

What Evolves in Organizational Co-Evolution?

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Abstract

Research in business and management has recently taken a co-evolutionary turn, driven both by the pace of environmental change, but also by the increasingly complex and interconnected nature of business environments. However few studies have drawn from the theoretical approaches used to study co-evolutionary processes in other scientific domains. In this paper recent advances in these other fields of study are examined with a view towards filling this gap, and providing a much needed theoretical underpinning to recent developments in co-evolutionary research. It is seen that the identification of the unit of evolution is a critical issue in this endeavor, with two broad approaches taken, namely the entity- and practice-based approach. In the former it is assumed that ideas, knowledge and capabilities are bound to individuals, groups and organizations with change over time being determined largely by external selection forces. In the practice-based view, the focus shifts to the process in which ideas, knowledge and capabilities are continually enacted and modified through actions. The paper further explores key theoretical and methodological issues relating to the development of both approaches, making a contribution not only to co-evolutionary research but to broader research in business and management.

Keywords: Evolution, Co-evolution, Routines, Practice, Innovation, Learning, Organizational Change

1. Introduction

Research in business and management has recently taken a co-evolutionary turn (Volberda and Lewin 2003; Rodrigues and Child 2003), with studies examining (co)evolutionary processes in internationalization strategies (Koza et al. 2011), off-shoring of business services (Lewin and Volberda 2011), networks (Dantas and Bell 2011), organizational adaptation (O'Reilly and Tushman 2008), organizational learning (Crossan et al. 2013) and organizational practices (Pentland et al. 2010; 2012). Murmann (2013) argues that interest in co-evolution has recently increased due to business environments becoming faster, more competitive and turbulent, with some calling for research to adopt a 'more encompassing, co-evolutionary perspective' (Lewin and Voberda 2012, p. 242). In addition to the pace of environmental change, business environments are increasingly complex and interconnected (McCarthy et al. 2010), and a co-evolutionary approach is well suited to study such regimes of change. Despite these recent calls for a co-evolutionary narrative, few studies have drawn from the theoretical approaches used to study co-evolutionary processes in other scientific domains such as biology, psychology or cultural evolution (Murmann 2013, Abatecola 2012; 2013). In this paper I will show how recent advances in these latter fields of study can be used to

fill this gap, and provide a much needed theoretical underpinning to recent developments in co-evolutionary research.

Evolutionary narratives have been emerging in the social sciences over the past few decades, advancing on a number of fronts from economics to cultural studies. These developments have taken place in the shadow of previous attempts to apply evolutionary concepts to human society, with the misinterpretations and abuses seen in Social Darwinism. However, theoretically-driven evolutionary approaches are finding new footholds in a number of fields of study including culture, economics, technology, and more recently business and management (Aldrich 1999; Arthur 2009; Boschma and Frenken 2011; Breslin 2008; Dennett 1995; Distin 2011; Mesoudi 2011; Nelson and Winter 1982; Plotkin 1994). In the last half century, scholars in particular have explored the possibility of using evolutionary ‘principles’ to study socio-economic change, both at the macro-level of populations of organizations (Hannan and Freeman 1977; Brittain and Freeman 1983) and increasingly at the micro-level of organizational change (Aldrich 1999; Campbell 1965; Nelson and Winter 1982). While the former group, known as population ecologists, shed light on the dynamics of competition and change in founding and disbanding rates of organizational forms at the population level, they downplay the importance of adaptation at the level of the organization and evolutionary processes within firms. Addressing this gap others have delved deeper into the workings of organizations, focusing their attention on the evolution of micro-level units of evolution (Aldrich 1999; Burgelman 1991; Murmann 2003; Nelson and Winter 1982). While differences in approach exist, this latter group of scholars have taken a number of core evolutionary concepts from biological evolution, and used these as the starting point for developing theory in the study of organizations (Campbell 1965; Hodgson and Knudsen 2004; Hodgson 2003), including for instance the generalized mechanisms of variation-selection-retention (Aldrich et al. 2008; Campbell 1965).

However, key to developing these co-evolutionary narratives is the question of what evolves? If organizations are seen to evolve over time, and in particular if that process is viewed as multi-level and co-evolutionary, then the identification of the unit(s) of evolution becomes a critical issue. In this paper I will show that two key approaches have been taken in this endeavor. In the first approach, it is assumed that the unit of evolution behaves as an entity whose change is largely subject to external selection forces. In the second, a voluntaristic perspective is taken with a focus on adaptive practices. I will further examine key theoretical and methodological issues relating to the development of multi-level co-evolutionary narratives using these two approaches. This paper thus seeks to make a key contribution to the co-evolutionary research project, by first reviewing recent developments in evolutionary research in organizations, and second by critically examining the potential of these approaches for multi-level conceptualizations of organizational co-evolution. Therefore the paper is structured as follows. A review of recent evolutionary research is first presented in section 2, in which similarities and differences in terms of how scholars have conceptualized the unit of evolution are examined. Section 3 then reflects on the recent shift from an entity- to a practice-based view in evolutionary research. In section 4 and 5 key theoretical and methodological

issues relating to each approach in the development of multi-level co-evolutionary accounts are then analyzed. Some final remarks are made in the conclusions.

2. An Evolving Entity or Practice?

As noted above some scholars have drawn from generalized concepts in biological evolution as a starting point for developing theory to study change in organizations. Researchers have thus used the concepts of variation-selection-retention (Campbell 1965) and the additional concept of the replicator-interactor (Aldrich et al. 2008) which represents the unit that evolves. In the biological world evolution occurs over time through the key mechanisms of variation (of genotypes), selection (of the consequent phenotype) and retention (of the underlying genotype), where the genotype is defined as the information inherited by an individual from its parents (i.e. genes), which has the potential to be transmitted to future generations. The phenotype on the other hand is the developmental expression of the genotype in a particular environment, as manifest through the physical characteristics of the organism. To distance themselves from biology, the concepts of 'replicator' and 'interactor' are abstracted from the genotype and phenotype (Dawkins 1976; Hull 1988), where the replicator is defined as anything in the universe of which copies are made such as genes in the biological world. Interactors have been defined as entities that interact as a cohesive whole with their environment in a way that causes differential replication of these elements (Hull 1988). The replicator-interactor concept thus represents the basic building block of any co-evolutionary account of organizational change. Therefore key issues which emerge from this discussion relate to identifying i) the unit of analysis (i.e. replicator-interactor) and ii) how these evolve through the mechanisms of variation-selection-retention. While a number of different approaches have been taken in this regard, evolutionary research has focused on three broad areas; innovation, organizational change and organizational learning.

2.1 Innovation and the Evolution of Ideas

Many scholars have conceptualized the process of innovation through the evolution of ideas and technologies. For example Basalla (1989) who gives an account of technological evolution, identifies technological artifacts as the unit of evolution (e.g. tools). In other detailed studies which seek to classify technological diversity, researchers have identified characters or attributes such as the standardization of parts, quality circles, flexible multi-functional workforce, preventive maintenance and job enrichment (McCarthy et al. 2000; McKelvey 1982). However what remains unclear in these evolutionary classifications, is the relationship between this variety of characters and attributes and the notion of the replicator and interactor. Indeed McCarthy (2005) calls for an approach which can explain how organizational diversity comes about. Whilst these classifications of diversity can shed light on the connections between organizations and the development of technologies, a clear distinction between replicators and interactors, and operationalization of these concepts at multiple-levels can help to fill in the gaps in the co-evolutionary story and specifically address McCarthy's call. Addressing these issues some have introduced the replicator-interactor duality to separate the informational content of the evolving technology, from its outward expression. In terms of the latter, some have conceptualized the interactor as an artifactual expression.

So Jablonka (2000) argues that whilst it might be easier to analyze the evolution of the phenotypic expression of technologies through artifacts, a true understanding of the detailed mechanisms of selection can only be gained through an analysis of the psychological and social context of the diffusion of innovations themselves (Fleck 2000; Jablonka 2000). Murmann (2003) distinguishes between the notion of the replicator as represented by ideas and knowledge, and the manifestation of that knowledge in physical artifacts. Mokyř (2000) on the other hand puts forward the organization as the interactor corresponding to technological techniques. Thus by understanding the interrelationship between technological knowledge (replicators) and the manifestation of that knowledge through technological artifacts (interactors) more detail can be shed on the process of innovation.

Other researchers have put forward a behavioral or narrative-based interpretation of the interactor. Weeks and Galunic (2003) argue that the expression of ideas-as-replicator includes not only technological artifacts but behavior and language. Indeed as early as 1975, Cloak differentiated between the concept of the i-culture which represents cultural instructions individuals carry in their heads, and the m-culture which includes features of an individual's behavior, technology and social organization. Drawing on this a number of researchers identify the meme as the replicator (Blackmore 1999; Dawkins 1976; Dennett 1995) in socio-cultural evolution, with the interactor being the 'outward and visible' manifestations of the meme in the outside world through words, music, visual images, gestures and skills (Dawkins 1982), or the behaviors (Blackmore 1999; Dennett 1995). More recently Distin (2011) and Mesoudi (2011) put forward a rich multi-level narrative in which discrete components of cultural knowledge evolve through their outward manifestation in behaviors. Taking a narrative turn (Price 2012) ideas 'coded' and retained as a mental representation (i.e. replicator) are expressed to 'others' through narratives (i.e. interactor) (Dobson et al., 2013).

In sum evolutionary research in innovation has taken two broad approaches when identifying the unit of evolution. In the first approach, the interactor is seen as the artefactual representation of the replicator. In the second the replicator interacts through manifest behaviors and narratives. The distinction between these two positions is an important one, and one that has parallels in other domains of study as noted below. In the former, the process of selection is seen to occur through the 'external selection' of ideas through artifacts. In the latter selection is a dynamic process occurring through the behaviors and narratives of individuals and groups.

2.2 Organizational Change and the Evolution of Capabilities

Scholars have also studied organizational change through an evolutionary lens with the routine seen as the unit that evolves. In many respects the adoption of the routine dates back to the notion of the 'routine as gene' introduced in Nelson and Winter's (1982) seminal work 'An evolutionary theory of economic change'. While the concept is generally defined as a collective phenomenon, whose enactment results in recurrent patterns of action (Becker 2005; Nelson and Winter 1982), different conceptualizations have resulted in quite distinct evolutionary narratives emerging. Some have tended to conceptualize the routine as a capability or entity (Rerup and Feldman 2011), with a

focus on how these phenomena influence wider organizational performance (Parmigiani and Howard-Grenville 2011). Various conceptualizations of the routines have reinforced this link with the organization. Nelson and Winter (1982) conceptualized the routine as a reflex-like, automatic process in which individuals within a group respond to certain stimuli with a particular set of repeated actions. Through reinforcement or conditioning certain behavioral responses become associated with certain stimuli over time, resulting in repeated patterns of actions. In addition to these behavioral characteristics, interlocking, conditional, and sequential behaviors between individuals (Hodgson 2008), and associated socio-political truces and coalitions (Cyert and March 1963; Nelson and Winter 1982) act to maintain the status quo. As a result, it is assumed that routines are enacted in an automatic sense, varying little over time, and so their evolution largely depends on external selection forces acting on the organization, as opposed to endogenous change by the individuals enacting them (Feldman and Pentland 2003). This dualism of the routine and organization is carried over in the conceptualization of the replicator-interactor. It is argued that the fate of these routines is inextricably linked to that of the organization (Hodgson 2008; Hodgson and Knudsen 2010). Over time organizations coalesce as entities, as founding entrepreneurs gain control of resources, with externals treating it 'as an ecological entity, a social unit with a life of its own' (Aldrich and Ruef 2006, p.94). The greater the pressures for coherence within the organization, the more change will occur at the 'level of the entire entity' (Aldrich and Ruef 2006, p.129). Organizational evolution is thus viewed as the study of self-replicating entities (i.e. routines), where replication is affected by external selective pressure (Warglien 2002), overlooking the internal dynamics of change *within* routines themselves. However this routine-organization dualism (and associated evolutionary accounts) has been criticized, as the voice of the individual and agency is lost, excluding the possibility of intentionality, learning (Witt 2004), motivation, creativity, imagination and deliberate adaptations (Cordes 2006).

However this routine as entity view has been heavily criticized not only from an evolutionary perspective (Breslin 2011a; Witt 2004) but from within routines research itself (Parmigiani and Howard-Grenville 2011; Rerup and Feldman 2011). Some have put forward a 'practice' view of routines (Parmigiani and Howard-Grenville, 2011), in which the focus shifts to parts of routines (Rerup and Feldman 2011), how they are enacted day-to-day and their internal dynamics. Parmigiani and Howard-Grenville (2011) argue that the practice perspective opens the black box of routines and their internal workings in specific organizational contexts. While the definition of the routine as a repetitive pattern of actions is similar to the entity approach, the emphasis here is on how these patterns are produced and reproduced, and to what extent the patterns remain stable versus change over time (Parmigiani and Howard-Grenville, 2011). Pentland and Feldman (2005) introduced the ostensive-performative duality to conceptualize this adaptive, improvisational nature of routines. They define the performative aspect of the routine as the 'actual performances by specific people, at specific times, in specific places', as opposed to the ostensive aspect of routines which are 'abstract or generalized patterns that participants use to guide, account for and refer to specific performances of a routine' (Pentland and Feldman 2005, p. 795). Feldman and Pentland (2003) argue that making a distinction between these two levels, captures the interaction between them as they adapt

over time to suit changing contexts. Evolutionary accounts have likewise been developed in which the replicator-interactor is defined through the ostensive-performative duality (Breslin 2008; 2011a; Feldman and Pentland 2003; Pentland et al. 2010; 2012). In this manner, behaviors (as represented by the performative aspect) are varied and selectively retained through the ostensive aspect over time, or in other words variations in performance are selectively retained through the guiding story or ostensive aspect (Feldman and Pentland 2003).

This 'practice' move marks a conceptual shift in emphasis in the story of organizational change. In the entity approach, change is seen to occur through the selection 'of' organizations which act as vehicles 'for' the underlying routines (Hodgson and Knudsen 2010). In this sense, the routine represents the replicator and the organization the interactor (Baum and Singh 1994; Hodgson and Knudsen 2010; Murmann 2003; Nelson and Winter 1982). In the practice view, change is seen to occur within the routine, with variation-selection-retention acting on the mutually constitutive duality of the ostensive-performative aspect. In this 'evolution-as-practice' account, the performances are thus the phenotypic expression of an underlying genotypic logic as represented by the ostensive aspect. In sum it can be seen that the shift from viewing selection as a force which acts on the organization, to one which acts on enacted behaviors, reflects a similar shift in innovation research as noted above.

2.3 Organizational Learning and the Evolution of Knowledge

Finally the shift from entity to practice is further seen in evolutionary research on organizational learning. A number of researchers have identified parallels between evolutionary and learning narratives, with routines in this case being viewed as repositories for learning (Bruderer and Singh 1996; Lant and Mezias 1992; Levitt and March 1988; Madsen et al. 1999; Mezias and Glynn 1993). Unlike early routine-based narratives outlined above, here agency is introduced with managers varying, selecting and retaining routines in response to performance and organizational aspiration levels. So managers search for variations in routines in response to shortfalls between actual and aspired levels of performance. These variants are selected if managers perceive the performance to be favorable (Levitt and March 1988) - though uncertainty and ambiguity surround this interpretation (March and Olsen, 1976). And finally 'successful' routines are retained. However, the link between the routine and the organization as a level of analysis is still retained. In this sense, the routine-'organizational performance' might be seen as the replicator-interactor. Crucially the routine here is conceptualized as a repository for learning (Levitt and March 1988), with external selection forces again being the driving force behind their evolution over time. While managers as agents of change interpret and act on feedback, the resultant evolutionary process nonetheless reflects a process of behavioral and experiential learning (Argyris and Schon 1978; Kim 1993; Nonaka 1994). Such experiential and backward-looking interpretations of evolution downplay the role of forward-looking cognition and logic of consequences (Gavetti and Levinthal 2000; 2004).

As with evolutionary-based narratives in innovation and organizational change, some have sought to break the link between the replicator and organization-as-interactor. So a

replicator-interactor duality is proposed with the former interpreted as the ‘stored information’, and the latter its behavioral ‘expression’ or enacted ‘manifestation’ (Breslin and Jones 2012; Plotkin 1994; Warglien 2002). In this view knowledge cannot be seen to be accumulated or indeed separated from the specific activity or practice involved (Orlikowski 2002). As Miner (1994) notes, many evolutionary accounts treat knowledge as entities independent of the individuals enacting them, thus ignoring social interaction. Therefore to link the replicator (as a repository of knowledge) with the socially constructed concept of the organization becomes problematic. For example, accumulated knowledge can pass between organizations and through spin-outs (Aldrich and Ruef 2006; Breslin 2011a; Szulanski 2000; Szulanski and Winter 2002). ‘So organizational boundaries are not sealed, because cultural norms and practices, institutional requirements, and flows of people permeate them ’ (Aldrich and Ruef 2006, p.130). Moreover, knowledge can be discontinued within organizations, as groups innovate, change and improvise behaviors (Argyris and Schon 1978). Given differences in personal dispositions and life histories, pockets of knowledge can also form within subgroups, despite the pressure for coherence at an organizational level (Aldrich and Ruef 2006). As a result organizations are rarely truly monolithic (Aldrich and Ruef 2006). As a consequence the ‘life’ of the knowledge is not always tied to the ‘life’ of one particular group or organization. Knowledge-in-practice on the other hand is tied to the fate of the practice and not the organization. It cannot be assumed that this continually evolving knowledge-in-practice is a static entity, subject to forces acting beyond the boundaries of the group or even organization. Its maintenance or variation occurs through the continual interrelationship between local performances and abstracted structure (Feldman and Orlikowski 2011). Therefore, it is through the individuals enacting and participating in the activity, that this knowledge is played out, and not through the actions of some distant managers pulling strings like puppeteers. The ‘replication’ of knowledge can only occur through involvement and participation of others in the activity (Brown and Duguid 1991; Lave and Wenger 1990), as opposed to being ‘transferred’ in some entity-like fashion. In sum, in this view the evolution of knowledge is subsumed within the practice, as individuals ‘learn to evolve’ (Breslin and Jones 2012).

Table 1: Evolutionary Approaches and the Unit that Evolves

| | Entity view | | Practice View | |
|--------------------------------|-------------------------|----------------------------|---------------------------------|--------------------------------|
| | <i>Replicator</i> | <i>Interactor</i> | <i>Replicator</i> | <i>Interactor</i> |
| <i>Innovation</i> | Idea | Technological artifact | Chunks of Discrete information | Behavior, language, narratives |
| <i>Organizational Change</i> | Routine as capability | Organization | Abstracted cognitive structures | Performances |
| <i>Organizational Learning</i> | Repository of knowledge | Organizational performance | Cognitive understandings | Socially Situated Practices |

Examining table 1, it can thus be seen that two broad approaches have been taken when conceptualizing the replicator-interactor in evolutionary studies of innovation,

organizational change and organizational learning. The entity approach assumes a replicator-interactor dualism (Farjoun 2010) with the interactor typically conceptualized as an entity, namely physical artifact or as a 'holding' organization. The latter interpretation appears to draw strongly from the biological metaphor of the organism as a vehicle for underlying genes (Dawkins 1976; 1982). In the second practice- or narrative-based approach, the replicator-interactor concept is seen as a duality (Farjoun 2010), in which informational or cognitive representations are mutually constituted through manifest behaviors and narratives (Price 2012). These different perspectives have significant implications for the conceptual and methodological development of future research. Before examining the potential for each approach in developing an evolutionary narratives, it is worth reflecting further on this recent shift from entity to practice.

3. From the Study of Entities to Practice

The recent shift towards context-specific, historical and multi-level studies of organizations reflects the need for research to draw closer to practice. This is reflected in the move away from the study of entities to the study of practice, and the complex, social and context-specific nature of the latter. Knowledge is thus viewed as a process of organizing (Weick 1979) that is 'grounded in practical consciousness' (Giddens 1984, p.60; Pentland and Reuter 1994). This practice perspective puts i) an empirical focus on how people act in organizational contexts (what), ii) a theoretical focus on understanding relations between the actions and structures (how) (Giddens 1984) and iii) a philosophical focus on the constitutive role of practices (why) (Feldman and Orlikowski 2011). First, action is viewed as being situated in a specific set of circumstances in which it is enacted (Parmigiani and Howard-Grenville 2011). In this sense, one cannot study the idea, routine or knowledge beyond the temporal, social and behavioral context in which it is situated. So rather than seeing the social world as external to human agents, with ideas, capabilities and knowledge viewed as entities, the practice approach sees the social world as brought into being through everyday activity. Second, a duality of actions and structure is put forward to capture the changing dynamics of practice. So actions are the unique set of behaviors actors enact as they deal with continually changing local and situated conditions. Structures on the other hand, as represented by the knowledge-in-practice (Orlikowski, 2002) or habitus (Bourdieu, 1990) are abstracted beyond specific instances of action to represent a range of performances which become associated with the particular practice in question. Evolutionary processes can be seen to define the interaction between these two concepts.

Structures and actions are seen to be mutually constituted (Feldman and Orlikowski 2011; Parmigiani and Howard-Grenville 2011; Schatzki 2006). Practice theorists reject dualisms such as structure and agency. In this way structures cannot be conceived without agency, and agency is always configured by structure (Feldman and Orlikowski 2011; Giddens 1984). So on the one hand, actions create generalized principles, structuring dispositions (Bourdieu 1990) or structures (Giddens 1984). These abstracted and general principles in turn configure, enable and constrain actions (Giddens 1984). In this manner the distinction/separation between actions and knowledge is seen as inappropriate, as both are reciprocally constitutive, and one cannot speak about

knowledge without speaking about action, as knowledge is viewed as an ‘an ongoing social accomplishment, constituted and reconstituted in everyday practice’ (Orlikowski 2002, p.252). In this manner a duality of structure and action replaces a dualism of entity and holding ‘vehicle’. In the case of routines, a duality of structure and agency includes; one part embodying the abstract idea of the routine or routine in principle (structure), and the other part consisting of the actual performances of the routine by specific people, at specific times, in specific places or routine in practice (agency) (Feldman and Pentland 2003). Both are interdependent and mutually constituted. So performances of routines create, maintain, and modify the ostensive aspect of routines, which in turn guides, refers to, and accounts for these performances through retrospective sense making (Feldman 2000; Feldman and Pentland 2003; Weick 1995). In this way, the ostensive and the performative are created and re-created through action (Feldman and Pentland 2003; Pentland and Feldman 2008). Neither part can exist independently and through this mutual constitution, the duality produces the system of which they are a part (Feldman and Pentland 2003; Feldman and Orlikowski 2011). Stability and change are thus different outcomes of the same dynamic rather than different dynamics (Feldman and Orlikowski 2011). Feldman and Pentland (2003) thus argue that making a distinction between these two aspects, captures the interaction between them as they adapt over time to suit changing contexts.

3.1 Can a Practice be the Unit that Evolves?

One might question whether the replicator-interactor concept can be used to represent the structure and agency of practice in this way. As noted above, the replicator represents the knowledge or informational component within the evolving unit that can be ‘transferred’ or ‘copied’ (Aldrich et al. 2008; Dawkins 1976). The ‘replication’ of generalized principles as represented by the ostensive aspect, structure (Giddens 1984) or habitus (Bourdieu 1990) can only occur through involvement and participation of others in the activity (Brown and Duguid 1991; Lave and Wenger 1990), as opposed to being ‘transferred’ in some entity-like fashion. This involves a new arrival working with those carrying out the routine, communicating with others to understand the logic behind sequences of actions and ultimately becoming part of, and participating in, the group activity (Lave and Wenger 1990). In this way, a new arrival for instance shares the experience of completing the task, and through communication begins to make sense of performances, as (s)he also develops a ‘shared’ understanding that is ‘similar’ to the ostensive aspect of other participants. As a result, others learn the practice and develop the ability to ‘enact - in a variety of contexts and conditions - the knowing in practice’ (Orlikowski 2002). So, over time and through shared engagement, abstracted principles emerge in connection with the set of shared performances. While clearly each individual’s unique understanding of the routine differs (Feldman 2000), each recognizes specific performances as instances of the routine and which are understood by fellow participants in the routine (Feldman and Pentland 2003). Through communication and the use of a ‘shared language’ (Hodgson and Knudsen 2010), and by participating in the performance of the task (Lave and Wenger 1990), individuals can ‘access’ the cognitive understandings of others, which facilitates the ‘transfer’ of the latter.

This leads onto the question of how enacted behaviors might represent the interactor. Hull argued that the latter interacts as a cohesive whole with their environment in a way that causes differential replication of the underlying replicator (Hull 1988). This definition draws directly from the notion of the interactor as a vehicle used in biology (Dawkins 1982). Indeed the routine-organization dualism might be seen to downplay agency, with both concepts being more associated with structures in Giddens's (1984) sense. The interactor might also be conceptualized as the developmental expression of the replicator through interaction with the environment, as opposed to an interacting 'cohesive whole' or 'entity' (Hull 1988) which carries associated replicators. In biology, this process is played out over the millennia, as the developmental expression of genes is varied in each passing generation. With knowledge however, the process is played out over successive interactions, events or activities. In this manner sets of performances are guided, referred and accounted for by the ostensive aspect (Feldman and Pentland 2003) as they are adapted to meet the local conditions on the ground. Or the performances represent the 'interaction' of these abstracted guiding principles (the ostensive) with the local environment, through their expression in practice. Indeed this 'interaction' with the external world through practice is reflected in the sense that those external to the group, interpret the routine through this complex of actions. Therefore, one can argue that the concept of the replicator-interactor can be represented by a duality of cognitive structure and manifest behaviors. The former represents the generalized structure of the knowledge-in-practice, shared between individuals through interaction, communication, socialization and working together. The latter represents the outward manifestation of this structure through enacted behavior, which through 'interaction' with the external world results in the differential replication of the former.

4. Developing a Multi-Level Co-evolutionary Narrative

Having established the conceptual foundations of both the entity and practice-based approach, one can examine the theoretical implications of both when developing multi-level, co-evolutionary narratives.

4.1 Entity-Based Co-Evolutionary Accounts

As noted in the introduction, various scholars have adopted the label co-evolution to reflect the interrelationship between micro- and macro-level change within organizations (Lewin and Volberda 1999). Some have used even the variation-selection-retention framework to conceptualize co-evolutionary processes within organizations (Burgelman 1991; Langton 1984; Murmann 2003; Tushman and O'Reilly 1996). However many of these accounts fail to clearly identify and then describe the co-evolution of units of evolution at different levels within this co-evolutionary hierarchy. Therefore the question of whether to adopt an entity or practice-based view is highly relevant in this endeavor. For example Arthur (2009) presents a detailed account of the evolution of technologies through a process he terms combinatorial evolution. In this account technologies inherit parts of technologies that preceded them in a complex, multi-level and interactive process, starting with the phenomena, or basic building blocks, from which humans ultimately develop working technologies. Drawing on biological analogies, Arthur views evolving technologies as metabolisms, in which phenomena are 'programmed' for a

purpose. He posits that phenomena are analogous to genes in the biological world. The technological elements are by extension viewed as the phenotypic expression of those underlying genes. The process through which new combinations of technologies arise is mediated by engineers and designers, and is defined by the mechanisms of variation (through combination), selection and retention, as combinations gain favor and spread through communities in a meme-like (Dawkins 1976) fashion. However it is unclear which evolving system/level Arthur is referring to and what the corresponding interactor might be. So while Arthur's account highlights the complexity of the process of technological evolution, he does not really commit himself to specifying units of evolution within the multi-level system he presents. This level of precision is needed in order to resolve the issues noted above, and to fully develop a complex multi-level and co-evolving conceptualization of technological evolution. In the field of organizational learning, Crossan et al. (2013) similarly put forward a multi-level conceptualization of organizational learning, in which they identify a number of replicators at different levels, including 'retained learning' (presumably knowledge) and even individuals (such as Steve Jobs at Apple). In their co-evolutionary account they argue that such replicators can exert selection pressures at different levels in the hierarchy. However this account lacks conceptual precision and consistency with replicators including on the one hand knowledge, and on the other individuals. Moreover, Crossan et al. (2013) fail to identify corresponding interactors at each level.

In developing theory-led co-evolutionary accounts, Baum and Singh (1994) stress the importance of defining and identifying units of analysis at each level within an organizational hierarchy. These co-evolving units need to be discrete classes of 'entities' with their own evolutionary path, yet at the same time interact with 'entities' at other levels. As noted above the entity view of the replicator-interactor concept assumes the organization acts as a vehicle for bundles of replicators (Hodgson and Knudsen 2010). So with increasing levels of organizational coherence, selective forces shift from evolving routines and schemata to the organization itself as an entity (Aldrich and Ruef 2006). The focus of attention thus remains largely at the level of the organization, with at best managers making choices on behalf of the firm (Levitt and March 1988), and as a result above the level of individual learning (Schulz 2002). This becomes somewhat problematic when examining the co-evolution of routines, knowledge or ideas within the organization itself. Addressing this problem, some have expanded the entity view by identifying units of evolution at different levels of analysis (Baum and Singh 1994; Hodgson and Knudsen 2010). For example Baum and Singh (1994) make a distinction between genealogical entities (replicators) that 'pass on their information largely intact in successive replications', and ecological entities (interactors) that are the 'structural and behavioral expressions of the genealogical entities, interact with the environment and this interaction causes replication to be differential' (Baum and Singh 1994, p.4) at each level in the organizational hierarchy. So the 'routine-job' represents the micro-level, moving to the 'organization-organization' and 'species-population' at higher levels, as shown in table 2. Nascent and growing organizations can use abstractly-defined idiosyncratic jobs to build organizational knowledge and so develop routines which are better fit to the emerging market (Aldrich and Ruef 2006). More recently Hodgson and Knudsen (2010)

argue that the ‘habit-individual’ represent the micro-level, with the ‘routine-group’ and ‘routine-organization’ representing higher levels.

Table 2: Entity Approaches in Multi-Level Co-Evolution

| Level | <i>Baum and Singh (1994)</i> | | <i>Hodgson and Knudsen (2010)</i> | |
|---------------------|------------------------------|-------------------|-----------------------------------|-----------------------|
| | <i>Replicator</i> | <i>Interactor</i> | <i>Replicator</i> | <i>Interactor</i> |
| <i>Organization</i> | Species | Population | Routine | Organization |
| <i>Group</i> | Organization | Organization | Routine | Group or Organization |
| <i>Individual</i> | Routine | Work Group or Job | Habit | Individual |

These entity-based conceptualizations might have some interesting implications for practice, and the management of co-evolutionary processes. In this sense, fit at each level of the organization is replaced by an examination of degrees of fitness at each level within an organization’s hierarchy. Are the routines within specific departments or groups suited to the changing circumstances or challenges faced by the organization? If not then perhaps the group or individuals concerned should be removed or replaced. Do the ideas of certain individuals dominate the innovation process, or are they an obstacle to change? Can other individuals be introduced to influence the dynamics of change, and champion entrepreneurial behavior? If idiosyncratic jobs imprint organizational practices at birth, what degrees of agency have subsequent arrivals? In this manner, such co-evolutionary narratives can encourage an examination of forces at multiple levels and crucially the interaction between these. However despite the multi-level nature of these proposed solutions, there is still an inherent assumption that evolving ideas, routines, or knowledge are terminally tied to the individuals, groups and organizations concerned. As noted above in many cases, this link has been focused on the organization as an entity, with the assumption being that integrative forces within the organization result in change largely occurring at the level of the firm (Aldrich and Ruef 2006). If one assumes however, that organizational cultures are fragmented or differentiated, then clearly the unit of selection shifts within the firm itself. So, selection ‘of’ these individuals and groups results in the selection ‘for’ associated ideas, routines and knowledge (Hodgson and Knudsen 2010). However, such an interpretation of selection downplays choices made by the individuals concerned (Witt 2005). Selection ‘for’ routines gives primacy to the selective powers ‘of’ the world external to the phenomena (e.g. managers, customers etc). In this way, poorly performing routines eventually become extinct as managers select different groups and individuals, or customers select different organizations. On the other hand, if individuals are viewed as ‘selecting’ habits or routines for enactment through the choices they make, then clearly foresight, anticipation of futures, and the interpretation of feedback from the external world come to the fore.

4.2 Practice-Based Co-Evolutionary Accounts

With practice-based evolutionary accounts, the replicator-interactor concept is represented as a mutually constituted duality of cognitive representations and manifest behaviors/narratives respectively. However most of these accounts again tend to focus

exclusively on only one level of analysis. For example Pentland et al. (2012) focus on the group as a level of analysis, with routines evolving and adapting in a mutually constitutive relationship between the ostensive guide and performative aspect. However, as noted above some have identified units of analysis at different levels in the development of co-evolutionary accounts (Mesoudi 2011; Plotkin 1994). So individuals and collective cognitive structures represent the replicators at the level of the individual, group and organization respectively (Breslin 2008). The corresponding interactor depends on the ‘micro-environment within which selection occurs, namely the set of actions performed by individuals, groups or firms’ (Breslin 2008, p.412), as shown in table 3.

Table 3: Practice/Narrative Approaches in Multi-Level Co-Evolution

| Level | <i>Breslin (2008)</i> | | <i>Dobson et al. (2013)</i> | |
|---------------------|---|-----------------------------------|--|--|
| | <i>Replicator</i> | <i>Interactor</i> | <i>Replicator</i> | <i>Interactor</i> |
| <i>Organization</i> | Shared understanding of routine by organizational members | Complex of Organizational Actions | Organization-wide mental representation of an idea | Organization-specific narratives |
| <i>Group</i> | Abstracted understanding of routine within group | Task-related Group actions | Idea shared in collective group mindspace | Collective shared narratives in group |
| <i>Individual</i> | Individual cognitive understanding of habit | Task-related Individual actions | Individual held mental representation of an idea | Individual narratives relating to idea |

A simple example of a product design group can help illustrate Breslin’s (2008) account (see table 3) of the co-evolutionary processes acting at each level.

- *Individual Level:* When completing a task such as an engineering calculation, individuals within the product development group can chose to select either a collective routine associated with that task, such as a ‘standard calculation’ routine, which they share with other members of the group, or they may chose to carry out a calculation habit which only they use. The individual can also attempt to vary replicators at both levels by changing their individual calculation habit or by persuading others to alter the more collective ‘standard calculation’ routine. Once selected by the individual, the routine or habit is then enacted through the individual’s actions, which in turn receive feedback from external parties, such as other members of the group, managers and customers (Breslin 2008). Based on the particular strength of these feedback signals, these variants of replicators are retained over time. So for instance if the individual interpreted the use of the calculation habit as resulting in better quality designs, the individual might choose to retain this habit over time. This individual-level evolutionary process is in turn nested within the evolution of collective routines within the group.

- *Group Level:* At the level of the group, each individual might choose to enact both individual habits, as outlined above, and collective routines. Again individuals are capable of attempting to vary and select these replicators. However, now the enactment and feedback from other group members is played out within the selection mechanism of the group. Through communication, dialogue and negotiation (Brown and Duguid 1991; Lave and Wenger 1990), the individual selection mechanisms are reconciled within the collective selection mechanism, resulting in a set of group actions which then receive feedback from the world external to the group. Each individual will interpret feedback both from other individuals and the world outside the group, including managers and customers (Daft and Weick 1984; March and Olsen 1975). In this way whilst one individual might interpret feedback based on the use of the collective standard calculation routine as positive, another individual might interpret this differently and call for a modification in the calculation routine. Over time different interpretations are resolved within the group through dialogue, negotiation and socialization (Lave and Wenger 1990) as routines are retained.
- *Organizational Level:* At a higher level, the evolutionary processes of each group are played out within the context of the organization. The organization will thus be a polythetic collection of individual habits, collective routines, and now organizational routines. This collection of replicators is polythetic in the sense that the existence of routines does not exclude the coexistence of individual habits and after the formation of the routine individuals can continue to adopt both group routines and individual habits. In this way, whilst individuals may be the agents enacting both group routines and individual habits, the replicators at each level are discrete in the sense that selection occurs at both levels, depending on the differential degree of fitness. Therefore whilst different groups within the organization develop routines in the completion of activities such as *idea generation*, *idea screening* and *product development*, they also 'share' broader organizational routines associated for instance with the management of project documentation and information through the company's information system. Individuals and groups can attempt to persuade others within the company to vary these organizational routines, perhaps by presenting alternative approaches to for instance project documentation. Individuals and groups can also choose to select this organizational routine, or may even choose to select alternative group-level routines or even individual-level habits associated with data management. Again these decisions to retain individual habits, group or organizational routines will depend upon the feedback from other groups, managers and agents external to the organization, such as customers.

The practical implications of this practice-based co-evolutionary narrative clearly differ from the entity-based view described above. First it is assumed that individuals and groups can change, innovate and learn, and as such ideas, capabilities and knowledge evolve within the collective mind space (Dobson et al. 2013). Increasing fitness levels then involves a shift in emphasis in the variation-selection-retention process. Are

variations in ideas, knowledge and capabilities generated at all levels of an organizations hierarchy? Are individuals and groups interpreting feedback based on enacted behaviors in such a manner that they are selecting the best fit variations? Are these selected variations retained and diffused within the wider organization? In brief co-evolution involves individuals and groups 'learning to evolve' (Breslin and Jones 2012), as opposed to being moved around on some metaphorical chessboard.

In summary, the co-evolutionary narrative one develops differs depending on whether one uses an entity- or practice-based interpretation of the replicator-interactor. In the former account, ideas, capabilities and knowledge are viewed as repositories tied to the life of individuals and groups. The evolution of these entities is experiential and as a result path dependant. In practice-based narratives, ideas, capabilities and knowledge are viewed as being enacted in practice, and having an existence through those actions. As a result they are not necessarily tied to the fate of the individuals and groups concerned. Individuals can change and learn, with ideas, capabilities and knowledge struggling for survival in the collective 'mind space' (Dobson et al. 2013). Examining these differences in approach taken, the choice to use a practice- or entity-perspective depends the relationship between organizational and environmental change. In the entity view, one largely assumes that the external environment (or that external to the entity in question) changes more rapidly than the associated individual or group. As a result, ideas, capabilities and knowledge are selected 'for', by the selection 'of' carrying individuals. On the other hand if one adopts a practice view, then one assumes that individuals and groups can adapt dynamically (and indeed prospectively) to external change. So while multi-level narratives can be developed using both approaches, the different positions taken reflect the long-standing dichotomy between deterministic and voluntaristic perspectives (Abatecola 2012). In the former it is assumed that structural inertia and environmental change have primacy, whereas in the latter adaptation and strategic choice hold sway (Abatecola 2012; Breslin 2008).

5. Implications for Research

Researching multi-level co-evolutionary processes clearly presents some considerable challenges in terms of research design and methods. In light of the discussion above a number of core issues come to the fore.

5.1 History and Context Matters

Evolution is a temporal process and as such history matters (Winter 2012). By studying organizations through cross-sectional methods, research is subject to a selective bias in that only 'surviving' firms are captured (Aldrich 2001; Martinez et al. 2011), and the historical process through which these survivors evolved is lost. Moreover, the context in which this evolutionary process takes place has a significant bearing on both the present and future 'states' of the resultant system. Understanding the context of change is therefore key to unpacking the processes of variation-selection-retention (Lippmann and Aldrich 2014). As a result, longitudinal studies must be seen as key research method. With the entity approach it is assumed that specific ideas, capabilities and knowledge are linked to individuals and groups. Assuming those same individuals and groups remain in

place over a period of time, so too do the underlying ideas, knowledge and capabilities. As a result proxy measures might be used to capture underlying capabilities, with snapshots being taken over a period of time. Such methods might include panel studies in which the same organizations are tracked over time (Reynolds and White 1997). On the other hand if one adopts a practice-based approach the changing nature of ideas, knowledge and capabilities must be captured through the study of actions, narratives and performances. A number of approaches might be taken here from analyses of recorded actions (e.g. log sheets) to ethnographic studies which seek to directly observe behaviors. While costly in terms of time and resources, ethnographic approaches can allow researchers to capture the totality and rich context of individual organizations (Lippmann and Aldrich 2014). Regardless of the methods chosen, the longitudinal nature of the research gives researchers the opportunity to explore key aspects of the evolutionary dynamic including the emergence, development and extinction of ideas, capabilities and knowledge over time.

5.2 Levels of Complexity

Co-evolutionary studies need to explore the multi-level complexities of organizations, including individuals, groups and associated interactions and relational qualities. Many past studies which have adopted an entity approach have focused on the organization or senior management as a level of analysis, and as a result have overlooked this multi-level nature of change. This has even led to a criticism that evolutionary accounts ignore the interaction between individuals and/or groups (Buenstorf 2006), with the approach being committed to just one level of analysis; e.g. the routine-organization as replicator-interactor. To address this criticism, future studies need to identify measures at multiple levels within the organizations hierarchy, to capture the co-evolutionary nature of changing ideas, capabilities and knowledge. Given the complex longitudinal nature of changing behavior in organizations, simulation models might be used alongside such studies allowing the researcher to explore these complex processes over time (Breslin, 2014; Lant and Mezias 1992; Carley and Hill 2001; Lomi et al. 2010). Such computational models can capture the contextual and historical complexity of changing organizational behavior (March 2001), as the path-dependant co-evolution of interacting parts is modeled over time. As Aldrich (2001, p.125) notes, 'the value of our research results depends on our ability to construct models of the underlying change process, use them to improve our theories, and then apply them to building better models'. A process in which evolutionary approaches can add significant value, given its inherent co-evolutionary and multi-level nature.

If one adopts a practice approach, the multi-level study of organizations can involve complex, in-depth and multi-layered ethnographic research. Some recent co-evolutionary research has indeed explored the rich complexities of change within organizations (Dantas and Bell 2011; Koza et al. 2011; Rodrigues and Child 2003; Volberda and Lewin 2003). However, as noted above these studies have not drawn on evolutionary concepts to develop their narratives. Practice-based studies need to also explore the social relations and interactions between individuals and groups at different levels. Individuals hold different understandings of the idea, capability and knowledge, and so to generate a complete understanding we need to consider different points of view across the

organization (Salvato and Rerup 2011). These narratives necessarily need to be unpacked into understandings which are unique to the individual, shared within the group performing the routine, or within the wider organization, as 'we cannot see the whole entity from a single perspective' (Pentland and Feldman 2008, p.286). As a result of the position taken, the practice-perspective is necessarily resource heavy in terms of empirical investigation.

Related to this latter point, practice-based studies also need to unpack the complexity of the mutually constitutive relationship between a hierarchy of cognitive structures and manifest behaviors. As a consequence, the means of inquiry employed must capture both observable performances, and more tacit cognitive structures. Indeed Parmigiani and Howard-Grenville (2011) note that in general, scholars exploring a practice-view of routines tend to use single case studies, derived from ethnographies and direct observation (Feldman 2000; Szulanski 2000). While observations can capture key performances over time (though limited to the exposure of the researcher to expressed behaviors), in-depth interviews are used to explore narratives, representing key cognitive understandings (Feldman 2000). In light of these issues, and given the duality of the ostensive-performative conceptualization, studies should seek to capture both observed actions and underlying interpretations and narratives, and the interrelationship between them.

6. Conclusion

This paper has shown that two broad approaches have been developed in evolutionary research when considering the unit of evolution. In the entity approach it is assumed that ideas, knowledge and capabilities are bound to individuals, groups and organizations with change over time being determined by external selection forces. In the practice-based view, the focus shifts to the process in which ideas, knowledge and capabilities are continually enacted and modified through actions. Both approaches can be used to develop co-evolutionary accounts, with associated conceptual and methodological consequences. In conclusion the approach taken in developing co-evolutionary narratives depends first on one's philosophical commitment regarding the nature of change within organizations. So if one assumes a deterministic stance, an entity approach is more likely, whereas a voluntaristic or adaptive view might favor a practice-based approach. Second, the approach taken is influenced by the research design and method adopted. Multi-level practice-based studies are resource intensive, involving complex and in-depth analyses of organizations over a period of time. This intensity includes both lengthy periods of investigation and subsequent analysis of findings. Entity approaches on the other hand can largely overlook the complex black-box of daily activities, and instead focus on proxy measures to capture underlying ideas, capabilities and knowledge. Ultimately the validity of both approaches will be determined by its usefulness to the practice of management.

Perhaps the greatest advantage in developing a co-evolutionary narrative based on evolutionary concepts is that the approach offers the possibility of carrying out multi-level studies under the same unifying theoretical framework. As noted by Lewin and

Volberda (1999, p.520) co-evolution also offers scholars the potential to integrate ‘micro- and macro-level evolution within a unifying framework, incorporating multiple levels of analyses and contingent effects, and leading to new insights, new theories, new empirical methods, and new understanding’. Previous research within these fields has stressed the importance of examining simultaneous and interacting processes occurring at multiple levels. For instance in studies of episodic change, sets of interdependencies within organizations converge and tighten during periods of relative equilibrium (Tushman and Romanelli 1985), leading to inertia (Tushman and O’Reilly 1996) as the organization is unable to change as rapidly as the environment. Continuous change (Weick and Quinn 1999) on the other hand refers to ongoing, evolving, and cumulative change in organizations, as they improvise and learn over time. Understanding the complex interaction of entities or practices co-evolving at different levels is therefore a key aspect in understanding the dynamics of these processes, and one of significant importance in the future development of research in organization studies.

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