dosages of some medicines.

#### **D18. Alerting and reordering app**

- The NVI here is a phone that provides reminders and alarms to take medication, personalised to the individual's specific course of medication.
- In addition, the app goes further and also has reordering capability.
- As such, the app would be able to track how much medicine has been taken from the previous order, how much is left, and when it is time to reorder. It would then prompt the patient to be able to undertake the reorder from their phone, which would then feed into the doctor and the pharmacy, or undertake the reorder process automatically if permitted.
- The app could potentially be marketed through pharmacies/offered in tandem with pharmacies. Clearly there is the potential for medicine reordered through the app to be delivered by post to the user through this service as allowed.

#### **D19. Basic medicine box**

- The NVI revolves around an off the shelf medicine container or box, that has different compartments for different days and different times of the day.
- The product is in essence a well structured box or container.

#### **D20. Pre-prepared medicine box**

- The NVI involves the preparation and dispatch of pre-stocked medicine containers. It is like a fulfilment service provided to the older person on behalf of the pharmacy or medical provider.
- In this way, fresh medicine is supplied each month, as per the patient's needs, but with the medication already lined up and populated in the different sections/dispensing boxes for each time slot on each day during the associated period. It is delivered to them as part of the service.
- When the previous box has run out, the client is provided with a new pre-populated tray that they simply insert into the container.
- The client pays for this on subscription.

#### **D21. Smart box that alarms, but also reorders automatically**

- The NVI is a smart box that has the medicines in different containers/segments, and which automatically alarms as to when the medicines are due.

- However in a further twist, the smart box also then automatically reorders.
- Like a smart fridge, it is able to track how much of each medication is left, and then automatically sends a message to the pharmacy (and as necessary the doctors) that additional pills are needed at the point when stock is running low.
- The new pills are then facilitated automatically without the client needing to do anything actively, which in turn ensures they don't run out of supply.

#### **D22. Alerting app that tied to a smart box**

- The NVI is a phone app, that undertakes the same alerting functionality as a basic phone app.
- However here there would be some connectivity between the phone and the smart box, such that either the smart box lights up (as to which container to use) or the app specifies the number of the container from the smart box that needs to be taken at that point.

#### **D23. The alarm being the smart box itself**

- The NVI is focussed on the alerting potential of the box itself rather than having a phone alarm. As such the smart box is itself alarmed (like a medical reminding device, but this time integrated with the smart box).
- The form of reminders from the smart box could be musical, an alarm, or even verbal. The reminder does not go off until it is reset.
- The key is that the relevant section of the smart box to be taken would be clearly marked/indicated alongside the alarm. Potentially the actual relevant container at that point could automatically open even.

#### **D24. Smart Box that alarms and also reorders**

- This NVI relates to a full service smart box. The pre segmented smart box, alarms when the customer is due to take a pill and dispenses those pills as per the standard alerting smart box concept.
- The further twist with this smart box is that the box also performs the automatically reordering function as well. The smart box reads when a particular pill is low in supply, and from there automatically notifies the GP/pharmacy so that a fresh supply can be automatically dispatched before it runs out.

#### **D25. Subscription service**

- The NVI focusses around the concept of a basic medicine subscription service.
- It is a remote pharmacy style concept, where the client specifies their medication requirements and which facilitates their prescriptions as required (potentially online, or linked), and from there the online pharmacy dispatches the medication to the patient.
- The patient is then charged a fee for the medicine and the delivery to their door.

#### **D26. Drone based delivery service**

- The NVI operates on a subscription service for medication to which the client subscribes.
- The twist with this idea is that the medication is then automatically delivered by drone, and deposited on a specific medicine box on the side of each house or apartment.

#### **D27. Fulfilment service for care homes**

- The NVI here is a specific B2B service focussed on the care home sector.
- The company provides a service where it takes all the medication needs of elderly people in a care home, and then fulfils these medication orders, such that they are ready to go for each person in the care home without involving care home staff.
- It is similar to the smart box concept, but on a larger scale as it is done for a whole care home, and the revenue model (a B2B one) is to charge the care home (saves staff time).

#### **D28. Home Help that comes round**

- The NVI is focussed on the provision of a service business, where the company operates as an agency and sends nurses or equivalent staff round to the older person's house to help them take their medication. This is laid out as a dedicated service, not part of existing home care services.
- The home help could potentially bring the medicines with them as part of the service. It is assumed that in many cases the patient may not be capable of taking their own medicine.

#### **D29. Visa placement service for carers**

- The NVI is focussed on the actual recruitment of carers who potentially could go to old people's houses and provide support with medication.
- It suggests that an employment style agency would be set up in Nigeria, and it would tap into potential staff supply. People would then come to the UK on the basis that they could potentially obtain a visa for this work.
- The agency would fulfil this visa application and the placement into the home care medicine sector.

#### **D30. Telephone home help service**

- This NVI service is a paid telephone form of home care support. in relation to medicines.
- It is suggested that as part of the agency service, rather than visiting in person, staff would phone the older person in question to provide a verbal reminder (real not automated) that they need to take their medication at the set time.
- This service has further benefits in that it provides company for the older person and would double up as a check on their general well being.

#### **D31. Automatic medicine ingestion machine**

- This NVI focusses around a physical product that would support the ingestion of medicines for older people.
- It would be a device that would link directly into the human body. It would be pre-populated by the relevant medicines and then would automatically dispense the medicines into the older person's body, at the right time and in the right amounts.
- This would in effect automate the process of taking medication, apart from the role of topping up the device (every few days, potentially by a carer or relative).

#### **D32. Robot carer**

- The NVI here focusses around the concept of a robot carer that operates in the old person's house.

- The robot would be loaded with medication, and pre scheduled as to the older person's medication requirements.
- At the said time, the robot would then move around the house to find the older person, tell them what is due at that point, provide instructions if required, and then dispense the medication required at that time.
- The medicine robot combines AI and robotics, it could even hold the spoon in the case of those where that proves helpful.
- This robot could potentially be leased (so just rented for the time that it is used)

**D33. Amalgamated pills**

- The NVI here relates to a potential pharmaceutical industry product, such that pills are merged together.
- Older people with multiple conditions do not then need to take multiple pills, but in effect one single pill is produced for the older person, that reflects all the different separate pills that they would otherwise need to take (3 into 1 principle).

**D34. Pills in liquid form**

- This NVI is again a potential product in relation to the pharmaceutical industry.
- It would relate to a genre of pills that rather than being provided in capsule form, were instead provided in liquid form. This would make the taking of the medicine potentially much easier for many older people, particularly if the medicine was mixed in with nicer tasting ingredients.

### D3. NVI quality - Coding guidelines

Each NVI idea was assessed by three separate judges, each with experience as multiple company founders. They were asked to grade the ideas according to novelty, appropriability, and overall quality.

In doing so, they were provided with the following set of guidelines in order to give each NVI a grading in each of the respective areas.

#### Novelty (How "new" does this idea appear)

Score	Summary	Typical Characteristics
1	Very Low Novelty	Common existent business idea
2	Low Novelty	Mundane and boring business idea
3	Limited Novelty	Some aspects of novelty, but largely a tweak to existing processes
4	Average Novelty	A new concept but low in originality
5	Some Novelty	A more original business idea
6	High Novelty	Highly original business idea
7	Very High Novelty	Rare, unusual, left field. New concept

#### Appropriability (ie: What is the "likelihood" that someone would "capture returns" from the exploitation of this idea)

Score	Summary	Typical Characteristics
1	Very very Low Appropriability	No real business model, hard to imagine as a stand alone offering
2	Low Appropriability	Very inconceivable idea that would seem to have real feasibility issues
3	Poor Appropriability	Largely unconvincing idea that can't see in practice
4	Average Appropriability	Believable idea but on a small scale
5	Good Appropriability	Relatively strong idea but on a local scale/limited scale
6	High Appropriability	Good idea that would seem obtainable and achievable, wide reach
7	Very high Appropriability	Very strong idea, likely feasible, defensible, high revenue potential

#### Overall Idea Quality - How would you rate the overall quality of this idea (factoring in novelty and appropriability)?

Score	Summary	Typical Characteristics
1	Very very poor	Eg: Not a new business idea (already being done), or no revenue model.
2	Very poor	Eg: Even if a new idea, appears totally impractical or unfeasible.
3	Poor	Eg: A new idea, but hard to see it being profitable, or having much demand. Eg: A new idea. Seems feasible, but lower originality, and less potential scale.
4	Average	Eg: An original idea, with some scale, but questions on feasibility and profitability.
5	Good	Eg: A more original idea, with greater scale.
6	Very Good	Eg: Highly original, looks achievable, with very good potential
7	Very very good	

## D4. NVI Quality Scores

The individual score given by each rater (coder) to each NVI variant in question can be seen below:

Idea No	Quality			Novelty			Appropriability		
	Rater 1	Rater 2	Rater 3	Rater 1	Rater 2	Rater 3	Rater 1	Rater 2	Rater 3
A1	4	5	5	3	4	5	4	5	5
A2	2	1	2	3	3	3	2	1	2
A3	4	2	3	3	2	3	4	2	3
A4	2	1	2	2	2	2	2	1	2
A5	1	1	2	2	3	4	1	1	2
A6	4	2	3	3	2	2	4	2	4
A7	4	4	4	4	4	3	4	5	5
A8	5	5	4	4	4	4	5	5	5
A9	5	4	3	5	3	2	5	5	4
A10	1	2	1	1	1	1	2	3	1
A11	4	5	5	3	3	3	5	5	5
A12	2	2	4	2	1	3	2	2	4
A13	6	5	5	5	4	3	6	5	5
A14	3	4	3	2	4	2	4	4	4
A15	2	4	4	2	2	3	3	4	4
A16	3	2	3	5	6	5	3	2	3
A17	1	1	1	2	1	1	1	1	1
A18	2	2	2	3	4	4	2	2	2
A19	2	2	4	5	5	3	2	2	4
A20	3	3	3	2	1	3	3	3	3
A21	3	4	3	2	2	2	4	4	3
A22	3	4	3	2	2	3	4	4	3
A23	4	5	4	3	2	4	4	5	4
A24	5	5	5	7	5	5		5	5
B1	1	3	3	2	2	2	2	3	4
B2	3	3	3	4	2	2	3	4	3
B3	5	1	2	5	5	5	5	1	3
B4	3	2	2	5	5	5	3	2	2
B5	4	5	3	6	5	5	3	3	3
B6	4	4	4	3	2	2	4	4	4
B7	3	4	2	2	3	2	4	4	2
B8	2	2	3	2	2	2	4	1	3
B9	5	5	5	5	3	4	5	6	5
B10	2	1	1	2	1	1	2	1	1
B11	2	1	1	2	1	1	2	1	1
B12	3	1	3	3	2	3	3	1	4
B13	2	1	1	2	1	2	2	1	1

B14	2	3	1	2	3	1	3	3	1
B15	3	3	3	3	3	3	4	2	3
B16	4	3	4	3	3	3	5	4	4
B17	5	4	4	4	4	4	5	4	4
B18	5	5	5	5	5	5	5	4	5
B19	2	2	2	4	4	4	2	2	2
B20	6	5	6	5	5	5	6	5	6
B21	1	2	2	1	4	3	1	2	2
B22	4	4	3	5	5	4	3	4	3
B23	3	4	1	3	1	1	2	4	1
B24	5	5	3	5	4	3	5	5	3
B25	1	1	3	2	1	3	1	1	3
B26	5	5	4	5	5	5	5	4	3
B27	4	3	2	6	3	5	3	3	2
B28	4	5	2	5	3	4	3	6	2
B29	3	4	4	5	4	3	3	4	4
B30	3	4	4	3	2	4	3	4	4
B31	2	1	1	2	2	1	2	1	1
B32	6	6	4	6	5	5	6	7	4
C1	1	1	1	1	1	1	3	4	4
C2	4	5	4	3	4	3	4	5	4
C3	4	3	3	5	3	3	4	3	3
C4	2	4	2	2	3	3	3	4	1
C5	2	2	2	3	4	3	2	2	2
C6	5	4	6	5	4	6	5	4	6
C7	3	3	1	2	2	1	4	3	1
C8	5	4	2	4	3	2	5	4	2
C9	5	4	3	5	4	3	5	4	3
C10	5	6	5	5	6	5	5	6	5
C11	6	5	5	6	5	4	6	5	5
C12	3	4	5	4	6	4	3	5	5
C13	5	4	5	5	3	4	5	4	5
C14	5	7	3	6	6	3	5	6	4
C15	4	4	3	4	3	3	5	5	4
C16	3	4	4	4	3	3	3	4	5
C17	5	5	3	5	5	3	5	5	3
C18	3	2	3	2	1	1	4	3	3
C19	6	4	3	5	5	3	4	6	2
C20	6	6	6	6	5	5	6	7	7
C21	2	2	2	2	2	1	3	2	3
C22	3	2	2	2	2	3	3	2	4
C23	2	4	3	2	4	3	2	4	3
C24	1	1	1	4	5	5	1	1	1
C25	2	3	3	2	1	2	2	3	4
C26	3	3	3	3	3	3	3	3	4
C27	2	2	2	5	3	5	2	2	2

C28	7	5	6	7	5	6	7	5	6
D1	1	1	3	2	2	3	1	1	3
D2	1	1	2	4	4	5	1	1	2
D3	3	3	2	2	2	3	4	3	2
D4	6	4	5	7	5	4	6	4	5
D5	1	1	1	1	1	1	1	1	1
D6	2	2	3	2	5	3	1	2	3
D7	2	2	3	2	2	3	2	2	4
D8	1	1	2	2	1	2	1	1	2
D9	3	3	3	3	3	2	3	3	3
D10	3	3	5	4	4	3	3	3	5
D11	3	2	4	3	3	3	3	2	5
D12	1	1	4	4	3	3	1	1	5
D13	2	2	4	2	3	3	2	2	4
D14	4	3	4	4	4	3	4	3	5
D15	5	5	5	5	5	3	5	5	6
D16	4	5	6	4	5	3	4	5	6
D17	4	6	6	5	6	4	4	6	6
D18	5	5	5	5	5	3	5	5	5
D19	1	1	1	1	1	1	2	1	1
D20	5	3	6	4	3	5	5	3	6
D21	5	4	3	5	3	5	4	4	3
D22	4	5	3	5	3	5	4	4	3
D23	5	4	4	5	4	4	5	4	4
D24	4	5	3	5	4	4	5	4	3
D25	2	3	1	1	2	1	2	3	1
D26	2	2	2	3	5	4	2	2	2
D27	5	5	6	4	5	5	5	5	6
D28	1	1	1	1	1	1	1	1	1
D29	1	1	1	2	1	1	1	1	1
D30	2	3	3	2	3	3	2	3	4
D31	4	2	2	6	5	6	4	2	2
D32	4	3	3	5	5	3	3	2	2
D33	3	4	2	5	6	6	2	4	2
D34	1	1	2	1	1	3	1	1	2
	<b>3.3</b>	<b>3.2</b>	<b>3.1</b>	<b>3.53</b>	<b>3.27</b>	<b>3.19</b>	<b>3.4</b>	<b>3.3</b>	<b>3.3</b>



For each NVI variant, the scores of the coders were averaged together to provide an average score across the different areas of overall quality, novelty, and appropriability. The final scores attributed to each idea variant are below:

<b>Idea No</b>	<b>Description</b>	<b>Quality Ave</b>	<b>Novelty Ave</b>	<b>Approp Ave</b>
<b>A. Lone Workers</b>				
A1	Company specific phone Apps	4.7	4.00	4.67
A2	Connected separate screens network	1.7	3.00	1.67
A3	Earpieces that are permanently on where communicate with office	3.0	2.67	3.00
A4	Communications App - Basic Undefined	1.7	2.00	1.67
A5	Buddy system/network (rent a friend)	1.3	3.00	1.33
A6	Wearable Cameras just recording	3.0	2.33	3.33
A7	Wearable Camera with panic button	4.0	3.67	4.67
A8	Wearable cameras that use AI to transmit	4.7	4.00	5.00
A9	Panic button - goes back to centre	4.0	3.33	4.67
A10	Just a panic alarm	1.3	1.00	2.00
A11	Tracking service if not dial in	4.7	3.00	5.00
A12	Hotline that they can call, support agency	2.7	2.00	2.67
A13	Meet up centres, communal break out room, activities	5.3	4.00	5.33
A14	Services - Staff rewards business	3.3	2.67	4.00
A15	Arrange out of ours meet ups for people in company	3.3	2.33	3.67
A16	AI Companion that plays songs/jokes and keeps company. Tailored.	2.7	5.33	2.67
A17	App that give you a boost check in on you, paid by employees	1.0	1.33	1.00
A18	Break pairing service for lone workers	2.0	3.67	2.00
A19	Pet renting business	2.7	4.33	2.67
A20	Health and safety consultancy that comes to remote workplaces	3.0	2.00	3.00
A21	Insurance (undeveloped)	3.3	2.00	3.67
A22	Training business (undefined)	3.3	2.33	3.67
A23	Training (more developed)	4.3	3.00	4.33
A24	Pooling lone worker staff service	5.0	5.67	5.00
<b>B. Tyres</b>				
B1	New Garage Opening hours	2.3	2.00	3.00
B2	Garage backed warranty	3.0	2.67	3.33
B3	Self Service Garage	2.7	5.00	3.00
B4	Tyre Vending Machine	2.3	5.00	2.33
B5	Tyre Changing Machine	4.0	5.33	3.00
B6	Garage in a parking lot	4.0	2.33	4.00
B7	Online tyre website	3.0	2.33	3.33
B8	Remote truck business - independent	2.3	2.00	2.67
B9	Networked remote truck operation	5.0	4.00	5.33
B10	Local Garage Forum	1.3	1.33	1.33
B11	Tyre forum	1.3	1.33	1.33
B12	Tyre chooser app	2.3	2.67	2.67
B13	Tyre chooser consultancy	1.3	1.67	1.33

B14	Tyre Database for cars	2.0	2.00	2.33
B15	Web booking engine - not comparison	3.0	3.00	3.00
B16	Phone booking engine	3.7	3.00	4.33
B17	Compairsson website	4.3	4.00	4.33
B18	Comparisson site through photo	5.0	5.00	4.67
B19	Compairson website - user pays	2.0	4.00	2.00
B20	Come to you booking service	5.7	5.00	5.67
B21	Better material for tyres	1.7	2.67	1.67
B22	Tyres from recycled rubber	3.7	4.67	3.33
B23	Insurance - Call out	2.7	1.67	2.33
B24	Insurance - Just tyres	4.3	4.00	4.33
B25	Car manufacturer based warranty	1.7	2.00	1.67
B26	Tyre testing machine	4.7	5.00	4.00
B27	Tyre tracker that monitors	3.0	4.67	2.67
B28	Tyre regulation monitoring firm	3.7	4.00	3.67
B29	Garage that finds second life for tyres	3.7	4.00	3.67
B30	Tyre recycling business	3.7	3.00	3.67
B31	Training service on how to change tyres	1.3	1.67	1.33
B32	Automatic jack	5.3	5.33	5.67
<b>C. Recruitment</b>				
C1	Standard recruitment agency	1.0	1.00	3.67
C2	Recruitment agnecy that does simulations	4.3	3.33	4.33
C3	Recruitment agency that trains/accredits	3.3	3.67	3.33
C4	Recruitment agency that tests org culture	2.7	2.67	2.67
C5	Recruitment agency based on volunteers first	2.0	3.33	2.00
C6	Automatic ad placer	5.0	5.00	5.00
C7	Interview booking app	2.3	1.67	2.67
C8	Basic filtering software	3.7	3.00	3.67
C9	Filtering software that books interviews	4.0	4.00	4.00
C10	Testing website	5.3	5.33	5.33
C11	Chat bot deploying AI	5.3	5.00	5.33
C12	Automatic interview that listened back	4.0	4.67	4.33
C13	Video Submission	4.7	4.00	4.67
C14	Tinder recruit service	5.0	5.00	5.00
C15	Speed dating recruitment fayres	3.7	3.33	4.67
C16	Competitions	3.7	3.33	4.00
C17	Scanning API	4.3	4.33	4.33
C18	Identifying right profile for the role	2.7	1.33	3.33
C19	Leavers profiling test	4.3	4.33	4.00
C20	AI that suggests best candidates	6.0	5.33	6.67
C21	CV Database	2.0	1.67	2.67
C22	Recruitment database for students	2.3	2.33	3.00
C23	Job board applicants pay for	3.0	3.00	3.00
C24	Facial recognition software	1.0	4.67	1.00
C25	Selling persoanity tests	2.7	1.67	3.00
C26	Sandwich board recruitment	3.0	3.00	3.33
C27	Reference review service	2.0	4.33	2.00
C28	Employee bidding system	6.0	6.00	6.00
<b>D. Medicine</b>				

D1	Live chat forum to discuss medicine with a professional	1.7	2.33	1.67
D2	Robotic hologram doctor	1.3	4.33	1.33
D3	Drug directory (online or catalogue)	2.7	2.33	3.00
D4	Medicine Support Group for people with same condition	5.0	5.33	5.00
D5	Improve the fonts on medicines (making them larger)	1.0	1.00	1.00
D6	Instructions come to you from a QR code	2.3	3.33	2.00
D7	App that just has medicine details in it	2.3	2.33	2.67
D8	Service (online) that shows you how to take medicines	1.3	1.67	1.33
D9	Phone Alarm App - Basic	3.0	2.67	3.00
D10	Phone App - Alarms, scans box, relatives	3.7	3.67	3.67
D11	Text message reminder service	3.0	3.00	3.33
D12	Alerting service tied to TV	2.0	3.33	2.33
D13	Automatic phone message service - not a person but automated	2.7	2.67	2.67
D14	Medicine Alexa that alarms, reminds, and explains the medication.	3.7	3.67	4.00
D15	Alexa with communication alarm	5.0	4.33	5.33
D16	Watch you wear that prompts, connects to relatives	5.0	4.00	5.00
D17	Wearable watch that adjusts doses, monitors	5.3	5.00	5.33
D18	Alerting and reordering App	5.0	4.33	5.00
D19	Basic Medicine box (as is)	1.0	1.00	1.33
D20	Medicine box that is delivered pre-prepared	4.7	4.00	4.67
D21	Smart box that reorders automatically	4.0	4.33	3.67
D22	Phone App - That linked to the box (of what they take, points to it)	4.0	4.33	3.67
D23	Smart box that talks at you, just alarms	4.3	4.33	4.33
D24	Smart box that talks and reorders..	4.0	4.33	4.00
D25	Pure medicine subscription service	2.0	1.33	2.00
D26	Drone based delivery service, to a smart box	2.0	4.00	2.00
D27	Medicines fulfilment service for care homes	5.3	4.67	5.33
D28	Home help that comes round to help you take the medication (agency)	1.0	1.00	1.00
D29	Home help agency - African visa scheme	1.0	1.33	1.00
D30	Telephone hotline that checks up on people	2.7	2.67	3.00
D31	Automatic ingestion machine, feeds the medicine in, adjust to need	2.7	5.67	2.67
D32	Robot carer	3.3	4.33	2.33
D33	Amalgamated pills	3.0	5.67	2.67
D34	Pills in liquid form (easier to take)	1.3	1.67	1.33
<b>Coder Average</b>		<b>3.2</b>	<b>3.3</b>	<b>3.3</b>

## D5. Participant NVI Scores

The individual NVI quality scores (overall quality, novelty, and appropriability) obtained by each participant related (drawn from the highest score idea they generated in each vignette area) can be seen below, alongside their total scores, when the 4 individual vignette scores are totalled.

Where the participant failed to generate an NVI for the vignette in question, they automatically scored '0' across for Novelty, Appropriability, and Quality.

Person	Lone			Tyres			Recruitment			Medicine			Total Score		
	Novelty	Approp	Quality	Novelty	Approp	Quality	Novelty	Approp	Quality	Novelty	Approp	Quality	Novelty	Approp	Quality
101	2.0	1.7	1.7	1.3	1.3	1.3	3.7	3.3	3.3	2.3	1.7	1.7	9.3	8.0	8.0
102	0.0	0.0	0.0	2.0	3.0	2.3	0.0	0.0	0.0	1.3	2.0	2.0	3.3	5.0	4.3
103	4.0	4.7	4.7	4.0	4.3	4.3	4.3	4.0	4.3	5.3	5.0	5.0	17.7	18.0	18.3
104	0.0	0.0	0.0	5.0	5.3	5.0	4.0	4.7	4.7	3.3	3.0	3.0	12.3	13.0	12.7
105	2.7	3.3	3.0	3.0	3.0	3.0	0.0	0.0	0.0	3.7	4.0	3.7	9.3	10.3	9.7
106	2.7	3.0	3.0	5.0	5.7	5.7	0.0	0.0	0.0	4.3	5.0	5.0	12.0	13.7	13.7
107	2.0	1.7	4.0	3.0	3.0	3.0	0.0	0.0	0.0	1.3	2.0	2.0	6.3	6.7	9.0
108	4.0	4.7	4.7	5.0	4.7	5.0	5.3	5.3	5.3	4.3	3.7	4.0	18.7	18.3	19.0
109	2.0	3.0	3.0	2.7	2.7	2.3	5.3	5.3	5.3	2.3	2.7	2.3	12.3	13.7	12.9
110	0.0	0.0	0.0	4.0	5.3	5.0	5.0	5.0	5.0	3.7	4.0	3.7	12.7	14.3	13.7
111	2.0	2.7	2.7	4.0	4.3	4.3	0.0	0.0	5.0	1.3	2.0	2.0	7.3	9.0	14.0
112	3.0	1.3	1.3	4.0	4.3	4.3	3.3	4.3	4.3	4.0	5.0	5.0	14.3	15.0	14.9
113	0.0	0.0	0.0	5.0	4.0	4.7	3.0	3.7	3.7	5.7	2.7	2.7	13.7	10.3	11.1
114	0.0	0.0	0.0	4.0	4.3	4.3	4.0	4.0	4.0	3.7	4.0	3.7	11.7	12.3	12.0
115	2.0	1.7	3.3	0.0	0.0	0.0	5.3	5.3	5.3	4.3	2.3	3.3	11.7	9.3	11.9
116	4.0	5.3	5.3	4.0	1.3	4.3	5.3	5.3	5.3	1.0	1.0	1.0	14.3	13.0	15.9
117	4.0	5.3	5.3	5.0	4.7	5.0	0.0	0.0	0.0	4.3	4.3	4.3	13.3	14.3	14.6
118	4.0	4.7	4.7	4.0	4.3	4.3	2.7	2.7	2.7	4.3	4.3	4.3	15.0	16.0	16.0
119	0.0	0.0	0.0	4.0	4.3	4.3	4.0	4.3	4.3	4.0	4.7	4.7	12.0	13.3	13.3
120	0.0	0.0	0.0	5.0	4.7	5.0	3.7	3.3	3.3	4.0	4.7	4.7	12.7	12.7	13.0
121	2.7	4.0	3.3	1.7	1.3	1.3	1.0	3.7	1.0	4.3	5.0	5.0	9.7	14.0	10.6
122	5.3	2.7	2.7	0.0	0.0	0.0	5.3	5.3	5.3	4.3	4.3	4.0	15.0	12.3	12.0
123	2.0	1.7	1.7	5.0	5.7	5.7	2.3	3.0	2.3	1.0	1.0	1.0	10.3	11.3	10.7
124	0.0	0.0	0.0	4.0	3.7	3.7	1.0	3.7	1.0	1.0	1.0	1.0	6.0	8.3	5.7
125	4.0	4.7	4.7	4.7	3.3	3.7	5.3	6.7	6.0	4.3	4.0	4.0	18.3	18.7	18.4
126	2.0	3.7	3.3	5.0	5.7	5.7	5.0	5.0	5.0	4.3	5.0	5.0	16.3	19.3	19.0
127	0.0	0.0	0.0	2.7	3.3	3.0	4.0	4.3	1.0	5.7	2.7	3.0	12.3	10.3	7.0
128	0.0	0.0	0.0	4.0	4.3	4.3	2.3	3.0	2.3	4.3	5.0	5.0	10.7	12.3	11.6
129	4.0	5.0	4.7	2.7	1.7	1.7	4.3	4.3	4.3	4.0	5.0	5.0	15.0	16.0	15.7
130	3.3	4.7	4.0	4.0	4.3	4.3	0.0	0.0	0.0	4.3	4.3	4.3	11.7	13.3	12.6
131	5.3	4.7	4.0	4.0	4.3	4.3	1.7	3.0	2.7	3.7	4.0	3.7	14.7	16.0	14.7
132	0.0	0.0	0.0	4.0	3.7	3.7	0.0	0.0	0.0	2.7	3.0	0.0	6.7	6.7	3.7
133	1.7	1.3	5.3	5.3	6.7	5.7	0.0	0.0	0.0	5.7	3.0	3.0	12.7	11.0	14.0
134	1.0	2.0	1.3	3.0	3.0	3.0	1.0	3.7	1.0	4.0	4.7	4.7	9.0	13.3	10.0
135	4.0	4.7	4.7	3.0	3.0	3.0	3.0	3.7	3.7	2.7	3.0	3.0	12.7	14.3	14.4
136	0.0	0.0	0.0	2.3	2.3	3.0	4.0	4.0	4.0	4.3	5.0	5.0	10.7	11.3	12.0

137	0.0	0.0	0.0	2.0	2.7	2.3	0.0	0.0	9.0	2.7	2.7	2.7	4.7	5.3	14.0
138	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.7	1.0	4.3	5.0	5.0	5.3	8.7	6.0
139	5.3	4.0	2.7	2.7	1.7	1.7	5.0	5.0	5.0	3.7	4.0	3.7	16.7	14.7	13.1
140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	3.0	3.0	2.7	3.0	3.0
141	2.3	3.7	3.3	4.0	4.3	4.3	1.0	3.7	1.0	1.3	2.0	2.0	8.7	13.7	10.6
142	3.0	5.0	4.7	2.3	3.3	3.0	1.0	3.7	1.0	1.7	2.0	0.0	8.0	14.0	8.7
143	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.0	2.7	1.7	1.3	1.3	3.3	4.3	4.0
144	0.0	0.0	0.0	5.0	5.7	5.7	3.3	4.3	4.3	1.3	2.0	2.0	9.7	12.0	12.0
145	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.7	3.7	1.0	1.0	1.0	4.0	4.7	4.7
146	0.0	0.0	0.0	2.7	2.7	2.3	1.0	3.7	1.0	3.7	4.0	3.7	7.3	10.3	7.0
147	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.3	3.0	1.0	1.0	1.0	4.0	4.3	4.0
148	3.7	4.7	4.0	3.0	3.0	3.0	0.0	0.0	0.0	4.3	4.0	4.0	11.0	11.7	11.0
149	4.3	2.7	4.0	3.0	3.7	3.7	4.3	2.0	2.0	4.3	4.0	4.0	16.0	12.3	13.7
150	5.7	5.0	5.0	3.0	3.0	3.0	5.3	5.3	5.3	4.3	4.0	4.0	18.3	17.3	17.3
151	4.0	5.3	5.3	3.0	3.0	3.0	3.3	4.7	3.7	4.0	4.7	4.7	14.3	17.7	16.7
152	3.3	4.7	4.0	1.7	1.3	1.3	4.0	4.0	4.0	5.7	2.7	3.0	14.7	12.7	12.3
153	2.0	1.7	1.7	2.7	1.7	1.7	0.0	0.0	0.0	4.3	4.0	4.0	9.0	7.3	7.4
154	4.0	4.7	4.7	4.0	4.3	4.3	5.3	5.3	5.3	3.0	3.3	3.0	16.3	17.7	17.3
155	2.0	1.7	4.0	3.0	4.3	3.7	3.0	3.0	3.0	4.3	3.7	4.0	12.3	12.7	14.7
156	2.0	2.7	2.7	5.3	4.7	4.0	4.0	4.0	4.0	3.7	4.0	3.7	15.0	15.3	14.4
157	0.0	0.0	0.0	0.0	0.0	5.0	1.0	3.7	1.0	3.7	4.0	3.7	4.7	7.7	9.7
158	2.0	2.7	1.7	3.0	3.0	3.0	1.0	3.7	1.0	1.3	2.0	2.0	7.3	11.3	7.7
159	2.3	2.7	3.3	4.0	4.3	4.3	4.0	4.7	4.7	4.3	4.3	4.3	14.7	16.0	16.6
160	0.0	0.0	0.0	4.0	4.3	4.3	1.0	3.7	1.0	4.3	3.7	4.0	9.3	11.7	9.3
161	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.7	3.7	3.7	3.7	3.7	6.7	7.3	7.4
162	4.0	4.7	4.7	2.3	4.0	4.0	0.0	0.0	0.0	2.7	3.0	2.7	9.0	11.7	11.4
163	3.7	4.7	4.0	5.0	5.7	5.7	1.7	3.0	1.0	3.7	3.7	3.7	14.0	17.0	14.4
164	2.0	2.7	2.7	0.0	0.0	0.0	1.7	2.7	2.0	5.7	2.7	3.0	9.3	8.0	7.7
165	2.7	1.7	3.3	4.3	4.3	4.3	3.7	3.7	5.3	4.3	5.3	5.0	15.0	15.0	17.9
166	2.3	3.7	3.3	3.0	3.0	3.0	5.0	5.3	5.3	4.3	5.0	5.0	14.7	17.0	16.6
167	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.7	3.7	1.3	2.0	2.0	4.3	5.7	5.7
168	3.0	4.3	4.3	4.0	4.3	4.3	4.0	4.0	4.0	1.0	1.0	1.0	12.0	13.7	13.6
169	0.0	0.0	0.0	4.0	2.0	2.0	0.0	0.0	0.0	1.3	2.0	2.0	5.3	4.0	4.0
170	4.0	4.7	4.7	0.0	0.0	0.0	4.0	4.7	4.7	1.3	2.0	2.0	9.3	11.3	11.4
171	0.0	0.0	0.0	2.7	2.7	2.3	3.0	3.7	3.7	1.7	1.3	1.0	7.3	7.7	7.0
172	3.7	4.7	4.0	4.0	5.3	5.0	0.0	0.0	9.0	3.3	2.3	2.0	11.0	12.3	20.0
173	4.0	4.7	4.7	2.7	1.7	1.7	1.7	2.7	2.0	2.7	2.7	2.7	11.0	11.7	11.1
174	2.0	2.7	2.7	1.3	1.3	1.3	4.3	2.0	2.0	0.0	0.0	0.0	7.7	6.0	6.0
175	3.0	1.7	1.7	4.7	3.0	3.0	3.7	3.3	3.3	2.7	3.0	3.0	14.0	11.0	11.0
176	0.0	0.0	0.0	5.0	2.3	2.3	1.7	3.0	2.7	2.7	3.0	3.0	9.3	8.3	8.0
177	2.0	3.7	3.3	5.3	3.0	4.0	1.7	2.7	2.3	0.0	0.0	0.0	9.0	9.3	9.6
178	0.0	0.0	0.0	5.0	5.7	5.7	0.0	0.0	0.0	5.7	2.7	3.0	10.7	8.3	8.7
179	0.0	0.0	0.0	2.7	2.7	2.3	0.0	0.0	0.0	2.7	2.7	2.7	5.3	5.3	5.0
180	4.0	4.7	4.7	4.0	4.3	4.3	4.0	4.0	4.0	4.3	5.0	5.0	16.3	18.0	18.0
181	1.3	1.0	1.0	3.0	3.0	3.0	6.0	6.0	6.0	3.7	3.7	3.7	14.0	13.7	13.7
182	3.0	5.0	4.7	4.7	3.3	3.7	5.3	5.3	5.3	4.3	3.7	4.0	17.3	17.3	17.7
183	4.0	5.0	4.7	5.0	5.7	5.7	4.3	4.3	4.3	1.0	1.3	1.0	14.3	16.3	15.7

184	3.3	4.7	4.0	4.0	4.3	4.3	5.0	5.3	5.3	4.3	5.0	5.0	16.7	19.3	18.6
185	3.0	5.0	4.7	2.0	2.7	2.3	0.0	0.0	0.0	5.0	5.3	5.3	10.0	13.0	12.3
186	3.3	4.7	4.0	5.3	5.7	5.3	0.0	0.0	0.0	4.3	4.3	4.3	13.0	14.7	13.6
187	2.0	1.7	1.7	2.0	2.3	2.0	1.7	2.7	2.0	4.3	4.3	4.3	10.0	11.0	10.0
188	3.7	2.0	2.0	0.0	0.0	0.0	1.3	3.3	2.7	1.3	2.0	2.0	6.3	7.3	6.7
189	0.0	0.0	0.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.7	4.7	11.0	11.7	11.7
190	2.0	1.7	1.7	4.0	4.3	4.3	2.7	3.0	4.0	1.3	2.0	2.0	10.0	11.0	12.0
191	4.0	5.0	4.7	2.7	2.7	2.3	0.0	0.0	0.0	4.3	4.3	4.3	11.0	12.0	11.3
192	2.0	1.7	1.7	4.0	4.3	4.3	5.3	5.3	5.3	3.7	4.0	3.7	15.0	15.3	15.0
193	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.7	1.0	0.0	0.0	0.0	1.0	3.7	1.0
194	0.0	0.0	0.0	2.7	1.7	1.7	4.0	4.0	4.0	2.7	3.0	3.0	9.3	8.7	8.7
195	3.0	5.0	4.7	3.0	3.7	3.7	3.3	2.0	2.0	4.0	4.7	4.7	13.3	15.3	15.1
196	0.0	0.0	0.0	4.0	5.3	5.0	3.0	3.7	3.7	4.3	5.0	5.0	11.3	14.0	13.7
197	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.7	4.7	4.3	4.0	4.0	8.3	8.7	8.7
198	3.0	5.0	4.7	4.0	4.3	4.3	1.7	2.7	2.0	3.7	3.7	3.7	12.3	15.7	14.7
199	3.7	4.7	4.0	2.0	1.7	1.7	1.0	3.7	1.0	1.3	2.0	1.0	8.0	12.0	7.7
200	0.0	0.0	0.0	2.0	2.3	2.0	4.7	4.3	4.0	4.3	2.3	3.3	11.0	9.0	9.3
201	2.0	1.7	1.7	4.0	4.3	4.3	5.3	5.3	5.3	2.3	3.0	2.7	13.7	14.3	14.0
202	4.0	4.7	4.7	4.0	4.3	4.3	1.0	3.7	1.0	4.3	5.0	5.0	13.3	17.7	15.0
203	2.0	1.7	1.7	3.0	4.3	3.7	1.3	3.3	2.7	2.7	3.0	3.0	9.0	12.3	11.1
204	4.0	5.0	4.7	5.0	5.7	5.7	0.0	0.0	0.0	4.3	4.3	4.3	13.3	15.0	14.7
205	3.3	4.7	4.0	4.0	4.3	4.3	3.3	4.0	3.7	1.3	1.0	1.0	12.0	14.0	13.0
206	4.0	4.7	4.7	2.7	1.7	1.7	4.3	4.3	4.3	3.7	4.0	3.7	14.7	14.7	14.4
207	0.0	0.0	0.0	1.7	1.3	1.3	1.3	3.3	2.7	4.3	4.3	4.3	7.3	9.0	8.3
208	2.0	2.7	2.7	5.0	5.7	5.7	0.0	0.0	0.0	4.3	5.0	5.0	11.3	13.3	13.4
209	2.0	3.7	3.3	3.0	3.0	3.0	3.0	3.7	3.7	1.0	1.3	1.0	9.0	11.7	11.0
210	2.3	3.7	3.3	3.0	3.0	3.0	1.0	3.7	1.0	4.3	5.0	5.0	10.7	15.3	12.3

## D6. Cronbach's Alpha workings

The Cronbach's Alpha table showing the reliability test performed on the three different measures of NVI quality (NVI Total quality, NVI novelty, and NVI appropriability) is listed below. It shows a Cronbach's Alpha coefficient of 0.95 on the three main dependent variables (overall NVI Quality, NVI Novelty, and NVI appropriability).

### Case Processing Summary

		N	%
Cases	Valid	110	82.7
	Excluded <sup>a</sup>	23	17.3
	Total	133	100.0

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

Cronbach's Alpha	N of Items
.946	3

## E. Research results – Cognitive capabilities

### E1. Intellectual Fluidity

The intellectual fluidity (Gf) scores of each participant from the UCMRT test are detailed below. This also provides details of how many of the 23 questions each participant managed to complete within the 10 minute timeframe.

Participant	Gf Score	Completed
101	13	22
102	4	11
103	14	18
104	9	22
105	13	21
106	8	11
107	9	12
108	11	22
109	15	20
110	10	22
111	12	20
112	11	23
113	13	22
114	14	22
115	7	14
116	12	18
117	8	12
118	17	22
119	4	10
120	7	23
121	8	18
122	15	23
123	9	23
124	11	15
125	15	23
126	11	23
127	7	22
128	8	12
129	14	20
130	11	17
131	10	23
132	11	23



133	13	22
134	9	21
135	7	16
136	7	12
137	7	23
138	7	18
139	18	23
140	9	23
141	9	23
142	10	14
143	11	18
144	10	14
145	9	23
146	15	23
147	10	23
148	16	21
149	13	23
150	14	23
151	13	23
152	11	22
153	9	23
154	8	18
155	17	21
156	14	16
157	9	15
158	15	22
159	9	22
160	9	22
161	7	22
162	18	23
163	7	23
164	15	23
165	9	23
166	16	23
167	9	19
168	6	23
169	2	21
170	13	23
171	10	20
172	10	20
173	4	23
174	4	23
175	11	23

176	11	18
177	8	21
178	6	12
179	7	23
180	17	23
181	13	12
182	16	9
183	11	23
184	13	23
185	12	23
186	17	21
187	11	23
188	4	23
189	11	13
190	10	23
191	7	21
192	13	23
193	10	23
194	5	23
195	3	23
196	10	22
197	16	23
198	9	16
199	13	19
200	9	23
201	7	23
202	15	19
203	9	23
204	8	16
205	8	23
206	10	15
207	10	23
208	9	14
209	8	20
210	10	23

## E2. Memory retrieval scores

The respective memory retrieval scores recorded for each participant are contained in the table below. These are drawn from the separate scores that each participant recorded in each of the 2 quesitons dedicated to each memory area (AF, IF, Wf, Axf).

ID	AF - Good	AF - Hot	IF - Names	IF - Jobs	WF - TION	WF - Con	Afx - Cold	Afx - Music	AF - Ave	IF - Ave	WF - Ave	Afx - Ave
101	5	2	8	16	13	10	8	4	3.5	12	11.5	6
102	6	9	17	15	16	12	12	6	7.5	16	14	9
103	7	3	14	18	11	6	15	11	5	16	8.5	13
104	12	5	27	16	8	5	19	15	8.5	21.5	6.5	17
105	5	2	28	8	3	6	13	17	3.5	18	4.5	15
106	7	3	14	11	6	10	17	7	5	12.5	8	12
107	7	4	17	21	4	9	13	11	5.5	19	6.5	12
108	5	1	18	22	3	4	12	8	3	20	3.5	10
109	1	3	8	10	5	5	6	9	2	9	5	7.5
110	7	5	14	19	8	9	19	15	6	16.5	8.5	17
111	4	1	14	12	7	3	11	13	2.5	13	5	12
112	6	4	20	20	6	6	11	11	5	20	6	11
113	7	10	24	21	10	10	7	8	8.5	22.5	10	7.5
114	8	7	16	20	10	10	22	24	7.5	18	10	23
115	9	5	13	12	14	13	14	9	7	12.5	13.5	11.5
116	9	6	15	12	11	13	12	11	7.5	13.5	12	11.5
117	3	5	13	12	7	8	15	9	4	12.5	7.5	12
118	7	6	17	18	9	8	15	15	6.5	17.5	8.5	15
119	6	3	13	13	6	6	15	6	4.5	13	6	10.5
120	4	3	9	19	8	6	10	10	3.5	14	7	10
121	9	4	21	17	10	9	8	8	6.5	19	9.5	8
122	5	4	27	20	10	9	21	11	4.5	23.5	9.5	16
123	9	9	23	29	5	9	21	13	9	26	7	17
124	4	1	17	20	9	10	14	9	2.5	18.5	9.5	11.5
125	8	4	19	18	5	8	17	12	6	18.5	6.5	14.5
126	10	7	29	20	9	11	26	17	8.5	24.5	10	21.5
127	3	1	10	11	6	6	7	5	2	10.5	6	6
128	8	7	13	19	6	6	23	16	7.5	16	6	19.5
129	14	9	28	22	8	10	17	15	11.5	25	9	16
130	6	3	11	17	3	7	9	10	4.5	14	5	9.5
131	5	2	14	15	3	7	12	9	3.5	14.5	5	10.5
132	9	4	18	20	2	7	22	21	6.5	19	4.5	21.5
133	4	3	16	16	11	9	15	12	3.5	16	10	13.5
134	3	4	28	18	16	11	16	14	3.5	23	13.5	15
135	5	6	20	13	6	10	22	18	5.5	16.5	8	20
136	5	5	10	11	8	9	5	8	5	10.5	8.5	6.5
137	9	8	23	15	10	9	10	14	8.5	19	9.5	12
138	7	4	6	16	5	6	11	9	5.5	11	5.5	10
139	9	6	20	20	9	4	22	16	7.5	20	6.5	19
140	6	3	14	13	2	6	10	10	4.5	13.5	4	10
141	7	4	18	16	3	6	14	11	5.5	17	4.5	12.5
142	6	4	17	16	10	10	18	14	5	16.5	10	16

143	6	6	10	10	11	7	7	7	6	10	9	7
144	11	6	24	24	17	4	25	29	8.5	24	10.5	27
145	6	4	22	13	12	6	12	7	5	17.5	9	9.5
146	5	4	10	14	6	7	20	14	4.5	12	6.5	17
147	8	5	10	8	11	8	10	10	6.5	9	9.5	10
148	5	2	11	14	7	7	2	3	3.5	12.5	7	2.5
149	10	2	23	17	4	8	32	29	6	20	6	30.5
150	6	5	16	20	7	8	11	14	5.5	18	7.5	12.5
151	2	4	30	20	9	9	11	8	3	25	9	9.5
152	9	4	19	13	8	10	19	16	6.5	16	9	17.5
153	6	6	20	15	6	2	8	6	6	17.5	4	7
154	7	4	24	16	7	11	8	7	5.5	20	9	7.5
155	4	4	5	8	6	9	8	3	4	6.5	7.5	5.5
156	10	7	25	20	20	10	29	23	8.5	22.5	15	26
157	7	2	23	15	6	6	4	11	4.5	19	6	7.5
158	5	6	17	20	7	7	13	8	5.5	18.5	7	10.5
159	11	6	18	21	12	12	22	13	8.5	19.5	12	17.5
160	6	4	12	17	9	8	27	15	5	14.5	8.5	21
161	4	2	14	12	7	5	7	5	3	13	6	6
162	5	5	21	22	7	7	30	26	5	21.5	7	28
163	9	2	17	19	4	11	12	11	5.5	18	7.5	11.5
164	4	3	14	12	4	7	13	14	3.5	13	5.5	13.5
165	12	6	30	23	13	10	16	13	9	26.5	11.5	14.5
166	6	5	18	15	6	9	12	11	5.5	16.5	7.5	11.5
167	6	5	19	11	7	6	12	4	5.5	15	6.5	8
168	13	6	20	19	9	7	18	12	9.5	19.5	8	15
169	4	4	11	8	7	7	6	9	4	9.5	7	7.5
170	4	4	7	12	7	4	5	4	4	9.5	5.5	4.5
171	5	9	13	19	11	13	21	14	7	16	12	17.5
172	6	4	18	16	5	5	14	10	5	17	5	12
173	2	4	10	14	5	5	6	7	3	12	5	6.5
174	11	8	18	9	14	6	13	12	9.5	13.5	10	12.5
175	4	3	8	6	7	5	9	9	3.5	7	6	9
176	4	5	6	9	7	6	5	4	4.5	7.5	6.5	4.5
177	5	4	9	12	6	5	4	5	4.5	10.5	5.5	4.5
178	3	3	12	15	4	7	8	7	3	13.5	5.5	7.5
179	8	9	16	12	9	10	16	17	8.5	14	9.5	16.5
180	4	5	12	16	6	8	15	14	4.5	14	7	14.5
181	9	3	16	12	8	7	8	11	6	14	7.5	9.5
182	10	7	14	10	10	7	8	10	8.5	12	8.5	9
183	6	6	18	18	10	10	13	15	6	18	10	14
184	4	4	20	15	10	6	9	9	4	17.5	8	9
185	10	2	13	14	8	6	10	10	6	13.5	7	10
186	3	4	28	15	10	6	10	12	3.5	21.5	8	11
187	4	5	26	15	5	6	19	8	4.5	20.5	5.5	13.5
188	7	2	21	18	7	6	15	9	4.5	19.5	6.5	12
189	4	3	21	12	6	4	13	8	3.5	16.5	5	10.5
190	10	8	21	14	7	10	10	12	9	17.5	8.5	11
191	2	2	18	14	5	5	5	8	2	16	5	6.5

192	14	5	30	17	7	15	14	15	9.5	23.5	11	14.5
193	2	3	22	16	5	3	4	6	2.5	19	4	5
194	5	5	11	13	7	7	7	7	5	12	7	7
195	6	8	29	21	12	8	20	16	7	25	10	18
196	6	4	23	18	10	9	17	15	5	20.5	9.5	16
197	4	1	12	9	4	5	6	9	2.5	10.5	4.5	7.5
198	5	2	17	21	9	9	10	4	3.5	19	9	7
199	8	7	20	20	18	12	17	15	7.5	20	15	16
200	7	3	12	12	6	8	8	10	5	12	7	9
201	8	5	20	16	9	7	15	14	6.5	18	8	14.5
202	4	5	16	9	9	10	8	6	4.5	12.5	9.5	7
203	6	4	24	14	16	9	8	5	5	19	12.5	6.5
204	5	2	12	10	11	6	3	4	3.5	11	8.5	3.5
205	6	4	20	20	14	6	15	13	5	20	10	14
206	9	5	19	17	8	9	14	14	7	18	8.5	14
207	15	9	13	11	3	3	6	3	12	12	3	4.5
208	3	5	18	17	10	14	7	11	4	17.5	12	9
209	6	4	19	12	7	6	9	6	5	15.5	6.5	7.5
210	6	3	13	14	6	5	6	11	4.5	13.5	5.5	8.5

### E3. Memory retrieval details

The respective answers given by the different participants in response to the 8 memory retrieval questions were as follows:

ID	Question 1 (IF)	Question 2 (IF)	Question 3 (WF)	Question 4 (WF)	Question 5 (AF)	Question 6 (AF)	Question 7 (Afx)	Question 8 (Afx)
101	Excellent, nice, extraordinary, interesting, perfect	spicy, warm,	action, Admission, Reflection, affection, motivation, alternation, dedication, Monetization, organization, differentiation, education, motivation, interpretation,	configuration, consistent, content, Connect, connection, Controversy, continent, contain, Contain, Constant.	Anna, marie, Vasileos, Yorgus, Eleanor, Christos, Panos, Erodelius,	waitress, buyer, teacher, cleaner, driver, postman, dustman, plumber, electrician, computer programmer, astronaut, enginner, scientist, pilot, navigator	clothes, textiles, fabric, stitching, occupation, money, bank investment	Piano, skill, occupation, time,
102	nice, okay, better, perfect, adequate, fair,	warm, scorching, burning, boiling, spicy, sharp, tropical, balmy, summery	presentation, dissertation, competition, completion, revolution, solution, nation, attraction, subtraction, multiplication, option, motion, notion, potion, action, lotion	consistent, container, constitution, construe, conspiracy, constructive, congratulations, congregational, continue, conference, conjunction, content,	James, Oliver, sonny., Jennifer, William, Nick, David, Eliza, Amanda, Andrew, Anthony, Simon, Perry, Adrian, Nathan, Zach, Gerard	doctor, lawyer, artist, policeman, businessman, farmer, athlete, engineer, technician, manager, factory worker, accountant, accounts Assistant, teacher, scientist	Winter, Mountains, Skiing, Eskimos, Fur, deer, sledge, Eskimos, Santa, Christmas, presents, treats	Instrument, guitar, strings, sound, music, rock
103	okay, nice, commendable, excellent, exemplary, fantastic, considerable	spicy, humid, baking, warm	station, congratulation, nation, notification, traction, insertion, intersection, dissertation, section, sanction, mention	congratulate, continue, control, contraband, contradict, constraint	James, Jack, Martha, Joseph, Thomas, Kevin, Tom, Dennis, Marvin, Crandel, Bianca, Ithica, Leonardo, Isaac,	labourer, consultants, engineers, designers, construction worker marketer technology, consultant, data analyst, research analyst, digital marketing associate, teacher, plumber, electrician, pilot, astronaut, scientists, researchers	weather, seasons, nature, earth, animals, humans, plants, vegetables, onion, tears, sadness, guilt, wrongdoing, crime, prisoner,	instrument, guitar, strings, tune, melody, lullaby, song, happiness, euphoria, adventure, trip,
104	great, fantastic, brilliant, excellent, joyful, remarkable, spectacular delightful, joyous, nice, marvelous, wonderful,	spicy, sexy, burning, painful, heat,	action, celebration, vacation, beautification, destination, vibration, election, station,	confidence, conduct, conjunction, continue, conceive,	Beth, Becky, Rachel, Sheila, Chantal, Amaret, Paul, Peter, Charlie, Tina, Constance, Raphael, Adele, Noah, Albi, Joey, Bethanie, Juren, Gabriel, Cecilia, Toure, Kevin, Kane, Joseph, Cadel, Ann, Annette,	doctor, tour guide, teacher, nurse, biologist, dentist, cashier, security guard, engineer, scientist, accountant, manager, consultant, air hostess, pilot, priest,	ice, snow, scarf, clothes, style, fashion, celebrities, popularity, famous/fame, countries, regions, geography, tourism, places, destination, people, culture, values, connections,	Record, picture, photography, landscapes, paintings, art, creativity, artist, job, pharmacist, medicine., healing, spiritual, personal, development,

105	amazing, happy, great, excellent, perfect,	boiling, scolding,	caption, traction, partition,	construction, conclusion, congregate, cone, consent, contemplate,	John, Jack, Dave, Ryan, Taylor, Bethany, Christie, Anna, Amy, Keish, Benjamin, Tommy, Ben, David, Marcus, Kasper, Gary, Tracy, charlotte, Steph, Liam, Sean, Simon, Cleo, Leila, Katy	chef, footballer, sales assistant, sales manager, floor manager, gardener, florist, golfer,	ice, drink, glass, window, house, city, civilisation, people, animals, bird, monkey, tail, small,	sound, vibration, frequency, numbers, maths, subject, business, computers, technology, television, fridge, kitchen, oven, fire, lava, volcano, earthquake
106	perfect, splendid, great, stupendous, excellent, extravagant, satisfactory,	boiling, magma, flaming,	position, station, creation, nation, question, direction,	conversation, construction, conservative, congestion, conservation, conquest, connection, condition, conference, concision,	Sean, Taylor, Luke, Liam, Kyle, Christian, James, Charlotte, Hannah, John, Tyler, Jamie, penny, Penelope	entrepreneur, sales assistant, manager, bartender, trader, teacher, engineer, builder, tiler, roofer, bricklayer,	ice, drink, coca cola, brand, business, university, student, social, pub, beer, drink, thirst, hunger, food, burger, hot dog, chips, crisps	label, artist, [taylor swift, enimen, drake, two pack, two chains, little pump, little peap, little zan], painting, mona lisa, beautiful, woman, man,
107	great, fantastic, reasonable, fine, well, excellent, ecstatic,	boiling, firey, burning, humid,	attention, retention, lotion, potion,	content, context, connotation, converse, conversation, continue, continuation, convex, concise	David, Thomas, Andrew, Peter, Christine, Simon, William, Billy, George, Charlie, Caleb, Kane, Able, Joshua, Kieron, Alexander, Charles,	banker, nurse, doctor, accountant, teacher, professor, miner, garbage man, mechanic, engineer, trader, stockbroker, athlete, real estate agent, lorry driver, psychiatrist, pediatrician, dentist, policeman, fireman,	snow, Christmas, santa, elves, dwarf, short, tall, basetball, nba, league, football, football boots, socks, [feet, ankle, knee, shin, legs, stomach, chest, shoulders, head, hat]	record label, CDs, mp3, walkman, Samsung, galaxy, mars, earth, nasa, space ship, astronaut,
108	perfect, brilliant, best, positive, better,	warm,	education, innovation, globalization,	conventional, continent, contribution, continually,	Ebend, Hind, Sara, Adaid, Nora, Fay, Maye, Medda, Abdula, Abrul, All, Chaliad, Aziz, Aleena, Maria, Julia, Noah, Abraham	Teacher, CEO, CFO, project manager, doctor, engineer, developer, customer service assistant, nurse, salesman, farmer, driver, postman, dustman, milkman, bus driver, taxi driver, plumber, electrician, joiner, builder, roofer	winter, ice, sea, fish, meat, chicken, eggs, breakfast, cereals, corn, movies, tv,	you tube, videos, picture, fun, camera, photos, family, gathering,
109	great,	boiling, heat, flames,	action, addition, multiplication, complication, combustion,	consequences, confusion, configuration, continuation, contraction,	James, Fin, Max, Abigail, Jordan, Matthew, Peter, Jesus,	entrepreneur, accounting, doctor, teacher, banker, engineer, pharmacist, retailer, waitress, waiter,	heart, warm, moist, sweaty, tired, cranky,	instrument, violin, strings, threads, needles, knife, cut, injury, bleeding,

110	amazing, awesome, superior, fantastic, sublime, super califragious,	boiling, steamy, sexy, attractive, warm,	imagination, termination, fantacisation, extrapolation, communication, fascination, integration, signification,	conservatism, concoction, congratulation, conservation, contour, convince, connoisseur, connect, contribute,	Kieran, Conor, Mark, Jacob, Ashley, Leo, Carry, Mona, James, Oliver, Emily, Andrew, Christopher, Gary,	merchant, accountant, fishmonger, butcher, shopkeeper, electrician, it consultant, database manager, entrepreneur, musician, actor, author, animator, illustrator, designer, architect, cleaner, chef, dishwasher	ice, cubes, shapes, space, planets, mars, chocolate, coco, plants, flowers, roses, chocolate, food, pasties, Cornwall, England, Europe, France, Spain	guitars, Beatles, sixties, camper vans, Volkswagen, Germany, pretzels, bakery, high street, shoppers, people, economy, money, trade,
111	Fine, Okay, Satisfactory, Decent	sweltering	Information; Stagnation; Innovation; Condensation; Electrification; Magnification; minimisation	condensation; Connected, Concentration	Bill, Sarah, Lily, Leila, George, Edward, Taylor, Will, Fall, Abigail, Monique, Lacey, Daphne, Freya	Dentist, Analyst, entrepreneur, advertising agency, actor, writer, director, Producer, Stage manager scientist, teacher, singer.	Snow, Ice, Arctic, Penguins, cold, clothes, fashion, T shirts, trousers, jeans, denim	Singing, voice, Instrument, Guitar, strings. Violin, orchestra. Conductor, Stage, musicals, plays, theater, Acting
112	Nice. Lovely. Sweet. Interesting. gorgeous. Fantastic.	spicy, chili, burning, steamy	citation, confirmation, presentation, composition, temptation, projection,	confirmation, contain, contentment, continent, content, conversation	John, Brianna, Tarek, Matthew, Mark, Buki, Isabella, Isaac, Ivana, James, Sandra, Alexis, Christabel, Hilary, Jeremiah, Joshua, Angela, Elana, Mytire, Cherie,	banker. Project manager, cyber security, finance, doctor, dentist, ophamologist, Georgian, administrator, engineer, sales, marketing, HR, management, professor, lecturer, librarians, care home support, police,	Winter, jacket, boots, leather, fashion, clothing, bed-sheet, linen, design, art, painting,	concert, album, chart, record label, musical tour, grammys, award, platinum, billboard,
113	Great, nice, perfect, beautiful, supportive, better, competent	warm, chilli, burning, firey, boiling, heating, sweltering, roasting, blistering, scorching	attention, competitio, function, distraction, dentention, adoption, administration, addiction, objection, distortion	Conviction, contravention, conduction, contrast, concise, connection, condition, constitutional, constrcutuve, congratulations	Emma, Gene, Aarron, Sarah, Angelina, Michael, Ethan, Noah, Will, Daniel, James, Jack, Joseph,, Sam,, Nathan, Isaac, Jordan, Christopher, Owen, Gabriel, Alex, Anthony, Rosie, Grace.	doctor, pilot, engineer, nurse, physiotherapist, trainer, IT, Manufacturing workiner, Artist, Movei start, Forestry worker, Architect, Construction wroker, civil servant, comms officers, finance exec, HR exec, Marketing exec, Salesman, Lawyer	Jacket, Leather, Cow, Buffalo, Milk, Butter Cheese	Rock, Hip-Hop, Michael Jackosn, Dance, Weddings, Bride, Groom, Family



114	better, excellent, amazing, profitable, fine, well superior, adequate	warm, scorching, flaming, humid, torrid, raging, roasting	ratification, administration, cacation, mention, action, mutation, objection, orientation, competition, completion	confidence, continues, convict, concrete, converse, contemporary, convention, container, contention, control	Gerard, John, Joshua, Fred, Jenny, Amy, Jessica, Adrian, Henry, Isaac, Eddie, Edward, Andrew, William, Will, Lenny	Gardener, analyst, consultant, human resources, digital marketer, operations manager, technician, cleaner, housekeeper driver, house help, headmaster, waiter, chef, recruiter, accountant, engineer, Ceo, manufacturing worker, construction worker	Snow, snowboard, vacation, italy, culture, art, painting, brush, paint, online shopping, colthes, present, new, gift, raincoat, black, mud, shoe, Cinderella, child, toy, sleep	guitar, singer, bar, gin, factory worker, family, money, reward, wallet, shopping, clothes, shopping centre, blue water, raim, swimming paddle board, boat, sailor, outfit, washing power, clothes, woollen, art class, galaxy
115	helpful, useful, beneficial. Great, value, magnificent, profitable, kind, best	spicy, burning, scolding, heat, flaming	attention, communication, reception, assumption, resumption, pollution, consumption, application, rejection, solution, potion, motion, suction, projection	continue, conjunction, consumption, conclusion, confident, control conserve, content, consult, concert consent, consume, consequence	Christabel, Mary, John, Joseph, Matthias, Mathew, David, Joshua, James, Jesus, Emmanuel, Timothy, Martha	engineer, teacher, doctor, plumber, Bricklayer, carpenter, software developer, data analysis, banker, Accountant, astronaut	flu, winter, snow, snowman, carrot, rabbit, fluffy, pillow, duvet, bed, heater, kettle, water, fish	sound understanding smart, Einstein, logic, maths, physics, laws, jury
116	wonderful, beautiful, significant, important, kind, alright, okay, best, well	heat, radioactive. Burning, volcanic, spicy. Tropical	congratulation, summation, transformation, provocation, annunciation, vacation, information, relegation, celebration, revolution, attraction, exclamation, pollution, solution, resolution	congratulation, content, condescending, configure, contracts, confuse, condone, contradict, control, console, conniving, conundrum	Geoff, John, Isaac, Peter, Paul, Martha, Mary, Abraham, Sol, Malachi, Zach	Doctor, Lawyer, Economist, Microbiologist, Politician, Teacher, Fireman, Nurse, Midwife, Engineer, Scientist, Banker, Consultant	Ice, Water, Ocean, Fish, Scales, Measuring, Weight, Kilograms, Food, Cooking, Eating, Digesting	Dancing, Salsa, Spain, Spaghetti, Meatballs, Meat, Cows, Farm, Ranch, Horses, Hooves
117	great, decent, well done	warm, scolding, boiling, scorching, lukewarm	retention, detention, selection, election, secretion, collection, mention	connect, connection, continue, continuation, conduction, conspiracy, construct, conniving	John, William, Sam, Rachel, Sarah, Bethany, Jack, Toby, Archie, Harry, Ross, Hannah, Lucy,	Doctor, Dentist, Vet, Teacher, Finance Manager, Accountant, Fireman, Policemen, Actor, Actress, Gardener, Singer	Winter, Snow, White, Black, Dark, Gloomy, Cold, Rain, Water, Drink, Glass, Cup, Juice, Orange	Song, Songwriter, Producer, Studio, R&NB, Hip Hop, Culture Festivals, Summer
118	best, wonderful, helpful, great, fine, terrific, amazing,	boiling, scorching, sunny, blazing, warm sizzling	faction, nation, pollution, operation, revolution, organization, solution, attraction, option	conference, considerate, contraction, concise, constitute, contemplate, considered, contract	Jesus, Ben, Mary, Jonah, Emat, Mohammed, Omer, Nan, Seff, Janaid, Jenny, Gareth, Elizabeth, Maria, Anne, David, John	journalist, doctor, lawyer, researcher, physician, sportsman, TV anchor, fast food worker, hotel worker, lorry driver, comedian, actor ,singer, artists, software engineer, teacher, student	water, beach, party, people, students, university, accommodation, cycle, job, money, image gym, exercise, fit, pictures,	feelings, friendship ,students, school. Teachers, books, authors, money, cars, black, phone, wallet, car keys, metal, shiny

119	great, splendid, amazing, incredible, marvellous, ingenious	steaming, burning, heated	abortion, conversation, abomination, congregation, plantation, migration	concise, convict, condescending, conversation, conniving, condemn	Leo, Toby, Peter, Michael, Judah, Daniel, David, Peter, Paul, Silas, Samuel, Antony, So	Social care worker, economist, mathematician, Lecturer, Bus Driver, Accountant, Taxi Driver, Doctor, Lawyer, Pharmacist, Engineer, Journalist, Ambassador	Icey, air conditioner, house, estate, country planet, globe, classroom, student, teacher, school, educational, jobs, wages, teax	Notes, symphony, Beethoven, Middle Ages, Timeline, Time Travel
120	great, excellent, beneficial, advantageous	steamy, burning, flaming	suggestion, corruption, compensation, proposition, position, superstition, graduation, complication,	conference, configuration, constable, constant, concise, confirm	Wenaid, Ben, Sebastian, Tom, James, Patrick, Augustine, Maria, Mary	Accountant, Doctor, Nurse, Policeman, Teacher, Engineer, Plumber, Electrician, Handyman, Carpenter, Professor, Bank Manager, Lecturer, Surgeon, Software Developer, Phone Repairer, Mechanic, Investment Banker	Jacket, Gloves, Boots, Coat, Jumper, Mittens, Scarves, Hand warmer, Radiator, Heate	Record Label, album, Producer, Sound, Notes, Piano, Artist, Stage, Performer, Concert
121	better, fine, beautiful, valuable, worthy, attractive, beneficial, positive, best	temperate, heated, warm, sweaty	education, function, suction, auction, gumption, section, option, objection, subjection	confusion, congress, convulsion, contention, contribution, conman, connection, congratulate, conflict	Bookas, Matthew, Jeremiah, Hugo, Natalie, Esther, Zachael, Zafina, Mary, Jospeh, Paul, Peter, Timothy, Tutus, Zachariah, Judas, Lydia, Sabeta, Emanuel, Ebesza, Kathryn	Doctor, Lawyer, Teacher, Support Worker, Care Worker, Engineer, Pilot, Communications Officers, Advertising Agent, Waiter, Cook, Cleaner, Administrative Officer, HR officer, IT Staff, Tech support, nanny	Hot, Water, Shower, Soap, Washing Machine, Clothes, Shops, Cashier	Piano, Pianist, Concert, Tickets, Laws, Police, Judiciary, Lawyers
122	Best, Great, Nice, Awesome, Smoothing	Warm, Heated, Firey, Steaming, Boiling	Information, Definition, Creation, Objection, Action, Situation, Caption, Competition, Participation	Confidence, confirmation, confluence, concentration, consideration, convert, confused, contribute, control	Shiva, Kumal, Pujab, Shretin, Pridip, Himanshu, Rosie, Josephina, Krunal, Huma, Rishal, Shikka, Sana, Diana, Harmen, Gupta, Natasha, Menk, Nitel, Suraj, Couran, Atra, Bianca, Diplia, Gish, Sirag, Virat,	Doctor, engineer, construction worker, plumber, electrician, Psychologist, Carpenter, Artist, Musician, Photographer, Politician, Scientist, Banker, Analyst, Company Secretary, Auditor, Accountant, Director, Manager, Consultant	Winter, Winter wear, Wool, Sheep, Grass, Deer, Forest, Woods, Fire, Animals, Carnivores, Hu,ams, Children, Schools Studies, Books, Stationery, Companies, Publishers, Writers, Papers	Instruments, Piano, Plastic, Carbon, Chemistry, Elements, Earth, Planet, Mars, Stars, Galaxies

123	Well, Healthy, Excellent, Amazing, Fantastic, Not Bad, Swell, Great, Okay	Boiling, Sweltering, Roasting, Sweaty, Sexy, Attractive, Beautiful, Handsome, Gorgeous	Nation, Sensation, Sedation, Creation, Deletion	Concern, Contamination, Conman, Convert, Convey, Convalesce, Concur, Concept, Contract	Alex, Jeff, Cathy, Declan, Phil, Jen, John, Judy, Anna, Margaret, Sanna, Heditia, Ben, Nav, Dennis, Ilkin, Ade, Vicky, Carl, Carla, Alex	Marketing, HR, Sales, Carpenter, Plumber, Electrician, Window Cleaner, Professor, Head Teacher, Teacher, Product Manager, Intern, Trainee, Janitor, Customer Service Rep, CEO, CFO, CMO, Artist Director, Writer, Photographer, Illustrator, Potter, Graphic Designer	Flu, Chimney, Sweep, Brush, Broom, Vroom, Car, Speed, Ecstasy, Happiness, Drugs, Dealer, Cards, Blackjack, Casino, Betting, Gambling, Sheept, Lamb, Meat, Banquet	Creativity, Artists, Studio, Studios, Nerd, Inert, SoothSayers, Mysticism, Centric, Trees, Fayres, Gay, Happy
124	Great, Excellent, Nice, Wonderful	Angry	Examination, communication, exclamation, attention, meditation, medication, fascination, legislation, accreditation	conjunction, contribution, confused, concern, convince, conceive, connive, conduct, consume, conceal	John, Peter, Abraham, Mary, Mark, Luke, Martha, Maria, Tabatha, Hannah, Isaac, Jonah, Joshua, Belson, Paul, Francis, Joseph	Doctor, Lawyer, Nurse, Pilot, Engineer, Lecturer, Banker, accountant, Musician, Security Guard, Bank Tiller, Cashier, Entrepreneur, Sales Rep, Business Advisor, Consultant	Ice, Ice Cream, Cone, Traffic, Cars, Wheels, Motorcycle, Speed, Athlete, Muscle, Doctor, Injection, Nurse, Elderly	Dane, People, Chain, Jewellery, Earring, Lady, Children, Toys, Store,
125	Best, Excellent, Amazing, Mindblowing, Nice, Achievement, Extra-ordinary	Warm, Spicely, Sexy, Extra-ordinary	Question, Conjunction, Pronunciation, Identification, Communication	Conjunction, conceive, contraception, concatenate, congregate, condolences, contrive, conception	John, Samuel, Max, Elen, Joe, James, Jackson, Jordy, Angelo, Mie, Matthew, Mathias, Matt, Michael, Anna, Fran, Bronwyn, Austin, Robert	Data Analyst, Scientist, Engineer, Administrator, Banker, Social Worker, Banker, Consultant, Health Worker, Business Analyst, Auditor, Supply Chain Manager, Logistics Analysts, Student coordinator, Dean, Academic, Professor, Supervisor, Industrial Manager	Flu, Virus, Pandemic, Coronavirus, Mask, Preventative, Surgical, Instruments, Knife, Blade, Sharp, Edge, Cliff, Top, High, Sky, Clouds	Industry, Manufacturing, Production, Machinery, Conveyor belt, Raw Material, Logistics, Supply Chain, Human Resource, Workers, Rights, Minimum Wage
126	Great, Marvellous, Superb, Fantastic, Wonderful, Perfect, Outstanding, Awesome, Amazing, Fabulous	Warm, Suffocating, Boiling, Temperate, Burning, Attractive, Fit	Exaggeration, Abbreviation, Congregation, Termination, Conversation, Motivation, Elevation, Configuration, Determination	Configuration, Continuous, Confederation, Conspiracy, Contradiction, Controversial, Condiment, Contraction, coniferous, Cone, Conscious	John, Luke, Mary, Peter, Eleanor, Jose Carlos, Miguel, Bianca, Immi, Jan, Anthony, Louise, Caroline, Manuel, Maria, Sara, Zara, Alberto, Robert, Kane, Kirsty, Joseph, Judah, Mark, Michael, Anthony, Natalie, Brian	Lawyer, Economist, Administrator, Accountant, Waiter, Manager, Marketer, Cook, Taxi Driver, Shelf Stacker, Teacher, Student, Owner, Doctor, Nurse, Paramedic, Psychologist, Psychiatrist, Physiotherapist, Therapist	Winter, Snow, Snowman, Carrot, Vegetable, Health, Mediterranean, Spain, Madrid, Museum, Picture, Art, Music, Guitar, Flamenco, Dance, Culture, Europe, Belgium, Travelling, Trip, Train, Passenger, Airline, Airport, Waiting	Guitar, Chord, Accordion, Group, Popularity, Concert, People, multicultural, sharing, understanding, tastes, backgrounds, origin, Egypt, Pyramids, Sand, Deserts, Travelling

127	Ecstatic, Happy, Better	Fire	Nation, Mobilisation, Question, Intention, Affiliation, Identification	Constitution, constituency, confidence, conjunction, connection, connectivity	Joseph, John, Paul, Martin, Luke, Mark, Jude, Titus, Timutis	Nurse, Doctor, Physio, Philanthropist, Engineer, Electrician, Industrialist, Farmer, Philosopher, Teacher, Lecturer	Snow, Rain, Cloud, Winter, Hurricane, Wind, Sea	Piano, Guitar, Trumpet, Saxophone, Microphone
128	Perfect, brilliant, super, superb, outstanding, amazing, jolly, wonderful	baking, warm, blazing humid, scorching, sizzling, boiling	condition, ambition, addition, ignition, position, petition,	condition, constitutional, constipation, congestion, confession, congratulation	David, Mary, James, Peter, Adam, Abel, Nathan, Zacharias, Adrian, Kane, Samuel, Abraham, Zion	Entrepreneur, Fireman, Doctor, Nurse, Manager, Supervisor, Taxi Driver, Delivery Driver, Police Officer, Soldier, President, Prime Minister, Mayor, Chef, Waiter, Masseuse, Dentist, Politician, Customer Advisor	Ill, Hospital, Medicine, CPR, Drowning, Swimming, Sea, Life Guard, Policemen, Handcuffs, Gun, Taser, Cell, Court, lawyer, Solicitor, barrister, law school, school, chemistry, biology, physics, laws	Artist, Instrument, Orchestra, Accounting Piano, Violin, Trumpet, Sound Waves, Sound Check, Recording, Song, Single, Album, Musician, Engineer, Producer
129	Positive, Excellent, Satisfactory, Great, Delightful, Super, Wonderful, Beautiful, Splendid, Wicked, Nice, Pleasant, Fantastic, Awesome	Steamy, Warm, Scorching, Burning, Beautiful, Sexy, Attractive, Sizzling, Firey	Introduction, induction, conduction, malfunction, suction, function, lubrication, vacation	context, conduction, conclusion, continue, condense, connoisseur, conman, confer, conifer, continual	Jacob, James, John, Ben, Roger, Oli, Julie, Dennis, Anya, Ruby, Sophie, Chloe, Charlotte, Lewis, Jack, Jill, Veronica, Stephanie, Jane, Gary, Tyrone, Simon, Peter, Paul, Gregory, Anthony, Phillip, Chris	Consultant, Manager, Doctor, Surgeon, Engineer, Plumber, Waiter, Bar Tender, Escort, Pilot, Chauffeur, Cleaner, Nurse, Actress, Delivery Driver, Model, Security Guard, Bouncer, Dancer, Singer, Voice Over Artists, Radio Presenter	Pensioner, Poverty, Benefits, Advantages, Success, Competition, Market, Shops, Supermarket, Hypermarkets, Stadiums, Sports, Leisure, Fitness, Acrobats, Flexibility, Agility,	Symphony, Harmony, Perfection, Mastery, Taekwondo, Martial Arts, Immigrant, Business, Marketing, Publicity, Fame, Acting, Cinema, Drama
130	Excellent, perfect, nice, happy, amazing, great	suny, burning, heated	temptation, perfection, animation	contagious, contribution, concise, convreate, congratulations, contract, content	Tom, louise, robert, sandra, chris, margaret, naomi, nina, Otis, andrew, christian	Receptionist, Cleaner, Bouncer, Manager, Policemen, Cashier, Banker, Advertising Exec, Doctor, Nurse, Dentist, Ocologist, Sales Rep, Bar Tender, Chef, Designer, Assistant	Hands, Fingers, Nails Polish, White, Snow, Flake, Cold, Winter	Piano, Orchestra, Ballet, Costume, Colourful, Red, Rose, Date, Couple, Relationship
131	Beneficial, Great, Fabulous, Amazing, Brilliant	Warm, Boiling	Participation, Exaggeration, Automization	Confusing, contradictory, conflicting, contributory, con, condom, connecting	David, Jacob, Wlilian, Harry, Dom, Jonas, Peter, Simon, Patrick, James, Joe, Henry, Conor, Liam	Delivery Driving, Shop Work, Lecture, Dustman, Marketing, Manager, Baker, Waiter, Chief, Roadwork, Policeman, Fireman, Ambulance Driver, Technician	Cold, Temperature, Hot, Attractive, Beautiful, Perfection, Imperfection, Mistakes, Frustration, Emotions, Behaviour, Psychology	Sound, Audio, Books, Instruments - Skill, Talented, Performance, Audience, Judges

132	Great, Brilliant, Excellent, Fantastic, Marvellous, Superb, Extraordinary, Grand, Gorgeous	Spicy, Pretty, Sexy, Firey	Vacation, Suction	Conditional, Contemporary, Continent, Condition, Congestion, Conflict, Con	Daniel, James, Ella, George, Mary, Lisa, Abdul, Asmil, Joseph, Arun, Calil, Caleb, Ignis, Rudolph, John, Clare, Steve, Arnold	Cashier, Doctor, Dentist, Accountant, Investment banker, Auditor, Physio, Sports Therapists, Dietician, Paediatrician, Gynaecologist, Waiter, Waitress, Chef, Assistant, Manager, Supervisor, Cleaner, Secretary, Teacher, Headmaster	Warm, Hot, Fire, House, People, Children, Animals, Evolution, Darwin, Aristotle, God, Conflict, Coronavirus, Pandemic, Home, Cooking, Jamie Oliver, Shepherds Pie, Sheep, Farmer, Cattle	Happiness, Sad, Cold, Snow, Snowman, Children, Building, Architect, Money, Financial Analyst, Stocks, Markets, Strawberries, Cockroaches, Bugs, Gells, Ultrasound, Pregnancy, Gynaecologist, women, men
133	Nice, Positive, Cheerful, Happy	Humid, Unbearable, Uncomfortable	Graduation, Participation, Inauguration, Deliberation, Confirmation, Salutation, Unionisation, Alienation, Condensation, Generalisation, Evaporation	Condensation, Contemplation, Concentration, Conman, Convention, Convection, Conduction, Convolute, Convex	David, Beth, Adrian, Deborah, Luke, Mariah, Jessica, Thomas, Samantha, Isakil, Hank, Janet, Christiana, Frank, Phillip, Vanessa, Sandra, Stephanie	Doctor, Mortician, Teacher, Researcher, Astronaut, Politician, Engineer, Farmer, Mechanic, Entrepreneur, Psychiatrists, Psychologist, Polit, Secretary, Chef, Cleaner, Makeup Artist	Ice, Cap, Bottle, Beer, Liquor, Spirit, Grave, Paranormal, Investigation, Detective, Police, Safety, Monitor, Computer, Game	R&B, Beyonce, Queen, Elizabeth, Philip, Royalty, King, God, Religion, Islam, Israel, Country
134	Acceptable, okay, average	burning, warm, tepid, sexy	contribution, action, attention, contradiction, donation, elevation, fiction, lotion, motion, nation, option, potion, question, ration, station, tuition	conservative, contrition, convention, convection, condensation, confident, connection, conurbation, concoction, condition, con	Ellen, Beth, Charlie, David, Edgar, Fred, Gertrude, Joe, Isabel, Karen, Leila, Neil, Peter, Arthur, Roger, Stuart, Ton, Violet, Wilmar, Zoe, Adam, Barry, Clare, Eloise, Gale, Harriet, Juliet, Kurt	Accountant, Financial Controller, Physio, Carpenter, Bus Driver, Sailor, Teacher, Professor, Lecture, Manager, Shop Worker, Retail Assistant, Marketing Manager, Editor, Production Assistant, Astronaut, Writer, Graphic Designer	Snowman, Carrot, Humus, Vegetarian, Meat, Hunting, Bullet, Murder, Neflitx, Romance, Valentines Say, February, Spring, Bulbs, Light	Piano, Childhood, Mum, Distance, Holidays, Sun tan, Spray, Boutique, Nails, Colourful, Rainbow, NHS, Covid Death
135	Best, Fantastic, Perfect, Positive, Better	Warm, Humid, Sexy, Spicy, Firey, Boiling	Concentration, precipitation, deception, contraception, participation, communication,	concentration, cons, continue, consequences, contriving, contribution, condescending, concurrent, concept, connect	Adam, Joseph, Chris, David, Isac, Emmanuel, Gideon, Asher, Jacob, Sam, Jonah, Joshua, Justin, Jesus, Mary, Magdalene, Maria, Solomon, Augustine, Taz	Architect, Banker, Barman, driver, Mechanic, engineer, Teacher, fireman, policeman, soldier, plumber, electrician, manager	Ice cream, deliveries, food, curry, spicy, chilli, stomach, body, fitness, gym, muscle, biology, chemistry, census, finance, banking, money, investment, trading, profits, losses, economy	fun, enjoyable, concerts, people, friends, community, alcohol, drugs, police, prison, jail, freedom, lockdown, covid, pandemic, online, lectures, students

136	Better, Likeable, Appealing, Fine, Nice	Humid, Warm, Boiling, Sizzling, Blazing	Organization, sensation, Pronunciation, Ambition, Revolution, Nation, Prioritisation, Consultation	Continue, Constitution, Concentration, Contribution, Content, Consider, Confuse, Conceive, Condense	Esther, Sarah, Paul, Peter, Ben, David, Judah, Josiah, Mary, Jonah	Farmer, Doctor, Teacher, Marketer, Nurse, Engineer, Delivery Driver, Scientist, Musician, Advertising, Lab Worker	Weather, allergic, Pain, Jacket, Sick	Musician, Band, Record Label, Rap, Signing, Studio, Melody, Sound
137	Excellent, Great, Magnificent, Strong, Improved, Adequate, Fantastic, Brilliant, Effective	Scorching, Scolding, Boiling, Firey, Smouldering, Blistering, Blazing, Ablaze	Imagination, Automation, Innovation, Invention, Transportation, Preparation, Magnification, Realization, Fortification, Information	Concentration, Conclusive, Conducive, Conclusive, Consequently, Conditional, Conference, Contemplate, Confer	Richard, Julie, Tom, Matt, James, John, Alex, Heather, Frances, Brenda, Linda, Paul, Jack, Edwards, Joseph, Mary, Ethan, Yvonne, Diane, Chris, Christian, Robert Phillip	Accountant, Auditor, Teacher, Lecturer, Engineer, Operator, Administrator, Sales, Warehouseman, Fireman, Policeman, Doctor, Nurse, Dentist, Paediatrician	Snow, Snowflake, Ball, Fight, Boxing, Ring, Marriage, Couple, Ceremony, Event,	Instrument, Guitar, Strings, Six, Numbers, Maths, Algorithms, Analytics, Graphs, Data, Spreadsheet, Input, Source, Collection
138	Brilliant, Fantastic, Great, Outstanding, Spectacular, Splendid, Average	Boiling, Scorching, Scolding, Searing	Partition, Creation, Function, Suction, Triangulation	Contrast, Conman, Concierge, Converge, Constant, Constitute, Constitution, Congregation, Converse, conversation, Continue	John, Peter, Mark, Phillip, Zion, Susan	Banker, Analyst, Stockbroker, Dentists, Doctor, Teacher, Professor, Cleaner, Investigator, Policeman, IT technician, Miner, Athlete, Manager, Retail Assistant	Temperature, Climate, Sun, Heat, Clothes, Human, Body, Feet, Shoe, Floor, Tarmac	Artist, Song, Notes, Choir, Church, Congregation, People, Masses, Priest
139	Well, better, likeable, nice, lovely, amazing, brilliant, great, perfect	warm, firey, blazing, humid, beaming, boiling	application, fascination, internationalisation, nation, caution, reaction, dedication, medication, initiation,	converse, contradict, confirm, concert	John, William, Soren, Thomas, Jessica, Herogia, Shannon, Laura, Charlie, Ben, Helen, Chivaun, Charlotte, Tamsin, Oliver, Kay, Sebastian, Jervan, Emma, Archie	plumber, electrician, mechanic, engineer, accountant, banker, hedge fund manager, doctor, psychiatrist, psychologist, teacher, dental worker, barman, waitress, human resource, administrator, public relations, civil servant, general	snow, jacket, gloves, scarf, woollen, sheep, cow, chicken, farm, harvest, food, restaurant, meals, planning, organising, dictating, countries, capitals, parliament, government, prime minister, covid	music, songs, rhythm, beat, sound, notice, loud, crowd, people, outside, sunny, weather, cold, snow jacket, gloves
140	Great, Better, Amazing, Spectacular, Nice, Splendid	Warmer, Heated, Boiling	Education, Formation	Concentration, Confidence, Confusion, Commotion, Conducting, Continue	Abraham, Esther, Isaac, Jacob, Moses, James, John, Peter, Precious, Elijah, Israel, Matthew, Market, Luke	Teacher, Business analyst, investment banker, trader, recruiter, plumber, postman, broker, underwriter, head teacher, speech therapist, occupational therapist, performer	Weather, Seasons, Change, Good, Nice, Holidays, Sun, Beach, Water, Boat	Concerts, People, Crowd, Party, Loud, Trouble, Police, Jail, bad , sad

141	Fantastic, Superb, Great, Amazing, Delightful, Splendid, Phenomenal	Soldering, Flaming, Warm, Heated	Mention, Implementation, Function	Confusion, Conversation, concept, conclusion concert, conman	Rachel, Antonio, Nicholas, Mary, Joseph, Abraham, David, Daniel, Mark, Paul, Peter, Danielle, Rhodda, Esther, Ruth, Marian, Samuel, Joshua	Banker, Lawyer, Psychologist, Manager, Carpenter, Dentist, Doctor, Actor, Signer, Seamstress, Dancer, Chef, Security Guard, Design, Artist	Snow, Ice, Freezing, Freezer, Fridge, Food, Humans, Homes, Walls, Paint, Decoration, Designer, Arts, Colours	Entertainment, TV, Living Room, Radio, Sounds, Ears, Body, Movement, Dance, Audience, Talent
142	Excellent, Great, Amazing, Holy, well Nice	Scolding boiling, heated, roasting	temptation, elation, elevation, inhalation, consolation, intimidation, validation, congregation, limitation, victimisation	congregate, congratulation, consequences, congress, conservative, convict, continued, confusion, confiscate, convince	Tom, Dick, Harry, Larry, David, Patrick, Sam, Sarah, Jessica, Keisha, John, Ben, Daniel, Lance, Connor, William Fred	Janitor, Binman, Housekeeper, receptionist, doctor, fireman, pilot, dentist, software engineer, accountant, manager, bus driver, chauffeur, Chef, social worker, waiter	Snow, Castle, Moat, Water, Waves, Current, Amp, Electricity, Technology, Communication, Phones, Apps, Games, Tennis, Sports, Referees, Uniforms, Clothes	Sounds, frequency, vibrations, physics, Science, chemistry, chemicals, bleach, cleaning, organisation, OCD, disorders, mental health, therapy
143	Optimistic, Great, Brilliant, Excellent, Amazing, Fair	Burning, Boling, Heated, Angry, Scolding, Spicy	Congestion, Condition, organisation, pollution, accommodation, solution, addition, isolation, option, motion, nation	Condition, connotation, converse, conceal, conceivable, construct, congratulation	Adam, Jack, Chris, Sam, Jake, Nathan, Isaac, Joshua, Simon, Mark	Waitress, Waiter, Pharmacy Staff, Postman, investment banker, chef, construction worker, consultant, marketing manager, shop-worker	Chilly, freezing, frost, bitter, harsh, cruel, brutal	Songs, artists, drawing, picture, photos, portrait, image, statue
144	Well, Great, Satisfactory, Decent, Commendable, Merit, Fantastic, Outstanding, Sublime, Fabulous, Wonderful	Scorching, Flaming, Heated, Angry, Close, Humid	Competition, Relation, Meditation, Inflammation, Fabrication, Inundation, Station, Reformation, Recommendation, Palpitation, Combination, Perpetration, Translation, Transformation, Proportion, disqualification, spiritualisation	Confide, Console, Contempt, Continual, Conquest	Joseph, Peter, Mary, John, Francis, Paul, Ben, Johnathan, Isiquel, Jesus, Alfred, Fred, Christina, Bradley, Kane, Kevin, Russell, Kayne, Michael, Kobie, Patricl, Shaqeel, Lamar, Deshawn	Doctor, Lawyer, Engineer, CEO, CFO, COO, Teacher, Sole Trader, Physio, Athlete, Psychiatrist, Psychologist, Palstic Surgeon, Orthodontist, Bus Driver, Registrar, Taxi Driver, Manager, Cashier, Cleaner, Gardener, Investor, Software Engineer	Wet, Water, Neutral, Scale, Size, Weight, Gravity, Neutrons, ass, Density, Wide, Measurement, Tailor, Clothes, Sizing, Style, Taper, slim, child, infant, young, adolescent, teenager, academies, Exam, pressure, depression	Sound, Audi, Sonic, Ears, Biology, Anatomy, Organs, Heat, Doctor, Professor, School, Study, Exams, Grades, Hark work, focus, precision, perfection, dedication, dictator, wide, vast, land, harvest, farming, food, produce, consumption, substantial
145	Well, beneficial, great, wonderful, awesome, fine	warm, scorching, heated, burning	addition, condition, proclamation, diction, fiction, selection, subtraction, multiplication, tuition, section, direction, objection	condition, convict, consent, concept, conflict, concise	Harry, Emily, Jen, Jess, Amanda, Rebecca, Peter, Paul, Alice, Emma, Ai, Nadia, Katelin, Susan, Katie, Julie, Sarah, Aaron, Matthew, Mark, Like, Johnathan	Teacher, Doctor, Nurse, Dentist, Lecturer, Zoo Keeper, Shop Assistant, Accountant, Lawyer, Radiographer, Hygienists, Teaching Assistant, Social Worker	Weather, Sunny, Hot, Beach, Water, Sea, Land, Sand, Pebbles, .Rocks Boulder, Building	Song, Dance, Performance, Movies Actors, Entertainer, Musical

146	Better, Astonishing, Nice, Pleasant, Amazing	Heating, Beautiful, Volcanic, Warm	Concentration, abomination, salvation, redemption, elation, station,	connection, concentration, conspiracy, contract, constant, contradict, congregation	Christian, Bo, Michael, Ivan, Joanne, Nicholas, Peter, Demitriov, Constantine, Anna	Computer scientist, Doctor, Teacher, Accountant, Entrepreneur, Receptionist, Financial Advisor, Vet, Fashion Designer, Chef, Cleaner, Engineer, Construction Worker	Antarctica, Freezing, bear, Penguins, Ocean, Whale, Fish, Fisherman, Fishing boat, fishing rod, wood, string, guitar, music, instrument, drums, drummer, band, concern, people	Listening, ears, ahead, eyes, seeing, sensing, urging, experiencing, feeling, emotion, happy, family, parents, dinner
147	Better, well, nice, sunny, valuable, positive, advantageous, great	spicy, scorching, blazing, boiling, warm	annotation, motivation, inspiration, exception, solution, pollution, operation, revolution, attraction, deprivation, depreciation	contract, converse, contraction, concept, contribution, constitution, congratulation, consequently	Ivan, Mark, Chris, Chlarisa, Rado, Radowinskia, Nathan, Adrian, Gerard, John	waiter, accountant, manager, CEO, banker, bar tender, chef, volunteer	Freezing, fridge, food, market, supermarket branch, company, accountant, employee, labour	Guitar, rock star, concern, public, stage, lightening, electricity, electric company, power
148	nice, extraordinary, perfect, outstanding, well	Warm, spicy	tradition, nation, question, information, notification, caution, condition	condition ,controversial, context, contract, contact, conman, confounding	Ho, Tien Xin, Lol, Wong, Joel, Xu, Andrew, John, Polly	Teacher, Doctor, Driver, Waitress, Nurse, Scientist, Accountant, Data Analysts, HR, Marketing, Fund Raiser, Volunteer, Cleaner, Housekeeper	Down, Nurse	Classical, Lyric, Current
149	Great, Awesome, Excellent, Perfect, Well, Fantastic, Amazing, Nice, Fine, Alright	Boiling, Warm	Caption, station, protection, accommodation	conservative, consequences, context, congregate, conversation, context, consumer, confirmation	James, Jacob, Matthew, Mathias, Bella, June, Jude, Josphine, Amy, Martha, Ella, Victoria, Julia, Mathew, Magdaline, Natalia, Richard, Roger, Tom, Alexander, Kathlyn, Katie, Alissa	Lawyer, Policeman, Fireman, Judge, Manager, cook, Chef, Cashier, Fashion Designer, Footballer, Athlete, gardener, Cleaner, Accountant, Musician, Actor	Winter, Snow, White, Dress, Wedding, Party, Alcohol, Beer, Drink, Glass, Window, Mirror, Bedroom, Bed, Pillow, Sheet, Duvet, Warm, Sunny, Hot, Summer, Spring, Fall, Autumn, Leavers, Orange, Brown, Red, Xmas, Santa, Chocolate, Milk	Note, Violin, Piano, Song, Love, Couple, Relationship, Valentines Day, Chocolate, Movies, Actor, Actress, Awards, Dress, Suit, Red Carpet, Heels, Shoes, Feet, Nails, Polish, Makeup, foundation, eye liner, colourful, pink, blue, sky, clouds, rain
150	Well, great, amazing, outstanding, beneficial, upright	warm, boiling, tropical, firey, spicy	Celebration, Pollution, revolution, notion, solution, action, attraction	Congratulation, constituent, contagious, construct, configure, confident, contract, consent	John, Matilda, Nicholas, Ivan, Tom, Daniel, Jordan, Sam, Daisy, Emma, phoebe, Sarah, Lucy, Laura, Gary, Gordon	businessman, accountant, doctor, nurse, vet, surgeon, mathematician, physician, social media manager, TV presenter, director, headmaster, bus driver, builder, designer, engineer, builder, project manager, analyst, investor	winter, snow, snowman, Christmas, holidays, presents, meals, family, communication, celebration, festive	albums, songs, singer, fans, concerts, back stage, staff, lights, show, entertainment, fame, money, recognition, influence



151	Benevolent, Positive	Warm, Temperate, Boiling, scolding	explanation, discrimination, description, participation, caution, potion, portion, notion, nation	conjunction, congruent, confirm, congratulate, con artists, conform, confide, confidential, control,	Emma, Abi, Ollie, Edna, Becky, Josh, James, Luke, Libby, Rees, Posham, Jake, Alice, Teo, Lula, Tania, Melissa, Emily. Erica, Karen, Jan, Irene, Gary, Dan, Dom, Martin, Ben, Wilfred, William	Airhostess, hairdresser, beautician, waiter, manager, pilot, marketer, carpenter, mechanic, writer, musician, artists, actor, driver, baker, chef, travel agent, tour guide	winter, snow, snowfall, jacket, clothes, style, stylists, job, money, power, control	Signing, song writer, lyrics, beat, melody, creativity, content
152	Positive, Well, Nice, Lovely, Fine, OK, Great, Suitable, Convenient	Warm, boiling, ardent, spicy	Complication, Implication, Organisation, Position, Revolution, Nation, Option, Solution	Congratulation, constructive, construction, convention, conscious, controversial, confident, confidentiality, concept, condition	Tyler, Daniel, Andrew, William, Christian, Trixy, Beatrice, Liam, Oliver, Noah, Philip, Elizabeth, Alice, Veronica, James, Ben, Sophie, Elijah, Tommy	Nurse, Doctor, Waiter, Waitress, Assistant, Teacher, Professor, Manager, Accountant, Politician, Sales Assistant, Mechanic	Winter, Snow. Traffic, Skiing, Coat, Hat, Scarf, Rain, England, London, Capital, Rome, Colosseum, Romans, Ancient, History, Literature, Poets, Poetry	Concert, Artists, Singer, Guitar, Orchestra, Choir, Church, Religion, Muslim, Israel, Palestinian, Warm, Guns, Fear, Feeling Love
153	Amazing, well, perfect, great, astonishing, exceptional	warm, sharp, scolding, blazing, radioactive, spicy	convict, contraception	operation, negotiation, motion, accusation, persecution, accomodation	Philip, John, Henry, William,, David, Peter, Gerry, Barbara, Madie, Lucy, Hannah, Eugene, Dana, Thomas, Jeffrey, Ben, Mona, Donald, Roger, George	Plumber, Secretary, Director, Carpenter, Chef, Cleaner, Mechanic, Teacher, Professor, Entrepreneur, Manager, Accountant, Statistician, Mathematician, Lecturer	Snow, Ice, Snow man, Winter, Skiing, Snow board, sledging	Melody, rhythm, vibes, happiness, relaxation, free time
154	Amazing, awesome. Best, acceptable, great, fine, okay	spicy, heated, boiling, sunny	Contract, contagious ,concentrate, concrete, convey, contrary, consumer, contribution, convention, consideration , condition	restriction, decoration, station, rotation, declaration, question, situation	Valerie, Kiera, Adam, Bethany, Liam, Courtney, Amber, Chloe, Christine, Callum, David, Shana, Lauren, Kieran, Sophie, Victoria, Vanessa, Veronica, Mohammed, Freddie, Sam, Arthur, Robert, Edward, Ethan	Doctor, Engineer, Pharmacist, Musician, Artists, Baker, Software, Engineer, Teacher, Personal Trainer, Pilot, Cabin Crew, Barman, Chef, Driver	Winter, Coffee, Water, Earth, Land, Human, Animals, Living Being	Band, Concert, Audience, People, Children, School, Teacher
155	Great, Best, Productive, Fine	Warm, Thermal, Sizzling, Boiling	Conduct, contract, confirm, control, constitution, condition, constant, construction	Competition partition, association, ambition, temptation	John, Vicky, Warren, David, Tom, Chris	Engineer, Businessman, Doctor, Accountant, Plumber, Teacher, Builder, Nurse, CEO	Hot, thermal, water, liquid, ice, bar, beer, teenager	Piano, Pianist, Concert

156	Satisfactory, Appropriate, Adequate, Great, Wonderful, Amazing, Awesome, Fantastic, Mesmerising, Incredible	Warm, Attractive, Beautiful Pretty, Boiling Steaming, Burning	Motion, Solution, Gravitation, Revolution, Occupation, Hesitation, Invitation, Evaluation, Situation, Organisation, Inspiration, Nation, Congregation, Station, Perpetuation, Creation, Calculation, Motivation	Congregation, Contrary, Contrast, Convenience, contribution, contamination, connection, constipation, constant, connotation	Miraslav, Bob, Robert, William, Eleanor, Eleanor, Monica, Veronica, Jason, Jackie, Jeffrey, John, Jim, Brandon, Landon, Sarak, Sarah, Noel, Vanessa, Taylor, Jason, Todd, Alexander, Sally, David	Teacher, Plumber, Manager, Dr, Nurse, Librarian, Acrot, Surgeon, Painter, Dancer, police, Social Worker, President, Lawyer, Politician, Nanny, Sportsman, Salesman, Marketer, public relations	Winter, Slovalia, Me, Sister, Family. Home, Heritage, History, Schools, Grade, bad, Failure, Dispirited, Tears, Sadness, Depression, Mental Health, Physical Health, Working out, muscles, body, biology, teacher, student, youth, child, toys, dolls, scary, hairy, movie	Piano, Myself, child, teacher, terrible, hands, body, biology, anatomy, difficult, effort, results, grades, school, teacher, mother, daughter, sister, beautiful, standards, society, people, humankind
157	Great, Awesome, Well, Amazing, Generous, Fantastic, Alright	Warm, Tropical	Nation, Application, Variation, Diversification, Pollution, Verification	Conduct, Conception, Conceptual, Contract, Container, Contemporary	Lucy, James, Alex, Connor, Aiden, Liana, Amata, Caroline, Laura, Emma, Sophie, Abi, Alissa, George, Michael, James, Jeremy, Bradley, Robbie, Cameron, Joel, ax, Matthew	Teacher, Professor, Fireman, Dentist, Dr, Lecturer, Entrepreneur, Accountant, Banker, Financial Analyst, Auditor, Clerk, Nurse, Real Estate Agent, IT Technician	Ice, Freezing, Snowman, Balls	Lyrics, Story, Experience, Person, Audience, Support, Friends, Memories, Development, Personality, Individuality
158	Great, Incredible, Excellent, Fascinating, Grant	Warm, pleasing, sizzling, firey, spicy, angry	creation, medication, implication, replication, notion, medication, nation	conversation, contrast, convert, con-artist, convene, concave, convey	Adam, Albin, Aaron, Jessica, Mary, Brendan, Christine, Harry, Codey, Kamal, Darren, Derryk, Fred, Zoe, Hun, Emily, Joanna	Doctor, Lawyer, Accountant, Financial Analyst, Lecturer, Teacher, Cleaner, Writer, Publisher, Editor, Store Owner, Manager, Waiter, Waitress, Administrator, Architect, Designer, Engineer, Biologist	Ice, Drink, Summer, Beach, Sand, Shell, Sea Food, Restaurant, Customers, money, house, family, children	Guitar, performance, singer, stage, audience, tickets, sales, money
159	Nice, Excellent, Fabulous, Wonderful, Pretty, Beautiful, Superb, Happy, Amazing, Great, Delightful	Sizzling, burning, flaming, scorching, warm, boiling	Action, definition, conjunction, junction, caution, station, alliteration, fraction, subtraction, addition, multiplication, questions	conservative, conjunction, construct, condensation, confidence, conjuring, connection, conspiracy, constitution, conceptual, conceal, configuration, confirm	Adam, Cameron, Jacob, Jake, Jack, Oscar, Alex, Henry, George, Dexter, Duncan, Greg, James, Nathan, Isaac, Thomas, Luke	doctor, nurse, midwife, surgeon, practioner, accountant, financial advisor, investment analyst, policeman, fireman, baker, chef, waiter, waitress, swimmer, athlete, sports person, presenter, actor, baby sitter, actress	ice cream, sweet, chocolate, cake, birthday, candle, light, bright, sun, weather, snow, cold, freezing, freezer, food, meal, Lasagna, pasta, Italian, pizza, cheese, cheddar	Sound, loud, crash, ambulance, doctor, patient, health, medicine, well being, mental health, self care, face mask, patience

160	Nice, par, excellent, great, amazing, splendid, fantastic	Boiling, scorching, toasty, spicy	Function, election, ejection, rejection, combustion, education, participation, precipitation, station,	Contra-ban, controversial, consensus, convex, concave, construed, contain, confuse	John, Luke, Emmanuel, Zachary, Mary, Ben, Rose, Annabel, Michael, Miguel, Omah, Adeem	Accountant, Actuary, Estate Agency, Mortgage Advisor, Lecturer, Retail Worker, Warehouse Operative, Doctor, Nurse, Administrator, Investment Banker, Analyst, Train Driver, Bus Driver, Vet, Valet, Car Dealer	Warm Hot, Boiling Kettle, Water, Noodles, Food, Burger, Frosties, Cereal, Milk, Hot Chocolate, Drink, Te, Coffee, Sugar, Sugar cane, Plant, Ground, Soil, Ghana, Chocolate, Gold, Gold Coast, West Africa, Nigeria	Rap, Rock, Pop, America, New York San Francisco, Bay, Cliff, Drop Top, Silicon Valley, Investment, Stock, Amazon, Apple, Penny Stock
161	Great, cool, better, fine	warm, sweaty	Caption, promotion, motion, information, question, presentation, election	congregation, contrast, contribution, conduct, confession	Jane, Teresa, Emily, Hannah, Dan, Leanne, Thomas, Antonio, Jack, Jessica, Karen, Melissa, Matthew, William	Accountant, Manager, CEO, Driver, Hair Dresser, Exhibition staff, Writer, Translator, Shop Worker, Hostess, Promoter, Teacher	Antarctica, Polar Bear, Fish, Ocean, Ice berg, Water, Boat	Song, Instrument, Singer, Producer, Dancer
162	Optimal, Convenient, fitting, well, efficient	Warm, Attractive, Gorgeous, Scorching Piping,	Condition, selection, preparation, prediction, inclination, derivation, digitalisation	conclusive, congruent, consular, council, conman, connection, congratulation	Lorenzo, Luca, Matthew, Giovanni, Christian, Mathieu, Marcus, Eleanor, Michel, Elisa, Mathew, Marion, Julia, Celia, Sophia, Tom, Samuel, Daniel, Jordan, Leena, Beatrice	Construction worker, mechanic, accountant, analyst, banker, lawyer, engineer, Mayor, president, CEO, CFO, street cleaner, janitor, teacher, scientist, research, data scientist, investor, manager, Fast food worker, teacher, assistant	Freezer, fridge, food, chicken, kitchen, gas, pipe, metal, factory, engineer, science, maths, numbers, equations, book, data, tree, leaf, sun, hydrogen, water oxygen, rust, metal, iron, blood, human, sin, cream, oil, engine	Sound, Engine, exhaust, gas, fuel, pollution energy, electricity, copper, band, chicken fridge, cold, freezer, kitchen, table, food, chair, nails, oven, cars, rubber, eraser, pencil, paper, pen, ink
163	Excellent, Brilliant, Fantastic, Okay, Alright, Average, Satisfactory, Standard, Complete	Warm, Burning	Production, Malfunction, transformation, satisfaction,	condition, contract, constriction, conclusion, condense, concise, contradiction, concept, confusion, conduct, confidence	Jake, Rodney, Francesca, Alexandra, Samantha, Ethan, Yousef, Charlie, Henry, Luke, Oscar, Nathan, Mike, Matthew, Jo, Connor, Tracey	Bricklayer, Product Manger, Doctor, Neurologist, Physician, Pharmacist, Policeman, Pilot, Builder, Sound Engineer, Engineer, DJ, Singer, Dancer, Artist, Psychiatrist, Receptionist, Phone Operator, Waiter	Winder, Turbine, Electricity, Enginee, Power Company, Workers, Manager, Subordinates, Tasks, Deadlines, Time	Instrument, Guitar, Strings, Shoe lace, Shoe, Foot model, Beauty, Stallion, Horse, Freedom, Feminism
164	Well, brilliant, great, fine	Warm, firey, blazing	Exception, regulation, formulation, modification	continental confidential, consistency, consisting, controversial, convey, convenient	John, Mike, Ivan, William, Thomas, Becky, Ben, Josh, Peter, Angela, Anna, Ellie, Anthony, Elizabeth	Manager, CEO, Marketer, Entrepreneur, Assistant, Biologists, Mechanic, Archaeologist, Footballer, Bursary, Technician, Freelancer	Winter, Snow, Snowman, Ice, Ice block, Fridge, Food, Drinks, Coca cola, Food industry, Globalization, Money, Capital	Rock, Motorbike, Beer, beverage, soft drink, Fanta, summer, hot, beach, sand, castle, knight, horse, fields

165	Great, positive, wonderful, fantastic, beautiful, delightful, colourful, marvellous, perfect, amazing, rewarding, decent	boiling, fuming, warm, temperate, spicy, sensitive	correction, detention, attention, motion, action, dictation, notification, situation, lotion, deportation, transportation, motivation, vocation	considered, conservative, content, contact, cons, contagious, conservation, contrive, conventional, conference	Mary, Late, Kathryn, Maria, Harry, William, Margaret, Arthur, Sam, Archie, George, Charlotte, Megan, Rachel, Elizabeth, Oliver, Olivia, Kitty, Amy, Arnie, Marie, Alice, Lucy, Ashley, Emily, Naomi, Tom, Dan, James, Gregory	Teacher, Civil Servant, Military officer, navy personnel, waiter, waitress, fisherman, trader, marketing policy advisor, Public relations, content creator, human resources, professor, nursery teacher, dentists, doctor, occupational therapist, radiographer, speech and language therapist, podiatrist, physicist	thermometer, pharmacy, pharmacist, tablet, prescription, pill, water, family, mental health, support, awareness, charity, community, welfare, policy, party	Instrument, choir, competition, performance, orchestra, theatre, history, art, architect, tourist attraction, travel, cathedral
166	Great, Fantastic, Awesome, Amazing, marvellous, terrific	Warm, boiling, topical, newest, attractive	notion, competition, petition, creation, innovation, computation	controversial, convex, concentration, conclusion, continuation, contraction, control, conviction, connotation	Alex, Stefan, William, Oliver, Ben, Jack, Jason, Callum, Tiffany, Georgia, Jenny, Holly, Megan, Andrew, Richard, Phillip, George, Tom, Tim	Banker, Mechanic, Nurse, Social Worker, Marketing Manager, BDM, General Manager, CEO, Secretary, Bus Driver, Doctor, Police, Fire-fighter, Vet	Ice, Winter, Skiing, Sports, Exercise, Running, Shoes, Clothing, Fashion, Consumer, Markets, Economy	Instrument, Guitar, Wood, Tree, Forest, Rainforest, Jungle, Brazil, Country, Continent, World
167	Best, perfect, fine, ethical, profitable, advantageous	summery, boiling, baking, spicy, sharp	nation, pollution, organisation, relation, revolution, solution, contribution	concentrated, concern, concession, conclusions, concise, condition	Elias, Imran, Waka, Majot, Cehzaz, Ajab, Norman, Sohabonn, Shahib, Mohammed, Zakiel, Yasin, Naim, Noah, Nadime, Diaz, Abid, Sadiq, Azail	Police, Barrister, accountant, purchase manager, judge, army officer, marketer, HR manager, Labourer, Supply chain manager, merchandizing manager	winter, spring, season, warm, clothes, expensive, money, struggle, job, education, time	Feast, comfort, sad, mood
168	Well, brilliant, excellent, amazing, exceptional, joyous, flamboyant, terrific, extraordinary, incredible, splendid, magnificent, tremendous	Scorching, piping, beaming, flaming, burning, sizzling	information, formation, transformation, annexation, accreditation, nation, creation, civilisation, diversification	convince, consequence, convict, contraception, console, consolation, contraception	Jake, Charles, Ben, Ethan, Isaac, Bob, Jim, Anne, Lisa, Kim, Toby, Brandon, Mitchell, John, Luke, Matthew, Paul, Trevor, Dorothy, Elizabeth	Astronaut, Security Guard, Warehouse operator, Logistics manager, Doctor, Teacher, Lawyer, Accountant, Businessmen, Board Director, Salesman, Investment banking analyst, consultant, architect, tax advisor, chef, plumber, dinner lady	Weather, Thunder, Lightning, Bolt, Electricity, Electrician, Job, Income, Money, Wages, Assets, Liabilities, Finance, Mortgage, House, Family, Home, Dream	Melody, Base, Instrument, Guitar, Rock band, Musicians, Celebrities, Fans, Concerns, Excitement, Joy, Achievement

169	Best, Excellent, Superior, Extraordinary	Humid, Sunny, sexy, attractive	communication, digitalisation, globalisation, privatisation, pollution, classification, presentation	conversation, contribution, contrary, concentration, convenience, convincing, continent	James, Jim, Chris, Stewart, Ben, Joffra, Sameet, Warner, Sunyaya, Johnny, Jo	Engineer, Businessman, Videographer, Analyst, Data Scientist, Driver, Marketing Executive, Investment Banker	Hot, Sexy, Woman, Beautiful, Nature, Travel, Camping	Lyrics, Album, Single, Writer, Movie, Actor, Choreographer,
170	Excellent, phenomenal, great, nice	Temperate, humid, warm, boiling	evolution, pollution, regulation, attraction, situation, organisation, construction	condition, conclusion, construction, congratulations	Brijesh, Sherum, Abraham, Harnish, Michael, Michel, Pujan	Supervisor, Managing Director, Accounts Officer, clerk, CEO, teacher, Professor, consultant, technician, engineer, lawyer, chef	Heater, warm, movie, chain, party, fight	piano, song, composer, award night
171	Better, Awesome, Great, Superior, Quality	Steaming, boiling, spicy, strong, tropical. Burning, roasting, blazing, sizzling	pollution, nation, revolution, attraction, solution, option, integration, diversification, caution, station, implication	contest, connection, conclude, control, constitution, container, congratulation, contamination, contemplation, continual, connection, contemporary, contraction	Matthew, Mark, John, Luke, Samuel, Ruben, Noah, Jesus, Moses, Tim, Grace, Joseph, Mary	Doctor, Nurse, Manager, Retailer, Cleaner, Shop Assistant, carer, Bus Driver, Taxi Driver, Swim Coach, Basketball player, Athlete, Trainer, Teacher, Assistant, Banker, Accountant, Analyst, Baby sitter	Hot, summer, ice cream beach, sand castle, ocean, boat, river, shark, fish, sea food, restaurant, kitchen, cutlery, plates, sink, desk, work top, office, manager, building, firm	lyrics, song, stage, audience, artists, studio, video, internet, social media, comments, likes, photos, camera, picture
172	Impeccable, great, fabulous, amazing, wonderful, well	warm, boiling, smouldering, baking	competition, expedition, communication, information, composition	conservative, conservation, confuse, condense, concede	Andrew, William, Elliot, Elaine, Jamie, Alistair, Shaana, Jenifer, Alexandra, Ben, Steve, Douglas, Piers, tom, Peter, Robert, Tilly, Martha	Managing Director, Chief Operations Officer, Secretary, Journalist, Policeman, Pilot, Dentist, Doctor, Surgeon, Computer Programmer, Musician, Producer, TV Presenter, Illustrator, Consultant	Ice, Water, Hydrogen, Oxygen, Atmosphere, Space, Star, Moon, Planets, Orbit, Space X, Electric Car, Battery, Renewable Energy	Composer, Orchestra, band, drummer, Acoustics, Guitar, Country Music, Whisky, Drink, Bar
173	Well, pleasant	temperate, heated, uncomfortable, sunny	mention, retention, prescription violation, presumption	confidence, contrast, conference, convention, continent	John, Mary, Joseph, Paul, Thomas, Matthew, Esther, Ruth, Tom, Michael	Lawyer, Teacher, Professor, Manager, Doctor, Businessman, Engineer, Social Worker, Scientist, Writer, Actor, Director, Singer, Dancer	Weather, Sunny, Pleasant, Nice, Happy, Enjoyment	Bliss, Happy, Enjoyment, Outside, Driving, Car, Insurance
174	Great, well, happy, satisfactory, positive, valuable, excellent, marvellous, exceptional, reliable, efficient	smoking, spicy, boiling, balmy, burning, firey, ardent, heated	celebration, question, vacation, position, action, motion, lotion, nation, solution, revolution, attraction, pollution, addiction, location	contribution, construct, connect, conclude, contract, consensus	Jake, Ben, Eliza, Paul, Felix, Sophia, Liam, Oliver, Emma, Oscar, Noah, Eva, Rex, Georgia, Jasmin, Taylor, Kim, Kylie	Doctor, Policemen, Lawyer, Store Manager, Customer Assistant, Driver, Housekeeper, Businessman, Cook	Ice, Ice cream, summer, sun, sun cream, beach, ocean, sunburnt, hospital doctor, medicine, old people, grand parent	concert, group, guitar, guitarist, club, dancing, shoes, dress, partner, night, stars, moon

175	Better, best, quality, appreciative	warm, sunny, temperate	direction, dedication, reception, definition, desertification, qualification, clarification	Concern, concentration, conman, conclusion, contribution	Jim, Anthony, Joseph, Perrera, De Souza, Ala, Rose, Demala	Manager, Technician, Sales, Research Scientist, Broker, Receptionist	Winter, night, dark, light, heater, bonfire, BBQ, Salad, Quality Time	Instrument, Guitar, Strings, lectern, Words, Song, Melody, Singing, Chorus
176	Better, excellent, best, superior	summery, tropical. Boiling, warm, humid	competition, nation, pollution, solution, attraction, revolution, personification	connection, constitution, construction, congratulations, container, confident	Alex, Mark, Boho, Felix, Theo, Abel	Marketing, Sales, Entrepreneur, Farmer, Computer, Engineer, Musician, Scientist	Hot, Clothes, Heater, Socks	Tunes, guitar, violin, strings
177	Superior, better, ethical fine, quality	boiling, humid, tropical, burning	partition, competition, position, organisation, pollution, solution	convey, congratulation, condition, configure, concentrate	Tom, Harry, George, Nathan, Boho, Alicia, Barry, Ellen, James	Accountant, CEO, Entrepreneur, teacher, Nurse, Doctor, Police officer, Postman, Student, Journalist, Sales, Detective	Water, Drinking, Tea, Glass	Guitar, Song, Microphone, Speaker, Piano
178	okay, best, alright	focussed, warm, spicy	transportation, communication, pollution, population	conversation, construction, convenient, control, connection, contain, condition	John, Peter, Paul, Simon, David, Jude, Medinat, Karimat, Barrack, Wamid, Suliman, Aishat	Doctor, Lawyer, Banker, Accountant, Engineer, Police, Minister, Nurse, Optician, Dentist, HR Manager, Strategist, Finance Manager, Entrepreneur	Ice, Snow, Spring, Summer, Hot, Sea, Sugar, Chocolate	Beat, Party, Food, Cook, Ingredients, Market, Shops
179	Positive, brilliant, fantastic, decent, splendid, excellence, outstanding, exemplary	boiling, humid, roasting, spicy, blistering, firey, tropical, summery, baking	location, destruction, dissertation, identification, contrition, portion, question, mention, position	continue, conservative, conservation, con, connotation, confounding, connection, conflation, Congo, confronting	James, Milly, Lucy, Mark, Robin, Emma, Emily, Ben, Aaron, Gabriel, Kieran, Sam, Penny, Susie, Helen, Adam	Builder, teacher, bus diver, pilot, shopkeeper, cleaner, actor, dancer, singer, electrician, Plumber,	Antarctic, penguin, chocolate, cocoa, south America, football, England, London, busy, Tokyo, sushi, fish, ocean, shark, surfing, Australia	Festival, Leeds, Yorkshire, roast beef, cow, Amazon, environment, protests, politics, parliament, Boris Johnson, Eton, school, teacher, occupation
180	Positive, success, desirable. Spiritual	warm, good looking, bonfire, firey	proposition, conduction, superstition, ambition, diction, motion,	conjunction, constitute, connection, connectivity, contemporary, conscious, continent, content	John, Joseph, James, William, Matthew, Christopher, Aaron, Michael, Richard, Gerard, Kirsty, Kate	Doctor, lawyer, civil engineer, data scientist, programmer, biologists, lecturer, researcher, chief executive, carpenter, builder, plumber,	Raining, Weather, sunny, beaches, water, wet, jacket, fashion., accessories, purchases, money, job, salary, company, entrepreneur, retirements.	Songs, lyrics, poetry, therapy, help, food, exercises, endurance, travelling, nature, lover, habits, sleep, bed
181	Brilliant, excellent, marvellous, nice, beneficial, opulence, profitable, comforting, comfortable	dangerous, fire, sensational	nation, innovation, peroration, collection, faction, ideation, caption, gestation	concord, concern, concise, constellation, conflict, connect, conversation, conflict,	John, James, Jude, Mary, Paul, Zikhel, Jeremiah, David, Samuel, Naomi, Ruth, William Titus, Matthew, Luke, Tim	Banker, Nurse, doctor, lecturer, bricklayer, carpenter, truck driver, IT person, administrator, estate agent, property developer	Ice, Arctic, North America, Power, Business, entrepreneurship, Property	Sing, melody, happy, lyrics, notes, rhythm, synchronise, order, good, pleasant, fun

182	Nice, kind, caring, fantastic, amazing, incredible, perfect, considerate, best lovely	fiery, boiling, maximum, heat, fuming, burning, explosion	creation, allegation, probation, evolution, formation, attention, elevation, preparation, nation, vacation	connotation, conduct, conclude, confess, connect, conglomerate, convince	James, Mark, Paul, Monica, Sarah, Deborah, Ethan, Caleb, Magdalene, Mary, John, Isaac, Jacob, Tim	Electrician, Plumber, Painter, Driving Instructor, Teacher, Lecturer, Musician, Doctor, Nurse, Social Worker	Winter, snow, ice, skiing, snowman, hat, temperature, weather	Sound, noise, listen, earphones, phone, ring tone, play, beat, tempo, texture
183	Nice, successful, great, wonderful, peaceful, well mannered	Warm, heat, burning, flaming, fiery, temperature	arbitration, tuition, specification, correlation, function, detection, sanction, reputation, action, realisation	conviction, convection, conversation, conclusion, context, content, convict, convey, concept, contract	William, James, Jane, John, Sandra, Maria, Jose, Ibrahim, Carol, Tim, Tom, Annie, Leslie, Sarah, Susan, Jack, Joe	Engineer, Geologist, academic, physio, mathematician, doctor, administrator, office manager, environment scientist, analyst, finance officer, ESG specialist, accountant, operations manager, hairdresser, retailer, bus driver	Winter, coat, thick, salami, delicious, meal, hot, full, house, family, friends, relationship, romanticism	Rock, geology, Jurassic, dinosaur, extinction, history, future, politics, war, sad, interaction, psychology, peace, calm, belief
184	Nice, appropriate, aligned, useful	spicy, warm temperate, tropical	concentration, convention, Allocation, rotation, presentation, election, distribution, vacation, restriction	convention, conman, conjunction, contingent, connection, contrast	James, Lucy, Rajid, Ben, Pastov, Adam Simon, William, Thomas, Walker, Eva, Lauren, Henry, Matthew, Benny, Mahair, Alexandria, Chloe, Amelia, Marco	professors, lecturer, researcher, marketer, consultant, analysts, strategist, banker, policy analysts, data scientists, data analysts, photographer, comedian, actor	ice-cream. Children, school, teacher, Phd, research, income, vacation, entertainment	Musician, talent, demand, opportunities, income, facilities, comfort, satisfaction
185	Excellent, extraordinary, great, nice, well, grateful. Best, better, wonderful. Brilliant	warm, spicy	tradition, information, function, capitalisation, caution, condition, situation, manipulation	Continent, controversial. Contradict, contribute, conservative, contemporary	Chris, Andrew, Joseph, Becky, Ben, Ron, Harry, Harmony, Jack, Jason, Abi, Amber, Amanda	Teacher, Professor, Fireman, Chef, Receptionist, nurse, doctor, lecturer, banker, secretary, investor, housekeeper, policemen, solidier	Winder, snow, white, colour, rainbow, seven, number, odd, ordinary, abnormal	song, classic, piano, sound track, CD, player, technology, innovation, business, money
186	Nice, great, better	spicy, warm, burning, energetic	vocation, vacation, mention, selection, affection, rejection, creation, negotiation, domination, relation	consignation, connection, concise, conman, contract, contents	Raj, Roman, Hina, Harish, Harin, Aaron, Ran, Andrew, Naga, Abava, Sophia, Nandia, Helen, Diana, Marian, Kirsty, Adjeet, Maya, Neya, Vashah, Vervik, Veronika, Arbett, Abjeet, David, Vehill, Prianca, Richard	Software engineer, graphic designer, accountant, business administrator, analyst, data scientist, AI engineer, Civil engineer, mechanical engineer, HR manager, professor, Marketer, Office Manager, Waiter, Chef	Ice, ice cream, milk, cow, elephant, huge, world, human, kindness, helping	Bollywood, movies, actors, acting, drama, story, message, knowledge, thinking, growth, development, human

187	Positive, Upbeat, joyful, happy	Boiling, firey, spicy, smoking, burning	repetition, exemption,, description, segregation, hospitalization	convict, conscript, conclusion, converse, convex, concave	Brad, Phil, Theo, Harry Dillon, James, Tyler, Taylor, Regan, Sophie, Ellie, George, Georgia, Aiden, Lenny, Sam Rebecca, Kiana, David, Sharon, James, Simon, Peter, Olivia, Nicola, Isabella	Personal Assistant, Logistics officers, Oil broker, trader, underwriter, actuary, accountant, teacher, data analyst, plumber, electrician, carpenter, cleaner, pilot, air stewardess	Snow, frost, ice, water, fish, chips, plates, restaurant, service, date, relationship, love, girlfriend, fun, holidays, sun, beach, relax, swim	happy, fun, friends, festivals, summer, sun, pub, beer
188	Well, nice, alright, fine, amazing, positive, perfect	warm, temperate	sensation, emotion, alternation, invitation, participation, discrimination, violation	consumption, contribution, conversation, connection, contemplation, connotation	Kathy, Stan, Stephen, Dylsia, Daniel, Katie, Pat, Sarah, Abdul, Karim, Miriam, Mohammad, Ivan, Margaret, Joanna, Seb, Marina, Leah, Hannah, Noah, Petra	Manager, accountant, porter, nurse, taxi driver, pilot, cleaner, housekeeper, receptionist, barman, football scout, coach, researcher, professor, lecturer, gardener, hotel manager	Winter, snow, snowman, snowball, ice, rink, skater, Christmas, Santa, holidays, celebration, gifts, tree, gathering, family	musician, record, releases, sales, hits, revenues, predictions, good, bad
189	Great, amazing, awesome, cool	warm, blazing, scorching	assertion, convention, mention, creation, notion, potion, motion	concede, concrete, conceive, conscription, controversial	Geroge, Mary, Merthel, Paris, Jim, John, Maria, Julius, Julian, Juliette, Nick, Nicolette, Ranya, Randy, Randall, Matthew, Emma, Eva, Georgia	Businessman, Entrepreneur, Baker, Researcher, Labourer, Welder, Photographer, Blacksmith, Painter, Banker, Data Analyst, Data Scientist	Ice, Drink, Nightclub, Dancing, Party, Friends, Fun, Board game, Video game, Exercise, Sport, handball, Football	Arts, creativity, people, interesting, enjoyment, food, family , love
190	Great, Positive, Exceptional, Amazing, Excellent, Outstanding, Satisfactory, Commendable, Superb, Brilliant	Heated, Scorching, Warm, Sizzling, Boiling, Blazing, Flaming, Piping	Condensation, Motion, Notion, Differentiation, Option, Caption, Station	Conquest, congestion, control, contain, continue, contort, confirm, conjure, contempt, content	Alex, Aiden, Jack, James, Joviad, Ely, Ella, Edward, Edwin, Adam, Paul, George, Julian, Emmanuel, Zac, Nathan, Thomas, Martin, Louis, Louise	Teacher, Banker, Asset Manager, Social Media Manager, Influencer, Cleaner, Security Guard, Life Guard, Policeman, CEO, CFO, Manager, Events Organiser, Bus Driver	Snow, Fire, Marshmallows, Sweets, Disgusting, Tasty, Sandwich, Meal, Tesco, Supermarket	Instrument, Drum, Roll, Kick, High Hat, Percussions, Chorus, Singers, Orchestra, Show, Audience, Applause
191	Nice, amazing	Warm, burning	intervention, distraction, transformation, attraction, imagination	connection, content, contest, context, contamination	Christina, Tom, Peter, Alan, Jessica, Karen, Kimberly, Charlotte, Theo, Macy, Mark, Kieran, Penny, Maria, Brad, Leo, John	Doctor, Dentist, Teacher, Farmer, Pharmacist, Supermarket, Stack, Cashier, Manager, Supervisor, Personal Assistant, Scientist, Builder, Data Analyst	Warm, Hot, Frozen, Ice, Snow	Guitar, Violin, Sound, Melody, Orchestra, Team, Football, Ball, Handball



192	Brilliant, incredible, amazing, decent, possible, outstanding, mind grabbing, fantastic, splendid, stupendous, extraordinary, okay, fabulous	warm, boiling unbearable, temperate, intense	caution, elation, ration, nation, faction, traction, sensation	convey, contrast, contempt, content, cone, consultant, consensual, consent, constrain, contracts, container, contains, contrary, contractual, converge	Ann, Emma, Angela, Ian, Bob, Jack, June, Dawson, Frankie, Gregory, George, Gemma, Janet, Kyle, Zach, Jasmin, Codei, Connor, Trevor, William, Adam, Casey, Tracey, Owen, Lionel, Birt, Rachel, Daniel, Hank, Sean	Doctor, Nurse, Teacher, Engineer, Electrician, Telecoms engineer, Banker, Analyst, Data Scientist, Investment Banker, Consultant, Management consultant, Businessman, entrepreneur, contractor, accountant	hot, temperature, climate, change, different, unusual, strange, person, name, character, television show, Netflix, streaming	Composer, song, football, player, game, board, tired, feeling, emotion, brain, body, human, animal, monkey, mammal
193	Better, nice	heated, boiling, warm	nation, variation, registration, station, vacation	condition, condom, conservative,	Emily, Anthony, Ricky, Sunny, Steve, Younis, Tammy, Jodie, Irene, tom, Ellie, Maggie, Tiffany, Cathy, James, Jan, Victor, David, Paul, Ronald, Callum, Andy, Ben	Policeman, Fireman, Accountant, Banker, Driver, Nurse, Doctor, Technician, Musician, Lawyer, Teacher, Analyst, Salesman, Clerk, Professor, Bus Driver	Snow, Snowman, Kids, Toys	Piano, Song, composer, Singer, Audience, Concert Hall
194	Fine, Right, Superb, Honest, Fair	Warm Boiling, Tropical Sunny, Spicy	Intition, Cognition, Perception, Recalibration, Description, Diversification, Realisation	Connection, Congress, contempt, concept, contemplate, consciosus, constant	Sam, Alex, John, Neil, Kevin, Kate, Caitlyn, Ciara, Rose, Aisha, Monica	Economist, Accountant, Lawyer, Dentist, Doctor, Surgeon, Salesman, Agent, Administrator, Project Manager, Communications Assistant, Web Developer, Designer	Winter, ice, Traffic, congestion late, work, tired	headphones, combing, book background, bird, happiness, fulfilment
195	Great, Awesome, Marvellous, Exceptional, Satisfactory, Acceptable	Fever, Warm, Spicy, Saltry, Boiling, Scorching, Tropical	Anticipation, Participation, Station, Differentiation, Rationalisation, Hospitalisation, Verification, Immunisation, Action, Nation, Motion, Vacation	Condemnation, Content, Connect, Concord, Convince, Connect, Conclude, Consequently	Hazel, Ashwin, Helen, Rachel, Kathleen, Jack, Andrew, Jonah, Joshua, Able, Joel, Emanuel, Baker, Salomon, Naomi, Phoebe, Ashdeep, Arranga, Ivan, Ian, Bob, Andrea, Maria, George, William, Diana, Deborah, Fiona, Anoshka	Engineer, Medic, Accountant, Banker, Auditor, Financial Manager, Quantitative analyst, forensic accountant, plumber, entrepreneur, teacher, mechanic, Cleaner, pilot, air hostess, politician, pharmacist, nurse, policeman	Coffee, Beans, Tropical. Forest, Animals, Cheetah, Predator, Evil, Good, Angels, Sky, Cloud, Aeroplanes, Passengers, Passport, Travel, Destination, Beach, Sand, Waves	Song, Melody, Choir, People, Occupation Doctor, Surgery, Injection, Medic, Pharmacist, White coat, Rain, Umbrella, Handle, Door, Knob

196	Great, Wonderful, Happy, Fine, Amazing, Exciting	Steamy, Warm, Firey, Devilish	Option, Nation, Education, Causation, Designation, Perfection, Regulation, Interpretation, Motion, Motion	Consequence, Confectionary, Confetti, Contradiction, Concrete, Concur, Confiscate, consider, Contract	Emma, Kate, Elizabeth, Julia, Katrina, Daisy, Rosie, Rachel, Suzanne, Mary, Maria, Marion, Jessica, Esther, Millie, Gabriella, Henry, Harriet, Harry, Seb, Freda, Edward, Roman	Lecturer, Teacher, Tutor, Performance, Artists, Musician, CEO, Manager, Cleaner, Waiter, oook, Receptionist, Fireman, Police Officer, Doctor, Midwife, Nurse, Waitress	Snow, Winter, Season, Spring, Flowers, Bouquet, Present, Birthday, Celebrations, Happiness, Family, Gatherings, TV room, Sofa, Cosiness, Blanket, Warm	Sheet, Notes, Piano, Instrument, Orchestra, Opera House, Philharmonic, Medieval Age, History, Story, Relationship. People, Gatherings, Public
197	Great, Better, Amazing, Superb	Warm	Explanation, Question, Exaggeration, Faction	Conclusion, Congo, Convoy, Convey, Construction	Alex, Hazel, Jacob, Michael, Ciara, Susan, Joseph, Bruno, Angela, William, Kate, Nicole	Student, Contractor, Financial Analyst, Web Developer, Accountant, Teacher, Coach, Lecturer, Dress maker	Freezer, Kitchen, House, Neighbourhood, People, Running	Dance, Festival, Entertainment, Clown, Circus, Tricks, Halloween, Fancy Dress, Sweets
198	Decent, Genuine, Satisfactory, Reasonable, okay	Warm, boiling	Presentation, Commotion, Reactivation, Extrapolation, notion, promotion, contribution, formation, information	Constitution, Congregation, Control, Contributing, Contrary, Conversion, Conversation, Contradictory, Conversely	Anna, Jane, James, Melissa, Maria, Catherine, Jacob, Howard, Callum, William, Henry, Hannah, Leah, Luke, Johan, Hussein, Mohammad,	Doctor, Lawyer, Banker, Analyst, Risk Manager, Consultant, Nurse, Teacher, Professor, HR Manager, Recruiter, Data Scientist, Data Analyst, Actuary, Financial Analyst, Accountant, Cleaner, Cook, Waiter, Truck Driver, Taxi Driver	Winter, Snow, Snowman, Children, Kindergarten, Playing, Fun, Relaxing, Enjoyment, Happiness	Singing, Dancing, Nightclub, Youth
199	Great, Awesome, Fantastic, Fair, Decent, Wonderful, Brilliant, Equitable	Firey, Warm, Spicy, Strong, Blistering, Boiling, Blazing	Calculation, Description, Addiction, Innovation, Prediction, Presentation, Fluctuation, Prescription, Reiteration, Satisfaction, Notation, Justification, Clarification, Multiplication, Subtraction, Observation, Education, Quotation	Consequences, Conservation, Conversation, Consideration, Confident, Confusion, Condensing, Con, Consist, Constant, Confer	Adam, Jane, Felicity, Olive, Eve, William, John, James, Jack, Maria, Chloe, Esther, Marian, Emanuel, Joseph, Jose, Hardick, Nicholas, Wendy, Charlotte	Banker, Accountant, UX Designer, Product Manager, Software Developer, Product Manager, Digital Marketer, Economist, Financial analyst, Business analyst, data analyst, supply chain manager, HR manager, communications officer, Doctor, Lawyer, Engineer, Physician, Pharmacist, Graphic Designer	Warm, Hot, Fierce, Strong, Weak, Sick, Ill, Disease, Medication, Prescription, Pharmacy, Hospital, Children, Parents, Family, Friends, Colleagues	Dance, Travel, Beach, Sand, Stone, Water, Ocean, River, Shower, Bathroom, Bedroom, Bed, Pillows, Blanket, Warmth
200	Better, Great, Excellent, Nice, Awesome, Super, Best	Summery,, Burning, Sweaty	Action, Procrastination, Automation, Discrimination, Assassination, Deforestation,	Conclusion, Constant, Content, Context, Conservation, Continuation, Condition, Congratulation	Ann, Jennifer, Jessica, Justin, Sunny, Mia, Sachin, Virat, Shilpa, Sharuk, Narinda	Engineer, Doctor, Lawyer, Chef, Accountant, Hairdresser Civil Servant, Singer, Poet, Actor, Dancer, Model,	Jacket, Hoodie, Hot, Shower, Water, soup, Mouth, Lip-balm	Violin, Guitar, Instruments, Dancing, Choir, Church, Carol, Christmas, Santa, Crib

201	Fantastic, Great, Amazing, Positive, Happy, Excellent, Exceptional, Acceptable	Warm, Boiling, Humid, Scorching, Burning	Imagination, Creation, Dissertation, Action, Option, Education, Ration, Nation, Humiliation	Construct, Convey, Convex, Convert, Conventional, Considerate, Congratulate	Amy, Emily, Lucy, Maddie, George, Yasmin, Charlotte, Henry, Harry, Same, Katie, Lucy, Collette, Ruben, Michael, Ben, Millie, Holly, Neve	Cleaner, Shop worker, Accountant, Consultant, Nurse, Pharmacists, Gardener, Chef, Waiter, Driving Instructor, Journalist, Software Developer, Politician, Engineer, Author, Artist	Ice, Snow, Winter, Seasons, Temperature, Heat, Spice, Food, Fruit, Trees, Leaves, Autumn, Halloween, Pumpkins, Vegetables	Piano, Keys, Door, House, Village, School, Children, Toys, Shop, Retail worker, Salary, Income, Money, Bank
202	Great, Brilliant, Fine, Okay	Boiling, Warm, Steamy, Spicy, Firey	Institution, Organisation, Dissertation, Dissatisfaction, Rationalisation, Exemption, Addition, Solution, Caution	Confidential, Confiscate, Confuse, Condescending, Contrary, Context, Contract, Convoy, Control, Convict	John, Steve, Bridget, David, Paul, Simon, William, Henry, Harrison, Matthew, Jaspric, Aaron, Leo, Mary, Annabel, Emma	Banker, Doctor, Nurse, Engineer, Software Developer, Business Analyst, Surgeon, Economist, Lecturer	Weather, Rain, Umbrella, Dry, Hot, Spicy, Delicious, Water	Singer, Voice, Volume, Loud, Disturbance
203	Nice, Great, Balanced, Advantageous, Fine, Beneficial	Temperate, Burning, Soaring, Boiling	attention, detention, condition, completion, competition, nation, ambition, psotion, augmentation, imagination, construction, fiction, affection, attraction, solution, devolution	construction, confidence, condemn, constituent, considered, connect, consent, conform, confluence	Disha, Bridget, Priaka, David, John, Tricia, Dermot, Bushra, Rahev, Sonia, Pranav, Damed, Abdul, Simon, Karkek, Sashi, Regash, Minesh, Rashesh, Dunga, Uratah, Sandra, Andrew, Thomas, Palav,	Financial analyst, consumer exec, accountant, finance manager, equity research, salesman, marketing manager, investment banker, tech manager, doctor, teacher, nurse, professor, journalist	Winter, clothes, coat, boats, shoes, socks, angles, legs	Love, Peace, Positive, Life, Moment
204	Better, Excellent, Appropriate, Reasonable, Focussed	Temperate, Uncomfortable	Education, Completion, Appreciation,, Motivation, Adaption, Communication, Introduction, Situation, Fascination	Congratulation, Congregation, Contract, Confusion, Connection, Control	Willia, Linan, Asad, Kailou, Georgie, Hooda, Bastal, Mammood, Surwash, Ania, Aman	Teacher, Doctor, Lawyer, Consultant, Mediator, Mechanic, Writer, Journalist, Economist, Scientist	Breeze, Blow, Fluttering	Sound, Peace, Feeling, Observing
205	Excellent, Amazing, Special, Nice, True, Wonderful	Trendy, special, Exciting, Beautiful	Accommodation, Education, Induction, Solution, Promotion, Delineation, Destination, Habitation, Annunciation, Pronunciation, Illumination, Position, Remediation, Dictation	Conversation, Confusion, Coronation, condone, Confirmation, Condition	William, Richard, Dennis, Dixon, Ted, Tundi, Joy, Hannah, Tulo, Alex, Sarah, David, John, Jonathan, Elizabeth, Donald, Samuel, Ann, Sophia, Eleanor	Chemical Engineer, Mechanical Engineer, Industrial Engineer, Data Scientist, Data Analyst, Programmer, Accountant, Dancer, Plumber, Carpenter, Flight Attendant, Airport Manager, Soldier, Senator, Governor, Teacher, Doctor, Neurosurgeon, Cardiologist, Radiologist	Jacket, Factory, Business, Mogul, Wealth, Beauty, Women, Children, Home, Furniture, Carpenter, Trade, Plumber, Strength, Muscle	Keyboard, Piano, Church, Worship, Singer, Woman, Baby, Toys, Play, Juvenile, Beer, Drunk, Money

206	Better, decent, well, fine, amazing, awesome, splendid, healthy, nice	Warm, blazing, intense, gorgeous, beautiful	Situation, Condition, Solution, Provocation, Addition, Multiplication, Subtraction, Invention	Contemplate, Condition, Contemporary, Controversial, Conman, Continuity, Contrary, Concept, Conceptual	John, Josh, Emily, Krista, Emma, Vijay, William, Mike, Martin, Visha, Quasi, Daniel, Peter, Richard, Ricardo, Enrique, Felix, Faro, Kumar	Software engineer, HR Manager, Janitor, Opps Manger, Sales Manager, CMO, CFO, CEO, Doctor, Dentist, Specialist, Truck Driver, Taxi Driver, Delivery Man, Quality Control, Data Analyst, Financial Analyst	Ice, Cube, rubric, Puzzle, Intelligence, Brain, Neurons, Connections, Electricity, Chargers, Electron, Atom, Bonding, Molecule	Symphony, Composer, Rhapsody, Bohemian, Queen, Throne, Palace, Kingdom, Borders, War, Genocide, Suffering, Loss, Death
207	Excellent, fantastic, fine, okay, smooth, acceptable, lovely, nice, sure, awesome, great, appropriate, clean, affirmative, positive	blazing, chilli, scorching, burning, sunny, firey, heated, sweaty, summery	Salvation, Classification, Action	Constant, Concentrate, Consent, Connect, Connive	William, Michael, Jim, Peter, Bobby, John, Abi, Sandra, Amos, Susan, David, Gabriel Sarah	Pharmacist, Doctor, Carpenter, Plumber, Teacher, Artist, Realtor, Farmer, Pilot, Administrator, Lawyer	Feet, Shoes, laces, Dress, Gown, Long	Box, Wooden, Stake
208	Normal, acceptable, right	Warm, painful, sweltering, scorching, flaming	Mention, Expectation, Revolution, Pollution, Translation, Solution, Introduction, Option, Construction, Caution	Conscious, Conclusion, Condition, Concern, Concise, Configure, Conclude, Consistency, Construction, Contentious, Content, Conflict, Contract, Conspicuous	Aiden, John, James, Hassan, Hameed, Paul, Andrew, Fiona, William, David, Tom, Elizabeth, Keen, Greg, Shaiz, Jim, Laura, Lucy	Doctor, pilot, engineer, financial controller, driver, store manager, shop assistant, CFO, CEO, Account Manager, Astronaut, Student, Researcher, Educationalist, Advertiser, Marketer	Fridge, Shivering, Jacket, Heating, Warmth, Sun, Beaches	Poetry, calmness, relaxing, soothing, peaceful, calm, friend, partying, dancing, content, contentment
209	Nice, Well, Optimal, Fine, Content, Okay	Warm, Boiling, Piping, Extreme	Calibration, Communication, Irrigation, Rationalisation, Stimulation, Accumulation, Decriminalisation	Congregation, Convict, Continues, Connotation, Congratulate, Constrain	Jorge, Gabriel, Michelle, Malveca, Somara, Dinesh, Mariana, Rhys, Hose, Fernando, Belinda, Rafael, Ranata, Sanda, Ali, Jemartz, Vivian, Marco, Nicholas	Agent, Analyst, Supervisor, Specialist, Manager, Co-ordinator, CEO, CFO, Driver, Student, Administrator	Freezing, Hot, Warm, Rain, Snow, Slippery	Concern, Festival, Gig, Eighties, Pop, Guitar, Drums, Singer, Vocalist
210	Amazing, great, excellent, best, outstanding, outperformer	sweaty, uncomfortable, unbearable	Action, Reaction, Ambition, Beautification, Obligation, Creation	Contrary, Contradiction, Contribution, Conviction, Consistent	John, Jack, Sophie, Jay, Bilal, Sangan, Managa, Mike, Scarlett, Hershik, Sarah, Shriv, Angela	Engineer, Chef, Doctor, Actor, Plumber, Electrician, IT Professional, Fireman, Nurse, Economist, Entrepreneur, HR professional	Sweater, Windy, Rain, clouds, sky, temperature	Instrument, Musician, Guitar, Composer, Lyrics, Audience, Hearing, Auditorium, Ambience, Place, Environment.

## E4. Total memory rating

For each of the four memory areas (Associational Fluency (Afu), Ideational Fluency (IF), Word Fluency (WF), and Association Flexibility (Afx), the range of scores was split into 7 equally sized brackets between the bottom and top scores in the range.

Participants were then given a grade between 1 and 7 in each memory area which reflected the bracket in which their score in that memory area fell. These four grades were then averaged together to give an overall memory grade for each participant, one which circumvented the different scales measured in each memory area.

Participant ID	Afu Grade	IdeaF Grade	WordF Grade	Afx Grade	Overall Memory Grade
101	2	2	6	1	2.75
102	4	4	7	2	4.25
103	3	4	4	3	3.50
104	5	6	3	4	4.50
105	2	5	2	4	3.25
106	3	3	3	3	3.00
107	3	5	3	3	3.50
108	1	5	1	2	2.25
109	1	1	2	2	1.50
110	4	4	4	4	4.00
111	1	3	2	3	2.25
112	3	5	2	3	3.25
113	5	6	5	2	4.50
114	4	5	5	6	5.00
115	4	3	7	3	4.25
116	4	3	6	3	4.00
117	2	3	3	3	2.75
118	4	4	4	4	4.00
119	2	3	2	3	2.50
120	2	3	3	2	2.50
21	4	5	4	2	3.75
122	2	6	4	4	4.00
123	5	7	3	4	4.75
124	1	5	4	3	3.25
125	4	5	3	4	4.00
126	5	7	5	5	5.50
127	1	2	2	1	1.50
128	4	4	2	5	3.75
129	7	7	4	4	5.50
130	2	3	2	2	2.25
131	2	3	2	3	2.50

132	4	5	2	5	4.00
133	2	4	5	3	3.50
134	2	6	7	4	4.75
135	3	4	3	5	3.75
136	3	2	4	2	2.75
137	5	5	4	3	4.25
138	3	2	2	2	2.25
139	4	5	3	5	4.25
140	2	3	1	2	2.00
141	3	5	2	3	3.25
142	3	4	5	4	4.00
143	4	2	4	2	3.00
144	5	7	5	7	6.00
145	3	4	4	2	3.25
146	2	2	3	4	2.75
147	4	1	4	2	2.75
148	2	3	3	1	2.25
149	4	5	2	7	4.50
150	3	5	3	3	3.50
151	1	7	4	2	3.50
152	4	4	4	4	4.00
153	4	4	1	2	2.75
154	3	5	4	2	3.50
155	2	1	3	1	1.75
156	5	6	7	6	6.00
157	2	5	2	2	2.75
158	3	5	3	3	3.50
159	5	5	6	4	5.00
160	3	3	4	5	3.75
161	1	3	2	1	1.75
162	3	6	3	7	4.75
163	3	5	3	3	3.50
164	2	3	2	3	2.50
165	5	7	6	4	5.50
166	3	4	3	3	3.25
167	3	3	3	2	2.75
168	6	5	3	4	4.50
169	2	2	3	2	2.25
170	2	2	2	1	1.75
171	4	4	6	4	4.50
172	3	4	2	3	3.00
173	1	2	2	2	1.75
174	6	3	5	3	4.25

175	2	1	2	2	1.75
176	2	1	3	1	1.75
177	2	2	2	1	1.75
178	1	3	2	2	2.00
179	5	3	4	4	4.00
180	2	3	3	4	3.00
181	4	3	3	2	3.00
182	5	2	4	2	3.25
183	4	5	5	3	4.25
184	2	4	3	2	2.75
185	4	3	3	2	3.00
186	2	6	3	3	3.50
187	2	5	2	3	3.00
188	2	5	3	3	3.25
189	2	4	2	3	2.75
190	5	4	4	3	4.00
191	1	4	2	2	2.25
192	6	6	5	4	5.25
193	1	5	1	1	2.00
194	3	2	3	2	2.50
195	4	7	5	4	5.00
196	3	5	4	4	4.00
197	1	2	2	2	1.75
198	2	5	4	2	3.25
199	4	5	7	4	5.00
200	3	2	3	2	2.50
201	4	5	3	4	4.00
202	2	3	4	2	2.75
203	3	5	6	2	4.00
204	2	2	4	1	2.25
205	3	5	5	3	4.00
206	4	5	4	3	4.00
207	7	2	1	1	2.75
208	2	4	6	2	3.50
209	3	4	3	2	3.00
210	2	3	2	2	2.25

## F. Research results - Analogy use

### F1. Transcripts – Examples of analogical use

Whether a participant was deemed to have used analogical reasoning in their ideational activities was judged by two coders reviewing the transcripts from the verbal protocol associated with each vignette.

Before they undertook this task, the transcripts were broken down into numbered segments relating to each individual segment of thought. The coders were only presented with the segments of thought that appeared up until the New Venture Idea was first detailed. This ensured that we were tracking the creative use of analogy, rather than any subsequent use of analogy to legitimise or explain a particular NVI.

The coders read through each numbered thought (typically 1-2 sentences) to see if there was evidence of analogy in the transcript. Where there was, the coder was asked to highlight the relevant text with a marker.

Some examples of these relevant segments from a particular vignette are listed below, with the idea itself highlighted in red (the end of the section), and examples of the associated highlighted analogy highlighted coloured in blue in the text below:

#### Ideational Output (21)

**(100)** My Mom's a carer. So she tells me about all the medicines that people she is looking after a day have to take, so I know its quite high.

**(101)** Yeah, a lot of them obviously have health conditions regarding that like dementia and stuff so they get very confused about what medicines they are taking.

**(102)** It's not a nice experience for them. So this is definitely an issue.

**(103)** The only problem is obviously got to take into consideration that elderly and they don't really prefer to look at technology technological solutions to problems.

**(104)** So, straight away and app doesn't really seem not the best idea to go with, especially now, maybe in the future.

**(105)** So, device, because obviously I'm thinking as well. The elderly also may be struggling to read.

**(106)** So it could be a device, kind of like **Amazon Echo** in a way that is just set up in the living room maybe or even in the kitchen that just starts an alarm essentially and says, "You need to take your medicine now". And maybe it will describe to you what medicine, you're taking., and maybe reassure you, like maybe why you're taking it.



(107) You could have various settings of how vague or how in detail, you need to set the device, depending on the person, maybe they need more information to feel secure at the time, or maybe they don't necessarily require that they just need to be reminded about the time to take the medicine.

The device could also like record. How many times is set alarms for specific medicines, so we'll have a stock count within itself. So it could order itself so fixes that problem.

### Ideational Output - 50

(224) Okay. So I think in this in this scenario, the most important thing is the acknowledging the most important thing is a technology which comes in.

(225) So basically, first thing that we should be banning such things or such companies or any of that business which sells the tyre which is very rotten out and which is worn out, because in that case it can create a very, very harmful or accidental sort of issue for a person who's driving a car, which is having not a good time.

(226) So for new business ventures. I think there should be a machine which checks the tyre and which can predict which can predict the age or the life of that tire, or we can do different sort of analysis on them.

(227) So in that case, the people who are having to change their tyre, so they don't have to worry about the garage, and they have the machines which are which are needed to change your tyre.

(228) So I think first of all, in the business. The most important thing is cost. And even you have to compete with your competitors, you need to focus on your costs and costing so in that case.

(229) If I'm starting a business, and if I'm thinking about this issue, I will be searching about the market and I will be thinking what other competitors are doing.

(230) And in order to dominate the market, I'm going to be asking any company technology company to make me a machine which helps me predict the life cycle of the car tire and which tells me how long it will be working on.

(231) In that case it will not be an issue for the car driver, and in return for informing him that this tyre won't be good for him, and it will be better to buy a new one.

Or I can have a machine which repairs that worn out tired in such a way that is it is much cheaper than the new tyre and it's just like the new one.

## F2. Research participants – Use of analogy

In total there were 1,771 segments of text that were analysed from the 440 verbal protocol sessions. In relation to the use of analogy, the breakdown of how these were coded by the 2 coders is detailed below:

Segment No.	Coder 1	Coder 2	Segment No.	Coder 1	Coder 2	Segment No.	Coder 1	Coder 2	Segment No.	Coder 1	Coder 2	Segment No.	Coder 1	Coder 2
1	N	N	401	N	N	801	N	N	1201	N	N	1601	N	N
2	N	N	402	Y	Y	802	N	N	1202	N	N	1602	N	N
3	N	N	403	N	Y	803	N	N	1203	N	N	1603	N	N
4	N	N	404	Y	N	804	N	N	1204	N	N	1604	N	N
5	N	N	405	N	N	805	Y	Y	1205	N	N	1605	N	N
6	N	N	406	N	N	806	N	N	1206	N	N	1606	N	N
7	N	N	407	N	N	807	N	N	1207	N	N	1607	N	N
8	N	N	408	N	N	808	N	N	1208	N	N	1608	N	N
9	N	N	409	N	N	809	N	N	1209	N	N	1609	N	N
10	N	N	410	N	N	810	N	N	1210	N	N	1610	N	N
11	N	N	411	N	N	811	N	N	1211	N	N	1611	N	N
12	N	N	412	N	N	812	N	N	1212	N	N	1612	N	N
13	N	N	413	N	N	813	N	N	1213	Y	Y	1613	N	N
14	N	N	414	N	N	814	N	N	1214	N	N	1614	N	N
15	N	Y	415	N	N	815	N	N	1215	N	N	1615	N	N
16	Y	Y	416	N	N	816	Y	N	1216	Y	Y	1616	N	N
17	N	N	417	N	N	817	N	N	1217	N	N	1617	N	N
18	N	N	418	N	N	818	N	N	1218	N	N	1618	N	N
19	N	N	419	N	N	819	N	N	1219	N	N	1619	N	N
20	N	N	420	N	N	820	N	N	1220	N	N	1620	N	N
21	N	N	421	N	N	821	N	N	1221	N	N	1621	N	N
22	N	N	422	N	N	822	N	N	1222	N	N	1622	N	N
23	N	N	423	N	N	823	N	N	1223	N	N	1623	N	N
24	N	N	424	N	N	824	N	N	1224	Y	Y	1624	N	N
25	N	N	425	Y	Y	825	N	N	1225	N	N	1625	N	N
26	N	N	426	Y	Y	826	N	N	1226	N	N	1626	N	N
27	N	N	427	N	N	827	N	N	1227	N	N	1627	N	N
28	N	N	428	N	N	828	N	N	1228	N	N	1628	N	N
29	N	N	429	N	N	829	Y	Y	1229	N	N	1629	N	N
30	N	N	430	N	N	830	N	N	1230	N	N	1630	N	N
31	N	N	431	N	N	831	N	N	1231	N	N	1631	N	N
32	N	N	432	N	N	832	N	N	1232	N	N	1632	N	N
33	N	N	433	N	N	833	N	N	1233	N	N	1633	N	N
34	N	N	434	N	N	834	N	N	1234	N	N	1634	N	N
35	N	N	435	N	N	835	N	N	1235	N	N	1635	N	N
36	N	N	436	N	N	836	N	N	1236	N	N	1636	N	N
37	N	N	437	N	N	837	N	N	1237	N	N	1637	N	N
38	N	N	438	Y	Y	838	N	N	1238	N	N	1638	N	N
39	N	N	439	N	N	839	N	N	1239	N	N	1639	N	N
40	N	N	440	N	N	840	N	N	1240	N	N	1640	N	N
41	N	N	441	N	N	841	N	N	1241	N	N	1641	Y	Y
42	N	N	442	N	N	842	N	N	1242	N	N	1642	N	N
43	N	N	443	N	N	843	N	N	1243	N	N	1643	N	N
44	N	N	444	N	N	844	N	N	1244	N	N	1644	N	N
45	N	N	445	N	N	845	N	N	1245	N	N	1645	N	N
46	N	N	446	N	N	846	N	N	1246	N	N	1646	N	N
47	Y	N	447	N	N	847	N	N	1247	N	N	1647	N	N

48	N	N	448	N	N	848	N	N	1248	N	N	1648	N	N
49	N	N	449	N	N	849	N	N	1249	N	N	1649	N	N
50	N	N	450	N	N	850	N	N	1250	N	N	1650	Y	Y
51	N	N	451	N	N	851	N	N	1251	N	N	1651	N	N
52	N	N	452	N	N	852	N	N	1252	N	N	1652	Y	N
53	N	N	453	N	N	853	N	N	1253	N	Y	1653	N	N
54	N	N	454	N	N	854	N	N	1254	N	N	1654	N	N
55	N	N	455	N	N	855	N	N	1255	N	N	1655	N	N
56	N	N	456	N	N	856	N	N	1256	N	N	1656	N	N
57	Y	Y	457	N	N	857	N	N	1257	N	N	1657	N	N
58	N	N	458	N	N	858	N	N	1258	Y	Y	1658	N	N
59	N	N	459	N	N	859	N	N	1259	N	N	1659	N	N
60	N	N	460	N	N	860	N	N	1260	N	N	1660	Y	Y
61	N	N	461	N	N	861	N	N	1261	N	N	1661	N	N
62	N	N	462	N	N	862	N	N	1262	N	N	1662	N	N
63	N	N	463	N	N	863	N	N	1263	N	N	1663	N	N
64	N	N	464	N	N	864	N	N	1264	N	N	1664	N	N
65	N	N	465	Y	Y	865	N	N	1265	N	N	1665	N	N
66	N	N	466	N	N	866	N	N	1266	N	N	1666	N	N
67	N	N	467	N	N	867	N	N	1267	N	N	1667	N	N
68	N	N	468	N	N	868	N	N	1268	N	N	1668	N	N
69	N	N	469	N	N	869	N	N	1269	N	N	1669	N	N
70	N	N	470	Y	Y	870	N	N	1270	N	N	1670	N	N
71	N	N	471	Y	Y	871	N	N	1271	N	N	1671	N	N
72	N	N	472	N	N	872	N	N	1272	N	N	1672	N	N
73	N	N	473	N	N	873	N	N	1273	N	N	1673	N	N
74	N	N	474	Y	Y	874	N	N	1274	N	N	1674	N	N
75	N	N	475	N	N	875	Y	Y	1275	N	N	1675	N	N
76	N	N	476	Y	N	876	N	N	1276	N	N	1676	N	N
77	N	N	477	N	N	877	N	N	1277	N	N	1677	N	N
78	N	N	478	N	N	878	N	N	1278	N	N	1678	N	N
79	Y	Y	479	Y	Y	879	N	N	1279	N	N	1679	N	N
80	N	N	480	N	N	880	N	N	1280	N	N	1680	N	N
81	N	N	481	Y	Y	881	N	N	1281	N	N	1681	N	N
82	N	N	482	N	N	882	N	N	1282	Y	Y	1682	N	N
83	N	N	483	N	N	883	N	N	1283	Y	Y	1683	Y	Y
84	N	N	484	N	N	884	N	N	1284	N	N	1684	N	N
85	N	N	485	N	N	885	N	N	1285	N	N	1685	N	N
86	N	N	486	N	N	886	N	N	1286	N	N	1686	N	N
87	Y	N	487	N	N	887	N	N	1287	N	N	1687	N	N
88	N	N	488	N	N	888	N	N	1288	N	N	1688	N	N
89	N	N	489	N	N	889	N	N	1289	N	N	1689	N	N
90	N	N	490	N	N	890	N	N	1290	N	N	1690	N	N
91	N	N	491	N	N	891	N	N	1291	N	N	1691	N	N
92	N	N	492	N	N	892	N	N	1292	N	N	1692	N	N
93	N	N	493	N	N	893	N	N	1293	Y	N	1693	Y	N
94	N	N	494	N	N	894	N	N	1294	N	N	1694	N	N
95	N	N	495	N	N	895	N	N	1295	Y	Y	1695	N	N
96	N	N	496	Y	Y	896	N	N	1296	N	N	1696	N	N
97	N	N	497	N	N	897	N	N	1297	N	N	1697	N	N
98	N	N	498	N	N	898	N	N	1298	N	N	1698	N	N
99	N	N	499	N	N	899	N	N	1299	N	N	1699	N	N
100	N	N	500	N	N	900	N	N	1300	N	N	1700	N	N
101	N	N	501	N	N	901	N	N	1301	N	N	1701	N	N
102	N	N	502	N	N	902	Y	Y	1302	N	N	1702	N	N
103	N	N	503	N	N	903	N	N	1303	Y	Y	1703	N	N

104	N	N	504	N	N	904	N	N	1304	Y	Y	1704	N	N
105	N	N	505	N	N	905	N	N	1305	N	N	1705	N	Y
106	Y	Y	506	N	N	906	N	N	1306	N	N	1706	N	N
107	N	N	507	N	N	907	N	N	1307	N	N	1707	N	N
108	N	N	508	N	N	908	N	N	1308	N	N	1708	N	N
109	N	N	509	N	N	909	N	N	1309	N	N	1709	N	N
110	N	N	510	N	N	910	N	N	1310	N	N	1710	N	N
111	N	N	511	N	N	911	N	N	1311	N	N	1711	N	N
112	Y	Y	512	N	N	912	N	N	1312	N	N	1712	Y	Y
113	N	N	513	N	N	913	N	N	1313	N	N	1713	N	N
114	N	N	514	N	N	914	N	N	1314	N	N	1714	N	N
115	N	N	515	N	N	915	N	N	1315	N	N	1715	Y	Y
116	N	N	516	N	N	916	N	N	1316	N	N	1716	N	N
117	N	N	517	N	N	917	N	N	1317	N	N	1717	N	N
118	N	N	518	N	N	918	N	N	1318	N	N	1718	N	N
119	N	N	519	N	N	919	N	N	1319	Y	Y	1719	N	N
120	N	N	520	N	N	920	N	N	1320	N	N	1720	N	N
121	N	N	521	N	N	921	N	N	1321	N	N	1721	N	N
122	N	N	522	N	N	922	N	N	1322	N	N	1722	N	N
123	N	N	523	N	N	923	N	N	1323	N	N	1723	N	N
124	N	N	524	N	N	924	N	N	1324	N	N	1724	N	N
125	N	N	525	N	N	925	N	N	1325	N	N	1725	N	N
126	N	N	526	N	N	926	N	N	1326	N	N	1726	N	N
127	N	N	527	N	N	927	N	N	1327	N	N	1727	N	N
128	N	N	528	N	N	928	N	N	1328	N	N	1728	N	N
129	N	N	529	N	N	929	N	N	1329	N	N	1729	N	N
130	N	N	530	N	N	930	N	N	1330	N	N	1730	N	N
131	N	N	531	N	N	931	N	N	1331	N	N	1731	N	N
132	N	N	532	N	N	932	N	N	1332	N	N	1732	N	N
133	N	N	533	N	N	933	N	N	1333	N	N	1733	N	N
134	N	N	534	N	N	934	N	N	1334	N	N	1734	N	N
135	N	N	535	N	N	935	N	N	1335	N	N	1735	N	N
136	N	N	536	N	Y	936	N	N	1336	N	N	1736	N	N
137	N	N	537	N	N	937	N	N	1337	N	N	1737	N	N
138	N	N	538	N	N	938	N	N	1338	N	N	1738	N	N
139	N	N	539	N	N	939	N	N	1339	N	N	1739	N	N
140	N	N	540	N	N	940	N	N	1340	N	N	1740	N	N
141	N	N	541	N	N	941	N	N	1341	N	N	1741	N	N
142	N	N	542	N	N	942	N	N	1342	N	N	1742	N	N
143	N	N	543	Y	Y	943	N	N	1343	N	N	1743	N	N
144	N	N	544	Y	Y	944	N	N	1344	N	N	1744	N	N
145	N	N	545	N	N	945	N	N	1345	N	N	1745	N	N
146	N	N	546	N	N	946	N	N	1346	Y	Y	1746	N	N
147	Y	Y	547	N	N	947	N	N	1347	N	N	1747	Y	Y
148	N	N	548	N	N	948	N	N	1348	N	N	1748	N	N
149	N	N	549	N	N	949	N	N	1349	N	N	1749	N	N
150	N	N	550	Y	Y	950	Y	N	1350	N	N	1750	N	N
151	N	N	551	Y	Y	951	N	N	1351	N	N	1751	N	N
152	N	N	552	N	N	952	N	N	1352	N	N	1752	N	N
153	N	N	553	N	N	953	N	N	1353	N	N	1753	N	N
154	N	N	554	N	N	954	N	N	1354	N	N	1754	Y	Y
155	N	N	555	N	N	955	N	N	1355	N	N	1755	N	N
156	N	N	556	N	N	956	N	N	1356	N	N	1756	N	N
157	N	N	557	N	N	957	N	N	1357	N	N	1757	N	N
158	Y	Y	558	N	N	958	N	N	1358	N	N	1758	N	N
159	Y	Y	559	N	N	959	N	N	1359	N	N	1759	N	N

160	N	N	560	N	N	960	N	N	1360	N	N	1760	N	N
161	N	N	561	Y	N	961	N	N	1361	N	N	1761	N	N
162	N	N	562	N	N	962	N	N	1362	N	N	1762	N	N
163	N	N	563	N	N	963	N	N	1363	N	N	1763	N	N
164	N	N	564	N	N	964	N	N	1364	N	N	1764	N	N
165	N	N	565	N	N	965	N	N	1365	N	N	1765	N	N
166	N	N	566	N	N	966	N	N	1366	N	N	1766	N	N
167	N	N	567	N	N	967	N	N	1367	N	N	1767	N	N
168	Y	Y	568	Y	Y	968	N	N	1368	N	N	1768	N	N
169	N	N	569	Y	Y	969	Y	Y	1369	N	N	1769	N	N
170	N	N	570	N	N	970	N	N	1370	N	N	1770	N	N
171	N	N	571	N	N	971	N	N	1371	N	N	1771	N	N
172	Y	N	572	N	N	972	N	N	1372	N	N			
173	N	N	573	N	N	973	N	N	1373	N	N			
174	N	N	574	N	N	974	N	N	1374	N	N			
175	N	N	575	N	N	975	N	N	1375	N	N			
176	Y	Y	576	N	N	976	N	N	1376	N	N			
177	N	N	577	N	N	977	N	N	1377	N	N			
178	N	N	578	N	N	978	N	N	1378	N	N			
179	N	N	579	Y	Y	979	N	N	1379	N	N			
180	N	N	580	N	N	980	N	N	1380	N	N			
181	Y	Y	581	N	N	981	N	N	1381	N	N			
182	N	N	582	N	N	982	N	N	1382	N	N			
183	N	N	583	N	N	983	N	N	1383	Y	Y			
184	N	N	584	N	N	984	N	N	1384	N	N			
185	N	N	585	N	N	985	N	N	1385	N	N			
186	N	N	586	N	N	986	N	N	1386	N	N			
187	N	N	587	N	N	987	N	N	1387	N	N			
188	N	N	588	N	N	988	N	N	1388	N	N			
189	N	N	589	N	N	989	N	N	1389	N	N			
190	N	N	590	N	N	990	N	N	1390	N	N			
191	N	N	591	N	N	991	N	N	1391	N	N			
192	N	N	592	N	N	992	N	N	1392	N	N			
193	N	N	593	N	N	993	N	N	1393	N	N			
194	N	N	594	N	N	994	N	N	1394	N	N			
195	N	N	595	N	N	995	N	N	1395	N	N			
196	N	N	596	N	N	996	N	N	1396	N	N			
197	N	Y	597	N	N	997	N	N	1397	N	N			
198	N	N	598	N	N	998	N	N	1398	Y	Y			
199	N	N	599	N	N	999	N	N	1399	N	N			
200	N	N	600	N	N	1000	Y	Y	1400	N	N			
201	N	N	601	N	N	1001	N	N	1401	N	N			
202	N	N	602	N	N	1002	N	N	1402	N	N			
203	N	N	603	Y	Y	1003	N	N	1403	N	N			
204	N	N	604	N	N	1004	N	N	1404	N	N			
205	N	N	605	N	N	1005	N	N	1405	N	N			
206	N	N	606	N	N	1006	N	N	1406	N	N			
207	N	N	607	N	N	1007	N	N	1407	N	N			
208	N	N	608	N	N	1008	N	N	1408	N	N			
209	N	N	609	N	N	1009	N	N	1409	N	N			
210	N	N	610	N	N	1010	N	N	1410	N	N			
211	N	N	611	N	N	1011	N	N	1411	N	N			
212	N	N	612	N	N	1012	N	N	1412	N	N			
213	N	N	613	N	N	1013	N	N	1413	N	N			
214	N	N	614	N	N	1014	N	N	1414	N	N			
215	N	N	615	N	N	1015	Y	Y	1415	Y	Y			

216	N	N	616	N	N	1016	N	N	1416	N	N
217	N	N	617	N	N	1017	Y	Y	1417	N	N
218	N	N	618	N	N	1018	N	N	1418	N	N
219	N	N	619	N	N	1019	N	N	1419	N	N
220	N	N	620	N	N	1020	N	N	1420	N	N
221	N	N	621	N	N	1021	N	N	1421	N	N
222	N	N	622	N	N	1022	N	N	1422	N	N
223	N	N	623	N	N	1023	N	N	1423	N	N
224	N	N	624	N	N	1024	N	N	1424	N	N
225	N	N	625	N	N	1025	N	N	1425	Y	Y
226	N	N	626	N	N	1026	N	N	1426	Y	Y
227	N	N	627	N	N	1027	N	N	1427	N	N
228	N	N	628	N	N	1028	N	N	1428	N	N
229	N	N	629	N	Y	1029	N	N	1429	N	N
230	N	N	630	N	N	1030	N	N	1430	N	N
231	N	N	631	N	N	1031	N	N	1431	N	N
232	N	N	632	Y	Y	1032	N	N	1432	N	N
233	N	N	633	N	N	1033	N	N	1433	N	N
234	Y	Y	634	N	N	1034	N	N	1434	N	N
235	N	N	635	N	N	1035	Y	Y	1435	N	N
236	N	N	636	N	N	1036	N	N	1436	N	N
237	N	N	637	N	N	1037	N	N	1437	N	N
238	N	N	638	N	N	1038	N	N	1438	N	N
239	N	N	639	N	N	1039	N	N	1439	N	N
240	N	N	640	N	N	1040	N	N	1440	N	N
241	N	Y	641	N	N	1041	N	N	1441	N	N
242	N	N	642	N	N	1042	N	N	1442	N	N
243	N	N	643	N	N	1043	N	N	1443	N	N
244	N	N	644	N	N	1044	N	N	1444	N	N
245	N	N	645	N	N	1045	N	N	1445	N	N
246	N	N	646	N	N	1046	N	N	1446	N	N
247	N	N	647	Y	Y	1047	N	N	1447	N	N
248	N	N	648	N	N	1048	N	Y	1448	N	N
249	N	N	649	N	N	1049	N	N	1449	N	N
250	N	N	650	N	N	1050	N	N	1450	N	N
251	N	N	651	N	N	1051	N	N	1451	N	N
252	N	N	652	N	N	1052	N	N	1452	N	N
253	N	N	653	Y	Y	1053	N	N	1453	N	N
254	N	N	654	N	N	1054	N	N	1454	N	N
255	N	N	655	N	N	1055	N	N	1455	Y	Y
256	N	N	656	N	N	1056	N	N	1456	N	N
257	N	N	657	Y	N	1057	N	N	1457	N	N
258	N	N	658	N	N	1058	N	N	1458	N	N
259	N	N	659	N	N	1059	N	N	1459	N	N
260	N	N	660	N	N	1060	N	N	1460	N	N
261	N	N	661	N	N	1061	N	N	1461	N	N
262	N	N	662	N	N	1062	N	N	1462	N	N
263	N	N	663	N	N	1063	N	N	1463	N	N
264	Y	N	664	N	N	1064	N	N	1464	N	N
265	N	N	665	N	N	1065	N	N	1465	N	N
266	N	N	666	Y	Y	1066	N	N	1466	N	N
267	N	N	667	N	N	1067	N	N	1467	N	N
268	N	N	668	N	N	1068	Y	Y	1468	N	N
269	N	N	669	N	N	1069	N	N	1469	N	N
270	N	N	670	Y	Y	1070	N	N	1470	N	N
271	Y	Y	671	N	N	1071	N	N	1471	N	N

272	N	N	672	N	N	1072	N	N	1472	N	N
273	N	N	673	N	N	1073	N	N	1473	N	N
274	Y	Y	674	N	N	1074	N	N	1474	N	N
275	N	N	675	N	N	1075	N	N	1475	N	N
276	N	N	676	N	N	1076	N	N	1476	N	N
277	N	N	677	N	N	1077	N	N	1477	Y	Y
278	N	N	678	Y	Y	1078	N	N	1478	N	N
279	N	N	679	N	N	1079	N	N	1479	N	N
280	N	N	680	N	N	1080	N	N	1480	N	N
281	N	N	681	N	N	1081	N	N	1481	N	N
282	N	N	682	N	N	1082	N	N	1482	N	N
283	N	N	683	N	N	1083	N	N	1483	N	N
284	N	N	684	N	N	1084	N	N	1484	N	N
285	Y	Y	685	N	N	1085	Y	Y	1485	N	N
286	N	N	686	N	N	1086	N	N	1486	N	N
287	N	N	687	N	N	1087	N	N	1487	N	N
288	N	N	688	N	N	1088	N	N	1488	N	N
289	N	N	689	N	N	1089	N	N	1489	N	N
290	N	N	690	N	N	1090	N	N	1490	N	N
291	N	N	691	N	N	1091	N	N	1491	N	N
292	N	Y	692	N	N	1092	N	N	1492	N	N
293	N	N	693	N	N	1093	N	N	1493	N	N
294	N	N	694	N	N	1094	N	N	1494	N	N
295	N	N	695	N	N	1095	N	N	1495	N	N
296	N	N	696	N	N	1096	N	N	1496	N	N
297	Y	Y	697	N	N	1097	N	N	1497	N	N
298	N	N	698	N	N	1098	N	N	1498	N	N
299	N	N	699	N	N	1099	N	N	1499	Y	Y
300	N	N	700	N	N	1100	N	N	1500	Y	Y
301	N	N	701	N	N	1101	N	N	1501	N	N
302	N	N	702	N	N	1102	N	N	1502	N	N
303	N	N	703	N	N	1103	N	N	1503	N	N
304	N	N	704	N	N	1104	N	N	1504	Y	Y
305	N	N	705	N	N	1105	N	N	1505	N	N
306	Y	Y	706	N	N	1106	N	N	1506	N	N
307	N	N	707	Y	Y	1107	N	N	1507	N	N
308	N	N	708	N	N	1108	N	N	1508	N	N
309	N	N	709	N	N	1109	N	N	1509	N	N
310	N	N	710	N	N	1110	Y	Y	1510	N	N
311	N	N	711	N	N	1111	Y	Y	1511	N	N
312	N	N	712	N	N	1112	N	N	1512	N	N
313	N	N	713	N	N	1113	N	N	1513	N	N
314	N	N	714	N	N	1114	N	N	1514	N	N
315	N	N	715	N	N	1115	N	N	1515	N	N
316	N	N	716	N	N	1116	N	N	1516	N	N
317	N	N	717	N	N	1117	Y	Y	1517	N	N
318	N	N	718	N	N	1118	N	N	1518	Y	Y
319	N	N	719	N	N	1119	N	N	1519	N	N
320	N	N	720	N	N	1120	N	N	1520	N	N
321	N	N	721	N	N	1121	N	N	1521	N	N
322	N	N	722	N	N	1122	N	N	1522	N	N
323	N	N	723	N	N	1123	N	N	1523	N	N
324	N	N	724	N	N	1124	N	N	1524	N	N
325	N	N	725	N	N	1125	N	N	1525	N	N
326	N	N	726	N	N	1126	N	N	1526	N	N
327	N	N	727	N	N	1127	N	N	1527	N	N

328	N	N	728	Y	Y	1128	N	N	1528	N	N
329	N	N	729	N	N	1129	N	N	1529	N	N
330	N	N	730	N	N	1130	N	N	1530	Y	Y
331	N	N	731	N	N	1131	N	N	1531	Y	Y
332	N	N	732	N	N	1132	N	N	1532	N	N
333	N	N	733	N	N	1133	N	N	1533	N	N
334	Y	Y	734	N	N	1134	N	N	1534	N	N
335	N	N	735	N	N	1135	N	N	1535	N	N
336	N	N	736	N	N	1136	N	N	1536	N	N
337	N	N	737	N	N	1137	N	N	1537	N	N
338	Y	Y	738	N	N	1138	N	N	1538	N	N
339	N	N	739	N	N	1139	N	N	1539	N	N
340	N	N	740	N	N	1140	N	N	1540	N	N
341	N	N	741	N	N	1141	N	N	1541	N	N
342	N	N	742	N	N	1142	N	N	1542	N	N
343	N	N	743	N	N	1143	N	N	1543	N	N
344	N	N	744	N	N	1144	N	N	1544	N	N
345	N	N	745	N	N	1145	N	N	1545	N	N
346	N	N	746	N	N	1146	N	N	1546	N	N
347	N	N	747	N	N	1147	N	N	1547	N	N
348	N	N	748	N	N	1148	N	N	1548	N	N
349	N	N	749	N	N	1149	N	N	1549	N	N
350	N	N	750	N	N	1150	N	N	1550	N	N
351	N	N	751	N	N	1151	N	N	1551	N	N
352	N	N	752	N	N	1152	N	N	1552	N	N
353	N	N	753	N	N	1153	N	N	1553	N	N
354	Y	Y	754	N	N	1154	N	N	1554	N	N
355	N	N	755	N	N	1155	N	N	1555	Y	Y
356	N	N	756	N	N	1156	N	N	1556	N	N
357	Y	Y	757	N	N	1157	N	N	1557	N	N
358	N	N	758	N	N	1158	N	N	1558	N	N
359	N	N	759	N	N	1159	N	N	1559	N	N
360	N	N	760	N	N	1160	N	N	1560	Y	Y
361	N	N	761	N	N	1161	N	N	1561	N	N
362	N	N	762	N	N	1162	N	N	1562	N	N
363	N	N	763	N	N	1163	N	N	1563	N	N
364	N	N	764	N	N	1164	N	N	1564	N	N
365	N	N	765	N	N	1165	N	N	1565	N	N
366	N	N	766	N	N	1166	N	N	1566	N	N
367	N	N	767	N	N	1167	N	N	1567	N	N
368	N	N	768	N	N	1168	N	N	1568	N	N
369	N	N	769	N	N	1169	N	N	1569	N	N
370	N	N	770	N	N	1170	N	N	1570	N	N
371	N	N	771	N	N	1171	N	N	1571	N	N
372	N	N	772	N	N	1172	N	N	1572	N	N
373	N	N	773	N	N	1173	N	N	1573	N	N
374	Y	Y	774	N	N	1174	N	N	1574	N	N
375	N	N	775	N	N	1175	N	N	1575	N	N
376	N	N	776	N	N	1176	N	N	1576	N	N
377	N	N	777	N	N	1177	N	N	1577	N	N
378	N	N	778	N	N	1178	N	N	1578	N	N
379	N	N	779	N	N	1179	N	N	1579	N	N
380	N	N	780	N	N	1180	N	N	1580	N	N
381	N	N	781	N	N	1181	N	N	1581	N	N
382	Y	Y	782	N	N	1182	N	N	1582	N	N
383	N	N	783	N	N	1183	N	N	1583	N	N



384	N	N	784	N	N	1184	N	N	1584	N	Y
385	N	N	785	N	N	1185	N	N	1585	N	N
386	N	N	786	N	N	1186	N	N	1586	N	N
387	N	N	787	N	N	1187	N	N	1587	N	N
388	N	N	788	Y	Y	1188	Y	N	1588	N	N
389	N	N	789	N	N	1189	N	N	1589	N	N
390	N	N	790	N	N	1190	N	N	1590	N	N
391	N	N	791	N	N	1191	N	N	1591	N	N
392	Y	Y	792	N	N	1192	N	N	1592	N	N
393	N	N	793	N	N	1193	N	N	1593	N	N
394	N	N	794	N	N	1194	N	N	1594	N	N
395	N	N	795	N	N	1195	N	N	1595	Y	N
396	N	N	796	N	N	1196	N	N	1596	N	N
397	N	N	797	N	N	1197	N	N	1597	N	N
398	N	N	798	N	N	1198	Y	Y	1598	N	N
399	N	N	799	N	N	1199	N	N	1599	Y	Y
400	N	N	800	N	N	1200	N	N	1600	N	N

### F3. Ideation output relating to analogy

The ideational output of each participant in each vignette area is detailed below.

This report also records whether the numbered ideational output involved the use of analogy, and whether the participant had received analogical training prior to that ideation activity.

The overall quality/novelty/appropriability score is then allocated, to reflect the score given by the coders to the idea in question. When there was no NVI generated, this was reflected in a 0 score.

Participant	Vignette	Ideation No	Analogical Training	Used Analogy	NVI Quality	NVI Novelty	NVI Approp
101	Lone Workers	1	No Training	No	1.67	2.00	1.67
101	Buying Tyres	2	No Training	No	1.33	1.33	1.33
101	Recruitment	3	Analogical Training	No	3.33	3.67	3.33
101	Elderly Medicine	4	Analogical Training	No	1.67	2.33	1.67
102	Lone Workers	No Idea	Analogical Training	No	0	0	0
102	Buying Tyres	5	Analogical Training	No	2.33	2.00	3.00
102	Recruitment	No Idea	No Training	No	0.00	0.00	0.00
102	Elderly Medicine	6	No Training	No	2.00	1.33	2.00
102	Elderly Medicine	7	No Training	No	1.00	1.00	1.00
103	Lone Workers	8	No Training	No	4.67	4.00	4.67
103	Buying Tyres	9	No Training	No	4.33	4.00	4.33
103	Recruitment	10	Analogical Training	No	4.33	4.33	4.00
103	Recruitment	11	Analogical Training	No	2.33	1.67	2.67
103	Elderly Medicine	12	Analogical Training	Yes	5.00	5.33	5.00
104	Lone Workers	No Idea	Analogical Training	No	0	0	0
104	Buying Tyres	13	Analogical Training	No	5.00	4.00	5.33
104	Buying Tyres	14	Analogical Training	No	2.67	5.00	3.00
104	Recruitment	15	No Training	Yes	4.67	4.00	4.67
104	Elderly Medicine	16	No Training	No	3.00	2.67	3.00
104	Elderly Medicine	17	No Training	No	2.33	3.33	2.00
105	Lone Workers	18	Analogical Training	No	3.00	2.67	3.00
105	Lone Workers	19	Analogical Training	Yes	3.00	2.33	3.33
105	Buying Tyres	20	No Training	No	3.00	3.00	3.00
105	Recruitment	No Idea	Analogical Training	No	0	0	0
105	Elderly Medicine	21	No Training	Yes	5.00	4.33	5.00
106	Lone Workers	22	Analogical Training	No	3.00	2.67	3.00
106	Buying Tyres	23	Analogical Training	Yes	5.67	5.00	5.67
106	Recruitment	No Idea	No Training	No	0	0	0
106	Elderly Medicine	24	No Training	No	4.33	5	5
107	Lone Workers	25	No Training	No	1.67	2.00	1.67
107	Buying Tyres	26	No Training	No	3.00	3.00	3.00
107	Recruitment	No Idea	Analogical Training	No	0	0	0
107	Elderly Medicine	27	Analogical Training	No	2.00	1.33	2.00

108	Lone Workers	28	Analogical Training	No	1.67	2.00	1.67
108	Buying Tyres	29	Analogical Training	No	1.67	2.67	1.67
108	Buying Tyres	30	Analogical Training	No	4.33	4.00	4.33
108	Recruitment	31	No Training	No	4.00	4.33	3.67
108	Elderly Medicine	32	No Training	Yes	4.00	4.00	4.00
109	Lone Workers	33	No Training	No	3.00	2.00	3.00
109	Buying Tyres	34	No Training	Yes	2.33	2.67	2.67
109	Recruitment	35	Analogical Training	No	5.33	5.33	5.33
109	Elderly Medicine	36	Analogical Training	No	1.00	1.00	1.00
109	Elderly Medicine	37	Analogical Training	No	2.33	2.33	2.67
110	Lone Workers	No Idea	Analogical Training	No	0	0	0
110	Buying Tyres	38	Analogical Training	Yes	5.00	4.00	5.33
110	Recruitment	39	No Training	No	5.00	5.00	5.00
110	Elderly Medicine	40	No Training	No	2.00	1.33	2.00
110	Elderly Medicine	41	No Training	Yes	3.67	3.67	4.00
111	Lone Workers	42	No Training	No	2.67	2.00	2.67
111	Buying Tyres	43	No Training	Yes	4.33	4.00	4.33
111	Recruitment	No Idea	Analogical Training	No	0	0	0
111	Elderly Medicine	44	Analogical Training	No	2.00	1.33	2.00
111	Elderly Medicine	45	Analogical Training	No	1.00	1.00	1.33
112	Lone Workers	46	Analogical Training	No	1.33	3.00	1.33
112	Buying Tyres	47	Analogical Training	Yes	4.33	4.00	4.33
112	Recruitment	48	No Training	No	4.33	3.33	4.33
112	Elderly Medicine	49	No Training	No	5.00	4.00	5.00
113	Lone Workers	No Idea	No Training	No	0	0	0
113	Buying Tyres	50	No Training	No	4.67	5.00	4.00
113	Recruitment	51	Analogical Training	No	3.67	3.00	3.67
113	Elderly Medicine	52	Analogical Training	Yes	2.67	5.67	2.67
114	Lone Workers	No Idea	Analogical Training	No	0	0	0
114	Buying Tyres	53	Analogical Training	No	2.33	2.67	2.67
114	Recruitment	54	No Training	No	2.33	1.67	2.67
114	Elderly Medicine	55	No Training	No	3.67	3.67	4.00
115	Lone Workers	56	No Training	No	1.67	2.00	1.67
115	Buying Tyres	No Idea	No Training	No	0	0	0
115	Recruitment	57	Analogical Training	Yes	5.33	5.33	5.33
115	Elderly Medicine	58	Analogical Training	No	3.67	3.67	4.00
116	Lone Workers	59	Analogical Training	No	1.67	3	1.67
116	Buying Tyres	60	Analogical Training	Yes	4.33	4.00	4.33
116	Recruitment	61	No Training	Yes	5.33	5.33	5.33
116	Elderly Medicine	62	No Training	No	1.00	1.00	1.00
117	Lone Workers	63	No Training	No	5.33	4.00	5.33
117	Buying Tyres	64	No Training	No	5.00	5.00	4.67
117	Recruitment	No Idea	Analogical Training	No	0	0	0

117	Elderly Medicine	65	Analogical Training	No	2.00	1.33	2.00
117	Elderly Medicine	66	Analogical Training	Yes	4.33	4.33	4.33
118	Lone Workers	67	Analogical Training	No	4.67	4.00	4.67
118	Buying Tyres	68	Analogical Training	No	1.33	1.33	1.33
118	Buying Tyres	69	Analogical Training	Yes	4.33	4.00	4.33
118	Recruitment	70	No Training	No	2.67	2.67	2.67
118	Elderly Medicine	71	No Training	No	4.33	4.33	4.33
118	Elderly Medicine	72	No Training	No	3.00	2.67	3.00
118	Elderly Medicine	73	No Training	Yes	2.33	3.33	2.00
119	Lone Workers	No Idea	No Training	No	0	0	0
119	Buying Tyres	74	No Training	No	4.33	4.00	4.33
119	Recruitment	75	Analogical Training	No	4.33	4.33	4.33
119	Elderly Medicine	76	Analogical Training	No	4.67	4.00	4.67
120	Lone Workers	No Idea	Analogical Training	No	0	0	0
120	Buying Tyres	77	Analogical Training	Yes	5.00	5.00	4.67
120	Recruitment	78	No Training	No	3.33	3.67	3.33
120	Elderly Medicine	79	No Training	No	4.67	4.00	4.67
121	Lone Workers	80	No Training	No	3.33	2.67	4.00
121	Lone Workers	81	No Training	No	1.67	2.00	1.67
121	Buying Tyres	82	No Training	No	1.33	1.67	1.33
121	Recruitment	83	Analogical Training	No	1.00	1.00	3.67
121	Elderly Medicine	84	Analogical Training	No	5.00	4.33	5.00
122	Lone Workers	85	Analogical Training	Yes	2.67	5.33	2.67
122	Buying Tyres	No Idea	Analogical Training	No	0	0	0
122	Recruitment	86	No Training	No	5.33	5.33	5.33
122	Elderly Medicine	87	No Training	No	3.33	4.33	2.33
122	Elderly Medicine	88	No Training	No	3.33	4.33	2.33
123	Lone Workers	89	No Training	No	1.67	2.00	1.67
123	Buying Tyres	90	No Training	No	1.67	2.67	1.67
123	Buying Tyres	91	No Training	No	5.67	5.00	5.67
123	Buying Tyres	92	No Training	No	3.00	3.00	3.00
123	Recruitment	93	Analogical Training	YEs	2.33	2.33	3.00
123	Elderly Medicine	94	Analogical Training	YEs	1.00	1.00	1.00
124	Lone Workers	No Idea	Analogical Training	No	0	0	0
124	Buying Tyres	95	Analogical Training	No	3.67	4.00	3.67
124	Recruitment	96	No Training	No	1.00	1.00	3.67
124	Elderly Medicine	97	No Training	No	1.00	1.00	1.00
125	Lone Workers	98	No Training	Yes	4.67	4.00	4.67
125	Buying Tyres	99	No Training	Yes	3.67	4.67	3.33
125	Recruitment	100	Analogical Training	Yes	6.00	5.33	6.67
125	Elderly Medicine	101	Analogical Training	Yes	4.00	4.33	4.00
126	Lone Workers	102	Analogical Training	No	1.67	2.00	1.67
126	Lone Workers	103	Analogical Training	No	3.33	2.00	3.67

126	Buying Tyres	104	Analogical Training	Yes	5.67	5.00	5.67
126	Recruitment	105	No Training	Yes	5.00	5.00	5.00
126	Elderly Medicine	106	No Training	No	5.00	4.33	5.00
127	Lone Workers	No Idea	No Training	No	0	0	0
127	Buying Tyres	107	No Training	No	3.00	2.67	3.33
127	Recruitment	108	Analogical Training	No	1.00	4.67	1.00
127	Elderly Medicine	109	Analogical Training	No	3.00	5.67	2.67
128	Lone Workers	No Idea	Analogical Training	No	0	0	0
128	Buying Tyres	110	Analogical Training	No	4.33	4.00	4.33
128	Recruitment	111	No Training	No	2.33	2.33	3.00
128	Elderly Medicine	112	No Training	No	5.00	4.33	5.00
129	Lone Workers	113	No Training	No	4.67	4.00	5.00
129	Buying Tyres	114	No Training	No	1.67	2.67	1.67
129	Recruitment	115	Analogical Training	Yes	4.33	4.33	4.33
129	Elderly Medicine	116	Analogical Training	No	5.00	4.00	5.00
129	Elderly Medicine	117	Analogical Training	Yes	2.00	4.00	2.00
130	Lone Workers	118	Analogical Training	No	4.00	3.33	4.67
130	Buying Tyres	119	Analogical Training	No	4.33	4.00	4.33
130	Recruitment	No Idea	No Training	No	0	0	0
130	Elderly Medicine	120	No Training	Yes	4.33	4.33	4.33
131	Lone Workers	121	No Training	Yes	4.00	3.33	4.67
131	Lone Workers	122	No Training	Yes	2.67	5.33	2.67
131	Buying Tyres	123	No Training	Yes	4.33	4.00	4.33
131	Recruitment	124	Analogical Training	No	2.67	1.67	3.00
131	Elderly Medicine	125	Analogical Training	No	3.67	3.67	4.00
131	Elderly Medicine	126	Analogical Training	No	1.00	1.00	1.33
132	Lone Workers	No Idea	Analogical Training	No	0	0	0
132	Buying Tyres	127	Analogical Training	No	3.67	4.00	3.67
132	Recruitment	No Idea	No Training	No	0	0	0
132	Elderly Medicine	128	No Training	No	2	1.33	2
133	Lone Workers	129	No Training	No	5.33	4.00	5.33
133	Buying Tyres	130	No Training	No	5.67	5.00	5.67
133	Recruitment	No Idea	Analogical Training	No	0	0	0
133	Elderly Medicine	131	Analogical Training	No	2.67	2.67	3.00
133	Elderly Medicine	132	Analogical Training	Yes	3.00	5.67	2.67
134	Lone Workers	133	Analogical Training	No	1.33	1.00	2.00
134	Buying Tyres	134	Analogical Training	No	3.00	3.00	3.00
134	Recruitment	135	No Training	No	1.00	1.00	3.67
134	Elderly Medicine	136	No Training	No	4.67	4.00	4.67
134	Elderly Medicine	137	No Training	No	3.00	2.70	3.00
135	Lone Workers	138	No Training	No	4.67	4.00	4.67
135	Buying Tyres	139	No Training	No	4.30	4.00	4.33
135	Recruitment	140	Analogical Training	No	3.67	3.00	3.67

135	Elderly Medicine	141	Analogical Training	No	3.00	2.67	3.00
136	Lone Workers	No Idea	Analogical Training	No	0	0	0
136	Buying Tyres	142	Analogical Training	No	3.00	2.33	3.33
136	Recruitment	143	No Training	No	4.00	4.00	4.00
136	Elderly Medicine	144	No Training	No	5.00	4.33	5.00
137	Lone Workers	No Idea	No Training	No	0	0	0
137	Buying Tyres	145	No Training	No	2.33	2.00	2.67
137	Recruitment	No Idea	Analogical Training	No	0	0	0
137	Elderly Medicine	146	Analogical Training	No	2.67	2.67	2.67
138	Lone Workers	No Idea	Analogical Training	No	0	0	0
138	Buying Tyres	No Idea	Analogical Training	No	0	0	0
138	Recruitment	147	No Training	No	1.00	1.00	3.67
138	Elderly Medicine	148	No Training	No	5.00	4.33	5.00
139	Lone Workers	149	No Training	No	3.33	2.67	4.00
139	Lone Workers	150	No Training	No	2.67	5.33	2.67
139	Buying Tyres	151	No Training	Yes	1.67	2.67	1.67
139	Recruitment	152	Analogical Training	Yes	5.00	5.00	5.00
139	Elderly Medicine	153	Analogical Training	Yes	3.67	3.67	4.00
140	Lone Workers	No Idea	Analogical Training	No	0	0	0
140	Buying Tyres	No Idea	Analogical Training	No	0	0	0
140	Recruitment	No Idea	No Training	No	0	0	0
140	Elderly Medicine	154	No Training	No	3.00	2.67	3.00
141	Lone Workers	155	No Training	No	2.00	2.00	2.00
141	Buying Tyres	156	No Training	Yes	4.33	4.00	4.33
141	Recruitment	157	Analogical Training	No	1.00	1.00	3.67
141	Elderly Medicine	158	Analogical Training	No	2.00	1.33	2.00
142	Lone Workers	159	Analogical Training	Yes	4.67	3.00	5.00
142	Buying Tyres	160	Analogical Training	Yes	3.00	2.33	3.33
142	Recruitment	161	No Training	No	1.00	1.00	3.67
142	Elderly Medicine	No Idea	No Training	No	0	0	0
143	Lone Workers	No Idea	No Training	No	0	0	0
143	Buying Tyres	No Idea	No Training	No	0	0	0
143	Recruitment	162	Analogical Training	No	2.67	1.67	3.00
143	Elderly Medicine	163	Analogical Training	No	1.33	1.67	1.33
144	Lone Workers	No Idea	Analogical Training	No	0	0	0
144	Buying Tyres	164	Analogical Training	Yes	5.67	5.00	5.67
144	Recruitment	165	No Training	No	4.33	3.33	4.33
144	Recruitment	166	No Training	No	3.66	3.00	3.66
144	Elderly Medicine	167	No Training	No	1.00	1.00	1.00
144	Elderly Medicine	168	No Training	No	1.00	1.00	1.33
145	Lone Workers	No Idea	No Training	No	0	0	0
145	Buying Tyres	No Idea	No Training	No	0	0	0
145	Recruitment	169	Analogical Training	No	3.67	3.00	3.67

145	Elderly Medicine	170	Analogical Training	No	1.00	1.00	1.00
146	Lone Workers	No Idea	Analogical Training	No	0	0	0
146	Buying Tyres	171	Analogical Training	No	2.33	2.67	2.67
146	Recruitment	172	No Training	No	1.00	1.00	3.67
146	Elderly Medicine	173	No Training	Yes	3.67	3.67	4.00
147	Lone Workers	No Idea	No Training	No	0	0	0
147	Buying Tyres	No Idea	No Training	No	0	0	0
147	Recruitment	174	Analogical Training	No	3.00	3.00	3.33
147	Elderly Medicine	175	Analogical Training	No	1.00	1.00	1.00
148	Lone Workers	176	Analogical Training	No	4.00	3.67	4.67
148	Buying Tyres	177	Analogical Training	Yes	3.00	3.00	3.00
148	Recruitment	No Idea	No Training	No	0	0	0
148	Elderly Medicine	178	No Training	No	4.00	4.33	4.00
149	Lone Workers	179	No Training	No	2.67	4.33	2.67
149	Buying Tyres	180	No Training	No	3.67	3.00	3.67
149	Recruitment	181	Analogical Training	Yes	2.00	4.33	2.00
149	Elderly Medicine	182	Analogical Training	No	4.00	4.33	4.00
150	Lone Workers	183	Analogical Training	No	5.00	5.66	5.00
150	Buying Tyres	184	Analogical Training	No	3.00	3.00	3.00
150	Recruitment	185	No Training	Yes	5.00	5.00	5.00
150	Elderly Medicine	186	No Training	No	4.00	4.33	4.00
151	Lone Workers	187	No Training	Yes	5.33	4.00	5.33
151	Buying Tyres	188	No Training	No	3.00	3.00	3.00
151	Recruitment	189	Analogical Training	Yes	3.67	3.33	4.67
151	Elderly Medicine	190	Analogical Training	Yes	4.67	4.00	4.67
152	Lone Workers	191	Analogical Training	No	4.00	3.33	4.67
152	Buying Tyres	192	Analogical Training	No	1.33	1.67	1.33
152	Recruitment	193	No Training	No	4.00	4.00	4.00
152	Elderly Medicine	194	No Training	No	3.00	5.67	2.67
152	Elderly Medicine	195	No Training	No	1.00	1.00	1.33
153	Lone Workers	196	No Training	No	1.67	2.00	1.67
153	Buying Tyres	197	No Training	No	1.67	2.67	1.67
153	Recruitment	No Idea	Analogical Training	No	0	0	0
153	Elderly Medicine	198	Analogical Training	No	4.00	4.33	4.00
154	Lone Workers	199	Analogical Training	Yes	4.67	4.00	4.67
154	Buying Tyres	200	Analogical Training	No	4.33	4.00	4.33
154	Recruitment	201	No Training	No	1.00	1.00	3.67
154	Recruitment	202	No Training	No	5.33	5.33	5.33
154	Elderly Medicine	203	No Training	No	3.00	3.00	3.33
154	Elderly Medicine	204	No Training	No	3.00	2.67	3.00
155	Lone Workers	205	No Training	No	1.67	2.00	1.67
155	Buying Tyres	206	No Training	No	3.67	3.00	4.33
155	Recruitment	207	Analogical Training	No	3.00	3.00	3.00

155	Elderly Medicine	208	Analogical Training	No	4.00	4.33	3.67
156	Lone Workers	209	Analogical Training	No	2.67	2.00	2.67
156	Buying Tyres	210	Analogical Training	No	3.00	3.00	3.00
156	Buying Tyres	211	Analogical Training	Yes	4.00	5.33	3.00
156	Recruitment	212	No Training	No	4.00	4.00	4.00
156	Elderly Medicine	213	No Training	No	3.67	3.67	4.00
157	Lone Workers	No Idea	No Training	No	0	0	0
157	Buying Tyres	No Idea	No Training	No	0	0	0
157	Recruitment	214	Analogical Training	No	1.00	1.00	3.67
157	Elderly Medicine	215	Analogical Training	No	3.67	3.67	4.00
158	Lone Workers	216	Analogical Training	No	1.67	2.00	1.67
158	Buying Tyres	217	Analogical Training	No	3.00	3.00	3.00
158	Recruitment	218	No Training	No	1.00	1.00	3.67
158	Elderly Medicine	219	No Training	No	2.00	1.33	2.00
159	Lone Workers	220	No Training	No	3.33	2.33	3.67
159	Buying Tyres	221	No Training	No	4.33	4.00	4.33
159	Recruitment	222	Analogical Training	No	4.67	4.00	4.67
159	Elderly Medicine	223	Analogical Training	No	2.67	2.67	3.00
159	Elderly Medicine	224	Analogical Training	No	4.33	4.33	4.33
160	Lone Workers	No Idea	Analogical Training	No	0	0	0
160	Buying Tyres	225	Analogical Training	Yes	4.33	4.00	4.33
160	Recruitment	226	No Training	No	1.00	1.00	3.67
160	Elderly Medicine	227	No Training	No	4.00	4.33	3.67
161	Lone Workers	No Idea	No Training	No	0	0	0
161	Buying Tyres	No Idea	No Training	No	0	0	0
161	Recruitment	228	Analogical Training	No	3.67	3.00	3.67
161	Elderly Medicine	229	Analogical Training	Yes	3.67	3.67	3.67
162	Lone Workers	230	Analogical Training	Yes	4.67	4.00	4.67
162	Buying Tyres	231	Analogical Training	Yes	4.00	2.33	4.00
162	Recruitment	No Idea	No Training	No	0	0	0
162	Elderly Medicine	232	No Training	No	2.67	2.67	3.00
163	Lone Workers	233	No Training	No	4.00	3.67	4.67
163	Buying Tyres	234	No Training	No	5.67	5.00	5.67
163	Buying Tyres	235	No Training	No	5.00	5.00	4.67
163	Recruitment	236	Analogical Training	No	2.67	1.67	3.00
163	Elderly Medicine	237	Analogical Training	Yes	3.67	3.67	3.67
164	Lone Workers	238	Analogical Training	No	2.67	2.00	2.67
164	Buying Tyres	No Idea	Analogical Training	No	0	0	0
164	Recruitment	239	No Training	No	2.00	1.67	2.67
164	Elderly Medicine	240	No Training	No	3.00	5.67	2.67
165	Lone Workers	241	No Training	No	3.33	2.00	3.67
165	Buying Tyres	242	No Training	No	4.33	4.00	4.33
165	Recruitment	243	Analogical Training	No	5.33	5.33	5.33



165	Elderly Medicine	244	Analogical Training	Yes	5.00	4.33	5.33
166	Lone Workers	245	Analogical Training	No	3.33	2.33	3.67
166	Buying Tyres	246	Analogical Training	No	3.00	3.00	3.00
166	Recruitment	247	No Training	Yes	5.33	5.00	5.33
166	Elderly Medicine	248	No Training	No	5.00	4.33	5.00
166	Elderly Medicine	249	No Training	No	2.33	3.33	2.00
167	Lone Workers	No Idea	No Training	No	0	0	0
167	Buying Tyres	No Idea	No Training	No	0	0	0
167	Recruitment	250	Analogical Training	No	3.67	3.00	3.67
167	Elderly Medicine	251	Analogical Training	No	2.00	1.33	2.00
168	Lone Workers	252	Analogical Training	No	4.33	3.00	4.33
168	Buying Tyres	253	Analogical Training	No	1.33	1.67	1.33
168	Buying Tyres	254	Analogical Training	Yes	4.33	4.00	4.33
168	Recruitment	255	No Training	No	4.00	4.00	4.00
168	Elderly Medicine	256	No Training	No	1.00	1.00	1.00
169	Lone Workers	No Idea	No Training	No	0	0	0
169	Buying Tyres	257	No Training	No	2	4	2
169	Recruitment	No Idea	Analogical Training	No	0	0	0
169	Elderly Medicine	258	Analogical Training	No	1.00	1.00	1.00
170	Lone Workers	259	Analogical Training	No	3.33	2.00	3.67
170	Lone Workers	260	Analogical Training	No	4.67	4.00	4.67
170	Buying Tyres	No Idea	Analogical Training	No	0	0	0
170	Recruitment	261	No Training	Yes	4.67	4.00	4.67
170	Elderly Medicine	262	No Training	No	2.00	1.33	2.00
171	Lone Workers	No Idea	No Training	No	0	0	0
171	Buying Tyres	263	No Training	No	2.33	2.67	2.67
171	Recruitment	264	Analogical Training	No	3.67	3.00	3.67
171	Elderly Medicine	265	Analogical Training	No	1.00	1.00	1.33
171	Elderly Medicine	266	Analogical Training	No	1.33	1.66	1.33
172	Lone Workers	267	Analogical Training	Yes	4.00	3.67	4.67
172	Buying Tyres	268	Analogical Training	Yes	5.00	4.00	5.33
172	Recruitment	No Idea	No Training	No	0	0	0
172	Elderly Medicine	269	No Training	No	2.00	3.33	2.33
173	Lone Workers	270	No Training	No	4.67	4.00	4.67
173	Buying Tyres	271	No Training	No	1.67	2.67	1.67
173	Recruitment	272	Analogical Training	No	2.00	1.67	2.67
173	Elderly Medicine	273	Analogical Training	No	2.67	2.67	2.67
174	Lone Workers	274	Analogical Training	No	2.67	2.00	2.67
174	Buying Tyres	275	Analogical Training	No	1.33	1.33	1.33
174	Recruitment	276	No Training	Yes	2.00	4.33	2.00
174	Elderly Medicine	No Idea	No Training	No	0	0	0
175	Lone Workers	277	No Training	No	1.67	3.00	1.67
175	Buying Tyres	278	No Training	Yes	3.00	4.67	2.67

175	Buying Tyres	279	No Training	Yes	3.00	3.00	3.00
175	Recruitment	280	Analogical Training	No	3.33	3.67	3.33
175	Elderly Medicine	281	Analogical Training	No	3.00	2.67	3.00
176	Lone Workers	No Idea	Analogical Training	No	0	0	0
176	Buying Tyres	282	Analogical Training	Yes	2.33	5.00	2.33
176	Recruitment	283	No Training	No	2.67	1.67	3.00
176	Elderly Medicine	284	No Training	No	1.00	1.00	1.00
176	Elderly Medicine	285	No Training	No	3.00	2.67	3.00
177	Lone Workers	286	No Training	No	3.33	2.00	3.67
177	Buying Tyres	287	No Training	Yes	4.00	5.33	3.00
177	Recruitment	288	Analogical Training	No	2.33	1.67	2.67
177	Elderly Medicine	No Idea	Analogical Training	No	0	0	0
178	Lone Workers	No Idea	Analogical Training	No	0	0	0
178	Buying Tyres	289	Analogical Training	No	3.00	3.00	3.00
178	Recruitment	No Idea	No Training	No	0	0	0
178	Elderly Medicine	290	No Training	No	3.00	5.67	2.67
178	Elderly Medicine	291	No Training	No	3.00	2.67	3.00
178	Elderly Medicine	292	No Training	No	1.00	1.00	1.00
179	Lone Workers	No Idea	No Training	No	0	0	0
179	Buying Tyres	293	No Training	No	2.33	2.67	2.67
179	Recruitment	No Idea	Analogical Training	No	0	0	0
179	Elderly Medicine	294	Analogical Training	No	2.67	2.67	2.67
180	Lone Workers	295	Analogical Training	Yes	4.67	4.00	4.67
180	Buying Tyres	296	Analogical Training	Yes	4.33	4.00	4.33
180	Recruitment	297	No Training	No	4.00	4.00	4.00
180	Elderly Medicine	298	No Training	No	5.00	4.33	5.00
181	Lone Workers	299	No Training	No	1.00	1.33	1.00
181	Buying Tyres	300	No Training	No	5.67	5.00	5.67
181	Recruitment	301	Analogical Training	Yes	6.00	6.00	6.00
181	Elderly Medicine	302	Analogical Training	No	3.67	3.67	3.67
182	Lone Workers	303	Analogical Training	Yes	4.67	3.00	5.00
182	Buying Tyres	304	Analogical Training	No	3.67	4.67	3.33
182	Recruitment	305	No Training	Yes	5.33	5.33	5.33
182	Elderly Medicine	306	No Training	No	4.00	4.33	3.67
183	Lone Workers	307	No Training	Yes	4.67	4.00	5.00
183	Buying Tyres	308	No Training	No	5.67	5.00	5.67
183	Recruitment	309	Analogical Training	No	4.33	4.33	4.33
183	Recruitment	310	Analogical Training	No	3.67	3.00	3.67
183	Elderly Medicine	311	Analogical Training	No	1.00	1.00	1.33
184	Lone Workers	312	No Training	Yes	4.00	3.33	4.67
184	Buying Tyres	313	No Training	Yes	4.33	4.00	4.33
184	Recruitment	314	Analogical Training	Yes	5.33	5.00	5.33
184	Elderly Medicine	315	Analogical Training	No	5.00	4.33	5.00

185	Lone Workers	316	Analogical Training	Yes	4.67	3.00	5.00
185	Buying Tyres	317	Analogical Training	No	2.33	2.00	2.67
185	Recruitment	No Idea	No Training	No	0	0	0
185	Elderly Medicine	318	No Training	No	4.00	4.33	3.67
185	Elderly Medicine	319	No Training	Yes	5.33	5.00	5.33
186	Lone Workers	320	Analogical Training	Yes	4.00	3.33	4.67
186	Buying Tyres	321	Analogical Training	No	5.33	5.33	5.67
186	Recruitment	No Idea	No Training	No	0	0	0
186	Elderly Medicine	322	No Training	No	4.33	4.33	4.33
187	Lone Workers	323	No Training	No	1.67	2.00	1.67
187	Buying Tyres	324	No Training	No	2.00	2.00	2.33
187	Recruitment	325	Analogical Training	Yes	2.00	1.67	2.67
187	Elderly Medicine	326	Analogical Training	No	4.33	4.33	4.33
188	Lone Workers	327	Analogical Training	No	2.00	3.67	2.00
188	Buying Tyres	No Idea	Analogical Training	No	0	0	0
188	Recruitment	328	No Training	No	2.67	1.33	3.33
188	Elderly Medicine	329	No Training	No	1.00	1.00	1.00
189	Lone Workers	No Idea	No Training	No	0	0	0
189	Buying Tyres	330	No Training	No	3.00	3.00	3.00
189	Recruitment	331	Analogical Training	No	4.00	4.00	4.00
189	Elderly Medicine	332	Analogical Training	No	4.67	4.00	4.67
190	Lone Workers	333	Analogical Training	No	1.67	2.00	1.67
190	Buying Tyres	334	Analogical Training	Yes	4.33	4.00	4.33
190	Recruitment	335	No Training	No	4.00	4.00	4.00
190	Elderly Medicine	336	No Training	No	1.00	1.00	1.00
191	Lone Workers	337	No Training	Yes	4.67	4.00	5.00
191	Buying Tyres	338	No Training	No	1.67	2.67	1.67
191	Buying Tyres	339	No Training	No	2.33	2.67	2.67
191	Recruitment	No Idea	Analogical Training	No	0	0	0
191	Elderly Medicine	340	Analogical Training	No	4.33	4.33	4.33
192	Lone Workers	341	Analogical Training	No	1.67	2.00	1.67
192	Buying Tyres	342	Analogical Training	Yes	4.33	4.00	4.33
192	Recruitment	343	No Training	No	5.33	5.00	5.33
192	Elderly Medicine	344	No Training	Yes	3.67	3.67	4.00
193	Lone Workers	No Idea	No Training	No	0	0	0
193	Buying Tyres	No Idea	No Training	No	0	0	0
193	Recruitment	345	Analogical Training	No	1.00	1.00	3.67
193	Elderly Medicine	No Idea	Analogical Training	No	0	0	0
194	Lone Workers	No Idea	Analogical Training	No	0	0	0
194	Buying Tyres	346	Analogical Training	No	1.67	2.67	1.67
194	Recruitment	347	No Training	No	4.00	4.00	4.00
194	Elderly Medicine	348	No Training	No	3.00	2.67	3.00
195	Lone Workers	349	No Training	No	4.67	3.00	5.00

195	Buying Tyres	350	No Training	No	3.67	3.00	3.67
195	Recruitment	351	Analogical Training	Yes	2.00	3.33	2.00
195	Elderly Medicine	352	Analogical Training	No	4.67	4.00	4.67
195	Elderly Medicine	353	Analogical Training	No	3.00	2.67	3.00
196	Lone Workers	No Idea	Analogical Training	No	0	0	0
196	Buying Tyres	354	Analogical Training	No	5.00	4.00	5.33
196	Recruitment	355	No Training	No	3.67	3.00	3.67
196	Elderly Medicine	356	No Training	No	5.00	4.33	5.00
196	Elderly Medicine	357	No Training	No	1.33	4.33	1.33
197	Lone Workers	No Idea	No Training	No	0	0	0
197	Buying Tyres	No Idea	No Training	No	0	0	0
197	Recruitment	358	Analogical Training	No	4.67	4.00	4.67
197	Elderly Medicine	359	Analogical Training	No	4.00	4.33	4.00
198	Lone Workers	360	Analogical Training	No	4.67	3.00	5.00
198	Buying Tyres	361	Analogical Training	Yes	4.33	4.00	4.33
198	Recruitment	362	No Training	No	2.00	1.67	2.67
198	Elderly Medicine	363	No Training	No	3.67	3.67	3.67
199	Lone Workers	364	No Training	Yes	4.00	3.67	4.67
199	Buying Tyres	365	No Training	Yes	1.67	2.00	1.67
199	Recruitment	366	Analogical Training	No	1.00	1.00	3.67
199	Elderly Medicine	367	Analogical Training	No	1.00	1.00	1.33
199	Elderly Medicine	368	Analogical Training	No	1.00	1.00	1.00
200	Lone Workers	No Idea	Analogical Training	No	0	0	0
200	Buying Tyres	369	Analogical Training	No	2.00	2.00	2.33
200	Recruitment	370	No Training	Yes	4.00	4.67	4.33
200	Elderly Medicine	371	No Training	No	3.33	4.33	2.33
201	Lone Workers	372	No Training	No	1.67	2.00	1.67
201	Buying Tyres	373	No Training	Yes	4.33	4.00	4.33
201	Recruitment	374	Analogical Training	No	5.33	5.33	5.33
201	Elderly Medicine	375	Analogical Training	No	2.67	2.33	3.00
202	Lone Workers	376	Analogical Training	No	4.67	4.00	4.67
202	Buying Tyres	377	Analogical Training	Yes	4.33	4.00	4.33
202	Recruitment	378	No Training	No	1.00	1.00	3.67
202	Elderly Medicine	379	No Training	No	5.00	4.33	5.00
203	Lone Workers	380	No Training	No	1.67	2.00	1.67
203	Buying Tyres	381	No Training	No	3.67	3.00	4.33
203	Recruitment	382	Analogical Training	No	2.67	1.33	3.33
203	Elderly Medicine	383	Analogical Training	No	3.00	2.67	3.00
204	Lone Workers	384	Analogical Training	Yes	4.00	3.33	4.67
204	Buying Tyres	385	Analogical Training	Yes	5.67	5.00	5.67
204	Recruitment	No Idea	No Training	No	0	0	0
204	Elderly Medicine	386	No Training	Yes	4.33	4.33	4.33
205	Lone Workers	387	No Training	No	3.33	2.00	3.67

205	Lone Workers	388	No Training	No	4.00	3.33	4.67
205	Buying Tyres	389	No Training	No	4.33	4.00	4.33
205	Recruitment	390	Analogical Training	Yes	3.67	3.33	4.00
205	Elderly Medicine	391	Analogical Training	No	1.00	1.33	1.00
206	Lone Workers	392	Analogical Training	No	4.67	4.00	4.67
206	Buying Tyres	393	Analogical Training	No	1.67	2.67	1.67
206	Buying Tyres	394	Analogical Training	No	1.33	1.33	1.33
206	Recruitment	395	No Training	Yes	4.33	4.33	4.33
206	Elderly Medicine	396	No Training	No	3.67	3.67	4.00
207	Lone Workers	No Idea	No Training	No	0	0	0
207	Buying Tyres	397	No Training	No	1.33	1.67	1.33
207	Recruitment	398	Analogical Training	No	2.67	1.33	3.33
207	Elderly Medicine	399	Analogical Training	No	4.33	4.33	4.33
208	Lone Workers	400	Analogical Training	Yes	2.67	2.00	2.67
208	Buying Tyres	401	Analogical Training	Yes	5.67	5.00	5.67
208	Recruitment	No Idea	No Training	No	0	0	0
208	Elderly Medicine	402	No Training	No	5.00	4.33	5.00
209	Lone Workers	403	No Training	No	2.67	2.00	2.67
209	Lone Workers	404	No Training	No	3.33	2.00	3.67
209	Buying Tyres	405	No Training	No	3.67	3.00	4.33
209	Recruitment	406	Analogical Training	No	3.67	3.00	3.67
209	Elderly Medicine	407	Analogical Training	No	1.00	1.00	1.33
210	Lone Workers	408	Analogical Training	No	3.33	2.33	3.67
210	Buying Tyres	409	Analogical Training	Yes	3.00	3.00	3.00
210	Recruitment	410	No Training	No	1.00	1.00	3.67
210	Elderly Medicine	411	No Training	Yes	5.00	4.33	5.00

## G. Research results – Additional control data

### G1. Prior market knowledge

The following information details the control information garnered from participants in relation to their prior market knowledge of each of the relevant vignette areas in turn, alongside an average prior knowledge score from the four areas overall.

ID	Average Prior Knowledge	Lone Workers	Tyres	Recruitment	Medicine
101	5.75	6	4	6	7
102	6	6	6	6	6
103	4.75	4	6	6	3
104	5.75	7	6	4	6
105	5.25	5	6	3	7
106	3	4	2	4	2
107	2.25	3	1	4	1
108	4.25	3	6	4	4
109	4	3	4	6	3
110	2.25	4	1	2	2
111	3.25	4	1	2	6
112	3.5	1	4	6	3
113	5.5	4	6	6	6
114	3.75	3	2	4	6
115	2.5	1	2	6	1
116	1.5	1	1	2	2
117	2.25	3	1	2	3
118	3.75	2	6	1	6
119	1.5	1	1	2	2
120	2	1	2	3	2
121	3	1	2	6	3
122	4	5	1	6	4
123	3.5	5	1	6	2
124	4.25	4	4	6	3
125	4.25	4	<b>1</b>	6	<b>6</b>
126	6	5	7	6	6
127	6.25	5	7	7	6
128	3	3	6	1	2
129	1.75	4	1	1	1
130	3.75	5	6	3	1
131	5.5	6	4	6	6
132	4.25	3	2	6	6

133	5.25	5	4	6	6
134	6	7	3	7	7
135	4.75	5	6	4	4
136	5	1	7	6	6
137	4.75	3	6	4	6
138	5.25	6	3	6	6
139	1.75	1	1	3	2
140	1.75	1	1	4	1
141	1.75	1	1	3	2
142	2.5	4	1	3	2
143	2.5	3	2	2	3
144	2.75	2	1	4	4
145	2.5	2	3	1	4
146	4	6	6	3	1
147	5.5	6	6	3	7
148	2.5	2	3	1	4
149	3.5	5	4	2	3
150	3.5	1	3	4	6
151	2.25	1	1	6	1
152	4.5	5	3	6	4
153	3	4	4	2	2
154	5	4	4	6	6
155	4.5	5	3	6	4
156	3.5	1	4	6	3
157	4	5	1	4	6
158	2.75	4	2	3	2
159	3.75	2	3	4	6
160	1.25	2	1	1	1
161	2	2	1	2	3
162	3.5	3	6	2	3
163	4	3	7	3	3
164	3.75	3	2	6	4
165	4.75	5	2	6	6
166	3.25	1	6	4	2
167	6	6	6	6	6
168	2.75	7	1	2	1
169	6.75	7	7	7	6
170	5.25	2	7	6	6
171	4	5	2	6	3
172	5.25	3	6	6	6

173	3.5	3	4	4	3
174	2.75	2	2	3	4
175	6.25	7	6	6	6
176	5	4	6	4	6
177	4.75	4	6	6	3
178	4.5	4	6	4	4
179	3.75	4	4	4	3
180	5.25	5	4	6	6
181	6.25	6	6	6	7
182	3	2	1	6	3
183	5.5	7	6	3	6
184	4.5	6	2	4	6
185	4.25	4	3	6	4
186	4.75	3	6	4	6
187	5.5	4	6	6	6
188	4	5	2	6	3
189	3	3	1	6	2
190	4	3	6	6	1
191	3.25	2	3	6	2
192	4.25	3	2	6	6
193	6	7	4	7	6
194	3.5	5	1	2	6
195	4.5	4	2	6	6
196	2.75	2	4	2	3
197	5	3	7	6	4
198	3	1	2	6	3
199	6.25	6	6	7	6
200	5	6	2	6	6
201	3.75	1	2	6	6
202	4.5	4	6	6	2
203	3.75	3	4	4	4
204	2.75	3	4	2	2
205	5.5	6	6	4	6
206	5.5	4	6	6	6
207	3	4	1	1	6
208	5.75	5	6	6	6
209	4.25	2	6	7	2
210	6.25	6	6	7	6



## G2. Entrepreneurial intent

The following report details the additional control information garnered in this study around the participants entrepreneurial intent (7 being very high, 6 being high, 5 being quite high, 4 being neutral, 3 being quite low, 2 being low, and 1 being very low).

Subject ID	Entrepreneurial Intent
101	6
102	7
103	7
104	5
105	7
106	7
107	7
108	7
109	4
110	5
111	4
112	7
113	7
114	7
115	7
116	6
117	6
118	6
119	7
120	2
121	6
122	7
123	5
124	6
125	7
126	6
127	7
128	7
129	4
130	6
131	6
132	7
133	6
134	7

135	6
136	6
137	5
138	4
139	5
140	5
141	7
142	6
143	5
144	7
145	3
146	5
147	5
148	3
149	5
150	7
151	4
152	6
153	6
154	5
155	5
156	4
157	3
158	3
159	6
160	7
161	4
162	6
163	6
164	6
165	3
166	6
167	6
168	7
169	7
170	7
171	6
172	7
173	5
174	4
175	7
176	7
177	7

178	7
179	5
180	7
181	7
182	7
183	6
184	5
185	7
186	7
187	5
188	6
189	3
190	6
191	6
192	6
193	3
194	5
195	7
196	7
197	5
198	6
199	7
200	6
201	5
202	7
203	6
204	7
205	6
206	7
207	7
208	7
209	5
210	7