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Charting Sociotechnical Dimensions of Values for Design Research

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Abstract

The relationship of values to technology is an ongoing subject in the fields of information studies, human-computer interaction, media studies, and science and technology studies, but definitions and attributes of values differ within and among these fields. We suggest that researchers currently conflate multiple categories when they discuss values. Some of these categories are attributes of the source of values (i.e. people, systems, and hybrid assemblages), and others are attributes of the values themselves. This article disambiguates values in sociotechnical systems by providing a framework to describe where and how values are negotiated and enacted by people, institutions, and technology. The framework includes three dimensions that pertain to the source of values (*state*, *unit*, and *assemblage*) and three dimensions that pertain to attributes of values (*salience*, *intention* and *enactment*) to enable precision and comparison across this research trajectory. We illustrate each dimension with examples from the values and design literature.

I. Introduction

Investigating how values and ethics intertwine with technology development and use is an ongoing project in the fields of information studies (Knobel & Bowker 2011), human-computer interaction (Friedman, Kahn, & Borning, 2006), media studies (Flanagan, Howe, & Nissenbaum 2008; Jarvenpaa & Leidner 1998; Nissenbaum & Gaboury 2012), and science and technology studies (Johnson 1997; Sclove 1995; Winner 1986). However, these fields often discuss the role of values in design contexts differently. Definitions of values in these literatures also differ from earlier research on values (for a summary and synthesis, see Cheng & Fleischmann 2010) in fields such as anthropology (Kluckhohn 1951), sociology (Hitlin & Piliavin 2004), social psychology (Rokeach 1973; Schwartz 1994), and business (Guth & Tagiuri 1965; Ponsner & Schmidt 1993). In the literature considering values in technology or sociotechnical systems, values are

identifiable entities that appear in technologies, built in consciously or unconsciously by designers and concretized through affordances (Friedman & Nissenbaum 1997; Johnson 2000). In this context, values also emerge from human actors: designers (Fleischmann & Wallace 2010), technology users (Azenkot et al. 2011; Woelfer & Hendry 2010), or the social context of technology design and deployment (Nissenbaum 2009).

In anthropology, sociology, and social psychology, values are defined as criteria that people use to evaluate their behaviors, respond to people they encounter, and make judgments about events. They help explain a range of individual and social behaviors, such as charitable giving (Bennett 2003; Schwartz 2009), choice of field of work and study, consumer purchases, environmental behavior, religious observance, and voting (Bardi & Schwartz 2003). As social psychologist Rokeach puts it:

Values are determinants of virtually all kinds of behavior that could be called social behavior or social action, attitudes and ideology, evaluations, moral judgments and justifications of self to others, and attempts to influence others. (1973, 5)

These definitions are compatible with the values and design literature. As determinants of “virtually all kinds of behavior,” values can shape the technologies designers create, and guide technology use practices (Fleischmann 2006, 2007; Friedman & Nissenbaum 1996; Shilton 2010). Design approaches that explicitly consider values can change the affordances of resulting technologies (Fleischmann & Wallace 2009; Sengers, Boehner, David, & Kaye 2005; Shilton 2012). Much of the values and design literature is concerned with how values are exposed, negotiated, and materialized into technical features during the process of design, that in turn affect adoption, use, and eventually the social impact of design products (Le Dantec, Poole, & Wyche 2009). It is at this intersection of technology design and use that “values” becomes conceptually confused. Are values concrete attributes fundamental to individuals’ personalities and identities (Schwartz 2007)? Or, are values contextual concepts based on shared negotiations of space and place (Cohen 2012; Nissenbaum 2009)? How do the values of human actors become concrete features

built into a technology (Johnson 2000; Winner 1980)? And, how are values (whether fact or negotiation) mediated by use of these technologies (Jarvenpaa & Leidner 1998)?

These diffuse ways of interrogating values suggests a need to identify the range of characteristics and attributes that unify these disparate approaches concerned with values research in a design context. In this paper, we describe sociotechnical dimensions of values in a design context that incorporate definitions from all of these fields. Defining dimensions for values research will clarify what researchers look for and how they describe that work when studying values in a design context. We also offer these dimensions as a framework for comparing values research across disciplines. This paper proposes a framework of six dimensions of values in the design of sociotechnical systems: *state*, *unit*, *assemblage*, *saliency*, *intention*, and *enactment*. The goal here is not to provide an exhaustive framework, but to clarify a set of dimensions for describing and researching values and design more consistently across disciplines. This framework will allow for specificity when describing where values intersect with technology design and use. It can also support meta-analyses of findings across studies using a shared vocabulary, and enrich our methods for inquiry into values in sociotechnical systems.

II. Values and Design Research

Our selection of dimensions to describe values research in a design context is shaped by a rich literature and tradition of exploring values and design. Research that emphasizes values as components of design is often grouped under two major scholarly umbrellas: *Values in Design (VID)* (Nissenbaum & Gaboury 2012; <http://www.nyu.edu/projects/nissenbaum/vid/>) and *Value Sensitive Design (VSD)* (Friedman 2011; <http://www.vsdesign.org/>). These traditions, developed in the information studies, media studies, and human-computer interaction literatures, explore the ways in which moral or social values become part of technological artifacts through design and use (Friedman & Nissenbaum 1997).

Value Sensitive Design is primarily concerned with moral values, or what Friedman describes as “values that deal with human welfare and justice” (Friedman 1997, 3). Friedman, Kahn, and Borning define these as “pertain[ing] to fairness, justice, human welfare and virtue” (2006, 13), encompassing a variety of ethical perspectives including deontology, utilitarianism, and virtue ethics. VSD is characterized by a proactive perspective, seeking to influence technology during the design process (Friedman et al. 2006). It has developed both methods and theory that incorporate particular values into technologies through conceptual, empirical, and technical investigations. VSD methods have been applied to a number of projects that relate to a broad range of values for technology including accountability, autonomy, community, democracy, dignity, fairness, informed consent, and justice. Recent work has called for expanding this range of moral or universal values to enable application of VSD methods to other, more context-relative sets of values (Borning & Muller 2012).

Values in Design differs from VSD in that it does not prescribe a set of methods or approaches for studying values; rather it describes a research space focused on finding and naming values challenged by emerging technologies and infrastructures (Knobel & Bowker 2011). VID focuses on a broad range of values such as privacy, trust, security, safety, community, freedom from bias, autonomy, freedom of expression, identity, dignity, calmness, compassion, and respect, and is less prescriptive in its framing.

For simplicity, we refer to both of these frameworks as *values and design* to highlight the relationship between the two and to include the broad range of research and values classifications that has emerged in and among them. Values and design incorporates research from computer ethics (Brey 2000; Johnson 2000), social informatics (Hara & Rosenbaum 2008; Kling & Iacono 1988), participatory design (Schuler & Namioka 1993), Worth Centered Design (Cockton 2004), and other research traditions. In general, this research posits that the process of designing something is about interpreting meaning (Latour 2008). As an individual or group designs an artifact, they partially construct its uses and thereby its

meanings. Through this process, designers broach questions of ethics and values: as Latour puts it, “good versus bad design” (2008, 5).

In addition to considering the ethics of design decisions, research which explores the import of values within design recognizes that the values embedded in technological systems are shaped endogenously by their designers and exogenously by their users and use contexts (Friedman 1997). This recognition of interpretive flexibility during technology design and use references the important concept of technological affordances (Dourish 2001; Kaptelinin & Nardi 2012; Suchman 2007). Affordances are features built into an artifact that make it better suited for some tasks than for others, while leaving room for users to interact with the tool in a variety of ways. The concept of affordances began as an ecological approach to understanding human and animal perception and action with the surrounding environment (Gibson 1986). Gibson’s Theory of Affordances contrasts affordances with values, describing affordances as “in a sense objective, real, and physical, unlike values and meanings which are often supposed to be subjective, phenomenal, and mental” (Gibson 1986, 129). Norman (1988) and Gaver (1991) expanded affordances to incorporate technology, situating the concept of affordances as bridging the built environment with people who use designed objects.

Akrich (1992) and Latour (1992) expand on the concept of affordances by incorporating the metaphor of *scripts*, or the “program of action” that directs the interaction of technological and human actors (Latour 1992, 154). Understanding affordances as scripts suggests considering the ways in which a technology’s prescriptive features impact users. Scripts take into account the values that are inscribed into systems, either deliberately or incidentally, by designers. As an extension of this concept Verbeek (2006) suggests the term “technological mediation”, or the role that technology plays in modifying human action and experience. A mediated action perspective has become increasingly popular in understanding technological affordances (Kaptelinin & Nardi 2012). While affordances enable and mediate the interaction

between people and objects, technological mediation facilitates actors' interactions with reality, mediating both our perceptions (Ihde 1990) and our actions (Latour 1992, 1994). This mediation shapes how humans can be present in their world and how their world is present for them (Verbeek 2006, 364).

A mediated action perspective also raises the question of values as a component of design. When mediating our perceptions, affordances “amplify specific aspects of reality while reducing other aspects” (Ihde 1990, cited by Verbeek 2006). This amplification suggests normative and ethical questions – questions of who decides what to amplify, and how that amplification plays out among designers, users, and the technology itself. Our approach to understanding where values are negotiated by people and technology is inspired by this work on the mediating impact of technologies. Like affordances, values in a design context can be understood as having importance and agency, but are ultimately not fully determinate of action.

III. Attributes of Sources and Attributes of Values

Through design decisions, affordances, and social norms in both system design and use, values infuse every part of a sociotechnical system. Indeed, the line between people and technology in this research area is blurred, both in scale (from single human-computer interaction to sociotechnical interaction) and convergence (from traditional human-computer interaction to hybrid assemblages and even cyborg-cyborg interaction; Fleischmann 2009). Thus, when examining how affordances and values intersect in design, it is important to consider how values might relate not only to individuals but also to groups and hybrid interaction networks. It is important to consider the scale on which we might study values; the relative importance of particular values in any given design or use scenario; and the degree to which values are concretized as affordances within a system.

The first conceptual challenge that we found as we reviewed the values and design literatures was determining *where* values are negotiated in relationship to design. Values and design studies have typically focused on values from two sources: values held by people (often a focus of designer studies, user studies, and social psychology and communications research) and values embedded in technological, social, or sociotechnical systems (the focus of work in computer ethics and values-in-context). However, we suggest that the relationship between values, people, and systems is more complex than dividing values into attributes that can belong either to people or systems. Work in technology studies and social informatics suggests that people and systems form complex, hybrid assemblages, and in some cases, whether values belong to people or systems may be impossible to separate. Technology would arguably be stripped of values in a social vacuum, and people increasingly cannot function without technology figuratively (e.g., without smart phones) or literally (e.g., without pacemakers).

In addition, descriptions of the source of values negotiations should be extricated from dimensions that describe values themselves. Values, as Rokeach (1973) describes, are relative in their import and relationship to each other. As Friedman and Nissenbaum (1997) describe, values can be intended by designers or accidental in their manifestation. And as Johnson (2000) describes, values can be enacted or materialized in designs to various degrees. These are all descriptive dimensions that focus on the values themselves and are operationalized through their expression by people or their implementation in systems.

To describe sources of values separate from the description of the values themselves, we suggest that values and design researchers locate their investigations along six dimensions, which we divide into two broad categories: dimensions that describe the source of values and the sociotechnical setting in which values are found; and dimensions that describe characteristics of the values themselves. In the following sections, we describe these categories and their dimensions, and illustrate their use with case studies from the values and design literatures.

IV. Dimensions Describing the Source of Values

To describe the source of values in a design context, we suggest three dimensions: *state*, which considers the construction of the source on a continuum from natural to designed systems, *unit*, which considers scale, ranging from individuals to collective groups; and finally *assemblage*, which describes the convergence of the group holding the values, from homogenous to hybrid groups of actors. We define and describe each of these dimensions below.

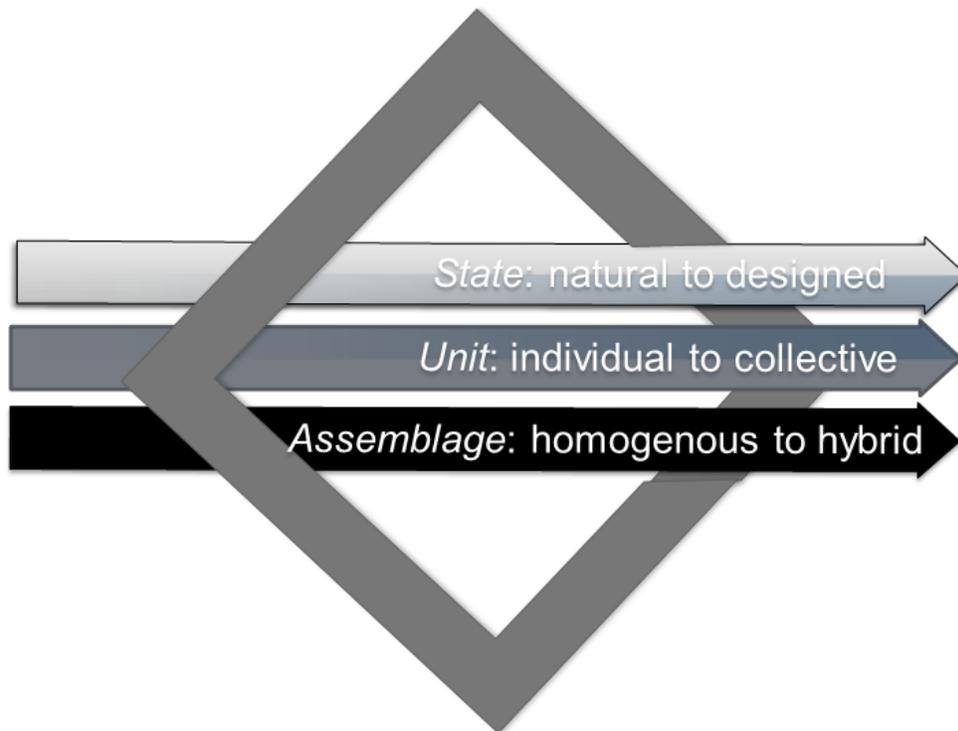


Figure 1: Dimensions that describe the source of values

State: Natural to Designed Actors

The first dimension is *state*, moving from values of natural to designed objects and systems. Points along this continuum might describe an entirely natural environment, a building, a wired building, a cyborg, or an autonomous machine. While people can be designed biologically or culturally through genetic or social

engineering, generally people fall toward the natural side of this spectrum (but not as far as rocks or plants, for example), while technologies typically fall toward the designed side of this spectrum.

The literature on values in social psychology (e.g., Rokeach 1979; Schwartz 2007) focuses on the values of one set of relatively natural actors: people. Values are treated as fairly stable properties of people, developed at an early age and enduring throughout life. Typically, we learn about people's values by asking or observing them. Surveys are a common method for eliciting values from individuals, asking them to rate the relative importance of a list of values as guiding principles for their actions. One of the most commonly known lists of values is the Schwartz (1992, 1994) Value Inventory, which has been operationalized in instruments such as the Schwartz (1994) Value Survey and the Portrait Values Questionnaire (PVQ; 2007), used in the European Social Survey (<http://www.europeansocialsurvey.org/>).

Values and design research, on the other hand, investigates designed objects or environments. Some research focuses on the socially designed settings of the design workshop or laboratory (Manders-Huits & Zimmer 2009; Shilton 2012); other investigations focus on technologies themselves as a source of values (Friedman & Nissenbaum 1997; McGregor & Wetmore 2009; Wetmore 2007); still other studies focus on values in technologically-mediated environments, designed through deployment and adoption of technologies (Cheng, Fleischmann, Wang, Ishita, & Oard 2012; Johnson 2000; Koepfler & Fleischmann 2011, 2012). This research is largely conducted using a variety of observation methods (Manders-Huits & Zimmer 2009; Shilton 2012) or technical analysis of artifacts (Friedman & Nissenbaum 1997).

Unit: Individual to Collective Actors

The next dimension is *unit*, which considers scale on a spectrum from individuals to collectives. Values are frequently discussed as both core components of individual people or technologies (Bardi & Schwartz 2003; Friedman & Nissenbaum 1997), as well as shared attributes of societies or systems (Nissenbaum

2009). Therefore it is useful for researchers to identify where, along a continuum, a set of values falls from being individually held to being shared by a collective. Points along this continuum might include values of individuals, families, working groups, institutions, sub-cultures, and societies, among others.

Values of individuals in design contexts may be values of the designer, the user, key stakeholders participating in the design process, or of a specific technological artifact. Designers, users, or stakeholders may value power, achievement, or universalism, and discuss these values during design or use of a technology. As with natural settings, values surveys are frequently used to observe individual values and correlate them with behaviors (Rokeach 1973).

Collective values form the other end of the continuum, and are the goals embedded in a given sociotechnical context (Nissenbaum 2009). A sociotechnical context is defined by its actors and their roles, the activities that happen there, behavioral norms appropriate to that context, the physical constraints and affordances of the overall ecology, and the values that tend to be highlighted or downplayed. For example, a school system prioritizes learning and development in children, and a healthcare system prioritizes health of its patients. Collective values may be found through conceptual analysis of laws, political economics, or other social systems which ascribe shared values. Understanding where values fall on a continuum from individual to collective can impact values-sensitive design processes. It is concern for conflicts and consensus between individual and collective values which is behind such key value sensitive design work as mapping values dams and flows (Miller, Friedman, & Jancke 2007). *Unit* applies to technologies as well. A single technology may have individual values, but collective values are found in systems or infrastructures. Collective values of people or technologies can be elicited through a variety of anthropological and sociological methods. Ethnography is a traditional method of understanding the norms and goals of particular social settings, such as design or engineering labs (Lofland, Snow, Anderson, & Lofland 2006). Collective values of an infrastructure might be found through technical investigations as

suggested by Friedman et al. (2006) and Nissenbaum (2009), or ethnographies of infrastructure as conducted by Bowker and Star (2000) and Edwards et. al (2011).

Assemblage: Homogeneous to Heterogeneous Actors

The last source dimension is *assemblage* (Latour 2007), which describes convergence between types of actors, moving from values of homogenous to heterogeneous actors. Collectives as described in this dimension are not always homogenous; indeed, values of designers, users, and technologies are often interlinked in complex and dynamic ways. Therefore it is useful for values researchers to identify whether their research examines a homogenous set of actors (whether people, technologies, or cyborgs) (Fleischmann 2009; Haraway 2000), or a heterogeneous *assemblage* of actors that combine distinctly different people, technologies, and cyborgs. Points along this continuum might include homogeneity of various sorts (whether a lack of demographic diversity or actors all of one kind – an all-cyborg group, for example), diverse humans of various types, groups of human actors interacting with one technology or social system, groups of human actors interacting with multiple sociotechnical systems, and finally humans and cyborgs interacting with multiple systems.

Homogenous actors can be either natural or designed, but not both; homogenous collectives are made up of similar actors. A group of chimpanzees or a server farm are both homogenous collectives. Heterogeneous actors are actors that are both natural and designed; namely, cyborgs, or cybernetic organisms (Haraway 2000). Cyborgs contain both human (natural) and technological (designed) components. While for most people the notion of a cyborg is closely linked to figures from science fiction, in contemporary society there are more subtle examples, including implanted technologies such as pacemakers, as well as increasingly ubiquitous mobile technologies, which play an increasingly important role in individuals' identity and productivity. Heterogeneous collectives include a diverse range of natural

and designed actors; thus, Kling's (2000) sociotechnical interaction networks are heterogeneous collectives including both human and technological actors. Heterogeneous collectives have been studied in VSD work that investigates values in mediated interaction, which includes both human and machine actors (Alsheikh, Rode, & Lindley 2011; Brunton & Nissenbaum 2011; Rahmati 2000).

V. Dimensions Describing Values Attributes

To describe attributes of values in a design context, we suggest three additional dimensions: *salience*, which considers the import of values in a given setting, on a spectrum from peripheral to central; *intention*, which accounts for how planned a value is, on a spectrum from accidental to purposive; and finally *enactment*, which describes the degree of operationalization of a value, on a spectrum from potential to performed.

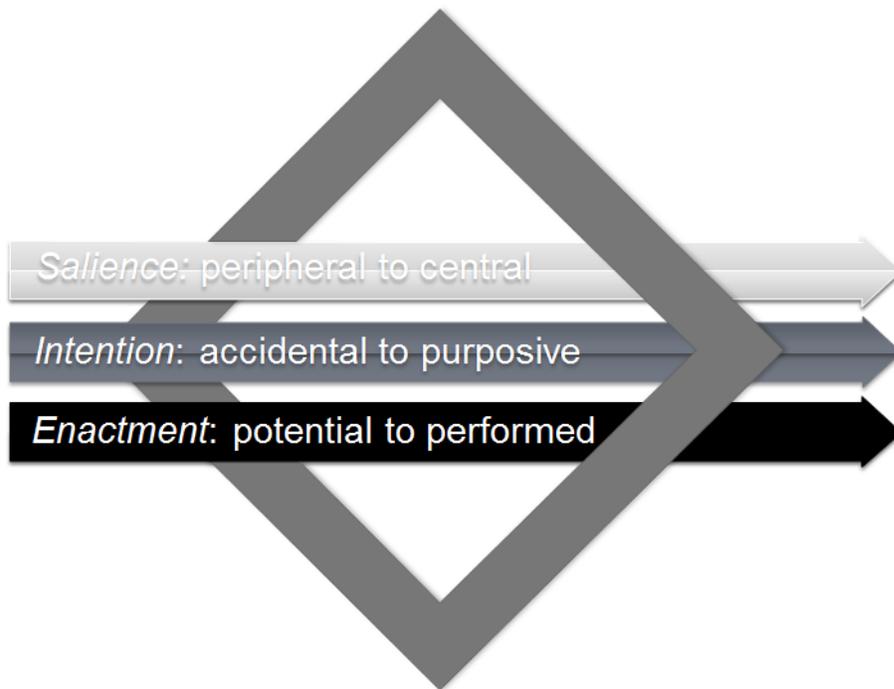


Figure 2: Dimensions that describe attributes of values

Salience: Peripheral to Central Values

The first dimension is *salience*, moving from peripheral to central values. A primary challenge for values research is identifying which values are of particular importance in a technology design or use context. The qualifier “salient” implies that individual or collective values will be more important in one situation or context, while other values have more importance in another situation (Siegrist, Cvetkovich, & Roth 2000). Salient values are dependent upon the sources of those values. Values of individuals, groups, and assemblages may be classified as core (central) or peripheral (Fleischmann 2007). Salient values may surface among individuals or groups, or from a hybrid social setting.

Most examples from values and design research illustrate shifting points along the *salience* continuum. Privacy may be more central for an individual in a workplace setting than at home with a spouse or close friends. In the latter case, disclosure may be a central value, as the sharing of information leads to stronger social relationships. This suggests that in a design research context, some values will be more central to design than others, and *salience* in use will depend upon a user’s understanding of the system and its affordances as well as the user’s information use environment (Taylor 1991). The relative *salience* of values arises in user-centered design processes when eliciting values dams and flows, for example. Values dams are cases where a value is so central to a subgroup of actors that it can block development of certain features and functions of a technology entirely (Miller et al. 2007). In contrast, values flows are cases where the majority of a design team share a value, and that shared value becomes central. The *salience* of particular values may also be identified in advance through empirical studies and conceptual investigations of stakeholders related to an existing set of technologies. For example, contextual inquiries (Beyer & Holtzblatt 1997) conducted in a workplace could surface central values prior to the development of a new intranet for managers, sales persons, and technicians.

Intention: Accidental to Purposive Values

The second dimension of values is *intention*, moving from accidental to purposive values. This dimension describes the degree to which a designer or system intends to materialize a value. Loo (2012) has suggested that design is a practice of performing ethics. Through the process of design, values are surfaced, exposed, and negotiated. This negotiation in turn affects the shape and characteristics of the resulting technology, and eventually the social impact of design products (Le Dantec, Poole, & Wyche 2009).

Accidental values emerge as unintended features or biases embedded in a technological system. Accidental values contribute to technical bias as described in work by Friedman and Nissenbaum (1997), and may be the result of other priorities, lack of attention to consequences of a design, or unconscious social biases materialized in a designed product. For example, if facial recognition designed with the intention of enhancing sociability among individuals is repurposed by police to find looters, control might be said to be an accidental value of that technology. The interpretive flexibility of technological objects is due in part to the accidental values of technologies. Accidental values of technologies can be elicited through *post hoc* technical investigations suggested in the work of computer ethics (Johnson 2000), social informatics (Kling 1996), ethnography of infrastructure (Star 1999), and value-sensitive design (Friedman et al. 2006).

Purposive values are those that are deliberately built into a technology by its designers, and are made material through the technology's affordances and policies. Designers may decide to incorporate values like privacy, consent, or openness into a system's features or terms of service (Shilton 2012). Most values and design approaches encourage designers to consider values as first order, purposive criteria, on par with usability and accessibility (Friedman 1997; Manders-Huits & Zimmer 2009). Purposive values of designers may be elicited through observation of the design process (Manders-Huits & Zimmer 2009;

Shilton 2012), or through conceptual analysis of design briefs, publications, or other documents of designers' intentions and decision-making process. Purposive values can also be attributes of users. Examples of this include users hacking or adapting technologies to suit their own values, such as in Brunton and Nissenbaum's (2011) study of user-adopted data obfuscation methods to counter surveillance. Users' purposive values may be observed through interviews, participant-observation, case study, critical incident technique, or a variety of historical methods. The Values at Play research project provides an example of the purposive construction of values into game-based systems in the Layoff Game, into which the design team purposively designed values of equality, fairness, and empathy (Flanagan, Howe, & Nissenbaum 2005; Nissenbaum 2011). Additional examples of purposive values include efforts to design privacy into technologies through features like filtering algorithms, anonymization techniques, and access control (Spiekermann & Cranor 2009).

The *intention* continuum from accidental to purposive values has been referred to as "embedded" values in previous literature (Fleischmann 2008; Johnson 2000); but the term embedded conflates designer *intention* (whether the designer meant a value to be applied) and *enactment* (whether a value materializes in the world). We suggest that *intention* and *enactment* are in fact separate dimensions to be considered in design research. Designer and user value intentions are not absolute; enactment of those intentions can be limited by the material constraints of a technology or the social context into which a technology is deployed (Joerges 1999; Pfaffenberger 1992). We therefore discuss a dimension based upon *enactment* in the next section.

Enactment: Potential to Performed Values

The third dimension is *enactment*, moving from potential to performed values. *Enactment* describes the degree to which a sociotechnical system brings a value into being. This dimension accounts for sociotechnical systems' values-laden impact on the world, while avoiding the strong claim that designers

directly transfer their values into artifacts of control (Joerges 1999). Design choices are not always intended to highlight social values; instead choices about features may be partially dictated by convenience, availability, or materiality. But the impact of these choices will bring some set of values into the world.

Potential values are held by humans, groups, technologies, or systems, but are not enacted. “Potential” is used here in the same sense as potential energy: potential values are present but inert. They may be purposive values of designers that are frustrated by the technical constraints of implementation; they may remain latent in systems due to misalignment between a designers’ vision and users’ interests or capacities; or they may never be performed because they fit ineffectively into the cultural milieu into which they are introduced (Pfaffenberger 1992). For example, designers may labor to produce granular filters for controlling information sharing and privacy, but those features remain unused by people uninterested or unable to use them. Or those responsible for introducing as well as legitimating a new technology may fail to properly align their users’ cultural and symbolic needs or the political landscape with their product (Pfaffenberger 1992). *Intended* but frustrated values of designers might be elicited from designers through values portraits, interviews, or ethnographic observation (Shilton 2012). Or, potential values that are embedded in a system but remain unperformed might be elicited through technical investigations suggested by the VSD literature (Friedman et al. 2006). One example is the Therac-25 system, which was used in laser surgery to remove brain tumors (Levenson & Turner 1993). Therac-25 malfunctioned due to a race condition that led to unpredictable behavior of the system at run time. In a race condition, two processes occur simultaneously, and which process completes first may vary, with significant consequences – in this case, the malfunctioning Therac-25 caused deaths and injuries. Thus, the race condition was a potential lack of reliability that became a performed value after it was triggered.

Performed values are those that a system materializes in the world. “Performed” is used here in the sense it is increasingly used in science and technology studies, to describe a factor that makes a difference

or brings about the world it envisions (MacKenzie 2008; Pollock & Williams 2010). Like purposive values, performed values build on concepts of embedded values in previous work by Winner (1986) and Johnson (1997). But emphasizing performed over embedded distinguishes the action embedded values take in the world. For example, the peer-to-peer communication built into internet architecture has performed the value of equity, increasing the amount of many-to-many communication in the world. But the addressing and tracing functions of internet architecture have simultaneously performed the value of social control, increasing the amount of government and corporate surveillance in the world (Johnson 2000). Performed values may be elicited through observation of a technology's impact on a setting, such as Johnson's (2000) analysis of the impact of internet architecture, or Friedman and Nissenbaum's (1997) evaluation of technical biases which undermined fairness for married couples using the National Resident Match Program.

VI. Values in Sociotechnical Networks: Case Studies

Next we offer three case studies from our own work to illustrate the application of dimensions to describe the source of values (*state, unit, and assemblage*), and dimensions to describe attributes of the values themselves (*salience, intention, and enactment*) in values and design research. It is important to note that not all of the dimensions are addressed in each project; these dimensions are meant to be applied as they are useful, rather than exhaustively. Once we have illustrated how the dimensions can be applied, we will discuss how researchers might use the framework during the research design phase or analysis phase of a values research investigation to classify their project along each of the dimensions. The *post hoc* application of the framework is useful for identifying existing gaps in the values and design literature; the *a priori* application is useful for building a common language across research studies.

Case Study 1: Values and Mobile Data Collection

Shilton spent three years as an ethnographer at the Center for Embedded Networked Sensing (CENS), a science and technology research center based at the University of California, Los Angeles (UCLA). She drew upon interviews, document analysis, and participant observation to understand how actors in the lab negotiated values within their design work. CENS designers were engaged in projects to collect new kinds of data about people, using an increasingly pervasive technology: the mobile phone. To undertake this new kind of data collection, designers collected very granular and sometimes sensitive personal data, including location, health information, habits, behaviors, and routines. Shilton investigated how a fairly homogenous group of designers (*assemblage* dimension) working on a designed system (*state* dimension) identified collective values (*unit* dimension). Through laboratory dialogue, privacy, consent, equity, and forgetting were agreed upon as central values (*salience* dimension) and therefore became design criteria and were transformed into purposive values (*intention* dimension) by building concrete technological features that responded to these values.

For example, some CENS designers held privacy and consent as individual values; others became concerned because their colleagues and mentors were concerned, signaling collective values (Shilton 2012). Privacy became a purposive value when the team made values-based modifications to the technologies under production, such as anonymization measures built into battery use monitoring software and data sharing filters developed for a protective data vault. Now that CENS technologies have been deployed in user-facing contexts, further evaluation could elucidate potential and performed values embedded in the systems, as well as the *salience* of values to the new *assemblage* created by users, the CENS software, and mobile phones.

Case Study 2: Values and Computational Models

Fleischmann and Wallace (2006, 2009, 2010; Fleischmann, Wallace, & Grimes 2010, 2011a, 2011b) conducted a multi-site mixed-method study of the role of values in computational modeling. The field sites for this study included a corporate lab, an academic lab, and a government lab, each of which had a large computational modeling group. Methods employed included surveys, interviews, and focus groups. The project investigated individual values of modelers and systems as well as collective values of organizations and sociotechnical infrastructures (*unit* dimension). The organizations being studied included both modelers (natural) and models (designed) (*state* dimension), and thus were quite hybrid (*assemblage* dimension). The study examined both central and peripheral values – indeed, in some cases, a central value for one actor was a peripheral value for another (*salience* dimension). Values under examination included both purposive and accidental values (*intention* dimension) and both potential and performed values (*enactment* dimension).

The combination of methods allowed for triangulation that was especially useful for getting at differences of *unit*, allowing for comparison of values held by individuals or by groups. Indeed, each lab had different central, collective values (Fleischmann, Wallace, & Grimes 2011a). Value conflicts emerged as an important illustration of the intersection of individual and collective units, where one individual or subgroup's values conflicted with those of another (Fleischmann & Wallace 2010; Fleischmann, Wallace, & Grimes 2011b). The survey method provided a means for quantifying *salience*, following Schwartz's survey approach (1994). Specifically, *salience* was measured in relation to issues such as the importance of following a code of ethics, which was correlated with values such as social justice and equality (Fleischmann, Wallace, & Grimes 2010). Finally, the mixed-method analysis revealed different degrees of the *enactment* dimension, from potential values as indicated through participants' responses to the Schwartz Value Survey, to performed values such as transparency, which were performed by the models

(Fleischmann & Wallace 2009). The multi-method approach employed in this study was useful for observing each of the dimensions in the framework proposed by this paper.

Case Study 3: Values and Online Communication

Koepfler and Fleischmann conducted an empirical investigation of the role that values played in the online communication of individuals on Twitter (2012). They compiled and analyzed a corpus of tweets (the 140-character form of communication afforded by Twitter) from a group of individuals who had experienced or who were currently experiencing homelessness. They used content analysis to compare this corpus to a corpus of tweets from individuals who did not identify with homelessness in their Twitter profiles. The study focused on the computer-mediated communication of two groups of hybrid actors engaging with the Twitter platform (*assemblage* dimension). They used content analysis to identify the performed (*enactment* dimension), peripheral values (*salience* dimension) of individuals, and then combined these to consider the values of collective stakeholder groups (*unit* dimension).

Twitter users performed a wide range of values in their tweets, but without further study, it is unclear whether these were accidental or purposive values. More direct research methods such as observation, interviews, or surveys might facilitate this determination. We considered these values to be at the peripheral end of the *salience* dimension because it was impossible to know if the Twitter users perceived the values they were expressing as central. As we aggregated results to the level of the collective, however, values central to that hybrid, technically-mediated context emerged. Adding an interview or survey component to this study may have helped to further elucidate the *salience* dimension, highlighting the benefits of mixed-methods approaches for addressing the broadest range of values dimensions.

VII. Future Work

Each of the dimensions we have described is sociotechnical: it is dependent on a blend of technologies (features, affordances, and impact through use), actors (designers, users, and systems), and the particular social settings in which technology is designed and deployed. Depending on the research questions of interest, different methods will be appropriate to examine each of these source and values dimensions. In future work, we will examine methods tailored to investigate each of these dimensions present within values and design projects.

Even with these dimensions identified, a major challenge remains. The dimensions help to elucidate values as a general construct of inquiry, but do not help identify values in the specific (i.e. differentiating privacy versus security, autonomy versus control, achievement versus competition, etc.). This is a challenging aspect of values research, which may investigate intrinsic values such as justice and virtue (Ess 2009), or instrumental values such as privacy, openness, or trust. Indeed, we use examples of both of these categories throughout this paper. The values research literature continues to debate whether there is an overarching list of proscribed values for which researchers should examine contexts (those relating to, for example, social justice), or whether instead researchers should examine emergent values in their research setting (Le Dantec, Poole, & Wyche 2009). We remain agnostic on this debate, believing that both proscribed and emergent approaches have a place in values and design research. Values can be found either deductively from a hierarchy or inventory (Schwartz 1992), or inductively through observation and grounded theory (Spates 1983), and in fact we recommend combining the two approaches to maximize the benefits of each (Koepfler & Fleischmann 2011). A proscribed list provides useful heuristics; whereas emergent processes allow for new values to emerge which could lead to unique innovations in design.

Regardless of approach, however, researchers should be explicit about their methods for finding and naming values as well as their attributes, and be aware of the limitations of their approach. Deductive approaches include those that use values inventories or seek to study how a particular set of values deemed important play out in a design context. Such deductive approaches may be well-suited for discriminating between central and peripheral values, for example, but risk missing other individual or collective values of research participants. Inductive approaches, also known as descriptive ethics (Ess 2009), include ethnographic observation of settings or conceptual analysis of texts or systems. Inductive approaches to eliciting values may be well suited for studying intended, performed, central, and collective values, but risk missing accidental, potential, individual, and peripheral values which are not openly expressed in a design setting or only appear in a use context.

VIII. Conclusion: Enabling Future Values Research in Design Contexts

By defining dimensions of values in sociotechnical systems, we are able to further values and design research by illustrating continua of values to investigate, describe, and analyze. Our framework suggests that to study values and design, researchers should first disaggregate dimensions which describe the source of values, and those that describe attributes of the values themselves. Researchers can then investigate values at a variety of scales and among *assemblages* of designers, users, stakeholders, or systems. They can investigate the *saliency* of values to a stakeholder group or a system; the degree of *intention* behind values in a design setting or system; and the *enactment* of values by designers, users, or technologies. Our framework of dimensions for values and design research highlights the fact that values are not fixed in people, or systems, or use contexts. Instead, they are a complicated negotiation between designers, artifacts and infrastructures, social contexts and use practices. Values researchers must

therefore distribute their focus across contexts of design, adoption, and use. Utilizing values dimensions can help values and design researchers clarify their observations and findings.

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