Borderline Issues: Social And Material Aspects Of Design

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ABSTRACT

The shared use of artifacts is, we argue, supported by latent border resources, which lie beyond what is usually recognized as the canonical artifact. These unnoticed resources are developed over time as artifacts are integrated into ongoing practice and stable conventions or genres grow up around them. For a couple of reasons, these resources may now deserve increased attention. First, because they lie outside conventional frames of reference, many new designs and design strategies inadvertently threaten to remove resources on which users rely. Second, because of the increasingly rapid proliferation of new technologies, users have less time to develop new border resources. Consequently, we suggest, designers now need to understand more fully the role border resources play and to work more directly to help users develop them. Meeting these goals will require more than an intensification of user-centered design. It will require a fundamental redirection of the way many designers look at both artifacts and users.

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1. INTRODUCTION: LOANS AND THEIR TERMS

Designers are great borrowers. Pieces of Greece, Rome, Paris, or London can be found "borrowed" on almost any high street, rocket fins have turned up on the tail pipes of cars, peasant clothes from one year appear on high fashion models in another, and the images of last week's art films will probably reemerge in next week's advertisements. Information technology design does its share of borrowing too. Like the Corinthian column on the courthouse, the desktop, the file, the powerbook and notebook, the window, and the pad invoke old or familiar designs to help situate the new or unfamiliar, as designers draw on what Adler and Winograd (1992) described as "alternative design languages" (p. 7). Whereas once the literary critic I. A. Richards (1926) startled his profession by claiming that "a book is a machine" (p. 1), now no one is particularly surprised to see informational machines discussed in the language of books, buildings, documents, paintings, and the like. What is not clear, however, is whether not just the images, but also ideas, strategies, and problematics underlying these alternative languages can be borrowed.

Our argument makes three assumptions about such borrowing in the field of informational technology design. First, we believe that borrowing can go beyond

metaphors. We take design to be fundamentally a communicative process. Thus, although different fields of design have their own particular concerns and interests, they nonetheless have common roots. These shared roots allow designers to reach beyond borrowed images to the fundamental insights, concepts, and techniques that lie behind them.

Second, we believe that borrowing should go beyond metaphors. Conventional design practice has produced some highly robust devices. The door and the book, for instance, have remained remarkably stable across centuries. If information technology designers can understand the sources of the simple efficiency of such designs, then, we believe, they will be in a position to give a similar simplicity and efficiency to their own work. However, if they fail to understand such achievements, they may well condemn themselves to a painful and wasteful process of rediscovery.

Third, where they borrow, designers may also lend. Working in a field of constant change, information technology designers habitually deal with evolving practices, fluid conventions, and unpredictable uses. Designers in older and traditionally more stable fields are now starting to face similar conditions. If avenues of exchange are opened, information technology design both could and should not only borrow, but also lend. It will thereby help to transform (not simply replace) more conventional design genres, rather as the emergence of film and television and the interchange and borrowings of writers have helped to both preserve and transform conventional plays and novels.

In this article, we discuss strategies that different design fields might usefully borrow and lend with regard to the difficult notion of context. We choose this topic because context is an essential component of communication and a major source of simplicity and efficiency, yet many approaches to interface design aim for or proclaim "self-evidence," which implicitly or explicitly assumes that context independence can be achieved. If we are right in holding that design is at root a communicative process, then the sought after self-evidence and context independence are probably neither feasible nor desirable.

In the first half of this article, we look at aspects of context in well-rooted practices of design and use.[1] We begin by analyzing context in terms of (a) a center, (b) its periphery, and (c) the border that mediates between the two (Section 2.1). We argue that these are not inherent in an artifact or self-evident, and they cannot be predetermined by designers or producers. But they are socially constrained by what, borrowing from literary theory, we call genres (Section

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[1] We are well aware that ours is a partial and highly circumscribed notion of context. As we say, it is aspects, not all, of context that we want to consider—aspects, in particular, that information technology design often seems to us to overlook. For other notions and explorations of context, see, for example, the discussions in Lave and Chaiklin (1993).

2.2). With a series of examples from different fields of design, we try to show how people develop significant uses for apparently peripheral and borderline aspects of artifacts (Section 2.3). In a brief analysis of these examples, we argue that communities of users rely, in subtle but powerful ways, on the taken-for-granted continuity of an artifact's material properties (Section 2.4).

But, as we argue in the second half of the article, continuity can no longer be taken for granted. Consequently, formerly dependable contributions from the periphery are becoming less reliable (Section 3.1), leading to a curious conflict, which we call the *paradox of demassification* (Section 3.2). To address this paradox, we conclude, a designer needs to look beyond the object, engaging more closely with the social contexts of use and responding more directly to communities of users, the negotiations their members undertake, and the genres they develop (Section 4).

2. WORKING ON THE BORDER

2.1. Center, Periphery, and the Border

Undoubtedly, to designers contemplating the unpredictability of the uses and settings of what they design, grappling with context can appear about as attractive as wrestling with a whale: The task looks overwhelming, and the opponent offers few obvious handholds. Context independence, by contrast, appears much less demanding. Moreover, the informational potential of new technologies, which seems to allow them to communicate directly and independently to their users, makes context independence now seem achievable. We, however, have both theoretical and practical reservations.

Striving after self-evidence and its underlying context independence is theoretically problematic because self-evident, context-independent artifacts face self-referential difficulties of the sort illustrated in the "Cretan paradox" of Epimendes, who announced, "I am a Cretan, and all Cretans are liars." Artifacts in isolation cannot alone testify on their own behalf any more than Epimendes's words could reliably comment on their own credibility or the text of a bank draft can certify its own authenticity. Context, not simply content, underwrites interpretation.

Whatever its theoretical difficulties, ignoring context also presents practical problems. Trying to define new practices without reference to users' past insights, common intuitions, shared understandings, and hard-won experience is actually far more difficult than grappling with context. Whatever its claims to decontextualized purity, design always enlists some degree of contextual support. Indeed, the pervasiveness of such support generally allows designers to rely heavily, if sometimes unreflectively, on it. The more designers struggle to attain freedom from context, however, the greater the tasks they set not only for themselves, but for the users of their designs.

To encourage more reflective reliance on the contribution of context, we find it helpful to think in terms of a relation between center and periphery.[2] We make this shift for a couple of reasons. First, we want to stress, through the interdependence implicit in these terms, the fundamental interconnectedness and inseparability of objects and their contexts. As the philosopher Whitehead (1933) put it, objects are "the outcome of their interconnections" and cannot be understood "in complete disconnection" from one another and their contexts (p. 144). Second, notions of centrality and peripherality connote both material and social relations—physical, spatial location on the one hand, and socially established priority on the other. As will become clear in the course of this article, we see the interplay of material and social aspects of artifacts as particularly important.[3]

Undoubtedly, this shift in terms does not lead to a satisfying crisp, theoretical definition of the notion of context. However, center-periphery relations are neither crisp nor theoretical. Rather, they are indeterminate and practical, depending on practice and changing dynamically with it. What is central to one practice at one time may be peripheral at another. The noise of a machine, for instance, is usually peripheral for most users, but it can be central for a mechanic. Moreover, when attention, perspective, or practice changes, parts of the periphery may be swept to the center of attention and vice versa. When a machine malfunctions, its sound may move from the periphery of its user's attention to the center.

The extent of the center or the periphery is also complexly underdetermined. On one side, the periphery extends indefinitely away from the center. Stars light-years away have, for instance, long formed a significant part of the navigational periphery of boats. On the other side, the periphery merges indeterminately with the center. Here, aspects of an artifact regarded as part of the canonical center from one standpoint may be regarded as quite peripheral from another. In the temperate climate of California, for instance, architects often design buildings with "outdoor rooms." These break the conventionally defining lines of a building, bringing the outdoors in or the indoors out so that it is impossible at certain points to say whether you are definitively in or out.[4] Center and periphery, then, do not meet along a well-defined line, on one side of

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[2] For the provenance of our use of *periphery*, see Lave and Wenger (1991) and their concept of learning as "legitimate peripheral participation"; they, however, deliberately avoid a notion of the center. See also Wallerstein (1974).

[3] In this respect, our notion of periphery is related to but distinct from new interface designs that use peripheral visual or auditory cues to help people locate themselves (viz. Clarkson, 1991, 1992; Dourish & Bly, 1992; Gaver et al., 1992). Although they make good use of the physical periphery, these designs are less concerned with social-material processes than we are.

[4] To take another example, for some readers footnotes are as important as the rest of a text and indivisibly central; for others they are as marginal as the page number.

which stands the center and on the other the periphery. Notions of independence overlook this practical inseparability of artifacts from contexts and practice. Wherever a line is drawn, some users may claim important features have been left out, and others may claim that peripheral features have been brought in. Designers, nonetheless, have to draw lines.

We call part of this region where center and periphery meet the *border*: In practice, the border may be inseparable from both the center and the periphery of an artifact, but analytically it stands distinct from each. It is distinct from the center because, like the periphery, its connection to the center appears conceptually contingent rather than necessary. To most typists, for instance, the skeletal rattle appears quite unnecessary to the integrity of a keyboard. Nevertheless, the sound is actually a useful border feature. A noiseless keyboard would disrupt many typists' rhythm. Not being recognized as part of the canonical artifact, the border is then distinguishable from it.

However, the border is also distinguishable from the rest of the periphery if it plays a socially recognized role in the artifact's use. The noise of a keyboard, for instance, provides people with the useful information that a colleague is at work in the room next door. The key word in this aspect of border resources is *social*. Individually, people can and do interpret aspects of the periphery every which way. A six o'clock cacophony from a garbage truck indicates to one person that it's time to get up; a familiar footstep, that it's time to start work. Everyone invests aspects of their periphery with individual significance like this. Border resources are similar to these individual ones in many ways, but they are distinct because, unlike other aspects of the periphery, border resources are invested with socially shared, rather than individual, significance. The border comprises those aspects of an artifact and its periphery that are available to each person involved in a particular interaction with that artifact. Border resources are those resources that are socially shared.

The border is not, then, simply an indisputable physical feature. Like the border of nations, it may appear fixed, but as a physical manifestation of complex social practices and conventions it is always susceptible to alteration and renegotiation. And, for the border of artifacts, as for political borders, gaining social recognition in times of radical change is profoundly problematic. We address this problem of recognition in times of flux in the second part of the article, but first our goal is to illustrate the role of the border in conditions of relative stability.

2.2. Border Conventions

A functionally well-designed office building provides us with an example of the contextual role of center-periphery relations in design. From a distance, a building offers a single center to anyone approaching it, but on the sidewalk or in the parking lot, the building may present not one, but several possible centers. For new visitors, the center may be the "main entrance"; for others,

however, it may be the employees', the freight, or the mailroom entrance. Architects try to help users recognize the appropriate center by grouping different features to appeal to different users' interests and conventions. The ways these configurations are handled and distinguished, the way garbage trucks are indirectly pointed away from the executive parking lot and the way board members are kept away from the dumpsters, contribute significantly to what makes the building functionally well designed.

In giving such subliminal directions, good architects rely less on written signs than on distinctions among different communities' practices, interests, and expectations. They know that if the contrast is clear, some visitors will head toward the deep-pile carpet that suggests senior management's offices, whereas others will take the thicker pile as a sign to hurry away. Designers marshal their resources—materials, colors, shapes, volumes, light, and so forth—to separate different practices efficiently. Reciprocally, users "read" artifacts to find a coherent set of center-periphery relations corresponding to the practice in which they are engaged.[5]

In attempting to read an artifact, it is essential for the reader to recognize the general type, for the center-periphery conventions differ from one type to another. In office buildings, for instance, physical elevation tends to indicate social elevation, and in apartment buildings, too, more than just the number of floors separate ground-floor occupants from those in the penthouses.[6] However, in retail buildings, the reverse tends to be true—the upscale retailers come down to the street, whereas the less profitable, more down-to-earth concerns are up the narrow stairways. Thus, people need to know the type before they can accurately read the details.

With buildings, once visitors have established the type, they can find spatial distribution particularly informative, distinguishing not just the mail room from the men's room, but also the important from the marginal—moving back and forth between physical and conceptual structure to separate the sheep from the goats. The conventional arrangement of offices in a corporate headquarters, for instance, indicates the arrangement of officers far more accurately than an organizational chart. One indicates the corporation's actual pecking order, the other its idealized version. On the ground, it is usually clear that the important people are those commanding the corners and the best views, not the top line on a chart; power brokers are those in offices near the corridors of power; and less influential people are those socially on the periphery—although physically in

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[5] As the historian Darnton (1985) noted, "One can read a ritual or a city just as one can read a folktale or a philosophic text. The mode of exegesis may vary, but in each case one reads for meaning—the meaning inscribed by contemporaries in whatever survives of their vision of the world" (p. 5).

[6] Cohn (1982), an anthropologist, argued, "The ordering of space does not merely reflect social relations and social structure, but is part of the actual constitution of the sociological order" (p. 249).

the sunless center close to the plumbing and the elevators. Explicit, central pronouncements (e.g., organizational charts) are often powerless to overcome conflicting information provided more robustly by the border.

Keeping with this notion of reading, we call the types that respond to particular interpretive strategies genres (the literary term for a type).[7] Genres are socially constructed interpretive conventions that bridge the two sides of communication. Put crudely, on one side producers—architects, authors, designers, speakers, and the like—try to invoke a particular genre, to establish the conventions they are putting into play. The architect tries to make it clear that the building is a factory, not a jail, a warehouse, or a school. However, consumers—visitors, readers, users, listeners, and so forth—try to recognize what genre has been invoked, what conventions are in play so that they may respond appropriately. Thus, for example, an author tries to establish that a particular book is a novel, not an autobiography; a reader tests a range of generic assumptions until one is found to fit. Similarly, a product designer tries to establish that a particular product is a consumer appliance, not a commercial or industrial one; reciprocally, a consumer tries to recognize which type of appliance he or she is confronting and to respond accordingly.[8] The repackaging of the Macintosh. as the Performa or of the IBM. personal computer as a cheap personal computer reflects attempts in design and marketing to shift generic conventions and thereby to raise different expectations and attract different market segments.

Genres are not particularly esoteric things. People are choosing among them when they decide whether to communicate through a personal phone conversation, a handwritten scrawl, an e-mail note, an office memo, or a formal letter. In choosing one genre over another, the sender is trying to orient the recipient, recognizing that, although the words may stay the same, the different genres can give the words quite different significance.[9] Many corporate officers

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[7] The provenance of the term *genre* goes back at least to Aristotle. Our own highly partial use of the term owes something to Bakhtin (1986) and a great deal to Nunberg (1986, 1993).

[8] In practice, of course, things are not so simple. Not only do producers fail to establish or consumers fail to recognize appropriate genre indicators, but the process also proceeds as much by transgressing as by honoring established conventions. For the purposes of this article, we have, for the most part, put aside this transgressive aspect of design and communication.

[9] Late in the writing of this article we came upon the insightful work of Orlikowski and Yates on genres in organizational communication (Orlikowski & Yates, 1993; Yates & Orlikowski, 1992). Much of what we have to say—in particular the example of office communication we have just laid out—is in fundamental agreement with their work. We differ (although not necessarily disagree) with them in trying to extend notions of reading, of genre, and of the "document" beyond conventional uses to include all communicative artifacts—particularly designed ones. We also lay more

would be traumatized if their informal meeting notes were reinscribed as press releases or their private e-mail messages were distributed on public bulletin boards. Getting the genre right—both as writer or designer and as reader or user—is essential to good communication. Getting it wrong can be quite unfortunate.[10] Getting the genre right is partly an intricate border issue. Changing the border can effect a change in genres and thus in interpretive strategies. Corporate stationery gives a comment a quite different meaning than does a handwritten Post-its™ .

2.3. The Border in Practice

In this section, we try to show through a series of examples how the border works, circumscribing and constraining generic interpretation and lending support to social practices. We have clustered our examples under four rough headings: Engaging Interpretation, Maintaining Indexicality, Transmitting Authority, and Sustaining Interpretation. In doing this, however, we make no claim to being either systematic or exhaustive.

It will quickly become evident that many of our illustrations are drawn from text-based communication. There are a couple of reasons for this. First, because our ideas about reading and genre come from the world of texts, examples can most readily be found in the same domain. However, second and more significant, text provides a test case for the generality of our argument. More than almost any other object of design, text appears to be context-independent—to mean the same thing whether you read in your bath or your neighborhood bar, in Boston or Bali. Texts would seem to be quintessential "self-evident" artifacts. If, however, even texts can be shown to be dependent on their periphery, it seems less likely that other artifacts can pursue a claim for independence. It is thus important for our more general argument that we hold the textual line—insisting that even text does not stand independent of context.[11]

Engaging Interpretation: The Portable Context

We give our claim for the context dependence of text some rather curious scholarly support. Recently, a University of California faculty member clutching a hijack note was taken off a plane in Phoenix by FBI agents. Only later was it

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stress on the way the physical substrate of documents (broadly or narrowly construed) participates in generic structure (however, see Yates & Orlikowski,1992, p. 319).

[10] The author Daniel Defoe was fined, imprisoned, and pilloried when his ironic pamphlet, *The Shortest Way With Dissenters*, was taken as a serious proposal.

[11] Complex literary-critical arguments that we do not discuss here about *intertextuality* (Barthes, 1979), *heteroglossia*, and *dialogism* (Bakhtin 1981) provide more conventional scholarly support for our claims for the contextual dependence of text. For important arguments against the insistence of the author's intention as the source of meaning and decontextualized text as its repository, see McGann (1983).

discovered that the note had been written by a child who had previously held the professor's seat. In the hands of an adult, not a child, and in the cabin of an airplane, without the intervening context of a game, the text took on a menacing significance.

A phrase like "This is a hijack" can reasonably occur in a number of genres—in, for instance, a hijack note, a book about hijacking, or a child's game. Pilots, FBI agents, juries, book readers, or other players in a game need some clues to know which they are dealing with. Clearly, when the phrase occurs in a book on a beach, its conditions of interpretation are quite different from when it occurs in a note in the right hand of someone who might carry a pistol in the left. The different borders set up different expectations.

Borders are not always as crude or as singular as pistols. More commonly, they are subtle features that contribute individually but gather their force collectively. Words in a book may fit several genres—a detective novel or a tome about detective novels, for instance—and thus may be open to a variety of interpretations. A reader usually discovers the appropriate genre and thus appropriate interpretation by weaving (often subliminally) a coherent pattern from various elements that make up the book.[12] In preparation for this, writers, book designers, and publishers carefully prepare those elements. Their task is tricky because the elements to be woven vary not only with the genre, but also with the audience. Genre cues that work for one audience do not necessarily work for all. Personal notes or manuscripts that circulate locally, for instance, can rely on local clues like handwriting to help readers determine what the writer might mean. However, local clues have local limits. As a manuscript moves out to a wider audience, it must acquire more widely recognized, public indications of its genre.

Here, the distinction we made earlier between individual and social resources is important. Publishers face the problem that a reader's peripheral clues may be highly personal and extend well beyond the artifact itself into areas over which the publisher has no control. Highly informative clues can come from things like the friend's coffee table, the library stacks, or the store shelves on which the book appears. The reader may start to read these clues long before reading a word of the central text. Publishers and book designers are not, however, completely powerless in the face of personal clues. They try as best they can to anticipate problems from individual preconceptions and the larger periphery by, among other things, designing book covers to make their "general list" books look incongruous if they are mistakenly placed on "academic" shelves and to make their academic books look out of place on many coffee tables. As a result, readers can usually distinguish pulp thrillers from scholarly investigations of pulp thrillers or science fiction from cognitive science. A lurid cover plays an

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[12] For this notion of "weaving," the etymology of the words *text* and *context* is helpful. Both come from the Latin root word *texere*, which means "to weave."

important part in preventing the phrase "This is a hijack" from offering any threat—either as a hijacking note or as a relentless sociological study. Contrary to cliché, one usually can judge some things about a book by its cover.

As a manuscript moves through the publishing house, it accumulates increasingly public signals. Publishing is literally a process of making something public, so private "in-house" resources for local interpretation—the editor's initials on the cover, the author's handwritten comments in the margin, copy editors' marks, and so forth—are stripped away, and public resources are interwoven with the underlying text. These resources used include the cover and cover material: The book is very definitely bound for the public. Other public resources include the type, layout, decoration, illustrations, the color and texture of its paper, and even its bulk.[13] In trying to constrain interpretation with these public resources, publishers are working on the border. They work beyond the book's textual content to provide a portable, public context to orient readers and engage a particular reading.

This notion of a portable context is, we believe, useful for understanding design and design strategies more generally. To make the point that it was not 'just another computer," for instance, the Macintosh® was not shipped in just another box. Designers produced a skillfully designed portable context that would travel with the computer and help new users cross the distance between their everyday world and the highly circumscribed environment of the device. Opening the box began a carefully structured physical and conceptual induction into Macintosh® practice. Objects were oriented to be manipulated, boxes nested within boxes, and icons intriguingly directed the new owner toward a computational world of objects, nested files, and icons. The "Tour of the Macintosh®" began long before the user actually ran the program of that name.

Indeed, not only is packaging somewhat like book covers, but in many ways product design is itself a process of publication. Like a manuscript in a publishing house, new products in a lab circulate internally without much difficulty. Here people easily recognize the hand of a colleague and deduce from it what type or genre of device they are looking at. In the lab, artifacts usually do not need a portable context, because they are not going anywhere. Unfortunately, the unnoticed efficiency of local clues can make products seem self-evident and product design consequently superfluous. However, once a product moves out of the lab into the public sphere, it needs a publicly recognizable, portable context to help invoke apt interpretive conventions.[14] As a book designer works on the border to address a particular public and engage a particular interpretation, so a product designer works on a product's border to address and engage a particular market segment.

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[13] Bulk is significant enough in helping define big novels, that paper manufacturers even produce "high bulk" paper (which has been extensively aerated) to "bulk up" books. The discerning book buyer makes distinctions between bulk and heft.

[14] See, for example, Rheinfrank, Hartman, and Wasserman (1992).

Maintaining Indoxicality: Getting the Point Across

The process of publication extends the group addressed by an artifact's implicit "you" beyond the private, local audience. This extension does not, however, end in a form of universal address. Although it can be very broad indeed, not everyone is included. (After all, the poster proclaiming "Your country needs you" was not intended to recruit aliens to spy for the enemy.) Designers address particular audiences, not the world at large, and designed artifacts are always simultaneously both inclusive and exclusive, aimed toward particular market segments and away from others. When moving into new niches, designers have to redirect the implicit "you"—usually by working on the border.

The border also allows people to identify addresser ("I") and addressee ("you") and other contextual contributions more finely. *I, you*, and words such as *now*, *here*, *there*, *next*, *last*, *tomorrow*, and *below* are indexical terms. These words "index" or "point to" the context of communication. As such, indexicals are unquestionably related to the periphery: It is the socially accessible periphery of communication that they index. In face-to-face conversation, indexicals support extremely efficient communication. The shared periphery simply makes available the "I" who speaks, the "you" who listens, the "he" to whom "she" points, and the "here," where "we" are.

Indexicals can become problematic, however, in communications that bridge time and space—the very conditions in which communicative artifacts are needed. In these conditions, the greater part of the periphery of a speaker or writer is simply not available to a listener or reader. Limits on indexicals are apparent to anyone who has lost track of who "I" or "you" are in a conference call. Similarly, international callers can stumble over words like tomorrow, and people listening to answering-machine messages know that some indexicals, quite precise for the speaker, can be infuriatingly imprecise for a listener, who, without other clues, cannot tell when a message saying "call me within the hour" was left.

Indexicals can remain robust across space and time, however, if people can rely on the portable context or border to help locate their meaning. Thus, handwriting helps to represent the "I" of a written note. The header on an e-mail note allows a writer to refer to "yesterday." The background shot of the White House in a TV news story enables a correspondent to refer to "here." The currency of newspapers (but not magazines) permits a headline to use "tomorrow," and shared screen access helps separated colleagues to refer to "this" icon, file, or whatever.

In such mediated communication, the border can play a highly elliptical and efficient role. Consider, for instance, the phrase "I'm not here now." In conversation, the phrase is almost unintelligible. To whomever "I" refers has to be "here," wherever "here" is, "now," whenever the three are yoked together. Yet, the phrase is used without problem on telephone answering machines. Here the

phrase has its own efficient logic and is not easily replaced. In terms of the border, it is instructive to recognize what allows the phrase to work. The words themselves do not clinch the matter. The same phrase would be unclear if the caller thought that he or she were listening to a live voice, but the border intervenes to make clear that this is not the case: The recorded quality of the voice, the background clicks and whirs, and the tape hiss make what otherwise might seem absurd intelligible.

The integral contribution of the border in such cases is so efficient that its presence is barely noticed until the resource is lost. When such a border could not be assumed, messages were preceded by the clumsy announcement, "This is a recording." As the quality of telephone lines rose relative to the quality of tape recordings, the recorded quality of the message provided a border to distinguish the genre and provide a context for the indexical use. The introductory phrase then dropped out of practice. Now, however, in voice-mail systems the quality of the recorded message is once again level with that of the live voice. There is no useful border. As a result, phrases such as "Hi, this is my voice mail ..." are becoming widespread. Among other things, this suggests that designers need to develop a careful eye (or ear) for the border when they introduce change.

Transmitting Authority: Force at a Distance

Understanding communication involves answering the question: "Who said what to whom?" (Lasswell, 1936). As Williams (1976) argued, however, more complex questions also need to be answered, including "under what conditions?", "with what authority?", and "through what mediating forms?" People need to know not just who pronounces them man and wife, domestic partners, or members of the bar association or who endorses use of an artifact as safe or appropriate, but whether that person has the authority to do so and has done so correctly.

The propositional content of a document alone is clearly not sufficient to convey authority. Anyone can write *good* on a bad check. Any piece of paper can declare Park Place to belong to the bearer. Only certain pieces uphold that claim in court. (These, however, would carry no weight in a game of Monopoly .) In such cases the border, in particular the physical substrate of a communication and its various configurations, helps to embody, preserve, and represent authority. Hence, the king's seal carried more weight than his words alone, a promissory note is more forceful than a verbal promise, a will can be proved but a wish cannot. In all, a border distinguishes between mere words and deeds.

The recipient of a document has to read well beyond the text itself to discover a sense of the authors, their authority, and their intentions. When *Admit One* is written on a ticket that is issued at an entry kiosk, the broader periphery can be read. This helps make authentication relatively unproblematic. As movie tickets are generally sold only at the door, they need little extra authentication and are,

consequently, quite insubstantial. But when tickets are sold at a remove, their authorial force often can be traced only in their portable context—as scalpers well know. In the resolution of authority, many different resources can come into play. More valuable tickets are usually given a more elaborate portable context. They and other important documents require things like watermarks, letterheads, specific types of ink, elaborate printing, engraving, or embossing. Some even need a corroborative, documented history of their own.

A significant contribution to authority comes from what we call the social *inertia* of objects—the extent to which they demand significant resources to get into circulation and resist changes once there. Social inertia is often directly related to physical inertia. For example, one significant feature in recognizing the authority of a book is its heft. Hefty books are expensive, for publishers as well as buyers. Because publishers invest a great deal, including their reputation, in getting reference books into circulation, they want, at all costs, to avoid having to invest as much again to take them out to correct mistakes. So, the faith of those who rely on a hefty reference book rests less on the word authoritative on the title page than on the weight of the book in their hand. Words, in this context, are relatively cheap. The material substrate, by contrast, can be usefully expensive and provide a solid estimate of diligence and credibility.[15] The very features of a dictionary that provide the physical inertia to stop a truck simultaneously provide commensurate social inertia to stop arguments.

When technological changes strip away ponderous physical constraints, they may also be removing the social inertia that has underwritten authority. Desktop publishing has stripped letterheads of an inertia they once had. High-quality photocopiers threaten to undermine the inertia contained in the engraving block of bank notes. Similarly, as dictionaries are put on line, the authority expressed by the inertia of a 10-lb book on a conventional desk is hard to trace in the indication of a 200 K dictionary file on the computer desktop (see Nunberg, 1993). As material forms change, designers and users need to look for new means to reconstitute authority.

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[15] The American Library edition of Melville's novels offers an interesting example of publishers, faced with an unfortunate mistake, attempting to redefine the genre of an object to avoid having to take it out of circulation. The first edition appeared with the author's name misspelled in large letters on the title page. To avoid the cost of recalling and destroying the entire edition, the publishers sent each bookseller a letter announcing that of course they would provide a refund or a replacement, but the bookseller should first make it clear that, because the edition was being replaced, if buyers held on to their copies, the error made the edition not, as it had been, a definitive edition of Melville's work, but a "collectible."

Sustaining Interpretation: A Sense of Closure

The border does not, as these examples might suggest, merely help interpretation get under way; it also plays various roles to sustain it. The novelist David Lodge (1972) drew attention to an intriguing example of the intimate and progressive contribution of the material border to narrative. He pointed out that while reading, the reader's thumb and fingers holding the right side of a book move imperceptibly toward each other, converging in increments the thinness of paper. At the same time, the fingers and thumb of the left hand move apart by the same amount.[16] Cumulatively, but slowly and delicately, in a manner even the most skilled author can convey no other way, the reader intuits that the narrative is being wound up. Relying on the reader's physical experience, novelists flirt with crises, thwart expectations, and generally pull surprises— without ever interrupting the matter in hand. The substrate directly participates in constructing and sustaining interpretation.

A similar provision of information from the border is a curious "feature" of low-powered computers. Someone writing one piece and printing another may find that the concurrent tasks slow the device down. (For some of us, it simply locks the machine up altogether.) The slow-down signals how long printing is taking and when it is over. The user is never called on to turn to a "print monitor" or respond to some explicit signal. This example is undoubtedly fairly trivial. However, in emphasizing the way contributions from the border work without interrupting the central action, it helps point to the difference between border contributions and explicit signals. Such signals may well be effective, but they are qualitatively different. Inserting the phrase *only five pages to go* would produce a quite different effect to that produced by a book's diminishing pages.[17] Similarly, beeps, screen messages, and the like are distinct from the diminishing speed of a machine. These lack the intimate and integral particularity of a border contribution. To the problem of interpreting the behavior of the machine, they add the secondary problem of interpreting the screen message or beep and the tertiary problem of then applying that interpretation to interactions with the machine.

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[16] This is, of course, only true for certain forms of writing. With some books, for instance, the pages move progressively from the left hand to the right hand.

[17] Such Shandean tropes are used and have, of course, a long history. They reappear periodically in literature with various claims to originality. Even Lodge's (1972) observation is prefigured by Austen (1818/1972) and subverted by Johnson's (1759/1976) famous "Conclusion in which nothing is concluded." Our general point is concerned less with books, whether fiction or nonfiction, than with the integral relation of form and content in well-established communicative genres.

2.4. Establishing the Border

To summarize the argument so far with the help of one of our recurrent examples, because books consistently and continuously have covers, covers have become more than a mere means to hold pages together. They have been transformed through social practice into integral resources by means of which authors, book designers, publishers, booksellers, and readers communicate with each other. More generally, important border resources are formed in similar ways around other artifacts.

In the previous section we tried primarily to illustrate border resources in use. In this section, we try instead to understand under what conditions the border develops into a resource. Two things—one material and one social— seem to us to be essential to this development: continuity and community. On the one hand, the process needs recognizable continuity in artifacts. On the other hand, the process requires a community whose members share, recognize, and over time reformulate conventions collectively. Between the continuity of features and the conventions of a community, borders and their generic conventions come into being.

Continuity

Although important to the development of a border, continuity is not in itself a particularly complex notion, so we discuss it here only briefly. To be turned into a border resource, features of the artifact need to be constant across time and space. If book covers, for instance, were merely optional, were changed sporadically, were provided randomly, or (as in the 18th century) were chosen individually, they would be unable to play their interpretive role. With continuity, however, the material substrate of artifacts can, over time, become a palimpsest of developing forms and practices. The continuity of the substrate, although allowing practice to change, simultaneously helps bring the history of practice to bear on the present.

Two types of continuity (or discontinuity) can be distinguished. The first involves continuity or changes within a particular form. A check made out for $20 but altered to $20,000 before it is cashed preserves the same basic material form and the same genre (the forger counts on this), although it clearly undergoes some sort of change and break in expected continuity. The ability to make or resist such changes depends to some degree on the inertia provided by the substrate. It is relatively easy to change a check or a document on a computer; it is comparatively much harder to change a bond or the software code with which the document is written.

The second type of continuity concerns genres. Continuity of a genre may be lost not through individual changes, but when the set of related data that loosely contribute to a particular genre is split. Books conventionally appear with pages,

cars with four wheels, typewriters with keys, and so forth. When these informally defining features do not appear, it is possible that a different type of artifact with different generic conventions is being considered: a portable computer, a hovercraft, or a daisy-wheel printer, perhaps. Here questions arise about what properties are essential to particular genres and consequently what genres can make the transition to new material forms in which certain border resources are missing. When only central features of functionality are considered, changes in technological form or media seem unproblematic. However, such changes can be problematic exactly because the border, instantiated in the technology, often plays an important role (see Section 3.2, later). By contrast, whether a particular shift will be problematic is hard to predict. Genres are polythetic rather than monothetic groupings (Needham, 1975). All instances of the genre do not necessarily have or need all the same constituent features. What continuity in the substrate is necessary to preserve a particular genre usually can be determined only in practice and, as we explain next, in the context of particular groups of users or "communities of practice."

Community

The use and interpretation of artifacts is not, we have already suggested, universal. Quite simply, different communities use objects differently. Akrich (1988) pointed to significant problems that the movement of technologies between cultural groups presents to designers and users. More generally, social historians (e.g., de Certeau, 1984) and cultural theorists (e.g., Hebdige, 1977; Willis, 1978; Willis, Jones, Canaan, & Hurd, 1990) provide numerous examples of ways in which artifacts are completely reappropriated, reinterpreted, and invested with new signification by different "subcultures." Consequently, an artifact, its border, its genres, and its uses have to be understood in relation to actual users. The prototype workstation in the human factors lab or among trade-show potted plants actually reveals little about whether, how, or why it will or will not be used. By contrast, the same workstation in use in the workplace—plastered with Post-its or masking tape, modified or marginalized by practice, and, in all, embedded in social activities—can tell a rich, well-situated story.

What designers need to know, then, is the social extent of an artifact's use and conventions. For us, this involves identifying what Lave and Wenger called the *community of practice* (Lave & Wenger, 1991; Wenger, in press).[18] The

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[18] Although for brevity we use *community* and *community of practice* interchangeably, the community of practice is importantly distinct from more general notions of communities—of neighborhoods, teams, work groups, and so forth. It is not necessarily contiguous, well-ordered, or well-defined; it is not particularly harmonious or "community minded"; and it is not something that can be

community of practice is that level of the social world at which practice is common, coordinated, and reproduced, at which significance is created, and consequently, in which the border is socially recognized and generic conventions are developed and shared. Thus, it is also the locus in which it is possible to explore and understand the social context of artifacts.[19]

In relation to communities, artifacts play a couple of analytically distinct roles. They can both mediate relations within a community and mediate relations and coordinate activities among communities. Artifacts that cross the boundaries among communities need to be understood both internally, that is, in terms of the role they play within a community, and externally, in terms of the way they mediate (and occasionally mask) relations among communities.[20]

This distinction between internal and external takes us back to our earlier account of the process of publication and product design. Publication takes an artifact out of the local community (e.g., the publishing house or the lab) into broader communities of users. An object of construction and investigation among lab members has to be transformed into an object that can move between producers and consumers and that can circulate among the latter. Signs recognized in the lab community have to be transformed into or replaced by signs shared by target communities. As the artifact crosses the boundary from the lab to the marketplace, product designers turn to features that in the lab may be quite peripheral, but that may be important resources for users. As marketing departments target different groups, yet other features have to be added or emphasized.

More usually, artifacts are not changed as they move back and forth among communities but remain the same. As a result, features that are quite significant for one community may be carried over into another where they are superfluous. Thus, although the removal or addition of a particular feature may be desirable within one community, such a modification may cause problems for the other, and therefore damage relations between the two. To offer a simple example, although engine noise can be a nuisance to people within a car, silent cars would make relations between drivers and pedestrians life-threatening. Changes in artifacts are not always so potentially dangerous, but they do tend to send unpredictable waves not only within but also outside the boundaries of particular communities.

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created by organizational fiat (Brown & Duguid, 1992) or that respects organizational boundaries (Orr, 1991).

[19] We are aware that our definitions of community of practice and the border seem inherently circular. This is because the two are mutually defining. Communities can be identified as those groups of people who use certain artifacts in a common way, whereas the border of an artifact is that aspect that is given social significance by a particular community.

[20] See Starr (1988) for an account of the boundary role of artifacts. For the importance of distinguishing internal and external mediation, see Appadurai (1988).

3. BEYOND THE STABLE STATE: BORDER PROBLEMS

The usefulness of the border relies heavily, as we have noted, on continuity. And continuity, in its turn, relies on the relative stability of artifacts and the communities that use them. However, design is now increasingly taking place, as Schön (1971) described it, "beyond the stable state."[21] In many workplaces, for example, designers and users face what Harvey (1989) described as the chameleon world of "flexible accumulation," where stability seems to be a problem, not a resource:

> Flexible accumulation requires flexibility with regard to labour processes, labour markets, products, and patterns of consumption. It is characterized by the emergence of entirely new sectors of production, new ways of providing financial services, new markets, and, above all, greatly intensified rates of commercial, technological, and organizational innovation. (Harvey, 1989, p. 147)

These conditions make it increasingly difficult for designers and users to take for granted, as they have in the past, continuity in artifacts, processes, practices, or communities. In the rest of this article we try to explore the sort of challenges that instability and flexibility present to the border and its resources and to propose some general strategies to deal with these challenges.

3.1. Ephemeral Borders: The Loss of Continuity

We can best illustrate problems of instability and flexibility in terms of our recurring examples of text and context and by considering the sociologist of science Latour's (1986) description of documents as "immutable mobiles" (p.7). Each of the two qualities, immutability and mobility, is important to what is recognized as a document. Mobility allows documents to communicate easily across space and in a variety of circumstances. A bond received in California but redeemable in New York can travel the distance between, and immutability allows it to survive both space and time unchanged. A bond generally can be

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[21] Evangelical claims that the present is fundamentally different from the past are so consistent across history and societies (see, in particular, Williams, 1973, chap. 2) that they actually seem to provide more evidence for continuity than for change. The first generation to claim that it is no different from its predecessors may be the first radically different generation. Williams's (1973) and Habermas's (1983) historically informed skepticism presents a healthy antidote to the general banality of assumptions about historical discontinuity and postmodern "dissociations of sensibility." Nevertheless, some sense of how things might appear different today—and why—can be found in reflective commentators such as Harvey (1989), Schön (1971), or Thackara (1988).

assumed to be substantially the same when it is redeemed as it was when it was issued. The "electronic document," however, appears to make Latour's definition obsolete. New "documents" are innovative exactly because they are mutable. Dictionaries, library catalogs, and sales inventories have, to a significant degree, been liberated from the books and binds they were in. In such cases, the advantages of mutability are evident and undeniable. Nevertheless, problems arising from the loss of immutability are also undeniable.

We see two basic types of problems, related to the two sorts of (dis)continuity we discussed earlier. In the first type, although center-border relations may remain fundamentally the same, the immutability of any particular center may be brought into doubt as its inertia is diminished. Printed documents, photographs, and photocopies, for instance, are becoming increasingly easy to change, but checks, passports, and other records require fixed face values. Although a particular check, photograph, or record may not have been altered, the possibility that it may have been casts doubt on all instances of the genres and consequently on the social practices that were built around it. One response of designers has been to raise the level of inertia by the addition of such difficult-to-replicate features as holograms.

In the second type of problem, mutability can be seen to challenge the genre as a whole by pulling apart the integral interrelationship of the center and the border. In the past, this interrelationship could usually be taken for granted because the components were, to a significant degree, interdependent. The immutability of a document was the inescapable result of using paper and ink as its medium. Thus, paper and ink were in an important way defining features of what made a check, what provided authorization for financial transfers. New materials and new media are, however, making certain center-border relations increasingly contingent. As a result, it becomes harder to say what are the essential or necessary properties of a particular genre. Faxes, which strip away the original material substrate of a document, as well as magnetic cards and wire transfers raise questions about which aspects of an original are necessary and which contingent for transmitting adequate authority and authorization.

3.2. The Paradox of Demassification: The Challenge to Communities

Because the social and material aspects of artifacts and practices are interwoven, the loss of physical continuity often disturbs social practice. Consequently, it is important for a designer to pay particular attention to their interplay. In this section, by considering the concept of *demassification*—a term that has both physical and social connotations—we illustrate problems that arise from failing to consider the way social practices can depend on physical form.

The first type of demassification describes the disaggregation of physical mass—an accelerating trend as so much technology moves from being

mechanical to digital-informational and the artifacts needed to process the information shrink dramatically. In recent years, huge mainframes that tied people together have been reduced to laptop computers. As a result, people no longer need to congregate in single buildings or communicate through central, unifying machines to work together.

Of course, the ensuing dispersion is not entirely new. It is only one step further in the increasing ability of communities to work, and even to form, although their members are widely separated.[22] The separation of their members has been made possible in great part by the availability of stable reproductions (Benjamin, 1978) of which the book is one of the earliest examples (Anderson, 1991). Once identical artifacts could be easily reproduced, people no longer had to gather together to coordinate their activities.[23]

The second sort of demassification refers to the ability of manufacturers to cater, not just to broad masses of people, but to small groups and even to individuals. This social demassification is, of course, partly the result of physical demassification. (Economies of scale guaranteed commonality of artifacts, but less labor- and material-intensive production has made those economies less important.) Conflicts between the trajectories of these two types result in a paradox. The more artifacts are tailored to individual users, the more the separation this social demassification is intended to allow becomes problematic. It is hard to share and coordinate practice if you don't share the same physical space. It is virtually impossible if you also do not share, in some way, the same objects.[24] At a minimum, people need a shared border to engage appropriate interpretive conventions, to maintain indexicality, to underwrite authority, and so forth. Centripetal social needs, met previously and unproblematically through the continuity inherent in material objects, are coming into conflict with the centrifugal influence of physical demassification that strips away the continuous material substrate to allow people to work apart. Increasingly, to maintain social viability, technology design will have to focus on both centrifugal desires and centripetal needs simultaneously.

Attempts to design electronic, individually constructed "newspapers" illustrate aspects of this paradox. The "paperless," do-it-yourself, personalized newspaper attempts to achieve both physical demassification (by removing the paper) and social demassification (by allowing the on-line replacement to be individually composed). This new form of news has been proposed for a long

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[22] For the formation of distal communities, see Strauss's (1978) account of a "social world."

[23] It is worth noting that this progression from congregation to dispersal is not always linear. Industries like cloth manufacturing began with weavers working separately before large spinning and weaving machines forced them into factories. "Outsourcing" and domestic piece-work have a long history.

[24] To answer questions about what *same* might mean, let us say that artifacts are the same to the extent that they are susceptible to common generic interpretations.

time, but so far it has failed to get successfully out of the lab.[25] Its difficulties are encapsulated in its oxymoronic name—*paperless paper*. Although apparently peripheral to the news, paper has been far from immaterial to newspapers' longevity. It provides important continuity and an efficient, portable context. The presence of paper in a newspaper is a substantial reason why print journalism has endured despite the best intentions of on-line publishing and the prior challenge from broadcast television and radio news, each of which has overconfidently foretold the newspaper's death.

The paper in newspapers plays several roles. First, it helps to determine and not just report what is news: Only certain items can fit within the bounds paper provides. In being fitted within those limits, items are deemed "newsworthy" and in the process become news—a distinct and socially recognized genre of information. The limited capacity of a newspaper usefully acts rather like a well-designed fishing net. Such a net will catch some things and let others get away. The huge data bases of on-line services, with no inherent size limitations within the bounds of human comprehension, are like netting that is too tight. Nothing gets away (which is qualitatively not very different from catching nothing). This is fine if what is wanted is the informational equivalent of everything from plankton to dolphins and whales, but not much help if all you really want are the tuna that everybody else is eating.[26]

Second, the spatial properties of paper intrinsically grade and relate the newsworthiness of what the paper does catch. The relative significance of particular items is conveyed not just by their presence in the paper, but by their position and juxtaposition. The Savings & Loan scandal, for instance, became major "news" when it moved from the business section to the news pages. Stories about errant baseball owners change status as they move from the sports to the business, news, or editorial pages. Given that there is only one front page and a limited area "above the fold," paper structures stories in an elaborate hierarchy of social significance. With its two dimensions and its "jumps," it provides far more elaborate relations of juxtaposition than relatively amorphous data bases or the simple temporal sequence available on television and radio. Editors convey a great deal of information with these resources. A well-composed paper can cautiously indicate yet never explicitly state a causal link between the fall of a senator and the rise of pork belly prices.

The social demassification of newspapers—targeting an audience of one—is made possible by physical demassification, and it is no less problematic. The immutability and mobility of print on paper across a society (ensuring that the "same" news is available to everyone at roughly the same time) turns items into "social facts"—common to a broad readership, not merely selected by

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[25] See, for example, MediaLab's lab-based experiments, or Knight-Ridder's commercial failure with Viewtron[TM].

[26] In relying heavily on the content of the nation's major newspapers, conventional on-line data bases tacitly acknowledge this prior role of newspapers.

individuals. If news items were gathered individually out of a vast data base, even if the resulting copy looked like a conventional newspaper, imitating its fold and front page headlines, it would lack the social significance that arises from editorial juxtaposition. A senator is disturbed to find his or her scandalous behavior splashed across the front page not because the story is news to him or her, but because it has become front-page news to 100,000 other people. The newspaper is essentially, as Anderson (1991) described it, a "one-day best seller" (p. 35)—and, as with a best seller, the point is that "everyone" is reading it. The personally tailored, genuinely unique "newspaper" selected privately from a data base—the ultimate outcome of the social and physical demassification of the newspaper as we now know it—offers neither physical, nor social continuity. Each individual output would be no more than that—an individual output. The juxtaposition of the senator and the pork bellies would then be not a composite, if oblique, social fact, but merely a result of personal serendipity.

4. BEYOND THE OBJECT: REPOSITIONING THE BORDER

The problems presented by the paradox of demassification seem to us to arise partly through an overly sharp focus on an artifact and its central functionality and a failure to consider the multiple, complex, and elaborate social processes that may also be engaged. Newspapers are not, we argue in essence, simply media for conveying information. They are also important social artifacts that help to determine the shape and extent of the community. A redesign must take into account the other roles it plays. In general, therefore, the conflicting forces of demassification will not be overcome by attending with ever greater intensity on self-sufficient artifacts, but by following Thackara's (1988) advice to look "beyond the object." and attend to people, their evolving needs, their improvised resources, and their robust social practices. If social resources arise in the interplay between continuity and community, then as continuity becomes less dependable, designers need to work more closely with communities. In the following sections, we try in very general terms to indicate what this might entail.

4.1. Knowing Communities Inside Out

Because social practice is extraordinarily rich and extremely complex—"deeply veined with the traditional, the circumstantial, and the transitory," as Oakeshott (1991, p. 7) put it—designers' chances of understanding it decrease almost exponentially with the distance between themselves and practitioners. In the gap—which human factors labs cannot bridge—ready-made prejudices and preconceptions and over-easy assumptions about "proper use" and "inherent functionality" substitute for insight and understanding arising from work with

the community itself. (Our distinction between "internal" and "external" properties does not, it is important to emphasize, refer to properties of canonical artifacts, but to features of community practice in relation to artifacts. See Section 2.3.)

Complete immersion is not, however, the antidote to the detachment of the lab. Problems of immersion actually mirror those of separation. Separation tends to view practice from across a no-man's land, thereby representing not so much what practice is like, as what it looks like from a distance, capturing the external relations, but missing the internal conditions.[27] User-centered design (Norman, 1988; Norman & Draper, 1986) and work-oriented design (Ehn, 1987), by contrast, promote design around actual practice. These are a significant improvement on the human factors lab, but they nonetheless risk focusing on internal requirements at the expense of external ones. Both approaches, then, have complementary limitations. Design from across no-man's land expects practice to submit to external demands. Design in the trenches often proceeds as if only internal demands need to be considered.

Designers need both to resist those traps and to position themselves to understand a practice both from within and from without—close enough to understand its internal requirements, but detached enough to observe external conditions and cross-boundary relations to other communities and to encompassing social structures. The growing contribution of ethnographers to workplace design is founded on anthropologists' understanding of the dilemmas of what they, with a deliberate sense of paradox, term participant observation—attempting to look simultaneously from outside in and from inside out (see, e.g., Blomberg, 1988; Jordan & Henderson, in press; Orr, 1991; Orr & Crowfoot, 1992; Suchman, 1987; Van Maanen, 1988).[28]

In addition to looking beyond the object in this way, designers also have to be prepared to look beyond objectified communities located within the structures of conventional organizations. Elsewhere (Brown & Duguid, 1991), we stressed the importance of groups that emerge in the interstices of organizations. Here we point to those that spring up outside existing organizations. "User groups," for instance, which have developed rapidly in the past decade, played a vital role in the wide acceptance and use of artifacts like the Macintosh. Forming rapidly and operating independently, these communities filled gaps that opened up as new practices outstripped the designers' preconceptions and documentation. Heterogeneous and loose knit, they provided enormously helpful resources for isolated users, who would otherwise be significantly cut off from the ongoing

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[27] See Williams (1973), Bourdieu (1977), and de Certeau (1984) for detailed explorations of this argument.

[28] It is important, however, to note and to resist a tendency of anthropologists to isolate the communities they study and consequently to ignore external relations (see, e.g., Wolf, 1982).

evolution of practice. Providing a centripetal force to counteract excessive centrifugal ones, these groups functioned like a cross between a community library and a neighborhood bar—repositories of information and places where people gathered (personally or through bulletin boards) to exchange local lore, make useful connections, and offer or request help. The user group has very much lent authority to emerging practices and framed practice with a socially continuous border.

The success of these relatively autonomous groups suggests that designers might find it worthwhile to try to seed them. The Washington, DC subway system provides an interesting example of something like this. When the system opened, it faced the problem of introducing thousands of people quickly to its automated ticketing machines. In existing systems, newcomers are usually able to watch old timers going about their business and imitate them. Unfortunately, in a completely new system, there are no old timers and no established practices. But with the DC system, the pump was cleverly primed. When it opened, a cadre of people who knew how to work the machines went repeatedly through the system, acting like well-established old timers. This gave the newcomers practices to watch and follow. In the process, the newcomers themselves became old timers. Wisely, the developers looked not to the machine—to instructions, LCD displays, error messages, and the like—to resolve their problem, but beyond to the community of users. This sort of approach needs, we believe, to become more general in technology design.

4.2. Negotiating Change

Having identified—or even seeded—a community of practice, designers have to pay particular attention to the ways it deals with change. In drawing attention earlier to the importance of continuity, we may have given the impression that social practice is constant and resistant to change. In fact, continuity of practice does not tend to reflect a refusal to change, but rather the successful adaptation to change.[29] For this, the process of negotiation is particularly important (see Lave & Wenger, 1991, especially pp. 33-34).

As with the term *community of practice*, our use of *negotiation* needs some qualification. The sort of negotiation with which communities handle change is not, like most negotiation, necessarily either direct or explicit.[30] Rather, it tends

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[29] Maintaining stability is, in effect, simply one way of negotiating change. Or, in the 17th-century diction of Francis Bacon (1612/1881), "Retention of custom is as turbulent a thing as innovation" (Vol.l, p. 85). See also Cooke and Yanow (1993).

[30] Thomas P. Moran (personal communication, April 1, 1993) pointed out that work-centered design relies predominantly on explicit negotiation.

to evolve over time and in practice as new artifacts, new practices, and new interpretations become available and are circulated, used, challenged, honed, marginalized, or outright rejected and as those involved reach a tacit, informal, and dynamic consensus about what works and for whom.

Recent studies of the introduction of new, complex tools and new working practices like those by Zuboff (1988), Allen, Linde, Pea, de Vet, and de Vogel (1991), Orr (1991), and Orr and Crowfoot (1992) emphasize the significance of negotiation. Moreover, the two studies of distal communities (i.e., Allen et al., 1991; Orr & Crowfoot, 1992) suggest that the more people work apart, the more the implicit negotiation has to be supplemented by increasingly explicit negotiation, calling in turn for both implicit and explicit support. Allen et al. (1991) found that two of the most significant factors in the successful integration of new technologies in separated worksites were the availability of common objects or representations for people to index and of direct communication lines for them to enter negotiations over the significance of what they indexed. The participants seemed as though they did not need complex "help" systems, but a direct way to reorient one another and to recoordinate and renegotiate their practice. Major difficulties over what items on the shared screens signified, what conventions were appropriate, what was central, what was peripheral, what was on the border were significantly resolved when the designers added a standard telephone. Similarly, Orr and Crowfoot's (1992) study shows how the addition of relatively simple, two-way radio could maintain and improve shared practice among colleagues widely separated in space. Once members could communicate directly within shared borders and thus negotiate, coordinate, and reorient community practice, some problems for these distal communities were reduced.

Negotiation is not a panacea. It is not an inherently easy process, nor is it a sufficient condition for the acceptance of complex design. It is, however, a necessary one, for it is through negotiation that a border is collectively invested with the significance that is crucial to maintaining shared practice both within and among communities. As designers contribute to the removal of old, well-recognized borders, they need equally to provide the means for people to generate new borders (and to increase, if they can, the speed of that generation)—and negotiation is essential here. Furthermore, the designs themselves must be open to interpretation.

In this context, we should qualify an impression we may have given earlier when, for simplicity's sake, we talked about designers adding publicly recognizable border resources to engage particular audiences or markets. Designers do not, as we may unintentionally have suggested, have a store of fixed resources to which users respond, Pavlovian fashion. The resources designers use arise and are given their significance within community negotiation. Designers deploy them, and they also refashion them or marshall them in new ways, but in so doing, they enter the negotiation process, they do not override or preempt it. As the anthropologist Mintz (1986) pointed out,

social significance is developed "as people use substances in social relationships" (p. xxviii). The significance of design and technology exists within this framework of negotiation and social relations. Designers can prompt and support change in communities of practice; they cannot predetermine it. Design and use mutually shape one another in iterative, social processes.

Undoubtedly, fostering negotiation is not the designer's only responsibility; nor, importantly, is it only the designer's responsibility. In the workplace at least, it is equally a managerial challenge. Of the communities studied by Allen et al. (1991) and Orr and Crowfoot (1992), one was a small company owned and run by the same people, another was a work team within a large corporation. The ability—not just the means—to negotiate in each case was thus fundamentally different. As we hope is evident by now, we do not believe social problems arising from power relations can be resolved by technology alone.

4.3. Regrouping Genres

Finally, along with communities and their negotiations, we feel that it is particularly important for designers to be aware of the various genres of activity that arise in those communities and through negotiation. Genres, as we noted earlier, are analytically distinct from the technologies that support them. (Thus book technology supports the genres of novels, plays, and histories.) Conflating the two can cause problems.

We built our earlier argument concerning the distinction between on-line news sources and conventional newspapers around the overlooked distinction between genre and technology. Although we may appear in that discussion to be simply Luddite, we were not dismissing on-line data bases as sources of news items.[31] However, we were arguing that the designers of such data bases should not assume that the on-line data base is in some absolute sense a "better" technology than newspaper. To conclude from such a notion of superiority that data base information sources should replace hard-copy newspapers is to ignore the distinct genres within a print technology and their different social roles. Such an assumption perhaps reflects a broader desire of some technologists to sweep away the old with the new—to insist dogmatically on replacing existing technologies without bothering to address each of their various social functions. This approach risks impoverishing society when, with more reflection, it could be enriched. Books are important in part because they augmented oral communication. They did not replace it.

Newspapers, we argued, do (at least) two different things. They convey news. Here, on-line sources have incalculable advantages over hard-copy circulation for

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[31] To be fair to the Luddites, we should point out that they were not simply Luddite either (see, e.g., Thompson, 1968).

doing this quickly and efficiently. However, before they convey news, newspapers first make it. News is not simply made and then put into papers—and so could just as easily be put into a data base. Rather, news is to a significant degree made in the process of being edited into papers and then circulated across a community so that it is simultaneously available in the same form at breakfast tables, subway kiosks, and street corners—for a ceremony Hegel likened to morning prayers.[32] What on-line, do-it-yourself services offer, then, is not a simple replacement. Rather, they provide a means to separate the genres. News data bases are extensive repositories of reports of contemporary events, but they are inadequate news creators—in part because they lack the immutable mobility and the efficient, stable border resources that have been developed around hard copy.

New technologies should then be seen as presenting an opportunity for genres to follow different trajectories, same moving to a new technology, some remaining with the old. So sales inventories, car manuals, encyclaepedias are moving out of book technology, but novels, histories, and philosophical treaties seem likely to remain in a technological form to which they have carefully adapted over 500 years. New technologies need not, as Victor Hugo's (1831/1978) archdeacon suggested, kill the old.[33] Instead, they should augment it. For this to happen, designers will need to parse the different genres within a technology to understand the different ends they serve.

This requires a clear understanding of the analytically distinct natures of genres, technologies, and border resources. The attempts to design an online, do-it-yourself newspaper suggest how easily the border, border contributions, and distinct genres within a technology can be overlooked. And, as we have been arguing, in conditions of increasing change, the problem becomes more acute because what used not to be feasibly separable, like news and paper, now can be separated. As the physical substrate of particular artifacts becomes less constant and more contingent, social practice and coordination—which in the past has been taken for granted (because constant, common objects to some degree guaranteed common and coordinated practices)—may in some cases become more difficult. This is not an inherent flaw in technology, but a problem of tunnel vision in design. Technological development that looks at artifacts in splendid and limited isolation produces paradoxes of demassification and what Zuboff (1988) saw as the threat of individualized exile. However, information technologies also hold the potential to engender social integration and maintain a sense of connectedness in communities more widely distributed than ever before.

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[32] Our argument here is in part based on E. H. Carr's (1964) notion of what distinguishes a historical fact from the plethora of facts in history. The reference to Hegel comes from Anderson (1991).

[33] In *Notre Dame of Paris* (Hugo, 1831/1978), the archdeacon predicts that the book will kill the building.

Which outcome results—integration or exile—depends to a significant degree on the extent to which designers are aware of and respond to the collective as well as the individual needs of communities and their members.

5. CONCLUSION

A sympathetic reader of a draft of this article asked us in a perplexed way if what we were really showing was how artifacts function differently in different contexts. We hoped to make the contrary point. The assumption of difference (a key concept in Derrida's, 1976, deconstructive notion of *différance*) can quickly conclude that because there is always a difference (and deferral), commonality and continuity are illusory. Believing that commonality and continuity are not illusory, we wanted to look not so much at the logical possibility of irreconcilable difference (or *différance*) as at the practical evidence for social interdependence and interaction. We were particularly concerned that aspects of design that pursue an imperative of social demassification were, unfortunately, more likely to produce radical *différance* (Zuboff's "exile" on a grand scale) than to support social integration. Our notion of the "border" is an attempt to embrace those resources that across all fields of design have resisted forces (and logics) of fragmentation.

These resources, lying as they do "beyond the object," seem to us profoundly undertheorized and generally unnoticed. From a practical point of view, whereas artifacts and their borders remain relatively stable, their reticence presents few problems. People have been writing and designing newspapers for centuries without needing to reflect on notions of border or genre. But artifacts and borders are no longer stable. Suddenly it seems possible to have not just books without covers, but news without paper, information without presentation, text without context, individual practice without social resources. To address problems of design and use in these unstable conditions, the border and its role in coordinating practice needs to be better understood—if only to explain what life will be like without them.

In addressing this problem, it seems to us important not merely to insist on the existence of commonality rather than unlimited difference, but also to map its extent. If interpretation is not individual to the point of solipsism, to what social extent can it be said to be shared? How broadly is it situated? Yet even when the "situation" is taken into consideration (as it is not in arguments for self-evidence and context independence), accounts tend, as Lave (1992) noted, to take it as primarily physical. For one reason or another, the social is ignored. (Overlooking social questions has, among other things, allowed discussions of design too often to ignore issues of race, gender, and class.) The situation, in our analysis, is actually complexly material and social. Thus, faced with the loss or

rapid and ongoing transformation of the material substrate of objects, designers need, we have claimed, to become increasingly aware of the social.

Undoubtedly, we are not the first to say this. Lately, there has been significant acknowledgment of the "user," the "customer," and the "worker." But, although "user-centered design" has helpfully shifted the focus of some design, it has taken the "user" as an almost natural category (and occasionally a universal one). By contrast, we wanted to identify the appropriate level of the social world in which, it seemed to us, practice was common. Borrowing from Lave and Wenger (1991) again, we suggested that the community of practice describes the appropriate level. This, it seemed to us, would be the locus in regard to which designers could both discover old and instantiate new shared resources—could, in short, rebuild the border so that designs can continue to engender continuity and community.

NOTES

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