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Growing an Interdisciplinary Hybrid: The Case of Acoustic Ecology

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Abstract

The author presents a case for the theoretical development of interdisciplinarity to include inherently interdisciplinary fields of study, or "interdisciplines." These are primarily emerging fields for which there is no single "home base" in an academic discipline. As an example of such a field, the emerging science of Acoustic Ecology – the study of sound and its effects on health, cognition, culture, and the environment -- is analyzed according to a variety of methodological parameters. A case is then presented for the necessity and utility of collaborative work between the sciences and humanities in such interdisciplinary fields.

Introduction[1]

In an account of the history and theory of interdisciplinary approaches to science, Julie Thompson Klein presents the metaphor of hybridization, the "formation of new animals, plants, or individuals and groups. A hybrid emerges from interaction or cross-breeding of heterogeneous elements."[2] Citing concepts from such fields as molecular biology and environmental sciences, she highlights the role of hybridization in the process of interdisciplinary problem solving, suggesting that the complexity of some types of investigation makes them impractical for all but hybridized problem-based approaches. Klein's earlier work includes a discussion of theoretical distinctions between interdisciplinarity and transdisciplinarity. The former is described as a combinative and interactive approach, the latter as an agreement to regard disciplinary boundaries as irrelevant to the problem being solved because the approach employed is applicable to many fields of inquiry: one of Klein's examples for this is rhetoric.[3] Both models are useful to the identification of emerging fields of study that develop from new observations of natural or social phenomena.

Hybridized fields occur in two categories. In the first are *combinative* or multidisciplinary hybrids — those that arise from a necessary combination of established knowledge bases brought together for the purpose of launching specific lines of inquiry. An example is Urban Planning, which draws from architecture, engineering, demographics, history, geography, sociology, and aesthetics. Specialists in its component fields cooperate to develop methodology unique to the hybrid, but rooted in traditional disciplines. A typical academic program will

include instructors with backgrounds in the component fields; they develop a philosophy and a curriculum from the conjunctions of their expertise. Since multidisciplinary fields have won a secure place in the academic domain, a detailed examination of them is not essential here. It is the second, more recently developed type of hybrid that concerns us.

In the second category are *inherent* or interdisciplinary hybrids, new fields of inquiry that arise from investigation of phenomena previously unknown, ignored, or considered insignificant. They are interdisciplinary because no single discipline is able to carry out a valid inquiry. They are, in fact, "interdisciplines."[4] There is no "home base" in an academic department that does not distort their nature. Their interdisciplinarity is inherent because they require specialists from related disciplines to interact in the learning and teaching of entirely new methods and approaches, as well as collaborating from within disciplinary frameworks. Researchers must open the gates of their specialized areas of knowledge to admit questions generated by the interdiscipline and answerable only within its parameters. Interdisciplines may become transdisciplinary if their approaches are broadly applicable outside of the inquiry for which they developed.

While theoretical parameters for this category can be drawn further,[5] an extended example may serve to establish them directly. It is provided by the emerging field of Acoustic Ecology, the study of sound — including ambient noise in natural and artificial environments, music, and silence — and its effects on health, cognition, and culture. Its innovative thesis is the importance of the acoustic environment, largely ignored in previous lines of inquiry even within environmental studies. The new methods it brings to light include the recognition and mapping of the auditory characteristics of geographic and cultural territory, and the use of sound to interpret cultural and historical phenomena, an approach that may in time develop transdisciplinary applications.

A Brief History of Accoustic Ecology

The concept of Acoustic Ecology is not a familiar one, and the field is not yet well connected with academic inquiry.[6] For this reason, a brief account of its origins is in order. The Acoustic Ecology movement began in Canada, with the work of composer and author R. Murray Schafer in the late 1960s at Simon Fraser University. Schafer, intrigued with the acoustics of indoor and outdoor performance venues on the perceived sound of his music, began to investigate the ambient sounds of various environments as important phenomena in their own right. He searched literary and historical texts for descriptions of natural, agricultural, and urban noise to develop a speculative history of noise pollution, and raised crucial questions about the nature and future of noise, borrowing perspectives from physics, architecture, aesthetics, and law. Schafer's work with graduate students in music and communications led to the Vancouver Soundscape Project, a map of Vancouver neighborhoods and districts in terms of their acoustic properties and ambient sounds.[7] His book *The Tuning of the World* (1977)[8] brought his discoveries and ideas to the general public and motivated musicians, composers, and broadcasters to consider the interactions between hearing, deemed passive, and listening, deemed active. During the 1980s, the new study of psychoacoustics, a branch of cognitive psychology concerned with the processing and interpretation of auditory phenomena by the human brain, began to fill in the physiological and psychological reasons for human responses

to sound, giving further validity to the idea that environmental sound is a significant focus for scientific and academic study.

In 1993, the World Forum for Acoustic Ecology (WFAE) was founded at a conference that brought together composers, musicians, musicologists, physicists, psychologists, educators, recording engineers, broadcasters, architects, city planners, environmentalists, and sculptors concerned with the acoustic properties of their works.[9] First based in Canada, the WFAE expanded to represent five international branch organizations.[10] It now fosters literature and research concerned with the preservation of natural and traditional cultural soundscapes,[11] through the establishment of noise-control legislation and "silent zones" in cities and through public education in the practices of conscious listening, as well as through music composition that promotes awareness of environmental sounds. There is already some controversy in the movement regarding the classification of urban ambient noise as a nuisance. Some theorists regard urban noise as a legitimate soundscape to be documented and observed, while others believe that documentation is merely the first step toward changing its conditions, making it less intrusive. Johan Redstrom, commenting on the controversy, cites the example of traffic noise, an annoyance to those living near a busy street, but a vital source of information to drivers, cyclists, and pedestrians on the same street.[12] Other theorists comment on the need to restore silence to urban and domestic life, citing its therapeutic properties.[13] Current practitioners of Acoustic Ecology are primarily composers, recording engineers, music educators, and communication theorists. There is considerable potential for the field to encompass expertise in environmental sciences, health sciences, engineering, law, linguistics, musicology, music theory, architecture, and urban planning. Doing so will produce new methods for investigation, as well as greater scope for significant research. By replacing the eye with the ear as a primary organ of perception and description, Acoustic Ecology may facilitate the development of new approaches to culture, history, ethnology, and communications, as well as science.

Categories of Inquiry

Acoustic Ecology provides a model for the blurring of conceptual boundaries that separate the traditional Western domains of inquiry into the categories of science, social science, and humanities. Like any branch of environmental study, it rests on a base of factual observation while defying reduction to mere facts. Context is crucial, and the connective tissue provided by cultural and humanistic parameters gives the scientific measurements meaning.

As a relatively new field of study, and one which deals with the interactions among environments, sensory perceptions, and interpretations, Acoustic Ecology provides an exemplary focus for the examination of interdisciplinary modeling of science/ social science / humanities hybridization. In its scientific aspect, it deals with acoustics, the properties of sound, and the measurable resonance of spaces, surfaces, and hearing mechanisms. As a social science, it examines and poses questions about the effects of noise, music, auditory communication, and silence on communities and cultures. In its humanistic aspect, issues of aesthetics, rights, community and individual welfare, and cultural experience all bear significance.

Several paths of inquiry can be demonstrated by examining the definitive aspects of Acoustic Ecology: it is a natural science, a social science, and a branch of the humanities. To be

practiced with full integrity, it requires information and methods from all three domains, here exemplified by questions central to each.

- Quantitative Scientific Approach:
  What quantitative measurements can be applied to sound (acoustics) and to hearing (audition)?
- Cognitive/Neurological (Psychoacoustic) Approach:
  What are the mechanisms by which hearing is accomplished and interpreted? How does hearing affect attention, cognition, and learning? How does auditory perception affect the development of the brain?
- Philosophical Approach:
  What is noise? Are its characteristics physical, perceptual, or both?
- Social Scientific Approach:
  Should environmental noise be observed, recorded, described? Corrected? What are the effects of various types of sound on populations and individuals? How does sound unify and divide communities?
- Legal Approach:
  What are individual and community rights to self-expression through sound and to quiet? Should noise be controlled, and if so, what approaches and methods are most effective and most acceptable?
- Health Care / Medical Approach:
  What effects do sound and hearing have on health and disease? What are the effects of music, of silence, and of noise on health and healing?
- Engineering/Architectural Approach:
  What are the effects of design, proportion, and physical structures on acoustics and on hearing? How can structures be built to minimize auditory distraction and annoyance and to optimize ambience?
- Aesthetic/Cultural Approach:
  What are the boundaries between noise and music, and how permeable are they? What effects does culture have on determining such boundaries? Is there a direct relation between culture (or aesthetic background?) and the perception of sounds as desirable, undesirable, or neutral?

Specific investigations can then be contextualized within the following categories of inquiry:

- Scientific (measurement, description, neurological certainties)
- Cognitive (interpretation of auditory signals, emotional responses, information transmission, attention)
- Structural (relation of auditory signals to parameters of an environment)
- Cultural (interpretation of auditory signals according to social norms and attitudes, age, gender, ethnicity)
- Medical (examination of norms and disorders of hearing and communicating, and of sound as a therapeutic or counter-therapeutic mode)
- Musical (aesthetic and communicative properties of sound signals).

Each area can, and should, be interwoven with others in research design. The cultural, medical, and musical categories are easily combined in the investigation of such questions as age-related and language-related preferences in music, which may influence the efficacy of music therapy. The cognitive and musical contexts are necessary for studying the effects of

rhythmic patterning on memorization, while the scientific, structural, and cultural categories inform investigations such as the Vancouver Soundscape Project. Each context represents a framework through which specialized scientific and sociocultural information can be gathered and interpreted.

Interdisciplinary Contexts

The focus of most scientific research is on finding the answers to very specific quantifiable questions. General questions may be ignored because they cannot be answered effectively by gathering specific data. Thus, a fully scientific approach will yield significant information only for specific parts of an interdisciplinary inquiry. Humanistic questions, concerned with meaning and experience, may yield general impressions rather than accurate conclusions. How, then, can the two modes of investigation be harmonized within a field that encompasses both? The process involves the completion of three stages of inquiry. In the first, quantitative stage, facts are gathered and measurements taken in order to satisfy the requirements of scientific investigation which bring validity to later claims and conclusions. In the second, a qualitative look is taken at *why* the investigation is useful: what larger categories of unexplored knowledge will it help to map? In the third stage, implications for further investigations are noted, moving outward from the context of the focused study to the larger network of contextual interpretations and linkages.

As an example, consider the case of *presbyacusis*, hearing loss due to aging. A context-based approach to hearing loss would include perspectives on physical and neurological changes in the course of aging, population aging and its resulting effects on auditory acuity as a social phenomenon, increases in ambient urban noise that can mask speech signals and diminish auditory comprehension, cultural attitudes toward noise as a symbol of power and territorial definition, and personal responses to auditory signals and ambiences. Any specific investigation of quantitative data on *presbyacusis* would have to be followed by considerations of context (symptoms and treatment: scientific and medical categories) and of implications (questions of aging and cognition, communication, and ambient noise in domestic and public spaces).

Thus, each stage of the investigation yields information that will contribute to the ability of health care and medical design professionals to treat conditions of hearing loss, as well as to the ability of individuals who experience hearing loss to adapt to the condition and minimize its impact. Treatments and solutions may move first from specific to general: if individual A benefits from treatment X, then so might individual B with the same symptoms. They may then swing back from general to specific, in order to meet the real needs of individual B, who has the same symptoms but a different interpretation of the problem. While mechanical hearing aids are the treatment of choice for hearing loss in general, some individuals may choose not to use them because the sense of privacy and peace associated with silence is more important to them than the restoration of normative communication. Such individuals may require more sophisticated control mechanisms for their hearing aids than the average user, since their preference may actually be for slightly diminished acuity in order to reduce the impact of extraneous mechanical noises in the home, the rustling of newspaper pages while reading, the sounds of chewing food, and other minor distractions.[14]

Recognizing that both extrapolations — specific to general and the reverse — are useful gives additional significance to the original quantitative study. In effect, the formulation of questions and focal points from contexts *outside* the obvious ones is essential to the building of a humanistic envelope for scientific investigation. Recognition of *what is missing* in a given paradigm or design for interdisciplinary research is often the key to its success, to the voicing of the unspoken. An example comes from the field of Music Therapy, an ancient branch of health care revived in the twentieth century and now gaining increasing respect as a technique for treating mental and physical disabilities, brain injuries, learning disabilities, and memory loss. It has been known for decades in Western culture — and for centuries in the traditional and aboriginal cultures of the world — that music works as a healing modality, but recent technological developments may make it possible to find out *how* it works. Brain imaging techniques are now providing a way to find answers to long unanswered questions of the connection between the sense of hearing and the generation of emotions, as well as of the effect of emotions on the functioning of the immune system.

The mechanisms by which Music Therapy works are not yet known, but paths of investigation are forming that are generating whole new questions: what is the role of memory in emotional responses to music? What role does familiarity with music play in the efficacy of Music Therapy? Are there differences in effect between live and recorded music? All of these questions, and many others to come, are missing from the research of the twentieth century, which focused primarily on the application of music to specific health conditions and on anecdotal studies of treatment designs. A fully interdisciplinary approach to such research in the future, as distinct from the cross-disciplinary collaboration of music with nursing that has traditionally characterized research in the field, might involve the collaboration on research design among neurologists, cognitive psychologists, nurses or physicians, acoustic ecologists, music therapists, and music theorists or musicologists.[15] The investigation of a specific intervention through Music Therapy might then take into account the following concerns:

- (Scientific and Medical Approach) What is the exact nature of symptoms exhibited by the research subject, and what additional treatments are being or have been administered? Does the music used for the intervention affect the symptoms directly or indirectly, and in what ways? Are there physical changes as a result of the music? Does it affect the subject's state of mind, comfort level, or feelings about the illness?
- (Musical/Aesthetic/Cultural Approach) What are the structural and cultural components of the music being used for the intervention? In what contexts is the music conventionally performed, and what associations might the subject have with them? Is the subject familiar with the music or with similar styles? In either case, what are his or her emotional, intellectual, spiritual, and physical responses to the music?
- (Environmental Approach) What are the acoustic properties of the room in which the music is heard and of the process by which it is heard (e.g. live or recorded performance, volume level, number of performers, quality of equipment used)?
- (Neurological/Cognitive Approach) What measurable responses are shown by the subject's brain while the music is being heard? Where in the brain are they located? Do they resemble any other patterns known to be indicative of a particular state or condition, or are they unique? Are they the same with repetition of the music, or do they change as familiarity increases?

- (Qualitative Approach) Before, during, and after the intervention, what is the subject's mood? Pain level? Comfort level? What comments or questions does the subject have about the experience? What language is used to describe emotions and experiences?

Such a study is, of course, hypothetical at this time for the simple reason that the cost of brain imaging technology is prohibitive. Should that situation change in the future, a fully developed picture of the exact nature of Music Therapy may emerge from the interaction of various disciplinary perspectives to produce an interdisciplinary approach. Such an approach must of necessity be somewhat flexible, permitting the details of the research plan to be determined by its content, rather than shaping content to fit a rigid mode of validation. For example, in the hypothetical research design given above, individual responses such as mood and comfort level in response to the music used in the therapeutic intervention will likely differ. This should not invalidate the study, since other parameters — such as the presence or absence of recognizable patterns in a brain scan and the severity of symptoms — can be used as quantitative measures.

Cautions and Speculations

The maturation process of a hybrid science can be measured by its growth in two areas, which may be considered either contradictory or complementary. The first is scientific accuracy, demonstrated by caution in the gathering of data and in the interpretation of its objective significance. The second is humanistic integration, demonstrated by the discovery and articulation of new ways of thinking and of applying knowledge, as well as by evidence of subjective significance. The former is exclusive and contractive, the latter inclusive and expansive. The contrast between them has long been used to keep them separate and their practitioners mutually suspicious. In an examination of "instrumental interdisciplinarity" in the sciences, Anthony Van Raan disparages the separation of the two realms as detrimental to the non-scientific disciplines:

> [T]he typical non-instrumental activities such as philosophy and parts of the social and behavioral sciences and the humanities are in danger of losing their connections with the natural, basically interdisciplinary advancement of science. As a consequence, they will then lose their objective, scientific character because they will be less and less subject to the regulating rigours of the hard disciplines that provide instrumentation. These disciplines will become more and more unscientific, moving towards ideology-based . . . activities dominated by current fashions. . . . In summary, scientific interdisciplinarity is the result of one of the main aspects of science itself, its socioeconomic, problem-driven character . . . reinforced continuously — and very effectively — by technological developments.[16]

In a hybridized field of inquiry, however, such suspicion is counterproductive to *both* camps. If, as Van Raan suggests, interdisciplinary research paradigms are natural to the evolution of science, then the implied trajectory of integration with non-scientific fields of

inquiry will expand the scope of the sciences as well as increasing the investigative precision of the humanities. In Acoustic Ecology, the questions raised by composers of music come to be explored by neurologists and engineers. As answers are found, the composers apply them to further aesthetic experimentation, which then feeds the imagination of the architects and city planners who design concert venues. Musicians, knowing the physics of their instruments from auditory — if not always mathematical — perspectives, produce critiques of concert venues and inform the design and construction of improvements. Just as a biological hybrid is produced by the combined characteristics of its parents, a hybrid field of inquiry combines different modes of thinking into a unity.

The process is one of evolution, and it does not happen with great speed. Time must be taken into account when considering the growth process of an interdiscipline. There is first the time required for specialists to instruct each other in the lines of inquiry useful to their fields; this, rather than the actual content of their knowledge, is most conducive to being shared. Then there is the working out of new methodologies or the modification of familiar ones, followed by their application to practical research questions. Finally, there is the necessity for teaching a new generation of collaborative practitioners who may then go on to form even more expansive alliances. As courses in Acoustic Ecology and other hybrid fields are taught and books are written, as graduate students are apprenticed to researchers, new bases of knowledge and methods will gain validity in academic and scientific terms. In the meantime, there is much work to be done.

Notes

1. I am grateful for the suggestions and critiques of my colleagues Barbara Schneider (Faculty of Communication and Culture) and Daryl Caswell (Faculty of Engineering) during their participation in the planning and execution of a session at *Paradigms Lost and Paradigms Gained: Negotiating Interdisciplinarity in the Twenty-First Century*, a symposium held at the University of Calgary May 9-12, 2001,which provided the impetus for this article. Colleagues in the Acoustic Ecology Research Group based at the University of Calgary have also contributed valued insights.

2. Julie Thompson Klein, "A Conceptual Vocabulary of Interdisciplinary Science," in *Practicing Interdisciplinarity*, ed. P. Weingart and N. Stehr (Toronto: University of Toronto Press, 2000), 3-24. Klein's metaphor is useful only to a certain obvious point: hybrids are sterile, and this is not a characteristic to be encouraged in fields of inquiry.

3. Julie Thompson Klein, *Interdisciplinarity* (Detroit: Wayne State University Press, 1990), 63-73.

4. Ibid.

5. See Marcia Epstein, "Teaching a Humanistic Science: Reflections on Interdisiplinary Course Design at the Post-secondary Level," *Current Issues in Education* 5, no. 3 (2004).

6. In fact, there is some resistance among its practitioners to becoming systematized. For discussion of the current methodological dynamics of the field, see Henrik Karlsson, "The Acoustic Environment as a Public Domain," *Soundscape* 1, no. 2 (Winter 2000/01).

7. For information about the project and its findings, see the website of the *World Forum for Acoustic Ecology*, http://interact.uoregon.edu/MediaLit/wfae/home/

8. R. Murray Schafer, *The Tuning of the World* (New York: Alfred A. Knopf , 1977). Second edition published as *Our Sonic Environment and the Soundscape: The Tuning of the World* (Rochester, VT: Destiny Books, 1994).
9. The *Tuning of the World* Conference, August 1993 at the Banff Centre for the Arts in Banff, Alberta. Among the participants were R. M. Schafer; physicist Ursula Franklin; music educator Pauline Oliveros; composers Allan Bell, Barry Truax, and Hildegard Westerkamp; and social scientist/author Jerry Mander.
10. For information about the WFAE, see its website (provided in note 7), particularly the articles in *The WFAE Online Reader*. International branches of the WFAE are located in Australia, Canada, Finland, Germany, and The United Kingdom/Ireland.
11. The term *soundscape* was coined by R. Murray Schafer to describe the auditory aspects of a landscape or locale. It is now in common use in the Acoustic Ecology movement.
12. Johan Redstrom, "Is Acoustic Ecology about Ecology?" *The WFAE Online Reader,* http://interact.uoregon.edu/MediaLit/wfae/home/.
13. See especially Ursula Franklin, "Silence and the Notion of the Commons," *The WFAE Online Reader*; article excerpted from paper presented at Tuning of the World Conference, Calgary, 1993.
14. Responses reported to me in conversations with three elderly users of hearing aids who chose to keep the aids turned off much of the time.
15. Music theorists are concerned with the vocabulary and grammar of music, such as harmonic and rhythmic structures; with the forms that hold musical elements together in recognizable patterns; and with the rhetoric created by combinations of such patterns. Musicologists work with the history and styles of music, and with the relation of music to other aspects of culture such as language, dance, theatre, architecture, religion, ethnicity, gender, demographics, geography, and climate.
16. Anthony F. J. Van Raan, "The Interdisciplinary Nature of Science," *Practicing Interdisciplinarity,* ed. P. Weingart and N. Stehr (Toronto: University of Toronto Press, 2000), 68-9.

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