Invisible Mediators of Action: Classification and the Ubiquity of Standards

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This article is a methodological think piece about the ways in which classifications (and standards) impinge in myriad ways on our daily lives. We argue that although they are frequently invisible to us, they are highly political and ethically charged. We suggest 4 principles garnered from our own research and that of others that can together be used to give a picture of their scope and reach: recognizing their ubiquity, analyzing their material texture, examining ways in which they reconfigure our understanding of the past, and exploring their practical politics. Together, the principles suggest a "reverse engineering" of classification systems to reveal the multitude of local political and social struggles and compromises that go into the constitution of a "universal" classification.

INTRODUCTION

A classified and hierarchically ordered set of pluralities, of variants, has none of the sting of the miscellaneous and uncoordinated plurals of our actual world. (Dewey, 1929, p. 49)

Classifications are powerful technologies. Embedded in working infrastructures, they become relatively invisible without losing any of that power. Classifications should be recognized as the significant site of political and ethical work that they are. They should, in a word, be reclassified as key sites of work, power, and technology.

For all this importance, classifications and standards occupy a peculiar place in studies of social order. Anthropologists have studied classification as a device for understanding the cultures of others—categories such as the raw and the cooked have been clues to the core organizing principles for colonial Western understandings of "primitive" culture. Some economists have looked at the effects of adopting a standard in those markets where networks and compatibility are crucial. For example, videotape recorders, refrigerators, and personal computer software arguably embody inferior technical standards, but standards that benefited from the timing of their historical entry into the marketplace. Some historians have examined the explosion of natural history and medical classifications in the late-nineteenth century both as a political force and as an organizing rubric for complex bureaucracies. A few sociologists have done detailed studies of individual categories linked with social movements, such as between the diagnosis of homosexuality as

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an illness and its demedicalization in the wake of gay and lesbian civil rights. Information scientists work every day on the design, delegation, and choice of classification systems and standards, yet few see them as artifacts embodying moral and aesthetic choices that in turn craft people's identities, aspirations, and dignity.[1] Philosophers and statisticians have produced highly formal discussions of classification theory but few empirical studies of use or impact.

We all know and make banal assertions such as "We do many things today that a few hundred years ago would have looked like magic." And if we don't understand a given technology, it looks like magic: We are perpetually surprised by the mellifluous tones read off our favorite CDs by (we believe) a laser. Even engineers black-box and think of technology "as if by magic" in their everyday practical dealings with machines and their management (Star, 1995). A common description of a good waiter or butler (one thinks of Jeeves in the Wodehouse stories) is that he or she clears a table "as if by magic." Are these two kinds of magic, or one, or none?

The question is of import for activity theory, in that it links the (often forgotten and ignored) technical mediation of action with the performance of (often invisible) work. In more prosaic terms, we pose the problem here as

• What work do classifications and standards do? We want to look at what goes into making things work like magic: making them fit together so that we can buy a radio built by someone we have never met in Japan, plug it into a wall in Champaign, and hear the world news from the BBC.

• Who does that work? We want to explore the fact that all this magic involves much work: There is a lot of hard labor in effortless ease. Such invisible work is often not only underpaid, it is severely underrepresented in theoretical literature (Star & Strauss, 1999). We discuss where all the "missing work" that makes things look magical goes.

• What happens to the cases that don't fit? We want to draw attention to cases that don't fit easily into our created world of standards and classifications: the left-handers in the world of right-handed magic, chronic disease sufferers in the world of allopathic acute medicine (Strauss, 1970), the onion-hater in McDonalds (Star, 1991b), and so forth.

These are issues of great epistemological, political, and ethical import. It is easy to get lost in Baudrillard's (1990) cool memories of simulacra. The hype of our times is that we don't need to think about work anymore: The real issues are scientific and technological— in artificial life, thinking machines, nanotechnology, and genetic manipulation. Clearly each of these *is* important. However, there is rather more at stake—epistemologically, politically, and ethically—in the day-to-day work of building classification systems and producing and maintaining standards than in these philosophical high-fliers. The pyrotechnics may hold our fascinated gaze; they cannot provide any path to answering our questions. We first consider what kinds of things classifications and standards are and then elucidate four principles for their analysis.

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[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 and critique has helped open up the discussion of values and categories in the field of computer-supported cooperative work. It is, importantly, a gloss on an earlier article by Langdon Winner (1980), "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 cataloguing. See also *Library Trends,* Special Issue on How Classifications Work: Problems and Challenges in an Electronic Age, edited by Susan Leigh Star and Geoffrey C. Bowker (Fall 1998, Vol. 47:2).

TWO DEFINITIONS

We begin 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). A *classification* is a spatial, temporal, or spatiotemporal segmentation of the world. A *classification system* is a set of boxes, metaphorical or not, into which things can be put in order to then do some kind of work—bureaucratic or knowledge production.

Classifications arise from systems of activity and, as such, are situated historically and temporally. Categories—our own and those of others—come from action, and in turn from relationships. 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 (1964) noted

> 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." (p. 21)

The hermeneutic circle is indeed all around us.

Much of the philosophical and cognitive literature on classification ignores both the historical situation and the basis of classification in practice. Such treatments of classification systems demand an internal consistency of classificatory principles, based on an idealized notion of how things should work. For example, many demand that such systems be solely *genetic*, or classified by origin (Tort, 1989). Others demand mutual exclusivity of categories, or completeness (total coverage of the world being described). No working classification system that we have looked at meets these "simple" requirements, and we doubt that any ever could (Desrosières & Thévenot, 1988).

For example, consider the International Classification of Diseases, a list of causes of morbidity and mortality administered by the World Health Organization. The full title of the current (10th) edition of the ICD is *ICD–10: International Statistical Classification of Diseases and Related Health Problems* (1992). Note that it is designated a "statistical" classification. This means that only diseases that are statistically significant are to be entered in (it is not an attempt to classify all disease). It calls itself a "classification," even though many have said that it is a "nomenclature," because it has no single classificatory principle (it has at least four; which are not mutually exclusive; Bowker & Star, 1994, 1999). In many cases it represents a compromise between conflicting schemes: "The terms used in categories C82–C85 for non-Hodgkin's lymphomas are those of the Working Formulation, which attempted to find common ground among several major classification systems. The terms used in these schemes are not given in the Tabular List but appear in the Alphabetical Index; exact equivalence with the terms appearing in the Tabular List is not always

possible" (*ICD–10,* 1992, pp. 1, 215). However, it presents itself clearly as a classification scheme and not a nomenclature. Since 1970, there has been an effort underway by the World Health Organization to build a distinct International Nomenclature of Diseases, whose main purpose will be to provide "a single recommended name for every disease entity" (*ICD–10,* 1992, pp. 1, 25). The point here is that we want to take a broad enough definition so that anything that is consistently called a classification system can be included. If we took a purist view, the *ICD* would be a nomenclature (and who knows what the International Nomenclature of Diseases would be).

With a broad definition, we can look at the work that is involved in building and maintaining a family of entities that people call classification systems, rather than attempt the Herculean, Sisyphian task of purifying the (un)stable systems in place. Howard Becker (1996) made the point here:

> Epistemology has been a … negative discipline, mostly devoted to saying what you shouldn't do if you want your activity to merit the title of science, and to keeping unworthy pretenders from successfully appropriating it. The sociology of science, the empirical descendant of epistemology, gives up trying to decide what should and shouldn't count as science, and tells what people who claim to be doing science do. (pp. 54–55).

STANDARDS AND CLASSIFICATION SYSTEMS

We take a "standard" to be any set of agreed-upon rules for the production of (textual or material) objects. There are a number of histories of standards that point to the development and maintenance of standards as being a key to industrial production. Thus, as David Turnbull (1993) pointed out, it was possible to build a cathedral like Chartres without standard representations (blueprints) and standard building materials (regular sizes for stones, tools, etc.). However, it is not possible to build a modern housing development without them: Too much needs to come together—electricity, gas, sewer, timber sizes, screws, nails, and so on. The control of standards is a central, often underanalyzed feature of economic life (for an exception see the work of Paul David—for example David and Rothwell, 1994—for a rich treatment). They are key to knowledge production as well. Latour (1987) speculated that far more economic resources are spent creating and maintaining standards than in producing "pure" science. Central dimensions of standards are

• They are often deployed in the context of making things work together; for example, computer protocols for Internet communication involve a cascade of standards (cf. Abbate & Kahin, 1995), which need to work together well for the average user to gain seamless access to the web of information. There are standards for the components to link from your computer to the phone network, for coding and decoding binary streams as sound, for sending messages from one network to another, for attaching documents to messages, and so forth.

• They are often enforced by legal bodies, be these professional organizations, manufacturers' organizations, or the State. We can say tomorrow that volapük (a universal language that boasted some 23 journals in 1889) or its successor Esperanto shall henceforth be the standard language for international diplomacy; without a mechanism of enforcement we shall probably fail.

• There is no natural law that the best (technically superior) standard shall win; the QWERTY keyboard, Lotus 123, DOS, and VHS are often cited in this context. Standards have significant inertia and can be very difficult to change.

An aside about the relation between classifications and standards: Some classifications become formally standardized, as with race categories on a census form or intelligence categories as measured by standardized tests. Others are more informal, or ad hoc. Where they are formal, categorizing becomes a kind of situated action embedded in bureaucratic, institutionalized practices.[2] At other times, classifications mark context for decisions or things; or they may be treated as bins, holding things or people. Standards, such as technical standards for operating the Internet, are agreements about procedures—dimensions, rates, ordinality—that have reach and scope across settings. Every successful standard imposes a classification system, in the sense that it forms boundaries around objects and activities.

WHAT SORT OF THING IS A CLASSIFICATION?

> 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, p. 65)

Classification is a core topic within anthropology, especially cognitive anthropology, and within computer science, as the quote from Goodwin attests. 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., Hutchins, 1995; Keller & Keller, 1996). Ascher (1981) and Roberts and Roberts (1996), discussing in turn the Quipu string code system and the Luba memory system, explored the technology and practice of classificatory infrastructures in nonmodern settings. In each case, and especially Goodwin's work, classification is a local and situated achievement—embedded in an institutional set of practices and arrangements. No classification or standard, of course, holds for all time. Things left out of classification schemes or made residual often disturb purists who would classify for all time. Things and processes that are standardized must be customized to fit particular situations; the customization threatens the standardization, and so on, recursively.

A difficulty in conceptualizing classifications is the heritage of idealism and Cartesian dualism in traditional cognitive approaches. We face here a problem similar to Cole's (1996) search for the nature of artifacts in mediated action. Cole noted that

> 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 form has been shaped by their participation in the interactions of which they were previously a part and which they mediate in the present. (p. 117)

The materiality of categories, like that of other things associated with the purely cognitive, has been difficult to analyze. The Janus-faced conceptual and material notion of artifacts suggested by Cole, combined with the attention to the use in practice of categories (Keller & Keller, 1996), is a

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[2]We are grateful to Naoki Ueno for helping clarify these points.

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 brute material, tools, and other artifacts. For example, being a left-handed tool-user in a right-handed world means not only that it's more difficult to open a can or to use scissors, but that the left-hander is reminded of the symbolic articulation of left-handedness with awkwardness. It is similarly felicitous to emphasize the material force of that which has been considered ideal, as with categories. Thus, if Foucault's *The Archaeology of Knowledge* is classified in the "archaeology" section of the library (as we have seen on occasion), it will frequently be materially inaccessible to students browsing the shelves in search of "philosophy of the social sciences." At the same time, the double nature imagery risks instantiating another Cartesian divide, and one that isn't really necessary to make both these valuable points.

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. 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, Thomas used it (as Becker would some decades later) to argue against essentialism in examining so-called deviants or problem children. If as a social scientist you do not understand people's definition of a situation, you 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 its cousin the cultural historical turn, emphasizes the ways in which things perceived as real may mediate action. If you take someone to be a witch, and develop elaborate technical apparatus with which to diagnose him or her as such, then the reality of witchcraft exists in the consequences—perhaps death at the stake. Classification systems are one form of technology, used in the sense Cole (1996) employed, linked together in elaborate informatic systems and enjoining deep consequences for those touched by them.

From the point of view of learning as membership and participation, 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 (1992), in his extensive investigations

into language and social life, noted 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. (p. 116)

Sacks (1992) drew attention to the ways in which being ordinary are not pre-given but are in fact a kind of job—a job that 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 to an "ordinary person" as this or that person, or as some average, i.e., a non-exceptional 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 and 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. (p. 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 re-made every day.

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

HOW ARE CATEGORIES TIED TO PEOPLE? FILIATIONS

> 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, p. 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 interactions: tension, knottiness or smoothness, bundling, proximity, thickness. We select a small number here to focus on in the following worked example.

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 or Dimensions (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 that 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, two important questions about filiations and their ecology that may be visualized in threadlike 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 vs. 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 an important loci of control as well. For example, an IQ test may be an important way to classify people. Those who developed the test are at some distance from those who take it. The measure, IQ, is controlled from afar. Past criticisms of IQ tests charge that this control is racially biased and biased by gender on these grounds.

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, as with the decades' long attempt of Sam Shepard's son to prove his father's innocence). Many are somewhere between, but knowing how reversible is the filiation is important for understanding its impact.

The model 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, as with the previous examples. More subtly, it is possible to think in terms of something like a myriad of Lilliputian threads, each weak in its own right, but collectively strong. Like Mark Granovetter's (1973) notion of the strength of weak ties, these sorts of filiations characterize the thousand and one classifications that weakly tie people to systems.

To summarize: The metaphor of filiation 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?

Both within and outside the academy, single categories or classes of categories may also become objects of contention and study. The demedicalization of the category "homosexual" in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed. [*DSM–III*]; American Psychiatric Association, 1980) followed direct and vigorous lobbying of the association by gay and lesbian advocates (Kirk & Kutchins, 1992). During this same era, feminists were split on the subject of whether the categories of premenstrual syndrome and post-partum depression would be good or bad for women as they became included in the *DSM–III*. Many feminist psychotherapists were engaged in the bitter argument about whether to include these categories. As Figert (1996) related, they even felt their own identities and professional judgements to be on the line. (A researcher into the *DSM–III* made the complicating observation that psychiatrists increasingly use its language to communicate with each other and their accounting departments, although they frequently don't believe in the categories they are using; Young, 1995.)

More recently, the option of choosing more than one racial category was introduced as part of the U.S. Government routine data collection mission, following Statistical Directorate 15 in October 1997. The Office of Management and Budget issued the directorate, and, conservatively, its implementation will cost billions of dollars. One direct consequence was the revision of the U.S. Census form, an addition that was fraught with political passion. A march on Washington concerning the revision took the traditional ultimate avenue of mass protest for American activists. The march was conducted by people who identified themselves as multiracial and their families and advocates. At the same time, the change was vigorously opposed by many African-American and Hispanic civil rights groups (among several others), who saw the change as a "whitewash"

against which important specific ethnic and policy-related distinctions would be lost (Robbin, 1998).

However, despite the contentiousness of some categories or systems, none of the previously named disciplines or social movements has systematically addressed the pragmatics of the invisible forces of categories and standards in the modern-built world, especially the modern information technology world. Foucault's (1970, 1982) work comes the closest to a thoroughgoing examination in his arguments that an archaeological dig is necessary to find the origins and consequences of a range of social categories and practices. He focused on order and its implementation in categorical discourse. The ubiquity described by Foucault appeared as an iron cage of bureaucratic discipline against a broad historical landscape. But there is much more to be done, both empirically and theoretically. No one, including Foucault, has systematically tackled the question of how these properties inform social and moral order via the new technological and electronic infrastructures. Few have looked at the creation and maintenance of complex classifications as a kind of *work practice*, with its attendant financial, skillful, and moral dimensions.

We have a moral and ethical agenda in our querying of these systems. Every standard and each category valorizes some point of view and silences another. This is not inherently a bad thing—indeed, it is inescapable. But it is an ethical choice, and as such it is dangerous—not bad, but dangerous. For example, the decision of the U.S. Immigration and Naturalization Service to classify some races and classes as desirable for U.S. residents and others as not resulted in a quota system that values affluent people from Northern and Western Europe above those (especially the poor) from Africa or South America. The decision to classify students by their standardized achievement and aptitude tests valorizes some kinds of knowledge skills and renders other kinds invisible. Other types of decisions with serious material force may not immediately appear as morally problematic. The collective standardization in the United States on VHS videotapes over Betamax, for instance, may seem ethically neutral. The classification and standardization of types of seed for farming is not obviously fraught with moral weight. But as Busch (1995) and Addelson (1994) argued, such long-term, collective forms of choice are also morally fraught. We are used to viewing moral choices as individual, as dilemmas, and as rational choices. We have an impoverished vocabulary for collective moral passages, to use Addelson's terminology. For any individual, group, or situation, classifications and standards give advantage or they give suffering. Jobs are made and lost; some regions benefit at the expense of others.

UNDERSTANDING CLASSIFYING AND STANDARDIZING

In our work on classification and categorizing, we have identified four major themes for understanding classifying, standardizing (and the related processes of formalizing), and their politics and histories. Each theme operates as a gestalt switch—it comes in the form of an infrastructural inversion (Bowker, 1994). Inverting our commonsense notion of infrastructure means taking what have often been seen as behind-the-scenes, boring, background processes to the real work of politics and knowledge production and bringing their contribution to the foreground. The first two, ubiquity and material texture, speak to the *space* of classifications; the second two, the indeterminate past and the practical politics, speak to their *time*. Taken together, they sketch out features of the historically creation of the infrastructure that (ever partially, ever incompletely) orders the world in such a way that actor–network theory becomes a reasonable description.

The first major theme is seeing the ubiquity of classifying and standardizing. Classification schemes and standards literally saturate the worlds we live in. This saturation is furthermore intertwined, or webbed together. Although it is possible to pull out a single classification scheme or standard for reference purposes, in reality none of them stand alone. So a subproperty of ubiquity is interdependence, if not smooth integration.

The second major theme is to see classifications and standards as materially textured. Under the sway of cognitivism, it is easy to see classifications as properties of mind and standards as ideal numbers or settings. But both have material force in the world and are built into and embedded in every feature of the built environment (and many of the borderlands, such as with engineered genetic organisms). When we think of classifications and standards as material, we can afford ourselves of what we know about material structures, such as structural integrity, enclosures, and confinements, permeability, and durability, among many others. We see people doing this all the time in describing organizational settings, and a common way to hear people's experience of this materiality is through metaphors. So the generation of metaphors is closely linked with the shift to texture.

The third major theme is to see the past as indeterminate. This is not a new idea to historiography, but it is important in understanding the evolution of ubiquitous classification and standardization and the multiple voices that are represented in any scheme. No one classification orders reality for everyone—for example, the red light–green light–yellow light categories don't work for blind people or those who are red–green color blind. In looking to classification schemes as ways of ordering the past, it is easy to forget those who are overlooked in this way. Thus, the indeterminacy of the past implies recovering multivocality; it also means understanding how standard narratives that seem universal have been constructed.

The fourth major theme is uncovering the practical politics of classifying and standardizing. There are two aspects of these politics: arriving at categories and standards, and, in the process, deciding what will be visible within the system (and of course what will thus then be invisible). The negotiated nature of standards and classifications follows from indeterminacy and multiplicity that whatever appears as universal or, indeed, standard, is the result of negotiations or conflict. How do these negotiations take place? Who determines the final outcome in preparing a formal classification? Visibility issues arise as one decides where to make the cuts in the system, for example, down to what level of detail one specifies a description of work, an illness, or a setting. Because there are always advantages and disadvantages to being visible, this becomes crucial in the workability of the schema.

Ubiquity

In the built world we inhabit, thousands and thousands of standards are used everywhere, from setting up the plumbing in a house to assembling a car engine to transferring a file from one computer to another. Consider the canonically simple act of writing a letter longhand, putting it in an envelope, and mailing it. There are standards for (inter alia) paper size, the distance that lines are apart if it is lined paper, envelope size, the glue on the envelope, the size of stamps, their glue, the ink in the pen that you wrote with, the sharpness of its nib, the composition of the paper (which in turn can be broken down to the nature of the watermark, if any; the degree of recycled material used in its production, the definition of what counts as recycling), and so forth.

Similarly, in any bureaucracy, classifications abound—consider the simple but increasingly common classifications that are used when you dial an airline for information (e.g., "If you are traveling domestically, press 1; if you want information about flight arrivals and departures, press 2…"). And once the airline has hold of you, you are classified by them as a frequent flyer (normal, gold, or platinum); corporate or individual; tourist or business class; short haul or long haul (different fare rates and scheduling applies); irate or not (different hand-offs to the supervisor when you complain).

A systems approach would see the proliferation of both standards and classifications as a matter of integration—almost like a gigantic web of interoperability. Yet the sheer density of these phenomena go beyond questions of interoperability. They are layered, tangled, textured; they interact to form an ecology as well as a flat set of compatibilities. There are spaces between (unclassified, nonstandard areas), of course, and these are equally important to the analysis. It seems that increasingly these spaces are marked as unclassified and nonstandard. How does that change their qualities?

It is a struggle to step back from this complexity and think about the issue of ubiquity broadly, rather than try to trace the myriad connections in any one case. We need concepts for understanding movements, textures, and shifts that will grasp larger patterns in this. For instance, the distribution of residual categories ("not elsewhere classified" or "other") is one such concept. "Others" are everywhere. The analysis of any one instance of a residual category might yield information about biases or what is valued in any given circumstance; seeing that residual categories are ubiquitous offers a much more general sweep on the categorizing tendencies of most modern cultures. Another class of concepts that are found ubiquitously, and that speak to the general pervasiveness of standards and classification schemes, concern those that describe tangles or mismatches between subsystems. For instance, what Strauss (Strauss et al., 1985) called a "cumulative mess trajectory" is a useful notion. In medicine, this occurs when one has an illness, is given a medicine to cure the illness, but incurs a serious side effect, which then needs to be treated with another medicine, and so on. If the trajectory becomes so tangled that you can't return and the interactions multiply, "cumulative mess" results. We see this phenomenon in the interaction of categories and standards all the time—ecological examples are particularly rich places to look. For example, the use of electric batteries in automobiles rather than gasoline often effectively displaces the pollution from one site to another. Although the streets of California might smell better, and air pollution be reduced by electric vehicles, the sites of manufacture of the batteries (in Mexico, say) themselves become more polluted from the manufacturing and disposal problems. Similarly, the chemicals used to recycle paper are toxic, and their disposal may offset the environmental gains from the recycling process meant to save trees. In each case, the remedy carries problems of its own, problems that may only be visible over large distances or lengths of time. There is no eagle's-eye view of these sorts of problems.

Texturing Classification and Standardization

How do we "see" this densely saturated classified world? We are commonly used to casually black-boxing this behind-the-scenes machinery, even to the point, as we noted previously, of ascribing a casual magic to it. All classification and standardization schemes are a mixture of physical entities such as paper forms, plugs, or software instructions encoded in silicon and

conventional arrangements such as speed and rhythm, dimension, and how specifications are implemented. Perhaps because of this mixture, the web of intertwined schemes can be difficult to "see." In general, the trick is to question every apparently natural easiness in the world around us and look for the work involved in making it easy. Within a project or on a desktop, the seeing consists in seamlessly moving between the physical and the conventional. So when a computer programmer writes some lines of C code, he or she moves within conventional constraints and makes innovations based on them, while at the same time striking plastic keys, shifting notes around on a desktop, and consulting manuals for various standards and other information. If we were to try to list out all the classifications and standards involved in writing a program, the list could run to pages. Classifications include types of objects, types of hardware, matches between requirements categories and code categories, and meta-categories such as the goodness of fit of the piece of code with the larger system under development. Standards range from the precise integration of the underlying hardware to the 60Hz power coming out of the wall through a standard-size plug.

Merely reducing the description to the physical aspect such as the plugs does not get us anywhere interesting in terms of the actual mixture of physical and conventional. A good operations researcher could describe how and whether things would work together, often purposefully blurring the physical and conventional boundaries in making the analysis. But what is missing there is a sense of the landscape of work as experienced by those within it. It gives no sense of something as important as the texture of an organization: Is it smooth or rough? bare or knotty? What is needed is a sense of the topography of all of the arrangements—are they colliding? coextensive? gappy? orthogonal? One way to begin to get at these questions is to begin to take quite literally the kinds of metaphors that people use when describing their experience of organizations, bureaucracies, and information systems (Star, in press). So, for example, when someone says something simple like "things are running smoothly," the smoothness is descriptive of an array of articulations of people, things, work, and standards. When someone says, "I feel as though the whole project is moving through thick molasses," it points to the opposite experience. These are not merely poetic expressions, although at some level they are that, too. As Schön (1963) pointed out in his seminal book, *Displacement of Concepts,* a metaphor is something imported, meant to illuminate aspects of a current situation via juxtaposition. For example, the use of linguistic metaphors has proved very fruitful in the development of molecular biology over the past 30 years. Such metaphors are also a rich and often unmined source of knowledge about people's experience of the densely classified world.

The Indeterminacy of the Past

There is no way of ever getting access to the past except through classification systems of one sort or another—formal or informal, hierarchical or not. Take the following unproblematic statement: "In 1640, the English Revolution occurred; this led to a 20-year period in which the English had no monarchy." The classifications involved here include

- The current segmentation of time into days, months, and years. Accounts of the English revolution generally use the Gregorian calendar, which was adopted some hundred years later, so causing translation problems with contemporary documents.

- The classification of "peoples" into English, Irish, Scots, French, and so on. These designations were by no means so clear at the time—the whole discourse of national genius really only arose in the 19th century.
- The classification of events into revolutions, reforms, revolts, rebellions, and so forth (cf. Furet, 1978, on thinking the French revolution). There really was no concept of "revolution" at the time; our current conception is marked by the historiographic work of Karl Marx.
- The classification of a "monarchy." What is a monarchy? There is a strong historiographic tradition that says that Oliver Cromwell was a monarch—he walked, talked, and acted like one, after all. Under this view, there is no hiatus at all in this English institution; rather an usurper took the throne.

There are two major schools of thought with respect to using classification systems on the past, one saying that we should only use classifications available to actors at the time (authors in this tradition warn against the dangers of anachronism; Hacking (1995) on child abuse is a sophisticated version) and the other that we should use the real classifications that progress in the arts and sciences has uncovered (typically history informed by current sociology will take this path; for example, Tort's (1989) work on "genetic" classification systems, which were not so called at the time but which are of vital interest to the Foucaldian problematic). Whichever we choose, it is clear that we should always understand classification systems according to the work that they are doing and the network within which they are embedded.

When we ask historical questions about the deeply and heterogeneously structured space of classification systems and standards, we are dealing with a four-dimensional archaeology: Some of the structures it uncovers are stable, some in motion; some evolving, some decaying. An institutional memory, about say, an epidemic, can be held simultaneously and with internal contradictions (sometimes piecemeal or distributed and sometimes with entirely different stories at different locations) across (a given institutional) space.

In the case of AIDS, for example, there are shifting classifications over the last 20 years, including the invention of the category in the first place. There is then a backward look at cases that might have been AIDS before we had the category (a problematic gaze to be sure, as Bruno Latour (in press) wrote about tuberculosis; see also Star & Bowker, 1997). There are the stories about collecting information about a shameful disease and a wealth of personal narratives about living with it. There is a public health story and a virology story, which use different category systems. There are the standardized forms of insurance companies and the categories and standards of the census bureau; when an attempt was made to combine them in the 1980s to disenfranchise young men living in San Francisco from getting health insurance, the resultant political challenge stopped the combination of this data from being so used. At the same time, the blood banks refused for years to employ HIV screening, thus refusing the admission of another category to their blood labeling and thus, as Shilts (1987) told us, with many casualties as a result.

Practical Politics

Someone, somewhere, often a body of people in the proverbial gray suits and smoke-filled rooms, must decide and argue over the minutiae of classifying and standardizing. The negotiations themselves form the basis for a fascinating practical ontology—our favorite example is when is someone really alive? Is it breathing, attempts at breathing, movement? And how long must each of

those last? Whose voice will determine the outcome is sometimes an exercise of pure power: We, the holders of Western medicine and of colonialism, will decide what a disease is and simply obviate systems such as acupuncture or Ayruvedic medicine. Sometimes the negotiations are more subtle, involving questions such as the disparate viewpoints of an immunologist and a surgeon, or a public health official (interested in even one case of the plague) and a statistician (for whom one case is not relevant; Neumann & Star, 1996).

Once a system is in place, the practical politics of these decisions are often forgotten, literally buried in archives (when records are kept at all) or built into software or the sizes and compositions of things. In addition to our archaeological expeditions into the records of such negotiations, we provide here some observations of the negotiations in action. Finally, even where everyone agrees on the way the classifications or standards should be established, there are often practical difficulties about how to craft their architecture. For example, a classification system with 20,000 "bins" on every form is practically unusable. (The original International Classification of Diseases had some 200 diseases, not because of the nature of the human body and its problems, but because this was the maximum number that would fit the large census sheets then in use.) Sometimes the decision about how fine-grained to make the system has political consequences as well. For instance, describing and recording the tasks someone does, as in the case of nursing work, may mean controlling or surveilling their work as well, and may imply an attempt to take away discretion. After all, the loosest classification of work is accorded to those with the most power and discretion, who are able to set their own terms.

These ubiquitous, textured classifications and standards help frame our representation of the past and the sequencing of events in the present. They can best be understood as doing the ever-local, ever-partial work of making it appear that science describes nature (and nature alone) and that politics is about social power (and social power alone). Consider the case discussed at length by Young (1995) and Kirk and Kutchins (1992) of psychoanalysts who, to receive reimbursement for procedures, needed to couch them in a biomedical language (the *DSM*) that was anathema to them but was the lingua franca of the medical insurance companies. There are local translation mechanisms that allow the *DSM* to continue to operate and to provide the sole legal, recognized representation of mental disorder.

CONCLUSION

This article is a methodological think piece about the ways in which classifications (and standards) impinge in myriad ways on our daily lives. The fact that they are frequently invisible to us ("transparency" being the highest goal in most information systems) does not make them any the less political and ethically charged. We have suggested four principles garnered from our own research and that of others that can together be used to give a picture of their scope and reach. Together, the principles suggest a "reverse engineering" of classification systems to reveal the multitude of local political and social struggles and compromises that go into the constitution of a universal classification.

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REFERENCES

Abbate, J., & Kahin, B. (Eds.). (1995). *Standards policy for information infrastructure.* Cambridge, MA: MIT Press.

Addelson, K. P. (1994). *Moral passages: Toward a collectivist moral theory.* Boston: Routledge & Kegan Paul.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.

Ascher, M. (1981). *Code of the Quipu: A study in media, mathematics, and culture.* Ann Arbor: University of Michigan Press.

Baudrillard, J. (1990). *Cool memories.* New York: Verso.

Becker, H. S. (1996). The epistemology of qualitative research. In R. Jessor, A. Colby, & R. A. Shweder (Eds.), *Ethnography and human development: Context and meaning in social inquiry* (pp. 53–71). Chicago: University of Chicago.

Berman, S. (Ed.). (1984). *Subject cataloging: Critiques and innovations.* Binghamton, NY: Haworth Press.

Berman, S. (1993). *Prejudices and antipathies: A tract on the LC subject heads concerning people.* Jefferson, NC: McFarland.

Bowker, G. C. (1994). *Science on the run: Information management and industrial geophysics at Schlumberger, 1920–1940.* Cambridge, MA: MIT Press.

Bowker, G. C., & Star, S. L. (1994). Knowledge and infrastructure in international information management: Problems of classification and coding. In L. Bud-Frierman (Ed.), *Information acumen: The understanding and use of knowledge in modern business* (pp.187–216) London: Routledge & Kegan Paul.

Bowker, G. C., & Star, S. L. (1999). *Sorting things out: Classification and its consequences.* Cambridge, MA: MIT Press.

Busch, L. (1995, May). *The moral economy of grades and standards.* Paper presented at a conference on agrarian questions. Wageningen, The Netherlands.

Cicourel, A. (1964). *Method and measurement in sociology.* New York: Free Press.

Cole, M. (1996). *Cultural psychology: A once and future discipline.* Cambridge, MA: Harvard University Press.

David, P., & Rothwell, G. S. (1994). *Standardization, diversity and learning: Strategies for the coevolution of technology and industrial capacity.* Stanford, CA: Center for Economic Policy Research, Stanford University.

Desrosières, A., & Thévenot, L. (1988). *Les catégories socio-professionnelles.* Paris: Découverte.

Dewey, J. (1916). *Essays in experimental logic.* Chicago: University of Chicago Press.

Dewey, J. (1929). *The quest for certainty: A study of the relation of knowledge and action.* New York: Monton, Balch.

Figert, A. (1996). *Women and the ownership of PMS: The structuring of a psychiatric disorder.* Chicago: Aldine de Gruyter.

Foucault, M. (1970). *The order of things: An archaeology of the human sciences.* London: Tavistock.

Foucault, M. (1982). *The archaeology of knowledge* (A. M. Sheridan Smith, Trans.). New York: Pantheon.

Furet, F. (1978). *Penser la revolution Francaise.* Paris: Gallimard.

Goodwin, C. (1996). Practices of color classification. Ninchi Kagaku. *Cognitive Studies: Bulletin of the Japanese Cognitive Science Society, 3,* 62–82.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 78,* 1360–1380.

Hacking, I. (1995). *Rewriting the soul: Multiple personality and the sciences of memory.* Princeton, NJ: Princeton University Press.

Hutchins, E. (1995). *Cognition in the wild.* Cambridge, MA: MIT Press.

ICD–10 International Statistical Classification of Diseases and Related Health Problems. (1992). (10th rev., Vol. 1). Geneva, Switzerland: World Health Organization.

Keller, C. M., & Keller, J. D. (1996). *Cognition and tool use: The blacksmith at work.* Cambridge, England: Cambridge University Press.

Kirk, S. A., & Kutchins, H. (1992). *The selling of DSM: The rhetoric of science in psychiatry.* New York: deGruyter.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society.* Milton Keynes, England: Open University Press.

Latour, B. (in press). *Did Ramses II die of tuberculosis? On the partial existence of existing and non-existing objects.* Manuscript in preparation.

Neumann, L. J., & Star, S. L. (1996). Making infrastructure: The dream of a common language. In J. Blomberg, F. Kensing, & E. Dykstra-Erickson (Eds.), *Proceedings of PDC (Participatory Design Conference) '96* (pp. 231–240). Palo Alto, CA: Computer Professionals for Social Responsibility.

Robbin, A. (1998). *The politics of racial and ethnic group classification.* Unpublished manuscript, School of Information Studies, Florida State University, Tallahassee.

Roberts, M. N., & Roberts, A. F. (Eds.). (1996). *Memory: Luba art and the making of history.* New York: Museum for African Art.

Sacks, H. (1975). Everyone has to lie. In M. Sanches & B.G. Bount (Eds.), *Sociocultural dimensions of language use* (pp. 57–80). New York: Academic.

Sacks, H. (1992). *Lectures on conservation* (Vols. 1– 2). Oxford, England: Basil Blackwell.

Schön, D. A. (1963). *Displacement of concepts.* London: Tavistock.

Shilts, R. (1987). *And the band played on: Politics, people, and the AIDS epidemic.* New York: St. Martin's Press.

Star, S. L. (1991). Power, technologies, and the phenomunology of standards: On being allergic to onions. In J. Law (Ed.), *A sociology of monsters? Power technology and the modern world* (Sociological Review Monograph, 38, 27–57). Oxford, England: Basil Blackwell.

Star, S. L. (1995). *The cultures of computing* (Sociological Review Monograph Series). Oxford, England: Basil Blackwell.

Star, S. L., & Bowker, G. (1997). Of lungs and lungers: The classified story of Tuberculosis. *Mind, Culture, and Activity, 4,* 3–23.

Star, S. L., & Strauss, A. (1999). Layers of silence, arenas of voice: The ecology of visible and invisible work. *Computer-Supported Cooperative Work: The Journal of Collaborative Computing, 8,* 9–30.

Strauss, A. L. (Ed.). (1970). *Where medicine fails.* Chicago: Aldine.

Strauss, A. L., Fagerhaugh, S., Suzcek, B., & Wiener, B. (1985). *Social Organization of Medical Work.* Chicago: University of Chicago Press.

Suchman, L. (1994). Do categories have politics? The language/action perspective reconsidered. *Computer-Supported Cooperative Work: The Journal of Collaborative Computing, 1,* 177–190.

Tort, P. (1989). *La raison classificatoire: Les complexes discursifs: quinze etudes.* Paris: Aubier.

Turkle, S. (1995). *Life on the screen: Identity in the age of the internet.* New York: Simon & Schuster.

Turnbull, D. (1993). The ad hoc collective work of building gothic cathedrals with templates, string, and geometry. *Science, Technology, & Human Values, 18,* 315–343.

Winner, L. (1980). Do artifacts have politics? *Daedalus, 109,* 121–136.

Young, A. (1995). *The harmony of illusions: Inventing post-traumatic stress disorder.* Princeton, NJ: Princeton University Press.