

A HANDLE ON ACCESSIBILITY

Designing for a Future of Limited Mobility

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Designing for a Future of Limited Mobility

According to the most recent census data and studies by the US Department of Health and Human Services, 1 in 7 people are 65 or older. By 2040, that number is estimated to grow to 1 in 5.¹ These statistics suggest that in less than 25 years, nearly a quarter of the US population will be faced with the physical limitations that come with aging: reduction of mobility and dexterity, visual and hearing impairment, bone and muscle weakness, and immune and memory deterioration. Consider, too, our veteran and other disabled populations, and the impending reality is a country challenged with physical limitations, with many physical environments not designed for universal accessibility.

On the front line of this accessibility challenge is the door handle. Like a handshake with the building, the door handle is one the few elements of a facility that all users routinely and unavoidably must engage. It is an element that needs to be highly functional, yet is an object whose poor design can make the experience of moving through a building extremely frustrating. Few guidelines exist to instruct designers how to ensure door hardware is accessible to those with physical limitations, however, as the needs of our country's population change, this void offers an opportunity to further advance accessible design.

Over the course of a six-month period, the Chicago office of Perkins Eastman looked to address this critical issue through an office-wide design exercise. Titled *A Handle On Accessibility*, the exercise challenged designers to not only create a more accessible door handle, but also develop a more empathetic design process. Using a user-centered design approach, integrating user analysis, and studying the physical constraints of aging, several teams of both designers and non-designers strived to fabricate a more usable handle.

The following case study is a review of key components of the design process and a summary of the exploration.

¹ U.S. Census Bureau, The Next Four Decades, The Older Population In The United States: 2010 To 2050 (2010), <https://www.census.gov/prod/2010pubs/p25-1138.pdf>.

Empathetic Design

A lot of what we do as designers happens in the abstraction of drawings and models. We imagine and visualize spaces and objects before they are constructed, and then go about creating a series of documents that help translate those ideas into easily understood instructions for construction. Through the repetition of putting pen to paper, mouse clicks to screen, we have become adept at imagining what it is like to occupy our imagined spaces. What is more difficult, however, is to view those spaces and objects through the lens and physicality of the end user.

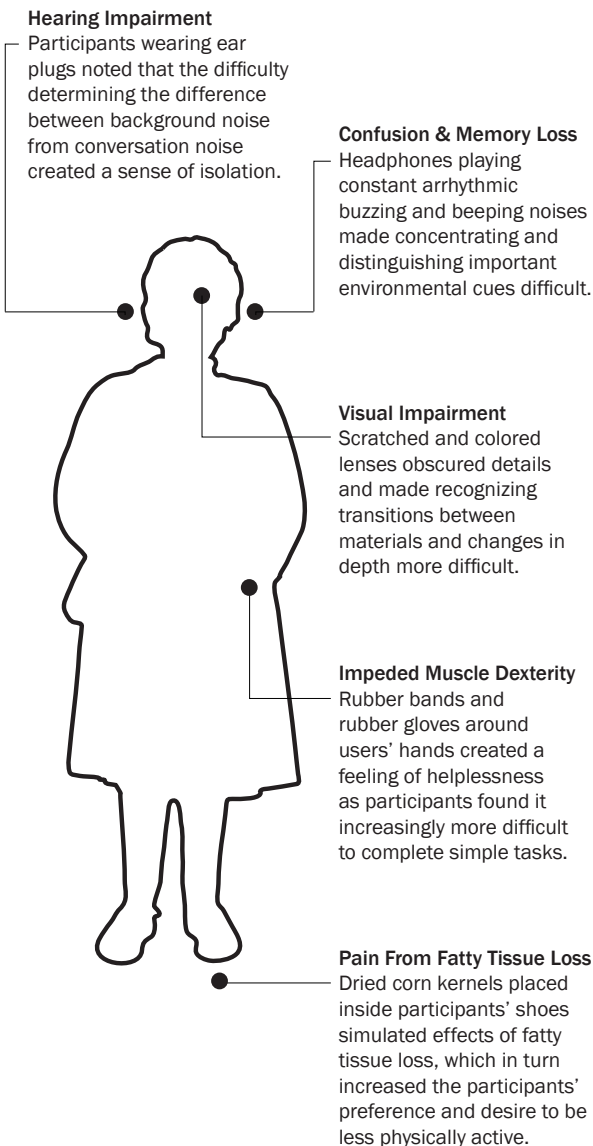
In order to develop new solutions, it is critical we understand the physical and cognitive needs of a wide variety of demographics and then develop and employ a more user-centered, empathetic design process. If we are to capitalize on opportunities to advance design, we must require ourselves to physically be in a similar situation as our end users and see what questions, observations, and conclusions can be drawn to inform our design decisions.

With the only parameter of the design exercise being the creation of an accessible door handle, design solutions were developed based on insights and observations gained about limited mobility through a series of human-focused analysis studies, or empathy experiments.

Aging Experiment

The first empathy experiment dealt with experiencing the physical and cognitive limitations that come with aging. While a large concentration of the Chicago office's work focuses on the senior living market, we wanted to broaden our understanding of the physical and cognitive effects of aging before fully immersing ourselves in the design of the door handles. With this objective in mind, we adopted and implemented an empathy exercise that simulated the tactile and sensory challenges seniors experience on a daily basis.

Designed to offer an enhanced exploration of the design factors that contribute to environmental cuing, the aging empathy exercise simulated five of the more common physical effects of aging through the use of wearables. Wearing inhibitors, participants were asked to attempt a series of mental and physical activities while experiencing symptoms of visual and hearing impairment, impeded muscle dexterity, confusion and memory loss, and pain from fatty tissue loss. Tasks focused on fine motor skills, reading comprehension, short- and long-term memory recall, and basic mathematical skills. Following the exercise, participants and viewers discussed how the simulation affected their ability to complete tasks and how their observations could influence future design decisions.



Special glasses and headphones replicate visual impairment, memory loss, and confusion.

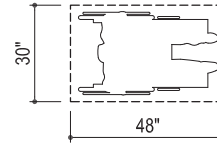
Abstraction vs. Reality Experiment

Building on the aging empathy experiment, the second empathy experiment was designed to develop an understanding of the physical realities of the accessibility guidelines and requirements we design to on a daily basis. Across the office, a number of the ADA's two-dimensional guidelines were taped out on the floor and participants were asked to maneuver through the various clear space guidelines in a wheelchair. With a majority of participants having little to no wheelchair experience, the experiment highlighted a number of the code's deficiencies and the challenges users face on a daily basis, even when spaces are designed within the recommended codes.

Clear Floor or Ground Space

(ADAAG - Figure 305.3, Figure 306.2)

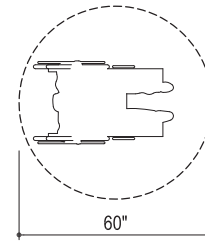
Maneuvering in and out of the clear floor space guidelines highlighted that although the guidelines offer ample space, it is not gracious. A compact wheelchair with a seated user fills a 30"x48" clear space with an inch or less on all four sides and as a result, moving in and out of the delineated clear space typically resulted in bumping adjacent objects or materials.



ADAAG - Figure 305.3
Clear Floor Space

Turning Space (ADAAG - Figure 304.3.1, Figure 304.3.2)

Similar to the 30"x48" clear space guidelines, a compact wheelchair can be maneuvered by a seated user within the 60" diameter and 60"x60" T-shaped turning space, but the wheelchair and user often bumped adjacent materials and objects.

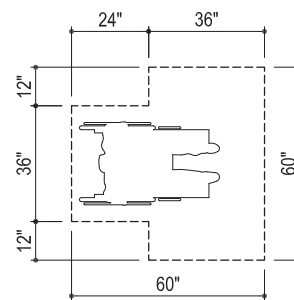


ADAAG - Figure 304.3.1
Circular Space

Reach Ranges and Maneuvering Clearances at Doors and Gates

(ADAAG - 308, Table 404.2.4.1)

Door approach and reach range guidelines (ADAAG - 308 Reach Ranges) are useful tools, but as two-dimensional diagrams they do not sufficiently characterize the three-dimensional complexities of operating a door when reaching for the door, opening the door, and moving through the doorway in a wheelchair or a walker. When an individual is seated in a wheelchair, the door handle is difficult to open while also moving through the doorway, and the wheelchair's footrest and the individual's feet commonly bump into the door and doorway. These challenges combined with other challenges associated with aging, make this task of moving through the doorway even more difficult.

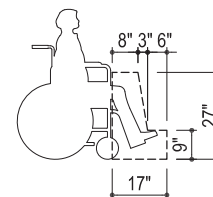


ADAAG - Figure 304.3.2
T-Shaped Turning Space

Door Hardware and Operation

(ADAAG - 404.2.7, 404.2.9, 309.4)

The code language noting "operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist" is valuable. Participants found a condensed height range between 36" to 42" is preferred to the allowable 34" to 48".



ADAAG - Figure 306.2 Toe
Clearance

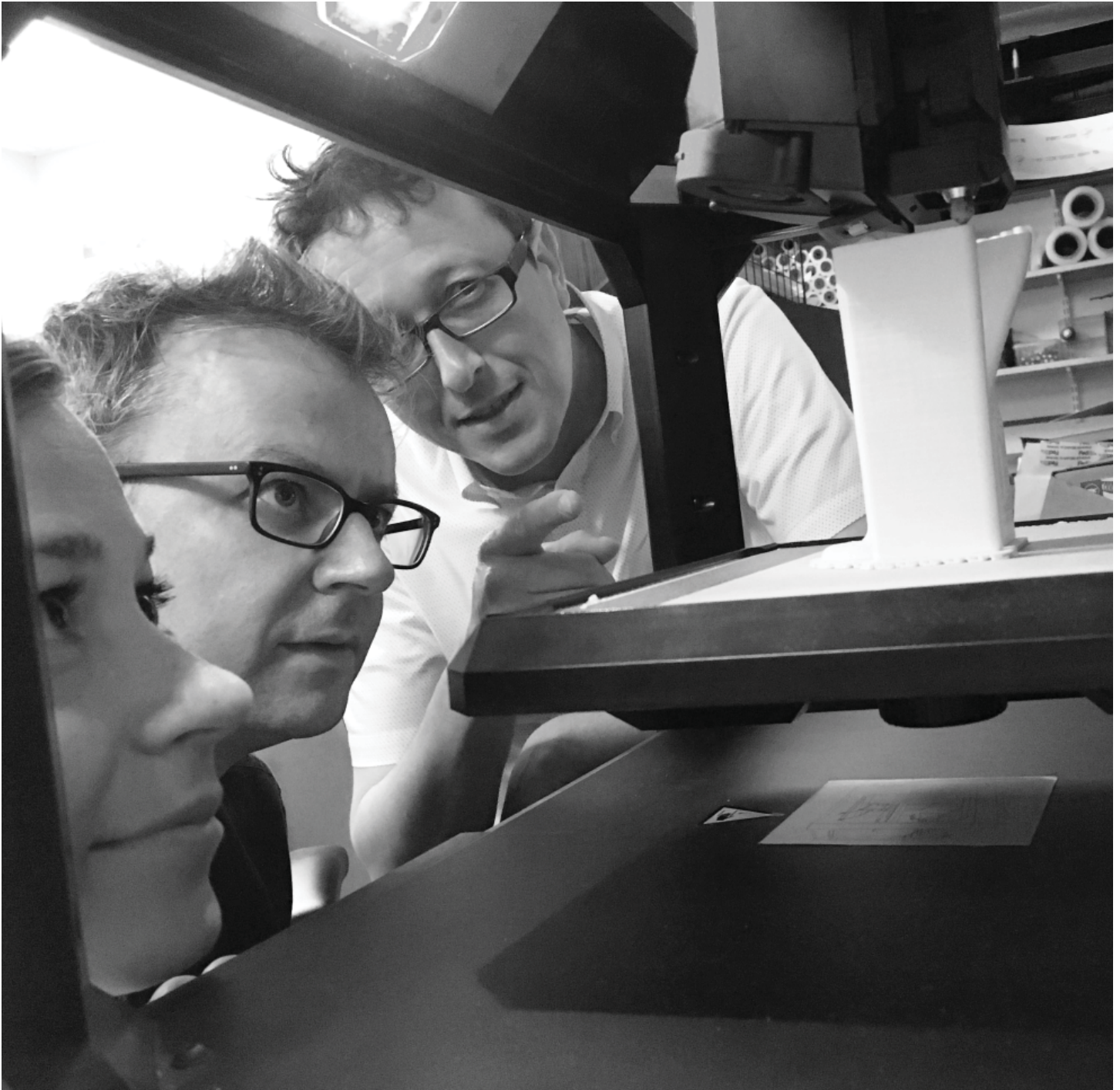
ADAAG - Figure 306.3
Knee Clearance



Navigating a door while seated in a wheelchair and navigating the 60" diameter clear space while using a wheelchair.

Digital Iteration & Physical Ideation

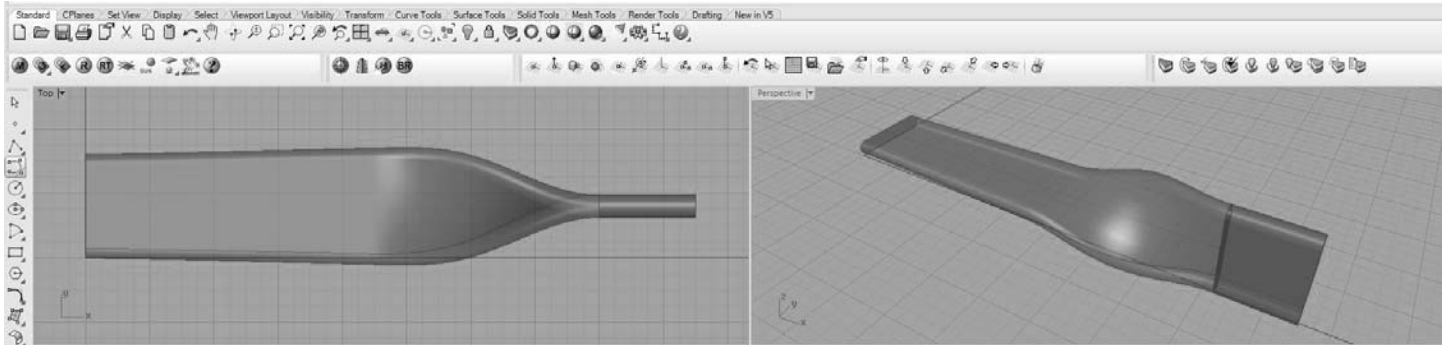
In addition to grounding our understanding of the critical issues that differently-abled users face on a daily basis, the empathy experiments highlighted the need to vigilantly test our ideas at a 1:1 scale. Today, a majority of design occurs digitally. Parametric design, rapid prototyping, generative design, and building information modeling are all buzz-worthy technologies that empower designers to create and realize increasingly complex designs. With this dependence and ease of use, however, the human connection to the end product can be easily lost. To ensure virtual space and our digital tools did not control the design process, it became essential to leverage opportunities with specific digital technologies and identify the proper tools to help test and establish our design decisions in the physical human experience.



3D printing a handle iteration.

Complex Digital Modeling Software

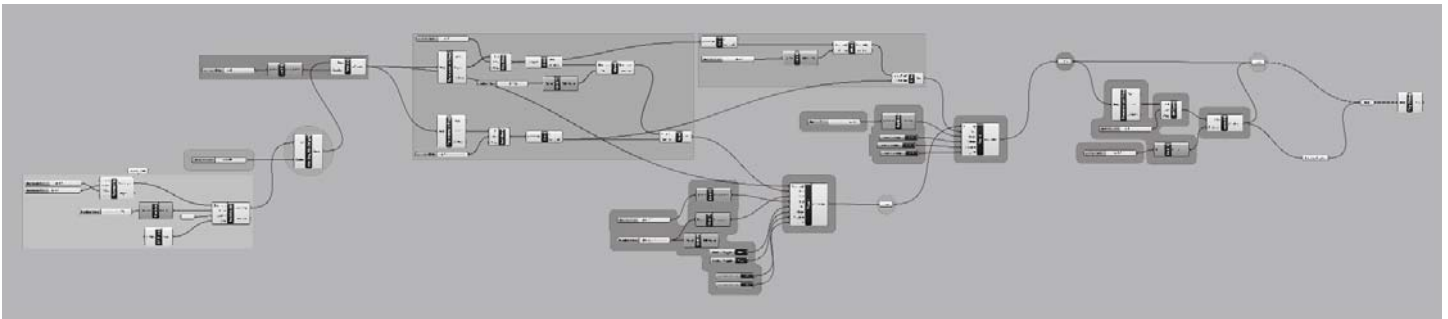
Employing surface modeling softwares like Rhinoceros and Solid Works allowed teams to develop precise dynamic and organic forms that accurately addressed complex ergonomics. Working in a digital environment, teams were able to study the complexities of the human hand and quickly iterate on their designs.



Working model within complex modeling software.

Parametric Design And Visual Scripting

Embedding visual scripting softwares like Grasshopper and Dynamo into the design process allowed teams to iterate on design options while tightly controlling key parameters of their design. By being able to visually see and adjust their designs' constraints, teams developed a more measured and objective decision making process.



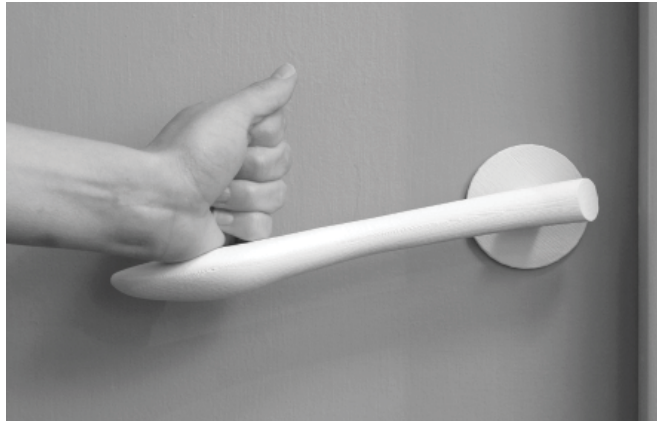
Visual scripting definition for digital model.

Rapid Prototyping

The introduction of 3D printing into the design process gave teams the ability to nearly instantly evaluate their ideas and design iterations at a 1:1 scale through the lens of the end-user. The power to physically construct complex forms directly from digital models and then test their success, created a swift feedback loop that allowed teams to focus on tactility and user-performance.



3D printed door handle iterations.



Design Explorations

Comprising a wide range of experience levels within the office, six teams of three people each explored the questions and observations they formed during the empathy experiments. As these conclusions drove the design process and solutions began to materialize, the resulting door handle designs could be organized into three primary categories: handles that adapted traditional handle forms, handles that rethought the handle form, and handles that rethought how a door could be operated.

Note: The proposed designs build upon the operation of a traditional lever where a rigid rod pivots around a centerpoint to unlatch the door. Levers are more typical than knobs, push buttons, and pull latches in accessible conditions due to their ease of use and mechanical simplicity.

Handles That Evolve The Existing Form

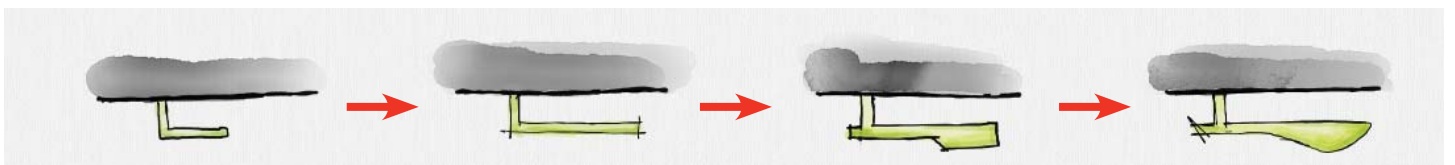
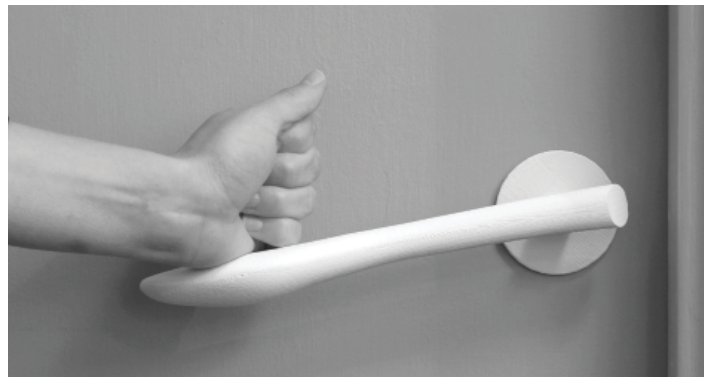
A quick internet image search for “accessible door handles” generates a collection of standard door handles that comply with ADA guidelines, mixed with after-market components that look foreign, but appear to make existing hardware easier to use. However, this simple search highlights the challenge facing users with more specific needs: the market lacks door handles that resemble door handles and are specifically designed to make operating a door more comfortable and enjoyable for those with limited mobility. Further research

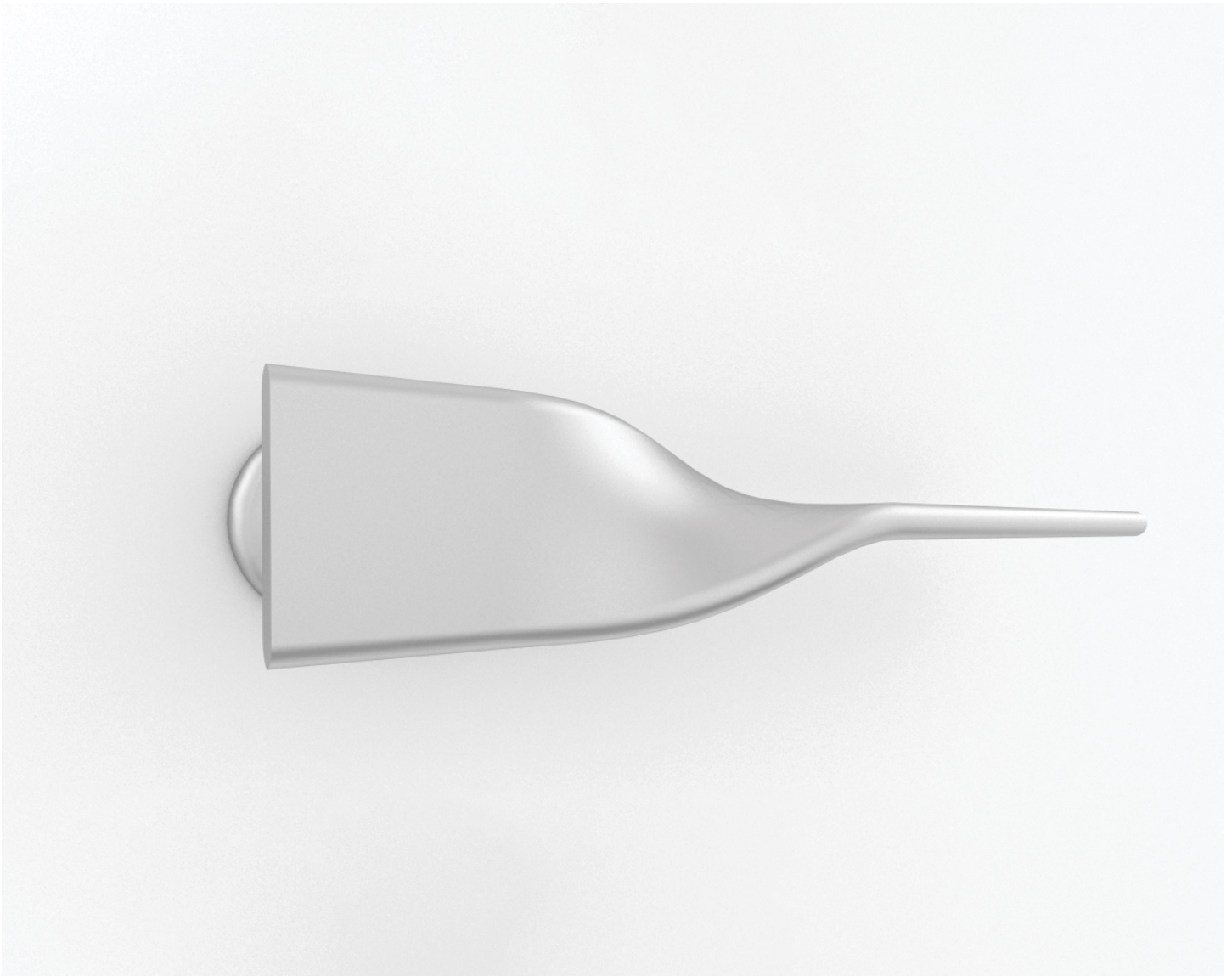
on the subject makes designers question, in designing for a population with limited mobility must familiarity and discreteness be at odds? Is there value in designing objects whose form is recognizable, but whose function is tailored to meet a broader range of needs? The first category of handle designs explore how existing forms can be adapted to be inclusive of a wide range of user needs while maintaining visual familiarity.



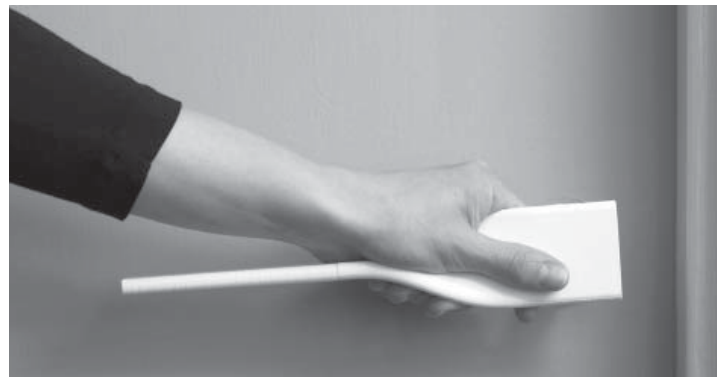
Seed Handle

How can natural and familiar forms inform design decisions that allow for a multitude of uses? With a pleasing curve, reminiscent of the shape of a Maple seed, a biomimicric approach to studying form and ergonomics brings a natural beauty and familiarity to this door handle. The bulbous-like end mimics that of a seed pod and provides a shape that is comfortable to the palm of the hand. The elongated lever requires less force to operate while also providing a rod between the bulbous end and pivot point should the user want to grasp the lever like a traditional door handle.





Twist Handle



Versatility between different user groups was a challenge that continued to be observed throughout the empathy experiments. Beginning with a traditional handle form, the Twist Handle employs a simple twist of the geometry along its length to create a series of more complex surfaces. This variation of surfaces provides users with different locations to comfortably place their palm, forearm, wrist, or a typical grip, while still maintaining the important visual cues of how the handle functions.

Handles That Re-Imagine Form

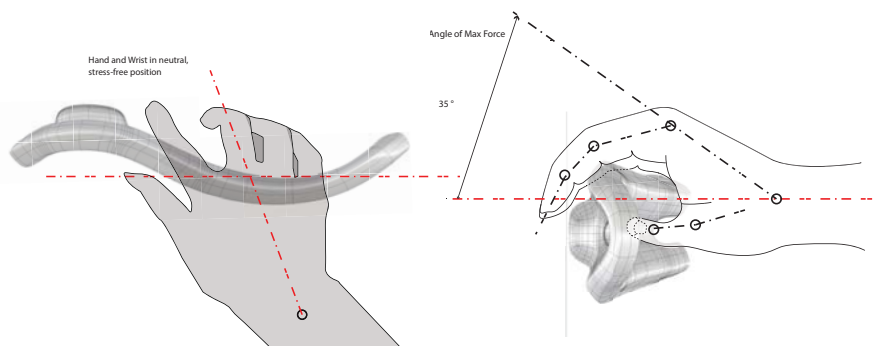
The experience of using a door handle varies greatly depending on our physical relationship to the hardware. Sitting as opposed to standing, or having a fully dexterous grasp compared to a partial grasp all affect the way a door handle feels in one's hand. Unfortunately, accessibility and the needs of those with limited mobility have not been at the forefront of door handle design. While ergonomics have always been the backbone of the design process, it is rare

to find handles whose forms are molded to the specific preferences of those with limited mobility. Ignoring standard form, and starting with the constraints of users with limited mobility and/or using a wheelchair, the following designs address how these specific ergonomics can be the basis of design, driving both the form and function of the hardware.



Hand Hold Handle

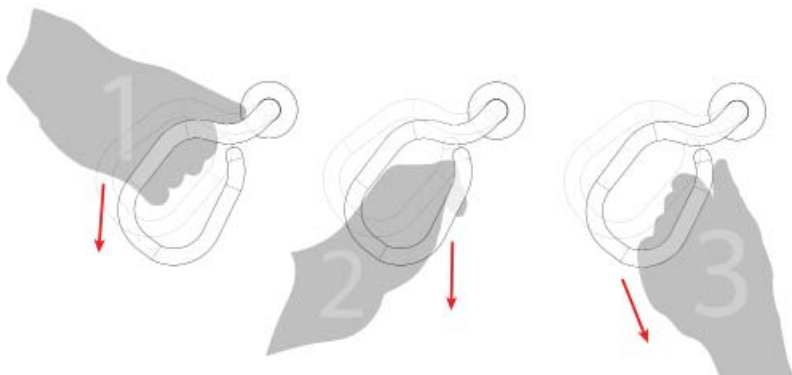
The ergonomics of a user's hand sitting in a wheelchair as they engage a door handle are different than that of a user who is standing. With a lower relationship to the handle than their standing counterparts, seated users require more grasping strength to form the posture needed to operate the hardware. Intended to be grasped from this lower vantage point, the Hand Hold design is tailored to create a more easily operated handle by providing a user deliberate points of contact for the thumb, palm, and most importantly grasping fingers. Although the form may seem foreign, its feel and ease of use is comfortable and inviting.





Loop Handle

The Loop Handle addresses the challenges of opening a door while seated in a wheelchair and the difficulty of holding the chair stationary with one hand, while simultaneously pulling a door open and past oneself with the other. Building off a simple form, the loop, this design enables individuals in a wheelchair to open a door from a fixed position by lowering the grasping height and positioning the hand for an easy transition around the edge of the door. While focusing on wheelchair users, the multi-functional shape also creates a handle that works well for differently-abled individuals and those with dexterity issues.



Handles That Rethink How To Operate A Door

Ergonomics and mechanism are the two key components that combine to create a usable door handle. Traditionally, a handle latches and unlatches the door. But could and should a door handle do more? When designing for a population of differently-abled users, we should think beyond form and economics to re-imagine how and what door hardware can

do to make the experience of opening and closing doors more effortless. This third category of designs explores door handles that engage with users differently and challenge conventional means of opening, closing, and moving through doorways.

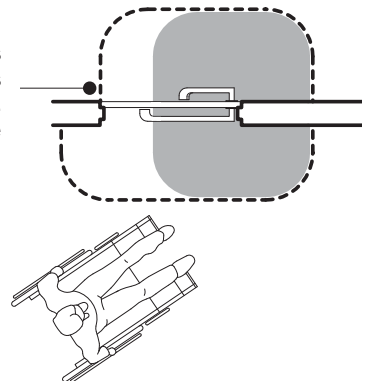


Long Handle

Three challenges of accessibility clearly emerged when dissecting the act of operating a door: getting to and reaching the door handle, opening the door, and moving through the doorway. The Long Handle addresses these challenges through one solution that is easier to reach by individuals in a wheelchair or using a walker, as well as the caregivers that assist them. Additionally, the exaggerated handle length provides greater leverage to minimize the strength, dexterity, and grasping ability required to unlatch the door. Of significant importance, the Long Handle also serves as a tool to keep the door out of the way while moving through.



A longer handle is easier to reach thus easier to operate. New reach range shown dashed.

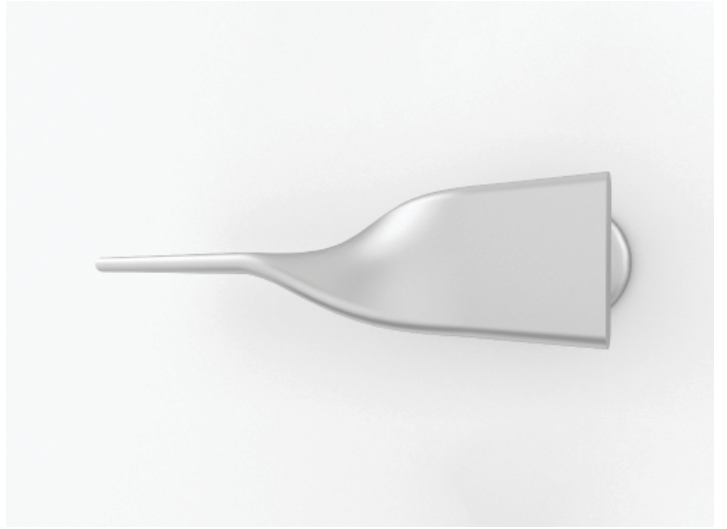




Crank Handle

One of the biggest challenges observed while sitting in a wheelchair and trying to operate a door was the amount of forward leaning required to open or close the door. In addition to being difficult, leaning is potentially dangerous. To reduce the risk of injury that could result from leaning out of one's wheelchair, this design explores how a door can be operated from further away. Capable of being rotated like a traditional handle, the design adds an additional hinge at the rosette that allows the handle to rotate towards the user, providing a few extra inches of maneuvering clearance while opening or closing the door.





Looking to the Future

As the US population continues to age and concerns about accessibility become a greater issue, designers have the opportunity to advance design through the re-working of overlooked elements of everyday life. The question at the heart of this exercise to design a more accessible door handle was: “how can, and should, we design for a population with limited mobility?” At the scale of a door handle, these explorations merged the sensibilities of accessibility and the functionality of ergonomics with real world applications. Simulating and critically analyzing user experiences challenged standard design processes to be more empathetic and user-focused, while leveraging emerging technologies to efficiently iterate and build complex forms generated a rich cyclical loop of analysis, study, and experimentation.

The range and variety of the final designs emphasize the power of recognizing others’ needs. It highlights the capacity of a human-driven design process to question and enhance established guidelines and seek new solutions that put users’ needs first. Looking forward, these explorations illustrate that the value of what we design ultimately lies in how well we understand the end-user and how well we are able to design for them.

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