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INTEGRATING INTERDISCIPLINARITY:
How the Theories of Common Ground and Cognitive Interdisciplinarity Are Informing the Debate on Interdisciplinary Integration

by

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Abstract: With the role of integration within theories of interdisciplinarity still contested, definitional and methodological questions persist within and outside of the field. Recent developments in cognitive psychology, with a particular emphasis on theories of common ground and cognitive interdisciplinarity, offer a productive vantage point for re-examining the debate. The synergies between these theories, the literature of interdisciplinarity, and the observed outcomes of student learning offer a sharper view of the place of integration in interdisciplinary process and of tools for more purposefully examining its impact.

While interdisciplinarians have been debating whether or not integration should be a defining characteristic of interdisciplinarity and of interdisciplinary work, cognitive psychologists have been developing the theories of common ground and cognitive interdisciplinarity. These theories have important implications for this debate and for the future of interdisciplinary studies. For one thing, they support the view of interdisciplinarians who argue that integration is integral to the notion of interdisciplinarity and that creating or discovering common ground is what makes integration possible. For another, these theories, when combined with the pioneering work of

William H. Newell on integration and Veronica Boix Mansilla on assessing the results of integration, produce three additional outcomes: They remove the semantic evasiveness surrounding the term "interdisciplinarity"; they show how integration is both a natural and an achievable cognitive activity, and they establish that integration is an assessable student learning outcome.

Two Notions of Interdisciplinarity

The flexibility and indeterminacy of the term "interdisciplinarity" is reflected in different understandings of the role of integration in interdisciplinary work. For the purposes of this essay, these diverse understandings are divided into two broad categories of interdisciplinarity—"generalist" and "integrationist"—to delineate their views on the pivotal issue of integration.

Generalist interdisciplinarians such as Joe Moran (2002) understand interdisciplinarity loosely to mean "any form of dialog or interaction between two or more disciplines" while minimizing, obscuring, or rejecting altogether the role of integration (p. 16).[1] Some generalists see the terms *interdisciplinarity* and *integration* as synonymous with *teamwork* as in team teaching and cross-disciplinary communication on research projects.[2] Other generalists such as Lisa Lattuca (2001) prefer to distinguish between types of interdisciplinarity by focusing primarily on the kinds of questions asked rather than on integration (p. 80).[3] Still other generalists such as Donald G. Richards (1996) go so far as to reject any definition of interdisciplinary studies that "necessarily places priority emphasis on the realization of synthesis [or integration] in the literal sense" (p. 114). However, generalists seeking to minimize, obscure, or reject the importance of integration as a process and/or product integral to interdisciplinarity are overlooking important theories developed by cognitive psychologists on common ground and cognitive interdisciplinarity and how these theories inform the debate over the role of integration.

Integrationists stress the priority of integration and are concerned with developing a distinctively interdisciplinary theory-based research process and describing how it operates (Newell, 2007, p. 245; Vess & Linkon, 2002, p. 89).[4] Integrationists Julie Thompson Klein and William H. Newell (1997) define interdisciplinarity as

> a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession and *drawing on disciplinary perspec-*

> *tives and integrating their insights* by producing a more comprehensive understanding [emphasis added]. (pp. 393-394)

This definition and its core premises have been incorporated into the definition of interdisciplinary research recently advanced by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine: Interdisciplinary research (IDR) is a mode of research by teams or individuals that

> *integrates* information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice [italics added]. (National Academy, 2005, p. 39)

For these three professional societies as well as for Klein and Newell, interdisciplinary research involves a research process, the disciplines or bodies of specialized knowledge, the integration of disciplinary insights, and practical problem solving.

Integrationists are especially concerned with the process and product of research, arguing that process determines product (Rogers, Scaife & Rizzo, 2005, p. 267; Boix Mansilla, Miller & Gardner, 2000, p. 18). The hallmark of the interdisciplinary research process, they insist, is integration, and the way to achieve integration is to create *common ground* among conflicting disciplinary insights (Haynes, 2002, pp. xii-xiii; Klein, 1996, p. 224). Once common ground is created, states Veronica Boix Mansilla, principal investigator of the Interdisciplinary Studies Project at Project Zero, Harvard Graduate School of Education (2005), integration can proceed, and the interdisciplinarian can produce the "interdisciplinary understanding of the complex problem or intellectual question." She defines "interdisciplinary understanding" as

> the capacity to integrate knowledge and modes of thinking drawn from two or more disciplines to produce a *cognitive advancement*—for example, explaining a phenomenon, solving a problem, creating a product, or raising a new question—in ways that would have been unlikely through single disciplinary means [italics added]. (p. 16)

In this formulation, she says, "*the integration of disciplinary [insights] is a means to an end, not an end in itself* [italics added]*."* Furthermore,

"disciplinary standards are upheld and leverage to achieve the end in question is gained by combining disciplinary lenses" (p. 16). In content integration (as distinguished from oral communication), notes Klein (2005b), the critical question "is whether disciplines provide different lenses for viewing the same phenomena or they examine different phenomena differently" (p. 35).

A Brief Etymology of Interdisciplinarity's Conception of Integration and Common Ground

Early Conceptions

Among the earliest conceptions of interdisciplinarity is Margaret Barron Luszki's (1958) *Interdisciplinary Team Research: Methods and Problems*. Luszki reports findings from five conferences all dealing with the problems of interdisciplinary team collaboration and research primarily in the area of mental health. Conference participants included leading practitioners in the fields of anthropology, pediatrics, psychiatry, neuro-physiology, physiology, internal medicine, psychology, social work, and sociology. An axiom of interdisciplinarity, Luszki declares, is that "an interdisciplinary *team* is required where there is need for the integration of different perceptual fields, or for the interrelation of a series of different sorts of observations made by different persons on the same object" (p. 11). A corollary to this axiom is "the development and use of a common language" by team members (p. 136). The interdisciplinarity of a piece of work, she says, "should be determined not by the number of disciplines from which the researchers come, but by the roles they play and *the [integrative] tools they use* in the work [italics added]" (p. 10). These "tools" include borrowed concepts and methods from other fields (pp. 4, 10).

The significance of Luski's report is that it connects the need for a common or collaborative language among research team members (typically performed at the front end of a research project) with the need to integrate disciplinary assumptions, theories, and concepts (typically performed at the back end of a project). Developing collaborative language and creating common ground among conflicting insights, assumptions, theories, and concepts involve techniques such as redefinition and extension, which integrationists are using today to create common ground. Unfortunately, conference participants were unable to agree on a process by which integration could be operationalized across the natural sciences, the social sciences, the humanities, and the applied fields. Though participants did

not use the term "common ground" per se, it is implicit in their notion of interdisciplinary collaboration. Luszski's emphasis on collaborative language and the perceived need to find a way to integrate disciplinary concepts anticipates recent integrationist conceptions of interdisciplinarity and the development of a research process that is distinct from disciplinary methodologies.

The same emphasis on collaborative language and integrating disciplinary concepts characterizes the seminal report, *Interdisciplinarity: Problems of Teaching and Research in Universities,* issued in 1972 by the Organization for Economic Cooperation and Development (OECD), a subdivision of the United Nations Education, Social, and Cultural Organization. Even today, this report remains one of the most widely cited references on interdisciplinarity, defining it as "the interaction among two or more disciplines" that "may range from simple communication of ideas to the mutual integration of organizing [disciplinary] *concepts, methodology, procedures, epistemology, terminology, [and] data*" [italics added] (p. 25). The OECD's definition is similar to Luszki's in its emphasis on collaborative communication and integrating disciplinary elements such as concepts (p. 25).[5] However, the OECD report fails to address the need for a process by which integration could be operationalized across the disciplines as Luszki does. Though the OECD report does not use the term "common ground," it does use related terms such as "common language," "interlanguage," "collaboration," "common set of axioms," and "common denominators."

Joseph J. Kockelmans (1979) makes two important contributions to the development of interdisciplinarity and common ground. First, he introduces the term "common ground," seeing it as a basis for collaborative communication—"a common ground"—among research scientists from different disciplines working on large government and industry projects. It is the fundamental element of all interdisciplinary investigation because, without it, "genuine communication between those who participate in the discussion would be impossible" (p. 141). Second, Kockelmans is the first to connect integrating relevant disciplinary "insights" (i.e., scholarly opinion grounded in research) with developing common ground. He is unclear, however, about *how* to develop common ground or *whether* a distinct interdisciplinary research process should be developed (pp. 142-143).[6]

Newell and William J. Green (1982) address both issues in their seminal essay "Defining and Teaching Interdisciplinary Studies" in which they link common ground to what they call "the interdisciplinary method" of conducting research (pp. 25, 29). This method, they explain, "requires an

appreciation of the full complexity of the disciplines involved, especially an awareness of their often unconscious assumptions, in order to discern the underlying *common ground* or conflict between their insights [emphasis added]" (p. 25). The significance of their essay to the present discussion on common ground is its description, in general terms, of a distinct interdisciplinary method or process of conducting interdisciplinary research that is applicable to any complex problem involving any combination of disciplines, regardless of their conflicting perspectives, assumptions, epistemologies, theories, concepts, and methods. The key to this research process and to achieving an integrated result (or an interdisciplinary understanding), they say, is identifying the underlying common ground among conflicting disciplinary insights. Missing from their conception of interdisciplinary work, however, is a detailed description or model of a distinctive interdisciplinary research process and an equally specific description of the role that common ground should play in it.

Klein (1990) fills this gap in *Interdisciplinarity: History, Theory and Practice.* Drawing on the earlier work of Hursh, Haas, and Moore, Klein advances a 12-step research model that, significantly, includes a separate step—number 7—that calls for "*resolving* disciplinary conflicts by working towards a *common vocabulary* (and focusing on reciprocal learning in teamwork) [italics added]" (p. 189). With Kockelmans, Klein believes that establishing a "common vocabulary" for interdisciplinary team members is what makes integration and interdisciplinarity possible (p. 196). The importance of Klein's model is that it particularizes Newell and Green's call for a distinctly interdisciplinary research process that features integration and includes common ground.

Newell's Contribution

The next significant reference to common ground in the literature is Newell's (2001) essay, "A Theory of Interdisciplinary Studies." His assertion that complexity should be the primary justification for interdisciplinary work and the controversy it continues to stir have overshadowed a second and equally important assertion that has gone largely unnoticed: that creating common ground makes integration possible and that integration is the hallmark of the interdisciplinary research process. Newell adopts much of Klein's model of the interdisciplinary process but makes a significant departure from it by adding a new step, "*creating* common ground" [italics added] (p. 15).[7] This step, he explains, involves the interdisciplinarian's modifying

or reinterpreting "components or relationships from different disciplines to bring out their commonalities so that linkages can be identified between sub-systems" (p. 20).

Newell's inclusion of this carefully worded step is significant for several reasons. For one thing, it separates developing a common vocabulary among members of multidisciplinary research teams (Step 9) from creating common ground among conflicting scholarly insights (Step 10). By separating terms that previous writers had conflated, Newell is stressing the special complexity involved in creating common ground between conflicting scholarly insights and their theories, concepts, and assumptions, compared to merely developing a collaborative vocabulary at the beginning of a research project. Moreover, he is arguing that these two activities are sequential rather than simultaneous. Second, Newell is shifting the emphasis from teams of disciplinary specialists to the disciplines themselves. This shift is important because researchers, whether working solo or in teams, must use disciplinary elements—i.e., theories, concepts, etc.—to develop a collaborative language *and* create common ground among conflicting disciplinary insights to produce an interdisciplinary understanding. Third, Newell's focus on the disciplines themselves rather than on large research teams effectively democratizes the research process by bringing it closer to the solo interdisciplinarian, particularly those working in the humanities. As J. Linn Mackey (2001) observes, Newell's model of the research process is "individualistic" (p. 64). Fourth, Newell's concept of common ground is small and local in that it is limited in its applicability to the problem at hand and not focused on future problems or on groups of problems. This feature, he believes, should allay the concerns of postmodern critics who bridle at any hint of grand, all-encompassing theories, especially those that claim some kind of transcendent and universal truth, because they miss the homogeneity of human experience (Newell, 2007, p. 247). Fifth, by adding this step, Newell is focusing laser-like on what has been the Achilles' heel of interdisciplinarity all along: the lack of clarity on precisely *what* to integrate and *how* to integrate. For Newell and for integrationists generally, integration requires creating common ground. Only then is a truly interdisciplinary outcome possible.

This brief etymology of interdisciplinarity's conception of interdisciplinarity, integration, and common ground provides three important insights about what leading integrationists have long recognized. First, integration has long been and remains inextricably linked to the notion of interdisciplinarity. Second, achieving integration and producing an interdisciplinary understanding depends primarily on the disciplines

(including interdisciplines and schools of thought) and involves establishing commonalities (i.e., common ground) among those elements (i.e., assumptions, concepts and theories) that conflict. Third, there is a need to operationalize theory in a way that transforms the "black box of integration" into an understandable, achievable (even for undergraduates), democratic (enabling solo interdisciplinarians to address complex problems), and assessable event.

Cognitive Psychology's Common Ground Theory and Theory of Cognitive Interdisciplinarity

As interdisciplinarians were developing the concepts of interdisciplinarity, integration, and common ground, cognitive psychologists were conducting research on human communication and developing common ground theory and, more recently, the theory of cognitive interdisciplinarity. Noted cognitive psychologist Herbert H. Clark traces the technical notion of common ground to Robert Stalnaker (1978) who based his notion on an older family of related notions that includes *common knowledge* (Lewis, 1969), *mutual knowledge* or *belief* (Schiffer, 1972). Clark (1996) defines common ground as the knowledge, beliefs, and suppositions that each person has to establish with another person in order to interact with that person (pp. 12, 116).

Cognitive Psychology's Theory of Common Ground

Central to Clark's theory of common ground is its emphasis on the *context* of language. He finds, for example, that all people take as common ground aspects of human nature such as physical senses, communal lexicons (i.e., sets of word conventions in individual communities), and cultural facts, norms, and procedures (pp. 106-108). Clark explains that when it comes to coordinating a joint action, "people cannot rely on just any information they have about each other. They must establish *just the right piece of common ground*, and that depends on them finding a *shared basis for that piece* [emphasis added]" (pp. 93, 99). Accordingly, "two people's common ground is, in effect, the sum of their mutual, common, or joint knowledge, beliefs, and suppositions" (p. 93).[8]

Though Clark's focus is limited to social interaction in a broad context, his theory has applicability to interdisciplinary work and the interdisciplinary understanding of common ground. This understanding, developed primarily

by Newell, involves "bringing out latent *commonalities* in the conflicting insights derived from the concepts, theories, or methods of different disciplines [italics added]" (2007, p. 257). Newell's understanding is that there is the possibility of multiple commonalities that the interdisciplinarian can use to integrate conflicting insights.[9] However, in Clark's formulation, common ground can only be in the singular—"just the right piece of common ground." Applied to interdisciplinary work, Clark's formulation means that the interdisciplinarian should seek out the *one* assumption, concept, theory, value, or principle that provides the basis for integration and for the production of an interdisciplinary understanding of a complex problem or intellectual question.

The Theory of Cognitive Interdisciplinary

Recently, the work of integrationists has begun intersecting with research by cognitive psychologist Rainer Bromme (2000) who is applying Clark's theory of common ground to interdisciplinary work. Though Clark's common ground theory was developed to explain everyday interactions, Bromme and others are applying it to communication across academic disciplines, especially the natural sciences.[10] Building on the work of Clark, Bromme develops a theory of cognitive interdisciplinarity. A significant finding of Bromme is that in *interdisciplinary communication,* differences in common ground are frequently "discovered" only when the partners of cooperation—i.e., the relevant disciplines—"find out that they use the same concepts with different meanings, or that they use different codings (terms, symbol systems) for approximately the same concepts" (p. 127).

Bromme's theory has direct applicability to the interdisciplinary research process developed by integrationists. This process calls for interdisciplinarians, whether they are developing a collaborative language or trying to integrate conflicting disciplinary insights, to *first* identify the theories providing different explanations or concepts with different meanings *before* attempting to discover common ground. Once these are identified, the interdisciplinarian can then proceed with creating or discovering the "common ground integrator"—i.e., the *one or more assumptions,* theories, concepts, values, or principles by which these conflicting insights can be integrated.

Other significant aspects of the theory of cognitive interdisciplinarity that pertain to interdisciplinary integration and the creation of common ground include the following:

- Common ground can be realized in the form of terminology common to two or more disciplines or knowledge domains. (Interdisciplinarians are also interested in different concepts that appear to have the same or similar meanings.)
- Common ground can be realized in the form of common terminology, which does not dissolve all the differences between disciplinary perspectives.[11] (How to modify conflicting disciplinary assumptions and concepts is addressed later under "Techniques Commonly Used to Create Common Ground.")
- Common ground can be composed of knowledge that is distributed among or is common to disciplines (i.e., in the form of assumptions, concepts, or theories).
- Common ground can also comprise agreement on what is *not* part of the shared knowledge. (2000, pp. 128-129)

Bromme's theory of cognitive interdisciplinarity establishes the theoretical basis for separating, as Newell does, the development of common language for members of interdisciplinary research teams at the outset of a research project from later identifying a single common ground integrator (i.e., the concept, theory, value, or principle) from among conflicting insights.

The Implications of These Theories for Integrative Work

Clark's common ground theory and Bromme's theory of cognitive interdisciplinarity inform the debate over the role of integration in interdisciplinary work in at least four ways. First, both theories claim that the activity of establishing common ground is a normal and basic feature of human communication and, therefore, is *natural* and *achievable*. What integrationists assert is possible, cognitive psychologists have discovered that everyday people do routinely. If it is possible for humans from differing social and other contexts to establish common ground to communicate, then it should also be possible to establish common ground between cognitive constructs such as disciplines and other knowledge formations. Clark and Bromme are reminding us that what integrationists seek is, at bottom, part of normal human discourse. If the easiest form of integration (i.e., that which occurs between conversants) is already part of humanity's collective social repertoire, then perhaps "more challenging cases may be tractable as well with attention to process and technique, and even the most challenging cases may yield to the skilled use of refined techniques within a practical

process" (Newell, personal communication, May 27, 2007). If creating, establishing, or discovering common ground is natural and achievable, then so should integration be *as well as the product of integration*—an interdisciplinary understanding of the problem. And if integration is natural and achievable, then there is no reason to divorce integration from a definition of interdisciplinarity as generalists feel compelled to do. The difference between cognitive psychologists and integrationists is the latter's assertion that if interdisciplinarians are self-conscious about process, they should be able to do pro-actively what people normally do reactively.[12]

Second, these theories emphasize the importance of the immediate *context* or *situation* (Clark) of the communication because these make finding common ground either easier or more difficult. The factors that inhibit or promote common ground in a given context are similar for Clark and Bromme. For Clark (1996), these include participant *self-awareness* of the immediate situation, and *information* external to the participants that (1) makes it possible for them to believe, know, assume, or be aware of the situation, and (2) can serve as the basis for their *mutual belief*, *mutual knowledge*, *mutual assumption*, and *mutual awareness* of common ground (pp. 93-94). For Bromme (2000), the key factor is *knowledge* or *perspective*, which comprises not only "special [disciplinary] methods or concepts, but also the epistemic styles typical for a discipline or a domain of research activities." Perspective, he says, refers to one's own perspective as well as that of the other person (pp. 119-120). For both Clark and Bromme, reflexivity is part of one's own self-awareness, one's perspective, and "one's integration into the social environment" (Clark, 1996, p. 95; Bromme, 2000, p. 120). As applied to interdisciplinary work, these theories point up the need to recognize that not all contexts are equal and that not all contexts are the product of a single causal factor such as power. These theories compel interdisciplinarians to ask, "Contextualize on what basis and according to which factors?" This means taking into account *all* factors—internal and external—that impinge on the problem and that are rendering it more or less susceptible to finding common ground and achieving integration.

A third implication of these theories to integrative work is that they characterize the finding of common ground as a *process* as opposed to a method. Interdisciplinarians typically describe the doing of interdisciplinary research as a "process" rather than "method," explains Repko (2008a), because

> process allows for greater methodological flexibility, particularly

> when working in the humanities….Many disciplinary writers, particularly those in the social sciences and even in the natural sciences, also use the term *process* to describe their approaches to research even though using specific research methods is part of the 'process.' (p. 12)

This process is straightforward: First, identify those cognitive elements (whether from disciplinary, interdisciplinary, schools of thought, or other knowledge formations)—e.g., assumptions, theories, or concepts—that are the sources of conflict between insights; then, identify which of these elements (there may be more than one) can be used to integrate the conflicting insights.[13]

A fourth implication is that these theories, focusing as they do on common ground and integration, provide a way to differentiate multidisciplinarity from interdisciplinarity. Multidisciplinarity refers to the placing side by side of two or more disciplines and limits activity to *appreciating* differences in disciplinary perspectives. The relationship between the disciplines is merely one of proximity, and no attempt is made to create or discover common ground much less integrate their insights (Moran, 2002, p. 16). Interdisciplinarity, however, identifies relevant insights, creates or discovers common ground among them, and uses it to integrate them. Multidisciplinarity is entirely subsumed within interdisciplinarity; it is a necessary but not a sufficient condition for interdisciplinarity (Newell, personal communication, February, 2007). Students demonstrate *interdisciplinary understanding* "when they integrate knowledge and modes of thinking from two or more disciplines in order to create products, solve problems, and offer explanations of the world around them" (Boix Mansilla et al., 2000, pp. 17-18). Removing integration as a defining characteristic of interdisciplinarity, as generalists urge, effectively blurs the line between these two very different approaches to teaching, learning, and research.

An Integrated Definition of Common Ground

The Integrationist Conception of Common Ground

The importance of these theories for interdisciplinarity and the debate over the role of integration provide sufficient grounds for revisiting the interdisciplinary conception of common ground developed by Newell. Working independently of Clark and Bromme, Newell (2001) is the first in the field to define common ground in interdisciplinary terms.[14] Common

ground, he says, involves using various integrative techniques to modify or reinterpret disciplinary components or relationships "to bring out their commonalities so that linkages can be identified between [conflicting insights]" (p. 20).

This definition contains three ideas:

1. Common ground is something that must be created, except between the natural sciences where it can often be discovered.
2. Creating or discovering common ground involves modifying or reinterpreting disciplinary components (i.e., its defining elements including perspectives, insights, theories, concepts, and assumptions).
3. Modifying these components involves using various integrative techniques.

Newell's particular contribution to understanding common ground is to show that it is part of the larger process of interdisciplinary integration and is, in fact, what makes integration possible. In effect, Newell has illuminated the mysterious "black box" of interdisciplinary integration so that one can readily perceive how to create or discover common ground and thus achieve integration.

An Integrated Definition

Repko (2008a) offers this definition of common ground that attempts to integrate Newell's definition with the formulations of Clark and Bromme: *"Interdisciplinary common ground is one or more theories, concepts, and assumptions by which conflicting insights can be reconciled and integrated. Creating common ground involves bringing out potential commonalities underlying the conflicting and theory-based insights so that these can be reconciled and ultimately integrated (p. 272)."* Integration is not the end of the interdisciplinary enterprise but the means to achieve it: The end or purpose is to produce an interdisciplinary product or understanding of the problem and propose a more comprehensive solution to it. The term "interdisciplinary understanding" is a construct that integrates the notions of "cognitive advancement" advanced by Boix Mansilla (2005), "a more comprehensive perspective" advanced by Klein and Newell (1997), "a more comprehensive understanding" advanced by Newell (2007), and "holistic meaning" favored by those in the humanities.

The Creation of Common Ground

The Components of Common Ground

Integrationists and cognitive interdisciplinarians agree that common ground is created from disciplinary assumptions, theories, and concepts (e.g., Newell, 2001, pp. 20-21; Bromme, 2000, pp. 127-128). *Assumptions* are the principles that underlie a discipline's perspective and are the accepted truths upon which a discipline's theories and concepts are based. *Theories* are generalized scholarly explanations of an entire class of phenomena and explain why and how the concepts of the discipline are related. Applied to a specific problem, object, or text, a theory provides insights into the problem (Calhoun, 2002, pp. 480-482). *Concepts* are technical terms used by a discipline to describe specific ideas developed by that discipline. A concept is a word or symbol that represents a phenomenon or an abstract idea generalized from particular instances (Wallace & Wolf, 2006, pp. 4-5). One needs to focus elsewhere than on the conflicting insights themselves in order to integrate them: One has to get behind the conflict itself to bring out the *source* of the conflict—i.e., assumptions, theories and concepts.

Common ground, however, is not created from disciplinary perspectives (commonly understood as a discipline's general view of that portion of reality typically of interest to it) but from the defining elements of these perspectives—i.e., their assumptions, theories, and concepts. *Perspective* is a discipline's overall approach to *any* problem or question (Repko, 2008a, pp. 53-54). An *insight* is what is produced when a disciplinary expert applies that perspective to a specific problem. If one attempted to integrate perspectives that characterize the overall approach of individual disciplines, one would be taking on a transdisciplinary task by attempting to devise an approach that replaces those of the contributing disciplines. It would be an approach that could then be applied to *any* specific question to generate insights into it. This is a formidable intellectual challenge, and one that is far beyond the interdisciplinary process. In contrast to the transdisciplinarian, the interdisciplinarian tries to solve a specific problem, not all problems or even a class of problems as transdisciplinarians attempt to do. The role of the interdisciplinarian is to integrate the *insights* produced by disciplinary experts into a single problem that is limited in time and space, if not also in culture (Newell & Green, 1982, p. 24; Klein, 1996, p. 3).

The Importance of Common Ground to the Integrative Process

Integrationists substantially agree that creating common ground is essential to achieving integration (Newell, 2001, pp. 14-15). Creating common ground prepares us for the actual reconciling of insights drawn from disciplines, interdisciplines, and schools of thought. Kockelmans (1979) emphasizes, "The search for a common ground is the fundamental element of all [interdisciplinary] investigation. Without such common ground,…genuine communication between those who participate in the discussion would be impossible" (p. 141).

Models of the interdisciplinary research process advanced by Klein, Newell, and Repko, as shown in Table 1, show the placement of common ground in their step-based descriptions.[15]

Table 1

COMMON GROUND IN MODELS OF THE INTERDISCIPLINARY RESEARCH PROCESS		
MODEL	***STEP#***	***DESCRIPTION OF STEP***
Klein (1990)[16]	7 of 12	*Resolving* disciplinary conflicts by working towards a common vocabulary (and focusing on reciprocal learning in teamwork) (p. 189)
Newell (2001; 2007)	9 of 14	*Resolving* conflicts by working towards a common vocabulary and set of assumptions (2001, p. 15; 2007, p. 248)
	10 of 14	*Creating* common ground (2001, p. 15; 2007, p. 248)
Repko (2008a)	8 of 10	*Creating or discovering* common ground

Regardless of where in the research process the STEP or decision to create common ground appears, these models all call for creating common ground *before* attempting to integrate conflicting insights. Creating common ground is like building a bridge in order to span a deep chasm. The near side is the place of identifying the sources of conflicts between insights; the opposite side is the place of combining as many insights as possible. Unless the interdisciplinarian builds the bridge of common ground to connect the two sides, the process of integration and producing an interdisciplinary understanding cannot proceed.

Ways of Creating Common Ground When Insights Conflict

Interdisciplinarians face three possible challenges in attempting to create common ground. Each concerns the nature and extent of the conflict between insights. The first is that there is *no apparent conflict among insights,* but commonality is nonetheless obscured by differences in the concepts used by the different disciplines to describe similar ideas. The second is that the

conflicting insights are different but not opposing perhaps because they are products of the same discipline and merely reflect alternatives. The third is that the *insights are diametrically opposed* because they reflect different disciplinary perspectives, voice different disciplinary theories, and rest on different disciplinary assumptions.

There are three ways to create common ground when insights conflict. The first and most direct way is to reconcile conflicts between the *theories* advanced by the insights (i.e., if the insights are theory-based). The second way is to reconcile conflicts between the *concepts*. The third way is to reconcile conflicts between *assumptions* that underlie the insights and their theory-based insights. Reconciling conflicts between disciplinary insights typically involves using one of several integrative techniques such as expansion, redefinition, extension, organization, and transformation, or possibly some combination of these.

The value of these integrative techniques is that they are *proven* ways to create common ground. These techniques achieve that objective by replacing the either/or thinking characteristic of the disciplines with both/and thinking characteristic of interdisciplinarity. Inclusion, insofar as this is possible, is substituted for conflict. As Newell (2007) expresses it, "Intellectual flexibility and playfulness are more useful than logic at this step in the integrative part of the interdisciplinary process" (p. 260).

Creating Common Ground Between Conflicting Disciplinary Theories Using the Integrative Technique of Expansion

The interdisciplinary literature on common ground is limited to Newell's work in which he discusses the integrative techniques of redefinition, extension, organization, and transformation, and shows how undergraduates at his university are profitably using these.[17] Repko (2008a) introduces an additional integrative technique being used in the undergraduate program at the University of Texas at Arlington: theory expansion**.** Of the possible sources of conflicts between insights, conflicts between theory-based insights are the most common situation the interdisciplinarian is likely to encounter. *Theory expansion* is used to modify a theory so that it can address all (or at least most) of the causal factors pertaining to the problem. Theory expansion may involve merely adding a factor or factors (e.g., a variable or variables) from any of the sources of alternative perspectives including different fields within the same discipline, different disciplines, a school of thought that cut across disciplines, interdisciplines, or even folk knowledge.

Students in an undergraduate problem-based interdisciplinary research methods course used close reading to evaluate the six relevant theories on the causes of suicide terrorism in the Middle East. These causes were grouped under three broad categories of causation as shown in Table 2: cultural, political/economic, and psychological. Cultural factors include the external influences of religion, social mores, and the family (immediate and extended). Political/economic factors include the external influences of institutions (including those of terrorist organizations), and the individual's socio-economic status. Psychological factors include those internal cognitive processes by which individuals make decisions such as "mental accounting" (i.e., that people tend to think about their gains and losses as if these were separate accounts), "justification" (an even stronger, more compelling, moral claim that overrides one's natural repugnance to engage in suicide terrorism), and "emotion" (e.g., traumatic memory, or regret for not exacting vengeance on an enemy) (Reisberg, 2006, pp. 465-470).

Once these broad categories of causation were identified, the next task was to determine which of the six theories came closest to addressing each of these causal factors. The one that did would be a prime candidate for serving as the common ground theory. The result of this evaluative process is shown in Table 2.

Table 2

THEORY-BASED CAUSES OF SUICIDE TERRORISM (ST) SHOWING KEY CAUSATION FACTORS			
Theory of ST	***Theory-based Causes of ST***		
	Cultural factors (External)	**Political/Economic factors (External)**	**Psychological factors (Internal)**
Terrorist Psycho-logic (Cognitive Psychology)	No	No	Yes
Self-sanction (Cognitive Psychology)	Yes	Yes	Yes, if expanded
Martyrdom (Cognitive Psychology)	No	No	Yes
Collective Rational Choice (Political Science)	No	Yes	Yes
Sacred Terror (Political Science)	Yes	Yes	No
Kinship Altruism (Cultural Anthropology	Yes	Yes	No

The table shows that Self-Sanction Theory (SST) comes closest to addressing all three causal factors and, if expanded, can satisfactorily address all of them. The theory explains how "socialized people" are converted into dedicated combatants by the terrorist organization "cognitively restructuring the moral

value of killing, so that the killing can be done free from self-censuring restraints" (Bandura, 1998, p. 164). Cognitive psychologist Albert Bandura (1998) explains that the process of moral cognitive restructuring includes (a) using religion to justify such acts by invoking "situational imperatives," (b) using the political argument of self-defense to show how the group is "fighting ruthless oppressors" who are threatening the community's "cherished values and way of life," and (c) using the psychological device of dehumanization to justify killing "the enemy" (pp. 174, 180-182). The strength of the theory is that it addresses cultural and political factors that inform individual decision-making, factors that are generally not the focus of cognitive psychologists. However, the theory excludes those individual personality factors in the would-be terrorist's decision-making process that the theories of personality and psycho-logic address in detail. This limitation can be overcome quite easily by using the technique of theory expansion. Since the theory already addresses individual behavior, one can expand the theory's focus on moral cognitive restructuring to include the role of mental accounting and emotion without distorting the theory. Expanded in this way, the theory can serve as the integrating or common ground theory.

Creating Common Ground Between Conflicting Disciplinary Concepts Using the Integrative Technique of Redefinition

Another common source of conflict between insights is conflict between disciplinary concepts. Concerning concepts, the interdisciplinarian is well advised to do two things. First, pay close attention to how some concepts are used differently in different disciplines within the context of the problem and how different disciplinary concepts are used to describe similar ideas (Wolfe & Haynes, 2003, pp. 155, 165). For example, "efficiency" has quite different meanings for economists (money out/money in), biologists (energy out/energy in), and political scientists (influence exerted/political capital expended) (Newell, 2001, p. 19).

Second, carefully redefine specific concepts so that it is easier to apply two or more disciplinary perspectives to the issue or problem under investigation (Wolfe & Haynes, 2003, p. 165). This step is essential and preparatory to creating common ground. Interdisciplinarians should also avoid using terminology that tacitly favors one approach at the expense of another.

Creating common ground between conflicting disciplinary concepts can easily be achieved by using the integrative technique of redefinition.

Redefinition involves modifying or redefining concepts and assumptions used by relevant disciplines to bring out a common meaning. Redefinition can reveal commonalities in concepts or assumptions that may be obscured by discipline-specific language. Since most disciplinary concepts and assumptions are obscured in this way, the technique of redefinition is involved in most efforts to create common ground, sometimes in conjunction with other integrative techniques as shown in this example of advanced undergraduate work. Janet Delph (2005) uses this technique in her capstone paper, "An Integrative Approach to the Elimination of the 'Perfect Crime.'"

Delph questions whether advances in criminal investigatory techniques are poised to eliminate the possibility of the "perfect crime." She defines a "perfect crime" as one that goes unnoticed and/or as one for which the criminal will never be caught (p. 2). Of the several disciplines and sub-disciplines that are relevant to crime investigation, the three that Delph finds most relevant are criminal justice (and its sub-discipline of criminal investigation), biology (and its sub-division of forensic science), and psychology (and its sub-division of forensic psychology). Delph identifies the current theories of these rapidly evolving sub-disciplines and finds that the source of conflict between them is their preference for two different investigatory methods and reliance on two kinds of evidence. Forensic science analyzes physical evidence whereas behavioral science (i.e., criminal investigation and forensic psychology) analyzes behavioral evidence. Each approach constructs a "profile" of the criminal with forensic science using physical evidence, and behavior science using a combination of intuition informed by years of experience and information collected from interviews and other sources.

Delph creates common ground between the conflicting approaches by *redefining* the meaning of profiling to include both forensic science with its emphasis on physical evidence and forensic psychology with its emphasis on "intuition" born of extensive experience and insights derived from crime scene analysis. This redefinition of criminal profiling enables her to bridge the physical (i.e., forensic science) and the behavioral sciences (i.e., forensic psychology and criminal investigation). Forensic scientists do not need to use profiling as long as they have adequate evidence to analyze. But in the absence of such evidence, profiling can move the investigation forward by using a combination of "intuition" born of extensive experience and insights derived from crime scene analysis (p. 29). In this way, profiling integrates the specialized knowledge that criminal investigation, forensic science, and forensic psychology offer.

Integrating Insights Using the Common Ground Concept

When exactly does integration occur? According to Szostak (2002), "Integration occurs when the insights of each particular theory and method are delineated, and it is shown how, in combination, they yield a better explanation than any in isolation" (p. 115).[18] Once the common ground assumption, theory, concept, principle, or value is identified, integration of the relevant conflicting insights can proceed.

Delph's study offers an example of some insights conflicting while others do not. On the one hand, Delph found "no apparent contradiction" between the insights generated by forensic psychology and criminal investigation, making the integration of these insights relatively easy to achieve. On the other hand, she found substantial conflict between the approaches of the physical sciences and the behavioral sciences concerning the standard practice of criminal profiling, meaning recreating the criminal act so as to obtain insights into the personality of the criminal. The physical sciences privilege empirically derived insights of investigative profiling whereas the behavioral sciences prefer intuitively derived insights (p. 29).

Integration of these very different approaches to profiling, of course, is predicated on creating common ground between the conflicting insights. More specifically, integration is predicated on creating common ground between the conflicting physical science and behavioral science views on profiling. Delph accomplishes this by redefining the meaning of profiling used by each field so that the broadened term integrates the specialized kind of knowledge that criminal investigation, forensic science, and forensic psychology each privileges. What is actually integrated is "the unique knowledge possessed by each of these areas of expertise" (p. 30). She proceeds to describe each kind of knowledge so that she can show how their integration provides the "more comprehensive solution" of so-called perfect crimes. Delph argues that many more crimes could be solved if the disciplines of criminal justice, forensic science, and forensic psychology "better understood each other's needs and integrated their theories and methods" (p. 29).

Implications of Common Ground Theory and the Theory of Cognitive Interdisciplinarity for the Debate Between Generalists and Integrationists

The theories of common ground and of cognitive interdisciplinarity, when

integrated with the work of Newell and Boix Mansilla, inform the debate between generalists and integrationists in at least three ways.

They Validate the Integrationist Case

Historically, the integrationist case has rested on curriculum design models developed by education reformers that show students being able to achieve "degrees of integration of disciplinary knowledge and on mounting evidence that integrative and cooperative approaches enhance learning and retention" (Klein, 2002, p. 6). By contrast, the generalist case for minimizing, obscuring, or rejecting, integration as a defining characteristic of interdisciplinarity rests on two principal claims, neither of which is grounded in theory. The first is the claim that integration is too difficult for students. Even with a carefully delineated research process, the availability of integrative techniques, and the proven use of these techniques in undergraduate programs, some remain concerned that integration is still too challenging for undergraduates, or even graduate students (Mackey, 2001, p. 64; Miller, 2005, pp. 5-7; Castellana, 2005, pp. 3-4). Their concern may well have been valid at a time when interdisciplinarians were uncertain about what exactly they were attempting to integrate and when they had not yet developed the techniques of integration and assessment currently available. The development of common ground theory and the theory of cognitive interdisciplinarity, combined with the work of Newell and Boix Mansilla, make clear that integrative learning and thinking are both natural and achievable. This is evident from the rapidly growing amount of integrative work produced by undergraduates.

The second claim made by generalists is the difficulty in establishing "a fixed point at which interdisciplinary integration occurs" (Lattuca, 2001, p. 18). Lattuca (2001), for instance, hearkens back to the CERI definition of interdisciplinarity that "suggests that interdisciplinarity exists on a continuum" (p. 18). Concomitantly, she wants interdisciplinarity to be "broadly defined" as "the *interaction* of different disciplines," thus leaving "*open*" the question of integration [italics added] (p. 78). Lattuca's approach raises two questions. One concerns *process*—i.e., how one goes about integrating along a continuum. Another concerns *product*—i.e., what the "answer" to an interdisciplinary focus question should look like. Unlike integrationists who have produced models of the research process that are undergirded by theory and that are being used in the classroom and in their own research, generalists have yet to produce a model, advance a theory, or provide examples of

their notion of interdisciplinarity. An additional problem raised by Lattuca's approach is what to call an interdisciplinarity that marginalizes integration. Her typology of interdisciplinarities that includes a dozen or so forms only adds to the definitional confusion surrounding the term.[19]

They Remove the Semantic Evasiveness Surrounding the Term "Interdisciplinarity"

Though Klein and Newell offered a definition of interdisciplinary studies in 1997 that has since gained wide acceptance, not all interdisciplinarians are aware of it or embrace it. Despite the efforts of Klein, Newell, and others to standardize the definition, definitional differences persist. "The problem," says Klein (1996), "is not that [interdisciplinarity] is devoid of meaning. It is replete with meaning—conflicting meaning" (p. 10). Klein (2005a) says that interdisciplinarity, like culture-based studies, "was once regarded as a single kind of activity framed against a stable system. That is no longer the case" (p. 69). Liora Salter and Alison Hearn (1996) lament that the term "interdisciplinarity" lacks a "coherent definition" (p. 4). Richards (1996) observes that there is considerable "ambiguity" surrounding the definition of interdisciplinary studies (p. 117). Boix Mansilla (2005) admits that for many, "Interdisciplinarity is an elusive concept. Stated definitions in the literature are varied, [and] the term is adapted to refer to a broad array of endeavors" (p. 16). Jeffrey N. Wasserstrom (2006, January 20) reports in *The Chronicle of Higher Education* that at Indiana University at Bloomington where he teaches, the meanings of interdisciplinarity and associated concepts "have become so fuzzy that a university's expression of commitment to them is close to meaningless" (p. B5). And Yvonne Rogers, Mike Scaife, and Antonio Rizzo (2005) state,

> The terms *multidisciplinarity* and *interdisciplinarity* are often used interchangeably to refer to researchers from different disciplines or backgrounds coming together to collaborate on a common goal, be it basic or applied research….Using the two terms interchangeably is not problematic if they are being used simply to refer to some kind of cooperation or collaboration between different people. However, the terms can have quite distinct meanings when used to denote different processes of collaborative activity. (p. 267)

In the face of these discordant notes, Newell (2007), Repko (2007), and Rep-

ko (2008a) insist that the field of interdisciplinary studies does indeed have "an emerging consensus definition," the centerpiece of which is the integration of disciplinary insights (Newell, 2007, p. 245; Repko, 2007, pp. 131-132; Repko 2008a, p. 12). The textbook by Augsburg (2006) and the book on interdisciplinary research process and theory by Repko (2008a) reflect this growing consensus by defining interdisciplinarity primarily in terms of integration.

They Constitute a Powerful Argument for Including Integration as an Assessable Student Learning Outcome in Undergraduate and Graduate Interdisciplinary Courses and Programs

Interdisciplinarians agree that interdisciplinarity is "the most authentic way to achieve desired educational outcomes" (Field & Stowe, 2002, p. 261). The persistent problem has been how to assess interdisciplinary work and programs. Greatly complicating this task has been lack of consensus about the meaning of interdisciplinarity and the role of integration. The problem, say Michael Field and Don Stowe (2002), is the heterogeneous nature of interdisciplinary courses and programs and the fact that "there is no single, widely accepted definition of interdisciplinarity, no accepted theory of interdisciplinarity, and no model of an interdisciplinary program" (p. 263).[20] Consequently, no widespread consensus exists on student learning outcomes of undergraduate interdisciplinary studies courses and programs, on whether integration should be included among student learning outcomes, much less on what constitutes integration and how it should be, or even if it can be, assessed.

Fortunately, the work of Clark, Bromme, Newell, and Boix Mansilla successfully lays the theoretical and practical groundwork for a consensus definition of interdisciplinarity. Their work also clarifies our understanding of integration and its role in interdisciplinary work and, most importantly, provides an epistemic framework for assessing this work. Interdisciplinary work, say Boix Mansilla and Howard Gardner (2003, December 1), can be assessed on three fundamental grounds:

1. The way in which the work stands vis-à-vis what researchers know and find tenable in the disciplines involved *(consistency with multiple separate disciplinary antecedents)*.
2. The way in which the work stands together as a generative and coherent whole *(balance in weaving together perspectives.*

3. The way in which the integration advances the goals that researchers set for their pursuits and the methods they use *(effectiveness in advancing understanding).* (p. 5)

Building on this framework, Boix Mansilla (2005) offers a way to assess student work. The concept of interdisciplinary understanding noted earlier is based on four core premises that underlie this concept:

1. "It builds on a performance view of understanding—one that privileges the capacity to *use* knowledge over that of *having* or *accumulating* it [emphasis added]."
2. It "is 'disciplined'—i.e., deeply informed by disciplinary expertise."
3. "It involves the integration of disciplinary views."
4. It "is purposeful" leading to "*cognitive advancement*—e.g., a new insight, a solution, an account, an explanation." (p. 17)

Boix Mansilla (2005) proposes an assessment matrix consisting of three core questions that interdisciplinarians *as well as disciplinarians* should ask about the end product of the interdisciplinary research process—i.e., the interdisciplinary understanding—as exhibited in a piece of work. Whether this work takes the form of a paper, a thesis, a video, or a piece of art, she says, these three questions can be used to assess its unique interdisciplinary qualities as follows:

- Is the work grounded in carefully selected and adequately employed disciplinary insights?
- Are disciplinary insights clearly *integrated* so as to *leverage* student understanding?
- Does the work exhibit a clear sense of purpose, reflectivity, and self-critique? (p. 18)

While it is beyond the scope of this essay to show how this assessment matrix can be profitably applied to student work at various levels (introductory, advanced undergraduate, and graduate) as well as to an entire program, thanks to the work of Clark, Bromme, Newell, and Boix Mansilla, the development of common ground is making integration achievable *and assessable*.[21] Most importantly for the future of the field of interdisciplinary studies, these theoretical and operational advances are enabling programs

to include integration among their student learning outcomes and to assess these outcomes more rigorously.

Conclusion

Interdisciplinarity, according to the integrationist view of it, is inextricably linked to integration. The objects of integration are the defining elements of disciplinary perspectives—i.e., their assumptions, theories, and concepts—that are expressed in disciplinary insights into a particular problem or question. Creating common ground requires integrating these conflicting insights by getting at their source. This is possible using the various integrative techniques that are already being used by undergraduate students and professionals. Before the insights of Clark, Bromme, Newell, and Boix Mansilla, critics of interdisciplinarity such as Stanley Fish (1991) charged that "being interdisciplinary is more than hard to do; it is impossible to do" (p. 106). Today there is no justification grounded in either theory or practice for excluding integration from conceptions of interdisciplinarity. Moreover, recent experience of undergraduates at leading interdisciplinary studies programs are demonstrating their ability to create or discover common ground, integrate conflicting insights, produce an interdisciplinary understanding of a problem, and express this understanding in practical and purposeful ways. In effect, these developments are illuminating what was once described as the "black box" of integration.

Biographical Note: Allen Repko is Associate Professor of Interdisciplinary Studies and Director of the Interdisciplinary Studies Program at the University of Texas at Arlington (PhD, University of Missouri, Columbia). His research interests include the theory and practice of interdisciplinarity, curriculum design, pedagogy, assessment, and the interdisciplinary research process. His recent and forthcoming publications include "Interdisciplinary Curriculum Design," *Academic Exchange Quarterly, (*Spring, 2007) 130-137; *Interdisciplinary Research: Process and Theory* (2008), SAGE; and "Assessing Interdisciplinary Learning Outcomes," *Academic Exchange Quarterly* (Fall, 2008) 171-178, which will not only fill a critical need within the higher education classroom but will also provide an avenue for connecting the interdisciplinary research process to real world problems.

Notes

[1] Moran (2002) is silent on "integration" and "common ground." Lisa Lattuca (2001) notes the lack of discussion on integration in interdisciplinary literature (p. 12).

[2] Concerning the relationship between integration and faculty collaboration in the classroom, James R. Davis (1995) states, "The greater the level of integration, the higher the level of collaboration required" (p. 44). However, Klein (2005b) states, "For many, the word *interdisciplinarity* is synonymous with teamwork. It is not" (p. 23).

[3] In her overview of typical operational definitions of interdisciplinary research, Lattuca (2001) cites several interdisciplinarians who, writing in the 1980s, stressed the limitations of an emphasis on disciplinary integration or "process or product" (p. 12).

[4] Integrationists are by no means unified on this point. Postmodernist interdisciplinarians are typically committed to integration but object to step-based models that specify how to conduct interdisciplinary research on the grounds that this might constrain freedom of activity or suggest objectivist modernism. On the matter of integration, then, postmodernists appear to be closer to the generalist position. J. Lynn Mackey (2002), for instance, thinks that Rick Szostak's (2002) set of steps or rules does not adequately characterize the nature of the interdisciplinary process, believing that interdisciplinarity is not a rule-based process but an intuition-based one (pp. 124, 126). But Klein (1996) points out "creativity is embodied in the act of crafting multiple elements into an organic [i.e., integrated] whole" (pp. 221-222). Klein, who agrees with David Sill (1996) that there is a link between creativity and integrative thinking, offers a generic model of integrative process that is iterative and dynamic (p. 223).

[5] The report defines interdisciplinarity as "an adjective describing the *interaction* among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organizing *concepts, methodology, procedures, epistemology, terminology, data*, and organization of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods, and data and terms organized into a common effort on a common problem with continuous intercommunication among the participants from the different disciplines" (pp. 25-26).

[6] Kockelmans (1979) had hoped that general systems theory, structuralism, or cybernetics "might well contain the core of the answer to this question," but this, he said, proved unworkable (p. 142). His work is significant because he is the first to stress the importance of integrating disciplinary "insights" by finding common ground among them (pp. 142-143).

[7] Significantly, all of the respondents to Newell's theory are silent on this issue.

[8] Clark's theory applies to both oral and written communication.

[9] In his development of the common ground concept, Newell states that he did not draw upon Clark, Bromme, or cognitive psychology's version of common ground theory (personal communication, July 22, 2006).

[10] Cognitive science is a 25-year-old interdisciplinary field that attempts to promote cross-disciplinary integration of concepts, methods, epistemologies, language, data, and infrastructures for research and education on cognition. See, for example,

Sharon J. Derry, Christian D. Schunn, and Morton Gernsbacher (Eds.), (2005), *Interdisciplinary Collaboration: An Emerging Cognitive Science.*

[11] This is an important point that is made by Angela M. O'Donnell and Sharon J. Derry (2005). The reason, they explain, is "each individual in an interdisciplinary team works from the perspective of his or her own discipline" (p. 72).

[12] Indeed, there are other fields (e.g., conflict resolution, dispute resolution, mediation, and diplomacy) that have closely examined the process and techniques for bridging differences when common ground resists discovery or does not yet exist and so must therefore be created. A follow-up article will address their implications for interdisciplinarity.

[13] Whereas Clark talks about one (and only one) commonality, integrationists talk about the possibility of more than one. Clark is talking about everyday practice in which people seize on the first and most obvious commonality that is sufficient for the task at hand. The fact that they see no need to search for additional commonalities in no way vitiates the possibility that others may exist. Integrationists may well be satisfied with a common ground integrator that works to produce an interdisciplinary understanding that "solves the problem." But interdisciplinarians should be open to examining other possible integrators and develop ways to evaluate the relative advantages of not only which common ground integrator is best but also which interdisciplinary understanding is best. For a discussion of possible tests, see Newell's (2007) decision-making chapter.

[14] Newell (2007) says that his interest in defining common ground and describing a process by which one creates it stems from "the recognition that interdisciplinary study would never be respected as rigorous as long as its defining feature of integration was unexamined and mysterious" (p. 258). He is correct in this view.

[15] Common ground is absent from another leading model of the interdisciplinary research process developed by Rick Szostak (2002) in his essay, "How to Do Interdisciplinarity: Integrating the Debate," in *Issues in Integrative Studies*, *20*, pp. 103-122, and in his book*, Classifying Science: Phenomena, Data, Theory, Method, Practice* (2004), pp. 254-257.

[16] More recently, Klein (2005a) has moved beyond her earlier models characterized by a linear sequence of steps to a model that acknowledges "the messier realities of integration." Even so, this model retains the earlier reference to the "evolution of common language" (pp. 42-43).

[17] Newell has addressed this subject at least three times: initially in 2001 in "A Theory of Interdisciplinary Studies" that appears in *Issues In Integrative Studies, 19,* 1-25, then in an unpublished paper, "Interdisciplinary Integration by Undergraduates," presented at the annual conference of the Association of Integrative Studies in 2005, and most recently in his chapter, "Decision-Making in Interdisciplinary Studies" in Göktug Morçöl (Ed.) (2007), *Handbook of Decision Making* (pp. 245-264).

[18] Klein (1996) adds that because achieving a working relationship between differentiation and combination is an ongoing task, the boundaries between stages also

blur. "Synthesis is not reserved for a final step. The possibilities are tested throughout, moving in zigzags and in fits and starts as new knowledge becomes available and new possibilities and limits arise" (p. 223).

[19] Lattuca's (2001) typology of four interdisciplinarities is as follows: (1) informed interdisciplinarity (instrumental interdisciplinarity, pseudointerdisciplinarity, cross-disciplinarity, partial interdisciplinarity); (2) synthetic interdisciplinarity (instrumental or cross-disciplinarity that is motivated by an interdisciplinary question, multidisciplinarity, partial interdisciplinarity, conceptual interdisciplinarity); (3) transdisciplinarity (transdisciplinarity, cross-disciplinarity); and (4) conceptual interdisciplinarity ("True" interdisciplinarity, critical interdisciplinarity, full interdisciplinarity) (p. 114).

[20] Field and Stowe (2002) also state "the assessment movement has shifted its emphasis from process to outcomes" (p. 263). This points up the importance for interdisciplinary programs to include integration among the outcomes to be assessed so as to identify how interdisciplinarity differs from disciplinarity and multidisciplinarity.

[21] See, for example, Repko (2008b, Fall), "Assessing Interdisciplinary Learning Outcomes," *Academic Exchange Quarterly, 171-178.*

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