Modification affordances: user-modified objects as inspiration for evolving industrial design practices

Abygail Berg

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By: Abygail Berg

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Signed by the final Examining Committee:

_____ Chair

Dr. Pippin Barr

_____ Examiner

Dr. Martin Racine

_____ Examiner

Dr. Florian Grond

_____ Thesis supervisor

Dr. Rilla Khaled

Approved by:

_____

Dr. Christopher Moore, Graduate Program Director

_____

Dr. Annie Gérin, Dean of Fine Arts

July 30th, 2025

Abstract

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Abygail Berg

Collapsed into every mundane, everyday object, that surrounds us are complex, mysterious, and interscalar worlds. As we begin to unpack those worlds we develop the understanding that our everyday objects are anything but mundane; rather they carry within them design history, cultural context, the marks of our systems of production, social biases, and possibilities. Using scalar thinking we can expand our perceptions of these everyday objects and open a discussion about who is most often failed by the shifts in scale required for mass produced objects to be designed, manufactured, and used. I propose that by looking at examples of where design has failed, we can learn new ways of designing to minimize exclusionary features.

Examples of user-modified objects were collected from study participants, and interviews were conducted about their relationships to modified objects, and the motivations behind their modifications. The qualitative coding of these interviews suggests reasons why people typically modify objects, considerations for modifications, and insight into the user-modification process. A research-creation process follows, focused on one of the participants' needs for a better grip for the Nintendo Switch. This custom modification process highlights the presence of design elements that allow for adaptations to take place. I propose that these design elements be considered “modification affordances”. Modification affordances can be seen as a point-in-time solution to consider how we might shift production away from mass produced markets and towards individual and custom alternatives, which can serve to benefit both people and the planet.

Keywords:

Industrial design, modifications, adaptability, affordances, inclusive design, disability, mass production, co-design, design theory

Research Questions:

What do user-modifications to mass produced objects contribute to the social critique of these systems of production? How can user-modified objects teach designers about inclusive design practices?

Land Acknowledgement

As a settler on the land which we today call Canada, it's of importance to me to begin this piece of academic work by positioning that my interest in the topics of this thesis stem from a foundational belief that all people deserve to live safe, comfortable, and dignified lives. Many of the systems discussed in this thesis which perpetuate cycles of poverty, marginalize people with disabilities, and lead to the environmental devastation of our lands are the same systems that historically and presently oppress the Indigenous peoples of Turtle Island. Any future we imagine for this land must include meaningful and realised reconciliation, collaboration, and decolonizing practices.

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To my research participants: without your ingenious, creative, and insightful modifications, this research would not exist. Thank you for daring to shape the world to work for you, and for taking the time to share conversation with me.

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Introduction

Everyday we interact with designed objects. They are our toothbrushes, phones, door handles, shoes, coffee mugs, chairs, game controllers, railings, faucets, umbrellas, beds, and the list goes on. These everyday objects afford us the ability to go about our daily lives; to eat, move, work, and play. When these interactions go smoothly, the objects fade into the background of the day-to-day. But when there is friction in the interaction, users must acknowledge the design of the object and decide to either continue using an object that does not meet their needs, find a new one, or modify the object in some way. This research explores the potential of user-modified objects to help inform more inclusive, malleable, and sustainable design practices, asking: What do user-modifications to mass produced objects contribute to the social critique of these systems of production? And, how can user-modified objects teach designers about inclusive design practices?

Our everyday objects exist at complex intersections of scale which they carry with them into their use. The competing forces of design process, manufacturing, human bias, and systemic contradictions collapse into all the little things around our houses. Though as designers it can feel impossible to unravel these competing forces in a way that makes better design possible, looking at moments of design failure can be a starting point. Documentation of the considerations, failures, and processes involved in user-modification helps create a dialogue between users and designers, to allow for designers to expand their understanding of the diversity of user needs. By looking at moments where design fails, we can learn more productive paths forward. Thus, this research centers the collection of real-world examples of objects of friction as case studies to learn form in order to uplift the collective voice of the everyday users, and challenge designers to consider everyday objects from new viewpoints. This practice allows me to seek out patterns and categories that can aid designers in empathizing with others during their design process, and importantly, it also provides knowledge grounded in the real world which addresses topics that are relevant to the practice of industrial design today.

Situating the research

The following section positions the realities of industrial design today, especially as experienced within a North American context. By unpacking the complexities of the different individuals, industries, and cultures that come together to make our everyday things, I then highlight moments of injustice or exclusion that exist within (and because of) these relations. When we observe the complexities of these problems, we see that equally complex answers are needed.

Everyday objects & scale

As I write this I drink coffee from a mug, I can no longer remember where *I* got the mug from, but it says "Made in China" on the bottom. A coffee mug like this one is a designed object, which means a designer once considered it and decided on its form, materials, and aesthetic. It is also a mass produced object, meaning it was made in a large batch and travelled through factories and shipping networks to arrive at its final home. The coffee mug is now owned and experienced by me, the final user. I sometimes get sentimental about the everyday objects I own. I like to think about all the people that worked together to create this vessel from which I now drink. I wonder: Who made the first 3D model of this mug? What design brief did they have? Did they love the design? Who gave the brief? What motivations did they have? Who signed the quote for the factory production of this object? Who made sure the machines were in good working order? Where did the raw materials come from? Who first held this very mug in the factory in which it was made? Who packaged it for shipping from China to Canada? How many people touched the boxes it shipped in? Who put it on the shelf in the store where it was to be sold? Who bought it? The actions of so many individual people come together to create the seemingly mundane objects that occupy our homes, and each individual person also exists within complex systems that impact the choices they make. So, in this thesis concerned with everyday objects I feel it's important to develop a picture of the complex intersections of scale that push against each other as objects come to life.

We can understand the mass production of objects as design at a very large scale; objects are designed and produced in great quantities for the general public or a large subgroup of the

population. Though we can chart a path of creation and production of an object, this path exists within complex lifeworlds of individuals, guiding structures, systems, and prevailing cultural norms. Thus, to observe phenomena like mass produced objects, we must recognize that non-linear methods of understanding are needed, and we must observe multiple levels (scales) and the ways in which they are interrelated in order to provide an accurate picture of the whole (Chapura, 2009). Scalar thinking invites us to consider that "*already within your everyday experiences* are other scales of being" (DiCaglio, 2021, p. 5); as I hold my coffee mug I can zoom in or out from my embodied experience to unfold the scalar relations that make up this interaction. In this thesis, I am mostly concerned with zooming out from the starting point of everyday objects, and taking a look at all the messiness that collapses together to create our daily things. In order to start this task, in the following chapter we will first **investigate three key areas in the life of an everyday object: the design, the production, and the use.** By doing so we will begin to frame the complexity that our mass produced objects hold, and all the frictions and opportunities that exist throughout these shifts in scale.

Design

Social understanding of the role of designers has shifted over time, and situating the role of designer can help to understand the present-day distinction between designer and user. In *Beyond Digital*, Mario Carpo (2023) discusses a social shift that happened within the field of architecture in 15th century Italy, which set the foundations for how we view designers today. Leon Battista Alberti promoted the severing of *thinking* from *doing* in the field of architecture, envisioning a world where construction was performed by silent and skilled workers who loyally followed the instructions of the architect. In this vision architects were the gods of buildings, they were the intellectual forces behind architecture and should be the sole recipient of praise for the building's creation with their intellect deemed separate (and above) the manual labour of the construction workers (Carpo, 2023). This anecdote alludes to the start of the gradual alienation between thinking and making, and today we can still see the lasting impacts of this ideology.

Design itself tends to be slippery and hard to define. There's tension between commercial and artistic motivations in design, and both are also in tension with the material realities of making.

There's a tendency to market design as an intellectual and artistic feat rather than a material one for much the same reasons as Battista did in the 15th century; design being an intellectual pursuit elevates it to "a respected professional activity, rather than [a] less prestigious manual activity" (Raizman, 2004). Though the designers of our everyday objects are rarely seen as the "gods" of their products, today there is a marked separation between designers, labourers, and users. How does this severing of thinking, making, and using impact our things? How does it change what it means to make something? And, how does it change what it means to own something?

In the current digital age we also see this separation morphing into the way we buy and own digital software. We are increasingly moving towards Software as a service (SaaS) models, which constitute many of subscription based applications we use daily for productivity and entertainment. In such models, users are analyzed and considered incessantly but given little to no power to actually make any changes to the programs they use. As we interface with advanced, polished technologies we see very little of the design process or development that goes into the software. This digital "seamlessness" serves to produce passive users who are not meant to think about or engage with the design or production of the technology, but only to *use* it (Ratto, 2007). The presence of seamless design transcends both digital and physical design outcomes. Our things arrive to us complete, made by the professionals, and we are not typically invited to tinker with them lest we void a warranty. In both instances, the less seams that are visible and available to manipulate, the more controlled the boundaries of interaction are, which often disproportionately fail non-normative users.

Whether it's called user-centered design, universal design, value-sensitive design, inclusive design, co-design, co-experience, or something else—designers think a lot about their users. Unfortunately, industrial designers are not always in a position to center their users in their creation processes. Industrial designers work within complex systems of manufacturing in which they are often not in control of design briefs or goals, meaning that they can unknowingly or *unwillingly* reproduce harmful cycles of exclusion through their work (Costanza-Chock, 2020). We begin to see here some of the first frictions between scales, that of the intentions of individual designers, and the goals of the companies who stand to profit. As *designer* becomes separate from *maker* and *user*, so too does *design* from *production*. In the next section we will

take a brief look at the state of mass production and the evolution of the globalized manufacturing chains designers find themselves working within today.

Mass production

"Between 1800 and 2010, world manufacturing output rose by an average of 2.6 percent a year" (Marsh, 2012), and this 200+ years of growth has seen the development and solidification of physical and systemic infrastructures to facilitate this change. Fueled by Fordism and industrialization, the 1950's onwards saw a rapid spike in human impacts on the earth, which has come to be known as the "Great Acceleration" (Steffen, 2005). Energy use, water use, paper production, telecommunications, fertilizer consumption, and transportation mark a few of the indicators of the Great Acceleration, which have all boomed in the industrialized years following 1950, mainly to the economic and consumer benefits of wealthy countries (Steffen et al., 2015). With increased production has come increased global emissions, the generation of excess waste, and the over-use of natural materials.

> Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. [...] Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected. (Calvin et al., 2023, p. 6)

We are currently living in a world defined by two centuries of massive growth in manufacturing, steered by the goal of profits. In this time marked by excessive production, consumption, and waste, there are competing and often conflicting social and environmental considerations to contend with as we look at what the future holds.

Economies of scale dictate that with increased production of identical copies of the same thing, unit costs go down, meaning that the object is less expensive to produce, and can be sold at a lower cost. Even though many people don't prefer the look or feel of mass-produced products, the argument for the consumption of them is extremely convincing as they are less expensive to buy and more readily available (Carpo, 2023). From the perspective of the consumer, we know this intuitively. While I don't prefer the wooden spatula I bought at Dollarama over more

expensive or bespoke options, I like that I could afford it and I only had to walk a couple of blocks to acquire it. This kind of cheap and easy relationship with our objects also cycles back into our issues with overproduction and waste. One way to combat a disposable consumer culture is to think of creative solutions that increase users' attachments to their objects (Lalande & Racine, 2006), one of which is customization. Well established systems of mass manufacturing like we have today actually increase our ability to make specialized products (Marsh, 2012). The opportunities for customization are further advanced by the rise of digital technologies, which have the possibility to localize production processes, which could in turn reduce the financial and environmental burdens of global shipping (Carpo, 2023). So while economies of scale still dictate how most of our mass manufactured products are made, we are also entering a new era of increased access to specialized and custom objects.

There is also a discussion to be had about the social and cultural shifts to labour that came with evolving manufacturing processes. In *Work, consumerism and the new poor,* Zygmunt Bauman details how the rise of factory work in Europe came along with increasingly demoralizing and repressive working conditions for labourers. Ultimately resulting in the disconnect of worker pride (or even awareness) of the outcome of their work. Through reduced wages and deplorable social aid benefits, factories were able to ensure that workers had just enough wages to last to another day of work, but not enough to advance to higher social positions which would mean the loss of a labourer (Bauman, 1998). In a more recent but equally insidious example, Walmart was known to pay their full-time employees so little that they had to rely on government aid for groceries, which they were then encouraged to spend buying food *from Walmart* through employee discounts (Kovacic-Fleischer, 2016). Human labour is a key factor in the cycles of production and consumption that prop up the wealthy, and here again we see a clear separation between the people who labour to produce and sell goods, and those that benefit from this economic activity.

Zooming out, a similar process of decentralization has been happening within the manufacturing industry as a whole. Where once a manufacturing company would be responsible for all steps of creating a product, they are now increasingly outsourcing steps across the globe to reduce costs and increase efficiency (Marsh, 2012). But what do these “reduced costs” mean for individual

people? The social ethics of international production chains notably entered the mainstream North American consciousness following the devastation of the Rana Plaza factory collapse in Bangladesh in 2013. Illegally built structures, ignored building code violations, and thousands of workers reliant on precarious daily wages resulted in the collapse of a factory which killed 1,134 people and injured over 2,500 more (Land & Zakaria, 2019). The factory was producing garments for popular clothing brands sold mainly throughout Europe and North America, and the global reactions to the horrific tragedy reflected the scalar complexity of our supply chains. Should the government of Bangladesh impose stricter regulations on factories and invoke legislation to protect workers? Should the wealthy nations that were profiting off of the cheap labour have an ethical responsibility in their selection of manufacturers? Should consumers choose not to buy products made in countries without safe working conditions? The easy answer to all of these questions is "yes". But of course, unfortunately, the answers also require much more nuance. For example, production was increasing in Bangladesh especially because of rising wages for workers in China (Land & Zakaria, 2019), leading wealthy countries to seek out a new market of workers that could, to be frank, be exploited. Had Bangladesh had stricter regulations and worker protections, which would in turn increase unit costs for garment production, European and North American companies would have been unlikely to invest their wealth into the country at all. In recent years, protests throughout Bangladesh have seen workers rightfully demanding increased wages, safer working conditions, and diversified industry in the country (*Fast Fashion Drove Bangladesh - Now Its Troubled Economy Needs More,* 2024). So we see that each of the above questions are points in a complex and intertwined web of cause and effects which would take much more unpacking than I have space for in this thesis. However the point I would like to leave off with is that the imbalance of power that results in this exploitation happens both between countries and between individual people, with the motivation of profit at the core and global production as the catalyst.

If we look only at the high-level realities of the path we are blazing towards environmental devastation, and the people who are harmed along the way, it can feel irresponsible to advocate for anything but a complete and immediate rejection of these structures. But, in a very abrupt clashing of scales, we also remember that we need to make dinner, wear boots to protect from the cold bite of winter, and buy a bike to get to work. Everyday people make up our systems of

mass production, whether they are designers, workers, or users. Much like the friction in scales between the goals of global production and the lived realities of individual workers, in the following section we will discuss users, and how the notion of the generalized "user" for whom mass produced objects are made is often at odds with the individual experience of use.

Use(ers)

Affordances

The concept of affordances was first put forward in 1979 by ecological psychologist J.J. Gibson in his text *The ecological approach to visual perception*. In this text Gibson expands the definition of "seeing" beyond the scientific definition to a more spatial and embodied understanding of seeing and interpreting the world in relation to the physical body. He wrote:

> The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. [...] I mean by [affordance] something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment." (Gibson, 2015, p.119)

Notably, Gibson points out that because of the significance of the relationship between animal and environment, though the environmental aspects of affordances are objective, this does not mean that the subjective experience of the *perception* of an affordance is the same for everyone. For example, a stone can be hard and flat and for an adult create the affordance of sitting, but this same affordance may not be present for a child who cannot reach the top of the stone (Gibson, 2015).

In 1988 Donald Norman, who had had many conversations and disagreements with J.J. Gibson personally (Norman, 2013), reinterpreted the concept of affordances for the field of design through the book *The Psychology of Everyday Things* (later renamed *The Design of Everyday Things*). In the original copy Norman introduces affordances as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (Norman, 1988, p. 9). While this fundamental interpretation remains similar to Gibson's proposed use, Norman also states that "affordances provide strong clues to

the operation of things. [...] When simple things need pictures, labels, or instructions, the design has failed." (Norman, 1988, p. 9). In this text, Norman is introducing into the theory of affordances a third party: the designer. There is still the animal (user), the environment (designed thing), but now there is also the designer, observing and analysing the interaction and attempting to exert some kind of control over it. *The Design of Everyday Things* was a huge success, but the term "affordances" did not perfectly translate to the field of design. Donald Norman released a "revised and expanded" version of the book in 2013, which includes the use of the clarifying term "signifiers". Norman (2013) writes: "Affordances define what actions are possible. Signifiers specify how people discover those possibilities: signifiers are signs, perceptible signals of what can be done." (p. xv). While for Gibson this idea of "signifiers" would be redundant, already accounted for in his definition of affordances, the differentiation within design was useful as a means to discuss user interactions, especially in an increasingly digital age. Today, affordances are used across disciplines of design, and have especially gained traction in UX design. Cognitive, physical, sensory, and functional affordances (Hartson & Pyla, 2019) are a few of the subcategories that have emerged to describe interactions between humans and technology. Though the relevance of these terms do not all translate into physical objects, they help exemplify the way affordances have been adapted and re-interpreted for different contexts.

The foundational works of Gibson and of Norman brought the idea of affordances into discussions surrounding human-object interactions, and for both authors there is a general assumption about the standard perceivable range of possibilities for what a body can or cannot do. In her book *Activist Affordances: How Disabled People Improvise More Habitable Worlds*, Arseli Dokumacı explores another perspective on affordances, one that takes into account the lived experiences of people with disabilities. She argues that for people with disabilities, affordances take on new context, one that must account for bodies that must navigate pain. She provides a new term, that of "activist affordances" which she defines as "performative microacts/-arts through which disabled people *enact* and *bring into being* the worlds that are not already available to them, the worlds they need and wish to dwell in" (Dokumacı, 2023, p. 5). She writes that these very acts are in themselves *world building*, through non-normative performances, disabled bodies perceive and act out modified affordances that would otherwise be painful, difficult, or impossible. Activist affordances can be considered a sub-category within

the broader definition of affordances, one that pays specific attention to the experience of disability. In addition, activist affordances tackle the idea of failure head on, speaking to the murky space between the built world and the *ability* to interact with it. Where for Gibson there could be no such thing as a "failed" affordance, when we use affordances as a lens for which to understand the built world (such as Norman proposes) we can see that designed objects have both affordances and signifiers that disproportionately fail people with disabilities. This failure becomes a space for growth and innovation, both for designers and users alike. Dokumacı (2023) proposes that activist affordances are: "a way to understand how disabled people literally *make up* whatever affordances fail to readily materialize in their environments (or otherwise be immediately available for perception) and at the same time must *make up for* that failure" (p. 6).

Sasha Costanza-Chock also discusses affordances from a perspective of design justice, considering how affordances reflect intersectional factors that privilege some over others. Costanza-Chock recognizes that affordances are not equality *perceptible*, or *available* to all people, and that designed affordances often reproduce biases (Costanza-Chock, 2020). Though affordances have grown to have many applications and understandings, I find that the term is helpful when thinking about everyday objects because it considers not what an object is *meant to do*, but how it is *actually* used. Affordances are not the intentions of a designer, but rather possibilities for action, which can be suggested but never forced by the act of design. Affordances are personal to each individual body and through observing which affordances are/not available to which people, we can understand how and whom design is failing.

Pain, illness, and aging

My interest in talking about pain and illness comes in part from a sentiment which is illustrated in Susan Sontag's (1977) book *Illness as Metaphor*, she writes: "Illness is the night side of life, a more onerous citizenship. Everyone who is born holds dual citizenship, in the kingdom of the well and in the kingdom of the sick" (p. 3). When one is in good health, and not experiencing pain, we forget that it will not always be so. It is a truth of the human condition that, especially if we are lucky enough to live long lives, we will have periods of health and periods of sickness and often pain will come and go throughout both. In a more modern example of the same line of thinking, Kat Holmes (2018) writes: "Many of us are temporarily able-bodied and will face new

kinds of exclusion as we age. When we design for inclusion we are designing for our future selves" (p. 135). Bodies are imperfect, and part of the precarity of life is that we can become ill or injured at any moment. When I was a child I fell while rollerblading and broke my wrist. Suddenly, wearing a blue cast adorned with my friend's signatures, my childhood world shifted around me and I had to learn new ways to navigate all my regular two-handed tasks. Heartbroken to not be allowed to swim or ride my bike, I remember finding a simple joy in learning I could slam tupperware containers closed using the hard edge of my cast, a task I had found difficult with my child's strength and leverage before. For me, this particular experience of pain was temporary. For many people, including a few of my close family members, pain is a recurring and ongoing experience. When pain becomes part of everyday life, it interacts with our everyday objects.

The Good Grips line of kitchen products is the example most often given when talking about objects designed in response to pain. As the story goes the founder of OXO, Sam Farber, saw his wife struggling to use a vegetable peeler due to arthritis, and in response committed to designing a line of kitchen tools with more comfortable grips (Liston, 2017). These tools have become a famous example of universal design, because though they were originally designed to respond to a particular experience of pain, the bigger handles and gilled rubber sides improved the experience of use for many people. However, within this example of OXO products, there is more context to the story than what is usually expressed. Though Sam's wife, Betsey, is typically only mentioned in relation to her husband, her arthritis, or her cooking, she was actually an architect herself and played a much more active role in the ideation of the Good Grips handles than the typical story expresses. Betsey and Sam had searched for better kitchen tools together, and Betsey knew what she wanted out of a tool to ease the pain she was experiencing (Jackson, 2018). When they were unable to find the tool Betsey wanted, Sam began developing the Good Grips products. Why does this clarification matter? It matters because in this version of the story, we see the line between designer and user blurs, providing increased agency to Betsey's knowledge of her own needs.

Though pain is a shared experience of life, it is necessary to acknowledge that not all experiences of pain or illness are the same. This is why I have chosen to separate my writing on pain and illness from discussions of disability, which are covered in the following section.

Disability

This research is situated, somewhat loosely, in the social model of disability. The social model places the onus for misaligned human-environment interactions *not* on the individual body of the user (as does the medical model of disability), but rather on the built world and the biased norms which are constantly designed into the world (Hendren, 2020). As a foundation for understanding the world, it is necessary as designers to hold onto the fact that the built world defines interaction, and thus also defines *barriers* for interaction, what people are *unable to do*. However, as we tread into discussions of design, disability, and inclusion, it's important not to be satiated by loose theories of universal or inclusive design as feel-good initiatives or moral endeavours (Holmes, 2018). These kinds of shallow designs "for" people with disabilities perpetuate the problematic structures of understanding that define disability as a problem to be solved. When design is produced *for* people with disabilities, not with or by them, it can serve to erase the authorship and agency of people with disabilities (Mills & Sanchez, 2023), depoliticize design outcomes, and "reinforce the division between disabled people as passive recipients of access or assistive technologies and non-disabled designers, developers, and technologists as experts" (Hamraie & Fritsch, 2019, para. 5). There is no one process that can be conveniently provided to non-disabled designers for making "inclusive" or "universal" designs. Non-disabled designers must be willing to engage with collaborative, flexible, and evolving design practices that center and trust the know-how of disabled users.

In her book *What can a body do?,* Sarah Hendren (2020) expresses the need for this active, lively kind of design, writing:

> My son doesn't need a gentle and pacifying form of "inclusion." Inclusion is necessary, but it will never be sufficient. He needs a world with a robust countervailing understanding of personhood and contribution and community in it, human values that are alive and operational outside the logic of the market and its insistent clock. He needs it, and so do the rest of us. (p. 182)

Going back to Dokumacı, while she does not reject the foundation of the social model of disability, she also finds it to be limiting and lacking in its ability to represent the whole, shifting, complex realities of disability. She proposes a concept of "shrinkage" with the goal of highlighting the way interactions with the built world can "shrink" from any moment to another, or otherwise put, that all the possible affordances available in a given situation may not be available to every person, all the time. The less these affordances are available, the more the world "shrinks" (Dokumacı, 2023). For example a stool may afford somebody sitting one day, but not the next because of a flare up of knee pain. She writes:

> This is what differentiates the ecological conceptualization of disability that I am putting forth from the concept of "misfit" and the social model of disability's environmental determinism. My concept of shrinkage is meant to recognize that there is a limit to the environmental adjustments that can be made. There is no end, ultimately, to what kind of access may be needed in an environment even for one body, let alone for all bodies with so many different impairments and their different (and potentially changing) access needs. (Dokumacı, 2023. pp. 68-69)

This idea of shrinkage serves to center the *experience* of disability. It acknowledges that the built world can be meaningfully (re)structured to avoid pain, but that disability is not only the friction between a body and the built world. Shrinkage is centered from the inside (the world shrinks and grows around me) rather than from the outside (the environment defines what I can do).

Applying shrinkage to design, we can again challenge the distinction of designers and users, and what meaningful collaboration between them looks like. If shrinkage is an ongoing experience, then static design solutions (especially when created by a non-disabled designer) will always fall short. Betsy's *experience* led to Good Grips; not her husband's observation of her experience. I argue then that the job of designers is not to provide the perfect object, but to approach design with the malleability that shrinking and expanding worlds require. How can we view everyday objects as ongoing conversations and negotiations between the physical world and the experience of living in a body? This is a question that has to contend with the rigidity of mass production and the deeply entrenched social norms surrounding expectations about what bodies "should" be able to do.

Imagining alternative futures

Considering how we might begin to break down the issues that the misalignment of the scales of design, production, and use creates, requires us to consider possible entry points of change. Within the current systems of production, looking for solutions to be introduced at the highest scales will lead to disappointment, as these decision-making forces exist as a result of the cultural and epistemological realities that put them in power in the first place (Escobar, 2018), and thus they will be unlikely to make significant change to the structures that uphold them. In the face of this discouraging reality, we can consider what catalysts of change exist at the level of individual people, groups of people, and communities. In *Design for the Pluriverse*, Arturo Escobar (2018) grapples with this very idea, stating that one of the main questions of the book is if "design [can] be extricated from its embeddedness in modernist unsustainable and defuturing practices and redirected toward other ontological commitments, practices, narratives, and performances" (p. 15). We can also understand this as a questioning of if the practice of design (not the profession of design, but instead the very human, natural, act of designing) can be unwound from the complex web of harmful industrial manufacturing in which it currently grows. Social action offers a possible response to these questions.

Social action

Ezio Manzini proposes that when the world is faced with complex problems, small-scale, local, social innovation can provide answers, and that such social innovation is happening increasingly in response to worsening living conditions throughout much of the world (Manzini, 2015). Manzini also talks about the concept of distributed (infrastructure, food networks, fabrication, economy, etc.) systems as naturally formed social innovation in the face of the biggest problems that society faces today. He expresses that the power of social innovation is rooted in its ability to respond to complex problems in equally nuanced ways. He writes that, with the complexity of social innovation "the traditional boundaries between designer, provider, and user of a solution become increasingly blurred" (Manzini, 2015, p. 23). Shifting to local, small scale systems creates resilience, breaks down barriers between defined roles, and allows for social innovation to react to local issues in the face of a complicated world.

In *Beyond Digital*, Mario Carpo (2023) shares a related vision of the future, writing that "digital making in general, are mostly immune to economies of scale; as they do not need to "scale up" to break even, they can be located closer to their markets, thus reducing the global transportation of mass-produced goods" (p. 13). Carpo's vision of the future sees the replacement of our current systems of mass production with many local, highly digital solutions in order to counter the environmental issues that mass production creates. While Manzini and Carpo agree that shifting to local and small(er) scale solutions is the best option we have in the face of the issues of the industrialized world, Carpo takes a more top-down and techo-optimistic perspective, while Manzini suggests a more open-ended solution that could include digital production, but may also develop differently depending on the desires of the community. Manzini's vision of the future is by definition unclear, and I think there's an interesting space to explore that's offered by this opaqueness. In re-imagining systems of production, how could we also re-imagine the relationship between the roles of designers, producers, and users?

The complexity of the field of design is well situated to help push forward meaningful progress. This idea is supported by Gui Bonsiepe's essay *The Uneasy Relationship between Design and Design Research* in which he writes: "Located at the interface of industry, the market, technology and culture (living practice), design is eminently suited for engaging in culturally critical exercises that focus on the symbolic function of products" (Bonsiepe, 2007, p. 31). How can designers use their positionality within an already complex field to respond to some of the complex ecological and social issues with production? We'll continue to explore this question throughout this thesis. First, in order to situate some of the current responses to the issues of mass production, in the following sections I will highlight a consumer-led movement and a design-led movement that offers possible direction.

Consumer-led: The Right to Repair

The Right to Repair movement has been growing in the United States since the early 2000's. Originally focused on the automotive industry, the movement believes that manufacturers should be required "to provide consumers and independent repair providers with replacement parts, repair manuals, and other such materials used to fix products they own" (Kramer & Lechner, 2024, para. 1). Despite federal discussions and state-level legislation being passed in relation to

the right to repair, manufacturers continue to resist releasing information to users, stating safety concerns with people "hacking" softwares and potentially accessing personal information. There is also concern that if these laws were enforced, manufacturers may flood the market with cheaper versions of their products to discourage users from repairing and instead buy a new product, to negative environmental consequences (Kramer & Lechner, 2024). In 2021 the United States Federal Trade Commission published a report to Congress, which included a list of 8 practices that restrict repair rights, in which design was mentioned twice: "Product designs that inhibit or prevent repair" and "Designs that make independent repairs less safe" (Nixing the Fix, 2021). The inclusion of these two points bring designers directly into the conversation, and recognize that consumer protections come not only through manufacturing, but from the very start of the design process.

In Canada, the Federal government is currently consulting "a range of consumer and industry stakeholders" on the topic of implementing a repairability policy for home appliances, consumer electronics, and farm equipment (*Right to Repair Consultation*, 2024). The very noncommittal and broad language of the consultation document states that the main goals of the consultation are to reduce costs for consumers and promote a circular economy with better environmental outcomes (*Right to Repair Consultation Document*, 2024). The document also acknowledges the prevalence of trade in the Canadian context, complicating the efficacy of any possible legislation in actual practice. While at the federal level the discussions remain noncommittal, Quebec has seen more concrete movement through the implementation of Bill 29 in 2023, which saw significant amendments to the Consumer Protection Act in order to strengthen regulations around the manufacturing and selling of goods. Key components of Bill 29 include banning the inclusion of planned obsolescence into any design manufactured or sold in Quebec, the requirement for manufacturers to provide information to consumers they required in order to repair goods, and the requirement to be able to repair goods using commonly found (non proprietary) tools (An Act to Protect Consumers from Planned Obsolescence and to Promote the Durability, Repairability and Maintenance of Goods, 2023).

In both the United States and Canada, the concept of the right to repair is gaining popularity, though without much substantial legislative force to back it up. Regardless of the legislative

outcomes, the popularity of this movement among users demonstrates a consumer desire for good quality products that they have the ability to own, tinker with, and repair.

Designer-led: Design for disassembly

On the side of designers and manufacturing, one movement acting in response to the limitations of production is Design for Disassembly (DfD). Design *for* Assembly emerged in the 70s aimed at optimizing assembly processes in manufacturing, DfD on the other hand started gaining traction in the 90s as a response to lack of material resources and growing concerns with waste production (Ostapska et al., 2024). While both movements had origins in optimizing manufacturing processes, DfD has also evolved into a designer-led sustainability movement, focusing on the ways in which products can be built for deconstruction, allowing parts to be replaced, repaired, or recycled more easily. DfD provides an interesting sustainability option that is grounded within existing frameworks of manufacturing, while offering an option for moving towards more sustainable futures. There are remaining sticking points with DfD, especially in relation to the cost and labour involved in the disassembly process which can de-incentivise manufacturers from engaging with the practice (Hoda Abuzied et al., 2020). Still, Design for Disassembly is a relevant discussion in manufacturing today, especially in industries with high material use.

Why modifications?

Designers (myself included) love the idea of desire paths. We love to look at those little dirt lines that communities of feet have beat into the ground to form a path where there wasn't one before and say: "Look! All we have to do is observe people, and then we will know what they want!" I too am not immune to the allure of a desire path, I tend to love clear examples. My fascination with "failed" designs started when reading the chapter "Affordances Demystified" in *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*. Hartson & Pyla (2019) wrote:

> If a device in the everyday world does not suit the user, we will frequently see the user modify the apparatus, briefly and unknowingly switching to the role of designer. We

> have all seen the little cognitive or physical affordances added to devices by users—Post-itTM notes added to a computer monitor or keyboard or a better grip taped to the handle of something. These trails of user-created artifacts […] are like wake-up messages, telling designers what the users think they missed in the design. (p. 657)

Examples of failed designs always inspire me to think of solutions, and so I wondered in what other physical ways design failures manifest. When somebody modifies an everyday object, we can read in the modification a story of the ways the design failed that particular user, and see how the user intercepted to correct the issue. Modifications to objects are a kind of desire path that indicate clearly what isn't working, and what improvement would look like, if we take the time to look at them.

Modifications also tell us stories of exclusion, or rather, who was not *included* in the design process. As Kat Holmes (2018) writes in her book *Mismatch: How inclusion shapes design:* "[...]it might not be possible to definitively design this elusive thing we call inclusion. Exclusion, conversely, is recognizable. It's measured and tangible. When someone is excluded they know it unequivocally" (p. 10). Modified objects often highlight moments of friction. Though not every mismatched design ends in a modification, often the very most immediate, necessary, or pressing examples of mismatch necessitate ingenious modifications.

Finally, I believe failure is a beautiful, rich ground from which progress grows when one is open to seeing it. By breaking down moments of "failure" through a desire to improve, we can shift our pointed finger of blame away from individuals and towards systems. I believe this is an important exercise for designers especially, as we notice ourselves being uncomfortably caught between our dedication to our users and the burden of markets. I would like to leave off this section with one final quote, this one is from Jack Halberstam's (2011) book *The Queer Art of Failure*:

> We can also recognize failure as a way of refusing to acquiesce to dominant logics of power and discipline and as a form of critique. As a practice, failure recognizes that alternatives are embedded already in the dominant and that power is never total or consistent; indeed failure can exploit the unpredictability of ideology and its indeterminate qualities. (p. 88)

In design, failure, mismatch, and friction will *always* exist. It can be easy to look the other way in these moments or write off particular users as falling too far from the norm to be worth including, but what could it look like if we instead steeped in these design failures, and used them as sources of inspiration?

Research methodology

In this stage of my research, I investigated examples of user-modified objects using an interview-based primary research phase, followed by a research-creation phase in which I continued to work closely with one of my study participants. The following chapter outlines the methodologies, ethical considerations and recruitment of the study, and methodology behind the qualitative data analysis.

Primary research: Collecting examples & conducting interviews

During the primary research phase, I sought out examples of people who had modified mass produced objects in order to investigate why people make modifications, how, and the person's feelings towards the modification. Following research approval from Concordia University's ethics board, I promoted my study through personal networks, posters on Concordia campus, and posts on social media platforms (Facebook, Instagram, LinkedIn). Participants were invited to submit examples of user-modified objects through an online form, at which point I contacted them directly via email to coordinate an interview time. After connecting with participants who submitted responses to my form, or who reached out to me directly, we scheduled a time to meet either virtually or in person at which time I conducted short interviews with each participant. The goal with the interviews was to help create a narrative around the particular modification examples, and develop a richer sense of the motivations and details of the modification. A semi-structured interview format was used to allow participants to have some control over the direction of the conversation, in combination with a "soft" interview structure, allowing participants to talk as much or as little about a topic as they felt comfortable, with the goal of creating a safe environment for discussion (Crouch and Pearce 112).

Some of the guiding questions for the interviews are listed below, though not all questions were asked in every interview. Questions asked were adapted depending on the direction of the individual discussions.

- Tell me about the modification you made.
- What materials or tools did you use to make the modification?
- How long after starting to use the object did you make this modification?
- How did the modification impact your relationship to the object?
- Do you often make modifications to your objects? Why/why not?
- Why did you not just buy a different object that better suits your needs?
- How would you imagine the design of this object having been different from the beginning? What would make it perfect for you?

The final step of this stage of the research was the analysis of the interview transcripts. I created transcripts of the recorded interviews and analyzed the transcripts using qualitative data coding software and techniques. This allowed me to identify core themes across the different examples, and further categorize the examples into similar cases.

Research-creation: Research through (re)design

Following the literature review and the collection of the examples in the step above, I planned to choose 2-3 examples from the objects documented and, as an act of research through design, redesign the objects in order to consider how it may have been designed with modification in mind from the beginning. For the purpose of this research, I am using Lois Frankel and Martin Racine's definition of "research through design" which is tied closely to the concept of applied research, and can be understood as research-creation that "seeks to provide an explanation or theory within a broader context" (Frankel & Racine, 2010). Using research-creation is well suited to reflecting on and critiquing the original design of the object as it puts me in the mindset of the person creating the design, and provides additional tacit insights through creation that would not be possible through theoretical considerations alone. One key benefit of approaching research-creation through participant examples is that it allows me to specifically consider how objects can be modified in an after-purchase context and without the production resources that are available in mass production. Reflecting on the creation process also allowed me to add to

the findings from my literature review and primary research through tangible examples of how theories of modifications may be applied.

The specifics of what these re-designs include were dependent on the results of the information gathered in the interviews and thus I entered into the process knowing that the methods used to design, produce, and test these redesigns would vary depending on the processes required and the needs of the users. I planned to test the design through peer critique and, if the participant was willing, through additional user testing with the original modifier of the object. Peer critique serves as designer-to-designer conversations about the design of the object and its functionality, production limitations, and aesthetic qualities. User testing with the original participant allows me to return the object to its original narrative and environment, and provides the participant with the opportunity to share further insights into the modification of the design.

Limitations

One clear limitation in this research is the highly complex nature of the intersecting factors to be researched. The realities of capitalism, cycles of poverty, and the environmental decline of our planet, are all touchpoints that must be acknowledged in research about the social effects of mass production. My research does not seek to solve these problems and I do not intend for this to be the outcome of my work. I aim to take a snapshot of where we are now and consider how we can design and produce better objects today, fostering a culture of designs that can be modified for individual use, hopefully encouraging a movement toward a more socially and environmentally sustainable future for everyone. My research is not meant to be final or representative of the issues at large within the world but rather act as a tool for reflection and a conversation starter surrounding how people interact with designed objects. Hopefully, my research outcomes can inspire and be interpreted to be applicable to different contexts. A final potential limitation of my methodological approach is that my ability to recognize and enact a modification on behalf of a participant is tied to my positionality as a designer. Users without training in design and creation practices may not be able to perceive or enact the kind of modifications that I am attuned to noticing and have the technical skills to make.

Study: Modifications & making meaning

Seven participants were interviewed during the study phase of my research, and a total of 19 modifications were discussed. The participants are listed below (in alphabetical order) including pictures and a short description of the modification(s) they submitted to the study. Participants who requested that a pseudonym be used in place of their name are marked by an asterisk in the below list and are referred to by the pseudonym only in all subsequent mentions.

Cindy

Cindy had first reached out to me to discuss the custom cushion she made for her reclining chair to ease foot pain caused by arthritis and bunions. While talking, she realized that she actually had a number of other modified objects around her house. Though she is now retired, she had previously spent years working as a seamstress, which means she can alter fabric goods or create bespoke sewn items with a trained confidence. When I asked her what inspires her to make her own things, she said: “I don't want to pay for another one, and I know it'll be tailored to meet my needs, you know, compared to just a general item that's gonna work for everybody in some way. I want it to work specifically for me.”

Figure 1 — Bean bag

Image provided courtesy of the participant.

Cindy has a long bean bag that could be heated and draped around her neck to help soothe neck pain. She was frustrated because all the beans would fall to either side, not staying on the spot on her neck where she needed the heat. She decided to make a version with lines sewn down the length of the bag so when it was around her neck the contents would stay in place.

Figure 2 — Footrest

Image provided courtesy of the participant.

After buying a new reclining chair, Cindy discovered that having her feet hanging off the end of the footrest caused her pain due to arthritis and bunions on her feet. To solve this issue, she sewed a custom cushion with a piece of cardboard and stiff stuffing inside. This rigid cushion rests on the footrest and provides an extension, so her feet don't hang off the end.

Figure 3 — Pillow

Image provided courtesy of the participant.

Neck pain, dizziness, and the obstacle of sleeping comfortably while wearing a CPAP machine mask inspired Cindy to modify her pillow. She wanted a pillow that would be low in the middle to keep her neck at a neutral angle while sleeping on her back, and still allow support for her head and shoulder while sleeping on her side. Her solution was to remove most of the stuffing from one strip in the middle of the pillow, but keep the stuffing high on both sides.

Elizabeth

Elizabeth expressed that she is the kind of person who likes to modify things, and finds herself often making modifications to improve the use or the aesthetics of different items. She mentioned having modified clothes, furniture, and home goods in the past, and described herself as a "high end modifier', noting her comfort and technical skills in making modifications to all

kinds of items. Most of our conversation revolved around finding clever ways to ensure she could continue doing one of her favourite activities, taking long walks, while avoiding the pain she suffers from ear aches. When asked how she feels about the objects she modifies, she said: “The fact that they serve my purpose 100% and I can come back from a walk
and my ear doesn't hurt and I haven't had wind in it. I value these, definitely, by modifying them. For me personally I've increased the value of both these items.”

Figure 4 — Headphones

Image provided courtesy of the participant.

Elizabeth noted experiencing painful ear aches after taking walks on windy days. Though she does not listen to music while walking for safety reasons, she likes the wind coverage that over the ear headphones provide. After much searching, she found a pair of second hand headphones that were comfortable and that had an aesthetic she liked. She cut the cord off the headphones (since they would not be used for audio), and added extra cushioning to the earpads to avoid headaches. With these headphones, she is able to protect her ears from the wind while also wearing something socially acceptable for all seasons.

Figure 5 — Hat

Image provided courtesy of the participant.

To accommodate for the height she likes to tie her ponytail, Elizabeth cut a hole in the back seam of her favourite hat.

HeatherEllen

HeatherEllen reached out to me after seeing my post on a Facebook group, and we met up on the Concordia campus one sunny fall afternoon. In their words: “the reason I have all these adapted objects in the first place is I have, not Ehlers–Danlos syndrome, but I just have generalized joint hypermobility everywhere, so often doing finicky little things is very annoying. Holding something in one place for a long time or whatever, shoelaces are really annoying.” Over the course of an hour HeatherEllen pulled item after item out of their backpack and we discussed each one and what worked or didn’t about it. Some modifications were suggestions from occupational therapists, some were bought online, and others were custom creations. They approached each modification with iterative energy and technical skills taken from a background of working in theatres.

Figure 6 — Nintendo DS

Photo taken by the author with permission of the participant.

Figure 7 — PlayStation Vita

Photo taken by the author with permission of the participant.

When holding onto hand-held gaming systems, HeatherEllen encounters wrist pain and numbness in their pinky fingers. To counteract this they have sought out grips for gaming devices like the Nintendo DS and the PlayStation Vita. They have found some solutions on eBay or independent sources online.

These have largely helped solve the problems encountered, however they expressed that a hard grip for a device like the Nintendo DS works better because the screen can be pivoted, whereas on a device with a flat screen they have to use their wrists to pivot the screen for viewing.

Figure 8 — Grip tapes

Photo taken by the author with permission of the participant.

The red object on the left is a foam pencil grip that HeatherEllen uses to increase the size of the grip of writing utensils.

On the right is a roll of tape she always carries in case she needs to use a tool (for example, a wrench) that does not have a rubberized grip, so she can wrap the tape around to increase the grip size.

Figure 9 — Dog walking harness

Photo taken by the author with permission of the participant.

Concerned about being able to hold onto a leash if her dog is pulling at it, HeatherEllen started attaching the leash to a carabiner attached to her clothes. As her dog got bigger she modified a series of harness systems to clip the leash to. She is currently on version three and still has modifications she would like to do. She bought a harness system designed for people who like to run with their dogs which included leg straps, but these were annoying to fit over her knee braces. Instead she attached the system to a fanny pack for added comfort.

To avoid the whole fanny pack shifting around as her dog runs, she added hand-braided cords to either side that are not fixed in place, so the whole bottom cord can shift without the fanny pack being pulled. One of the remaining changes she wants to make to the system is to change the position of the carabiner so that it doesn't hit the top of her knee braces.

Figure 10 — Makeshift desk setup

Image provided courtesy of the participant.

Figure 11 — Final desk setup

Image provided courtesy of the participant.

HeatherEllen has gone through various iterations of adapting their desk to improve the ergonomics. During COVID they had to transition to working from home, and found their current setup needed adjustment. In the first iteration (*Figure 10*), they pulled their desk drawer out and put a skateboard on top of the drawer to lower the height of their keyboard. They also taped pillows to the armrests of their chair to support their arms and used various boxes as monitor risers.

In later variations (*Figure 11*) they bought specific ergonomic products including a split keyboard, a trackball mouse, and wrist rests that hover in front of the keyboard. This too had iterations, originally having bought a vertical mouse as the cheapest ergonomic option, they quickly had to try a new option when they dislocated their shoulder, leading them to the trackball mouse.

Figure 12 — Shoes with elastic laces

Photo taken by the author with permission of the participant.

To avoid having to tie and untie shoelaces, HeatherEllen replaces the laces with elastics that have hardware at the top to adjust the tightness. The elastics can be bought in kits for this purpose, or, can be bought from fabric stores.

Figure 13 — Crutch

Photo taken by the author with permission of the participant.

HeatherEllen explained that immediately after buying this pair of crutches she realized she would need to modify them. There is a gap in the front of the crutch, and though this would be useful for some users, for her it means that if she lets go of the grip the crutch can easily fall to the ground because her arms are small enough to fit through the gap.

To start she put a hair elastic across the gap using the outwards flare to keep it in place, but after losing a few she tied a piece of cord across the gap for a more permanent solution.

*Jane

Jane and I discussed her experience of going from being an avid runner, to finding out she had bone spurs in both her heels, and having to suddenly find new ways to negotiate what footwear would be both functional and would alleviate inflammation. She mostly wore sandals for a few years to avoid any undue pressure, but at the time rock climbing was a big part of her life and she wanted to find a way to navigate tight climbing shoes with less pain. She said: “So I was wondering, I was like, what the hell do I do? So I put the shoe on and then I marked out, I found the pressure points, I have 2 on both feet and I marked it with Sharpie and then I took an xacto and just absolutely sawed through it, which was rough. And then it surprisingly worked. Because it just relieves the pressure on those exact two points, and that's all I needed.” She also expressed having a particular challenge of finding comfortable steel toe boots, which she needs for manual labour work.

No photo available.

Due to a heel injury, Jane expressed that she was not able to wear shoes with hard backs for about a year while she healed and let the inflammation improve. This was difficult while rock climbing as the shoes are very tight. Fed up with the discomfort, she used a sharpie to mark out the pressure points on the heels of the shoes, and cut big X’s into them so that the pressure would be relieved, but there would still be rubber in between her heel and the climbing grips.

Stephen

Stephen brought a few examples of things from around his house that he had modified, and we also chatted about other items he had the intention to modify some day pending free time or the learning of new skills, like mending socks. We discussed that modifying was something he saw his dad (Tony, the next participant) do a lot while he was growing up, so it felt second nature to him, and that it came along with a bit of a thrifty mentality. About his journal, Stephen said: “There's a bit of an ecological element to it, like with the journal. I mean, I can see how some people would just be like, OK, thanks for the journal. And it's a freebie giveaway. And then they just chuck it in the trash or something. But that just seems wrong to me. You know? But it also felt for some reason, the aesthetic of it was prohibitive to use. I was like, I'm not going to fill this

thing with important thoughts if every time I look at it, I cringe, you know?" At the end of our interview, Stephen also commented on how being able to make modifications to things can feel like taking time to invest in yourself, and that made him feel more attached to the objects.

Figure 14 — Shoes with insoles

Photo taken by the author with permission of the participant.

Having bought a pair of shoes that caused discomfort and pain during wear, Stephen used a series of different insoles added near the heel of his shoes to create a more snug fit, eliminating the possibility for the movement that was causing the pain.

Figure 15 — Pen

Photo taken by the author with permission of the participant.

Noticing the need for a pen on his fridge, Stephen used a piece of surplus magnet taken from the packaging of a fridge magnet game and glued it to the back of a pen.

Figure 16 — Notebook

Photo taken by the author with permission of the participant.

Stephen had received a free notebook from an event that did not fit his personal aesthetics. He kept it out of a desire to reduce waste, and eventually spent time adding a collage of images to both sides of the notebook. It has now become a cherished object.

Tony

Tony has a background as an auto mechanic, and has history with woodwork, electrical work, and handy work generally. We connected over a video call and discussed some modifications he had made recently. We also discussed modifications in general, and Tony had some great insights, saying: “I think a lot of people that I know who [make modifications] have two things in their background. Either they’re sort of mechanically inclined and kind of like to tinker with stuff, which I do. [...] And the second thing I think comes from a background of not being too well off, you try to reduce reuse, you know, redo it in some way and not spend money.” He also mentioned that for him, adapting has an environmental aspect, and can be an intentional act of reducing consumption.

Figure 17 — Phone case

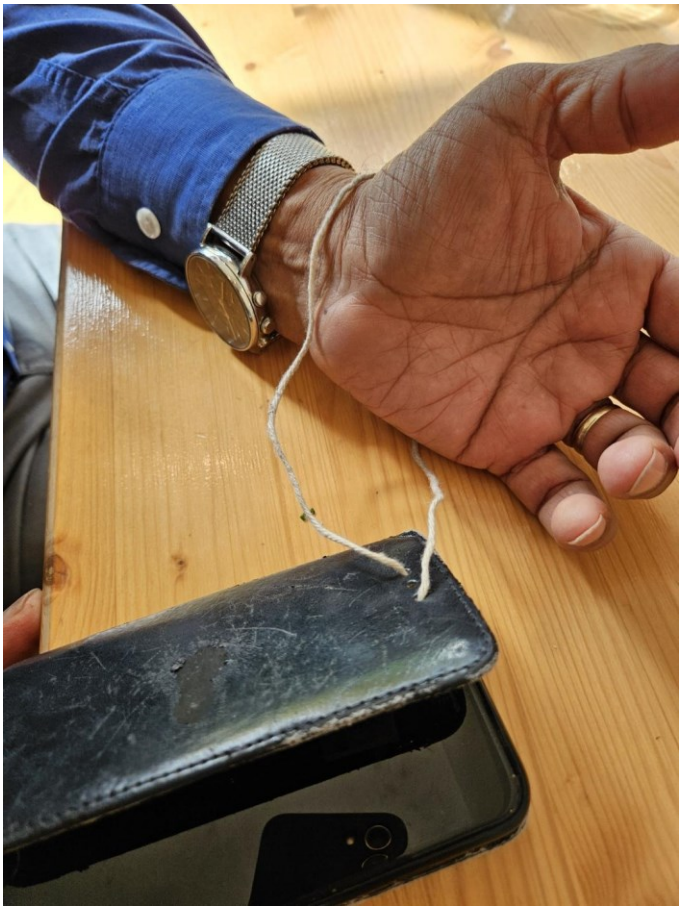


Image provided courtesy of the participant.

While door knocking for a political party, Tony became annoyed that in the winter he would drop his phone due to cold hands having less mobility. He used the existing speaker holes in his phone case to feed string through, providing a loop to put over his wrist. He’s able to pull the strings through to the other side of the case and tuck them into a card slot when not in use.

No photo available.

Tony has a device that allows his hearing aids to connect via Bluetooth to his TV, but because his TV was an older model it didn't have the ability to connect to the device. Using his background in mechanics he wired the device to connect to his TV. However he did not solder the wires in place, so sometimes his cat will knock the wires out of place. As his next modification, he plans to cut a toilet paper roll to wrap around the device to prevent the cat from knocking the wires loose.

*Will

Will, on a break between university classes joined me over a video call. We talked about how he didn't have to make many modifications generally, but that he did recently have to find a solution for a very annoying noise, the metal handle on a piece of furniture. He explained: "It makes this little metallic ticking noise whenever it gets moved, and since I'm in an older apartment with creaky floors [it] would make these little knockers, you know, 'tick, tick, tick, tick, tick' as I moved around or I got in bed or got up."

Figure 18 — Cabinet handle

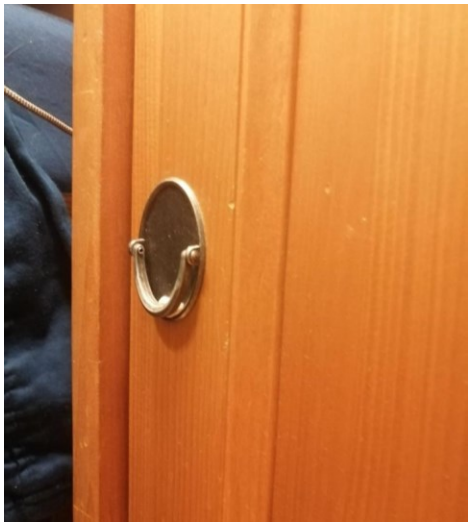


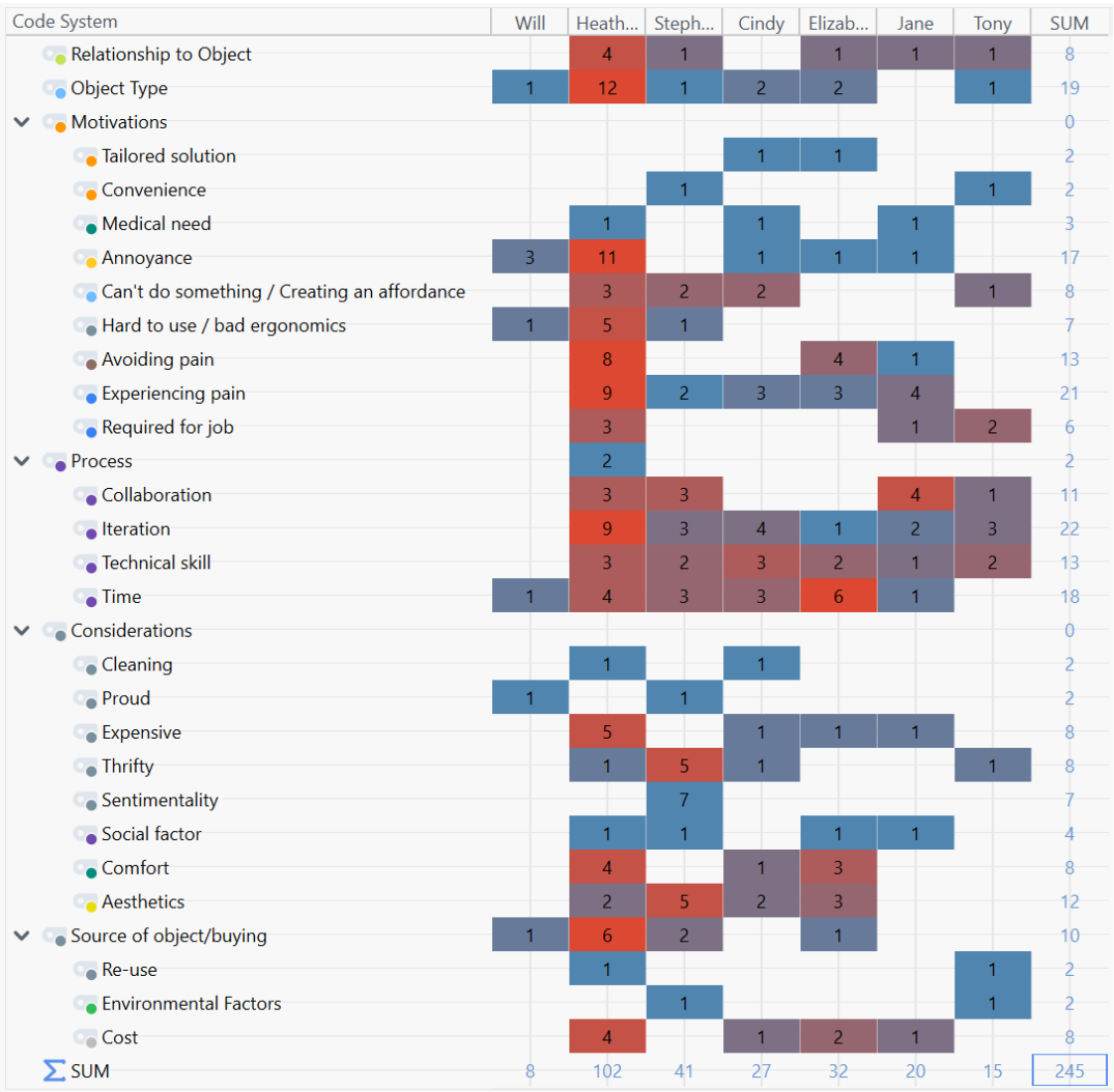
Image provided courtesy of the participant.

Will added a small piece of sticky tack underneath the pivoting handle on a shelving unit because every time there was movement nearby, the handle would tap the metal plate behind it, making an annoying noise.

Coding

Following the participant interviews, I manually reviewed the approximately 100 cumulative pages of interview transcripts to identify recurring themes. I used a qualitative data analysis software (MAXQDA) to facilitate a manual coding process. Through this coding process, four main categories emerged:

1. Types of objects
2. Motivations to modify
3. Considerations for the modification
4. The modification process



Code System	Will	Heath...	Steph...	Cindy	Elizab...	Jane	Tony	SUM
Relationship to Object		4	1		1	1	1	8
Object Type	1	12	1	2	2		1	19
Motivations								0
Tailored solution				1	1			2
Convenience			1				1	2
Medical need		1		1		1		3
Annoyance	3	11		1	1	1		17
Can't do something / Creating an affordance		3	2	2			1	8
Hard to use / bad ergonomics	1	5	1					7
Avoiding pain		8			4	1		13
Experiencing pain		9	2	3	3	4		21
Required for job		3				1	2	6
Process		2						2
Collaboration		3	3			4	1	11
Iteration		9	3	4	1	2	3	22
Technical skill		3	2	3	2	1	2	13
Time	1	4	3	3	6	1		18
Considerations								0
Cleaning		1		1				2
Proud	1		1					2
Expensive		5		1	1	1		8
Thrifty		1	5	1			1	8
Sentimentality			7					7
Social factor		1	1		1	1		4
Comfort		4		1	3			8
Aesthetics		2	5	2	3			12
Source of object/buying	1	6	2		1			10
Re-use		1					1	2
Environmental Factors			1				1	2
Cost		4		1	2	1		8
SUM	8	102	41	27	32	20	15	245

Figure 19 — Overview of different codes used across all participants.

Types of objects

Though all the modifications I collected were everyday objects, there was a wide range of types of objects including handheld devices, shoes, clothing, assistive devices, and furniture. Some objects had been bought and used for a long time before they were modified, and others were bought with the intention of modifying from the start. I did not find a significant difference in the motivations, considerations, or process of modification based on the type of object being modified.

Motivations to modify

Four main categories emerged as overarching motivations for my participants to undertake a modification:

- **Creating an affordance:** This category consists of people making modifications because without it, they would be *unable* to perform a particular task/action.
- **Avoiding or responding to pain:** This category consists of modifications in response to, or in anticipation of experiencing physical pain.
- **Correcting an annoyance or irritation:** This category consists of people making a modification to lessen/eliminate an annoyance or irritation they experience.
- **Aesthetics or entertainment:** This category is for modifications that improve the aesthetic enjoyment of an object, or that are purely for augmenting the enjoyment of an object that already technically functions well for the user.

The motivation to make modifications was one of the main categories I was interested in, because these categories help to prioritize the significance of some modifications over others, and situate the importance for the users. For example, making a modification in order to create an affordance, should be considered differently than a modification for aesthetics. While both are important, one has the potential to provide physical access for interacting with the built world, while the other lies in personal preference and social positioning. Both can be barriers for using an object, as exemplified through Stephen's statement about his notebook that "the aesthetic of it was prohibitive to use". However, aesthetics should still be categorized differently than a modification to create an affordance or to avoid pain.

To explain my reasoning for this, we can return to Dokumacı's concept of shrinkage. She emphasizes that "Impaired, sick, painful bodies, mad selves, debilitated populations, vulnerable beings [...] live in environments that for them are shrunken or shrinking. The activist affordances that they create from within this shrinkage are not a question of choice or preference, but of necessity" (Dokumacı, 2023). This necessity can be seen in varying degrees through the main motivations I've identified for making modifications. Though none of the motivations are insignificant, some are more pressing and have heavier consequences than others. We cannot be annoyed with using an object unless we are first able to use it. Below I also discuss some additional motivations for modifying, which I feel are not categories in themselves but instead could be contributing factors to any of the main categories.

Collaboration

There were a few key examples of participants talking about collaboration being a motivation for undertaking a modification. For example, Stephen noted that he had not considered collaging his notebook until he was prompted to do so by somebody else:

> *"And then one day, me and my former partner decided to do collaging. And so I had leftover stickers and then a bunch of Nat Geo magazines. And so yeah, we spent an evening covering it all up."*

Iterations of modifications can also be a collaborative process, as we undertake trial and error to find the best solution we discuss our process with those around us for additional ideas. We see this in Tony's quote below:

> *"The thing about it is it's not solid in place, so occasionally the cat goes behind the TV and hits the wires and all of a sudden it stops working. So now what my daughter told me is just put a little toilet roll around it and that will prevent him from knocking it. So that's another adaptation that I have just to help me be able to listen to TV easier."*

Collaboration can also come through professional recommendations, for example HeatherEllen's elastic shoelaces was a recommendation from an occupational therapist:

"She was just talking to me about things I was struggling with. And I mentioned shoes. And she was like, you can just get elastic laces. I'm like, why didn't I think of that? Especially, I work in theater. We do that all the time to shoes for quick changes. And so I've done it to lots of pairs of shoes, but I didn't think about it for me."

Notably in this quote is the last line, showing the significance of collaboration in modification processes; other people prompting ideas or giving permission for you to modify something can open up whole new realms of possibility.

Having the courage

Many participants (6/7) noted that there was a period of time between realizing an object didn't work for them, and finally reaching a breaking point of making a modification.

"Well, this was my favorite hat and I finally got up the courage, and I've actually cut a little hole in the back of it." —Elizabeth

"I've had DS's since they came out, so I've lived with that one for a long time and always had lots and lots of wrist pain. And then it was when the switch came out during COVID specifically I was playing it a lot and so I was like, I'm taking all this time off work. My joints are going to be so much better. And I was like, wow, I'm in pain constantly from playing this switch. So I bought the other thing and I was like, I wonder if I can do that to all my retro consoles as well." —HeatherEllen

Building up the courage to make a modification took many participants time, sometimes years. This can be attributed in part to technical skills and financial barriers, which are discussed in the following section.

Considerations for the modification

Technical Skills

A discussion that came up throughout multiple interviews were the skills required to make modifications. Many of the people interviewed (6/7) noted having some kind of technical skills that contributed to their modifications, or were concerned about not having the appropriate technical skills. Cindy, who mostly showed me modifications to fabric, had a background in sewing that gave her the confidence to make the modifications she needed:

> *"Well, I've been sewing since I was probably like 10 years old. And sewing comes easy to me. And sometimes I have a good imagination. You know I can sew a lot of things, like when I worked in a drapery workroom like, you know, the head seamstress would come up with the ideas and I could, you know, put them together and stuff like that."*

Similarly, Tony had the confidence to modify electrical components because of his past experiences:

> *"I have a background as an auto mechanic and I did a lot of woodwork and a bunch of electrical work and stuff, so I'm just mechanically inclined and so I kind of like to do that stuff and adapt things."*

On the other hand, participants such as Stephen expressed that lacking technical skills was a barrier to making modifications:

> *"I have a whole drawer full of socks that have holes in them that I intend to repair, but I don't know how, so I have to learn. I mean, I like the idea of making an object work for you. However, I think some people could probably be more creative with modding."*

People tended to stick to categories of modification that they had practical experience in, largely because of the fear of ruining an object that was expensive.

Cost

A commonly recurring theme was an expression of how expensive products are to buy. This was a consideration both for the risk of undertaking a modification, and a reason to modify a cheap product to avoid buying a specialized version of a product. Participants also expressed that despite the custom solutions being expensive, they often still did not perfectly meet their needs. A few participant quotes below exemplify this issue:

> *"I modified a pillow that I have. My neck bothers me and stuff like that and I still have all that dizziness going on. And I have a CPAP machine and when you wear the CPAP mask, you got this big hose, so when you turn on your side, the hole basically pushes off your face. So they do have pillows that you buy, you pay 100 and some dollars for the stupid pillow, and it has a little cut out. So when you lay on the side that the actual hose goes through there, but it's made out of that memory foam crap and it's just that's so hard. Like I mean, how can you sleep on something like that?" —Cindy*

> *"I had actually looked at headphones up to the maximum of about $60. Thinking that if I ever found one that fit my criteria anywhere, I would have bought it. But I probably tried on 30+ different headphones over the last year, and like I said, it's the width. And so this one fit the bill." —Elizabeth*

> *"The price points on adaptable shoes are awful. And the looks of some of them are also, like they're just ugly." —HeatherEllen*

> *"I think that comes from years as a child where, you know, it didn't have a lot of money and you do try and reuse stuff, adapt stuff and so on. So I think that part of the drive as well for me anyway in terms of just trying to not throw things away. Try to reuse them or adapt them a little bit." —Tony*

The modification process

The most frequent connection between all the interviews (with 22 instances across 6/7 interviews) was the presence of iteration in the modification process. Participants discussed the process they went through between noticing a need and finding a solution to the need through the modification of an object. We can understand this process as mirroring the "design process", though none of the participants used this discipline-specific language.

For the sake of this comparison, I will use the below illustrated design process. Though there are many variations of this process represented across designers, the below is what I personally have developed and relate to:

1. Understanding/Empathizing
2. Ideation
3. Prototyping
4. User testing
5. Finalizing/production

Participants naturally worked through steps 1-4 of this process through the identification of a need in their own life, thinking of ways to solve the issue, and then developing multiple iterations until something that worked for them was found.

Jane, discussing the next steps after realizing the issue with her climbing shoes:

> *"So I was wondering, I was like, what the hell do I do? So I put the shoe on and then I marked out, I found the pressure points, I have 2 on both feet and I marked it with Sharpie and then I took an xacto and just absolutely sawed through it, which was rough. And then it surprisingly worked."*

HeatherEllen, discussing the process for modifying their crutches:

> *"Just trial and errored it. Yeah, I was getting really tired of it falling off all the time, and originally it was hair elastics. So anytime I had a hair elastic, I would just slip it on there and then it would eventually go missing. And I'd put another one on. This is tie line from the theater because I lost my hair elastic and didn't have any more."*

Most modifications end at a prototype, as do many design projects. This does not mean that the process is unfinished, but rather that the goal of the process is to find a personal solution, not one aimed for manufacturing. Users show that they are more than able to intuitively engage in the design process at the personal level when the object they are modifying affords this kind of alteration.

Key takeaways

Here are the main takeaways from the study results for designers to keep in mind:

- There are four main categories of modifications: Creating an affordance, Avoiding or responding to pain, Correcting an annoyance or irritation, and Aesthetics or entertainment.
- Most modifications don't happen right away. People tend to use unideal objects until they reach a tipping point and decide that risking a bad modification is better than continuing to use the object in its current state. Collaboration can help encourage users to feel they have the permission to make a modification.
- Having technical skills related to the modification gave users the confidence to dive in.
- Cost is a major concern for users, they worry about losing an investment on an object if their modification doesn't work or makes the object harder to use.
- Most users enter into a modification as an iterative process; they have an idea, try it out, and then make adjustments based on how it feels rather than undertaking meticulous planning before they start.

This initial case study cast a wide net and did not segregate for niche user demographics or needs. However, each of these takeaways have the potential to fluctuate in importance depending on materiality, user demographics, price points, and the cultural context of the particular case study at hand. For example, narrowing the scope to look specifically at user-modifications to cell phones might have a higher emphasis on the need for technical skills and the consideration of financial investments.

Research-Creation (Modification)

The need

During our interview, HeatherEllen showed me two examples of different handheld gaming systems that they had bought after-market grips for. The grip for the Nintendo DS had a more refined feeling and was likely manufactured using a more industrial production process. The grip for the PlayStation Vita was a 3D printed solution bought online. They explained that these grip solutions worked pretty well, but that they still had not been able to find a good solution for the Nintendo Switch. They were particularly interested in something that could facilitate using the two modular controllers separately from the screen, so that their wrists could rest in comfortable positions instead of the rigid position that the attachment to the screen or the existing controller allowed for.

> *"I have [a grip] for the Nintendo Switch too. That one is a little bit less useful I'll say, so I want to find a better solution for that. [...] The Switch is so heavy. I've taken recently [...] to finding a way to hold the screen up separately. Actually, I guess this is kind of a user modification thing, using an airplane neck pillow, I take the screen off and I put it in the neck pillow and then just have the controllers [separately]."*
>
> *—HeatherEllen*

I did some searching online and did not find anything that addressed this particular need. On sites that manufacture after-market grips, there were solutions to add a grip across the whole device, but HeatherEllen already had one of these, and expressed that the weight of the device and the flat screen made it an imperfect solution. Looking into 3D printing forums I found a few examples of people creating models to solve this issue, and I also found many people commiserating that the narrow shape of the Nintendo Switch made hand-held play difficult, especially with larger hands. Given this, I was excited when HeatherEllen responded that they would be willing to meet with me so we could collaborate on creating a custom solution for the Nintendo Switch for them.

Co-design workshop

Figure 20 — Wrist angle while holding the Nintendo Switch.

To kick-off the process, I met with HeatherEllen and conducted a co-design workshop where we discussed the issues with the current design of the Nintendo Switch, the needs they had for the redesign, and the additional considerations. Because the Switch is already a modular system, this posed both interesting opportunities and challenges in the modification. It allowed for the controllers to be held separately, affording more natural hand positions than having to hold hands close together on a traditional controller, but also means that the controllers and screen body both having moving parts. The interactions of the parts needed to remain possible throughout the modification.

Below is a summary of the issues, needs, and considerations that came up during the workshop:

Issues	Needs	Considerations
- Screen is heavy which is painful to hold up over time - Screen has no stable way of propping up on its own (current solution is a neck pillow) - Controllers are too small/thin, this causes pain with extended use	- Support to prop up the screen, and ideally be able to be used on a soft surface - Grips to increase the size of the controllers, and that can be used separately - Design must be portable and able to be packed up relatively small for transportation - Design must not damage the Switch console - Be easy to put on/take off (no permanent alterations)	- Can the controllers still connect to the screen for charging and playing handheld? - Can the controllers with grips stay attached while the screen is docked for charging?

HeatherEllen and I attached clay to a Switch controller in order to find the most comfortable shape and size of grip for them. After discussions and a few iterations, we landed on a shape that felt good to hold and that we also thought might allow for the most leeway for the controller interaction with the screen and charging dock.

Figure 21 — Final clay model on the controller.

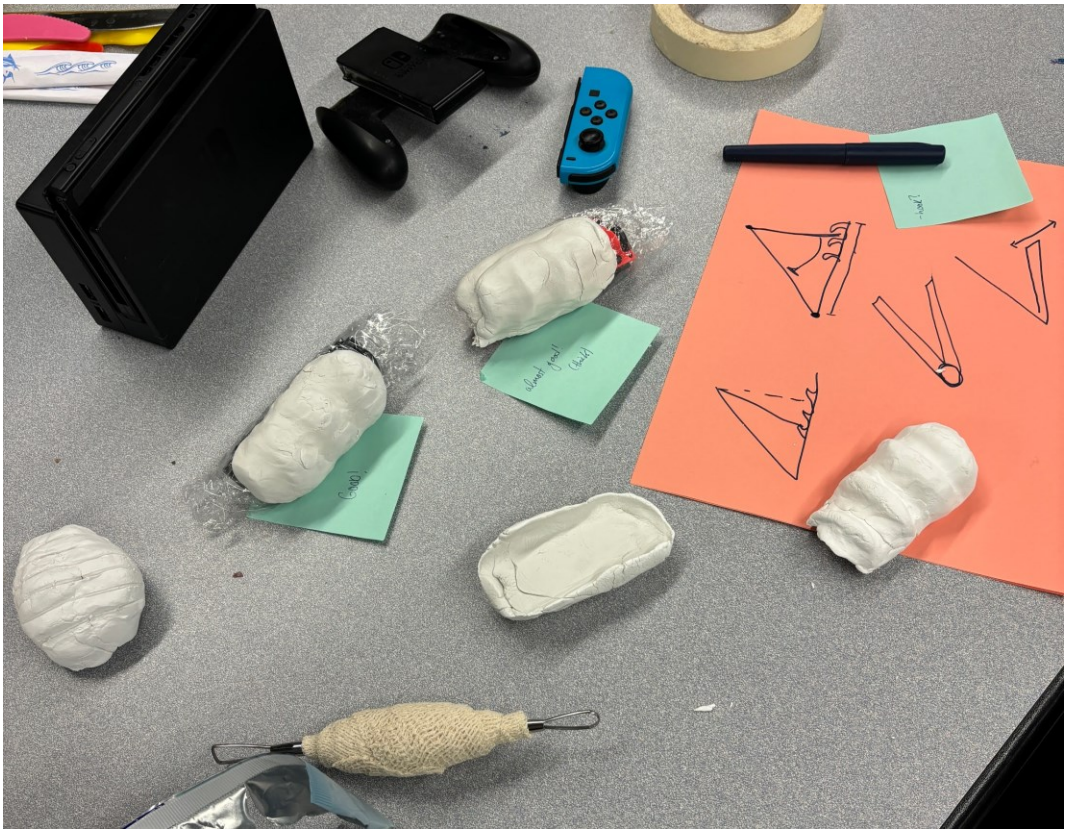


Figure 22 — Various clay model iterations.

Prototyping

I took these clay models and started brainstorming ways to implement a solution for this device. Because the Nintendo Switch is a modular system with very small components, it posed a design challenge that 3D printing felt the most suited to address. I was also drawn to 3D printing because of the online makers communities in these spaces. I was interested in developing a solution that was custom to HeatherEllen but also had the potential to be reused and further adapted for other users.

I 3D scanned the clay model, allowing me to bring the physical model into a digital space and begin the work of developing a 3D model in Rhino. I sourced the first base structure for attachment onto the controllers from an existing model on the 3D model sharing website *Thingiverse*. I developed the screen attachment from scratch through taking measurements on my console and developing them out in Rhino. This process led to this first few sets of iterations.

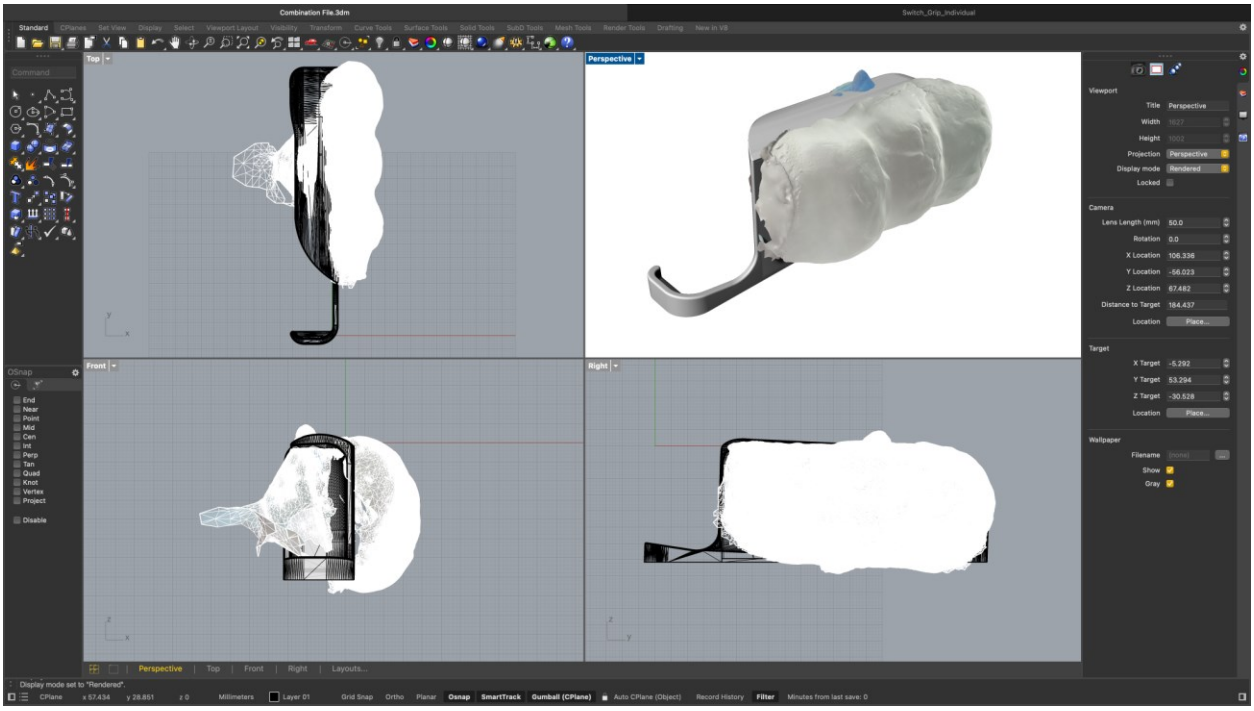


Figure 23 — 3D scanned clay model on sourced controller attachment.

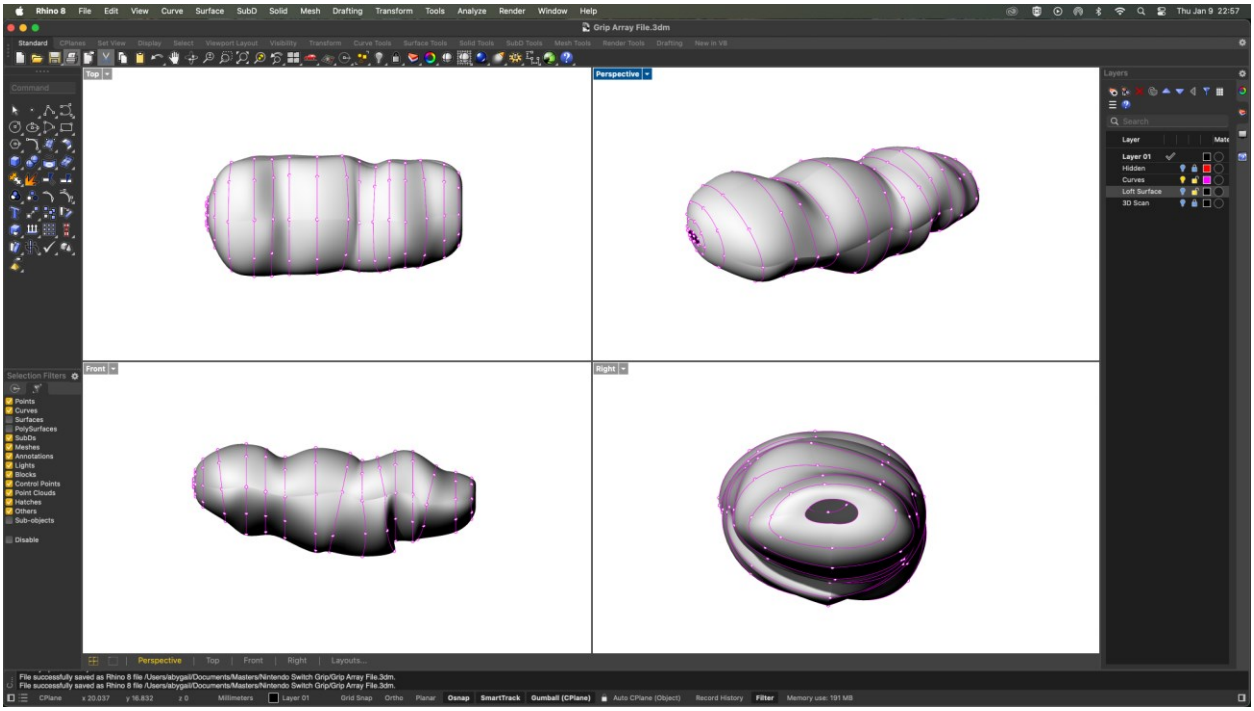


Figure 24 — First version of the grip array using the 3D scan as the guide.

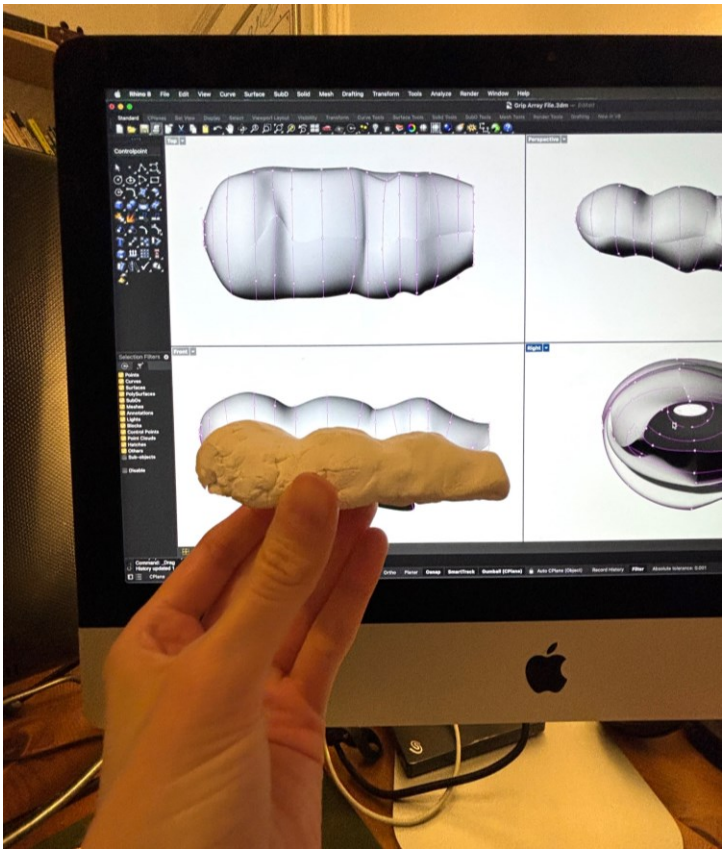


Figure 25 — Holding the clay model up to the digital file.

Figure 26 — First few print tests.

Some of the issues worked out in these first few iterations include:

- Finding a way for the screen support to fold inwards for travel while still providing a range of different screen angles
- The folding arms of the screen holder have no way of being secured into place, so they fly open at unideal times
- In these iterations, the screen slides into the screen holder, but there's no way to prevent the screen from sliding back and forth while in use, and, some of the buttons are covered on the top of the consol
- The transition between the grip shape and the controller attachment is not smooth
- The controller attachment works decently well, but the attachment is loose

Version three was sent back to the participant for user testing over the course of a couple of weeks, at which time we had another meeting to discuss how it was working. Many of the issues HeatherEllen noted were the same as above, however they also noted that the grips would sometimes come off the controllers while playing, so a more secure controller attachment was needed.

Figure 27 — The version of the grips and screen support that went back for user testing.

I found it necessary to rebuild the controller attachment myself so I would have more ability to modify the design, after a few test prints I found a solution. This also allowed me to strengthen the thin section of the attachment at the top, and have it cover more of the front of the controller, allowing for a more secure attachment.

I also went through iterations of the screen support to develop a system that would clip onto the screen rather than one that the screen slides into. I was able to do this because of one divet on the back of the Nintendo Switch which provided a space to clip into to prevent the back and forth motion. Through trial and error I was able to develop a system that clips to the screen, leaving all the buttons and plugs of the console accessible and creating a secure attachment that can be propped up on a table, or mounted hanging.

Figure 28 — Showing the small divet in the back of the Switch that allowed for the screen holder the attach.

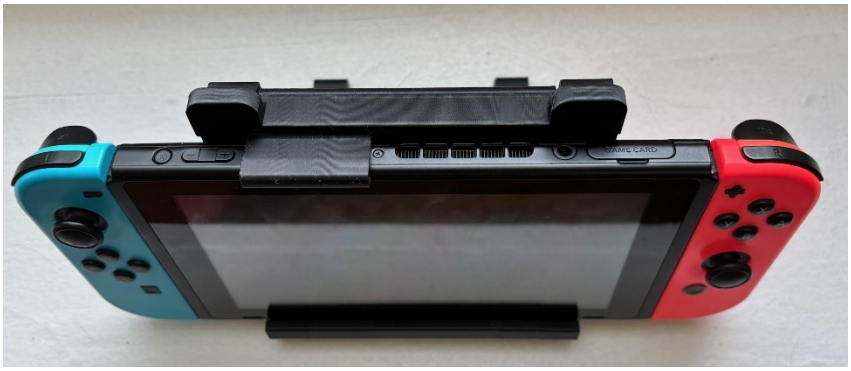


Figure 29 — All the buttons and slots are left accessible.

Care was put into the shape of the back of the screen support to allow for the most flexibility in use. The final shape allows the screen to be hung from a hook or knob, with two additional hooks that allow for attachment using rope, a hair elastic, or other similar attachment methods.

Figure 30 — Detail shot of the back of the screen holder.

I also worked through various iterations of finishing methods, including: filler, spray paint, heat treating, and surface acetone treatment

Figure 32 — Spray paint test.

Figure 31 — Filler test.

Though the spray paint yielded the most refined finish, I was hesitant to use this approach because of the nature of the objects. Having them be hand-held object that would be used over extended periods of time, I was concerned about the long-term use of spray painted plastic against the sweaty palms that are a reality of gaming. In user-testing I found that even after weeks of drying the spray paint still left a chemical smell on hands.

Figure 33 — PlastiDip test.

In the final iterations, the attachment to the grip was quite strong, however there was still some horizontal slipping happening on the bottom of the controller, but because of the modularity, it was not possible to have the grip clip over the bottom corner. Instead I found a solution adding a small amount of PlastiDip along the inner bottom of the grip, increasing the friction of the controller fit into the grip and creating a snug connection. This step would not always be necessary for recreating the model, but is nice to have for extended use.

Figure 34 — Some process iterations.

Outcome

The final outcome of this research-creation process is a refined solution that works with the existing modularity of the Nintendo Switch but provides increased grip width and allows for flexibility in using the controllers attached to the screen or separately.

Figure 35 — Final print files.

Because I recreated the attachment to the controller myself, I have a fully modifiable file that could easily be adapted for different grip sizes, shapes, or attachments. My participant chose a light purple for their final print, and I decided not to spray paint it to ensure that above all else, the grips were functional and safe to use. I sanded down the rough edges from the 3D print and reinforced the friction fit on the back of the screen support with a small piece of metal as it's an area that had failed on previous iterations, and I wanted to make sure their support would remain functional for them for a long time to come.

Figure 36 — Side view of the screen support and grips.

Figure 37 — The final print files, showing how the screen support folds.

Figure 38 — Detail shot of the final prints.

Modification affordances

The research-creation process highlighted for me the ways in which small aspects of the current design allowed for adaptations more easily than others, leading me to consider them as "modification affordances". Modification affordances are elements of a design that make adaptations possible. The hems at the bottom of pants are a modification affordance; they facilitate the act of shortening or lengthening a pant leg. For the Nintendo Switch, the small gaps in the plastic body that were intended to help guide the connection of the modular pieces served as modification affordances. Though these modification affordances for the Nintendo Switch were unintentional, they still allowed me to connect grips and the screen support into these spaces, making the adaptation I made possible.

So, what would make the Nintendo Switch easier to modify? Through this process, I noted a few challenge areas that could have aided in the ability to modify the original design. Though these considerations are specific to the Nintendo Switch, they are also broad enough that similar suggestions could be included for other objects made of hard materials such as plastic, metal, or rubber that are intended to afford holding and gripping:

- Registration indents (especially in 2 or more axes)
- More robust screw holes that allow for attachments
- Intentional spaces or gaps in the body of the object that allow for attachments
- Small loops or hole that afford tying something onto the object
- Alternative back options provided by the manufacturer

Interestingly, a new edition of the Nintendo Switch launched during the course of this project. The new version of the Nintendo Switch includes a built-in stand, addressing the lack of ability to prop the screen up on its own in this current model. However, it also boasts a wider screen with the same screen thickness, which means that the whole system will likely be heavier, but with no thicker grip surface. The new version also ditches the rail attachment system for a magnetic attachment (*Nintendo Switch 2,* n.d.). Though the magnetic attachment opens up a new realm of modification affordances, I struggle to imagine a grip solution that could clip over the new controllers and can be used independently as well as attached to the screen like the current

system allowed for. The main modification affordance that allowed me to develop the grip solution I did is missing from the new version of the controller. Though there are some additional controller options for the new console, there remains no option to play with your hands separately while increasing the size of the controller grip *(Nintendo Switch 2 Accessories - Nintendo CA,* n.d.). Like many similar products, as the design becomes more sleek and refined, the ability to make modifications also lessens. While a new product launch is an opportunity to improve a product for all users, if modifications are not part of the discussion during the design process, they are likely to become increasingly inaccessible.

Applying the idea of modification affordances to another example from the interviews, we can revisit the modification that HeatherEllen made to her crutches (*Figure 13*). In the interview, she had said: “It's useful that there is a gap. I can see why, but also it's not useful for me.” Dealing with the experience of her arm slipping out of the hole in the front of the crutches, HeatherEllen capitalized on a potentially unintentional modification affordance for this adaptation. Likely, the outwards flare of the crutch was designed so if somebody was pushing their arm into the crutch it would push against the flare and help smoothly open the gap. This flare acted as a modification affordance when a hair elastic and eventually a length of cord was wrapped around it, to prevent HeatherEllen’s arm from slipping out. Through listening to user observations, this modification affordance could be intentionally added to the design by increasing the curve of the flair or providing an optional strap to go across the gap, which some crutches already provide.

Designers, despite our best efforts, will never be able to know precisely how to empathize with everyone, all the time. Nor will we be provided the privilege of having the time to meaningfully incorporate collaborative design processes into the creation of everyday things. Making objects that facilitate modifications acknowledges that we can’t know everything, and offsets some of the design process to the users. By allowing users to effectively finish the design for themselves, there is also potential to increase user connection to their objects, reducing the likelihood of throwaway consumerism. There is of course still a need for collaborative design processes within the design *of* modifiable objects, not for finding the one perfect design solution, but rather for identifying potential areas of friction, and designing in the malleability needed for users to respond.

Modification affordances respond to the complexities in scale in the production of everyday objects, providing a call to action for designers which is situated in an understanding that under our current systems of production, everyday objects cannot be made custom for every individual. Instead it provides an interesting design challenge to ask how our mass produced objects might be made more modifiable. Though this design challenge exists in direct conversation with the scale of production, how people choose to modify the object is personal, individual, and intimate. Modification affordances can help ease some of the friction that the shifts in scale in mass manufacturing produce. This can in turn offer more autonomy to users, increase the longevity of objects, and productively muddy the line between designer and user.

Conclusion

Collapsed into each of the ordinary objects around you right now are complex, mysterious, and interscalar worlds. As we unpack those worlds it becomes clear that our everyday objects are anything but mundane; rather they carry within them design history, cultural context, the marks of our systems of production, social biases, and possibilities. We also know that the vast diversity of human needs means that no one single object will work perfectly for everybody, and that some people are disproportionately failed by generalized design solutions. In the face of this inequality, one powerful way to respond is by inviting users to make modifications to their objects. This simple invitation serves to transcend some of the complexity of human experience that is lost in the shifting of scales required in mass manufacturing processes. Modification affordances explicitly invite people who are often excluded from mass produced designs to not only be considered by designers, but to play an active role in creating objects that work for themselves, resulting in a productive diffusion of responsibility between designers and users.

Modification affordances also promote a shift away from reliance on mass production as the solution to all our consumption needs. When users are invited to tinker with their objects, they're invited to build stronger emotional connections to the things they own, engage with local production alternatives, and find solutions to continue using existing things rather than repeating cycles of consumption and waste. When users modify a mass produced object, we see a kind of marriage of scales; objects can still be created within the systems of production that exist today, but effectively the design and production process is only finished in individuals' homes. In this way, modification affordances define the relationship between designer and user in a way that sets it apart from other theories in design. Though rooted in the profession of design, it challenges the necessity of designers having the final say and presupposes the ability of users to meaningfully engage with the design process on their own terms. Designing with modification affordances uses the skills of designers to imagine all possibilities of action, to facilitate these possibilities, and then to release these designs into the world and give up control over what happens next. This enters existing conversations of collaboration in design in a new way, by inviting users to participate not only in the ideation or testing stages, but also through production and use.

This thesis focuses on modification affordances within the field of industrial design, and especially on everyday objects, however designing for modification affordances is actionable across disciplines of design. Both physical and digital designs can be presented with seams that afford the act of modification, whether it be clothing, bikes, game controllers, tax forms, or cellphone operating systems. There remains opportunity to expand the discussion on theories of modification affordances through the replication of the research-creation methodology included in this thesis. By investigating areas of design failure within narrowing disciplines of design, communities, user groups, or categories of objects, a broader picture will be developed and understood both within distinct categories and in conversation between these categories. From here, guidelines or taxonomies can be developed as references for designers to share knowledge and to better understand how to apply modification affordances within their field of study.

Despite the many flaws and injustices our systems of mass production enable, we cannot avoid the realities of manufacturing that have been built up over centuries to make our world as it is today, and as such, the path towards a better future for design cannot be developed entirely apart from these systems. Instead, designers and users alike must imagine creative solutions that allow for transition from *within* our systems of manufacturing that push our habits of consumption and production towards more sustainable futures. Modification affordances are a point-in-time solution that exist in dialogue with the complexities our everyday objects hold, treading a new path forward for the benefit of people and the planet alike.

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