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Susan Leigh Star

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Susan Leigh Star¹

Abstract

There are three components to boundary objects as outlined in the original 1989 article. Interpretive flexibility, the structure of informatic and work process needs and arrangements, and, finally, the dynamic between ill-structured and more tailored uses of the objects. Much of the use of the concept has concentrated on the aspect of interpretive flexibility and has often mistaken or conflated this flexibility with the process of tacking back-and-forth between the ill-structured and well-structured aspects of the arrangements. Boundary objects are not useful at just any level of scale or without full consideration of the entire model. The article discusses these aspects of the architecture of boundary objects and includes a discussion of one of the ways that boundary objects appeared as a concept in earlier work done by Star. It concludes with methodological considerations about how to study the system of boundary objects and infrastructure.

Keywords

boundary objects, Leigh Star, Grounded Theory

¹ School of Information, University of Pittsburg, Pittsburg, PA, USA

Corresponding Author:

Geoffrey C. Bowker, Professor and Senior Scholar in Cyberscholarship, 601A IS Building

Email: gbowker@pitt.edu

Introduction

There are three dimensions and a critical set of dynamics in the model of boundary objects I put forward in 1988 and with Jim Griesemer in 1989 (Star 1988; Star and Griesemer 1989). Later, the concept would be scaled up by Bowker and Star (1999) in writing about some of the ways that multiple boundary objects and systems of boundary objects grow to become what we called “boundary infrastructures.”

Let us turn to the architecture of the boundary object. First, there is the aspect of interpretive flexibility, as there is in any object. So, as Griesemer and I argued, a road map may point the way to a campground for one group, a place for recreation. For another group, this “same” map may follow a series of geological sites of importance, or animal habitats, for scientists. Such maps may resemble each other, overlap, and even seem indistinguishable to an outsider’s eye. Their difference depends on the use and interpretation of the object. One group’s pleasant camping spot is another’s source of data about speciation. This aspect of boundary objects is hardly new in philosophy or history. Interpretive flexibility has been one cornerstone behind much of the “constructivist” approach in recent sociology of science, however. In addition, it has certainly been the aspect of the boundary objects model most noted and used and (in social science, medicine, organization theory, history and feminist theory, and in the new information sciences). Because it was in the right place at the right time, boundary objects became almost synonymous with interpretive flexibility.

The two other aspects of boundary objects, much more rarely cited or used, are (1) the material/organizational structure of different types of boundary objects and (2) the question of scale/granularity. Boundary objects are a sort of arrangement that allow different groups to work together without consensus. However, the forms this may take are not arbitrary. They are essentially organic infrastructures that have arisen due to what Jim Griesemer and I called “information needs” in 1989. I would now add “information and work requirements,” as perceived locally and by groups who wish to cooperate. “Work” is also a word that stretches, and should, to include cooperation around serious play endeavors such as skiing, surfing, and hiking (in other words, work-play is a continuum; what is important for boundary objects is how practices structure, and language emerge, for doing things together (Becker CITE).

The words “boundary” and “object” may need some explaining, as well. Often, boundary implies something like edge or periphery, as in the boundary of a state or a tumor. Here, however, it is used to mean a shared

space, where exactly that sense of here and there are confounded. These common objects form the boundaries between groups through flexibility and shared structure—they are the stuff of action. Originally, I entertained the idea of calling them “marginal objects,” which would have been even more confusing. Marginality in sociology, in earlier times, refers to those who belong to two or more significant social groups, such as those who are of mixed racial heritage. However, today, marginality invokes the idea of margin/periphery and the fiction of a center even more than does boundary, and I decided to use boundary as a compromise word.

In common parlance an object is a thing, a material entity composed of more or less well-structured stuff. In the term “boundary object,” I use the term object in both its computer science and pragmatist senses, as well as in the material sense. An object is something people (or, in computer science, other objects and programs) act toward and with. Its materiality derives from action, not from a sense of prefabricated stuff or “thing”-ness. So, a theory may be a powerful object. Although it is embodied, voiced, printed, danced, and named, it is not exactly like a car that sits on four wheels. A car *may* be a boundary object but only when it is used between groups in the ways described above.

Bowker and I discuss the four-dimensional and complex meanings of both boundary and object in Chapter 9 of our book, *Sorting things Out: Classification and Its Consequences* (1999). We are in a sense stuck with using Newtonian language for quantum phenomena. This becomes less confusing when each term is explained with respect to actions and cooperation, I hope. However, boundary objects are at once temporal, based in action, subject to reflection and local tailoring, and distributed throughout all of these dimensions. In this sense, they are n-dimensional.

In the original boundary objects article, Griesemer and I suggested four forms that these objects might take, based on particular forms of action and cooperation. (These were NOT meant to be exclusive, but to start a more general kind of catalogue!) For example, we suggested that one kind of object, a repository, took the form of a set of modular things. These are things that might be individually removed without collapsing or changing the structure of a whole. A library, for example, or a collection of case studies (as in some parts of medicine, or in the Talmud), is a repository.

A repository of this sort comes from the need for an assembly of things that are conceived iteratively. It has the feature that heterogeneity (internally) across things can be maintained but need not become confrontational. In a repository, the heuristic advantage is the encapsulation of internal units

(the pages of a book are bound by covers or electronic conventions; the limits of a Web site by the initial URL).¹

The instance-based work and information needs, the ontology of the repository are well suited for conducting private investigations (either individually or in small groups), and controlling the nature of commentary or debate. It is not initially a formal sort of a work process (i.e., dropping away particulars) but rather an iterative one (that preserves particulars).

Other forms vary, some allowing for shared vagaries, when heterogeneity is smuggled in (in a sense) by individual groups, not mentioning this across groups, but rather quietly allowing the vagueness to float on the virtual table of cooperative work.

Since the publication of the original boundary object papers some twenty years ago, many other forms have been suggested: textbooks, performances, computer operating systems, and various aspects of design. I have never made any attempt to adjudicate or prevent how anyone uses the concept. It has felt a bit unseemly, perhaps, contrary to the original spirit of the development of the concept itself. However, in the dozens of talks and presentations I have given, I am invariably asked the question, “*well, but what is NOT a boundary object?*” (or, along the same lines, “*Couldn’t anything be a boundary object?*”). I will discuss my answer to these questions below, in the context of discussing my own research practices and values.

Finally, I turn to the promised third component: the processes implied by the description of boundary objects. My initial framing of the concept was motivated by a desire to analyze the nature of cooperative work in the absence of consensus. Many models, in the late 1980s and continuing today, of cooperation often began conceptually, with the idea that first consensus must be reached, and the cooperation could begin. From my own field work among scientists and others cooperating across disciplinary borders, and two historical analyses of heterogeneous groups who did cooperate and did not agree at the local level, it seemed to me that the consensus model was untrue. Consensus was rarely reached, and fragile when it was, but cooperation continued, often unproblematically. How might this be explained?

The dynamic involved in this explanation is core to the notion of boundary objects. Griesemer and I defined these as the following:

- The object (remember, to read this as a set of work arrangements that are at once material and processual) resides between social worlds (or communities of practice) where it is ill structured.
- When necessary, the object is worked on by local groups who maintain its vaguer identity as a common object, while making it more specific,

more tailored to local use within a social world, and therefore useful for work that is NOT interdisciplinary.

- Groups that are cooperating without consensus tack back-and-forth between both forms of the object.

This latter dynamic has often been ignored in papers using the boundary object concept, except through the mention of it as solving a particular kind of problem. I did not mean in the 1988, 1989, or the 1999 usages that this be the final word. For example, when the movement between the two forms either scales up or becomes standardized, then boundary objects begin to move and change into infrastructure, into standards (particularly methodological standards), and into things and yet other processes, which have not yet been fully studied as such.

Origins of Boundary Objects in Earlier Work

John Dewey said that inquiry begins in doubt and ends when that tension is relieved. My initial inquiries into nature of scientific knowledge began as ethnographic journeys—examining the way that scientists work together, in the context of their allies and institutions. Because I come from a tradition in sociology that has tended to study people from all walks of life, I was predisposed to look at the ecology of the workplace—all of the things that are involved in the mediation of knowledge, from the janitor to the Nobel prize winner. (Symbolic interactionism, and/or the Chicago School of sociology, cherishes this as hallmarks.)

I teach students in my fieldwork classes to listen and look for two things: first, for the special language used in the location, metaphors, *mots justes*, turns of phrase, private codes used by one group and not another. Second, for things that strike them as strange, weird, and anomalous. What is causing them doubt? How may it become inquiry? In this, the strength of fieldwork is its anthropological strangeness and nowhere is that more important than in the beginning stages of inquiry.

Over the past several years, in studies of various groups of scientists, technicians, doctors and nurses, and patients, I have often encountered that funny feeling of finding an anomaly, sometimes embedded in the distinct language of a workplace or health care venue. It is a little irritating feeling, kind of a pre-sneeze sensation—and it is also exciting. Learning to trust this message is the toughest lesson I have to teach my students—no less than myself.

Below, I will highlight five anomalies that have tickled my nose, and use them to form the basis for a discussion of infrastructure and boundary objects, and the program of research into standards I have been developing over the past few years.

The first three come from a study I did some years ago of neurophysiology and brain surgery. After a field study in an electroencephalogram (EEG) lab, I wrote a historical book on a group of nineteenth-century British researchers, administrators, and patients who were trying to locate functional areas in the brain (Star 1989). In fact, they as a group invented modern brain surgery—over the forty-year period I studied, at the beginning the mortality rate was 100 percent; by the end it had fallen to about 60 percent. I read hospital records, letters from patients and their families, lab notebooks, administrative records, notes about patience from both physicians and surgeons, and published documents.

My first anomaly occurred while I was analyzing one of the physician/physiologist David Ferrier's notebooks in the Royal College of Physicians archives in London. The archives are royally housed in an imposing building overlooking Hyde Park, lushly carpeted in deep red, and bookcases filled with leather-bound gold-trimmed volumes. After carefully divesting myself of anything toxic, such as a pen or food that might damage the materials, I was seated at a mahogany table, and Ferrier's lab notebooks were brought out to me—literally—on a silver platter. Gingerly lifting them up (hoping I was not sweating or anything else a primate might do) I gingerly opened the old book. I turned to one experiment where Ferrier records his attempt at trying to measure the effect of a lesion he produced earlier in the day, on the brain of an ape. The ape is less than cooperative—Ferrier's handwriting occasionally flies off the page, wobbles, and trails off in what clearly is a chase around the room after the hapless animal. The pages, in sharp contrast to my chapel-like surrounds, are stained with blood, tissue preservative, and other undocumented fluids. By contrast—and this is a finding repeated in sociology of science through the 1980s—the report of the experiment is clean, deleting mention of the vicissitudes of this experimental setting. This anomaly drew my attention to two things: the magnitude of invisible work that subtends any scientific experiment or representation and the materiality that acts to mediate the conduct of science. Invisible work, a concept I had encountered in doing feminist activist work, originally referred to unpaid housework (see Star and Strauss 1999). I went on to develop models of invisible work for computer systems development and to examine the kinds of materiality involved in museum representations. In all of these, the gap between formal representations, including

publications, and unreported “back stage” work, became itself an important site of analysis. It subtly influenced the development of boundary objects in the sense of understanding local tailoring as a form of work that is invisible to the whole group and how a shared representation may be quite vague and at the same time quite useful.

The second anomaly came from the same brain study, this time from a set of clinical data on epileptic patients. The same researchers who were doing nasty things to monkeys were also looking at human patients—those with brain tumors, epilepsy, syphilis, and other “nervous disorders.” They were not well funded, and at the time, physiological research on either animals or humans was relatively rare and highly contested in nineteenth-century Britain. Absent modern medical telemetry, researchers enlisted the families of epileptic patients to record information about seizures on what they called “fits sheets,” or printed forms, which had checklists of symptoms, timing, and other data. Family members, poor and afflicted as they all were, tried desperately to comply in the data collection effort. The forms they filled out are moving documents revealing the relations of class and medicine in late nineteenth-century England, penciled in, misspelled, and assiduously brought to the doctor’s files. And they tell another story as well: all around the edges of the documents are scribbled messages to the doctor that do not fit the actual form. “Had too much hot soup yesterday.” “Exposed to night air.” “Rode alone in carriage.” A whole folk medicine exists in the side comments—alongside the filled-in forms. However, this wealth of information was discarded as unimportant—lost in the files—even though in a sense the patients were acting as research assistants to the clinicians. This anomaly drew my attention to the problem of collecting, disciplining, and coordinating distributed knowledge. How does delegated work—what Julius Roth called “hired hand research” affect data quality? How do forms shape and squeeze out what can be known and collected?² (see Thévenot 1986, for a lovely analysis.) The current Web-based patient information exchange groups face conceptually similar problems of group memory, language differences, and what fits on the forms of traditional medicine versus what the patients really know in their lives. I went on to analyze this problem with Bowker in our model of the management of data collection in the international classification of diseases, and the tensions between traditional systems of medical knowledge and the forms distributed by the WHO (1999), and later, with Martha Lampland, in an analysis of standardization (2009). I began to think of standards and boundary objects as inextricably related, especially over time.

The third anomaly, and my final brain example, comes from another set of documents in another posh British library. In the archives of The Royal Society, sticking again with the red velvet trope, but not the silver platter, I found a curious set of referee reports of a paper David Ferrier submitted to the Society for publication. The paper was partly based on the experiments I examined with the monkeys. To explain fully the weirdness of this, one must realize first that monkey brains and human brains are very different in size and shape, and presumably, function (although in this latter sense, perhaps not as different as we think). Ferrier had been trying to plot, at the millimeter level of scale, differences in function when he administered electricity to the surface of the monkey's brain. The article is about *human* brain function. Lacking human subjects (Penfield's famous surgical experiments with epileptics were almost a century later), Ferrier took the expedient step of simply taking the monkey map and transposing the circles marking functional areas directly onto the human brain sketch. Anatomically, this is the functional equivalent of taking a map of the Paris subway and superimposing it on Cleveland, and using it to talk about traveling around Cleveland, reasoning that all large cities essentially have the same sort of transportation infrastructure, just as all mammals, or primates, have the same localization of function in the brain.

Ferrier's article was published, and was an enormous success. Why? I asked myself. The answer seemed to be that the map did not *need* to be accurate to be useful. It could serve as the basis for conversation, for sharing data, for pointing to things—without actually demarcating any real territory. It was a good communicative device across, for example, the goal is worlds of clinical and of basic research. Its mediational qualities seemed to be that it “sat in the middle” between different groups, very ill structured or sketchy in the common usage. But when a clinician or physiologist needed a real map, they would take the lineaments of Ferrier's diagram and adjust it to their own needs for surgery or the study of lesions. Later, in a related study of amateurs and professionals in a zoological museum, I would come to identify this class of arrangements as that “tacking” functionality in using boundary objects and also in identifying a type of boundary object Griesemer and I called a Platonic form.

The next *éclat* came while working in another archive, this time the Bancroft Library at the University of California, Berkeley. This archive requires the same sort of hushed *rite de passage* as did the British ones—I had to leave my lunch, my pens, and my backpack in a specially provided locker before entering. This time, being some years later, I was allowed to take in a pencil and a personal computer. Here in California, one fills out

little slips of paper and applies for boxes, which you yourself then cart over to the table you are using. No silver platters, but the lighting is much better. I was examining the letters, field notebooks, and accounts of the development of the Museum of Vertebrate Zoology, founded in 1906. This was a fascinating venue in which to develop the boundary objects idea—amateur naturalists, trappers, professional biologists, philanthropists, and university administrators all left their imprint on the museum's development. I was able to flesh out the triangulation, mediation, standardization, and translation issues much more thoroughly here. Here is the anomaly: One day, as I was reading a particularly dull bit of the accounts and receipts from an expedition to the Mojave to document gopher behavior, I lifted up one of the manila folders, opened it, and much to my astonishment, a dead bluebird (totally desiccated) fell out. A letter was also in the folder—"Dear Dr. Grinnell, I found this in my yard and I want to know what this is. I know you are the man who knows about these things. Can you help me?"

Grinnell, being a courteous man, I am sure answered the person's query, although there was no record of his reply in the archives. At the same time, the image of the bird stuck with me forcefully. This thing did not fit his categories. In natural history, if you collect something without a proper label, or documentation of its habitat, it essentially is useless for the professional biologist (or as one respondent at the museum, a curator, told me bluntly, "without a label, a specimen is just dead meat"). But Grinnell was also a "birder," active in amateur circles. Perhaps, he knew the man who wrote the letter. He did not throw out the bird; instead, he found a file folder and stuck it in there with a bunch of miscellaneous receipts. This fourth anomaly drew my attention to those things that do not fit categories or standards, which literally or figuratively get shoved into the nearest file folder or functional equivalent. Strictures and standards, and the exercise of brute force solutions to intercategory problems, have continued to fascinate me. This has come to include people as the objects of both scientific and political marginality or "otherness." I have both taught courses on marginality and written about the topic. Intercategorical objects, residual categories (such as "not elsewhere specified") and how standards make "others" are problems I am still trying to analyze.

My fifth and final example comes from a more recent study, an ethnographic study I conducted of a community of biologists who were sequencing the genome of a nematode. I worked as a partner with a computer scientist/systems developer to make sure that the system, an electronic data sharing/publication "virtual lab" matched the work needs of the biologists. This was one of the early attempts by funders to design "collaboratories"

and encourage data sharing between scientists (collaboratoires, in French). This occurred in the early 1990s, just at the advent of the Web, and it was itself not Web based. (I might add that I was contacted by this computer scientist after he read the brain book and recognized all of the workplace challenges involved in building a system to communicate across social worlds!) The anomaly I will write of here occurred during the course of traveling to more than forty laboratories and interviewing nematologists (worm biologists) about their use of the prototype system. A typical interaction: I would telephone a laboratory and say, I'm Leigh Star, and I'm doing requirements analysis and usability for the Worm Community system. Are you using the system? May I come and watch you work and interview you about it?" They would say, yes, sure, we love the system, come on over. So I would come on over—where "over" sometimes meant flying from England to Vancouver—and arrive in the lab, yellow legal pad and pen at the ready to take my field notes. I would begin to ask them to show me how they had installed the system and where it fit in the flow of their work. On several occasions, the interaction unfolded like this, me: "So, show me how you use WCS." "Um, well, I know it's here somewhere. Let me just check. No, that's right, there's a postdoc who's using it. She's not in today." (yelling) "Anybody here using WCS?" I would, very patiently I thought, point out that they had said they were using the system. Where was it? Then the anomalous phrase that made my ethnographer's nose twitch: "Oh, we are using it. We're just about to use it." Where was the conflation of future and present coming from? Were they just trying to spare my feelings? These were not otherwise mendacious people (in fact they were lovely and honest), and they were not afraid to criticize the system or give me feedback on it. As I delved deeper into the relations between developers and users, it became clear that a kind of communicative tangle was occurring. I used to work of Gregory Bateson, who had studied these sorts of communicative mishaps under the heading of "double binds." As with Bateson's work on schizophrenics, and what he called "the trends-contextual syndrome," the messages that were coming at level one from the systems developers were not being heard on that level by the users and vice versa. What was obvious to one was a mystery to another. What was trivial to one was a barrier to another. Yet, clarifying this was never easy. The users liked the interface when they were sat in front of it. Yet, they did not know how to make a reliable working infrastructure out of it. They would ask the WCS team, who would reply in terms alien to them. I began to see this as a problem of infrastructure—and its relative nature.

My colleague Karen Ruhleder and I used this puzzle to develop a list of characteristics of infrastructure (Star and Ruhleder 1996):

- *Embeddedness*. Infrastructure is sunk into, inside of, other structures, social arrangements and technologies;
- *Transparency*. Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks;
- *Reach or scope*. This may be either spatial or temporal—infrastructure has reach beyond a single event or one-site practice;
- *Learned as part of membership*. The taken-for-grantedness of artifacts and organizational arrangements is a *sine qua non* of membership in a community of practice (Lave and Wenger 1991; Star 1996). Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalized familiarity with its objects as they become members;
- *Links with conventions of practice*. Infrastructure both shapes and is shaped by the conventions of a community of practice, for example, the ways that cycles of day–night work are affected by and affect electrical power rates and needs. Generations of typists have learned the QWERTY keyboard; its limitations are inherited by the computer keyboard and then by the design of today’s computer furniture (Becker 1988);
- *Embodiment of standards*. Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion.
- *Built on an installed base*. Infrastructure does not grow *de novo*; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base. Optical fibers run along old railroad lines; new systems are designed for backward-compatibility; and failing to account for these constraints may be fatal or distorting to new development processes.
- *Becomes visible upon breakdown*. The normally invisible quality of working infrastructure becomes visible when it breaks: the server is down, the bridge washes out, there is a power blackout. Even when there are back-up mechanisms or procedures, their existence further highlights the now-visible infrastructure.
- *Is fixed in modular increments, not all at once or globally*. Because infrastructure is big, layered, and complex, and because it means different things locally, it is never changed from above. Changes take time and negotiation and adjustment with other aspects of the systems involved.

The fact of infrastructure as relative to the knowledge of particular communities of practice, and redefining it in other ways as above, has led to many articles and research projects trying to understand the nature of the growth, maturation, and death of infrastructures (both failed and successful infrastructures).

These five threads are woven together in all the studies I have done since the original boundary objects article, and in fact together form a program of research. The venues are varied, from nursing classification to South African apartheid, and on to standards as mentioned above. However, these analytic threads, originally arising from the study of anomalies, have been a useful base.

What is NOT a Boundary Object?

Any concept—from feminist standpoint theory to the circulation of capital or how markets function to structure democracy—is useful to some and not to others, is subject to partial usage and analysis, and is limited by scale and scope. The same is true of any idea or method. As I said above, I have always refrained from normative statements about the true and proper meaning and use of boundary objects. At the same time, because of those questions that have been asked of me in dozens of presentations about boundary objects, I would like to address this as a kind of collective answer on my part to some of those questions.

Scale

What is not a boundary object has much to do with scale. Many times, people have asked me about what is not a boundary object in the terms of a kind of scale question. That is, questions such as “could not anything be a boundary object?” Or “what about a word? Could not a word be a boundary object?” My answer to this has invariably been that all concepts are most useful at certain levels of scale. I think the concept of boundary objects is most useful at the organizational level. If one only thinks of the ambiguity of objects then the questions about “anything” are more obvious. However, better concepts about the ambiguity of words have come from philosophers of language such as Wittgenstein’s notion of language game, or from linguistic experiments in natural language processing. This includes the famous attempts to disambiguate statements such as “time flies like an arrow; fruit flies like a banana.” If one considers the question in light of the structure and dynamics presented above, then the answer is, yes, under

certain circumstances. For instance, when archaeologists and classical scholars collaborated to interpret particular words from the Rosetta stone, it would seem likely that a small group of words (or even a single word) could form a boundary object based on the nature of their work relationships. However, any word heard coming out of anyone's mouth certainly carries interpretive flexibility, for a listener, or audience. However, it is more rare for scholars to study the work arrangements and other characteristics outlined above of boundary objects considered as a set of working arrangements. The exception to this of course may be the study of scripture or certain philological enterprises.

Scope

Another kind of question I have often been asked about boundary objects concern highly diffuse, distributed objects that, like words, may or may not be attached to cooperative work arrangements. For example, a common question has been, "well, aren't the Beatles (or other very well-known people) boundary objects?" A variant on this sort of question includes asking whether the national flag, the Bible, a particular film, or other famous things could not be boundary objects.

My answer to this is similar to those I give concerning scale. Under some circumstances, any of those examples might become a boundary object. All are certainly subject to interpretive flexibility. However, I believe that the most useful level of scope for the concept is more specific. I think it would be more interesting to study people making, advertising, and distributing American flags, and their work arrangements and heterogeneity than to simply say that many people have different interpretations of the American flag. While this is true, it does not get us very far analytically in understanding both the materiality and infrastructural properties of this flag.

Conclusion: The Growth and Death of Boundary Objects

A final question concerning the boundaries of boundary objects concerns their origin, development, and, sometimes, death and failure. I believe that this concerns three dimensions: standards, methods, and residual categories. One way to tell the arc of this story is that a boundary object is arranged according to the parameters described above. Over time, people (often administrators or regulatory agencies) try to control the tacking back-and-forth, and especially, to standardize and make equivalent the ill-structured

and well-structured aspects of the particular boundary object. Examples of this abound in the digital world—consider the fate of different territorial representations under many geographical information systems (GIS) regimes. Older cartographic and qualitative representations, often themselves boundary objects, become standardized with respect to coordinates, databases that subdivide the maps, and which collapse the difference between an ill structured, shared object and a locally tailored object.

Over time, all standardized systems throw off or generate residual categories. These are categories that include “not elsewhere categorized,” “none of the above,” or “not otherwise specified.” As these categories become inhabited by outsiders or others, those within may begin to start other boundary objects . . . and a cycle is born. One of the things that I have become aware of in trying to capture this complex and longitudinal phenomenon is the need for new methods for capturing each aspect, including the nature of the back-and-forth between ill structured and well structured; the architecture of the infrastructures involved; and especially the movement within and from those inhabiting residual categories, and how they form new boundary objects. Below see figure 1, a sketchy visual representation of the cycle.

Methodological Considerations

One of the methods needs resulting from the above conundrums concerns a way to make objects of the actions presented above, especially the relationship between standardization and residual categories. Star and Busch (2009) have argued that the distribution of standards is at the core of many social justice issues concerning standardization. This includes what sorts of residual categories are generated by what sorts of standardization regimes have been developed in situ, as it were. Dwelling with the inhabitants and objects of residual spaces, even our own, is another methodological requirement. Because many of these processes occur over decades, if not centuries, there is a clear call for archival and historical expertise.

A combination of these requirements would move us forward in understanding the basic dynamics described above. A final requirement, and perhaps most important of all, is the further development of a sophisticated analytic framework for understanding information, lived experience, and infrastructure. We live in a world where the battles and dramas between the formal and informal, the ill structured and the well structured, the standardized and the wild, are being continuously fought. These battles are sometimes benign and sometimes tremendously helpful to humankind, such as

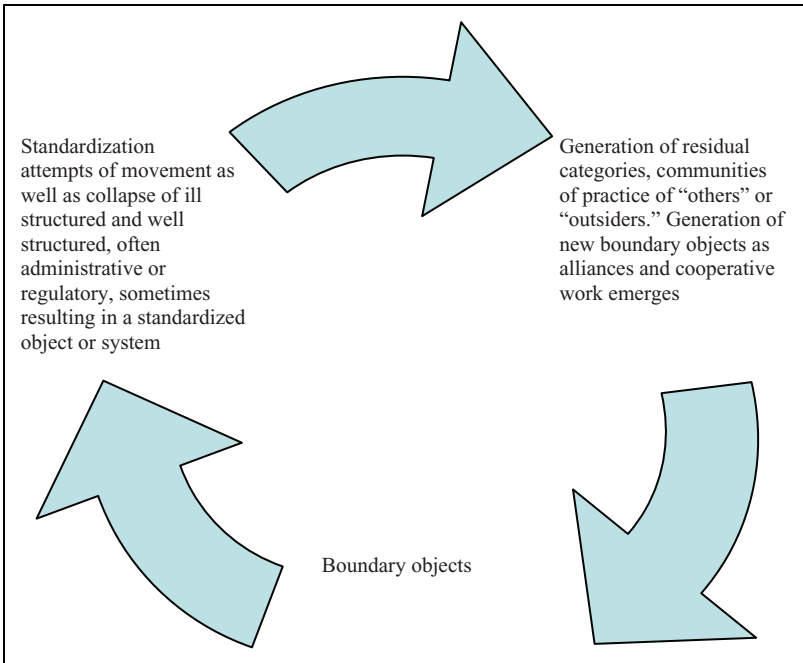


Figure 1. Relationships between standards and residual categories.

the standardization of climate change data (or attempts to do so). However, attempts to overstandardize (using tools such as electronic surveillance) are haunting social justice. So thickly imbricated are these battles now with electronic life and daily offline life that it is no longer a question of choice. If not now, when?

Notes

1. Of course, the boundaries of a Web site are more easily breached, more quickly than that of a book, in ways we are beginning to engineer and understand. But see Star (1998) on grounded theory and faceted classification for an examination of earlier attempts to create multiple sorts of "boundaries."
2. One of the funniest anomalies I ever encountered was one of my first research projects. I had signed up to work as an interviewer on a project in San Francisco that wished to document, from a psychological point of view, the sexual practices of gay men and lesbians over the age of sixty-five. Part of the data collection simply meant filling out forms with data including age, number of sexual partners in

the last year, occupation, and so on. During the data coding, I heard a voice from the other room, where the men were coding gay male information. We were in a separate room, coding lesbian data. The voice I heard yelled out, “What do I do, if I need three digits?” I giggled because the maximum number of sexual partners from the lesbian side was two; clearly, the men were living a more variegated sexual life! (This was in the late 1970s, just before the AIDS epidemic hit San Francisco and changed everyone’s sexuality).

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