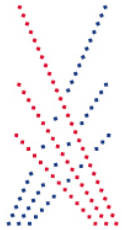

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The role of analogical reasoning in the formation of innovative New Venture Ideas - A systematic literature review and research agenda

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Abstract

Reasoning through analogy has been proven as an important mechanism of creative cognition in fields such as science, art, music and literature. This systematic literature review critiques the small but growing body of scholarship that exists at the junction of analogical reasoning and innovative New Venture Ideas. Within this context, it examines how the entrepreneurship literature understands these analogical processes to operate, and characterises the antecedents involved. Amongst recommendations for future research, it suggests that analogical reasoning be examined across a wider range of opportunity types, proposes that antecedent differences between individuals be further explored, and calls for greater consideration of the moderating effects that influence the efficacy of analogical retrieval in generating insights for future entrepreneurial ventures.

Keywords

analogical reasoning, analogy, structural alignment, new venture ideas, divergent thinking, entrepreneurial cognition.

Word Count

6,978 words (excluding tables and references)

The role of analogical reasoning in the formation of innovative New Venture Ideas - A systematic literature review and research agenda

1. Introduction

Reasoning through analogy, with its ability to recognise common relational structures across different contexts (Gentner and Maravilla, 2018), is considered an important mechanism of divergent thinking and creative cognition. Within entrepreneurship, divergent thinking has been directly equated with the emergence of innovative opportunities (Kakouris and Liargovas, 2017). Such opportunities are frequently characterised as comprising a degree of novelty, and of involving a value proposition which is unique relative to incumbents (Dyer *et al*, 2008). Given the benefits that such opportunities can offer for society, engendering both new products and services alongside wider economic gains, it remains important to examine the processes that lead to the early-stage perception of these ideas (Koellinger 2008).

The study of New Venture Ideas (NVIs) is located at the beginning of the process of entrepreneurial opportunity recognition. As a field of study, research into the first emergence of venture ideas is increasingly being delineated from the subsequent development of these venture ideas into venture opportunities (Vogel, 2017). A New Venture Idea (NVI) is the first candidate insight 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). In itself, an NVI is thus far from a refined opportunity. Instead it is representative of a 'vague insight' with respect to the creation of future value (Kornish and Ulrich, 2014). As time goes on, this initial venture idea will be iteratively adjusted, evaluated, and developed in tandem with others (Dimov, 2007). It may be cultivated into a full blown entrepreneurial opportunity, or simply rejected and relegated to the status of a passing redundant thought. Yet building an understanding of how such NVIs originally emerge is important. These first insights remain the precursor for anything that might or might not follow. They constitute the starting point of a particular entrepreneurial journey. However much they are later modified not least by the cognitive processes of mental simulation or counter factual thinking, those subsequent entrepreneurial opportunities could not develop without the formation of these initial ideas (Hayton and Cholakova, 2012).

This paper addresses the relationship between processes of analogical reasoning and the formation of innovative New Venture Ideas. References to analogical reasoning, and to the component process of structural alignment (*aligning structures from domains that appear superficially different*), have steadily been gaining traction within the entrepreneurship literature. This review identifies 22 publications that touch upon analogical reasoning or structural alignment within the context of NVIs, almost all of which emanate from the last ten years. As with many studies on entrepreneurial cognition, the focus is on thought processes operating at the individual actor level. For NVIs typically result in a new 'means-ends' relationship where a person's mental mode of thinking must 'break away' from its existing associations (Eckhardt and Shane, 2003). The findings of this paper reaffirm that the creative use of analogy is an important cognitive mechanism that enables this 'break away' to transpire.

This review makes three contributions. Firstly by mapping the intellectual terrain surrounding analogical reasoning and NVIs, it furthers conceptual understanding on the role of divergent thinking within entrepreneurial cognition. Secondly, it represents the first systematic literature analysis of its kind into the creative use of analogy in the formation of NVIs. It thus serves to apprehend the emerging body of entrepreneurship research that does exist on this subject. For in spite of the recent upturn in writing, the picture is not straight forward. The overall body of literature remains somewhat scant, and many researchers have frequently referenced analogical reasoning within the context of wider research questions. Thirdly, it develops a future agenda for the investigation of analogical mechanisms within the context of new venture ideation. Finding the connection between the constantly developing body of literature on analogy within the field of cognitive psychology, and that within the entrepreneurial literature, often to be relatively remote, it suggests a number of possibilities for worthwhile future research.

This systematic literature review starts by providing an overview of analogical reasoning, before progressing to detail the scope and process methodology utilised within its systematic appraisal of the entrepreneurial literature. It then presents its thematic findings, identifying contentions and competing observations. Finally it strives to use that analysis to highlight potential omissions and develop an agenda for future entrepreneurship research, before concluding its findings.

2. Analogical Reasoning

2.1 Background

The concept of analogical reasoning within cognitive psychology blossomed in the 1980s following 'Multi-Constraint Theory' (Gick and Holyoak, 1980) and 'Structural Mapping Theory' (Gentner, 1983). Although the two approaches differ in places, notably around the role of purpose in the mapping stage, they resulted in a notable degree of consensus as to the process by which a more familiar situation (the source) operates to inform a less familiar situation (the target). Portrayed as a mechanism that allows prior knowledge from one domain to be brought to bear on the acquisition of new knowledge in another domain (Vosniadou and Schommer, 1988), analogical reasoning through the alignment of structural relations became established as a central mechanism in both explanatory and creative thought processes.

Analogical reasoning has since been repeatedly cited as a key creative engine in fields ranging from architecture, music, literature, computer science, to product design (Dahl and Moreau, 2002) and management strategy (Gavetti, 2008). Within the history of science the creative use of analogy has been shown to lie behind discoveries such as 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. In the field of innovation, creative analogy can be seen at work with Guttenberg's invention of the printing press, Bell's development of the telephone, and in more recent times with the origination of the Google search engine.

It is this second dimension of analogy, the inventive power caused by the incorporation of structural knowledge from external fields, which can create the initial insights for potential

entrepreneurial ventures. 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 transferal of search engine algorithms to what are now some seven trillion travel combinations a year. Subsequently developing into full blown entrepreneurial opportunities, and in time phenomenally successful billion dollar businesses, these are just two examples which illustrate the role that creative analogy can play in the initial conception of New Venture Ideas.

2.2 Processes of Analogical Reasoning

Within cognitive psychology, analogical reasoning is characterised by the assertion that the relationship structure that normally applies in one domain can be applied to another (Holyoak *et al*, 1984). Overcoming a lack of superficial similarity, it 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. This process of structural alignment, rooted in the use of analogies, connects knowledge from disparate environments to so develop knowledge and understanding in contexts that are new or unfamiliar (Markman and Gentner, 1993). Unfolding over four separate stages, the ability to perceive and utilise the relational similarity between two otherwise superficially different situations, enables fresh inferences to be drawn from structural commonalities (Gentner and Markman, 1997).

First there is an access or retrieval stage. Confronted with a new target situation, the mind scrolls for potentially interesting references to align with the stimulus (Keane *et al*, 1994). At one extreme, this can happen serendipitously, for example suddenly stumbling upon or noticing something that could have relevance to a target under consideration. But more commonly, pertinent sources are retrieved from long term memory. In analogical thinking, such memory access is said to be heavily influenced by superficial similarities (Forbus *et al*, 1995). What is returned from memory is first and foremost guided by similarities in surface-level features.

Second there is a mapping stage, one from which the potential sources retrieved into working memory are then selected on the basis of their level of structural correspondence with the target. This involves a one to one equivalence whereby a single aspect of the source is matched with a parallel aspect in the target. The ensuing comparison then focuses on 'higher order relations' such as causal principles or chains, goal statements, motives and needs (Holyoak and Thagard, 1995). This mapping process is said to be governed by the principle of 'systemacity' (Gentner, 1983). Rather than searching for an isolated pair of matching relationships, the mind seeks out the most systematic analogy, the one with largest and deepest connected system of matching relationships. In a quest for the most plausible source, the implicit preference is for analogies which are the most informative, and which are thus most likely to have inferential power (Gentner and Smith, 2012).

In a third stage, inferences are drawn from the newly selected base domain in order to enrich the attended and typically less well understood target domain. Such inferences are said to arise automatically via a process of structural pattern completion (Day and Gentner, 2007). Once the base and target have been aligned, and their common relational structure has been found, elements of the relational pattern which are found in the base and not yet present in the target, will be brought over as candidate inferences (Gentner and Smith, 2012). There are no

prior expectations of what matches or inferences to seek (Clement and Gentner, 1991). Transcending superficial similarities, the mind has been able to escape the process of linear thinking (De Bono, 1990). By aligning analogies it creates new knowledge, knowledge that can open up fresh possibilities, fill in gaps, and enhance understanding through its abstraction of common relational patterns (Hofstadter and Sander, 2013).

In a fourth and final stage, the candidate inferences that emerge from this process of analogical reasoning are then evaluated. Here, their goal relevance to the problem or situation at hand is thought to be significant (Gick and Holyoak, 1983). Inferences are judged for their validity relative to an existing understanding of the world, the gain in knowledge they generate, and their adaptability and relevance to the target situation (Gentner and Maravailla, 2018). Where inferences are judged to be false, analogies will be rejected or revised. Where the initial insight is deemed valid, the process of analogical reasoning will typically result in a learning experience. Such learning can lead to the storage of fresh instances in memory, and to the induction of virgin schemas whereby shared relational structures are potentially abstracted and represented as new concepts (Gick and Holyoak, 1983). The newly stored analogy can then be revisited to elaborate further inferences in the future (Gentner, 1998).

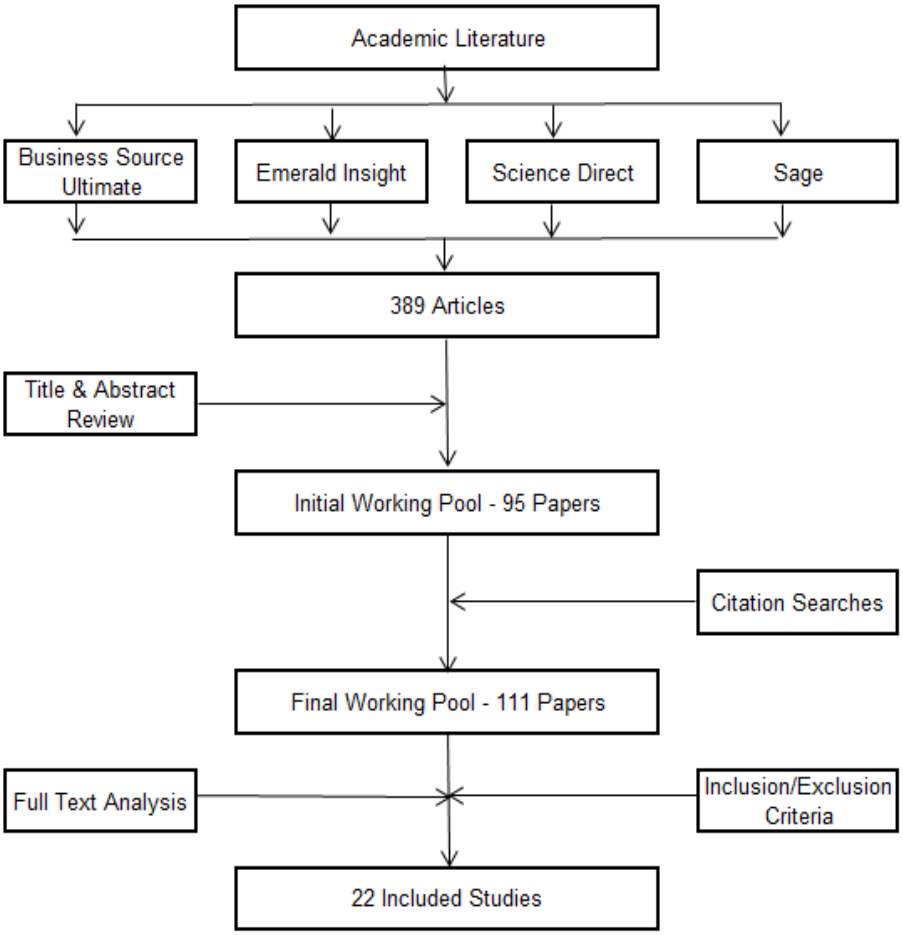
Through these four stages, there exists a degree of harmony as to the central processes involved in analogical reasoning. Yet although analogical transfer can lead to considerable creative insights, creative analogising is far from ubiquitous. Within cognitive psychology, the conclusion from a large body of research is that the prior retrieval of appropriate analogies, ones with structural similarity, often simply fails to occur (Gentner and Maravailla, 2018). In this way, the later phases of the analogical reasoning process (structural mapping, inference and evaluation) are shown to be highly contingent on the quality of the potential sources first drawn into the process (analogical retrieval).

The cognitive challenges in reasoning through analogy can be observed directly in relation to the formation of NVIs. For in popular discourse, when a successful new business idea attains mainstream status, it is not uncommon to hear people lamenting as to why they themselves didn't think of that particular concept. They feel they too possessed the necessary knowledge to make such a connection. Yet within the immense storehouse of information that constitutes memory, they nonetheless failed to retrieve the proverbial needle in the haystack (Holyoak and Thargard, 1995). Within psychological research, this failure to retrieve appropriate knowledge sources into working memory has been described as the 'inert knowledge' problem (Lancaster and Kolodner, 1987). It characterises a dichotomy whereby superficial features can be more easily retrieved from memory, yet it is the more highly camouflaged structural relations, which are the most useful.

3. Methodology

Having outlined the main tenets of analogical reasoning within the cognitive domain, the objective of this Systematic Literature Review is to enhance understanding of how this cognitive mechanism has been perceived within the entrepreneurial field, particularly in the context of the formation of NVIs. As illustrated in Figure (1), the methodology followed in this endeavour has involved a multi-stage review (Macpherson and Jones 2010, Tranfield *et al*, 2003).

Figure 1 – The Review Process



A systematic search of the electronic databases Business Source Ultimate, Science Direct, Sage and Emerald Insight between the years 2004-2019 identified relevant research. These searches used the Boolean search terms "analog*" AND "entrepren*", alongside "structural align*" AND "entrepren*" within the 'Full Text' fields of the articles. In databases where a shortening of the search term was not possible, the terms 'entrepren*' and 'analog*' were substituted with 'entrepreneur' and 'analogy' OR 'analogical'. Operationalising these searches returned 389 separate publications, whose abstract was then read so to filter out sources that were not directly connected with entrepreneurial opportunities. This led to the establishment of an initial working pool of 95 papers. This pool increased to 111 articles after the citations at the end of each article revealed a further 16 papers with potential relevance. Each paper within the working pool was then reviewed to ensure that the final shortlist of selected items matched the objectives of this research. Given the nascent nature of this particular area, the use of inclusion and exclusion criteria was limited. The selection process focussed specifically on the initial formation of NVIs thereby discounting papers whose focus was primarily on the use of analogy in venture communication and validation.
For the purposes of this study, the focus was also on the formation of innovative NVIs, ones that don't simply mimic an existing market offering, but rather provide something which is incrementally new.

By following this methodology, a total body of relevant work to be reviewed emerged. This yielded a comparatively sparse cohort of 22 articles (Table 1). Yet it also revealed the degree to which extant research around analogical reasoning in the context of NVIs has only recently come to the fore. Some 20 of the 22 articles (91%) were published within the last decade, with 11 (50%) emanating from the last 5 years alone. The overwhelming majority of these journals, 18 of the 22 in total (82%), emanated from the entrepreneurship literature, with the balance coming from the psychology, learning, and information management fields (Table 2). It is contended that within the databases that were queried, these 22 studies amount to the core population of peer reviewed research surrounding the role of analogical reasoning in the formation of innovative NVIs. Although the body of literature is relatively meagre, itself a limitation with this particular study, the specificity of the search criteria does at least ensure that sufficient focus is directed to the scientific research task at hand. With 15 of the 22 journal articles (68%) published in journals graded by the Chartered Association of Business Schools 'Academic Journal Guide (2018)' at Grades of 4* or 4, the comparatively sparse number of total publications does not affect the cohort's quality.

Table 1 – Summary of publications included within the Systematic Review

No.	Lead author	Date	Paper title	Paper type	Study design	Relevance to Analogical Reasoning in the formation of NVIs
1	Ward, Thomas	2004	Cognition, creativity and entrepreneurship	Conceptual	n/a	The way in which creative cognition (including specifically analogical reasoning), together with the paradoxical role of knowledge, influences entrepreneurial idea creation.
2	Dew, Nicholas	2009	Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices	Empirical	Verbal Protocol	The way in which experienced/novice entrepreneurs frame decisions, with novices seen to use less analogies.
3	Cornelissen, Jean	2010	Imagining and rationalizing opportunities: Inductive reasoning and the creation and justification of new ventures	Conceptual	n/a	The way in which inductive analogical reasoning creates novel ventures, with the process shaped by prior entrepreneurial experience and the motivation to resolve uncertainty.
4	Fillis, Ian	2010	The role of creativity in entrepreneurship	Conceptual	n/a	The role of creativity within entrepreneurial thinking, and the associated role of analogy.
5	Grégoire, Denis	2010	Cognitive processes of opportunity recognition: The role of structural alignment	Empirical	Verbal Protocol	A model of opportunity recognition based on a cognitive process of structural alignment, using verbal protocol analysis to illustrate the use of this reasoning process.
6	Vandor, Peter	2010	See Paris and... found a business? The impact of cross cultural experience on opportunity recognition capabilities	Empirical	Experimental	The way in which structural alignment process are used to recognise opportunities by migrant/expatriate entrepreneurs.
7	Johannison, Bengt	2011	Towards a practice theory of entrepreneuring	Conceptual	n/a	An analysis of the process perspective of entrepreneurship, and how analogy works within a constructionist view.
8	Grégoire, Denis	2012	Technology market combinations and the identification of entrepreneurial opportunities	Empirical	Experimental	Superficial and structural similarities characterise different opportunity ideas, and in doing so, influence the formation of initial opportunity beliefs.

9	Gielnik, Michael	2012	Creativity in the opportunity identification process and the moderating effect of diversity of information	Empirical	Experimental	A diverse supply of information has a positive effect on divergent thinking.
10	Nambisan, Satish	2012	Entrepreneurship in innovation ecosystems: Entrepreneurs' self–regulatory processes and their implications for New Venture success	Conceptual	n/a	An investigation on ecosystem entrepreneurs, highlighting structural alignment as a means of thinking beyond the ecosystem.
11	Valliere, David	2013	Towards a schematic theory of entrepreneurial alertness	Conceptual	n/a	A schema based theory of entrepreneurial alertness, with reference to how new schemas are formed and abstracted.
12	Gielnik Michael	2014	Antecedents of business opportunity identification and innovation: Investigating the interplay of information processing and information acquisition	Empirical	Quantitative	The effects of divergent thinking are amplified when complemented with information search.
13	Santos, Susana	2015	Prototype models of opportunity recognition and the decision to launch a new venture: Identifying the basic dimensions	Empirical	Quantitative	The nature of the business opportunity prototype, drawing similarities between prototyping and structural alignment.
14	Luis, Martins	2015	Unlocking the hidden value of concepts: A cognitive approach to business model innovation.	Conceptual	n/a	The innovation of new business models, and how they can emerge from analogical reasoning.
15	Nambisan, Satish	2016	The role of demand-side narratives in opportunity formation and enactment	Conceptual	n/a	The development of 'demand side' opportunities, referencing the relevance of structural signals in the opportunity formation process.
16	Paivi, Karhu	2016	How do ambidextrous teams create new products? Cognitive ambidexterity, analogies and new product creation	Empirical	Qualitative	The use of analogies driving new product and business creation in the sports equipment sector.
17	Mueller, Brandon	2016	Making the most of failure experiences: Exploring the relationship between business failure and the identification of business opportunities	Empirical	Verbal Protocol	The circumstances in which experience of business failure results in the heightened use of structural alignment processes in identifying future opportunities.
18	Lindberg, Erik	2017	Methods to enhance student's entrepreneurial mind-set: A Swedish example	Empirical	Experimental	Interventions within education that can support the development of an entrepreneurial mind-set, with reference to structural alignment.
19	Ryan, Rumble	2017	How to use analogies for creative business modelling	Conceptual	n/a	Drawing on analogies can support the creation of new business models.
20	Garbuio, Massimo	2018	Demystifying the genius of entrepreneurship: How design cognition can help create the next generation of entrepreneurs	Conceptual	n/a	The consideration of ways to improve traditional entrepreneurial teaching methods, referencing analogical reasoning.
21	Phiri, Tina	2018	Entrepreneurship and Innovation: The Antecedents of opportunity	Conceptual	Qualitative	Borrowing from other contexts is a relevant factor when studying the antecedents of entrepreneurial opportunity recognition.

22	Barnard, Brian	2018	Entrepreneurship, Innovation and Creativity: The creative process of entrepreneurs and innovators	Empirical	Qualitative	The creative thought processes used by entrepreneurs and innovators, referencing analogical thinking.

Table 2 – Publications used within this Systematic Review

Entrepreneurship and Management Literature	**Psychology Literature**
Journal of Business Venturing (6 articles)	Applied Psychology (1article)
Organizational Science (2 articles)	**Learning & Information Management Literature**
Entrepreneurship Theory and Practice (2 articles)	Academy of Management Learning and Education (1article)
Academy of Management Journal (1 article)	European Journal of Training and Development (1 article)
Academy of Management Review (1 article)	Knowledge and Process Management (1 article)
Strategic Entrepreneurship Journal (1article)	
Journal of Enterprising Culture (1article)	
Social Science Research Network (1article)	
International Journal of Entrepreneurial Behaviour and Research (1 article)	
Journal of Business Strategy (1 article)	
Expert Journal of Business and Management (1 article)	

This literature body has then been examined using a narrative synthesis methodology, one which involved collating the studies and amalgamating them into a wider mosaic (Hammersley 2001). In developing a conceptual understanding of the construct of analogical reasoning in the formation of NVIs, this paper follows the approach of Bagozzi and Fornell (1982). It specifies and defines the construct and its operation, investigates its relevant antecedents and causes, and then details its consequences and outcomes. This analytical framework is one that has been used previously in literature reviews on cognitive constructs within entrepreneurship (Grégoire *et al* (2011) on entrepreneurial cognition, Baldacchino *et al* (2015) on intuition within entrepreneurship).

4. Thematic findings

4.1 Specification and definition

Where the management literature observes analogies primarily in terms of solving problems and reducing uncertainty, there is an emerging theme within entrepreneurship that deliberates on the inventive power of analogies in generating NVIs. Building upon Gentner's 'Structural Mapping Theory' (1983), the extant entrepreneurship literature clusters in particular around the concept of 'structural alignment', the mapping stage within processes of analogical reasoning, one whereby knowledge from a base domain is projected onto a target domain. . Mueller and Shepherd (2016) describe structural alignment as involving the 'cognitive processes of comparisons between items or ideas that result in useful implications'. An entrepreneur's ability to connect structural similarities is thus seen as an important factor in why some entrepreneurs are better able to identify certain opportunities than others (Grégoire

and Shepherd, 2012). It enables them to generate fresh inferences and identify new ideas in what has been described as an act of 'creative imitation' (Johanisson, 2011).

In entrepreneurship, analogical reasoning is not presented as being superior to, or operating at the exclusion of, alternative mechanisms of divergent thinking. It is however distinct. So where the cognitive process of conceptual combination looks for differences, such that by merging separate attributes a wholly new concept emerges (Bruni, 2017), analogical reasoning by contrast focuses on harnessing similarities. Where schema based problem solving is portrayed as involving the application of existing knowledge through pre-established solution schemas (Valliere, 2013), analogical reasoning is portrayed as actively leveraging and creating new knowledge in a target domain (Martins *et al*, 2015). Where counter-factual thinking looks at the ongoing exploration of the functional space at an abstract level, analogical reasoning is defined as the cognitive act of adopting knowledge from a sphere that is familiar and using it in the construction of an idea that is new (Phiri and Barnard, 2018).

In accordance with Gentner's 'Structure Mapping Theory' (1983), entrepreneurship scholars conceive the analogical reasoning process as commencing with a preliminary 'retrieval' stage. Entrepreneurs are guided down a path towards the discovery of potentially efficacious analogies through the comparison of superficial features, for example similarities in market contexts and raw materials (Grégoire *et al*, 2010). Such initial comparisons are typically said to be made by recalling knowledge stored within memory, but it has also been recognised that they might be constructed 'live' on the basis of salient information encountered within a person's current environment or situation (Shepherd, 2018).

Having identified preliminary candidate analogies through superficial comparisons, the entrepreneurship literature then focusses on how a secondary and deeper process of structural alignment arises. During this process, potentially relevant analogies are prioritised on the basis of similarities in their relationships (Fillis, 2010). Structural alignment occurs when the mental representations of supply and demand are found to correspond in terms of their higher order relations such as causal chains, conditional rules and goal statements (Grégoire *et al*, 2010), or what has also been described as their ultimate benefits (Mueller and Shepherd, 2016). Citing the Ninetendo Wii as an example, Mueller and Shepherd (2016) highlight how aligning structures between the gaming technology found within the Nintendo Wii (such as its position sensing and onscreen motion mimicry), and a totally separate market (such as those seeking more stimulation in the home fitness arena), led to the formation of a whole new solution compared to that of a conventional gaming offering.

Given that ideas for new ventures are typically ambiguous (Grégoire *et al*, 2010), it is through this mental alignment of deeper structural relationships that entrepreneurs are said to be able to draw fresh inferences, perceive meaningful patterns from prior knowledge, and generate new insights. Such a process is presented as occurring spontaneously and automatically rather than consciously (Garbuio *et al*, 2018). The unusual nature of newly found structural commonalities serves to alert consciousness and generate cognitive arousal (Shepherd, 2018). Successful structural alignment then engenders a process of learning between the two mental representations, typically in the form of abstraction, contrasting, inference-projection, and re-representation (Barnard and Herbst, 2018).

Within the last decade, scholars have undertaken a number of empirical studies which have successfully operationalised this process within entrepreneurship. Firstly this has been

achieved through experimentation, particular in relation to cases of technology transfer. By manipulating the information provided in an empirical study of 149 experienced entrepreneurs Grégoire and Shepherd (2012) showed how superficial and structural variables were shown to have both independent and joint effects on the identification of entrepreneurial venture ideas[1].

Secondly, this process has been observed through verbal protocol studies. Avoiding the retrospective bias frequently attributed to qualitative examinations in this area, this methodology has attempted to capture entrepreneurial 'thought processes' live as they occur. Grégorie *et al* (2010) recorded how nine experienced entrepreneurs sought out potential market domains for two new technologies (3D printing, and a simulation tool developed by NASA to improve concentration). Codifying the entrepreneur's spoken thoughts as they considered uses for these technologies, they demonstrated how superficial features directed initial thinking, but highlighted how far more cognitive time and effort was then expended in reasoning around the alignment of structural relationships. Separately presenting a cohort of 114 experienced entrepreneurs with three opportunity vignettes and similarly recording their thoughts in a verbal protocol study, Mueller and Shephard (2016) again demonstrated the relevance of cognitive structural alignment to the initial identification of business ideas.

Developing an understanding of how the core process of analogical reasoning operates in generating NVIs, the literature under review, variously touches in more detail on particular dimensions of that process. Reflecting on the extent to which target situations actually need to be pre-formed and pre-understood within an entrepreneurial context, it has been suggested that analogical reasoning can occur when both the 'target' and 'source' are unfamiliar (Barnard and Herbst, 2018). Contemplating the significance of analogical distance, the literature considers the tension between the expediency of 'near' or within domain analogies (Ward, 2004), and the claim that it is 'far' or 'intra domain' analogies which best abstract common relations and initiate the mental leaps that lay behind New Venture Ideas (Barnard and Herbst, 2018, Paivi *et al*, 2016). Extrapolating beyond the remit of technology transfer, the literature extends its focus towards the potent use of business models as analogical sources for NVIs, not least given that such models are already constituted as structured representations (Martins et al 2015, Rumble and Minto, 2017).

4.2 Antecedents and causes

Alongside the establishment of a framework through which analogical reasoning operates in the context of new venture ideation, the entrepreneurship literature under review has variously considered the antecedents or independent variables that lie behind this process. These antecedents can generally be characterised as falling into one of two categories: the knowledge from which structural relations are abstracted, and factors at the individual level that enable the mechanism to operate.

Firstly, knowledge is advanced as a core antecedent to effective processes of analogical reasoning. Prior knowledge about the means of supply and the nature of demand is what facilitates and triggers structural comparisons. Rather than simply being a differentiator between people, prior knowledge is characterised as the 'cognitive resource' that actively

[1] A separate empirical study in which information was manipulated in an experiment of 127 business undergraduates had previously been presented by the same authors to Frontiers of Entrepreneurship Conference (Grégoire and Shepherd, 2004).

allows people to transcend superficial differences and identify key structural parallels (Grégoire and Shepherd, 2010). It is suggested that entrepreneurs rich in possession of professional knowledge develop a cognitive preference for reasoning through the alignment of structures (Mueller and Shepherd, 2016).

Within the literature under review, avenues are further advanced through which prior knowledge is believed to support this alignment of structural relationships. Emphasising the importance of knowledge depth, one empirical study analyses the performance of 27 experts in a particular domain compared with that of 37 novices (Dew *et al*, 2009). It revealed how the experts identified three times the number of potential markets for a particular technology than the novices. In this way, the existence of richer knowledge structures is said to allow entrepreneurs to sub-ordinate more tasks to automatic processing. Echoing the writings found in the cognitive domain (Chi *et al*, 1989, Finlayson and Winston, 2006), knowledge is portrayed as creating a conceptual vocabulary that allows entrepreneurs to attend to structural similarity and which increases their capacity to focus on structural parallels (Grégoire *et al*, 2010). Possessing a depth in knowledge about markets, technologies and products is what enables an entrepreneur to better align the capabilities of a given business solution to the needs of a target population (Mueller and Shepherd, 2016). And where the wider entrepreneurship literature has referred to the impact of failing to solve past problems (Dimov, 2004), in the context of analogical reasoning, these failure indices are seen to serve as signposts which support later informational retrieval (Grégoire *et al*, 2010).

Elsewhere within the literature under review, the emphasis is placed on knowledge breadth. Indeed the possession of too much knowledge is portrayed as risking the engenderment of 'cognitive entrenchment', frustrating the ability to radically reorganise concepts and recombine ideas (Ward, 2004). Instead, experience within multiple industries is presented as providing access to the kind of causal descriptions that are necessary to induce analogies based on commonalities in relations (Cornelissen, 2010). The significance of knowledge diversity is also something that has been demonstrated within migrant and expatriate entrepreneurship. The dissimilarity between cross-cultural knowledge, and that then encountered in the domestic environment, is said to provide fertile ground upon which analogical reasoning can operate (Vandor and Franke, 2016). Whilst Nambisan (2016) suggests that new digital infrastructures (3D printing, virtual prototyping and social networks) can assist with processes of higher order reasoning by offering richer mental representations in demand driven contexts.

Secondly the literature under review directs its gaze onto the antecedents which at an individual level support the operation of this particular cognitive mechanism. It is suggested that the possession of a cognitive style which is intuitive rather than more structured or analytical may support entrepreneurs in processes of analogical reasoning (Mueller and Shepherd, 2016). The existence of metacognitive awareness, such that an individual is reflecting upon, considering and controlling their own cognition (Schraw and Dennison, 1994), is tendered as having the potential to influence the effective processing of analogies (Nambisan and Baron, 2012). Within entrepreneurial education programmes, the classroom development of such processing skills has been advanced as particularly important (Linberg *et al*, 2017). In exploring the structural characteristics of specific examples (Garbuio *et al*, 2018), or by comparing one case with another (Valliere, 2013), it is suggested that the analogical skills required for aligning structures and abstracting generalised schemas can be developed.

Reflecting the themes identified in cognitive science, such as concerns with working memory performance (Goldstone and Medin, 1994, Baddeley, 2000), the entrepreneurship literature reflects on the cognitive environment in which analogical processing may best occur. Grégoire *et al* (2010) tender that being under conditions of stress, time pressure or cognitive load negatively impacts the effectiveness of structural alignment, and suggest merit in testing this empirically. Mirroring the weight attributed within cognitive science to the role of goals and motivations in analogical reasoning (Holyoak and Thagard, 1995), entrepreneurial intent is also thought likely to render individuals more mindful of new information. Allowing entrepreneurs to 'zero in' on structural matches (Grégoire and Shepherd, 2012), intent is said to help overcome impulses which might otherwise serve to restrict the alignment of more complex and cognitively demanding structural relationships (Nambisan and Baron, 2012).

In a similar vein, the literature under review considers the role of entrepreneurial experience. It is suggested that when generating ideas through divergent thinking, a lack of entrepreneurial experience can be compensated by active information search (Gielnik *et al*, 2014). However the literature also demonstrates how encounters with business failure in the past, can support the use of structural alignment for identifying opportunities in the future. Mueller and Shepherd (2016) showed this to be particular potent when experience of business failure was combined with the existence of wider cognitive tools, namely expert knowledge of the 'business opportunity prototype' (Baron and Ensley, 2006) and an 'intuitive cognitive style' (Hayes and Allinson, 1998). With entrepreneurial failure often precipitated by the lack of an adequate fit between market need and product benefit, failure experience in this context, is said to lead to a distinctive change in the subsequent cognitive processing of the entrepreneur, one whereby greater emphasis is placed on structural alignment (Mueller and Shepherd, 2016).

4.3 Consequences and outcomes

The literature under review is consistent in perceiving the outcome of processes of analogical reasoning to be a first entrepreneurial insight or idea, or what is also referred to as a strategic solution (Phiri and Barnard, 2018). When such an idea first appears in consciousness, the insight will not have been fully considered or developed. This outcome thus constitutes a pre-inventive form (Ward, 2004), one that enables subsequent opportunity processes to then occur.

Considering the characteristics of emergent idea outcomes in more detail, Grégorie and Shepherd (2012) claim that the intrinsic nature of a particular venture idea can make it inherently more difficult to identify. This insight has implications that stretch beyond the initial formation of the New Venture Ideas. The interactive effects between superficial and structural features are said to directly impact on the intensity of subsequent opportunity beliefs. This line of research thus connects theories of structural alignment to the distinctiveness and viability aspects of the 'business opportunity' prototype (Santos *et al*, 2015). Empirically using a within person experiment, Grégoire and Shepherd (2012), demonstrate how the respective strengths of superficial and structural similarities within technology-market combinations, also directly shape confidence in the opportunities under consideration.

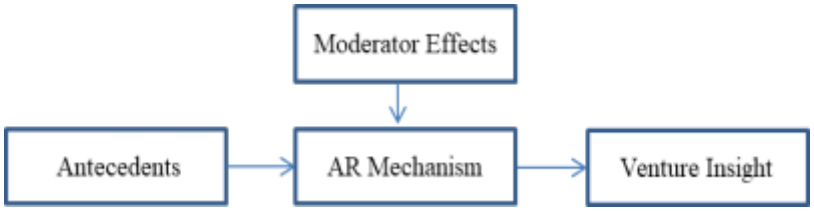
5. Discussions and future research

5.1 Analogical Reasoning and innovative New Venture Ideas

During the course of the last decade, levels of scholarship surrounding analogical reasoning and the emergence of NVIs have grown considerably. Extant research has established a solid foundational platform as to how this particular cognitive mechanism operates within entrepreneurship, and furthered erudition of the antecedents that enable it to generate outcomes in terms of fresh entrepreneurial insights.

However as with any emerging field, there still remain neighbourhoods in which understanding could be further advanced. The process by which structural relations are aligned may be well-grounded within the entrepreneurial literature, but it has yet to be examined with a full range of opportunity types. Doing so would further its validity, and simultaneously elucidate wider aspects of the process. There is also similar potential to further understand its antecedents, particularly those operating at an individual level which might allow one person to better reason through analogies than another. Moreover, where the literature in cognitive psychology has increasingly stressed the centrality of analogical retrieval to the overall effectiveness of analogical reasoning, and looked in particular at moderating factors which support such retrieval, this is an area in which the entrepreneurship literature remains largely silent. Going forward, there are thus notable opportunities for entrepreneurship research to develop its understanding of the conceptual framework that lies behind this particular cognitive mechanism (Figure 2).

Figure 2 – The effectiveness of Analogical Reasoning in New Venture Ideation – A conceptual framework



5.2 Broadening the application of Analogical Reasoning mechanisms

The creative application of analogy involves drawing structural knowledge from a source domain that is generally better understood, and applying it to a new target situation that is typically less well fathomed. Within the entrepreneurial field, such new situations can relate to evolving sources of supply (means), or to emerging customer demands (wants), neither of which have yet been connected by the market mechanism (Shane and Venkataraman, 2000).

However when it comes to the aligning of structural relationships, the entrepreneurship literature and its associated empirical investigations have focussed heavily on circumstances involving technology transfer. Technological transfer concentrates upon circumstances whereby an entrepreneur seeks out a particular market for a known means of supply, for example when Roy Jacussi having identified the potential of blowing air bubbles into water, reflected upon a relevant application for this technology (Dimov, 2007). Yet given that technology transfer is regularly conceptualised as involving a convergent learning style

(Dimov, 2007), it is perhaps a little surprising that these types of opportunities dominate the existing discussion of what is the divergent process of analogical reasoning.

Although Mueller and Shepherd (2016) included vignettes relating to the respective market needs of the growing American Latino population and the retiring American baby boom generation within their research, future studies into the use of analogical reasoning within entrepreneurship could look to more extensively test the mechanism within a demand driven context. This is something that was acknowledged by Grégoire *et al* (2010) who commented that the 'ecological validity' of their findings would benefit from being tested in the context of different opportunity signals. For NVIs also emerge in response to demand driven observations, ones in which it is the potential source of supply that is actually unknown. When developing the lightweight running shoe to meet the established needs of long distance runners, Nike's Phil Knight and Bill Bowerman experimented with a waffle iron and latex (Dimov, 2007). In these types of situation, rather than actively seeking out a potential market, the emphasis is on how to discover a new and improved way of doing things, for a market which is already known.

Expanding the field of study beyond the realm of technological transfer in this way has the potential to open doors of enquiry into wider aspects of the process. For example, it would allow better consideration of entrepreneurial situations where the 'target' is actually far less obvious or well understood (Barnard and Herbst, 2018). Observing analogical reasoning within 'demand driven' settings would shine attention onto a more diverse range of potential analogical sources such as differing production practices or alternate business models. And it might enable a deeper analysis of the role of analogical distance in the reasoning process, including an assessment of the relative significance of knowledge breadth compared to knowledge depth. For where such empirical studies have been undertaken in the innovation literature (Kalogerakis *et al*, 2010, Franke *et al*, 2014), investigations into the importance of distance have yet to be undertaken within an entrepreneurial context. By assessing the level of novelty that is garnered from near and far analogies respectively, it would be informative to gauge the extent to which analogical distance correlates with the numbers of subsequent ventures that emerge, and the length of their later duration.

Broadening the nucleus of attention could also allow the concept of analogical reasoning to be investigated in situations where what was being borrowed was not always so intrinsically positive. Garbuio *et al* (2018) highlighted how the development of Apple's iTunes store was influenced by the failure of Napster. Although proving the popularity of the market for music downloading, Napster highlighted the difficulties of peer to peer music sharing by concomitantly demonstrating the challenges faced with piracy and illegal downloading. In this sense, Napster served as an antilog rather than an analog. Apple was able to borrow and learn from what didn't work, allowing it to create an online music store which circumvented those legal issues by levying a small fee for music download. It is this contended that processes of analogical reasoning which occur through the lens of past failures, what not to borrow in effect, may thus be an equally useful area for future research.

5.3 Developing understanding of 'individual centric' antecedents

In striving to identify why one person may be better able to ideate new venture ideas through the use of analogies than another, the opportunity exists to further understand the antecedents

that operate at an individual level. Such research might directly examine the correlation between a person's overall ability to process analogies (such as the 'Miller Analogy Test') with their equivalent ability to ideate NVIs. And with the processing of structural considerations said to be cognitively demanding, research might beneficially take up the challenge previously suggested by Grégoire *et al* (2010) to scrutinise the impact of environmental factors such as stress, time pressure, and the prevalence of competing tasks.

With the effectiveness of analogical reasoning said to be dependent on the aptness with which current contexts are mapped to latent and non-obvious sets of sources (Levinthal and Rerup, 2006), future research should delve in greater detail into an individual's mind-set. Given the importance attributed to intent in analogical mechanisms within cognitive science (Gick and Holyoak, 1983), it would be worthwhile to empirically correlate levels of entrepreneurial intent with the volume of venture ideas generated through the use of analogies. It would be similarly informative to observe the extent to which particular metacognitive strategies, such as deliberately prioritising reasoning in terms of structural relations, or being actively open to breaking traditional boundaries, supported the creative use of analogy in forming NVIs. In particular through analogical training it would be interesting to assess the extent to which the ability to think analogically can be cultivated. For where a previous conference paper suggested the existence of a supportive empirical relationship between metacognitive awareness and analogical training in relation to an assessment of the likely profitability of new ventures (Haynie *et al*, 2004), it would be illuminating to test the same relationship within the context of new venture ideation.

Moreover it would be would be enlightening to observe whether particular individual situations or contexts (for example travelling or walking) supported the increased use of analogy in venture ideation. And although the first cognitive insights behind entrepreneurial NVIs are typically presented as occurring within the mind of a particular individual, it would be interesting to understand the extent to which analogical recollection may be supported by social interaction. For example it could be productive to observe whether brainstorming processes within an entrepreneurial team environment, exuded the same productive application of analogy that was recorded in the weekly laboratory meetings of molecular biologists in a scientific environment (Dunbar, 2001).

5.4 Considering the role of moderating effects within analogical retrieval

Hitherto the entrepreneurship literature has focussed far more heavily on the actual processes of structural mapping and structural alignment, than it has on the initial process of analogical retrieval. Yet within cognitive science, the research focus surrounding the challenges in reasoning through analogy, has gravitated towards the importance of analogical retrieval (Gentner and Maravilla, 2018). In applying such cognitive developments to the entrepreneurship field, it would be similarly instructive to develop understanding of how the 'inert knowledge' problem might be circumvented in the ideation of NVIs.

Accordingly, the opportunity exists for entrepreneurship research to deepen its investigation of potential moderating effects which may better distil the abstract structure of a 'target' situation, thereby unlocking access to more distant and yet more potent structural analogies. Within the last decade, this has been championed within cognitive psychology by the theory of 'late analogical abstraction' (Gentner *et al*, 2009). This approach tenders how the

comparison of analogous exemplars can lead to the formation of relational schemas. Better able to access the wealth of everyday knowledge that lacks structural encoding, and which is otherwise contextually bound, such schemas serve as far more effective retrieval probes within memory (Gentner *et al*, 2009). Whilst if such secondary analogous examples are not readily available for the purposes of comparison, the cognitive literature has further tendered that novel problems, analogous to the target situation, could be beneficially created (Minervino *et al*, 2017).

Going forward, it would be informative to investigate whether either the introduction of a second analogous situation (Gick and Holyoak, 1983, Gentner et al, 2009), or the creation of a second isomorphic problem (Minervino *et al*, 2017), might moderate the effective generation of insights for entrepreneurial ventures through the mechanism of analogical reasoning. For example, an entrepreneur observing the difficulties in sleeping faced by elderly or infirm pet dogs, could find an analogous example in relation to elderly people. In this demand led context, identifying how specialist orthopaedic beds have offered extra comfort for humans could help in conceiving a venture idea based around the notion of specialist beds for canines. Similarly where higher prices and the aggravation of travelling to a physical location may deter people from signing up to exercises classes at a gym, the construction of a novel analogous problem in terms of people's experiences with adult learning, might equally assist in the formation of a novel venture idea. Witnessing how low priced learning had successfully been delivered to groups through the internet, a new insight could be analogised for the exercise market. A new low cost service could be conceived whereby people work-out at home, but through an app are collectively connected to the instructor and other class participants online.

6. Conclusion

The aim of this systematic review was to contribute to the entrepreneurial literature on the formation of NVIs, doing so through the prism of analogical reasoning. It does so firstly by mapping the cognitive terrain that exists around this particular divergent thinking mechanism within entrepreneurship, secondly by advancing understanding of the collective body of literature that has hitherto been published, and thirdly by suggesting important areas within the current and surrounding valleys of this research that would warrant further exploration.

Given the extent to which inventive analogising has been attributed significance within cognitive science, it is perhaps a little surprising that the number of publications exploring this process within the realm of entrepreneurship is so sparse. The fact that so many of the publications within this review are weighted to the last few years, suggests a correction may now be underway. As of today, the existing entrepreneurship literature explains how the process of structural mapping and alignment operates within this field, and touches upon the particular antecedents which enable it to effectively generate NVIs. However there remain notable areas to be further discovered in future studies, not least in investigating the application of this cognitive mechanism with a wider range of opportunity types and elaborating on its individual level antecedents. Moreover given the significance attributed within cognitive psychology to the importance of analogical retrieval in the efficacy of processes of analogical reasoning, in the context of NVIs, there here exists an undiscovered and potentially expansive plateau for future study.

Entrepreneurship research has increasingly focussed on how entrepreneurial opportunities emanate from particular mental processes (Baron, 2004, 2006, Fredericks *et al*, 2018). Accordingly, it is contended that only by examining the operation of these specific cognitive mechanisms in more detail, can a clearer understanding be obtained of how entrepreneurial insights first emerge. When it comes to the selection of the most apt cognitive processes to investigate, analogical reasoning must surely be one of the first names on this particular team sheet. Given that every opportunity has an initial idea as its progeny (Dimov, 2007), and that successful ideas are described as the 'lifeblood of entrepreneurship' (Ward, 2004), the further exploration of analogical reasoning in this context, should provide for a fruitful and stimulating journey.

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