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Emergence and Emergents in Entrepreneurship: Complexity Science Insights into New Venture Creation

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Abstract: Emergence is at the nexus of entrepreneurship and complexity science because the former studies how and why new organizations emerge, and complexity examines the emergence of new order in dynamic systems. As a means of summarizing work in emergence, this invited paper presents six insights that complexity science has brought to entrepreneurship: An emergence process generates an emergent outcome; emergence is driven by agency; emergence increases the capacity of a system; emergence occurs in cycles; emergence follows a distinct logic; and entrepreneurial emergents follow an 80/20 rule.

Keywords: complexity science, emergence, agency, process

As an academic field, entrepreneurship has long explored the creation of new companies, how and why new organizations emerge, and the conditions that spark entrepreneurial innovation and growth (Schumpeter 1934; Kirzner 1982; Stevenson and Gumpert 1985). Many scholars have used complexity science to help explain entrepreneurial behaviors, in part because creating a company is almost always more complex than one expects. In addition, complexity science brings insight into the underlying system dynamics that give rise to new ventures and new companies.

Entrepreneurship was one of the first academic areas to utilize complexity science. Bygrave (1989a, 1989b) was the first to do so; as PhD physicist turned entrepreneurship scholar he applied *deterministic chaos theory* to new venture emergence. Then Stevenson and Harmeling (1990) applied *dissipative structures* theory to entrepreneurship. These were part of an earlier set of contributions in the management literature more generally, by Bigelow (1982), Allen (1982), Ulrich and Probst (1984), Gemmill and Smith (1985) and Arthur (1988) to name a few. Note that complexity science was not “formally” introduced to the organization science community until Anderson et al. (1999).

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Complexity is still at the forefront of entrepreneurship research, as seen in recent papers by Fulmer and Ostroff (2015), Selden and Fletcher (2014), Crawford et al. (2015) and Garud et al. (2015). Complexity applications to entrepreneurship are intuitive and insightful because both fields share similar dynamics: creation and emergence, opportunity and new potential, innovation and growth. In this short reflective essay, my goal is to consider key insights that complexity science has generated for entrepreneurship scholars.¹

Emergence is at the nexus of entrepreneurship and complexity science because the former studies how and why new organizations emerge, and complexity examines the emergence of new order in dynamic systems. Many have showed that emergence is foundational for both fields (Katz and Gartner 1988; Gartner 1985; Gartner and Starr 1993); (Anderson 1999; Goldstein 1999, 2000; Garud, Kumaraswamy, and Sambamurthy 2006; Garud et al. 2015). Based on my studies into these fields (Lichtenstein 2009, 2011, 2014), I'm going to suggest six key insights that complexity science has brought to entrepreneurship. Listed as a summary, they reflect a “paradigm” or framework for thinking about agency and the creation of sustained social structures.

As a summary: (1) Emergence is a *process* that generates an outcome: an “emergent.” (2) Emergence is sparked through *agency* – it is driven by intention. (3) Emergence increases the *capacity* of the system. (4) Emergence occurs in cycles; each cycle has an internal logic of five sequential phases. (5) Emergence in entrepreneurship follows a distinct *process/pattern*, which is far more predictive of start-up success than the behavioral content, i.e. *what* the entrepreneur actually does. (6) Finally, entrepreneurial outcomes are not arrayed on a normal curve, but according to a Pareto curve (the 80/20 rule): The vast majority of instances have no influence in the dynamic system, but a few instances have tremendous leverage.

1 Emergence is a *Process* that Creates an Emergent *Outcome*

The process has become well known through research in the Prigogine tradition, including Nonaka (1988), Chiles et al. (2004), Plowman et al. (2007), and others. Based on these inductive process studies, complexity researchers are virtually

¹ I am grateful to Vernon Ireland and Alex Gorod for giving me this distinct opportunity.

agreed around the five key dynamics of emergence – the five sequential phases in the process (Lichtenstein 2014). These are described in #4 below.

The outcome of emergence is emergent order – *an emergent*. An emergent is the tangible expression of what's been created, whether an organization, a new system/innovation, a collaboration or shared value; it is a new social agent. Examples of emergents include teams, projects, innovations, ventures, organizations, companies, alliances, social innovations, community initiatives, and some institutions. They are constantly organizing themselves (Tsoukas and Chia 2002; Weick 1979), and as such they remain discernable in their economic/social environment.

This distinction between the process of emergence and the outcome, an emergent, is not often made by researchers. Nor is it easy to discern the difference, for in our multi-layered social world the latter is often fully embedded in the former. Still, by attempting to bring more clarity to the process vs. the outcome, we may be able to better integrate each other's work.

2 Emergence is Sparked by Agency – Generative Emergence is Intentional

All social entities – all emergents – are created through agency: entrepreneurs use intention, aspiration and personal passion to create their ventures/projects. Often they combine their agency with others, to expand the potentiality of the venture.

Although this seems obvious to entrepreneurship scholars, it is anathema to most complexity science researchers, who argue that emergence happens “naturally” when agents follow simple rules of interaction. In this sense new order will simply *self-organize*, without any added intent or drive by its agents (Kauffman 1993, 2000). Generative emergence takes the opposite view: emergence is intentional. Agency, even if distributed, is the source of successful organizing.

At the same time, having intention does not mean having control. As all entrepreneurs know, there is nothing predictable about entrepreneurial outcomes, especially because they are often non-linear. Instead of trying to control, successful entrepreneurs learn how to be flexible in their organizing, to improvise (Sawyer 2003; Garud and Karnøe 2000), innovate (Garud and Karnøe 2003), use effectuation (Sarasvathy 2001; Dew et al. 2011), and so on (Garud, Kumaraswamy, and Sambamurthy 2006; Mullins and Komisar 2009). Further, they operate with this flexibility so as to continuously adapt to the dynamic social world (Arteaga and Hyland 2013). In these ways, agency is central to emergence.

3 Emergence Increases the Capacity of the System

The emergent reflects a new way of organizing that dramatically increases the capacity – effectiveness, efficiency, quality – of the system (Corning 2003). Perhaps the most remarkable example of this capacity increase is Margulis' (1971, 1981) research on symbiogenesis. Within a cell, an internal micro-structure (semi-autonomous organism) emerges and *envelopes* the local mitochondria into itself. As a result, the cell can produce 2000 times more metabolic energy than the “normal” cell without the emergent (Corning 2002). Another example is Prigogine's dissipative structure: Hexagonal “cells” (vortexes) of molecules emerge that increase by “*orders of magnitude*” the capacity of the container to dissipate heat (Swenson 2000).

Emergence researchers have identified increased capacity in a variety of ways. Plowman et al. (2007) describe how re-emergence at the church yielded more services to the residents, more space for expanding the programs, and increased meals served. Smith and Gemmill (1991) do an algorithmic calculation of the enhanced capabilities of groups that self-organized. Nonaka (1988) shows how innovations can totally re-create the companies they originate in. Chiles, Meyer, and Hench (2004) identify six key growth indicators for the dramatic expansion of the Branson theater sector, as the area emerged and re-emerged over time.

Entrepreneurs intuitively understand increased capacity, because the success of a new venture depends on generating more value than the cost of producing it. A classic example is Adam Smith's pin factory which, when organized, was able to produce 100 times more pins than individuals doing all the tasks themselves.

Perhaps *increased capacity* should be framed as a proposition, i.e. an assertion to be further tested. This is because entrepreneurs rarely know at the outset how increased capacity will be generated, so tracking its emergence is extremely difficult. Second, some outcomes of emergence generate intangible outcomes, e.g. expanding a company's mission or goals, remaking the boundaries of a project, integrating new learning into the firm. These important outcomes may dramatically increase capacity but in ways that are very hard to measure. Still, the overall proposition argues that new order creation leads to very positive effects for the system.

4 Emergents Arise in Cycles of Emergence

The fourth insight/claim is that the process of emergence is a progression of five sequential phases or dynamics, which together lead to new order

creation. This is a cycle of emergence. Those five phases reflect a specific logic that explains why and how emergence happens in social systems (Lichtenstein 2014).

The cycle is initiated when an entrepreneur starts to pursue an idea for value creation, which enacts or takes advantage of an opportunity. The entrepreneur's organizing – this intense activity and innovation – pushes the system into a state of disequilibrium. As this intensity of *disequilibrium organizing* continues, in phase 2 of the cycle the system will generate *stress, tensions and experiments*. Stress becomes more widespread due to the inability of current routines and relationships to manage the increased levels of activity, as well as the pressure to figure out the innovation and get it on the market. This also leads to experiments: new ideas and structures that aim to solve the disjunctions of intensity. More importantly, any experiment can become the seed of the needed solution, the new framework for increasing overall capacity.

As these continue, in phase 3 the system can become *amplified to a critical event*. According to the logic of emergence, positive feedbacks within the system accumulate, whereby a single further event can push the system into an entirely new regime of organizing. After this tipping point the system will either reorganize with increased capacity, or fall apart, unable to find a sustaining state. This reorganization is captured in phase 4, *new order through re-combinations*. Here, the newly organized entity is based on resources and capital that are already in the system, re-combined with new components; together these generate the next *dynamic state* of the entity. Alternatively, the critical event pushes the venture over the edge into failure, ending the organizing effort.

Finally, the cycle concludes with *stabilizing feedback*, whereby the system seeks to anchor the change, slow down the non-linear drivers, and find the parameters that maximize its efficiency and sustainability in the social ecology. The logic of emergence is oriented around the idea that ventures will remain in a dynamic state until the *next* opportunity tension arises, leading to a new round of disequilibrium organizing, and so on (Lichtenstein, 2014).

5 In New Venture Start-Ups (Using PSED Data), Process is More Important than Content in New Venture Creation

Another insight from complexity science is based on an analysis of longitudinal data from 1000 + entrepreneurs who were in the process of starting up their own

companies – the PSED data² (Lichtenstein et al. 2007). We applied longstanding complexity hypotheses to examine these entrepreneurs' organizing efforts, looking at the dynamics that distinguished those businesses that started up successfully vs. those that failed. It turned out that the key causal factor was not *what* these entrepreneurs did, but the *pacing* of their behaviors over time. That is, the activities of successful entrepreneurs were more evenly spaced, but with more activities occurring later rather than earlier in the process. This held true regardless of *what* the actual behaviors were, i.e. it didn't matter whether they were writing a business plan, getting a phone number for the business, arranging child care, talking with clients, developing financials etc. Instead, their success was correlated to the pattern of entrepreneurial activity. This insight might be extremely beneficial to new ventures in start-up mode; these findings have not yet been tried in practice.

6 Emergence has Power Law Outcomes

A final insight from complexity science to entrepreneurship is stated by Crawford et al. (2015), in a study of the actual distributions of entrepreneurial factors and outcomes. The key question is whether these factors of entrepreneurship are normally distributed on a Gaussian curve, or if the data are better described through a Pareto curve, i.e. the 80/20 rule, where a small percentage of data is causing most of the effect in the overall system. The study mathematically analyzed 46 variables on resources, cognition, action and environments. Our findings showed that 95% of these common factors are *not* arrayed on a normal curve, but on a Pareto curve. That is, the assumption of normality is proven inaccurate for virtually all of these common variables; instead, the underlying distributions are explained through a power law.

These findings matters for at least two reasons. First, virtually all extant research in entrepreneurship and management is based on *methods that assume the underlying distribution is normal*, including all research using regression analysis, ANOVA, averages, etc. All of this research may be inaccurate due to missing key dynamics that exist in the margins of the system. Although the

² Panel Study of Entrepreneurial Dynamics; Gartner et al. 2000, which was the first truly random study of new business start-ups, and was longitudinal – data was collected annually for 4 years. We used PSED 1 data, the enactment of 26 start-up activities, e.g. opened a bank account, did some marketing, hired employees, worked 35+ hours/week, etc.

advice in many statistics classes is to carefully “throw out the outliers,” those so-called outliers are actually *driving* system outcomes.

A second key impact is best explained by how the Pareto curve’s 20/80 rule operates in society. For example, 80% of sales are made by 20% of salespeople; 80% of deposits are made by 20% of customers, 80% of calls are made by 20% of individuals. And as we now appreciate, 99% of the wealth is held by 1% of the people. As an entrepreneur, these findings mean that a very small portion of all activities or resources may have a disproportionate effect in the outcomes. Although it may be impossible to know ahead of time which activities have the most leverage, the entire framework may offer unique innovations into entrepreneurial organizing and action.

7 Discussion

How do these insights change how we think about entrepreneurship and entrepreneurial behavior? To begin, they derive from a broad framework that contrasts with the linear, economics-based explanation of new business growth. The emergence\emergents framework assumes a highly dynamic world of social agents. Agents are constantly organizing themselves and continuously learning and adapting; new agents emerge and re-emerge over time. Emergence is driven by entrepreneurial behavior: someone sees a potential, an opportunity, a chance to generate value, and they put their passionate agency into making it real in the world. Ultimately the goal of our entrepreneurial behavior is to generate emergence, by creating new value, solving a problem, capitalizing on an opportunity, improving a situation, generating more capacity. Emergence, rather than competition and profits, is really the driver of economic activity.

For those engaging in entrepreneurship, this view of the world also offers insight into *how* an emergent is generated, namely through a cycle of emergence – the five dynamics described above. Thus, agency and organizing can be directed in ways that parallel the cycle, starting with the initial drive the entrepreneur pursues, and continuing through the other four phases in turn. The outcome would be the creation of a new emergent, which brings higher capacity. This proposed methodology is ripe for application.

These insights also offer suggestions to entrepreneurs in the start-up mode. If success is more dependent on the temporal pattern of activities, as compared to what activity the entrepreneur does, the focus of start-up organizing should incorporate a different kind of balance over time – namely, not doing too much too soon. Likewise, if outcomes accrue according to a power law, entrepreneurs

might be able to identify and leverage a few key elements of their efforts, which could have a non-linear effect in the system.

My hope is that these ideas can support entrepreneurial scholars and practicing entrepreneurs, to help understand and generate the emergence of new ventures, new projects, new collaborations, and new social entities.

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