Considering the Role of Guidelines in Visualization Design Practice

Paul Parsons*
Purdue University

Prakash Shukla†
Purdue University

ABSTRACT

Guidelines are commonly viewed as an important form of design knowledge that can support the principled application of research findings to visualization design. Researchers regularly propose design guidelines as outputs from studies with the aim of prescribing design activity. However, inquiry into the actual use of design guidelines by practitioners is often unaddressed or left for future work. We propose there is a need for visualization researchers to better understand the realities of design practice, especially its epistemological foundations, and how different forms of design knowledge are actually employed rather than how researchers imagine them to be employed.

1 INTRODUCTION

Guidelines are commonly viewed as important to the theoretical foundation of visualization, alongside frameworks, taxonomies, principles, and other theoretical forms [2]. Visualization researchers have developed a plethora of design guidelines, focusing on interaction techniques, visual encodings, perceptual and cognitive factors, and others. It is a common practice in the visualization literature to propose design guidelines as outputs or 'takeways' from research studies. This practice is likely undertaken with the aim of making the research more concrete or applicable. Despite the intended effect on design practice, investigation of actual effects on practice are much less common [15, 17]. The actual use of design guidelines by practitioners is often unaddressed or left for future work.

The proposal of design guidelines should rest on a solid understanding of how practitioners design in the wild, not on how researchers imagine design practice to be. Previous work in HCI and visualization has suggested a misunderstanding on behalf of researchers regarding how design practice actually works [3, 8, 10, 17, 21, 28]. We propose a need for visualization researchers to better understand the realities of design practice, especially in relation to epistemological differences with the activity of science, and how different forms of design knowledge are actually employed. In this short paper, we draw on work from design theorists across multiple disciplines to raise questions about how guidelines and other forms of design knowledge should be viewed. We then suggest 3 topics that visualization researchers should investigate if interested in the role of guidelines for design practice: the need for practice-focused inquiry, tacit and explicit design knowledge, and implications for education and training.

2 GUIDELINES AND THE EPISTEMOLOGY OF PROFESSIONAL PRACTICE

Guidelines are commonly viewed as important for guiding the practice of design. They are seen as bringing order, coherence, and the principled application of general knowledge to particular problems and situations. For instance, Diehl et al [5] suggest guidelines are important for (i) guiding novices and practitioners in the design and application of visualizations for specific problems, and (ii) to structure the vast knowledge and research in the field. This view is uncontroversial and likely shared by most visualization researchers; however, it makes several assumptions about the nature of design practice and design knowledge. It is based on an underlying epistemology that Schön has called Technical Rationality [23]. Schön traces the history of this view and argues that it thoroughly dominates institutions of higher education and shapes our thinking about research, practice, and education. A summary of this view is outside the scope of our discussion here and has been partially provided in the context of visualization elsewhere [18]. What is important to note is what the model of Technical Rationality says about practice—namely, that professional activity consists in instrumental problem solving made rigorous by the application of scientific theory and technique. The notion of 'rigor' and its relation to the application of scientific theory is critically important here. Technical Rationality suggests that rigorous practice results in the application of general, codified knowledge to the specific situations in which practitioners find themselves. It is the job of researchers to develop general knowledge (principles, laws, guidelines, etc.), and it is the job of practitioners to apply it.

Several design theorists have written about this application-driven view and have largely denounced it as lacking empirical validity (e.g., see [1, 4, 6, 13, 26]). Although the view may seem reasonable at first, it is only so based on a coherence with the positivist underpinnings of Technical Rationality, and not based on empirical scrutiny of the nature of design practice. When discussing the nature of wicked problems in design thinking, Buchanan [1] has suggested that every scientific field with a connection to design has viewed design as simply an applied version of its own knowledge, and the activity of design as a practical demonstration of the more general knowledge contained within the field's body of literature. Indeed, in the visualization literature, design practice and application are sometimes even viewed as interchangeable (e.g., [11]). This assumed equivalence shows how deeply embedded the model of Technical Rationality is in the field.

2.1 Can Designers be Guided in Action?

Stolterman and colleagues [13, 16, 26, 27], have built on Schön's views and extended them into the field of interaction design and user experience design. They have written about the nature of design guidelines in relation to the epistemology of practice. Stolterman [26] has written specifically about the issue of guidelines in design, characterizing the view outlined above as the 'guideline approach'—i.e., the idea of guiding the designer through the design process with the help of prescriptive guidelines. He outlines four key assumptions underlying this approach: (i) the 'rationality' of practice—that practice based on the application of objective knowledge (e.g., guidelines) is more rational and predictable; (ii) the transferability of rationality—that guidelines, which embody rationality, can be articulated generally and then transferred across designers and situations; (iii) the limited role of the designer—if the guidelines are good enough, and the designer is competent, the outcome of the design process not dependent on the particular individual doing the designing; and (iv) controlling the design process—if the design processed can be made to be rational and predictable through guidelines, not relying too much on the individual designer, then the outcome can better controlled. Each of these assumptions is important and requires reflection. Much could be written about each

*e-mail: parsonsp@purdue.edu
†e-mail: shukla37@purdue.edu

of these in relation to the body of visualization literature, reflecting on whether these assumptions are indeed held and whether they are properly substantiated. Due to the short nature of this paper, we point to topics we think are important for dialogue on visualization design guidelines rather than explicating them in any detail.

3 Suggested Topics for Investigation

Practice-focused inquiry. Researchers often have a view of what design practice is like. This is likely especially true in fields like visualization, where researchers are often designing visualization tools themselves. It is easy, in such circumstances, to make assumptions about what all design practice is like, including design that is done in commercial settings and has no affiliation with research. These assumptions have been shown to exist in the context of interaction design research [8, 10, 21, 22], where researchers often rely on a 'projected' practice community rather than one grounded in real-world investigation [10]. The practice of adding "design guidelines" or "implications for design" [7] makes it all too easy to simply tack them on at the end of a research study based on a projection of how they will be used. To address this issue, we propose that research must foreground real-world, professional practice as a topic of inquiry rather than viewing practice as an afterthought—or as an already-known phenomenon, which risks the projection of an imagined community of practice in place of the real one. We have previously proposed different avenues for this kind of research, which can be led by either researchers or practitioners [17].

Tacit and explicit design knowledge. The 'guidelines approach', which is based on the Technical Rationality paradigm, makes several assumptions about the nature of design knowledge. The extreme version of this paradigm (c.f., positivism) expects that all valid knowledge should be explicit and objective. Design decisions should be rational and essentially separable from the designer. Such are the hallmarks of valid knowledge and rigorous decision making. This view was perhaps most famously epitomized by Simon in his *Sciences of the Artificial* [25], in which he wrote in praise of computer programs that could fully represent complex design processes, where "there is no question [. . .] of the design process hiding behind the cloak of 'judgment' or 'experience"'. We posit that this view is prevalent in the visualization community, which is predominately positivist in orientation [14, 18]. However, investigation of design practice in several fields has demonstrated the essential importance of personal, tacit knowledge in design practice. In our own studies with visualization design practitioners (see [17, 19, 20]), we have heard similar sentiments when asking them about the use of theoretical knowledge (principles, guidelines, theories, frameworks). For instance, one practitioner noted: *"Unfortunately, I would love to say that I'm explicitly checking things [theories/guidelines], but yeah, I know them and so hopefully I'm double checking them subconsciously. Yeah, very occasionally."* Similarly, another stated *"I don't think specifically about any of the most of those things consciously, you know, but I've absorbed a lot of that information over the years and I like to think that I'm putting it into practice subconsciously."* When asked if they make use of any theoretical knowledge, another said: *"I'm sure it's ingrained in my practice, but I can't pull out what it is."* And another, *"I would say I don't formally or explicitly rely on them. Yeah, I've been reading about design principles and things like that for sometime, so I think some of this is kind of internal knowledge or something."*

There are aspects of design that cannot be articulated or codified—even in principle. We suggest that future discourse on visualization guidelines must account for the interplay between tacit and explicit knowledge. Focusing on explicit knowledge only—e.g., by attempting to guide design through prescriptive guidelines, making design activity more 'rational'—is to ignore the essential role of tacit knowledge in design and will likely lead to failure as in other disciplines. We need to study the use of design guidelines in the wild, drawing from findings of design practice in other fields that already have decades of inquiry. We need to ask not only how guidelines should be specified and curated, but also what their uptake is in practice. And as educators, we need to ask how we should train future visualization practitioners in ways that are resonant with the realities of real-world practice.

Education and training. The nature of design practice, including the use of guidelines and other forms of knowledge, should fundamentally influence how educational experiences are designed. The philosophical underpinnings of visualization educators need to be critically examined and drawn out for scrutiny. For instance, if educators embrace the Technical Rationality paradigm—whether explicitly or not—they are likely to adopt the "application" approach described above. If educators embrace a more constructionist view of professional practice (see [23] for a general discussion and [18] for a specific focus on visualization), they are less likely to adopt the application view. Which view is adopted considerably impacts how guidelines are taught in the classroom. Several design theorists [13, 27] have argued that educators should not train students to be *guided-in-action*; instead, they should train students to be *prepared-for-action*. The distinction is subtle yet significant. Löwgren and Stolterman [13] compare competent designers to musicians. An expert musician does not need to be guided in their improvisation—rather, they are prepared and know how to play skillfully in the moment without relying on rational or logical thought processes. However, this does not mean their playing is irrational or unprincipled; it is a creative act that is temporally and contextually bound, yet based on many hours of practice and preparation. This kind of training allows the musician to operate skillfully and the moment without needing to rely on any external guidelines. Although design may not be the same as playing music, there is plenty of empirical evidence that expert designers also engage in this kind of intuitive improvisation, which is based on patterns of prior experience from which competent *judgments* can be made [16, 19]

If we are to prepare students to operate skillfully in the context of real-world practice, we need to think about how to prepare them for the range of judgments they are likely to make. Studies of naturalistic decision making across various fields suggest a way of doing so—expose practitioners-in-training to a wide variety of situations that they might encounter in the field so that they can operate skillfully based on recognition rather than rational choice [12]. We know, based on empirical study of design practice, that designers typically do not take systematic or rational choice approaches to the application of guidelines [17, 24]. Rather, experienced designers have a vast repertoire of tacit design knowledge, including guidelines, that get used in practice. Models of design pedagogy have shown success in throwing students into the messiness of design situations [9]. This kind of just-in-time, experiential learning is likely more effective at preparing students for action than trying to teach guidelines abstractly so they can be guided-in-action later on.

4 Summary

Guidelines are an important form of design knowledge, and there is value in collecting, refining, critiquing, and disseminating them. However, if the ways in which they are used in real-world practice are not properly understood, attempts to influence design practice will be lacking. In this short paper, we briefly outlined some considerations for how guidelines are actually used, based on our own previous inquiry and on the work of design theorists across several disciplines. Successful influence of design practice requires and understanding of the epistemological issues at play, and should ideally be driven by practice-focused inquiry rather than imagining what practice should be like.

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