DSGN 1 Final Project: *The Final Can-down*

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I. Introduction

Figure 1. Can opener used during interviews

For our final project, we decided to redesign the can opener. The very first can opener was designed in **1858**, making this a nearly **200 year old** product. The modern version of the can opener was designed in 1925 and continues to be used to this day. The standard manual can opener, with a "rotating cutting wheel and a serrated wheel" for stability *(shown above in Figure 1)*, is still widely used and found in many household kitchens. Despite its widespread use and relative popularity, can openers are known to be difficult to use and confusing for most users, indicating possible issues with its current design.

After conducting research about can openers, we realized users avoided using a can opener due to both of the reasons stated prior. From models learned in class, including the phenomena with **supply and demand**, we learned that more products are created and commercialized to satisfy customer demand. Yet, only one type of hand-held can opener has been available since 1925. Furthermore, the rate at which technology advances makes the pervasiveness of such a notoriously problematic design all that more surprising. We even found out that such a poor design is not only causes users to suffer, but can jeopardize the success of large industries as well. For instance, in one article (*found here*), a tuna can company is at risk of going bankrupt because of the can opener's **complexity** and **lack of user compatibility**. With all this information, we decided to go into the real world to observe and gain perspective on how users interact with can openers. We wanted to collect our own data and to identify all of the parts of the design that users struggled with, so that our redesigned can opener and prototype could influence a positive experience for future users.

II. Data Collection

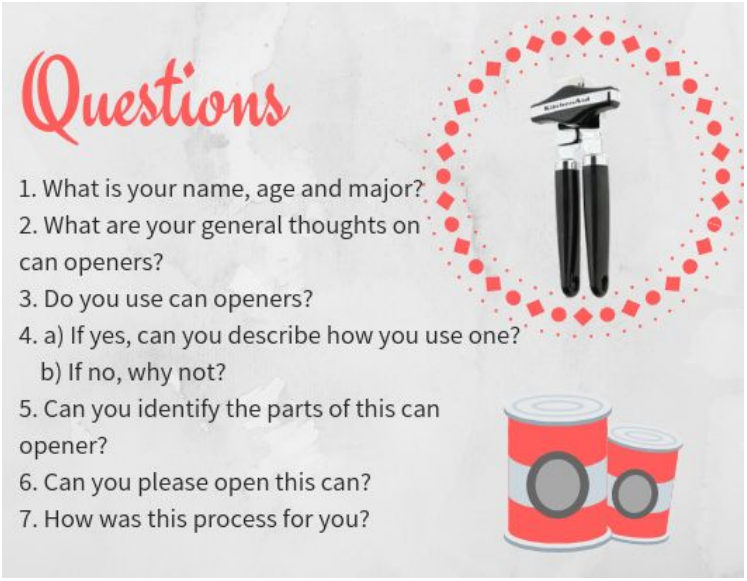


Figure 2. List of Interview Questions asked.

We conducted **eighteen** interviews in groups of **three** so there would be one person to ask the questions, one to take notes of the responses and nonverbal cues, and one to record each user's interactions with the can opener. We each took turns as the scribe, recorder, and interviewer. This increased the **robustness** of our observations by allowing multiple people to analyze the same situation, as well as have video proof of the interaction. We asked all interviewees the same set of questions *(shown above in Figure 2),* before asking them to physically interact with the object and open a can. Before the interviews, each group member bought 3 standard-sized cans (all 3x5 inches). We used the same can opener for all interviews to maintain **consistency** among all 18 interviews since our sample was randomized.

By asking interviewees how they felt about can openers before and after using one, we were able to gain insight into the user's experience and to avoid making assumptions about their thought process. We would also ask them to describe to us how to use a can opener in order to see if they can easily identify and understand the different mechanisms of the design. By filming the users opening the can, we can refer back to them later, ensuring we don't miss any mistakes made or misremember someone's struggles. These interviews were conducted in several different locations to allow for a more varied sample pool. They were split up evenly between the Gilman Transit Center, the ERC commuter lounge, and Geisel Library. Interviewees were approached randomly and asked if they had a couple of minutes to spare for an interview.

Interview data spreadsheet can be found here.
NOTE: There is a link to each of our videos on this spreadsheet

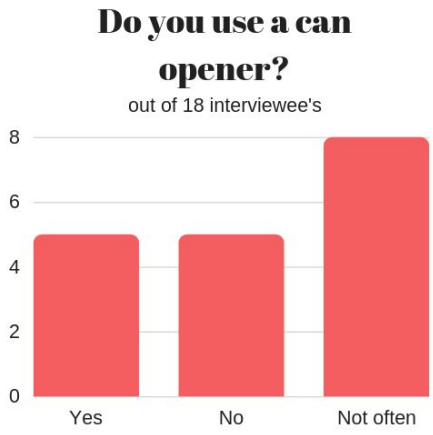


Figure 3. Bar graph showing the amount of interviewees per experience level in using a can opener

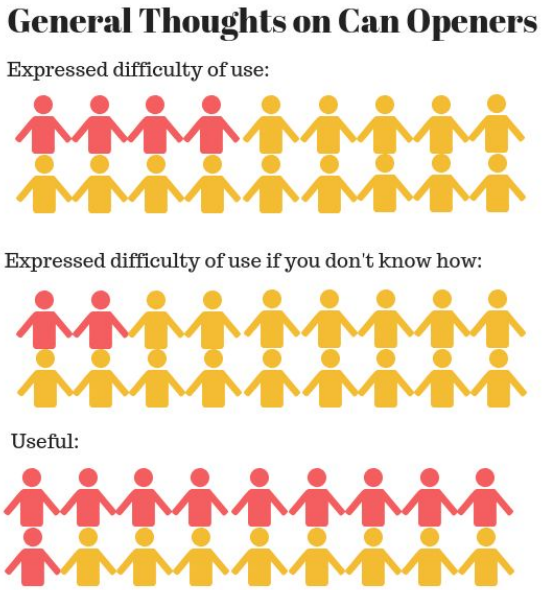


Figure 4. Visual representation of the number of people and what they rated their experience with can opener. A coral icon equals how many people out of 18 felt that way.

III. Problems and Trends

We chose the can opener because even though it is a common everyday item, many individuals still have difficulties using it. Our whole group agreed and related to the frustration of attempting to understand and utilize the can opener's design. We were able to identify the core problems of the can opener's design based on our own personal experiences and then later explore the issues through the data and observations collected from our interviews. The information we gathered from the interviews allowed us to dig deeper and discover the different aspects of the design that serve as the root of the issues.

Figure 3 (above) depicts **quantitative data** from our interviews, and reflects an interesting finding that we expected to impact user experience more than it did. It was found that 5 out of 18 interviewees had prior experience using a can opener, 5 out of 18 interviewees did not have any experience with a can opener, and 8 out of 18 interviewees had experience using a can opener, but not often enough for them to be confident in their experience. A prior conjecture we had made was that users with some or ample experience with a can opener wouldn't struggle as much as those without experience (as this tends to hold true for most user-product relationships). However, it was found in interviews that a user's failure to use a can opener

seemed to be due to lack of signifiers and affordances at that moment, and did not strongly correlate with the user's prior experience.

Additionally, *Figure 4* depicts **quantitative data** about the interviewees general thoughts on can openers prior to interacting with the device. Of the 18 users we interviewed, only 4 expressed that a can opener was difficult to use, and another 2 expressed it was difficult to use if one didn't have any prior knowledge or experience. Furthermore, 10 expressed that a can opener was quite useful, suggesting that they were familiar with and had ample experience with a can opener. Therefore, we hypothesized the possibility of two potential **trends**. First, when experienced users used a can opener and made a mistake, it was due to an **action-based slip**. This means that users meant to perform an action that they knew was the proper action, but executed a different action by accident. Second, when inexperienced users used a can opener and made a mistake, it was due to a **knowledge-based mistake**. This is because users had little to no prior knowledge on can openers, so they were unable to perform the action they intended to.

However, this didn't seem to be the case after interviews were conducted. Even though only 4 interviewees seemed to express that a can opener was difficult to use, it was found that 9 out of the 18 interviewees struggled to use it. This reinforces our prior point from *figure 3* that regardless of a user's prior experience or in this case knowledge of a can opener, the device's poor design, lack of signifiers, and lack of affordances led to a poor mental model for users and poor user discoverability during use.

One core problem was that the crank of the can opener can occasionally **be difficult to turn**. Although the crank affords turning due to its physical ability to twist and move the gear, it can be a difficult action to perform. Simply turning the crank may seem like a simple and easy task to do, but if the can opener is not clamped on correctly, twisting the handle is likely to become a frustrating and tiring task. Additionally, the friction of the gear and blade against the rim of the can creates resistance, which increases the difficulty of getting the blade around the rim of the can. The grip and difficulty associated with turning the can opener presents barriers that can inhibit those physically able from successfully using the can opener.

Figure 5. Interviewee 6 struggling with the crank.

This core problem is further exacerbated by that fact individuals experienced the issue of not knowing **what angle the can opener should be in**. There are no clear signifiers that provide the user with information about what angle the can opener should be attached at in order to clamp on correctly. This issue contributes to the difficulty of turning the handle, since the can opener needs to be attached correctly in order to twist more easily.

Because users struggled with both **turning the crank** and **knowing what angle the can opener should be in**, and most users tend to be right-handed, we made a **qualitative** prediction that left-handed users would struggle more when using a can opener, and may not even be able to use it properly at all. However, after collecting **quantitative** data, our hypothesis surprisingly proved false. Of all 18 users, 2 were left-handed, and both were able to open a can easily. Although, our conjecture wasn't completely unprecedented because both left-handed individuals were nervous to use the device. Both individuals stressed that it felt awkward to use, because - as we observed from their interviews which reinforced what they said - they had to turn the crank with their right-hand and stabilize the handles with their left-hand. This was unnatural for them, as we found right-handed users performed the same actions. Therefore, users generally want to use their dominant hands on the crank and their non-dominant hands on the handles. Thus, hand-held can opener designs should ambidextrous to accommodate different types of users instead of generalizing and commercializing one type.

The can opener's design includes a round blade and gear, where the blade affords cutting due to its sharp edge and the gear affords gripping onto the side of the can based on its position in relation to the blade. However, there are **no signifiers** that allow the user to identify these affordances. The lack of signifiers can result in the user clamping onto the lid incorrectly resulting in the blade not effectively cutting into the lid of the can. This issue can also result in users using the can opener upside down, since there is nothing to indicate that the blade needs to be on the top while the gears must be placed at the bottom in order to correctly cut into the lid of the can. If the can opener is used upside down, it results in the blade cutting into the side of the can. When the user continues to twist the handle, the blade will cut along the side of can and cause the contents to spill out from the sides (as shown below in *Figure 6*). This type of situation results in a mess and frustration from the user.

Figure 6. Interviewee 9 using the can opener upside down, causing the liquid to leak out of the can.

Figure 7. Interviewee 5 struggling to latch the can opener onto the can due to incorrect positioning.

The can opener consists of many different features that contribute to its **functionality**, but unfortunately users are often unable to identify its various parts. There is a **lack of signifiers** to clearly indicate where each feature is and what it does. For example, there can be confusion with the functionality of the gear and the blade of the can opener. It is a common mistake that users **misidentify** the gear as the blade and vice versa, because the gear is serrated and appears to afford cutting. The gear actually aids in turning the blade, which is flat and dull around the edges.

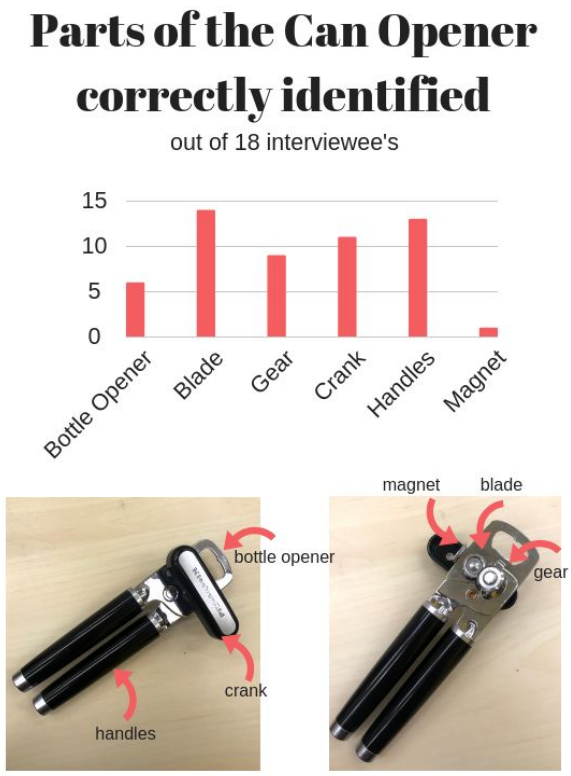


Figure 8. Shown in bar graph: 6 people identified the bottle opener, 14 identified the blade, 9 identified the gear, 11 identified the crank, 13 identified the handles, and 1 identified the magnet.

When our group researched the specific can opener we were using for our interviews (Kitchenaid), we realized that there were **various parts of the design that even we were unaware of**. Some of us did not originally identify the bottle opener on the top, and none of us realized that the design includes a small magnet on the side, which is used to safely take off the metal lid of the can and reduce the likelihood of being cut. The fact that these aspects of the can opener's design are useful but not clearly communicated to the user through the use of signifiers can cause **confusion and failure to use the item** correctly and effectively. *Figure 8* shows what parts the interviewees correctly identified. Aside from the magnet, the second most unidentified part was the bottle opener. Although the bottle opener is clearly in sight and has the appropriate affordances and signifiers, it was overlooked because the main function of a can opener is to open cans. The magnet and bottle opener are both unnecessary to open a can, but are still there to add additional functionality. A user's **goal** in using a can opener is to simply open a can, but due to the poor design features of this common household item, individuals struggle with executing that goal.

IV. Prototype

For our prototype, we decided to completely change the design of the can opener. Instead of having a manual, hand-held device, we switched to an electric can opener that can automatically open and remove the lid of a can. With our problems in mind, we wanted to eliminate users making a **slip** or **mistake** when attaching a can opener to the can, so we introduced a magnet into our prototype that a can attaches to automatically. This way, the magnet does the job of correctly positioning the can. Our second problem was the user struggling to turn the knob of the can opener. In order to mitigate this issue, we redesigned the can opener to not consist of any manual functions and instead move forward to an electronic prototype, so a larger group of users would be able to use it successfully. After identifying the core problems with can openers and what we wanted our ideal redesign to have, our group did an 8-fold prototype exercise. .

Initially, we iterated through some handheld designs in order to stay close to the original can opener's structure. The first one spun and was easier to turn, but harder to control and actually cut the can. The second one was a knife type of opener, but it was not safe or precise. The third was electric, but still handheld and lacked precision as well. With these designs, the issues of difficulty turning the can opener crank and lack of ambidextrous support still remained. It also seemed as if there was no other product that matched new user's mental model of a product that afforded to open things. Instead of redesigning a manual, hand-held can opener (since the act of physically opening the can itself was also difficult for users), our final redesign was an electric can opener. Our fourth prototype was a circular blade that just cut the top off, but this was messy and dangerous. Prototype five had an automatic function, but had a dangerous element to it. Six opened the can from the side, which could lead to spillage of what was inside the can. The eighth one was our final redesign. The redesign is similar to users' mental model of electric coffee machines, such as a Keurig. For example, the user would conduct the same action of placing their can on the base of the can opener as a coffee mug on the base of a Keurig and then leaving the machine to complete the task for them. With the inspiration of a coffee machine in mind, we prototyped different ways we could potentially redesign a can opener, leading us to eventually, what we consider the most efficient redesign.

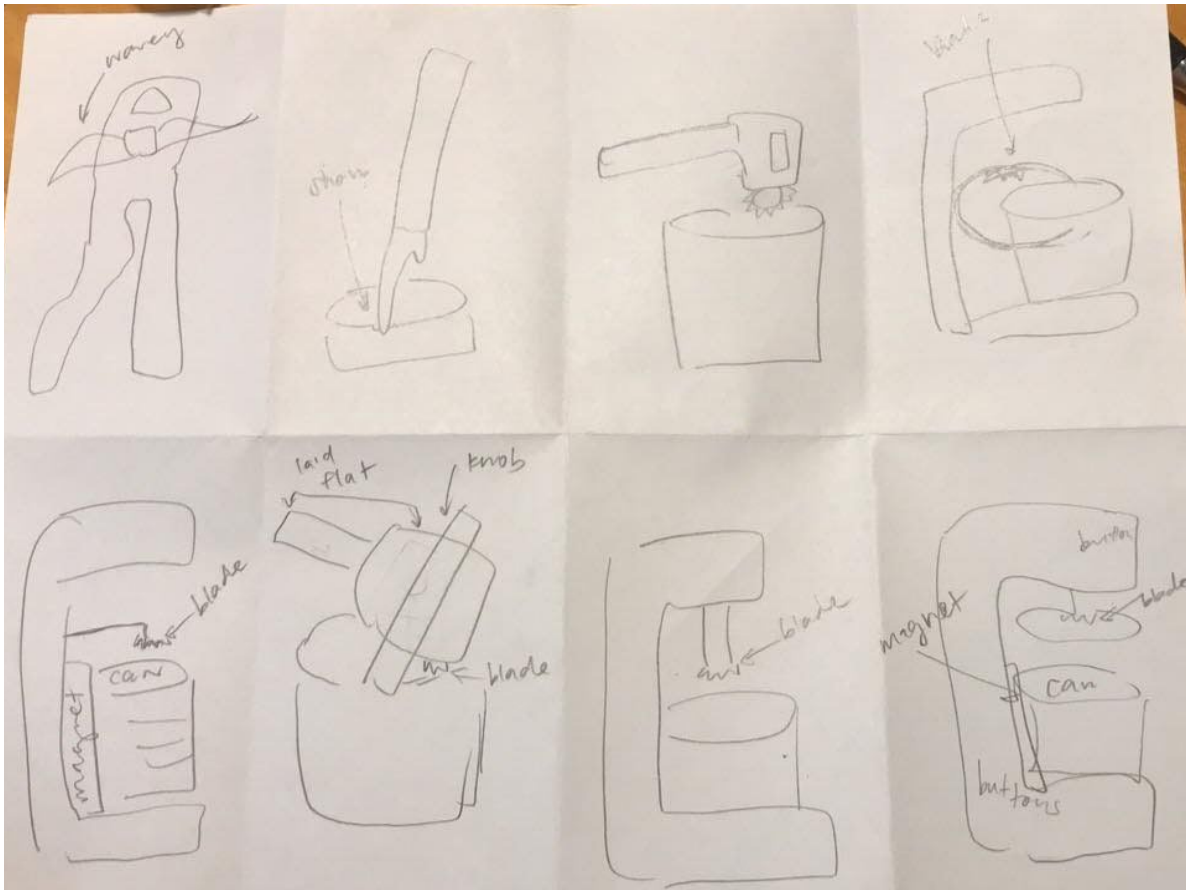


Figure 9. Our 8 fold prototyping process.

V. Design Space and Redesign

Our design space included two main trade-offs that were identified during our interviews. One problem that users faced when using a can opener was identifying the features of the can opener. A can opener with easy to find features had a **high discoverability**, while a can opener with difficult to find features had a **low discoverability**. Having features that are easily recognizable by the user aids in the user's successful interaction with the product. On the other side of our axis, we had simplicity or complexity of design. A can opener with multiple features and affordances was considered a **complex design**, while a less physically complex can opener was a **simple design**.

To gauge where the can opener we used for our interviews and our proposed can opener redesign ranked, we used other can openers that group members owned. We asked the owner of the can openers to rank their can opener for the two trade offs (discoverability vs. design complexity) on a scale from 1 to 5, as shown below. 1 means the can opener had hard to discover features or had a very complex design. 5 means that the can opener had easy to discover features or a simple design.

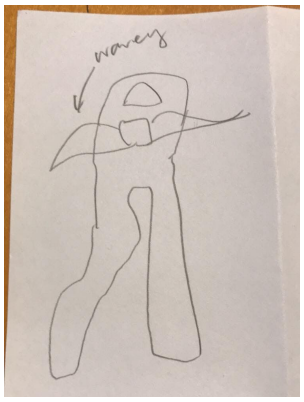
Brand: Norpro
Discoverability: 4/5
Complexity: 3/5

Brand: Up&Up
Discoverability: 4/5
Complexity: 4/5

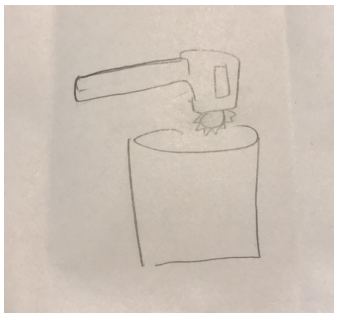
Brand: Swing-a-Way
Discoverability: 2/5
Complexity: 2/5

Brand: Unknown
Discoverability: 3/5
Complexity: 4/5

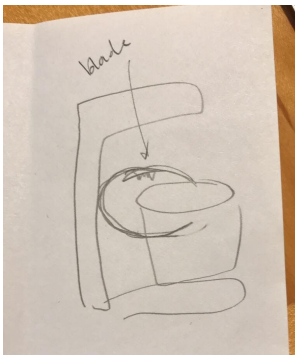
Brand: Kitchenaid
Discoverability: 2/5
Complexity: 2/5



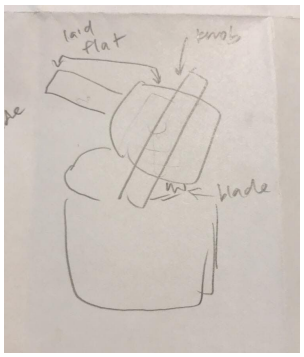
Potential Redesign 1
Discoverability: 3/5
Complexity: 3/5



Brand: Potential Redesign 2
Discoverability: 2/5
Complexity: 3/5



Brand: Potential Redesign 3
Discoverability: 2/5
Complexity: 1/5



Brand: Potential Redesign 4
Discoverability: 1/5
Complexity: 2/5

Based off of this chart, we mapped out our Design Space (below).

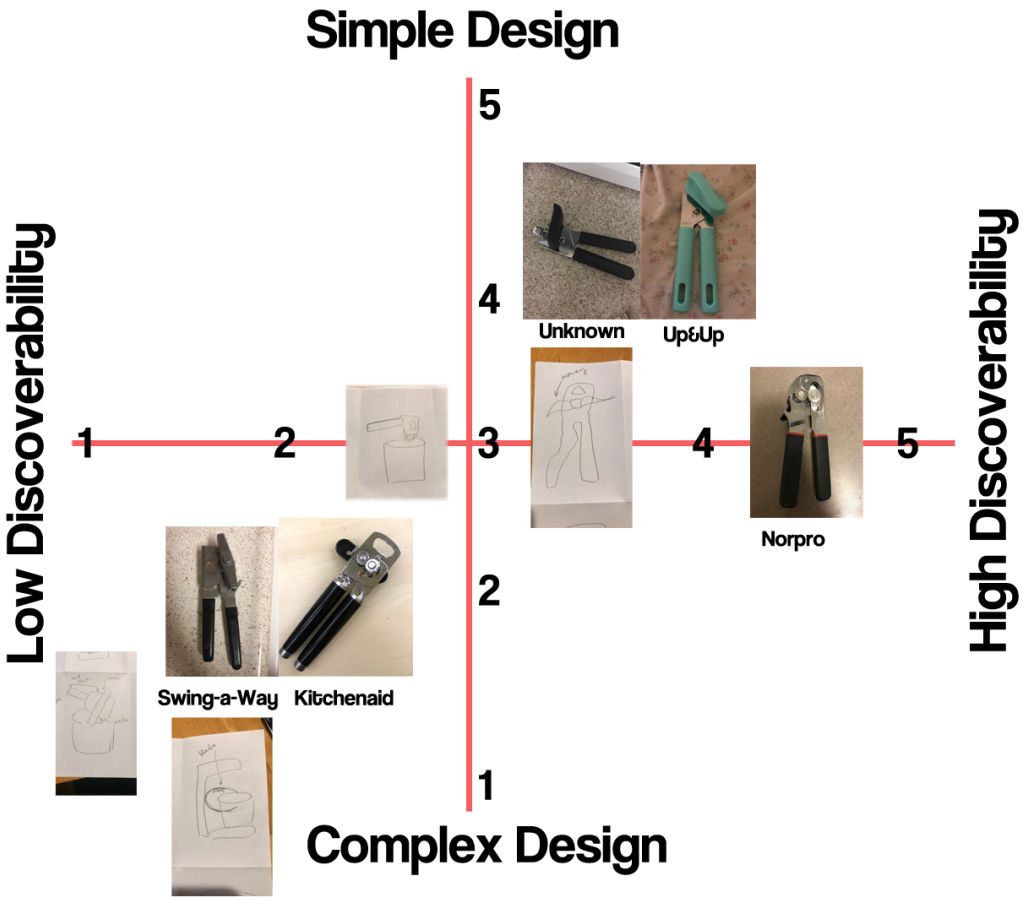


Figure 10. Design Space before redesign.

Our ideal redesign needed to have a high discoverability of features, because it was one of the main issues identified through our interviews. However, the redesign did not necessarily need to be a simple design. A complex design that matched the user's mental model and had the appropriate affordances and signifiers would be just as good and effective of a design. By providing buttons in our redesign that acted as signifiers and affordances, it allows the user to identify how to use the machine without any confusion.

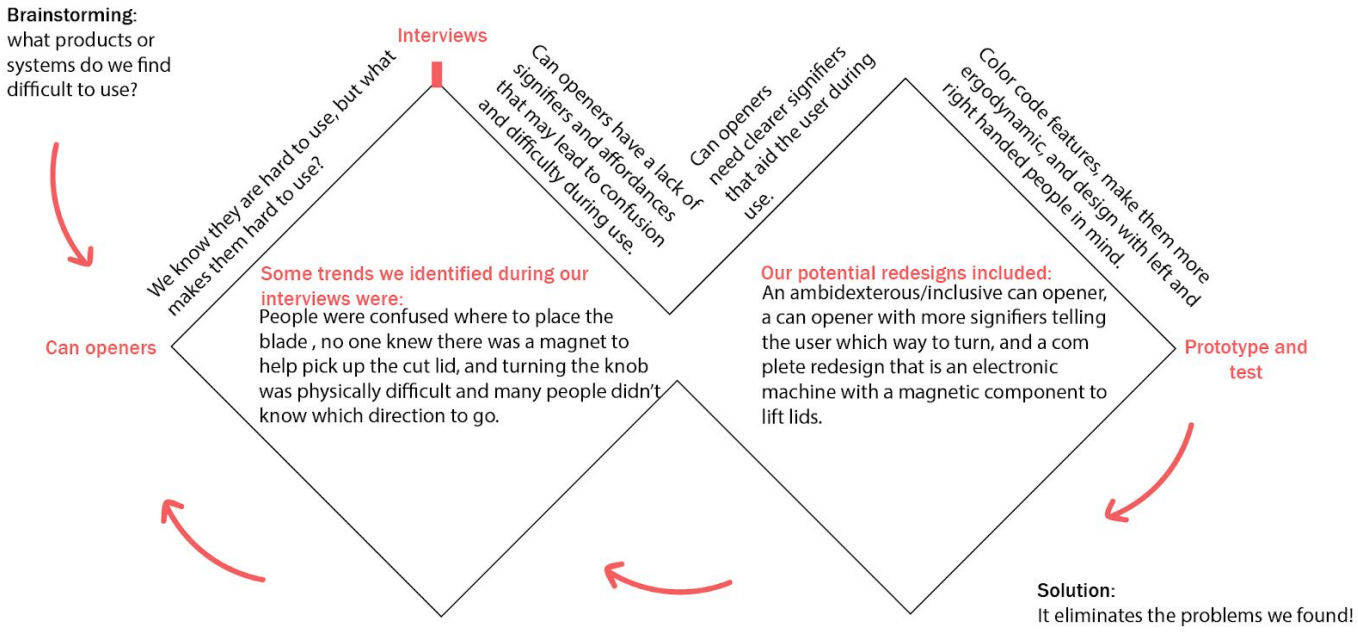


Figure 11. The double diamond design process we followed to help us redesign a can opener.

The redesign resolves the problems we found through our interviews. As stated on our double diamond model, people were confused on where to place the can, so our can opener design incorporates a base with signifiers to indicate to the user where to place the cans. Since it is an electric can opener, the only action the user has to do is place the can on the **magnetized base** of the can opener and press a button to start it. After pressing the big red button to start, the **blade housing unit** automatically lowers and attaches the can, cuts lid open, and then raises it up with a magnet so the user can safely grab the removed lid and the opened can separately without any additional work.

The magnet on the base allows the can to be easily attached to the opener while also providing feedback to the user that it has been correctly set in the machine. This new can opener design also eliminates the need to use the right hand because it is an **ambidextrous design**, making it both simpler to use and more inclusive. Another perk of the can opener's electric and automatic design means that users do not have to struggle to know how to place the can opener on the can or to even physically open the can themselves. The can opener does all of the work after the user places it correctly on the base. To prevent the user from possibly cutting themself with the serrated edge of the can, the magnet located in the blade housing unit picks up the lid for the user once it is separated from the can. It bridges the **gulf of execution** by following a mental model familiar to many user's and having signifiers that help identify parts. It bridges the **gulf of evaluation** by having visible and audio **feedback** of the blade coming down and cutting the can.

This a 3D-mockup of our electric can opener design.

It is powered by connecting the power cord (not pictured) to any available outlet.

The blade housing unit is able to expand to a diameter of 100 mm and cut cans with diameters equal to or less than that with its patented aperture system!

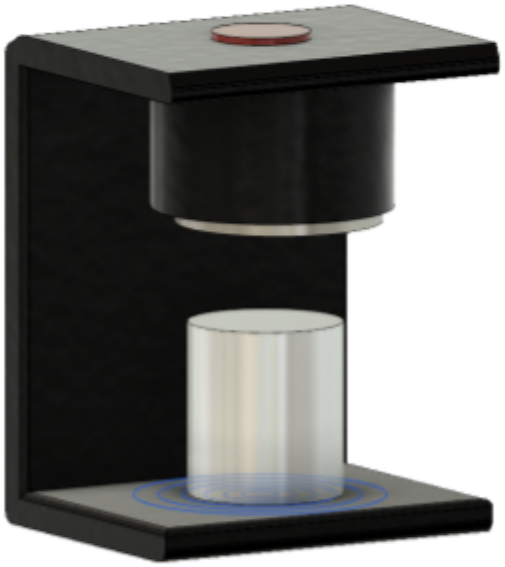
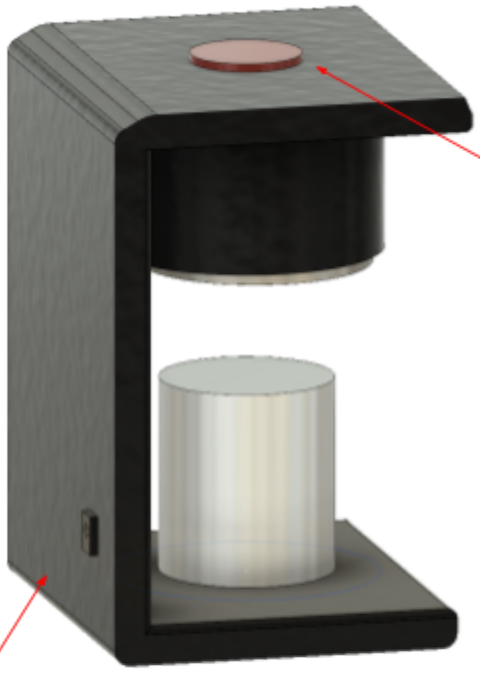


Figure 12

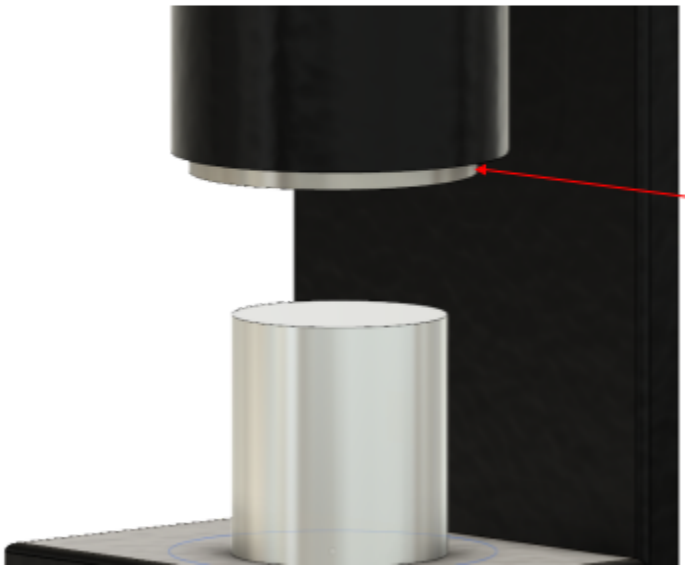
Figure 13



The red button on top is placed there in accordance to users' mental model of similar devices such as a Keurig coffee machine. The color allows for it to stand out and to indicate its dynamic nature. Once pressed, the blade housing unit will lower to cut the can's lid.

There are only two buttons needed to operate the can opener. This one turns the machine on/off.

Figure 14



The blade housing unit lowers once the red button is pressed. The built-in sensors stops the lowering process once it reaches the lid of the can. The unit then closes its aperture to fit the diameter of the can's lid.

Figure 15

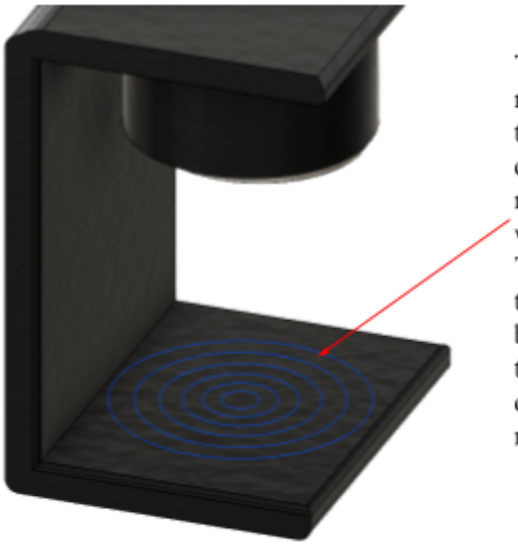
This animation shows the blade housing unit's lowering mechanism in action. Once the blade finishes cutting into the can, it lifts up the lid with the magnet located inside the blade housing unit.

Figure 16

The blades' aperture operation is similar to that of a camera lens. It closes to fit the lid's diameter before cutting it in a circular motion.

Image from
https://goo.gl/u31anU

Figure 17



The base of the machine has multiple rings to indicate where to place the can. The area the circles encircle are the magnetized zones where the cans will properly attach to the base. The largest circle corresponds to the largest possible diameter the blade housing unit can open up to. Thus, no can with a larger diameter is usable with the machine.

The proposed redesign does not come without trade offs. Although it has a high discoverability of easy to use features, it is an electrical product. This makes the product larger in size than hand held, human powered, can openers and does not allow the user to use it on the go. The design traded portability for more automated functionality. Since the can opener needs to be plugged in to work, this restricts its use to locations with an outlet. The electric can opener also has a much more complex design than most manual can openers, so another trade off would be

price due to its necessity of costlier parts and mechanisms. Additionally, another trade off in our redesigned electric can opener would be the sizes of cans that are able to be opened by it. The can opener would only be able to open cans that had a diameter smaller than its blade housing unit's diameter, 100 mm (easily accommodating most standard cans). Our design traded off the flexibility that a hand operated can opener would have, with the ability to open a wider range of cans, in order to have a practically sized blade housing unit that would allow users extreme easy in opening the majority of cans that they would want opened.

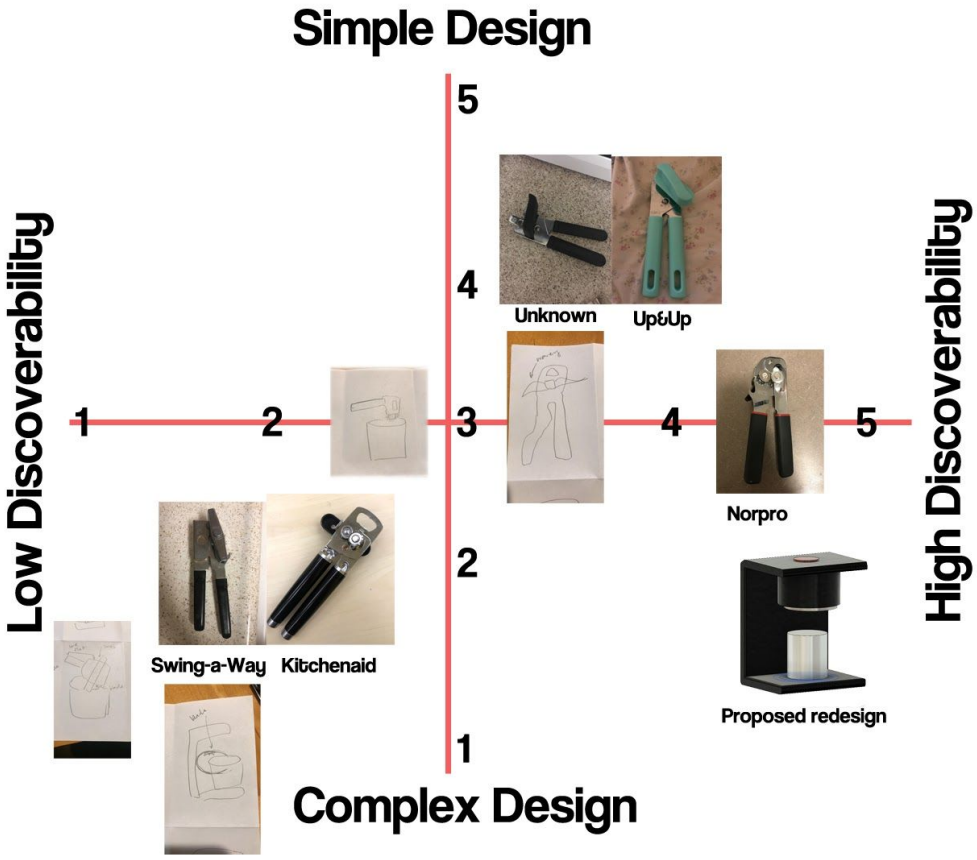


Figure 18. Shows the design space with the proposed redesign included.

The proposed redesign was rated a 5 for discoverability, and a 1 for complex design. It has buttons with clear signifiers of the purpose of the buttons, giving it a high discoverability. It is also an electric can opener, which is a more complex design compared to the handheld ones.

VI. Conclusion

In conclusion, the can opener is **outdated** and poorly designed. The can opener has an **absence of signifiers** that help guide the user on what part is what, and what each part affords. Through our interviews, we found trends that helped us identify this, as well as what parts

specifically the users did not know how to use. Our redesign aimed to eliminate the core problems we found: confusion on how to attach the blade to the can, difficulty turning the handle, the inability to identify the magnet safety feature, and the inconvenience of the right-hand design.

The next steps for this project would be to actually create a functioning prototype of our redesign and do some **user testing** to make sure new problems do not arise. Additionally, we could look into redesigning cans and their standards. One solution to the problems of a can opener is cans with pull tabs (2 out of our 18 interviewees actually mentioned them). However, the pull tabs still have issues. First, they are not standardized: not all cans come with pull tabs. Second, the tabs can break off. If not manufactured correctly or pulled too hard, the tabs can break off, leaving the user to either use a can opener or be unable to open their can at all. A problem that tabbed cans and manual can openers pose is that they are hard to use for those who do not have the physical strength, or a condition like carpal tunnel or arthritis. To mitigate this, there are tabbed can opener's, but these would not be needed if our redesign existed.

Figure 19. A can with a tab on it and a tab opener. Image 1 credit and Image 2 credit.

Figure 20. Shows Interviewee #10 opening a can and getting the corn liquid everywhere.

Another issue with cans is that when the user opens a can using a can opener, the liquid from inside the can leak out and get everywhere (as shown above in Figure 20). In the post task question, Interviewees #8 and #10 expressed how they felt opening the can was “wet” and “moist”. A possible solution to this would be to decrease the amount of liquid and product in a can. Although the user would get less product, it is less likely that it would spill while the can is being opened. In order to eliminate all of these possible issues, it seems we should do away with the can completely and discover a better way to preserve foods.