

doing interface ecology: the practice of metadisciplinary

Author

Andruid Kerne
Interface Ecology Lab | Center for
the Study of Digital Libraries
Computer Science Department
Texas A&M University
3112 TAMU
College Station, Texas 77843 USA

+1.979.862.3217
andruid@cs.tamu.edu

ABSTRACT

The interface can be modeled as an ecosystem: connected, dynamic, and characterized by relationships. The model is predicated on a process of working with the interface as a border zone between heterogeneous systems of representation. This paper uses sensation, embodiment, and semiotics to initiate this process, by addressing the range of systems of representation that are involved in its own production. This presence of the theorist is found to create a self-referential metastructure.

As an alternative to the beneficial but ad hoc assemblages of multi-, inter-, and trans-disciplinary approaches, the ecosystems approach establishes that meshing of systems of representation is an inherent property of interface phenomena. The meshing process causes elements from the involved representational systems to recombine, forming hybrids. Recombinant information is a structural formula for creating new knowledge, which can be invoked for that purpose, intentionally.

Theorists are part of the environment that they theorize about. The products of theorizing are information artifacts that are also part of the environment. They themselves function as interfaces. The term “metadisciplinary” is developed to describe the inherent and self-referential nature of this structure. The structure of metadisciplinary connects theory and practice. This stands in direct contrast with studies approaches, such as performance studies, which is separate from theater practice.

border zone where systems of representation meet

An interface is a border zone where systems of representation come into contact. It is a membrane, regulating the exchange of vital messages from one side to the other. The more open the membrane, the more flow, the more new combinations that an interface supports. Particular membrane structures can act as filters, tuning feedback loops.

Interface Ecosystem, The Fundamental Unit of Information
Age Ecology (Kerne, 2002)

What are the systems of representation that are brought into relationships by interfaces? Let's start with a simple example: a typical personal computer, connected to the internet. Most immediately, we have the sensation systems of a human being seeing a computer screen, touching a mouse and a keyboard. The physical is translated into the electronic, and vice versa. The analog representations of the physical, real world are converted to and from the digital representations manipulated by the computer. We have layers of hardware and software. Since I specified “typical,” that means Intel processors and

a Microsoft Operating System. Thus, we have the old anti-trust litigation between Apple and Microsoft, and newer jostlings with Linux and those who believe in free software. Somewhere, the voices of the hardware and software engineers are echoing. Perhaps they worked very long hours. Perhaps they were content with their rewards; perhaps they felt exploited.

Those working on the “low level” manufacturing were probably women [Grossman, 1980]. Among them, those who built the primary circuit board, known as the *motherboard*, were probably Chinese (Millard, 2003). Let's open the case and check it out. Perusing the motherboard, integrated circuit labels indicate that they were made in countries such as China (again), Malaysia, the Philippines, El Salvador, and Guatemala. According to the LABORSTA database of the International Labour Organization, during 2000, the average woman electronic equipment assembler in China earned \$106 per month (ILO, 2002). The interface of the personal computer puts the user in touch with the assemblers, tactilely and economically. The economic relationships leave a sticky trail of money. It gets under my fingernails. As I close the case and get back to writing this paper, I worry it will gum up the keyboard.

So many relationships, and we have not yet gotten to the network. There are some open standards here, the TCP/IP protocol stack, and higher-level protocols such as HTTP for the web, SMTP and POP for email. There are standards, too, for declarative languages such as Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS). Of course, no web browser is complete without search. So Google is here, too.

At the time of this writing, it seems that there is an 85% likelihood that the web browser being used is Microsoft Internet Explorer (Upsdell, 2004). So then we have another of Microsoft's anti-trust litigation scenarios, this one with Netscape. The U.S. Department of Justice and the Sherman Antitrust law are here. So are various states and judges, and the European Union. Operating systems, application systems, legal systems, economic systems, national systems, international systems, and multinational systems are interconnected in complex flows.

At the moment, I am sitting in front of an IBM laptop. So product designers are represented. Selker's work on the Trackpoint sits in front of me (Ehrlich, 1997). So does the brand identity of Big Blue. Paul Rand's logo is present and accounted for. In my memory, a legion of ad campaigns wails reverberantly, from “Solutions for A Small Planet,” to “His name is Linux ... The future is open.” The sound over sound sounds muddy.

Vast infrastructures of research and production are at work. Universities, national labs, and corporations carve out highly connected roles (DeLanda, 1997, Hayles, 1999). They constitute the social relations of digital production. They selectively filter what gets produced, and what gets omitted.

We have yet to begin browsing, to encounter “content.” Yet, already, I feel like I’m caught in the sticky web of a horror movie, or at least, a haunted house. I’m typing this paper in Microsoft Word, wanting to experience a blank slate for writing. Yearnings for tabula rasa give way, to the multilayered reality of a highly structured, complex ecosystem of entities and representations. There are too many windows, too many menus, too many entries, too many buttons. The magical number that defines the capacity of working memory, 7 ± 2 , is violated repeatedly (Miller, 1956). Branded toolbars pervade the digital parchment. I <alt-tab> back and forth from the word processor to web browsers, scanning for supporting materials, and then writing some more. Icons trail my every move.

In my web browser, I jump from a background article in an industry rag (Millard, 2003) to the SIGGRAPH Proceedings web site to the New York Times for today’s news. I drop in on Slashdot, then over to the ACM Digital Library for more research. Then to whatisthematrix.com to find a link to a video, which I connect to an entry about Baudrillard’s concept of hyperreality, in the site for the metadisciplinary undergraduate class I am teaching, Structures of Interactive Information (Kerne, 2004a). The hyperreal refers to the replacement of real-world representations, relationships, and values by electronic ones (Baudrillard, 1983). I keep myself over-stimulated to the point of anxiety. I am saturated with information, out of habit.

This little computer is a meeting point for many codes. Codes of signification. Codes of automata: operators and operands. Codes of expression. Codes of control. A mesh of media renderings, disciplinary structures of methodology, cultural groundings, and epistemological foundations is formed. As I consider all these systems of representation that are in play, all of this signification, I return to the start of this exegesis, to the role of my body-mind. I return to sensation, the core of user experience. I turn to phenomenology:

The sensor and the sensible do not stand in relation to each other as two mutually external terms ...
It is my gaze which subtends colour, ... In this transaction between the subject of sensation and the sensible it cannot be held that one acts while the other suffers the action, or that one confers significance on the other (Merleau-Ponty, 1962).

According to Merleau-Ponty, sensation is an active process. Sensation situates the individual in the environment. In the field of artificial intelligence and robotics, Brooks’ model of embodiment operates similarly: perception and action are integrated through cognition (Brooks, 1999). Through the process of sensation, through perception and action connected, at the nexus of the interface, I encounter all of these systems of representation, their forms as media, the rules that govern their production and the subversions that attempt to countervail, the underlying epistemologies, and their methodologies of practice. As a creative agent, my body is signifier and signified, subject and object. I create information artifacts, which function as interfaces. This paper is one such. I am linked into the

complex web of relationships, through my act of writing about this interface ecosystem. With this action of cognition, the representational forms that I produce are likewise linked. Soon these words will move from the word processor. They will be uploaded as bits using a browser, and web protocols. Perhaps they will be published. They may influence the environment they refer to. This is our first encounter with the reflexive, recursive, self-referential structure called *meta-*.

disciplinary assemblages

Behind each type of representational form that interfaces connect lies one or more disciplines of methodology. These disciplines enable and govern practice with their codifications of methodological discourse (Foucault, 1972). The composition of disciplines into hybrid assemblages is necessary, in order to address the diverse heterogeneous systems of representation that connect through the interface border zone. Examples of these disciplinary assemblages are well known. (Gaver, 1991) and (Norman, 1988) translated Gibson’s perceptual model of affordance (Gibson, 1979) from cognitive science into human-computer interaction. Walczak brought notions of temporality and self-organizing structure from architecture into interaction design, in the web-based artwork, Apartment (Lamontagne, 2001). Schiphorst utilized techniques and philosophy from choreography and somatics while creating the Bodymaps installation (Schiphorst, 1997). Mateas and Stern have developed computational models of theater’s “beat” and integrated them with artificial intelligence and computer graphics for the computer game, Façade (Mateas, 2003). Kerne has built a generative space for browsing, authoring, and collecting with principles from music composition and collage, as well as machine learning and computer graphics in CollageMachine (Kerne, 2000). In collaboration with creative cognition researcher Smith (FWS, 1992), principles of cognitive science are being integrated with this work in combinFormation (Kerne, 2004b).

transdisciplinarity

While these examples constitute instances of practice, they are not sufficient to define an approach. Prior work has begun to address these phenomena of disciplinary assemblage more systematically. Century describes the advent of the studio-laboratory, “a site ... through which artists, scientists, technologists, and theorists commingle” (Century, 1999). Among the examples he gives are ZKM, Banff, Ars Electronica, and IRCAM. (Gibbons, 1994), (Norman, 1997), (Century, 1999), and (Ascot, 2002) call these assemblages transdisciplinary. Transdisciplinary research is said to “interpenetrate disciplinary epistemologies” (Century, 1999); it is “transgressive” (Nowotny01).

Transdisciplinarity’s valuing of the practice of disciplinary assemblage is a good beginning. The problem is that trans- means, “across, to or on the farther side of, beyond, over” (OED, 1992). While going across, beyond, and over disciplinary boundaries, what is missing in the denotation of trans- is the structural imperative for assembling disciplines, and a sense of how processes of disciplinary recombination are a formula for creating new knowledge. (Nowotny, 2004) observes that, “Transdisciplinarity ... is more than juxtaposition ... If joint problem solving is the aim, then the means must provide for an integration of perspectives in the identification, formulation, and resolution of what has to become a shared problem.” But how can this type of integration occur?

recombinant information

In fact, juxtaposition is a starting point for integration. As the collages of Ernst established early in the 20th century, juxtaposition can serve as the first step in a human algorithm for generating new meanings. Juxtapositions and recontextualization draw the mind to puzzle about potential connections between elements. The next steps depend on what sensory and semiotic relationships can be drawn between elements, through cognitive processes. As (Kerne, 2003) develops, Dada collage, filmic montage, Debord's detournement, audio sampling and remix, and hypertext practices of authoring by reference are all examples of this cognitive and semiotic restructuring. They are types of recombinant information.

"Recombination is the process of taking existing coded compositions, breaking them down into constituent elements, and recombining those elements to form new codings" (Kerne, 2003).

Recombinant information forms new meanings through the process of composing elements from the disparate systems. (Kerne, 2003). The process works similarly to the shuffling of base pairs in genetics, except here, cognition plays the role of interpreter.

Our cognitive processing of recombinant information is addressed by the *geneplore* model of creative cognition (FWS, 1992). According to *geneplore*, creative experiences sometimes develop when phases of generative processes (for example, memory retrieval, analogical transfer) alternate with exploratory interpretive operations (for example, attribute finding, hypothesis testing). Certain conditions increase the likelihood of creative experience. The generation of *preinventive structures*, which serve as the grist of creative process, makes the development of creative results more likely. Combinations of images and words (recombinant information) are a form of preinventive structure, as are visual patterns and mental models. The exploration phase consists of articulation, interpretation, and refinement. We play with the preinventive structures in search of understanding. We may iteratively cycle back and forth between phases of generate and explore.

Some preinventive structures are also characterized by *preinventive properties*. Examples of these include ambiguity and incongruity. That is, when information elements are recombined, if a combination makes sense immediately, the cognitive process is not likely to go anywhere. But, if there are potential relationships that are not immediately clear, the mind tends to work on making sense of them, to find new connections. Sometimes, configurations of preinventive structures don't lead anywhere. There are no guarantees. On other occasions, we experience, "Ah-ha!" This is the emergence of new ideas.

A theorem of recombinant information, then, is that the ambiguous and incongruous juxtaposition of heterogeneous elements that are related through the operation of an interface is likely to stimulate the emergence of new hybrid forms. *Element* here may be a nested signifier. That is, whole representational systems of elements can function themselves as the elements that are juxtaposed. In interface ecosystems, among the elements that are subjected to processes of juxtaposition and recombination are systems of representation, such as sensation and text, video and interactivity.

The notion of *metadisciplinarity* focuses on the recombination of disciplinary systems. Disciplines are referenced and juxtaposed by the

sensory, media, and technical intersections of the interface border zone. The juxtaposition invokes recombinant information principles of collage, detournement, and *geneplore*. Disciplines are represented by methodologies and epistemologies. Using them together initiates processes of translation. Translations are inherently imperfect. And that is where things get interesting. In the context of the interface ecosystem, practitioners have to resolve the ambiguities between disciplines. They/we have to figure out how things fit together. The theorem of recombinant information applies. The result is that when juxtaposition is followed by *geneplorative* processes of conceptual integration, interface ecosystems generate hybrid metadisciplinary forms, as well as new media and new theory. These processes create new species of meaning. Those of us with any need to sell something (including grant proposals) may be prone to calling this a formula for innovation.

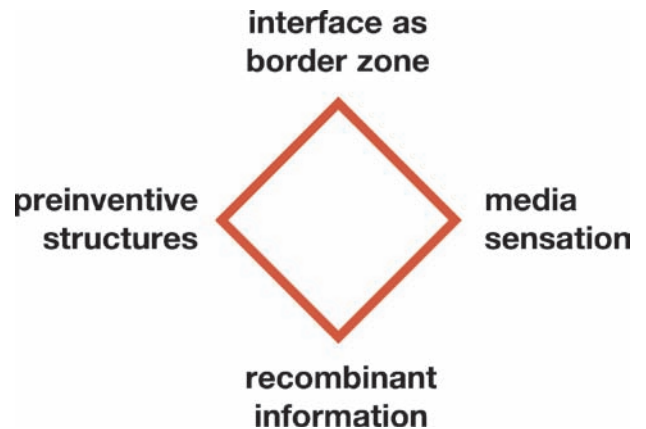


Figure 1 Sensation of Recombinant Information. Emergence of new hybrid forms.

metadisciplinarity

Hofstadter uses the term *strange loop* to describe a tangled hierarchy in which following a chain of levels of reference returns us to a previous state (Hofstadter, 1979). These levels of reference are *metalevels*. One example is Gödel's proof of the incompleteness of Whitehead's *Principia Mathematica* (PM). PM is not complete, because it can't contain all possible statements about itself. (The counter-example is: "P.M. is not complete.") Those are meta-statements. Mathematics and metamathematics (and by extension, recursively, metameta...mathematics) are parts of the same system.

The interface described in the first section above, which develops and represents theory about interfaces is another example of a *strange loop*. We will find this structure again, by examining the role of disciplines in the interface ecosystems of the information age.

The notion of *metadisciplinarity* develops a structurally identical chain of self-reference. In examining and developing phenomena of interface ecosystems, we refer to the underlying knowledge structures of disciplinary inquiry. We refer to the structure of disciplines, themselves. Our process of referencing is situated in our bodies, which are connected to technology and information through sensation, in experiences of reading and writing, seeing and clicking, authoring and designing. Sensation and action mesh in cognition. Action has the potential to express and create. This grounds metadisciplinary inquiry in an ecosystem of practice. This theorizing becomes part of

our work with interfaces. It takes form as a metadisciplinary interface.

Using cognitive principles such as *geneplore* to describe the process through which we form relationships between disciplines and their constituent languages is another form of self-reference, another strange loop. The practice of metadisciplinary invokes cognitive science to understand and explain phenomena such as its invocation of cognitive science in constellation with other disciplines, such as computer science and cultural theory. And so we see again that the theory of metadisciplinary constitutes its practice.

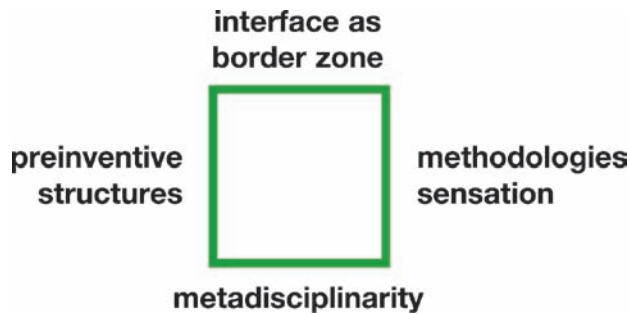


Figure 2 Sensation of Multidisciplinarity. The notion of metadisciplinary develops a structurally identical chain of self-reference.

ethnography and “studies”

While relativity and quantum mechanics have previously refuted the notion of the unbiased observer, this model still pervades the scientific method. And even while the subject and observer model is refuted and critiqued in discourse, it still governs the structure of disciplines in the humanities and social sciences.

Ethnography has been known as “writing culture.” With the suffix *-graphy* involved, we extend this to include the visual. In his classic work of cultural anthropology, Geertz identified “doing ethnography,” as thick description, a piling of layers of narrative signification, which situates the emblematic stories of particular individuals in broader contexts of social practices and relationships, aesthetics, and values (Geertz, 1973). (Clifford, 1986) followed by turning ethnography’s tools into its practice. He identified the reflexivity of ethnography, realizing that what gets written down is inevitably about the writer, as much as “the other.” The result is an onus on the writer to make her/his presence explicit.

We apply this sense of reflexive self-reference to the products of writing culture, and representing it graphically. The products of ethnography are, themselves, information artifacts. They function culturally, in the ecosystem of the culture that is described. By representing observations, in the form of thick descriptions, they may exert influence. They are *meta-artifacts* that integrate theory and practice.

However, ethnography is located in the discipline of anthropology. The making of cultural artifacts involves self-expression. It is typically found in disciplines such as art, design, and creative writing. The separation of theory and practice by disciplines interferes with the development of hybrid forms, obscuring the development of the creative role of the individual in “discourse.”

This is the model of many *studies* approaches, such as performance studies, which observes and writes about theater, dance, and ritual, without engaging directly in performance practice. In currently established procedures, performance studies these are not performances. This is true, in spite of the fact that a sampling of the NYU Performance Studies Department listserv indicates that many performance studies scholars are accomplished, practicing performers, and that doing performance is important to them.



Figure 3 Theorizing and Developing. The structure of metadisciplinary connects theory and practice.

conclusion

The structure of metadisciplinary connects theory and practice. Doing interface ecology involves analysis, to develop understanding of interface phenomena. It involves synthesis, the development of new interface phenomena. These modes of practice are inseparable. Metadisciplinary develops an awareness of the structure of situated disciplines forming relationships in interfaces. Through its practice, cultivating these relationships intentionally, we can create hybrid forms of representation.

When we are doing interface ecology, we are awash in strange loops of signification, producing self-referential information artifacts. As doing ethnography is creating thick description, so doing interface ecology also creates branching structures of reference across levels of signification. Here, metadisciplinary is constituted through the reflexive relationships of methodologies invoked to understand and create the interface’s inherent panoply of representational systems, while theorizing and developing wrap in a generative postmodern braid.

Doing interface ecology means connecting theory and practice through metadisciplinary structures. Separating New Media Studies, or Internet Studies from practice would avoid the metadisciplinary nature of interface phenomena. Connecting disciplines promotes the creation of hybrid forms. As computational artifacts and their interfaces become tangible and pervasive, as they permeate a wider and wider range of human activities and environments, the need for metadisciplinary practice grows. Future work will explore how the practice of metadisciplinary can play a new role in pedagogy and research among fields such as computation, information, graphics, interaction design, and “new” media.

References

- Ascot, R. (2002). Mission: CAiiA: Center for Advanced Inquiry in the Interactive Arts - STAR: Science Technology and Art Research, www.caiia-star.net/mission/index.html, 2002.
- Baudrillard, J. (1983). The ecstasy of communication, in Foster, H., ed, *The Anti-Aesthetic: Essays on Postmodern Culture*, New York: New Press, 1983.
- Brooks, R. (1999). *Cambrian intelligence: The early history of the new AI*. Cambridge, MIT Press, 1999.
- Clifford, J., and Marcus, G. (1986). *Writing Culture: The Poetics and Politics of Ethnography*. Berkeley: U of California Press, 1986.
- De Landa, M. (1997). *A Thousand Years of Nonlinear History*. New York: Zone Books, 1997.
- Ehrlich, K. (1997). A conversation with Ted Selker, *ACM Interactions*, 4:5, 34-47, 1997.
- Finke, R.A., Ward, T.B., Smith, S.M. (FWS, 1992). *Creative Cognition*, Cambridge, MIT Press, 1992.
- Foucault, M. (1972). *The Archaeology of Knowledge and The Discourse on Language*, New York: Pantheon Books, 1972.
- Gaver, W. (1991). Technology affordances, *Proc CHI 1991*, 79-84.
- Geertz, C. (1973). *The Interpretation of Cultures*, New York: Basic Books, 1973.
- Gibson, J.J. (1979). *The ecological approach to visual perception*, Houghton Mifflin, New York, 1979.
- Grossman, R. (1980). Women's place in the integrated circuit, *Radical America*, 14:1, 29-49, Jan-Feb 1980.
- Hayles, K.N. (1999). *How we became posthuman : virtual bodies in cybernetics, literature, and informatics*, Chicago: Univ of Chicago, 1999.
- International Labour Organization (ILO, 2002). LABORSTA database of labour statistics, www.ilo.org/public/english/bureau/stat/portal/online.htm, 2002.
- Kerne, A. (2000). CollageMachine: An interactive agent of web recombination. *Leonardo* 3:5, 347-350, Nov 2000.
- Kerne, A. (2002). Interface ecosystem, the fundamental unit of information age ecology. *Proc SIGGRAPH 2002: Art and Animation*, 142-145.
- Kerne, A. (2004a). Structures of Interactive Information, csdl.tamu.edu/~andruid/sii
- Kerne, A. Smith S.M., Mistrot, J.M., Sundaram, V., Khandelwal, M., Wang, J.M. (2004b). Mapping Interest and Design to Facilitate Creative Process During Mixed-Initiative Information Composition, *Proc Creativity & Cognition Symposium: Interaction: Systems, Practice and Theory*, 2004.
- Lamontagne, V. (2001). Interview with Marek Walczak & Martin Wattenberg, www.mobilegaze.com/mg3/apartment_en.html, 2001.
- Mateas, M. (2003). *Interactive Drama, Art, and Artificial Intelligence*, Ph.D. Thesis. Technical Report CMU-CS-02-206, CMU School of Computer Science. Dec 2002.
- Merleau-Ponty, M. (1962). *Phenomenology of perception*. New York: Humanities Press, 1962.
- Millard, E. (2003). Inside the Hidden World of Motherboard Manufacturing, www.technewsworld.com/perl/story/31786.html, TechNewsWorld, Oct 8, 2003.
- Miller, G.A. (1956). The Magical number seven, plus or minus two: some limits on our capacity for processing information, *Psychology Review*, 63:81-97, 1956.
- Norman, D. (1988). *The Psychology of Everyday Things*, New York: Basic Books, 1988.
- Norman, S.J. (1997). Transdisciplinarité et genèse de nouvelles formes artistiques, Délégation aux arts plastiques, Ministère de la Culture de France. www.culture.fr/culture/mrt/bibliotheque/norman/norman.rtf, 1997.
- Nowotny, H., Scott, P., Gibbons, M. (2001). *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty*, Oxford: Polity.
- Nowotny, H. (2004). The Potential of Transdisciplinarity, in *Rethinking Interdisciplinarity*, www.interdisciplines.org/interdisciplinarity/papers/5/24, Jan 2004.
- Oxford University Press. (OED, 1992). *Oxford English Dictionary on Compact Disk*, Second Edition. Oxford: Oxford University Press, 1992.
- Schiphorst, T. (1997). Bodymaps: artifacts of touch, *Electric Garden, Visual Proc SIGGRAPH 1997*, 72-73.
- Upsdell, C. (2004). Browser News: Stats > Trends, 279:Jan 24, 2004, www.upsdell.com/BrowserNews/stat_trends.htm.