How a prototype argues

Alan Galey
Faculty of Information/Book History and Print Culture Program, University of Toronto, Canada

Stan Ruecker
University of Alberta, Canada

With the INKE Team[1]

Abstract

In this article, we argue that, just as an edition of a book can be a means of reifying a theory about how books should be edited, so can the creation of an experimental digital prototype be understood as conveying an argument about designing interfaces. Building on this premise, we explore theoretical affinities shared by recent design and book history scholarship, and connect those theories to the emerging practice of peer-reviewing digital objects in scholarly contexts. We suggest a checklist for subjecting prototypes directly to peer review:

- Is the argument reified by the prototype contestable, defensible, and substantive?
- Does the prototype have a recognizable position in the context of similar work, either in terms of concept or affordances?
- Is the prototype part of a series of prototypes with an identifiable trajectory?
- Does the prototype address possible objections?
- Is the prototype itself an original contribution to knowledge?

We also outline some implications for funding agencies interested in supporting researchers who are designing experimental computer prototypes. For instance, if a series of prototypes functions as a set of smaller arguments within a larger debate, it might be more appropriate to fund the sequence rather than treating each project as an individual proposal.

Correspondence:
Alan Galey,
Faculty of Information/Book History and Print Culture Program,
University of Toronto.
Email:
alan.galey@utoronto.ca

1 Prototypes as theories

It makes a difference whether we think in terms of processes or of products. The differences between *computer* and *computing*, or *model* and *modelling*, are more than grammatical. As Willard McCarty asserts, the participle 'turns things into algorithmic performances' (2008, p. 254), and signals intellectual processes whose full complexity cannot be contained within single artifacts. It thus enriches our vocabulary far more to speak of *computing* than of *the computer*. That principle also helps explain the widespread takeup of John Unsworth's idea of scholarly primitives—*discovering*, *annotating*, *comparing*, and so on—which he expressed not as nouns but as participles, implying communities of practice based on performable actions, not just shared products (Unsworth, 2000). Our intention is to extend this logic of process to terms like *designing* and *prototyping*, both of which name activities at the core of the digital humanities. We approach this issue by exploring how the often

Literary and Linguistic Computing, Vol. 25, No. 4, 2010.
doi:10.1093/llc/fqq021 Advance Access published on 27 October 2010

disparate fields of design and book history understand the relationship between artifact and process. Both of these fields operate in the messy middle ground between interpretation and making, and both can contribute to a theoretical framework for new questions facing humanists.

The Implementing New Knowledge Environments (INKE) project, for example, includes research teams based in Interface Design and Textual Studies, among others, with all researchers working collaboratively on strategic prototypes for new reading environments (Siemens *et al.*, 2009; Galey *et al.*, forthcoming). As these sorts of collaborations become viable on a broad scale, it becomes essential to develop shared vocabularies and research questions. Accordingly, this article aims to address the questions of how the process of designing may be used simultaneously for creating an artifact and as a process of critical interpretation, and whether new forms of digital objects, such as interface components and visualization tools, contain arguments that advance knowledge about the world. We explore these questions first by exploring theoretical affinities shared by recent design and book history scholarship, and then by connecting those theories to the emerging practice of peer-reviewing digital objects in scholarly contexts.

These questions touch upon scholarly best practices and their codification. Guidelines abound in the digital humanities, and yet, although we have guidelines for evaluating digital scholarship in institutional contexts (see the MLA's Guidelines for Evaluating Work with Digital Media in the Modern Languages), the profession has paid less attention to how to evaluate the products and processes of digital scholarship as intellectual contributions. How can design become a process of critical inquiry itself, not just the embodiment of the results? This question puts at stake some of our fundamental assumptions about the relationship of tools to interpretation, and of research products to research processes.

One longstanding tradition of design is to understand it as an invisible handmaiden to content, where form follows function, and where the typography in a book, for example, becomes transparent to the reader (Bringhurst, 2005). Good design in this school of thought is design that goes unnoticed. An alternative tradition treats design as creative expression, where the hand of the designer is evident and we see a style that can be associated with the person responsible (Rand, 1985). A related variation, sometimes referred to as *critical design*, is predicated on design as a rejection of the first tradition, resulting in, for example, typography that is intentionally difficult to read and chairs that no one can sit in (Dunne, 2005). All of these approaches to design have their place, and we would argue that each of them can legitimately be understood as a form of interpretation. However, we also propose that there is another distinct possibility, where one of the goals of the designer has been deliberately to carry out an interpretive act in the course of producing an artifact.[2] As Lev Manovich has publicly phrased it, 'a prototype is a theory' (2007). One of the functions of the artifact then becomes to communicate that interpretation, and to make it productively contestable.

Our purpose in this article is to find a useful bridge between the tool-building tradition of the digital humanities on one hand, and interpretive and critical traditions like book history and science and technology studies on the other. As digital humanities tool-building—another participle—matures from being primarily service-based to inquiry-based, now may be an apt time to revisit an argument made by Langdon Winner in his touchstone essay 'Do Artifacts Have Politics?' (1980). In Winner's analysis of Robert Moses's infamous design for Long Island's expressways—with overpasses deliberately too low for public transit busses to clear, effectively barring access to parts of Long Island to all but (mostly white) car owners—he argues for an understanding of technology and society that 'takes technical artifacts seriously' and pays 'attention to the characteristics of technical objects and the meaning of those characteristics' (1980, p. 123). Book historians, design scholars, and digital humanists alike have been making the very same case in recent years, but from the perspective of makers, users, and critics of highly technical objects. Though our digital objects may be new, and not necessarily the kind imagined by Winner, his article makes a point that

builders and critics of tools alike cannot afford to ignore: 'If our moral and political language for evaluating technology includes only categories having to do with tools and uses, if it does not include attention to the meaning of the designs and arrangements of our artifacts, then we will be blinded to much that is intellectually and practically crucial' (1980, p. 125). In this view, even doorknobs have politics in that they may be round, requiring a human hand to turn them, or shaped as levers, such that a person with a prosthetic limb or an armload of groceries with one free elbow can still successfully use them. This is more than simply a matter of utility. Both designs are political in that they presume and construct different kinds of worlds, with the round doorknob presuming a world in which everyone's bodies are the same, and in which hands with opposable thumbs and sufficient grip strength are always available.

Again, these are familiar arguments in fields like inclusive or universal design, and science and technology studies. The digital humanities must not lose sight of the design of artifacts as a critical act, one that may reflect insights into materials and advance an argument about an artifact's role in the world. Our purpose here is to follow the implications of a hermeneutical approach to design for digital humanities projects that entail the strategic prototyping of digital artifacts. We both lead projects, separately and together, which combine digital prototyping with critical analysis, and focus on a research model rather than a service model (a crucial distinction for the INKE project, for example). Our various collaborations have prompted us to look for ways that our respective home fields of design and book history intersect.

The argument we offer is two-pronged. First, we offer book history and design as examples of two fields that have more or less independently been theorizing the collaborative production of artifacts as a critical and creative process, involving multiple kinds of agency worthy of analysis. These are by no means the only fields where this tendency is present—there are similar examples in film studies, software studies, and literary studies, to name a few—and recognizing this methodological link across fields benefits all of them, particularly those located at intersections, like digital humanities and book history. We argue that the digital artifacts humanists create can do more than simply measure up to standards for interoperability and usability. We recognize that digital artifacts have meaning, not just utility, and may constitute original contributions to knowledge in their own right. The consequence of this argument is that digital artifacts themselves—not just their surrogate project reports—should stand as peer-reviewable forms of research, worthy of professional credit and contestable as forms of argument.

2 Design and interpretation in the history of the book

Ideas about design enter the digital humanities from a number of directions, each bringing certain disciplinary predispositions with them. Edward Tufte, for example, has published several books richly depicting the variety of information design strategies, often with the same comprehensive historical scope one finds in book history conferences and publications but without the deep contextualization book history brings to the objects it studies (cf. Tufte, 1997). Like design, the field of book history offers a perspective on the ethos of *thinking through making* which informs much digital humanities research and pedagogy generally. Manovich's assertion that 'every prototype is a theory' has a counterpart in Bernard Cerquiglini's claim for textual scholarship that 'every edition is a theory' (1999, p. 79). The symmetry of these two statements extends to much of design and book history as cognate but often separate fields.

New forms of scholarly creation, especially those emerging from the digital humanities, need to be understood within the epistemic contexts that design and book history have concurrently been modeling in recent years. Although literary studies and hypertext theory have, in the wake of post-structuralism, redefined what it can mean to be an author, it has fallen to book historians to recontextualize authorship within broader contexts of meaning-making that are not purely linguistic or textual, but also material—such that *authoring*

becomes only one activity among many, including *designing*, *manufacturing*, *modifying*, *reading*: these and other processes shape the meanings of books, and are no less vital to the interpretive potential of digital artifacts.

Book history, an interdisciplinary field comprising history, bibliography, and literary studies (Howsam, 2006), has a more complex relationship with design than may appear on the surface. In its most public form of dissemination, the academic monograph (usually single-author), book history may seem to non-practitioners to be more concerned with understanding the past from a distance, analyzing and commenting upon the history of books with tremendous acuity and vigour, but not directly intervening in the stories its practitioners tell. On closer inspection, however, we can find forms of textual scholarship whose scholarly primitives can materially change the field of evidence, such as book historians who uncover new artifacts through archival research (*discovering*; cf. Tischendorf, 1867), and analytical bibliographers who radically change our understanding of how particular books came to be as they are (usually by *comparing*; cf. Hinman, 1963). We also find editorial theorists and literary critics who change those stories, in effect, by prompting us to look with new eyes at the same evidence, and to revise the vocabularies we use to conceptualize foundational ideas. Although we are a long way from the period when the definitive account of the printing trade was written by a printer (Moxon, 1683), one can look at recent history and find textual scholars who themselves operate presses and design books.

Studying the history of book design has long been part of bibliography, but the work of D. F. McKenzie, Jerome McGann, and others since the 1980s has brought the materiality of texts to the attention of wider audiences in the humanities, and emphasized the crucial link between the design factors in a text's material forms and that text's possible interpretations (McGann, 1991; McKenzie, 1999). Fredson Bowers, for example, excoriated literary scholars for failing to account for material influences in the transmission of texts, but did so with textual accuracy as his foremost concern (Bowers, 1959). By contrast, McKenzie's 1985 Panizzi Lectures, published the following year and again in 1999 as *Bibliography and the Sociology of Texts*, accomplished a more successful kind of outreach by emphasizing the meaning-making power of book design and material form. He also drew attention to the importance of collaboration between multiple agents in the construction of meaning in books and other textual artifacts, expressed in the simple formulation 'forms effect meaning' (1999, p. 13). Where Bowers sought to drag literary interpreters back down to earth, McKenzie instead brought the objects of interpretation back to the level of the human, emphasizing texts' physical embodiment in particular editions (e.g. McKenzie, 2002), historical documents (e.g. his discussion of the Treaty of Waitangi in McKenzie, 1999, pp. 77–128), and even features of landscape in aboriginal cultures (e.g. his discussion of the Arunta country in Australia in McKenzie, 1999, pp. 39–41).

His approach to the sociology of texts was well-timed, coinciding not only with the rise of book history as a new field, but also with the proliferation of personal computers and other forms of digital media. In the two decades since McKenzie's Panizzi Lectures, the study of design in the history of the book has progressed from chronicling aesthetic and technological developments to become something more like the history of meaning-making through design. Practitioners in both fields study the intimate and profound connections between how things work and what they mean.

3 Documents as conversations, peer review as paratext

The printed book has functioned as both an object and a means of peer review. These two functions have intersected at crucial moments in the development of the book's material form, and the design of books often reflects—even shapes—their anticipated evaluation by communities of expert readers. In our own time, traditional models for peer review are being challenged in tandem with traditional forms of the book, as for example (Fig. 1) in MediaCommons Press's open peer-review process

for Kathleen Fitzpatrick's book *Planned Obsolescence: Publishing, Technology, and the Future of the Academy*.[3] At the time of writing, in the winter of 2010, a draft of Fitzpatrick's book is publicly available on the Web via an interface which records paragraph-by-paragraph annotations by readers, and permits notes on those notes and so on—including responses by the author herself. It is no coincidence that Fitzpatrick's book *about* peer review is itself a prototype for the review process it describes. Like other prototypes, it demands evaluation not just of its content but also of its form as a digital object. Her draft chapter on 'The History of Peer Review' surveys crucial moments in the development of peer review as a process, such as the Royal Society's creation in 1752 of a Committee on Papers for its journal, *Philosophical Transactions* (see also Kronick, 2004).

However, it may be worth taking a broader view of related practices in the history of the book, as we advocate in this paper. For example, Adrian Johns suggests that the Royal Society's peer-review practices began not with the papers reviewed in the early to mid-eighteenth century, but as early as 1661 via the Society's system of 'perusal,' a kind of gift economy in which whole books or manuscripts were

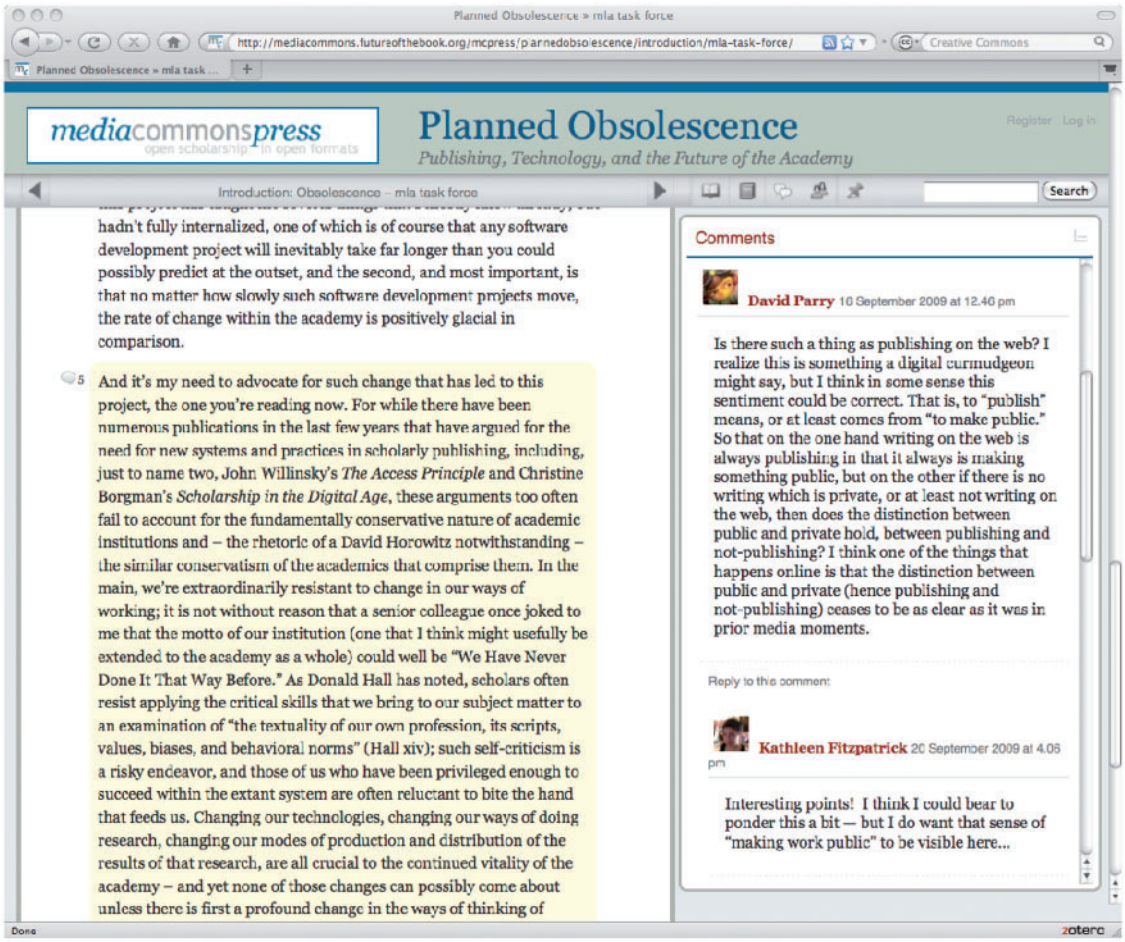

Fig. 1 Text and commentary from Fitzpatrick's *Planned Obsolescence* as it appears in MediaCommons Press's open-review interface

presented to the Society, delegated to a specific reader, and discussed among the Society's membership as part of a complex system of responses (Johns, 1998, pp. 482–91). Worth noting, with a view to our argument about peer review of artifacts, is Johns's point that the Royal Society's official books for registering submitted letters and papers grew to include theories and hypotheses in general, as well as artifacts and inventions (pp. 485–6). The latter were usually submitted (in a sealed box held by the Society's secretary) not for peer review but to settle disputes over priority. The convergence of these mechanisms anticipates our own view of digital prototypes. This system depended not only on print as a technology, but also on the inclusive sociology of texts that McKenzie extended to media of all kinds, old and new. In this light, a parallel history of antecedents for emerging forms of peer review may be found by examining the connections between book design, paratext such as annotations and prefatory materials, and the emergence of peer review itself.

Planned Obsolescence and CommentPress make their argument jointly through the relationship between text and notes made possible by the interface. As can be seen in Fig. 1, the interface itself and the kind of dialogue it permits are relatively familiar; annotations are not merely product reviews, in the genre of user comments on retail websites like Amazon.com, but rather the kind of dialogue between author and readers that we associate with blogging (the interface, CommentPress, is a plugin for the WordPress blogging engine). As annotations to a single text, however, the reviewers' comments also continue a long tradition of collaborative annotation in the history of the book.

For example, CommentPress's goal of 'turning a document into a conversation' (http://www.futureofthebook.org/commentpress/) has an antecedent in the early editions of *Utopia*. Literary scholars and historians have long recognized the first Latin editions of *Utopia* to be among the most important early humanist books to combine printed annotation and other forms of paratext with the idea of a community of peers (Allen, 1963; Carlson, 1993; Jardine, 1993; Leslie, 1998; Kinney, 2005; Massai, 2007, pp. 49–55), such that sole attribution to More as an individual author misrepresents the collaborative nature of *Utopia* as a project. As with the CommentPress interface, its early editions stand on the threshold between books as published products and conversations as unfolding processes. With their successive changes and additions to *Utopia*'s complex paratextual frame, the editions of 1516 (Louvain), 1517 (Paris), and 1518 (Basel) begin to seem like a series of iterative prototypes.[4] Certainly by 1518 *Utopia* could be regarded as a creation not just of its named author, Thomas More, but also of several collaborating agents, including: other humanists in More's circle such as Erasmus and Peter Giles, both of whom contributed prefatory letters and possibly the edition's printed marginalia; the humanist printer John Froben; and the engraver Ambrosius Holbein, whose contributions included a figure of the fictional island and an image of the dialogue in Giles's garden, represented in the book.

The printed glosses which first appear with the 1518 edition of *Utopia*, sometimes attributed to Giles or Erasmus, signal only a fragment of the collaborative efforts which generated *Utopia* as a humanistic experiment in the possible relations between imaginative literature, social critique couched in irony, and the design of the printed book. As Warren Wooden and John Wall have argued, even details in Holbein's woodcuts, such as the distinctive ornamental vines which connect the map of Utopia to the figure of the dialogue about it (see Fig. 2), work together by design to support *Utopia*'s metafictional frames-within-frames (Wooden and Wall, 1985).

Another key to this experiment was the layer of commendatory letters between the members of More and Erasmus's circle which framed the early editions of *Utopia*, and which by 1518 had expanded into a network of exchanges between peers with More's text at their centre. Like the online annotations solicited by CommentPress's open peer-review process, the early letters accompanying *Utopia* serve both to authorize the text, bestowing individual stamps of approval, and to contextualize it within a specific community of readers. As Peter Allen suggests, 'On its first appearance, then, *Utopia* carried with it a group of names which would clearly identify it for the knowledgeable sixteenth-century

Fig. 2 The first page of Book 1 of the 1518 *Utopia*, featuring Holbein's woodcut of the dialogue which frames the book (reproduced by permission of the Huntington Library, San Marino, California).

reader as a document of northern European, not just English, humanism' (1963, p. 97). Such authorization was no less a form of 'editorial marketing' (Vallée, 2004, p. 53) than the lists of respected peer-reviewers found in present-day scholarly journals. Taking Allen's reading together with Wooden and Wall's, we could say that the 1518 *Utopia* editions had the equivalents of both an editorial board (the prefatory letter-writers) and a design team (Erasmus, Froben, Holbein, and perhaps others).

What we see in *Utopia*—as one example among many—is a precursor to open peer review in the form of these scholars' efforts to create, as Anthony Grafton describes it, 'a new kind of virtual community that was sustained not by immediate, direct contact and conversation so much as by a decades-long effort of writing and rewriting' (2009, p. 23). However, as we have been arguing, terms like *writing* and *rewriting* may too easily conflate other meaning-making activities like *designing*, which must be recognized if we are to understand both the history and the future of the book. The complex emergence of peer review, broadly construed to include the humanities and not just the sciences, requires us to contextualize recent prototypes like CommentPress not only within developments in intellectual history, but also within changes in the design of those material objects that gave intellectual history its shape. These prototypes were theories whose meaning was inseparable from their material form.

4 The arguments of objects and processes

If we take seriously the idea that books and other objects from the past can embody complex ideas about the cultures that created and used them, what then of the digital objects that we design in the present? By understanding how fields like book history take the design decisions embedded in physical artifacts as interpretive objects, we can begin to see digital humanists' creation of new digital artifacts as interpretive acts. The word *book* in *book history* is deceptively narrow; we use it, as Leslie Howsam suggests, 'only for lack of any better collective noun' (2006, p. 3). Within the digital humanities, attention to the design of the 'expressive form' of books and 'non-book texts' (McKenzie, 1999) is poised to extend into the study of digital objects, including electronic literature and video games. Although McKenzie suggested a natural extension of bibliography's analytical and interpretive methods to texts in all media, including film, sound recording, and electronic text, the digital object presents challenges to hermeneutic assumptions carried forward from the print-based bibliography of the past century. Anthony Dunne aptly describes the interdisciplinary challenge when he asks, 'How can we discover analogue complexity in digital phenomena without abandoning the rich culture of the

physical, or superimposing the known and comfortable onto the new and alien?' (2005, p. 17).

In contrast to digital text production and software design, we have a fairly well-defined understanding of the traditional roles of non-authorial agents in print and manuscript book production, such as scribes, binders, typographers, compositors, correctors, and illustrators. 'The sociology of texts' names an interpretive orientation which embraces these agents' contributions to the traditionally authorial process of meaning-making. In essence, book history has embraced design as a hermeneutic process, but has done so using a print-based vocabulary inherited from bibliography. Reciprocally, William Gaver and others in the worlds of design and human–computer interaction have been incorporating into their work an emphasis on interpretation and ambiguity, acknowledging the influence of humanities perspectives, but also drawing on a vocabulary suited to systems as well as artifacts, and to future designs as well as past ones (Gaver *et al.*, 2003; Sengers and Gaver, 2006). The challenge now is to bring these perspectives together to understand the kinds of agency that produce meaning in digital objects, and to appreciate the critical potential of digital objects in terms limited neither to print culture nor to the utilitarianism of industrial design (Dunne, 2005).

We believe that the theoretical questions and convergences described above are strongly relevant to the emerging area of peer review, evaluation, and authorship status of digital objects. Just as the boundary between digital documents and software applications has become less distinct due to web technologies, so has the boundary between traditional scholarly monographs and digital objects such as the 'interactive media submissions' solicited by *Digital Humanities Quarterly* and *Vectors*. By recognizing that digital objects—such as interfaces, games, tools, electronic literature, and text visualizations—may contain arguments subjectable to peer review, digital humanities scholars are assuming a perspective similar to that of book historians who study the sociology of texts. In this sense, the concept of design has developed beyond pure utilitarianism or creative expressiveness to take on a status equal to critical inquiry, albeit with a more complicated relation to materiality and authorship.

If we take seriously the suggestion that a digital object can embody an argument, then it should be possible to apply to digital objects some of the standard criteria for reviewing arguments. For Booth *et al.* (2008), the three key components of a good thesis topic are that it is contestable, defensible, and substantive. To be contestable, the thesis must try to convince people of a position that not everyone already believes. To be defensible, it must be possible, given the right kind of argument or evidence, that members of a reasonable audience could be convinced to change their minds and accept it. To be substantive, the argument must be worth the time and effort it takes for the writer to make it and the reader to engage with it.

For a prototype, we propose that contestability might reasonably consist of the inclusion somewhere in the interface of either an old affordance, earlier seen in other interfaces but now done in a new way, or else a new affordance—one not earlier seen. Defensibility might equate to the heuristic evaluation of the possible strengths and weaknesses of the new affordance, both in its own right and also in comparison with other ways of providing the same affordance.

For instance, someone might be proposing a new visual browser for text collections such as Texttiles (Giacometti *et al.*, 2008). Texttiles provides a set of small tiles that can be dynamically sorted. There are many existing alternatives for file browsing, including conventional methods such as hierarchical trees (as in desktop file systems), advanced methods such as coverflow interfaces, and experimental approaches such as microsliders (Ahlberg and Shneiderman, 1994). In order to subject the Texttiles prototype to peer review, it would be useful to expand this catalog to include as many varieties of visual systems as possible for file handling that have been attempted, and to compare the strengths and weaknesses of the new system in the context of the others.

Another frequent form of evidence consists of the results of user studies, which often involve measures of performance or preference. For old affordances handled in a new way, the studies could be

comparative. For new affordances, comparison is not really possible, but the strategies that can be adopted include looking at what we have elsewhere called 'affordance strength' (Paredes-Olea *et al.*, 2008; Ruecker, 2006). However, since we are arguing here for a direct form of peer review that is unmediated by an accompanying article or study, we must discount the possibility of evidence from user studies, which in any case tends to be most satisfying and useful during the formative phase of a project, rather than as a means of justifying a tool that has already been completed.

Whether or not a prototype idea is substantive is somewhat harder to determine. It rests on the potential significance of the design both in terms of intellectual importance and practical value. It is not always possible to evaluate such factors with any precision, especially early in the process. This is, however, equally true for conventional scholarship.

In addition to the argument made by a single prototype, it is also important in some cases to look at a trajectory of iterations of the prototype or of the larger research project that has produced the prototypes. Iteration involves a series of decisions about the argument being made, which should best be understood by considering the alternative choices that were available at each stage. For example, as Roberts-Smith *et al.* (2009) argue, the Watching the Script project began with a 2D stylized interface that privileged the concept of the text as the central governing object in the production of a play. The current 3D version of the interface, on the other hand, takes as its central organizing principle the Aristotelian line of action, which includes the text but emphases directorial choices about everything that is happening on stage. This change in perspective has had profound consequences for the prototype, including the need to support a full range of viewing angles of the stage, and the radical decoupling of movement from speech.

The question of authorship is another factor to consider in the adoption of peer review of digital objects. Unlike research results in the sciences, arts research is still frequently published by a single author. However, in the case of digital objects, it is rare for a single person to be responsible for the entire process of conceptualization, design, development, and testing (Sinclair *et al.*, 2003). At what point is a contribution significant enough to warrant the digital equivalent of authorship? Who should be first author—the person who had the original idea, or the person who did the bulk of the design, or the person who did the programming? These are questions which, if asked within a book-history context, would resonate with Roger Stoddard's often-quoted assertion that 'authors do *not* write books. Books are not written at all. They are manufactured by scribes and others artisans, by mechanics and other engineers, and by printing presses and other machines' (1987; emphasis in original). Peer review of digital objects thus involves digital humanities in a kind of sociology of texts with respect to the re-evaluation of authorship, while also foregrounding new aspects of digital design such as fragmentariness, modularity, and interoperability.

5 Peer review of digital objects

We propose that it is possible to interpret digital objects, and in particular experimental prototypes, as forms of argument. Our contention is that this kind of interpretation can be the basis for academic peer review of the prototypes themselves, not just of articles that describe prototypes. In this section, we outline a set of conditions that should be met in order for peer review of digital objects to be successful, and provide a checklist that may serve as a starting point for peer reviewers.

First, it is necessary to determine whether or not a prototype is intended to be making an argument or whether it is something else entirely, such as a production system. Just as in the complex system of other forms of scholarly knowledge, it is therefore necessary for the reviewers to be familiar with the context of the prototype within the history of prototyping, and to be sensitive to the nuances of the genre.

The idea of a genre of prototype can be understood in two ways. First is the possibility that there are a range of related pieces of software that either work in somewhat the same ways, or else attempt to

provide the same affordances. Second is prototype genre in the sense of design transferability (Chow and Ruecker, 2006), where a prototype designed for one set of users working in a particular domain is transferred to a new set of users in a new domain, such as civil engineers using maps and antiquarians using facsimiles based on the same technology. In this case, the concept for the prototype may have already been well established in another content domain but not in the current one, so that, for example, an innovation in image browsing has been introduced for collections of photographs but has not been used for collections of 3D objects in archeology. In these cases, part of the review should involve discussion of how well the prototype addresses the needs of the new domain, and whether modifications were required for the transfer.

Once it is clear that the prototype does reify an argument, it is necessary to identify the various points being raised. This process can be somewhat difficult, since visual arguments, like written arguments, may require some unpacking and testing and ruminating. A visual argument is not likely to proceed through a series of syllogisms, but many written arguments are similarly less formal. Reviewing the points in a visual argument involves identifying the larger argument, then examining visual details to see how they contribute to the whole. It is also useful to look for ways in which the prototype attempts to accommodate possible objections, as it is often the case that these attempts will result in compromises to the purity of the prototype idea. For example, a browsing prototype may also include a search function. While search functions are not intrinsic to the affordance of browsing, it is widely understood that search functions are helpful and that any subsequent user study would consider the lack of a search function worth mentioning.

In the context of peer review, it is perhaps also worth mentioning that it may not be the most effective approach to have the designers and programmers responsible for a new prototype also provide the analysis and description of their own work in the context of reporting on a user study. First, it is very difficult to establish the proper intellectual basis for the critique. Second, as with authors, so with designers and programmers—they are not always the best critics of their own arguments.

Finally, we should address the thorny question of when it is best to provide the peer review of a prototype. If we consider a development process that begins with design sketches (first static, then kinetic), moves to a working prototype (either vertical, with one important function working properly, or horizontal, with many functions working superficially), then continues to a production system (with everything working to some extent, although still subject to bug fixing and iterative improvement), we are presented with a spectrum of possibilities.

From the perspective of computing science, the design is usually not sufficient. Computer scientists have a well-founded fear of 'vaporware' where designers discuss features for systems that have never existed and will never exist, and the obvious answer is to only deal with working prototypes. The disadvantage of this approach is that it devalues design to the point that it can be nonexistent.

From the perspective of researchers and granting agencies, it would perhaps be most useful to introduce a first peer review stage following design, before the time and expense of building the prototype ever occurs. 'Paper prototyping' was a well-established method in the visual communication design community by the early 1990s and continues to be used by designers to take paper mockups into user studies (e.g. Helmer-Poggenpohl, 1999). Prototypes that pass peer review at the design stage would then have more authority when seeking resources for programming, user studies, and further phases of peer review.

A checklist for peer-reviewers might read as follows:

- Is the argument reified by the prototype contestable, defensible, and substantive?
- Does the prototype have a recognizable position in the context of similar work, either in terms of concept or affordances?
- Is the prototype part of a series of prototypes with an identifiable trajectory?
- Does the prototype address possible objections?
- Is the prototype itself an original contribution to knowledge?

It is worth noting the difference between the above criteria and those which normally apply in more entrepreneurial scenarios: is it useful? will it work? is it the most efficient design? will it be profitable? is it patentable? These are relevant questions in many contexts but, as Winner argued, there is a danger in reducing the meaning of an object to its use-value.

6 Case studies of digital objects

As examples of how the peer review process for digital objects might work, we offer three brief case studies, consisting of radically different kinds of prototypes: Stefanie Posavec's Literary Organism, W. Bradford Paley's TextArc, and Adrian Cheok's Poultry Internet.

In her Literary Organism project (Figs 3 and 4), Stefanie Posavec provides a visualization of Jack Kerouac's *On the Road*. Posavec creates a set of flowers that represent themes in the book with different colours, while a branching structure represents the ordered hierarchy of content objects from chapters down to words.

There appear to be several related arguments expressed by Literary Organism:

- an infographic can be beautiful as well as meaningful
- themes can be used as the basis for an infographic about a novel
- prospect on the entire text is worthwhile
- an infographic about a novel need not contain words or directly represent numbers

Taking the items in sequence, it seems important first of all that Posavec is insisting on the beauty of the infographic. A person can read Robert L. Harris's monumental *Information Graphics: A Comprehensive Illustrated Reference* (2000) from cover to cover without having the point brought home that a beautiful object is more attractive to spend time studying than a plain object. Yet in Posavec's work, the beauty of the image is the most immediately striking thing about it.

There are, however, some potential objections to Posavec's argument. First is that not everyone may agree on what is beautiful or attractive. Despite the difference in people's tastes, however, it is possible to argue that the manifest attention to detail in a beautiful object still produces some effect—perhaps even increasing the user's trust in the quality of the prototype (Ruecker *et al.*, 2007). From this point comes a second, and perhaps more serious, objection that attractive objects may arouse suspicion in the viewer, who feels in danger of an attempted manipulation. This suspicion is particularly acute in the academic world, where there is an established rhetoric of resistance to commercial interests arising from a legitimate concern that someone may be 'selling something' rather than presenting a balanced argument.

That themes can serve as the basis for an infographic is similarly unusual in the context of other infographics. Although it is possible to find visualizations based on words (cf. TextArc, to follow), we are much more used to seeing a phenomenon converted to numbers and thus numerically displayed in an infographic. Emphasizing the themes of Kerouac's work suggests that the manual identification of themes is part of the process, since techniques for the automatic identification of themes are still themselves in the experimental stage. In fact, elsewhere on her site is an image of the work in progress, showing how she manually highlighted and marked the themes in the text using coloured markers and pens (Fig. 5).

Third is the argument that prospect on the entire text is worthwhile. Posavec does not produce portions of the diagram, but instead includes the complete text. Although it is becoming increasingly recognized that people are able to deal very well in perceptual terms with complex environments, and in particular with those where they have some agency over the data, we live with the legacy of information overload, a concern that is valid under certain circumstances but not necessarily under well-designed ones.

Finally, Posavec proposes that the diagram does not need to include two affordances that are normally expected: there are no actual words, and there is no interactivity in the sense of tools to selectively search or otherwise emphasize different portions of the image or to access the text. There is a contestable element in each of these visual assertions. The last is

Fig. 3 Detail of Stefanie Posavec's Literary Organism design, which shows Part One of Jack Kerouac's *On the Road* (reproduced with permission from Stefanie Posavec).

probably the least defensible, and the design could be strengthened in several ways by providing various forms of interactivity, including direct access to the text. This kind of increased affordance would also render the design significantly more substantive as an argument.

Our second case study looks at W. Bradford Paley's TextArc visualization (Fig. 6). TextArc has been well-known in the digital humanities community for many years, representing a striking departure from earlier concordancing approaches such as the Key Word In Context (KWIC) list.[5] That departure in the direction of the visual overview of the entire document is the most central contestable element in the prototype. TextArc also shares with Literary Organism the concept that infographics can be beautiful without losing their function. Its least defensible argument, however, is that this much visual complexity is appropriate for a collocation tool.

It is worth noting that both the Literary Organism and TextArc visualizations make arguments which require not simply comprehension of data, but the kind of active interpretation of texts that sometimes involves reading against the grain. For example, both are contestable at the level of their overt assertions, as we have discussed, but both digital objects also make consequential arguments at the level of form in the way they tacitly represent their materials. Literary Organisms's trees use a visual structure found in the natural sciences (such as cladistics) as well as in textual scholarship (such as the stemmatic trees used to chart the relationships between material witnesses of texts), and philosophy (such as the scheme of branches of knowledge represented in the *Encyclopédie*). In all these cases, the potential disjunction between materials and representational scheme has prompted contestation.[6] In the case of Literary Organisms, one might object to Posavec's matching of one

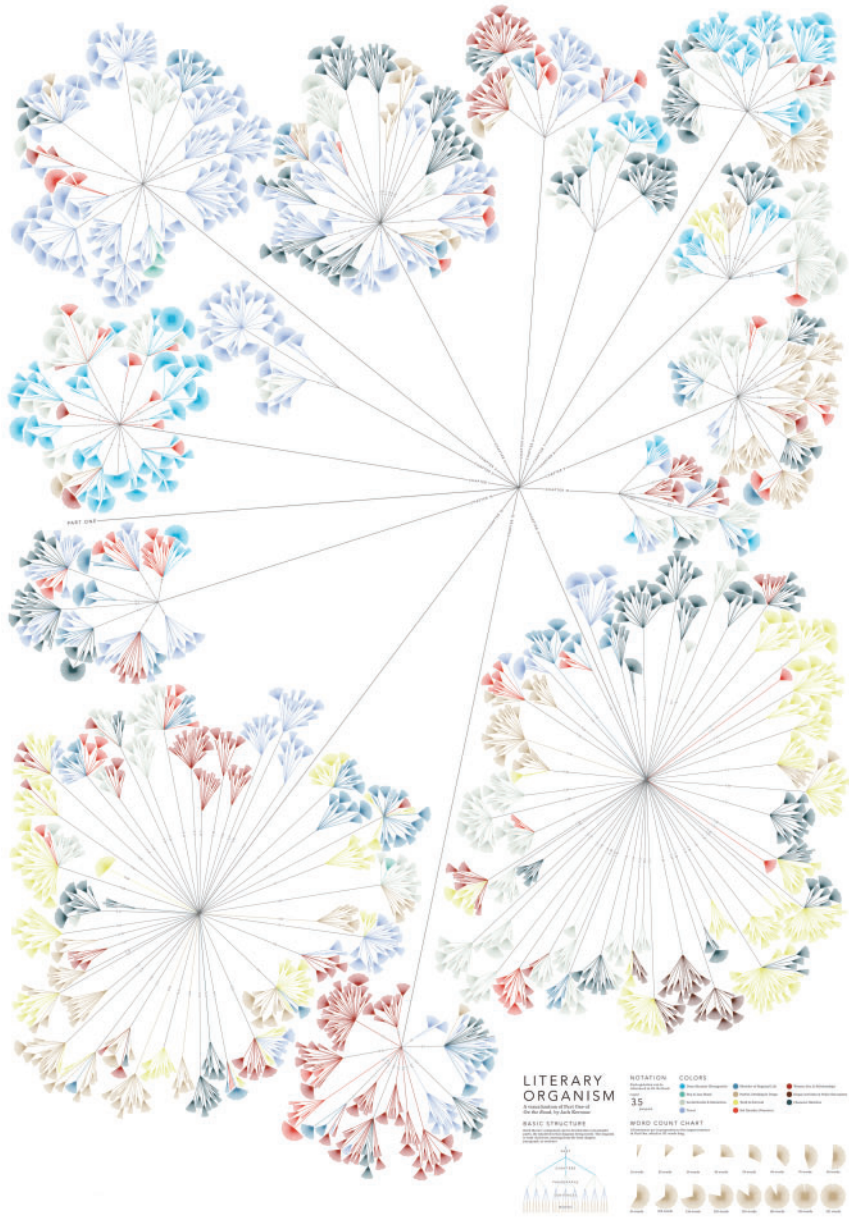

Fig. 4 This poster shows the entire text of *On the Road*, as configured into branching colour-coded themes by Stefanie Posavec (reproduced with permission from Stefanie Posavec).

theme or another with any given part of the text, or even to her categorization of themes—though as Fig. 5 shows, she has visualized these assumptions forthrightly, in a way that invites alternate readings. However, reading Posavec's visualizations critically also requires us to pay attention to the expressive form of the digital object. The form of the tree depends on the premise that a novel like *On the Road* may be represented as an ordered hierarchy of content objects, a premise which has been fiercely

Fig. 5 Posavec shows here some of the manual work done in preparation for the infographic, involving marking the themes in the text with a highlighter and pen (reproduced with permission from Stefanie Posavec).

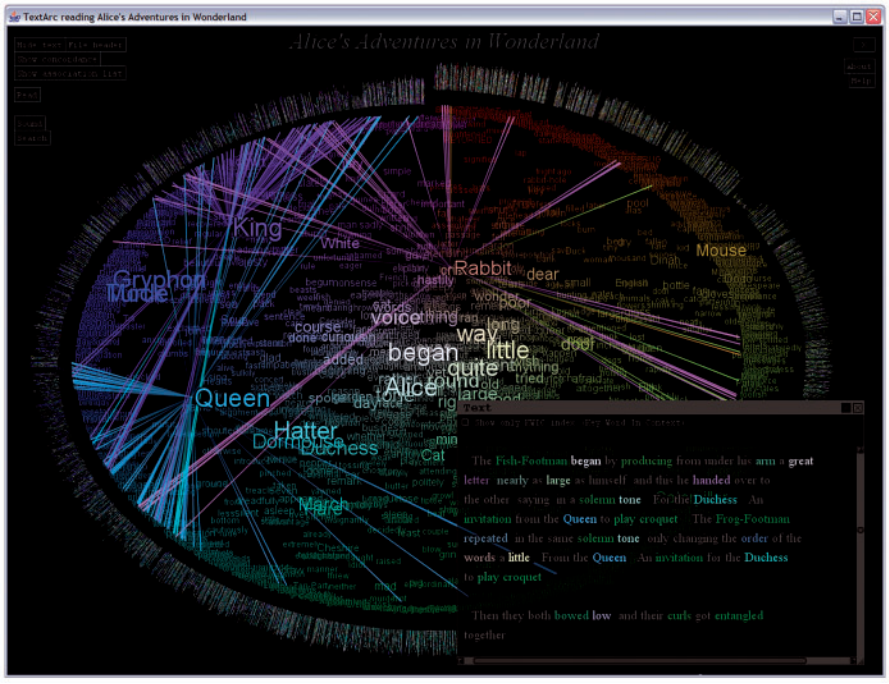

Fig. 6 TextArc, a visual text analysis tool, as applied to *Alice's Adventures in Wonderland*, showing inter-episodic use of 'Rabbit,' and four foreshadowing references to 'Queen' before the co-occurring character 'King' appears (reproduced with permission from W. Bradford Paley).

debated (DeRose *et al.*, 1990; Renear, 1997; McGann, 2001, p. 185; Hayles, 2005, pp. 89–116; Robinson, 2009) and whose origins in the rigidly logical structures of computer text-processing belie the organic metaphors of the visualization.

Similarly, TextArc's choice to represent the microtext as a circle invokes the longstanding symbolic connection in the Western tradition between circular forms and the concept of perfection or completeness. Like the perfect circular orbits of heavenly bodies in astronomy prior to Kepler, or Antonio Panizzi's famous circular reading room in the British Museum, circular forms encompass complexity. However, one could read TextArc against the grain by looking at the ways it avoids the complexity of materials in the sublunary human world, especially materials like *Hamlet*, whose text survives in three authoritative yet incommensurable printed versions, not to mention its long history of editorial interventions and theatrical adaptations (Mowat, 1988; Werstine, 1988). None of this material complexity is reflected in TextArc's visualization, which simply parses through one of Project Gutenberg's plain-text transcriptions and leaves editorial issues unaddressed. TextArc's visualizations are not really about *Hamlet* or *Alice in Wonderland* or its other sample texts; they are about TextArc's own algorithmic and aesthetic complexity. Yet TextArc's greatest value may appear when we stop wanting it to be a tool and surrender up some unseen use-value. Like many of the most enduring works in the arts and humanities, we do not necessarily need to agree with TextArc's underlying assumptions in order to appreciate it as a spur to further work along similar lines. The capacity to inspire should not be underestimated when we evaluate digital objects.

The preceding examples are familiar kinds in digital humanities research, especially in their reliance on text-processing, but it is important not to have too narrow a conception of what a prototype object can look like. Our third example is Adrian

Fig. 7 Adrian Cheok's Poultry Internet is intended as a means of increasing good relations between people and their pets (http://www.youtube.com/watch?v=1x-8EzuMiqU). This image shows Cheok with the rooster Charlie, who is wearing the jacket that allows him to be petted remotely (reproduced with permission from Adrian Cheok).

Cheok's Poultry Internet (Fig. 7), which is an attempt to produce a means for people to interact physically with their pets at a distance. This example tests the limits of our analysis in a number of ways. First, it takes us outside the domain of visualization and into the realm of interaction, as fairly broadly defined. Second, the design introduces not only new software, but also new hardware. Third, it enters into an area of public debate, namely animal rights, in such a way as to highlight the differences between conventional research concerns and what might be described as a form of action research, where the design has larger social implications.

Cheok is making the following arguments:

- technology should be used to intervene in cases of previous inhumane action
- technology should support animal-human relationships
- technologies which support animal-human relationships may also support relationships between humans
- warm-heartedness is a research objective

These points are contestable: not everyone would agree with Cheok's implicit arguments; some might agree with his premise but think of other ways it could develop into an argumentative prototype. The Poultry Internet is explicitly a response to factory farming, as Cheok makes clear in his video [http://www.youtube.com/watch?v=1x-8EzuMiqU (accessed 19 August 2010)]. His user study participants were not the people, but rather the chickens. The research question was: 'Did the chickens enjoy wearing the jacket?' They apparently did, choosing the jacket 73% of the time. From the field of animal studies, we recognize that chickens are iconic animals in factory farming, where they are similarly hooked up to machines and remote feedback systems. The question is whether the prototype successfully subverts or instead reinforces cultural perceptions of chickens as mechanized organisms.[7] This question asks us to critically examine the details of the implementation of the prototype without necessarily attacking the premise outlined in the points above, and works in the inevitable gap—big or small—that may exist between all intentions and implementations.

But is the premise itself defensible, in the sense that it is capable of being defended through argument? We would say perhaps not, which is to say that there are some issues where people are not readily convinced by evidence and arguments, no matter what form those take. Such is the difference between arguments and convictions. Reasonable people subscribe to both, and both in turn are reflected in the prototypes that digital humanists build.

Finally, the Poultry Internet does raise a substantive issue—something that is true of much of the work of Cheok and his team. In the best spirit of critical design they remind us that artifacts do indeed have politics, whether that artifact is a chicken–human interface, a highway system, an annotated page, or an encoded text and corresponding visualization.

7 Conclusion

All of the prototypes we have discussed here are also theories. One theory is not necessarily as good as the next, but the digital humanities will surely benefit from recognizing the diversity of forms which

theories and critical arguments may take. Although scholars usually find themselves making cases for their work both in writing and in person, traditional genres can limit the persuasiveness of arguments which take non-traditional forms—such as the Poultry Internet, which is about as non-traditional as we can imagine. All too often, intricate and dynamic digital objects become flattened into screenshots for the purposes of project reporting. We suggest that prototyping as a critical process demands that we move beyond the binary in which written project reports become stand-ins for digital objects themselves, in all their complexity and media-specificity. This perspective requires us to learn to read digital objects critically, respecting their intellectual potential in the same way that a peer-reviewer recognizes the potential of an article, book, or grant application—keeping in mind that recognition and approval are not the same thing.

Our argument also raises questions about how to support research, which we have not explored here. Should a prototyping project be the only one of its kind which receives funding, or is it best to have a number of parallel projects working on the same questions in different ways? The utilitarian impulse might prefer the former model, but we imagine more net gains, in the form of a critical debate occurring among prototypes, from the latter. If we were to embrace the implications of this approach, we might call, for example, for funding programs where three distinct teams, working at different locations, were all to receive parallel funds to carry out the same project. Our prediction would be that the results would be far richer in terms of the theories expressed through prototyping than any we have seen to date.

Alternatively, we might propose a more longitudinal form of funding that intentionally supports a series of prototypes. Projects of this kind could more readily form a trajectory over time, without gaps in the middle of the process caused by the current need to find distinct funds for each step in the series. This also sidesteps the possible negative connotations of reviewers correctly pointing out that the work is not necessarily sufficiently original at each step.

There are also implications for crediting work. Fields like digital humanities, book history, and design tend to incorporate a plurality of attribution models, borrowing aspects from the humanities, sciences, and creative arts, though hopefully all would agree that proper attribution is a matter of ethics. Digital objects make the practical side of attribution tricky, since it is standard practice for programmers to re-use code between projects and to incorporate code libraries shared by others. We also believe that as the concept of design transferability finds ever greater support, we will see a similarly increasing redeployment of design assets into families of prototypes. More work on the question of attribution is needed, though the answer probably lies not in adopting a single disciplinary model but in understanding design as a complex practice that does not work the same way in all contexts. We argue that a helpful theoretical apparatus may be found in McKenzie's notion of the sociology of texts, which recognizes the different kinds of agency at work in human artifacts, collaborating and contesting with each other to make meaning.

As a way of thinking, design positions us in a potent space between the past and the future. Failing to recognize design as a hermeneutic process means failing to understand how our inherited cultural record actually works. Yet the other side of the coin is the opportunity to understand how our own designs are part of a longer continuum than project cycles normally prompt us to think about. Even *Utopia* could be regarded as an ongoing project in critical design, in the sense that the complexity of its design continues to provoke new interpretations and debates. Should digital artifacts not strive for the same kind of interpretive afterlife? Michel de Certeau's description of the paradox of historical research applies equally well to the temporal orientations of design and book history in the digital humanities: 'founded on the rupture between a past that is its object, and a present that is the place of its practice, history endlessly finds the present in its object and the past in its practice' (1988, p. 36). Understanding how objects argue is one way of responding to this rupture, making a virtue of the entanglement of past and future intentions in any human artifact.

Funding

This work was supported by the Social Sciences and Humanities Research Council of Canada.

References

Ahlberg, C. and Shneiderman, B. (1994). *The Alphaslider: A Compact and Rapid Selector: Conference Proceedings on Human factors in Computing Systems: Celebrating Interdependence*. Boston, MA: SIGCHI, pp. 365–71.

Allen, P. R. (1963). Utopia and European humanism: The function of the prefatory letters and verses, *Studies in the Renaissance*, **10**: 91–107.

Booth, W. G., Colomb, G. G., and Williams, J. M. (2008). *The Craft of Research*. 3rd edn. Chicago: University of Chicago Press.

Bowers, F. (1959). *Textual and Literary Criticism*. Cambridge: Cambridge University Press.

Bringhurst, R. (2005). *The Elements of Typographic Style*. 3rd edn. Vancouver: Hartley & Marks.

Carlson, D. (1993). *English Humanist Books: Writers and Patrons, Manuscript and Print, 1475–1525*. Toronto: University of Toronto Press.

Cerquiglini, B. (1999). *In Praise of the Variant: A Critical History of Philology*, trans. Betsy Wing. Baltimore: Johns Hopkins University Press.

de Certeau, M. (1988). *The Writing of History*, trans. Tom Conley. New York: Columbia University Press.

Chow, R. and Ruecker, S. (2006). *Transferability—A Wonder on the Ground of Design Research: Proceedings of Wonderground*. Lisbon, Portugal: The Design Research Society, pp. 1–6.

Darnton, R. (1984). Philosophers Trim the Tree of Knowledge: The Epistemological Strategy of the *Encyclopédie*. In *The Great Cat Massacre and Other Episodes in French Cultural History*. New York: Basic Books, pp. 191–214.

DeRose, S. J., Durand, D. G., Mylonas, E. and Renear, A. H. (1990). What Is Text, Really? *Journal of Computing in Higher Education*, **1**(2): 3–26.

Dunne, A. (2005). *Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design*. 2nd edn. Cambridge, MA: MIT Press.

Fitzpatrick, K. (2009). *Planned Obsolescence: Publishing, Technology, and the Future of the Academy*. New York: NYU Press. [Forthcoming; accessed in open peer review version at http://mediacommons.futureofthebook.org/mcpress/plannedobsolescence/ (accessed 19 August 2010)].

Galey, A., Cunningham, R., Nelson, B., Siemens, R., and Werstine, P. and the INKE Team. (forthcoming). Beyond Remediation: The Role of Textual Studies in Implementing New Knowledge Environments. In Nelson, B. and Terras, M. (eds), *Digitizing Material Culture, from Antiquity to 1700*. Toronto & Tempe, AZ: Iter/Arizona Centre for Medieval and Renaissance Studies, n.p.

Gaver, W. W., Beaver, J., and Benford, S. (2003). *Designing Design: Ambiguity as a Resource for Design: Proceedings of the Conference on Human Factors in Computing Systems*. Ft Lauderdale, FL: ACM Press, 2003.

Giacometti, A., Ruecker, S., Craig, I., Derksen, G., and Radzikowska, M. Introducing the Ripper Interface for Text Collections. Paper presented at the Canadian Symposium on Text Analysi (CaSTA) Conference: New Directions in Text Analysis. A Joint Humanities Computing, Computer Science Conference at University of Saskatchewan, Saskatoon, October 16–18, 2008.

Grafton, A. (2009). *Worlds Made by Words: Scholarship and Community in the Modern West*. Cambridge, MA: Harvard University Press.

Gibson, R. W. (1961). *St. Thomas More: A Preliminary Bibliography*. New Haven, CT: Yale University Press.

Haraway, D. J. (2008). *When Species Meet*. Minneapolis: University of Minnesota Press.

Harris, R. L. (2000). *Information Graphics: A Comprehensive Illustrated Reference*. Oxford: Oxford University Press.

Hayles, N. K. (2005). *My Mother Was a Computer: Digital Subjects and Literary Texts*. Chicago: University of Chicago Press.

Helmer-Poggenpohl, S. (1999). *Design Moves: Approximating a Desired Future with Users: Conference Proceedings on Design and the Social Sciences: Making Connections*. Edmonton, AB: Department of Art and Design, University of Alberta.

Hinman, C. (1963). *The Printing and Proof-Reading of the First Folio of Shakespeare*. 2 vols. Oxford: Clarendon.

Howsam, L. (2006). *Old Books and New Histories: An Orientation to Studies in Books and Print Culture*. Toronto: University of Toronto Press.

Jardine, L. (1993). *Erasmus, Man of Letters: The Construction of Charisma in Print*. Princeton, NJ: Princeton University Press.

Johns, A. (1998). *The Nature of the Book: Print and Knowledge in the Making*. Chicago: University of Chicago Press.

Kinney, A. F. (2005). *Utopia's* First Readers. In Honselaars, T. and Kinney, A. (eds), *Challenging Humanism: Essays in Honor of Dominic Baker-Smith*. Newark, NJ: University of Delaware Press, pp. 23–53.

Kronick, D. A. (2004). *'Devant le Deluge' and Other Essays on Early Modern Scientific Communication*. Lanham, MD: Scarecrow Press.

Leslie, M. (1998). *Renaissance Utopias and the Problem of History*. Ithaca, NY: Cornell University Press.

Manovich, L. (2007). Q&A Session at the Digital Humanities (DH) 2007 Conference. Urbana-Champaign, IL, June 2007.

Massai, S. (2007). *Shakespeare and the Rise of the Editor*. Cambridge, MA: Cambridge University Press.

Mayr, E. (1976). *Evolution and the Diversity of Life: Selected Essays*. Cambridge, MA: Harvard University Press.

McCarty, W. (2008). What's Going On? *Literary and Linguistic Computing*, **23**(3): 253–61.

McGann, J. J. (1983). *A Critique of Modern Textual Criticism*. Charlottesville, VA: University Press of Virginia.

McGann, J. J. (1991). *The Textual Condition*. Princeton, NJ: Princeton University Press.

McGann, J. J. (2001). *Radiant Textuality: Literature After the World Wide Web*. New York: Palgrave Macmillan.

McKenzie, D. F. (1999). *Bibliography and the Sociology of Texts*. Cambridge, MA: Cambridge University Press.

McKenzie, D. F. (2002). Typography and Meaning: The Case of William Congreve. In McDonald, P. D. and Suarez, M. (eds), *Making Meaning: 'Printers of the Mind' and Other Essays*. Amherst, MA: University of Massachusetts Press, pp. 198–236.

Moxon, J. (1683). *Mechanick Exercises: Or, the Doctrine of Handy-works Applied to the Art of Printing*. London.

Mowat, B. (1988). The Form of *Hamlet's* Fortunes, *Renaissance Drama* [new ser.], **19**: 97–126.

Paley, W. B. (2002). *TextArc: An alternate way to view a text*. http://www.textarc.org/ (accessed 19 August 2010).

Paredes-Olea, M., Ruecker, S., Fiorentino, C., and Forbes, F. (2008). *Using an Affordance Strength Approach to Study the Possible Redeployment of Designs for Decision Support Visualization*. Paper Presented at the 9th Advances in Qualitative Methods Conference 2008, Banff, AB, October 2008.

Posavec, S. (2007). *Literary Organism*. http://www.itsbeen real.co.uk/ (accessed 19 December 2010).

Rand, P. (1985). *Paul Rand: A Designer's Art*. New Haven, CT: Yale University Press.

Ratto, M. (2009). *Critical Making: Conceptual and Material Studies in Technology and Social Life*. Paper Presented at Hybrid Design Practices workshop, Ubicomp 2009, Orlando, FL.

Ratto, M. and Hockema, S. (2009). Flwr Pwr: Tending the Walled Garden. In Dekker, A. and Wolfsberger, A. (eds), *Walled Garden*. The Netherlands: Virtueel Platform: http://www.virtueelplatform.nl/en/#2780.

Renear, A. (1997). Out of Praxis: Three (Meta)Theories of Textuality. In Sutherland, K. (ed.), *Electronic Text: Investigations in Method and Theory*. Oxford: Clarendon Press, pp. 107–26.

Roberts-Smith, J., Gabriele, S., Ruecker, S., Sinclair, S., Bouchard, M., DeSouza-Coelho, S., Kong, A., Lam, D., and Rodriguez, R. (2009). *The Text and the Line of Action: Re-conceiving Watching the Script: Proceedings of the INKE 2009: Birds of a Feather Conference*. Victoria, BC, October 2009.

Robinson, P. (2009). What Text Really Is Not, and Why Editors Have to Learn to Swim. *Literary and Linguistic Computing*, **24**(1): 41–52.

Rockwell, G. What Is Text Analysis, Really? *Literary and Linguistic Computing*, **18**(2): 209–19.

Ruecker, S. (2006). *Proposing an Affordance Strength Model to Study New Interface Tools*. Paper Presented at the Digital Humanities 2006 Conference, at the Sorbonne, Paris, July 2006.

Ruecker, S., Sinclair, S., and Radzikowska, M. (2007). Confidence, Visual Research and the Aesthetic Function. *Partnership: the Canadian Journal of Library and Information Practice and Research*, **2**(1): http://journal.lib.uoguelph.ca/index.php/perj/ (accessed 19 August 2010).

Sengers, P. and Gaver, W. (2006). *Staying Open to Interpretation: Engaging Multiple Meanings in Design and Evaluation: Proceedings of the 6th ACM Conference on Designing Interactive Systems*, University Park, PA: ACM, pp. 99–108.

Siemens, R., Warwick, C., Cunningham, R., Dobson, T., Galey, A., Ruecker, S., Schreibman, S., and the INKE

Team. (2009). Codex Ultor: Toward a Conceptual and Theoretical Foundation for New Research on Books and Knowledge Environments. Spec. issue of *Digital Studies / Le champ numérique*, **1**(2), ed. John Bonnet and Kevin Kee, http://www.digitalstudies.org/ojs/index.php/digital_studies/article/view/177/220 (accessed 19 August 2010). Conjointly published in French as Codex Ultor: Vers une base conceptuelle et théorique pour la nouvelle recherche sur les livres et les environnements documentaires, *Mémoires du livre / Studies in Book Culture*, **1**(1) (2009), http://www.erudit.org/revue/memoires/2009/v1/n1/ (accessed 19 August 2010).

Sinclair, S., Bradley, J., Ramsay, S., Rockwell, G., Siemens, R., and Guédon, J.-C. (2003). Peer Review of Humanities Computing Software. Panel at The Association for Computers and the Humanities / The Association for Literary and Linguistic Computing (ALLC/ACH): The 2003 Joint International Conference. Athens, Georgia. May 29–June 2, 2008. Draft articles online at http://tada.mcmaster.ca/Main/PeerReviewCluster (accessed 19 August 2010).

Stoddard, R. (1987). Morphology and the Book from an American Perspective. *Printing History*, **9**(17): 2–14.

Tischendorf, C. (1867). *When Were Our Gospels Written? An Argument by Constantine Tischendorf with a Narrative of the Discovery of the Sinaitic Manuscript.* 2nd edn. London: The Religious Tract Society.

Tufte, E. R. (1997). *Visual Explanations: Images and Quantities, Evidence and Narrative*. Cheshire, CT: Graphics Press.

Unsworth, J. (2000). Scholarly Primitives: What Methods Do Humanities Researchers Have in Common, and How Might Our Tools Reflect This? http://www3.isrl.illinois.edu/~unsworth/Kings.5-00/primitives.html (accessed 19 August 2010).

Vallée, J.-F. (2004). The Fellowship of the Book: Printed Voices and Written Friendships in More's *Utopia*. In Heitsch, D. and Vallée, J.-F. (eds), *Printed Voices: The Renaissance Culture of Dialogue*. Toronto: University of Toronto Press, pp. 42–62.

Werstine, P. (1988). The Textual Mystery of *Hamlet*. *Shakespeare Quarterly*, **39**(1): 1–26.

Wooden, W. W. and Wall, J. N. (1985). Thomas More and the Painter's Eye: Visual Perspective and Artistic Purpose in More's *Utopia*. *Journal of Medieval and Renaissance Studies*, **15**: 231–63.

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, **109**(1): 121–36.

Notes

1. A complete list of INKE team members and partners may be found at inke.ca. We are grateful to Emily Monks-Leeson, the audience at Digital Humanities 2009, and especially John Bradley, for their comments on an early version of this paper.
2. For a similar approach, see Matthew Ratto's Critical Making Lab at the University of Toronto's iSchool: http://www.criticalmaking.com/ (accessed 19 August 2010). See also Ratto, 2009 and Ratto and Hockema, 2009.
3. We are grateful to Katherine Rowe for bringing the MediaCommons project to our attention. It should be emphasized that all references to *Planned Obsolescence* appearing here refer to a draft undergoing open peer review the published version may change substantially.
4. To be precise, there were two 1518 editions of *Utopia* published by John Froben in Basel, one in March and the other in November. The differences between the two are negligible for the purposes of this discussion. A thorough collation of *Utopia*'s changing paratexts may be found in Gibson, 1961.
5. For a similar critical reading of the forms of concordances themselves and the assumptions they embody, see Rockwell, 2003.
6. For an example of the debate over cladistics (also known as phylogenetics), see Mayr, 1976, pp. 433–78; on stemmatics, see McGann, 1983; on Diderot and D'Alembert's tree of knowledge, see Darnton, 1984.
7. For an analysis of interactions between humans, technologies, and particular species, see Haraway, 2008, esp. her chapter "Chicken" (pp. 265–74).