Project 3:

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Figure 1: The interviewee turns the dial of their campus mailbox.

Data Collection

Brainstorming

When our group first started the brainstorming process for this project, we wanted to investigate an aspect of an online application, such as using ChatGPT or the GPS on your phone. However, when discussing procedures like these more in depth, we realized there was a lot of variability in user error, making what we had discussed hard to generalize across populations. For what we had discussed, what may be confusing to one user may not be to another, making it hard to identify patterns and trends. Thus, we turned our discussion towards objects which would have more errors due to their physical attributes rather than online procedures which are more varied. Ultimately, our discussion landed on locks, specifically, the on campus mailbox locks that can be found in every college. This object is used pretty universally by undergraduate UCSD students, making it possible for us to find a variety of interviewees that would help us establish trends and patterns in relation to errors. To further our discussion about these locks, we created a mind map exploring its physical properties, and potential **errors** and **tradeoffs**.

Mind Map

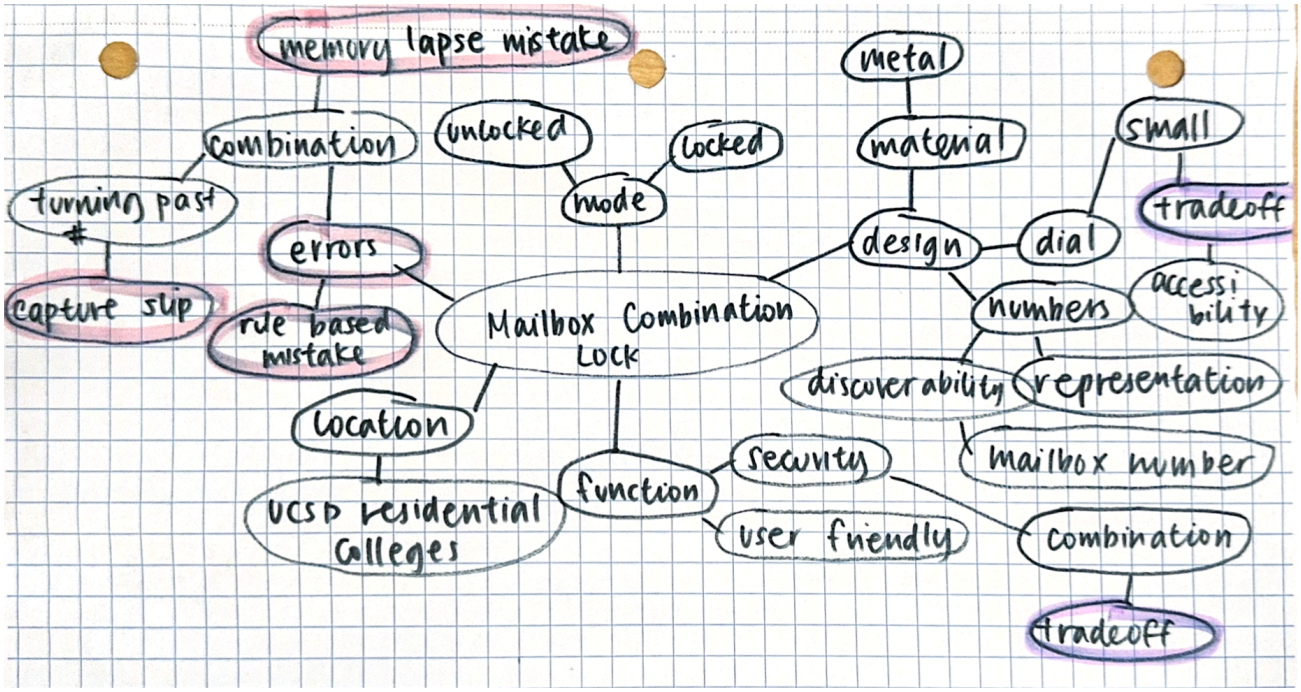

Figure 2: Mailbox Combination Lock Mind Map

Interview Methodology

When creating our questions, we knew that we wanted a combination of both questions and tasks so that we could gain both qualitative/quantitative data as well as detailed insight into the user experience. We wanted the user to demonstrate how they would use a mailbox lock in the real world as per the **master-apprentice model** so that we can get a first hand look at how they cross the **Gulf of Execution and Evaluation**. Lastly, we decided to make the questions open-ended rather than multiple choice because of the possibility of it being more of a **leading question**.

To find our interviewees, we landed on a central part of campus, Sixth College. We knew that most residents who live on campus would be second and first years and this would be reflected in our data. However, we tried to interview a variety of majors and ethnicities to ensure our data would reflect the diverse student population of UCSD. For our interviews themselves, we used a Google Form to record answers during the interview, ensuring that each interviewee was asked the same question.

Task

1) **Show me how you would open your mailbox.**

This task makes use of the **master-apprentice model**, which is when the interviewee shows the interviewer how they would complete the action. In this case, the interviewee showed

us how they would use the lock to open their campus mailbox while use (the interviewers) take note of their actions. All 12 interviewees turned it to the left, right, and left before pulling the dial to open it.

This task shows the users' **conceptual model** of how to use the mailbox lock. By going through the action of showing us how they opened the mailbox, we can better understand this **conceptual model**, which is how a user understands the way to use an object. The **feedback** of being able to open the mailbox, along with the user's **conceptual model**, allow us to evaluate the **Gulf of Evaluation**. As 3 out of 12 people struggled to open the mailbox on the first try, there is some evidence to suggest that the design of the campus mailbox locks are flawed.

Questions

We then wanted to get an idea of how often our interviewees use their mailbox and how often they encounter **errors** while using it, so we can get an idea of what percent of the time they struggle with the design of the lock. We then asked what sort of problems they run into so we can glean the specific types of **errors**. Finally, our last question helped us obtain some quantitative data to compare with other interviewees and their problems to see if we can extrapolate any trends.

1) **How often do you open your campus mailbox per month?**
    - This question will give us an idea of how much **knowledge in the head** the person has when using their mailbox. Having seen them demonstrate their use of the mailbox lock, we can get an idea of how much experience they have using the design.

    a) **Of those times, do you ever struggle to open your mailbox? If so, how often?**
        - We then asked this follow-up question to get a sense of what percent of the time someone struggles to use the design, which will allow us to gauge the severity of any flaws or human error that occurs.

    b) **If you struggle opening the mailbox, what problems do you run into?**
        - We asked this follow-up question in order to get some concrete issues directly from the user, in order to reinforce anything we may have observed when watching them operate the lock.

2) **How easy or difficult is it to turn the dial accurately to the numbers? On a scale from 1 (easy) - 5 (difficult)**
    - This question is important because it goes into the **affordances** and **signifiers** of the mailbox lock's dial mechanism, helping us figure out how intuitive the design is for use. If users find it difficult to turn the dial accurately, their rating may

suggest that the dial's **feedback** is unclear, suggesting that the dial is difficult to use. Or, it may tell us that it is easy to use if users rate it lower.

a) **Why do you say so?**
   - This question allows us to see why the user chose their rating. We can understand their reasoning and apply that to our redesign of the mailbox lock.

3) **Rate the functionality of this lock from 1-5 (1 being the worst and 5 being the best)**
   - This question helps us gain quantitative data measuring interviewee opinion about our chosen object. Quantitative data helps us form our graphs to display our responses statistically and expose any trends.

a) **Explain why**
   - This question shares the interviewee's thinking (positive or negative) towards the lock as well as their supporting rationale. Combined with our other interviewee data, the answer to these questions gives us insight into potential patterns and trends in **errors** or positive aspects of the lock.

Proof of Data

We created this Google Form with the questions to help us record interviewee answers as we talked to them. This Google Form also helps us aggregate data and create graphs. There is a linked Google Sheets to correspond with the responses received in the form.

Contributions

Each member of our group conducted three interviews to contribute to data analysis and collection. These interviews can be found in their entirety in the linked Google Sheets found above. Lucy collected the interviews shaded in green, Varun in red, Phoebe in blue, and Ava in purple. We all collaborated on this project, with Lucy working primarily on Methodology and assisting in error identification/classification, Varun on Design Space charts and tables, Phoebe on error identification/classification and the redesign, and Ava on patterns/trends and tradeoffs. Each group member also contributed to analysis of the questions, Varun working on 1, Ava on 2, Lucy on 3, and Phoebe on 4. Once we finished our parts, we all read over the entire project and edited it for correctness and clarity.

Errors

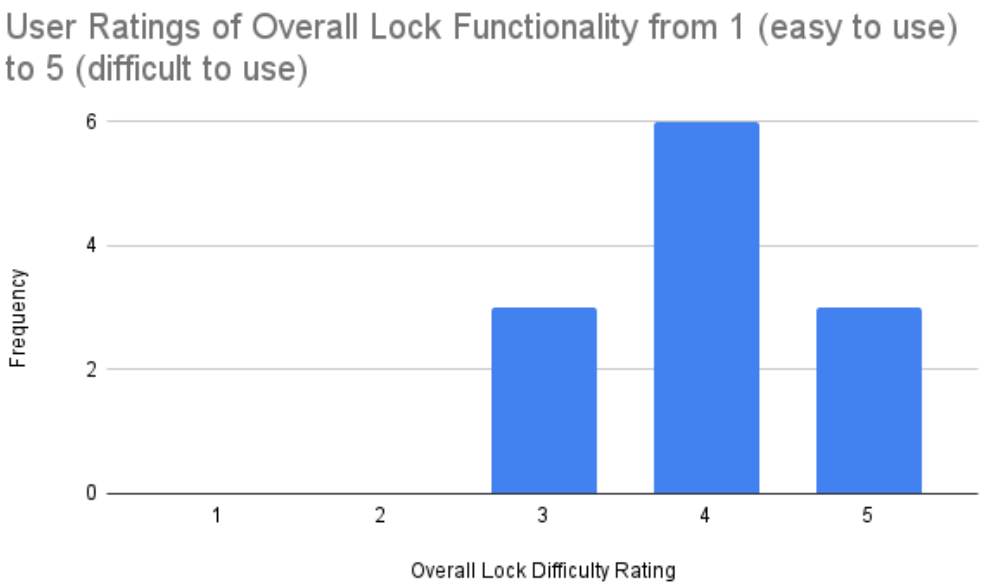

Figure 3: Graph of Overall User-Difficulty Rating

After conducting our interviews and observations, the overall consensus seems to be that 12 out of 12 interviewees find the overall use of the campus mailbox lock design to be moderately difficult, with 9 out of 12 rating it in the 4 to 5 range (**Figure 3**). This means that most users seem to struggle when using the locks, and the specific problems that we observed users experiencing can be boiled down to three distinct errors.

Error #1: Trouble with dial sensitivity and accuracy

One error users deal with include having trouble with the sensitivity and the accuracy of the dial. One user said, "The dials are too sensitive, and it often results in the combination being wrong." This can be classified as an **action-based slip**, because the users' intentions are to dial to a certain number, but they end up either not turning to the correct number or missing it slightly. In addition, 11 out of 12 people say that they struggle to open their mailbox "almost every time" and that it "takes a few times to open it." This overwhelming majority of people who find it difficult to open their campus mailbox show that there is an issue with the design of the campus mailbox lock.

Figure 4: Sixth College Mailbox Lock

Error #2: Small numbers on the dial itself

Another error that users deal with are issues pertaining to the small numbers on the lock itself. 10 out of 12 of our interviewees rated the difficulty of inputting the locker combination from moderately to very difficult (**Figure 5**). In our interviews. On the dial (**Figure 4**), the arrow denoting what number is thick, while the line is thin, making it hard to line up, due to the incompatibility in size. Combined with the dial sensitivity and the aforementioned amount of users who struggle to open their mailbox most of the time, it can lead to **action-based slips**, where the user intends to input a certain number but inputs the wrong one due to not being able to see it properly. This was exemplified by interviewee 4, who “usually [has] trouble entering each number of the combination”, and interviewee 6, who said it's “hard to turn to a specific number”.

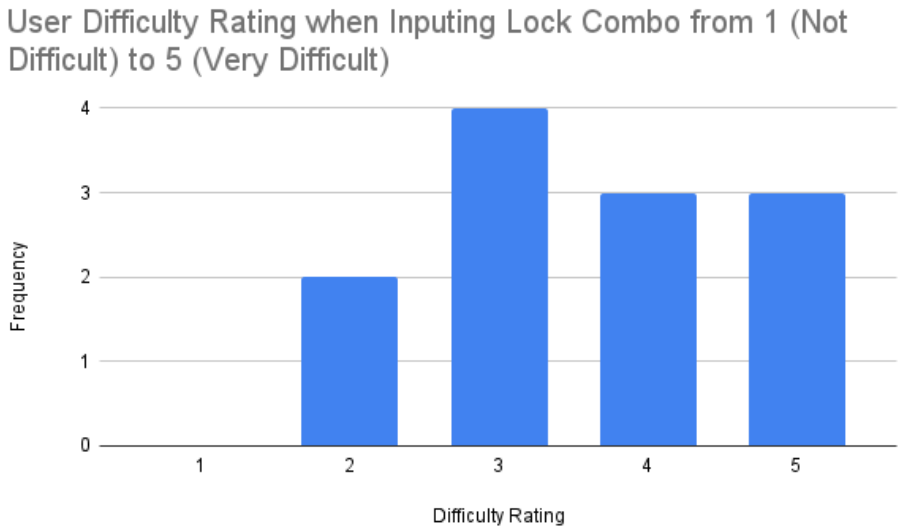

Figure 5: Graph of user difficulty when inputting lock combination

Error #3: Confusing Process

Another area that raised some errors had to do with the complex process of unlocking the lock. Combination locks, much like the mailbox locks that we chose, have a process that involves turning the dial in several different directions with specifications such as passing 0 or passing one of the numbers in the combination. These tricky details are not very intuitive and can cause some errors with this object as 6 out of 12 interviewees had issues with the process. Additionally, we observed that sometimes interviewees would sometimes turn to the previously inputted number when they did not mean to, showing that there is a trend of **capture slips**. The confusing process also leads to **memory-lapse slips**, as users may accidentally turn one too many times. Interviewee 9 said "a lot of aspects are difficult to remember and not intuitive". These problems are also examples of **rule or knowledge based mistakes**, as interviewees 3, 6, and 12 expressed difficulty using the lock as first-time users, which can include people who have never used any form of combination lock before.

Overall Patterns/Trends:

- **Regular Mistakes Due to Dial Sensitivity**

  One noticeable trend among users is the high rate of mistakes generated by the dial's sensitivity. Because the dial is so sensitive, 5 out of the 12 interviewees have said that they have accidentally landed on the wrong position or went over the digits. People who don't use the mailbox very often may find this particularly difficult since they don't know how to utilize the lock properly. Words like "the dial is too sensitive and often results in the combination being wrong" describe how frustrating it is for students/users. According to this pattern, dial sensitivity improves security but is annoying for users who don't often use the lock.

Pros: Higher security because of the accuracy needed, which discourages use by people who aren't supposed to.
Cons: Due to the dial's sensitive adjustments, there are a lot of mistakes and frustration for users, especially those who don't use it very often.

- **Complexity of Sequence Leading to Errors**

  Another significant trend is the elevated mistake rate linked to the complexities of the lock's turning sequence. 5 out of 12 interviewees encountered challenges in remembering and performing the multi-step turning procedure, especially if they infrequently checked their mail. This trend suggests that although the sequence improves security, it results in a significant **memory-lapse mistake** rate, which is frustrating for beginner and occasional users.

- **Poor Readability of Small Dial Markings**

  Another trend that came up is that a lot of people have trouble reading the small numbers on the dial. 4 out of our 12 interviewees had trouble seeing or aligning the numbers on the lock because it is so small. This is especially true in low light or for people who have sight problems/have low vision. This trend points out the usage problems caused by the lock's small size, which makes it harder to read.
  Pros: It saves space because it's compact and built in.
  Cons: Limited visibility that leads to frustration and errors.

Trade-offs:

- **How secure vs how user friendly**

  Balancing security and convenience of use is one of the main **trade-offs** with the mailbox lock. Traditional combination locks are difficult for thieves to crack because they require a user to follow a series of steps. Mail and other valuables are best kept safe by this level of protection. On the other hand, there is a downside to all this complexity, and it is that it requires a lot more **knowledge in the head** for the user. Users have to memorize exact turning sequences, which may be annoying, particularly for occasional users who could forget or have trouble understanding the steps or if they want to do it fast and the steps get mixed up. It would be easier and faster to open if the lock system was made simpler. However, making the lock less complicated might also make it less safe, making it easier to break. A balance must be found between information protection and user discomfort .

- **Compactness vs. readability**

The current lock design is compact and allows the lock to blend in with the mailbox because of its compactness. However, readability decreases as a result, as users struggle to properly orient the dial due to the tiny numerals and tight space. Essentially, if the lock is too small, it decreases the effectiveness of its **signifiers**. In low light or for those with vision problems, the numerals might be difficult to see. The dial may be made larger or the spaces between the mailboxes might be made wider to make it easier to read and enter the proper combination. But this upgrade might increase the cost of production and need more room on the mailbox door. Finding the right balance between size and readability would keep the lock's small shape while making it easier to use and lessening the chance of **action-based slips** caused by misread numbers.

- **Privacy vs. Accessibility Support**

  The current design of the lock ensures mail security and privacy by requiring users to enter their own combination. However, there is no obvious method for friends or staff to help users who are having trouble with the lock (the only way is to give them your passcode and have them help you open it), especially those who are not familiar with the combination sequence or the way it works, without compromising their privacy. It would be simpler to assist users who run into problems if there was an alternate design that permitted a backup access process, such as a staff-held master key or a chance to change the code. However, if the master key is not tightly secured, this strategy may raise privacy issues. The balance between providing alternatives for user help and protecting user privacy is important.

Design Space and Redesign

Design Space Chart #1: Security vs. User-Friendliness

Lock	Security	User-Friendliness
Campus Mailbox Lock	5	1
Combination Padlock (Multiple Dials)	3	3
Number Pad Lock	4	4
Ideal Design	3.5	5

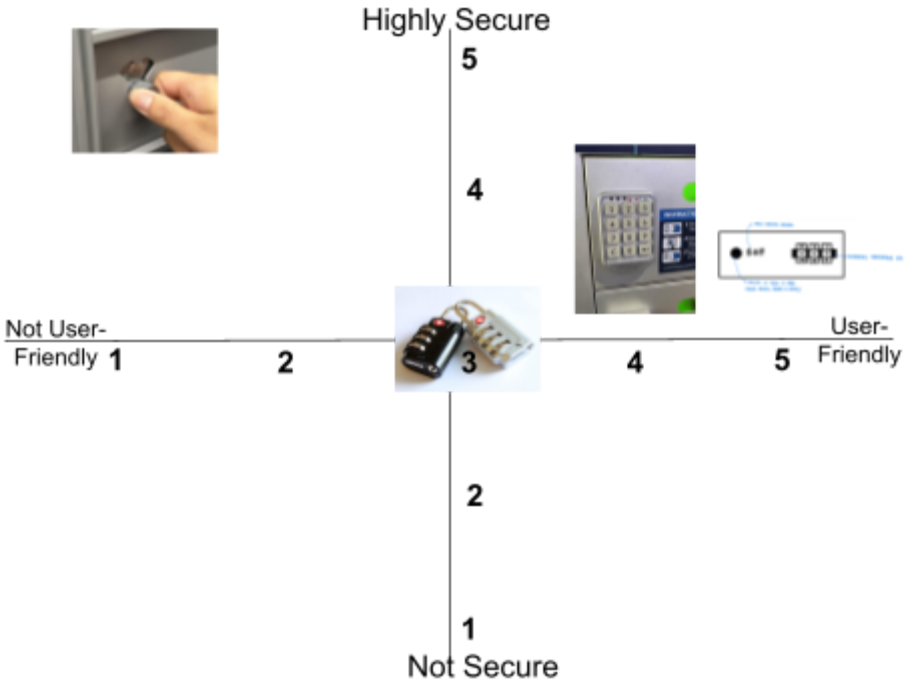

Figure 6: Security vs. User-Friendliness Design Space

In this design space, we rated the campus mailbox design that we are investigating at a 5 for highly secure but at a 1 for user-friendliness (generally how easily the user can cross the **gulfs of execution and evaluation** with minimal **error**). One of the reasons for its high level of security is the amount of total numbers it has. With up to 50 numbers and 3 important inputs, there are around 125,000 different locker combinations. The different amount and directions of turns on the dial that are required to open the locker also adds to the lock's security. However, this complexity makes it difficult for not just potential thieves, but also users, as 12 out of 12 expressed at least some struggle when opening their locker, showing that most users have trouble bridging the **gulf of execution**. Interviewee 3 said, "when I turn to enter each of the codes it's hard to keep a count", showing that the complexity leads to **memory-lapse slips**. Combination padlocks have 10 digits and at least 3 inputs, with at least 1000 possible combinations, and no requirement of memorizing turns. Still a numerous combination, but not quite as secure as the mail lock, giving it a rating of 3. However, because there is less complexity in the lock, it is less likely for the user to have errors of **memory-lapse** when opening. However, the user could still make a **memory-lapse slip** by forgetting to re-scramble the lock combination or forgetting to bring the lock all together, since it is portable. For this reason, its user friendliness is at a 3. The number pad lock is rated similarly to the combination lock for these reasons, however because it automatically relocks itself after closing and is embedded into the locker, it has a 4 in each category rather than 3. Its comparable **system image** to other locking mechanisms such as passcodes on a PC or phone also contribute to its user-friendly design, as people are more likely to have an accurate **conceptual model** of how it works, reducing the chance of **rule-based mistakes** (experience with passcodes also contributes to the combination padlock's

user-friendliness, since there is greater **knowledge in world**). An ideal design would be secure but just as importantly, based on the fact that 10 out of 12 interviewees rate the difficulty of inputting their code from 3-5, would be user-friendly. This would mean adopting a design similar to the simplicity of the padlock that is also embedded into the locker like the number pad or mailbox lock. It would also need to provide clearer tactile **feedback** of when a number has been selected, as interviewees 2 and 8 commented on the hypersensitivity of the mailbox lock dial making it hard to land on the right number. Having the numbers physically click into place like the padlock would be ideal. A 3.5 level of security and a 5 level of user-friendliness would give a good balance of security and simplicity for the user.

Design Space Chart #2: Compactness vs. Readability

Lock	Compactness	How easy it is to read input(s)
Campus Mailbox Lock	5	1
Combination Padlock (Multiple Dials)	5	3
Number Pad Lock	1	5
Ideal Design: Combination lock embedded into mailbox	3	4

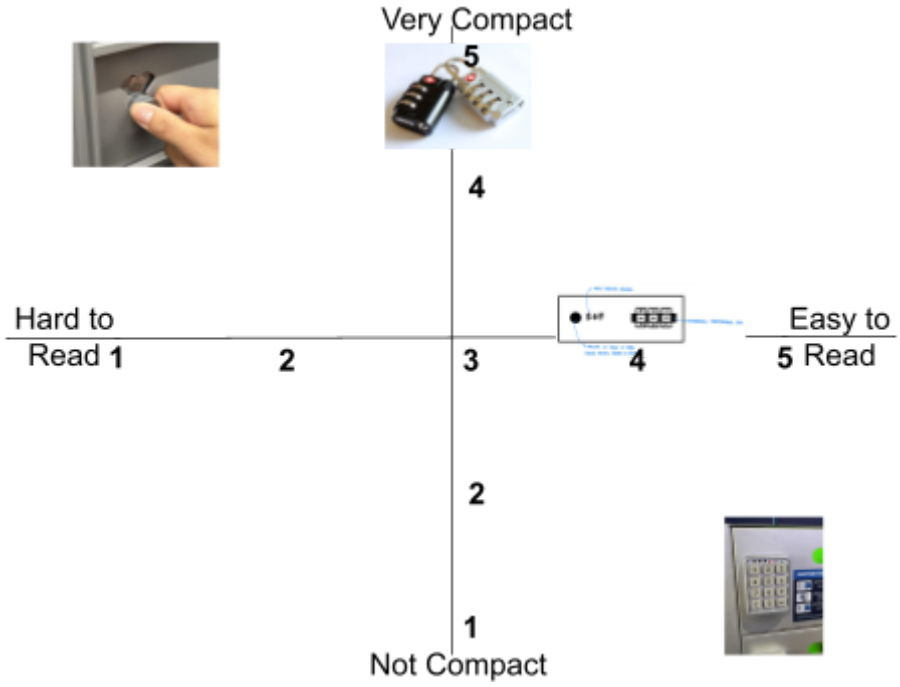

Figure 7: Compactness vs. Readability Design Space

For this design space, we rated the campus mailbox lock at a 5 for compactness and a 1 for readability. The dial or the lock takes up a very small amount of space on the locker hatch, making it more space and cost efficient. The **trade-off** of this is that the small size, combined with the tightly packed notches in the dial makes it hard to read. Interviewee 4 said, "the dials are pretty small and hard to see", while interviewee 2 said that he would want "bigger dials" for "less chance of error". Comparing it to other designs, a combination padlock is similarly compact, giving it a 5 rating, but with fewer numbers, the numbers can be spaced out and larger, increasing their readability to a moderate level. The number pad lock is even bigger and thus very readable, but it is extremely large and would not fit on the compact and close-together campus mailbox hatches, giving it a 5 in readability but a 1 in compactness. Our ideal design would have a moderate level of compactness at level 3, but with the multiple-dial design of the combination padlock would be more readable than the mailbox lock, putting it at around 4. Prioritizing readability should reduce the chance of the **action-based slips** that the users reported being prone to with the smaller, sensitive, and less readable dials on the mailboxes, and will also help them bridge the **gulf of evaluation** by allowing them to more easily see if the number they inputted was correct.

Redesign sketch

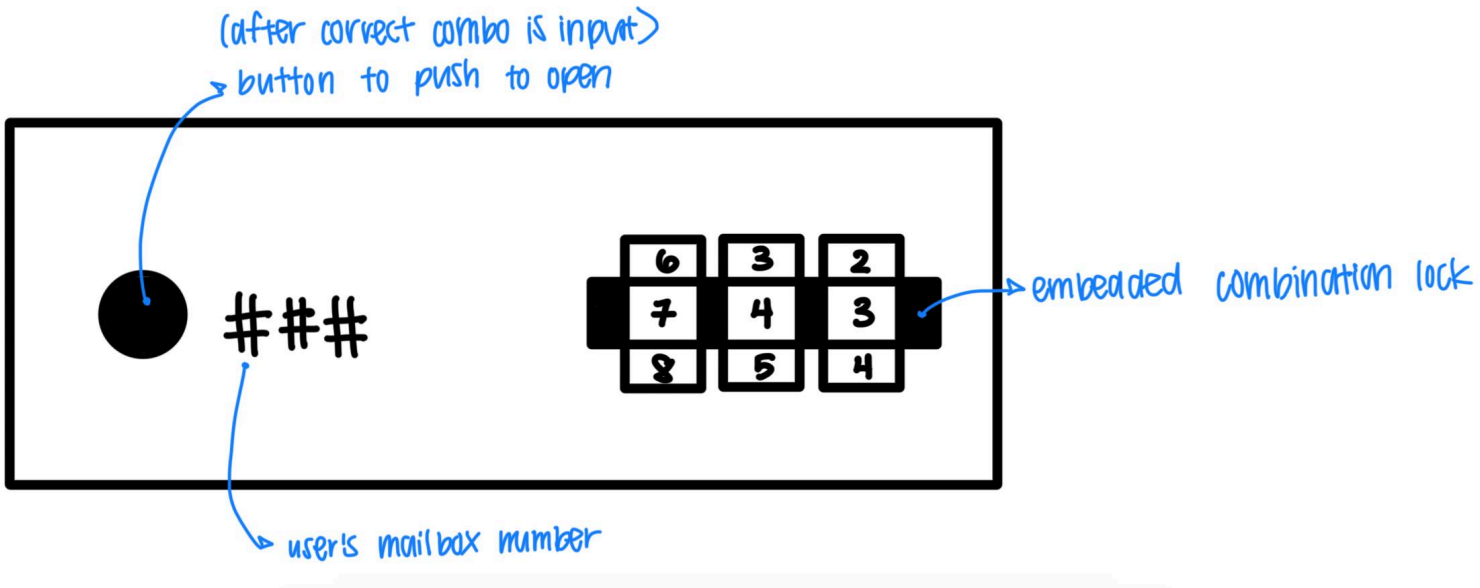

Figure 8: Redesign of the campus mailbox lock. With a combination lock that users can easily spin to input, users can gain access to their mail without frustration.

Redesign Justification

Our redesign of the campus mailbox lock (**Figure 8**) is to make the lock a combination lock that is directly embedded in the mailbox itself. 7 out of 12 interviewees said that the lines on the dial are too small and that there are too many numbers. 4 out of 12 interviewees also said they had difficulty opening the mailbox lock due to the dials being too sensitive. One interviewee said, "[The] lock is really small, [with] tiny lines; [it is] easy to mess up." Because of these struggles, we decided to change the design into something that would get rid of this problem.

In addition, another problem users ran into was not easily understanding how to turn and use the lock. One user states: "Even now knowing how to use it, it is still hard to open it most of the time because I don't use it often enough." Another claims that there are too many steps, which add to the frustration of using this design, as it requires more **knowledge in the head**.

This is why redesigning the campus mailbox locks into an embedded combination lock would be the best option. By getting rid of the complicated steps and the tiny lines that make the original design flawed, users can easily turn to the correct numbers for each dial and open their mailbox with ease.

Redesign Tradeoffs

However, this redesign also has its **trade offs**. Users would have to remember to scramble the lock combination after closing the mailbox, so that other people cannot open it. If people do not remember to do so, it might compromise the mail sent to their mailbox. However, this redesign would make it easier for people to gain access to their paper mail, so we believe that makes it better than the original.