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Sorting Things Out

Classification and Its Consequences

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Envoi

We would hate to have to assign a Dewey classification number to this book, which straddles sociology, anthropology, history and information systems, and design. Our modest hope is that it will not find its way onto the fantasy shelves.

9
Categorical Work and Boundary Infrastructures: Enriching Theories of Classification

Where do categories come from? How do they span the boundaries of the communities that use them? How can we see and analyze something so ubiquitous and infrastructural—something so "in between" a thing and an action? These questions have been at the heart of much of social science over the past 100 years. Sociology and history are both concerned with relationships—that are invisible except through indicators such as the actions people perform. One cannot directly *see* relations such as membership, learning, ignoring, or categorizing. They are names we give to patterns and indicators. If someone is comfortable with the things and language used by a group of others, we say that he or she is a member of that group. In this sense, categories—our own and those of others—come from action and in turn from relationships. They are, as sociologists like Aaron Cicourel (1964) remind us, continually remade and refreshed, with a lot of skilled work. The cases in this book are framed in dialogue with an extensive literature on language, group membership, and classification.

This chapter makes several aspects of that dialogue more explicit. Our goal here, however, is much more modest than a thoroughgoing analysis of categorization and language. We examine classification systems as historical and political artifacts very much as part of modern Western bureaucracy. Assigning things, people, or their actions to categories is a ubiquitous part of work in the modern, bureaucratic state. Categories in this sense arise from work and from other kinds of organized activity, including the conflicts over meaning that occur when multiple groups fight over the nature of a classification system and its categories.

This chapter picks up the theoretical strands of the cases in this volume to begin to develop a more general notion of these classifica-

tion systems. By so doing, we take a step back and look at how the various kinds of classification we have discussed knit together to form the texture of a social space. We move from classifying and boundary objects to *categorical work and boundary infrastructures*, weaving along the way the many strands that our cases have presented. As noted in chapter 1, maintaining a vision that allows us to see the relationships among people, things, moral order, categories, and standards is difficult. It requires a good map and a working compass that we attempt to provide here.

The journey begins by clearing away some of the theoretical brush surrounding the very notions of categories and classification. Many scholars have seen categories as coming from an abstract sense of "mind," little anchored in the exigencies of work or politics. The work of attaching things to categories, and the ways in which those categories are ordered into systems, is often overlooked (except by theorists of language such as Harvey Sacks 1975, 1992).

We present classification systems in modern organizations as tools that are both material and symbolic. As information technologies used to communicate across the boundaries of disparate communities, they have some unique properties. Next, we present some basic propositions about large-scale information systems, examining how they are used to communicate across contexts. These systems are always heterogeneous. Their ecology encompasses the formal and the informal, and the arrangements that are made to meet the needs of heterogeneous communities—some cooperative and some coercive.

The third part of the journey involves understanding two sets of relationships: first, and analytically, between people and membership, and then between things and their naturalization by communities of practice.

The fourth step moves away from the analytical device of single person-single membership and single object—single naturalization—to describing a more complex set of multiple relationships. Everyone is part of multiple communities of practice. Things may be naturalized in more than one social world—sometimes differently, sometimes in the same fashion. Both people's memberships and the naturalization of objects are multiple, and these processes are, furthermore, intimately intertwined.

The fifth part of the chapter introduces the idea of categorical work—the work that people do to juggle both these multiple memberships and the multiple naturalizations of objects. In this work is the

genius of what Sacks called "doing being ordinary" (1975) or what Strauss pointed to as "continual permutations of action" (1993). In the simplest seeming action, such as picking an article of clothing to wear, is embedded our complex knowledge of situations. (Where will I go today? What should I look like for the variety of activities in which I will participate?) These situations involve multiple memberships and how objects are used differently across communities. (Will this shirt "do" for a meeting with the dean, lunch with a prospective lover, and an appointment with the doctor at the end of the day?) Many of these choices become standardized and built into the environment around us; for example, the range of clothing we select is institutionalized by the retail stores to which we have access, traditions of costuming, and so forth. To think of this formally, the institutionalization of categorical work across multiple communities of practice, over time, produces the structures of our lives, from clothing to houses. The parts that are sunk into the built environment are called here boundary infrastructures—objects that cross larger levels of scale than boundary objects.

Finally, the chapter concludes with a discussion of future directions for research into classifications, standards, and their complex relationships with memberships in communities of practice. This includes ways we might visualize and model these intricate relationships.

The overall goal of the chapter is to trace theoretically what we have shown empirically and methodologically throughout the book: that categories are historically situated artifacts and, like all artifacts, are learned as part of membership in communities of practice. We want as well to talk about this insight beyond the individual "mind," task, or the small scale. Classifications as technologies are powerful artifacts that may link thousands of communities and span highly complex boundaries.

What Sort of Thing Is a Category?

> In so far as the coding scheme establishes an orientation toward the world, it constitutes a structure of intentionality whose proper locus is not the isolated, Cartesian mind, but a much larger organizational system, one that is characteristically mediated through mundane bureaucratic documents such as forms.
> *(Goodwin 1996, 65)*

Classification is a core topic within anthropology, especially cognitive anthropology, and within computer science. Recently, there has been a move to understand the practical, work-related aspects of

classification as part of a larger project of revisioning cognition (e.g., Suchman 1988, Hutchins 1996, Keller and Keller 1996, Lave 1988).

Revisioning Cognition

Within anthropology, psychology, and the sociology of science, the last two decades have seen a resurgence of the struggle to understand the material, social, and ecological aspects of cognition. The work in this book has been deeply informed by that intellectual movement. In brief, the research in this tradition seeks to ground activities previously seen as individual, mental, and nonsocial as situated, collective, and historically specific. On this view, for example, solving a mathematical problem is not a matter of mentally using an algorithm and coming up with the correct answer in a fashion that exists outside of time or culture, rather, it is a process of assembling materials close to hand and using them with others in specific contexts. Jean Lave, for example, studied mathematical problem solving in everyday life and contrasted it with formal testing situations (1988). She followed adults shopping for the best buy in a supermarket, people in Weight Watchers weighing cottage cheese to get the correct unit for the diet's specifications, and a variety of other mundane activities. She observed people performing highly abstract, creative mathematical problem solving in these circumstances. They were creating new units of analysis transposed against given ones in order to measure units, literally cutting up the cottage cheese, moving these material units around, or holding one can against another. These tasks were performed successfully by people who tested badly in a traditional math test. There was, she argued, no way to separate the material circumstances of the problem solving from the mathematical challenges. Those who appear to solve mathematics problems without such outside help are not working in a putative realm of pure number; rather, they and their observers have so naturalized the structures within which they are operating that they have become invisible. Lucy Suchman makes a similar argument for the process of planning as material resource, Ed Hutchins for navigation problems (1995), and Janet and Charles Keller (1996) for designing and measuring in doing iron blacksmithing work. In this book we join their effort at reforming the notion of categorizing and classifying so often seen as purely mental.

The problem of conceptualizing classifications is also akin to Cole's (1996) search for the nature of artifacts in mediated action. Cole notes,

"An artifact is an aspect of the material world that has been modified over the history of its incorporation into goal-directed human action. By virtue of the changes wrought in the process of their creation and use, artifacts are simultaneously *ideal* (conceptual) and *material*. They are ideal in that their material from has been shaped by their participation in the interactions of which they were previously a part and which they mediate in the present" (Cole 1996, 117). The materiality of categories, like that of other things associated with the purely cognitive, has been difficult to analyze. The Janus-faced conceptual-material notion of artifacts suggested by Cole combined with the attention to the use in practice of categories is a good way to begin. Classifications are both conceptual (in the sense of persistent patterns of change and action, resources for organizing abstractions) and material (in the sense of being inscribed, transported, and affixed to stuff).

Cole's intent is to emphasize the conceptual and symbolic sides of things often taken as only materials, tools, and other artifacts. It is similarly felicitous to emphasize the brute material force of that which has been considered ideal, such as categories.

The Pragmatist Turn

The most radical turn taken by Pragmatist philosophers such as Dewey and Bentley, and closely followed by Chicago School sociologists such as Thomas and Hughes, is perhaps the least understood. It is related, both historically and conceptually, to the cognitive reforms detailed above. Consequences, asserted Dewey against a rising tide of analytic philosophy, are the thing to look at in any argument—not ideal logical antecedents. What matters about an argument is who, under what conditions, takes it to be true. Carried over into sociology, W. I. and Dorothy Thomas used it (as Howard Becker would some decades later) to argue against essentialism in examining so-called deviants or problem children (Thomas and Thomas 1917, Becker 1963). If social scientists do not understand people's definition of a situation, they do not understand it at all. That definition—whether it is the label of deviant or the performance of a religious ritual—is what people will shape their behavior toward.

This is a much more profound cut on social construction than the mere notion that people construct their own realities. It makes no comment on where the definition of the situation may come from—

human or nonhuman, structure or process, group or individual. It powerfully draws attention to the fact that the materiality of anything (action, idea, definition, hammer, gun, or school grade) is drawn from the consequences of its situation.

The Pragmatist turn, like the activity theoretical turn taken by Cole and others, emphasizes the ways in which things perceived as real may mediate action (Star 1996). If someone is taken to be a witch, and an elaborate technical apparatus with which to diagnose her or him as such is developed, then the reality of witchcraft obtains in the consequences—perhaps death at the stake. Classification systems are one form of technology, used in the sense Cole employs, linked together in elaborate informatic systems and enjoining deep consequences for those touched by them.

The following section discusses the problems of scaling up, from boundary objects and classifications systems on the one hand to a notion of boundary infrastructure. This analysis draws together the notions of multiplicity and the symbolic-material aspects of categories as artifacts discussed above.

Information Systems Across Contexts

At its most abstract, the design and use of information systems involves linking experience gained in one time and place with that gained in another, via representations of some sort. Even seemingly simple replication and transmission of information from one place to another involves encoding and decoding as time and place shift. Thus the context of information shifts in spite of its continuities; and this shift in context imparts heterogeneity to the information itself. Classifications are a very common sort of representation used for this purpose. Formal classification systems are, in part, an attempt to regularize the movement of information from one context to another; to provide a means of access to information across time and space. The ICD, for example, moves information across the globe, over decades, and across multiple conflicting medical belief and practice systems.

One of the interesting features of communication is that, broadly speaking, to be perceived, information *must* reside in more than one context. We know what something is by contrast with what it is not. Silence makes musical notes perceivable; conversation is understood as a contrast of contexts, speaker and hearer, words, breaks and breaths. In turn, in order to be meaningful, these contexts of informa-

tion must be relinked through some sort of judgment of equivalence or comparability. This occurs at all levels of scale, and we all do it routinely as part of everyday life.

None of this is new in theories of information and communication: we have long had models of signals and targets, background, noise and filters, signals, and quality controls. We are moving this insight here to the level of social interaction. People often cannot see what they take for granted until they encounter someone who does not take it for granted.

A radical statement of this would be that information is only information when there are *multiple* interpretations. One person's noise may be another's signal or two people may agree to attend to something, but it is the tension between contexts that actually creates representation. What becomes problematic under these circumstances is the relationships among people and things, or objects, the relationships that create representations, not just noise. The ecological approach we have taken in this volume adds people as active interpreters of information who themselves inhabit multiple contexts of use and practice (Star 1991b). This multiplicity is primary, not accidental nor incidental.

Consider, for example, the design of a computer system to support collaborative writing. Eevi Beck (1995, 53) studied the evolution of one such system where "how two authors, who were in different places, wrote an academic publication together making use of computers. The work they were doing and the way in which they did it was inseparable from their immediate environment and the culture which it was part of." To make the whole system work, they had to juggle time zones, spouses' schedules, and sensitivities about parts of work practice such as finishing each other's sentences as well as manipulating the technical aspects of the writing software and hardware. They had to build a shared context in which to make sense of the information. Beck is arguing against a long tradition of decontextualized design where only the technical, or narrowly construed considerations about work hold sway.

We lack good relational language here. There is a permanent tension between the formal and the empirical, the local and the situated, and attempts to represent information across localities. It is this tension itself which is underexplored and undertheorized. It is not just a set of interesting metaphysical observations. It can also become a pragmatic unit of analysis. How can something be simultaneously concrete and abstract? The same and yet different? People are not (yet, we

hope) used to thinking in this fashion in science or technology. [47] As information systems grow in scale and scope, however, the need for such complex analyses grows as well. In opposition to the old hierarchical databases, where relations between classes had to be decided once and for all at the time of original creation, many databases today incorporate object-oriented views of data whereby different attributes can be selected and combined on the fly for different purposes. The tailorability of software applications similarly becomes very important for customizing use in different settings (Trigg and Bødker 1994).

If we look at these activities in the context of practice, we see what Suchman and Trigg (1993) call the "artful integration" of local constraints, received standardized applications, and the re-representation of information. The tension between locales remains, and this tension it is not something to be avoided or deleted. When the sort of artful integration discussed by Suchman and Trigg becomes (a) an ongoing, stable relationship between different social worlds, and (b) shared objects are built across community boundaries, then boundary objects arise.

Boundary objects are one way that the tension between divergent viewpoints may be managed. There are of course many other ways. All of them involve accommodations, work-arounds, and in some sense, a higher level of artful integration. It too is managed by people's artful juggling, gestalt switching, and on the spot translating.

Too often, this sort of work remains invisible to traditional science and technology, or to rational analyses of process. This tension is itself collective, historical, and partially institutionalized. The medium of an information system is not just wires and plugs, bits and bytes, but also conventions of representation, information both formal and empirical. A system becomes a system in design and use, not the one without the other. The medium is the message, certainly, and it is also the case that both are political creations (Taylor and Van Every 1993). In Donna Haraway's words, "No layer of the onion of practice that is technoscience is outside the reach of technology of critical interpretation and critical inquiry about positioning and location; that is the condition of embodiment and mortality. The technical and the political are like the abstract and the concrete, the foreground and the background, the text and the context, the subject and the object" (Haraway 1997, 10). A fully developed method of multiplicity-heterogeneity for information systems must draw on many sources and make many unexpected alliances (Star 1989a, chapter 1, Star 1989b, Hewitt 1986, Goguen

1997). If both people and information objects inhabit multiple contexts and a central goal of information systems is to transmit information across contexts, then a representation is a kind of pathway that includes everything populating those contexts. This includes people, things-objects, previous representations, and information about its own structure. The major requirements for such an ecological understanding of the path of re-representation are thus:

1. How objects can inhabit multiple contexts at once, and have both local and shared meaning.

2. How people, who live in one community and draw their meanings from people and objects situated there, may communicate with those inhabiting another.

3. How relationships form between (1) and (2) above—how can we model the information ecology of people and things across multiple communities?

4. What range of solutions to these three questions is possible and what moral and political consequences attend each of them?

Standardization has been one of the common solutions to this class of problems. [48] If interfaces and formats are standard across contexts, then at least the first three questions become clear, and the fourth seems to become moot. But we know from a long and gory history of attempts to standardize information systems that standards do not remain standard for very long, and that one person's standard is another's confusion and mess (Gasser 1986, Star 1991b). We need a richer vocabulary than that of standardization or formalization with which to characterize the heterogeneity and the processual nature of information ecologies.

Boundary Objects and Communities of Practice

The class of questions posed by the slippage between classifications and standards on the one hand, and the contingencies of practice on the other, form core problematics both in the sociology of science and in studies of use and design in information science. A rich body of work has grown up in both fields that documents the clever ways people organize and reorganize when the local circumstances of their activities do not match the prescribed categories or standards (see Gasser 1986, Kling and Scacchi 1982, Lave 1988, Sacks 1975, Star 1983). Making

or using any kind of representation is a complex accomplishment, a balance of improvisation and accommodation to constraint.

People learn how to do this everyday, impossible action as they become members of what Lave and Wenger (1991) call *communities of practice,* or what Strauss (1978) calls *social worlds*. A community of practice (or social world) is a unit of analysis that cuts across formal organizations, institutions like family and church, and other forms of association such as social movements. It is, put simply, a set of relations among people doing things together (Becker 1986). The activities with their stuff, their routines, and exceptions are what constitute the community structure.[49] Newcomers to the community learn by becoming "sort of" members, through what Lave and Wenger (1991) call the process of "legitimate peripheral participation." They have investigated how this membership process unfolds and how it is constitutive of learning.

We are all in this sense members of various social worlds—communities of practice—that conduct activities together. Membership in such groups is a complex process, varying in speed and ease, with how optional it is and how permanent it may be. One is not born a violinist, but gradually becomes a member of the violin playing community of practice through a long period of lessons, shared conversations, technical exercises, and participation in a range of other related activities.

People live, with respect to a community of practice, along a trajectory (or continuum) of membership that has elements of both ambiguity and duration. They may move from *legitimate peripheral participation* to full membership in the community of practice, and it is extremely useful in many ways to conceive of learning this way.

How Does This Include Categories?

Learning the ropes and rules of practice in any given community entails a series of encounters with the objects involved in the practice: tools, furniture, texts, and symbols, among others. It also means managing encounters with other people and with classes of action. Membership in a community of practice has as its sine qua non an increasing familiarity with the categories that apply to all of these. As the familiarity deepens, so does one's perception of the object as strange or of the category itself as something new and different.[50] Anthropologists call this the *naturalization* of categories or objects. The more at home you are in a community of practice, the more you forget

the strange and contingent nature of its categories seen from the outside.

Illegitimacy, then, is seeing those objects as would a stranger—either as a naïf or by comparison with another frame of reference in which they exist. And this is not to be equated with an idealized notion of skill, but with membership. One does not have to be Isaac Stern to know fully and naturally what to do with a violin, where it belongs, and how to act around violins and violinists. But if you use a Stradivarius to swat a fly (but not as part of an artistic event!) you have clearly defined yourself as an outsider, in a way that a schoolchild practicing scales has not.

Membership can thus be described individually as the experience of encountering objects and increasingly being in a naturalized relationship with them. (Think of the experience of being at home, and how one settles down and relaxes when surrounded by utterly familiar objects; think of how demented one feels in the process of moving house.)

From the point of view of learning-as-membership and participation, then, the illegitimate stranger is a source of learning. Someone's illegitimacy appears as a series of interruptions to experience (Dewey 1916, 1929) or a lack of a naturalization trajectory. In a way, then, individual membership processes are about the resolution of interruptions (anomalies) posed by the tension between the ambiguous (outsider, naive, strange) and the naturalized (at home, taken-for-granted) categories for objects. Collectively, membership can be described as the processes of managing the tension between naturalized categories on the one hand and the degree of openness to immigration on the other. Harvey Sacks, in his extensive investigations into language and social life, notes that categories of membership form the basis of many of our judgments about ordinary action. "You can easily enough come to see that for any population of persons present there are available alternative sets of categories that can be used on them. That then poses for us an utterly central task in our descriptions; to have some way of providing which set of categories operate in some scene—in the reporting of that scene or in its treatment as it is occurring" (1992, vol. 1, 116). Sacks draws attention to the ways in which being ordinary are not pregiven but are in fact a kind of job—a job which asserts the nature of membership:

> Whatever we may think about what it is to be an ordinary person in the world, an initial shift is not to think of an "ordinary person" as some person, but as somebody having as their job, as their constant preoccupation, doing

> "being ordinary." It's not that somebody *is* ordinary, it's perhaps that that's what their business is. And it takes work, as any other business does. And if you just extend the analogy of what you obviously think of as work—as whatever it is that takes analytic, intellectual, emotional energy—then you can come to see that all sorts of normalized things—personal characteristics and the like—are jobs which are done, which took some kind of effort, training, etc.. So I'm not going to be talking about an "ordinary person" as this or that person, or as some average, i.e., a nonexceptional person on some statistical basis, but as something that is the way somebody constitutes themselves, and, in effect, a job that they do on themselves. Fate and the people around may be coordinatively engaged in assuring that each of them are ordinary persons, and that can then be a job that they undertake together, to achieve that each of them, together, are ordinary persons. (1992, vol. 2, 216)

The performance of this job includes the ability to choose the proper categories under which to operate, to perform this ordinariness. The power of Sack's work, like that of John Dewey (e.g. 1929), is that he draws attention to the ways in which the ordinary—and the interruption to the expected experience—are delicate constructions made and remade every day.

Boundary Objects

Science and technology are good places to study the rich mix of people and things brought to bear on complex problem-solving questions, although the points made here are more generally applicable as well. Categories and their boundaries are centrally important in science, and scientists are especially good at documenting and publicly arguing about the boundaries of categories. Thus, science is a good place to understand more about membership in communities. This point of departure has led us to try to understand people and things ecologically, both with respect to membership and to the things they live with, focusing on scientists (Star 1995a). One of the observations is that scientists routinely cooperate across many communities of practice. They thus bring different naturalized categories with them into these partnerships.

In studying scientific problem solving, we have been concerned for a number of years to understand how scientists could cooperate without agreeing about the classification of objects or actions. Scientific work is always composed of members of different communities of practice (we know of no science that is not interdisciplinary in this way, especially if—as we do—you include laboratory technicians and janitors). Thus, memberships (and divergent viewpoints or perspectives)

present a pressing problem for modeling truth, the putative job of scientists. In developing models for this work, Star coined the term "boundary objects" to talk about how scientists balance different categories and meanings (Star and Griesemer 1989, Star 1989b). Again, the term is not exclusive to science, but science is an interesting place to study such objects because the push to make problem solving explicit gives one an unusually detailed amount of information about the arrangements.

Boundary objects are those objects that both inhabit several communities of practice and satisfy the informational requirements of each of them. Boundary objects are thus both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use and become strongly structured in individual-site use. These objects may be abstract or concrete. Star and Griesemer (1989) first noticed the phenomenon in studying a museum, where the specimens of dead birds had very different meanings to amateur bird watchers and professional biologists, but "the same" bird was used by each group. Such objects have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting communities.

Another way of talking about boundary objects is to consider them with respect to the processes of naturalization and categorization discussed above. Boundary objects arise over time from durable cooperation among communities of practice. They are working arrangements that resolve anomalies of naturalization without imposing a naturalization of categories from one community or from an outside source of standardization. (They are therefore most useful in analyzing cooperative and relatively equal situations; issues of imperialist imposition of standards, force, and deception have a somewhat different structure.) In this book, sets of boundary objects arise directly from the problematics created when two or more differently naturalized classification systems collide. Thus nursing administrators create classification systems that serve hospital administrators and nursing scientists; soil scientists create classifications of soil to satisfy geologists and botanists (Chatelin 1979). Other outcomes of these meetings are explored as well—the dominance of one over another or how claims of authority may be manipulated to higher claims of naturalness.

The processes by which communities of practice manage divergent and conflicting classification systems are complex, the more so as people are all members in fact of many communities of practice, with varying levels of commitment and consequence. Under those conditions a series of questions arise: How are boundary objects established and maintained? Does the concept scale up? What is the role of technical infrastructure? Is a standard ever a boundary object? How do classification systems, as artifacts, play a role?

Membership and Naturalization: People and Things

As Engeström (1990b) and other activity theorists note so well, tools and material arrangements always mediate activity. People never act in a vacuum or some sort of hypothetical pure universe of doing but always with respect to arrangements, tools, and material objects. Strauss (1993) has recently made a similar point, emphasizing the continuity and permeability of such arrangements—action never really starts from scratch or from a tabula rasa. Both Engeström and Strauss go to great lengths to demonstrate that an idea, or something that has been learned, can also be considered as having material-objective force in its consequences and mediations.

"Object" includes all of this—stuff and things, tools, artifacts and techniques, and ideas, stories, and memories—objects that are treated as consequential by community members (Clarke and Fujimura 1992a, 1992b). They are used in the service of an action and mediate it in some way. Something actually *becomes* an object only in the context of action and use; it then becomes as well something that has force to mediate subsequent action. It is easier to see this from historical examples than it may be to look to contemporary ones. For instance, the category of hysteria was naturalized in medicine and in popular culture at the end of the nineteenth century. People used the diagnosis of hysteria for purposes of social control as well as for medical treatment. It became a category through which physicians, social theorists, and novelists discussed pain and anxiety and, arguably, the changing social status of women. The point is not who believed what when but rather that the category itself became an object existing in both communities. It was a medium of communication, whatever else it may also have been.

A community of practice is defined in large part according to the co-use of such objects since all practice is so mediated. The relationship

of the newcomer to the community largely revolves around the nature of the relationship with the objects and not, counterintuitively, directly with the people. This sort of directness only exists hypothetically—there is always mediation by some sort of object. Acceptance or legitimacy derives from the familiarity of action mediated by member objects.

But familiarity is a fairly sloppy word. Here it is not meant instrumentally, as in proficiency, but relationally, as a measure of taken-for-grantedness. (An inept programmer can still be a member of the community of practice of computer specialists, albeit a low status one in that he or she takes for granted the objects to be used.) A better way to describe the trajectory of an object in a community is as one of naturalization. Naturalization means stripping away the contingencies of an object's creation and its situated nature. A naturalized object has lost its anthropological strangeness. It is in that narrow sense desituated —members have forgotten the local nature of the object's meaning or the actions that go into maintaining and recreating its meaning. [51] We no longer think much about the miracle of plugging a light into a socket and obtaining illumination, and we must make an effort of anthropological imagination to remind ourselves of contexts in which it is still not naturalized.

Objects become natural in a particular community of practice over a long period of time. (See Latour's (1987) arguments in *Science in Action* for a good discussion of this.) Objects exist, with respect to a community, along a trajectory of naturalization. This trajectory has elements of both ambiguity and duration. It is not predetermined whether an object will ever become naturalized, or how long it will remain so; rather, practice-activity is required to make it so and keep it so. The more naturalized an object becomes, the more unquestioning the relationship of the community to it; the more invisible the contingent and historical circumstances of its birth, the more it sinks into the community's routinely forgotten memory.[52] Light switches, for instance, are ordinary parts of modern life. Almost all people living in the industrialized world know about light bulbs and electricity, even if they live without it, and switches and plugs are naturalized objects in most communities of practice. People do not think twice about their nature, only about whether or not they can find them when needed. Commodity and infrastructural technologies are often naturalized in this way. In a sense they become a form of collective forgetting, or naturalization, of the contingent, messy work they replace. We wrote

this chapter on Macintosh and IBM computers, for example, and cutting and pasting are no longer phenomenologically novel operations, although we can remember when they once were. We have naturalized the mouse, the operation of selecting text, and the anachronistic "cut and paste" metaphor.

Multiplicity

This chapter, so far, has discussed analytically two sets of relationships: between people and membership on the one hand; and objects and naturalization on the other hand. In any given instance, *both membership and naturalization are relations along a trajectory*. In saying this, we do not want to recreate a great divide between people and objects, reifying an objectless human or wild child. Ironically, social science has spent incredible resources on precisely this sort of search. There is something compelling about the idea of a person without "a society," naked even of touch or language. The sad case of "Genie," a child kept captive by her parents for many years (Rymer 1993, Star 1995d), or the "wild child of Aveyron" who amazed eighteenth-century philosophers, are emblematic of this propensity. They have been seen as holding the key to language or in a way to what it is to be human.

Exactly the opposite, however, is true. People-and-things, which are the same as people-and-society, cannot be separated in any meaningful practical sense. At the same time, it is possible for analytical purposes to think of two trajectories traveling in tandem, membership, and naturalization. Just as it is not practically possible to separate a disease from a sick patient, yet it is possible to speak of the trajectories of disease and biography operating and pulling at one another, as seen in chapter 5 in the case of tuberculosis.

Residual Categories, Marginal People, and Monsters

People often see multiplicity and heterogeneity as accidents or exceptions. The marginal person, who is for example of mixed race, is portrayed as the troubled outsider; just as the thing that does not fit into one bin or another gets put into a "residual" category. This habit of purity has old and complicated origins in western scientific and political culture (e.g. as explicated by Dewey 1916). The habit perpetuates a cruel pluralistic ignorance. No one is pure. No one is even average. And all things inhabit someone's residual category in some

category system. The myriad of classifications and standards that surround and support the modern world, however, often blind people to the importance of the "other" category as constitutive of the whole social architecture (Derrida 1980).

Communities vary in their tastes for openness, and in their tolerance for this ambiguity. Cults, for example, are one sort of collective that is low on the openness dimension and correspondingly high on the naturalization-positivism dimension—us versus them.

In recent years social theorists have been working toward enriching an understanding of multiplicity and misfit, decentering the idea of an unproblematic mainstream. The schools of thought grappling with this include feminist research (e.g., Haraway 1997), multicultural or race-critical theory (e.g., Ferguson et al. 1990), symbolic interactionism, and activity theory (e.g., Cole 1996, Wertsch 1991, 1998). During the same period, such issues have become increasingly of concern to some information scientists. As the information systems of the world expand and flow into each other, and more kinds of people use them for more different things, it becomes harder to hold to pure or universal ideas about representation or information.

Some of these problems are taken up in the intellectual common territory sometimes called "cyborg." Cyborg, as used for example by Donna Haraway (1991) and Adele Clarke (1998), means the intermingling of people, things (including information technologies), representations, and politics in a way that challenges both the romance of essentialism and the hype about what is technologically possible. It acknowledges the interdependence of people and things, and it shows just how blurry the boundaries between them have become. The notion of cyborg has clearly touched a nerve across a broad spectrum of intellectual endeavors. The American Anthropological Association has hosted sessions on cyborg anthropology for the past several years; the weighty *Cyborg Handbook* was published a few years ago (Gray 1995).

Through looking at ubiquitous classification systems and standards, it is possible to move toward an understanding of the stuff that makes up the networks that shape much of modern daily life in cyborg fashion. We draw attention here to the places where the work gets done of assuring that these networks will stick together: to the places where human and nonhuman are constructed to be operationally and analytically equivalent. By so doing, we explore the political and ethical dimensions of classification theory.

Why should computer scientists read African-American poets? What does information science have to do with race-critical or feminist methods and metaphysics? The collective wisdom in those domains is one of the richest places from which to understand these core problems in information systems design: how to preserve the integrity of information without a priori standardization and its often attendant violence. In turn, if those lessons can be taken seriously within the emerging cyberworld, there may yet be a chance to strengthen its democratic ethical aspects. It is easy to be ethnocentric in virtual space; more difficult to avoid stereotypes. The lessons of those who have lived with such stereotypes are important, perhaps now more than ever.

Borderlands and Monsters

People who belong to more than one central community are also important sources for understanding more about the links between moral order and categorization. Such "marginal" people have long been of interest to social scientists and novelists alike. Marginality as a technical term in sociology refers to human membership in more than one community of practice. [53] Here we emphasize those people who belong to communities that are different in key, life-absorbing ways, such as racial groups (see our discussion in chapter 6). A good example of a marginal person is someone who belongs to more than one race, for example, half white and half Asian. Again, we are not using marginality here in the sense of center-margin or center-periphery (e.g., not "in the margins"), but rather in the old-fashioned sense of Robert Park's marginal man, the one who has a double vision by virtue of having more than one identity to negotiate (Park 1952, Stonequist 1937, Simmel 1950 [1908], Schütz 1944). Strangers are those who come and stay a while, long enough so that membership becomes a troublesome issue—they are not just nomads passing through, but people who sort of belong and sort of do not.

Marginality is an interesting paradoxical concept for people and things. On the one hand, membership means the naturalization of objects that mediate action. On the other, everyone is a member of multiple communities of practice. Yet since different communities generally have differently naturalized objects in their ecology, how can someone maintain multiple membership without becoming simply schizophrenic? How can they naturalize the same object differently, since naturalization by definition demands forgetting about other worlds?

There are also some well-known processes in social psychology for managing these tensions and conflicts: passing, or making one community the shadow for the other; splitting, or having some form of multiple personality; fragmenting or segmenting the self into compartments; becoming a nomad, intellectually and spiritually if not geographically (Larsen (1986) covers many of these issues in her exquisite fiction).

One dissatisfaction we have with these descriptions is that they all paint each community of practice as ethnocentric, as endlessly hungry and unwilling collectively to accommodate internal contradictions. There is also an implicit idea of a sort of imperialist über-social world (the mainstream) that is pressing processes of assimilation on the individual (e.g., Americanization processes in the early twentieth century). Communities vary along this dimension of open-closedness, and it is equally important to find successful examples of the nurturing of marginality (although it is possible that by definition they exist anarchically and not institutionally-bureaucratically). Here again, feminism has some important lessons. An important theme in recent feminist theory is resistance to such imperializing rhetoric and the development of alternative visions of coherence without unconscious assumption of privilege. Much of it emphasizes a kind of double vision, such as that taken up in the notion of borderlands by Anzaldúa (1987), or the qualities of partiality and modesty of Haraway's cyborg (1991).

Charlotte Linde's book on the processes of coherence in someone's life stories also provides some important clues. She especially emphasizes accidents and contingency in the weaving together of a coherent narrative (Linde 1993). The narratives she analyses are in one sense meant to reconcile the heterogeneity of multiply naturalized object relations in the person, where the objects in question are stories-depictions of life events. Linden (1993) and Strauss (1959) have made similar arguments about the uncertainty, plasticity, and collectivity of life narratives.

In traditional sociology this model might have overtones of functionalism, in its emphasis on insiders-outsiders and their relations. But functionalists never considered the nature of objects or of multiple legitimate memberships. If we think in terms of a complex cluster of multiple trajectories simultaneously of both memberships and naturalizations, it is possible to think of a many-to-many relational mapping.

The mapping suggested here pushes us further into the analysis of the cyborg. On the one hand, cyborgs as an image are somehow

grotesque. Imagining the relationships between people and things such that they are truly interpenetrated means rethinking human nature itself. It is reminiscent somehow of bad science fiction. Yet analytically, it is a crucial notion for understanding technoscience and classifications as artifacts.

How can we think of cyborgs in the analysis presented in this chapter? The mapping among things, people, and membership provides a way in. Anzaldúa's work on borderlands rejects any notion of purity based on membership in a single, pristine racial, sexual, or even religious group (1987). Haraway's work pushes this analysis a bit further. In speaking of borderlands, both those concerning race and those concerning the boundaries between humans and things, she employs the term "monsters."

A monster occurs when an object refuses to be naturalized (Haraway 1992). A borderland occurs when two communities of practice coexist in one person (Anzaldúa 1987). Borderlands are the naturalized home of those monsters known as cyborgs. If we read monsters as persistent resisters of transparency-naturalization within some community of practice, then the experience of encountering an anomaly (such as that routinely encountered by a newcomer to science, for instance most women or men of color) may be keyed back into membership. A person realizes that they do not belong when what appears like an anomaly to them seems natural for everyone else. Over time, collectively, such outsider experiences (the quintessential stranger) can become monstrous in the collective imagination. History and literature are full of the demonizing of the stranger. Here is what Haraway (1992) has called "the promise of monsters" and one of the reasons that for years they have captured the feminist imagination. [54] Frankenstein peering in the warmly lit living room window; Godzilla captured and shaking the bars of his cage are intuitions of exile and madness, and served as symbols of how women's resistance and wildness have been imprisoned and reviled, kept just outside.

In a more formal sense, monsters and freaks are also ways of speaking about the constraints of the classifying and (often) dichotomizing imagination. Ritvo (1997) writes of the proliferation of monsters in the eighteenth and nineteenth century, linking it to a simultaneous increase in public awareness of scientific classification and hunger for the exotic. As classification schemes proliferated, so did monsters:

> Monsters were understood, in the first instance, as exceptions to or violations of natural law. The deviations that characterized monsters, however, were both

> so various and in some cases, so subtle as significantly to complicate this stock account . . . . As a group, therefore, monsters were united not so much by physical deformity or eccentricity as by their common inability to fit or be fitted into the category of the ordinary—a category that was particularly liable to cultural and moral construction. (Ritvo 1997, 133–134)

In a practical sense, this is a way to talk about what happens to any outsider. For example, it could refer to experience in the science classroom when someone comes in with no experience of formal science, or to the transgendered person who does not fit cultural gender dichotomies (Stone 1991). It is not simply a matter of the strangeness, but of the politics of the mapping between the anomalies and the forms of strangeness-marginality.

In accepting and understanding the monsters and the borderlands there may be an intuition of healing and power, as Gloria Anzaldúa (1987) shows us in her brilliant and compassionate writing. In her essay, "La conscientia de la mestiza," the doubleness and the ambiguity of the male-female, straight-gay, Mexican-American borderland becomes the cauldron for a creative approach to surviving, a rejection of simplistic purity and of essentialist categories (1987). At the same time, she constantly remembers the physical and political suffering involved in these borderlands, refusing a romanticized version of marginality that often plagued the early sociological writers on the topic.

The path traced by Anzaldúa is not an easy healing and certainly not a magic bullet but a complex and collective twisted journey, a challenge to easy categories and simple solutions. It is, in fact, a politics of ambiguity and multiplicity—this is the real possibility of the cyborg. For scholars, this is necessarily an exploration that exists in interdisciplinary borderlands and crosses the traditional divisions between people, things, and technologies of representation.

Engineered versus Organic Boundary Objects

Would it be possible to design boundary objects? To engineer them in the service of creating a better society? On the surface, this idea is tempting. In some sense, this has been the goal of progressive education, multiculturalism in the universities, and the goal of the design of information systems that may be accessed by people with very different points of view.

Most schools now are lousy places to grow boundary objects because they both strip away the ambiguity of the objects of learning and impose or ignore membership categories (except artificial hierarchi-

cally assigned ones). [55] In mass schooling and standardized testing, an attempt is made to insist on an engineered community of practice, where the practices are dictated and the naturalization process is monitored and regulated while ignoring borderlands. They are virtual factories for monsters. In the 1970s and 1980s many attempts were made to include other communities in the formula via affirmative action and multicultural initiatives. But where these lacked the relational base between borderlands and the naturalization of objects, they ran aground on the idea of measuring progress in learning. This is partly a political problem and partly a representational one. As feminists learned so painfully over the years, a politics of identity based on essences can only perpetuate vicious dualisms. If a white male science teacher were to bring in an African-American woman as a (Platonic) representative of African-American-ness and/or woman-ness, for example, then attempt to match her essential identity to the objects in the science classroom (without attending much to how they are fully naturalized objects in another community of practice), costly and painful mismatches are inevitable. The teacher risks causing serious damage to her self-articulation (especially where she is alone) and her ability to survive (a look at the dismal retention statistics of women and minority men in many sciences and branches of engineering will underscore this point). Any mismatch becomes her personal failure, since the measurement yardstick remains unchanged although the membership criteria appear to have been stretched. Again, both borderlands and anomalous objects have been deleted. Kal Alston (1993), writing of her experience as an African-American Jewish feminist, has referred to herself as a unicorn—a being at once mythical and unknowable, straddling multiple worlds.

But all people belong to multiple communities of practice—it is just that in the case of the African-American woman in science, the visibility and pressure is higher, and her experience is especially rich, dense in the skill of surviving multiplicity. Thus Patricia Hill Collins' title, "Learning from the Outsider Within," has many layers and many directions to be explored as we all struggle for rich ways of mapping that honor this experience and survival (1986). Karla Danette Scott (1995) has recently written about the interwoven languages of black women going to college, and how language becomes a resource for this lived complexity. They "talk black" and "talk white" in a seamless, context-driven web, articulating the tensions between those worlds as a collective identity. This is not just code switching but braided identity—a borderland.

Wildness

Things and people are always multiple, although that multiplicity may be obfuscated by standardized inscriptions. In this sense, with the right angle of vision, things can be seen as heralds of other worlds and of a wildness that can offset our naturalizations in liberatory ways. Holding firmly to a relational vision of people-things-technologies in an ethical political framework, there is a chance to step off the infinite regress of measuring the consumption of an object naturalized in one centered world, such as the objects of Western science, against an infinitely expanded set of essentially-defined members as consumers.

By relational here we argue against misplaced concretism or a scramble unthinkingly to assimilate the experiences of things to pregiven categories. We affirm the importance of process and ethical orientations. We also mean to take seriously the power of membership, its continual nature (i.e., we are never *not* members of some community of practice), and the inherent ambiguity of things. Boundary objects, however, are not just about this ambiguity, they are not just temporary solutions to disagreements about anomalies. Rather, they are durable arrangements among communities of practice. Boundary objects are the canonical forms of all objects in our built and natural environments. Forgetting this, as people routinely do, means empowering the self-proclaimed objective voice of purity that creates the suffering of monsters in borderlands. Due attention to boundary objects entails embracing the gentle and generous vision of *mestiza* consciousness offered by Anzaldúa.

Casual versus Committed Membership

Another dimension to acknowledge here is the degree to which membership demands articulation at the higher level. Being a woman and African-American and disabled are three sorts of membership that are nonoptional, diffused throughout life, and embedded in almost every sort of practice and interaction. [56] So it is not equitable to talk about being a woman in the same breath as being a scuba diver—although there are ways in which both can be seen under the rubric community of practice (Lagache 1995). But if we go to the framework presented above, there is a way to talk about it. Where the joint objects are both multiply naturalized in conflicting ways and diffused through practices that belong to many communities, they will defy casual treatment. So for scuba diving—it is primarily naturalized in a leisure world and not

especially central to any others. Its practice is restricted and membership contained, neither contagious nor diffuse. On the other hand, learning mathematics is multiply naturalized across several powerful communities of practice (mathematics and science teachers and practitioners). At the same time it is both strange and central to others (central in the sense of a barrier to further progress). It is also diffused through many kinds of practices, in various classrooms, disciplines, and workplaces (Hall and Stevens 1995). Some communities of practice expect it to be fully naturalized—a background tool or a substrate-infrastructure—to get on with the business of being, for example, a scientist (Lave 1988). There is no map or sense of the strangeness of the object, however, across other memberships. Here, too, information technologies are both diffused and strange with rising expectations of literacy across worlds.

These relations define a space against which and into which information technologies of all sorts enter. These technologies of representation are entering into all sorts of communities of practice on a global scale, in design and in use. They are a medium of communication and broadcast as well as of standardization. The toughest problems in information systems design are increasingly those concerned with modeling cooperation across heterogeneous worlds, of modeling articulation work and multiplicity. If we do not learn to do so, we face the risk of a franchised, dully standardized infrastructure ("500 channels and nothing on," in the words of Mitch Kapor from the Electronic Frontier Foundation) or of an Orwellian nightmare of surveillance.

Feminism and race-critical theory offer traditions of reflective denaturalization, of a politics of simultaneity and contradiction intuited by the term cyborg. Long ago feminists began with the maxim that the personal is political and that each woman's experience has a primacy we must all learn to afford. Feminism went from reductionist identity politics to cyborg politics in less than twenty years. Much of this was due to the hard work and suffering of communities of practice that had been made monstrous or invisible, especially women of color and their articulation of the layered politics of insider-outsider and borderlands. One part of the methodological lesson from feminism read in this way is that experience-experiment incorporates an ethics of ambiguity with both modesty and anger. This means that how we hear each other is a matter of listening forth from silence. Listening is active, not passive; it means stretching to affiliate with multiplicity. In Nell Morton's words, this is "hearing to speech":

• Not only a new speech but a new hearing.

• Hearing to speech is political.

• Hearing to speech is never one-sided. Once a person is heard to speech she becomes a hearing person.

• Speaking first to be heard is power over. Hearing to bring forth speech is empowering. (Morton 1985, 210).

Part of the moral vision of this book concerns how we may, through challenge and analysis of infrastructure, better hear each other to speech.

Multiple Marginality, Multiple Naturalizations: Categorical Work

The model proposed here takes the form of a many-to-many relational mapping, between multiple marginality of people (borderlands and monsters) and multiple naturalizations of objects (boundary objects and standards). Over time, the mapping is between the means by which individuals and collectives have managed the work of creating coherent selves in the borderlands on the one hand and creating durable boundary objects on the other.

It is also not just many-to-many relational, but meta-relational. By this we mean that the map must point simultaneously to the articulation of selves and the naturalization of objects. One of the things that is important here is honoring the work involved in borderlands and boundary objects. This work is almost necessarily invisible from the point of view of any single community of practice. As Collins (1986) asks, what white really sees the work of self-articulation of the black who is juggling multiple demands-audiences-contingencies? It is not just willful blindness (although it can be that), but much more akin to the blindness between different Kuhnian paradigms, a revolutionary difference. Yet the juggling is both tremendously costly and brilliantly artful. Every community of practice has its overhead: "*paying your dues, being regular, hangin', being cool, being professional, people like us, conduct becoming, getting it, catching on.*" And the more communities of practice one participates in, the higher the overhead not just in a straightforwardly additive sense, but interactively. Triple jeopardy (i.e., being old, black, and female) is not just three demographic variables or conditions added together, but a tremendously challenging situation of marginality requiring genius for survival. *The overheads interact.*

From Articulation Work to Categorical Work

What is the name for this work of managing the overheads and anomalies caused by multiple memberships on the one hand and multiply naturalized objects on the other? Certainly, it is invisible. Most certainly, it is methodological, in the sense of reflecting on differences between methods and techniques. At first glance, it resembles articulation work, that is, work done in real time to manage contingencies; work that gets things back on track in the face of the unexpected, that modifies action to accommodate unanticipated contingencies. Within both symbolic interactionism and the field of computer-supported cooperative work, the term articulation work has been used to talk about some forms of this invisible juggling work (Schmidt and Bannon 1992, Gerson and Star 1986).

Articulation work is richly found for instance in the work of head nurses, secretaries, homeless people, parents, and air traffic controllers, although of course all of us do articulation work to keep our work going. Modeling articulation work is one of the key challenges in the design of cooperative and complex computers and information systems. This is because real-time contingencies, or in Suchman's (1987) terms, situated actions, always change the use of any technology (for example, when the host of a talk forgets to order a computer projector, can one quickly print out and assemble a handout?)

Other aspects of cooperative work concern novelty and the ways in which one person's routine may be another's emergency or anomaly (Hughes 1970), or in the words of Schmidt and Simone (1996) both the consequences and the division of labor of cooperative work. The act of cooperation is the interleaving of distributed tasks; articulation work manages the *consequences* of this distributed aspect of the work.

[57]

Schmidt and Simone note the highly complex dynamic and recursive relationship between the two—managing articulation work can itself become articulation work and vice versa, ad infinitum.

The consequences of the distribution of work, and its different meanings in different communities, must be managed for cooperation to occur. The juggling of meanings (memberships and naturalizations), is what we term categorical work. For example, what happens when one clerk, User A, entering data into a large database does not think of abortion as a medical matter, but as a crime; while another, User B, thinks of it as a routine medical procedure? User A's definition excludes abortion from the medical database, User B's includes it. The

resulting data will be, at the least, incomparable, but in ways that may be completely invisible to User C, compiling statistics for a court case arguing for the legalization of abortion based on prevalence. When this aspect of the coordination of work is deleted and made invisible in this fashion, then voices are suppressed and we see the formation of master narratives and the myth of the mainstream universal (Star and Strauss 1999).

Thus, we can see categorical work as partly about managing the mismatches between memberships and naturalization. One way to think about this is through the management of anomalies as a tracer. Anomalies or interruptions, the cause of contingency, come when some person or object from outside the world at hand interrupts the flow of expectations. One reason that glass-box technology or pure transparency is impossible is that anomalies always arise when multiple communities of practice come together, and useful technologies cannot be designed in all communities at once. Monsters arise when the legitimacy of that multiplicity is denied. Our residual categories in that case become clogged and bloated.

Transparency is in theory the endpoint of the trajectory of naturalization, as complete legitimacy or centrality is the endpoint of the trajectory of membership in a community of practice. Due to the multiplicity of membership of all people, however, and the persistence of newcomers and strangers as well as the multiplicity of naturalization of objects, this is inherently nonexistent in the real world. For those brief historical moments where it appears to be the case, it is unstable.

In place of transparency—and it is a good enough counterfeit to work most of the time as transparency—one encounters convergence: the mutual constitution of a person or object and their representation. People get put into categories and learn from those categories how to behave. Thus there is the ironic observation that East Enders in London learn cockney (and how to be cockney) through watching the soap opera East Enders on television. "I am an East Ender therefore I must talk like this; and I must drink such and such a brand of beer." Aided by bureaucratic institutions, such cultural features take on a real social weight. If official documents force an Anglo-Australian to choose one identity or the other—and if friends and colleagues encourage that person, for the convenience of small talk, to make a choice—then they are likely to become ever more Australian, suffering alongside his or her now fellow countrypeople if new immigration measures are introduced in America or if "we" lose a cricket test. The same process occurs

with objects—once a film has been thrown into the x-rated bin, then there is a strong incentive for the director to make it really x-rated; once a house has been posted as condemned, then people will feel free to trash it.

Where the difference lies between transparency and convergence is that where transparency ideally just produces a reflection of the way things really are (and so, in Jullien's (1995) beautiful phrase captures the "propensity of things" in any situation); convergence can radically break down—over time or across geographical borders. When categories do break down in this fashion they leave no continuous trace back to the previous regime. So, for instance, when the category of "hysteric" became medically unfashionable, then people with (what used to be called) hysteria were distributed into multiple widely scattered categories. At that juncture, there was no point in their seeing the same doctors, or learning from each other what hysteria was.

Scaling Up: Generalization and Standards

> Similarity is an institution.
> —*Mary Douglas* (1986, 55)

In this whole complicated coconstruction process, what are the things that make objects and statuses seem given, durable, and real? For, as Desrosières (1990) reminds us, partly through classification work, large-scale bureaucracies are very good at making objects, people, and institutions hold together. Some objects are naturalized in more than one world. They are not then boundary objects, but rather they become standards within and across the multiple worlds in which they are naturalized. Much of mathematics and, in the West, much of medicine and physiology fits this bill. In the Middle Ages a lot of Christian doctrine fit this, too. The hegemony of patriarchy rose from the naturalization of objects across a variety of communities of practice, with the exclusion of women from membership and the denial of their alternative interpretations of objects (Kramarae 1988, Merchant 1980, Croissant and Restivo 1995).When an object becomes naturalized in more than one community of practice, its naturalization gains enormous power to the extent that a basis is formed for dissent to be viewed as madness or heresy. It is also where ideas like "laws of nature" get their power because we are always looking to other communities of practice as sources of validity, and if as far as we look we find naturalization, then the invisibility

layers up and becomes doubly, triply invisible. Sherry Ortner's (1974) classic essay on "man: culture-woman: nature" shows that this has held for the subjugation of women even where specific cultural circumstances vary widely, and her model of the phenomenon rests on the persistent misunderstanding of borderlands and ambiguity in many cultures. Before her, Simone de Beauvoir (1948) wrote of the ethics of ambiguity, showing the powerful negative consequences of settling for one naturalized mode of interaction. We need an ethics of ambiguity, still more urgently with the pressure to globalize, and the integration of systems of representation through information technologies worldwide.

We have presented here a model of memberships, naturalizations, and the work we do in managing their multiplicity. Further analysis is needed to examine different types of categorical work and how they emerge under different circumstances. The next section continues with a discussion of boundary infrastructures.

Boundary Infrastructure

Any working infrastructure serves multiple communities of practice simultaneously be these within a single organization or distributed across multiple organizations. A hospital information system, for example, has to respond to the separate as well as the combined agendas of nurses, records clerks, government agencies, doctors, epidemiologists, patients, and so forth. To do so, it must bring into play stable regimes of boundary objects such that any given community of practice can interface with the information system and pull out the kinds of information objects it needs.

Clearly boundary infrastructures are not perfect constructions. The chimera of a totally unified and universally applicable information system (still regrettably favored by many) should not be replaced by the chimera of a distributed, boundary-object driven information system fully respectful of the needs of the variety of communities it serves. To the contrary, as we saw in the case of NIC, nurses have needed to make a series of serious concessions about the nature and quality of their data before hoping to gain any kind of entry into hospital information systems. These difficulties generalize, though they are to some extent counterposed by processes of convergence.

Boundary infrastructures by and large do the work that is required to keep things moving along. Because they deal in regimes and networks of boundary objects (and not of unitary, well-defined objects),

boundary infrastructures have sufficient play to allow for local variation together with sufficient consistent structure to allow for the full array of bureaucratic tools (forms, statistics, and so forth) to be applied. Even the most regimented infrastructure is ineluctably also local: if work-arounds are needed, they will be put into place. The ICD, for example, is frequently used to code cultural expectations (such as low heart attack rates in Japan) even though these are nowhere explicitly part of the classification system.

What we gain with the concept of boundary infrastructure over the more traditional unitary vision of infrastructures is the explicit recognition of the differing constitution of information objects within the diverse communities of practice that share a given infrastructure.

Future Directions: Texture and Modeling of Categorical Work and Boundary Infrastructures

> If you could say it, you would not need metaphor. If you could conceptualize it, it would not be metaphor. If you could explain it, you would not use metaphor. (*Morton 1985, 210*)

So far this chapter has given a series of analytic categories that we hope will prove useful in the analysis and design of information infrastructures. At the limit, as Nelle Morton points out, we arrive at the sets of metaphors that people use to describe information networks of all kinds. These metaphors we live by are powerful means of organizing work and intellectual practice. We will now look at one cluster of metaphors—centered on the concept of filiations—which we believe, offers promise for future analytical work.

How Are Categories Tied to People?

> The frequency with which metaphors of weaving, threads, ropes and the like appear in conjunction with contextual approaches to human thinking is quite striking. (*Cole 1996, 135*)

Categories touch people in a variety of ways—they are assigned, they become self-chosen labels, they may be statistical artifacts. They may be visible or invisible to any other group or individual. We use the term filiation here—related via Latin to the French "fil" for thread—as a thread that goes from a category to a person. This metaphor allows a rich examination of the architecture of the multiple categories that touch people's lives. Threads carry a variety of textural qualities that are often applied to human

filiation (fIlI'eIS&schwa.n). Also 6 filiacion.

1. Theol. The process of becoming, or the condition of being, a son.

Many Dicts. have a sense 'adoption as a son,' illustrated by the first of our quotes from Donne. The sense is etymologically justifiable, and may probably exist; but quot. 1628 seems to show that it was not intended by Donne.

2. The designating (of a person) as a son; ascription of sonship.

3. The fact of being the child of a specified parent. Also, a person's parentage; "whose son one is."

4. The fact of being descended or derived, or of originating from; descent, transmission from.

5. The relation of one thing to another from which it may be said to be descended or derived; position in a genealogical classification.

6. Formation of branches or offshoots; chiefly concr., a branch or offshoot of a society or language.

7. = Affiliation 3. lit. and fig. (*Oxford English Dictionary*, 2)

interactions: tension, knottiness or smoothness, bundling, proximity, and thickness. We select a small number here to focus on.

Loosely Coupled–Tightly Coupled

A category (or system of categories) may be loosely or tightly coupled with a person. Gender and age are very tightly coupled with a person as categories. One of the interesting aspects of the investigation of virtual identities in Multi User Dungeons (MUDs) and elsewhere on line is the loosening of these traditionally tightly coupled threads under highly constrained circumstances (e.g., Turkle 1995). Loosely coupled categories may be those that are transient, such as the color one is wearing on a given day or one's position in a waiting line. Somewhere in the middle are hair color, which may shift slowly over a lifetime or change in an afternoon, or marital status.

Scope

Categories' filiations have variable scope. Some are durable threads that cover many aspects of someone's identity and are accepted as such on a very wide or even global scale. (Noting for the record that none

are absolute, none cover all aspects of someone's identity, and there is no category that is completely globally accepted.) The category alive or dead is quite thick and nearly global. So we can think of two dimensions of scope: thickness and scale. How thick is the individual strand—gossamer or thickest rope? With how many others is it shared?

What Is Its Ecology?

Classifications have habitats. That is, the filiations between person and category may be characterized as inhabiting a space or terrain with some of the properties of any habitat. It may be crowded or sparse, peaceful or at war, fertile or arid. In order not to mix too many metaphors. Important questions about filiations and their ecology that may be visualized in thread-like terms are: How many ties are there? That is, how many other categories are tied to this person, and in what density? Do these threads contradict or complement (torque versus boundary object of cooperation)? That is, are the threads tangled, or smoothly falling together?

Who Controls the Filiation?

The question of who controls any given filiation is vital to an ethical and political understanding of information systems whose categories attach to individuals. A first crude characterization concerns whether the filiation was chosen or imposed (an echo of the sociological standard, achieved or ascribed); whether it may be removed and by whom; and under whose control and access is the apparatus to do so. Questions of privacy are important here, as with medical information classifying someone with a social stigmatized condition. The nature of the measure for the filiation here is important loci of control as well. For example, an IQ test may be an important way to classify people. People at some remove from those who take the test developed it. The measure, IQ, is controlled from afar. On these grounds, past criticisms of IQ tests charge that this control is racially biased and biased by gender.

Is It Reversible or Irreversible?

Finally, there is the important question of whether the filiation is reversible. The metaphor of branding someone is not accidental in this regard, branding meaning that a label is burned into the skin and completely irreversible. Some forms of filiation have this finality for the individual, regardless of how the judgment was later regarded (e.g., a charge of guilt for murder may mean permanent public guilt

regardless of a jury's verdict. Many are somewhere between, but knowing how reversible is the filiation is important for understanding its impact.

The metaphor of filiation presented here could be used to characterize a texture of information systems where categories touch either individuals or things. The aesthetics of the weave and the degree to which the individual is bound up or supported by it are among the types of characterizations that could be made. There are brute renderings, such as having two thick, irreversible threads tying one person to conflicting categories. More subtly, it is possible to think of something like Granovetter's strength of weak ties and characterize the thousand and one classifications that weakly tie people to information systems as binding or torquing in another way.

The metaphor of filiation is useful to the extent that it can be used to ask questions of working infrastructures in new and interesting ways. Two questions that rise directly out of our treatment of the metaphor for any individual or group filiation are: What will be the ecology and distribution of suffering? Who controls the ambiguity and visibility of categories?

Conclusion

This chapter has argued that there is more to be done in the analysis of classification systems than deconstructing universal master narratives. Certainly, such narratives should be challenged. We have attempted to show, however, that there are ways of scaling up from the local to the social, via the concept of boundary infrastructures, and that we can in the process recognize our own hybrid natures without losing our individuality. The value of this approach is that it allows us to intervene in the construction of infrastructures—which surely exist and are powerful—as not only critics but also as designers.

10
Why Classifications Matter

At the beginning of this book we told the story of the homicidal maniac who needed the insight of a psychic to understand his murderous urges as such. "Don't you get it, son? You're a homicidal maniac." End of explanation. The story is powerful and funny because it reminds us, ironically, that a classification is not of itself an explanation. All we understand at the end of the scene is that the maniac now has a label that others, and he himself, can apply to his behavior. Although the classification does not provide psychological depth, it does tie the person into an infrastructure—into a set of work practices, beliefs, narratives, and organizational routines around the notion of "serial killer." Classification does indeed have its consequences—perceived as real, it has real effect.

Classifications are powerful technologies. Embedded in working infrastructures they become relatively invisible without losing any of that power. In this book we demonstrate that classifications should be recognized as the significant site of political and ethical work that they are. They should be reclassified.

In the past 100 years, people in all lines of work have jointly constructed an incredible, interlocking set of categories, standards, and means for interoperating infrastructural technologies. We hardly know what we have built. No one is in control of infrastructure; no one has the power centrally to change it. To the extent that we live in, on, and around this new infrastructure, it helps form the shape of our moral, scientific, and esthetic choices. Infrastructure is now the great inner space.

Ethnomethodologists and phenomenologists have shown us that what is often the most invisible is right under our noses. Everyday categories are precisely those that have disappeared into infrastructure, into habit, into the taken for granted. These everyday categories are seamlessly interwoven with formal, technical categories and specifications. As Cicourel notes:

> The decision procedures for characterizing social phenomena are buried in implicit common sense assumptions about the actor, concrete persons, and the observer's own views about everyday life. The procedures seem intuitively "right" or "reasonable" because they are rooted in everyday life. The researcher often begins his classifications with only broad dichotomies, which he expects his data to "fit," and then elaborates on these categories if apparently warranted by his "data." (1964, 21)

The hermeneutic circle is indeed all around us.

There is no simple unraveling of the built information landscape, or, *pace* Zen practice, of unsettling our habits at every waking moment. Black boxes are necessary, and not necessarily evil. The moral questions arise when the categories of the powerful become the taken for granted; when policy decisions are layered into inaccessible technological structures; when one group's visibility comes at the expense of another's suffering.

There are as well basic research questions implied by this navigation into infrastructural space. Information technology operates through a series of displacements, from action to representation, from the politics of conflict to the invisible politics of forms and bureaucracy. Decades ago, Max Weber wrote of the iron cage of bureaucracy. Modern humans, he posited, are constrained at every juncture from true freedom of action by a set of rules of our own making. Some of these rules are formal, most are not. Information infrastructure adds another level of depth to the iron cage. In its layers, and in its complex interdependencies, it is a gossamer web with iron at its core.

We have looked at several sets of classification schemes—the classifications of diseases, viruses, tuberculosis, race, and of nursing work. These are all examples of working classification systems: they are or have been maintained by organizations, governments, and individuals. We have observed several dances between classifier and classified, but have nowhere seen either unambiguous entities waiting to be classified or unified agencies seeking to classify them. The act of classification is of its nature infrastructural, which means to say that it is both organizational and informational, always embedded in practice (Keller and Keller 1996).

In our interviews of public health officials, nurses, or scientists, we have found that they recognize this about their own classification systems. At the same time, there is little inducement to share problems across domains. Because of the invisible work involved in local struggles with formal classification systems and standards, a great deal of what sociologists would call "pluralistic ignorance" obtains. There is

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the feeling that "I am the only one." People often have a picture that somehow their problems are unique: they believe that other "real" sciences do not have the same set of makeshift compromises and work-arounds.

It is important in the development and implementation of classifications (and many related fields such as the development and deployment of standards or archives) that we get out of the loop of trying to emulate a distant perfection that on closer analysis turns out to be just as messy as our own efforts. The importance lies in a fundamental rethinking of the nature of information systems. We need to recognize that all information systems are necessarily suffused with ethical and political values, modulated by local administrative procedures. These systems are active creators of categories in the world as well as simulators of existing categories. Remembering this, we keep open and can explore spaces for change and flexibility that are otherwise lost forever.

Such politics are common to most systems employing formal representations. Rogers Hall, in his studies of algebra problem solving by both children and professional math teachers, talks about the shame that children feel about their unorthodox methods for arriving at solutions (1990). Often using innovative techniques such as imaginary devices, but not traditional formulaic means, they achieved the right answer the wrong way. One child called this "the dirt way." A grown-up version of the dirt way is related by the example given earlier of the "good organizational reasons for bad organizational records" (Bitner and Garfinkel 1967). There are good organizational reasons for working around formal systems; these adaptations are necessarily local. What is global is the need for them.

In this book we have attempted to develop tools for maintaining these open spaces. Michel Serres has best expressed the fundamental ethical and political importance of this task. He has argued that the sciences are very good at what they do: the task of the philosopher is to keep open and explore the spaces that otherwise would be left dark and unvisited because of their very success, since new forms of knowledge might arise out of these spaces. Similarly, we need to consistently explore what is left dark by our current classifications ("other" categories) and design classification systems that do not foreclose on rearrangements suggested by new forms of social and natural knowledge.

There are many barriers to this exploration. Not least among them is the barrier of boredom. Delving into someone else's infrastructure has about the entertainment value of reading the yellow pages of the

phone book. One does not encounter the dramatic stories of battle and victory, of mystery and discovery that make for a good read.

In an introductory chapter we laid the theoretical framework for the discussion of classification as an infrastructural practice, stressing the political and ethical texturing of classification schemes. In part I we examined the International Classification of Diseases (ICD) as a large-scale, long-term system ingrained in the work practices of multiple organizations and states. We argued that their organizational roots and operational exercise texture such systems. Such texture is an inescapable, appropriate feature of their constitution, and it is a feature that merits extended consideration in a discussion of the politics of infrastructure. In part II, we looked at the intersection between classification and individual biography in the case of the classification of tuberculosis and of race classification under apartheid in South Africa. Generalizing the arguments made in these chapters, we maintained that individuals in the modern state operate within multiple classification systems, from the small-scale, seminegotiated system—as with the informal classification of tuberculosis patients negotiated with doctors—up to enforced universal systems such as race classification. We drew attention to the torquing of individual biographies as people encounter these reified classifications. Finally, we examined classification and work practice, taking the example of the classification of nursing work. We argued that multiple tensions between representation and autonomy, disability and discretion, forgetting the past and learning its lessons, make such classifications a key site of political and professionalization work. We are all called upon to justify our productivity when we are embedded in complex modern organizations. The dilemma faced by nurses in accounting for their work is omnipresent in the modern organization. Even children are not exempt.

We have seen throughout this book that people (and the information systems they build) routinely conflate formal and informal, prototypical and Aristotelian aspects of classification. There is no such thing as an unambiguous, uniform classification system. (Indeed, the deeper one goes into the spaces of classification expertise—for example, librarianship or botanical systematics—the more perfervid one finds the debates between rival classificatory schools.) This in turn means that there is room in the constitution of any classification system with organizational and political consequences—and few schemes if any are without such dimensions—for technical decisions about the scheme to systematically reflect given organizational and political po-

sitions. Since we are dealing, then, with an agonistic field, there will be no pure reflection of a single position but rather dynamic tensions among multiple positions. And finally, since the classification system is not a pure reflection of such positions (an impossible aim in its own right—no classification system can reflect either the social or the natural world fully accurately) but also integrally a tool for exploring the real world, there is no simple prediction from how a given set of alliances or tensions leads invariably to a given classification used in a given way.

As sets of classification systems coalesce into working infrastructures they become integrated into information systems of all sorts. Thus we have argued throughout this book that information systems design should be informed by organizational and political analysis at this level. We are not offering this as an ex cathedra design principle. Rather, we have—along with many researchers in the field of social informatics—demonstrated empirically that invisible organizational structures influence the design and use of systems: the question is not whether or not this occurs but rather how to recognize, learn from, and plan for the ineluctable presence of such features in working infrastructures. We have suggested one design aid here—long-term and detailed ethnographic and historical studies of information systems in use—so that we can build up an analytic vocabulary appropriate to the task.

Working infrastructures contain multiple classification systems that are both invisible, in the senses above, and ubiquitous. The invisibility of infrastructure makes visualization or description difficult. The metaphors we reach for to describe infrastructure are ironic and somehow childish. We speak of "way down in the underwear," "underneath the system," or use up-down metaphors such as "runs under," or "runs on top of." Lakoff and Johnson (1980) write of metaphors we live by. Our infrastructural metaphors show how baffled we often are by these systems. They are like undergarments or tunnel dwellers.

Another set of metaphors often used in organizations speaks indirectly to the experience of infrastructure. These are the metaphors of texture omnipresent in human relationships. Texture metaphors speak to the densely patterned interaction of infrastructures and the experience of living in the "classification society." Texture speaks to the way that classifications and standards link the individual with larger processes and structures. These links generate both enabling-constraining patterns over a set of systems (texture) and developmental patterns for an individual operating within a given set (trajectory).

Thus we have used the metaphor of the texture of a classification system to explore the fact that any given classification provides surfaces of resistances (where the real resists its definition), blocks against certain agendas, and smooth roads for others. Within this metaphorical landscape, the individual's trajectory—often, for all that, perceived as continuous and self-consistent—is at each moment twisted and torqued by classifications and vice versa.

Therefore we have, through our analysis of various classification systems, attempted to provide a first approximation to an analytic language that recognizes that the architecture of classification schemes is simultaneously a moral and an informatic one. This book has brought to light as crucial to the design process the reading of classification schemes as political and cultural productions. We have stressed that any classification scheme can be read in this fashion. We initially deliberately eschewed cases like DSM-IV, where categories have often already become explicit objects of political contention, such as "homosexual" or "premenstrual tension." In the psychiatric case, there can in this sense often be a more direct read-off from political exigencies to disease categories. Although such readings are of course highly valuable in their own right (see Kirk and Kutchins 1992, Kutchins and Kirk 1997, and Figert 1996), we first took the more muted cases posed by the ICD where the politics were quieter. This we hoped would show the generalizability of the thesis that all category systems are moral and political entities. This was balanced later in the book with an analysis of the much more obviously politically laden categories generated by the proapartheid government and its scientific apologists.

This book has implications for both designers and users (and we are all increasingly both) of complex information spaces. It provides intellectual and methodological tools for recognizing and working with the ethical and political dimensions of classification systems. In particular we have underlined several design exigencies that speak both to the architecture of information systems encoding classification systems and to their development and change:

• *Recognizing the balancing act of classifying.* Classification schemes always represent multiple constituencies. They can do so most effectively through the incorporation of ambiguity—leaving certain terms open for multiple definitions across different social worlds: they are in this sense boundary objects. Designers must recognize these zones of am-

biguity, protecting them where necessary to leave free play for the schemes to do their organizational work.

• *Rendering voice retrievable.* As classification systems get ever more deeply embedded into working infrastructures, they risk getting black boxed and thence made both potent and invisible. By keeping the voices of classifiers and their constituents present, the system can retain maximum political flexibility. This includes the key ability to be able to change with changing natural, organizational, and political imperatives. A caveat here, drawn from chapter 7's lesson about the invisibility of nursing work: we are not simply celebrating visibility or naively proposing a populist agenda for the empire of classification. Visibility is not an unmitigated good. Rather, by retrievability, we are suggesting that under many circumstances, the "rule by no one" or the "iron cage of bureaucracy" is strengthened by its absence. When classification systems and standards acquire inertia because they are part of invisible infrastructure, the public is de facto excluded from policy participation.

• *Being sensitive to exclusions.* We have in particular drawn attention here to the distribution of residual categories (who gets to determine what is "other"). Classification systems always have other categories, to which actants (entities or people) who remain effectively invisible to the scheme are assigned. A detailed analysis of these others throws into relief the organizational structure of any scheme (Derrida 1998). Residual categories have their own texture that operates like the silences in a symphony to pattern the visible categories and their boundaries.

Stewart Brand's (1994) wonderful book, *How Buildings Learn,* gives many examples of how buildings get designed as they are used as much as on the architect's drawing board. Thus a house with a balcony and numerous curlicues around the roof will become a battened-down square fortress block under the influence of a generation of storms from the northeast. Big single-family mansions become apartment buildings as a neighborhood's finances change. These criteria generalize to classification systems. Through these three design criteria we are drawing attention to the fact that architecture becomes archaeology over time. This in turn may become a cycle.

Overall, we have argued that classifications are a key part of the standardization processes that are themselves the cornerstones of working infrastructures. People have always navigated sets of classification spaces. Mary Douglas (1984), among others, has drawn

attention to this feature of all societies from the indigenous and tribal to the most industrialized.[58] Today, with the emergence of new information infrastructures, these classification systems are becoming ever more densely interconnected. This integration began roughly in the 1850s, coming to maturity in the late nineteenth century with the flourishing of systems of standardization for international trade and epidemiology. Local classification schemes (of diseases, nursing work, viruses) are now increasingly giving way to these standardized international schemes that themselves are being aligned with other large-scale information systems. In this process, it is becoming easier for the individual to act and perceive him or her self as a completely naturalized part of the "classification society," since this thicket of classifications is both operative (defining the possibilities for action) and descriptive.[59] As we are socialized to become that which can be measured by our increasingly sophisticated measurement tools, the classifications increasingly naturalize across wider scope. On a pessimistic view, we are taking a series of increasingly irreversible steps toward a given set of highly limited and problematic descriptions of what the world is and how we are in the world.

For these reasons, we have argued in this book that it is politically and ethically crucial to recognize the vital role of infrastructure in the "built moral environment." Seemingly purely technical issues like how to name things and how to store data in fact constitute much of human interaction and much of what we come to know as natural. We have argued that a key for the future is to produce flexible classifications whose users are aware of their political and organizational dimensions and which explicitly retain traces of their construction. In the best of all possible worlds, at any given moment, the past could be reordered to better reflect multiple constituencies now and then. Only then we will be able to fully learn the lessons of the past. In this same optimal world, we could tune our classifications to reflect new insitutional arrangements or personal trajectories—reconfigure the world on the fly. The only good classification is a living classification.

NOTES

1. Two notable exceptions are Lucy Suchman and Sanford Berman. Suchman's article challenging the categories implicit in a popular software system was entitled "Do Categories Have Politics?" (Suchman 1994). This article/critique has helped open up the discussion of values and categories in the field of computer-supported cooperative work (CSCW). It is, importantly, a gloss on an earlier article by Langdon Winner (1986), "Do Artifacts Have Politics?" which similarly drew attention to the moral values inscribed in aspects of the built environment. Berman (1984, 1993) has done invaluable work in the library community with his critiques of the politics of catologuing. See also *Library Trends* special issue on classification, edited by Geoffrey Bowker and Susan Leigh Star (1998).

2. As authors, we recognize that "we" is problematic here and throughout this work. At the same time, it would be awkward to qualify each of these sentences by saying Western, academic, middle-class people. We the authors recognize that not everyone--Western or not--holds individualist, rational choice moral models. Where possible, we have tried to qualify the voice assumed throughout this book. Furthermore, the book's entire argument is directed at subverting any sense of an overriding master voice. We are grateful to Kathy Addleson for bringing the question of voice to our attention.

3. As Holmes explained to Watson when he uncovered the chain of deductions (each link so simple) that allowed him to produce a thrust of "magical" insight. See Star and Strauss (1999).

4. O'Connell (1993) gives a fine analysis of the development of electrical standards. The study of standards has been an exciting strand in recent science studies--as witness recent work in *Social Studies of Science* devoted to the topic: Alder (1998), Curtis (1998), Mallard (1998), and Timmermans and Berg (1997).

5. The Journal of Online Nursing at http://www.nursingworld.org/ojin/tpc7/intro.htm presents a good introduction to issues of classification in nursing.

6. Chapter title shamelessly stolen from Howard Becker's *Tricks of the Trade* (Chicago: University of Chicago Press 1998).

7. This is formally similar to Hewitt's open systems properties (1986); see also Star (1989).

8. We refer to Latour (1993 and 1996a, b) in seeing knowledge production and political work as twin outcomes of a single set of processes.

9. This useful term means administrative procedures, things, and technologies that are combined to produce a given effect. The punishment of a prisoner in jail, for instance, is a dispositif technique combining walls and bars, prison procedures and routines, judicial rules, and computerized crime records. In this, the term is close to that of Kling and Scacchi's notion of the "web of computing"--workable computer systems mean that hardware, software, and organizational and cultural mores are working together (1982).

10. We borrow this phrase from Hacking (1995); it is also explored in C. Becker (1967).

11. Social informatics is the study of the design, use, and impact of information technology considered from the point of view of social organization.

12. One finds similar complaints today about the World Wide Web, to the point where a special electronic journal has been founded: Journal of Internet Cataloging: The International Quarterly of Digital Organization, Classification, and Access. Its URL is: http://jic.libraries.psu.edu/. See also Marcia Bates' (in press) excellent article on incomparability between Web search engines.

13. Under external causes of morbidity and mortality, contact with venomous snakes and lizards is X20. There is a list of eight snakes and one Gila monster to be included, but these are not broken down in the actual coding. So the rural inhabitant could not distinguish the density of sidewinders versus rattlesnakes, as they may well want to do for safety purposes.

14. Rodney King was stopped and beaten by several police officers; this was captured on videotape and led to a celebrated trial involving issues of due force.

15. Ironically, the slogan, "nobody dies of old age" was an anti-ageist aphorism first popular in the 1980s and used by groups such as the Grey Panthers. It was meant to imply that the social invisibility of old people led to them being medically invisible or overlooked as well. It is an interesting example of the inversion of the prototypical and Aristotelian aspects of death!

16. As Everett Hughes (1970) was fond of saying about sociological analysis: "It might have been otherwise."

17. The general principle is: "when more than one condition is entered on the certificate, the condition entered alone on the lowest used line of part I should be selected only if could have given rise to all the conditions entered above it" (ICD-10, 3: 34).

18. *Pace* cybernetics (Bowker 1993).

19. A famous example of such bootstrapping from the history of science is the story of Newton's prism used for his optical experiments. Italian researchers got different results using different prisms; and Newton only succeeded in establishing the veracity of his experiments once he had succeeded in imposing his prism as the standard, and he could therefore ascribe failures to replicate his experiment to defective prisms. The only way of choosing between Italian and English prisms, however, was whether or not they gave suitable results to Newton's experiments (Schaffer 1989). This interpretation has been questioned by Shapiro (1996); our thanks to an anonymous reviewer for pointing this out.

20. Again, similar to the story H. Becker (1982) tells of the intertwining of aesthetics with materials and conventions in his classic *Art Worlds*.

21. DRGs are used for medical accounting and rely on rearrangements of medical classifications and procedures.

22. This is essentially the same as what organizational theorists call the garbage can approach to decision making. Since the garbage category has a specific meaning here, we have maintained that terminology.

23. The original scientific aphorism, attributed to the medieval philosopher William of Occam, was "thou shalt not multiply entities without necessity." It is often interpreted as a value of parsimony in scientific explanation; equally, here, it applies to the design of forms!

24. AIDS presents a similar challenge as a condition, not per se a disease, and equally protean in expression.

25. Roth (1963) makes an eloquent analysis of how this image has come to be a powerful one in the medical literature; he argues it is in fact statistically quite rare.

26. In the European context here, "sister" means "nurse."

27. After the 1847 Dumas novel, *La Belle Dame aux Camélias*.

28. At this point, following Dubow (1995), we stop putting quotation marks around words such as race or coloured. We trust the reader to recognize that the entire argument here opposes any essentialist or simplistic interpretation of these terms, or acceptance of racist constructions! Except in direct quotes, we conform to the MIT style of using lowercase for 'black', 'white', and 'colored'. The South African usage was not standardized.

29. "They will count us. My friend was checked yesterday. Count us, count us!" (authors' translation from the Afrikaans).

30. An early antiapartheid organization noted for greeting officials at airports and the like wearing black sashes of protest.

31. Although DeKlerk in 1962 attributes this to purely technical reasons, "to use descent as a test it would have meant digging far back into the past for

> proof, and the moment one has to start digging into the past one becomes lost in a labyrinth . . . in earlier years there was no reliable record of many of these facts. For example, in some of the provinces facts of this kind this have only been noted since 1915 in registrations of births and deaths. In other words one cannot trace the origin and the race of the person" (De Klerk 1962, 9).

32. "Kaffir" is a rude word equivalent to "nigger."

33. Not surprisingly, the school officials were of little help. The mother superior of a convent explained, "If I could have had my way I would have admitted the little girl. But we depend on public goodwill, and as I see it we would only have trouble if we admitted her. We have to consider the feelings of our parents and children" (*Ebony* June 1968, 88).

34. "This classification provides a minimum standard for maintaining, collecting, and presenting data on race and ethnicity for all federal reporting purposes. The categories in this classification are social-political constructs and should not be interpreted as being scientific or anthropological in nature. They are not to be used as determinants of eligibility for participation in any federal program. The standards have been developed to provide a common language for uniformity and comparability in the collection and use of data on race and ethnicity by federal agencies.

The standards have five categories for data on race: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, and white. There are two categories for data on ethnicity: "Hispanic or Latino," and "not Hispanic or Latino."

1 Categories and definitions

The minimum categories for data on race and ethnicity for federal statistics, program administrative reporting, and civil rights compliance reporting are defined as follows:

• American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

• Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

• Black or African American. A person having origins in any of the black racial groups of Africa. Terms such as "Haitian" or "negro" can be used in addition to "black or African American."

• Hispanic or Latino. A person of Cuban, Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race. The term, "Spanish origin," can be used in addition to "Hispanic or Latino."

• Native Hawaiian or other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

• White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

Respondents shall be offered the option of selecting one or more racial designations. Recommended forms for the instruction accompanying the multiple response question are "mark one or more" and "select one or more."

2 Data Formats

The standards provide two formats that may be used for data on race and ethnicity. Self-reporting or self-identification using two separate questions is the preferred method for collecting data on race and ethnicity. In situations where self-reporting is not practicable or feasible, the combined format may be used.

In no case shall the provisions of the standards be construed to limit the collection of data to the categories described above. The collection of greater detail is encouraged; however, any collection that uses more detail shall be organized in such a way that the additional categories can be aggregated into these minimum categories for data on race and ethnicity.

With respect to tabulation, the procedures used by federal agencies shall result in the production of as much detailed information on race and ethnicity as possible. Federal agencies shall not present data on detailed categories, however, if doing so would compromise data quality or confidentiality standards.

a. Two-question format

To provide flexibility and ensure data quality, separate questions shall be used wherever feasible for reporting race and ethnicity. When race and ethnicity are collected separately, ethnicity shall be collected first. If race and ethnicity are collected separately, the minimum designations are:

Race:

• American Indian or Alaska Native

• Asian

• Black or African American

• Native Hawaiian or Other Pacific Islander

• White

Ethnicity:

• Hispanic or Latino

• Not Hispanic or Latino

When data on race and ethnicity are collected separately, provision shall be made to report the number of respondents in each racial category who are Hispanic or Latino." See http://www.ameasite.org/omb15v97.html.

35. Our colleague Stefan Timmermans provided valuable assistance on earlier drafts of the argument in this chapter. We gratefully acknowledge his help. (See Timmermans, Bowker, and Star 1998.)

36. Although it may appear at first sight that comparatibility and standardization are the same thing, we see an important difference between the two concepts. Two things can be comparable but not standardized. You can compare an education at Harvard with an education at the local community college, for example, because you know that in general a lot more resources are pumped into Harvard and outcomes tend to be different because of the homogeneity of backgrounds. In this case, one would be high on the comparability side of standardization but low on the standardization side: no exact metric exists for the differences. If you then subject all students to a single standardized test, you have to measure comparability to provide standardization (and in the case of comparing educational systems, this is both politically and organizationally complex and fraught).

37. The NIC principal investigators maintain that at present there is effectively no scientific nursing knowledge: it is only with the creation and maintenance of a stable classification system that the groundwork will have been done to make such knowledge attainable.

38. Personal communication.

39. From a talk given at the Program for Cultural Values and Ethics, University of Illinois, December 1993.

40. See Michael Lynch's (1984) work on turning up signs in neurological diagnosis for an example of the inexhaustible discretion and improvisation in every human activity--the study of which has been a major contribution of ethnomethodology and phenomenology.

41. See Wagner (1993), Egger and Wagner (1993), Gray et al. (1991), and Strong and Robinson (1990).

42. Strauss et al. (1985) call this activity articulation work.

43. One of their arguments is that the truth of a memory is constructed in discourse in social settings and so is never fixed for all time.

44. Notes taken at Iowa intervention project meeting of 8 June 1995. (Hereinafter IIP 6/8/95.)

45. This is clearly a reference to Thompson's classic (1967) "Time, Work Discipline and Industrial Capitalism." It is questionable of course whether all nursing has ever been thought of as process, just as industrial work has often had its rhythmic side (the cycles of boom and bust in the eighteenth and nineteenth centuries, for example).

46. The translations from Comte's French are Bowker's.

47. Such a way of thinking is common in art, myth, and literature--especially in surrealist art and multivocal fiction and film--and in aspects of feminist and race-critical theory.

48. The two other types are (1) formal or axiomatic approaches and (2) encyclopedic listings with flattened or standardized nomenclatures. Both present other sorts of equally interesting political problems (Star 1989).

49. The term community of practice is interchangeable with the term social world (Strauss 1978, Clarke 1991, 1990) although they have different historical origins.

50. Clearly questions of language are central here as well, and we do not mean to exclude them by emphasizing things. Language considered as situated tool, in relationship with other tools and things, is part of this model.

51. The work of Schütz (1944) and subsequent ethnomethodologists such as Cicourel, Sacks, and Schegeloff, among many others, investigates this naturalization process through language.

52. Deconstructing this invisibility is one of the major shared projects of ethnomethodology, symbolic interactionist studies of science and of gender, and the Annalist school of historiography.

53. Things, strictly speaking, do not analytically have membership, in the sense of negotiated identity.

54. Thanks to Peter Garrett for insightful discussions of this topic.

55. We borrow the phrase from Howard Becker's classic, "A School is a Lousy Place to Learn Anything In," an essay that covers related ground (1972).

56. One of the intriguing features of electronic interaction is that it makes disclosure of these memberships voluntary, or at least problematic, where participants do not know each other in real life.

57. This distinction is in line with Strauss' original distinction between production work and articulation work (1988, Strauss et al. 1985).

58. The classification of societies, ranging from "primitive" to "developed" is of course a particularly tendentious one with its own complex political history. For a direct criticism from the library vantagepoint, see Berman (1993, 1984) and Dodge and DeSirey (1995).

59. We are grateful to Ina Wagner (personal communication July 8, 1998) for coining this term.

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