The Design Stance in User-System Interaction

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Introduction

Ideas about what users think and do have always had an important place in the theory and practice of design.[1] These ideas are especially important when trying to understand how users interact with designed systems, whether those systems are physical products, digital interfaces, or more abstract services. In recent years, traditional concerns for the users' efficiency, safety, and satisfaction have expanded to also include issues like meaning, engagement, and fulfilment.[2] Consequently, attention is now focused on how interactions are situated in contexts of use,[3] how users are constructed during interaction,[4] and how interaction can itself be aesthetic.[5] These broader concerns reflect a more humane approach to users, respecting them as active, aware, and intelligent people rather than just viewing them as being less predictable than the designed systems with which they interact.[6]

This article suggests that fully respecting users' sophistication means acknowledging that they have the capacity to recognize that designed systems *have been designed*. That is, as users interact with systems, they may reason about the design processes from which these systems result. Such reasoning may help users predict the behavior of systems, especially when they consider how designers might have expected users to act. Furthermore, this reasoning may also influence other aspects of how users experience a system, including the meaning that it holds for them, their engagement with it, and the fulfillment that it brings. This article refers to these phenomena as users adopting a design stance towards the system.

The term "design stance" was coined by philosopher Daniel Dennett, who proposed that an effective way for users to reason about how a system will behave is to think about what it was designed to do.[7] The design stance and other related concepts have received a great deal of attention from philosophy, psychology, and a broad range of other disciplines that are concerned with the interpretation and use of artifacts. Despite Dennett's prominence, and despite the relevance of the design stance to how people interact with designed systems, this concept has attracted relatively little discussion in the literature on interaction and design. This literature also contains very few empirical studies that can be related to the design stance, and in any case, those studies that are relevant primarily focus on other phenomena. Consequently, the role of the

1 Victor Margolin, "Getting to Know the User," *Design Studies* 18:3 (1997): 227–36; Philip E. Agre, "Conceptions of the User in Computer Systems Design," in *The Social and Interactional Dimensions of Human-Computer Interfaces*, ed. Peter J. Thomas (Cambridge, UK: Cambridge University Press, 1995), 67–106; Geoff Cooper and John Bowers, "Representing the User: Notes on the Disciplinary Rhetoric of Human-Computer Interaction," in *The Social and Interactional Dimensions of Human-Computer Interfaces*, ed. Peter J. Thomas (Cambridge, UK: Cambridge University Press, 1995), 48–66.

2 Daniel Fallman, "Persuade Into What? Why Human-Computer Interaction Needs a Philosophy of Technology," in *Proceedings of the 2nd International Conference on Persuasive Technology* (Palo Alto, CA: Springer-Verlag, 2007), 295–306.

3 Lucy Suchman, *Plans and Situated Actions* (Cambridge, UK: Cambridge University Press, 1987).

4 Johan Redström, "RE: Definitions of Use," *Design Studies* 29:4 (2008): 410–23.

5 Caroline Hummels and Kees Overbeeke, "Special Issue Editorial: Aesthetics of Interaction," *International Journal of Design* 4:2 (2010): 1–2; Paul Locher, Kees Overbeeke, and Stephan Wensveen, "Aesthetic Interaction: a Framework," *Design Issues* 26:2 (Spring 2010): 70–9.

6 Liam Bannon, "From Human Factors to Human Actors: the Role of Psychology and Human-Computer Interaction Studies," in *Design at Work: Cooperative Design of Computer Systems*, ed. Joan M. Greenbaum and Morten Kyng (Hillsdale, NJ: Lawrence Erlbaum Associates, 1991), 25–44.

7 Daniel C. Dennett, *The Intentional Stance* (Cambridge, MA: The MIT Press, 1987).

design stance in user-system interaction has still not been thoroughly explored, either conceptually or empirically.

The objective of this article is to encourage a focus on the design stance so that its relevance to user-system interaction might be better understood. To support this goal, the relationship between designers, users, and systems is presented, first as it is conventionally understood and then in the way it is considered here. Next, the design stance is outlined in the terms in which Dennett introduced it, but it is then strengthened and broadened through references to other related work. Attending to this other work demonstrates that the design stance holds implications for studying not only how things are used, but also how they are experienced. It further shows how the design stance is related to—*and yet distinct from*—other concepts with which interaction researchers have been concerned. With the design stance defined and contextualized, its analytic value is then illustrated by applying it to a detailed account of an interaction episode.

The User's Image of the Designer

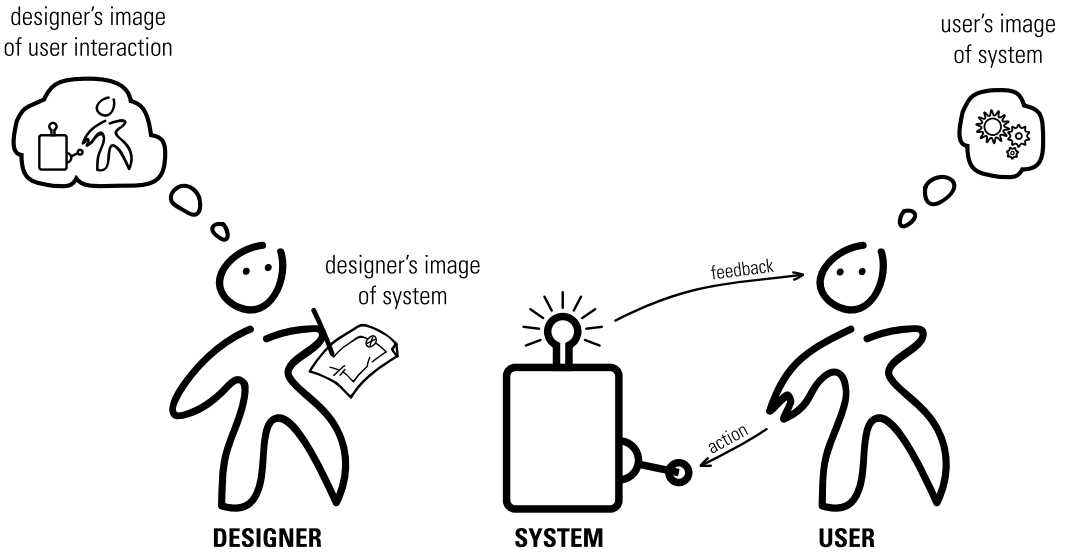
In an effort to understand how people interact with designed systems, cognitive studies have traditionally emphasized the idea that users construct a "mental model" of how a system works, and that they use that model to interact with the system.[8] This perspective is often represented with a diagram (see Figure 1) that depicts three key things: (1) The designer has an image of how a system will work and how the user will interact with it,[9] (2) the system presents the user with certain opportunities for actions and offers feedback in response to those actions, and (3) the user forms an image of how the system works based on their interactions with it.[10] This diagram exists in various forms, but all forms depict how users

8 For example, Stephen J. Payne, "Users' Mental Models: the Very Ideas," in *HCI Models, Theories, and Frameworks*, ed. John M. Carroll (San Francisco, CA: Morgan Kaufmann, 2003); Martina A. Sasse, "Users' Models of Computer Systems," in *Models in the Mind*, ed. Yvonne Rogers, Andrew Rutherford, and Peter A. Bibby (London, UK: Academic Press, 1992), 225–40; Richard M. Young, "The Machine Inside the Machine: Users' Models of Pocket Calculators," *International Journal of Man-Machine Studies* 15:1 (1981): 51–85; Nancy Staggers and A. F. Norcio, "Mental Models: Concepts for Human-Computer Interaction Research," *International Journal of Man-Machine Studies* 38:4 (1993): 587–605.

9 This capacity for theory of mind may actually be a basic requirement for designing. Andy Dong, "Biological First Principles for Design Competence." *AI EDAM* 24:04 (2010): 460–1.

10 For example, see Klaus Krippendorff and Reinhart Butter, "Product Semantics: Exploring the Symbolic Qualities of Form," *Innovation: The Journal of the Industrial Designers Society of America* 3:2 (1984): 6; Donald A. Norman, *The Psychology of Everyday Things* (New York, NY: Basic Books, 1988),16.

Figure 1
The designer thinks about the system and the user, and the user thinks about the system.



interact with systems independently of designers, and how designers communicate with users through the systems they design.[11]

In the traditional mental models approach, the user's understanding of the system seemingly develops without the user being aware that the system has been designed. There is no explicit acknowledgement that users have the capacity to recognize *that they are users*—users whose interactions with the system will have been anticipated. As such, in Figure 1 the designer is viewed as having an image both of the system and of the user's interaction with it, but the user is viewed simply as having an image of the system. What is not shown is that through interaction with the system the user might also form an image of the designer, and also an image of the designer's image of the user. This image that the user holds of the designer need not be well formed and need not be accurate for it to influence the user's response to the system (see Figure 2). Note that unlike Figure 1, which presents acts of design and acts of use in the same view, Figure 2 only presents acts of use; the designer is imagined by the user, and only the system, the user, and the user's thoughts are actually depicted.

If users were to view technological systems as a consequence of human thought and action, they could reason about those systems on the grounds that they result from intentional design processes. This orientation towards the design process might allow users to better explore, discover, and anticipate the behavior of technological systems because they would recognize that use of those systems has been considered and designed for. For example, such awareness of design might help users to determine where a particular feature could be ("*where would the designer have put it?*") or how something might be operated ("*how was I expected to use it?*"). In approaching technology in this way, users could exploit their wealth of experience

11 Nathan Crilly, David Good, Derek Matravers, and P. John Clarkson, "Design as Communication: Exploring the Validity and Utility of Relating Intention to Interpretation," *Design Studies* 29:5 (2008): 425–57; Nathan Crilly, Anja Maier, and P. John Clarkson, "Representing Artefacts as Media: Modelling the Relationship Between Designer Intent and Consumer Experience," *International Journal of Design* 2:3 (2008): 15–27.

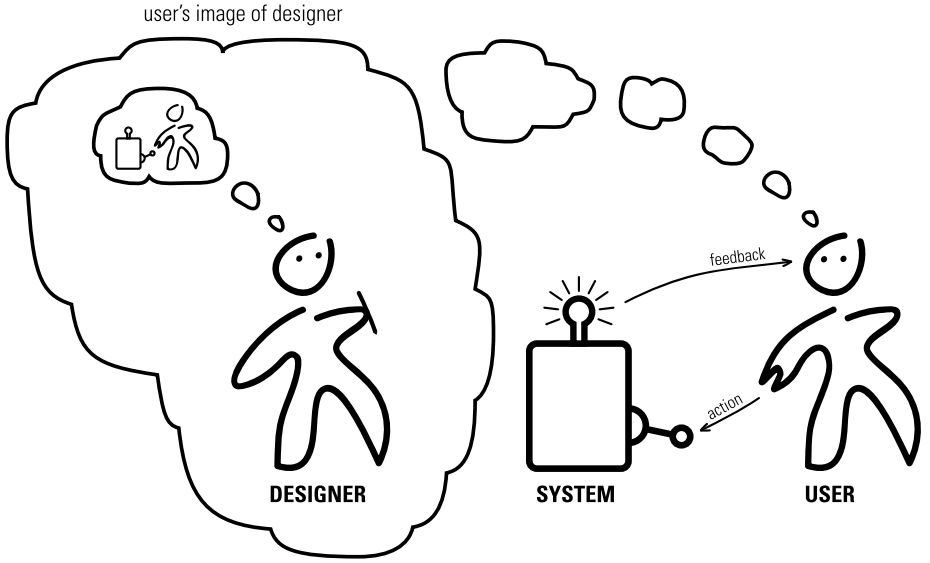


Figure 2
The user thinks about the designer of the system, and also about the designer's thoughts about the user.

in social interactions, leveraging their knowledge of how people think about people to understand how a designer might have thought about them. Where this social knowledge is more developed than users' technical knowledge, their awareness that the system has been designed might promote interactions that are more effective and more rewarding. In other words, it may be better for users to think about *why* the system is the way it is, rather than to just think about *what* the system is or *how* it works.

The Design Stance

The perspective illustrated in Figure 2 can be related to Dennett's design stance. This is just one of three stances that Dennett claims people adopt when they are making predictions about how things will behave.[12] On Dennett's account, for relatively simple things (e.g., doors and chairs), people can predict the behavior of objects purely on the basis of physical structures obeying physical laws. In adopting this "physical stance" toward objects, people use some intuitive grasp of physics to predict that, for example, pushing the back of a chair beyond a certain point will cause it to topple over. (Compare the adoption of this stance with the perception of "affordances," a concept that is typically used to emphasize a relational capacity for *action* rather than an intuitive means of *prediction*.)[13]

For things that are more complicated than doors and chairs (e.g., clocks and calculators), most people have insufficient knowledge of the physical structure and workings to reliably predict how those objects operate simply by adopting the physical stance. Instead, people adopt a "design stance" toward such objects, which allows them to make these predictions based on the assumption that the object will behave *as it is designed to behave*. Having some idea of what a calculator *is supposed to do* when a button is pressed gives people some clues as to what it might actually do. Or, with respect to computers, and in Dennett's own words,

> [M]ost users of computers have not the foggiest idea what physical principles are responsible for the computer's highly reliable, and hence predictable, behaviour. But if they have a good idea of what the computer is designed to do (a description of its operation at any one of the many possible levels of abstraction), they can predict this behaviour with great accuracy and reliability, subject to disconfirmation only in cases of physical malfunction.[14]

Although Dennett refers to the users' ideas about design, in recent discussions of the design stance, considerable debate has arisen as to whether design stance reasoning is based simply on knowledge of the system's function (without reference to the designer's intentions) or whether it is based on knowledge of the designer's *intended* function.[15] However, in contrast to the biological organisms with which Dennett is primarily concerned, the functions of

12 Daniel C. Dennett, "Intentional systems," *The Journal of Philosophy* 68:4 (1971): 87–106; Dennett, *The Intentional Stance*; Dennett, "The Interpretation of Texts, People and Other Artifacts," *Philosophy and Phenomenological Research* 50 (1990): 177–94.

13 James J. Gibson, *The Ecological Approach to Visual Perception* (Boston, MA: Houghton Mifflin, 1979); Joanna McGrenere and Wayne Ho, "Affordances: Clarifying and Evolving a Concept," in *Proceedings of Graphics Interface 2000* (Montreal, Canada: ACM Press, 2000), 179–96; Norman, *The Psychology of Everyday Things.*

14 Dennett, *The Intentional Stance*, 17.

15 Matthew Ratcliffe, "A Kantian Stance on the Intentional Stance," *Biology and Philosophy* 16:1 (2001): 29–52; Giacomo Romano, *Thoughtful Things: an Investigation in the Descriptive Epistemology of Artifacts* (PhD Thesis: Technische Universiteit Eindhoven, 2009); Krist Vaesen and Melissa van Amerongen, "Optimality vs. Intent: Limitations of Dennett's Artefact Hermeneutics," *Philosophical Psychology* 21:6 (2008): 779–97.

technical systems are generally taken to depend on the intentions of the system's creator. Therefore, to adopt a design stance toward a technical system is to reason about what the designer wanted and about how the designer acted. Throughout this article, it is this stronger version of the design stance (or the "design*er* stance") with which we are concerned.[16]

If the behavior of simple things can be predicted with the physical stance, and more complicated things with the design stance, Dennett suggests that a third stance is adopted for things that are yet more complicated still. For things like animals and people, neither the physical stance nor the design stance is effective; instead we must adopt an "intentional stance." Here, intentions are attributed to the things themselves, and their behavior is predicted on the basis that they will behave in ways that suit their own goals. For example, if we recognize that an animal is hungry, then we can predict how that animal will behave when it is presented with food by expecting that it will act to satisfy its drives.

The adoption of the intentional stance need not be reserved just for truly intentional systems; someone might predict the behavior of a computer by adopting the intentional stance (e.g., if its sophistication suggests that it is taking goal-directed actions). Similarly, someone might adopt the physical stance to predict the behavior of a calculator (e.g., if it were being dropped), and someone might predict the behavior of an animal's heart by adopting the design stance (e.g., if Mother Nature were thought to have designed it to serve some function). As such, although it might at first seem that the stance a person adopts is determined by the type of entity with which they interact, it is really determined pragmatically by some trade-off between the reliability of the predictions that a stance permits and the efforts required to make those predictions from that stance.[17]

The Scope of the Design Stance

Dennett's three stances have been very influential and have particularly attracted the attention of philosophers concerned with the mind, its workings, and its evolution.[18] However, psychologists have also taken an interest in Dennett, and the design stance is now explicitly associated with a significant stream of experimental work.[19] This work has shown that people name and categorize artifacts according to what they believe the designers' intentions were. For example, a collection of things called "clocks" might all be considered *to be* clocks even if those things take different physical forms (e.g., analogue and digital clocks), and even if they do not all tell the time (e.g., because they are broken or need a new battery). This is because these things were all intended to be clocks, and their form and behavior are just clues to this intention. Conversely, something might very well resemble a clock (perhaps a child's drawing) and something might accidently permit the time to be read (perhaps the

16 Stefano Borgo, Massimiliano Carrara, Pawel Garbacz, and Pieter E. Vermaas, "The Design and the Designer Stance," in *Vol. 1 of Copenhagen Working Papers on Design*, ed. Helle Hove and Per Galle (presented at the CEPHAD 2010: The Borderland between Philosophy and Design Research, Copenhagen, Denmark: Danish Design School Press, 2010), 39–40. Also see Pieter E. Vermaas, Massimiliano Carrara, Stefano Borgo, and Pawel Garbacz, "The Design Stance and Its Artefacts," *Synthese* (2011). doi:10.1007/s11229-011-9885-9.

17 John Heil, *Philosophy of Mind: a Contemporary Introduction*, 2nd ed. (New York, NY: Routledge, 2004), 157–8.

18 For example, see notes 15 and 16, and also contributions in Don Ross, Andrew Brook, and David L. Thompson, eds., *Dennett's Philosophy: A Comprehensive Assessment* (Cambridge, MA: MIT Press, 2000). Dennet's three stances have also concerned those interested in design cognition. Charles Burnette, "Intentionality and Design," in David Durling and John Shackleton, *Common Ground: Design Research Society International Conference*, London, UK (2002): 12; Udo Kannengiesser and John S. Gero, "Understanding Situated Design Agents," in *CAADRIA'05*. (TVB, New Delhi, 2005): 277–87.

19 See review in Deborah Kelemen and Susan Carey, "The Essence of Artifacts: Developing the Design Stance," in *Creations of the Mind: Theories of Artifacts and Their Representation*, ed. Eric Margolis and Stephen Laurence (Oxford: Oxford University Press, 2007), 212–30.

moving shadow from a building), but if people don't think those things were intended to be clocks, then those things won't be thought of as being clocks.[20]

Beyond psychological research, and independently of Dennett, the inference of creative intentions is considered to be of central importance to the interpretation of many acts and media.[21] This perspective is notably influential in the study of spoken and written communication,[22] but it also is important when considering paintings,[23] prehistoric relics,[24] architecture,[25] cinema,[26] consumer products,[27] branding,[28] and advertising.[29] Although the disciplines that study these various kinds of artifacts use different terminology (e.g., "intent attribution," "inference of intention," "persuasion knowledge"), they all describe phenomena closely related to the design stance, and all consider those phenomena to strongly influence how artifacts are experienced. The attribution of design intention therefore affects not only what an artifact is, but also what it means and how it is responded to.

Those disciplines that focus on how people construct an image of an artifact's creator implicitly invoke the idea that people have beliefs about other people's thoughts. More formally, the concept of folk psychology (or naïve psychology) is used to describe this common-sense knowledge of cognition that lay people use to predict and explain the behavior of others.[30] This knowledge is not always correct and does not always permit accurate predictions,[31] but it is still influential in determining how people interact socially.[32] In these terms, we might consider whether people possess a folk knowledge of design that tells them how a technical system came into existence, what decisions have been made about it, and what drove those decisions. Such reasoning involves folk psychology being applied through abduction: Rather than predicting human behavior on the basis of some naïve understanding of psychology, people explain the results of human behavior (the system) on the basis of some more or less naïve understanding of the design process and the psychology behind it.[33]

From across the range of disciplines that have been concerned with something like Dennett's design stance, we see that when people reflect on the agent responsible for a system, these reflections might influence more than just predictions about that system's behavior. Instead, these reflections might also influence the way in which people categorize what a system is, understand why it is there, and assess its aesthetic and symbolic value. To cover this range, the term "design stance" is here used in a broader sense than Dennett himself used it. However, there is good precedent for this expansion in the large body of psychological work that is conducted under the heading of "design stance" research.[34] Consequently, in this article, "design stance" is used to refer to the way in which users' engagement with systems is mediated by their conception of the design activities from which those systems result.

20 H. Clark Barrett, Stephen Laurence, and Eric Margolis, "Artifacts and Original Intent: a Cross-Cultural Perspective on the Design Stance," *Journal of Cognition and Culture* 8:1 (2008): 1–22; Paul Bloom, "Intention, History, and Artifact Concepts," *Cognition* 60:1 (1996): 1–29; Tim P. German and Susan C. Johnson, "Function and the Origins of the Design Stance," *Journal of Cognition and Development* 3:3 (2002): 279–300.

21 Raymond W. Gibbs, *Intentions in the Experience of Meaning* (Cambridge: Cambridge University Press, 1999).

22 Raymond W. Gibbs, Julia M. Kushner, and W. Rob Mills, "Authorial Intentions and Metaphor Comprehension," *Journal of Psycholinguistic Research* 20:1 (January 1991): 11–30; Raymond W. Gibbs, "Authorial Intentions in Text Understanding," *Discourse Processes* 32:1 (2001): 73–80; H. P. Grice, "Meaning," in *Philosophical Logic* (London: Oxford University Press, 1967), 39–48; John R. Searle, *Speech Acts: An Essay in the Philosophy of Language* (Cambridge, UK: Cambridge University Press, 1969); Dan Sperber and Deirdre Wilson, *Relevance: Communication and Cognition* (Oxford, UK: Blackwell, 1986).

23 Richard Kuhns, "Criticism and the Problem of Intention," *The Journal of Philosophy* 57:1 (1960): 5–23; Jerrold Levinson, "Defining Art Historically," *British Journal of Aesthetics* 19:3 (1979): 232–50; Jerrold Levinson, "Refining Art Historically," *The Journal of Aesthetics and Art Criticism* 47:1 (1989): 21–33.

24 Cameron Shelley, "Visual Abductive Reasoning in Archaeology," *Philosophy of Science* 63:2 (1996): 278–301; Elizabeth Slater, "Studying Artefacts," in *Companion Encyclopedia of Archaeology (Volume 1)*, (London, UK: Routledge, 1999), 344–88.

25 Juan Pablo Bonta, *Architecture and Its Interpretation: A Study of Expressive Systems in Architecture* (New York, NY: Rizzoli, 1979).

26 David Bordwell, *Making Meaning: Inference and Rhetoric in the Interpretation of Cinema* (Cambridge, MA: Harvard University Press, 1989).

The Design Stance in Human-Computer Interaction

Although concepts like the design stance have excited those disciplines concerned with the *interpretation* of artifacts, this emphasis on interpretation disguises a lack of attention given to the design stance in studies of *interaction*. Because of its emphasis on man-machine relations, a natural place to look for such work is the field of human-computer interaction (HCI). However, Dennett's stances—*and especially his design stance*—have attracted much less attention in the HCI field than might be expected. For example, there are only a few general HCI texts in which Dennett is mentioned, and in those texts it is typically his intentional stance which is emphasized.[35] Dennett's three stances *are* distinguished from each other in some more specific theoretical discussions,[36] where they are related to alternative categorizations of reasoning offered by Rasmussen,[37] Pylyshyn,[38] and Zuboff.[39] However, in none of these works is a concept like the design stance offered as a challenge to conventional ways of understanding how users might appraise or interact with systems.

Moving away from general HCI theory, Dennett's stances appear to be of most interest to those studying how humans interact with robots, animated characters, and other, seemingly sentient devices.[40] In particular, Terada and colleagues have conducted experiments to discern which stances people adopt when responding to different types of robots,[41] artifacts,[42] and entities.[43] In these laboratory-based studies, the researchers applied verbal and non-verbal self-report techniques to elicit the stances that users adopted with respect to the systems they interacted with or observed. Although all three of Dennett's stances were considered (and ostensibly revealed), Terada and colleagues interpreted the design stance as simply requiring consideration of a system's function, rather than as requiring the attribution of intentions to the system's creator. Their perspective is therefore fundamentally different from that developed in this article, but in any case, it is actually the user's adoption of the intentional stance that they are promoting.

While HCI robotics promotes the intentional stance, there is work in HCI semiotics that seems to promote something like the design stance, albeit without reference to Dennett. In an independent argument, de Souza says that technology users may recognize that they are not interacting with autonomous machines, but with the product of a rational human mind.[44] This recognition allows users to interact with technology by exploiting their expectations about the intellectual and creative behavior of other people—the designers. In this sense, de Souza views the designed system as a designer-to-user message, the meaning of which is: "Here is my [the designer's] understanding of who you [the user] are, what I've learned you want or do, in which preferred ways, and why."[45] de Souza and Leitão thus propose that designers follow a process of "semiotic engineering,"

27 Crilly et al., "Design as Communication;" Kevin Malkewitz, Peter A. Bibby, and Marian Friestad, "Persuasion by Design: the State of Expertise on Visual Influence Tactics," in *Persuasive Imagery: a Consumer Response Perspective*, ed. Linda M. Scott and Rajeev Batra (Mahwah, NJ: Lawrence Erlbaum and Associates, 2003), 3–15; Thomas J. L. Van Rompay, "Product Expression: Bridging the Gap Between the Symbolic and the Concrete," in *Product Experience*, ed. Hendrik N. J. Schifferstein and Paul Hekkert (San Diego, CA: Elsevier, 2008), 333–51.

28 Douglas Rushkoff, *Coercion: The Persuasion Professionals and Why We Listen to What They Say* (London, UK: Little Brown, 2000).

29 Marian Friestad and Peter Wright, "The Persuasion Knowledge Model: How People Cope With Persuasion Attempts," *Journal of Consumer Research* 21 (1994): 1–31; Amna Kirmani and Margaret C. Campbell, "Taking the Target's Perspective: The Persuasion Knowledge Model," in *Social Psychology of Consumer Behavior*, ed. Michaela Wänke (New York, NY: Psychology Press, 2009), 297–316; Linda M. Scott, "The Bridge From Text to Mind: Adapting Reader-Response Theory to Consumer Research," *Journal of Consumer Research* 21:3 (1994): 461–80.

30 Alvin I. Goldman, "The Psychology of Folk Psychology," *Behavioral and Brain Sciences* 16:1 (1993): 15–28; Stephen P. Stich and S. Nichols, "Folk Psychology," in *The Blackwell Guide to Philosophy of Mind*, ed. Stephen P. Stich and Ted A. Warfield, Blackwell philosophy guides 10 (Oxford, UK: Blackwell, 2003), 235–55. Dennett explicitly relates his work to such ideas. Dennett, *The Intentional Stance*, 8–11 and Chapter 3.

31 Lee Ross, "The Intuitive Psychologist and His Shortcomings: Sistortions in the Attribution Process," in *Advances in Experimental Social Psychology: Volume 10*, ed. Leonard Berkowitz (New York, NY: Academic Press, 1978).

which can guide users toward inferring the design rationale from which the system results.[46]

Although work on semiotic engineering has suggested that something like the design stance is adopted by users, the focus of that work is quite different from what is proposed here. First, semiotic engineering originates in linguistics, and the interfaces to which it has been applied predominantly use conventional symbols in the form of verbal instructions, menu lists, and graphical icons. Second, this attention to explicit communication leads to asking questions primarily about *voice*: Who is seen to be saying what to whom? Third, it is the designer who is emphasized, including the messages that the designer can send and the interpretations that the designer can encourage. Consequently, there is no focus on how users might respond to interfaces that are less explicitly communicative (e.g., physical interfaces), and the reported qualitative studies do not reveal that users have some conception of the designer.[47] Therefore, although semiotic engineering promotes the idea that users adopt something like the design stance, it is actually that this idea is assumed; it is not elaborated on or investigated directly.

The idea that users adopt the design stance, and that this should be encouraged, stands in opposition to the work of researchers who have focused on "the media equation," a theory which proposes that people respond to media (e.g., computers) in a manner equivalent to how they respond to people. For example, in considering how people orient to sources, Reeves and Nass assert that consumers do not think of advertisers (but compare this with modern marketing theory),[48] and that computer users do not consider computer programmers.[49] To test this theory, Sundar and Nass conducted an experiment in which one group of participants interacted with computers that were labeled and referred to as "Computer," and another group interacted with computers that were labeled and referred to as the work of a "Programmer." Because the researchers found clear differences in how the different participant groups appraised the computers, they concluded that "humans working with a computer are not orienting to an unseen programmer but instead are interacting with the computer as a distinct social actor."[50]

It is in explicit opposition to Dennett that proponents of the media equation claim that users do not normally consider designers during interaction. However, these researchers do acknowledge that users think about the designer of the system when things go wrong, and that these thoughts are useful when reasoning about how to put things right.[51] Their experimental results might thus be reinterpreted as suggesting that when users adopt the design stance, this changes their experience of the systems with which they are interacting. They report that this change in experience led users to consider the system as being less friendly, less playful, and less effective.[52] However, the users in these studies were forced into adopting the design stance;

32 Joshua Knobe, "The Concept of Intentional Action: a Case Study in the Uses of Folk Psychology," *Philosophical Studies* 130:2 (8, 2006): 203–31. Note that this folk psychology is used in the intentional stance just as some form of naïve physics is used in the physical stance. Patrick J. Hayes, "The Second Naive Physics Manifesto," in *Readings in Qualitative Reasoning About Physical Systems*, ed. Daniel S. Weld and Johan De Kleer (San Francisco, CA: Morgan Kaufmann Publishers, 1989), 46–63.

33 Peter Kroes, "Technological Explanations: the Relation Between Structure and Function of Technological Objects," *Philosophy and Technology* 3:3 (1998): 18–34.

34 For example, see Barrett, et al. "Artifacts and Original Intent;" Margaret Anne Defeyter and Tim P. German, "Acquiring an Understanding of Design: Evidence from Children's Insight Problem Solving," *Cognition* 89:2 (2003): 133–55; German and Johnson, "Function and the Origins of the Design Stance;" Kelemen and Carey, "The Essence of Artifacts: Developing the Design Stance."

35 For example, see John M. Carroll, ed., *HCI Models, Theories, and Frameworks* (San Francisco, CA: Morgan Kaufmann, 2003); Terry Winograd and Fernando Flores, *Understanding Computers and Cognition: a New Foundation for Design* (Norwood, NJ: Ablex, 1986).

36 David Benyon and Dianne Murray, "Adaptive Systems: from Intelligent Tutoring to Autonomous Agents," *Knowledge-Based Systems* 6:4 (1993): 197–219; Michael Lewis, "Designing for Human-Agent Interaction," *AI Magazine* 19:2 (1998): 67–78; Peter Pirolli, *Information Foraging Theory: Adaptive Interaction with Information* (Oxford, UK: Oxford University Press, 2007).

37 Jens Rasmussen, *Information Processing and Human-Machine Interaction* (New York, NY: North-Holland, 1983).

38 Zenon W. Pylyshyn, *Computation and Cognition: Toward a Foundation for Cognitive Science* (Cambridge, MA: MIT Press, 1984).

39 Shoshana Zuboff, *In the Age of the Smart Machine: the Future of Work and Power* (Oxford, UK: Heinemann Professional, 1988).

nothing had gone wrong, and users were not reasoning about how to put things right. Questions remain over what circumstances might promote the spontaneous adoption of the design stance, and what effects the design stance might have under these circumstances.

The Design Stance in User-System Interaction: an Account

To explore how the design stance might be adopted and what possible effects its adoption might have, what follows is a detailed hypothetical account of an interaction episode. The account permits easy reference to a concrete example and conveniently covers a number of different aspects of the design stance within one extended episode. Although a single comprehensive account of this sort may be difficult to achieve empirically, the expectation is that individual components of such an account could be generated through experimental, observational, or self-report methods.[53] In the account, a user (called Ursula) adopts the design stance as she reasons about the location of a control within a motor car. The paragraphs are numbered to permit later analytic commentary on specific incidents in the overall episode.

1. A friend of ours, Ursula, doesn't own a motor car but has hired one for the weekend so that she can visit her family. Once her journey has started, the weather becomes increasingly overcast, and when a light drizzle starts up, the windshield wipers are soon required. Ursula, who used to own some other brand of car, instinctively reaches for the wrong control and activates the turn signals instead of the wipers. In doing so, she experiences some frustration as she wonders why these things can't be the same for each car model. As Ursula continues along the busy road, the gusts from passing trucks mean that the windshield requires regular wiping and regular spraying from the washer nozzles.

2. Ursula's rental car had not received a proper service before being rented out to her, and it soon runs out of windshield washer fluid. The car and the washer system are now brought to our friend's attention as she pulls into a service station to fill the washer reservoir. Not seeing any convenient source of water that could be used to fill the reservoir, Ursula decides to buy some bottled water from the service station. Looking for a large bottle of water in the refrigerator, she is struck for the first time by the motifs of purity that adorn the bottles. The pictures of mountains and streams stand in stark contrast to the image that she has of her future self pouring this expensive water into the car's washer reservoir.

3. Once back at the car, Ursula sits down in the driver's seat to activate the hood release mechanism. She reaches under the steering wheel to feel about for the lever that she expects to find there, but she doesn't find it. Ursula swings her head down to the side to get better a look at the situation and is confronted with a smooth, featureless panel. She sits back up and looks quizzically at the dashboard, examining each of the switches and their associated

40 Terrence Fong, Illah Nourbakhsh, and Kerstin Dautenhahn, "A Survey of Socially Interactive Robots," *Robotics and Autonomous Systems* 42:3 (2003): 143–66; Akira Ito and Kazunori Terada, "Producing Intentionality in Eye-Contact Robot," in *11th International Conference on Human-Computer Interaction* (presented at the HCI International, Las Vegas, NV, 2005), 22–7; Zsófia Ruttkay and Rieks op den Akker, "Affordances and Cognitive Walkthrough for Analyzing Human-Virtual Human Interaction," in *Verbal and Nonverbal Features of Human-Human and Human-Machine Interaction*, ed. Anna Esposito et al., vol. 5042 (Berlin, Germany: Springer-Verlag, 2008), 90-106; Noriko Suzuki, Yugo Takeuchi, Kazuo Ishii, and Michio Okada, "Effects of Echoic Mimicry Using Hummed Sounds on Human-Computer Interaction," *Speech Communication* 40:4 (2003): 559–73; Karim A. Tahboub, "Intelligent Human-Machine Interaction Based on Dynamic Bayesian Networks Probabilistic Intention Recognition," *Journal of Intelligent & Robotic Systems* 45:1 (2006): 31–52.

41 Kazunori Terada, Takashi Shamoto, Haiying Mei, and Akira Ito, "Reactive Movements of Non-Humanoid Robots Cause Intention Attribution in Humans," in *Proceedings of the 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems* (San Diego, 2007), 3715–20.

42 Kazunori Terada, Takashi Shamoto, and Akira Ito, "Human Goal Attribution Toward Behavior of Artifacts," in *Robot and Human Interactive Communication, 2008. RO-MAN 2008. The 17th IEEE International Symposium on* (Munich, Germany, 2008), 160-5.

43 Kazunori Terada, Kouhei Ono, and Akira Ito, "Detecting Underlying Stance Adopted When Human Construe Behavior of Entities," in *Proceedings of Advances in Robotics* (presented at the FIRA RoboWorld Congress 2009, Incheon), (Korea: Springer-Verlag, 2009), 5–12.

44 Clarisse Sieckenius de Souza, "The Semiotic Engineering of User Interface Languages," *International Journal of Man-Machine Studies* 39:5 (1993): 753–73.

symbols. She vaguely expects that one of these switches will have a little pictogram of a car with its hood open, but none of them do. Becoming frustrated, Ursula opens the glove compartment to find the owner's manual for the car, but the manual is missing.

4. During her time looking for a lever, a switch, or a symbol, Ursula mutters things like *"where is it?," "where can it be?,"* and finally *"where have they put it?"* Ursula has now looked in all the places that she expected the control to be, all the places that she thought it plausibly could be, and has now started to think about where some unspecified agent (the *"they"*) could or would have placed it. Ursula starts hopelessly flipping down the sun visors to see what's behind them but mutters *"no… they wouldn't have put it there,"* and as she opens the glove compartment again to search for the lever, she says, more emphatically *"oh, that's ridiculous, I can't have been expected to look in here!"* Thinking about where *they* could possibly have thought *she'd* look, Ursula next examines the space between the front seats and the space between the driver's seat and the door. Neither approach is successful.

5. Feeling that she has exhausted the possibilities inside the car, Ursula steps outside. She peers at the front of the hood but sees only a lip to pull up on, with no obvious catch or switch to release it. The only prominent detail is the badge that marks the brand of the car, a badge that is covered, like the rest of the car, in a thin layer of road spray. *"It could be a button…"* she says, but even as she reaches toward it, she hesitates, thinking *"…but it gets so filthy; they couldn't have wanted me to touch that."* As she pushes on the badge it doesn't move in, but it does feel loose. She presses it again, and as it pivots slightly upward, she shifts the direction in which she applies her force; the badge now swings cleanly out of the way, revealing the keyhole that opens the hood.

6. With the keyhole now exposed, Ursula is relieved to have found her way in and also irritated that she had to search for so long. This irritation is diffuse, directed partly at the car, partly at herself, and partly at those responsible for the system. As Ursula twists the key in the lock, she notes that she's never had to use a key to open the hood before, but reasons that without the key, the hood wouldn't be secure. *"That's clever!"* she says, as she considers the problem that someone must have solved and as she recognizes that the car badge stops the keyhole from getting too dirty. With the hood now open, the remainder of the refill procedure proceeds without incident, and Ursula is soon back on her way, with this episode now thankfully behind her.

The Design Stance in User-System Interaction: a Commentary

The preceding account relates to the design stance in various ways. To illustrate this, the following analytic commentary considers each stage of the episode in turn, using paragraph numbers that correspond to those used in the account.

45 Clarisse Sieckenius de Souza, *The Semiotic Engineering of Human-Computer Interaction* (Cambridge, MA: The MIT Press, 2005), 25.

46 Clarisse Sieckenius de Souza and Carla Faria Leitão, *Semiotic Engineering Methods for Scientific Research in HCI* (San Francisco, CA: Morgan & Claypool Publishers, 2009), 101; also see Donald A. Norman, "Design as Communication," 2004, http://www.jnd.org/dn.mss/design_as_comun.html (accessed September 10, 2010).

47 de Souza and Leitão, *Semiotic Engineering Methods for Scientific Research in HCI*, 85–6.

48 Kirmani and Campbell, "Taking the Target's Perspective."

49 Byron Reeves and Clifford Nass, *The Media Equation: How People Treat Computers, Television and New Media Like Real People and Places* (Cambridge, UK: Cambridge University Press, 1996). Also see Clifford Nass and Youngme Moon, "Machines and Mindlessness: Social Responses to Computers," *Journal of Social Issues* 56:1 (2000): 81–103.

50 S. Shyam Sundar and Clifford Nass, "Source Orientation in Human-Computer Interaction," *Communication Research* 27:6 (2000): 693–4.

51 Reeves and Nass, *The Media Equation*, 188.

52 Sundar and Nass, "Source Orientation in Human-Computer Interaction," 693.

53 For example, see review in Sasse, "Users' Models of Computer Systems"; Gerrit C. van der Veer and Maria del Carmen Puerta Melguizo, "Mental Models," in *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*, ed. Julie A. Jacko and Andrew Sears (Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 2002), 52–80.

1. Ursula's first reported awareness of the car is when she experiences some mild frustration over the differing placement of the controls in different car models. In activating the wrong control, she has become aware of an undesirable situation (variation in control placement across models) and has imagined some preferable alternative (standardization). Had she continued to reflect on this matter, she might have reasoned about why things are the way they are (perhaps constructing some historical cause) and imagined how change might be brought about (perhaps imagining some system of legislation or incentive). If these thoughts brought design—both its failings and its potential—into Ursula's awareness, this would increase the likelihood of her adopting the design stance in future interactions with technology.

2. In purchasing water to fill up the washer fluid reservoir, Ursula notices the motifs of purity on the bottles in a way that she has not done before. The use to which she is about to put the water makes the packaging features incongruous and thus conspicuous. Just as the accidental activation of the turn signal control brought the car to her attention before, the rhetoric of the bottle design is now more prominent than it would otherwise have been. If Ursula had reflected on this further, she might have identified why those features are present, considered the effect that they have on consumption choices, and judged the extent to which this marketing approach is acceptable. However, perhaps as with the matter of the control placement, she is at this moment too distracted by other things and insufficiently motivated to consider this issue in greater depth right now.

3. Because Ursula has to locate the lever for the hood, she first looks where her previous experiences direct her to look—perhaps without being fully aware of what she is doing. When this approach proves unsuccessful, Ursula then looks in the places where she expects the control might reasonably be. This move could involve something like the physical stance; a mechanical connection between the lever and the hood is tacitly assumed, and therefore the lever is expected to be close to the hood. Searching based on prior experience and on reasoning about the system's operation is unsuccessful, but this repeated failure serves to bring the system prominently into Ursula's consciousness and prompts her to adopt some other strategy.

4. In Ursula's frustrated mutterings, we finally see our first clear evidence that the design stance has been adopted. In saying "*where have they put it?*" Ursula reveals her awareness that certain agents ("*they*") are responsible for the system with which she is interacting, and that those same agents have taken actions ("*put*") that have determined the location of the control she seeks. In saying, "*I can't have been expected to look in here!*" Ursula further reveals her awareness that these same agents would have thought about her need to find the control and that they would have held some

image of how that control would be sought. Ursula has now shifted from a physical stance to a design stance: She is reasoning about the plausible location of the control on the basis of some imagined agent's expectations of her own actions.

5. Ursula's reasoning about the agent's reasoning is most evident when she hesitates to touch the car's badge. Ursula here sensibly anticipates that the agent would not have wanted her to unnecessarily interact with some predictably dirty part of the car. Ursula here attributes a user-centered perspective to the agent, and in doing so she almost misses her opportunity to locate the opening system for the hood. The design stance here works against Ursula because the image she has formed of the agent and the design process is incomplete. Without knowing all of the motivations and constraints that the agent was driven by, Ursula might overlook a broad range of technical, economic, and aesthetic influences.

6. With the opening system located, Ursula's experience of the car (and her reflection on that experience) is influenced by the image of the agent that she has now developed. Her frustration and disappointment are aimed not just at the car as an inanimate object or at herself as an uninformed user, but also at the agents responsible for the car and its design. Her experience is not all negative though; as she reasons about the explanations for some of the system's features, she gains satisfaction from feeling that her security and her convenience have been considered. Ursula now sees the implementation of the lock and its cover as resulting from the concerns of a human agent who has tried to solve problems on her behalf.

Discussion

In addition to the particular sequence of events considered in the commentary above, Ursula's interaction episode points to three general sets of issues that warrant discussion here: First, there are issues of what factors prompt the adoption of the design stance; second, issues of whether it must really be a designer that is imagined; and third, issues about what knowledge of design users actually have. We shall now consider each of these issues in turn before reflecting on how such matters fit with the developing literature on design and interaction.

In the example with the car, our user is placed in a situation where her expectations have been confounded, and yet she is highly motivated to determine the location of the control. The car and its design have thus become salient in a way that they might not have otherwise. This idea of heightened awareness can be seen as an extension of Heidegger's distinction between *ready-to-hand* and *present-at-hand*,[54] a distinction that is commonly made in discussions of interaction.[55] In this view, a system is seemingly non-existent to users (ready-to-hand) when they are focused on the work to be done, but the system becomes salient (present-at-hand) when some "break-down" occurs. The design stance takes this progression

54 Martin Heidegger, *Being and Time* (Malden, MA: Blackwell, 1962, *trans.*).

55 For example, see Paul Dourish, *Where the Action is: the Foundations of Embodied Interaction* (Cambridge, MA: MIT Press, 2001); Winograd and Flores, *Understanding Computers and Cognition.*

further and suggests that this present-at-hand condition can also lead the user to become more conscious of the designer's actions. In this sense, we might expect that the design stance is more likely to be adopted when a system is prominent in the user's mind, whether because of interest, surprise, or frustration.

Our user is not explicitly invoking some image of a designer, but rather some diffuse and non-specific agent, "*they*." This agent is somehow taken to be responsible for how the system is, is assumed to have had some choice over how the system works, and is thought to have considered how the system might be used. From an external perspective, this might sound like the role of a designer, but the user need not necessarily assign that label to the agent. Users might recognize that systems result from various motivations and constraints, even if they do not explicitly consider these to be design issues.[56] Therefore, the design stance is best considered as an analytic perspective on user-system interaction, rather than as a description of how that interaction is necessarily conceptualized by the person involved.

Our user's adoption and implementation of the design stance is influenced by the knowledge she holds of what might generally be called "design," even if she would not necessarily use that term. This knowledge need not be founded on reliable sources, but might be composed of suspicions, rumors, misinformation, and various ideas from popular culture. As users modify the systems they use, and as they devise workarounds and fixes for the systems' deficiencies, they are themselves involved in design activities, and so they also learn about design by doing it.[57] Design knowledge might thus be incomplete, inconsistent, and dynamic, as hints and fragments of information are pieced together over time from different sources. In this sense, knowledge of design is assembled and developed through the course of people's lives and might be influential, even if it is inaccurate.

Conclusion

In the opening pages of *The Intentional Stance*, Dennett says that "Philosophy does not often produce stable, reliable 'results' the way science does at its best. It can, however, produce new ways of looking at things, ways of thinking about things, ways of framing the questions, ways of seeing what is important and why."[58] In line with this suggestion, this article has taken Dennett's own concept of the design stance as a starting point for considering how users might respond to and interact with designed systems. A strong version of that concept requires the inference of design intent, and a broad version considers the influence that this exerts on experience, as well as interaction. Interpreting the design stance in this way offers a new perspective from which user behavior might be viewed and from which designed systems might be analyzed. Such a perspective fits with recent work on design and interaction—work that has opened

56 Martin Woolley, *Design, Product Identity and Technological Innovation* (PhD Thesis: Sheffield City Polytechnic, 1983); M. Woolley, "A Comparison of Design and User Perceptions," in *Objects and Images: Studies in Design and Advertising*, ed. S. Vihma (Helsinki, Finland: University of Industrial Arts, Helsinki, 1992): 76–85.

57 Jodi Heintz Obradovich and David D. Woods, "Users as Designers: How People Cope with Poor HCI Design in Computer-Based Medical Devices," *Human Factors* 38:4 (1996): 574–92; Pieter E. Vermaas and Wybo Houkes, "Technical Functions: a Drawbridge Between the Intentional and Structural Natures of Technical Artefacts," *Studies in History and Philosophy of Science* 37:1 (2006): 5–18.

58 Dennett, *The Intentional Stance*, 2.

up to consider the full richness of human experience. With a more sophisticated understanding of users now gaining ground, the way seems well prepared for acknowledging that they can recognize themselves as being users and can anticipate that designers have designed systems with them in mind. Exploring the implications of users adopting such a stance has the potential to expand and refine our basic understanding of user-system interaction.

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