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Ecologists and Institutionalists: Friends or Foes?

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In this chapter, we consider the web of relations between institutional and ecological analysis of organizations. These research traditions are very similar in some ways, notably that foundational articles for both were published in the same year (Meyer and Rowan, 1977; Hannan and Freeman, 1977). Yet, in other ways, they are remarkably different, as evidenced by vociferous debates between ecologists and institutionalists (e.g., Carroll and Hannan, 1989a *vs*. Zucker, 1989 *vs*. Carroll and Hannan, 1989b; Hannan, Carroll, Dundon, and Torres, 1995 *vs*. Baum and Powell, 1995 *vs*. Hannan and Carroll, 1995). Given their concurrent origins and the combination of similarity and difference in their lived histories, it is not surprising that these two research traditions have been sometimes contrasted and other times combined. In this chapter, we will review how and when ecological theory has been used in contrast to or in combination with institutional explanations, and suggest how they might be fruitfully combined in future research.

Our title poses a question about the nature of the relationship between ecology and institutionalism. Depending on whom you ask, you will get divergent answers to this question. Some will say that ecologists and institutionalists are happy bedfellows because they ask similar questions about the nature and functioning of organizations and they provide similar answers (e.g., Fligstein and Dauter, 2007). Both sets of scholars attend to many of the same concepts, notably legitimacy and organizational form, and seek to explain change and stability in organizational systems. Moreover, both sets of scholars tend to conduct longitudinal analysis of original data on collections of organizations – populations in the case of ecologists and fields in the case of institutionalists. Such basic similarities are not surprising, as both ecology and institutionalism emerged as corrections to the rationalist approach prevalent in the 1960s and early 1970s, which focused on the design and management of efficient organizations, and both directed attention towards the external environment

and away from internal organizational functioning.

But when faced with the same question, other scholars will wonder whether ecological analysis is inconsistent with institutionalism (e.g., Zucker, 1989; Baum and Powell, 1995). Perhaps the most obvious divide stems from the fact that ecologists investigate highly abstract models of population evolution and organizational outcomes, while institutionalists seek nuanced explanations that are sensitive to the specifics of time and place. This yields, by necessity, a difference in relationships between theory and data: research in organizational ecology is driven by a desire to test and extend formal models with general applicability, while research in the institutional tradition is driven by a desire to explain particular empirical phenomena. This divergence in research activity stems from a profound difference in theoretical perspective: organizational ecology focuses on demography (numbers of organizations and their vital rates), while institutional analysis focuses on culture (norms, values, and expectations) and its manifestations (rules, regulations, conceptions, frames, and schemas).

To discover our own take on the vexing question of whether ecologists and institutionalists are friends or foes, you must read on. To convince you that our answer is correct, we proceed in stages. We first define the nature and scope of ecological analysis. After briefly reviewing the institutional perspective, we reflect in detail on how, and how well, ecology and institutionalism get along intellectually. Our assessment of convergence and divergence encompasses research questions, assumptions, predictions, and methods; we pay particular attention to those hard-to-define, harder-to-defend, yet critical issues that are related to taste and style. After answering the question posed in our title, we conclude by suggesting how scholars in both traditions can benefit from a closer relationship.

Some disclosure is in order before we begin. Heather is an organizational theorist who, when surrounded by ecologists, feels like a stout-hearted institutionalist, and when surrounded by institutionalists, feels like a died-in-the-wool ecologist. Robert is an organizational theorist who has delved into both traditions, yet never feels quite like a 'pure' ecologist or a 'pure' institutionalist. We are thus members of both communities, in varying proportions, depending on time of day, question at hand, and surroundings. But at heart, we are members of a broader community – organizational sociologists. As such, our goal is to understand formal organizations, the building blocks of all modern societies and the most powerful actors in those societies (Coleman, 1974; Perrow, 1991). We are happy to achieve this objective with any implements that we can use skillfully – including, but not limited to, institutional and ecological tools.

WHAT *IS* ORGANIZATIONAL ECOLOGY ANYWAY?

Organizational ecologists wonder 'why are there so many kinds of organizations?' and seek to understand the distribution of organizations across different environments (Hannan and Freeman, 1977: 936). To this end, ecologists have adapted and applied theories and formal models of population biology and human demography to explain the evolution of organizational systems – that is, to explain rates of organizational founding, failure, growth, performance, and change. Ecologists begin with the core assumption that understanding organizational diversity requires 'population thinking' (Hannan and Freeman, 1989: 15). Populations are aggregates of organizations that share a common dependence on material and cultural environments. Empirically, populations have been identified as sets of organizations that produce similar goods or services, use similar resources, and have similar identities. Organizational diversity increases when new populations emerge and expand in size;

it declines when existing populations decrease in size and become extinct.

In the paragraphs below, we briefly review the main assumptions underlying ecological analysis and the main lines of research.[1] Our commentary involves four areas: density dependence, resource partitioning, structural inertia, and organizational identity. We discuss each in turn.

Density dependence

The basic model of organizations' vital rates is density dependence, which proposes that organizational founding and failure depend on population density, meaning the number of organizations in a population. When density is low, increasing density enhances the legitimacy, or taken-for-grantedness, of the population; thus, at low levels of density, increases in density cause founding rates to rise and failure rates to fall. At higher levels of density, however, more organizations vie for resources, so competition becomes more intense. At the same time, increasing numbers of organizations provide only incremental legitimacy benefits. Thus, as density increases, competition begins to overwhelm legitimation as the primary mechanism driving vital rates. At high levels of density, therefore, further increases in density cause founding rates to fall and failure rates to rise. Over the full range of density – from very low to very high – this logic predicts non-monotonic effects on vital rates, specifically an inverted-U-shaped relationship between density and founding rates, and a U-shaped relationship between density and failure rates. The earliest empirical investigations of the density-dependence model were Hannan and Freeman's (1987, 1988) studies of labour unions in the United States. They found that unions' founding and failure rates followed the predicted non-monotonic patterns. Many studies of other organizational populations have yielded similar effects (e.g., Carroll and Hannan, 1989a; Hannan and Carroll, 1992).

Ecologists have extended and refined the basic density-dependence model. One approach involves assessing the effect of density across subpopulations defined along such key dimensions of organizational form as goals, size, technology, and location. For example, a study of competitive interactions (those that harm one or both parties) and mutualistic interactions (those that benefit one or both parties) between commercial (for-profit) and mutual (non-profit) telephone companies in Iowa disaggregated population density according to technology and location relative to the focal organization (Barnett and Carroll, 1987). This analysis revealed that the non-local density of both commercial and mutual telephone companies raised failure rates, as did the local density of commercial companies. These results indicate purely competitive interactions. Only the local density of mutual companies contributed to mutualistic interactions. Density has been disaggregated by subpopulation in studies of organizations as varied as breweries (Carroll and Swaminathan, 1992), health-care organizations (Wholey, Christianson, and Sanchez, 1992), and credit unions (Barron, West, and Hannan, 1994), demonstrating the broad applicability of this approach.

Another way to disaggregate density is to allow for the fact that organizations in a population often differ in *degree* rather than kind. To reflect this, some ecologists have followed McPherson (1983) and assessed similarities (and differences) between population members by how much their domains overlap (or not) along some dimension. One such study showed that Manhattan hotels experienced more intense competition from hotels that overlapped in terms of size, geographic location, and price (Baum and Mezias, 1992). Going even further, a study of day-care centres in Toronto showed that competition and mutualism varied with overlap in the ages of children enrolled: a high degree of overlap between a focal day-care centre and other centres raised failure rates, while a high degree of non-overlap

lowered failure rates (Baum and Singh, 1994).

Resource partitioning

A related stream of research focuses on competition and mutualism between organizations that serve a wide range of clients with a diverse array of products ('generalists') and organizations that focus on a more limited clientele, offering them a narrower set of products ('specialists'). The basic argument is that when there are economies of scale and a resource distribution with a single rich centre and poor peripheral regions, the resource 'space' (the combination of inputs and demand for output) becomes partitioned, with generalists occupying the centre and specialists the periphery (Carroll, 1985; Carroll, Dobrev and Swaminathan, 2003). This happens because generalists compete with one another to control the resource-rich centre by offering generic products with broad appeal. Specialists, meanwhile, avoid competing with generalists in the market centre, instead exploiting peripheral regions by serving small groups of clients with idiosyncratic tastes. Because economies of scale favour large organizations, the generalist subpopulation concentrates; a smaller number of larger generalists competes for the market centre. As this happens, generalists focus more tightly on the market centre and abandon more of the periphery to specialists. The upshot of this partitioning of the resource space between a core occupied by generalists and a periphery occupied by specialists is that increasingly intense competition between generalists leads to not only higher failure rates for generalists, but also lower failure rates and higher founding rates for specialists. Like the density-dependence model and its offshoots, the resource-partitioning model has been tested on a wide array of organizations, including newspapers (Carroll, 1985; Boone, Carroll and van Witteloostuijn, 2002), auditors (Boone, Broecheler and Carroll, 2000), breweries

(Carroll and Swaminathan, 1992, 2000), wineries (Swaminathan, 1995), and automobile manufacturers (Dobrev, Kim and Hannan, 2001).

Inertia

Organizational ecology proceeds from the assumption that the core features of organizations change slowly, if at all, because of strong inertial pressures (Hannan and Freeman, 1984). Eight constraints on adaptation are proposed, four internal and four external (Hannan and Freeman, 1984). The internal constraints are investment in plant, equipment, and specialized personnel; limits on the internal information received by decision-makers; vested interests; and organizational history, which justifies past action and prevents consideration of alternatives. The external pressures for stability are legal and economic barriers to entry and exit; constraints on the external information gathered by decision-makers; legitimacy considerations; and the problem of collective rationality and the general equilibrium. All of these pressures favour organizations that perform reliably and can account rationally for their actions, which in turn requires that organizational structures be highly reproducible – that is, unchanging (Hannan and Freeman, 1984). If inert organizations are favoured over changeable ones, inert organizations will be less likely to fail.

The structural inertia thesis does not imply that organizations *never* change; rather, it implies that when organizations *do* change, resources are diverted from operating to reorganizing, reducing effectiveness and increasing the likelihood of failing. Ecologists distinguish between two consequences of change: process effects, which stem from the inevitable frictions generated by undertaking change and which are inherently deleterious, and content effects, which derive from the altered fit between changed organizations and their environments, and which may be good if fit to the environment is improved, or

bad if fit is worsened (Barnett and Carroll, 1995). Notwithstanding the grim prognosis for organizational change, some of the more optimistic ecologists have investigated the possibility that in some circumstances, organizations can adapt and change can be beneficial, such as when organizations diversify after large-scale shifts in external conditions (Haveman, 1992), or when organizations' constituencies support the content of change and are willing to supply resources to effect change (Minkoff, 1999). Others have shown that ties to state and community institutions, which provide resources and legitimacy, can buffer organizations from the deleterious effects of change (Baum and Oliver, 1991). Despite these important limitations on the inertia hypothesis, empirical analysis generally shows that change harms organizations (Barnett and Carroll, 1995; Carroll and Hannan, 2000: 357–380).

Change may be harmful, but organizations *do* often change. Change exhibits momentum: the more organizations have changed in the past, the more they are likely to change in the future because they have learned how to change (Amburgey and Miner, 1992; Amburgey, Kelly and Barnett, 1993; Greve, 1998). Change is often driven by prior performance, assessed relative to goals, and by changes made by rivals, which in the aggregate alter an organizational population's demography (Greve, 1998). If the forces that drive change (notably performance) also drive failure, analyses of change and failure must account for endogeneity. Doing so reveals that even though change causes performance to decline and the chance of failure to rise, there is a big difference between well- and poorly-performing organizations. Poorly-performing organizations may benefit from change, but well-performing ones are usually harmed (Greve, 1999).

Because older and larger organizations are expected to be more inert and thus less likely to fail, empirical research has often focused on the effects of age and size on organizational failure. Failure rates have been found to decline with age in studies of many kinds of organizations, including newspaper publishers (Carroll and Delacroix, 1982; Freeman, Carroll and Hannan, 1983; Amburgey et al., 1993), labour unions (Freeman et al., 1983), and semiconductor manufacturers (Freeman et al., 1983). But these studies confounded the effects of age with those of size (Barron et al., 1994; Hannan, 1998). Findings that failure rates decline with age may be spurious because there is a positive correlation between size and age, and a negative effect of size on failure. This was clear in an analysis of New York credit unions: age on its own had a negative effect on failure, but after including size in the analysis, the effect of age became positive, while the effect of size was negative (Barron et al., 1994). Similarly, size dampened failure rates for all but the largest life insurance companies in New York, while age increased failure rates (Ranger-Moore, 1997). The current consensus is that failure rates generally decline with size and increase with age (Hannan, 1998). However, the effect of age, after controlling for size, may be non-linear – increasing in the first few years after founding, as fledgling organizations use up their initial stores of resources, then decreasing, as organizations learn how to operate efficiently and develop solid reputations (Levinthal, 1991).

Organizational form as identity

The newest strand of ecological theory involves analyzing organizational forms as identities or social codes, which are 'recognizable patterns that take on rule-like standing and get enforced by social agents' (Pólos, Hannan and Carroll, 2002: 89; see also Hannan, Pólos and Carroll, 2007). Such socially-coded identities comprise both rules of conduct and signals to internal and external observers. Rules of conduct provide guidelines for members of a population by delimiting what they should and should not be and do, while signals generate a cognitive understanding about the population because

they define what observers understand the members of an organizational population are and what they do.

Thinking about organizational form as identity has benefited the other strands of ecological analysis. Consider resource partitioning first. An analysis of the identities and competitive tactics of U.S. breweries showed how and why established firms (mass-producer breweries) that are under siege by insurgents (microbreweries and brewpubs) have a limited ability to adopt the beneficial features of their new rivals (Carroll and Swaminathan, 2000). Quite simply, it is difficult for organizations with established identities to present themselves as entirely different kinds of organizations, even when their identities are based on intangibles such as perceived authenticity. In a similar vein, a study of American feature films showed that there is a fundamental tradeoff between appealing to a broad customer base (being a generalist) and targeting a more focused base (being a specialist): films pitched in multiple genres attracted larger audiences but were less appealing than films pitched in a single genre, because audiences found multi-genre films difficult to make sense of (Hsu, 2006).

For the density-dependence model, analyses of identities among disk-array producers showed that, contrary to what happens when classic density-dependent competition and legitimation operate, increases in the density of disk-array producers did not legitimate the disk-array-producer form (McKendrick and Carroll, 2001; McKendrick, Jaffee, Carroll and Khessina, 2003). Most disk-array producers had heterogeneous origins and continued to derive their primary identities from other fields. These heterogeneous origins and persistently derivative identities made it impossible for the disk-array-producer form to cement its own distinctive identity. Following this logic, only increases in the density of firms with *focused* identities, not increases in *total* density, should result in the establishment of a distinct organizational form.

With regard to inertia, research on young high-technology firms in California showed that the content effects of change are most hazardous when they involve shifts in identity (Hannan, Baron, Hsu and Koçak, 2006). Growth in market capitalization slowed and failure rates rose following changes in human-resource blueprints – a core aspect of these firms' identities. In contrast, outside CEO succession depressed growth in market capitalization but did not affect failure rates. This study redirects attention from the internal consequences of change – disruption of routines and structures – to the external consequences, in particular, to what happens when organizations violate the expectations of external observers (here, investors). Thus, it paves the way for empirically assessing the content effect of change, to complement previous studies of the process effects of change (e.g., Amburgey et al., 1993; Greve, 1999).

Summary

The great strength of the ecological tradition is its high level of paradigmatic consensus (Pfeffer, 1993). Ecologists agree on what outcomes to study (founding, failure, growth, performance, and change), what explanatory factors to consider (the number of organizations of various (sub)forms, as well as their sizes, ages, locations, technologies, networks, and identities), and what analytical strategies to employ (primarily quantitative analysis of original data sets covering entire populations of organizations over extended periods of time). Among theories of organizations, ecology displays the highest degree of logical rigour. Indeed, ecology has benefited from several logical tests: of resource partitioning (Péli and Nooteboom, 1999), inertia (Péli, Bruggeman, Masuch and Ó Nualláin, 1994; Hannan, Pólos and Carroll, 2003), and density dependence (Kamps and Péli, 1995). These tests have revealed inconsistencies and incoherencies in natural-language statements of ecological theory and so paved the way for theoretical refinements.

In sum, because organizational ecologists have always built on and refined each other's work, they have accumulated much knowledge about organizational dynamics.

But the strength of the ecological research programme reveals a weakness: precisely because it is such a 'normal-science' activity, some find it too narrow to interest anyone except ecologists themselves (e.g., Hedström, 1992). As van Witteloostuijn (2000: v) put it, organizational ecology has a 'relatively small influence outside the inner circle of its own parish'. Narrowness may overtake this paradigm because much work clarifies and refines the basic theory without extending it in truly novel directions; as a consequence, ecologists' work rarely intersects with – or draws the interest of – scholars in other research traditions. The marginalization of organizational ecology is revealed in analyses of submissions to the Organization and Management Theory Division of the Academy of Management Annual Meetings of 2004 and 2005 (Thompson, 2004; Davis, 2005). According to author-assigned keywords, which could indicate either theory or phenomenon, a relatively small number of papers labelled as 'ecological' were submitted, far fewer than the number of papers labelled as 'institutional'. Perhaps more important, organizational ecology occupied a relatively peripheral position in the network of references to other perspectives and phenomena, as it was used in combination with few other perspectives and it was used to explain relatively few phenomena. This situation is unfortunate, given ecology's many theoretical advances and empirical successes.

HOW DO *WE* UNDERSTAND INSTITUTIONAL ANALYSIS?

Before comparing institutional analysis of organizations to ecology, we want to make sure we're all 'on the same page', so we offer our own brief assessment of the nature and scope of organizational institutionalism (for a more detailed review, see Greenwood [Introduction, this volume] or Scott [1995/2001]). Like ecological analysis, institutional analysis of organizations can be broken down by subject area. Three of the most important are legitimation and institutionalization, isomorphism and diffusion, and strategic action. We discuss each in turn.

Legitimation and institutionalization

Legitimacy is *the* central concept in institutional analysis. Organizations are legitimate when they are comprehensible and taken for granted as the natural way to achieve some collective goal (Berger and Luckmann, 1967), when they are justified and explained on the basis of prevailing values, role models, and cultural accounts (Meyer and Rowan, 1977; Douglas, 1986), when they are sanctioned or mandated by authorized actors (DiMaggio and Powell, 1983), and when those involved cannot even conceive of alternatives (Zucker, 1983). Legitimacy can rest on any of three foundations: regulative, which includes the laws and administrative guidelines that constitute the basic rules governing relationships within and between organizations; normative, meaning 'expert' sources of information and value judgments about the nature of organizations; and cognitive, meaning shared perceptions of organized social activity (Scott, 1995 [2001]). Highly legitimate forms of organization are highly institutionalized – perceived as objective and exterior facets of social life (Berger and Luckmann, 1967). The greater the legitimacy attributed to an organizational form, the less any member of that form will require active justification and the more it will be taken for granted and accepted by observers. Legitimacy improves access to resources and acceptance from customers, and thus contributes to organizations' ability to persist (Meyer and Rowan, 1977). Empirical research has supported these ideas for many

kinds of organizations, including hospitals (Ruef and Scott, 1998), biotechnology start-ups (Stuart, Hoang and Hybels, 1999), day-care centres (Baum and Oliver, 1991), and banks (Deephouse, 1996).

The flip side of institutionalization is deinstitutionalization: erosion of activities or practices (Oliver, 1992). And the flip side of legitimation is delegitimation: reduced acceptance of activities or practices. Some scholars see the continuance of structures, rules, and routines as inherently problematic, and see deinstitutionalization as an inevitable process (e.g., Covaleski and Dirsmith, 1988; Zucker, 1988) Deinstitutionalization can be precipitated by political, functional, or social forces (Oliver, 1992). Some forces for deinstitutionalization are internal to the focal organization, including increasing workforce diversity, declining performance, and executive succession. For instance, poor performance triggered the abandonment of permanent-employment guarantees and increased downsizing by Japan firms; moreover, the rate of abandonment increased with the number of firms downsizing (Ahmadjian and Robinson, 2001). Other forces for deinstitutionalization are external, such as technological innovation, shifts in the polity or general culture, economic booms or busts, and changes in regulation. For example, the decline of large conglomerates in the 1980s was precipitated by shifts in attitudes and beliefs about the nature of the firm (Davis, Diekmann, and Tinsley, 1994). The idea of the firm as a bounded social entity, analogous to a sovereign body which could not be dismembered, lost legitimacy in the face of evidence that conglomerates were inefficient; as a result, many were taken over and broken up. Similarly, several forms of savings-and-loan associations, each embodying a different set of opinions, beliefs, and judgments, were extinguished by a combination of technical pressures (changes in human demography and employment patterns) and institutional pressures (changes in attitudes towards bureaucracies precipitated by the Progressive movement)

(Haveman and Rao, 1997; Haveman, Rao and Paruchuri, 2007).

Isomorphism

Institutionalists wonder why organizations are so similar (DiMaggio and Powell, 1983). Accordingly, one of the most important ideas in institutional analysis is that of isomorphism (literally, 'same shape'). As communities of organizations evolve, a variety of forces (interorganizational power relations, the state and professions, and competition) promote isomorphism within sets of organizations that either play similar roles or are tied directly to each other. There is a logical connection between isomorphism and legitimacy. The more prevalent an organizational structure, practice, or tactic, the more legitimate it is. Therefore, one indicator of legitimacy is the spread of organizational features, which increases isomorphism within fields (Tolbert and Zucker, 1983). Moreover, the three bases of legitimacy map neatly onto the three processes driving isomorphism: cognitive legitimacy onto mimetic processes, regulative legitimacy onto coercive processes, and normative legitimacy onto normative processes (Scott, 2001).

Interest in isomorphism has produced many, many studies of the diffusion of formal structures and practices across organizational fields, encompassing all three engines of diffusion. Coercive pressures accelerate diffusion; for instance, structures mandated by the state diffuse more rapidly than structures encouraged but not mandated (Tolbert and Zucker, 1983). Although state regulations appear to be simple coercive forces, reality is often more complex, as many state regulations allow discretion in their interpretation and application (Dobbin and Sutton, 1998). For example, in response to legal mandates against employment discrimination, firms experimented with several ways to demonstrate compliance – creating both new rules and new units (Edelman, 1992) – until court rulings showed

one way – formal, merit-based rules governing hiring and promotion – to be sufficient, after which the sanctioned approach diffused widely (Dobbin, Sutton, Meyer and Scott, 1993).

Normative pressures often trump coercive pressures, because state regulations often allow discretion in their interpretation and application (Edelman, 1992; Dobbin et al., 1993). Take, for instance, the diffusion of human-resources practices among U.S. firms. Human-resources managers and labour lawyers used the ambiguity inherent in employment law to promote particular solutions – those that would solidify their power – and discourage others (Dobbin and Sutton, 1996; Sutton and Dobbin, 1998). Thinking more broadly, the civil-rights mandates of the 1960s created a normative environment that led employers to adopt several human-resources procedures, even in the absence of formal legal sanctions (Edelman, 1990).

Mimetic pressures are ubiquitous but subtle. In the early stages of diffusion, adopters of new structures and practices tend to be those facing technical problems of control and co-ordination they hope will be solved by these innovations; later, however, as the innovations become widespread, connections between technical rationality and adoption are attenuated and the causal engine shifts from technical rationality to blind imitation, as innovations become taken for granted as the 'right' way to do things (Tolbert and Zucker, 1983; Baron, Dobbin and Jennings, 1986). There is widespread evidence of mimetic diffusion: corporations were more likely to adopt the multidivisional form when others in their industry had done so (Fligstein, 1985), savings and loans were more likely to expand into new service areas when large and profitable firms were active there (Haveman, 1993), acquiring firms were more likely to select investment banks used by large and profitable others (Haunschild and Miner, 1997), and hospitals were more likely to adopt standardized (as opposed to customized) total quality

management (TQM) programmes as TQM adoption increased (Westphal, Gulati and Shortell, 1997).

Strategic action

Organizations do not simply react to environmental demands; instead, they are often proactive and control their environments. Recognizing this, institutionalists place conformity on a continuum of responses that includes compromise, avoidance, defiance, and manipulation (Oliver, 1991). Indeed, organizations can avail themselves of many different tactics for gaining legitimacy (conform to, select, or manipulate the environment), maintaining legitimacy (police internal activity, eschew obvious appeals for legitimacy, and stockpile goodwill), and repairing legitimacy (offer normalizing accounts, restructure, and (our favourite!) don't panic) (Suchman, 1995). These ideas pave the way for investigating when conformity will or will not occur, and assessing the effectiveness of various strategic responses.

Empirical work on strategic action often investigates how rhetoric is used to legitimate change. For example, tracing the evolution of corporate takeovers from 1950 through 1985 revealed that rhetoric created powerful new patterns of meaning, which in turn affected the status attributed to buyers and target firms alike (Hirsch, 1986). As the practice of hostile takeovers diffused, the language used to describe them became more positive and more complex (borrowing from more genres; evaluating bidders *and* targets). Moreover, takeovers came to be framed as violent when the bidder was outside the corporate establishment, but dispassionately and benignly when the bidder was an insider. In the same vein, a study of attempts to repair legitimacy after a public-relations crisis in the cattle-ranching industry demonstrated the efficacy of verbal accounts (Elsbach, 1994). Similarly, a study of accounting firms showed that the profession was 'framed' as

being under threat and that change was thus natural, almost inevitable; thus, rhetoric portrayed the broadening of accounting firms' professional scope as a solution to evolving client needs and heightened competition (Greenwood, Suddaby and Hinings, 2002). Strategic actors in accounting deployed many rhetorical strategies to legitimate multidisciplinary partnerships: appealing to myths of progressive rationality, suppressing contradictions, and emphasizing consistency with professional values (Suddaby and Greenwood, 2005). Finally, institutional entrepreneurs in the HIV/AIDS-treatment field framed new practices of consultation and information exchange among community organizations and pharmaceutical companies in ways that integrated the interests of many different stakeholders and that were consistent with existing routines (Maguire, Hardy and Lawrence, 2004).

Strategic action is especially obvious when people are trying to create new kinds of organizations. Such institutional entrepreneurship requires the skillful use of resources to overcome skepticism and persuade others to believe entrepreneurs' representations of reality and thus to support their new ventures (DiMaggio, 1988; Fligstein, 1997). For example, art historians and their patrons co-operated in the nineteenth century to develop art museums as a distinct cultural form by creating a framework that distinguished vulgar art from high art and by establishing non-profit enterprises to showcase and conserve their cultural capital (DiMaggio, 1991). Product-testing organizations and consumer leagues promoted consumer watchdog associations by tapping into the growing customer-service and truth-in-advertising movements; these institutional entrepreneurs also linked their activities to home-economics professors, who already enjoyed the legitimacy accorded to academia (Rao, 1998). Such actions conferred normative appropriateness to the new consumer-watchdog form and shielded it from opposition, thus allowing it to stabilize and persist. Even individuals and groups that are

marginalized and have little power – like women in the late nineteenth and early twentieth centuries – can develop new kinds of organizations; these ventures are most likely to succeed when they embody familiar structures and practices (Clemens, 1997).

Summary

The strength of the institutionalist perspective is its sweeping reach. Consider the core concepts, *institution* and *institutionalization*. Scholars working in this tradition have claimed that institutionalization is both an outcome, which suggests attention to stability, and a process, which suggests attention to change. They have identified the carriers of institutions at multiple levels of analysis: the routines, rules, scripts, and schemas that guide the perceptions and actions of individuals and small groups; local regional or demographic-group identities and regimes; meso-level organizations, occupations, and fields; and society-wide norms and codified patterns of meaning and interpretation. They have identified a wide array of mechanisms through which institutionalization occurs: habituation, blind or limitedly-rational imitation, normative conformity, accreditation, social obligation, and coercion. In building theory, they have drawn not only on sociology, but also on cognitive psychology, philosophy, and linguistics. Finally, they have employed a wide array of methodologies, ranging from ethnographies and qualitative historical studies to laboratory experiments to statistical analyses of survey and archival data. As a result of its breadth and flexibility, institutionalist analysis has recently dominated submissions to the Organization and Management Theory Division of the Academy of Management Annual Meetings (Thompson, 2004; Davis, 2005). Institutional analysis was also central in the network of references to other perspectives or to specific phenomena, indicating that institutionalism was used to explain a wide range of phenomena and was used in combination with many other perspectives.

But the strength provided by this broad reach also generates a critical weakness. If institution and institutionalization mean everything and explain everything – change and stability; routines, values, and norms; intra-organizational, organizational, and interorganizational structures and behaviours; cognitive, regulative, and normative processes – then they mean nothing and explain nothing. The institutional 'tent' houses a loose collection of propositions, of varying degrees of formality, some seemingly incompatible and others only tenuously connected. For example, it is unclear when coercive, mimetic, or normative forces predominate, and to what extent these are conceptually or empirically distinct phenomena (Mizruchi and Fein, 1999). Given these fundamental uncertainties, debates in the institutionalist tradition tend to be unproductive feuds about intellectual origins and definitions, rather than substantive arguments about logic or evidence (e.g., Scott, 1995 [2001] *vs*. Hirsch, 1997). Institutionalists have not built systematically on one another's work to the same extent that ecologists have, and the institutional perspective has not accumulated empirical successes at the same rate as ecology has. This lack of accumulation of knowledge happened because institutionalists eschewed 'theories of the mid range' – logically interconnected sets of propositions, derived from assumptions about essential facts (axioms) and causal mechanisms (unobservables), that yield empirically testable hypotheses and deal with delimited aspects of social phenomena (Merton, 1968: 39–72).

COMPARING ECOLOGICAL AND INSTITUTIONAL ANALYSIS

We begin by laying out the things that make ecology and institutionalism similar. We then discuss the things that make them different. We conclude by weighing similarities and differences, then – finally! – answering the question posed in our title.

Points of similarity

Ecological and institutional approaches have as their most basic commonality their origins: both developed as corrections to rationalist and adaptationist theories that were in use in the 1960s and early 1970s, which assumed that those in charge of organizations could survey the environment and determine what the organization should do, and that organizations could easily change their strategies and structures, and thus improve their performance. Both organizational ecology and institutionalism broke with the assumption that organizations could be adapted to external conditions in a technically rational way. In the case of ecology, inertial forces prevent timely adaptation; in the institutional perspective, conforming to institutional rules can prevent efficient operation.

Another deep commonality – albeit one that is often mistaken for a basic difference – is a concern for the variety (or lack thereof) of organizations. As we noted above, ecologists ask 'why are there so many kinds of organizations?' (Hannan and Freeman, 1977: 936), while institutionalists wonder why organizations are so similar (DiMaggio and Powell, 1983: 148). The apparent contrast in these questions is illusory, however, because they point to the ends of a *single continuum*, which runs from a setting in which each organization is unique to one in which all organizations are identical. To explain one end of the continuum, one must explain the other. The real questions are *how much* organizational variety there is and *what factors* contribute to more or less variety.

These core similarities have led researchers within the two traditions to focus on similar constructs and to study similar phenomena: legitimacy, organizational form, the emergence and spread of new organizational forms and features, organizational change

(or persistence), and organizational survival or failure. Consider legitimacy: ecologists and institutionalists alike believe that legitimacy is necessary for the emergence of new organizational forms, and the proliferation and persistence of existing organizational forms. For ecologists, legitimacy is cognitive in nature and accrues to an organizational form as it increases in numbers and thus becomes accepted as the natural way to effect collective action (Hannan and Freeman, 1987, 1988). Institutionalists also recognize the cognitive aspect of legitimacy, but attend to its regulative and normative dimensions as well (Scott, 2001). Both traditions also emphasize organizational survival as a central outcome of interest; this stands in contrast to other areas of organizational scholarship, such as strategic management, that focus on profitability or market share. For ecologists, organizational survival is determined by tangible resource flows, whereas for institutionalists it is rooted in the subjective assessments of constituents. This overlapping interest in a core set of constructs and phenomenon, despite differences in the ways they have been conceived and measured, forms the basis for considerable conceptual, methodological, and empirical common ground.

Indeed, methodological similarity is obvious, as both sets of scholars employ original data on collections of organizations – populations in the case of ecologists and fields in the case of institutionalists. This empirical strategy stands in stark contrast to much other sociological research, where reliance on publicly-available data, especially survey data, is the norm. Both research traditions also emphasize longitudinal analysis. This contrasts with the approach taken in other research traditions, such as transaction-cost economics and resource-dependence theory, both of which tend to rely on cross-sectional data.

Points of difference

Despite these basic commonalities, there are important differences between ecology and institutionalism. The most basic discord stems from their theoretical agendas. Ecologists value parsimony and generality, while institutionalists prefer richness and contextual specificity. Therefore, ecologists strive to identify broad regularities across populations. Institutionalists, in contrast, attempt to offer highly contextualized and nuanced depictions of organizations or fields. This conflict is difficult to reconcile because it reflects a difference of taste in theorizing, but it could be settled by careful empirical analysis. The issue boils down to whether or not relationships between explanatory and outcome variables vary over time and across contexts – clearly empirical questions. For instance, does density dependence operate over a population's entire history or just within particular periods defined by larger forces, such as technology, social mores, and the state (e.g., Dobbin and Dowd, 2000)? Does the similarity (or difference) between a focal population and related populations affect density-dependent processes (e.g., Ruef, 2000; Dobrev, 2001)? And does the nature of the organizations under study or their context determine how inert they are and whether change harms or helps them (e.g., Dobrev, Kim and Carroll, 2003)?

Ecologists' concern for parsimony and generality has led them to follow a tight normal-science trajectory, while institutionalists' concern for richness and contextual specificity has yielded a more emergent and diffuse research agenda. To put it more formally, ecology is a collection of overlapping theories of the mid-range, each of which builds on a small set of assumptions and causal mechanisms to derive empirically testable predictions about a delimited set of organizational outcomes. Institutionalism, in contrast, is not really a single mid-range theory, or even a collection of such theories – despite the prevalence of the label 'institutional theory'. Instead, institutionalism is a perspective – a congeries of ideas and empirical tests of those ideas that demonstrate the power of rules and regulations; frames and schemas; and norms,

values, and expectations in explaining organizational genesis and functioning.

Institutionalists and ecologists also differ remarkably in their ontological stance – their understanding of the essential nature of the empirical world. Basically, ecologists are empirical realists who believe that the material world is primary and consciousness is secondary; thus, the material world, including organizations and their environments, exists outside of and independent of our observations. In stark contrast, institutionalists are social constructionists (subjective idealists) who believe that all phenomena are mental constructions created through social interaction; thus, the material world is subjective and interior, rather than objective and exterior. To put the difference in plainer terms, ecologists believe that organizational environments are 'real' phenomena, while institutionalists hold that they are created by the shared perceptions and interactions of individuals, groups, and organizations.[2]

Differences in goals and philosophy lead naturally to differences in constructs, predictions, and methods. As noted above, even though the construct of legitimacy figures prominently in both traditions, ecologists have focused exclusively on its cognitive dimension, while institutionalists have variously studied its regulative, normative, and cognitive components. There are two related issues here: what does legitimacy mean, and how should it be measured? According to organizational ecologists, legitimacy is the degree to which an organizational form is taken for granted. To capture legitimacy, researchers simply count the number of organizations in the focal population. Institutionalists recoil from this simple approach (Zucker, 1989; Baum and Powell, 1995). They protest that legitimacy encompasses cognitive, normative, and regulative dimensions, which may or may not correlate with one another (Scott, 2001). To institutionalists, a count of organizations of a given form says little about the subjective evaluations constituents make about that form. Institutionalists therefore argue that we must

use contextually sensitive measures of the three bases of legitimacy, none of which can be reduced to simple counts: links between the focal organizations or fields and powerful supporting organizations or fields, such as the state or professions; coverage of the focal organizations or fields in the news media, either positive or negative; and laws and regulations supporting or undermining various forms of organization.

The last core difference between ecology and institutionalism is that while both traditions feature quantitative analyses of longitudinal data on collections of organizations, institutionalism encompasses a greater variety of methods, including case studies of single organizations (e.g., Ritti and Silver, 1986), qualitative historical analyses of fields (e.g., DiMaggio, 1991; Rao, 1998), and laboratory experiments of organizational members (e.g., Zucker, 1977; Elsbach, 1994). Ironically, the tradition most interested in organizational diversity – ecology – displays little diversity in its theoretical and methodological approaches, while the tradition interested in isomorphism – institutionalism – displays a great deal level of diversity.

The bottom line: answer the question already!

After surveying the nature of organizational ecology and institutional analysis of organizations, and considering their points of similarity and difference, we conclude that ecologists and institutionalists have in the past been both friends and foes, but that they have good reason to be far friendlier in the future. Both sets of scholars reject the assumption, pervasive in the late 1960s and early 1970s and still popular today, that organizations are pliant tools that can easily be made to fit technical exigencies. Both sets of scholars are centrally concerned with explaining organizational variety, even though they use different terms – ecologists talk about heterogeneity, institutionalists about homogeneity. Moreover, both sets of

scholars seek to explain organizational adaptation, or lack thereof, to shifting circumstances, even though they use different terms – ecologists discuss inertia, institutionalists persistence. In addition, both sets of scholars emphasize the role of legitimacy, although they disagree about its basis – purely cognitive for ecologists; cognitive, regulative, and normative for institutionalists. Moreover, both traditions generally focus on collections of organizations, rather than individual organizations or subunits, although they use different labels – ecologists talk of populations and communities while institutionalists discuss fields and sectors. Finally, both sets of scholars take a dynamic, rather than comparative-static, approach to organizational phenomena and use original longitudinal, rather than derivative cross-sectional data.

We may be wide-eyed optimists, but we see differences between ecology and institutionalism eroding. Consider the basic unit of analysis for ecologists and institutionalists alike, organizational form. Ecologists originally conceived of distinct forms of organizations as having a unitary standing with respect to the environment, and identified them empirically through observable social discontinuities and conventional cognitive maps (Hannan and Freeman, 1977). In other words, for ecologists, the difference between forms could be deduced from observation of their inputs and outputs. In contrast, institutionalists typically classified organizations according to their distinctive logics – the socially-constructed sets of beliefs and values upon which they are based. To identify a form, researchers would need to understand the cultural elements upon which the form was built (e.g., DiMaggio, 1991; Rao, 1998). This distinction between resource flows and cultural underpinnings is disappearing, as ecologists have recently come to conceive of organizational forms as identities or social codes (Pólos, Hannan and Carroll, 2002; Hannan, Pólos and Carroll, 2007), which is much closer to the conception of form used by institutionalists.

We are also hopeful because we see an increasing number of well-executed studies that combine ecological and institutional arguments to gain richer insights. For example, in a study of child-care centres, Baum and Oliver (1991) tested the structural-inertia hypothesis of organizational ecology by taking into consideration sociopolitical legitimacy as understood by institutionalists. They found that linkages to powerful state actors mitigated the high failure rates of young and small organizations. Haveman (1993) combined ideas about density dependence in organizations' vital rates with the mimetic isomorphism hypothesis to predict diversification into new markets in the savings-and-loan industry; she found that increases in the number of successful organizations in a market drew in new entrants until competitive effects swamped legitimating ones, at which point new entries began to decline. Dacin (1997) found that both sheer density *and* sociopolitical factors like rising nationalism could be used in concert to explain founding rates of Finnish newspapers. Similarly, Wade, Swaminathan and Saxon (1998) showed how both density and particularistic institutional conditions – non-uniform state-government regulation – affected the geographic distribution of breweries' foundings and failures. Most recently, David and Strang (2006) combined insights from ecology's resource-partitioning model with notions of mimetic behaviour from institutional analysis; they showed how among management-consulting firms, generalists and specialists exploited different types of demand and reacted differently to shifts in collective understandings regarding popular management practices.

PRESCRIPTIONS FOR FUTURE RESEARCH

Our final task is to offer suggestions for readers about how to engender a more productive exchange of ideas between the two

research traditions. In particular, we suggest how scholars in each tradition can learn from the other to improve their research.

How to live peaceably and prosper

Can institutionalists and ecologists stop sniping and develop productive intellectual exchanges? Although there is a substantial middle ground between ecology and institutionalism, important philosophical, theoretical, and empirical differences (and the occasional dust-up over them) have prevented much fruitful interaction. Indeed, clashes between ecologists and institutionalists have been intense precisely *because* there are such great overlaps between the phenomena they study and close similarities in the constructs they use to explain these phenomena. If ecologists and institutionalists were studying very different things using very different ideas, the divergence in their theoretical tastes – that is, basic preferences for parsimony *versus* richness – would not vex them so much.

Given this, how can accord be achieved? The answer is simple: ecologists and institutionalists *must* reach a level of consensus concerning the many constructs they share, and agreement concerning the logical and empirical relationships between them. Fuzzy construct definitions open doors for fruitless debates: 'he-said-*vs*.-she-said' situations develop in which both parties talk past and caricature each other, rather than talking to and hearing each other. While some theoretical tension between the perspectives is healthy, we are hopeful that we can escape a situation in which ecologists seem like they are from Mars and institutionalists from Venus. An excellent place to start would be legitimacy. As explained above, ecologists and institutionalists define this construct differently. The situation is exacerbated by the fact that institutionalists do not agree among themselves how to categorize the various aspects of legitimacy – sociopolitical and constitutive (Haveman et al., 2007), regulative,

normative, and cognitive (Scott, 2001) or pragmatic, moral, and cognitive (Suchman, 1995) – and the fact that ecologists have been expansive in their use of this term – talking not just about taken-for-grantedness but also about conformity to recognized principles or accepted rules and standards (Aldrich and Fiol, 1994), and normative (value) judgments by observers (Pólos et al., 2002; Hannan et al., 2007). This bewildering list must be winnowed down. What kinds of legitimacy result from which sources, and what effect does each have? Do different kinds of legitimacy work in tandem or opposition? Which kinds are most potent, when, and for which outcomes? Not until these questions about legitimacy are answered, along with similar questions about other constructs central to both ecology and institutionalism, can the research traditions fruitfully co-exist.

How can institutionalists learn and benefit from the experiences of ecologists?

Our first prescription is for institutionalists to develop a set of related theories of the midrange (that is, to focus on delimited and substantively important topics), in order to accumulate knowledge (that is, to reject some ideas and affirm others). We are not alone in thinking this way. Institutionalists have already produced solidly cumulative knowledge about U.S. employers' responses to employee-rights legislation in the U.S. (Edelman, 1990, 1992; Dobbin et al., 1993; Dobbin and Sutton, 1996; Sutton and Dobbin, 1998; Guthrie and Roth, 1999; Kelly and Dobbin, 1999). This knowledge informs subsequent research on the effectiveness of organizational structures and practices in decreasing sex and race segregation (Reskin and McBrier, 2000; Kalev, Kelly, and Dobbin, 2006). Notwithstanding this valuable example, much more could be done.

One excellent candidate for more focused and paradigmatic theorizing is institutional entrepreneurship – currently a 'hot' topic, as

evidenced by our finding of 115 citations to DiMaggio's (1991) pioneering paper on the topic, and 12 articles published in 2005 and 2006 using this term in the title, abstract, or keywords.[3] Work on institutional entrepreneurship presents a much needed theoretical and empirical 'boost' to the generally woeful state of entrepreneurship research more generally, which has long been dominated by rationalist ideas, functionalist logic, and cross-sectional research designs. This means that institutionalists have a great opportunity to make an intellectual contribution. How does institutional change create entrepreneurial opportunity (e.g., Sine and David, 2003)? How do entrepreneurs seize this opportunity to found new organizations (e.g., Sine, Haveman and Tolbert, 2005)? How do entrepreneurs modify or create institutions to advance their interests (e.g., Lawrence, 1999; Garud, Jain and Kumaraswamy, 2002)? Institutionalism is uniquely placed to address such questions in a focused, cumulative manner that can expand our knowledge about an important social and economic phenomenon.

A second candidate for focused theorizing is the diffusion of new organizational features. This should be an easy pill to swallow, as we have two first-rate models on which to build. DiMaggio and Powell's (1983) article about institutional isomorphism explains both what kinds of forces drive the diffusion of organizational features to create isomorphism within institutional fields (mimetic, coercive, normative) and the mechanisms by which diffusion operates (cohesion and structural equivalence). Strang and Tuma's (1993) article provides a detailed, integrated model of diffusion processes, one that bridges the gap between natural-language theory and hypothesis testing. It should not be difficult to turn the growth industry that is institutionalist studies of diffusion into a true knowledge-building project.

Even if you accept our suggestions, it will be difficult to make institutionalist research more paradigmatic and cumulative. First, we need to reach agreement on the meaning of central constructs and stop using the vapid umbrella term 'institution.' (See also our ideas about how to live peaceably and prosper, above.) Second, we must formulate more coherent and more clearly falsifiable hypotheses about relationships between constructs, and disdain loose propositions. In other words, we should act (just a little bit!) more like ecologists: in exchange for greater generality and cumulative knowledge, sacrifice theoretical ambiguity and some small degree of contextual specificity. Doing so will have the benefit of allowing some institutionalist predictions to be disconfirmed by empirical analysis, while others are confirmed, perhaps in contingent formulations. Following this prescription will also allow us to take stock of the vast institutionalist output and outline scope conditions – explicit statements of the circumstances under which predictions do and do *not* hold, and the types of phenomena that are more and *less* amenable to institutional analysis.

How can ecologists learn from the experience of institutionalists?

We offer two related prescriptions that will refresh ecological research and return it to the centre of organizational theory. First and most fundamentally, we should develop richer conceptions of organizational contexts, ones that are more sensitive to time and place. In other words, we should take a page out of the institutionalist handbook, and sacrifice some parsimony and generality to acquire conceptual richness. Theoretically, this means returning to our roots in human ecology, as pioneered by Park and Burgess (1921), and refined by Hawley (1950). Empirically, it means expanding our set of explanatory variables. Most ecological analysis has used the characteristics of the focal organization and the focal population to explain organizations' vital rates. Little 'pure' ecological work has considered characteristics of the world outside the focal population, including the state, social and political movements, socially-constructed technological systems, and belief systems. Those more macroscopic explanations have

been the domain of institutional analysis. Indeed, in some ways ecological analysis, as it has been practiced to date, can be seen as nested *within* institutional analysis. By this, we mean that processes that have been the object of ecological analysis, such as density dependence, resource partitioning, structural inertia, and identity valuation, seem to operate within contexts that are assumed to be invariant in time and space (Dobbin and Dowd, 2000). Expanding the reach of ecological analysis to include forces exogenous to the population will connect ecology to many other research traditions: sociology of culture, political sociology, sociology of law, and sociology of work. There is precedent here, as ecologists have long noted the importance of political environments on population evolution (e.g., Carroll, Delacroix and Goodstein, 1988).

Second, ecology would benefit from greater methodological pluralism. Statistical analyses of longitudinal archival data on entire populations of organizations, augmented by computer simulations and logical analyses, have demonstrated the veracity of core ecological ideas. We are now in a position to expand our horizons in two ways. First, we could cement our knowledge of core causal mechanisms by gathering new kinds of data. For example, questions about organizational identities can be answered by gathering data on the opinions of observers, both internal and external, through surveys and interviews. This is something that innovative ecological research is beginning to do (e.g., Carroll and Swaminathan, 2000). Questions about inertia can be given new life through direct observations of change efforts in theoretically important cases – organizations that are either exemplary of their form, outliers, or hybrids. Field methods like participant observation can also help us develop more nuanced understandings of how the members of new organizations develop structures, routines, and norms, thus clarifying the *process* of organizing. Questions about how new organizations, especially those using novel forms, borrow or

inherit legitimacy from other pre-existing entities can be answered by observation in the field and by qualitative analysis (e.g., textual analysis) of organizational archives; these methods can shed new light on the *content* of organizing. Finally, experimental methods like vignette studies can allow us to control, in a rigorous way, alternative explanations for several observed relationships, such as density dependence in founding and failure rates. The second use to make of a greater variety of empirical methods – direct observation in the field, laboratory experiments, historical/narrative analysis, textual analysis – is to expand our set of core research questions by gathering new kinds of data on forces exogenous to organizational populations (see our first prescription for ecologists).

FINAL WORDS

In closing, we wish to step back and take the perspective of nearby outsiders: strategy researchers, economists, cognitive and social psychologists, and applied mathematicians. To them, institutionalism and ecology look remarkably similar. All of these fields are highly rationalist. When scholars steeped in these traditions examine organizations, their focus is generally on understanding and improving organizational performance. If institutionalism and ecology arose as an antidote to rationalism within organizational theory, then they might very well be seen as allies within the broader context of organizational studies. Both institutionalists and ecologists care deeply about theory, methodological rigour, and building an understanding of organizations that goes beyond a narrow focus on optimizing performance. It is often those groups that are most similar to each other – French and English Canadians, Flemish and Walloon Belgians, Protestant and Catholic Irish – that fight most intensely, even when more important battles lie elsewhere. The intellectual world of organizational studies would benefit from a true peace – not a form

of mutually assured destruction – between ecologists and institutionalists.

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NOTES

1 For more detailed reviews, see Carroll and Hannan (2000) and Baum and Shipilov (2006). Note that our analysis does not cover the study of internal organizational demography and demographic change. Both reviews delve into this more microscopic line of work.

2 Organizational theory is not alone in being divided into material realists and social constructionists/idealists. Physics, for example, has long been fraught by similar disagreements. Recall Einstein's famous quip, when he rejected the idea from quantum mechanics that reality was indeterminate and subjective: 'God does not play dice with the universe'. To put it crudely, the ontology of classical physics is material realism, while that of quantum mechanics is subjective idealism.

3 These statistics come from searches conducted on the Web of Science, February 2007.

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