

INTERACTION DOMAIN OF DIGITAL DEVICE ADOPTION

CREATING DISCOURSE AND SPECULATION AROUND DEVICE EXPERIENCES

Lorraine Sohee Shim

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A thesis submitted to the School of Design, Carnegie Mellon University,
for the degree of Master of Design in Design for Interactions

Lorraine Sohee Shim | Candidate

Professor Cameron Tonkinwise | Advisor

ABSTRACT








The 21st century is interwoven with technological innovation and expanding networks. In the midst of such change, some designers have advocated that we pause and assess the objects with which we been surround ourselves. Erik Stolterman and his colleagues wrote in *Device Landscapes* that “The number of interactive digital artifacts is growing surrounding personal lives, and individuals have an increasing need to describe, analyze, and interpret what it means to own, use, and live with a large number of interactive artifacts” (Stolterman et al., 2013).

With the emergence and rapid proliferation of technology devices, the divide between tangible and intangible things has been questioned as information and data have emerged as important extensions of personal devices. A sea of informational artifacts, therefore, poses a challenge for users to fully adopt them into their daily interactions.

In response, I conducted an inquiry-driven investigation into the domain of device adoption and highlighted seven key themes in the context of current and speculative technology. The exploration was designed on a iterative model of areal definition and research to outline the greater territory. For the sake of a sensible scope, I have limited my target users to millennials who I describe as a unique generation of early adapters that are both active participants and architects of technological change.

To present the research outcome, I propose an annotated portfolio-styled exhibition that curates ideations and explorative concepts that have emerged from each round of research. The exhibited concepts simulate a range of device experiences and encourage pedagogic discourse around current and future models of device interactions. They are designed to induce informed reflection and discussion over innovation of digital devices and on how to build true agency over objects that are constantly evolving and changing.

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INTRODUCTION

The digital age has challenged the way we understand material possessions. Before digital devices such as smart phones and tablet PCs became prevalent, personal goods were relatively simple in function and form. They performed a number of tasks, but their functions were not complex enough for them to build a significant relationship with their users. Appropriation would occur based on tangential experiences and not necessarily have do with the objects themselves (Lastovicka and Fernandez, 2005). During research, when participants were asked

“Consumers value possessions beyond possessions’ functional benefits due to public and private meanings (Belk 1988; Richins 1994). Public meanings reflect self identity (Belk 1988; Kleine, Kleine, and Allen 1995) and play a role in social communication (McCracken 1986). Private meanings that are indexical in a spatio-temporal sense help define identity and personal history (Grayson and Shulman 2000)” (Lastovicka & Fernandez, 2005).

to describe items they found significant to them, an individual talked about a painting she purchased in India during her extensive travels. To the owner, the painting was a mere representation of her experiences and had little functional value as a standalone object.

Designers have studied and researched product attachment and consumption, but little focus has been given to digital things independently. Digital devices offer multidimensional interaction points that complicate the relation between the artifact and its owner. Digital devices, with the right mental model, offer enhanced performance such that “the person + artifact is smarter than either alone” (Norman, 1993). Consequently, digital devices should be evaluated within a distinct class of personal objects.

People in the global consumer class nowadays spend enormous chunks of their time using personal devices. Considering how dependent such people are on their devices, it is worth studying their understanding of how these devices work: what new mental capacities do such products require and enable. For example, do users understand

how device storage works? What does the invisible infrastructure of the machines look like, and how does its design change the way people organize and access information through inter-connected devices? Despite thinking of these complex machines as “possessions,” do people truly have control over these objects? The thesis looks into setting up a constructive evaluation model through which people can reflect on the functions, affordances, and cognitive implications of personal devices and whether they have established adoption of their digital possessions.

The final deliverable of the thesis takes form in two parts:

The first is of an annotated portfolio that discusses seven major categories through which personal devices can be evaluated. Each chapter is explained and explored through different mixes of literature reviews, empirical studies, and rapid ideations.

- **Entity:** the voice that the device projects
- **Interaction Degree:** the design of task performance

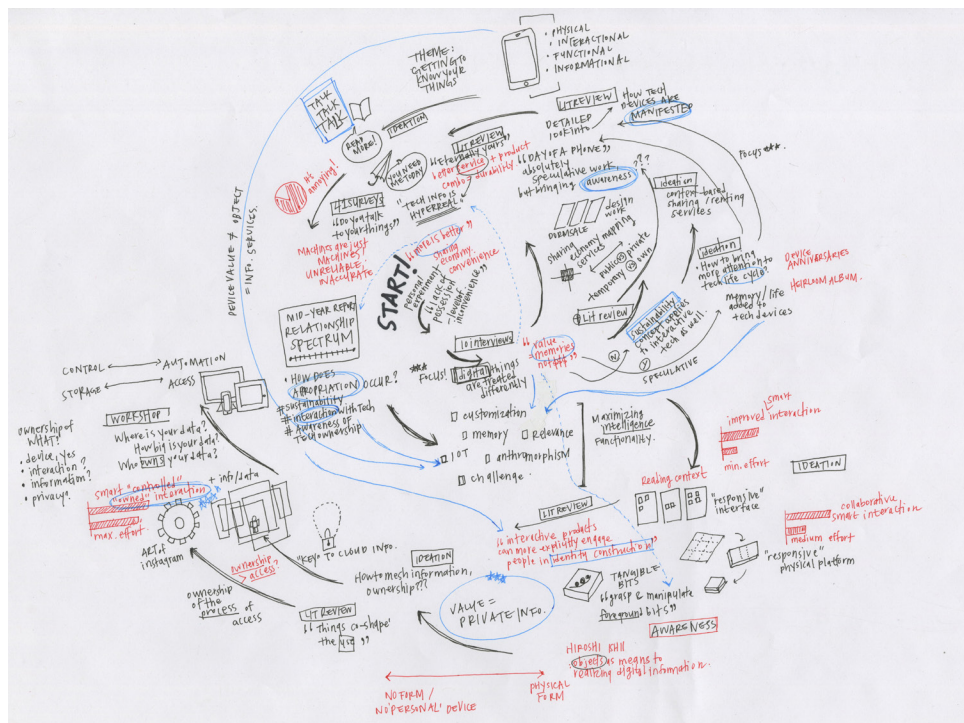
- **Material Affordance:** physical presence and form
- **Device Intelligence:** the device’s learning capacity
- **Invisible Artifacts:** the things, systems, and space behind the screen
- **Context:** the environment and orientation of the device
- **Device Family & the Greater Network:** access, transfer, and security within a body of devices

The thesis in its latter part is presented as a blueprint for an exhibition-like experience. Concepts and ideations that were introduced during the research are staged as exhibition artifacts and are mapped to the seven facets of device adoption through which participants can “walk through” and start discussions about the current interaction design status of personal devices.

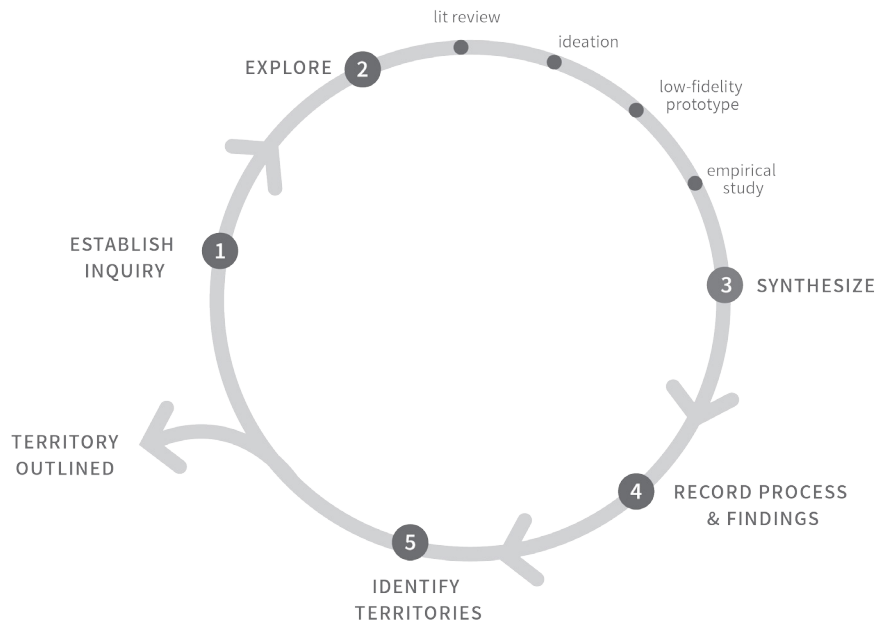
DESIGN APPROACH

The research followed an inquiry-driven process with a repeated model of questioning, exploration, and synthesis to outline the territory for device interactions and adoption. The territory of exploration grew organically, as each research approach inspired and revealed insights about different facets of the topic. For example, an online

survey was designed to evaluate how people felt about different voices and attitudes their personal devices project. Survey results revealed people's discomfort with certain tones of talking objects and encouraged further investigation into the underlying tension users felt caused by the lack of trust in device intelligence.



Img 1. Early brainstorm of overall process



Img 2. Final model of overall process

The research process in reality, as shown in Img 1, was quite messy in that different investigations were executed simultaneously and clear distinctions among identified themes were often difficult to make. However, Img 2 summarizes the conclusive model I came down to through repeated cycles of exploration. The cycle would begin with an inquiry, which will be explored through different combinations of methods such as literature review, quick ideations, low-fidelity

prototypes, and empirical study involving participants. Once the data is synthesized and recorded, the body of work would represent a central theme and mapped among previously identified themes. The collection of themes would eventually build up a comprehensive outline of the greater territory. This model may also be applied to exploring other domains of interactions.

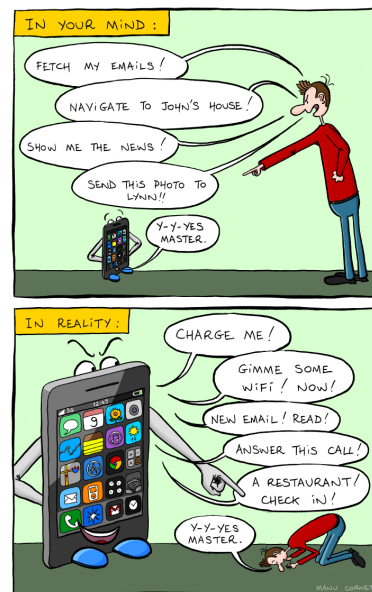
■ INSIGHT ONE: ENTITY

Entity refers to the voice one's device projects. Many contemporary devices arrive packaged with unique voices that interact with their users. Device voices define the behavior, attitude, and the being of individual devices. Overall, because interactions between users and devices have become more complex, engaging, and responsive, object *Entity* for devices have become a notable dimension for in-depth discussion.

Entity could refer to the audible voice of the intelligent agent embedded in device software. Common examples of device voices include Siri in iOS devices and Echo, which is a conversational interaction system designed for shopping at Amazon. It is important to pay close attention how and why different characterizations are attributed to device voices. People often find themselves annoyed or angry at the way a device treats them. Devices can seem assertive, robotic, or simply dumb. Maryam Afshar describes smart objects, or what she calls “meta projects,” as “pervasive semi-intelligent, semi-autonomous objects of everyday life” and uses Manu Cornet’s cartoon (Img 3) to depict the interaction dynamic people have with

their devices (Afshar, 2014). I explored this dynamic through a survey that is discussed and analyzed under Insight Four: *Device Intelligence*.

Entity also involves history and memories tied to using devices (both in the software or the physical object that contains the software). The accumulation of memories derived from using devices allow a strong relationship to



Img 3. Mobile Relationship by Manu Cornet (Afshar, 2014)



Img 4. 1:1 Interview

develop and helps overcome the distance users may feel with the standardized designs of digital artifacts. Phil Turner and Susan Turner write that devices lack the “[literal] and metaphorical patina” that “things” harbor as they are “mass produced and quality controlled to ensure that it is identical to the artefact in the next box” (Turner & Turner, 2012). However, better recognition of the device’s character, established through unique interactions with the owner, can challenge this notion.

In order to assess the current dynamic between individual devices and owners, I conducted ten personal interviews asking people how they discard and move on from old devices. Interviews revealed that there

are various timelines and motives for when people decide to replace their devices. Eli Blevis notes, “Everyone wants one. The iPhone is an awesome and wonderful paradigm-shifting example of inter- action design and fashion. Wanting the latest thing before the thing you already have has reached the end of its useful service life is common and understandable” (Blevis, 2008). This was indeed an attitude I observed from some of the interviewees. However, some individuals also shared how they struggled to let go of old devices for reasons beyond practical matters and finances.

Some of the interview questions included:

- ***When was the last time you lost your phone/laptop? Or When did you last replace your phone, gadgets and for what reason?***
- ***What was your reaction? Were you more concerned about the device or the information in it?***
- ***Do you decorate/leave marks on your devices to show that they are yours?***
- ***When is a device finished? And what do you do with them afterwards?***

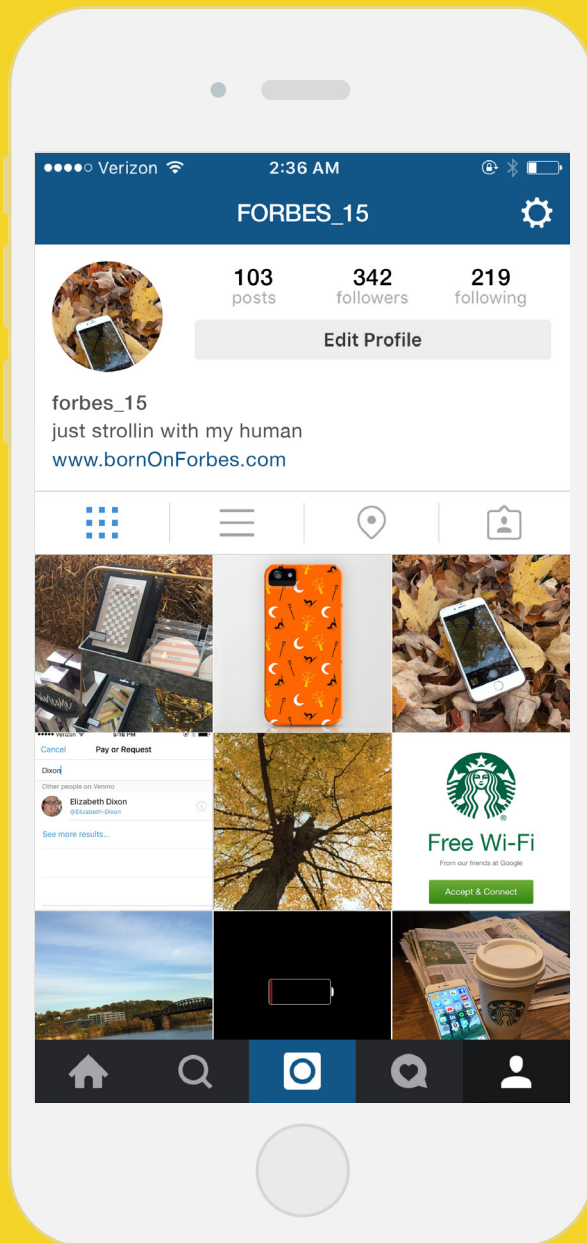
(Refer to the appendixes for a full list of interview questions)

There was an individual who expressed her discomfort in hastily getting rid of older devices since there wasn't a proper protocol for discarding. Also, there was another interviewee who talked about the value of her old device based on old text conversations left on the device that represented a significant relationship in her life. One person shared her love of an old iPod Mini that she no longer used but would keep for its unique design and memories attached to it. She simply exclaimed, "Cuz I love it!" Devices can

"Cuz I love it!"

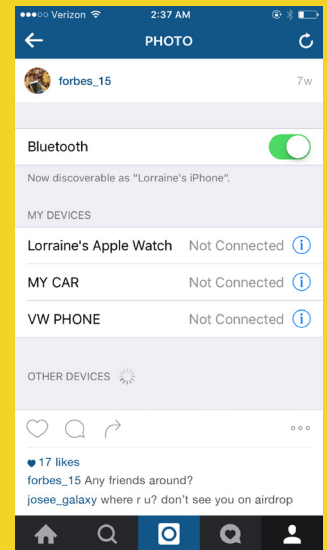
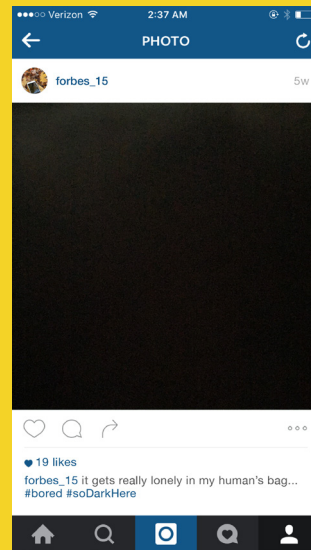
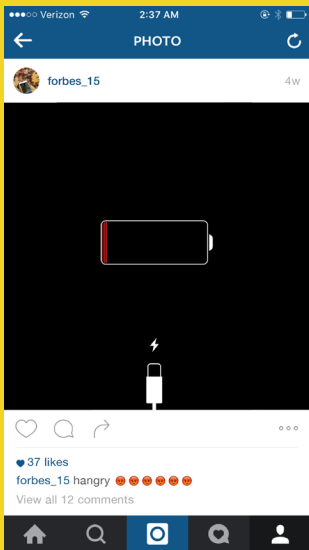
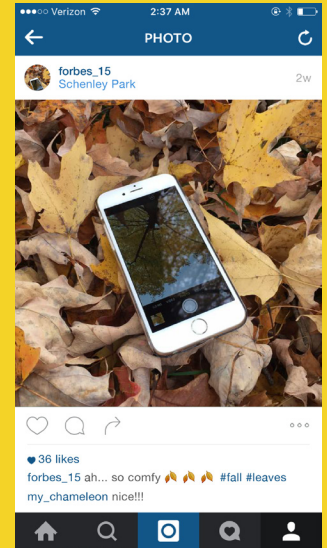
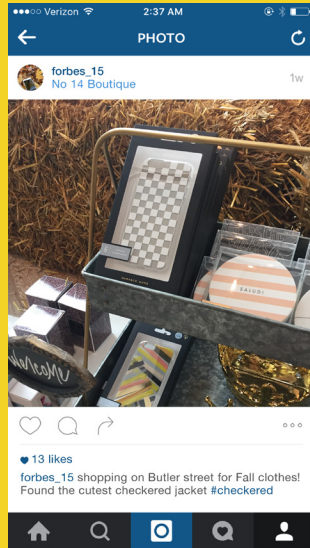
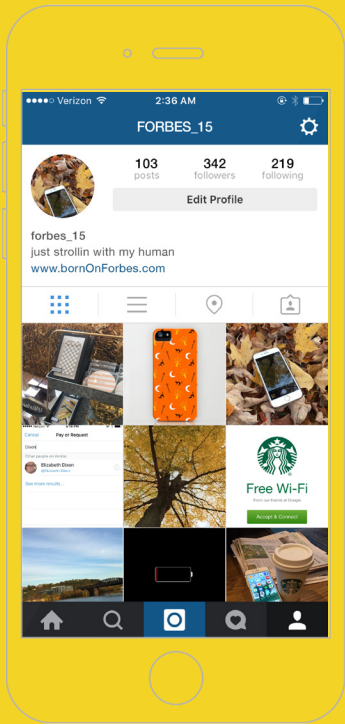
embody unique entities and serve as markers in life, symbol of memories, or even a piece of design work to be collected.

Rapid ideations of services were also made to push for more effective and an even unusual ways to externalize device *Entity*. **IDEATION ONE**, Adding Life to Devices, imagines a mobile phone using an Instagram account to express its needs and feelings. Such coarse anthropomorphism may not be practical, but brings the character of a device to presence.

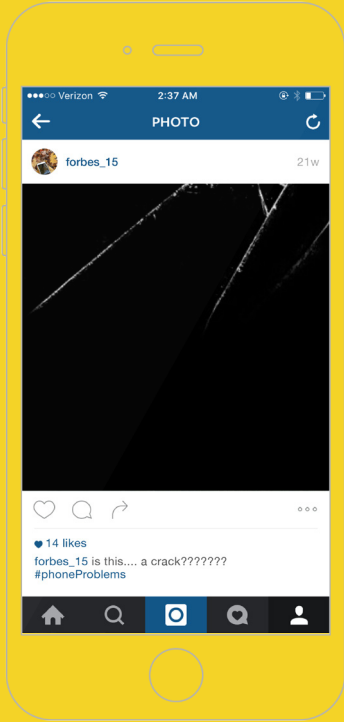
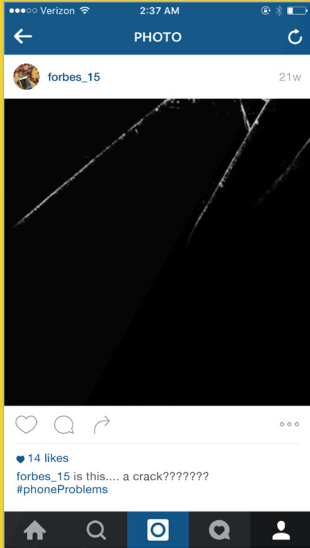
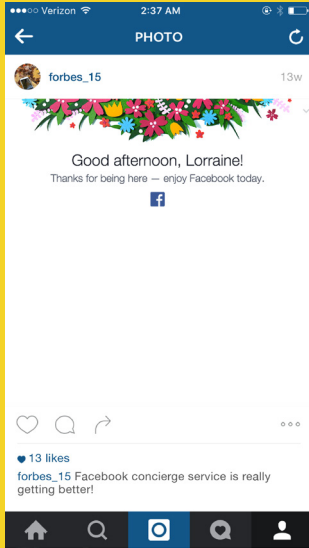
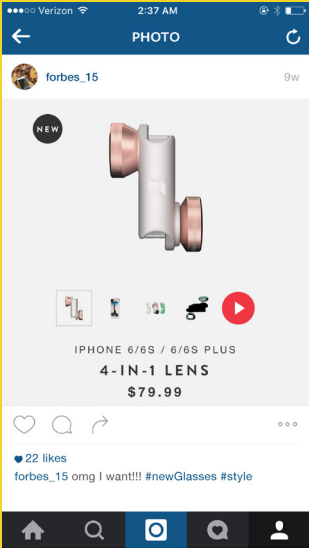
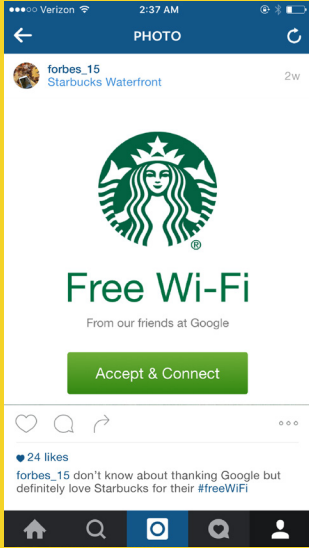
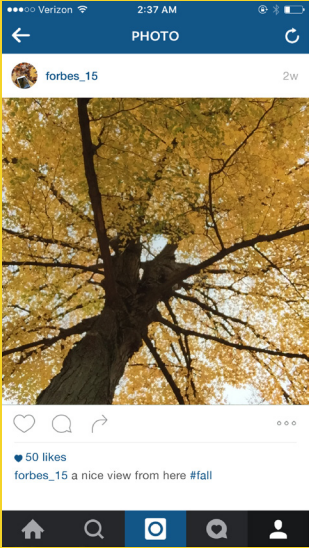
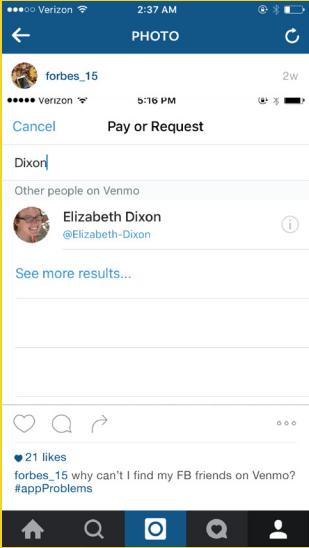


IDEATION ONE ADDING LIFE TO DEVICES

A phone has a social media life on its own. It keeps a feed of its own experiences of the world. It complains that it's running out of batteries, it shops around and likes new external camera lenses released for its model.



Img 5. Extensive prot

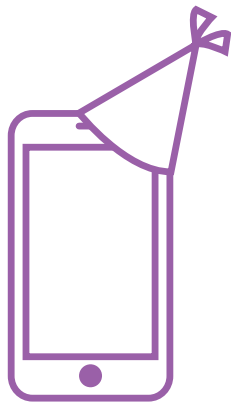
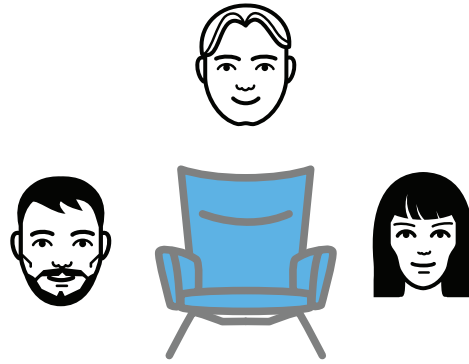


prototype of ideation one

IDEATION TWO

OBJECT LINEAGE

Objects often get passed down through people. What if each object that one receives from someone comes with a lineage or a story? One gets to hear about where it was, what it was used for, who used it, etc.



IDEATION THREE

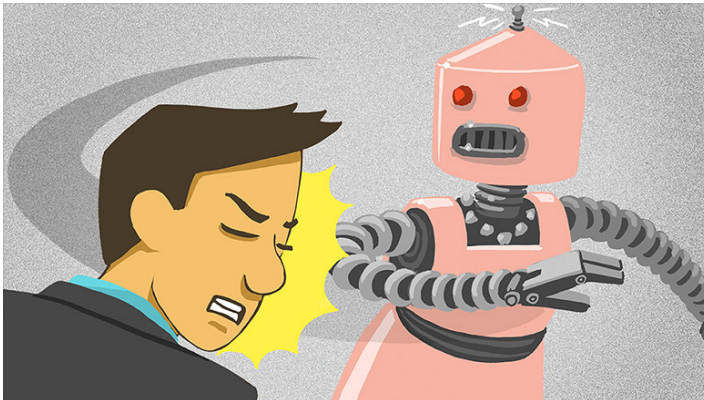
DEVICE ANNIVERSARIES

A phone celebrates its journey with its user from its initial purchase/acquisition. It announces and sends messages about anniversaries and makes notes on the calendar of exciting events that have happened in the user's life with the phone by his/her side.

The ideations encourage users to think about the life and the being of devices, and an increased awareness may elicit a deeper sense of ownership. Erik Stolterman and others write that “In any landscape, some artifacts survive and some ‘die’ and become ‘extinguished.’” (Stolterman et al., 2013). The concepts add human qualities to devices so that they can be perceived as dynamic and more relational entities whether than lifeless, static objects. Img 7 already depicts the changing dynamics between users and their digital devices. More ideations (such as Img 6) can also be found in James Pierce’s paper, *Material Awareness: Promoting Reflection on Everyday Materiality*, where he suggests concepts that define object narratives and characters (Pierce, 2009).



Img 6. “The Animate Clock occasionally grows bored with displaying the correct time and deviates by displaying an incorrect time.” (Pierce, 2009)



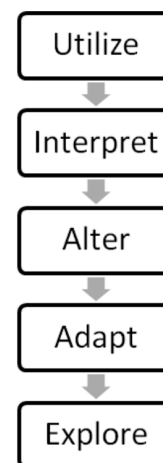
Img 7. “Even virtual assistants are sexually harassed.”

■ INSIGHT TWO: INTERACTION DEGREE

Interaction Degree refers to the design of the device task performance. Is the device interaction engaging, challenging, or more catered to ease of use and seamlessness? Users are often passively accept the way things are done on their devices. It is important for people to realize that the degree of engagement and the interaction steps required to achieve tasks are designed.

Devices are built to perform seamlessly, and such ease often leads people to become complacent with the way things are done. However, technology is a hybrid construct that can be patched up and designed in different ways (Chalmers & Galani, 2004). For example, “The Most Dangerous Writing App” (Img 9) is a writing platform that puts a hard timer on writing, and when the user stops typing, the content is wiped out. The design of the software breaks down the seams of interaction and makes users more aware of how a task can be designed differently through device intervention. True adoption of personal devices would require informed knowledge of how interactions are designed for devices and skills to alter them according to their needs.

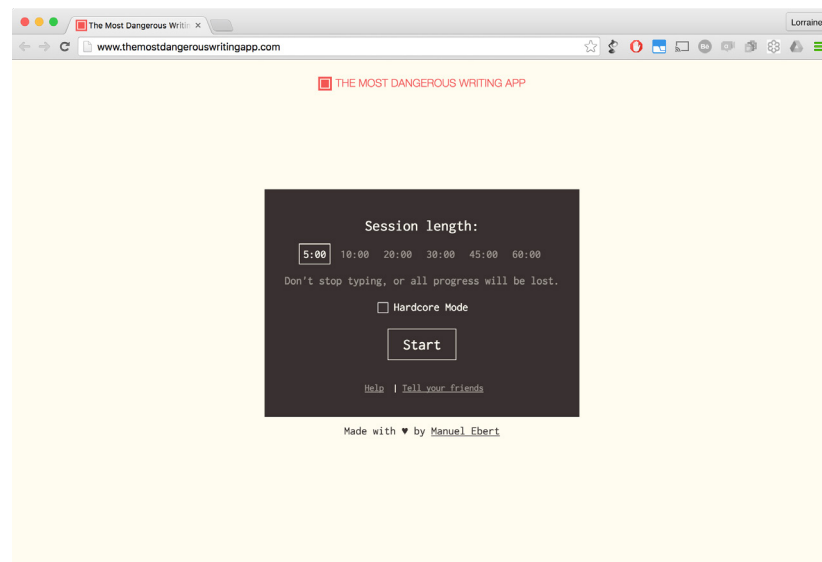
The notion of users getting involved in the design of software experience has been reinforced by the spread of the DIY (Do-It-Yourself) culture, through which people feel empowered to study, modify, and build software and hardware of machines. Akah & Bardzell write that “the design of



Img 8. “Summary diagram of the Appropriation-Identity Design Guidelines” (Akah & Bardzell, 2010)

**“The seams are perceivable—
the technology is ‘seamful’—
but we can call the whole
system a single, hybrid object
because coupled use of the
parts is so unproblematic
in users’ interaction i.e.
interaction is non-rationalized
and seamless” (Chalmers &
Galani, 2004).**

empowering products must enable users to adapt products to reflect their values and meet their needs” and pose five guidelines (see Img 8) to achieving successful and personal appropriation (Akah & Bardzell, 2010). User design intervention can occur at various degrees (corresponding to the “alter” and “adapt” stages in Img 8). For example, users rearranging the apps on their mobile phones is a simple hack. It is a way building a personal navigation path. More complex alterations would require expertise and insight, but the Internet already provides abundant resources for high-level intervention; the key is inspiring the motivation to do so.



Img 9. The Most Dangerous Writing App (<http://www.themostdangerouswritingapp.com/>) The site puts a hard timer on the writing software to help beat writer's block. The interface rigorously checks for user performance and proposes a new writing experience.

IDEATION ONE is bizarre and even impractical, but it challenges people to rethink how a phone is charged. Is it enough that people learn to connect the USB charger to the wall? Can there be other ways charging can be designed to inform users how and when electricity impacts the performance of devices?

IDEATION TWO and **IDEATION THREE** propose a way to make services more engaging by creating obvious interruptions during a reading experience. Redström and Wiltse write “A significant aspect of this continuing

relationship between providers and users is that ‘use’ can be precisely scripted and either enabled or limited in dynamic ways” (Redström & Wiltse, 2015). The designs ask people to reflect on how they would prefer to design a simple everyday experience by breaking the seamlessness of a device performance.

As interaction becomes digitized, the art and meaning behind process often gets lost. Interaction becomes too quick and simple for users to take time and celebrate the effort that goes into achieving a task.

IDEATION ONE

PET YOUR PHONE

The phone is an electronic pet. On top of charging by plugging in, it requires the user pet it enough to “feel” better about performing. It acts up whenever it hasn’t received enough attention or care. The user caresses it by holding it close to him/her, and it charges and performs faster with extra care. If it detects that a part is not working, it starts to show its discomfort by vibrating, making noises, and turning lights on.





question from: <http://www.sparknotes.com/lit/pride/quiz.html>

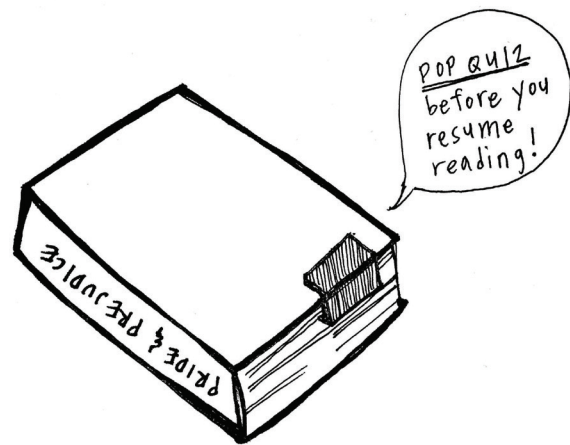
IDEATION TWO EBOOK POPQUIZ

An e-book app/device quizzes the owner on the book he/she is reading upon resuming. It throws random fun facts or interesting insights to enrich the owner's reading experience. It even makes suggestions for the next book when finished.



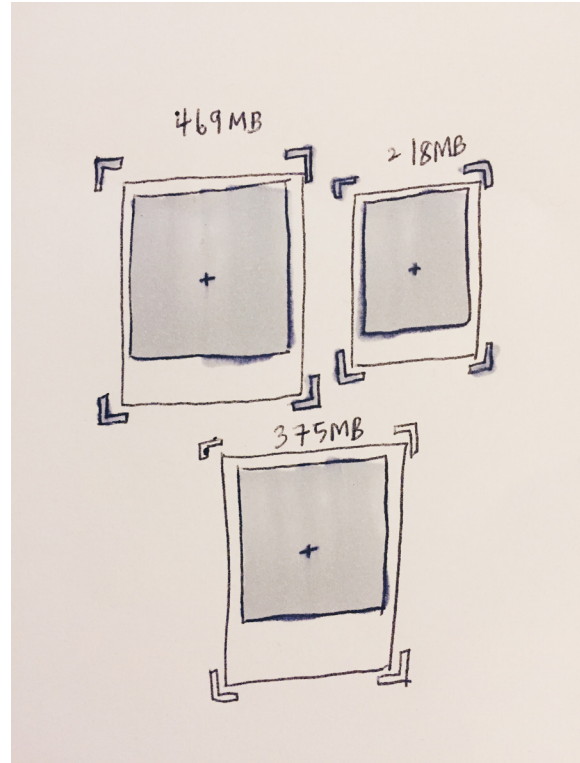
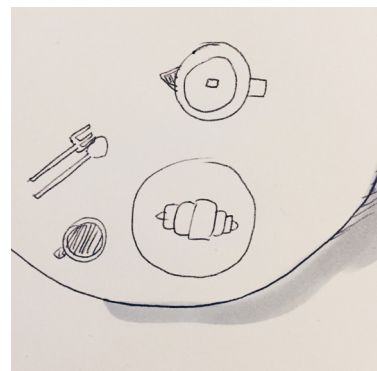
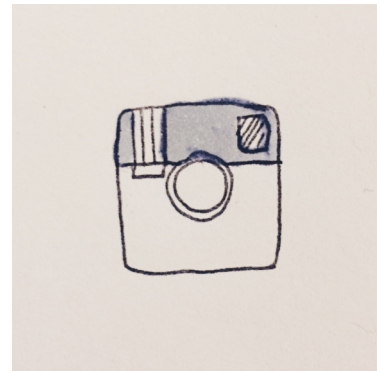
IDEATION THREE BOOKMARK KEEPER

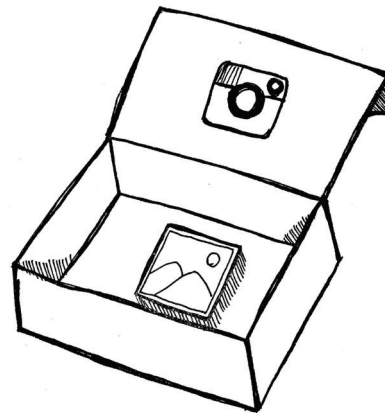
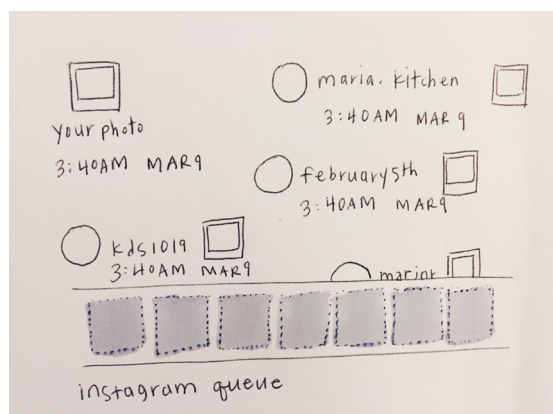
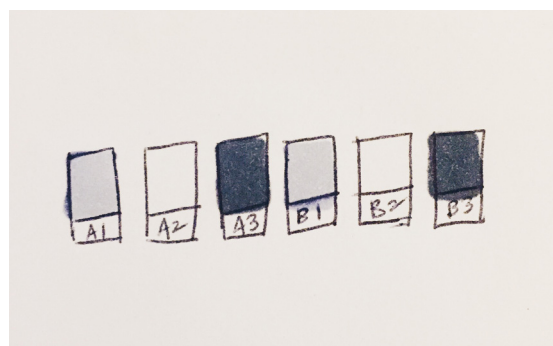
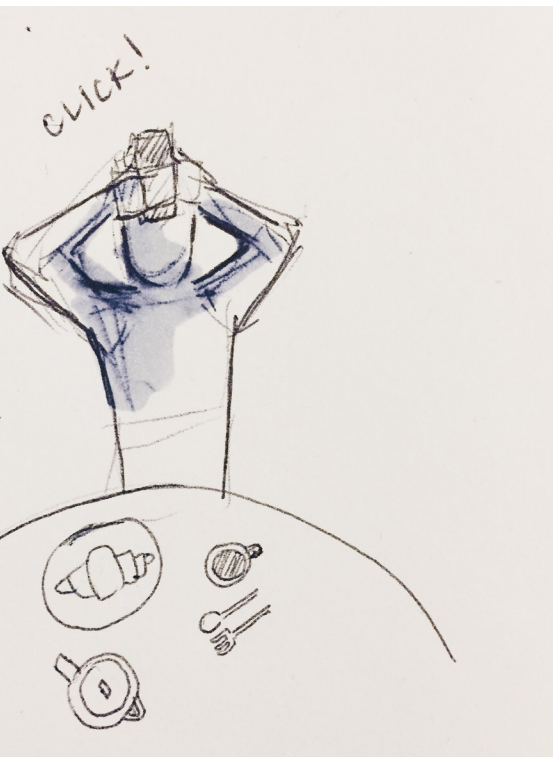
It's a spin on idea two, but now there's a real lock that functions also as a bookmark. It clamps onto the portion of the book left to be read. Every time the owner resumes, the "lock" throws him/her questions based on the content one has most recently read. For instance, when about to read *Guns, Germs, and Steel*, and the lock asks the reader, "when are humans predicted to have migrated towards Eurasia?"



“For the photographers, whose shared values express the strong belief that the artistry of photographic production happens at least as much in the darkroom as it does behind the viewfinder, the process of print production is critically important. However, the question of what it means to ‘make’ a print – to have control over this process, and to possess the means to make it – is thrown into question by digital photography” (Dourish & Mazmanian, 2011).

Nourish & Mazmanian discuss how digital photography has lost “the artistry of photographic production” (Dourish & Mazmanian, 2011). **IDEATION FOUR** explores how the art of production could be brought back to mobile apps like Instagram. *Interaction Degree* highlights the need for users to become more engaged in task designs as a way to build agency through process and put greater value on their input.





IDEATION FOUR

THE ART OF INSTAGRAM

The art of “positing” something online has become more difficult, laborious, and slower. For instance, when one wants to post a new photo on Instagram, he/she has to submit a real photo to the FB headquarters in California (in a nice package). If the user wants to delete what is already posted, he/she has to request FB to return one’s submission and literally destroy the artifact.

Img 10. Early sketch of ideation four, incorporating more complication to make a post on Instagram



Material Affordance refers to the physical presence and form of the devices. Examples can range from screen sizes to hardware capacity. Tangibility is a critical facet of device interactions as current product manufacturing allows creative modularity in form. Traditionally, technology-embedded objects were limited by critical gaps between form and the digital content contained in that frame.

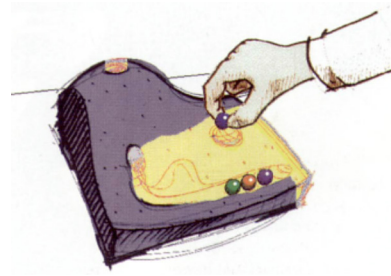
The material portion of digital products increasingly serve as casing that can be replaced with yet another identical copy, with true value being the intangible content (Verbeek & Kockelkoren, 1998). However, emerging technologies challenge the way form is perceived and suggest ways that can merge the gap between form and content.

Durrell Bishop's famous project the Marble Answering Machine (Img 11) highlights the impact of adding tangibility and materiality to invisible digital information. Hiroshi Ishii has also been strong proponent of creating dynamism and engagement in static objects through technology and has challenged

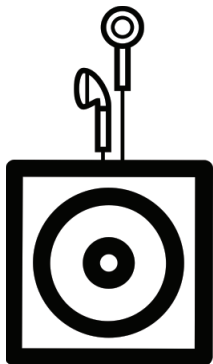
“...the bond that may arise between the user and the product will mainly concern the nonmaterial that is represented by the product, and not the material thing itself... The attachment such products evoke concerns their meaning and not themselves as material objects. They could, after all, be replaced by any other object with the same sign-value” (Verbeek & Kockelkoren, 1998).

how materials can be coupled with content. His works reflect “ways to turn each state of physical matter – not only solid matter, but also liquids and gases – within everyday architectural spaces into ‘interfaces’ between people and digital information” (Ishii & Ullmer, 1997).

IDEATION ONE, Twenty Songs Only, encourages people to think about hardware limitations and their direct impact on device experiences. Img 12 is a comical example of how devices can be repurposed. **IDEATION TWO**, Transformer Screen, creates a physically modular device that can be shaped by direct user input. It builds agency for users to determine appropriate device sizes, encouraging people to reconstruct the ways devices can be made more useful.



Img 11. Durrell Bishop's Marble Answering Machine



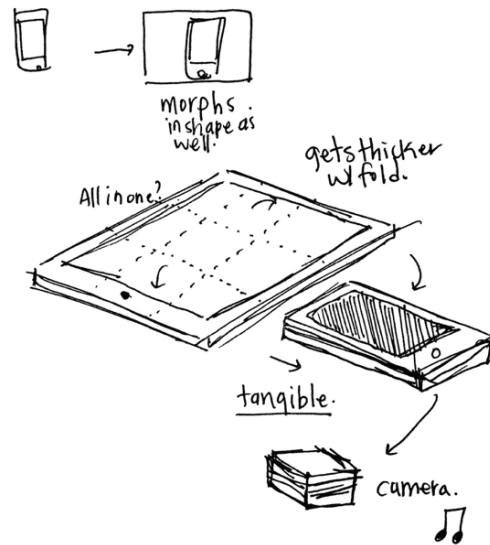
IDEATION ONE **TWENTY SONGS ONLY**

This music player only allows the user to keep 20 songs, so the list one creates is highly curated, thought of, and designed. There are no shuffle or fast forward features, so sequence is quite important. Editing this list requires the user to do manual work (similar to burning a CD, not being able to revisit the content).

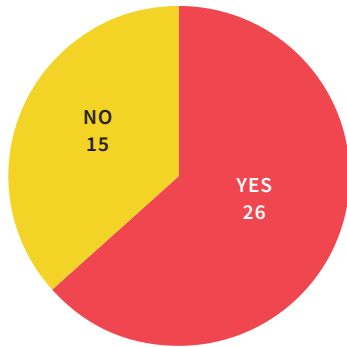
IDEATION TWO

TRANSFORMER SCREEN

In order to declutter the number of devices and boost efficiency, devices are foldable based on need (as determined by the user). For instance, a tablet-size interface is appropriate for work, while mobile-size screen is more fit for making calls and sending quick texts. The object is aware of these changes and adjusts the content and organization of the interface accordingly.



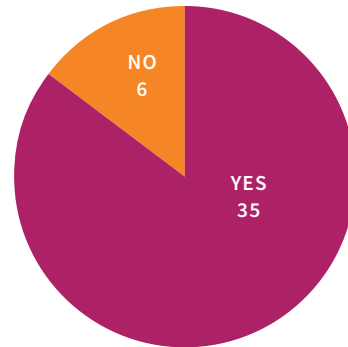
Img 12. Capture of video from Germany portraying a father using an iPad given as a gift from his daughter as a chopping board



Do you ever “talk” to your things (computer, phone, alarm clock, refrigerator, etc.)?

“I feel like I am the ‘master.’ It should do my bidding and tell me what I need to know.”

“I feel like I am talking to another machine that isn’t very capable.”



Were you ever annoyed with things that talk to you (Siri, Echo, GPS, low battery signs, etc.)?

“Are you kidding? Machines are just machines!”

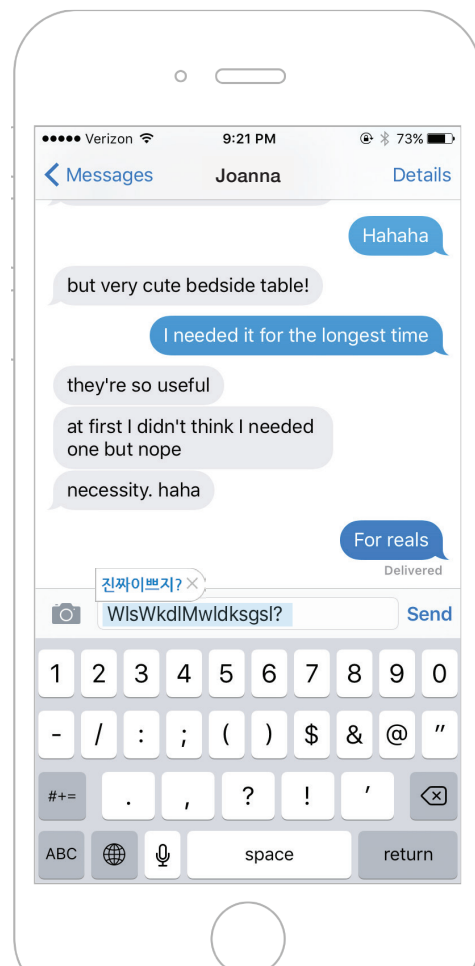
“I feel like I’m supposed to feel like I have a connection but it always just feels like a generic often malfunctioning software.”

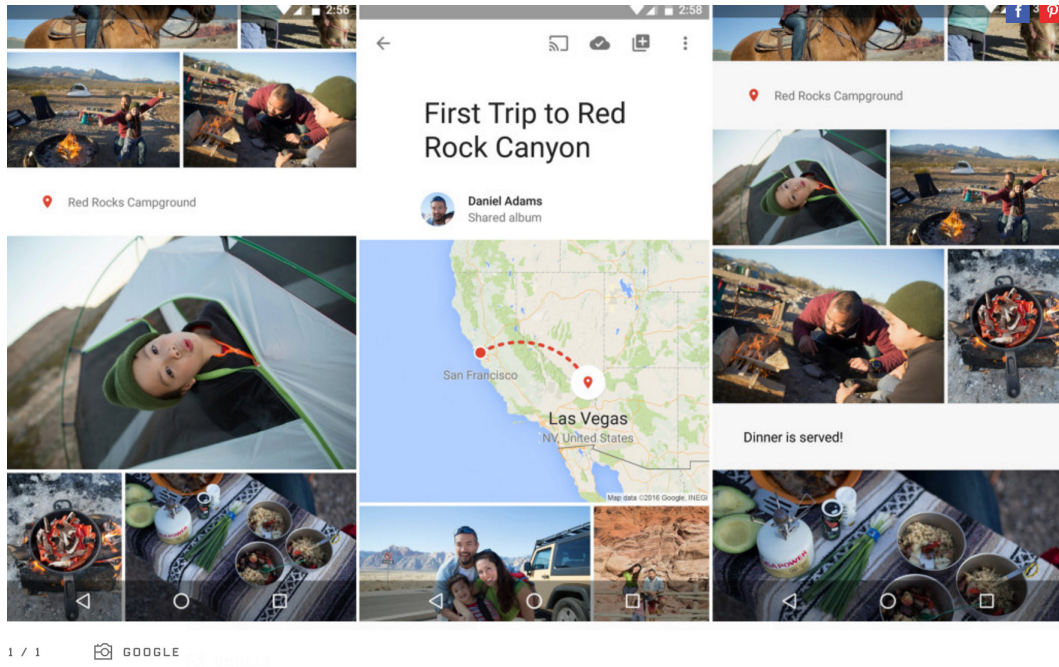
IDEATION ONE and **IDEATION TWO** provide passive and soft services. During concept testing sessions (read under *Prototype* for details), people responded positively to both ideas because they acknowledged that technology was better at tasks that required such accuracy and speed. More attention should be paid to assessing user tolerance level for machine assistance. For instance, are people happy with Google Photos (Img 13) automatically arranging their photos? *Device Intelligence* is developing fast, but people have to identify which areas where it would be served best and readily accepted.

“Instead of having a smart environment track you, you can have your smart device track the dumb environment. For example, instead of every book in the bookstore sensing you, your smart device senses every book (perhaps through dumb RFID tags). This immediately centralizes the data on a single device, where you can view it, ask questions of it, and delete it” (Harrison et al., 2010).

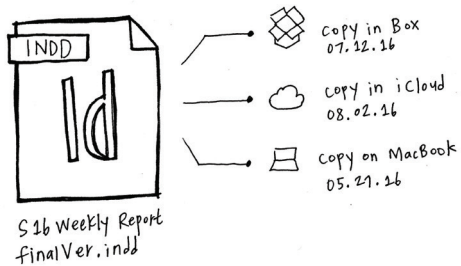
IDEATION ONE **BILINGUAL DETECTOR**

If a phone knows that the user is multilingual and often switches the keyboard to talk to other multilingual friends, the keyboard automatically picks up words in appropriate languages regardless of the keyboard mode.



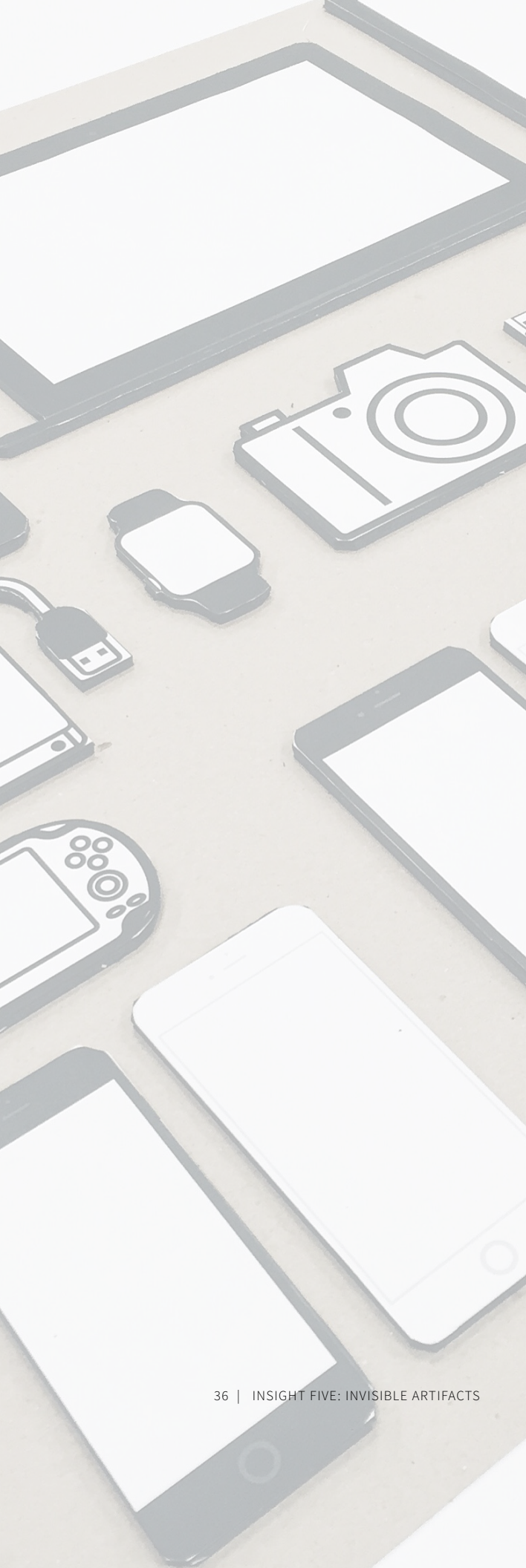


Img 13. Google Photos automatically curates your photos



IDEATION TWO KNOW YOUR FILES

Each digital data has a map of which device/ cloud it sits in, making sure the user can trace any duplicates. People often keep multiple copies of files all across their digital landscapes without much awareness of their organization system and get lost, giving up and taking advantage of the “limitless” space provided in the digital sphere.



■ INSIGHT FIVE: INVISIBLE ARTIFACTS

Much of the value of devices derives from what sits behind the screens. Devices often frame and create a point of access to digital artifacts, but the volume of information has long exceeded the pace of product innovation, and there has been a major gap between devices and the data accessed through those devices. Users explore through “digital substrates” (Wiltse, 2013), but the construction of these invisible layers is often not paralleled by the device’s physical build and lacks proper visualization. For instance, on people’s desktop interface alone, various digital entities sit on the same page. There are icons for different software products that trigger a chain reaction of further actions and information, and versions of files, documents, and folders that branch out to a larger pool of digital things.

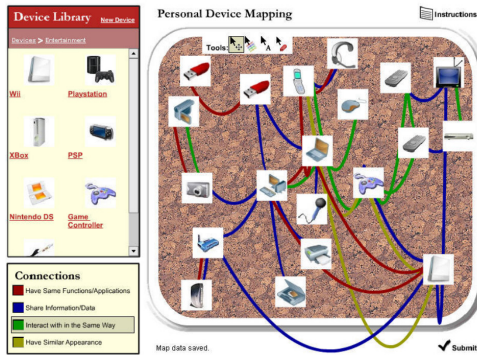
When online, the interaction path explodes into a messy volume. The definition of what is mine becomes hazy. Social media throws lists of content pulled from both the individual and everyone in one’s immediate and distant network, and creates threads of shared artifacts. There are also different models

“These traces are both marks and connections, the visible result of a chain of actions that begins in the physical world and is propagated through various layers and processes of digital substrates” (Wiltse, 2013).

to the users themselves” and “capture an individual’s experience of their ecologies” (Ryan et al., 2009).

I wanted to expand on this exercise and add tangibility, graspable volume, and layers, so people can get a deeper sense of how their devices harbor the myriad of invisible artifacts that they own but fail to picture accurately.

of access employed online—streaming services, for instance, challenge how people traditionally understand digital data storage. To get a better sense of how millennials are mapping their digital sphere, I conducted an individual workshop that encouraged people to construct and build their device-information topology. Ryan and his colleagues had designed a software tool called the “Device Ecology Mapper,” as shown in Img 14, that served as a “...tool or method for learning about user’s artifact ecosystems, which may be unclear even



Img 14. “One author’s personal artifact ecosystem using the device ecology mapper” (Ryan et al., 2009)

Business Origami Workshop (Hanington, B. & Martin, B., 2012) on Materializing Digital Possessions

This participatory workshop was designed to help individuals visualize and build a tangible model of their digital possessions. Through the 30 min - 1 hr sessions, individuals were encouraged to recognize digital materials as part of space-consuming matter and mentally integrate them into personally owned goods.

The workshop asked participants to build their digital workspace in hierarchical progression. First, they identified all their physical devices. Then, using differently colored lego blocks, they quantified the amount of digital data stored in each device. Finally, they added any online or streamed data they have access to.

Each session started and ended with a question that asked participants to identify themselves on a spectrum; 1 indicates the ultimate minimalist and 10 signifies a collector (I used the term 'hoarder' in the beginning, but a participant suggested that people may be hesitant about its negative connotation). Using the scale, I observed

whether the workshop had changed the participants' understanding/perspective of their ownership styles.

The individual workshops created rich conversations and revealed much insight:

- There is a critical disconnect between devices and the data accessed through those devices.
- Users are less hesitant to create multiple copies of data and are less worried about using up space.
- There is still anxiety over use of cloud-based services, and people prefer having tangible casing to data.
- People are less organized in virtual space than they are in real life.

ooo

minimalist

1

10

collector



Img 15. Spectrum presented to participants at the beginning and end of workshop.



Img 16. Participant during business origami workshop

“If I need more storage space, I would buy another hard drive, than delete that.”

“Everything lives in a different part of my computer... I made different directories for all of them... It all lives separately, and within that I have organization systems. ”

You don’t own CDs, but does track number matter to you?

“Yes, because I want to listen to it in the order that the artist intended for me to listen to it. I don’t want it to be alphabetical, because in some cases, tracks are meant to follow other tracks—because there are transitions, and there’s a narrative in the album, and I want to retain that.”



Img 17. Participant during business origami workshop

“With my physical things, I eliminate stuff. Because stuff that is online and digital, I don’t feel the weight of mobility, so I don’t eliminate as much stuff.”

“Before that, I didn’t have an external hard drive, and everything was on my laptop... both the photos, all the work I’ve done... I didn’t back it up on like iCloud or anything like that. And one point, I think I put it on Box, I just don’t like how those things back up stuff for you. I like an external hard drive just because the way I can create own folder structure with them.”

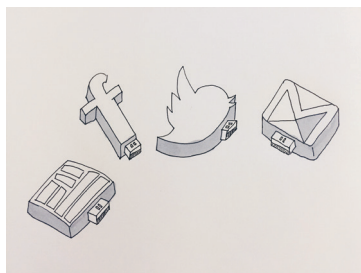
“... on principle, that these are all these private things, I don’t trust the fact that they’re on a cloud, even though I know they are encrypted...”

“Originally I was thinking about mobility... now that I think about the digital stuff, what I’m thinking about is more of how much of a curator I am.”

IDEATION ONE imagines adding a presence and framed visibility to personal accounts reflect on privacy and ownership and those attributes can be further reinforced or discouraged through embodiment. In addition to sketching the idea, I also made a low-fidelity mockup that displayed the look and feel of the concept. **IDEATION TWO**, Visible Cloud, adds 3D visualization to data. Invisible artifacts have space for great innovation due to its formless nature, but much work needs to be focused on bridging the very different natures of data and device forms.

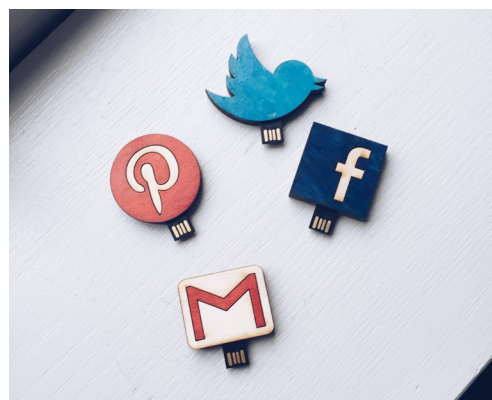
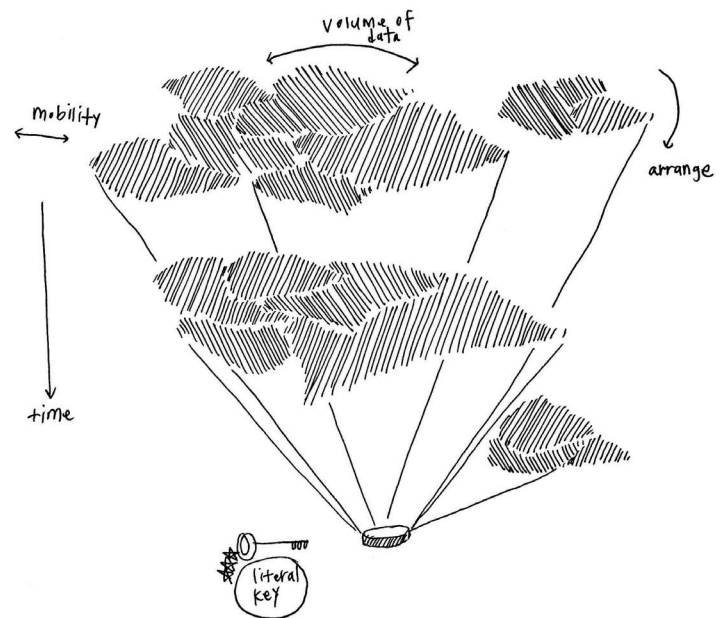
IDEATION ONE MY ACCOUNTS ARE ALL MINE

What if all one's personal social media data is stored in one object? All of his/her previous posts, shares, likes, reactions, bio info, views, and all kinds of cookies data only exist in single form in an external device. And logging in would require plugging in the device each time. One can also decide to get on or off the grid entirely by configuring this device.



IDEATION TWO VISIBLE CLOUD

Cloud storage now sits in a single, portable object (like hard drive with wifi). It is accessible with a physical key or touch ID. When opened, it visualizes all of user's data by the way he/she organized them.



Img 18. Low-fidelity prototype for ideation one

■ INSIGHT SIX: CONTEXT

Devices are not only constrained by their build (refer to section on *Material Affordance*) but also to their contextual appropriateness. Digital things are and should be designed to perform in a responsive manner towards layers of its physical, social, and timely contexts to boost device efficiency and user agency. Specificity plays an important role in creating meaningful experiences with attention to narrative, memory, and sense-making in the presence of and interaction with personal devices (Redström & Wiltse, 2015).

There are multiple categories and scales of context to be considered when evaluating appropriateness of personal devices. For instance, objects surrounding a person and arrangement can define *Context*. One of my ideations was a desk replica service (**IDEATION ONE**) that would replicate a person's default work station in multiple locations, whether it be at home or at an office. Devices, stationaries, and even the pressure of each key on a keyboard would be maintained identically and updated daily to allow the client to feel familiar with the working environment. It was to test to see how sensitive and aware people were to

their spatial environment while interacting with their devices and whether they had a strong contextual preference. One response during the concept testing phase was about the participant's tendency to sit at the same computer station in a public computer room and how, within a short period, she had developed attachment to a single device/station/location.

Contextual clues can derive from “the physical, environmental, cultural, and social constraints found in the context of use” (Zimmerman et al., 2007). Need-based curation and filter can improve access to

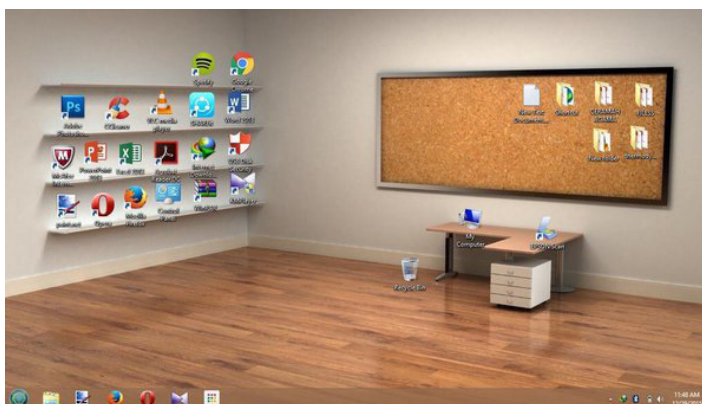
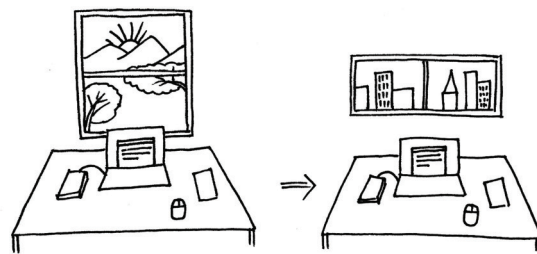
**“a thing is unique not only
to a specific person, but
also to a specific person at
different points in time space”
(Redström and Wiltse, 2015).**

the many functions and services in personal devices and effectively boost usefulness. Specific life events or activities harbor many of those listed constraints and can narrowly define technological needs. **IDEATION TWO** imagines a context-driven interface that suggests apps based on the location and assumed activities that may follow. In implementation, some technological conditions to pay attention to may include “context, unobtrusiveness, truthfulness, seamfulness, timeliness, and fast interaction” (Raento et al., 2005) especially in the mobility aspect. Situations provide metadata for accurate identification of users needs; therefore, improved awareness of *Context* can boost device usability for improved appropriation.

IDEATION ONE

DESK REPLICA SERVICE

A service that replicates the user’s home work space. It copies the models of all his/her devices, placement, and even the tiniest details like the feel and sound of each key in the keyboard, dents on the devices, and finger print marks on the screens. It’s updated daily so that wherever the user works, it feels like he/she has never left one’s original desk at home. The interfaces are synced perfectly as well.

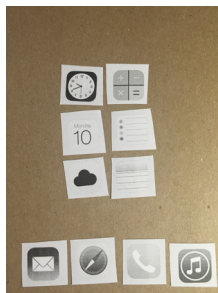


Img 19. “the right way to organize your desktop”

IDEATION TWO

CONTEXT DRIVEN INTERFACE

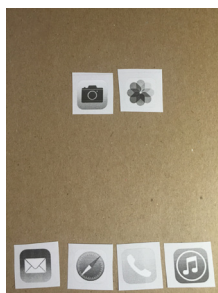
The device screen automatically changes the arrangement of the owner's apps and other mobile services based on the space he/she is in. For instance, when at the airport, the screen enlarges the clock and highlights travel and scheduling apps to make sure the owner is best assisted in his/her travels. It also pulls up the news and ebook apps to keep one entertained during wait periods.



school



hazard



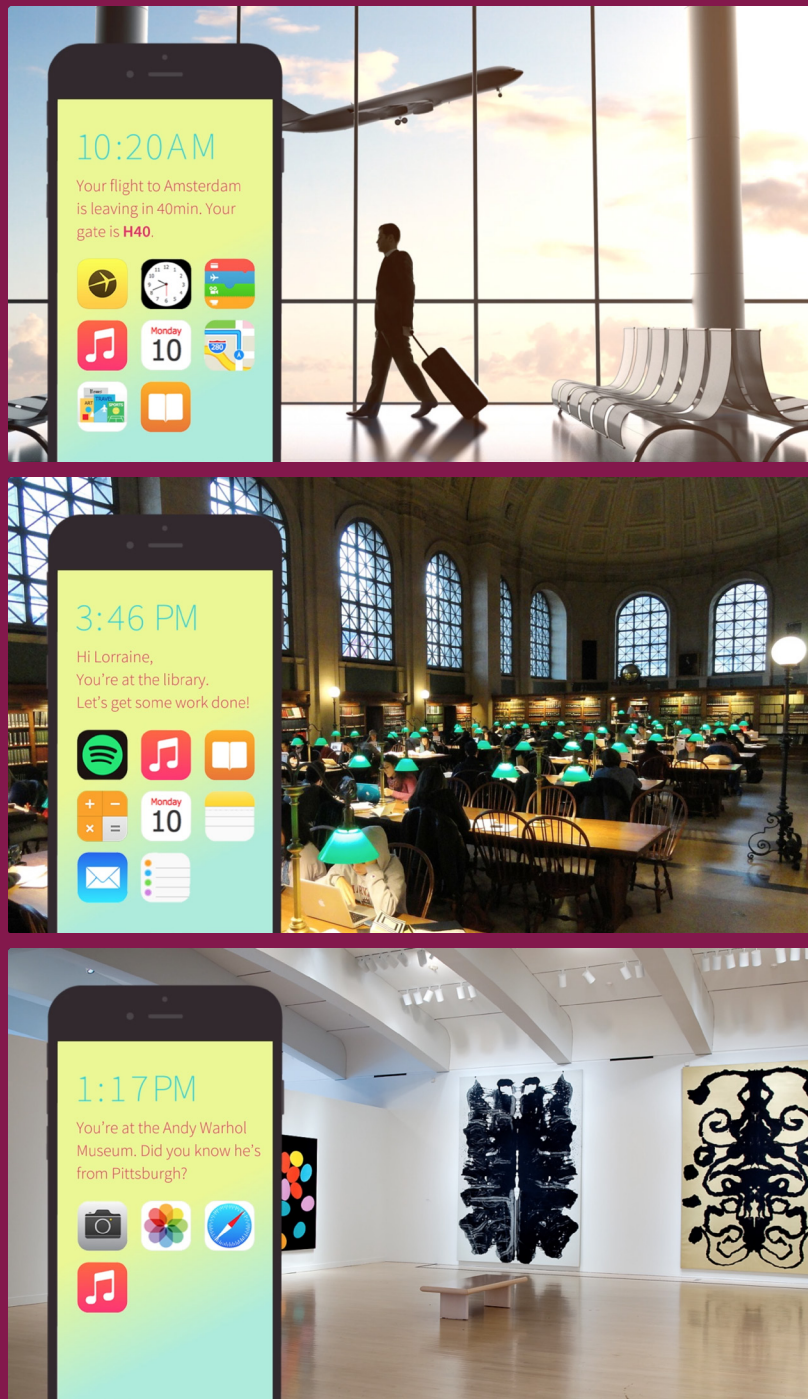
museum



cafe



Img 20. Low-fidelity paper prototype of ideation two



Img 21. Animated prototype of ideation two.
Demo can be seen here: video demo: <https://vimeo.com/154813329>

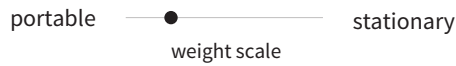
Device Family and The Greater Network refer to the connectedness of devices, and the network's allocation of access points, privacy, and fluidity. Activities such as sharing, duplicating, and moving information are quick and simple in the digital sphere, and due to such ease, people build extensive networks through their devices.

The amorphous character of information and “domestication of technology” inform us that “technological operations could ultimately be seen as decontextualized conceptual arrangements (templates or matrices) on the basis of which reality is ordered to objects or patterns” (Kallinikos, 2012). The digital space gives users a lot of creative space to build personalized mental models of how they are wired to their things. Stolterman et al. calls the user's network of personal devices and digital artifacts as “device landscapes” and advocates a relational reading of a group of devices around its owner.

Connection between devices can be evaluated from both physical and software perspectives. Apple, for instance, strongly emphasizes cohesion among their products in terms of physical affordance and software

interaction. Their designs assume people will use a family of Apple products, so the Apple designer create an interaction map that focuses on consistent tactile, visual, sequential, and interface experience. Workflow is made seamless through both appearance and *Interaction Degree* (read more about how *Interaction Degree* is defined in the early chapter).

“...we are trying to conceive a new way of thinking about computers in the world, one that takes into account the natural human environment and allows the computers themselves to vanish into the background. Such a disappearance is a fundamental consequence not of technology, but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it” (Weiser, 1999).



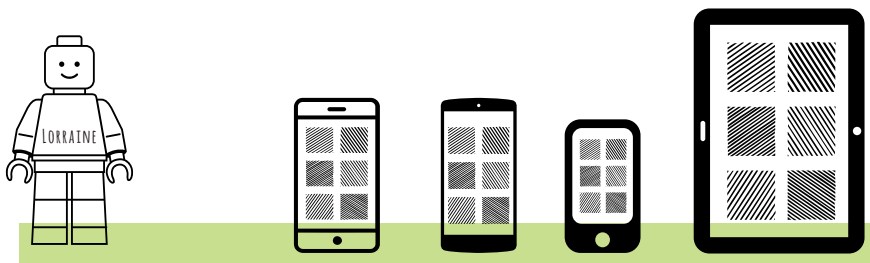
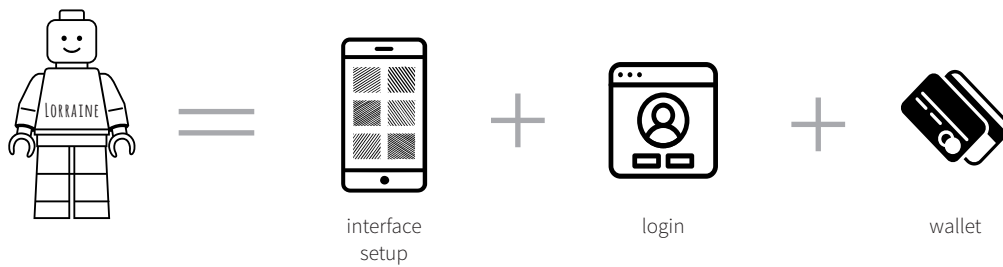
IDEATION ONE borrows from Weiser’s vision for future computer experiences, where the appearance of computers will mentally vanish from users’ perspectives. The concept suggests a design of a SIM card that could easily be pulled in and out of any device and questions users whether they would be willing to be open to a model of interaction that not only gives them freedom and agility among their own, private circle of devices but also access to non-personalized devices. The idea points to the value of mobility and portability as allowed by device-enabled networks. Also, the concept gets rid of thing-based limitations, redefines the meaning device ownership, and encourages users to imagine a new model of digital networks.

“The notion of landscapes makes it possible to see artifacts as elements or objects situated in a (digitally augmented) physical environment, and it makes it possible to focus on and analyze distances, clusters, connections, and relationships between the physical artifacts.”
(Stolterman et al., 2013)

IDEATION ONE

AVATAR ALL MY STUFF!

A portable, all-encompassing SIM card that personalizes every device that it the user comes across. For instance, when the user puts it physically next to a random phone (doesn't matter who the physical device belongs to), it brings up one's platform, IDs, settings, interfaces, whatever screens that only the user been using, with all your information. When he/she pulls out (literally move away with it), all info leaves the display and "walks away."



PROTOTYPE: EXHIBITION OF CONCEPTS

I designed an experience that pushed people to think critically about the different facets of device ownership. The different ideations from the research process ranged from being practical to highly speculative, and as a collection, served as a comprehensive resource to the topic. I used the format of an annotated portfolio to arrange and sequence the ideas, and prototyped a potential exhibition. As Gaver & Bowers note the juxtapositions of concepts could stir richer discussions and chains of thoughts.

“The juxtaposition of the two artifacts, however, gives breadth as well as depth to some of those annotations and motivates comparative discussion over others” (Gaver & Bowers, 2012).

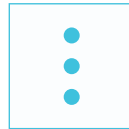
The exhibition experience is broken down into three parts:

1. **fill out device owner taste profile**
2. **study the map of the seven facets of ownership**
3. **explore the 16 concepts and discuss**

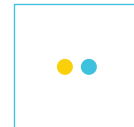
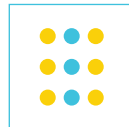
First, the participant fills out a taste profile that gives an idea of what kind of device owner he/she is. There are seven categories and the participant evaluates their ownership preference on a scale as shown on page 51.

Secondly, the participant reviews the exhibition map (Img 22) and where each concept is located. The walk-through sequence is mapped to the seven facets of device ownership that were discussed previously. Each layer of color represents a facet, and there are areas of overlap. Some concepts cover multiple categories. For instance, concept #8 points to *Interaction Degree*, *Material Affordance*, and *Invisible Artifacts*.

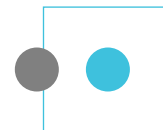
curated or jumbled?



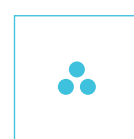
collector or minimalist?



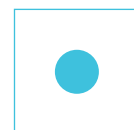
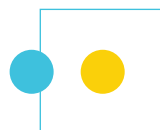
fixer or replacer?



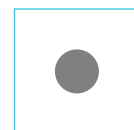
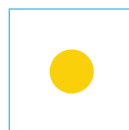
willing to share or private?



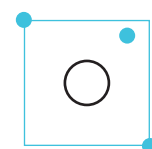
trend-sensitive or impartial?

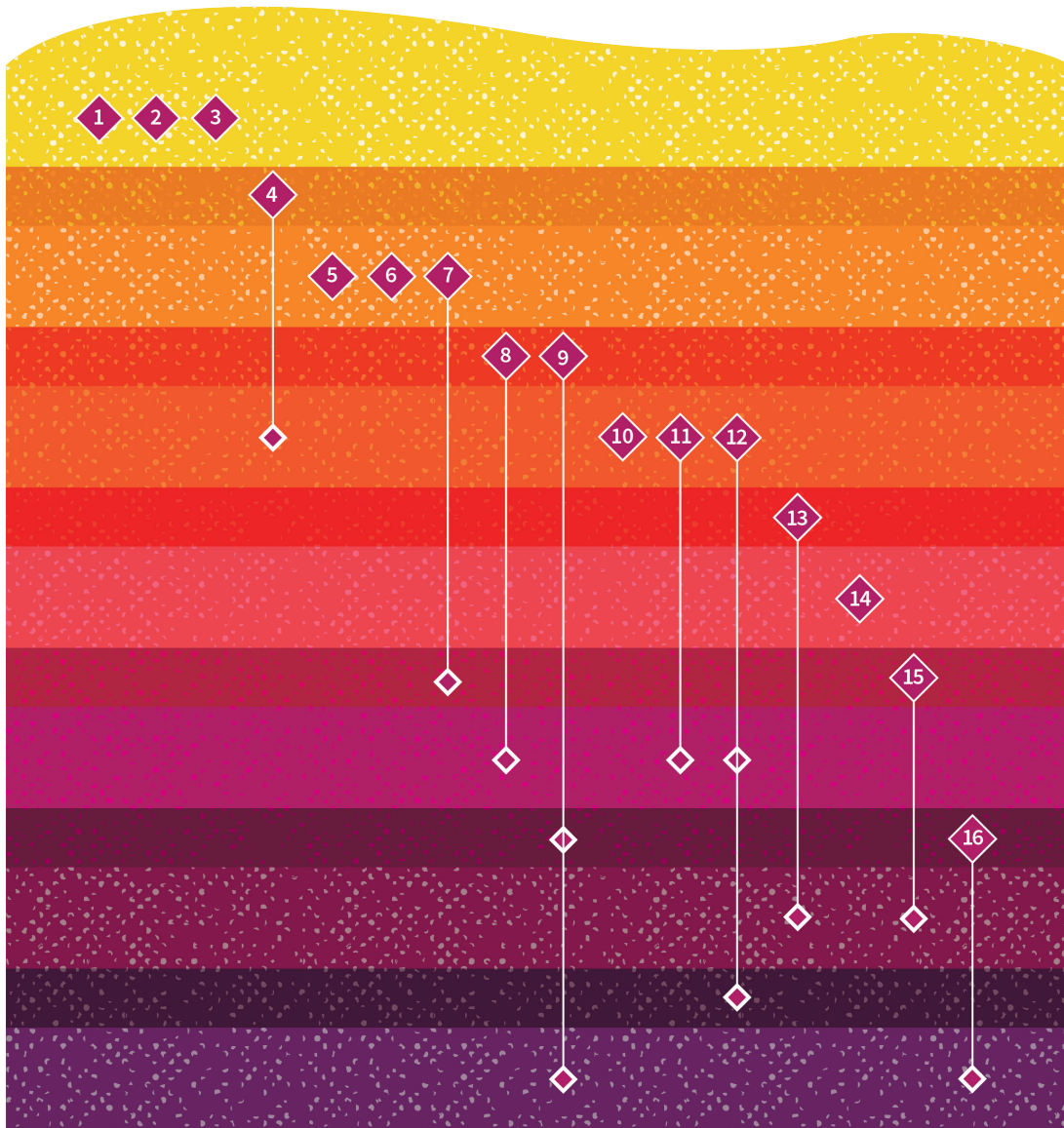


new or vintage?



device dependent or independent?





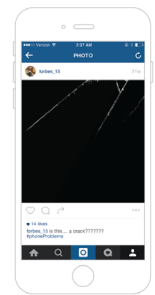
Img 22. Map and sequence of exhibition

ENTITY	1. Adding life to devices
INTERACTION DEGREE	2. Object lineage
MATERIAL AFFORDANCE	3. Device anniversaries
DEVICE INTELLIGENCE	4. Pet your phone
INVISIBLE ARTIFACTS	5. eBook pop quiz
CONTEXT	6. Bookmark keeper
DEVICE FAMILY & THE GREATER NETWORK	7. Know your files
	8. Art of Instagram
	9. Visible cloud
	10. Twenty songs only
	11. My accounts are all mine
	12. Desk replica service
	13. Transformer screen
	14. Bilingual detector
	15. Context-driven interface
	16. Avatar all my stuff

Lastly, the participant explores the 16 concepts using the description, simple sketch, leading questions, and related literatures provided with each idea. For the prototype, individual cards were made for each concept, so people could easily share and shuffle through. Each card is numbered to indicate sequence, and also labeled with the facets of device adoption they fall under. The categories are color coded for better recognition.

1 ADDING LIFE TO DEVICES

A phone has a social media life on its own. It keeps a feed of its own experiences of the world. It complains that it's running out of batteries, it shops around and likes new external camera lenses released for its model.



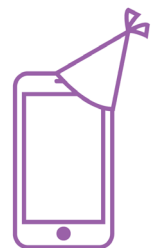
QUESTIONS

What if the phone starts judging you?
Should the device only exist to cater to your needs?

entity

3 DEVICE ANNIVERSARIES

A phone celebrates its journey with its user from its initial purchase/acquisition. It announces and sends messages about anniversaries and makes notes on the calendar of exciting events that have happened in the user's life with the phone by his/her side.



QUESTIONS

Do you treat your phone with care?
Do you remember which devices are present at different points of experiences?

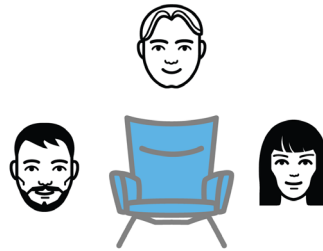
entity

"Devices are hence the opposite of focal things; they are disposable, often mass-produced, discontinuous and detached from any larger context, and appealingly glamorous."

A different way of seeing: Albert Borgmann's philosophy of technology and human-computer interaction
Daniel Fallman

2 OBJECT LINEAGE

Objects often get passed down through people. What if each object that one receives from someone comes with a lineage or a story? One gets to hear about where it was, what it was used for, who used it, etc.



QUESTIONS

How would this model work for devices?
When would you want to access the data?

entity

"Amplifying the histories of things involves designing emergent and evolving representations that reflect aspects of a person's experience with a particular thing, in turn, altering the way a person engages with and experiences that thing. This material-hermeneutic cycle, prompted by the physically evolving representation, may encourage meaningful human-artifact relationships that develop and endure with time."

Material Awareness: Promoting Reflection on Everyday Materiality
James Pierce

"In any landscape, some artifacts survive and some 'die' and become 'extinguished.' We have found that most people have evidence of this in their homes in the form of older devices no longer in use, but still saved in drawers or garages."

Device Landscapes—A New Challenge to Interaction Design and HCI Research
Erik Stolterman, Heekyoung Jung,
Will Ryan, and Martin A. Siegel

4 PET YOUR PHONE

The phone is an electronic pet. On top of charging by plugging in, it requires the user pet it enough to "feel" better about performing. It acts up whenever it hasn't received enough attention or care. The user caresses it by holding it close to him/her, and it charges and performs faster with extra care. If it detects that a part is not working, it starts to show its discomfort by vibrating, making noises, and turning lights on.



QUESTIONS

Do you ever pet your devices to encourage them to perform better?
Would this be more appealing to children?

entity + interaction degree + material affordance

"We found clear evidence of appropriation, in that people carried about with them small personal artefacts such as mobile phones, jewellery and photographs. This (physical) intimacy suggests that people are attached to things which they have made their own."

Emotional and Aesthetic Attachment to Digital Artefacts
Phil Turner and Susan Turner

5 EBOOK POP QUIZ

An e-book app/device quizzes the owner on the book he/she is reading upon resuming. It throws random fun facts or interesting insights to enrich the owner's reading experience. It even makes suggestions for the next book when finished.



QUESTIONS

Will it matter what kind of book you're reading?
How would you design the frequency and timing of the quiz to make sure the service adds to your reading experience?
Would you feel interrupted?

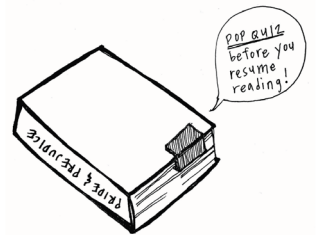
interaction degree

"As digital objects become smarter and more autonomous, the balance between intimacy and intimidation needs to be also critically considered in terms social effects of design intention that goes beyond observed user needs."

*Digital Form and Materiality: Propositions for
A New Approach to Interaction Design Research*
Heekyoung Jung and Erik Stolterman

6 BOOKMARK KEEPER

It's a spin on idea five, but now there's a real lock that functions also as a bookmark. It clamps onto the portion of the book left to be read. Every time the owner resumes, the "lock" throws him/her questions based on the content one has most recently read. For instance, when about to read *Guns, Germs, and Steel*, and the lock asks the reader, "when are humans predicted to have migrated towards Eurasia?"



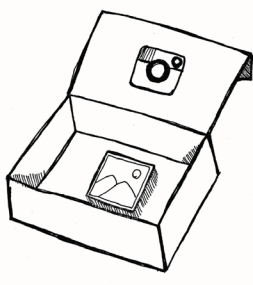
QUESTIONS

Will hearing the question (versus reading the question) feel differently? Does the device add "voice" to your book?
Can this create a group experience?
Will you start hate reading? Does it feel like you're locked out of your own book?

interaction degree

8 ART OF INSTAGRAM

The art of "posting" something online has become more difficult, laborious, and slower. For instance, when one wants to post a new photo on Instagram, he/she has to submit a real photo to the FB headquarters in California (in a nice package). If the user wants to delete what is already posted, he/she has to request FB to return one's submission and literally destroy the artifact.



QUESTIONS

Is it too much work?
How important is real time publication?
Does your mobile camera seem/feel differently to you?

interaction degree + material affordance + invisible artifacts

"The attachment such products (postmodern products) evoke concerns their meaning and not themselves as material objects. They could, after all, be replaced by any other object with the same sign-value."

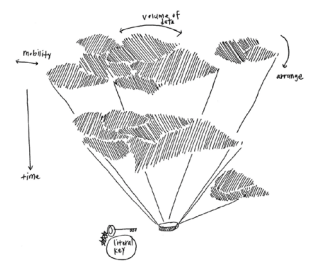
The Things That Matter
Peter-Paul Verbeek and Petran Kockelkoren

"For the photographers, whose shared values express the strong belief that the artistry of photographic production happens at least as much in the darkroom as it does behind the viewfinder, the process of print production is critically important. However, the question of what it means to 'make' a print – to have control over this process, and to possess the means to make it – is thrown into question by digital photography."

*Media as Material: Information Representations as
Material Foundations for Organizational Practices*
Paul Dourish and Melissa Mazmanian

9 VISIBLE CLOUD

Cloud storage now sits in a single, portable object (like hard drive with wifi). It is accessible with a physical key or touch ID. When opened, it visualizes all of user's data by the way he/she organized them.



QUESTIONS

Is it reassuring to have a physical thing that represents your invisible and intangible things?
What would feel/look like to hold your data?
Would you carry this around with you?

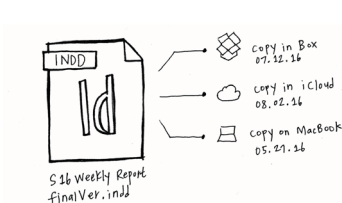
interaction degree + material affordance + invisible artifacts
+ context + device family & the greater network

"The seams are perceivable—the technology is 'seamful'—but we can call the whole system a single, hybrid object because coupled use of the parts is so unproblematic in users' interaction i.e. interaction is non-rationalized and seamless."

Seamful Interweaving: Heterogeneity in the Theory and Design of Interactive Systems
Matthew Chalmers & Areti Galani

7 KNOW YOUR FILES

Each digital data has a map of which device/cloud it sits in, making sure the user can trace any duplicates. People often keep multiple copies of files all across their digital landscapes without much awareness of their organization system and get lost, giving up and taking advantage of the "limitless" space provided in the digital sphere.



QUESTIONS

What meta data would help you learn more about a group of files without having to open them?

interaction degree + device intelligence + invisible artifacts

"Information and the underlying technologies used to produce, process, and represent it can be seen as mediating reality (Kallinikos 2011)."

"When traces in digital material are interpreted in order to understand the activities that caused them, they can be seen as mediating a relation with the world. Specifically, this is a hermeneutic relation in which some aspect of the world is transformed into a text which is then read.(24)"

"These traces are both marks and connections, the visible result of a chain of actions that begins in the physical world and is propagated through the various layers and processes of digital substrates."

The Mediating Role of Responsive Digital Materials
Heather Wiltse

"We are exploring ways of both improving the quality and broadening the bandwidth of interaction between people and digital information by: allowing users to 'grasp and manipulate' foreground bits by coupling bits with physical objects, and enabling users to be aware of background bits at the periphery using ambient media in an augmented space."

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms
Hiroshi Ishii and Brygg Ullmer

10 TWENTY SONGS ONLY

This music player only allows the user to keep 20 songs, so the list one creates is highly curated, thought of, and designed. There are no shuffle or fast forward features, so sequence is quite important. Editing this list requires the user to do manual work (similar to burning a CD, not being able to revisit the content).



QUESTIONS

Are you always bound by space?
Will you end up enjoying each song more or less?

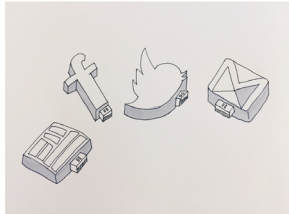
material affordance

"We see a real opportunity to advance the design of pleasurable products by actively searching for opportunities where interactive products can more explicitly engage people in identity construction activities. We call this design approach 'designing for the self.'"

Reverse Alarm Clock: A Research Through Design Example of Designing for the Self
Kursat F. Ozenc, James P. Brommer, Bong-Keum Jeong, Nina Shih, Karen Au, John Zimmerman

11 MY ACCOUNTS ARE ALL MINE

What if all one's personal social media data is stored in one object? All of his/her previous posts, shares, likes, reactions, bio info, views, and all kinds of cookies data only exist in single form in an external device. And logging in would require plugging in the device each time. One can also decide to get on or off the grid entirely by configuring this device.



QUESTIONS

How much thought do you put into posting content on your social media accounts?
Would this be (more) secure storage?

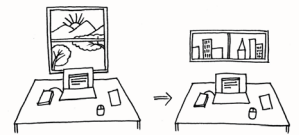
material affordance + invisible artifacts

"The objective in design is to provide tools and services that empower and enable people themselves to address their social, rational, and emotional needs. Equality, autonomy, and control are the goals of empowering design."

*Finding Meaningful Uses for Context-Aware Technologies:
The Humanistic Research Strategy*
Antti Oulasvirta

12 DESK REPLICA SERVICE

A service that replicates the user's home work space. It copies the models of all his/her devices, placement, and even the tiniest details like the feel and sound of each key in the keyboard, dents on the devices, and finger print marks on the screens. It's updated daily so that wherever the user works, it feels like he/she has never left one's original desk at home. The interfaces are synced perfectly as well.



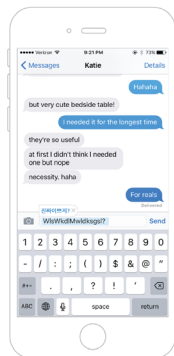
QUESTIONS

Does this design encourage better work flow?
Do you have specific habits or expectations around your work space?

material affordance + invisible artifacts + context +
device family & the greater network

14 BILINGUAL DETECTOR

If a phone knows that the user is multilingual and often switches the keyboard to talk to other multilingual friends, the keyboard automatically picks up words in appropriate languages regardless of the keyboard mode.



QUESTIONS

Which languages would best apply for this service?
Would precision be a concern?
How long would it take to get used to this function?

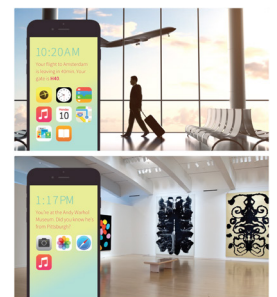
device intelligence

"Particularly for digital devices, many are interested in new technologies and find specific needs based on their knowledge; the more they learn, the more specific their needs become. Even though some people may become really attached to certain things in this way, it may be seen as temporary compared to what we mean by ensoulment or heirloom status (because an object is easily exchanged for another object with improved functionality)."

*How Deep Is Your Love: Deep Narratives of
Ensoulment and Heirloom Status*
Heekyoung Jung, Shaowen Bardzell,
Ell Blevis, James Pierce, and Erik Stolterman

15 CONTEXT-DRIVEN INTERFACE

The device screen automatically changes the arrangement of the owner's apps and other mobile services based on the space he/she is in. For instance, when at the airport, the screen enlarges the clock and highlights travel and scheduling apps to make sure the owner is best assisted in his/her travels. It also pulls up the news and ebook apps to keep one entertained during wait periods.



QUESTIONS

Do you remember where things are on your interface?
Would you feel assisted, helped, or interrupted?

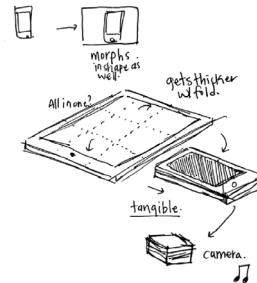
device intelligence + invisible artifacts + context

"Thus we included a small text display that showed the name of the place nearest to the Table's virtual location, allowing people to track their approximate whereabouts from memory or by checking a map."

The Drift Table: Designing for Ludic Engagement
William W. Gaver, John Bowers, Andrew Boucher,
Hans Gellersen, Sarah Pennington, Albrecht Schmidt,
Anthony Steed, Nicolas Villar, and Brendan Walker

13 TRANSFORMER SCREEN

In order to declutter the number of devices and boost efficiency, devices are foldable based on need (as determined by the user). For instance, a tablet-size interface is appropriate for work, while mobile-size screen is more fit for making calls and sending quick texts. The object is aware of these changes and adjusts the content and organization of the interface accordingly.



QUESTIONS

Would this improve your work flow? How about mobility?
Does having just one device versus many boost convenience? Or
create more anxiety about the possibility of losing the device?

material affordance + device intelligence + context

"Instead of having a smart environment track you, you can have your smart device track the dumb environment."

Achieving Ubiquity: The New Third Wave
Chris Harrison, Jason Wiese, and Anind K. Dey

"Approaching computational power from the perspective of texture encourages designs to achieve particular effects by considering potential material properties desirable for interaction. From this vantage no interface or computer need be integrated into the environment. Rather, the environment would be composed of relations between materials, or textures, that might have new kinds of names. This kind of sensibility, already present in architecture and industrial design, might find its way into the working vocabulary of interaction designers."

Texturing the "Material Turn" in Interaction Design
Erica Robles and Mikael Wiberg

"So a thing is unique not only to a specific person, but also to a specific person at different points in time and space."

Press Play: Acts of Designing (in) Fluid Assemblages
Johan Redström and Heather Wiltse

16 AVATAR ALL MY STUFF

A portable, all-encompassing SIM card that personalizes every device that it the user comes across. For instance, when the user puts it physically next to a random phone (doesn't matter who the physical device belongs to), it brings up one's platform, IDs, settings, interfaces, whatever screens that only the user been using, with all your information. When he/she pulls out (literally move away with it), all info leaves the display and "walks away."



QUESTIONS

What kind of objects could make effective icons?
Does this make sharing easier?
Is access enough or do you still want to own your devices?

invisible artifacts + context + device family & the greater network

"Whenever people learn something sufficiently well, they cease to be aware of it... that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals."

The Computer for the 21st Century
Mark Weiser

PROTOTYPE: FEEDBACK

The prototype of the exhibition was tested with seven participants (five independently, two in a group) using concept testing method. Concept descriptions were read out loud sequentially (the sequence was edited and changed along the way) with simple sketches. People shared comments on feasibility, preferences, likability, and practicality of each concept. When conversations came to a halt, I facilitated the discussion with follow up questions to allow participants to think more deeply and critically.

I took notes and made audio recordings of the testing sessions. Some concepts, especially ones that were highly speculative, elicited similar negative reactions while some received divided feedback based on different taste profiles. For instance, people showed strong aversion to **IDEATION 4**, Pet Your Phone, since they thought they were already spending enough time on their devices and the service would require unnecessary work. On the other hand, everyone responded positively to **IDEATION 7**, Know Your Files,



Img 23. Individual concept testing

for its practicality and helpfulness. Such observations showed that there was a general barometer for how much and the type of engagement from devices people were willing to tolerate. Services that offered interaction beyond that of functionality were considered laborious and unnecessary, and people had strong opinions on how much assistance they needed.

Some ideations revealed that people had different preferences about how device interactions should be designed. Some thought that **IDEATION 14**, the transformer screen, would boost mobility by consolidating devices into one and being able to pack light. Another participant in contrast considered the design hazardous and showed concern that the all-in-one approach would create anxiety by assigning too much value into a single device. Many people shared potential problems with **IDEATION 15**, the context-driven interface. Users put work into arranging their screens and develop navigation skills by habit and memory, and automated redesign of screen organization would prevent building stable mental interaction models. A participant, who described herself as quite trend-sensitive, had a more positive reaction to **IDEATION 15**. She shared, “This could be a suggestive thing... if I’m in an art museum, and an app maybe that I don’t have or that I do have comes up, then It’ll make me think, oh, do people use... would this enrich my experience in the art studio? So it’d lead to question using different

Response to Ideation 2, Object Lineage modified to apply to used phones:

“I don’t think I want to know all their personal information, but... who it came from, where it’s been, kinda connecting humanity.”

Responses to Ideation 4, Pet Your Phone:

“I keep my phone next to me enough.”

“I don’t want to feel more obligated than I already do. I already feel gross about my obsessive compulsiveness with it, and my obsession with it already. I don’t want to turn that into ‘now I actually have to keep it alive.’ It turns into a necessity...”



Img 24. group concept testing

Response to Ideation 9, Visible Cloud:

“The idea of having this object freaks me out a little bit because I break things and I lose things. And I don’t want to lose it or break it.”

apps in different environments.” She was open to new experiences and possibilities created by smart suggestions. The same participant also showed interest in **IDEATION 6**, the bookmark keeper, while others were quick to dismiss it as an annoying service. She suggested that adding a component to the service that lets other people join conversations about the book one is reading would create more meaningful and enjoyable experiences. Human-device relationship may be considered insignificant, but a device-enabled relationship, the human-device-

human model, is valuable to users—creating narrative during device interactions often surfaced as important components. For instance, most people were opposed to **IDEATION 10**, Twenty Songs Only, but some suggested that they would use the product as meaningful gifts to others.

Regardless of whether people identified themselves as a minimalist or collector, people shared about similar behaviors when it came to information storage. Participants throughout the research have often mentioned their habit of creating multiple copies of similar documents, across local, external, and shared drives. This phenomena is partially fed by limitations on device networks and syncing (refer to chapter on *Device Families and The Greater Network*). However, I also found that such practices also give users comfort in knowing that there are multiple copies of files and that they are safe even if devices malfunction or clouds fail. Interviews revealed that people still had distrust and doubts about technology performance.

Overall, observations and testing sessions revealed three major insights. First, users prefer to keep a distance between their devices as mediums of service and wish to exercise strict control. Ideas that deviate too far from contemporary practices often evoke quick distaste. Secondly, people have very different inclinations for interaction degrees, and device interactions cannot be

standardized to fit all types of users. And lastly, there is underlying tension and doubt people share about the robustness of digital devices and services, and the issue is not addressed perfectly in the current design.

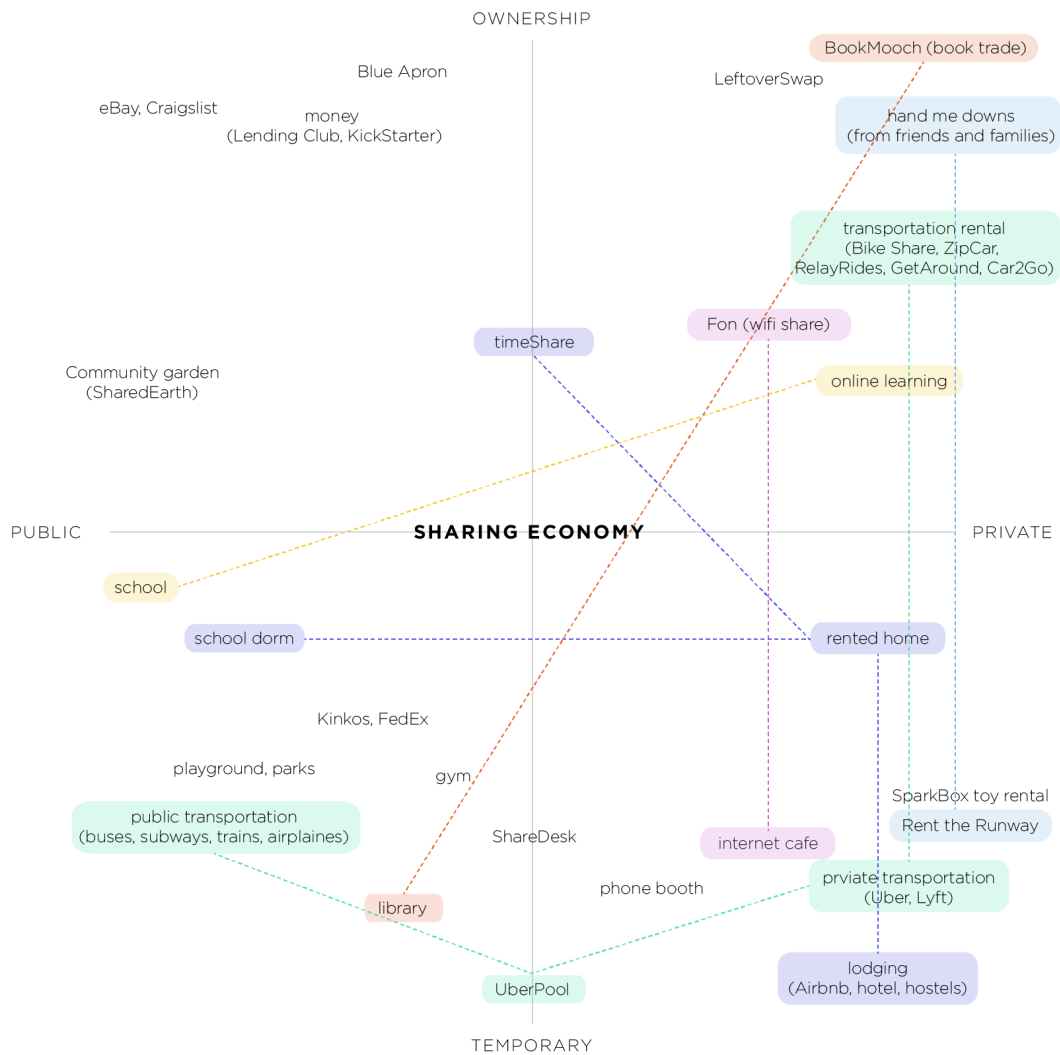
The format of the testing was promising in some aspects but also revealed room for improvement. Sessions moderated with leading questions and feedback led to rich conversations, and some participants even suggested ways to improve ideations based on their preferences. Some considered the exercise as a simple interview while there were others who were more aware of the objective of the thesis and the insights it shares. Moving forward, the session would be more meaningful with a clear introduction to the context and its goals and make stronger ties between research insights and the participant's sense of device ownership.

SUGGESTIONS & MOVING FORWARD

The research explored device adoption as a territory, and through an iterative process of ideations, literature review, and empirical studies, seven major facets were identified as definitive sub-areas. Each facet was then supported by rationale, relevance, and analysis of opportunity areas and summarized as follows:

- **Entity**, the life of a device, explores how relational value is built between a user and his/her device.
- **Interaction Degree** reveals people's growing technical competence and engagement in the design of interaction experiences
- **Material affordance** is recognized as an emerging, exploratory territory as technology has allowed physical modularity in production
- There is ongoing power dynamic between users and **Device Intelligence**, and a large gap between device form and data
- **Context** is a rich source of usability cue
- **Device Family & The Greater Network** looks at device-to-device compatibility and problems in achieving seamless device experiences

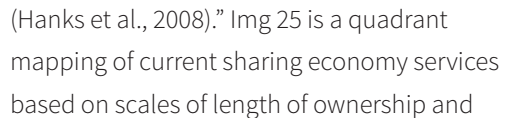
The research suggests a new design method for territory scoping. The explorative approach delivered a comprehensive survey of a design topic and revealed a body of insights about the current status of user needs and concerns, trends, and major areas for innovation. The survey serves as solid, early-stage research and a critical step to identifying opportunities for specific product development. The body of ideated concepts show previews of potential solutions and a comparative summary of the field. It also serves as an effective communication tool when interacting with users and clients. Such design method can be implemented in the exploration of various research areas. Early territorial survey helps designers grasp the industrial and academic climate of their topics and determine areas of critical user needs. It's an effective sense-making exercise when approaching unfamiliar field or an



Img 25. Mapping of sharing economy services
(reference, "Collaborative Economy Honeycomb Ver 1.0"
by Crowd Companies)

extensive topic and will encourage improved contextualization of a design challenge.

Moving forward, it is important to note that research as such is difficult to put a definite finish to, and with rapid developments in technology, there will be more explorative areas to study. Also, the presented work was catered and tested specifically to millennials (people in their 20s and mid-30s), and a different user base may generate very different outcomes. Lastly, work should be done to applying the project into various contextual scenarios.

Major areas not included in the current scope of research are implications on sustainability. With sharing economy becoming a central model for many object ownership experiences and services, it is worth looking into how understanding of private ownership of personal devices can be challenged and altered. Current speculations on what could constitute as sensible and environmentally friendly solutions to rapid device turnovers are based on limited considerations on device detachment. Hanks and her colleagues write that, “Shipping old electronics overseas so that parts can be harvested, equipment can be donated to needy organizations, or precious metals can be salvaged has become a common practice. Numerous problems complicate such forms of reuse and recycling (Hanks et al., 2008).”  is a quadrant mapping of current sharing economy services based on scales of length of ownership and

privacy. It would be interesting to see how device ownership can fit into this map.

Device Entity and *Device Intelligence* are merging progressively as intricate sensors and artificial intelligence are creating products that are extremely sensitive to human input. Embodiment has been taken metaphorically and literally in a sense that technology is performing beyond the role of an assistant. Cassel wrote in 2001 that “ECAs (embodied conversational agents) that engage humans in natural face-to-face conversation, including speech and nonverbal modalities such as gesture, gaze, intonation, and body posture” (Cassell, 2001). The advances for smart entities have been discussed for a long time, but haven’t been embedded fully into personal devices, leaving speculations for future designs.

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usb: <https://thenounproject.com/search/?q=usb&i=25896>

hard drive: <https://thenounproject.com/search/?q=external+drive&i=29499>

camera: <https://thenounproject.com/search/?q=camera&i=308298>

psp: <https://thenounproject.com/search/?q=psp&i=45110>

console: <https://thenounproject.com/ervin.bolat/collection/xbox-consoles/?oq=xbox&cid=0&i=91357>

tv monitor: <https://thenounproject.com/search/?q=television&i=249514>

kindle: <https://thenounproject.com/search/?q=kindle&i=7248>

clutter: <https://thenounproject.com/search/?q=chaos&i=166598>

phone holding: <https://thenounproject.com/search/?q=holding+phone&i=85007>

cd: <https://thenounproject.com/search/?q=cd&i=234878>

earphones: <https://thenounproject.com/search/?q=earphones&i=379899>

heart: <https://thenounproject.com/search/?q=heart&i=275169>

APPENDIXES

INTERVIEW QUESTIONS

- Tell me a story about moving.
- Can you recall the last time you moved? Could you share your experience?
- Which items needed most care?
- Which items did you ship separately and brought with you?
- Tell me about a guilty decision to throw something away rather than bring it with you.
- Do you take care of some things more than others? Which, why, how?
- What items do you have special attachments to?
- What were the things you threw away? or left with someone else, or even donated/gifted to others?
- Do you use sharing services like Uber, Lyft, AirBnB, Craigslist? Or does your family have a timeshare? And do you find them convenient? If not, why?
- When was the last time you lost your phone/ laptop?
- OR when did you last replace your phone, gadgets and for what reason?
- What was your reaction?
- Were you more concerned about the device or the information in it?
- Do you decorate/leave marks on your devices to show that they are yours?
- when is a device finished? and what do you do with them afterwards?

SURVEY QUESTIONS (SURVEYMONKEY.COM)

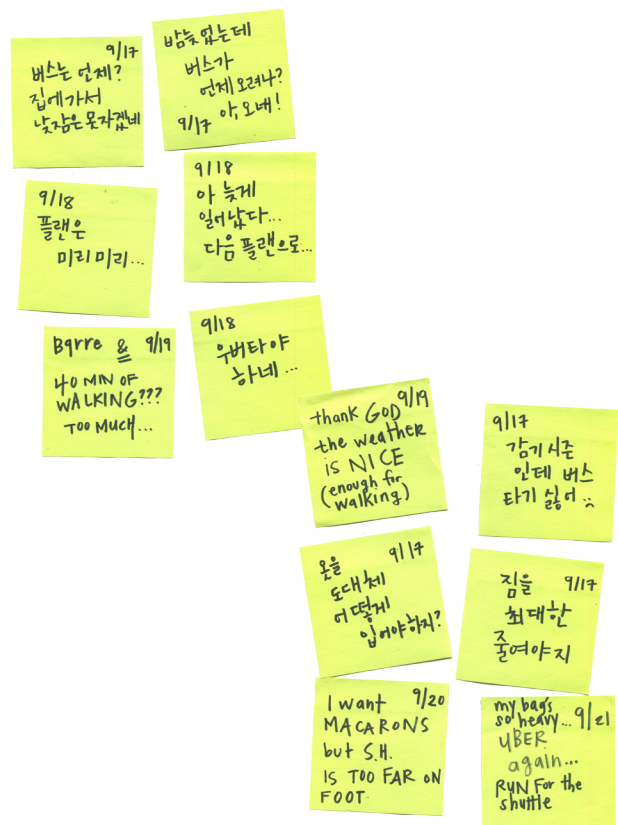
1. Do you ever “talk” to your things (computer, phone, alarm clock, refrigerator, etc.)?
2. If yes, can you elaborate?
3. Were you ever annoyed with things that talk to you (Siri, Echo, GPS, low battery signs, etc.)?
4. If yes, can you elaborate?
5. When you are talking to/with a responsive object (e.g. Siri), do you feel like you own that entity or do you feel like are talking to another person/ machine/etc.?

WORKSHOP DIRECTIONS

1. Where do you identify yourself on this spectrum?
Are you a minimalist or a collector? Why do you describe yourself that way?
2. Using these props, can you talk through all the devices you have as you place them on this board?
Tell me if there are any devices you don't use but still own.
3. Now using these lego blocks, can you quantify how much data you have stored in all these devices?
Place them on the devices accordingly; if there are on the cloud, put them around the devices and make sure you note them through sticky notes.
4. Are there information/data you get access to, but now own? Draw them with these bigger wooden blocks.
5. Are there material extensions of these things?
6. Can you tell me about an organization system implemented in this sphere?
7. Going back to the first question, do you now think differently about your self-evaluation?

PERSONAL EXPERIMENT (UNMENTIONED)

Personal experiment on living without personal car:
comments recorded on sticky notes



IDEATIONS (UNMENTIONED)

01. Moving Barter

: a bartering service that replaces the exact goods that movers leave behind with used ones in the new location

By leveraging what movers donate as what they can later receive, the service encourages people to keep goods in tradable conditions and prevents quick disposal when moving to distant locations. For example, if movers donate four chairs in good condition, they receive four equally valued chairs available in their new location.

02. Heirloom Album

: a photo journal of every user's happy memories with hand-me-down products

It borrows from how people add meaning to heirlooms and adds emotional value to durable goods, such as toys, clothing, and furniture, to encourage sharing.

03. Travel in Style

: clothing rental service at the airport for departure that rents out your entire wardrobe based on your style and the weather of your travel destination

The service packs a wardrobe of rental clothing based on the consumer's length of travel, weather of the destination, and professional styling advice. By renting an entire luggage, consumers don't have to buy new clothing that are destination-specific (a Californian traveling to Alaska). Also, fashion stylists design smart combinations of clothing to minimize number of items and maximize variety of looks. It encourages consumers to carry less, purchase less, and add another element of 'new' to their travel experiences.

04. Dorm Kit

: rental service that rents an entire dorm kit for semester at a time

Throughout four years, college students need to pack, unpack, and repack their entire belongings at every end of the semester or year. This consequently creates massive amount trash of perfectly usable goods. The Dorm Kit service rents out a consumer-selected kit of dorm-specific goods (bed risers, side tables, cabinets, lamps, bean bags, mini fridges, etc) and delivers/picks up the kit based on college calendars.

05. "Mommy" Study Lamp

Your study lamp assesses your schedule and "calls" for you to complete your work and assignments.

06. Professor Bookshelf

The bookcase keeps record of the collection of books it carries and analyzes the diversity, level of difficulty, and chronology of publication. It informs readers of new releases and makes appropriate suggestions as the owner matures in age and intellect. It encourages readers to finish reading by sending previews via the reader's phone of the turn of events in the book that the reader has started but didn't finish.

07. Friendly Umbrella

The umbrella makes noises when the owner is about to leave the house whenever it is raining outside or will rain later in the day.

08. Honest Carpet

The carpet's color saturates, counting the days from the last day it was cleaned. It's an honest, but embarrassing way to tell the owner to clean more often and regularly.

09. Car with Friends

The car refuses to start if you haven't driven with company in the non-driver seats for a certain period. Or it reminds you how lonely you may be if it hasn't detected any company. Perhaps it starts to play songs that talk about loneliness to emphasize.

10. Smart Washing Machine

The washing machine scans the clothing it is about to wash and tells the user to separate certain colors or directs him/her to select certain settings based on the material. It informs and teaches how to clean. It also indicates the machine's cleanliness level and when next to change certain parts. It spits clothes out if the appropriate setting is not matched or incorrect colors are put together.

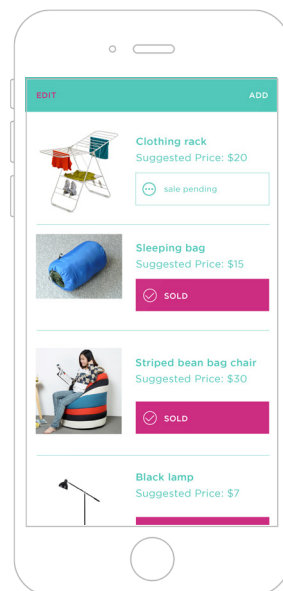
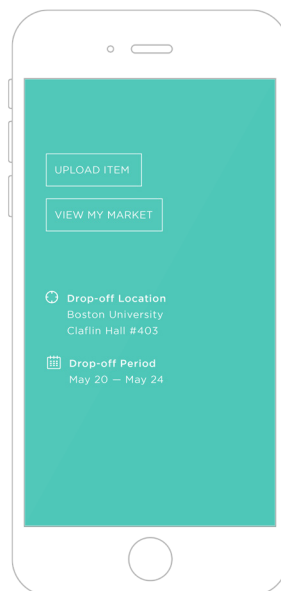
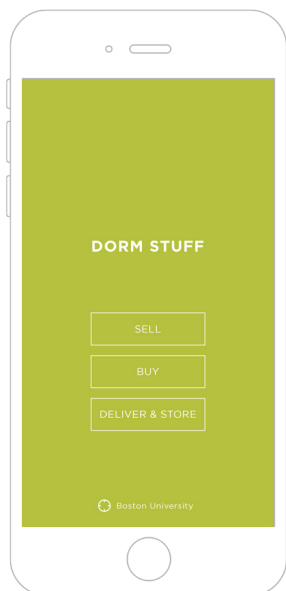
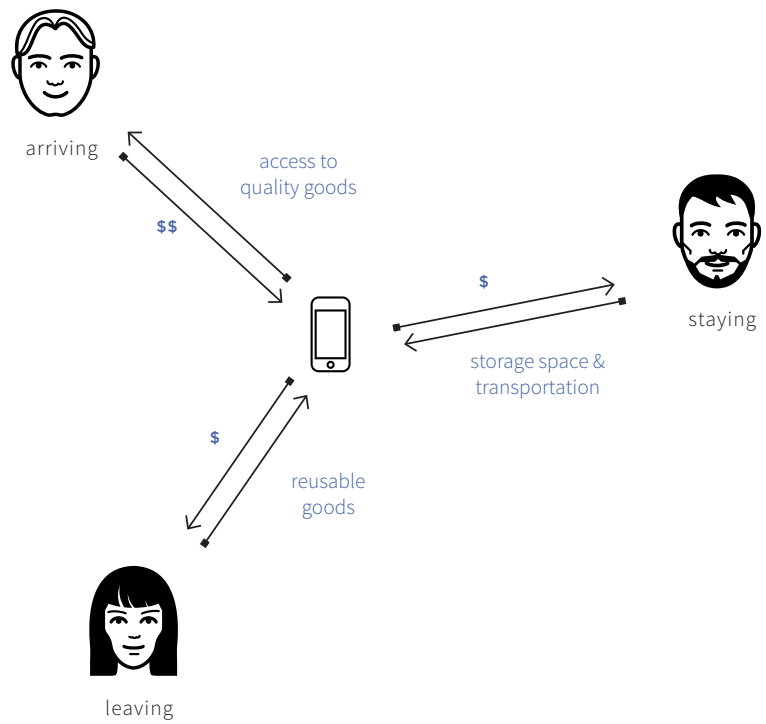
11. Memory Sofa

Keeps the dent that the last owner made and molds solely based on usage. Newcomers can read popular spots, positions, and follow or pioneer new behavior.

IDEATIONS (UNMENTIONED) - CONTINUED

12. Back to School Garage Sale

This sharing service model connects new and old students on campus as well as local residents to sell, purchase, and store usable goods from annual student moves.



IRB

Carnegie Mellon University

APPROVAL OF SUBMISSION

February 10, 2016

Type of Review:	Initial Study
Title of Study:	Human Relationship with Material Possessions
Investigator: Study Team Members:	Lorraine Shim Cameron Tonkinwise
IRB ID:	STUDY2015_00000222
Funding:	None

The Carnegie Mellon University Institutional Review Board (IRB) has reviewed and granted **APPROVAL as Exempt on 2/10/2016, in accordance with 45 CFR 46.101(b)(2)**.

This approval does not expire. However, if you wish to make modifications to this protocol, please contact the IRB regarding these changes prior to their implementation to ensure compliance with this designation.

The Investigator(s) listed above in conducting this protocol agree(s) to follow the recommendations of the IRB of any conditions to or changes in procedure subsequent to this review. In undertaking the execution of the protocol, the investigator(s) further agree(s) to abide by all CMU research policies including, but not limited to the policies on responsible conduct research and conflict of interest.

Sincerely,

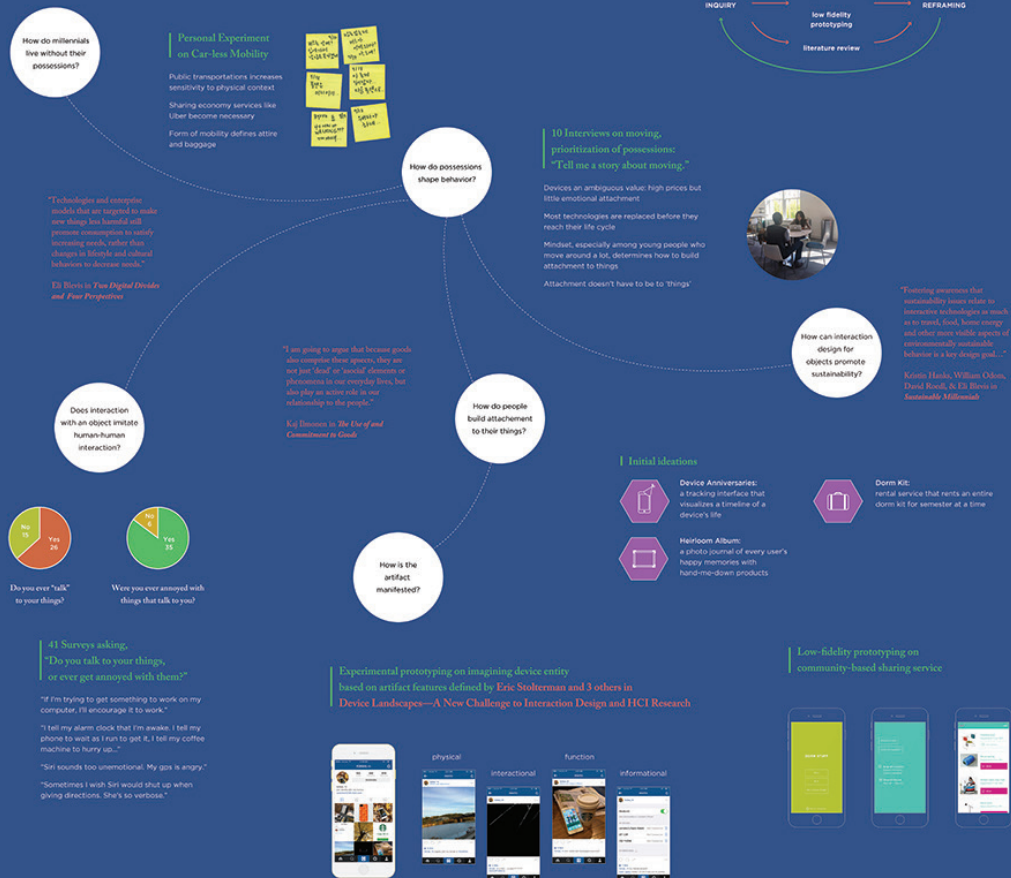


John Zimmerman
IRB Chair

Relationship Domain of Material Ownership

Lorraine Shim, Master of Design Candidate
Cameron Tonkinwise, Thesis Advisor

EXPLORATION & FINDINGS



FUTURE WORK

Continue pursuing the inquiry-driven research process
Explore and collect a sizeable portfolio of domain areas within the topic
Narrow down target areas for ideation and in-depth concept development

Does interaction with an object create a relationship?

How can appropriation be designed?

How can design improve transfer of ownership?

REGISTRATION OF IDEAS

Last modified December 17, 2015.
For mid-year thesis presentation

INTERACTION DOMAIN OF DIGITAL DEVICE ADOPTION

CREATING DISCOURSE AND SPECULATION AROUND DEVICE EXPERIENCES

Lorraine Shim, Master of Design Candidate
Professor Cameron Tonkinwise, Thesis Advisor

ABSTRACT

The 21st century is crowded with innovation, new technologies, and expanding networks. In the midst of such change, designers have been advocating for the opportunity to pause and assess the objects that we have been surrounding ourselves with. Erik Stolterman and his colleagues wrote in *Device Landscapes* that "The number of interactive digital artifacts is growing surrounding personal lives, and individuals have an increasing need to describe, analyze, and interpret what it means to own, use, and live with a large number of interactive artifacts."

With the emergence and rapid proliferation of technology devices, the divide between tangible and intangible things have been challenged, and invisible things such as information and data have emerged as important extensions of personal devices. Numerous devices and a

sea of informational artifacts are constantly changing in their intelligence, form, and network, and pose a challenge for users to fully adopt them into their daily interactions.

In response, I conducted an inquiry-driven investigation into the domain of device adoption and highlighted seven key themes in the context of current and speculative technology. The exploration was designed on an iterative model of area definition and research to outline the greater territory. For the sake of a sensible scope, I have limited my target users to millennials who I describe as a unique generation of early adopters that are both active participants and architects of technological change.

To present the research outcome, I propose an annotated portfolio-styled exhibition that curates ideas and explorative concepts that have emerged from each round of research. The exhibited concepts simulate a range of device experiences and encourage pedagogic discourse around current and future models of device interactions. They are designed to induce informed reflection and discussion over innovation of digital devices and on how to build true agency over objects that are constantly evolving and changing.

APPROACH

Iterative exploration for domain mapping:

The research followed an inquiry-driven process with a repeated model of questioning, exploration, and synthesis to outline the territory for device interactions and adoption.



INSIGHTS

Dimensions of digital device adoption:

- ENTITY**
the object that the device projects
- INTERACTION DEGREE**
the degree of task performance
- MATERIAL AFFORDANCE**
physical presence and form
- DEVICE INTELLIGENCE**
the device's learning capacity
- INVISIBLE ARTIFACTS**
the things, systems, and space behind the screen
- CONTEXT**
the environment and orientation of the device
- DEVICE FAMILY & THE GREATER NETWORK**
rooms, families, and security within a body of devices

additional findings

There is a critical disconnect between devices and the data accessed through those devices.

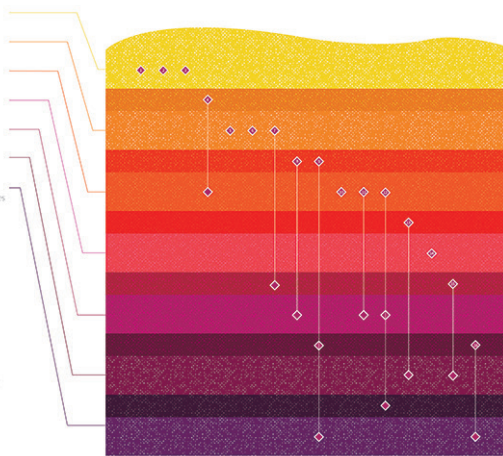
True value of devices are recognized by some as their intelligence and its development and behavior directly based on the user's life experiences.

There is ongoing tension for users to rely less on devices and fight habits.

Presentation of challenging concepts and ideas can prompt active reflection on areas of tension and fragility in current and future interaction models.

RESEARCH OUTCOME

16 interaction concepts from research are mapped across the seven dimensions of device adoption and proposed as an exhibit.



METHODS



"Even though I don't have that many photos... one thing that really bothers me is, I have information everywhere, especially my photos, since I have them all on my computer, my phone, or my camera—often times I don't know how much is overlapped... that's why I choose to keep all of them."

[response to Idea #12]
"The idea of me having this object breaks me out a little bit because I break things, and I lose things."

RESEARCH DESIGN WORKSHOP
LIFE QUALITY PROTOTYPING
PERSONAL EXPERIMENT
LITERATURE REVIEW
CONCEPT TESTING
DATA ANALYSIS
USER TESTING
INTERVIEWS
PROTOTYPING
SURVEY

Taste profile. Users have different interaction preferences and tastes.



1. Applying life to devices
2. Object to image
3. Device environment
4. Physical presence
5. Ability to project
6. Bookmark keeper
7. Know your files
8. Area of images
9. Visible cloud
10. Twenty-four-hour
11. My accounts are always
12. Data exploration
13. Transformer screen
14. Big and small detector
15. Connect down reflection
16. And all things out

Note. Along with a brief description of the proposed interaction, there are leading questions that can facilitate deeper conversations. Reference quotes are also available on the backdrop.

Suggested exhibition experience sequence



FUTURE DIRECTIONS

Investigation into new device-enabled interactions: wearables, virtual reality, and speculative gestural and sensory devices

Observation of device handling at the end of life cycles and implications on sustainability for holistic usage cycle

Thorough and evidence-based documentation of the research journey

Research into different generations

