THE COMPLEXITY OF OPPORTUNITY

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Abstract

This paper argues that entrepreneurship can usefully be characterized as the search for peaks on a fitness landscape. This conceptualization is useful in linking together several different views on the nature of opportunity, highlighting reasons for disagreement, and providing a way of bridging differences. In particular, the paper allows some old debates on the ontology and epistemology of opportunity to be laid to rest, and posits a new set of challenges for the field.

THE COMPLEXITY OF OPPORTUNITY

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes." - Marcel Proust

The issue of whether opportunities are discovered or created has inspired a great deal of debate in the entrepreneurship literature (Alvarez & Barney, 2007; Alvarez, Barney, & Anderson, 2013; Sarasvathy, Dew, Velamuri, & Venkataraman, 2010). The realist school sees opportunities as out there waiting to be discovered (Shane & Venkataraman, 2000; Ventakaraman, 1997), while the constructionist camp maintains that opportunities are created through entrepreneurial action, with opportunities not existing *a priori* to such action (Baker & Nelson, 2005; Garud & Karnøe, 2003; Sarasvathy & Dew, 2011).

The debate is a foundational one because it determines the objects of study for the entire field. Traditionally, an entrepreneur has been defined as one that pursues or exploits an opportunity, implying that the opportunity exists independently of the entrepreneur (Shane & Venkataraman, 2000; Stevenson & Gumpert, 1985). If, instead, opportunities are created, then the processes used by entrepreneurs to achieve success may be completely different from those previously envisaged and require a major shift in pedagogical philosophy and technique (Baker & Nelson, 2005).

Some authors have attempted to bridge the divide between the two schools by taking a contingency approach, – entrepreneurs should be discovery driven in some situations and effectual in others (Alvarez et al., 2013). Another set of authors has argued that the opportunity construct should be jettisoned as unhelpful (Chiles, Bluedorn, & Gupta, 2007; Klein, 2008). This paper seeks to enter this debate by positing a number of propositions about the nature of opportunities drawing on the literature of complexity theory for inspiration. While arguably a realist philosophy, complexity theory has grappled with similar issues that are now facing entrepreneurship and has developed a more nuanced view of the issue that may assist in bridging the discovery-creation divide in entrepreneurship.

No new matter is created.

The Merriam-Webster dictionary defines creation as "the act of making or producing something that did not exist before". This is an unfortunate turn of phrase because, at some fundamental level, no new matter is being brought into existence by the act of creation[1]. The entrepreneur is not god like. He or she is not conjuring up substance from nothingness. In this sense, the entrepreneur does not stand apart from the world. The clay that the entrepreneur uses to mold a venture is the same clay that we all use. There is nothing metaphysical about the results of entrepreneurship.

Entrepreneurs create new combinations

[1] Strictly speaking we treat the universe as a closed system where total mass or energy is conserved – it can change form but not increase or decrease.

Another way to make this point is that the factors of production (land, labor, and capital) can be combined, and recombined, in different ways. Several economists have used the term 'project' to describe a potentially profitable combination (Casson, 1982; Klein, 2008). To conceptualize entrepreneurship as 'merely' recombining factors and not doing something original or creative is to severely underestimate the nature of combination.

Imagine a short essay of 300 words. There are five characters in an average word. Each character can be represented by one of 26 letters. Thus, there are at least $26^{(300*5)}$ ways of writing this short essay[2], which represents an almost infinite number of combinations. The tendency for choices to expand geometrically as the number of elements increases linearly is known as a 'combinatorial explosion' in the complexity literature (Fellows, Gaspers, & Rosamond, 2011). Of course, most of the combinations will be nonsensical to an end user and only a small subset of the letter combinations will make sense to a reader of English.

When we extend this example to the economy, we start to see that the set of all possible combinations of factors of production is unbelievably large, much larger than the number of stars in the universe, or even seconds since the big bang. Consider that we are not only talking about the physical proximity of one factor to another but also the way that each factor is deployed over time (Lewin & Phelan, 2000). For instance, an airliner might be more valuable if allocated on a New York-Boston route from Monday to Friday but more profitable flying New York-Los Angeles on a weekend. The number of ways that even a single airliner can be deployed are enormous, let alone the possibilities with a fleet of hundreds of planes. However, like the essay example, only a tiny set of all possible economic combinations will be viable and an even smaller set will be profitable[3].

An important consideration is that the alphabet or factors used in our examples have a finite number of elements. The author in our example was limited to using only 26 letters in the English language for each character. Similarly, DNA only uses four nucleotides – guanine, adenine, cytosine, and thymine - to produce all of the complexity observable in DNA and thus life on this planet. In the airline example, no new jets are created, just positioned in different ways.

For the creationist, this raises the possibility that a new element might be invented or added to the mix. Why not add a new letter to the alphabet? Couldn't we invent a new nucleotide or buy a new jet for the fleet? This is missing the point. In a closed system, the basic elements are finite. We have argued that the universe is a closed matter-energy system albeit one in which the combinations are almost infinite. However, no new elements can be added. The building blocks are given.

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[2] The number of possible combinations increases substantially if we allow the inclusion of spaces, punctuation marks and capitalized letters in the essay.

[3] An entrepreneurial opportunity is thus a potentially profitable combination or project and we will use the terms interchangeably moving forward.

Of course, it almost goes without saying that we are not aware of all combinations or the likely beneficial (or detrimental) effects of novel combinations. We have certainly not experienced every possible combination nor will we ever do so in ten lifetimes. Thus, we can always be surprised and delighted by novel combinations. Our society has combined resources together in ways that were simply unimaginable for humans from an earlier era. It is in this sense that creating a new combination is bringing something novel or unseen into existence.

Entrepreneurship as search on a fitness landscape

The concept of a fitness landscape was first introduced in theoretical biology by Wright (1937) and subsequently applied in physics, computer science, and business (Beinhocker, 1999). The height of a given point on a fitness landscape represents the payoff to a given combination of finite elements and actors in the landscape are assumed to prefer higher payoffs[4]. Given that entrepreneurship involves the combination of factors in search of profit, it is possible to conceptualize entrepreneurship as the search for higher peaks on a fitness landscape.

A fitness landscape is said to be rugged if it contains many peaks and troughs (see Figure 1)[5]. An NK-model is a theoretical model where the ruggedness of a fitness landscape can be 'tuned' (Rivkin, 2000; Rivkin & Siggelkow, 2003; Weinberger, 1991). The ruggedness of a landscape is relevant for search as agents can be trapped on 'local' peaks where moving to a global peak involves moving through troughs or valleys of lower fitness.

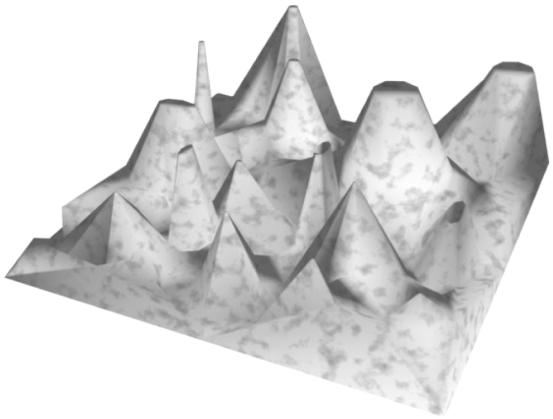

Figure 1. A rugged fitness landscape

Much effort has been expended in computer science attempting to find algorithms to

[4] In biology the factors being combined are nucleotides, in business they are resources or factors of production.

[5] Although a landscape is usually pictured in three dimensions for expositional purposes, it is actually an n+1 dimensional space, where n is the number of factors being combined.

locate global optima on different types of fitness landscapes. The algorithms are usually contrasted with *brute search* (i.e. trying every possibility), which is clearly expensive and time consuming, and *hill climbing*, which involves altering one element at a time and retaining variations that improve performance. While hill climbing is guaranteed to reach a local optimum, it invariably proves ineffective on a rugged fitness landscape, as searchers are unable to cross troughs in the landscape to regions of higher payoff.

In physical, biological and computer sciences, the agents searching the fitness landscape are typically engaged in blind search, that is, they have no ability to perceive the contours of a fitness landscape, thus all search must be guided by feedback. An entrepreneur, on the other hand, may *anticipate* that a particular combination may yield a higher payoff. This is akin to being able to see a higher peak on a fitness landscape. The implications of this property will be explored in greater detail throughout the paper.

New combinations are not subjective, imagining new combinations is subjective

Because the factors of production belong in the physical world, the act of combination is a physical act. When I move an airplane and aircrew from a Boston-Los Angeles route to a Dallas-Phoenix route *real* things *really* move. There is nothing subjective about a new combination.

The literature on opportunity has been greatly concerned about how evident these new combinations are to different individuals. Kirzner (1973, 1997) maintains that some entrepreneurs are simply more alert to opportunities than others, implying that anyone with a goodly dose of alertness should be able to perceive any opportunity. In contrast, Shane (2003) details how past knowledge and experience may condition certain people to see opportunities that others do not, limiting perception to 'knowledge corridors'.

Taken to the extreme, we can argue that each person has a unique set of experiences, so that every entrepreneur might see the possibilities for new combinations in a unique way. This contention lies at the heart of the radical subjectivity of Chiles et al (2007) and Lachmann (1976). There is also some debate whether this knowledge can be shared with others. Sarasvathy and Dew (2008) argue the shared experience of working together can generate an inter-subjectivity that enables agreement on the objective presence of an opportunity. On the other hand, Langlois and Robertson (1989) have coined the term 'dynamic transaction costs' to refer to the costs of educating others on your vision. If these costs are high enough, an entrepreneur may be forced to act unilaterally without the support of others.

At the other end of the spectrum is the view that opportunities may not be perceptible in advance. In the effectuation literature, entrepreneurs are guided by the results of their actions to build on successes and abandon failures (Sarasvathy, 2008). It seems hardly relevant how the idea for a new combination arises or whether it needs to be perceived accurately at all.

From the perspective of a complexity theorist, these debates can be conceptualized as

arguments about the perceptibility of the fitness landscape. If the landscape is visible to all agents then an opportunity is simply the observation that there are higher positions to occupy on the landscape, and the best opportunity is the highest peak. This corresponds well to the notion of *opportunity recognition*, the Kirznerian notion that anyone that bothers to look can recognize an opportunity (Sarasvathy et al., 2010).

Shane's (2003) concept of *opportunity discovery* corresponds to a more restricted view of the landscape. Some agents have a better view of the landscape due to their relative position. Metaphorically, being at the top of a local peak may give you a better view of the surrounding terrain than being in a valley or on some other peak. Different agents will perceive different opportunities and some agents will be more perceptive than others. However, if perception has a limited range, no single agent will be able to see all of the landscape, even when on the highest peak.

Finally, the effectual entrepreneur assumes little knowledge of the landscape at all. The entrepreneur starts at virtually any point on the landscape and then uses feedback to move to areas of higher fitness. Sarasvathy et al (2010) refer to this as *opportunity creation* but it is clear from our earlier discussion that nothing is being created in the process. It might be more accurate to call this *opportunity revelation* as the fitness landscape is still present but opportunities are not perceptible *ex ante*, revealing themselves over time instead.

The effectuation process thus has a great deal in common with blind search on a fitness landscape. As we have seen, brute search and hill climbing are two techniques that can be used to search complex fitness landscapes but more sophisticated techniques have also been developed. Ultimately, the choice of algorithm will depend on the characteristics of the landscape. In some ways, effectuation represents an algorithm, or perhaps a family of algorithms, for blindly exploring fitness landscapes.

All combinations are not created equal

All potentially profitable combinations (a.k.a. opportunities) are not created equal. At the very least, variations occur in the complexity, duration, and novelty of an opportunity. Complexity can refer to both the sheer scale of operation – the quantity of people and capital to realize an opportunity as well as the difficulty of melding the constituent elements together. Duration refers to the length of time required to assemble and maintain factors to realize a return, while novelty refers to the degree of departure from existing combinations or forms.

It is reasonable to surmise that the more complex or specialized an act of recombination the fewer people will be able to grasp the nature of the opportunity, particularly if it relies on some specialized expertise or experience. Similarly, the novelty of a combination, by its very definition, is unlikely to be widely appreciated by others. These factors are also not independent. More complex projects are apt to take more time.

In the fitness landscape metaphor, novel combinations are combinations that are more

distant from existing combinations. If we assume that economic agents cluster around known combinations and agents do not have perfect knowledge of the landscape then fewer agents will perceive these novel combinations, typically those on higher peaks or closer to the fringes[6].

The notion of complexity is not necessarily problematic for the fitness landscape metaphor given that a fitness landscape already represents all possible combinations. Of course, if the actors are unaware of certain elements, this will make the parts of the landscape involving those elements invisible to them. The invention of electricity or the web browser may thus reveal a whole new world of possibilities that were hitherto unknown. In this sense, progress is possible. The economic system will display some path dependence based on previous innovations and the level of complexity in the system will increase as the number of available building blocks increases.

Time has been incorporated into complexity studies through the notion of a 'dancing' fitness landscape, where the actions of various agents cause the landscape to endogenously change over time (Kauffman & Johnsen, 1991). Changes in the landscape may also occur due to exogenous forces or shocks. This complicates the search process as the landscape may change over time and there is no guarantee that a perceived opportunity in one time period will still exist at a later time. It also means that the requirements for a successful combination will change over time.

Some recombinations are more uncertain than others

The possibility of a dancing fitness landscape greatly complicates the search process. Even if an opportunity is accurately perceived it may not be present when the combination is realized. Thus, the passage of time creates uncertainty. This uncertainty exists even in the simplest example of arbitrage. Seeing a $100 bill lying on the ground represents an opportunity, but even in the time it takes to bend down and pick it up the situation might change – someone else might beat you to it or the wind might blow it away. Generally, the longer the period of time between perception and execution, the greater the uncertainty, but some uncertainty is present in every project.

Note that this is pure uncertainty in the Knightian sense (Knight, 1921). Risk management involves forming probabilities from historical data (e.g. the mortality rates of a given population). Uncertainty, however, refers to those 'black swan' events that have the potential to alter the underlying historical distribution (Taleb, 2010). In other words, the landscape may change in unanticipated ways.

There can also be issues with perception. Following Shane (2003), only a few people will have the requisite experience to assess the viability of a highly complex or highly novel project. To the layperson, these projects will always appear highly uncertain. At the extreme, only the entrepreneur (or entrepreneurial team) will have the capability to see

[6] Of course, if we take the position that no one can perceive an opportunity then the question becomes one of how a novel combination is ever attempted.

the potential of a novel or complex project. The entrepreneur can also be wrong in their perceptions and investors must factor this uncertainty into their determinations.

It is also possible to completely reject the possibility of accurate perception and this *radical uncertainty* may be one of the hallmarks of the effectuation and lean startup movements (Ries, 2011; Sarasvathy, 2008). If one relies only on feedback to determine the viability of a project then it also follows that an entrepreneur is incapable of accurately perceiving opportunities in the environment. This position is indistinguishable from blind search on a fitness landscape, a position that has led Blank and Dorf (2012) to propose (paraphrasing Moltke) that "no business plan survives first contact with customers" (p. 22).

Not everyone agrees a given combination will have a successful outcome

Related to the proposition that some combinations are more uncertain than others is the proposition that not everyone will agree that a given combination will have a profitable outcome. Building on the discussion above, this disagreement may come from two sources: first, a perceptual disagreement about the viability of a course of action, and second, a more existential disagreement about whether knowledge of profitable combinations is even possible.

In the first case, there is strong evidence that one's personal/educational background and career/industry experience shapes how one perceives opportunities (Shane, 2000; Shane & Khurana, 2003). As such, no two individuals will see the same opportunity in precisely the same way. This difference in perception may, in turn, lead to a difference of opinion about the profitability of a venture. Of course, the more common the background or shared experiences of a group, the more likely they are to perceive a common opportunity and this may explain why angel investors are more likely to invest in industries where they have experience. However, as we have seen, an entrepreneur may not be able to convince others of the vision, and may have to go it alone (which may or may not lead to success).

Given that perceptions vary, theorists in entrepreneurship have wondered whether opportunities really exist independent of the observer and how shared knowledge is possible (Alvarez & Barney, 2010; Alvarez et al., 2013). Shane and his co-authors in the discovery school make a sharp distinction between the subjective conjectures (or business ideas) of entrepreneurs and objective opportunities (Eckhardt & Shane, 2013; Shane, 2012; Shane & Venkataraman, 2000; Shane, 2003). For Eckhard and Shane (2003:336), opportunities are: "Situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends, or means-ends relationships".

From a complexity perspective, it is not clear whether those from the discovery school are referring to possible combinations, viable combinations, or profitable combinations.

Nucleotides may be combined in almost infinite combination[7], but only a tiny fraction of possible combinations will generate a viable design[8], and only a small fraction of those designs will survive in a given environment[9]. In fact, biologists estimate that human DNA is 99.9% identical, which is remarkable given the enormous range of possible combinations available (Thomson, Pritchard, Shen, Oefner, & Feldman, 2000).

A close reading of the discovery school suggests they are referring to viable combinations as the measure of objective opportunities as they make explicit reference to the physical world acting as a constraint on possible designs (Eckhardt & Shane, 2013). For instance, while it is possible for us to vividly imagine teleportation (in no small part thanks to works of science fiction like "Star Trek"), we currently do not have the technological means to achieve this end. Thus, teleportation is not an opportunity in the discovery framework.

Because knowledge is dispersed, entrepreneurs are not aware of every use for a given technology. This has led to the development of a critical realist approach in the discovery school, where knowledge is acknowledged to be partial and subject to revision (Alvarez & Barney, 2010; Mole & Mole, 2010), much as the allegorical blind men might touch different parts of an elephant and provide different reports on what they have found (Mintzberg & Lampel, 1999).

Critics of the discovery school's approach have focused on humanity's general inability to predict viability in advance of experimentation (Alvarez & Barney, 2013). Indeed, history is full of inventions that were imagined, declared to be impossible, then realized at a later date, human flight being just one storied example. This creation of new means (or ends) lies at the heart of Sarasvathy et al's (2010) conception of opportunity creation, where the means or ends or both are presently unknown.

Bridging the divide

One way to bridge this divide is to erase the false duality between a viable and non-viable combination and focus on *relative fitness* instead. First, as we mentioned earlier, the outcome of every possible combination is uncertain. There is no sure thing because even a global optimum can shift in a dancing fitness landscape. But it is also possible to make educated guesses. The reason that humans have 99.9% of human of their DNA in common is because it has adapted well to our current environment. In complexity-speak, humans are clustered around some sort of optimum. We do not know if this is the global optimum but it is definitely better than many other alternatives.

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[7] There are 3 billion base pairs in human DNA

[8] A specific genetic combination is known as a 'genotype'. Except for identical twins, no two genotypes are the same, although children share 99.5% of their DNA with their parents (give or take a few mutations).

[9] The term 'phenotype' refers to a specific physical instance of a genotype. Even identical twins, who share the same genotype by definition, will have slightly different phenotypes (e.g. fingerprints differ between identical twins).

Natural selection is a form of blind search, where sexual reproduction enables variation on a common theme, which enables a species to explore its local fitness landscape. Mutations enable species to escape local optima and find regions of greater fitness (although most mutations are non-viable). Computer scientists have developed a technique called a 'genetic algorithm' based on the principles of natural selection, to explore theoretical fitness landscapes with some success in complex optimization problems (Goldberg, 1989; Goldberg, 2002).

Beinhocker (1999, 2007) has suggested the use of similar principles in business, arguing that business strategy should involve a combination of short jumps (to optimize local performance) and medium-long jumps (to escape local optima and develop capabilities in advance of landscape shifts). Although the number of small jumps should exceed the number of larger jumps, Beinhocker is relatively silent on the exact proportions.

Artificial Selection

It is tempting to conclude that opportunity discovery involves local search (or small jumps) and opportunity creation involves bold leaps into the unknown. However, the discovery school is also arguing that entrepreneurial search is not blind. In biology, such directed search is known as artificial selection (or selective breeding). Dogs are a good illustration of artificial selection. Most breeds of dogs today did not exist a few hundred years ago but within that time humans have managed to produce hundreds of distinct breeds, a result that would have taken natural evolution many thousands of years, if at all.

A number of important points for entrepreneurship can be drawn from artificial selection in biology. First, two animals must be able to reproduce together. Breeders have not spent much time trying to create dog/cat hybrids because those species cannot reproduce together. This did not prevent people from imagining (or attempting) something like a dog/cat hybrid but such attempts were doomed to failure[10]. Second, animals with desirable traits like size, speed, or aggressiveness were mated together by breeders. Although not guaranteed to produce an improvement in the desired trait, over several generations the breeder was usually able to achieve a more desirable result. Third, the desired traits were already present in the population in some way. Breeders did not alter the underlying genes although mutations could always give rise to new traits. The result was a process that accelerated natural selection and nudged the results in desired directions.

Alvarez and Barney (2010) have characterized discovery as some sort of risk management activity (in the Knightian sense) in that a probability can be assigned to certain courses of action through analyzing trends and collecting market research allowing the use of risk-based decision tools like net present value, real options, and scenario analysis. In practice, it is often exceedingly difficult to assign probabilities of success to novel combinations.

[10] This section is describing historical practice prior to genetic engineering. Scientists allegedly created a dog/cat hybrid in 2009.

Artificial selection is a different sort of risk-management technique. The purposeful selection of traits limits the search to the most viable part of the landscape. For instance, if you were seeking to produce a purely white dog, you would mate two mostly white dogs in the hope of producing an even whiter dog. You would never mate two black dogs together and hope for a white dog nor would you mate a dog with a cat and hope for a white dog. In this sense, selective breeding combines relatively fit instances together to seek a higher level of fitness. Artificial genetic algorithms also use this technique to accelerate search by weighting the selection of parents on the basis of relative fitness.

Entrepreneurial discovery is advocating a similar sort of search strategy. An entrepreneur would be well advised to base a new combination on building blocks that have proved relatively fit in the past. Thus, a company seeking to create the next generation of a learning management system (LMS), like Canvas[11], will inevitably reproduce a host of successful elements from Black Board, the market leader of the previous generation, including assignment submission, grade book, modules, and discussion boards. In this case, Canvas is also using cloud-based technology to host its LMS. Once again, they are not inventing new techniques in this area, just incorporating popular functionality like mobile apps, cloud storage, and open source development. While it would be possible to construct an LMS from the ground up with a completely new set of user functions, this imposes unnecessary risks (and delays) relative to using elements that have already passed a market test. The discovery school would like to label any such combination of tested elements as an opportunity.

It is important to note that this calculation does not involve any sort of probabilistic determination in a Knightian sense. Using a known technology involves an almost 100% chance of success even if the viability (or fitness) of the resultant combination is uncertain. In this sense, discovery entrepreneurs are economizing on dynamic transaction costs, which are the costs of introducing novelty beyond the immediate production costs (Langlois & Robertson, 2002).

Canvas is a hybrid of two successful technologies, LMS and cloud technology. In this sense, it is like trying to crossbreed two successful species to create a hybrid. This is more uncertain than recombining successful elements from individual organizational forms. The strategy might lead to a region of higher fitness or fall into the valley between local peaks. Advocates of blue ocean strategy laud the benefits of finding a new part of the landscape that is unoccupied by competitors but they tend to underplay the inherent risks of venturing too far from tested solutions (Kim & Mauborgne, 2005). On the other hand, organizational ecologists have long observed the tendency of organizations in a given industry to display a high degree of similarity (Hannan & Freeman, 1993). Although often attributed to a need for social legitimacy, this observation is perfectly consistent with the evolutionary logic of building on past success.

The LMS example also allows us to build a bridge to the creationist perspective. While the founders of Canvas might have had prior experience in traditional LMS and cloud-

[11] www.instructure.com

based technologies, it is also possible that the opportunity was sparked by a chance encounter between an LMS specialist and cloud specialist. The effectuation literature emphasizes the importance of the 'crazy quilt', which is the new knowledge that arises from such interactions and additions to the entrepreneurial team (Sarasvathy, 2008). Of course, many applications are moving to the cloud, so the thought of a cloud-based LMS, was not particularly avant-garde.

The crucial distinction between the discovery and creation approaches seems to be whether the actions were intended or not. The debate is reminiscent of the deliberate/emergent debate in strategy, where realized strategy is a product of intended and emergent strategies (Mintzberg & Waters, 1985). An LMS specialist might have deliberately sought out a cloud specialist to develop a new combination but they may just have equally met by chance. In reality, every company is likely to be a combination of deliberate pairings and happy accidents.

The market provides the only test for a combination

Effectual theorists have contested whether advanced knowledge of profitable projects is even possible. In their view, any claim to possess such knowledge can only rise to the level of a hunch or hypothesis because the only true test is an empirical one (Blank & Dorf, 2012; Ries, 2011). From the fitness perspective, the market is still the ultimate arbiter of success, just as survival is the ultimate test for an organism. Business combinations that are not profitable will ultimately not survive.

However, from the preceding discussion, it should be clear that all hypotheses are not created equal. Business combinations that build on previously successful elements are more likely to succeed. Just as artificial selection accelerates natural selection, so too can directed discovery improve the search process in entrepreneurship. Of course, this does not mean that long jumps into uncharted territory cannot be successful but they are also riskier.

Selection pressures have the effect of winnowing out poor choices. This has led theorists in entrepreneurship to embrace a form of evolutionary realism, with the success of a combination being a strong proof that an objective opportunity truly existed (Alvarez & Barney, 2010). Actually, evolutionary realists prefer to use the term 'verisimilitude', the appearance of being true or real, rather than 'truth' to indicate the tentative nature of knowledge (McKelvey, 1999). A prediction of success is another strong indicator that the entrepreneur has knowledge of the underlying causal mechanisms but, following critical realism, there is a chance that this knowledge is wrong. As Alchian (1950) pointed out in economics many years ago, in a large population many actors will be successful by luck alone and Barney (1986) has also discussed the role of luck in the strategy literature.

Complexity theory also acknowledges that fitness can be improved by virtually any variation, random or otherwise. A range of factors may affect the fitness of a combination, including: blind search, directed search, luck, the actions or inactions of competitors, and exogenous changes in the environment. The beliefs of others agents in

the economy, such as customers suppliers and employees, will also interact with those of the entrepreneur to determine success (Barney, 1986). For instance, there must be a difference in expectations about the future for a trade to occur. Over time, evolutionary realists believe that market feedback will cause revisions in faulty beliefs in line with the underlying objective reality.

Klein (2008) has been sharply critical of the opportunity debate in entrepreneurship. A market test can only occur after committing resources to a given course of action. If an opportunity is just a successful market test then it is a tautology. Opportunity is just another word for success. The discovery school attempts to avoid this problem by defining opportunities as viable combinations that are independent of the business idea but, as we have seen, there is no test for a viable combination independent of a market test. The creation school prefers to argue that opportunities emerge from the entrepreneurial process itself and cannot be predicted in advance.

For Klein (2008), opportunities are basically superfluous. In the same way that consumer choices are guided by underlying subjective preferences, we can infer that the subjective mental models of entrepreneurs guide entrepreneurial actions. However "…action is a real thing" (Von Mises, 1949:13), so are results. Just as economists are wary of stated preferences over revealed preferences (i.e. real choices), Klein (2008) questions the focus on (stated) opportunities instead of action. Words are cheap. Action forces an entrepreneur to use judgment, sell others on the idea, and put resources at risk.

Discussion: Bridging the Divide

Contra Klein (2008), I believe that the opportunity construct serves a useful purpose for entrepreneurs. An opportunity is the business idea or conjecture that guides future action (Eckhardt & Shane, 2003, 2013). An opportunity is rational because the entrepreneur believes it will result in goal satisfaction, which in a business setting usually means monetary gain (Von Mises, 1949). However, in most cases, there is a significant period of time between the decision to pursue an opportunity and its realization (Parker & Belghitar, 2006; Reynolds & Curtin, 2011). Moreover, most ideas will be subject to revision and many will be abandoned without firm formation[12]. Thus, the pursuit of an opportunity is a journey rather than an act (Cha & Bae, 2010). Even after execution, the nature of the underlying opportunity will continue to evolve. We utilize these insights to highlight four ways that the different theories of opportunity may come together and heal their differences.

Subjectivism

The discovery and Austrian schools often portray the entrepreneur as a misunderstood genius who struggles to assemble resources to realize a vision that is unappreciated by the majority. However, to quote Donne, "no man is an island". As a very human construct,

[12] The two panel studies on entrepreneurial dynamics report that only 30% of ideas had resulted in new firm formation after six years. About 20% were still actively pursuing the opportunity but almost 50% of ideas had been abandoned.

the business idea is subject to a wide range of psychological and sociological influences. Dopfer and Potts (2007, 2009) have argued that every economic agent is embedded in a micro, meso and macro context that evolves over time.

On the micro-level, every interaction with a stakeholder in the business, including co-founders, employees, investors, customers, partners, associations, and other agencies will influence the entrepreneur's business idea, possibly taking it in a new direction or confirming existing beliefs. In turn, the actions of the entrepreneur will also influence the belief systems of the stakeholders that come into contact with the business, leading to a co-evolution of micro-institutions, relationships, and beliefs reminiscent of the structuration approach to opportunity (Sarason, Dean, & Dillard, 2006).

At the meso-level, the institutions are typically other firms in the same industry or sector that are using similar combinations of resources and pursuing similar strategies (Hannan & Freeman, 1993). The actions of these firms, and their resultant successes and failures, will feed into the business idea of the focal firm, just as the actions of the focal firm will influence the industry. At the macro-level, traditional macro-environmental trends and events, such as the state of the economy, the political system, and social values will also shape the business idea over time and be influenced by the actions of firms.

The business idea must then be in constant flux as all levels of the entrepreneurial system are in constant flux. This has led the Lachmannian branch of Austrian economics to view the economy as a system in constant disequilibrium with no intrinsic tendency towards rest (Chiles, 2003; Chiles, Tuggle, McMullen, Bierman, & Greening, 2009; Lachmann, 1976). Disequilibrium economics is closely related to the concept of a dancing fitness landscape. Chiles (2003) has described this as a kaleidic process, where combinations shift from one pattern to another as the underlying payoffs change.

The process is also intensely subjective. Every entrepreneur will have a different set of interactions with these micro, meso and macro institutions and will bring a different set of demographic, psychological, and experiential attributes to the situation. The result is that no two entrepreneurs are likely to have exactly the same business idea. This is what Chiles et al (2007) mean by radical subjectivism[13]. One way to bridge the divide in the opportunity debate is for all sides to accept that opportunities (or business ideas) are subjective states, influenced by psychological and sociological factors, and subject to revision over time.

Realism

All major theories of opportunity (the discovery, creation, Austrian, and complexity approaches) can agree that the entrepreneur starts with a business idea or conjecture. In the complexity approach presented here, the business idea *is* the opportunity and the terms are strictly interchangeable. Moreover, all four theories acknowledge some

[13] Note, however, that radical subjectivism is consistent with critical realism. Subjectivism in this sense is not the opposite of objectivism (i.e. it is not the denial of an objective reality).

ontological reality independent of the business idea, which determines whether some realized combination of resources is more profitable than another. The metaphor of a fitness landscape describes the relative payoffs in this ontological space. These payoffs exist independently of entrepreneurs' beliefs but cannot be measured directly.

Elements of the creation school have toyed with the notion that entrepreneurs are "creating something from nothing" and that reality is a social construction (Baker & Nelson, 2005). On closer inspection, these theorists are just arguing that existing resources can be recombined for new purposes if we remove artificial limitations on how resources can be used. Thus, an inflammatory position that smacks of relativism can be reduced to exploring unexplored parts of the fitness landscape and remains consistent with a realist worldview.

Epistemology

Epistemology concerns what can be known about the ontological reality described above. While the complexity approach has much in common with the discovery school's view that certain objective combinations are more profitable than others, it rejects the view that the viability of a combination can be definitively known *ex ante* independent of a market test, particularly when the fitness landscape is subject to change. However, complexity theory maintains that historical patterns and precedents can serve as useful guides to areas of superior fitness. Entrepreneurs with detailed knowledge of successful configurations are thus likely to outperform those with limited knowledge of a market although such knowledge can also lead to core rigidities that prevents adaptation when the time comes (Leonard‐Barton, 1992).

The Austrian school has been somewhat disinterested in the mental states of entrepreneurs and what they know or claim to know. Yes, an entrepreneur might have a mental model; in fact it is quite likely to be the case given that humans are rational and goal-driven. But action is the ultimate expression of the conviction of one's beliefs. Beliefs may be influenced from any range of factors but ultimately the choice (or judgment) to commit resources in the face of irreducible uncertainty is the true hallmark of an entrepreneur and something that cannot be delegated (Chiles et al., 2007; Foss, Klein, Kor, & Mahoney, 2008; Klein, 2008)[14]. It has also been noted that the ownership of assets within a firm makes it easy to redeploy them in new combinations thus opening the door for an entrepreneurial theory of the firm based on the ability to economize on the costs of experimentation (Klein, 2008).

The key debate then seems to be whether *ex post* knowledge is preferable to *ex ante* knowledge. One way to approach the issue is to view it as a false dichotomy. Surely it is preferable to have *both* types of knowledge. Both are based on the belief that an observed regularity will continue in the future (Phelan, 2001). Even the supposedly superior *ex*

[14] The decision to realize an opportunity does not necessarily imply the entrepreneurial will to assemble the constituent parts according to the original vision. As the PSED data indicates, many entrepreneurs start down the path of venture creation but fail to complete the job.

post technique pre-supposes it can be repeated or extended. In fact, there might be more *ex ante* evidence to proceed in a certain direction. There are certainly plenty of cases of successful small market tests not scaling effectively. Conversely, in a high-velocity environment, knowledge may rapidly become obsolete pushing the balance towards *ex post* knowledge.

Another way to approach the issue is to assume that all knowledge is fallible. Just because the sun rose yesterday, and has risen today, there is no guarantee it will rise tomorrow (although it is a fair bet it will). Entrepreneurs should always be prepared to adapt to new or changed circumstances. Even successful operations can probably become more efficient (i.e. move to higher levels of fitness) and the underlying fitness landscape can always change in unexpected ways.

Experimentation

To date, the creation school has focused on experimentation as the best way to test an idea against reality, but there has been a lack of discussion on how to form conjectures, which leaves the impression that 'anything goes' and that any given starting point on the landscape is as good as any other. For instance, the lean startup literature discusses the need to pivot if an experiment fails (Ries, 2011). There is some attempt to categorize different types of pivots but specific details on the direction or magnitude of a pivot are lacking. In the effectuation literature, entrepreneurs are advised start to take action with the resources and relationships they already control or influence (the bird in the hand principle). Experiments should be made with an eye to 'affordable loss' that enables the entrepreneur to financially weather a test. The 'crazy quilt' principle lets the business model evolve as new resources and relationships are added to the mix but there is little guidance on which resources and relationships are the most relevant for success.

From a complexity approach, the view that 'anything goes' is patently false. It would be a dire mistake to start a search anywhere on the fitness landscape if prior information existed about the relative viability of various sections of the landscape. As we have seen, living organisms share an enormous amount of DNA in common and nature is careful to stick close to successful combinations by relying on sexual reproduction with occasional mutations that might, every now and then, drive evolution in a new direction. The strategy of natural selection, on the whole, is extremely conservative. We have also seen that a variety of search strategies exist for efficiently exploring fitness landscapes faster than brute search or hill climbing. Techniques such as artificial selection can greatly speed up the evolutionary process.

Of course, blue ocean strategies are always possible (Kim & Mauborgne, 2005). Unexplored areas of the landscape are still capable of generating extraordinary payoffs whether located by deliberate search or 'happy accident'. By definition, any dancing fitness landscape will constantly be changing its payoff structure so using historical precedent to guide search may also be a dangerous strategy when change is accelerating (Christensen, 2013). This is why Beinhocker (2007) has advocated that mature companies use a mix of small and long jumps; the exact mix being determined by the degree of change and uncertainty in the industry.

However, all else being equal, the more novel, complex or time-consuming an opportunity, the less likely its chances for success. Much like DNA, opportunities that are built on successful elements are more likely to succeed and long jumps or pivots should be used sparingly. More work is needed in this area.

Conclusion

In this paper, we have strongly argued that an opportunity is a business idea or conjecture on how resources or factors of production can be combined to yield higher returns or payoffs on a fitness landscape. This approach is able to preserve the subjectivity (or pluralism) of the Austrians and creationists, while maintaining the objective realism of the discovery and complexity theorists. The paper also touches on the issue of ex ante and ex post knowledge and most effective methods of experimenting with new combinations.

A number of issues were identified for future research, including the tradeoff between specialized knowledge and core rigidities, the most favorable ways to combine *ex ante* and *ex post* knowledge, and the best search strategies in different entrepreneurial environments, including the right mix of short and long jumps under various conditions. It is hoped that moving past the definitional issues that have plagued the field will allow further work on these issues.

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