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# THE KNOWLEDGE-BASED VIEW, NESTED HETEROGENEITY, AND NEW VALUE CREATION: PHILOSOPHICAL CONSIDERATIONS ON THE LOCUS OF KNOWLEDGE

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**At what level is new value created, or, put differently, what is the locus of knowledge? While knowledge and capabilities-based researchers argue that the locus of new value and knowledge lies at the firm level, we challenge this conceptualization and theoretically build toward more individualist foundations. We explicate the underlying philosophical assumptions of extant knowledge and capabilities-based work and discuss attributional problems. Nested (individual-level, a priori) heterogeneity may provide a better explanation of collective heterogeneity.**

> There is really no need for the firm to be the fundamental unit of organization in invention; there is plenty of reason to suppose that individual talents count for a good deal more than the firm as an organization (Arrow, 1962: 624).

The knowledge and capabilities-based views (KBV) in strategy have largely extended resource-based reasoning by suggesting that knowledge is the primary resource underlying new value creation, heterogeneity, and competitive advantage (Barney, 1991; Grant, 1996; Kogut & Zander, 1992). However, despite the recent proliferation of research into knowledge-based arguments, a number of fundamental constructs and questions have yet to be clearly defined and explored (e.g., see Kaplan, Schenkel, von Krogh, & Weber, 2001, for a recent overview). A critical, implicit debate underlying much knowledge and capabilities-based work is whether the individual or the collective is the source of new value or, put differently, the locus of knowledge.[1] That is, at what level is new value created?

Nahapiet and Ghoshal (1998: 246), among others (e.g., Grant, 1996: 112), have pointed out that scholars have clearly taken sides in this debate and given primacy to one of two different competing sources of value or knowledge loci—individuals or collectives. While a few scholars have argued for the primacy of the individual (Grant, 1996: 112; Simon, 1991: 176), most have focused on a collective locus of knowledge (e.g., Adler, 2001; Brown & Duguid, 2001; Eisenhardt & Martin, 2000; Kogut, 2000; Kogut & Zander, 1992, 1995; Nahapiet & Ghoshal, 1998; Nelson & Winter, 1982; Powell, Koput, & Smith-Doerr, 1996; Spender, 1996; Tsoukas, 1996; Winter, 2003; Zollo & Winter, 2002).

The theoretical and practical implications of the debate between an individual and collective locus of knowledge are far from pedantic for our conceptualization of new value creation. Sev-

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[1] We roughly concur with Kaplan's definition of the locus problem and apply the question to knowledge-based work: "The locus problem may be described as that of selecting the ultimate subject-matter for inquiry in behavioral science, the attribute space for its description, and the conceptual structure within which hypotheses about it are to be formulated" (1964: 78).

eral fundamental questions are implicated. For example, is new, value-creating knowledge fundamentally about organizational processes, or is it rooted more in the attributes and abilities of the individuals involved? Are innovations the result of new value and ideas that are created as a collective process that is independent of individuals, or does new value creation start with the individual? Moreover, is knowledge transfer more about structural and organizational processes, or is it about the underlying abilities of the respective individuals to absorb knowledge? Finally, from a strategic perspective, are knowledge-based advantages the result of an organization's ability to acquire and build strategic assets, or are these advantages the result of the underlying individuals' abilities to make astute resource acquisition decisions? Overall, the practical implications for how a firm creates new value are radically different, depending on the underlying assumption about the locus of knowledge.[2]

To foreshadow our conclusions, we argue that a coherent theory of new value creation must start with a consideration of the individuals who make up the organization. While collectivist knowledge and capabilities-based work assumes that individuals a priori are homogeneous, infinitely malleable, or randomly distributed into organizations, we argue and provide evidence that this conceptualization is flawed and has lead to theoretical, locus-related misattributions, with direct implications for our understanding of the origins of new value. Specifically, in lieu of an alternative approach to understanding new value and knowledge creation, we build on and discuss the implications of accumulating empirical evidence from cognitive science, which gives significant importance to heterogeneous a priori individual-level knowledge. We also discuss the underlying attributional problems of collectivist approaches, which include not accounting for individuals as initial conditions, focusing on proximate versus final causes, and measurement problems. By way of grounding our analysis, we highlight locus-related concerns by revisiting empirical knowledge and capabilities-based work, which has argued for contradictory sources of new value in the context of the biotechnology and pharmaceutical industries. In conclusion, we discuss the immediate next steps necessary to disentangle the locus of knowledge question or individual- and collective-level effects and associated implications for new value creation.

[2] We thank the editor and an anonymous reviewer for pointing out some of these implications.

## INDIVIDUAL VERSUS COLLECTIVE KNOWLEDGE IDEAL TYPE

To facilitate our discussion, we explore the collectivist and individualist traditions of knowledge (cf. Nahapiet & Ghoshal, 1998: 246) as pure or ideal types (Weber, 1949; cf. Adler, 2001; Ouchi & Johnson, 1978), or as Mertonian paradigms. We first discuss our justification for employing ideal types and then review the essential positions of the two perspectives. Thereafter, we contrast the collective and individual ideal types on important philosophy of science dimensions. These dimensions include epistemology, ontology, and mereology, which deal with issues of causal directionality and part-whole relations. We then contrast the two perspectives in light of their underlying assumptions with regard to levels-of-analysis issues and human nature.

### Note on Methodology and Parameters

For our purposes, the comparison between individual and collective ideal types serves two functions. First, research tends to eschew paradox and conflict in theory building in favor of tractable models (Poole & Van de Ven, 1989: 563). However, we make the implicit debate between an individual versus collective locus of knowledge the very focus of our paper and our explicit strategy for comparing assumptions and key theoretical dimensions. From the perspective of new value creation, our underlying question is "Where (primarily) is new value created?" In explicating these two ideal types, we use two of Poole and Van de Ven's (1989: 566) theory-building strategies: opposition and spatial separation. As suggested by the authors, "A great deal can be learned from juxtaposing contradictory propositions and assumptions, even if they are incompatible" (1989: 566). Second, while ideal types do not replace theory, they can nevertheless offer a stepping-stone for the development of subsequent theoretical arguments, broadly addressing the question of which key

variables and constructs theories should address and which should be discarded (Bacharach, 1989: 497; Weick, 1995).

It is important to briefly discuss some parameters and limitations. First, given the vast literature on knowledge in strategy and organization theory (including several recent journal special issues), we do not pretend to include all of the knowledge-based literature in our analysis but focus, rather, on key foundational articles. Several of these articles make an explicit choice about the key sources of new value, whereas others assume it implicitly. Thus, the dichotomy we employ is not our creation. Furthermore, the discussion of extremes or polar modes provides a compelling way to study these arguments, since mixed, dualist, or interactionist modes are permutations of the two extremes and often suffer from problems of internal contradiction and incoherence (Rosenberg, 1995: 22; Sawyer, 2001: 570; cf. Conner & Prahalad, 1996: 478). Moreover, social analysis inherently begins with a focus on either individuals or collectives as the key independent causal variables or as the antecedent to social outcomes (e.g., Coleman, 1990: 2; Wrong, 1961: 183); in our case, what specifically are the primary, fundamental drivers of new knowledge and value creation?

Second, there have been a number of parallel developments and extensions in the knowledge-based literature, including research looking at competencies, routines, capabilities, and, more broadly, organizational learning (e.g., Eisenhardt & Martin, 2000; Henderson & Cockburn, 1994; Levitt & March, 1988; Nelson & Winter, 1982; Teece, Pisano, & Shuen, 1997; Zollo & Winter, 2002). We broadly subsume and discuss this research under the KBV heading since the work shares significant overlaps (cf. Argote & Ingram, 2000; Madhok, 1997).

## Individual Versus Collective Locus of Knowledge

Extant knowledge-based research largely focuses on collectives as the source of new value or the locus of knowledge (e.g., Henderson & Cockburn, 1994; Kogut & Zander, 1992; Nelson & Winter, 1982; Teece et al., 1997). From the collectivist perspective, knowledge is fundamentally a social phenomenon that is different from the aggregation of individuals (Nahapiet & Ghoshal, 1998: 246). For example, Nelson and Winter state that

> the possession of technical "knowledge" is an attribute of the firm as a whole, as an organized entity, and is not reducible to what any single individual knows, or even to any simple aggregation of competencies and capabilities of all the various individuals, equipments and installations of the firm (1982: 63).

Kogut and Zander also point to a distinctly collectivist perspective by arguing that "firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible to individuals" (1992: 384). The authors later define the firm further as "a social community specializing in the speed and transfer of knowledge" (Kogut & Zander, 1996: 503). Spender concurs and has further pointed out that the collectivist tradition presumes (specifically referring to Nelson & Winter, 1982) that "the firm has an ability to know independently of its employees, or at least independently of their conscious reasoning" (1996: 51). Researchers have also alluded to a "collective mind" (Weick & Roberts, 1993; also see Durkheim's [1962] notion of "collective conscience"). Furthermore, collective knowledge is argued to be the most important kind of strategic knowledge, and, thus, collectivist theories inherently must recognize that "by restricting the scope of our analysis only to social knowledge, we will be unable to capture the influences that . . . individual knowledge may have on the intellectual capital of the firm" (Nahapiet & Ghoshal, 1998: 247; also see Spender, 1996). Overall, only collective variables are allowed as explanans for outcomes, or as the antecedent to new value—such as culture, community, routine, and environment.

An exception to the prevailing mode in knowledge-based work is the theoretical work of Simon and Grant. This individual-oriented tradition takes the position that individuals are the primary locus of knowledge and should be the basis for understanding new value creation and organizational outcomes. Grant emphasizes the role of the individual as the key knowledge locus. He turns the collectivist logic discussed above on its head and suggests that

> the emphasis upon the role of the individual as the primary actor in knowledge creation and the principle repository of knowledge, I believe, is essential to piercing the veil of organizational

> knowledge and clarifying the role of organizations in the creation and application of knowledge (Grant, 1996: 121).

Simon has further argued that "all organizational learning takes place inside human heads; an organization learns in only two ways: (a) by the learning of its members, or (b) by ingesting new members who have knowledge the organization didn't previously have" (1991: 125).

When viewed against philosophy of science dimensions such as epistemology, ontology, and mereology, stark contrasts are apparent between the individualist and collectivist knowledge perspectives in terms of the sources and origins of new value (see Table 1). These contrasting assumptions have received little explicit attention from KBV scholars. Yet these differences are important given that, as noted by

**TABLE 1**
**Dimensions of Individual and Collective Knowledge Ideal Types**

| Dimensions | Individual Ideal Type | Collective Ideal Type |
|---|---|---|
| Locus of knowledge or source of new value | Individual | Collectives |
| Methodological tradition or epistemology | Methodological individualism | Methodological holism or collectivism |
| Representative quote | ". . . the belief in the empirical existence of social wholes or collectives, which may be described as naïve collectivism, has to be replaced by the demand that social phenomena, including collectives, should be analyzed in terms of individuals" (Popper, 1968: 341) | "Sociological method as we practice it rests wholly on the basic principle that social facts must be studied as things, that is, as realities external to the individual. There is no principle for which we have received more criticism; but none is more fundamental" (Durkheim, 1952: 39) |
| Causal directionality | Micro-micro, micro-macro; upward causation | Macro-macro, macro-micro; downward causation |
| Explanans or independent variables | Individuals | "Social facts"—community, collective, routines, culture, environment, organizing principles, capabilities, etc. |
| Collective ontology | Reducible to individuals—whole is the sum of parts; only individuals are "real" | Not reducible to individuals—whole is greater than sum of parts or independent whole |
| Mereology—i.e., part-whole or individual-collective level relationship | Resultant whole (supervenience) | Emergent whole (multiple realizability) |
| Level of analysis assumptions | Individual heterogeneity, independence from higher-level interaction | Individual homogeneity, higher-level collective heterogeneity—e.g., firm, culture, environment |
| Theory of knowledge | Internalist | Externalist |
| Source of knowledge | A priori or innate | Environmentally determined |
| Human nature | Nature | Nurture, blank slate |
| Key variables and mechanisms | Individual mobility, personnel selection, appropriation, incentives, HR practices, self-selection | Routines, competencies, capability, process, culture, community |
| Representative quote | "The firm is in no sense a 'natural unit'. Only the individual members of the economy can lay claim to that distinction. All are potential entrepreneurs. . . . The ultimate repositories of technological knowledge in any society are the men comprising it . . . in itself the firm possesses no knowledge" (De Graaf, 1957: 16) | ". . . the possession of technical 'knowledge' is an attribute of the firm as a whole, as an organized entity, and is not reducible to what any single individual knows, or even to any simple aggregation of competencies and capabilities of all the various individuals, equipments and installations of the firm" (Nelson & Winter, 1982: 63) |

Rosenberg, "Being clear about a discipline's philosophy is essential because at the frontiers of the disciplines, it is the philosophy of science that guides inquiry" (1995: 4). Indeed, collectivist assumptions have guided most knowledge-based work. Moreover, such assumptions have important implications for how we interpret the findings of research and also for how the field thinks about new value creation.

**Epistemology: Methodological individualism versus collectivism.** The individual and collective knowledge ideal types map squarely onto the epistemological traditions of methodological individualism and collectivism. The perennial debate between these two traditions has plagued a number of the disciplines that the field of strategy draws on, including economics, sociology, and philosophy (see O'Neill, 1973, for a compilation of key readings; see also Popper, 1957; Rosenberg, 1995; Udehn, 2001). However, the individualism-collectivism discussion has only rarely been alluded to in the management literature (see Donaldson, 1990, for an exception). This omission is unfortunate, since the basic values and questions suggested in this debate are particularly critical regarding our assumptions about new value creation, given that knowledge-based arguments directly build on these respective traditions. The crux of this debate has been whether individuals *or* collectives should serve as the locus in explaining and predicting social outcomes—micro-macro versus macro-macro (Kincaid, 1997). We briefly review each tradition in turn.

Methodological collectivism builds on a Durkheimian sociological tradition, which provides the basis for much extant knowledge-based work (e.g., Kogut & Zander, 1996). Methodological collectivists argue that there is something emergent about collectives leading to "social facts," which are sui genesis, or worth studying in their own right (Durkheim, 1952: 39; Popper, 1957: 71; Rosenberg, 1995: 132).[3] Individuals are, in effect, considered extraneous to collectivist theories since collective facts (e.g., community, routines) largely determine outcomes (Durkheim, 1962: 103). Collectives must be considered real because they exhibit "downward causation" or determine the behavior of lower levels or individuals (Durkheim, 1952; cf. Sawyer, 2001). In his classic analysis of suicide, for example, Durkheim concluded that the phenomenon was a function of top-down, extraindividual "social facts" and cultural environment (Durkheim, 1952: 324). That is, not only do these collective facts exist, but they also have primary causal influence on lower levels of analysis. The strong methodological assumption is that structure and organization exist prior to individual action and drive the behavior of individuals (Coleman, 1990; Rosenberg, 1995: 5). Individuals and collectives only behave according to a priori routines, structure, roles, or organization. These are independent of individuals, or ontologically autonomous.

Methodological individualists, however, have argued that collectives are inherently made up of and result because of individuals, and individuals should thus be the basic unit of analysis (Elster, 1989; Nagel, 1961; Popper, 1968). Popper, for example, has argued that "the belief in the empirical existence of social wholes or collectives . . . has to be replaced by the demand that social phenomena, including collectives, should be analyzed in terms of individuals" (1968: 341; see also Tuomela, 1990). Individualists deny the existence of the metaphysical and therefore argue that only individuals should serve as explanans (cf. Hempel & Oppenheim, 1948). Collectives such as organizations then result from individuals and their actions. The term *methodological* connotes an a priori, epistemological commitment to seeking individual-level explanations or, perhaps more accurately, the belief that only individuals exist in any real sense and should provide the basis for all collective explanation (Rosenberg, 1995: 125). Therefore, individual human action is the key level of analysis (Elster, 1989: 74). Inherently, organizations and collectives are made up of individuals.

**Ontology and mereology.** In line with methodological collectivism, knowledge-based scholars have generally argued that organizational knowledge is either *emergent* or even *completely independent* of the individuals or parts that make up the whole or the organization. Collective theorists argue, for example, that routines, the building blocks of organization, are "independent of the individual actors who execute them" (Levitt & March, 1988: 320; also see

[3] The terms *collectivism* and *holism* are considered synonyms for the purposes of our analysis. Some authors have introduced fine-grained distinctions, although the two terms have been used interchangeably in most of the philosophical and sociological literature (Popper, 1957; Udehn, 2001).

Nelson & Winter, 1982). That is, the collective cannot be understood by reducing it to its parts and is, thus, ontologically independent: emergent (multiply realized) or even completely independent of its parts (cf. Sawyer, 2001). Focus in this perspective has been given to various *supra*individual structures, including routines (Nelson & Winter, 1982; Winter, 2003), interactions (Argote & Ingram, 2000), organizing principles (Kogut & Zander, 1992), capabilities (Teece et al., 1997), and community (Brown & Duguid, 2001).

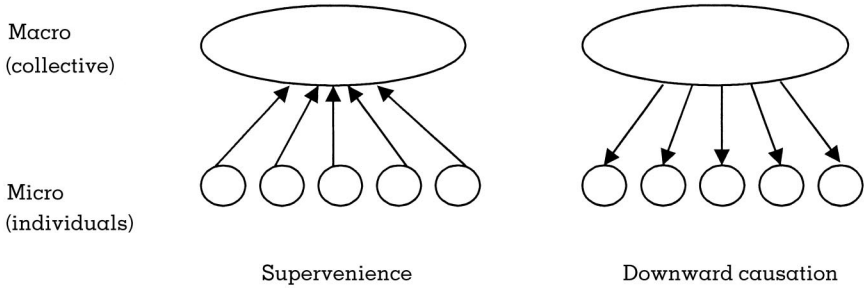
These a priori structures, similar to Durkheim's (1952) analysis of suicide, determine individual behavior and thus become the key antecedent or explanan for analyzing outcomes (see Figure 1). Independence and top-down (macro-micro, macro-macro) causality between the two levels are critical, strong assumptions, which drive the analysis (Durkheim, 1962; cf. Rosenberg, 1995). The same collective outcome can be realized through a number of different individuals, given their homogeneity, and the relation between the individual and organization is not determined by the individuals who make up the organization—thus the emphasis on routines and other extraindividual considerations such as routines and collectives (cf. Levitt & March, 1988; Nelson & Winter, 1982).

The notion of "supervenience" has been discussed extensively in the philosophy of science literature and provides the opposite prediction in the part-whole relationship (cf. Kim, 1993; Sawyer, 2001). Supervenience means that any changes at a higher level are strictly a function of changes at the level below and that all collective outcomes can (or ultimately can) be explained with reference to individuals (cf. Elster, 1989). The whole results from the parts (see Figure 1). In other words, supervenience is defined as higher-level dependence or determination based on lower-level properties or facts (Kim, 1993; Sawyer, 2001). In terms of our individual knowledge ideal type, as argued by Simon (1991), the organization only learns based on the individuals that it is composed of, or based on its lower-level supervenience base. Ontologically, only individuals are real and they therefore determine organization and outcome.

### Implicit Assumptions in Choosing a Level of Analysis

Related to our discussion of mereology, which focuses on the causal flow between different levels, collectivist approaches raise very specific theoretical and methodological concerns about assumptions that are implicitly adopted in choosing a level of analysis (cf. Klein, Dansereau, & Hall, 1994: 224; Rousseau, 1985). In specifying a level of analysis, scholars make strong assumptions about other levels, which are rarely explicitly stated and perhaps not even recognized (Dansereau, Yammarino, & Kohles, 1999). While levels-related matters are often considered to be largely empirical matters (e.g., firm versus industry debate; Rumelt, 1991), or the stuff of statisticians, we concur that they are, "first and foremost . . . the domain of theorists" (Klein et al., 1994: 224). Two levels-related issues and assumptions, highlighted by Klein et al. (1994: 199), are of primary interest to us with regard to our individual and collective knowledge ideal types: specifying homogeneity and specifying independence. We discuss each of the two levels-related assumptions in turn, along with subsequently explicating what these

**FIGURE 1**
**Mereology and Causal Directionality Between Individuals and Collective**



assumptions reveal about our understanding of human nature, knowledge, and causality.

First, in specifying an organization or any kind of collective as the key level of analysis, scholars implicitly attribute homogeneity to lower levels of analysis (Klein et al., 1994). This, of course, is the assumption, although in reality, given potential heterogeneity at all levels, the question in theorizing is where most heterogeneity lies. In the field of strategy, the question of where heterogeneity resides has led to large-scale variance decomposition work comparing the performance effects at differing levels of analysis, including industry, corporate, and business levels (e.g., McGahan & Porter, 1997; Rumelt, 1991). As a point of illustration, if industry is specified as the key level of analysis (e.g., research on industry-level product markets), then homogeneity at the firm level is assumed. Resource and knowledge-based scholars have, of course, challenged the assumption of firm-level homogeneity and have argued that the firm is a more important source of heterogeneity (cf. Rumelt, 1991). Just as the industry level of analysis assumes firm homogeneity, so firm-level heterogeneity (often implicitly) assumes individual homogeneity.

The second implicit assumption involved in choosing a level of analysis has to do with independence. When the firm, for example, is specified as the key level of analysis, it is assumed that all firms are independent of any higher-level interaction with other firms—industry, for instance (cf. Dansereau et al., 1999). Tying the levels assumption of independence to the firm versus industry debate, a firm-level focus suggests that there is nothing systematic about belonging to an industry. Therefore, firm-level analysis generally has controls for industry-level variables. Again, in reality, interaction and heterogeneity exist at several levels of analysis, and, thus, theorists inherently make critical decisions and assumptions about where most of the heterogeneity lies by specifying a level for their theory and attempting to control for potential alternative explanations from differing levels of analysis. There is, of course, a second-order problem in specifying another divisible collective as the key level.

In choosing a level of analysis for a theory, one cannot completely rule out interaction and heterogeneity at alternate levels. Thus, theorists typically simplify and idealize in the interest of parsimony. As noted by Nelson and Winter,

> Theorists should aim to tell the truth in their theorizing, but they cannot aim to tell the whole truth. For to theorize is precisely to focus on those entities and relationships in reality that are believed to be central to the phenomenon observed—and largely ignore the rest (1982: 134; see also Coleman, 1990).

This simplification involves choosing a particular level of analysis, which is presumed to be more heterogeneous than lower levels (for which homogeneity has to be specified). Thus, in choosing a level of analysis, critical trade-offs between heterogeneity and independence are involved. Specifically, when knowledge-based scholars focus on the collective, they are implicitly assuming that some collective, firm-level dynamics (for e.g., routines or capabilities), rather than individual differences, account for knowledge heterogeneity.

## HUMAN NATURE, LEVELS, AND KNOWLEDGE

The discussion of levels in the terms we have outlined above (homogeneity and independence), while instructive and necessary, provides a rather sterile and detached look at the underlying choices that researchers make, and therefore needs to be more carefully unpacked. More specifically, in choosing a level of analysis, researchers unveil, or at least implicitly make, critical assumptions about human nature. These assumptions are rarely stated, but they go to the very core of theorizing and therefore ought to be explicated more carefully. As forcefully stated by Simon, "Nothing is more fundamental in setting our research agenda and informing our research methods than our view of the nature of the human beings whose behavior we are studying" (1985: 303).

When specifying a collective as the key level of analysis, what specifically are the underlying assumptions regarding human nature implied by "homogeneity at the lower level"? Durkheim was very clear when he argued that "individual natures are merely the indeterminate material that the social factor molds and transforms" (1962: 106). The Durkheimian assumption, shared by collectivist knowledge-based scholars, is that individuals are indeterminate material or homogeneous (or a "blank slate"), which heterogeneous social facts (such as culture, social

context, and environment) shape and determine. Or, put in light of the knowledge locus problem, no individual-level, a priori knowledge exists without environmental stimulus and learning. That is, heterogeneity in stimulus, context, and environment determines differential individual- and collective-level outcomes.

The above sentiments for homogeneity are strongly echoed and built on in collectivist work in the KBV (e.g., Brown & Duguid, 2001; Henderson & Cockburn, 1994; Nahapiet & Ghoshal, 1998). Specifically, emphasis in collective knowledge-based work is placed on heterogeneous collective process, social construction, situation, and experience (Eisenhardt & Martin, 2000; Teece et al., 1997; Weick & Roberts, 1993). Spender, for example, states that "we must argue that organizations learn and have knowledge only to the extent that their members are *malleable beings* whose sense of self is influenced by the organization's evolving social identity," and, thus, learning is "*primarily* internalized from the social context" (1996: 53; emphasis added).

Collective knowledge-based scholars justify the emphasis on individual "malleability," even to the point of "questioning the concept of the individual" by citing work in psychology, which emphasizes that cognitive abilities and knowledge in general are context dependent and environmentally determined (Spender, 1996: 52–54; also see Brown & Duguid, 2001). The explicit theoretical foundation for collectivist knowledge-based work (along with Durkheim) is the work of externalist and behaviorist psychologists and philosophers, such as Bandura, Bruner, James, Piaget, Polanyi, Ryle, and Vygotsky (e.g., Brown & Duguid, 1991, 2001; Hargadon & Fanelli, 2001; Kogut & Zander, 1996; Nahapiet & Ghoshal, 1998; Nonaka, 1994; Spender, 1996; Tsoukas, 1996; Weick & Roberts, 1993). Given that this literature provides the explicit foundation for much of collectivist knowledge and capabilities-based work in strategy, it is worth highlighting that most of the above externalist scholars (both in psychology and philosophy) developed a substantial part of their arguments for the primacy of environment and social context based on their studies of language acquisition (e.g., Rylean linguistic behaviorism) and child development. Language arguably is one of the most basic and critical, but also creative, acts of human beings, providing a "window to the mind," and thus allowing us to understand sources of knowledge and learning. Overall, this externalist learning tradition argues that language acquisition and learning in general is socially constructed, emergent, context dependent, and, for the most part, environmentally determined—providing the theoretical basis for assuming homogeneity and malleability at the individual level and the primacy of heterogeneity in social context, environment, and collectives in determining knowledge outcomes.

The environmentally oriented, externalist, and collectivist learning tradition discussed above has been sharply criticized and fundamentally challenged by the Chomskyan cognitive revolution in linguistics, cognitive psychology, and philosophy. Given that this literature directly challenges the very foundations of collectivist knowledge-based arguments and relates to the above levels assumptions, it is important to carefully explicate the key implications as they relate to the knowledge locus question. This is also warranted given that, quite surprisingly, Chomsky's key arguments for the primacy of a priori and innate, individual-level knowledge have received virtually no attention in the management literature, despite their radical implications for the very notion of learning.[4]

Beginning with his harshly critical review of Skinner's (1957) *Verbal Behavior*, Chomsky (1959) argues and empirically shows that external environmental input and socialization play only a minimal triggering role in language acquisition, while he gives primacy to a priori, individual-level knowledge (Chomsky, 1986, 2000). More specifically, human beings have a genetically determined "initial state," competence, or endowment, which is individual, intensional, and internal (Chomsky's "I"-language) and provides the fundamental basis for learning. Chomskyans, in fact, are uncomfortable with the very notion of "learning," given the "poverty of stim-

[4] While Chomsky occasionally has been cited in the management literature, a search of key management journals found no discussion, reference, or citation of his key contribution with regard to the primacy of individual-level knowledge or his challenge of behaviorism and empiricism. Pentland (e.g., 1995) does extensively cite Chomsky, although, as he himself admits, his arguments are far from Chomsky's original intention, and he furthermore makes an externalist, social structural, and collectivist argument.

ulus" (i.e., inputs scarcely reflect outputs); they argue, rather, that individual knowledge develops from within or grows or matures with relatively minimal external influence or environmental causal importance (Chomsky, 2002).

We should, of course, note that the emphasis on individual innate cognitive abilities sans environment does not imply that outcomes are completely determined by individual competencies but that they are simply significantly more important than environmental influences, thus reversing the causal arrows of previous externalist and collectivist learning theory. For Chomsky and many linguists, languages (e.g., Chinese, English, Finnish—Chomsky's "E"-language) are simply surface structures or epiphenoma, and thus artifacts, while the most significant driver of language acquisition is the universal deep structure or innate syntax, which is independent of semantics (Chomsky, 2000, 2002).

Further evidence for a priori and innate knowledge is provided by numerous other psychologists (e.g., Susan Carey, Alan Leslie) and philosophers (e.g., Peter Carruthers, Jerry Fodor), including, for example, Elizabeth Spelke's pioneering experimental work with infants, which shows strong support for a priori innate knowledge in infants in other (other than language acquisition) cognitive domains (e.g., Spelke, Breinlinger, Macomber, & Jacobson, 1992).

The Chomskyan theoretical arguments and empirical findings are not alone in giving primacy to human nature and innate knowledge, as well as in challenging social constructionist learning theory. While much of the above has focused on innate versus external knowledge, Chomskyans have said relatively little about the heterogeneity of innate knowledge. Recent empirical studies in the cognitive sciences and psychology have provided strong evidence not only for the innateness of knowledge but also for its substantial heterogeneity and invariance over time, thus further challenging the primacy of learning theories and collective and heterogeneous environmental influence (Bouchard & McGue, 2003; Lubinski, 2000; also see House, Shane, & Herold, 1996). Variance decomposition studies of separated twins (replicated by numerous databases throughout the world) have provided a natural experiment for testing the relative importance of the individual-level versus environmental and collective factors in learning outcomes (see Bouchard & McGue, 2003, and McGue & Bouchard, 1998, for reviews). The twin studies have largely included monozygotic twins (who, by definition, share the same exact genetic, innate material) living in shared or nonshared (separated) environments, and have also included large-scale empirical analysis and comparisons of other reference groups (adopted siblings, siblings, etc.).

McGue and Bouchard (1998; also see Bouchard & McGue, 2003), in their meta-analyses of twin and adoption studies, show that, depending on the study, 50 to 85 percent of variance (75 percent weighted average over numerous studies) in cognitive abilities and intelligence (percentages are also similar, although somewhat lower, for various dimensions of personality) is genetically and individually determined, while the environment only, at best, accounts for a marginal percentage (at most, one-fourth of the genetic explanation) of the variance. Most astonishingly, empirical studies of separated twins raised in nonshared or different environments show little or no environmental influence (McGue & Bouchard, 1998). Furthermore, adoptive siblings raised together (same environment/socialization, etc.) show *no* correlation in cognitive abilities and intelligence (or other psychological dimensions), thus significantly questioning the environmental and blank slate hypothesis (see Scarr, 1997, for an excellent methodological overview). Overall, despite criticism, the robust findings for individual-level, innate, invariable differences in cognitive abilities and intelligence have withstood numerous critiques and are among the most robust empirical studies in psychology (see Bouchard, 1997; Lubinski, 2004; Scarr, 1997, for further discussion and key references).[5]

The Chomskyan cognitive revolution in linguistics, the twin studies, and cognitive psychology research suggest some critical implications for the KBV. First, findings in the cognitive sciences directly challenge the externalist learning theories that much of knowledge-based work builds on. Specifically, a priori and heterogeneous individual-level knowledge may provide a significant alternative explanation for

[5] The twin studies have, of course, been criticized, although these criticisms have been responded to persuasively. The interested reader is referred to excellent discussions by Bouchard (1997) and Scarr (1997).

the primacy given to context, environment, and collective in learning outcomes. Collectivist knowledge-based theories may wrongly be attributing learning to the organization, while a more simple, parsimonious explanation has not been controlled for—the individual level. At the very least, the findings for a priori knowledge suggest that the individual level needs to be carefully controlled for, measured, and understood.

## ATTRIBUTIONAL PROBLEMS IN COLLECTIVIST APPROACHES

In previous sections we have shown how collectivist knowledge-based approaches make strong assumptions, either explicitly or implicitly, about important methodological, epistemological, and ontological considerations. We have also demonstrated that collectivists adopt assumptions about the homogeneity and malleability of individuals that are at odds with growing theoretical consensus and rapidly accumulating empirical evidence in fields such as cognitive psychology. We have also raised several issues that suggest the strong possibility that individual heterogeneity may account for much of what is attributed to collectives in knowledge-based theorizing and research.

There are, however, three more fundamental concerns about how collectivist approaches make attributional errors, arising from methodological individualists in philosophy and sociology. The concerns about collectivist approaches follow from the underlying assumptions with regard to individual homogeneity and human nature discussed above, but, nevertheless, they deserve more explicit treatment. Our concerns relate to the attributional problems in collectivist knowledge-based work in accounting for initial conditions, problems in identifying proximate as opposed to final causes of phenomena, and, finally, misattributions and problems in measurement.

### Individuals As Initial Conditions

Few things are as critical in theory building and testing as understanding initial conditions, given that initial conditions may fatefully determine outcomes and, if not accounted for, may result in confounded, nonscientific findings and underspecified models. As noted by Popper, "If the initial conditions cannot be ascertained, the scientific way of predicting breaks down" (1959: 198; see also Nagel, 1961: 32). In experimental design, for example, it is unacceptable to consider an experiment valid unless initial conditions are specified, measured, or controlled. The randomization of subjects accomplishes this in studies where a manipulation is involved and provides the control for potential confounds based on individual differences in a given construct (although even randomization may mask key drivers based on a priori individual differences; Stanovich, 1999). The Chomskyan cognitive revolution highlighted above strongly points out the need to better understand initial conditions, or the individual "initial state," which, prior to Chomsky, was assumed to be homogeneous and largely environmentally determined. Specifically, prior learning and socialization studies have confounded heterogeneous socialization and learning effects with nested individual effects (Chomsky, 2000; Scarr, 1997).

In the context of new knowledge and value creation, the question is "What are the individual-level initial conditions in terms of a priori abilities to learn and create knowledge, which may fundamentally drive (or confound) collective-level outcomes?" For example, March's (1991) highly cited model of organizational learning fundamentally is dependent on initial knowledge and abilities (rates of learning) at the individual level and subsequent turnover—that is, *who* is joining and leaving the organization is absolutely fundamental to overall outcomes (also see Arrow, 1974, and Castanias & Helfat, 2001). Schneider's (1987) classic attraction-selection-attrition framework also points out the need to understand the question of *who*. Specifically, Schneider's perspective "rests on the idea that people are not randomly assigned to settings. It argues that it is the people who are attracted to, are selected by, and remain in a setting that determine the setting" (1987: 440). Thus, the underlying causal driver is the initial condition of *who* composes the organization—the competencies, propensities, personalities, or, more broadly, the individual-level general abilities to create and absorb knowledge.

The initial conditions or a priori propensities of individuals within an organization of course have fundamental implications for performance heterogeneity and new value creation. While

the term *organization* is used as shorthand to describe the actions of a group of individuals, nested within the collective level nevertheless are heterogeneous individuals who take action and make critical decisions, which determine collective-level outcomes. Inherently, when talking about collective performance, the underlying capabilities of the individuals must receive consideration as an antecedent to collective-level outcomes. While it, in effect, "looks like organizations determine behavior" (Schneider, 1987: 440), the causal arrows can and should be reversed.

The implications of considering initial conditions for knowledge and capabilities-based scholars are clear. Failing to account for individual effects may lead to spurious reasoning about collectives. The implied rationale for the focus on collectives in management and strategy research is that organizational environments represent "strong situations" (Davis-Blake & Pfeffer, 1989) or emergent, collective environments (Nelson & Winter, 1982; Teece et al., 1997). Thus, it is implied that the individual homogeneity assumption (top-down causation) is warranted. Yet simply arguing that the field has defined itself based on a given level does not remove the fact that plausible and more powerful alternative explanations are often readily apparent from the individual level (cf. Coleman, 1990: 2–5). Given measurement at the organizational level, individuals often get sidelined, although their heterogeneity may provide an alternative explanation for strategic outcomes. Specifically, while the mantra of "the whole is greater than the sum of its parts" has readily been invoked in knowledge and capabilities-based collectivist theories (e.g., Nahapiet & Ghoshal, 1998; Nelson & Winter, 1982), the arithmetic has scarcely been resolved (Nagel, 1961: 380).

The heart of the debate is whether collective outcomes are the result of the individuals who make up an organization, or whether something else, emergent, is realized (not reducible to individuals)—which should receive primary consideration in accounting for outcomes. It is important to note that scholars should also be ready to concede that even if lower individual-level effects are controlled for and emergence is found, inaccurate measurement at the lower individual level, or subsequent scientific findings allowing for better individual-level measurement, may in effect wipe out emergent, collective effects (see Nagel, 1961: 366–397, for an excellent discussion; see also Oppenheim & Putnam, 1958). For example, Scarr (1997) has recently rerun the results of several classic socialization and learning studies in child development and has found that individual-level explanations (initial conditions in terms of innate cognitive ability) provide significantly more robust and parsimonious empirical findings (largely wiping out heterogeneous socialization effects), which previous studies had confounded with real collective-level learning effects. Similarly, Jencks (1972) has rerun large data on school effects and found that, once initial conditions in terms of individual-level ability to learn were controlled for (i.e., intake test scores), school effects became marginal to nonsignificant.[6]

### Final Versus Proximate Causes and Artifacts

Closely related to the logic of accounting for initial conditions is another attributional problem in collective theorizing that has been discussed by individualist-oriented sociologists, particularly Coleman (1990) and Boudon (1998a,b). This problem is a tendency to focus on proximate causes and artifacts rather than more fundamental or final causes. By finality, we do not mean a final theory to completely explain heterogeneity at all levels but, rather, a theory that provides more than cursory attention to whether the explanation provided does not readily induce further questions as to more fundamental antecedents and origins (Coleman, 1990: 15–16; see also Boudon, 1998a: 172). Put differently, does the theory simply explain artifacts, or, perhaps, only proximate (versus more final) causes, thus "black boxing" what is theoretically most important? By artifacts, we refer to correlated, though not causal, explanations for any given phenomenon. Causality therefore re-

[6] The confounds recently discussed in the child development literature are instructive to note for scholars in other fields. While previous studies assume a blank slate in child development, and thus no need to control for individual differences, more recent theoretical and empirical work has challenged these notions. Child learning is confounded by the fact that innate, genetic differences exist between individuals, and given these differences, they may lead to the "creation" of different environments (Scarr, 1997; Scarr & McCartney, 1983).

quires understanding the underlying "reasons" (Boudon, 1998a,b) and answering the theoretical and causal question of *why* (Whetten, 1989; also see Nagel, 1961).

Given that the notion of more final causes and artifacts is fairly abstract, a brief illustration from knowledge-based work is warranted. Nahapiet and Ghoshal discuss the role that social capital plays in collective knowledge outcomes—in short, "'who you know' affects 'what you know'" (1998: 252). However, this externalist argument readily invites questions about the more final causal relation between the two constructs, or, more specifically, why do you know who you know? The causal relationship may be reversed—that is, what you know affects who you know. More specifically, some initial condition or a priori reason provides the basis for the relationship and subsequent interaction. For example, a self-assortive mechanism based on individual-level characteristics and capabilities can provide a more fundamental, underlying explanation (Zenger, 1994; also see Teece, 2003). As a practical example from a different context, college students with the highest standardized test scores (or some other, perhaps better, objective measure of individual ability) go to the best schools and, thus, have more talented peers and faculty or a "better, more central" network position to draw on. While the origins of this individual-level heterogeneity can be questioned (e.g., socialization), recent work has pointed to the primacy of invariant, innate, individual-level, and heterogeneous knowledge (Lubinski, 2000). Overall, assuming homogeneity at the individual level implies that the causal mechanism is knowing someone versus the more final explanation that is based on why you know who you know.

The notions of initial conditions and more final causes certainly have a temporal connotation (Nagel, 1961). They raise the question "How far back do we go to find the theoretical, causal antecedents and explanations of a particular phenomenon or event?" As argued by Lewis, "Any particular event that we might wish to explain stands at the end of a long and complicated causal history. We might imagine a world where causal histories are short and simple; but in the world as we know it, the only question is whether they are infinite or merely enormous" (1986: 214). Long causal histories are indeed problematic for the social sciences, particularly in the strategic analysis of established firms, since systematically uncovering the past compositions and actions of individuals in organizations is tedious, if not impossible. This limitation, however, does not excuse scholars who ignore lower levels of analysis that are accessible. Simply stated, scholars need to more carefully take account of individual-level explanations, before they cite emergence (cf. Coleman, 1990: 3–5).

### Measurement

A final problem in collectivist theorizing is the lack of empirical measures for key constructs, such as routines and capabilities (Collis, 1994; Winter, 2003). As noted by Winter, "At present we lack an adequate approach for characterizing routines in ways that would be useful for statistical analysis" (Murmann et al., 2003: 29). What has partially contributed to this problem is the broad and fairly vague definition of routines (e.g., routines as organizational truce, memory, genes, etc.; Nelson & Winter, 1982). Thus, as Bacharach persuasively argues, if a theory "is not testable, no matter how profound or aesthetically pleasing it may be, it is not a theory" (1989: 512). While Nelson and Winter (1982: 72) explicitly develop their arguments for the existence of routines through a metaphor between individual skills and collective routines, "organizational routines" have nevertheless received something of a life of their own and central theoretical status in knowledge-based theories (Eisenhardt & Martin, 2000; Teece et al., 1997), despite not having moved beyond metaphorical status (cf. Bacharach, 1989). Given the problems with measurement and definition, giving primacy to these collective notions seems premature without an understanding of individual-level antecedents. The individual level is most certainly more measurable than higher collective effects and provides a natural starting point (Coleman, 1990).

## EFFORTS AT RECONCILIATION

We should note that efforts to reconcile the competing perspectives of an individual and collective locus have been made (Giddens, 1979, 1984, 1985; also see Bourdieu, 1977). Giddens most famously treats the individual-collective dilemma (or action-structure dilemma) as an in-

separable dualism or, in his own words, "structuration." That is, the individual and collective cannot be separated in any meaningful way because each simultaneously instantiates the other. Thus, the ontological focus is on process and recursive social practice. This has led to a growing body of "knowledge practice" literature, which builds on the arguments of both Giddens and Bourdieu (e.g., Carlile, 2002; Orlikowski, 2002).

The practice or structuration approach largely sides with more collectivist approaches (e.g., Brown & Duguid, 2001: 112), given its underlying assumption of individual homogeneity. Specifically, the practice approach dismisses the very notion of levels by not only arguing for a fundamental, all-encompassing meta-"level" between individual and collective—that is, practice (Brown & Duguid, 2001; Tsoukas, 1996)—but thus also implicitly suggests that the individual and collective do not exist as real, separate entities (cf. Archer, 1995). The argument of level-"less" and individual-"less" structure deflates the ontological depth of organizing by completely questioning, in postmodern fashion, the very existence of the individual, for the process, practice, and context are inseparable from the individual (Giddens, 1979, 1985).

Furthermore, as noted by Archer, structuration theory "throws a blanket over the two constituents, structure and agency, which only serves to prevent us from examining what is going on beneath it" (1995: 102; see Sawyer, 2002, for further discussion). Overall, given our theoretical arguments and empirical support for the critical importance of a core, innate self, sans social construction, the structurationist perspective does not resolve central problems for addressing the locus of knowledge problem. Furthermore, we fundamentally concur with both Popper (1957) and Simon (1985), for whom the notion of the individual seems uncontroversial and absolutely fundamental in theory building.

We should note that it appears the interactionist approaches, such as the knowledge practice literature, may be fundamentally incompatible with the goals of scientific realism, as noted by both Weick (1979) and McKelvey (1997). While interactionist approaches focus on the context-specific description of process, scientific realism focuses on generalizability, prediction, parsimony, and objective measurement (e.g., Weick, 1979: 35)—our goal clearly being the latter. Our intention is not to argue that the interactionist or process approach is wrong—only that it operates from fundamental paradigmatic assumptions that are difficult or impossible to reconcile with scientific realism (cf. McKelvey, 1997). We acknowledge that the rich description that flows from the knowledge practice approach can yield useful insights (Carlile, 2002; Orlikowski, 2002; Weick & Roberts, 1993), but such an approach seems to largely assume away our central question of interest—that is, what is the locus of knowledge, or what are the sources of new value?

## KNOWLEDGE LOCUS PROBLEM IN PRACTICE

Our efforts at finding a potential locus of knowledge and source of new value have a clear analog in strategic management, where the field's raison d'être, as we have discussed, is to uncover the relative importance of different sources of performance heterogeneity (e.g., Bowman & Helfat, 2001; McGahan & Porter, 1997; Rumelt, 1991). In past research scholars have done variance decomposition studies in an effort to try to understand the key source or level of heterogeneity—for example, firm versus industry. Just as early industry studies that failed to account for lower-level (i.e., firm) effects erroneously overattributed causality to industry factors, we argue that knowledge studies that focus on collective levels without accounting for individuals face a similar problem. Individual effects have not been ruled out as an alternative explanation in most strategic studies of collective or firm-level knowledge. Thus, current collectivist explanations may in some cases merely capture what are really the effects of differing individual inputs in skills and knowledge.

### Locus Problem in Biopharma

To ground our analysis of the locus problem and to explicate the attributional problems and associated levels-related assumptions discussed above, we highlight empirical studies that give primacy to various levels of analysis in the biotechnology and pharmaceutical industry (biopharma). Of particular note in this large body of work in the biopharma sector is the emphasis that different scholars have given to disparate, contradictory levels as the key level of analysis, or the key source of new value. The

biopharma industry provides a good setting for highlighting important assumptions with regard to the knowledge locus problem, since the industry has created tremendous amounts of new value over the past few decades and has also been the subject of significant academic interest at several levels of analysis, including industry, network, firm, research program, and individual (e.g., Baum, Calabrese, & Silverman, 2000; Gulati & Higgins, 2002; Henderson & Cockburn, 1994; Kaplan, Murray, & Henderson, 2003; Pisano, 1994; Powell et al., 1996; Rothaermel, 2001; Zucker, Darby, & Brewer, 1998)—see Table 2 for a summary of representative articles. Our purpose here is simply to highlight the divergent conclusions that scholars have come to in analyzing this industry and to discuss these in light of the knowledge locus problem. We specifically highlight that lower levels and individuals can provide an alternative explanation to numerous collective outcomes by briefly discussing research at the level of alliances and networks (e.g., Powell et al., 1996), firms (e.g., Henderson & Cockburn, 1994), and individuals (e.g., Zucker et al., 1998).

**Networks and alliances.** Powell et al. unequivocally argue that "the locus of innovation is found within the networks of interorganizational relationships that sustain a fluid and evolving community" (1996: 142; also see Kogut, 2000). Subsequent articles have further pointed out the need for biotechnology companies to "not go it alone" (e.g., Baum et al., 2000; Rothaermel, 2001). Specifically, Baum et al. (2000: 287) argue that the establishment of diverse alliances with established rivals leads to increased performance. Network and alliance relations have also received significant theoretical emphasis as the key locus and source of heterogeneity (Adler, 2001; Dyer & Singh, 1998; Kogut, 2000). Adler, for example, suggests that "the consensus in the field is that the proliferation [of interfirm relations] is driven in large measure by the challenge of growing knowledge intensity" (2001: 224).

A full exegesis of the rapidly growing alliances literature is not feasible, but a couple of problems are readily apparent and related to the locus of knowledge problem. First, networks can be construed as artifacts, or, put differently, networks may only be proximate causes of new value, while more final explanations lie nested within the firm. That is, networks are, to some degree, and perhaps a great degree, a covarying reflection of the compositional quality of the nodes in a network, rather than the final causal source of heterogeneity. To take an extreme example to illustrate the point, consider a newly emerging but promising high-technology company with a potential compound to cure cancer. A firm with such valuable knowledge will attract a network commensurate with its own capabilities and future potential. That is, a priori firm-level heterogeneity may determine network structure, which is only a proximal cause, and, thus, assuming lower-level homogeneity (as is done in the networks and alliances literature) simply confounds the analysis for understanding the sources of new value (cf. Dansereau et al., 1999).

The practical implications of network analysis readily reflect the artifactual problems of the network and alliances literature. The prescriptive advice for young biotechnology companies is to ally with the top (or most central) pharmaceutical company (or vice versa). Yet, arguably, only the most promising new firms in terms of either discoveries or scientists with outstanding track records are able to gain the most favorable network positions. Thus, this recommendation points out that network effects may simply reflect underlying lower-level heterogeneity or, specifically, what particular firms have to offer each other, rather than an emergent opportunity. Network position, while certainly increasing the chances for success or survival, is potentially another post hoc artifactual measure of underlying firm capabilities, but most likely not the true source of a potential advantage.[7] Overall, while networks may provide a component in firm performance (e.g., Dyer & Singh, 1998; see Kogut, 2000, for a general overview), we argue that there must be some a priori, hierarchically nested rationale for exchange, and, thus, these studies prove rather descriptive since they describe relationships that are artifacts of compositional qualities. In other words, overall initial conditions (Poincaré, 1903) lead to a path-

[7] We should note that some network analysis does control for various firm effects—for example, age and size (Powell et al., 1996)—but these controls do not properly account for the underlying heterogeneity in terms of ability and potential, as our practical example readily points out. Thus, an unmeasured lower-level confound may drive the purported higher-level (network) effects.

**TABLE 2**
**Nested, Alternative Sources of Knowledge Locus Heterogeneity in Biopharma**

| Locus or Key Source of Heterogeneity | Representative Articles | Independent Variables | Representative Quote |
|---|---|---|---|
| Collectives—alliances/networks | Baum, Calabrese, & Silverman (2000), Powell, Koput, & Smith-Doerr (1996), Rothaermel (2001), Shan, Walker, & Kogut (1994) | Networks/alliances and communities of learning | "The locus of innovation will be found in networks of learning, rather than in individual firms" (Powell et al., 1996: 116).<br>"We have argued that in a field of rapid technological development, such as biotechnology, the locus of innovation is found within the networks of interorganizational relationships that sustain a fluid and evolving community" (Powell et al., 1996: 142). |
| Collectives— firm/organization | Cockburn, Henderson, & Stern (2000), DeCarolis & Deeds (1999), Henderson & Cockburn (1994, 1996), Pisano (1994), Yeoh & Roth (1999) | Capabilities—e.g., promotion based on publication, R&D spending | "Our results suggest that a focus on architectural or integrative or combinative capabilities as a source of competitive advantage may provide useful insights into the sources of competitive advantage" (Henderson & Cockburn, 1994: 77). |
| Individuals—managers | Higgins & Gulati (2003), Kaplan, Murray, & Henderson (2003) | Two streams: (1) managerial cognition and skills; (2) upper echelon affiliations and ties, managerial networks | "Our findings are consistent with the hypothesis that would suggest that managerial sensemaking (recognition and interpretation) of the environment may be an additional explanatory factor in understanding firm fate and performance during periods of technological discontinuity" (Kaplan et al., 2003). |
| Individuals—scientists | Audretsch & Stephan (1996), Darby & Brewer (1998), Darby & Zucker (2003), Lacetera, Cockburn, & Henderson (2004), Liebeskind, Oliver, Zucker, & Brewer (1996), Zucker, Darby, & Brewer (1998) | Scientists' abilities, skills, cognition | "Scientific breakthroughs are created by, embodied in, and applied commercially by particular individuals responding to incentives and working in specific organizations and locations" (Zucker & Darby, 1998).<br>"Until recently, economists and sociologists studying science and technology have been averse to viewing scientists—particularly top scientists—as pursuing private motives, viewing them instead as disinterested contributors to a shared common pool of knowledge. Our results suggest that star scientists often are better viewed as entrepreneurial individuals who value both financial rewards and the pleasure, recognition, and resources that come from being the first to make a significant new discovery" (Zucker & Darby, 1998). |

dependent accumulation of resources in general and network relationships more specifically.

**The firm.** Moving from networks to lower levels, we next consider work at the organizational level or, in the case of Henderson and Cockburn (1994), the program level. We first briefly revisit the highly cited and foundational article of Henderson and Cockburn (1994).[8] The article demonstrates some of the potential confounding explanations that can result when researchers do not account for heterogeneous individual-level effects. As a counterpoint to Henderson and Cockburn, we subsequently highlight some recent work by Zucker and colleagues (e.g., Darby & Zucker, 2003). The purpose here is not to address all aspects of Henderson and Cockburn's paper but to briefly illustrate the assumptions made in light of the levels literature and the knowledge locus problem. Henderson and Cockburn's (1994) article serves as a good benchmark and point of comparison, because it is both widely cited and celebrated for its theoretical and empirical contributions (e.g., Barney, 2001: 46).

Building on earlier work highlighting the primacy of organization-level capabilities in R&D-intensive environments, Henderson and Cockburn begin with a distinctly collectivist premise by looking at heterogeneous firm-level competencies as drivers of innovation (Henderson & Cockburn, 1994: 63). They proceed to show, for example, that the extent to which external publication plays a key role in promotion is a significant organizational competence that leads to increased innovation (proxied by patenting).

Henderson and Cockburn's analysis illustrates several important points. First, they do not account for individual-level variation in scientists and, thus, explicitly assume a priori homogeneity in individuals (Henderson & Cockburn, 1994: 79). More specifically, they assume that heterogeneity in organizational practices is *the* primary, collective-level heterogeneous driver of performance outcomes. The assumption is that scientists' publications are a function of the extent to which organizations encourage publication (through ties to promotion) rather than the individual scientist's ability (again assumed to be homogeneous). Individual heterogeneity provides an important alternative explanation for both the independent variable (promotion based on publication) and the dependent variable (patenting). Stern (2004), for example, specifically points out the significant a priori innate heterogeneity of these very scientists, who self-select into particular organizations, which points out a completely confounding explanation that needs to be controlled for. Although numerous other confounds exist (e.g., because of a policy to promote based on publication, scientists may self-select, or scientists simply may create their own environment or firms), the bottom line is that individual-level initial conditions play an important confounding role in subsequent attributions of innovation performance.

We strongly suspect that the underlying abilities of individual scientists may well be more important than firm capabilities. Thus, individual ability and self-selection on the part of scientists potentially provide a critical primary effect. In any case, empirically, it simply is not possible to make claims for collective knowledge or competencies without accounting for individuals (particularly given the remarkable a priori heterogeneity that is even anecdotally evident).

Second, the four organizational competencies (independent variables) that are highlighted by their work (Henderson & Cockburn, 1994)—(1) publication playing a key role in promotion, (2) rich information flow, (3) single individual making resource decisions, and (4) worldwide research managed as an integrated whole and the dependent variable of the number of patents—can all be feasibly reduced to or reinterpreted as a result of heterogeneity from lower levels. Thus, the individual-level explanation provides, arguably, a more parsimonious theoretical solution.

**The individual.** The findings and conclusions of Henderson and Cockburn (1994), as well as those pointing to the primacy of alliances/networks (Powell et al., 1996), differ markedly from the arguments of Zucker and colleagues (e.g., Darby & Zucker, 2003; Liebeskind, Oliver, Zucker, & Brewer, 1996; Zucker et al., 1998). In an unusually comprehensive study of an industry

[8] Henderson and Cockburn's (1994) paper is among the most highly cited works in the knowledge and capabilities-based literature, combining both theoretical and empirical elements. The authors have further built on this work with numerous related publications, also well received and cited (e.g., Cockburn, Henderson, & Stern, 2000; Henderson & Cockburn, 1996). Furthermore, Henderson and Cockburn's (1994) paper has been highlighted by Barney (2001: 46) as an exemplary empirical paper measuring resource-based arguments.

(including multiple methods, in over a decade of work), Zucker and Darby unequivocally settle on the primacy of a few key individuals in creating and embodying knowledge.

> Scientific breakthroughs are created by, embodied in, and applied commercially by particular individuals responding to incentives and working in specific organizations and locations; it is misleading to think of scientific breakthroughs as disembodied information which, once discovered, is transmitted by a contagion-like process in which the identities of the people involved are largely irrelevant (Zucker & Darby, 1995: 1).

Zucker and colleagues emphasize heterogeneous individuals as the key causal driver and locus of knowledge in biotechnology (e.g., Zucker et al., 1998).[9] They specifically point to the role that superstars play in creating new value by showing that certain scientist-entrepreneurs are central in starting new companies and are even the antecedent to the subsequent formation of regional biopharma clusters (e.g., Zucker et al., 1998). Based on their findings (e.g., Zucker & Darby, 1998), in light of assumptions about knowledge creation, they furthermore suggest that

> until recently, economists and sociologists studying science and technology have been averse to viewing scientists—particularly top scientists—as pursuing private motives, viewing them instead as disinterested contributors to a shared common pool of knowledge. Our results suggest that star scientists often are better viewed as entrepreneurial individuals who value both financial rewards and the pleasure, recognition, and resources that come from being the first to make a significant new discovery (1998).

Overall, the work of Zucker and colleagues provides evidence for the role of certain highly skilled scientists as the locus of knowledge, since they not only play a significant role in innovation outcomes but also in starting companies, which further commercialize these products. The primacy they give to individuals differs markedly from much of the collectivist biopharma research, which assumes individual homogeneity (Henderson & Cockburn, 1994: 79) and the primacy of collective heterogeneity (routines, network, competence, etc.). It should be noted that not all of the causal links are completely disentangled in Zucker and colleagues' work. To be sure, Zucker et al. partially infer that certain incentives (presumably organizational) drive knowledge outcomes, although we suspect that heterogeneity in individuals rather than heterogeneity in routines is driving new value creation, particularly where these superstars are largely responsible for starting these companies, which, of course, further confounds the analysis.

### Nested Heterogeneity

Research and practice are replete with empirical and anecdotal evidence of the primacy of individuals as the locus of knowledge and source of new value. However, decomposition studies that disentangle individual versus organizational effects are lacking. Nevertheless, some relevant empirical work deserves consideration. With respect to the remarkable heterogeneity of individuals, it was Lotka (1926) who first noted the highly skewed distribution and heterogeneity of innovative output among scientists. His early work, looking at scientific publications in chemistry over a seven-year period, showed that roughly 5 percent of scientists were responsible for more than half the scientific output. This analysis did not account for or weight output in terms of quality, which points to significantly higher concentrations in scientific output and, thus, substantial heterogeneity.

Narin and Breitzman (1995), in their analysis of scientists in four large semiconductor companies, showed that a few key scientists, akin to the Lotka distribution (but with an even higher concentration), were responsible for most of those firms' innovation output (as measured by patents). More recently, an analysis of forty-three German companies in three disparate industries (chemical, mechanical, electrical) also pointed to a similar distribution (Ernst, Leptien, & Vitt, 2000; see also Huber, 1999, and Stolpe, 2002). Although the above evidence cannot con-

[9] Jewkes, Sawers, and Stillerman, in their study of numerous innovations, concur with the above analysis and conclude that

> it is the practice of some writers to present a fuzzy picture of invention as a "social process"; to suggest that, if one inventor had not done what he did when he did, someone else would have done it. . . . this attitude—that nothing can be understood unless all is understood, that by piling one unresolved enigma upon another some all-comprehending solution is made the more likely—involves the error of "seeing depth in mere darkness", as Sir Isaiah Berlin once put it (1969: 26–27).

clusively be argued as undeniable support for the primacy of the individual (given interaction effects), it nevertheless strongly suggests that nested individual-level heterogeneity may provide a significant alternative explanation and confound to collective-level arguments, which presume individual-level homogeneity.

The above discussion leads to a hypothetical litmus test for the locus of knowledge, which may shed light on the locus problem and potential key sources of new value. That is, what happens to the organization and its advantage if a key individual leaves the organization? Based on current collectivist arguments in the KBV, organizations can withstand "considerable" turnover, given the emphasis placed on heterogeneous, collective-level routines and, thus, homogeneous individuals (Levitt & March, 1988: 320; also see Kogut & Zander, 1992: 383, and Nelson & Winter, 1982).

However, some rather interesting, albeit preliminary, work has been done looking at the turnover of key scientists in technology-motivated acquisitions. This research sheds some light on our litmus test, providing a natural experiment to test the relative importance of individuals versus collective structures. Granstrand and Sjoelander (1990), for example, found that acquisitions failed to generate new value when key scientists left the organization. In a more comprehensive analysis of scientist turnover, Ernst and Vitt (2000) further found that after key scientists left a company after an acquisition, there was a significant overall decrease in the innovative output for the organization as a whole. Although these studies are preliminary and are missing some controls, they nevertheless point toward the relative greater importance of individuals.

Finally, empirical work on "organizational diseconomies" (the observation that small companies are proportionally much more innovative) between large and small companies has also pointed to the primacy of highly productive individuals. That is, the best engineering talent readily moves to either start or join smaller companies (Zenger, 1994), which suggests that self-selection or an assortive mechanism based on heterogeneous individual-level abilities is at the root of much new value creation.

The above examples largely have been drawn from R&D-intensive settings, such as biopharma and semiconductors, given that these have been the primary research setting for knowledge-based work. We should note that recent work by Teece (2003) also points out the importance of key individuals, such as experts and professionals, as the locus of knowledge in service-oriented companies. Experts and professionals do not rely on traditional firm-type organizations but, rather, are organizations unto themselves, often structured in such disaggregated forms as partnerships (cf. Zenger & Hesterly, 1997). This increased disaggregation indeed has been driven by an increased ability to measure performance at lower levels, thus allowing more precise imputation of inputs, even in team production environments (Alchian & Demsetz, 1972). The incentives as well as autonomy and flexibility of disaggregated forms give control to these highly skilled individuals. Overall, this disaggregation and the relative importance given to individuals (Teece, 2003; Zenger & Hesterly, 1997) are quite contrary to the communal knowledge arrangements anticipated and discussed by collectivist scholars such as Adler (2001).

## IMPLICATIONS AND FUTURE DIRECTIONS

The full implications of the current collectivist knowledge-based research agenda, its logical future directions, and assumptions about new value creation and the locus of knowledge were recently summarized and advocated by Howard Aldrich as follows: "If we truly focused on routines, competencies, practices and so on, we would *not* follow people anymore in our research. Instead we would follow how competencies spread, replicate, and insinuate themselves into organizations. People would disappear from our equations" (Murmann et al., 2003: 27). Given our arguments for the importance of a priori, innate, and individual-level knowledge, we fundamentally question this projected path. Quite contrary to collectivist work, we see promising knowledge-based work explicitly focusing on the role that individuals play in creating and embodying new value. We specifically focus on three critically important areas for future work and their implications with regard to new value creation: (1) property rights and appropriation, (2) individual mobility, and (3) tests of nested heterogeneity.

First, our emphasis on the individual level from the perspective of new value creation and

knowledge highlights the need to understand such questions as *who* creates and owns new value and *who* captures that value—implicating both the property rights (e.g., Liebeskind, 1996) and rent appropriation literature (Coff, 1999). The shift to more carefully imputing new value to nested sources within collective settings reflects the fact that knowledge and associated advantages inherently are created by and embodied in specific individuals (lest we reify the organization). Furthermore, knowledge-based advantages are increasingly rooted in experts, superstars, and other highly productive individuals (Teece, 2003). Thus, opening up the proverbial black box of the firm by explicating the underlying a priori capabilities and knowledge of the individuals involved provides a natural starting point and microfoundation for explaining the creation of new value. Moreover, resource-based logic also is still firmly rooted in the firm level (Barney, 2001), while more final theoretical explanations (compared to proximate explanations) of the origins of resources would seem to lie at the individual level. For example, (purposeful) resource endowments must inherently be the result of individual-level insights and abilities (cf. Coff, 1999). More broadly, any organizational output should, in theory, be imputable to specific individuals, and understanding the various individuals' respective contributions is paramount to explaining the collective outcome (cf. Alchian & Demsetz, 1972).

The second critical implication of our arguments, given the emphasis we have placed on the individual level in understanding knowledge and new value creation, concerns mobility. While collectivist knowledge and capabilities-based work explicitly argues that individual mobility is a "nonevent," or, put differently, heterogeneous routines are independent of the individuals who execute them (e.g., Kogut & Zander, 1992: 383; Levitt & March, 1988: 320), we argue that this conceptualization is partially flawed. Specifically, *who* the organization is composed of is fundamental to overall outcomes. Thus, *who* turns over or *who* joins the organization has a significant impact on how the organization performs. The mobility of individuals provides a natural opportunity for future research, and it overall has received little attention (given our collective-level theories) in the strategy literature (Song, Almeida, & Wu, 2003: 352).[10]

With regard to individual mobility, it should be noted that there is a readily apparent, locus-related disconnect between collectivist theory and individual-level empirical measurement, which our theoretical arguments can begin to alleviate. For example, Lacetera et al. (2004: 3–4) wrestle with problems of causality and measurement related to the knowledge locus problem by citing and attempting to build on collectivist knowledge-based theory, yet arguing that new capabilities reside in individuals (see also Song et al., 2003). Thus, while there is a prevailing assumption in much collectivist work that knowledge belongs to the firm (e.g., patents) and is the result of heterogeneous organizational capabilities (Henderson & Cockburn, 1994), nevertheless, the underlying (perhaps more) heterogeneous abilities of the individuals creating this knowledge do not get measured or controlled. Furthermore, quite counter to their theoretical assumptions, collectivist theories readily attribute new capabilities to specific individuals coming into the organization—an inherent contradiction. Overall, this research points out that our collective theories need to be carefully revisited, the dichotomy between collective theory and individual empirical measurement being fundamentally incompatible. Our arguments for a potential individual locus of knowledge provide at least an initial step toward more carefully understanding the underlying theoretical causalities of new value creation.

The third readily apparent implication and future direction, which our arguments directly imply, is a comparative, empirical test of indi-

[10] There has been some work on mobility, some of which needs to be highlighted briefly. Almeida and Kogut (1999), for example, show that the mobility of key engineers plays a critical role in the diffusion of knowledge among firms. Specifically, knowledge is localized by region since key individuals tend to be geographically constrained. Similar intuition is also evident in the history of Silicon Valley, where knowledge creation in the nascent semiconductor industry was simply a function of certain individuals leaving their old companies and starting new ones, thus partially implying that key capabilities, in fact, resided in these very employees (cf. Saxenian, 1994). Relatedly, Song et al. (2003; also see Moen, 2004) empirically show how "learning-by-hiring" plays a critical role in bringing in new knowledge and capabilities into organizations. Furthermore, Lacetera et al. (2004) show how new capabilities are built by bringing certain "star" individuals into an organization.

vidual versus collective effects in knowledge outcomes—similar to the competitive tests between firm and industry (Rumelt, 1991). The finding for the relative importance of the firm over industry level has not ruled out nested sources of heterogeneity arising from the individual level (cf. Bowman & Helfat, 2001). Just as the observation that profitable companies belong to certain industries was confounded by lower-level firm effects, which were assumed to be homogeneous, similarly, firm effects may be confounded by heterogeneous individual-level effects. The clear confounds arising from nested, individual-level heterogeneity are readily apparent in our analysis of the biopharma industry, where individuals are assumed to be homogeneous and collective, heterogeneous capabilities are given primacy (e.g., Henderson & Cockburn, 1994).

Overall, while recent work has pointed toward a CEO effect (Bowman & Helfat, 2001), a more systematic approach that measures individual-level performance more broadly is necessary to disentangle individual and collective effects. Empirical, multilevel data with individual-level performance measures (ideally, intake measures; e.g., Stern, 2004) or sufficient individual mobility from firm to firm would allow scholars to disentangle the causal relationships that have proven so problematic. Based on our theoretical arguments and recent findings in the cognitive sciences, we conjecture that much of the variance in knowledge can be attributed to relatively invariant and stable individual-level characteristics, which a priori are heterogeneous or are significantly more heterogeneous than collective environments. We should briefly note here that our emphasis on the individual level is not to say that work at collective levels is unimportant. Just as findings of relatively more heterogeneity at the firm level (Rumelt, 1991) did not completely displace industry analysis, we do not expect or want collective-level analysis to be replaced.

## CONCLUSION

In sum, we have argued that knowledge-based theory and research must begin with individuals rather than the collective level in understanding new value creation. We have shown that collectivist approaches that do not account for individual-level heterogeneity simply cannot rule out heterogeneous individuals as an alternative explanation in explaining new value and knowledge creation. The observation that knowledge may to a significant extent be a priori, innate, and heterogeneous at the individual level has important implications. Individual knowledge is not wholly (perhaps not even mostly) socially constructed or environmentally determined, as is assumed in large part in the KBV, but, rather, there is a core self, which may to a large degree determine learning and knowledge outcomes. We have argued that this individual-level knowledge provides a significant alternative explanation for much of collectivist knowledge-based work, and we therefore challenge knowledge-based scholars to carefully revisit their underlying philosophical and theoretical assumptions about the primacy given to collectives and to consider potential individual-level explanations as antecedents to new value creation.

Our analysis has limitations of course. First, in many ways, we have raised some age-old philosophical questions regarding the fundamental origins of knowledge, which have yet to be completely resolved. Given the one-sided nature of the arguments in the extant knowledge and capabilities-based literature and recent conflicting empirical findings in the cognitive sciences, we think our focus on the individual level is justified, although future empirical work sorting out individual and collective effects remains to be done. Second, there has been a temptation on our part to attribute everything to initial conditions or the lowest level—that is, individuals. We by no means doubt the existence of collective-level effects, but, as we have pointed out, individual-level controls are necessary since they confound the analysis and potentially provide a more parsimonious explanation. Third, the present debates, both in the disciplines that strategic management draws on and in the popular press, about the primacy of innateness (nature) versus environment (nurture) in knowledge acquisition have obviously led to heated discussions, which have had a tendency to stir significant controversy and debate. However, given that emphasis in knowledge-based work has been on nurture, collective, and environment (e.g., Nahapiet & Ghoshal, 1998: 247; Spender, 1996: 53), we have tried to objectively summarize and build on theoretical and empirical arguments from cognitive science

that directly challenge collectivist conceptualizations of knowledge and have critical implications for the future of the KBV and associated efforts to understand new value creation.

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