Exploration of User Perceptions of Attractiveness and Functionality

by

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ABSTRACT

People think that more attractive objects are more usable, even when they do not work. This is worrisome to the field of engineering, usually devoted to creating the most functional solution. If indeed customers are more satisfied with more attractive objects, more emphasis should be placed on object beauty, not just object functionality. Eighty subjects were interviewed and rated the attractiveness, functionality, and an unrelated factor (weight) before and after using a salt shaker. Eight different salt shakers were used, that varied in attractiveness and functionality. It turns out that people were more satisfied with the functionality of attractive, nonfunctional objects and unattractive, functional objects. They also bonded more with nonfunctional objects and found them more attractive after using them. There is a complex relationship between a person's perceived functionality of a device and its attractiveness.

Thesis Supervisor: Prof. Maria Yang, PhD
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Table of Contents

Introduction 7

Background 8

Fundamentals of Design for Customer Appeal 8

Previous Studies relating Attractiveness and Perceived Functionality 9

Hypothesis 11

Procedure 12

The Object: A Salt Shaker 12

Salt Shaker Characteristics 15

Survey Procedure 15

Survey Procedure Analysis 15

Results and Discussion 16

Subject Population 16

Analysis Methods 16

Analysis of Attractiveness Ratings 17

Analysis of Functionality Ratings 18

Analysis of Weight Ratings 20

Limitations 21

Conclusion 22

References 24

Appendices 25

List of Figures

Figure 4-1. Salt Shaker Dimensions 12
Figure 4-2. The Eight Salt Shakers 13
Figure 4-3. Comparison between a sharp and rounded salt shaker 13
Figure 4-4. Comparison between a bright red and dull red salt shaker 14
Figure 4-5. Comparison between a nonfunctional and functional salt shaker 14
Figure 4-6. Scripted Survey Procedure 15
Figure 5-1. Art Appreciation Histogram 16
Figure 5-2. Attractiveness rating data 17
Figure 5-3. Functionality rating data 18-19
Figure 5-4. Weight rating data 21

List of Appendixes

Appendix A. Survey 25

Chapter 1

Introduction

The practice of engineering focuses on the importance of how a product functions. However, people think more attractive objects work better, even when they don't. This surprising statement has been shown in past studies on computer screen interfaces, and in the author's study with physical objects (salt shakers). This information is extremely important to product design companies and mechanical engineers attempting to design usable objects that people will buy.

Don Norman has written many books on this topic, including *Psychology of Everyday Things* and *Emotional Design.* His theories and expertise heavily influenced the design of this study. Kashimura and Kurosu, and Tractinsky have run similar studies with computer screen interfaces. They found that people think that computers with prettier screen layouts work better, even when they do not. This study's procedure paralleled the Tractinsky study, and had similar but not identical results.

Chapter 2

Background

2.1 Fundamentals of Design for Customer Appeal

Don Norman studies the design of everyday objects and customer appeal in depth. He is known for the books, *Psychology of Everyday Things* and *Emotional Design*. Throughout these books, he emphasizes the usability of household objects as a very important design parameter when designing objects. He analyzes why people fall in love with certain objects and just have to buy them, and why they hate but tolerate others.

He gives a classic example of the teapots that he collects. He has quite the variety of teapots, each of which specialize in different things – beauty, functionality, etc – and yet he uses some simple, slightly annoying teapot every day, but his favorite teapot is yet another nonfunctional one. This example illustrates how important understanding how people (your customers) bond to objects. What causes this bond? What causes them to buy an object? How satisfied are they with an object after they use it? Would they use it again? Recommend it to a friend?

Don Norman has some answers to these questions. First, he categorized the types of human-object bonding into three emotional levels.

1. Visceral
2. Behavioral
3. Reflective

The visceral level is the human-based, initial reactions when you see or use an object. This is the "automatic, pre-wired layer" (Norman) that deals mostly with appearance or other basic senses.

The behavioral level deals with use of the object and its performance. This isn't just "Does the object work?" but also, can you figure out how it works? Does your mental model of the object correspond with how it actually works? Is it easy to figure out or frustrating? Feedback is also important here – at minimum, the device needs to work *and* the user needs to realize that it worked to be satisfied.

The reflective level considers the experience of using the object, evaluating how it worked, what could be changed, and what the experience meant to the individual. It is about message, meaning, and memories: People cherish objects (even ones that don't work well)

because they have great personal value, because it reminds them of someone special, portrays a pleasing image about the owner, or otherwise.

Norman has a list of attractive characteristics that he thinks that are engrained in humans at the visceral level, that we inherently find attractive and "give rise to positive affect."

warm, comfortably lit places
sweet tastes and smells
*bright, highly saturated hues**
harmonious music and sounds
smiling faces
rhythmic beats
symmetrical objects
*rounded, smooth objects**

Figure 1-1 Norman's list of what might be automatically programmed into the human system (abbreviated, emphasis added)

From these three levels, objects can have a positive affect, or a negative affect. The result of a negative affect is that humans are focused and detail-oriented, and try to escape from their situation (a bad interaction with an object, such as trying to figure out how it works). Unfortunately the natural response is to try harder, or to 'use more force.' However, the "answer" is usually not to do the same action more – it's usually some more creative solution (such as pulling a door to escape rather than pushing it harder). Thus, the person becomes frustrated at being unable to use the object.

On the other hand, a positive affect causes the user to be more relaxed, creative, and open to big picture problem solving. They're more relaxed and able to tolerate initial errors with the object, and simply try again until it works. They're more able to solve problems creatively, and thus later recall the object working just fine. All of these questions are very important and have been analyzed before, but mostly with computer screen interfaces.

2.2 Previous Studies relating Attractiveness and Perceived Functionality

Norman references a study that originally occurred in Japan. Kashimura and Kurosu studied the "apparent usability" (how usable you think it is) and "inherent usability" (how well it actually works) of ATM machine user interface layouts. They chose 26 screen layouts and asked

subjects to rate "how much they look to be easy to use (apparently usable) and how much they look beautiful" (Kashimura and Kurosu). They found that apparent usability was related to the layout's aesthetics more so than to the layout's inherent (actual) usability.

The ATM layouts had 15 buttons – the numbers 0-9, multipliers 1000s and 10,000s, the Yen, cancel, correction – and two displays. For example, a layout with the buttons arranged neatly in a 3x5 grid is more beautiful, but is also less functional, since you are more likely to hit the cancel button on accident. However, the apparent usability of the device was rated higher, with its higher attractiveness, rather than with its lower inherent usability.

Some researchers in Israel (Noam Tractinsky, et al, 1999) were very surprised at Kashimura and Kurosu's results and ran a more detailed, rigorous study with the same ATM layouts. There were two stages to the study. The first stage involved subjects simply rating the attractiveness of many ATM layouts. The second stage had subjects rate the aesthetics, usability, and amount of information displayed on the ATM both before and after using the ATM screen to do a series of tasks. In short, Tractinsky's study duplicated the results of Kashimura and Kurosu's study. They too found that "the post-experimental perceptions of system usability were affected by the interface's aesthetics, not by the actual usability of the system" (Tractinsky). Subjects also tended to increase the aesthetic (and usability) rating after using the system.

These results are not a result of survey method or other extraneous factor, as they also surveyed the subjects about the amount of information displayed on the screen. These ratings did not correlate with aesthetics or usability, meaning that the correlations found with the aesthetics and usability ratings are valid. Overall,

> *"Users in the medium- and low-aesthetics groups tended to evaluate the ATM's usability and especially its aesthetics more favorably after they used it relative to their initial evaluations...Perhaps, these results reflect the process of users' adapting to a system with which they had to interact. In a sense it is the HCI version of 'love the one you're with'. Clearly, more research is needed on this issue" (Tractinsky).*

In summary, Tractinsky's study found that user ratings of usability were affected by the ATM's aesthetics more so than its actual usability, and that users generally increased ratings of aesthetics (and usability) after using the ATM. These results were very surprising to the researchers.

Chapter 3

Hypothesis

The Kashimura and Kurosu, and Tractinsky studies were done using computer interfaces, not physical objects. People interact with computer screens very differently than with physical objects that they get to pick up, hold, and examine. The author's study aims to repeat the Tractinsky study with physical objects.

Different factors will come into play with physical objects rather than computer screen interfaces. The feel of the object is completely different – people interact with computers by screens and buttons, but they interact with objects by picking them up and holding them, and moving switches or dials around.

The hypothesis is that the user will feel more connected to the physical object, but through very similar mechanisms, and will continue to relate perceived functionality with the object's attractiveness.

Chapter 4

Procedure

4.1 The Object: A Salt Shaker

To run this study using physical objects rather than computer UIs, a basic object was chosen – the salt shaker – and both functionality and attractiveness were varied. Eight salt shakers were produced: each was a different combination of functionality, attractive color, and attractive feel. Each permutation of high and low values for these three factors was produced and a full factorial design of experiments analysis was run.

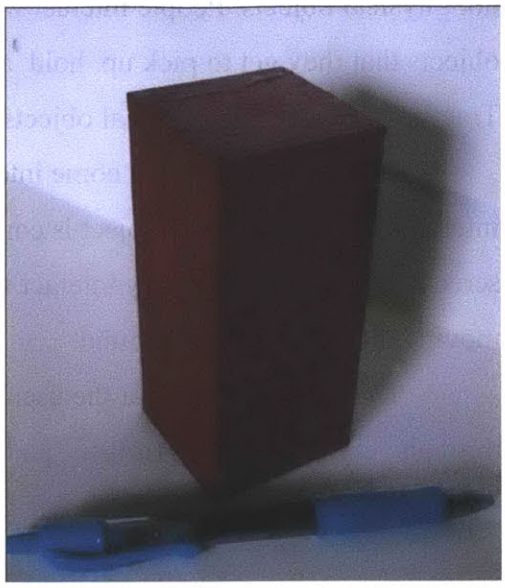


Figure 4-1 Each salt shaker was 2 in by 2 in by 4 in.

Attractiveness was varied by color and feel, because these two factors were basic to Norman's list (figure 1-1). According to Norman, bright colors are attractive; dull colors are less attractive Bright and dull red were used. Rounded, smooth objects are attractive, so sharp and rounded salt shakers were used for attractive and unattractive feel respectively. The salt shakers' functionality was varied by the size of the holes on top, such that the nonfunctional ones barely let any salt out.

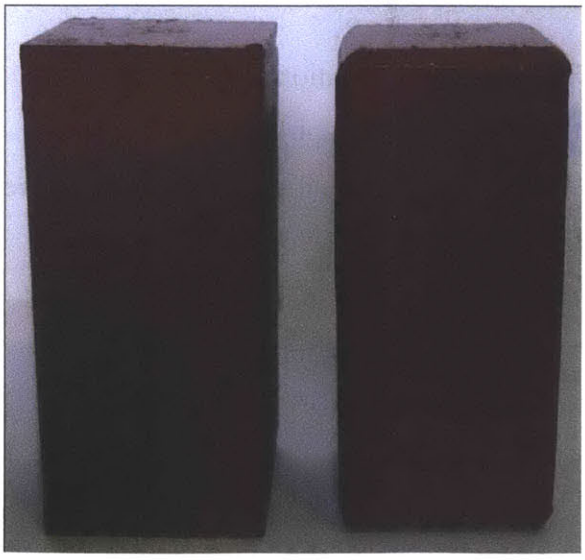
Figure 4-1 shows a salt shaker and its dimensions (approximately the same size as a normal salt shaker bought at the store). Figure 4-2 shows all eight salt shakers and the three characteristics that were varied.

Nonfunctional Sharp Bright	Functional Sharp Bright	Nonfunctional Rounded Bright	Functional Rounded Bright	Nonfunctional Sharp Dull	Functional Sharp Dull	Nonfunctional Rounded Dull	Functional Rounded Dull

Figure 4-2 The eight salt shakers used in the study.

4.2 Salt Shaker Characteristics

The Feel of the Salt Shaker (figure 4-3)



The sharp salt shakers had no modifications from the square tubing and sheet acrylic that were glued together to form the salt shaker. The rounded salt shakers were significantly rounded at each edge of the rectangular prism, so that it felt comfortable to hold.

Figure 4-3 Comparison between a sharp (left) and rounded (right) salt shaker.

The Color of the Salt Shaker (figure 4-4)

The base color red was chosen. Bright red and dull red were painted on the entire exterior of the salt shaker. All the salt shakers were painted with the same method, resulting in the same quality paint job.

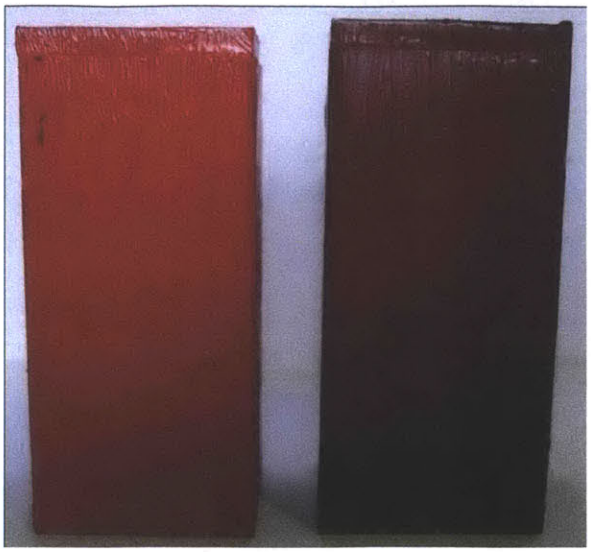


Figure 4-4 Comparison between a bright red (left) and dull red (right) salt shaker.

The Functionality of the Salt Shaker (figure 4-5)

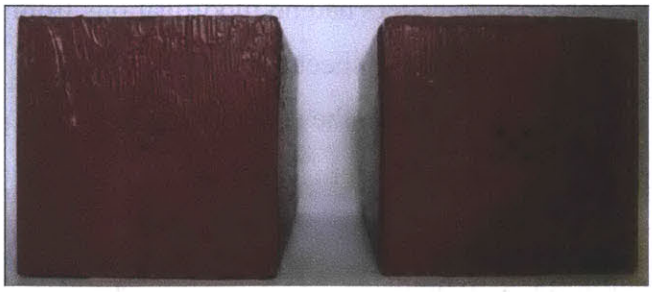


Figure 4-5 Comparison between a nonfunctional (left) and functional (right) salt shaker. The nonfunctional salt shaker has tiny holes that barely allow the salt to escape.

The salt shaker functionality was varied by the size of the holes on the top of the salt shaker. The functional salt shaker holes were 0.005" in diameter, which is approximately the same size as the many salt shakers at your local kitchen store. The nonfunctional salt shakers had holes of 0.002", which allows the salt to come through, but only when you shake it vigorously.

4.3 Survey Procedure

Subjects were passerbys in the MIT student center who agreed to take the survey in exchange for the incentive of a candy bar.

The survey procedure is very similar to the Tractinsky study: Each subject rated attractiveness, functionality, and weight (an unrelated factor) of the salt shaker while only looking at the salt shaker, and again after using it. Finally, users filled out a demographics survey. The survey is included in appendix A. For consistency, the researcher followed a script, as shown in figure 4-6.

Researcher	"This is a salt shaker. You may not touch it. Fill out this survey."
Subject	Rates attractiveness, functionality, and weight on 1-7 scale.
Researcher	"Use the salt shaker to salt this bowl of food."
Subject	Uses salt shaker to salt a bowl of food.
Subject	Rates attractiveness, functionality, and weight on 1-7 scale. Fills out demographics survey.

Figure 4-6 The scripted survey procedure.

4.4 Survey Procedure Analysis

The attractiveness variables for the salt shakers fit into the visceral level that Norman describes and references on his list of basic attractive features. The attractiveness variables (color and feel) apply to the visceral level. The functionality applies to the behavioral level. Any outside factors or preconceived notions about salt shakers or cultural differences that affect each subject are on the reflective level.

The data analysis will also be performed similarly to the Tractinsky study. The change in each user's rating of attractiveness, functionality, and estimated weight before and after they use the salt shaker will be analyzed to see what salt shaker characteristics affected the rating change.

Chapter 5

Results and Discussion

5.1 Subject Population

There were 82 people surveyed, at 8-12 people per salt shaker. The population was 90% MIT students in varying majors (60% engineering, 28% science, and 12% humanities, management, or urban planning) and years (20% freshman, 22% sophomores, 16% juniors, 26% seniors and 16% grad students or alumni). The population was 23% international. There were 37 women and 45 men surveyed. Each of the subjects also rated how much they appreciate of art on a 1-7 scale (see figure 5-1).

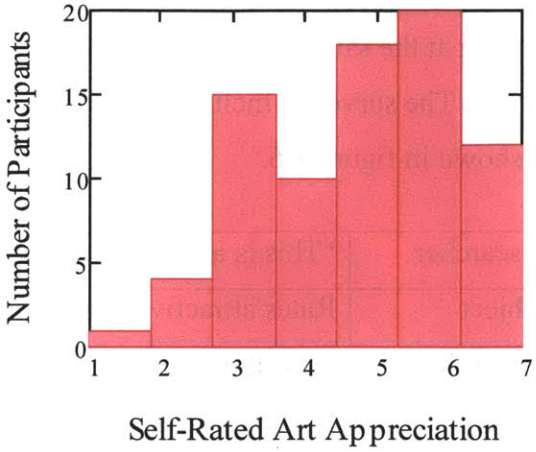


Figure 5-1 Histogram showing how each subject rated how much they appreciate art. (7 appreciates art very strongly)

5.2 Analysis Methods

Since each person rated the attractiveness, functionality, and weight on a 1-7 scale, the magnitude of the rating is not meaningful when compared to other subjects', since each person will have a different idea of what each number represents. Instead, we will analyze the change in each subject's ratings before and after using the device. There are three possibilities: The rating increased, decreased, or stayed the same.

Remember that subjects rated the attractiveness, functionality, and weight before and after using the salt shaker independently; they filled out the entire survey both times. The "before" survey paper was no longer in front of the subject while filling out the "after" survey, so he or she did not consciously choose to increase, decrease, or keep the rating the same, but simply rated their new, perceived attractiveness, functionality, and weight.

5.2 Analysis of Attractiveness Ratings

The following section will describe how subject's ratings of attractiveness changed after using the salt shaker. Please refer to figure 5-2.

Attractiveness Ratings of Nonfunctional Salt Shakers	Sharp (ugly)	Round (pretty)
Dull (ugly)	Same: 90% Increased: 10% Decreased: 0%	Same: 90% Increased: 10% Decreased: 0%
Bright (pretty)	Same: 100% Increased: 0% Decreased: 0%	Same: 60% Increased: 40% Decreased: 0%

Attractiveness Ratings of Working Salt Shakers	Sharp (ugly)	Round (pretty)
Dull (ugly)	Same: 50% Increased: 30% Decreased: 20%	Same: 90% Increased: 0% Decreased: 10%
Bright (pretty)	Same: 70% Increased: 20% Decreased: 10%	Same: 80% Increased: 0% Decreased: 20%

Figure 5-2 Attractiveness rating data. Each square represents one of the eight salt shakers, and lists the information about how many subjects increased, decreased, or did not change their rating. The color is a visual representation of general trends – green indicates that people generally increased the rating, red that people decreased the rating, and gray that both happened about equally. Darker colors indicate a higher percentage of people increasing or decreasing the rating.

Zero subjects decreased the attractiveness of nonfunctional salt shakers. They generally kept attractiveness the same, unless it was attractive in both variables (round and bright), in which case they were 5.8 times more likely to increase the attractiveness. In short, after using a nonfunctional salt shaker, subjects rated ugly salt shakers' attractiveness the same, and increased pretty salt shakers' attractiveness.

This is possibly because the subjects bond with the nonfunctional salt shaker over the frustrating experience of trying to get salt out of it. The data says that if the salt shaker was ugly, users thought it was the same attractiveness as before (but not less attractive), and if it was pretty, users thought it was more attractive. It's possible that the users all bonded with the nonfunctional object, but more so with the pretty one – thus rating it higher, rather than the same.

The data shows no trends for attractiveness ratings of the working, sharp salt shakers – a similar number of subjects kept the rating the same, and there was about an equal likelihood of increasing and decreasing the rating. However, for the working, round salt shaker, zero subjects increased the rating, and many more kept the attractiveness the same.

5.3 Analysis of Functionality Ratings

The following section will describe how subject's ratings of functionality changed after using the salt shaker. Please refer to figure 5-3.

Functionality Ratings of Nonfunctional Salt Shakers	**Sharp (ugly)**	**Round (pretty)**
Dull (ugly)	Same: 20% Increased: 40% Decreased: 40%	Same: 12% Increased: 38% Decreased: 50%
Bright (pretty)	Same: 40% Increased: 30% Decreased: 30%	Same: 42% Increased: 42% Decreased: 16%

Figure 5-3 Functionality rating data for nonfunctional salt shakers. More on the next page. Each square represents one of the eight salt shakers, and lists the information about how many subjects increased, decreased, or did not change their rating. The color is a visual representation of general trends – green indicates that people generally increased the rating, red that people decreased the rating, and gray that both happened about equally. Darker colors indicate a higher percentage of people increasing or decreasing the rating.

Functionality Ratings of Working Salt Shakers	Sharp (ugly)	Round (pretty)
Dull (ugly)	Same: 60% Increased: 40% Decreased: 0%	Same: 42% Increased: 33% Decreased: 25%
Bright (pretty)	Same: 40% Increased: 40% Decreased: 20%	Same: 50% Increased: 12% Decreased: 38%

Figure 5-3 continued Functionality rating data for working salt shakers.

Nonfunctional Salt Shaker Trends

Subjects had no trends for the nonfunctional sharp salt shakers – a similar number kept the rating the same, and there was about an equal likelihood of increasing or decreasing the rating. More subjects increased the functionality rating for the prettier nonfunctional bright salt shaker (as expected). In fact, subjects were 3.1 times more likely to decrease functionality of the ugly (sharp) bright salt shaker than pretty (round) one.

Functional Salt Shaker Trends

The working salt shaker shows a great trend as more subjects increased the rating as more variables were ugly. Subjects increased the functionality of working ugly-ugly salt shakers more frequently than ugly-pretty ones. Finally, pretty-pretty salt shakers functionality was increased very infrequently; more subjects decreased the functionality. Subjects were 22 times more likely to decrease the functionality rating of pretty working salt shakers than ugly ones, and 3 times more likely to increase the functionality rating of ugly ones.

Overall Trends

Subjects increased the functionality of nonfunctional pretty and working ugly salt shakers.

People increased the functionality of nonfunctional pretty salt shakers, and decreased the functionality of nonfunctional ugly salt shakers. This corroborates the initial hypothesis that people think pretty things work better, even when they don't. The reasoning behind this is that people are more forgiving with attractive objects for not working, are more creative to find workarounds, and as a result, remember the experience more positively.

The subjects also increased the functionality of the working, ugly salt shakers. The reason for this is unclear, but a few possible reasons exist: The subjects initially rate the pretty salt shaker as being very functional, and the ugly salt shaker as being very nonfunctional. Then they use the salt shaker and adjust their rating to be less extreme. However, this only applies to the working salt shakers – not the nonfunctional ones, when users rate apparent functionality based on aesthetics, rather than inherent functionality.

It seems that people only think pretty things work better *when* they don't – but people think that ugly things work better when they do. This does not exactly match the Trachtinsky study results, that people think prettier things work better regardless if they do or don't – perhaps this is the difference between computer interfaces and physical objects.

5.4 Analysis of Weight Ratings

The following section will describe how subject's ratings of weight changed after using the salt shaker. As expected, the change of subject's ratings of weight was not affected by the usability or attractiveness of the salt shaker.

About 50% of the subjects increased the weight rating, 33% decreased, and 17% kept it the same. The only correlation between change in rating and salt shaker type is that slightly more subjects decreased the weight rating of bright salt shakers, instead of keeping the rating the same (versus the dull salt shakers – see figure 5-4). Other research has demonstrated how color affects people's perception of weight and other device characteristics, but that's not important for this analysis. What is important is that the functionality and attractiveness of the salt shakers did not significantly affect the weight ratings. Thus, the factors affecting the functionality and

attractiveness ratings (discussed above) are a result of changed user perceptions because of the different salt shaker types, rather than an experimental bias.

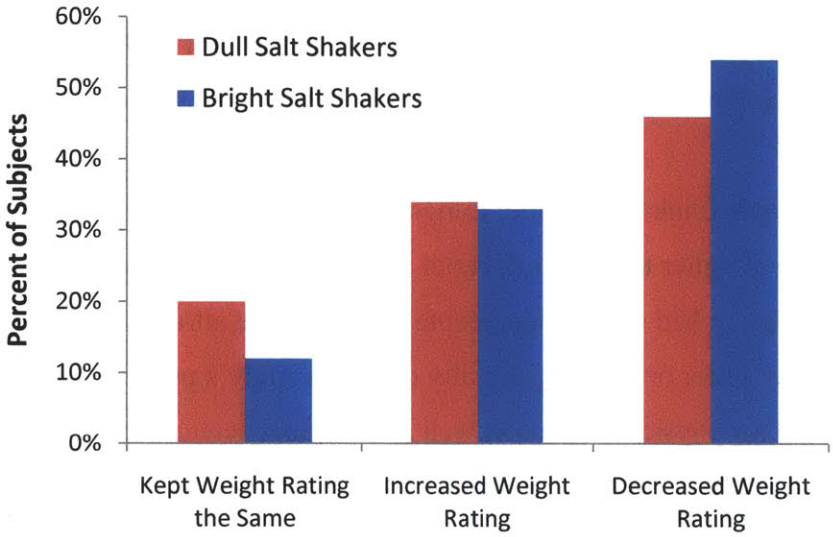


Figure 5-4 Subjects' change in weight ratings for bright and dull salt shakers. This is the only correlation between salt shaker type and weight rating.

5.5 Limitations

There are a few limitations that this study faces. First, 90% of the survey respondents were MIT students, who are not representative of the world population and likely interact with objects differently. Secondly, only 8-12 people were surveyed per salt shaker, and many of the interesting trends involved 10-20% of the group. That means that only 1-2 people could offset the analysis. It would be valuable to increase the sample size significantly. Finally, it would be helpful to filter the visceral perceptions from the reflective perceptions. It's possible that some people had pre-conceived ideas about salt shakers that affected their responses to the survey. Overall, these limitations are fairly inconsequential, but should be considered for future studies.

Chapter 6

Conclusion

This thesis documents the work conducted by Stephanie M. Schmit, MIT S.B. '11, to design and run a study analyzing user perceptions of functionality compared to inherent attractiveness.

This study verified that people think that prettier things work better even when they don't, and revealed that people think uglier things work better when they do. Past research by Kashimura and Kurosu, and Tractinsky had shown that people thought more attractive computer user interfaces functioned better, whether or not they actually did. This study's purpose was to determine if these trends held true for physical objects as well as computer screen interfaces. The same methods were used for both studies. Subjects rated attractiveness, functionality, and an unrelated factor both before and after using the device. The unrelated factor was used to verify that the other results were not a result of experimental bias, but actually a result of the attractiveness-functionality relationship under investigation.

As expected, the change of subject's ratings of weight (the unrelated factor) was not affected by the usability or attractiveness of the salt shaker, and was slightly affected by the color. This validates the findings about functionality and attractiveness; it was not an experimental bias.

Subjects bonded with the nonfunctional salt shakers over the frustrating experience trying to use it. They bonded even more with the pretty nonfunctional salt shakers than the ugly ones. As a result, zero subjects decreased the attractiveness rating of the nonfunctional salt shakers, and were 5.8 times more likely to increase the rating of really pretty ones than ugly ones.

No such bonding occurred between the subjects and the working salt shakers. Zero subjects increased the attractiveness rating of the working, round salt shakers, and it was equally likely for a user to increase or decrease the rating of the working, sharp salt shakers.

The initial hypothesis that people think more attractive objects work better, even when they don't was confirmed: Subjects increased the functionality ratings of nonfunctional pretty salt shakers, and decreased the functionality of nonfunctional ugly salt shakers! Additionally, subjects increased the functionality rating of working, ugly salt shakers. This was unexpected, and may be a result of initial rating biases: If subjects initially rate the pretty salt shaker as being

very functional, and the ugly salt shaker as being very nonfunctional, and adjust their rating to be less extreme after use. However, this only applies to the working salt shakers – not the nonfunctional ones, when users rate apparent functionality based on aesthetics, rather than inherent functionality. Clearly more research is needed to understand this reversal of trends between nonfunctional and working objects.

Overall, people increased the functionality rating of nonfunctional pretty and working ugly salt shakers. Thus it seems that people only think pretty things work better when they don't – but think that ugly things work better when they do. This does not exactly match the Trachtinsky study results – that people think prettier things work better, both if they do and if they don't – perhaps this is the difference between computer interfaces and physical objects. The author recommends further studies to include both computer interfaces and physical objects to further distinguish the differences to determine the best course of action for user interface and device usability designers. This study showed a definite correlation between beauty and perceived functionality, and thus user satisfaction. It is very important to consider this relationship when designing objects for user interaction.

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Appendices

Appendix A

Here is the survey that was used to interview the subjects in this study. The first page is the "before" survey, and the second page is the "after survey" (they are identical). The next three pages are the demographics survey. Not all of the demographics data collected was used.

How attractive do you think this object is?

Very ugly	1	2	3	4	5	6	7	Beautiful

How usable do you think this object is?

Not usable at all	1	2	3	4	5	6	7	Usable

How much do you think this object weighs?

Very light	1	2	3	4	5	6	7	Very heavy

How attractive do you think this object is?

Very ugly	1	2	3	4	5	6	7	Beautiful

How usable do you think this object is?

Not usable at all	1	2	3	4	5	6	7	Usable

How much do you think this object weighs?

Very light	1	2	3	4	5	6	7	Very heavy

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other

In what year were you born? _____

Where have you lived? List as many as you find relevant.

Country _____ State _____

Country _____ State _____

Country _____ State _____

School (if MIT, leave blank) _____
Year _____
Major(s) (MIT course number OK) _____

What MIT living group(s) do you most identify with? List as many as you find relevant.

Do you consider yourself a person who appreciates art?

No; disagree strongly	1	2	3	4	5	6	7	Yes; agree strongly

With which of the following groups do you most identify? Check all that apply.

- ☐ Black or African American
- ☐ Asian
- ☐ Pacific Islander
- ☐ Hispanic/Latino
- ☐ American Indian or Alaska Native
- ☐ Caucasian
- ☐ Other

What is your religious affiliation?

- ☐ Atheist
- ☐ Agnostic
- ☐ Christian
- ☐ Catholic
- ☐ Jewish
- ☐ Muslim
- ☐ Hindu
- ☐ Buddhist
- ☐ Other
- ☐ None

What languages do you speak at home?

Which of the following best describes you or your household's annual salary (plus any bonus) before taxes?

- ☐ Less than $10,000
- ☐ $10,000 to $19,999
- ☐ $20,000 to $39,999
- ☐ $40,000 to $59,999
- ☐ $60,000 to $79,999
- ☐ $80,000 to $99,999
- ☐ $100,000 to $149,999
- ☐ $150,000 or more

What is the highest level of education your parents have completed?

Mother	Father	
☐	☐	Less than High School
☐	☐	High School/GED
☐	☐	Some college
☐	☐	2 year Degree (Associate's)
☐	☐	4 year Degree (BA, BS)
☐	☐	Master's Degree
☐	☐	Doctoral Degree
☐	☐	Professional Degree (MD, JD)

Is there anything else I should know about culture groups that you identify with?

Thank you!