

Group 17 - Final Project: Toothpaste Tube

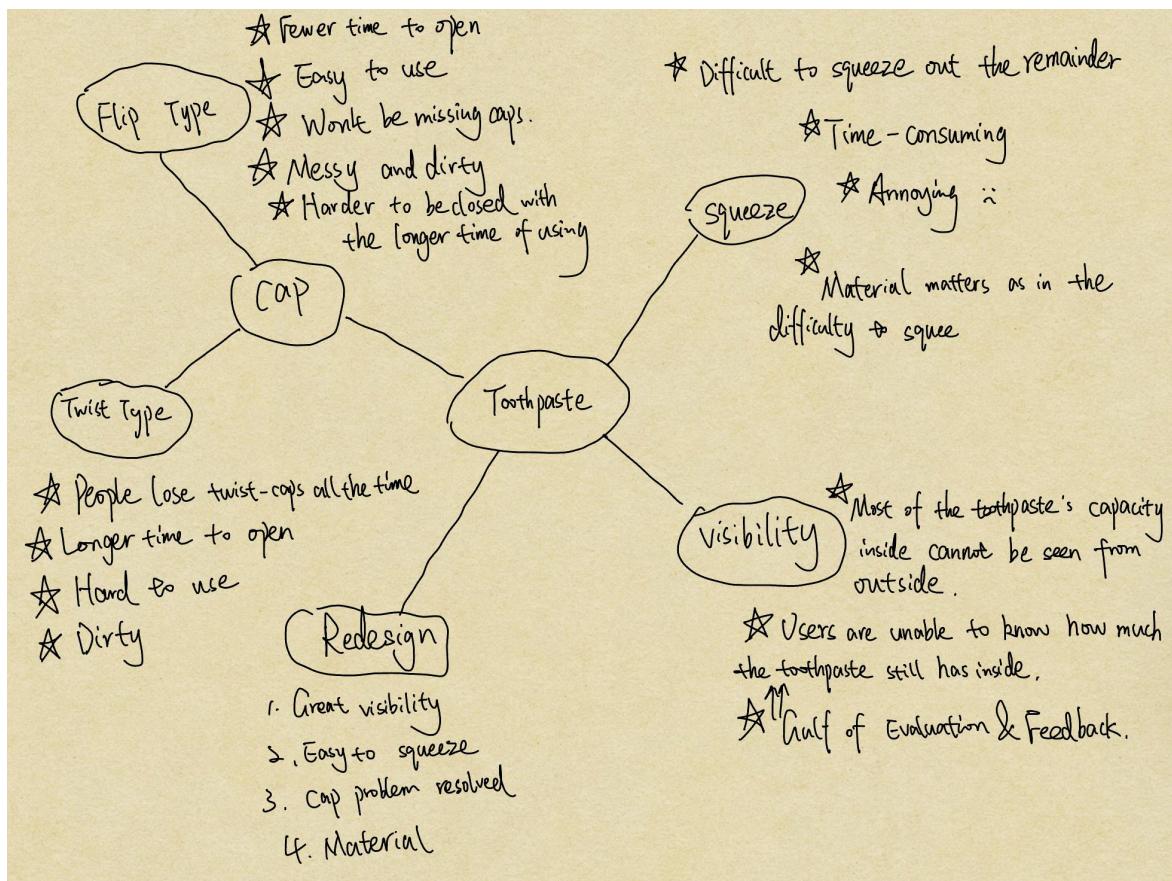
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* the choice of an empty tube is important not to give any leading ideas to interviewees!

Data Collection

Brainstorming Mind Map



Methodology

Interview Questions (3-4 interviews):

Pre-task Questions:

1. How often do you use it?
 - By asking this question in the pre task section allows for better understanding and learning about the frequency of using toothpaste from the user. Gaining this information is important prior to performing the task because the amount of frequency can affect how one user performs better or faster than the other. In addition, as the amount of the frequency goes up, one user can be more efficient in performing the task and sometimes avoiding some slips and mistakes.
2. What's your favorite brand? Why and what are its features?
 - When knowing the favorite brand of the user, it gives an insight to knowing their preference on the existing products can shorten our time on product research. In addition, when the user gives us its feature of the toothpaste we can further understand the background of why the user is consistently using the product even though mistakes and slips occur.
3. Can you describe any problems you've had with it?
 - Through this question it can identify user's **errors** while using the product. The user will provide us detailed information and run down problems they have encountered with this item. Thus, giving us a conclusion to the problem statement and how we can better redesign the product and bridge the gap between conceptual model and mental model.
4. Have you ever lost your cap before?
 - Although this question can be very leading, it is a core item and a special part of the toothpaste tube. Asking this question gives us an insight of how many users often lose their cap. Thus, can help us know better about a specific **error**: losing caps. As this will be the key problem we will be focusing on, that aided with our redesign process.
5. Can you show me the existing toothpaste you use?
 - By asking this question, it allows us and interviewers to see the current toothpaste that the user is using, can visualize the **errors** better and bridge the gap between **conceptual models**.

Task Questions:

* We will have participants use a full / used toothpaste tube.

1. Can you open/close the cap of the tube?
 - By letting users directly show us how to use the product, we apply the **Master-apprentice Model**.
2. Now conduct the entirety together! Can you open the tube and distribute the product on your toothbrush?
 - This one is also applying the **Master-apprentice Model** through a detailed task.
3. How would you get the remainder of the product of?
 - By assigning this specific task, we can gain a better understanding of the user's specific **error**: difficulty of squeezing out the remainder.

Post-task Questions:

1. On a scale for 1-5 (1-easy 5-difficult) how was it completing the task? Why?
 - We are asking for user's feedback on the assigned task. Since the tasks are designed in a way to facilitate our research on user's **errors**, their feedback is important too.
2. After conducting the task can you tell how much is left?
 - This question specifically asks about one of our redesign goals: visibility. User's answers to this question will help us improve the user experience on our redesigned product as in the visibility.
3. How comfortable is the tube to hold and manipulate? Is it easy to grip and apply pressure without slipping?
 - The answers to this question will help us learn more about how toothpaste material affects user experience. This also bridges the gap between user and designer's **conceptual models**.
4. Did the amount of product in the tube affect usability?
 - This can also gain more information about the impact of the toothpaste material and its relationship with the squeezing difficulty.
5. When did you decide to dispose of your toothpaste?
 - This helps us better understand the usefulness of visibility.

Proof of Data

Qualitative Data

Individual Data:

- ☰ Project4 —interview by Cancan Huang
- ☰ Final Project Interviews - Jelani Lizarraga
- ☰ Project 4 — Interview by Zhaorui Zhang
- ☰ Project 4 — Interview by Cindy Jin
- ☰ Final Project Interviews - Zainab
- ☰ Final Project Interviews - Hailey

Quantitative Data

Have you ever lost your cap before?

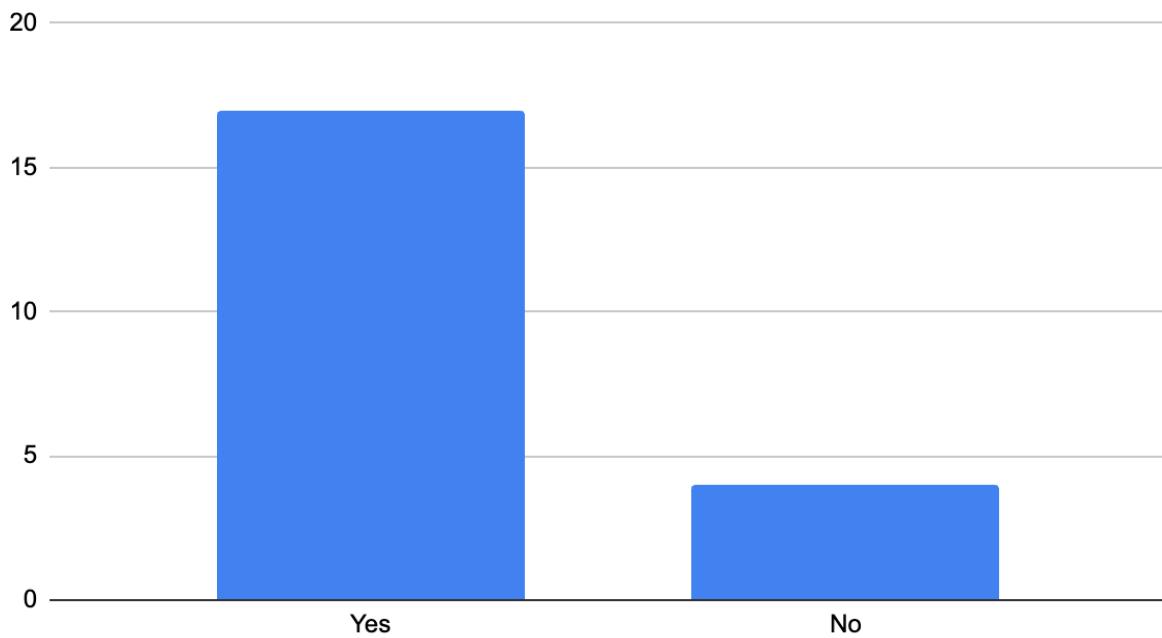


Chart 1. This chart shows the number of interviewees who have ever lost their toothpaste cap before.

Did the amount of product in the tube affect usability?

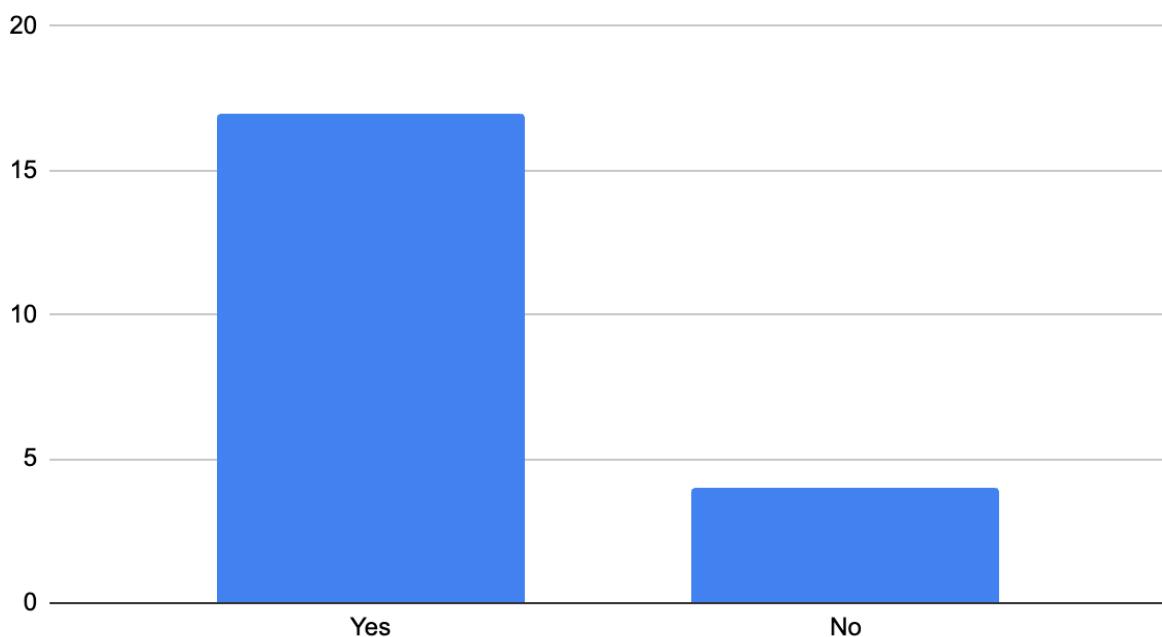


Chart 2. This chart shows the number of interviewees who believe the amount of product in the toothpaste tube affects usability.

When did you decide to dispose?

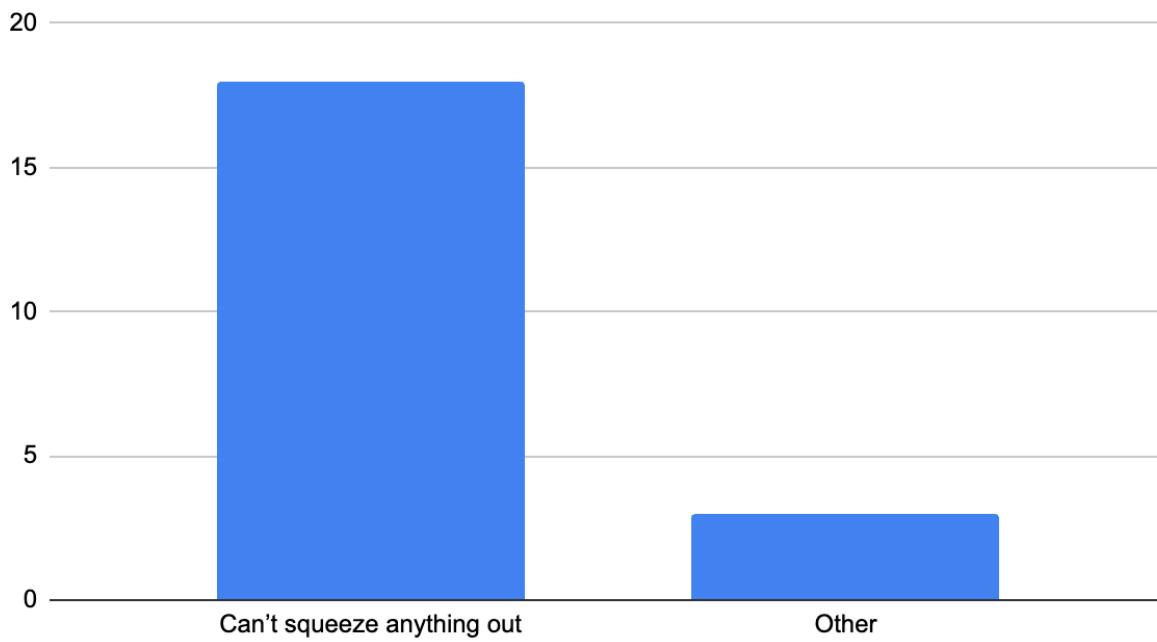


Chart 3. This chart shows how interviewees decide to dispose of their toothpaste.

On a scale for 1-5, how was it completing the task?

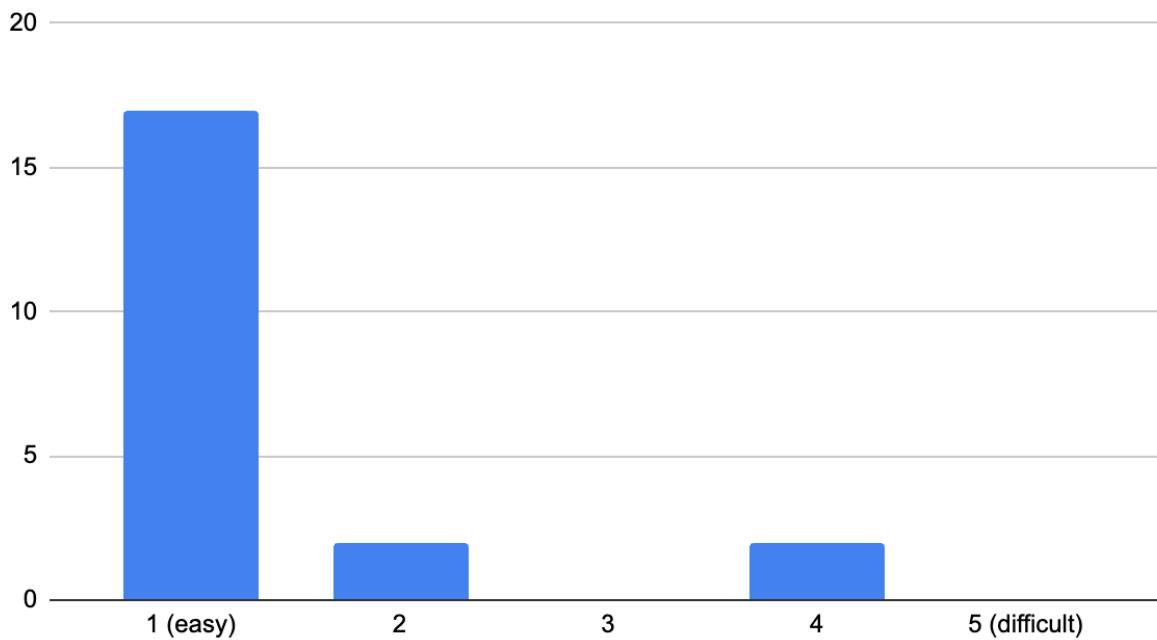


Chart 4. This chart shows how interviewees rated the difficulty of completing the task of opening the tube and distributing the product on the toothbrush.

Contributions:

CanCan: I wrote the part of Design space charts, including two sets of trade-offs and the design space charts based on them.

Jelani: I contributed to three interviews. I also contributed with creating the visibility vs. usability design space as well as gathering the images for it. I also came up with the idea for the redesign as well.

Zhaorui: I drew the brainstormed mind map with my team members and wrote the methodology part following the interview questions. I also did my interview part. I made a writing hub appointment and asked for some grammatical and structural suggestions for us.

Cindy: I wrote all the quantitative data charts under the “Proof of Data” section and all the components within the “Problems & Trends” section, including “Problems”, “Trends”, and “Analysis”. I also contributed to three interviews.

Zainab: Starting from the beginning of our brainstorming for the final object, I aided in formulating pre, task, and post-task questions for interviews. During the first critique in class edits were made to the questions and feedback was given that was taken into consideration to modify the questions. From this I held interviews like the rest of my teammates and used the data we collected to build prototypes and determine tradeoffs for our redesign. Leading to the interaction second of develop and deliver worked in contribution with Hailey.

Hailey: Throughout this final paper, I wrote the justification section and also aid with the iteration section with the prototype given by Zainab. In addition, I also provided the spark and inspiration for the trade offs design space chart. At the end, I topped it off by finishing the conclusion section of the final paper. To add onto that, I further added more details on the pre-task question of the methodology.

Problems & Trends

Problems

1. Cap Longevity
 - a. 17 out of 21 interviewees stated that they have lost their toothpaste caps before. Most of the toothpaste brands on the market that people like to use have twisted and relatively smaller caps (shown in the figure below). This kind of cap is likely going to lead to a human error, which is losing the caps. This is likely a Memory-lapse slip because users may forget to close their caps after they are done using the toothpaste, and these caps are so small that they are easy to lose.



2. Product (toothpaste) Accessibility
 - a. 17 out of 21 interviewees say that the amount of product in the tube does affect usability. 12 of them say that the toothpaste tube becomes hard to squeeze when the product inside is close to running out (shown in the figure below). 4 of them say that it is hard to control the amount of toothpaste they want to squeeze out, and sometimes they over-squeeze. This shows that the shape and material of most of the toothpaste on the market negatively affect users' execution. The **Gulf of Evaluation** is big because there is a gap or mismatch between the user's understanding of the product and the output of squeezing the toothpaste tube.



3. Visibility of the Remaining Toothpaste
 - a. 18 out of 21 interviewees say that they decide to dispose of the toothpaste when they can't squeeze anything out of the toothpaste tube. Product visibility may prohibit users from getting the tube's full product usage, as well as determining the amount left. In the case that toothpaste is low in quantity, visibility in viewing the product may aid in usage as well as determining "worth".

Trends

1. A trend that our group noticed is that 19 out of 21 interviewees voted either 1 or 2 on the question: "On a scale of 1-5 (1-easy 5-difficult) how was it completing the task?" This means that the **Gulf of Execution** is small between users and the distributing toothpaste on their toothbrushes. Users can easily figure out how to accomplish this task. More evidence supporting this is that 10 out of 21 interviewees take 5 or less than 5 seconds to complete the task.
2. During the task, 12 out of 21 interviewees hold the toothpaste tube with one hand and twist the cap with the other hand. This is related to the user's **mental model**. Users develop **conceptual models** based on their knowledge, experiences, and expectations regarding how to open a toothpaste cap. Some objects in daily life that users may relate to are water bottle caps, fuel tank caps, and shampoo bottle caps.
3. Another trend that we find out is that 11 out of 21 interviewees stated that they either roll up (figure below on the left) or flatten (figure below on the right) the bottom of their toothpaste tubes in order to get the remainder of the product out. However, one interviewee said that the plastic

material of the toothpaste tube is not flexible enough, thus not **affording** the user to fully roll it up, so this can lead to a possible redesign of the toothpaste tube.



Analysis

The design of toothpaste caps, particularly their small size and twisted mechanism, contributes to the problem of cap longevity. The small size makes them easily misplaced or lost, while the twisted design may lead to **memory-lapse slips**, where users forget to close the caps after using the toothpaste. From the perspective of **affordance**, toothpaste caps may lack **signifiers** that communicate their intended use and the need to close them. The small size and absence of clear **signifiers** can make it easy for users to forget or overlook the task of closing the cap. Additionally, the small size of the caps may present **physical constraints**, making them challenging to manipulate and increasing the likelihood of losing them. The shape and material of toothpaste tubes contribute to problems related to product accessibility. Users reported difficulties in squeezing the toothpaste when the product inside is close to running out. This issue can be understood in terms of the **Gulf of Evaluation**, which refers to the mismatch between the user's understanding of the product and the feedback received from interacting with it. The shape and material of the toothpaste tubes create a gap in the user's perception of how much force is required to squeeze out the toothpaste. As the product nears depletion, the tube becomes harder to squeeze, making it difficult for users to control the amount of toothpaste dispensed. This lack of **feedback** hampers the user's ability to accurately gauge the output and can lead to over-squeezing. The inability to visually assess the remaining toothpaste inside the tube is another significant problem. Users reported disposing of the toothpaste when they can no longer squeeze any more out, indicating a lack of visibility of the product.

Design space & Redesign

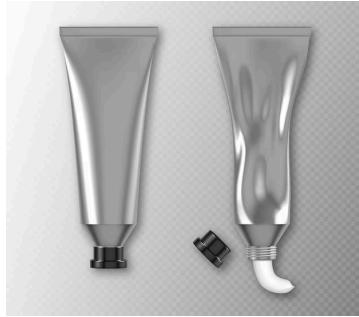
Design space charts

Tradeoff between visibility and usability: Visibility refers to the aspect of being able to easily see the amount of toothpaste remaining in the tube. High visibility toothpastes usually have clear packaging. Usability, on the other hand, is related to the practicality and functionality of the toothpaste. Available toothpaste is easy to handle, distribute and use. It may feature user-friendly designs such as a

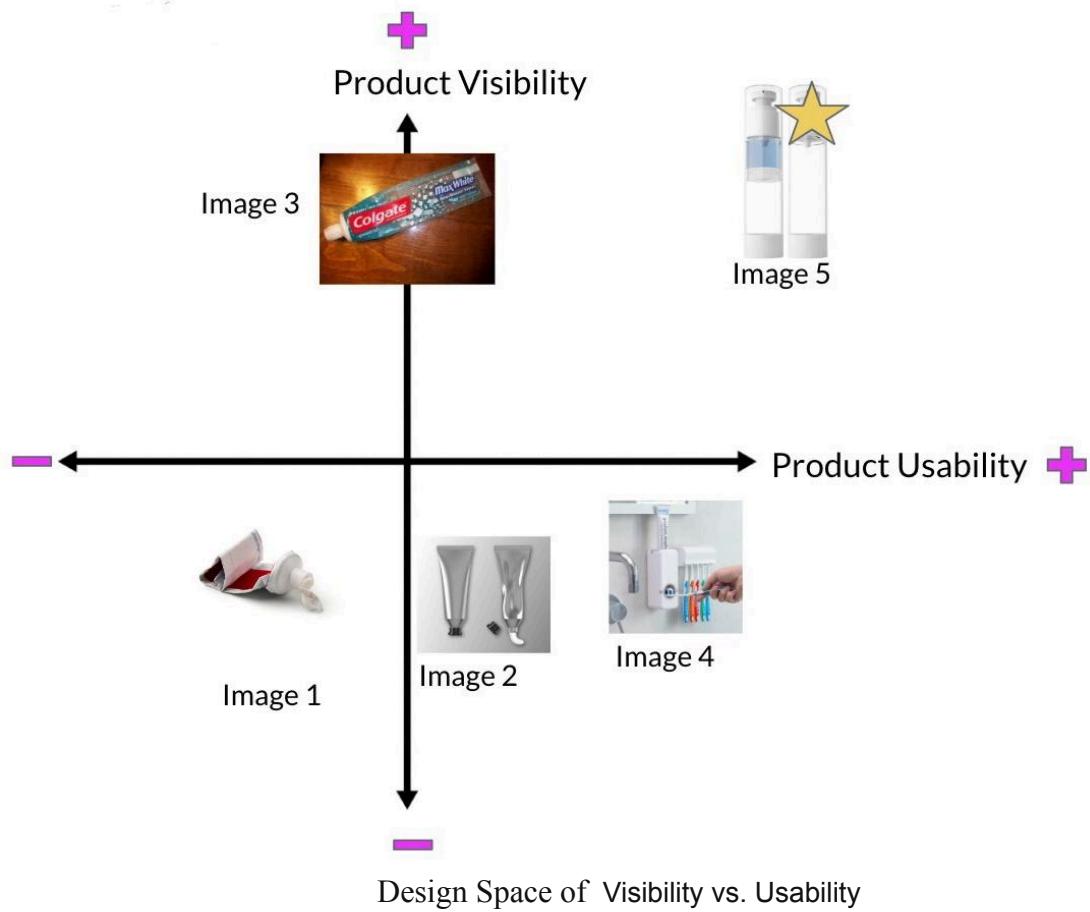
well-designed lid, a comfortable grip, or a tube that allows precise control of how much toothpaste is squeezed out.

Table 1: Product's Visibility vs. Usability

Note: The rating scores below are from 1-5. For reliability, 1 = poor, 5 = good. For cost, 1 = more expensive, 5 = cheaper.

| Types of Toothpaste Tube | Visibility | Usability | Reason |
|---|------------|-----------|--|
|  | 1 | 2 | The difference in the design of this toothpaste is that the cap is integrated with the toothpaste, which can avoid losing the toothpaste cap. However, in the process of squeezing toothpaste, it is easy to have residual toothpaste around, and it is difficult to keep clean. And the amount used is not visible. |
|  | 1 | 3 | This toothpaste is very common. It is convenient in use most of the time, but there is a problem that the cap is easy to lose and the amount of extrusion cannot be confirmed. |
|  | 5 | 2 | This toothpaste is good in Visibility, the transparent packaging can clearly see the remaining amount. But there are not many improvements in use. The cap of toothpaste and toothpaste are integrated. |

| | | | |
|---|---|---|--|
|  | 3 | 5 | <p>This toothpaste cannot be determined by the appearance of the remaining amount. But in use it is convenient, the machine helps squeeze, and also avoids cap loss.</p> |
|  (Ideal) | 5 | 5 | <p>This toothpaste is redesigned by us. It's transparent housing that shows how much is left, and a pump helps squeeze.</p> |

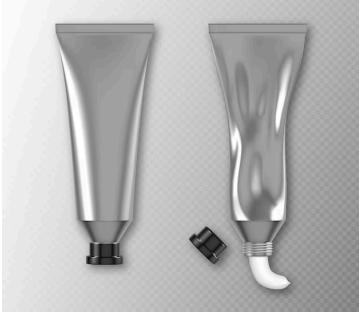


Tradeoff between Convenience and Portability: Toothpaste tubes need to be convenient and portable, making them easy to squeeze and carry. However, when the toothpaste tube is nearly empty, plain packaging may be less convenient. Or some easy-to-use toothpastes are not easy to carry.

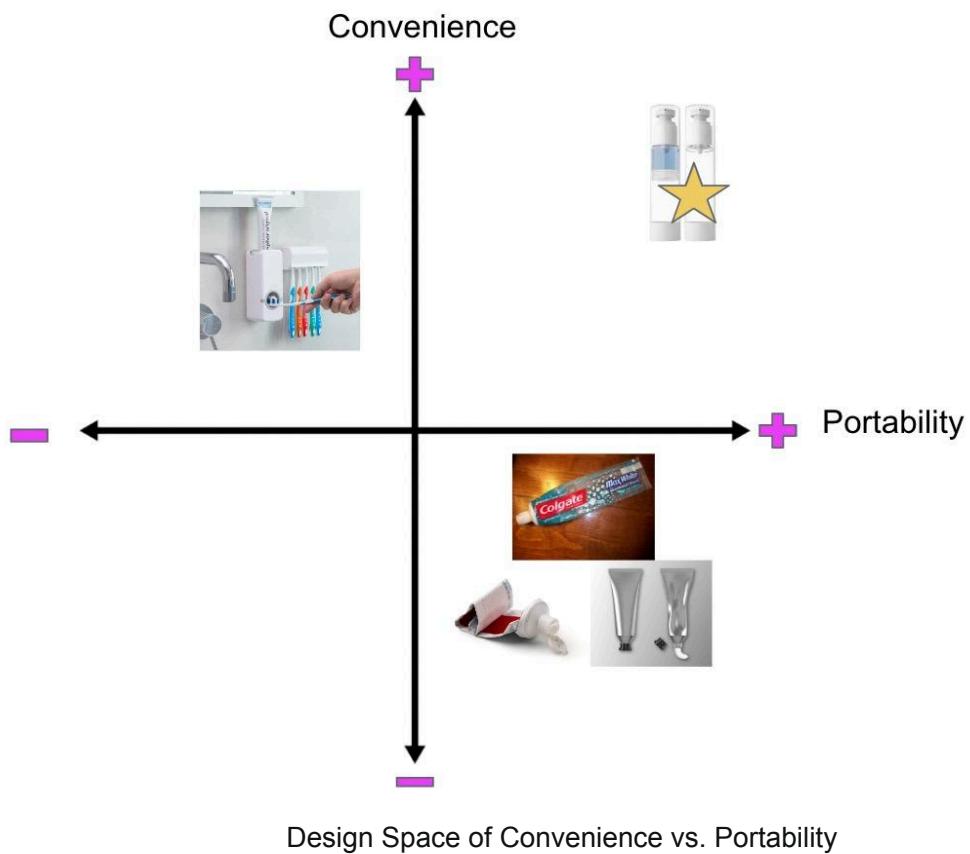
Table 2: Convenience vs. Portability

Note: The rating scores below are from 1-5. For reliability, 1 = poor, 5 = good. For cost, 1 = more expensive, 5 = cheaper.

| Types of Toothpaste Tube | Convenience | Portability | Justification |
|--------------------------|-------------|-------------|---------------|
| | | | |

| | | | |
|---|---|---|---|
|  | 2 | 4 | <p>This toothpaste needs to clean the area around the cap when used, as it is easy to get extra toothpaste on it. The size and shape are easy to carry.</p> |
|  | 2 | 4 | <p>This toothpaste has some problems with applying pressure, because it is not easy to control the amount of toothpaste squeezed out. But the size and shape are easy to carry.</p> |
|  | 3 | 4 | <p>This toothpaste also has some problems with applying pressure, because it is not easy to control the amount of toothpaste squeezed out. But the amount of toothpaste used can be seen, and the size and shape are easy to carry.</p> |
|  | 4 | 1 | <p>This toothpaste is very easy to use, using a machine instead of manual squeezing. But the machine is fixed and completely immovable.</p> |

| | | | |
|--|---|---|--|
|  (Ideal) | 5 | 5 | <p>This toothpaste is redesigned by us. It pumps to help squeeze, and the tubular shape is also easy to carry.</p> |
|--|---|---|--|



Redesign

- After several design iterations we decided that our final design was going to be a pump dispenser. The clear container allows for the user to know the amount of toothpaste that is left since 14 out of 20 interviewees mentioned that they weren't able to tell how much product was left after each use. This pump is called an airless pump and it allows for the bottom to rise as you go through the product which scoops all the toothpaste to top allowing for minimal waste. The cap is also bigger which allows the user to find it with ease in case it is dropped since 17 out of 20 interviewees

have lost a toothpaste cap before. This container also allows for easier usability since it is easier to control than other



Final design on the left and initial design on the right

Justification

- The main problem we encountered with toothpaste was cap longevity, visibility, and product accessibility when toothpaste was running low. In terms of cap longevity, this happens because caps often get lost in the process of performing the task. With that in mind, the design of a pump dispenser eliminates the memory lapse mistake of losing the cap. The dispenser design thus allows for smooth and efficient pumping.

On the other hand, the regular packaging of the toothpaste does not allow for much visibility in terms of how much is left in the packaging through the human eye. To solve this problem, with the implementation of the pump dispenser, the case/body of the toothpaste dispenser would be clear/transparent, allowing for judgment through human eyes. In addition, since it is a pump dispenser, the remaining product is less likely to go to waste. Even if we cannot pump it anymore towards the end, the visibility of this redesign allows for transferring of the product.

Lastly, the third problem we encountered is product accessibility. This happens when the product is coming to its end, but the material and packaging of the toothpaste tube do not allow for efficient squeezing. As a result, most users abandon the product, leading to product waste. To combat this problem, as mentioned above, the pump-type dispenser does not require hard squeezing but instead provides a steady and efficient dispensing that allows the user to more easily control how much will come out from the dispenser.

Trade-offs

- **Cost:** While the pump, clear, and larger cap redesign does provide benefits of visibility, accessibility, and address other aspects we noticed in our trends, the overall production of this with the added elements will equate for a much pricier outcome than the typical tube design we are familiar with. This is a factor that one does have to consider as cost for production will result in higher prices for the product itself, which designers should take into consideration. If prices are too high that consumers themselves can't purchase the product that

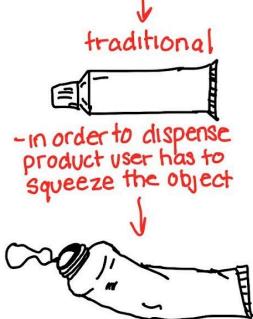
- **Size:** The new redesign will aid in the **user's mental model** as the pump mechanism will showcase the conventional push to disperse model; but the overall size and appearance of the toothpaste will change (as shown in prototypes). This will result in a much bulkier and larger toothpaste product. While we didn't necessarily focus on visual appearance the larger size of the product may be a tradeoff for users. In addition the increased size of the toothpaste may affect portability as well as storage. A concern that we did have in mind when it came to portability
- **Specific Dispense:** With the traditional tube the user is able to control just how much product they dispense on their toothbrush by adjusting the pressure they apply. The malleable-ness of a tube **affords** for precise product dispensing. The pump function aiding in product accessibility will have a standard amount that is distributed (until it starts to reach its end). Providing a benefit for some but also possibility leading to waste or more being distributed than the user would want.

Redesign Prototype

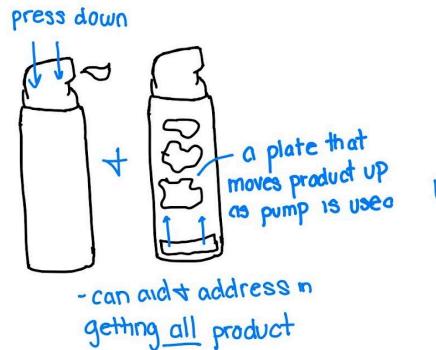
Prototypes

Prototype 1

squeeze vs. pump

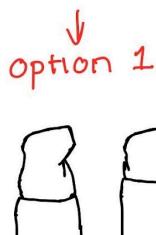


- by pressing down on pump once users can get an exact + easy distribution
- stability
- clear tube for visibility



Prototype 2

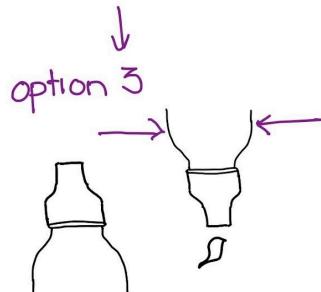
pump/product dispenser



- thicker nozzle
- more stability



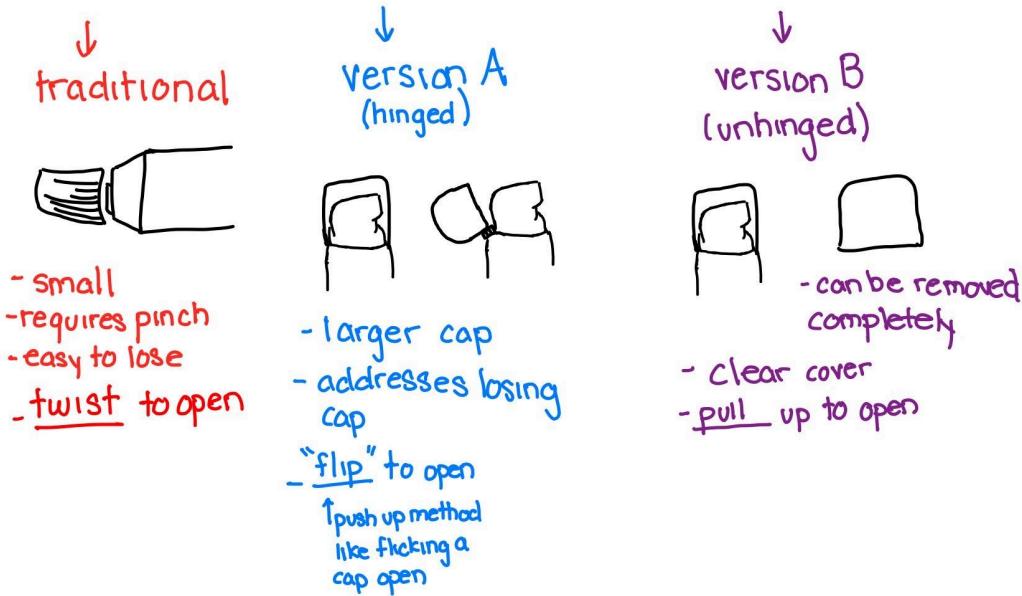
- inspired by lotion pumps
- skinnier nozzle may have vulnerabilities
- familiar mental model for users



- squeeze model with attached non-removable cap

Prototype 3

- cap presentation



Iteration

- Discover/Define: Through the process of redesigning, we incorporated the double diamond model to fully establish our potential with our redesign. Following the double diamond model of discovering and exploring the problem, we aimed to understand where the user experiences difficulties when using the toothpaste. Through interviews and observation of users performing the task (interviews can be found in the data section), one of the main problems encountered was losing the cap. The three prototypes shown above convey and address the issue of losing caps. With that in mind, a key word that came to mind was "pumping." Using that keyword, we expanded and created more ideas and mappings that would enhance the functionality of our prototype. The brainstorming map above in the redesign portion shows the pumping design, which has effectively eliminated basic problems like cap longevity. Additionally, while considering the pump option, we also included the capping option, as shown in our prototype 3. Moving on to the next step of the double diamond model, which is "define," we identified the problems and came up with the basic functionality of pump dispensing. We not only addressed the cap-related issues but also took into consideration the visibility and accessibility of the product. We further analyzed and determined that the materials/packaging were interrupting the user's experience. Based on that analysis, we began to develop further modifications to our prototype process.
- Develop/Deliver: To develop these prototypes, we looked to our discovery stage to see what aspects we want to address in our redesign. Breaking this down into 3 separate prototype sections we worked through what worked, pros and cons of each version and narrowed down on what we

liked to keep or expand on. Starting from prototype 1, the start of developing a final redesign had to start from our tube structure. As that would address many points such as product accessibility and visibility. Transitioning to a clear standing pump model we worked around what elements of this would like and how that would come to present itself. Shown in prototype 1, we made sure to illustrate what the redesign option would provide for “users” to ensure direct development of ideas discovered & defined. Once that was done and decided on we moved to other prototype aspects that would have options and provide options to consider. Prototype 2 shows a display of developing what would be the best and most efficient product distributor for our redesign. Writing down elements of what each option would provide helps to direct us as to what would be the most ideal design for areas we wanted to touch on. Due to functionality option 1 proves to be the best when standing up against the rest. This is a similar process for Prototype 3 that starts off with our traditional cap and expands on what would change. While adjusting the cap to work with the pump, there were considerations of a hinged cap as well as size to address the trend of users losing their cap. This shows intentional and user focused redesign as we trailed through the double diamond model to reach our final conclusion.

Conclusion

- All in all, through the interviews and task questions, we have come to the conclusion that the problems we encountered were cap longevity, visibility affecting usability, and accessing the product when it's low in quantity. Our solutions to these problems are reflected in our redesign, which aims to solve the issues faced by our users.

First, our design includes pumping options inspired by lotion pumps, reducing the likelihood of memory lapse mistakes with caps. Furthermore, to address visibility and accessibility of the product, our redesign incorporates a see-through container that allows for high visibility. This design completely eliminates the need for users to apply excessive force to dispense toothpaste towards the end of the product.

The next step for our project is to further expand on our redesign and explore how we can bring it to reality. To achieve this, we will conduct additional research on the materials required for creating this design and reach out to a designing company for assistance with material and appearance design.

Overall, these improvements are necessary because many people continue to struggle with these problems. By implementing our redesign, we aim to enhance the user experience and provide a practical solution to the issues associated with toothpaste packaging.

Writing Hub Extra Credit Link:

<https://kdocs.cn/l/chZ7afxfLYII>