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MARKERS OF QUALITY IN DESIGN PRECEDENT

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The generation and description of design precedent is at the core of design case scholarship. However, traditional standards of quality and rigor that are relevant for other types of design and scientific scholarship do not always apply equally to the generation of design cases. In this paper, I describe the nature of design precedent and the standards for evaluating precedent artifacts in a way that foregrounds access of the reader to aspects of design complexity in the design work being described. Standards of quality point towards the appropriateness and potential contribution of the precedent material to design knowledge, across the following dimensions: interest to other designers; rich representation of the design; articulation of transparency and failure; accessibility of style; and acknowledgement of complexity and scope.

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INTRODUCTION

A wide range of design knowledge informs and supports the work of designers as they engage in their work, live within the world, and extend these personal and professional experiences both opportunistically and intentionally. Types of design knowledge extend broadly to include all aspects of the human lived experience, stretching from abstract theories that describe or allow us to interrogate our world to lived and embodied experiences that are subjectively situated and temporally bound. Indeed, it is this range of design knowledge "types" that makes the work of design so complex and indeterminate, and the education and cognitive modeling of designers' activities so elusive.

In this paper, I will focus primarily on *design cases* as a distinct type of rigorous knowledge production that is undertaken with the intent of building the knowledge base of designers. Design case authors may include instances where designers were directly involved, as well as journalistic or historical cases where design outcomes and process are considered through archival materials or interviews (see Boling, 2014; Boling et al., in press; Young, 2014 as examples of this latter type). While my goal is to articulate the means by which designers can productively construct design cases in the context of designs for learning, these guidelines may also apply more broadly to other disciplines—both those disciplines with a long history of building design precedent knowledge (e.g., architecture, visual design), and emergent design disciplines that are still working to build such stores of precedent knowledge.

Design cases as one distinct form of precedent knowledge have been used in a broad range of design disciplines as a way to preserve and share design knowledge across space and time. Design precedent—as it exists in traditional design disciplines—is often presented with minimal contextual cues, as in the case of plan books in architecture or logo reference books in visual design, but these require a good deal of interpretation—including lived experience or other scaffolding—to be exploited deeply. For example, an image search shown in Figure 1 for "type specimen books" quickly yields a wide range of examples of typography spanning multiple decades, formats, cultural traditions, and visual forms, providing rich opportunities for the development of a

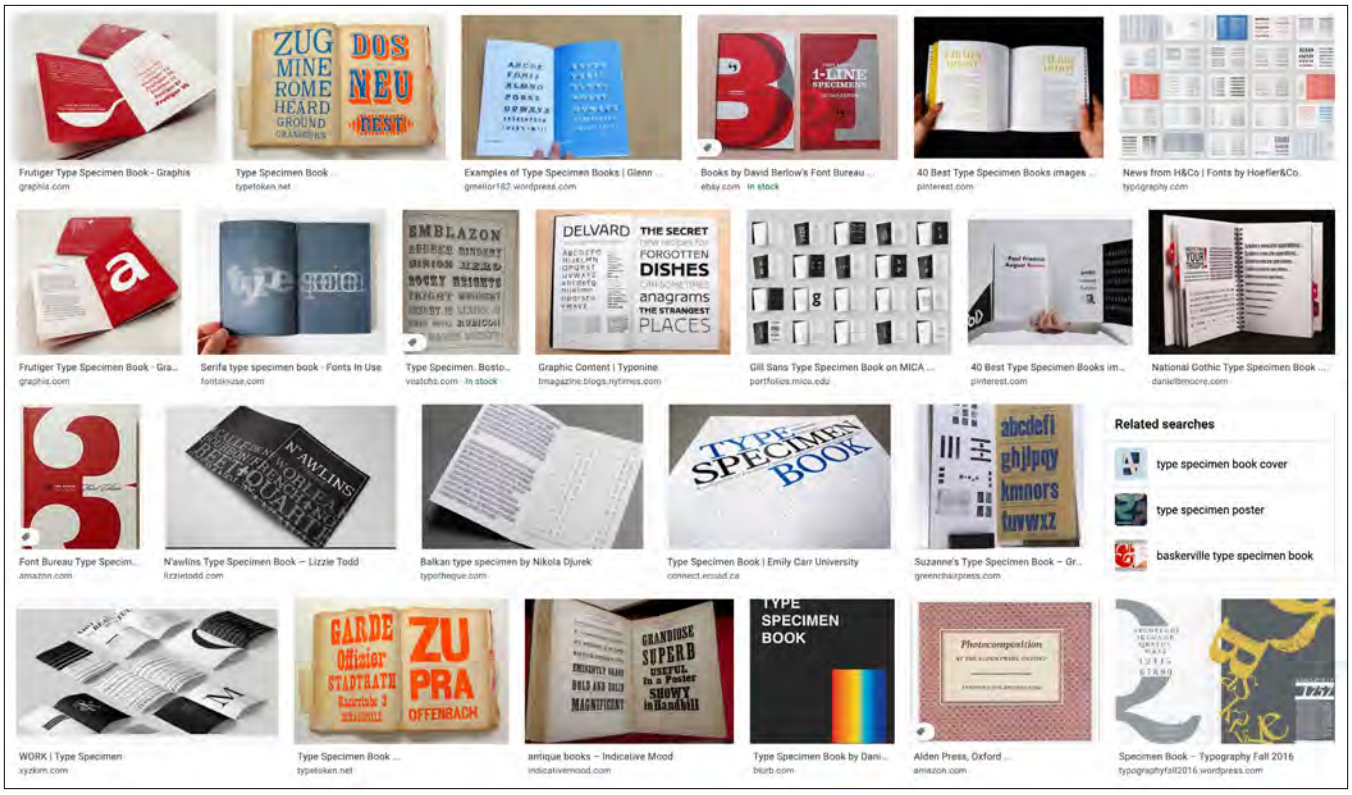

FIGURE 1. Google Images search of "type specimen books," revealing forms of visually-focused precedent common in other design fields.

designer's repertoire. Due to the visual representation that is central in graphic design, static or dynamic images provide useful starting points for future design work, even when they lack an explicit acknowledgement of the process that led to the design of these artifacts. However, not all design artifacts are as easily represented, leading to different challenges of access and experience. Due to some of these representational concerns, design cases have been used in an instructional design context to reveal both visually representative outputs and the design knowledge, decisions, and implementation contexts through which these design artifacts were created. Thus, prior scholars have positioned design cases as a specific, rigorous form of knowledge building in the tradition of precedent, offering an in-depth view into the process of designing a specific artifact, including the context of creation, successes and failures within the process, and important design decisions (Boling, 2010; Smith, 2010).

WHAT IS DESIGN PRECEDENT?

By design precedent, I refer to any material or experiential knowledge that a designer builds over their lifetime in relation to existing designed artifacts or experiences, which they are able to draw upon—analogically, referentially, or otherwise—in the creation of new designed outcomes. For instance, an architect implicitly builds a mental repository of all of the buildings they have walked through, perhaps occasionally augmenting this store of episodic memory with photos, reference books, or swatches of certain architectural materials. Designers of learning experiences also build this type of knowledge, often referencing or building upon prior syllabi, instructional activities, or even implicit instructional norms as they design new learning experiences or materials. While design precedent has been used informally from a designer perspective for centuries, or even millennia, in the craft tradition, acknowledgment of this form of knowledge generation and utilization in the formal design research literature is relatively new. Oxman (1990) presents a foundational understanding of design precedent as one source of design reasoning and creative abduction in design practice, and most research in the succeeding years has followed in this general direction (e.g., Eckert & Stacey, 2000; Goldschmidt, 1998, 2003; Lawson, 2004). Design researchers have also sought to understand the role of precedent from the perspective of praxis (Lawson, 2004; R. Oxman, 1999; Rivka Oxman, 2004; Restrepo et al., 2004), although within the traditional art and design community, they have not attempted to situate the role of precedent as a unique form of knowledge generation (Nelson & Stolterman, 2012). However, recent design scholarship in human-computer interaction (HCI) and related disciplines has engaged more deeply with the epistemological dimensions of design knowledge, with specific proposals to more deeply investigate situational design knowledge (Rasmussen et al., 2019), identify how design knowledge is expressed and structured in online conversations among designers (Gray & Kou, 2019, 2017), articulate different forms of "intermediate-level knowledge"

that exist between theory and concrete artifacts (Höök et al., 2015; Höök & Löwgren, 2012; Löwgren, 2013), and potential hierarchies of design knowledge (Kolarić et al., 2020).

These broader investigations into the nature of design knowledge inform my own positioning of precedent knowledge, which can be located as closer to concrete artifacts and experiences with the goal of articulating what is "real" about our own subjective experience of the world, rather than abstract articulations of what might be universally "true." By this I mean that the pursuit of what is "true" is by its very nature abstract and removed from reality; in contrast design activity results in concrete and often physical changes to our world and reality, thus designed artifacts are generally "felt" in embodied ways rather than through propositional forms of meaning making. In Figure 2, I build upon schemata from Nelson and Stolterman (2012) and Löwgren (2013) to depict the area of these continua where design precedent—and its scholarship—might rest in relation to other forms of knowledge building. While scientific knowledge attempts to document general truths—those which are replicable—design knowledge touches on the reality of our world; thus, design can be considered more *real* than *true*. With this epistemic shift, the role of design knowledge changes similarly; rather than the ultimate goal of replicability, design knowledge is meant to be a generative source of possible futures, accessed and worked out through abductive reasoning which bring new *ultimate particulars* (Nelson & Stolterman, 2012) into the world.

Design precedent has also been discussed in the design literature for the past several decades in various forms; however, the conversation in the design community has historically focused primarily on the creation of systems to disseminate and allow access to precedent materials (i.e., visual or multimedia resources). Indeed, prior to the availability of digital systems, many of these precedent materials took the form of slide libraries, and many established art and design schools had librarians to manage, extend, and organize these collections (Baxter, 2013; Heller, 2005). While there are challenges in managing and building upon such established collections (e.g., lack of engagement with physical artifacts being represented; Western-centric hegemony and norms of collection; variations in capture quality and means of viewing), the main issue presented in traditional collections of precedent is one of encouraging structure or scaffolding—where a large quantity and variety of materials are available, and the main issue being one of access and structure rather than availability or means of production. This prior focus on management of precedent reveals the lack of critical inquiry into the nature of this design knowledge, owing to the already accepted status of design knowledge in these communities. Because precedent is considered a valid and typical form of knowledge creation that has already been deemed legitimate in this community, there has been little exploration into the construction of precedent, or the standards of rigor by which precedent might be appropriately judged, especially in contrast to traditional scientific modes of scholarship.

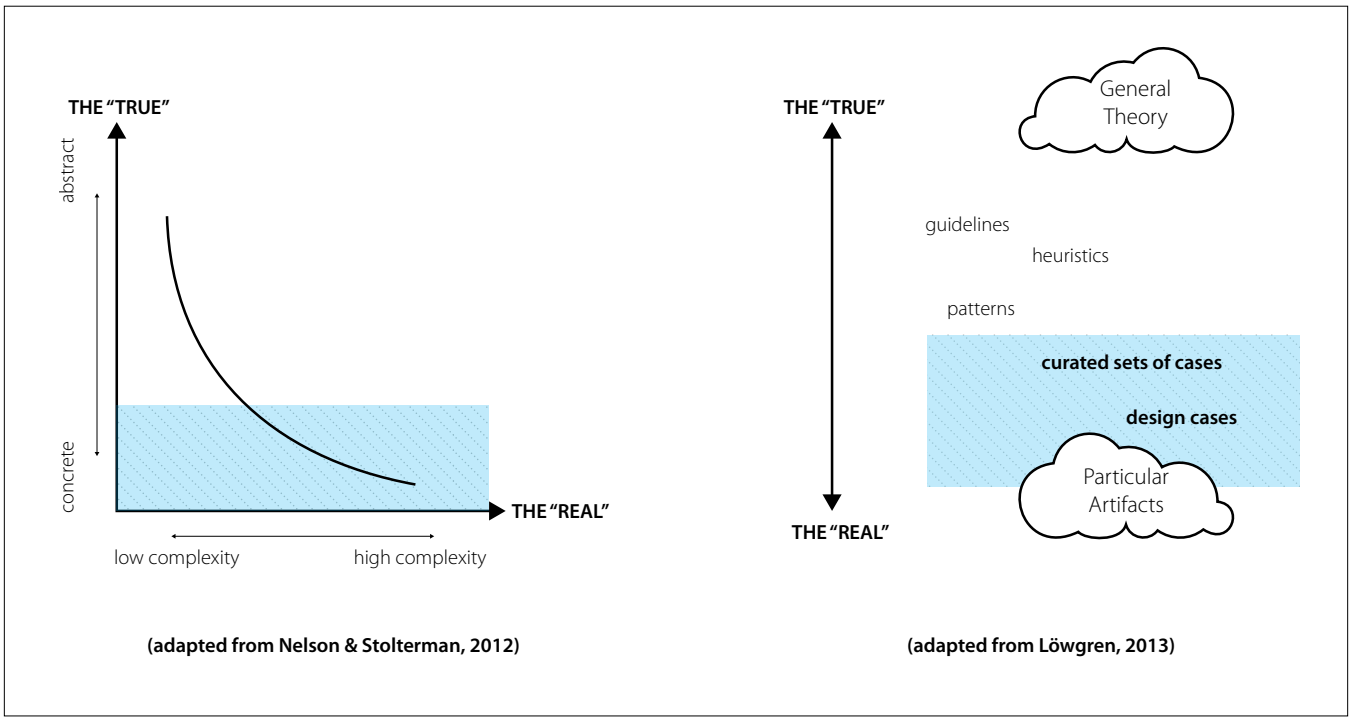

FIGURE 2. Two schema that illustrate the differences between knowledge production that is situated towards the "true" and the "real," with blue shaded areas indicating the primary opportunity for design case scholarship. Adapted from Nelson and Stolterman (2012) and Löwgren (2013).

Over the past decade, the editorial staff of this journal have promoted the rigorous generation of design knowledge, seen as separate from scientific knowledge, by researchers and practitioners. Coming from the field of instructional design and technology (IDT), a field with no tradition of rich design precedent (Boling et al., 2015), this journal has also sought to foreground the role of rigor in creating precedent materials (Boling & Smith, 2009) as a means to build value and impact for this form of knowledge building. This approach, while informative in the limited context of instructional design work, may also extend the ways in which precedent is theorized, created, and supported in the larger design community. I focus the remainder of this paper on addressing this theoretical discussion of precedent knowledge, with a focus on evaluating and producing this knowledge in robust, meaningful, and rigorous ways.

EVALUATION OF PRECEDENT

In broaching the conversation of how rigorous, published precedent might be evaluated, it is important to address two different dimensions previously mentioned by Smith (2010): the rigor and utility of a design case. According to Smith, "It is assumed...that design case utility is not contingent on its rigor, but that increasing rigor heightens the likelihood that…[the design case] will be useful across a broader range of contexts" (2010, p. 10). Rigor is the primary criterion by which much experimental scientific knowledge is judged, using standards such as replicability, reliability, validity, transferability, and trustworthiness (Patton, 2014). Different combinations of these criteria are foregrounded in other disciplinary forms of knowledge production, based on the epistemological and ontological stance of the researcher (Guba & Lincoln, 1994). Relevant standards of rigor and quality should also be addressed in evaluating design precedent for publication, but because the standards are separate from the utility of a case they must necessarily be different than those used for the creation of experimental, generalizable knowledge—and even different from some of the standards used for the creation of knowledge in an interpretivist qualitative mode.

Many design cases are high utility, and a portion of these cases display some dimensions of rigor—rich representation, for example—but in order to consistently publish peer-reviewed precedent that meets multiple standards of rigor, the editors and board have created a set of review criteria for the *International Journal of Designs for Learning* (IJDL). These criteria were based, in part, on an ontology of design precedent that springs from design as a unique tradition and way of knowing (Cross, 2001; Nelson & Stolterman, 2012), with clear links to naturalistic inquiry (Smith, 2010), but these criteria have evolved in practice. Howard (2011) has previously offered a helpful baseline for critiquing common writing issues found in design cases, with suggestions for improvement, outlining desirable characteristics in terms of rhetorical and structural approach. Gray and Boling (2016) have also leveraged past design cases to demonstrate how precedent might be used to promote broader understanding of design complexity, including the ethical dimensions of design practice. This article will focus more on the *holistic* assessment of rigor and utility in a case, with the goal of formalizing components of rigor in design precedent—first in designs intended for learning, and more broadly in precedent as it is understood in all design disciplines. Viewing the components holistically, I will refer to them as the qualities of a rigorous, peer-reviewed case, or simply *quality*.

These criteria have not been developed in a vacuum, but rather represent an adaptation of standards that are common—ordinary, even—in design disciplines with a history of producing and publishing precedent, albeit without explicit consideration of rigor. I will attempt to document, with examples from the broader design tradition and past submissions to this journal, the sources of these standards of quality, their importance to the development of design precedent in general terms, and their value in relation to documenting designs for learning. These quality standards parallel the review criteria that have been used at IJDL since 2010 to judge submitted manuscripts and guide reviewer feedback; and so, a second purpose, perhaps, is to demystify the review process. All of these efforts build upon my own experiences as a designer in multiple domains, including instructional design, user experience design, and graphic design, along with my experience in various editorial capacities with IJDL.

STANDARDS OF QUALITY

The IJDL review form includes five criteria[1], which necessarily overlap (Figure 3). Given the nature of the journal, and the relatively few authors who have extensive experience producing rigorous precedent, these criteria do not simply provide reviewers a checklist; rather, they promote a conversation between the reviewers and editorial staff regarding both the rigor and potential utility of a case. These criteria include formal properties of a case, such as presence of rich representation or treatment of failure and alternative design decisions; but they also include less clear cut characteristics such as the potential relevance of the case to designers and design knowledge, and the use of a style that is accessible to scholars and designers alike. Finally, the review criteria include holistic characteristics, such as the desire for a full accounting of a design's complexity in relation to the scope that was set out in the design process.

[1] From 2010 to 2020, the IJDL review form included six criteria. The first criterion, labeled as "relevance" with the question "Does this case contribute to design knowledge?" was removed in 2020 based on a decision from the editorial staff and resituated instead as a critical screening question.

Interest: What aspect (if any) of this design case makes it particularly interesting to other designers?

Representation of the design: Does the manuscript include artifacts, illustrations or descriptions of the design itself? Does the manuscript include a discussion of the user experience? To what extent does the treatment of the design convey a concrete understanding of what was created?

Support and transparency: Does the article address design failures, or ways in which the design failed to create the intended outcomes? How is this discussion linked to design decisions that were changed or modified during the design process?

Style: The manuscript is written from a stated point of view (i.e. the point of view of the designer, stakeholder, or investigator), with a direct, personal, and engaging voice. The project is described rather than being advertised or discussed only in theoretical or strategic terms.

Scope: Does the article deal with the full complexity of the issues related to how the design came to be as it is?

FIGURE 3. Criteria used by IJDL reviewers to judge the rigor and utility of design cases.

Appropriateness and Potential for Contribution to Design Knowledge

The first question asked from an editorial perspective about a design case is whether the article is *appropriate* for IJDL. This judgment, formally asked as an explicit question regarding relevance to reviewers, points toward the ontological characteristics of the submission and whether the epistemological assumptions built into design precedent are satisfied. Ontologically, design cases point toward the generation of knowledge that exists independently from existing knowledge and the design artifact that brings intentional change in the world (Hatchuel et al., 2013), while epistemologically, design cases orient the reader towards specific forms of knowledge construction with specific markers of quality, warrants, and goals. For example, submissions inappropriate for IJDL may be structured as a teaching case (e.g., Ertmer et al., 2013), a case study (Yin, 2009), an evaluation or validation study (Dick & Johnson, 2002), a design-based research study (Barab, 2006), or a research on/in/through design study (Frayling, 1993; Zimmerman et al., 2007). While all of these knowledge-building forms are legitimate, these forms do not share the same focus and characteristic qualities of design cases, thus the criteria shown in Figure 3 may not be adequate or relevant. Assuming that there is a core design precedent contribution in the submission, the remaining criteria can be used to form a holistic assessment of the design case.

It is difficult to produce an effective design case without an understanding of what design knowledge *is*, and how it varies from other traditions of knowledge building. Design knowledge is, in its most grounded, concrete, and contextualized form, knowledge of the ultimate particular (Nelson & Stolterman, 2012). Research about design processes or methods is valuable, but published design precedent seeks to represent specific designs rather than seeking to generalize the outcomes of one design process to apply universally, or even categorically, to other situations or other designers. Therefore, the design case does not *report on* design knowledge, as in other similarly named methods that have recently gained favor (e.g., design-based research, research through design); it constitutes a form of design knowledge as an ontology and design cases as an epistemology, in its own right. Numerous examples from traditional design disciplines serve as an indicator of what this form of knowledge building looks like, even if rigor is not a central issue or primary criterion for success; mass market books can be found at any local bookshop that focus on the building of a skyscraper, development of a logo for a large company, or a review of fashion trends from a particular designer; in many cases dozens of designs will be covered. These instances represent design knowledge in its very essence; knowledge that exists to elucidate a specific, particular design process and the decisions that underlie that process in a phenomenological sense, not with the goal of replication, but rather as one of many elements that fills an individual designer's *repertoire* (Schön, 1990).

In addition to asking about the contribution to design knowledge, this criterion addresses designs *for learning*. Design cases focused on learning may cross interdisciplinary boundaries because the purpose of the design—the support of learning—is not based on the design's formal properties. IJDL is intended to invite all design disciplines—insofar as the cases submitted resulted in a design intended for learning—to participate in the rigorous publication of design knowledge. The term "design for learning" is intentionally broad, and may capture artifacts, experiences, services, or systems that include some level of focus on the acquisition of new knowledge; thus, IJDL does not limit the scope to traditional forms of classroom instruction, or even to what may be considered "training." Rather, a design for learning may be as diverse as an onboarding tutorial built into a smartphone application explaining its use, instructions that guide a user in learning to play a new board game, or the creation of immersive museum experiences—in addition to more obvious contexts of learning in K-12 education, higher education, or corporate training.

This focus on developing a tradition of building design precedent might be seen as especially beneficial to disciplines where design as a key philosophical differentiator is still emerging or becoming established, such as instructional design, human-computer interaction, and engineering design. These are all contexts where a history of design

precedent as a unique and productive form of knowledge is not yet fully secured or normative.

Interest to Other Designers

Establishing the potential interest of a case requires a knowledge of who designers out in the field *are*, how they work, and what they value. While cases on academic designs are welcomed, there are many more types of design artifacts and experiences intended for learning than might be encapsulated by formal academic systems. Many cases are created because the designers of a product recognized something about it that will interest *other* designers—not as an object lesson, or as advice to them, but in the spirit of having a good story to tell at a dinner party with other designers working in the same area.

Wiberg and Stolterman (2014) have discussed this issue of interest as a form of novelty, with potential grounding of this novelty in one of four areas: "the particular manifestation, the character of the design, its inspirational roots and its patented form." These aspects of novelty may also be viewed differently from the perspective of a scholar or a designer. For instance, while grounded work situated in the particular manifestation of a design might be situated by a scholar as formative research on an instructional model or theory (e.g., Reigeluth & Frick, 1999) or as a means of proving a hypothesis, a designer might view a particular manifestation of a design as a novel technology or approach that opens up a design space, or helps to identify relevant norms or design patterns. This positionality reflects the different rhetoric and priorities of designers and scholars, with scholarly tropes being much easier to capture as characteristic types (e.g., proves a hypothesis, formative research on a model, informs generalized principles of learning) than equivalent tropes for designers (e.g., how they dealt with complexity, tough constraints, novel technology or approach). From each perspective there is the potential of interest and opportunistic use of the resulting knowledge, however in generating interest for designers, authors must foreground the pragmatic and non-deterministic role of knowledge in design work rather than the goal of building and validating theory.

Building on the issue of role and perspective, a case is also not interesting merely because it happened. There are many designs that are created in a mechanical, modular, or containerized way by instructional designers which are not necessarily unique, insightful, or unusual in a broad sense. But there are multiple dimensions of interest, not always related directly to the physical or material properties of the final design, or the specific content being taught. Interest can be established along dimensions of process, context, use, iteration, failure, or designer experience, just to name a few. A design case should be analyzed through this lens, with the author establishing early on what dimension they feel might be most compelling as a means of structuring the case narrative, and then using this lens to present the case. Most cases have an interesting dimension inherent in them, but occasionally, an outside reader is needed to locate that dimension.

However, although the author of a design case should seek to identify points of interest that they wish to convey, this identification is not absolute. Other designers may find other points of interest in a case than was originally intended, choose to follow the opposite path of one that is suggested in a case, or misread information that leads to valuable design insights grounded in their own work. Unlike use of knowledge in the realm of the "true," this opportunistic—and even factually incorrect—use of knowledge in a design mode may lead the design process forward for a designer in productive and meaningful ways. Thus, while a design case should have interest along one or more defined dimensions, other points of interest may emerge over time due to historical, technological, or social shifts—or the whim of the designer reading the case—that bring continuing value and relevance.

Rich Representation of the Design

A rich representation of a design requires more than just a screenshot or a one-paragraph description, as is common in the depiction of designs for learning when embedded into a larger scientific framing. Consider some of the great architectural designs—say, *Fallingwater* by Frank Lloyd Wright (Figure 4) to provide one example to think through. One can easily find a full-length book on the design and building of this residence, detailing the experience of planning, building of models, difficulties encountered once construction began, and the relationship between the architect and his client. This mirrors many important architectural landmarks, which likely even have a documentary or other online materials dedicated to it, if the building is of sufficient importance. While not every design for learning is as complex as *Fallingwater* or similar architectural accomplishments, many initiatives can be documented closer to that level of richness than the descriptions that are available in most of the literature.

Formal and Embodied Properties

Using this architectural example to ground the conversation, what might it take for a reader of a case to come away feeling as if they have experienced the design, even at a distance, removed from the original context of design activity? First, it may be helpful to ensure that the formal properties of the design are documented, as in the floor plan on the next page; these formal properties might be considered more universal descriptors that would not be contested, but rather help provide a categorical understanding or

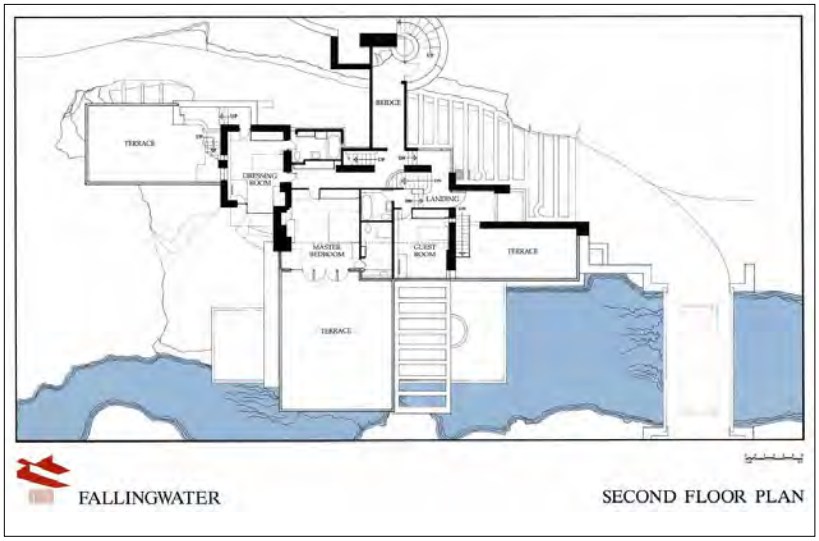

FIGURE 4. Site photograph of Frank Lloyd Wright's Fallingwater (top) and a floor plan drawing (bottom). Top photo by Esther Westerveld, licensed as CC BY 2.0; bottom photo in the public domain.

framing of the designed artifact. For instance, a design for learning might be described as a two-day instructor-led training, using a combination of direct instruction and online modules authored in Adobe Captivate. This description of formal properties is often where descriptions of designs in instructional design begin and end, but for a design case, these properties are only the beginning. To describe a design in a way that is intelligible to readers—communicating not only the formal qualities of a design, but also the experiential qualities of creating the design or participating in the final learning experience—more description is needed.

Table 1 (next page) includes a brief comparison of the types of formal properties that might be helpful to consider, as well as the kinds of experiential qualities that might help to communicate an insider's perspective on the creation or use of the design for learning. In the example of Fallingwater, a floor plan might only convey one view of the final residence—and one that is not particularly meaningful for readers who are not architects, and who might struggle to translate a two-dimensional top-down view into a three-dimensional experience. Similarly, just including the text of a design document belies the creation of that artifact, or how it relates to the final experience a learner might have in the materials created from that design document. In moving beyond formal properties, it may be especially helpful to identify what aspects of the experience were especially meaningful to you or the end user/learner; what emotions you felt when engaging in the learning experience; what role the learner was able to take on; the narrative arc that the learning experience encouraged; and the temporal journey that this narrative represented. Without taking the time to identify these experiential and embodied qualities, it will be difficult to decide which visual, interactive, or textual elements will be needed to translate these qualities into a narrative that is accessible to the reader and articulates the richness of the designed experience.

Design Process and Context

Rich description applies not only to the final design, but also the process that led to that design. This might begin with representations of the design team, including their personalities, roles in the project, educational or professional backgrounds, and working relationships. These descriptions of the "actors" and the organization of the design work lay the groundwork for a more detailed description of the process through which the outcomes were achieved. Rather than a simple recapitulation of a formal design process or model, the description and representation of process should be situated and contingent, reflecting what the designers actually did (including judgments, decisions, and other design moves) rather than limiting the design process only to abstract academic depictions of design work. Representations of this often chaotic and messy process could include sketches, discarded prototypes, engagement with different kinds of collected design knowledge, or even portions of meeting notes.

Similarly, the design context might be more fully communicated through a depiction of the political and social climate in which design activity took place—was it a fast-paced consultancy with a multi-national client, or was it a professional development team at a local high school? Were learners involved in the creation of their own designed experiences,

REPRESENTATION OF FORMAL PROPERTIES	REPRESENTATION OF EXPERIENTIAL AND EMBODIED QUALITIES
• Size • Color • Format/Dimensions • Sequence of events • Presence of images or multimedia elements • Technology used • Tools/methods/ procedures used • Topic domain of instruction	• What does it look like? *sound* like? *feel* like? *remind you of?* • Use of emotion (implicitly or explicitly) in guiding the experience • Role of the learner (prescribed and actual) (Gray, 2015) • Narrative qualities of the experience (situational, temporal, directional)? (Boling et al., 2013) • Aesthetic qualities that make the experience especially meaningful (Parrish, 2013; Parrish, 2009)

TABLE 1. Formal properties compared with experiential and embodied qualities that contribute to a rich representation of a design.

or were these decisions made solely by instructors and administrators? In addition, understanding the prior work a team has produced is helpful in situating a specific design; are there relevant theories, methods, or approaches that this team implicitly relies upon? Is this a first-time attempt in a new design space, or the tenth iteration of this type of instructional material? Is there rich precedent that the team is intentionally building from? Once the context is firmly established, a description of the process that unfolded provides insight to the readers as to how the design team undertook brainstorming, organization of materials or tasks, communication with stakeholders, and interaction with development personnel. Offering multiple views of this unfolding context and process is also potentially valuable, establishing the voices of different types of stakeholders.

Transparency and Failure

To be transparent about design decisions, you have to be aware that you have made them. This metacognitive awareness includes first recognizing what design decisions are, and then using that knowledge to robustly identify how these design decisions are shaped continuously and complexly through design judgments (Boling et al., 2017; Gray et al., 2015). Many of these judgments and related decisions are made intuitively, but have the potential to be unpacked later on, thereby explicating the inner thought process that may have led to a specific decision and not to other ones. In terms of recognition, it is important to understand what a design decision is—how judgments were made and how you thought of them *at the time* in addition to post-hoc justification.

One of the most lacking areas in the ID literature is recognition and representation of failure in design. While almost all of us as designers can share colloquial accounts of failure in projects we have been a part of, this kind of knowledge building has not been valued in traditional scientific venues—perhaps most palpably felt by scholars in the rejection of manuscripts with "no significant differences." In the design community, depiction of failure varies widely, but is paramount in areas where safety is concerned, such as engineering design (e.g., the academic journal *Engineering Failure Analysis*). In this discipline, failure is a big deal, and avoiding it is of utmost importance; even mass market books, such as those by Petroski (1992, 2012) underscore this point. But there is also a latent recognition that you cannot avoid failure if you do not, at the very least, document where failure already exists and recognize your role as a designer in influencing potential futures (Boling & Gray, 2015; Gray & Boling, 2016).

Failure, like many other characteristics of design, might be documented across a number of different dimensions, such as: failure of process or lack of designer/client flexibility, failure of the design materials to produce the desired outcomes, failure of design to be enacted or implemented as intended in the "real world," failure due to an unplanned for learning context or set of learners, et cetera. These failures also provide access to the emotional qualities of the design process and team. Many designers enjoy trading their "war stories" or negative client experiences (see "Clients from Hell" as one popular example; https://clientsfromhell.net/); and while these negative, client-focused experiences are certainly one source of failure, the everyday design processes we all undertake to make sense of complex contexts and seek to frame our opportunities for action are also equally fallible or incomplete as experienced in the moment. Completely failed design processes and/or outcomes could be a good candidate for a design case; other forms of failure may not be total, and could be reframed as: exploration; consideration of alternatives; misdirection; redirection; response to new information; realization of unplanned or unforeseen constraints; new social, political, or cultural experiences; shifts in technological availability or capacity; or simply the reality that our plans do not perfectly (or even partially, in many cases) represent how we execute those plans (cf., Suchman, 1987). However, these reframings of failure do not always result in a complete "overcoming" of failure; in contrast, moments of failure often result in design outcomes which are not able to be fully realized in one dimension or another. Thus, these aspects of design failure are not shameful or avoidable, in most cases; they are part of designing new futures with incomplete and constantly

shifting knowledge, and thus are an integral part of the design experience to convey in a design case.

In addition to failure, there is a general need to document design decisions—not only the ones that were explicitly made and understood by the design team to be important, but also the paths that were discussed but not followed, or "negative" cases. Expert design is characterized by continual and opportunistic combinations of ideation, iteration, and prototyping/testing moves (Lawson & Dorst, 2009); and each of these cycles are informed by a multitude of design decisions, many of which are not immediately accessible in the final design. Explication of and reflection on an important subset of these decisions is vital for a full accounting of how a design came to be the way that it is.

Accessible Style

The accessibility of the design case is perhaps one of the more difficult characteristics of quality, particularly for those used to scholarly writing. As academics, we become good at couching our descriptions of process in sanitized ways, giving agency to methods, theories, or principles (often through the use of third person), and ignoring or downplaying our active role as a human instrument (Boling, 2008; Boling & Gray, 2015) in enacting these elements as tools or methods in a specific design process.

A good design case frequently has a strong, even vivid narrative quality to it. Often, this takes the form of a chronological retelling of the design process with first-person pronouns and active verbs used to personalize the experience and draw the reader into the phenomenological qualities of that design process. This is not a dispassionate narrative, but rather one with accessible psychological elements—frustration, anger, overwhelming complexity, triumphantly successful design solution—all of these might appear in a design process, and should be indicated in an accessible case. While the case should draw the reader in, it is not an advertisement for the project outcomes, process, or design team; instead, the goal is to communicate the contingent and situated messiness of actual design work which might inspire future adaptation, but does not promise the generalizable efficacy of certain approaches.

The structure of the case also relates to the accessibility of the design process to the reader. A well-constructed narrative is not merely a retelling of events with sufficient detail; otherwise, a typical technical writing approach would suffice. In contrast, a successful design case often has a narrative quality which is memorable, immersive, and personal. Consider as one example the experience of an academic conference; while occasionally, conference talks are interesting and engaging, it is often the conversations that occur at dinner or over drinks at a bar that capture our imagination and help us to more fully understand the researcher's experiences. In service of this more colloquial, conversational goal, it is useful to consider what might constitute the "heart" or "core" of the case. This "core" can then be used as a narrative point of focus, allowing you as an author to determine which elements of the chronology are superfluous, which judgments and design decisions were most pivotal, and what technical language or formal properties of the case are critical to the retelling of the story.

Complexity and Scope

Perhaps paradoxically in relation to the previous section, the narrative of a rigorous design case cannot be simplistic, even if it is straightforward. Accounting for complexity is one of the hardest qualities to achieve, largely because it is such a holistic measure. Complexity is indicated by all of the previous measures of quality in an integrative way—where a complex experience is conveyed through media-rich storytelling, using an intimate and frank discussion of the winding design process to bring the reader into the experience of designing a particular artifact.

An appropriate level of complexity or scope in a design case includes a felt understanding by the reader that they can experience *for themselves* how the design process unfolded, with sufficient detail to craft their own understanding of how the design came to be, and thus filling their repertoire with another unique design. This feature of a design case relies on rich representation, but also the juxtapositioning of this representation with a compelling story wherein the reader can find multiple points of interest.

Preparing rigorous design cases requires forethought and reflection. It can be difficult to represent design knowledge by trying to distill it from scientific projects already completed with design activities embedded within them. It can be difficult to describe design moves that you made unconsciously and did not record at the time. Without photographs, memos, or recordings of conversations to guide your writing, it can be difficult to fill in the gaps of the narrative and present your case in a way that is compelling and complete. However, like all forms of writing and communication, design case scholarship is a craft that is improved with repetition, feedback, and reflexivity.

IMPLICATIONS

Across all of these standards of quality, the greatest aid to the designer and design scholar is practice. I invite readers of this article to seek out and consume design cases from this journal, alongside other sources of design knowledge that they come across in their everyday experiences. Consider using the standards of quality I have described here as lenses with which to interpret, interrogate, and enrich the reading of design cases, recognizing that not all cases will include attention to each aspect of quality in equal measure. Just as a lover of art might spend a lifetime going to a range of museums and regularly inspect favorite works of art across

many mediums, getting something different from the same museum or work of art each time, a designer similarly builds, tends, and organizes a schema of design precedent. Over time, and through practice, one's repertoire of precedent becomes more coherent, with aspects of quality more deeply considered. The standards of quality referenced here are simply one guide to both write about the complexity of design activity, and to interpret and build appreciation for existing and future design cases.

In addition to the heightened rigor and evaluative processes of a design case that are realized through the creation and sustainment of one's precedent, there is also a need for a wide range of precedent materials in IDT—from the equivalent of a collection of 1000 logos to a full-length book on a substantial design to specialized journals on failure of learning designs. All of these documentations of precedent provide different sorts of design knowledge—with varying levels of rigor and utility—and inform an individual designer's repertoire in different ways. Ultimately, this knowledge is not for the scholar—although scholars might gain substantial knowledge about design as a human activity, which might then inform research—but for the designer. Design cases are only one form of relevant precedent knowledge, but many of the markers of quality addressed in this article may also be relevant in representing other aspects of design complexity in more lightweight forms that also build on designers' precedent knowledge.

Finally, the production of precedent materials, such as those contained in this journal, imply a need for changes in the way instructional designers are educated. Drawing from the design tradition, one goal is providing opportunities for interaction with precedent in non-deterministic, generative ways—so that designers-in-training can use the repertoire of designs they have been exposed to build up their own schemata of design and set of gambits via design precedent (Lawson, 2004). This approach to training designers indicates that rich examples of design processes, decisions, and final outcomes are needed (Boling et al., 2015; Boling & Gray, 2018; Tracey & Boling, 2014), not just case books of sanitized design case studies which are "realistic" rather than "real" (e.g., Ertmer et al., 2013). If we expect to build a corpus of rigorous, high utility precedent, we must commit ourselves as a scholarly community to understanding the creation of precedent materials such as design cases and providing designers and design students alike with a range of precedent to inform their design activity.

CONCLUSION

A design case should display rigor appropriate to design knowledge rather than to experimental scientific knowledge. Without this, it is poor science and useless design. The concept of a design case—as a specific type of design precedent—is more rigorous than most forms of knowledge building in the traditional design community. This heightened rigor, while important in the social science tradition in order to gain legitimacy in a relatively scientized discipline, may also provide a venue and framework for extended rigor in the production of design precedent in many other disciplines of design.

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