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Stability, Instability, and Interdisciplinarity

by

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Abstract: This article argues that cross-disciplinary linkages – that is, relationships among phenomena studied by those in different disciplines – often serve to destabilize, at least temporarily, systems of stability that are theorized to operate within the sets of phenomena studied within most disciplines. It surveys across disciplines both systems of stability and mechanisms of instability, and derives several implications for interdisciplinary and disciplinary research practice. In particular it argues that systems of stability deserve to be included within conceptions of disciplinary perspective. It speculates on how a general connection between stability and instability might be explored. The article thus informs our understanding both of what interdisciplinarity is and how it is best performed.

Keywords: stability, instability, disciplinary perspective, interdisciplinary research practice

Introduction

Interdisciplinarity can be distinguished from disciplinarity by observing that scholars doing the former synthesize the insights generated by the specialized research performed by scholars within disciplines (Repko & Szostak, 2017). Newell (2001), among others, has wondered, though, if there are further distinguishing features of interdisciplinarity. If so, these might affect not only our understanding of what interdisciplinarity is but also our understanding of how it is best performed. Newell has posited that interdisciplinary research engages complex questions and that these in turn are characterized by non-linear relationships among phenomena (variables) studied within different disciplines. Clearly, such a definition of interdisciplinarity would have important implications for the practice of interdisciplinarity.

This article develops an alternative hypothesis:[1] that disciplines tend to theorize systems of stability among the phenomena that they investigate, and that interdisciplinary analysis often exposes linkages among the phenomena studied by different disciplines that can serve to destabilize these supposedly stable systems.[2] Economists, for example, theorize a set of equilibrating mechanisms within each market that generate a price at which consumers buy everything that producers produce; these equilibrating mechanisms are expected to generate stability at the level of the aggregate economy (indeed economists struggle to explain severe business cycles) – but this stability arguably can be disrupted by technological innovation, war, political transformation, and a host of other influences from outside the economy.

This article sets out to investigate this hypothesis and then discuss its implications. These two tasks are complementary. The hypothesis must have some validity in order for its implications to be worth considering. But if the hypothesis did not have important implications there would be no point in establishing its validity.

We will return to a discussion of Newell (2001) below. But we can note here one important implication of the debate that surrounded that article. Many authors questioned the very attempt to identify a necessary and sufficient condition for interdisciplinarity. They were generally willing to accept that complexity and non-linearity were important characteristics of much interdisciplinary research but less willing to accept that these attributes must characterize all interdisciplinary research (see the various comments on the Newell article in the 2001 volume of this journal in which it was published). We will thus not argue in this article that all interdisciplinary research is destabilizing – nor that all disciplinary research stresses stability – but merely that identifying destabilizing linkages is a common characteristic of interdisciplinary research and one with important implications for interdisciplinary practice.

Our first task is to establish that many/most disciplines do indeed tend to theorize systems of stability among the phenomena that they study. That is, they theorize about why these phenomena change little or not at all through time. Our task could be performed in a variety of ways. We might summarize in a citation-intensive fashion the scholarly debates within each discipline regarding the nature of that discipline. Such an approach would be difficult to encompass within the confines of one article. And scholarly debates about

[1] The reader can later judge if this hypothesis is best seen as a complement to the Newell hypothesis.

[2] Interdisciplinary scholars might be seen as placing disciplinary systems within a larger and more complex system encompassing all phenomena; this bigger system arguably exhibits far less stability than the "subsystems" on which disciplinary scholarship focuses.

the nature of disciplines may fail to capture the shared assumptions at the heart of each disciplinary perspective. As often in interdisciplinary research, the purposes of this article will be best achieved by stressing breadth of coverage over depth of analysis. In the next section we will briefly survey the main disciplines across the human and natural sciences, identifying the key theories of stability within them.

We can recognize here that disciplines generally have good reason for positing some degree of stability among the phenomena that they study. That is, these systems of stability appear to exist in the world as well as in the imaginations of disciplinary scholars. We will strive to be clear in what follows as to when we are referring to the theorization of stability and when we are referring to actual stability in the world.[3] We can note here that our contention is that linkages among phenomena studied within different disciplines serve to interfere with the *reality* of stability among the phenomena studied within particular disciplines. Our concern is that this implication is not always fully appreciated within the *theorization* of stability.

We will also in the next section ask to what degree each discipline recognizes de-stabilizing mechanisms. We will find that where these are countenanced they are generally thought to be temporary in effect: It is presumed by scholars within a discipline that stability is restored fairly quickly within whatever stable system they have theorized. More centrally for our purposes we will find that when de-stabilizing mechanisms are identified by disciplinary scholars these almost always involve phenomena studied primarily by those in other disciplines.

This last point deserves emphasis. Each discipline chooses to focus its analysis on a certain set of phenomena – this is indeed one of the defining characteristics of disciplines (Klein, 1990; Salter & Hearn, 1997). Each discipline then theorizes some stability-generating system of interaction among these phenomena. Some disciplines recognize de-stabilizing mechanisms, but these typically involve phenomena that the discipline tends not to study. It follows that disciplinary research will be biased toward stressing systems of stability among the phenomena studied by those in that discipline. Interdisciplinary researchers in turn, since they tend to study

[3] A further distinction might be drawn with the stability of theories themselves. This is not our focus in this paper, though it may be the case that theories that posit stability in the real world tend to be maintained in a relatively unchanged format by disciplines over time. We are making an ontological assumption in this paper that there is an external reality and an epistemological assumption that we have some capacity to comprehend this.

relationships among phenomena studied by different disciplines, must often engage instability in cross-disciplinary mechanisms.

We should pause here to clarify what we mean by "cross-disciplinary mechanisms." We are referring here to relationships among phenomena that are studied (primarily) by different disciplines. It is thus not the disciplines themselves that are linked but the phenomena that those in disciplines study. But it would be inconvenient in what follows to refer repeatedly to "linkages among the phenomena studied by those in different disciplines" rather than the more congenial "cross-disciplinary linkages." It is hoped that the use of "cross-disciplinary" rather than "interdisciplinary" helps to signal that it is not the disciplines as a whole that are being connected but the phenomena that the disciplines study.

The third section of this article then explores several implications of our hypothesis for interdisciplinary practice. That section concludes by arguing that stability-enhancing mechanisms thus deserve emphasis in conceptions of disciplinary perspective. Interdisciplinary scholarship has long stressed the importance of disciplinary perspective: in particular that the insights generated within a discipline need to be evaluated in the context of its overall perspective. By adding a new element to our understanding of disciplinary perspective we enhance our capacity to evaluate disciplinary insights. Since evaluation precedes integration, we thus also indirectly aid our ability to then integrate across disciplinary insights in order to move towards the more comprehensive understanding of complex phenomena that is the goal of the interdisciplinary research process.

Our hypothesis also has important implications for disciplinary research practice. Disciplines might strive to reduce the bias toward stability that we have identified. We explore these implications in the fourth section of the article, and how the relationship between disciplines and interdisciplinarity might be reconfigured. We then explore in the fifth section of this article whether and how we might identify general lessons for the study of instability.[4]

The last substantive section of the article then returns, as promised, to the

[4] The literature on interdisciplinarity (see *About Interdisciplinarity,* 2016) assumes that there are common challenges faced – and strategies developed in response – by interdisciplinary researchers and teachers across the natural and human sciences (though there may, of course, also be important field-specific challenges and strategies). This entire article has been predicated on that assumption. If interdisciplinary research will often explicate cross-disciplinary mechanisms that interfere with disciplinary systems of stability, this represents an additional challenge that deserves recognition – though these linkages may be of greatest importance in social science (see below).

work of Newell. We also address there some influential research of Talcott Parsons. We clarify the areas of agreement and disagreement with each, and discuss the implications. A brief concluding section follows.

Disciplinary Stability and Cross-disciplinary Instability

This section surveys the stability-enhancing systems that are important to several disciplines. Special attention is paid to whether disciplines appreciate cross-disciplinary mechanisms that might disturb stability among the phenomena studied in that discipline. After all, it is true that instability is also theorized in some of these disciplines. Sociologists, in particular, have often attempted to understand periods of social change as well as periods of social stability. Physicists study nuclear chain reactions as well as the general case of atomic stability. In many/most disciplines theories of stability are dominant. In others they are important but less dominant. The key point is that in all cases the mechanisms posited as generating stability can be disrupted by the effects of phenomena studied in other disciplines. This disruptive effect will have more profound implications for disciplines in which theorization of stability dominates, but will still prove challenging in disciplines in which theorization of stability is merely important.

Economics. As noted above, within most individual markets the forces of supply and demand are expected to lead to an equilibrium price at which the amount producers produce is equal to the amount consumers consume. A variety of exogenous shocks, such as changes in tastes, technology, or weather (all phenomena studied by other disciplines), may disturb demand or supply, but markets will move toward a new equilibrium. At the level of the whole economy, equilibrating mechanisms (especially with respect to wages and interest rates) are also expected to limit the size and duration of business cycle fluctuations. Economics has struggled to understand business cycles, given the fairly rapid return to equilibrium predicted for each individual market. And economics has notoriously failed to produce a compelling explanation of the Great Depression (I argued in 1995 that this could only be done through recognizing the cross-disciplinary linkage between technological innovation and various economic variables). Economists have also had difficulty theorizing about the dynamic process of economic growth: It is notable that growth models often predict steady rates of growth through time (sometimes steadily declining rates of growth), a kind of dynamic stability quite at odds with observed growth processes. Again an interdisciplinarity approach is useful in connecting theory to empirical reality: Cross-disciplinary linkages suggest that economic growth

will be far less "stable" than growth theory implies. Economic growth reflects changes in technology, institutions, values, population, and a host of other phenomena; and none of these "causes" of economic growth changes smoothly through time (Szostak, 2009).

Cultural Anthropology. Cultures allow humans to predict and regulate the behaviors of other members of a particular society. They thus serve a critical role in allowing individuals to function in society, and in individuals' evaluations of their own efficacy and self-worth. They also encourage individuals to behave in certain ways. To serve these roles, cultures need to be consistent: Attitudes favoring egalitarianism and ambition do not readily coexist. Anthropologists in the past were often guilty of exaggerating the stability of traditional cultures. They tended to view cultures as "monolithic": Each attitude or behavior was tightly linked to every other attitude or behavior in a belief system that was not seen to be subject to change or internal diversity. Especially as anthropologists have turned their gaze to non-traditional societies (as the number of traditional societies dwindles) they have come to appreciate that cultures evolve and are generally characterized by some degree of internal diversity. They have often stressed the effects of cross-cultural contact, especially when traditional societies come in sudden contact with societies with more complex economies and polities and technologies. Here we can see an appreciation of the destabilizing impact on culture that political, economic, and technological forces can exert. Cultural instability can in turn induce psychological instability as individuals no longer know how to behave.

Interdisciplinarity can clarify our understanding in this area in several ways. Most centrally, interdisciplinary scholars could essay to better understand the links between culture and psychological well-being: How much cultural change can humans endure without losing their bearings? Then we can better understand the links among culture, economy, and polity: How do and should cultures adapt to changes in other spheres? Scholars in the field of cultural studies have often hoped that cultural changes will lead to political changes: The precise linkages involved could be more carefully elucidated and evaluated. We can usefully better understand, that is, both the causes and effects of cultural instability by exploring multiple linkages between cultural and non-cultural phenomena.

Sociology. Sociology encompasses at least four distinct fields of inquiry. Sociological interest in *culture* intersects with the interests of cultural anthropologists (see above). The field of *demography* studies human populations. It is necessarily somewhat interdisciplinary in outlook as a variety of economic, medical, and other variables have powerful influences

on birth rates and death rates. The best-known theory in demography, Malthusian theory, posited a rough equilibrium between population levels and food output through time: If agricultural productivity increased population would expand and push levels of income for the bulk of humanity back toward subsistence levels (if societies did not control fertility, then war or famine or epidemic would reduce populations to levels that could be fed).[5] In recent centuries, agricultural productivity has grown faster than population could, and so Malthusian theory is generally judged to be a better explanatory device for pre-modern societies. Most of the contemporary world is nevertheless characterized by low rates of population increase, and demographers still predict stability or decline over the next decades in much of the world. They appreciate, though, that changes in nutrition, disease, or incomes – all phenomena studied in other disciplines – can generate periods of demographic instability.

Sociologists also discuss *social structure*: the division and (usually) stratification of all societies by gender, occupation/class, ethnicity, family, sexual orientation, and other characteristics. They have necessarily addressed how cultural attitudes and/or political institutions often reinforce and thus stabilize social stratification. Yet they have naturally also studied how social relations can change. Here again cross-disciplinary linkages are crucial. Technologies such as washing machines and vacuum cleaners in the home facilitated the movement of women into the labor force at a time when typewriters, political decisions, and cultural attitudes generated employment opportunities as secretaries, nurses, and teachers; and the world wars and the birth control pill further acted to transform women's role in most societies. Gender relations that had seemed stable were thus transformed by a set of technological, economic, political, and cultural influences.

Criminology is the fourth major field in sociology. While crime is a serious social problem, it operates in most societies at a level that does not prevent either economic or political stability. While criminologists naturally devote much of their time to examining how the incidence of crime might further be reduced, they also examine how crime has historically been maintained at "acceptable" levels, at least for those in positions of political or economic influence. Such stabilizing mechanisms must necessarily involve cultural attitudes and political institutions. Economic circumstances also matter: Those with limited economic opportunities are more likely to turn to crime (though this empirical result may in part reflect lower levels of reporting of white collar crime). Changes in these or other variables can thus transform

[5] This theory shows that interdisciplinary theories of stability are quite possible: Interdisciplinarians need not always investigate instability.

what might otherwise be fairly stable crime rates.

As noted above, there is a long tradition in sociology of theorizing about social change. It is worth stressing that such theories have tended to emphasize what we have called cross-disciplinary linkages. Max Weber (1904), for example, posited a relationship between religious belief and economic performance. Karl Marx (1867) posited relationships among technological, economic, cultural, social, and political variables that generated cumulative social and political and economic change.

Political Science. Political science has necessarily faced the twin facts that some political regimes last for centuries (albeit often with changes in particular institutions), while others fall to political revolution. Both stability and instability thus require explanation. Political scientists naturally study how certain political institutions are self-sustaining. Yet political science has tended to be more outward-looking than most other social science disciplines, recognizing that political stability is more likely if the economy is stable and cultural attitudes are supportive. Cross-disciplinary linkages have been observed to be even more critical in generating periods of political instability. Economic disruptions in particular are often seen as key triggers of political change. Historically, climatic shocks have often also been seen to trigger political change.

Psychology. Though psychology has long been associated in the popular mind with the study of mental disorders – that is, mental instability – even theories of disorders naturally had to imagine a healthy stability from which those with disorders deviated. Increasingly in recent decades psychologists have turned to "positive psychology" that investigates the sources of happy and efficacious frames of mind. A variety of cross-disciplinary linkages – health, relationships of various sorts, economic well-being, cultural attitudes – have been implicated in studies of both psychological stability and instability. Importantly, as individuals develop mental schemas that guide them through life, they must assume that there is stability in the way that the world works in order to be confident of their ability to make appropriate decisions. Surprising and especially traumatic events can disrupt psychological stability.

History. History can be seen as a study of the interchange of stability and instability. Empires last for centuries only if they develop some types of stability (taxes finance necessary expenditures, cultural attitudes are not too hostile to authority, local elites do not become too powerful, and so on), but they all eventually fall. The trick has always been to understand both continuity and change. The key likely lies in understanding the mechanisms of instability that bring about change. The empire establishes a stable tax

and spending system but this is undercut by other forces over time: Local elites confiscate funds and gain exemptions from taxes while the very financial stability of the state invites raids by outsiders and technological and climatic shocks further disrupt financial stability. History as a discipline – and especially world history – could benefit from a more explicit recognition of the importance of cross-disciplinary linkages in driving societal change. It is common, for example, for world history texts to take a "thematic" focus in which they trace polity, economy, technology, and/or culture through time. The analysis of this article suggests that the focus should be on the interactions among such themes (not to mention the careful definition of themes in terms of the phenomena we study) as much as or more than on the themes themselves (Szostak, forthcoming).

Humanities. *Cultural studies* was addressed briefly above. With respect to the study of *art and literature*, one key question regards the degree to which artwork of either sort reflects the status quo or can be revolutionary. This key question can obviously only be addressed by investigating the links from various societal phenomena both to and from such work. Though artistic styles – and their appreciation – change through time, these can only evolve slowly for audience appreciation is shaped by past experience of works of art. There is thus an important degree of artistic stability generated by cultural expectations, but over time a variety of forces can induce unforeseen changes in the arts. These often involve phenomena from outside the arts areas that humanists study, though artistic creativity itself can cause change within the limits circumscribed by audience expectations. Artists reflect and affect cultural attitudes. They respond to economic incentives and cope with political censorship.

It may well be that theorization within the humanities focuses less on stability in the areas of endeavor that humanists study and thus that disruptions from forces outside the arts that affect artistic endeavor are less disruptive to that theorization than they might be in other disciplines. But the ubiquity of artistic schools or styles that characterize a certain time and place indicates the existence of important systems of stability within the phenomena studied by those in the humanities.

Physics. At the level of the universe, physicists have developed theories of why (some) stars and galaxies maintain stability for billions of years; yet they have also posited a universe with a definite beginning and end, and, hence, instability. At the level of subatomic particles, physicists have identified four forces that almost always hold atoms together. Physicists have struggled successfully to identify precise conditions under which atomic fission or fusion – both instances of atomic instability – might occur:

Notably they have had to work with a variety of scientists and engineers to build bombs and power plants. Theories of stability are thus central to the discipline, but its practitioners have certainly appreciated important instances of instability.

Chemistry. Chemical bonds of various types keep molecules very stable. Chemical reactions that form qualitatively new molecules occur under precise conditions of temperature and pressure (and sometimes require electric current or some sort of catalyst). Insights from physics regarding sub-atomic particles have aided chemists greatly in understanding the conditions under which stable molecules are transformed into quite different types of stable molecules. For example, a molecule with an "extra" electron can bond strongly with a molecule with a missing electron. Chemical instability – transformation of one molecule into another – is thus a result of actions at the sub-atomic level explicated by physicists – one of many examples of cross-disciplinary linkages increasingly appreciated by chemists.

Biology. Organisms are complex systems that can only survive by achieving a high degree of systemic stability. Biology has thus necessarily focused much attention on how organisms maintain this stability. Evolutionary biology appreciates change but generally assumes this to be gradual and seeks to understand how each small change has enhanced the organism's genetic fitness (its survival and reproductive potential). However, biologists have come to acknowledge that we can only understand genetic fitness, and thus how organisms evolve through time, by appreciating how the organism interacts with its environment. Instability – in this case the change in the genetic composition of a species – is yet again conditioned by cross-disciplinary linkages.

Ecology. Eco-systems involve a highly complex set of interactions among a large number of species and natural processes. Environmental science struggles to understand precisely how a variety of human actions affect ecosystems: How much can these adapt into new stable sets of interactions and at what point do we observe a dramatic decrease in ecological functioning? The very idea of an ecosystem implies stability; it is shocks from outside the system, and especially a variety of human actions, that threaten this stability. Understanding this dynamic, ecologists are among those disciplinarians who are (and have always been) interdisciplinarily inclined–and given to appreciation of the need to study cross-disciplinary linkages.

Geology (Earth Science). The earth is a dynamic body with ever-shifting tectonic plates and boiling magma that occasionally breaks through the surface. Though the earth experiences earthquakes and volcanoes with

some frequency most areas of the world's surface most of the time are little affected by such dramatic forces. Geologists seek to understand the general stability as well as the infrequent but important occurrences of instability. Notably the earth returns to stability after fairly brief periods of instability by geological standards. The major exception to general geological stability (at least during historic times) involves climate that has fluctuated a great deal in human history and is showing even greater instability at present. And this is, of course, the natural process that has been most affected by humans, and all the mechanisms of instability that human behavior introduce into the phenomena that geologists (and climatologists) study.

Mathematics. It is much easier to develop an equilibrium mathematical model than a stochastic model that generates unpredictable or unstable outcomes. And this has encouraged the prominence of models that generate stability in mathematical disciplines such as Economics or most natural sciences. Since instability-generating cross-disciplinary mechanisms are difficult to incorporate into stability-generating disciplinary models, mathematical preferences limit the appreciation of the nature and effects of these cross-disciplinary linkages. Yet mathematicians have been encouraged by scholars in other disciplines to develop approaches – such as complexity modeling and the practice of computer simulations – that can cope with the realities of unstable systems.

Summary. We have identified a number of systems of stability that involve only the phenomena studied by one discipline: economic (both individual markets and the aggregate economy), cultural, psychological, artistic, nuclear, chemical, biological, geological, and mathematical. In a handful of other cases, we identified systems of stability that were centered on the phenomena of one discipline but had some recourse to linkages with phenomena studied by other disciplines: demography, social structure, crime, politics, and ecology. Systems of stability are important to all disciplines and absolutely central to many.

However and most importantly for our purposes, cross-disciplinary linkages disrupt all of these systems of stability to a greater or lesser extent: Changes in tastes or technology move us away from economic equilibrium; new technologies or economic developments transform and occasionally destroy stable cultures; changes in technology or economy or health have caused population to increase or decrease; new technologies and cultural attitudes have transformed gender and ethnic and class relationships; crime rates vary with economic and legal and cultural changes; economic and climatic shocks often trigger political change; disease or job loss can trigger psychological instability; artists are buffeted by economic and political

and cultural forces; nuclear instability can be engineered; forces identified by physicists guide chemical reactions; organisms evolve in response to a host of environmental changes; ecosystems are challenged by a wide range of human activities; and mathematicians struggle to address instability in general. These mechanisms of instability are most obvious among phenomena studied by those in the social sciences but can be identified also in natural science and the humanities. And we have not striven to be exhaustive in elucidating mechanisms of instability: Many more destabilizing cross-disciplinary interactions could be posited and investigated.

We have only provided very brief sketches of 16 distinct disciplines (if sociology is appreciated as four distinct fields). There may well be room to quibble with our analysis of particular disciplines. But we hope we have done enough to establish the ubiquity of both discipline-based systems of stability and cross-disciplinary mechanisms of instability. We think we can say that disciplines will generally theorize some systems of stability and that interdisciplinary scholars are more likely than disciplinarians to be willing and able to investigate cross-disciplinary mechanisms of instability.

Implications for Interdisciplinary Analysis

Since disciplinarians will naturally downplay the role of cross-disciplinary mechanisms, interdisciplinary analysis will be critical in identifying such mechanisms and then explicating how they disrupt systems of stability that scholars from individual disciplines have studied and privileged in their thinking. This observation has several important implications for interdisciplinary theory and practice. We address first some theoretical implications, and then some strategic implications regarding the relationship between interdisciplinarity and disciplinarity. We close with what might be viewed as a conceptual implication: The existence of disciplinary thinking that privileges systems of stability, often failing to acknowledge – much less study – mechanisms of destabilization, deserves inclusion in our conception of disciplinary perspective.

Theoretical Implications

The argument in this paper has important implications for several steps in the interdisciplinary research process outlined in Repko and Szostak (2017). In Step 3, identifying relevant disciplines, the interdisciplinary researcher could reflect on which disciplinary systems of stability are implicated in a research question. The interdisciplinary researcher may wish to learn

more about these systems in conducting the literature search (Step 4) and developing disciplinary adequacy (Step 5). In Step 6, evaluating disciplinary insights, the interdisciplinary researcher will want to ask if each discipline in question exaggerates the degree of stability in relationships among its own phenomena. The tendency of disciplines to stress stability may be a source of conflict among disciplinary insights (Step 7). The recognition that cross-disciplinary linkages often serve to destabilize discipline-based systems of stability may then provide (elements of) common ground for integrating disciplinary insights (Step 8). The more comprehensive understanding (Step 9) can still embrace discipline-based systems of stability while appreciating that these are disrupted by certain cross-disciplinary linkages. This last point can be stressed when communicating the more comprehensive understanding to disciplinary audiences (Step 10).

It is often hoped in interdisciplinary research that the more comprehensive understanding will help society to address complex public policy challenges. The goal of such research is often to identify superior public policies. While such policies may at times be designed to generate ongoing change (instability) in particular directions (innovation policy that hopes to encourage a series of technological innovations leaps to mind here), the goal is more often to move to some sort of new stability with features that we consider superior: a permanent reduction in poverty rates or crime rates or pollution. An appreciation of the systems of stability reflected in disciplinary-level thinking can be useful in appreciating why public policy challenges so often seem intractable. But then our analysis in this article guides us to look outside of disciplinary-level thinking for mechanisms (influences of phenomena studied by other disciplines) that can drive the system toward a new and better equilibrium.[6] Our analysis, then, provides both a rationale for and a caution regarding interdisciplinary analysis of complex problems. The rationale is that cross-disciplinary linkages are often critical in moving society toward a stability with desirable characteristics. The caution is that we must respect the symbiotic nature of interdisciplinarity and disciplinarity: Only by integrating our understanding of cross-disciplinary mechanisms of instability with our understanding of systems of stability theorized by disciplines are we able to identify desirable public policy interventions.

Public policy is naturally future-oriented, and is thus (or at least should be) informed by our best projections of the future. There is already a strong

[6] For example, how do minimum wage laws or cultural opposition to discrimination affect the workings of the economic system? If – for the sake of argument – minimum wages do increase unemployment rates within the economic system then increasing minimum wages may not achieve the desired result of reducing poverty. Note that while minimum wage laws are theorized by economists they are instituted politically.

connection between interdisciplinarity and futurism – evidenced by the many special issues of the journal *Futures* devoted to transdisciplinarity. The present article has important implications for the role of interdisciplinary analysis in projecting the future. There is always a temptation in futurism to extrapolate current trends into the future. Yet of course futurists know that the future like the past will be full of surprises. Futurism can thus benefit from a careful articulation of how discipline-based systems of stability interact with cross-disciplinary mechanisms of instability through time. Indeed it may well be that futurists should focus their attention on identifying cross-disciplinary linkages likely to destabilize in an undesirable direction so that we can take steps to avoid these undesirable outcomes.[7]

Further theoretical insights come from the recognition that interdisciplinary analysis is a creative process (Szostak, 2017, discusses how creativity can infuse several steps in the interdisciplinary research process). And creativity involves transcending existing structures (Sill, 1996). We will be better able to do so if we are aware of the structures we transcend. We prepare ourselves for creativity by gathering relevant insights and consciously evaluating them: Novel connections are then drawn subconsciously.[8] This is generally done visually (as subconscious thought processes are non-lingual). Conscious appreciation of the existence and limitations of disciplinary theories of stability, and of cross-disciplinary mechanisms of instability, prepares us to subconsciously imagine ways that we can move apparently stable sets of phenomena in desired directions. One strategy recommended by Buzan (2010) is mind-mapping in which one places all relevant concepts and theories on a piece of paper and consciously draws connections among them; new connections are then identified subconsciously. There is obvious scope for appreciating both systems of stability (privileged in disciplinary thinking) and mechanisms of change (complex enough to be best understood with interdisciplinary thinking) within such an approach. The point to stress is that we are better able to trigger creative solutions to complex problems if we first consciously appreciate both the discipline-based systems of stability and the cross-disciplinary mechanisms of instability at work.

In addition to these general implications our analysis has more focused implications for particular systems of stability or mechanisms of instability. Interdisciplinary scholars may, in particular, be guided to pay special

[7] That is we would identify an interdisciplinary research question that would guide us to study a cross-disciplinary linkage and how it might be transcended.

[8] Psychologists often prefer the term "unconsciously." There is debate in psychology as to whether it makes sense to speak of a "subconscious" but little doubt that we have thought processes that are non-lingual in nature.

attention to psychological and cultural stability. In the last centuries, rates of societal change have accelerated. But humans need some sort of stability or they become dislocated psychologically. And without some degree of cultural stability we lose a sense both of how we should behave and how we can expect others to behave. As we explore policies for effecting societal change we need to be cognizant of the challenges of psychological and cultural dislocation. This may be particularly important at this point in time with respect to indigenous peoples. More generally, we will be better able to restructure cultural and psychological stabilities if we recognize this as a goal of public policy.

We briefly addressed evolutionary analysis when discussing biology above. But evolutionary analysis can be applied also to art, culture, technology and science, and the institutions studied by political scientists and economists. Evolutionary analysis may prove particularly valuable in navigating the connection between stability and instability. As noted above, evolutionary analysis allows us to understand a process of change through time that is nevertheless reflected at any point in time by a large degree of stability. Szostak (forthcoming) indeed relies heavily on evolutionary analysis in navigating the interaction between stability and instability in history.

Strategic Implications

Our argument has been that interdisciplinary understandings will often transgress the theories of stability embraced by particular disciplines. This will be a source of (often subconscious) disciplinary resistance to interdisciplinary understandings. That is, disciplinary scholars will balk at suggestions that the systems they study are not as stable as they assume. Notably, they may balk even if their own theories recognize the possibility of "shocks" from outside of the systems they posit that may temporarily disrupt stability. As noted above disciplines focus primarily on their own phenomena, and thus the systems of stability instantiated in them. Moreover it is generally easier to treat mathematically these systems of stability, and thus mathematically-oriented disciplines face a further incentive to stress stability. Scholars within disciplines will then be hesitant to appreciate sources of instability, and especially arguments that such cross-disciplinary linkages exert a frequent and/or powerful influence on the systems they posit. Interdisciplinarians will be better able to meet this resistance if they are aware of it.

An example may be useful here. Several decades after it ended, economists still struggle to explain the Great Depression. This major episode of economic

instability is generally viewed as an insult to economic theory – which posits that this sort of instability should not occur – rather than an invitation to identify explanations of this unusual bout of instability involving the phenomena studied by other disciplines. Technological shocks have been suggested as an explanation of the Great Depression by several authors starting in the 1930s (Schumpeter, 1939), but most economic analyses of the Great Depression restrict their attention to economic variables alone (Szostak, 2005). From the perspective of this article, one would think that economists should welcome a cross-disciplinary explanation of the unique experience of the Great Depression (which was far more severe in terms of depth, length, and international extent than any other episode of economic instability); by recognizing the importance of unusual shocks in propagating that unparalleled calamity they could increase their confidence in their theorization of general stability. But economists like practitioners of all disciplines prefer explanations in terms of their own favored phenomena, even if this means they struggle to understand episodes of instability.

The interdisciplinary scholar can seek to address this kind of disciplinary resistance directly. It can be stressed that the interdisciplinary insight is a *complement* to disciplinary understandings rather than a *substitute* for these understandings. The fact that mechanisms of instability are identified in no way means that systems of stability are not important. As noted above, we need to appreciate both stability and instability in order to understand and change the world. The interdisciplinary scholar is thus guided to express appreciation of the discipline-based system of stability being destabilized. If, as is often the case, the destabilizing effect of cross-disciplinary linkages is temporary, this fact can be emphasized.

Over the longer term interdisciplinarians can aspire to educate all scholars about the relationship between cross-disciplinary mechanisms of instability and discipline-based systems of stability. This might be one of the key lessons we seek to impart in both undergraduate general education and (especially interdisciplinary) graduate training. Disciplinary scholars might come to expect complementary interdisciplinary analyses that would explain occasional episodes of instability in the systems of phenomena they study that disciplinary theories have difficulty coping with. In such a world scholars of the Great Depression would naturally expect that cross-disciplinary linkages might be important. And economists more generally might recognize that they are better able to appreciate the workings of internally-generated business cycles if they first recognize the exogenous shocks that occasionally cause even greater instability than business cycle theory allows.

The scholarly enterprise in the end needs to understand *both* stability and

instability. Recognizing that disciplines are particularly adept at the former and that interdisciplinarity will often expose the latter (though there are exceptions on both sides) can serve as a powerful motive for pursuing a symbiotic relationship between disciplinary and interdisciplinary research. Each type of researcher can more readily appreciate – and will thus be less likely to be offended by – the insights of the other.

We can imagine a further type of symbiosis: between the theoretical implications above and the strategic implications discussed here. The strategic case for interdisciplinarity is buttressed with every elucidation of an important cross-disciplinary mechanism of instability. And each such elucidation will be more readily appreciated as the general case for interdisciplinarity is made.

A Conceptual Implication

The scholarship of interdisciplinarity stresses the importance of disciplinary perspective: the way that each discipline views the world. Disciplinary perspective influences both the questions that disciplinary scholars ask and the ways that they go about answering them. Yet disciplinary perspective is often absorbed subconsciously, and thus disciplinary scholars may not be aware of its influence on their work. It is argued that the insights generated by disciplines need to be evaluated in the context of disciplinary perspective (Repko & Szostak, 2017). If most/all of the arguments made in this article have any merit, it follows that interdisciplinary researchers and teachers should include theories of system stability in their understandings of disciplinary perspectives. Such theories, as has been seen, are of particular importance to the nature of disciplines. They shape how scholars within disciplines view the world and influence their resistance to the explication of cross-disciplinary linkages that generate instability.

It is quite straightforward to include theorization of systems of stability in our understandings of disciplinary perspective. Repko and Szostak (2017) provide brief sketches of the disciplinary perspectives of key disciplines. The perspective of Economics already stresses the importance of market interactions; this description of disciplinary perspective could be extended to recognize that such interactions are generally presumed to generate equilibrium prices and quantities. The perspective of Physics recognizes the four key physical forces and their effect on "the underlying structure of observable reality." We can add that these forces usually cause atomic-level stability. We can also add some introductory remarks about the importance of systems of stability alongside other elements of disciplinary

perspective. We can stress that theorization of systems of stability is an important source of disciplinary resistance to interdisciplinary insights. These simple adjustments to our understanding of disciplinary perspectives will significantly deepen our understanding of each discipline.

Implications for Disciplinary Analysis

Disciplines are likely to exaggerate the importance of discipline-based stability-enhancing mechanisms and downplay the importance of de-stabilizing linkages to the phenomena studied by other disciplines. This tends to leave disciplinary thinkers ill-prepared to understand or forecast political revolutions, economic crises, changes in cultural attitudes, or even chemical explosions. Interdisciplinary scholarship can thus play a critical role in guiding those in the disciplines toward a greater understanding of sources of instability in the systems of phenomena that they study.

Though disciplinarians focused on stability may see these interdisciplinary linkages as a threat, it is conceptually quite feasible to embrace both intra-disciplinary stability and cross-disciplinary instability. Imagine a feedback loop among a handful of variables studied in one discipline (such as between prices and quantities of goods produced and demanded in a particular market) that generates stability (a price at which the amount produced is precisely the amount consumed). Imagine then a shock from some phenomenon studied elsewhere (perhaps a change in technology or tastes): This leads to instability. Often the instability is temporary (a new price is found at which new levels of production match new levels of consumption). In such a case a disciplinarian should be able to see the study of stability and the study of instability as complements – though stability may lend itself to more mathematically or diagrammatically elegant theorization. The disciplinarian might investigate empirically the relative importance of stability and instability – and if and how quickly stability is restored after a shock.

As noted above, scholars of interdisciplinarity often posit a symbiotic relationship between disciplinary and interdisciplinary investigation (e.g. Repko, Szostak, & Buchberger, 2017). Here we see a powerful way in which interdisciplinary scholarship can encourage more comprehensive and realistic understandings among those working within disciplines.

Stability from Instability?

We should recognize the possibility of dramatic change in a particular direction, such as nuclear chain reactions that escape control or the descent

of once-stable polities into anarchy. But casual empiricism suggests that dramatic changes often segue into new systems of stability in both natural and social systems. Political revolutions sometimes generate decades of instability and at other times usher in centuries of stability. If we accept the argument of this article that cross-disciplinary linkages are often destabilizing, then it makes sense to ask under what conditions this instability is only temporary.[9] Interdisciplinary and disciplinary analyses have often approached this question on a case-by-case basis: For example, why do some political revolutions "succeed" while others "fail"? But the key insight of the scholarship of interdisciplinarity is that there are important commonalities across different interdisciplinary investigations, regardless of the questions addressed or disciplines engaged. If there is a general tendency for cross-disciplinary linkages to destabilize then there may also be general understandings of how, when, and why a new stability is then instantiated in the world. If so, these understandings should also be instantiated in theory: both interdisciplinary and disciplinary. Since one of the key purposes of interdisciplinary analysis is to help us engineer stabilities with desirable attributes (see above), a general understanding of how to generate a new stability could prove invaluable. Do discipline-based systems of stability simply re-assert themselves over time – as disciplinary theory often implies? Or is there some feedback effect within cross-disciplinary mechanisms that (at least some of the time) generates an eventual return to stability? The likely answer is "both," but we can usefully investigate the relative importance of disciplinary and cross-disciplinary forces in generating stability. As elsewhere in interdisciplinary scholarship this can best/only be done by drawing comparisons across a wide array of interdisciplinary analyses (see Krohn, 2010).

It is of course beyond the scope of this article to perform such a comparison. But the key to comparative analysis is knowing first what to compare. Our analysis in this article suggests that we should look at many cases in which a cross-disciplinary linkage(s) generated instability in a discipline-based system of stability and compare if, how fast, and why stability was restored. (This might make for a wonderful Ph.D. dissertation.)

Connections to Previous Literature on Disciplines and Interdisciplinarity

The preceding analysis allows us to revisit two key contributions to scholarly understandings of disciplines and interdisciplinarity. Newell (2001)

[9] Empirically, our evaluation of "temporary" will depend on the particular system being engaged. Biologists posit stability over much longer time frames than social scientists.

posited complexity as the critical component of interdisciplinary analysis. His conjecture has attracted great interest and considerable controversy: It is the most cited article ever published in *Issues in Integrative (*now *Interdisciplinary) Studies*, and has been commented on in detail in several subsequent publications in that journal and elsewhere. One might summarize this considerable literature as recognizing that Newell had an important insight into the nature of interdisciplinarity but evincing some skepticism regarding his argument that it was non-linear relationships among phenomena studied by different disciplines that were the defining characteristic of interdisciplinary analysis. The present article in many ways parallels Newell's analysis but differs from it in two respects. First, rather than focus attention as Newell did on the degree of *linearity* of individual causal linkages it emphasizes instead the *effects* of cross-disciplinary linkages on systems of phenomena examined within disciplines. It thus locates the essential nature of (much) interdisciplinary analysis in what it does rather than what it is. It may well be that the systems of stability theorized by disciplines are most often composed of linear relationships between variables[10] whereas the cross-disciplinary linkages examined by interdisciplinary scholars often involve non-linear relationships. But this article moves the essence of the distinction between disciplinarity and interdisciplinarity toward their respective perspectives on systemic stability: Interdisciplinary research will often focus on linkages that de-stabilize systems of stability observed among phenomena and then posited within disciplines. We have seen above that this simple distinction has important consequences for both interdisciplinary and disciplinary practices. We also differ from Newell (2001) in not seeking to draw a sharp dichotomy between disciplinary and interdisciplinary practices. In line with Szostak's (2015) extensional definition of interdisciplinarity that identifies a continuum between disciplinary and interdisciplinary practices, and also with the interdisciplinary strategy of transformation pioneered by Newell that urges us to place seeming opposites on continua (see Repko & Szostak, 2017), this article appreciates that the boundary between disciplinary and interdisciplinary practices will be fuzzy. As noted above, disciplines may often identify sources of (almost always temporary) instability among the phenomena they study, and interdisciplinary analysis will often posit the return to a new stability.

Talcott Parsons (1977), one of the pioneers of modern sociology, was much concerned with societal stability (though, of course, he also appreciated the reality of social change). He posited a set of fairly autonomous systems at work in society that each tended toward stability: economic, psychological, cultural,

[10] Note, though, that physical forces such as gravity that generate physical stability are non-linear, albeit moderately so.

and so on.[11] This analysis, importantly, while an attempt to comprehend social reality, simultaneously provided a philosophical justification for fairly autonomous social science disciplines. Economists would study a fairly autonomous system that provided economic stability, psychologists would likewise investigate psychological stability, anthropologists would examine systemic cultural stability, and so on. Yet Parsons recognized that there must be some connections across these discipline-based systems. Otherwise overall societal stability would seem an amazing coincidence: Why should all systems be stable at the same time? He thus suggested that stability in each system somehow encouraged stability in others. The analysis here concurs that there is a certain logic to disciplinary specialization in the study of certain stability-enhancing systems. And we have seen important examples of cross-disciplinary linkages that encourage stability as when cultural attitudes support economic and political inequalities. But our analysis suggests that the phenomena studied by one discipline often serve to destabilize the stability of systems of phenomena studied by other disciplines. In doing so our analysis helps us to understand both societal stability and societal change (and this argument, as we have seen, can be extended to natural science). It thus suggests a much greater importance for interdisciplinary analysis than Parsons recognized. And it suggests that disciplines may be a bit less reflective of the nature of reality than he envisaged and suffer more than he imagined in their ability to comprehend reality when they eschew the exploration of linkages to phenomena studied by other disciplines.

Concluding Remarks

Linkages between phenomena studied across different disciplines often induce instability in systems of stability studied and theorized by those within particular disciplines. Interdisciplinary researchers will provide

[11] It is of course impossible to summarize briefly the work of someone as productive and controversial as Parsons was. He certainly emphasized "subsystems" that contributed to what he termed "social order." As a sociologist he tended to stress the importance of stability within a system of values. He also talked a great deal about the systems inherent in human personality. He sometimes lumped other social sciences into a combined social structure: "Thus conceived, a social system is only one of three aspects of the structuring of a completely concrete system of social action. The other two are the personality systems of the individual actors and the cultural system which is built into their action" (1951, p. 3). But he generally appreciated the stability inherent in economic systems. He was more skeptical that politics could be studied in isolation.

more useful and creative understandings, and will be more persuasive in extolling the advantages of these understandings to disciplinary scholars, if they appreciate the interaction between discipline-based systems of stability and cross-disciplinary linkages that often generate instability – and the implications of this interaction for both disciplinary and interdisciplinary theory and practice. Interdisciplinary teachers can usefully explain the relationship between stability and instability to students and employ it in class discussions of interdisciplinary analyses. They may then prepare a future generation of scholars to better appreciate the symbiotic relationship between interdisciplinarity and disciplinarity in allowing us to better understand both stability and change.

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