Searching for Intrinsic Value in Interaction: Reflections on the Conceptual Designs of Digital Music Players

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Abstract. The value of most consumer electronics made today makes these products worth only slightly more than the parts needed to build them. In our research we have explore the aesthetics of interaction, searching for how interaction can add intrinsic value to products. Through an analysis of 20+ music players designed to emotionally link a variety of different users with their music across different contexts, we have identified three emerging thematic opportunities. These include interaction designs that (i) integrate the interaction into objects within the context, (ii) bridge the user activity and social role, and (iii) socially connect the user to other people. This paper details these themes and offers conceptual designs that illustrate how they work in products.

1 Introduction

Today most interactive, electronic products hold a value that is slightly higher than the cost of the materials needed to manufacture them. From TV settop boxes to mobile phones to computers, companies that make electronic products must produce them at very high volumes and sell them with very low margins in order to survive the competition. Companies can increase a product's value by investing in the technology to increase the product features, to increase performance, or to increase both. They can also increase a product's value by investing in design either through the product form or through the company's brand.

Investment in technology is the most common choice electronics companies make. This most likely is driven by the engineering mindset that pervades many technology companies, where every problem seems to need a technological solution. However, as seen in the market place, value added through technology does not last very long because competitors quickly follow innovators, matching performance and features. Also, the rapid pace to technological advancement allows companies to continually leapfrog each other through both new features and improved performance.

Technology Investment Examples

- **Increasing Product Features:**. Over their short history, manufacturers of DVD players have tried to keep prices from falling at meteoric speeds by adding features such as the ability to play MP3 files from a CD, output of

progressive scan, decoding and output of multiple audio formats, etc. Often most consumers will never need these features; however, their addition to the product helps convince consumers they are getting *more* for their money.

- **Increasing Performance:** Both televisions and personal computers provide excellent examples, demonstrating how manufacturers have tried to prevent accelerating price erosion by making PCs faster and by increasing the image quality of TVs. While PCs have endured a fairly steady decline in price coinciding with Moore's law of increasing in power, TVs have managed to substantially increase their price through the dramatic increase in quality brought by the new digital standards. The cost of these screens, however, has rapidly fallen. The value in performance also comes from making electronics smaller (mobile phones) and making them larger (flat screen displays).

While the technology investment can provide immediate and short-term increases, investment in design, through form and brand, can produce more sustaining value. The *intrinsic* value from these design investments—when appropriately applied to a product—can significantly increase the value, making a product worth many times more than the cost of the materials needed to manufacture it. This value has been well researched in the literature on consumer behavior including [5, 2]

Design Investment

- **Improving Product Form:** The original colored/transparent iMacs from Apple, the BeoCom 2 telephone from Bang and Olufsen, and Shure E4c earbud-style headphones all provide examples of companies increasing the value of everyday electronics through an investment in the product form. This investment adds value not in the utility function of the device, but in the lifestyle its ownership promises.
- **Enhancing Brand:** Sony's introduction of the "My First Sony" line of toy music players for children offers an example of an electronics company investing in brand enhancement. Through this investment, Sony hopes to create a "cradle to grave" relationship with consumers and generate brand loyalty that increases the value of the Sony products by diminishing the consideration of price in a product selection.

New features affect performance and often have an impact on the form and brand. Manipulations of the product size as a matter of performance clearly relate to the product form. Features, performance, and form contribute to a consumer's interpretation of the brand. In order for companies to effectively maximize the value of their products, they need to keep the relationships between all of these forces in mind.

In our research, we have been exploring what we see as a gap in product value. We have been investigating how interaction design, which sits between technology and design, can add additional intrinsic value (see Fig. 1). In this diagram the interaction straddles the boundary between technology and design as the interaction capabilities of a product—such as its ability to understand natural language or interpret physical action—are so closely tied to the technology. The form has been place more squarely in the design space, because today, the transition of interactive products from me-

chanical to digital-electronic, have considerably freed the form from technological constraints.

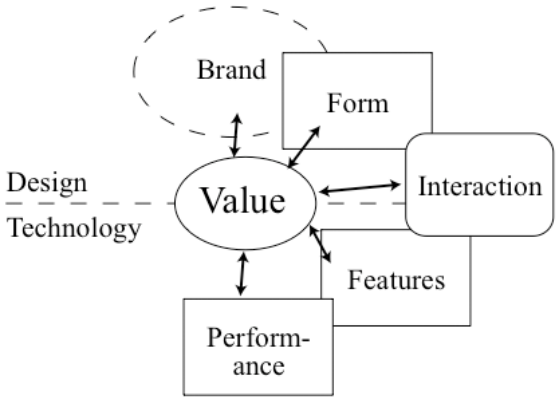

Fig. 1. Model for adding value to electronic products. The field of interaction design can bridge the technology and designed form of a product.

We have been working with students to explore the interaction design of digital music players, looking at how interaction with the player can generate connections between user + other people, user + activity, and user + context. We have identified three emerging opportunities where interaction may be able to add intrinsic value by

- Using objects and actions naturally found within a context to inform the interactions
- Integrating the user's identity and the activity
- Connecting and communicating with others

This paper provides a high-level overview of our process and details several conceptual music players that illustrate the emerging opportunities interaction design creates for infusing value into electronic products.

2 Related Work

In the design and HCI research community, research on emotional design and interaction design has naturally merged in the study of rich physical interactions for designed products [4]. In the design community, a body of work has described the lack of tangible and emotional interactions that characterize today's mobile devices as an "interaction design cul-de-sac" [7]. These products, which are weakly linked to our perceptual motor skills at best, forward human-technology interaction rather than human-product interaction. The interaction relabelling approach was an early method to study and be inspired by a set of products that rely on their ability to be touched to inform the interaction—products such as drums, coffee mugs, scissors, and office chairs.

Two important principles of these interactions are the exploitation of the richness of the user's perceptual motor skills and the relationship between the input by the user and the output by the system [4]. These concepts have been tested and elaborated

through the creation of an alarm clock that responds to the user's emotional state and a digital camera with capture and playback controls that mimic natural interaction [4]. They have been formalized in a series of frameworks that describe to practicing designers how to incorporate input and output signals from tangible interfaces into the design of new products [10].

Similar concepts have been explored by researchers in the HCI community [8]. Tangible user interface guidelines have been described through the following four characteristics: 1) physical representations that can be computationally coupled to underlying digital information; 2) physical representation embodying mechanisms for interactive control; 3) physical representations that are perceptually coupled to actively mediated digital representations; and 4) the physical state of interface artifacts that partially embody the digital state of the system. These principles have been exemplified in the design of physical desks that impart information through their physical interactions [8], and answering machines with physical tokens representing incoming messages, among others [3].

Our work advances this previous work by applying the theories around the richness of user's perceptual motor skills and further exploring the value of tangible interfaces. We have broadened the definition of tangible interaction to include all aspects of the human perception system, as well as mechanical products, in conceptual designs that are much closer to commercial products.

3 Process

Over the course of three years that include five interaction design classes, we have assigned 26 student teams to design music players by exploring the emotional connection users, their context of use, their activity, and music. While details of the assignment have evolved over time, the overall purpose of exploring the emotional connection has remained constant. Throughout the assignment we urged students to explore the emotional quality of interaction; to search for harmony between the device and activity, to move beyond standard interaction widgets such as buttons and touch screens, and to explore the context of use as it relates to the user and to music. Their process includes user research, synthesis of findings, concept generation and validation, construction of a rough physical prototype, construction of a video sketch documenting how their design meets the user's needs, and construction of a detailed web process book that documents their work.

Working in teams of three to four, the students are asked to select a target group and context of use. These have included:

- Wearable/mobile player for teen girls to use away from home
- Portable player for teen boys to use both at and away from home
- Portable or fixed player for office workers who work in cubicles
- Portable or fixed player for families to use in their kitchen that supports users as young as four
- Portable or fixed player for elders to use at home
- Fixed player for "young moderns" to use at home
- Wearable/mobile player for female athletes to use while exercising

Each team begins by breaking through any preconceived notions they may have about their target group. To do this, they conduct interviews and shadow real users as they listen to music and interact with their devices in the context of use. Students have spent weekends in the kitchens of families, taken field trips to offices that contain cubicles, followed girls at the mall, and visited elders in their homes.

The student teams also conduct bricks and mortar research, i.e., shopping for music players and talking to salespeople about how customers select a product. Finally, each team looks at media targeted to their users including magazines, web sites, TV shows, etc.

The teams apply design research techniques they have previously learned to help synthesize and distill their findings. Through post-it exercises, charts, team brainstorming sessions, scenarios, mood boards, class presentations, etc., the teams make connections between their findings and the design concepts they wish to explore. With several concepts documented as storyboards, the teams conduct concept validation sessions with their intended audience to explore the overlap between the needs the teams have observed and the needs the users perceive in themselves. They then used the results to inform their final concept and scenarios of use, paying particular attention to the interactions, contexts of use, and emotions of the users.

The final assignment has a physical component that takes into account the rudimentary physical prototyping skills of the students. We expect that the student prototypes will be rough, unpolished, and non-functioning. They serve instead to reinforce interactions and provide a means to explore interfaces beyond the standard widget set found on most devices today.

The teams also must produce a two-minute video sketch containing several vignettes that illustrate how the design meets the users needs within the context. They have to script, storyboard, shoot, and produce the sketch as if it were the means with which they would validate their concept to interested investors or product managers.

Finally, the process, model and video sketches are presented in a final presentation that showcases all of the designs.

4 Emerging Opportunities

In order to find patterns in the many different conceptual designs produced by the students, we broke the designs down by method of interaction, user, context, and activity. We then produced a series of quadrant plots to help us uncover the emerging opportunities where interaction added intrinsic value to the different conceptual designs. Three main themes emerged (Fig. 2):

1. Contextual Integration—interactions that relate to the objects and interactions in the environment.
2. Activity and Social Role—interactions that bridge the primary activity and the socially constructed emotions and roles around it.
3. Social Connection—interactions that exhibit personal values, and in order to communicate status to others.

Please note that these categories are not distinct, and many of the prototypes have elements of each. In addition, the student's designs do not firmly embody these emerging opportunities, but instead by looking at many examples, we could begin to see the possibility of a direction to mine for value showing through. The following section details how different concepts begin to reveal these emerging opportunities.

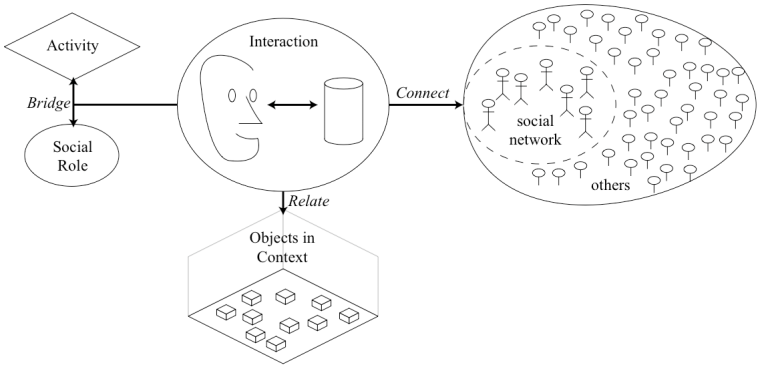

Fig. 2. Model of value from interaction design is this the right caption?

4.1 Contextual Integration

Interaction designs that embody contextual integration add value by connecting and extending familiar objects and actions in the context or environment of use with a new device or application. Benefits of this approach include (i) increased ease of use as the interactions are already familiar to the user within this context; (ii) extensibility to other devices and applications as the interaction derives from the context and has only a loose connection to the specific activity or application; and (iii) diminished need for introducing new products/devices into the context of use. Three design examples help illustrate how contextual integration adds value and offers some insights into the target demographics and contexts best suited to this approach.

Fig. 3. FamilyTime: designed for families to use in the kitchen.

Intended as a music player for families to use in their kitchens, the FamilyTime music player repurposes magnets commonly found on refrigerators as a method for music selection (see Fig. 3). Users interact with the system by placing a magnet—a pointer to a playlist—into a frame on the refrigerator. The simplicity of the interaction enables both adults and small children to express their intent to the system; it allows for easy cleaning in an environment where hands are often dirty; and it encourages sharing of the space by allowing users to mix multiple personal playlists. The design demonstrates contextual integration by building on the interactions within the context of use instead of mapping more directly to a specific activity like cooking or cleaning. The magnet design is quite easy for families to use as it builds on their experience of collecting and rearranging magnets on the surface of the refrigerator as they reorganize visual content such as calendars, photos, drawings, and notes. Because the design draws from the context and not the activity, the magnets can easily be extended to other content selection or information retrieval tasks. For example, a magnet might switch a TV to a favorite channel or it could be used as a method of selecting an electronic cookbook. Finally, the reuse of an already present object negates the introduction of a new device into an already crowded space.

Fig. 4. iCubed: designed for office workers to use in their cubicles.

The iCubed music player also illustrates the value of contextual integration (Fig. 4). In this case students needed to design a player for "cube workers", whose environment provides little desk or shelf space, where public playing of music may be frowned upon, and where normal work activities may cause tangled wires. The iCubed design addressed this issue by integrating the music player into the chair, the main physical location of the user. Speakers in the headrest use directed sound to allow workers to listening to music while staying auditorialy connected with the activities in their environment. Workers interact with the iCubed player by gesturing with a special pen on the desk surface. The use of a pen and gesture for interaction builds on both the common objects and common actions in the context; it extends the experience users have with pen and paper to a new activity. Like the kitchen magnets, the interaction is not specific to the activity, but instead matches the context. This makes it easy to extend the interaction to other tasks. The interaction can easily map to other information retrieval tasks and can also be extended to control other devices in the environment such as the lighting, window shades, telephones, etc. Like the magnets, the integration of the device in the chair and the interaction in the pen allow this music player to gracefully enter the cubicle without taking additional space or requiring the user to change their surroundings to accommodate a music player.

Fig. 5. Frame Player: designed for elders to use at home

The Frame Player offers a third example of the value of contextual integration (Fig. 5). Designed for elders who often have trouble with the physical dexterity required to handle CDs and their cases, and who often find screen-based menu systems confusing, the Frame Player allows users to make selections by sliding a paper card into a picture frame. The frame reads a barcode on the back of the card and plays the appro-

priate playlist. While less directly tied to specific actions in a space, the frame player builds more closely on the physical objects common to a location. Like FamilyTime and iCubed, the design allows for easy extensibility to other applications.

These three examples help illustrate how contextual integration can add value for many different target audiences (families, workers, and elders) within many different contexts (kitchen, cubicle, and living room). Like the design-focused work on tangible interaction, they take advantage of elements of context within the user's range of visual, auditory, and tactile perception to maximize the experience of product use. Two main forces help to shape the benefits of this design approach. First, they target audiences that require extreme ease of use, particularly for supporting very young children in the kitchen and elders who may be beginning to suffer from physical and cognitive decline. Second, they work well in contexts already crowded with devices, in this case the kitchen and the office cubicle.

4.2 Activity and Social Roles

Research into consumer behavior has explored how people express different social roles that are particularly important to them in the products they purchase [1]. They will construct an idealized vision of themselves in a specific social role and then purchase products that help them to approach this vision [6]. For example, the purchase of a commercial Viking range helps people construct an image of themselves as master chefs. The product itself becomes a promise of the person the user might become, and through use of the product, people can self-construct and refine their social identity within a specific social role.

In our analysis of the music player concepts, we stumbled upon this opportunity, a design theme that the student teams working on their individual projects never saw. Because listening to music is often a secondary activity, the interaction with the player offers an unusual opportunity to construct a bridge to the social roles present in the primary activity. The Sonaqua music player designed for use in the home kitchen and the MusicWear player designed for female runners help illustrate how both the exact physical location of the interaction and the relationship between the interaction and the primary activity add intrinsic value by supporting the construction of self identity.

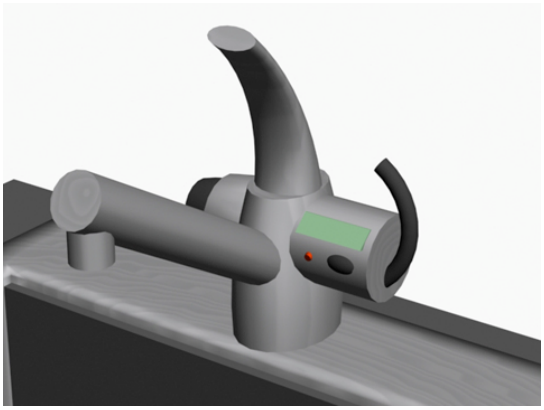

Fig. 6. Sonaqua: Music player for the kitchen

The Sonaqua music player resides within the faucet found on the kitchen sink, placing it at one of the main hubs of kitchen activity (see Fig. 6). Users interact with the player through a wand on the side of the faucet that draws both its form and interaction from the water control wand on the back of the faucet. Interaction with the player allows music to flow out just like water. Users push the wand back to turn the player on and increase the volume. Moving the wand to the left or right advances or skips tracks, and a small dial on the opposite side of the faucet allows users to cycle through playlists. The interaction design builds on social roles such as chef, maid, parent, etc. Both the location of the player within one of the primary devices for these social roles along with an interaction design that builds on the experience of activity related to the social role allow the interaction with the player to help people construct and refine their social identity within the activities conducted at the sink. While this example has strong aspects of contextual integration—through placement of the player within the faucet—the interaction relates specifically to the activities of cooking, cleaning, and caring for a family instead of leveraging off of the many non-cooking actions common found in this context.

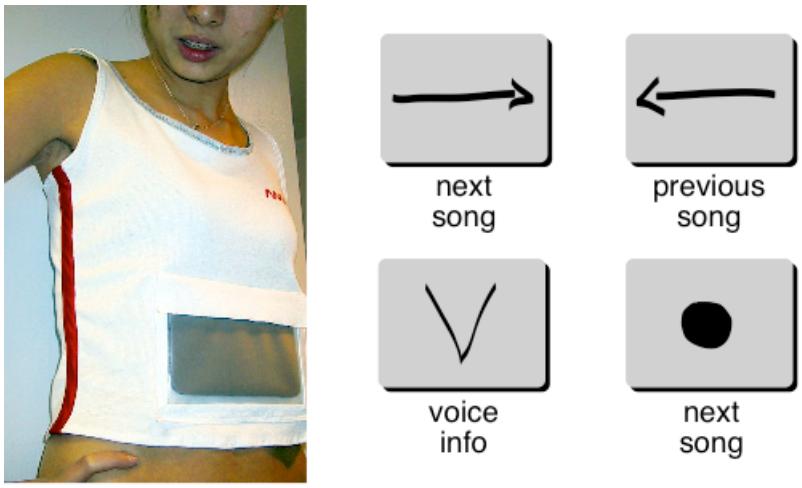

Fig. 7. MusicWear: designed for female athletes

Designed for female runners, users interact with the MusicWear player by stroking a soft pad worn on their lower, front torso (see Fig. 7). Like many of the contextual integration designs, the interaction provides improved ease of use for runners whose hands often lose fine motor control due to both the exercise and exposure to cold. However, the real benefit of the design comes from the connection to the social roles that surround the running activities. The location of the interaction on the lower torso and the action of stroking helps users focus inward on their bodies, reinforcing the relationship between running, the body, and the social roles. The inward focus helps users construct a vision of themselves as an athlete in training or competing, as a woman making her physical self more attractive, or as a sister, mother, daughter, friend, etc. working to stay healthy and strong.

As an approach of adding intrinsic value to products, the use of interaction to bridge activity and social role seems very strong; however, the range of opportunities to follow this path are less clear. This approach seems quite appropriate for activities with strong connections to the social roles people care about inhabiting. It worked well to connect interaction with a device as a secondary activity to the social role and actions of the primary activity, but not many products fall into this category. At this point we do not have the right kind of examples to tell us if this approach would benefit devices related directly to the primary activity. The examples the students produced are far from perfect, as the teams never made the connection between the activity and the social role. At this point we are interested in further exploring this emerging opportunity for increasing value by asking future student teams to specifically address this theme. We hope that these future examples will extend research in this area to include the socially constructed emotions that shape the context of use of a product.

4.3 Connection to People

Interaction design can also add intrinsic value to a product by exhibiting values that connect the user to other people. In our analysis of the concepts, we noticed that this worked in two ways. First, the interaction can help establish an explicit link with a person, reinforcing a strong social network connection. The SqeezeDrop and rCast music players designed for teenage girls help illustrate this explicit linking. Second, through *exhibition*, people can use the public interaction with a product to help communicate their status and values within a social hierarchy. The Maestro music player designed for young moderns to use in their homes helps demonstrate this interaction and exhibition benefit.

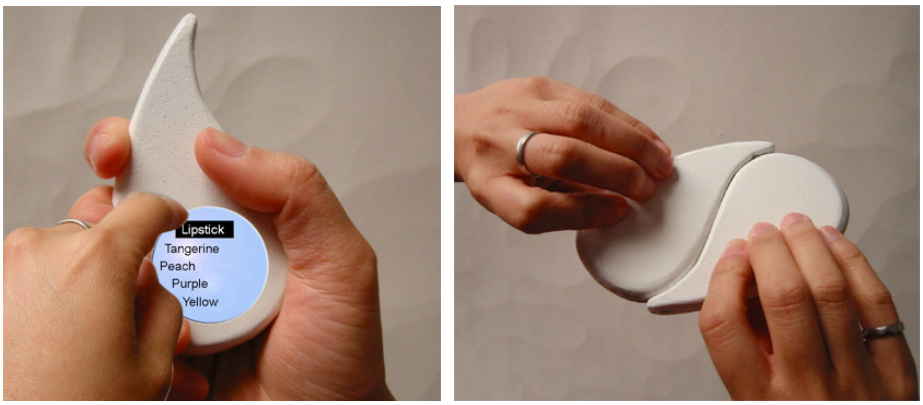

Fig. 8. SqueezeDrop: music player for teenage girls to use away from home

Fig. 9. rCast: music player for teenage girls to use away from home

In their user research for a music player for teenage girls, two different student teams picked up on the way girls used music as a type of currency to help form, maintain, and explicitly communicate their values in sharing music and thus their close social connections. In addressing this finding in their designs, both teams emphasized this connection through tangible interactions with the product. In the SqueezeDrop design (see Fig. 8), two girls can touch their drop shaped players to form an abstracted ying-yang symbol or friendship charm. This action allows them to share the same playlist. With rCast (see Fig. 9), a group of girls can tap their players together, forming a network of players that synchronously all play the same playlist. When the girl shakes her player, it releases the connection to the network and allows her to play her own playlist.

For both rCast and SqueezeDrop, the physical/tangible aspects of the interaction build on the experience of physically expressing social connections through a hug, kiss, or caress. The interaction requires both physical proximity and consensual touching to express the connection. However, unlike hugs, kisses, and caresses, the connection persists after the participants have moved apart. The intrinsic value in the interaction comes from the link between the explicit communication of the personal connection and the social currency (in this case music) involved in the transaction.

Fig. 10. Maestro: designed for young moderns to use at home

In designing music players for "young moderns" (young singles and couples who do not have children) the student teams consistently encountered a desire to instill envy and to communicate social status. The young moderns did this, not surprisingly, through the selection and display of products in their homes. Several of the teams leveraged this desire in the interaction design of their music player, focusing on simple yet unobvious interactions. The Maestro music player provides a good example (see Fig. 10). Users interact with the music player gesturing with a wand that is similar in form to a conductor's but with accelerometers in both the tip and the base. Through a series of gestures the user can easily control the music player, selecting

playlists, adjusting the volume, switching tracks, etc. The interaction is *exhibitionistic*: designed specifically for others to see. This instills envy and communicates an increased social status for the user by placing them in a position of power, communicating that only a select few have the power and the knowledge to express their intent to the system. The concept of tangible interaction as conveying value is an interesting one that we will explore further in future research.

5 Conclusion

The exploration of aesthetics in interaction design has resulted in research on more tangible interaction and on the expressive and perceptual capabilities of both people and their interactions with products. By looking through the lens of *increasing product value*, the exploration of interaction aesthetic offers one method for transforming our world full of cheap, disposable, electronic products sold in bulk to a world where people form strong attachments to their products through their physical and social interactions. Using an exploration of people's emotional connection to music players and an analysis of conceptual designs produced around this theme, we have identified three emerging thematic opportunities where interaction has great potential to increase the intrinsic value of products. *Interaction designers* can add value by (i) extending interactions with objects currently found in the context of use to new applications; (ii) using interactions to bridge users' activities with corresponding social roles, supporting users' construction of their social identity; and (iii) leveraging interactions as a method to explicitly and implicitly communicate and connect the user with others.

While these themes offer promise, much work still needs to be done. First, we are sure that many more opportunities for interaction to increase intrinsic value exist, and we will continue to search and document these. Additionally, we plan to perform a formal evaluation in order to measure how much value can be added by embracing these themes and to better understand how these themes relate to different user groups, products, and activities. Finally, we plan to explore how explicitly addressing these themes at the inception of a design project influences the types of interactions designers create.

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