

# User Experience Report: Heuristic Evaluation

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## Executive Summary

We conducted a heuristics evaluation for the typical toothpaste tube at home. Our heuristics evaluation provided a standardized way to generate insight into functionality and aesthetic issues that may need to be addressed in a future toothpaste tube design. We each perform the same heuristic evaluation on the toothpaste tube individually. We used the ten heuristics from Nielsen & Molich (1990), rating each heuristic on a severity scale of 0 (not a usability problem) to 4 (usability catastrophe; imperative to fix) Likert-scale. Once we had all individually evaluated, we combined our individual results to obtain aggregate results and proposed design recommendations.

**Finding 1:** Users cannot determine the amount of toothpaste in a tube.

**Recommendation 1:** We recommend introducing a transparent strip along the center of the tube so the users can know the distribution of paste within.

**Finding 2:** When a user squeezes from the center, the tube will become harder to use when the quantity of paste decreases.

**Recommendation 2:** Adding visual and physical indicators can prevent the user from squeezing the tube in the middle.

**Finding 3:** Users are not given any guidance on how they can maximize the amount of toothpaste they can get from the tube.

**Recommendation 3:** Display usage instructions prominently and incorporate tactile guides to inform users about the 'correct' way to squeeze

**Finding 4:** It takes longer to squeeze the tube optimally. Since users are often sleepy while brushing their teeth, they prefer squeezing it in the middle since it is just easier.

**Recommendation 4:** Make it easier for a user to squeeze the tube at the end furthest from the cap.

**Finding 5:** Efficiency of the toothpaste tube is subjective to the user.

**Recommendation 5:** Make the tube consistent and easier so users can get the same efficiency without increasing levels of effort.

We believe that by addressing these five findings with their corresponding recommendations, the design of the toothpaste tube will become more functional and enjoyable.

## Introduction

In 1892, the American dentist Dr. Washington Sheffield thought it unsanitary when multiple people dipped their toothbrush into the same jar of toothpaste and thus invented the toothpaste tube. While hygienic, the tube comes with drawbacks. This report details our team's analysis of the usability of the standard, commercially available toothpaste tube.

Through our user research, we determined that users want to maximize the toothpaste usage in a tube but struggle to do so. Our team will be focusing on answering the following research questions:

- What are the major usability issues of a toothpaste tube?
- How can a toothpaste customer maximize the amount of toothpaste they can use while using a tube?

## Methods

The toothpaste tube was evaluated using the ten heuristics from Nielsen and Molich (1994). The heuristic evaluation provided a standardized way to generate insight into functionality and aesthetic issues that may need to be addressed in a future toothpaste tube design.

The heuristics used are as follows:

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Helps users recognize, diagnose, and recover from errors
10. Help and documentation

Each team member went through the heuristics one by one, noting down any issues identified and rating them on a severity scale. For the severity scale, we adopted Nielsen's severity scale described below:

| Severity | Description                                                                 |
|----------|-----------------------------------------------------------------------------|
| 0        | Don't agree that this is a usability problem                                |
| 1        | Cosmetic problem; no need to fix unless extra time is available             |
| 2        | Minor usability problem; fixing this should be given low priority           |
| 3        | Major usability problem; important to fix, so should be given high priority |
| 4        | Usability catastrophe; imperative to fix before product can be released     |

Following the individual evaluations, we collated our results into five findings and corresponding usability suggestions.

## Combining Results

Once the individual heuristics were completed by all members of the team, we analyzed the individual heuristics and looked for themes of problems that were repeating. These repeating problems were identified as critical issues. Based on these critical issues, we further assessed each issue to identify the level of severity across the team. We then focused on the key issues with the highest severity and ultimately came up with a set of recommendations to address those issues.

## Findings

Finding 1: Users cannot determine the amount of toothpaste in a tube

- **Heuristic violated:** Visibility of System Status
- **Severity:** 3

A major issue we identified was a lack of indication as to how much paste was left inside a toothpaste tube. The only way a person could judge the amount of toothpaste left was by looking at the shape of the tube, which got flat and uneven as the amount of paste decreased. However, this is not precise, and users could misjudge the amount of paste they have left, causing frustration.

### Recommendation:

To address this problem, we suggest adding a transparent strip along the long sides of the toothpaste tube. This strip would let them see into the tube and judge the amount of paste inside far more precisely than in the standard, opaque design. We decided to go with this recommendation because of its simplicity and general applicability, and users do not need to learn anything new to use it.

Finding 2: When a user squeezes from the center, the tube will become harder to use when the quantity of paste decreases

- **Heuristic violated:** Error prevention
- **Severity:** 3

When users have a new toothpaste tube, they generally squeeze it in the middle. Users do this primarily because it is simpler and feels satisfying. However, doing this creates a division, with some paste getting pushed to the front (closest to the cap) and some to the back (furthest from the cap). When the toothpaste in the front is used up, users will have to squeeze the contents from the back all the way to the front. If the paste has been squeezed too many times in the middle, it also creates a rift in the tube itself, which would require extra energy to push the paste through it. As the toothpaste tube gets emptier, it becomes harder to squeeze from the back, which is not efficient.



A rift in the toothpaste tube

### Recommendation:

To prevent users from experiencing the inefficiency of squeezing paste from back to front, we suggest adding visual and physical indicators to instruct users not to squeeze the tube in the middle. Visual instructions could be illustrations instructing them not to do it, as well as color coding optimal squeezing instructions onto the tube itself, such as

a gradient that could begin from the bottom (best place to squeeze) and change as it goes to the top. Physical indicators on the tube could be different materials of the tube, where the middle has a rougher material than the top bottom, which could discourage squeezing there.

Finding 3: Users are not given any guidance on how they can maximize the amount of toothpaste they can get from the tube

- **Heuristic violated:** Help users recognize, diagnose, and recover from errors
- **Severity:** 3

Users are not provided any instructions on optimizing their experience with the toothpaste tube. Toothpaste companies advertise the quality of the toothpaste rather than the design of the tubes, which has been standardized. Although many toothpaste tubes offer any instructions about squeezing paste out of the tube, these instructions are not predominant and are often overlooked. Because most people do not read these instructions, it makes the experience of using a toothpaste tube inconsistent and inefficient.

**Recommendation:**

To help instruct users on how to optimally use a toothpaste tube, we suggest displaying usage instructions prominently on the tube. Providing instructions using illustrations *and* short text instructions like 'squeeze from here' and 'fold here' can offer assistance in communicating how to best squeeze out paste and where the ideal location is to squeeze out paste. Utilizing tactile guides such as varied texture throughout the tube and raised markings to show where to squeeze can also help catch and guide users attention to best get as much paste out of the tube as possible.

Finding 4: It takes more effort for a user to optimally squeeze the tube at the bottom

- **Heuristic violated:** Flexibility & efficiency of use
- **Severity:** 2

If a user has squeezed a new tube in the middle, they would eventually have to squeeze from the end, which becomes difficult in the existing system. From our research, we found that users employ techniques like folding, cutting, or using devices like sticks to extract the paste, leading to additional steps and burdens. While the goal of this redesign is to prevent users from doing this, flexibility must also be an option.

This finding is different from Finding 2, because those that squeeze from the middle in Finding 2 know they should squeeze from the bottom, but forget to and make a mistake. However, those that choose to squeeze in the middle within this Finding 4 are actively choosing to squeeze in the middle (no mistake) because of comfort and ease.

### **Recommendation:**

A suggestion to let users squeeze optimally from the bottom of the tube would include reshaping the tube and using different materials to help the tube become more flexible and squeezable while not compromising the resilience of the tube. This redesign can help users twist or squeeze the tube as they want without having to struggle to do it.



A table edge being used to squeeze toothpaste to the front

Finding 5: Efficiency of toothpaste tube usage is subjective to the user

- **Heuristic violated:** Consistency and standards
- **Severity:** 1

The current efficiency of the toothpaste tubes lies in the user's determination to squeeze out every drop. However, not every user thinks this way or doesn't have the time to act on this thought. Different users have different routines, which may not let them invest energy in optimally using toothpaste. This could lead to users throwing away the tubes

that are not empty, leaving residual feelings of wasting things. Prematurely throwing away toothpaste tubes that still have paste in them is bad for the environment. The design of the tube should not provide such divided experiences to users; there needs to be consistency.

### **Recommendation:**

To ensure consistency and provide users with equal efficiency without putting in more effort, we suggest redesigning the tubes to make them easier to squeeze. This could involve redesigning the tube materials and tube shape design as well as adding written instructions to the tube. These changes make it easier for everyone to get out the same amount of toothpaste (all of it), which ensures a uniform experience for all users while also improving usability.

## **Study limitations**

While conducting the heuristic evaluations, the study is limited by subjectivity and the biases of the researchers. This section goes over each limitation in detail.

1. **Limitation 1: Subjectivity in Severity Ratings:** Severity ratings, based on Nielsen's scale, inherently involve a degree of subjectivity. Individual perceptions and biases can influence these assessments, suggesting that our ratings reflect a consensus among the evaluators but may not universally apply across all user demographics.
2. **Limitation 2: Scope of heuristics:** While Nielsen & Molich's ten heuristics provide a robust framework for evaluating digital interfaces, their direct application to the physical design of a toothpaste tube may not capture all relevant usability aspects.

## **Conclusion**

The heuristic evaluation allowed us to use existing standards to identify usability problems with the toothpaste tube and provide actionable recommendations. By combining this with our findings from our other user research process steps, we will be able to paint a holistic picture of user frustrations and design issues with the toothpaste tube. Following this heuristics evaluation, our team will conduct a task analysis to further identify specific user pain points.

## References

Sheffield Pharmaceuticals, LLC. (2023). *Since 1850*. <https://drsheffieldsnaturals.com/history/>

Nielsen, J., & Molich, F. (1990). Heuristic evaluation of user interfaces. *Proceedings of SIGCHI Conference on Human Factors in Computing Systems (CHI '90)*, New York, 249-256.  
<https://doi.org/10.1145/97243.97281>

# Appendices

## Appendix A: Individual Evaluations

0 = don't agree that this is a usability problem

1 = cosmetic problem

2 = minor usability problem

3 = major usability problem; important to fix

4 = usability catastrophe; imperative to fix

NUI = no usability issue

### 1. Yesh Chala

| Ten Heuristics                         | Description                                                                                                                                                                                                                                                                                          | Severity rating (0-4) |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1. Visibility of system status         | Cannot see how much toothpaste is left, due to the fluid nature of toothpaste tubes                                                                                                                                                                                                                  | 3                     |
| 2. Match between system and real world | NUI                                                                                                                                                                                                                                                                                                  | 0                     |
| 3. User control and freedom            | NUI                                                                                                                                                                                                                                                                                                  | 0                     |
| 4. Consistency and standards           | There is no industry standard. The availability of numerous add-on tools also causes confusion in consistency.                                                                                                                                                                                       | 1                     |
| 5. Error prevention                    | No error prevention, too much toothpaste can come out and no way to correct it                                                                                                                                                                                                                       | 2                     |
| 6. Recognition rather than recall      | NUI                                                                                                                                                                                                                                                                                                  | 0                     |
| 7. Flexibility and efficiency of use   | The current toothpaste tubes efficiency is subjective, people who have time and are properly awake in the mornings can get the most out of a toothpaste tube, those who are not morning people or are in a hurry, cannot afford to sit and squeeze, they will throw away pastes as they get close to | 3                     |

|                                                            |                                                                                                                                                                                                       |   |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                            | empty. It is not efficient for everyone,                                                                                                                                                              |   |
| 8. Aesthetic and minimalist design                         | NUI                                                                                                                                                                                                   | 0 |
| 9. Help users recognize, diagnose, and recover from errors | Error recovery is absent when more toothpaste is squeezed, shape gets wobbly ( wobbly shape gives wrong estimates of contents). Error recovery is difficult when grooves and caps get dirty by usage. | 2 |
| 10. Help and documentation                                 | NUI                                                                                                                                                                                                   | 0 |

## 2. Pranav Iyer

| Ten Heuristics                         | Description                                                                                                                             | Severity rating (0-4) |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1. Visibility of system status         | Users can only estimate the approximate amount of toothpaste in a tube. There is no way for them to predict how long it would last them | 3                     |
| 2. Match between system and real world | Toothpaste tubes are familiar to users. Users know that they have to squeeze to extract toothpaste                                      | 0                     |
| 3. User control and freedom            | When a user accidentally squeezes out too much toothpaste, there is no way for them to put it back in.                                  | 2                     |
| 4. Consistency and standards           | This depends on the brand, but generally, all of them have the same-shaped tubes and caps that users are familiar with                  | 0                     |
| 5. Error prevention                    | Users can squeeze tubes from the middle, which makes it harder to use when the quantity of paste decreases.                             | 3                     |
| 6. Recognition rather than             | Users are familiar with the                                                                                                             | 0                     |

|                                                            |                                                                                                                                                                                                |   |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| recall                                                     | toothpaste tube design, and this is generally consistent across brands.                                                                                                                        |   |
| 7. Flexibility and efficiency of use                       | There are no shortcuts to using a toothpaste tube since it is a pretty simple process. However, a user has the freedom to use different techniques to squeeze out the desired amount of paste. | 0 |
| 8. Aesthetic and minimalist design                         | A toothpaste tube is simple and intuitive. They generally have screw-on or flip caps, both of which are fairly simple designs.                                                                 | 0 |
| 9. Help users recognize, diagnose, and recover from errors | Users get no indication that they are not squeezing optimally                                                                                                                                  | 3 |
| 10. Help and documentation                                 | Toothpaste tubes generally have instructions stating that they should be squeezed from the bottom.                                                                                             | 0 |

### 3. Jessica Lee

| Ten Heuristics                         | Description                                                                                                                                     | Severity rating (0-4) |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1. Visibility of system status         | For close to empty tubes, people can't tell how much is left and how close it is to coming out                                                  | 3                     |
| 2. Match between system and real world | NUI                                                                                                                                             | 0                     |
| 3. User control and freedom            | Users will often squeeze from the middle of a new tube by mistake because it is easier in the short term (but makes the task much harder later) | 2                     |
| 4. Consistency and standards           | NUI                                                                                                                                             | 0                     |
| 5. Error prevention                    | Users get no indication of improper squeezing locations                                                                                         | 2                     |

|                                                            |                                                                                                         |   |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---|
|                                                            | when it is happening/about to happen                                                                    |   |
| 6. Recognition rather than recall                          | NUI                                                                                                     | 0 |
| 7. Flexibility and efficiency of use                       | NUI                                                                                                     | 0 |
| 8. Aesthetic and minimalist design                         | NUI                                                                                                     | 0 |
| 9. Help users recognize, diagnose, and recover from errors | Users get no indication of improper squeezing locations when it has already happened                    | 2 |
| 10. Help and documentation                                 | Users are not given any guidance to how to properly extract the most amount of toothpaste from the tube | 2 |

#### 4. Yuktha Veeranki

| Ten Heuristics                         | Description                                                                                                                              | Severity rating (0-4) |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1. Visibility of system status         | The toothpaste tube doesn't indicate how much product is left inside                                                                     | 3                     |
| 2. Match between system and real world | While the product generally does well in this area, more specific benefits could be highlighted more clearly for better decision-making. | 0                     |
| 3. User control and freedom            | The choice between screw-off and flip-off caps affects user control and freedom in usage and preference.                                 | 2                     |
| 4. Consistency and standards           | Toothpaste tubes generally follow a consistent design and usage pattern but may vary significantly in cap design and functionality.      | 1                     |
| 5. Error prevention                    | Squeezing from the middle or                                                                                                             | 3                     |

|                                                            |                                                                                                                                               |   |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                            | end, based on the amount of toothpaste left, indicates a design that does not prevent inefficiency                                            |   |
| 6. Recognition rather than recall                          | Toothpaste tubes often require users to remember to shake or manipulate the tube as it empties to access remaining content.                   | 3 |
| 7. Flexibility and efficiency of use                       | Limited customization in how toothpaste is dispensed, affecting users differently                                                             | 2 |
| 8. Aesthetic and minimalist design                         | Toothpaste tubes are generally well-designed aesthetically, with clear branding and necessary information.                                    | 1 |
| 9. Help users recognize, diagnose, and recover from errors | When users squeeze the tube inefficiently or struggle to get the last of the toothpaste, there is no guidance or help provided by the design. | 3 |
| 10. Help and documentation                                 | There is generally no help or documentation provided with toothpaste tubes, assuming users know how to use them efficiently.                  | 1 |