

A Story Without End: Writing the Residual into Descriptive Infrastructure

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ABSTRACT

To enable efficient searching and consistent interpretation of information, traditional metadata design practice emphasizes precisely delineated attributes. These sharp boundaries, however, reject data points that lie outside permissible values. For example, a Gender attribute with associated Male and Female values may appear perfectly clear and unambiguous, in line with traditional standards. Increasingly, however, people have begun to identify themselves as both, neither, other, or dynamic gender, rejecting cleanly separated Male/Female duality. In this project, student designers used critical design to explore how the descriptive infrastructure of a database might foreground, instead of restrict, the “residual”—a term that encapsulates the ambiguity and plurality masked by simple category structures like Male/Female. Our findings suggest that “writing” a database to exploit the residual is enmeshed with “reading” the content being structured. We identify three modes of reading that characterize these designs, and we describe how the residual emerges from each mode.

Author Keywords

critical design; interaction criticism; metadata

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous..

INTRODUCTION

Classificatory infrastructures mediate many of our daily interactions. In the context of HCI, category systems determine the available attributes and permissible values that make up database schemas, the taxonomies that provide a foundation for Web site information architectures, and the set of menus and associated commands that order and explain potential actions within applications, among many other possibilities. Perhaps because of their mundane

ubiquity, these category systems have not been extensively considered within HCI as objects of design, and accordingly, neither have they been extensively considered as objects of design research. But information interactions rely extensively on classification design and application for their structure and success. To achieve intended goals of navigational clarity and flexibility, for example, Web “breadcrumbs” require an underlying system of well-defined content categories and relationships. Browsing features such as cascading menus and faceted navigation systems similarly necessitate attention to category nomenclature, boundaries, and relations. We submit that, given their importance in mediating so many forms of interaction, the design of such underlying descriptive infrastructures is a matter of concern for HCI.

While information studies does have a deep tradition of scholarship and practice regarding the creation and application of category structures, these activities have not typically been approached as design projects [9]. Although classification researchers recognize that category infrastructures are human artifacts and not natural phenomena, the process of classification development within information studies nonetheless continues to be conceptualized more as a form of scientific documentation than design [14]. In this view of the practice, the creator of a category system (the classificationist) compiles the conceptual structures of a selected knowledge domain and then ensures that the resulting category system conforms to technical standards. These standards help the classificationist to establish clear category boundaries and reduce ambiguity, requirements that aim to facilitate information retrieval and selection [15]. One such rule suggests categories at a single level in a hierarchy should be jointly exhaustive and mutually exclusive. When a set of sibling categories abides by these principles, all possibilities should be included in the system, and there should be no overlap between sibling classes. For example, given a Gender attribute, the set of available values should encompass all possible genders (jointly exhaustive), and each item to be classified should fall cleanly into one of the available values (mutually exclusive). From the perspective of classificatory integrity, if the values for a Gender attribute were Male and Female, all people should be either Male or Female and not both, or neither, or some other unexpressed value. Moreover, values, once assigned, should remain constant. One should not be Male sometimes and

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Female other times. Such rules enable consistency and predictability within information systems.

But the world is messy, vague, and diverse, and ambiguity abounds. Even areas that appear stable and precisely delineated can reveal themselves as blurry and confused with just a small change in perspective. Male and Female may initially seem a straightforward division for human beings. Growing numbers of people, however, have begun to decouple notions of gender and biological sex, and may accordingly self-identify as both, neither, other, or dynamic gender, rejecting simple Male/Female duality.

The example of a person who subscribes to a non-binary gender identity forced to choose between Male or Female categories in an information system illustrates the notion of residuality, a phenomenon of classification articulated by Star and Bowker [16]. The residual encompasses everything that doesn't quite fit into a category system. A residual state might be absent, inadequately expressed, or split between existing categories. More generally, the residual represents the persistent vagueness, ambiguity, and invisibility that standard classificatory practice attempts to eliminate via the systematic application of technical rules to establish neatly differentiated relationships.

In this project, we employ critical design to foreground the residual instead of minimizing it, inverting standard practice for creating classification systems and descriptive metadata. We emphasize the role of the classificationist as a designer who interprets a situation and makes judgments, and not merely as a compiler who aims for accurate application of technical rules. In our study, student designers questioned the status of residuality as a design problem by actively engaging it as a generative resource for creating descriptive infrastructure. Each designer created an experimental "transformation" of the same digital video library. The original video collection was structured with standard descriptive metadata; the student transformations redesigned this metadata infrastructure to highlight, rather than suppress, the residual.

We focus on two research questions:

- How can information collections exploit residuality?
- What is the design, or writing, experience for such collections?

Our findings demonstrate that design begins with "reading" the source material used as the basis for classification development, and that "writing" a database to emphasize the residual is enmeshed with this reading. We identify three modes of reading that characterize these designs, and we describe how the residual emerges from each mode.

This project contributes to the HCI design community in several ways. First, we surface the development of classificatory infrastructure as a design activity that merits

increased attention in the context of HCI. Second, our emerging recognition that the expression of the residual in writing a database requires equal attention to the active reading of its precursor materials aligns with notions of "design-after-design," or the creative appropriation and refashioning of design artifacts by users [2, 6]. Our project provides an example of how the "infrastructuring" of existing designs can facilitate this innovative reuse [2, 6]. Finally, our method demonstrates the productive synthesis of interaction criticism with critical design experiments, and we suggest that combining these methodological approaches facilitates the development of artifacts that encourage design-after-design.

CONCEPTUAL FOUNDATIONS

We connect the residuality of Star and Bowker to the concept of *mestiza* consciousness described by feminist theorist Gloria Anzaldua [1]. For Anzaldua, the term *mestiza*, or mixed one, extends beyond its typical definition involving ethnic heritage to involve the dynamic interplay of extended elements of identity, including culture, class, language, and sexuality. Anzaldua describes her own self as a blend of ambiguous, conflicted, and indeterminate categories, a condition that she names *mestiza consciousness*. The notion of *mestiza* consciousness reorients the residual, making it central.

Mestiza consciousness involves operating in what Anzaldua calls a pluralistic mode. The "new *mestiza*" that Anzaldua envisions embodies a status between oppositions (such as Male and Female); this status is continually evolving. From the perspective of classificatory infrastructure, we can think of this as a perpetual process of understanding what a category like Gender can mean: what it is to be, to not be, to partly be, or to once have been Male or Female, all as a specific, ephemeral experience.

We also see *mestiza* consciousness as a rhetorical strategy. In *Borderlands*, Anzaldua's seminal work, the reader's path echoes the *mestiza*'s path: Anzaldua includes historical and scholarly material mixed with poetry, personal anecdotes, and dreams, mostly written in English but also in a variety of untranslated Spanish dialects. Uncomfortable, unfamiliar ideas are presented in uncomfortable, unfamiliar forms. To achieve understanding, the reader must release conventional expectations for rhetorical coherence and accept a level of unknowing. In articulating their concept of residuality, Star and Bowker similarly adopt an untraditional approach for scholarly work, using alternating first-person narratives that reveal intimate anecdotes and emotions.¹

Both Star and Bowker and Anzaldua's works demand a level of imaginative engagement from the reader that aligns

¹ Although *mestiza* consciousness and residuality are not equal, their overlap is extensive enough, given our research goals, that we use the term *residuality* to incorporate both notions for the remainder of this paper.

with that proposed for literary fiction by reader-response critic Wolfgang Iser [13]. According to Iser, one reason that literature rewards multiple re-readings is because it both facilitates and requires this imaginative activity on the part of the reader. In HCI, a complementary idea is that of “infrastructuring” as proposed by the A. Telier group and further advanced by Björgvinsson, Ehn, and Hillgren [2, 6]. In [2, 6], the program of participatory design is extended to encompass the sociomaterial conditions under which artifacts may be continually evolved and reappropriated by an engaged group of user-designers. The “user” here is like the “reader” for Iser; the initial design is such that the user is encouraged to actively participate in its continued development through design-after-design.

METHODOLOGICAL FOUNDATIONS

Critical design uses the development and deployment of artifacts that upend conventional assumptions to provoke insight. Often, critical design focuses on revealing and interrogating the sociocultural values embedded in designed artifacts. Anthony Dunne describes his “value-fictions” as created not to satisfy user needs but to explore the enactment of alternate value states, to “stimulate discussion in a way that a film or a novel might” [8]. Shaowen Bardzell and colleagues follow this approach in their “significant screwdriver” and “whispering wall” designs, which were created to stimulate discussion of gender roles and expectations in two everyday situations, home repair and personal fitness at the gym [5]. In these uses of critical design, evocative artifacts promote understanding of sociotechnical systems and associated activities (such as gender roles in home repair). These studies are less focused on understanding the artifacts themselves (such as screwdrivers and other hand tools).

Other forms of critical design direct attention more explicitly on the artifact itself, although, as suggested by Bardzell and Bardzell, these studies may not identify themselves as critical design [4]. Bardzell and Bardzell propose that projects such as Dalsgaard and Dindler’s interactive peephole fit into this category [4, 7]. Interaction criticism constitutes another approach to generating insight on the designed artifact [3]. Criticism involves the development of scholarly “readings,” or interpretations.

Because we are interested in the expression of the residual within databases, as well as the design process to produce databases that emphasize the residual in this way, our project melds interaction criticism and critical design. The following section describes our study design in more detail.

STUDY DESIGN

Fourteen students created design transformations of a single digital video library as the focal project in a master’s-level course in digital collection design and agreed to have their coursework included in the study. The first author was the instructor, and the second author was the teaching assistant. To ensure fairness in grading and avoid potential bias in

data collection, a faculty member outside the research group handled the informed-consent process, and the research team did not know which students had agreed to participate until after grades were submitted.

The course combined design work with readings in classification research, HCI, design, digital humanities and rhetoric, and science and technology studies. In preparation for creating their own designs, students spent four weeks interrogating three example transformations that attempted to foreground the residual in different ways. The students’ critical examination of the example transformations was informed by reading Star and Bowker and Anzaldúa; they also read about critical design and interaction criticism. This preparatory phase culminated in writing extensive critical essays (approximately 3,000 words) on one, two, or all three of these example transformations, as the students chose. These examples were based upon a different original video library, with different subject matter, than the students would subsequently use (the examples were on the theme of Texas, while the students redesigned a library focused on the subject of Sustainability). The examples were created by the researchers, but the students did not know who had created the examples.

After this period of critical reading, the students began to design their own video collections. The initial library that the students transformed contained 56 short videos, gathered from a variety of sources, in the general subject domain of “sustainability.” The original Sustainability collection was created in 2010 as a teaching and research tool, and its descriptive infrastructure was designed to follow traditional metadata rules—that is, to restrict the emergence of residuality. The original Sustainability collection was created with the Open Video Digital Library Toolkit (OVDLT), an easy-to-use environment for digital video libraries that includes a wide array of customizable metadata elements [11]. These include:

- Browsing categories (a group of descriptors, or index terms [such as Energy, Lecture, or South America] identified with a broader category label [such as Subject, Genre, or Location]).
- Titles, brief summaries, and abstracts of content.
- Roles associated with the video or its metadata record (such as a director or metadata cataloger).
- Dates associated with the video or its metadata record (such as the video’s original broadcast or the date the record was created).
- Freeform tags.
- “Collections,” or thematic playlists of annotated videos.

Figure 1 shows some of these elements for the original Sustainability collection. The student transformations manipulated copies of this collection with the OVDLT

tools. Accordingly, all 14 transformations and the original collection include the same 56 videos. Layout and interface features are standardized by the OVDLT. Only the descriptive infrastructure (browsing categories and associated descriptors, titles and abstracts, and other metadata elements) was changed. The core design work involved reimagining the system of metadata elements (for example, the sets of browsing categories, the use of titles) and then applying that system to the 56 videos. Just as with the original collection, the metadata system thus designed could potentially be applied to additional videos.

These design projects were “critical” in that they explored different means of enacting an alternate value state: exploiting the residual instead of minimizing it. They were “design” in that they created systems of descriptive infrastructure that shaped access to, and interactions with, the content resources, which were not themselves changed. Project deliverables included the transformation itself and a design brief that explained how each metadata element was used. As a final assignment, students wrote 3,000-word reflection essays that examined their design experience and their design transformation in the context of foregrounding the residual in database interactions.

Our selection of student designers was strategic, not opportunistic. The students put 15 weeks of sustained intellectual engagement, including design work, extensive reading, and rigorous writing, into this project. They were both interested in our theoretically oriented questions and motivated to explore them. Too, the students’ projects complemented our own critical design work on the example Texas transformations, as described in the next section.

FINDINGS

Our data sources include the students’ critical essays, designs and accompanying briefs, and final reflective essays, along with notes from class discussions. In analyzing this data, we use critical reading techniques associated with humanist forms of inquiry, as opposed to the thematic coding often used in social science research. We chose this approach because, in congruence with goals of critical design, our interest lies in using the students’ work generatively, to extend our thinking about the residual and its expression. Because we aim to achieve conceptual insight, and not to prove a hypothesis, we did require the reliability offered by systematic coding.

In a previous study, we performed similar critical readings of the example Texas transformations, using as data sources our own authorial reflections on the transformations that we had made (similar to the students’ reflective essays on their own work), along with the students’ critical essays and additional critical responses solicited from a set of invited experts (including both scholars in aligned fields and practicing information professionals working in libraries and archives) [10]. In that study, we suggested, as the result of our analysis, that two of our example Texas

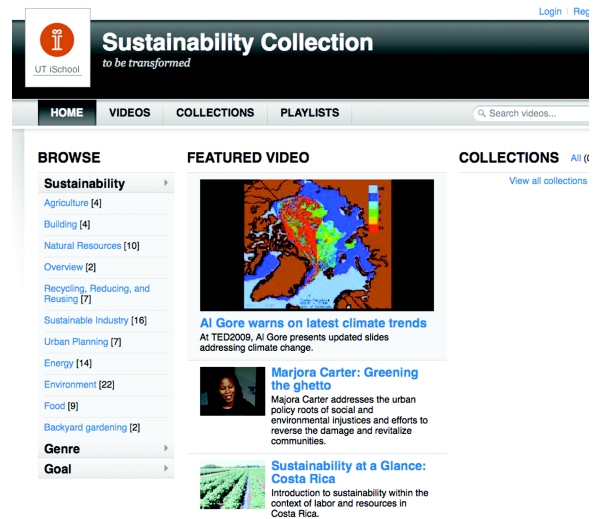


Figure 1: Home page of the original collection. Browsing categories are on the left. The original collection did not use thematic playlists (“collections”).

transformations enacted the residual in a way that encouraged a form of database interaction characterized by the notion of wayfaring, as expressed by the anthropologist Tim Ingold [12]. In describing interactions with a physical landscape, Ingold makes a distinction between *wayfaring*, which involves inhabiting a place, emphasizing the journey, and *transport*, which involves moving over a landscape purely to reach a destination. Our non-wayfaring Texas transformation, as well as the original collection upon which the Texas transformations were based, seemed to have an “end” in a way that the wayfaring transformations did not. Put another way, a database focused around wayfaring interactions is more productively *read*, instead of *searched*. In that initial study, we also proposed that the wayfaring mode of interaction that we associated with the two Texas transformations was facilitated by what we called *flow*, or enmeshed strands of the transformation author’s own interpretation, or “reading,” of the collection source material. This flow functioned like wandering footsteps in an unfamiliar terrain; it provided a way to make partial sense of the landscape by following along the fragmentary path of a previous traveler. As with the fractured, incomplete rhetorical coherence of Anzaldua’s work, we argued that this database flow ultimately facilitated the database reader’s imaginative interpretation of the transformation, providing a partial, and yet fertile base for the reader to produce a new interpretation of the content, complementary or contradictory to that of the original transformation author.

As a brief example, one of the two wayfaring Texas transformations included a category called Nowhere in Texas, full of idiosyncratic descriptors such as Apologies, Melancholy, and Pedestrians. No videos in the collection were assigned to these descriptors; they appeared in the transformation as empty sets. These empty descriptor

elements provided a sort of viewpoint on both the video collection and, perhaps, Texas itself, as seen through the transformation author's eyes. This viewpoint was clearly fragmentary, inconsistent, uncertain, and perhaps ephemeral—of course there really are pedestrians, apologies, and melancholy in Texas—but one that, in combination with other such design choices for the descriptive infrastructure, provided a form of coherence for the transformation even without the sense of an “end” or clear outcome associated with transport mode. The transformation author's reading of the collection, as demonstrated through the descriptive infrastructure, produces an idea of Texas that elides melancholy and apologies. These empty Nowhere in Texas descriptors were useless for searching: they weren't assigned to any videos. Nonetheless, these descriptors provided a framework for productive and coherent reading of the database—an act of reading for the database user based on a previous act of reading, that of the transformation author. *Flow* was our name for the form of coherence that enabled this secondary act of reading.

Our analyses of the students' Sustainability transformations and reflections extend and refine these ideas of wayfaring and flow, strengthening the connection between writing a database to foreground the residual and reading a database in wayfaring mode. We came to our understanding of wayfaring in this context after the course had concluded; the students were not aware of the wayfaring concept and did not use this terminology in their work. The three primary design strategies adopted in the students' transformations, however, align themselves with a wayfaring form of interaction, and demonstrate what we describe as three variations of flow.

In the following sections, we detail the three design strategies that we see in the student transformations, as exemplified through an extended case study for each type. The three strategies that we describe each involve a different form of “reading” the source content of the collection, and accordingly a different means of expressing that reading through the “writing” of the transformed database. We suggest that these three design strategies additionally lead to different forms of flow, resulting in different forms of wayfaring interactions.

Moreover, we read all of these design strategies against the ideas of infrastructuring and design-after-design. As demonstrated in our three case studies, designs that facilitate wayfaring interactions in the context of the residual seem to involve not just the expression of an idea, but the expression of the process of coming to that idea. Writing a wayfaring database is itself a form of design-after-design, in that it makes apparent the process through which the designer interprets, or appropriates, the source content as design material, and the process through which the designer communicates that interpretation. Writing a wayfaring database further facilitates design-after-design, in

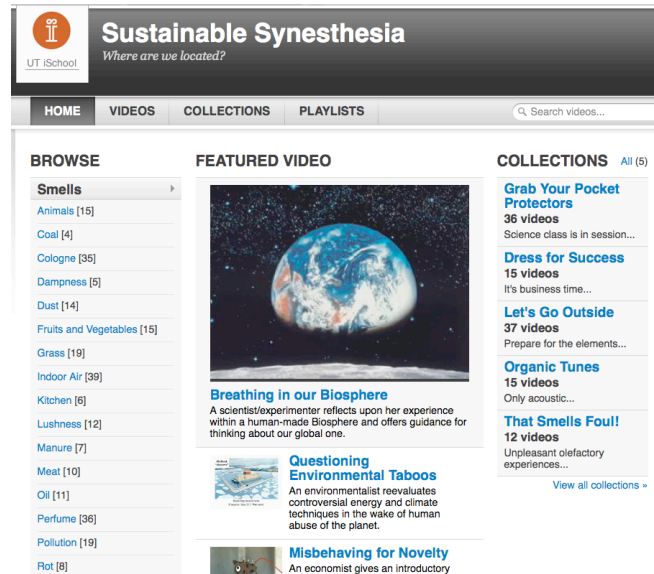


Figure 2: P14's design. Eight descriptors in the Smells category run off the page. Browsing categories not shown include Sounds, Speaker Style, Surroundings, and Threads.

that its goal is not to enforce a particular reading outcome but instead to demonstrate the process of reading as an active, imaginative, precursor to a new design. The students' design strategies all portray the act of reading as enmeshed with writing, with the process of perceiving the material being read as the potential object of a new interpretation, or reappropriation into a new design configuration. The different forms of flow are different forms of infrastructuring for that creative reading process.

Design strategy 1: Writing the residual database as reading a new story from the source content

We identify this first design strategy as content-oriented. In adopting this strategy, students focused on what they saw as residual elements in the original Sustainability collection and developed new readings, or stories, by reorienting those previously residual elements as central classificatory principles. Flow here is characterized by the juxtaposition of the new reading (as enacted through the transformation) with the original collection. We use student P14's design to illustrate this conceptualization of the authoring process.

P14's transformation, Sustainable Synesthesia, questions the goals of sustainability as a movement based on what P14 identifies as its deep integration with capitalist structures. To put forth this reading, the Sustainable Synesthesia collection uses a primary strategy of “sensory cross-pollination,” as described in its design brief. Capitalism focuses on abstractions at the expense of lived experience, and this transformation accordingly uses “an assortment of sensory descriptors” to “give a fuller context of experience” with an emphasis on the illumination of a “messy” and inexact humanity within a capitalist-infused, abstract rhetoric. Sustainable Synesthesia (Figure 2)

describes its videos with a dizzying array of Smells and Sounds. The remaining three descriptor sets—Surroundings, Speaker Style, and Threads—link these sensory impressions to the rhetorical machinery at work in each video: the environment that provides the speaker’s setting (with values including Conference, Farm, City), the manner in which the speaker presents information (with values such as Nervous, Scientific, Hippie), and the speaker’s clothing (with values including Corporate, Fashionable, Indigenous). These last three descriptor sets implicate the “branding” of each video, an annotation that is made explicit via the video’s role metadata, which includes elements for On-Screen Participants, Sponsoring Organization, and Brand itself. Participant P14 elucidates in the brief, “This cross-pollination within the [roles] metadata opens up more space for questions about who claims sustainability and how comfortable we are with smooth or disjointed appearances of capital.”

Sustainable Synesthesia does not make explicit references to the original collection of videos that served as its basis, and it does not describe itself as a “reading” of a previous text. However, the objective tone of the original version is cited in the video summary metadata for Sustainable Synesthesia. The Sentence Summary field, which appears throughout the interface to identify and disambiguate each video, describes each video’s content in a neutral manner similar to the original collection, additionally removing all proper names in favor of roles (“an environmentalist,” “an economist,” and so on). Participant P14 describes this strategy as “infusing each video with anonymous agency.” This innocuous-seeming, bland summary both invokes the “normal” character of the original collection and locates the rest of Sustainable Synesthesia as a set of annotations that aim to destabilize that core text. The idea of residuality that emerges through Sustainable Synesthesia lies in this relationship between original text and its alternate reading, and its form of flow emerges from that implicit, tenuous link. Sustainable Synesthesia demonstrates previously invisible, contradictory ideas in the original collection as it acknowledges its own inability to comprehensively express the new interpretation that it offers. The individual descriptors, some of which are also gathered in Sustainable Synesthesia’s thematic playlists, are “designed to fall apart under closer analysis,” as P14 explains in the design brief. The identification of “foul-smelling” matter in the assembled videos, as one of the thematic playlists purports to achieve, is both a discriminatory judgment and a clearly impossible one. This form of residuality finds plurality in the implied multiplicity of readings that are possible and in the necessary incompleteness of any one of those readings.

For P14, the residual emerges from the imperfect and fragmented relationship between P14 as the author, the original content, P14’s reading of the original content via the Sustainable Synesthesia transformation, and the new reader of Sustainable Synesthesia. In the reflective essay,

P14 suggests that the flow through which P14 connects the new reader to the original collection must remain somewhat indeterminate. Were P14 somehow to enable the new reader to understand all the subtleties of Sustainable Synesthesia, then the experience of residuality would actually be lost. In other words, the reader is not supposed to “solve” the transformation, or arrive at its “end”; the reader is meant to wander the transformation, seeing it not as an answer to a question but as a demonstration of evolving interpretation.

In our analysis, four students besides P14 used similar content-based design strategies that focused on surfacing the latent residuality of the original collection. While Sustainable Synesthesia used uncommon sensory impressions to question the original collection’s linkage of capitalism and sustainability, other transformations that employed this strategy centered themselves around the location of the videos, the actions enabled through the videos, the grammatical tense, mood, and perspective (first person, second person) of the videos, and the causation of the effects described in the videos.

In formulating design strategies based on such deconstructive readings of the original collection, these designers expressed, through their transformations, an idea that any story told through a database will be fragmentary, ephemeral, potentially inconsistent, and potentially contradictory. In tracing the relationships between the original collection and its reading, as embodied through the transformation, the form of flow instantiated by these students demonstrates how each reading was constructed, and displays its internal motivations. The flow provides infrastructure for new readings, or design-after-design.

Design strategy 2: Writing the residual as reading the stories that others tell about the source content

We identify this second strategy as character-oriented. In adopting this strategy, students used the imagined interaction between the original collection and some “other” perspective to produce new readings that surfaced the residuality associated with these “other” perspectives as much as the residuality associated with the original collection. Flow here is characterized by the weaving of character perspectives through the content. We use student P6’s transformation Cacophonic Symphony to illustrate this conception of the authoring process.

Cacophonic Symphony is structured around the audience of the original collection, not its content. In the brief, P6 explains that although “the descriptors within the [original] collection seemed generic,” they upon further inspection implied “an intellectual, reflective, decidedly liberal audience with enough free time to worry about sustainability.” P6 decided to “focus my collection around someone who was actively hostile to those ideas,” with a politically conservative viewpoint. In addition, P6 postulated an “agent-centered” approach to description, concentrating on the people responsible for making the

Barton Seaver

Details [Storyboard](#) [Fast Forward](#)

Excerpt

Overview

Duration:
00:09:26

Alternative Title:
"Forget nuclear holocaust. It's the fork we have to worry about."

Sentence Summary:
Who is this man, really?

Abstract:
Chef Barton Seaver highlights the problems with the brutal consumption inherent in the current seafood industry. He then says lots of feel-good things to make us think that slaughtering fish is actually not as evil as it seems, as long as it allows him to charge \$90 for a dinner.

[Watch Full Size Video \(MP4\)](#)

Who is this man, really?

[Download](#) MP4 38

MB

Barton Seaver

Details [Storyboard](#) [Fast Forward](#)

Excerpt

Overview

Video Information

Dates

Descriptors

Agent:
Yuppie, Messiah

Philosophy:
Paternalism, Environmentalism

Fear:
Choice

Technique:
Fear Mongering, Moralizing, Parade of Horribles, Social Pressure, Groupthink, Guilt

Agenda:
Limitation, Restriction, Consumption

Figure 3: A video metadata record from P6's Cacophonous Symphony transformation. The Abstract, on the left, represents the politically liberal character, while the descriptors on the right represent the politically conservative character. The Alternative Title (left) represents the video speaker, and the Sentence Summary represents a potential critical reader. Note that the liberal character is both supportive and critical of the video's subject, Chef Barton Seaver.

video more than the video content. This approach aligns with the character interests of the hostile, conservative persona. As P6 continued with the project, however, the outcomes of this initial strategy seemed limited, as one myopic viewpoint was exchanged for a different one. So P6 broadened the scope of the transformation to include several competing "voices" that, while representing opposite political views, were nonetheless somewhat "nuanced" in each finding areas to praise and criticize in the included videos. A convoluted conversation of opinionated, but nonetheless rational and complex characters became the heart of Cacophonous Symphony. Here, the idea of residuality expressed through the transformation is located in the readings that each character exhibits—of the video content, but also of the video creators, and of each other. The form of flow enacted through the transformation emerges from the alignments and misalignments between these perspectives, which often, but not always, contradict. For P6, "the most interesting points" occurred where, unpredictably, multiple perspectives agree.

In Cacophonous Symphony, the descriptors represented the conservative voice, and the abstracts associated with each video represented a liberal voice. To complement these, P6 created alternate titles for each video that represented the "voice of the video agent" speaking in the video. These alternate titles were quotations taken directly from the video itself. While this quotation strategy has some similarities to the citations of the original collection made by P14, the goal is different: it is focused on the *person* who made the video, not on the video content. As a final character in the mix, P6 included a "critical" voice in the form of a question. Placed into the Sentence Summary field, this questioning voice was intended "for the viewer to realize that she was bringing her own voice and perspective to the

collection." To focus attention on the interplay of characters within each video's context, P6 downplayed descriptive elements that might make one video seem more interesting than another. The video titles are the names of the video's primary speakers and appear all alike; the images accompanying each video are all black; there are no themed playlists to demarcate special groups. For an example that shows all these elements at work, see Figure 3.

The form of residuality enacted by P6 finds plurality not only in the four character voices represented, but in the implied multiplicity of innumerable characters and perspectives alluded to through its four representatives, and in the associated incompleteness of any particular perspective. (Assigning each character to a different type of descriptive element—descriptors, abstract, alternative title, and sentence summary—emphasizes the fragmentary nature of each.) For P6, the residual emerges through these "real human beings with agendas" and their imperfect and tenuous relationships with the video content, the video creators, and each other. In the reflective essay, P6 suggests that the form of flow in Cacophonous Symphony relies on the reader's being able to find his or her own space amidst these "chatterboxes" in the transformation. P6 asserts that "what the individual reader brings to the transformation" is necessary to animate the intersecting paths laid by these previous readers, the four unruly characters.

In our analyses of the students' work, four additional designers besides P6 adopted similar character-oriented strategies. One of these, similar to P6, adopted a four-character strategy, although this transformation expressed the character perspectives through thematic playlists, using a mechanism different than P6. Two other transformations also focused on "other" perspectives enacted through

characters, but used a single persona, with the implied reader taking on the dialogic partner aspect. One of these transformations enacted a politically conservative perspective, similar to P6's initial plan. The other transformation portrayed the reactions of a future society upon their historical documents. The final transformation with this strategy took a very different approach. In this transformation, the "other" character being surfaced was not a person but another text, in this case, the book *Silent Spring* by Rachel Carson (a key work in the history of the environmental movement). This transformation inserted quotations from *Silent Spring* into every video record, and created thematic playlists that illustrated *Silent Spring* chapters. Nonetheless, we see this as a character-oriented strategy, in that its focus is on creating a dialogue between agents (except here, the agents are texts and not "people").

In formulating design strategies based on interactions between actants (readers, writers, texts), these designers expressed, through their transformations, an idea that any reading of a database is continually mediated through the interactions of other perspectives. In tracing the relationships between such perspectives, as embodied through the transformation, the form of flow instantiated by these students demonstrates a dialogic process of understanding. Once again, the flow provides infrastructure for new readings, or design-after-design; because the form of flow is different, we argue that it facilitates different types of new readings, or new appropriations, than the content-based strategy described in the previous section.

Design strategy 3: Writing the residual database as reading oneself

We identify the third strategy as author-oriented. In adopting this strategy, students produced new readings of themselves, as authorial personas, as occasioned through their reading of the original collection. Flow here is characterized by episodes of authorial progress, or the design process itself. We use Sustaining Something for Somebody, P16's design, to illustrate this strategy.

P16 began the design process by considering not the content of the original collection, nor its audience, but the people associated with the videos, as either speakers or subjects. Most of the descriptive elements in P16's transformation, Sustaining Something for Somebody, are manipulated to reveal the "self-interest" and "personal motivations" of these parties. P16 also noted a lack of racial, gender, and economic diversity in these associated persons, and used some descriptive elements to highlight this homogeneity. These areas merged for P16 in the original collection's high representation of videos from TED conferences, which for P16 epitomized the white, educated, urban, economically privileged perspective of the original collection. As an example of P16's strategy here, the descriptor set Keep Food on the Table contrasts descriptors for people who are Rich, who have PhDs, and who Watch TED Talks with people who are Not Rich and

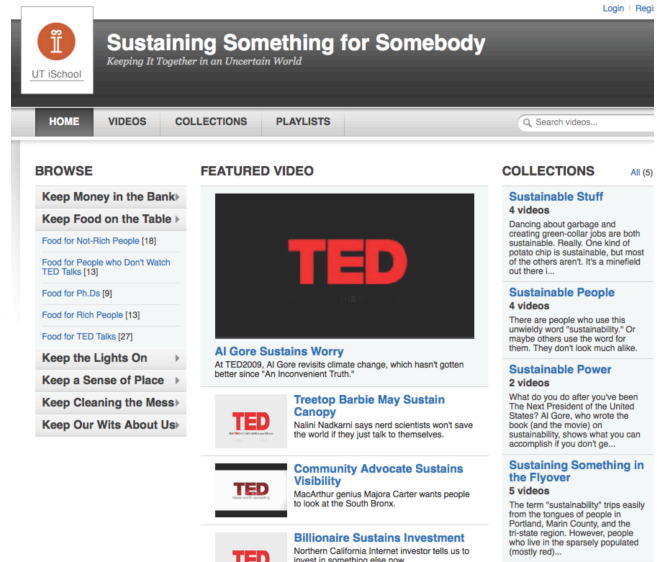


Figure 4: P16's transformation. The Keep Food on the Table category, on the left, highlights the economic and educational privilege that the author associates with TED talks.

who Do Not Watch TED Talks (see Figure 4). However, as the design process continued, P16 began to realize her own role in the story she was telling. P16's personal background was white and educated, but rural, not urban. As P16 explains in the reflective essay:

TED makes invisible the space where I most closely see engagement with sustainability: a ranching environment in which residents sustain a grasslands habitat as well as a fragile rural community. Videos that define sustainability in terms of investing in Walmart, practicing permaculture in Marin County, or singing to Al Gore do not speak to my experience of sustainability.

As a result of this recognition, P16 wrote herself into the transformation in several ways. One themed playlist, Sustainable People, uses annotations to present P16's reinterpretations of video subjects, such as comparing the owner of Angelic Organics "to farmers I have known." Another playlist, Sustaining Something in the Flyover, "directly compares how sustainability is understood in both rural and urban environments." P16 also repurposed an OVDLT generic About page to present an account of her family heritage, as shown in Figure 5.

In P16's transformation, the residual ultimately appears through the relationship between P16's evolving reading of the content and, ultimately, herself. The form of flow here shows the stages of a dynamic understanding, as the three personal elements both amplify and refute their antecedent reading at the same time. Moreover, the rural perspectives adopted by P16 to counter the TED-oriented reading are not perfectly aligned responses; P16 herself may be a bridge between rural and urban perspectives, but that means she is

The collection records that resonated with my experience depicted rural communities and family farms. From my perspective, this experience appeared to be marginalized and poorly represented. These rural, non-technical topics are not likely to be the subject of TED sustainability talks. Yet many people who grew up on farms see it as their life's work to treat the land gently and pass it on to people who come after them. I admire and respect the brilliant technical solutions that may potentially save our planet from ending in fire and ice, yet I'm more moved and heartened by the sentiments of Wendell Berry's "Manifesto: The Mad Farmer Liberation Front":

Sustaining a family



*Put your faith in the two inches of humus
that will build under the trees
every thousand years.
Listen to carrion – put your ear
close, and hear the faint chattering
of the songs that are to come.
Expect the end of the world. Laugh.
Laughter is immeasurable. Be joyful*

*though you have considered all the facts.
So long as women do not go cheap
for power, please women more than men.
Ask yourself: Will this satisfy
a woman satisfied to bear a child?
Will this disturb the sleep
of a woman near to giving birth?*

Many things need sustaining, and everyone has ideas about where to start. Pick one.

Figure 5: About page from P16's transformation. The photograph represents P16's own family history.

wholly part of neither. As P16 suggests in the reflective essay, the rural friends and family that she invokes (and of whose community she was once, but is no longer, a part), “would never willingly be part of a classification that celebrates a liberal icon such as Al Gore.” The plurality in this transformation is of multiple selves over time, intersecting in the process of an ongoing reading.

In our analyses of the students' work, two additional designers besides P16 adopted this author-oriented strategy. One, P11, created a transformation that assessed each video's feminist credentials. But the form of residuality in P11's transformation was not in its feminist stance, but in its acceptance of radical subjectivity in applying that stance. P11 asserted both that the transformation's assessments of “patriarchy” or “not” were hers alone, and that these unique judgments were worthwhile and interesting, even as they might also be unstable and even inconsistent. The other, P12, created a transformation that initially seemed like an incomprehensible hodgepodge, with descriptors like “Antelopes,” “Readin, Ritalin, Rithmatik,” and “lacuna prima.” Although it spins off in a bewildering number of directions, P12's transformation is not absurd; it has an underlying motivation and logic. P12's transformation reflects the internal mental process of P12's understanding what such a transformation is or might be, and accordingly what residuality is or might be. It is a sketchbook of ideas in progress that demonstrates the progress of P12's grasp of the transformation project and P12's own relationship to it, as mediated through the design materials.

In formulating design strategies based on interactions between one's own readings, these designers expressed, through their transformations, an idea that any reading of a database is constantly mediated by one's continually evolving and partially inconsistent self. In tracing the relationships between readings and selves, as embodied through the transformation, the form of flow instantiated by these students demonstrates the ongoing nature of reading, and the associated instability of any one interpretive

moment. The flow provides a third variety of infrastructure for new readings, or design-after-design.

CONCLUSION

We conclude by suggesting how three of our findings bear upon more general ideas of infrastructuring for design-after-design. These are:

- From the integration of reading and writing that characterized both the design process and product for all our participants, we suggest that design that incorporates an awareness of its own material composition constitutes a form of infrastructuring.
- From the three forms of “flow,” or narrative motivation and coherence, that our student participants enacted, we suggest that design that incorporates an awareness of its own history constitutes a form of infrastructuring.
- From the welcoming attitude that our participants adopted toward open-ended and indeterminate interpretation and appropriation of their work, we suggest that the integration of criticism and design constitutes a form of infrastructuring.

We briefly address each of these proposals.

Our project involved a particular design situation, one that aligned itself exceptionally well to notions of reading and writing: not only did it involve the integration of single texts (videos) into a composite text (the collection), the goal of the critical design exercise was to exploit the “cracks” in a common interpretive strategy to discover new interpretive strategies. Accordingly, our student participants began their design process by “reading” the composite text they were to invert, and they continued that orientation throughout their design, or “writing” process. However, we see potential application of this “reading/writing” orientation to other design situations. More generally, our participants saw the design process as an ongoing interpretation of their design materials—videos, but also descriptive metadata elements, and even more abstractly, ideas of residuality, of databases as interactive communicative forms, and of the ultimate goals of database interactions. Moreover, our participants sought to “write” their evolving interpretations of all of these material elements, both concrete and abstract, into their transformations. The design was in some sense documentation of a dynamic understanding of materials. Further, the means by which all these material elements were stitched together were purposefully left open, making the seams of material composition another element for the transformation reader to encounter and interpret. As P14 emphasized in the reflective essay, the descriptor choices in Sustainable Synesthesia were *designed* to fall apart, to reveal their materiality to the reader. We see this as one aspect of the form of coherence that we call flow; even as it demonstrates the transformation author's process of relating the different material elements, it both joins the elements

together and reveals the substance of that join. These open mechanisms of relating the various material components of design are a form of infrastructuring. The reader is aware that the relationship between (in the case of Sustainable Synesthesia) a smell like Animals or Indoor Air and any particular video is contingent, tenuous, and personal, even as the rationale and acuity of such assignments may be equally apparent. The mechanisms of design in merging materials is made visible, and the reader is encouraged to use awareness of these mechanisms in reappropriating the materials for a new interpretation.

As our study designs incorporate a sense of their own composition, they also incorporate a sense of their own history, in terms of providing internal evidence of their changes. Of our case studies, P16's transformation shows this most clearly, in that the personal elements that ultimately form the conceptual heart of the transformation are structurally peripheral and proportionally small. When the reader arrives at these elements, however, they reveal themselves as being conceptually antecedent to the primary bulk of the transformation, and evolution and annotation upon it. As it reveals the mechanisms involved in merging materials, the working of flow reveals the mechanisms of reconsidering materials over time, of coming to understand their qualities differently. P16 realizes that her discomfort with TED arises from both acceptance and recognition and a discomfort within herself; her initial strategy of demonstrating submerged imbalances within the TED environment transforms into a dual strategy of demonstrating imbalances within herself as well. This is also a form of infrastructuring; the mechanisms through which design strategies change over time are included as part of the design, and awareness of these mechanisms underscores the reader's agency in continuing these design processes. Our participants embraced such possibilities.

This encouragement of reader agency was instigated by the student designers' reflection upon their own critical reading processes, both as outside readers of the example Texas transformations prior to the design transformation project, and as active designers reading the original Sustainability collection in order to transform it. This link between their own critical activities and the facilitation of agency in their own subsequent readers was not necessarily immediate. P6, for example, wrote in the reflective essay how she was initially pleased to think that she had figured out "the answer" to the example Texas transformation she had examined in the critical essay, and she undertook the transformation design process with the goal of producing a similar realization of "getting it" in her readers. But eventually she came to believe that "getting it" was a relatively superficial goal, and that her own initial critical reading was more shallow than she had initially conceived. Instead of creating an artifact to be solved, P6 created one

to be read; the reflective attitude that enabled this design goal is also, we propose, a form of infrastructuring.

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