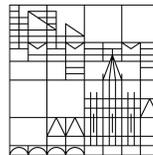


The Bandwagon Effect Helps Mitigating the Fear of Social Embarrassment in
Interactive Public Display Use

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Table of Contents

Chapter 1: Introduction	1
1.1 Related Research in the Field	1
1.2 Relevant Findings Contradicting Display Blindness	2
1.3 Potential Social Underpinnings of Display Avoidance and Under Use	2
1.3.1 The Fear of Social Embarrassment.	2
1.4 Linking Social Effects to Observed Interaction Behaviors in Public Settings	3
1.5 Mitigating Fear of Social Embarrassment by Leveraging the Bandwagon Effect	4
1.6 Classification by DISCOVERY Model	5
Chapter 2: Conceptualization of Study	7
2.1 Implementing the Bandwagon Effect into an Interface Design	7
2.1.1 The implicit Percentage-Counter	8
2.1.2 The explicit Star-Rating	9
2.1.3 Call-to-action condition	9
2.1.4 Control condition	9
Chapter 3: Development of Hypotheses	11
Chapter 4: Design of Experiment	13
4.1 Interface Design	13
4.1.1 Bookshelf	14
4.1.2 Interactive Books and the Main Work Flow	14
4.1.3 Simple Book Movement to Attract Passersby	16
4.1.4 The Graduate Cap and the Community Icon	16
4.2 Experimental Conditions	17
4.2.1 Percentage Counter	17
4.2.2 Star-Rating	18
4.2.3 Call-To-Action	20
4.2.4 Control	21
4.3 Questionnaire Design	21
4.4 Experimental Design	22
4.4.1 General Experimental Design	22
4.4.2 Independent Variables and Dependent Variables	22

Chapter 5: Methods	23
5.1 Overview	23
5.2 Materials	23
5.3 Location	23
5.4 Procedure	24
5.5 Participants	25
5.6 Data Extraction	25
5.6.1 Kinect	25
5.6.2 Video Camera, Touch Display, and Questionnaire	26
Chapter 6: Results	27
6.1 Amount Passersby and Touches for each Condition	27
6.2 Impact of the Choice of Condition on Touching Behavior	29
6.3 Chi-Squared Tests for Each Experimental Condition Separately	29
6.3.1 Percentage-Counter	29
6.3.2 Star-Rating	30
6.3.3 Call-to-action	30
6.4 Conversion Analysis	30
6.4.1 Attraction Power	32
6.4.2 Engagement Power	33
6.5 Holding Power	34
6.6 Anxiety Level for each Condition	36
6.6.1 Percentage-Counter	38
6.6.2 Star-Rating	38
6.6.3 Call-to-action	38
Chapter 7: Discussion	39
7.1 Hypotheses' Review	39
7.1.1 Hypothesis 1	39
7.1.2 Hypothesis 2	39
7.1.3 Hypothesis 3	40
7.1.4 Hypothesis 4	40
7.1.5 Hypothesis 5	40
7.2 Effects of Interfaces That Implemented Bandwagon Effect	41
7.2.1 Implicit Percentage-Counter	41
7.2.2 Explicit Star-Rating	41
7.3 The Snob-Effect	42
7.4 Efficacy of the Bandwagon-Effect	42
7.4.1 Call-to-actions' efficacy	43
7.4.2 Explicit Star-Ratings' Efficacy	43
7.5 The Need for Socially-Safe Interaction	45
7.6 Limitations	45
7.7 Future Research	46
Conclusion	49

Appendix A: Survey	51
References	59

List of Tables

5.1	Procedure of the experiment as a Latin square.	25
6.1	Amount of people that passed by for every condition.	27
6.2	Amount of people that touched the display for every condition.	28
6.3	Amount of people that (didn't) touched the display for every condition.	29
6.4	Amount of people for every condition that were intrigued by the display, or just passed by.	32
6.5	Amount of people for every condition that touched the display, or just were intrigued by it.	34
6.6	Mean, SD, and quantiles of duration times for every condition.	35
6.7	Anova on the impact of the choice of condition on the length of duration.	36
6.8	Mean and SD of SPIN18_SCORE for every condition.	36
6.9	Mean and SD of FACTOR1I_SCORE for every condition.	37
6.10	Anova on the impact of the choice of condition on SPIN18_SCORE	37
6.11	Anova on the impact of the choice of condition on FACTOR1I_SCORE	37

List of Figures

1.1	DISCOVER model by Cheung (2016)	6
4.1	The bookshelf which forms the visual scaffold of the interface.	13
4.2	Top part of the display that will change depending on the experimental condition.	14
4.3	Books on the middle tier that are interactive.	15
4.4	Opening of a book.	15
4.5	Speech bubble that pops up after the display was touched.	15
4.6	Tilting of one book.	16
4.7	The Graduate Cap and the Community Icon.	16
4.8	The interface used in the percentage-counter condition (condition 1).	18
4.9	The interface used in the star-rating condition (condition 2).	19
4.10	The feedback given after participants rate in the star-rating condition.	20
4.11	The interface used in the call-to-action condition (condition 3).	20
4.12	The interface used in the control condition (condition 4).	21
5.1	Hallway in a building (Engineering 5) at the University of Waterloo.	24
6.1	Absolute number of people interacting differently for every condition	31
6.2	Percentage of people interacting differently for each condition.	32
6.3	Distribution of Duration Length with Normal and Transformed Data	35

Abstract

While there is support for the assumption that people are concerned to interact with public displays, we thought of ways to overcome this concern. This resulted in the development of two interfaces that implemented the bandwagon effect as implicit and explicit recommendation systems. While the implicit percentage-counter condition was not able to cause more people to interact with our public display, we found that the explicit star-rating condition was successful in causing people to interact with the display. Most interestingly, the explicit star-rating seems to be more successful in drawing in higher socially concerned passersby than the control condition. This is why we think that the bandwagon effect is a potential design option that helps overcome social concerns such as the fear of social embarrassment in public display use.

Während es Unterstützung für die Annahme gibt, dass Menschen soziale Bedenken in der Nutzung von öffentlichen Displays haben, haben wir versucht in dieser Studie diese Bedenken mit der Hilfe des Bandwagon Effekts zu überwinden. Dies resultierte in der Entwicklung von zwei Interface Konditionen, die den Bandwagon Effekt als ein explizites und implizites Bewertungssystem implementieren. Während der implizite Percentage-Counter nicht erfolgreich war, schien das explizite Star-Rating wirksam als Ursache zu sein, dass mehr Menschen den öffentlichen Display zu berühren als in der Kontrollgruppe. Interessanterweise, war das explizite Star-Rating erfolgreich sozial ängstlicher Menschen anzuziehen als die Kontrollgruppe. Daher kann man annehmen, dass der Bandwagon Effekt eine Möglichkeit sein kann, die hilft soziale Bedenken, wie die Angst vor sozialer Blamage, zu überwinden.

Chapter 1

Introduction

Large (touch) displays have become available for public deployment because of falling prices. Even though these displays are supposed to increase the user experience in public settings, they are, however, highly underused. Research has identified different reasons for this. One of those reasons is the so-called display blindness.

Public displays do not seem to be the eye-catchers they were thought to be (Huang, Koster, & Borchers, 2008). In their observational field study, Huang et al. (2008) found that people barely looked at public displays, and if they did, they just looked in the direction of the display for one or two seconds. This phenomena was coined “display blindness” one year later (Müller et al., 2009). Display blindness is described as the tendency to ignore public displays by passersby. In interviews, Müller et al. (2009) found that people do so because they expect uninteresting content such as advertisement.

Furthermore, people avoid public displays. Huang et al. (2008) already realized that some people tend to look more into the direction of a display if something in the vicinity of the display caught their attention first. However, after realizing the display, people tend to actively ignore the display (i.e. they stopped looking into the displays direction). This behavior was named “display avoidance” (Kukka, Oja, Kostakos, Gonçalves, & Ojala, 2013).

Mechanisms such as display blindness and avoidance seem to hinder people in the process of interacting with a display. Fortunately, a body of research has formed about how to design and deploy public displays to tackle those mechanism. In the following, we will briefly share some findings relevant to our research.

1.1 Related Research in the Field

Interesting to this study is the tendency that groups are more likely to interact with displays than individuals that pass by. This tendency was shown in different studies (Cheung, 2016; Müller, Walter, Bailly, Nischt, & Alt, 2012). Müller et al. (2012) argues that groups are more likely to discover public displays than individuals because they contain more people.

Another interesting finding was made by Gentile et al. (2017). They studied

the impact of an audience on interactions of passersby with a display. Their results suggest that people are less likely to interact with the display when there is a higher number of people sitting on benches close to the display. Furthermore, they found that many people abandoned interaction in the first place and returned later when there was no audience anymore. Additionally, they found that people interact with the display from a greater physical distance when there are people in the audience. This distance even increased sometimes if people in the audience were directly looking at the interacting person.

1.2 Relevant Findings Contradicting Display Blindness

Interesting to notice in Cheung's et al. (2016) study is that most of the passersby looked at the screen (around 90%). This is contradictory to the above mentioned display blindness which claims that most people do not look at the screen. Indeed, there are more studies questioning the fact that people are "blind" to displays. In a recent eye-tracking study, Dalton et al. (2015) found that more people actually looked at displays in comparison to earlier assumptions. This was true even though the study was conducted in an high-information overload setting (i.e. a shopping center). Another interesting phenomenon Dalton et al. (2015) realized is that people tend to discover displays from much greater distance (i.e. around 8 meters). This newer study using eye-tracking and a conservative coding-style suggests that many people might actually see displays in public settings. This weakens the foundation of display blindness, and questions its impact. Indeed we argue that Huang et al. (2008) might not have been able to notice glances from a far distance in their observational field study. In summary, display blindness might have a smaller impact on passersby than originally assumed.

The fact that many people actually appear to perceive displays in a public setting, but still avoid them (cf. display avoidance by Kukka et al. (2013)), brings us to an assumption that we hold throughout this paper. We argue that the social obstacles of display use in public settings are appreciated and mentioned in much research dealing with display blindness, but are, however, highly unexplored. Furthermore, we think that those social obstacles might have a bigger impact on display use than originally assumed.

1.3 Potential Social Underpinnings of Display Avoidance and Under Use

1.3.1 The Fear of Social Embarrassment.

In past research, the fear of social embarrassment is mentioned as one of the main factors why people avoid public displays (Brignull & Rogers, 2003; Buerger, 2011; Wouters et al., 2016). In their research, Cox et al. (2016) give a nice example when

they describe this social embarrassment. They observed that people quickly walked away when they had failed to interact with a display (i.e. touched a non-touch screen). This might be caused by the feeling of social embarrassment. This embarrassment might hinder them to interact with unknown displays in the future because they might embarrass themselves again in trying to. In order to understand the fear of social embarrassment and its implications for the design of public displays, there is need to understand its origins. The examination of the impact of social embarrassment can be found in Psychology Bachelor's thesis "*The Impact of Social Embarrassment on the Use of Public Large Interactive Displays*".

1.4 Linking Social Effects to Observed Interaction Behaviors in Public Settings

Before talking about how those social obstacles such as the fear of social embarrassment can be mitigated, related research should be linked and compared to the above mentioned effects of social embarrassment. In particular, it is interesting to see that social effects can offer an alternative explanation of many phenomena that research has perceived.

First, it explains the success of the honey-pot phenomenon. In order to overcome the fear of social embarrassment, Brignull et al. (2003) argued that the honey-pot phenomenon can create a "social buzz" in the area of the display that attracts more and more people. It is argued that this honey-pot signals interesting interaction possibilities to people in the proximity of the display (Brignull & Rogers, 2003), and reduces the likelihood for social embarrassment (Wouters et al., 2016). The honey-pot is, therefore, a pure social phenomenon that attracts more people than most displays ever could.

Second, the fear of social embarrassment would explain why different interaction modalities are more successful than others. While waving hands in the air can cause a lot of attention, moving from one physical spot to another may contain a lower-level risk of embarrassment (Coenen, Claes, & Moere, 2017). This result suggests that people might prefer interactions with less potential of social embarrassment. Therefore, people may be much more likely to interact with displays that offer "socially safe" interactions (i.e. a low risk of embarrassment).

Third, as the findings of Gentile et al. (2017) have shown, people seem to be aware of audiences. In front of a display they might, therefore, feel exposed and be less likely to interact with the display (Gentile et al., 2017). This might be because of a higher likelihood of social evaluation which is perceived as a higher social threat.

Those alternative explanations of past research are just a sneak preview of more thorough examination that can be found in my Bachelor's seminar paper. With this background and the findings of my Psychology thesis we argue, therefore, that people may avoid displays because of the fear of social embarrassment, and thus social exclusion. People do not want to look stupid or silly, because it is a symbol for incompetence. This incompetence lowers people's inclusionary status and excludes

them from groups. Therefore, situations in which people might look incompetent are avoided.

To overcome those issues, we sought potential, design solutions that may help encourage or persuade people to overcome the fear of social embarrassment or exclusion. The evaluation of those design solutions will be the main contribution of this study.

1.5 Mitigating Fear of Social Embarrassment by Leveraging the Bandwagon Effect

Given the long history of using psychological persuasion in advertising, we investigated the literature of advertisement for potential solutions and found a promising persuasive phenomenon that helps people feel socially included: the bandwagon effect. This effect describes the tendency of an individual to demand/buy more of a certain good if other people also demand/buy more (Leibenstein, 1950). Literally, the bandwagon was a wagon to carry a band. Climbing or jumping on top of it means to put oneself at the head of the crowd. More broadly speaking, jumping on the bandwagon means to join the winning side, or the side that seems more likely to be successful (Collat, Kelley, & Rogowski, 1981). The bandwagon effect can be applied to politics and public opinion (i.e. people go with the public opinion when they jump on the bandwagon) (Nadeau, Cloutier, & Guay, 1993), or advertisement (i.e. higher chance of buying something if other people bought it, too) (Nadeau et al., 1993). As a reason for the bandwagon effect, past research asserts that people have a need for conformity which makes them adopt majority views (Marsh, 1985; Mutz, 1992; Parsons, Ballantine, Ali, & Grey, 2014). We believe that the bandwagon effect can be applied to public displays as well (e.g. by displaying the number of people that interacted or touched the display).

Indeed, the bandwagon effect has impacted different areas close to our field. First, it has effected users searching for news articles on a website. Users tend to rely on the recommendation system based on other users (i.e. most viewed articles) around 50% of the time (Yang, 2016). Second, the bandwagon effect might impact shopping behaviors on websites (e.g. by using product and producer ratings, or sales counters) (Parsons et al., 2014; Sundar, Oeldorf-Hirsch, & Xu, 2008; Sundar, Xu, & Oeldorf-Hirsch, 2013). Third, people seem to rely on the amount of views of online videos to guide their search (Fu & Sim, 2011).

We argue, therefore, that the bandwagon effect might help us to increase the amount of interaction with public displays. This is because people tend to conform to certain majority behavioral norms in order to increase their social inclusionary status (Leary, 1990). The above mentioned need for conformity might be, therefore, nothing else than a substitute for the need to belong (cf. my Psychology thesis). In other words, people might conform to group standards in order to belong to the group (Leary, 1990). We think, therefore, that people might see the group of people that interacted with a display as a group itself that is worth joining. Bringing this to the next level, we might even be able to reproduce small versions of the honey-pot phenomenon when no one or just a few people are around the vicinity of the display

(i.e. individuals or small groups get attracted by the bandwagon effect as they would be attracted by the honey-pot effect). We think this might happen because the honey-pot effect may be caused by the bandwagon effect. Indeed, the honey-pot effect causes people to group together in the vicinity of an interesting object just like they would, metaphorically speaking, group together on a bandwagon. In both effects, people get attracted by the presence of a group. That is why those two effects might describe the same phenomenon.

In summary, we think that leveraging the bandwagon effect might help display designers to overcome people's fear of social embarrassment when they perceive that other people interacted with the display before. Furthermore, it might attract people that seek inclusion to a group (i.e. the group of people that touched the screen), and make people less likely to avoid the display because they are more influenced by the bandwagon effect than by concerns about their social inclusionary status. Last but not least, we might be even able to reproduce small versions of the honey-pot phenomenon. Before the approach of implementing the bandwagon effect into an interface design is discussed, this research is classified by the DISCOVERY model in order to have a broader overview over the topic and to complete this introduction.

1.6 Classification by DISCOVERY Model

There are many discovery models that describe how passersby discover large public displays, how they get intrigued by it, and finally how they interact with the display. Depending on the research design, interventions might operate on different stages of those models. In this study we will test the bandwagon effect as an intervention to mitigate the effects of social embarrassment.

Cheung (2016) offers a comprehensive DISCOVERY model that we will use to classify this research (Figure 1.1). It consists of different states that the DISCOVERY model describes people to be in. In the beginning people do not know the display. As soon they notice the display they are notified. If the content of the display seems interesting to people, they get intrigued by the display. If not, they will withdraw. After they find the content interesting, people might realize that the display is interactive, and start exploring (i.e. user intentionally interacts with the display). While using the display the user discovers the system's features and capabilities (i.e. the user purposefully engages with the system). The discovery of the display can be competent (i.e. successful engagement), or frustrating. In the end the user will withdraw.

Our research will operate on different states, and different transitions, but not on all of those that are described by the DISCOVERY model. Since we assume that the impact of display blindness is smaller than assumed (because of social obstacles), we argue that most users will already be notified by the display. This is reinforced by the fact that the display that we use is a non-stationary, mobile display, and, therefore, greatly appealing in its physical appearance. As soon as passersby notice the display, the question is if they will be interested in its content. While leveraging the bandwagon effect, we hope that more users will think that the content offered is interesting.

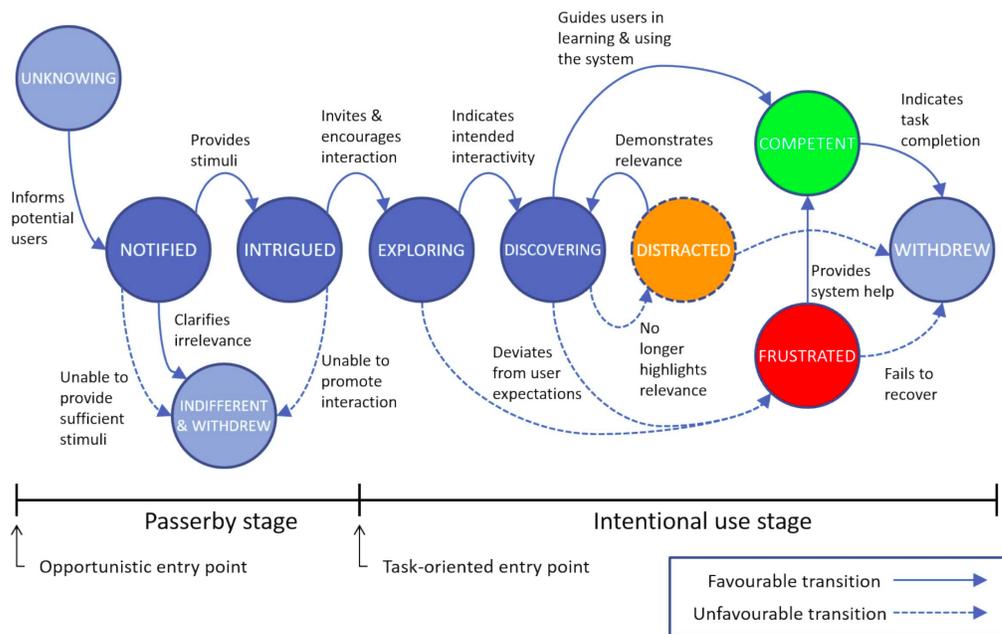


Figure 1.1: DISCOVER model by Cheung (2016)

After the user is intrigued, the display has to invite and encourage interaction. This transition is the focus of this research because we argue that social obstacles such as anxiety, or social embarrassment impede this transition between stages. In detailed words, people that identified that the display is both interesting and interactive might be hindered to interact because of potential social embarrassment. While leveraging the bandwagon effect, we hope to lower the potential of social embarrassment and make the interaction more “socially safe”. That is why this transition is the key transition in our research. It will be interesting to see if more people will be able to reach the exploring state when being exposed to an experimental design in which we implement the bandwagon effect. As soon as the user is interacting with the display we do not focus on the exploring and discovery behavior of the user anymore. Therefore, in summary, our focus lies on the second (i.e. from notified to intrigued) and third (i.e. from intrigued to exploring) transition.

Chapter 2

Conceptualization of Study

2.1 Implementing the Bandwagon Effect into an Interface Design

As described earlier, the bandwagon effect shows its' effects when people realize that other people have already bought a certain product, joined a majority opinion about politics, or interacted with a public display before. There are various ways, however, to make people realize that other people have been in touch with the product, or the system before. A very common way is the implementation of a recommendation system as it was used by Yang (2016), Parsons et al. (2014), or Fu et al. (2011). These recommendation systems recommend some items over others. According to Knobloch-Westerwick et al. (2005), there are two versions on how these recommendation systems work and what they are based on.

At first, there is the implicit recommendation system that is based on selections users have made (Knobloch-Westerwick et al., 2005). It is implicit because users are not required to give explicit information about products, newspaper articles, or other items. Instead their implicit selection behavior is tracked (i.e. who has visited what Internet page, or has seen what product). Most-viewed, most-popular, or most-commented rankings are examples how an implicit recommendation system can look like.

Second, there is the explicit recommendation system (Knobloch-Westerwick et al., 2005). It is based on explicit information about the product users leave on websites. This information can be in the form of 1 to 100 rankings, star-ratings, like/dislike-ratings (Cosley, Lam, Albert, Konstan, & Riedl, 2003) or whole product-reviews (Sundar et al., 2013).

Both effects have been tested in different settings and gained support. Explicit recommendation systems seem to be working well for newspaper article rankings (Knobloch-Westerwick et al., 2005). Implicit recommendation systems, however, have gained mixed report. While Knobloch et al. (2005) showed that implicit recommendation systems work to a certain extend (i.e. people selected more articles with both high and low view numbers in comparison to intermediate view numbers), Parson et al. (2014) found no statistically significant difference between two implicit

recommendation systems and no recommendation system at all. Yang (2016), however, found that the implicit recommendation system is working on news websites. Since the results offer mixed support for the implicit recommendation system, Yang (2016) calls for more research that tests both implicit and explicit recommendation systems.

Since the bandwagon effect has never been applied to a similar setting, we would like to, therefore, test both the implicit and the explicit recommendation system in our study. Both recommendation systems are supposed to cause the bandwagon effect by signaling potential users that the screen has been used by other users before. There might be other (and better) ways to do so, however. A problem using recommendation systems is that most recommendation systems have been tested with many items. However, the display is going to be a single item equipped with a recommendation system that is just about this single item. In other words, there is no way to compare the display with other displays/items/etc. in rankings, for example.

While we were discussing different design perspectives, we came across two interfaces that will be tested as two of a total of four experimental conditions. As an implementation of an implicit recommendation system we developed an implicit Percentage-Counter. As an implementation of the explicit recommendation system we developed an explicit Star-Rating. The third condition is going to be a Call-to-action condition and the fourth condition is going to be a Control condition. Therefore, we will have four experimental conditions in total.

Before discussing a first design iteration, it is important to know that the bandwagon effect works best for popular items. This makes sense because best-ranked items are the most demanded ones. It is in our interest, therefore, to set both the implicit Percentage-Counter as well as the explicit Star-Rating to an appropriate number in the beginning. This number will be artificially high, and temporary stable. That means that the amount of actual interaction in the experiment does not have an impact on those fake numbers. This deception is necessary in order to profit most from the bandwagon effect, and to create a stable environment in which we can research. A real, dynamic counter or rating could confound our results.

In all four conditions, the bottom portion of the interface (ca. 75% of the screen) will display an existing public display experimental platform which shows a visual bookshelf and allows people to obtain further information about the local university campus (e.g. public transit schedules, coffee shops, student clubs, etc.) by opening (i.e. touching) the corresponding books. The title of the interface is “Uwaterloo Community”. All the information that is available on the display is related, or offered by the community of the University of Waterloo. It is not a well-defined concept such as an organization or a club, and has to be seen more as a conglomerate of different services offered on the campus at the University of Waterloo. The top portion (ca. 25%) of the display will change depending on the condition.

2.1.1 The implicit Percentage-Counter

In this condition the top part of the display will contain a counter that shows the percentage of people that touched the display of the amount of the people that passed the screen. Additionally, it will be set to an appropriate number at the

beginning (eg. 55.04% of viewers touched the display today) in order to increase the bandwagon's effects. We argue that this deception is necessary because the real numbers of people touching a display is particularly low. The Percentage-Counter is an implicit recommendation system because it implicitly recommends the touch display to other people by only referring to user's selection behavior (i.e. people touched the screen). We chose the percentage counter because it is similar to a views counter for online videos (cf. (Fu & Sim, 2011)). However, we chose the percentage-Counter over absolute numbers (e.g. 132 people touched this display) because it might be really hard to find an appropriate starting number. The counter does not increase when people touch the screen in order to keep the same number throughout the whole experiment.

2.1.2 The explicit Star-Rating

In this condition the top part of the display will contain a 5-star rating as an explicit recommendation system. It will be set to an appropriate number at the beginning (eg. 4.2 stars) in order to increase the bandwagon's effects. The Star-Rating is explicit because it asks people to explicitly rate the display. Even though a short feedback is given after the rating by passersby, the rating does not have an impact on the displayed score. This score will be stable throughout the whole experiment. We chose the Star-Rating because it is very popular recommendation system on online shopping sites.

2.1.3 Call-to-action condition

In general, a call-to-action sign is a sign that signals the user affordances of displays or other devices, and even sometimes prompts the user to interact with the system. Research has shown that those signs increase the amount of interaction with displays in public settings (eg. (Coenen et al., 2017)). Those signs can have different forms and appearances. In this condition we are going to implement a call-to-action sign as a written sentence (eg. "Touch here!") which is placed at the top of the screen. Although this paper focuses on the bandwagon effect, we chose this condition because it offers a comparison between the bandwagon effect and the effects of call-to-actions sign. It is interesting to find out how well the bandwagon effect performs in comparison to the Call-to-action condition. Furthermore, it will be fundamentally important to know if the Call-to-action condition is able to draw in higher anxious people and cause them to interact with the public display in comparison to the Control group. We argue that might happen because call-to-action signs decrease the display's ambiguity, and, therefore, offer less room for misunderstandings and thus social embarrassment.

2.1.4 Control condition

The Control condition will leave the upper part of the display blank. We will use this condition to compare it with the experimental conditions in order to show their effectiveness.

Chapter 3

Development of Hypotheses

We hope that we can leverage the bandwagon effect in order to increase the amount of people that interact with public displays. We define interaction as people stopping to look at the display, approaching the display, and touching the display. This is different from just looking at or passing by the display which does not define as interaction. Our main focus will be on how many people touched the system which is our main form of interaction.

After our introduction we believe that the Bandwagon-Effect indeed might help us increase the interaction of people with public displays. Our main research hypothesis is, therefore:

Hypothesis 1: Both the implicit Percentage-Counter as well as the explicit Star-Rating will cause more people to touch the display in comparison to the Control condition.

Furthermore, we argue that more people will interact with the display in the explicit Star-Rating condition than in the implicit Percentage-Counter condition because of two reasons. First, the implicit bandwagon condition has gained less support than the explicit bandwagon condition (Fu & Sim, 2011; Knobloch-Westervick et al., 2005). Second, the snob-effect might mitigate the effects of the bandwagon effect. The snob effect describes the effect that people buy less if already many other people have bought the product before (Leibenstein, 1950), because they want to see themselves as more individualistic and exclusive. It is the reverse effect of the bandwagon effect. Leibenstein (1950) argues, however, that for most buyers the desire for exclusiveness is limited. It still might effect our results. This might be especially true for the implicit Percentage-Counter. Indeed, Parsons et al. (2014) could not find any statistical difference between buying likelihoods in low-and high-counter conditions (i.e. 14 vs 1038 people bought this product) in implicit recommendation systems. This might be because both effects worked against each other. In order to attract many “bandwagoners”, we are going to set the Percentage-Counter artificially high. This might scare off “snobs” which is why less people in total interact with the display. However, we still think that more people interact with the display in the implicit Percentage-Counter condition than in the Control conditions. As indicated above our hypothesis is:

Hypothesis 2: The explicit Star-Rating will cause more people to touch the display in comparison to the implicit Percentage-Counter condition.

The reason why we grouped together different ways how people interact with displays (i.e. stopping to look, approaching, touching) is because we think that the ratio of how many people stopped to look, approached, and touched with the people that just passed by is not different throughout our conditions. We believe that if an interface in one condition is able to attract more people in comparison to other conditions this increase will happen on all levels of interaction. In other words, we do not think that we are able to increase the number of people that touched the display while the amount of other forms of interaction such as approaching and stopping will stay the same. Therefore, our next research hypothesis is:

Hypothesis 3: The ratio of how many people stopped to look, approached, and touched the display with the people that just passed by is not different throughout our conditions. Those ratios will be independent from the total amount of interaction that we will register.

Call-to-action signals have been successful in increasing the amount of people that interacted with a display. This means for our Control conditions that we assume that our Call-to-action condition attracts more people than our Control condition. Our hypothesis is:

Hypothesis 4: People are much more likely to touch the display in the Call-to-action condition than in the Control condition.

By using the SPIN we hope to gain insight into the inner workings of people's feelings and thoughts surrounding the use of public displays. The SPIN will give us an indication of the severity of people's social anxieties in the form of a score. From there we can link people's anxiety scores with their actual behavior they have shown in terms of display use. If we are correct with our assumption of this paper (i.e. people can be anxious about public display use), we think that people with low anxiety scores are more exploratory and are, therefore, more likely to interact with our display. The answer to this research hypothesis is given in my Psychology's Bachelor thesis. In this paper, however, we want to find out how more anxious people react to our experimental condition. We hope that the Bandwagon-Effect helps overcome the fear of social embarrassment. We hope, therefore, to increase the number of anxious people interacting with the display in our experimental conditions in comparison to the Control conditions. Our research hypothesis is:

Hypothesis 5: Anxious people are more likely to touch the display in the experimental conditions in comparison to the Control conditions. In other words, the SPIN score for people interacting with the display in the experimental conditions is higher than in the Control conditions.

Chapter 4

Design of Experiment

4.1 Interface Design

The bookshelf and all other visual objects were designed by Mojgan Ghare. They were used in an earlier study conducted by Mojgan Ghare and Dr. Stacey Scott. Since this experiment is a sequel to this earlier study, it made sense to use the existing interface. The bookshelf itself stayed mostly as it is whereas the top of the bookshelf was modified in every experimental condition. While Marvin Pafla was conceptualizing the experimental conditions and the visual objects needed for them, Mojgan Ghare was designing them. After the design Marvin Pafla added them to the interface which was designed in Unity.



Figure 4.1: The bookshelf which forms the visual scaffold of the interface.

4.1.1 Bookshelf

The bookshelf forms the visual scaffold of the interface (Figure 4.1). It covers around 80% of space of the interface, and consists of three tiers. The bookshelf holds the title “UWATERLOO COMMUNITY” at the middle tier of the bookshelf. In empty spaces left and right next to the community symbol interactive objects (i.e. books) are placed. The top and bottom tier hold all kinds of static objects (e.g. books, clock, mug with scissors, or world globe) which are neither interactive (i.e. nothing happens when you touch or click on them) nor moving. The purpose of those static objects is to increase the visual appearance of the bookshelf and to make it look more realistic. The top part of the display (i.e. 20% of space of the interface) is left blank and will change depending on the experimental condition (Figure 4.2).

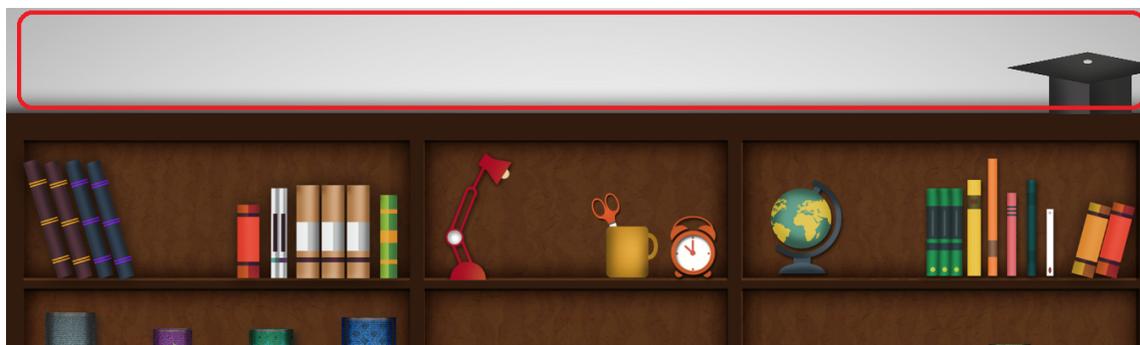


Figure 4.2: Top part of the display that will change depending on the experimental condition.

4.1.2 Interactive Books and the Main Work Flow

The books on the middle tier (Figure 4.3) are interactive and part of the main work flow of the display. When somebody touches them they open up in an animation (Figure 4.4). When the books are open they display a symbol that is representative for the book (e.g. a coffee for the coffee book). After they opened up, a speech bubble (Figure 4.5) pops up that thanks the users for touching the display, and directs them to the researchers desk in order to gain further information and to pick up a prize (e.g. candy) if there is interest. This is the basic work flow of the interface. Even though it can be anticipated that the system is supposed to reveal information about the campus community, it is actually just thanking people for touching the display and showing simple animations. This is acceptable because we are going to debrief people, and we are mainly concerned about finding out if the display is able to attract more people in the experimental conditions than in the control conditions. How people actually interact with the display, after they got attracted by it, is not relevant to this study. The animations of the books opening were designed by Mojgan Ghare in a previous study.



Figure 4.3: Books on the middle tier that are interactive.

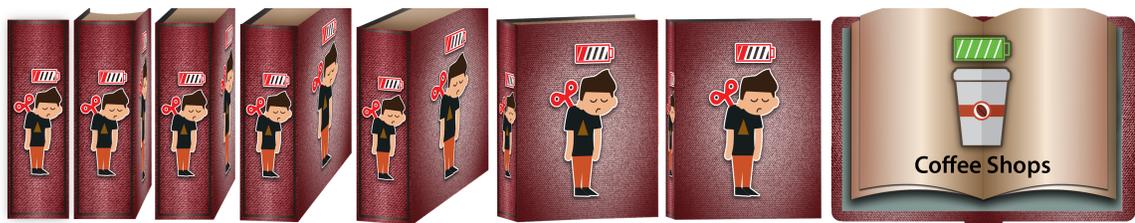


Figure 4.4: Opening of a book.



Figure 4.5: Speech bubble that pops up after the display was touched.

4.1.3 Simple Book Movement to Attract Passersby

The interface shows simple book animations in order to attract passersby. Those animations are displayed in all experimental conditions. The first kind of animation the interface shows is the tilting of books. In this animation books are randomly selected to tilt to either the left or the right side (Figure 4.6). This tilting can happen to three books at the same time. After a book is tilted it will not tilt again for 1.5 seconds. The second kind of animation is the random opening of books. It is the same animation that is displayed when a user touches one of the books (Figure 4.4). A book is randomly picked to open for 5 seconds. After it opened it will not open again for 10 seconds. Only one book at a time can be open. The animations of the books opening were designed by Mojgan Ghare in a previous study. The purpose of this random movement is to attract passersby to engage with the display throughout the whole experiment.

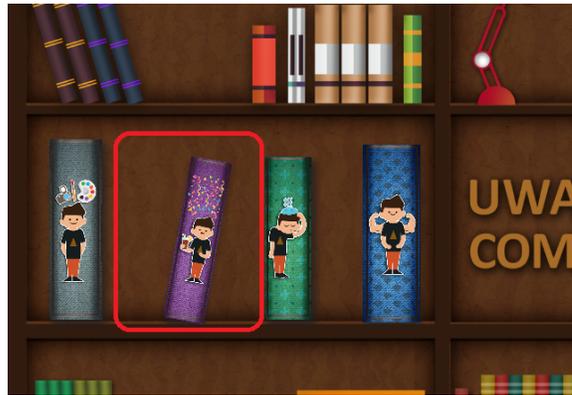


Figure 4.6: Tilting of one book.

4.1.4 The Graduate Cap and the Community Icon

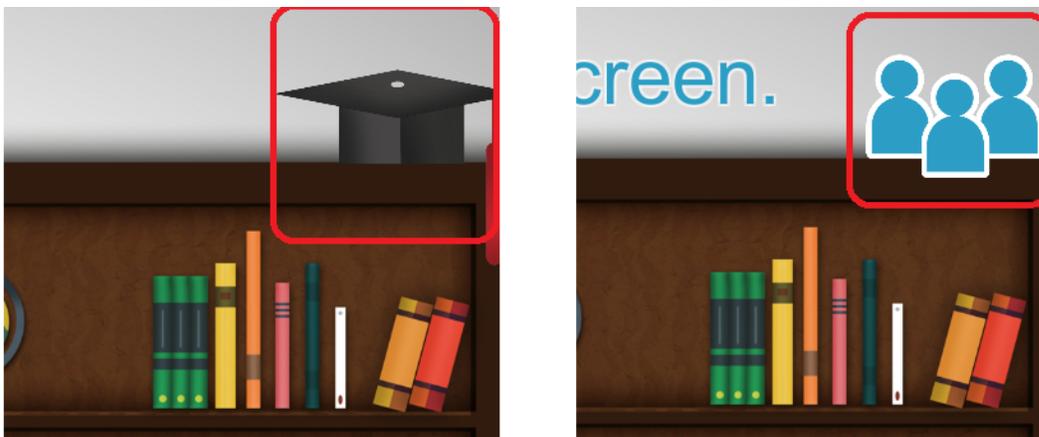


Figure 4.7: The Graduate Cap and the Community Icon.

At the top right part of the display we will place different icons (i.e. either a graduate cap or a community icon) depending on the condition the experiment is currently running in. While in our experimental conditions (i.e. percentage-counter and star-rating condition) the community icon is used, the graduate cap icon is used in our control conditions (i.e. the call-to-action and the control condition).

The community icon (Figure 4.7) consists out of three abstract figures that are supposed to represent an abstract community in general, or the the local campus community of the University of Waterloo in particular. The icon's purpose is to increase the effects of the Bandwagon-Effect by making people realize that the display has been used before by other people. Furthermore, we hope that the icon increases the Need To Belong by symbolizing a community that is worthy to join. All in all, by choosing the community icon we tried to emphasize the community component of the Bandwagon-Effect (i.e. literally the people on the bandwagon).

The graduate cap icon (Figure 4.7) is supposed to be a neutral symbol that is used in our control conditions. Its job is to fill in the space that is left by the community icon, and to make the display more fitted to its environment (i.e. an academic campus).

All in all, we think that the icons will not be mentioned by any participant in the questionnaire, or after we debriefed them. This might be the case because we argue that those changes in icons might implicitly change user's behavior without ever reaching the level of consciousness.

4.2 Experimental Conditions

4.2.1 Percentage Counter

The percentage-counter forms the first experimental condition (Figure 4.8). As mentioned above, the top right part of the display holds the community icon. The top middle part holds the title of the display "74.6% of viewers touched this display". The title has the same color as the community icon in order to stress the community component of the display, and to reinforce the Bandwagon-Effect.

We hope to increase the effects of the Bandwagon-Effect by making the percentage-counter as accessible as possible. Therefore, we chose this title because of several reasons. First, it is a short, easy to grasp title. Second, the percentage number is the first part of the sentence, and therefore, the first thing to read. By placing the percentage number at the beginning of the sentence, we hope that people will see it really quick and get attracted by it. Third, we chose the word 'viewers' over 'passersby' or 'users' because we believe that most people will identify with 'viewers' when they read (i.e. view) the title.

Furthermore, we picked the number 74.6% as the percentage number because we think that it will attract as many people as possible without being too high and unrealistic. After reviewing the numbers that our research group gave us (i.e. 22.93% for people that actually touch the display in reality, and 70.64% for the number the percentage number should be set on in order to attract as many people as possible), we think that the number should be over 70% and below 80%. Therefore, we arbitrarily

picked 74.6%.

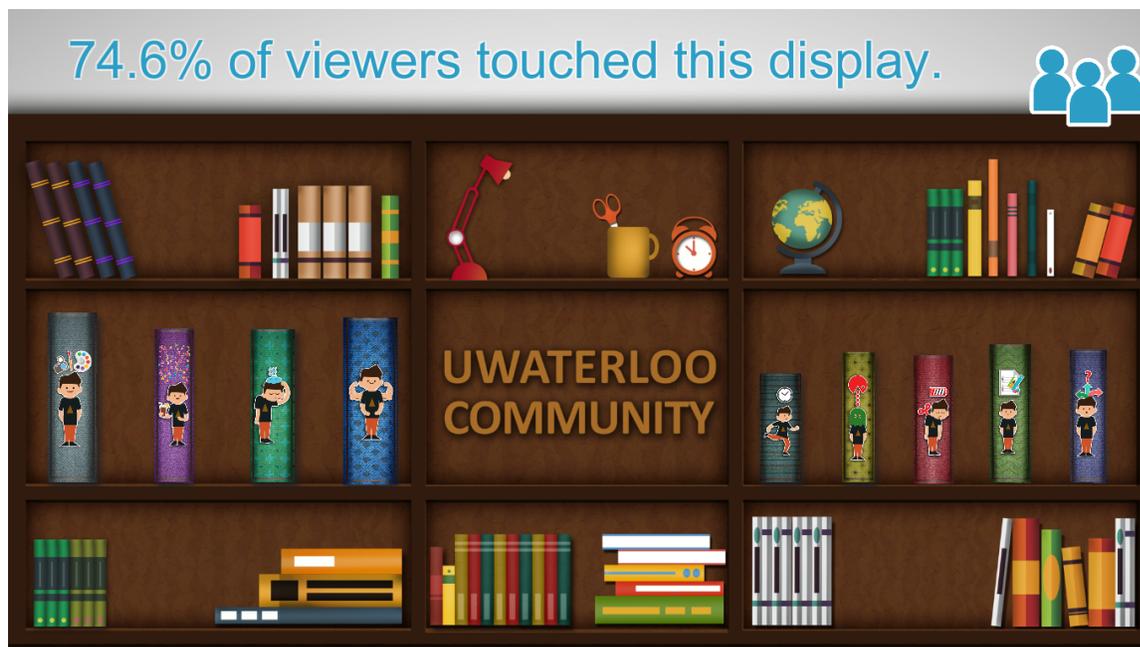


Figure 4.8: The interface used in the percentage-counter condition (condition 1).

4.2.2 Star-Rating

The star-rating forms the second experimental condition (Figure 4.9). After our piloting we realized that we had to make changes to our initial design. Now, the star rating is supposed to rate the community of the University of Waterloo itself. The community of the University of Waterloo is not a well-defined concept such as a club, or an organization. It is much more the conglomerate of various students clubs, drink-and food places, and different services offered by different providers at the university. Therefore, the meaning of the community of the University of Waterloo might be different for different individuals. After discussing the conditions in our research group we realized that it might be ambiguous what the community of the University of Waterloo is, and what the star-rating is supposed to rate. Since it might not be necessary to have an unambiguous rating in order to attract people, we argue that some ambiguity can be accepted in this context. Indeed this implicit, metaphorical technique (i.e. not explicitly stating the message, but offering visual and rhetoric bits that can be used for own interpretations) is successfully used in advertisement (Jeong, 2008). That is why we decided to take the rating about the community of Waterloo as our second experimental condition.



Figure 4.9: The interface used in the star-rating condition (condition 2).

As mentioned above, the top right part of the display holds the community icon. The top left part holds a star-rating followed by a score. The top middle part holds a arrow that is pointing down as well as the title “Rate the Waterloo community”. The middle tier of the bookshelf (where the title “UWATERLOO COMMUNITY” is positioned) is slightly modified.

The star-rating consists out of five stars. The first four stars are fully ‘filled’ (i.e. they are colored in a brighter orange) while the fifth star is only ‘filled’ for about a third (i.e. a third is colored in a bright orange while the rest is more pale). The score next to the star rating consists out of the number 4.3. Obviously, the star-rating is supposed to visualize the score of 4.3. Therefore, four stars are fully colored while the last one is only colored for about a third.

The arrow has the same color as the title, and the community symbol. The title says “Rate the Waterloo community” which prompts the user to interact with the display by rating the Waterloo community. The arrow points down towards the middle of the display (i.e. the middle tier of the display where the “UWATERLOO COMMUNITY” title is positioned). The aim of the arrow and the title is to signalize an interaction affordance to the user (i.e. the rating of the Waterloo community at the middle of the display).

The middle tier of the bookshelf was modified. The title “UWATERLOO COMMUNITY” moved up for a bit in order to make room for five ‘empty’ stars (i.e. the stars look pale). The purpose of those stars is to indicate a possible rating option of the university campus. The stars can be touched on. After touching one of the stars, all of the stars from the left up to the touched star fill up. Furthermore, an animation is played that makes the stars come out and go in (Figure 4.10).



Figure 4.10: The feedback given after participants rate in the star-rating condition.

The reason for this behavior is to give a feedback to the user that the rating was ‘successful’ (the score is actually static, and the rating given by the users does not count towards the score). After three seconds the animation stops and the stars turn pale again. Subsequently, the above described speech bubble pops up and thanks the user for touching the display.

4.2.3 Call-To-Action

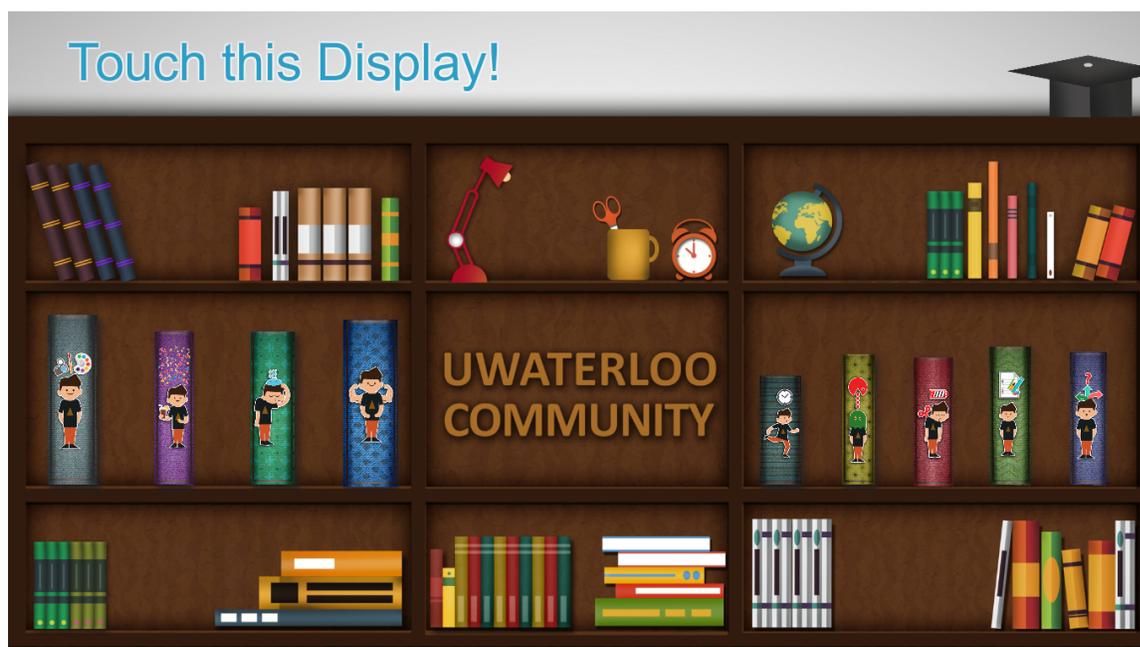


Figure 4.11: The interface used in the call-to-action condition (condition 3).

The call-to-action condition is the first control condition (Figure 4.11). As mentioned above, the top right part of the display holds the graduate cap icon. At the middle top part of the display the title “Touch this display!” prompts the user to interact with the display. It is written in the same color as in the previous conditions (i.e. blue) in order to keep colors congruent throughout the conditions.

4.2.4 Control



Figure 4.12: The interface used in the control condition (condition 4).

The control condition is left for comparison to the experimental conditions. (Figure 4.12). As mentioned above, the top right part of the display holds the graduate hat icon. The top part of the display, apart from the graduate hat icon, is left blank.

4.3 Questionnaire Design

The questionnaire is a central element of this experiment. It consists out of four central questions that are all mandatory to answer. The first question asks the participants if they have seen the display. The second question asks the participants if they have stopped to look at the display. The third question asks the participants if they approached the display. Last but not least, the fourth question asks the participants if they have touched the display. Those four questions are asked in this order. As soon as a participant answers one of those questions negatively, we do not ask any more of those questions left. This is because we assume that those questions are built on top of each other. For example, somebody that touched the display had to approach and look at the display before. In case a question is answered negatively, we ask the

participant why they had to answer negatively (e.g. why did you not approach the display?). We offer a range of answers for those questions. However, the participants always have the possibility to express their own thoughts. After those four questions we ask participants to fill out the SPIN which consists of 17 elements which are split onto 4 pages. Last but not least, we added a 18th element “I fear to embarrass myself in front of public displays” to the questionnaire. We thought it would be interesting to directly ask participants about their levels of anxiety concerning the public display. The questionnaire can be found in the appendix.

Furthermore, we asked participants if they agree to take part in this experiment, if their data can be anonymously quoted, and to what they were attracted to in case they have looked at the display. This offers us more feedback about the interface itself, and helps us understand the effects of our design interventions.

4.4 Experimental Design

4.4.1 General Experimental Design

The experimental design consists of two experimental conditions and two control conditions. The experimental conditions are the percentage-counter condition and the star-rating condition. The control conditions are the call-to-action condition and the control condition. All conditions are deployed on a public display for the same amount of time. Since a single user that is passing by our display is only exposed to one condition, we would consider our experimental design as a between-subject design. However, we can not make sure that a user passes by multiple times per day throughout the week and, therefore, is exposed to multiple conditions (which we would consider a within-subject design). Therefore, idealistically, it is a between-subject design. In reality, however, it is a mixed design since we cannot control whether participants approach the display multiple times.

4.4.2 Independent Variables and Dependent Variables

The only independent variable that we actually manipulate throughout our experiment is the condition that our interface is in. Therefore, our independent variable has four factors: the percentage-counter, the star-rating, the call-to-action, and the control condition. However, in our statistical analysis we will have other independent variables as well that are based on self selection (e.g. anxious vs non-anxious people according to the SPIN, gender, etc.).

Since interaction with displays is a relatively open concept, we have many ways to measure it. Examples of measurement are how many people stopped to look at the display, how many approached the display, how many touched the display, how much time they spent in front of the display, etc. Therefore, our dependent variable (i.e. the amount of interaction people have with the display) is multi-dimensional for most of our research hypotheses.

Chapter 5

Methods

5.1 Overview

A large display is deployed in a public setting for four days. During those days people that pass by the display are going to be exposed to different kinds of interfaces. In total we expose people to four different kind of interfaces which form our four conditions. Those four conditions are the percentage-counter, the star-rating, the call-to-action, and the control condition. For all of these conditions we measure the amount of interaction of people with the display (eg. how many people looked at, stopped to look, approached, and touched the display). Furthermore, we track how much time people spent in the area in front of the display as well as how many people in total passed by the display. While running the experiment we ask people to fill out a questionnaire that we prepared.

5.2 Materials

Attached to the display we will position the Kinect 2.0 which will be used for person tracking. Furthermore, we will use tablets (Microsoft Surface 2 tablets) that we can hand over to passersby that want to fill out the questionnaire. Additionally, we will have candy ready at a desk that is close to the display. After people touched the display they can pick up the candy as a reward. Last but not least, we will video record the scene from the tables close the display with our video-cameras (Panasonic HDC-HS250 HD digital camcorder).

5.3 Location

The public setting is a building (i.e. research building Engineering 5) at the campus of the University of Waterloo. The display will be deployed at the third floor in a semi-busy hallway that leads to a bridge (Figure 5.1). The bridge connects two large research buildings above a busy street, and is used very often when it is cold or rainy. The display will be placed in front of a wall right before the hallway opens up more

after. This is why most people will pass by the display sideways. On the other side of the hallway you will find stairs, elevators, and study places. Those study places are group tables. We will position ourselves at one of those tables to have a good overview over the scene. Most of the people that will pass this area are either students or employees of the University of Waterloo. Both the bridge as well as the classrooms guarantee a solid flow of people throughout our experiment.



Figure 5.1: Hallway in a building (Engineering 5) at the University of Waterloo.

5.4 Procedure

People that pass through the hallway will pass by our display. Some people will not see the display, some will see the display, some will stop to look at the display, some will approach the display, and some will touch the display. After they have touched the display, they will be thanked for touching the display, and informed that they are allowed to pick up their prize now. At the table close by we will offer candy for those that want to pick up their prize, and want to gain further information about the study. While all this happens we will record the whole scenery with two cameras. Furthermore, the motion is tracked by the Kinect, and the touch display saves the information of any touches. While we are passively watching the scenery, we will ask some people that interacted and some people that did not interact with the display to fill out a questionnaire that we provide on a touch tablet. We will record special characteristics of the people that fill out the questionnaire in order to recognize them later in the video that we record.

The display will be deployed on four days (Monday -Thursday) for four hours each day (i.e. 10am – 2pm). We will apply each of our four conditions (i.e. percentage-counter, star-rating, call-to-action, and control) for one hour each day. This adds up to four hours of deployment for each condition throughout the week. The deployment will be counter-balanced in a Latin Square (Table 2).

After the experiment is finished, we will place a piece of paper at the position where the display was deployed at. This paper explains the purpose of the deployment and offers a contact if people want to gain further information about the study or the display. The purpose of this paper is to debrief people as much as possible.

Table 5.1: Procedure of the experiment as a Latin square.

Time	Day 1: 07/17/2017	Day 2: 07/18/2017	Day3: 07/19/2017	Day 4: 07/20/2017
10am - 11am	Condition 1: Percentage- Counter	Condition 2: Star-Rating	Condition 3: Call-to-action	Condition 4: Control
11am - 12pm	Condition 2: Star-Rating	Condition 1: Percentage- Counter	Condition 4: Control	Condition 3: Call-to-action
12pm - 01pm	Condition 3: Call-to-action	Condition 4: Control	Condition 1: Percentage- Counter	Condition 2: Star-Rating
01pm - 02pm	Condition 4: Control	Condition 3: Call-to-action	Condition 2: Star-Rating	Condition 1: Percentage- Counter

5.5 Participants

According to previous studies in this area, around 72% of the participants will be male, 25% will be female, and 3% will be other. Around 94% of the participants will be between 18 and 24 years old. Most of the participants (i.e. around 84%) have used a public display before. Most of the participants will be students, or working staff.

5.6 Data Extraction

5.6.1 Kinect

The Kinect 2.0 by Microsoft will be placed on top of the display. Its main purpose is to track user behavior in the form of movement in front of the display. The Kinect is able to track up to six people in front of the display. As soon as a person enters the room in front of the display, a XML-log is created. It saves the time, the condition the display is in, and gives a unique ID to every new person that enters the room in front of the display. Unfortunately, we cannot avoid users from re-entering the room in front of the display which will result in giving the same user two IDs. Therefore, the same user can have two unique IDs when the user entered and left the space in front of the display for two distinct times. When the user leaves the space in front of the display, a new XML-log will be created that saves the time the user left, and the condition the display has been in at that moment.

5.6.2 Video Camera, Touch Display, and Questionnaire

The video cameras will record the whole scenery. They will be placed on one of the study tables that are close to the display. The video will be used for video analysis.

The touch display will create a log every time a user touches the display. It will save the time, the condition the display is in at the time of the touch, and what has been touched.

We will save all the information that we gain from the user from the questionnaire. *Surveymonkey.com* is used to create the questionnaire, to collect the responses and to analyze them. A printed version can be found attached to this paper.

Chapter 6

Results

The scope of a Bachelor's thesis does not allow for a detailed video analysis. Therefore, alternative ways to measure the amount and type of interaction (i.e. the dependent variable) have been done. Throughout this *Results* section, we will describe two types of interaction. Those types are touching behavior, and intriguing behavior (i.e. stopping to look). While touching behavior has been identified with the help of a video analysis, intriguing and passing by behavior were recorded with the help of the Kinect. Approaching behavior cannot be identified without thorough video analysis. In the following, all people that approached the display joined the group of people that were at least intrigued by the display (which is the next lower form of interaction).

6.1 Amount Passersby and Touches for each Condition

Table 6.1: Amount of people that passed by for every condition.

	Percentage-Counter	Star-Rating	Call-to-action	Control
Passed by	368	360	333	376

Table 6.1 displays the number of people that passed by our display for every condition. It is important to note that those numbers combine the data of all four days the experiment has been run. We will do so with all our data. As one can see the traffic was approximately the same for each condition.

The Kinect was used as a way to extract this data. The numbers presented in this table are the amount of unique IDs in the log that the Kinect created. As mentioned in the *Methods* section, participants could pass by our display multiple times. Therefore, they might be included multiple times in those numbers. Nevertheless, those numbers are the right indicators to display the traffic for each condition, and relativize further calculations.

Table 6.2 displays the amount of touches that were made in every condition. Those number were raised with the help of a video analysis. This analysis was necessary

because the log of the touch display alone was not really helpful. Since the touch-log of the display (that records the time, the position and the condition the experiment) saves every single touch, those numbers are highly dependent on outliers (i.e. people that touched the display multiple times). In fact, in condition 3 (i.e. Call-to-action condition) two children created over 100 touch log entries. That is why we had to approach this issue with the help of video analysis. By going through the log and confirming every touch we could save valuable time.

Table 6.2: Amount of people that touched the display for every condition.

	Percentage-Counter	Star-Rating	Call-to-action	Control
Number of Touches	17	22	18	7

However, video analysis entails the serious question about coding. The question is what can be considered as a touch and what cannot be. It is directly connected to group behavior. To illustrate this issue, we look at an example. In condition 1 (i.e. the Percentage-Counter condition), we recognized a huge appearance of the honey-pot phenomenon which resulted in multiple people touching the display. This appearance could not be found in any other condition. That is why this single occurrence would skew our data strongly.

To fix this issue, we reinterpreted touching behavior. Since this research tries to answer the question how people can be made touching a public display, the key behavior is to overcome hesitation of any kind, and to start to interact with the public display. That means that the numbers of touches that can be found in Table 6.2 actually have to be seen as times an individual or a group started to interact with the system. This implies that touch behavior was linked to a group as a whole. In other words, as soon as one member of the group started to touch the display, all other members of that same group do not count towards those touch numbers. By doing so, we eliminate the analysis of group behavior from this research. Indeed, it will need further video analysis to understand those group dynamics.

With the separation of groups and individuals, there arises the problem of identifying them. In the following, we will describe the rules that we used in our coding sheet in order to solve this issue. However, in the setting we ran the experiment (i.e. a university building), it is difficult to identify groups and individuals, because students might know each other (and, therefore, exit and join new groups quite rapidly).

We identified and coded groups when at least two individuals passed by the display together. Together means, in this context, that they walked either next to each other, or behind each other without much distance in between. If they were not walking next to each other, they had to have contact (i.e. they talked to each other). For most cases, this was easy to identify and distinguish. Problems arise when groups mix, dissolve or join. A typical example was that an individual, or a group, was already interacting with the display while another individual, or group was passing by. If this individual or group then approaches the display as well, we looked whether they seem to know each other, or not. This was sometimes difficult to say. In general, therefore, we coded conservatively which means that in difficult cases we rather coded a group

than an individual, and just one group instead of multiple ones.

6.2 Impact of the Choice of Condition on Touching Behavior

Table 6.3: Amount of people that (didn't) touched the display for every condition.

	Touch	Did Not Touch
Percentage-Counter	17	351
Star-Rating	22	338
Call-to-action	18	315
Control	7	369

A key question to this analysis is whether the interface condition people were exposed to has an impact on whether people touch the display or do not touch the display (describes as touching behavior). In Table 6.3 you can find the joined information that we gained above. Note that the number of the people that did not touch the display is the subtraction from the number of people that touched the display from the amount of people that passed by. Since this data is represented in a frequency table, a Chi-Squared test can be applied. The test result is $\chi^2(3) = 8.9929$, $p = 0.0294$, which indicates that the choice of condition people were exposed to, indeed, has an impact on whether people touch the display or do not touch the display. In the following, we will compare each experimental condition plus the Call-to-action condition with the control condition.

6.3 Chi-Squared Tests for Each Experimental Condition Separately

In this section we extract the data from Table 6.3. For the Percentage-Counter, Star-Rating, and Call-to-action condition, we will each extract the data of the respective condition plus the data from the control condition. This will give us three 2 x 2 tables that we run Chi-Squared tests on.

6.3.1 Percentage-Counter

In this section we try to find out whether the choice of condition (i.e. being in the Percentage-Counter condition or the Control condition) does have an impact on the touching behavior. The result of the Chi-Squared test is $\chi^2(1) = 3.6908$, $p = 0.0547$, which means that the difference in ratios is not statistically significant. Therefore, whether people were exposed to the Percentage-Counter condition or in the Control condition, does NOT have an impact on touching behavior.

6.3.2 Star-Rating

In this section we try to find out whether the choice of condition (i.e. being in the Star-Rating condition or the Control condition) does have an impact on the touching behavior. The result of the Chi-Squared test is $\chi^2(1) = 7.6874$, $p = 0.0056$, which means that the difference in ratios is statistically significant. Therefore, whether people were exposed to the Star-Rating condition or in the Control condition, does have an impact on touching behavior.

6.3.3 Call-to-action

In this section we try to find out whether the choice of condition (i.e. being in the Call-to-action condition or the Control condition) does have an impact on the touching behavior. The result of the Chi-Squared test is $\chi^2(1) = 5.5191$, $p = 0.0188$, which means that the difference in ratios is statistically significant. Therefore, whether people were exposed to the Call-to-action condition or in the Control condition, does have an impact on touching behavior.

6.4 Conversion Analysis

In this section we will introduce the last data dimension that we mentioned in the beginning of the *Results* section. In Figure 6.1 one can find the absolute numbers of people that touched and passed by the display (i.e. the same as above), as well as the amount of people that were intrigued by the display. This information was won with the help of the Kinect, and the following logic. A person that spends a larger amount of time in the vicinity of the display must have slowed down or stopped. We consider them as being intrigued because they did not pass by the display with normal walking speed. Furthermore, this class also contains the people that approached the display. Unfortunately, without video analysis we are not able to distinguish people that just stopped to look at the display, or that actually approached it.

There are two things to note. First, the time that people need to pass by the vicinity of the display is four seconds. This information was revealed by Victor Cheung (2016) who ran a similar study with the same display at the exact same place. Therefore, we use this four seconds identifier as well. Second, a person that spends more than four seconds in the vicinity of the display does not necessarily has to be interested in the display. We accept this inaccuracy by assuming that this might be the case throughout all our experimental conditions.

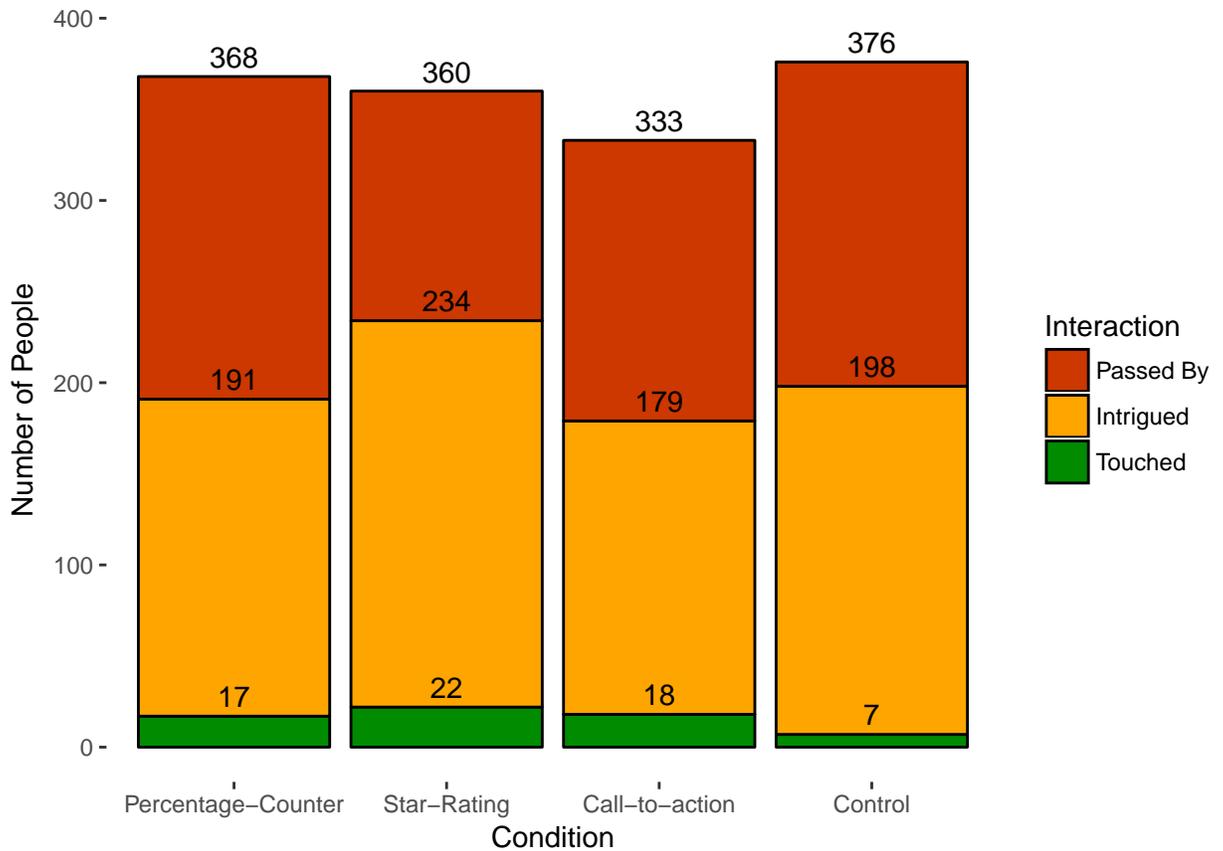


Figure 6.1: Absolute number of people interacting differently for every condition

As the DISCOVER model by Cheung (2016) implies, the interaction stages passed by (walked by), notified, intrigued, approaching, and exploring are run through consequently. This means that the people that touched the display, also had been intrigued by it, and passed by the display, etc. That is why you can find the data in Figure 6.1 in stacked-up bars.

Figure 6.2, on the other side, offers the relative percentage of people interacting with the display. That means that for each condition only a certain number of people out of 100% of the people that passed by the display did interact (i.e. intriguing or touching) with it. As one can see, the Star-Rating was the most successful in both intriguing people (65% of the people that passed by the display) and making them touch the display (6.1% of the people). In the following, we will look at the attraction and engagement power of each interface. They were described by Cheung et al. (2016) in his analysis.

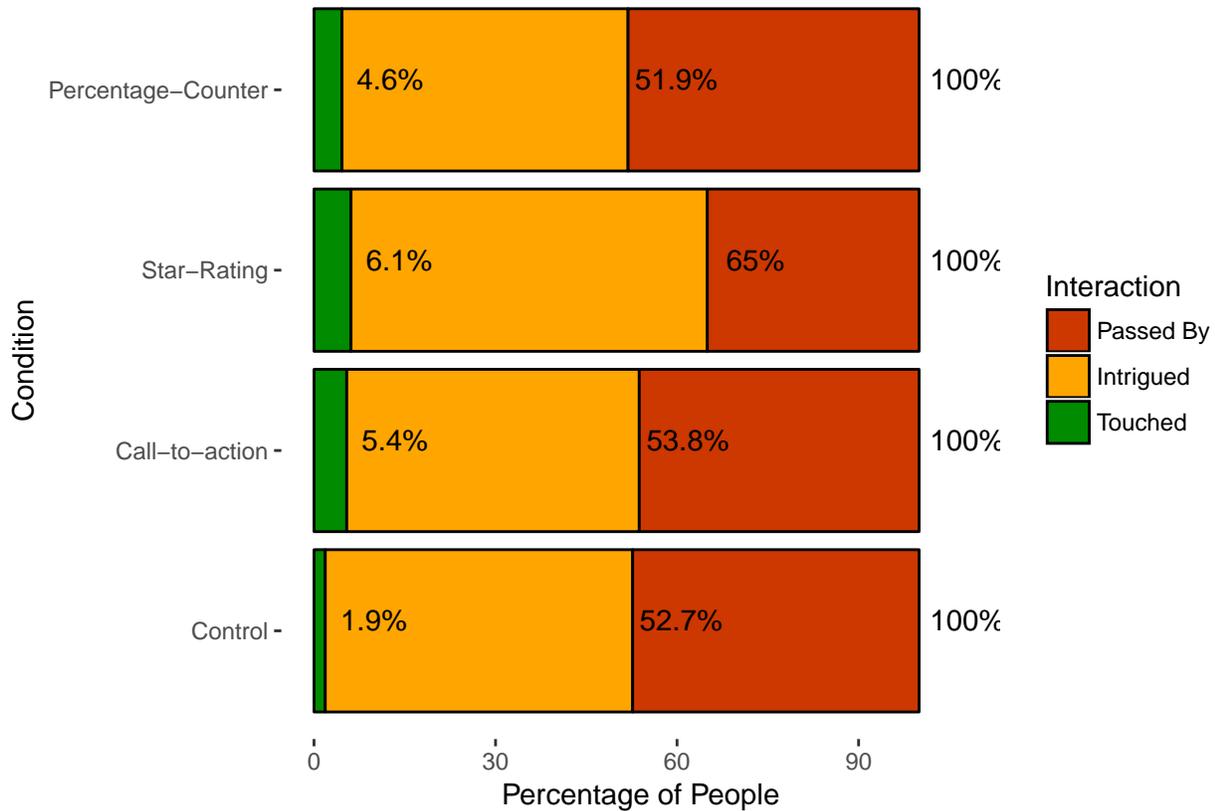


Figure 6.2: Percentage of people interacting differently for each condition.

6.4.1 Attraction Power

Table 6.4: Amount of people for every condition that were intrigued by the display, or just passed by.

	Intrigued	Passed By
Percentage-Counter	191	368
Star-Rating	234	360
Call-to-action	179	333
Control	198	376

The attraction power of a display is the strength of a display to attract people. With reference to the DISCOVER model, the power describes how many people transfer from the stage of being notified of the display to the stage of being intrigued by it. In more simple words, the attraction power describes the displays' ability to gain peoples' interest by providing attracting stimuli. In the following, we analyze the displays' attraction power which can be described by the ratio of people passing by the display and people that are intrigued by it. That is why we focus on the numbers that can be found in Table 6.4. They show the number of people that were intrigued by the

display and the number of people that just passed by the display. Consequently, we will compare the Percentage-Counter, the Star-Rating and the Call-to-action condition with the Control condition. That is why we will run three Chi-Squared tests.

Percentage-Counter

In this section we try to find out whether the choice of condition (i.e. being in the Percentage-Counter condition or the Control condition) does have an impact on the amount of people that are attracted by the display. The result of the Chi-Squared test is $\chi^2(1) = 0.0028$, $p = 0.9576$, which means that the difference in ratios is not statistically significant. Therefore, whether people were exposed to the Percentage-Counter condition or in the Control condition, does NOT have an impact on the attraction of the display.

Star-Rating

In this section we try to find out whether the choice of condition (i.e. being in the Star-Rating condition or the Control condition) does have an impact on the amount of people that are attracted by the display. The result of the Chi-Squared test is $\chi^2(1) = 2.7997$, $p = 0.0943$, which means that the difference in ratios is not statistically significant. Therefore, whether people were exposed to the Star-Rating condition or in the Control condition, does NOT have an impact on the attraction of the display.

Call-to-action

In this section we try to find out whether the choice of condition (i.e. being in the Call-to-action condition or the Control condition) does have an impact on the amount of people that are attracted by the display. The result of the Chi-Squared test is $\chi^2(1) = 0.0095$, $p = 0.9225$, which means that the difference in ratios is not statistically significant. Therefore, whether people were exposed to the Call-to-action condition or in the Control condition, does NOT have an impact on the attraction of the display.

6.4.2 Engagement Power

The engagement power of a display is the strength of a display to engage people in an interaction. With reference to the DISCOVER model, the power describes how many people transfer from the stage of being intrigued by the display to the stage of exploring it. In more simple words, the engagement power describes the display's ability to engage people in interacting with the display after it gained peoples' interest before (cf. attraction power). In the following, we analyze the displays' engagement power which can be described by the ratio of people that are intrigued by the display and the people that touched the display. That is why we focus on the numbers that can be found in Table 6.5. They show the number of people that were intrigued by the display and the number of people that touched the display. Consequently, we will compare the Percentage-Counter, the Star-Rating and the Call-to-action condition with the Control condition. That is why we will run three Chi-Squared tests.

Table 6.5: Amount of people for every condition that touched the display, or just were intrigued by it.

	Touched	Intrigued
Percentage-Counter	17	191
Star-Rating	22	234
Call-to-action	18	179
Control	7	198

Percentage-Counter

In this section we try to find out whether the choice of condition (i.e. being in the Percentage-Counter condition or the Control condition) does have an impact on the amount of people that touch the display after they are intrigued by it. The result of the Chi-Squared test is $\chi^2(1) = 3.4459$, $p = 0.0634$, which means that the difference in ratios is not statistically significant. Therefore, whether people were exposed to the Percentage-Counter condition or in the Control condition, does NOT have an impact on the touching behavior after participants were intrigued by the display.

Star-Rating

In this section we try to find out whether the choice of condition (i.e. being in the Star-Rating condition or the Control condition) does have an impact on the amount of people that touch the display after they are intrigued by it. The result of the Chi-Squared test is $\chi^2(1) = 4.3386$, $p = 0.0373$, which means that the difference in ratios is statistically significant. Therefore, whether people were exposed to the Star-Rating condition or in the Control condition, does have an impact on the touching behavior after participants were intrigued by the display.

Call-to-action

In this section we try to find out whether the choice of condition (i.e. being in the Call-to-action condition or the Control condition) does have an impact on the amount of people that touch the display after they are intrigued by it. The result of the Chi-Squared test is $\chi^2(1) = 4.7021$, $p = 0.0301$, which means that the difference in ratios is statistically significant. Therefore, whether people were exposed to the Call-to-action condition or in the Control condition, does have an impact on the touching behavior after participants were intrigued by the display.

6.5 Holding Power

According to Cheung (2016), the holding power of a display describes the displays' ability to bind people temporarily in the vicinity of the display. The idea here is that the more time is spent in front of a display, the more likely it is that a person interacts

with a public display. A display that is able to hold people as long as possible (i.e. has high holding power) is preferable. In Table 6.6 one can find the mean holding time in seconds as well as the standard deviation, and all quantiles.

Table 6.6: Mean, SD, and quantiles of duration times for every condition.

	Mean	SD	Q0%	Q25%	Median	Q75%	Q100%
Percentage-Counter	27.35	35.64	4.00	7.24	13.45	29.45	241.74
Star-Rating	26.19	27.76	4.04	7.84	15.71	33.42	187.67
Call-to-action	23.00	30.17	4.12	6.23	11.42	26.61	179.88
Control	26.33	32.88	4.02	7.37	13.85	28.16	195.75

As the numbers indicate, the standard deviation is fairly high for every condition. In fact, for all conditions the standard deviation is higher than the actual mean. The indication of this is that the data might not be normally distributed. In fact, if you look at the quantiles, one can note two things. First, the median is approximately the half of the mean for every condition. This leads to the second note. The highest values (i.e. 100% centile) are relatively high, and the means are relatively close to the 75% centile. That means that around 75% of the duration stays are below the mean (and just 25% are above it). The indication of this that the data is not normally distributed. A look at the histogram of the data reveals that the data follows a logarithmic distribution (left Figure 6.3). An ANOVA on this data, therefore, cannot be applied. We will overcome this barrier by trying two things.

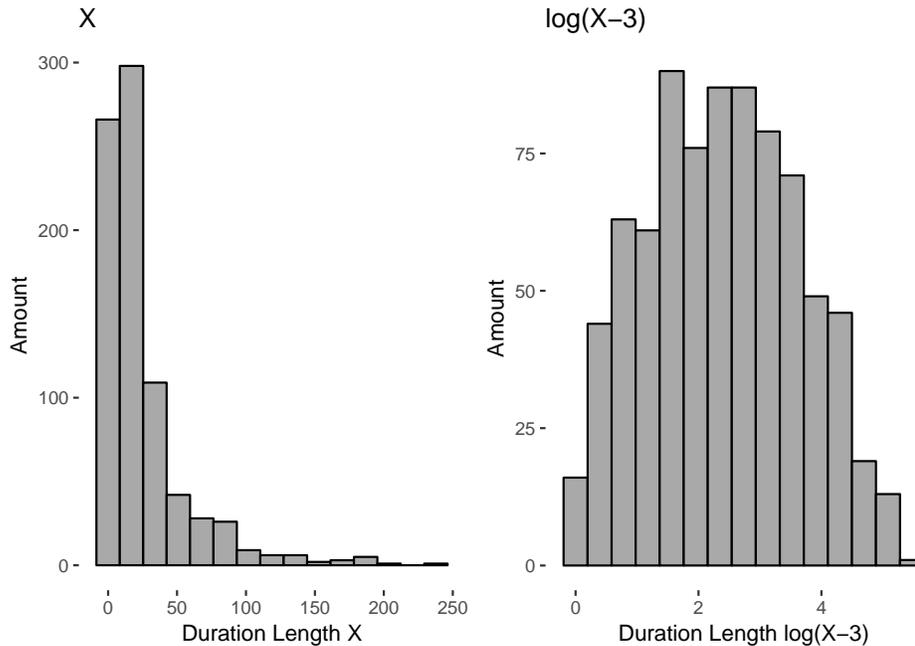


Figure 6.3: Distribution of Duration Length with Normal and Transformed Data

First, we transform our logarithmic distribution into a normal distribution. This is done with the help of the logarithmic function. The histogram of the transformed data can be found on the right Figure 6.3. Since the distribution looks like a normal distribution we can apply an ANOVA. The results for the ANOVA can be found in Table 6.7. As the table reveals the ANOVA is not significant, $F(3, 798) = 1.8611$, $p = 0.1347$.

Table 6.7: Anova on the impact of the choice of condition on the length of duration.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Condition	3	8.5207	2.8402	1.8611	0.1347
Residuals	798	1217.8488	1.5261		

Second, we can apply a non-parametric test. The Kruskal-Wallis test is the non-parametric pendant to a one-way ANOVA. The test shows no statistic significance as well, $\chi^2(3) = 6.2197$, $p = 0.1014$.

6.6 Anxiety Level for each Condition

In this section we try to answer the question whether the choice of condition does have an impact on the anxiety levels of passersby. As explained in my Psychology Bachelor's thesis, SPIN18 was our first approach to measure those levels of anxiety. After an exploratory factor analysis we came up with a new, improved factor called FACTOR1I. This factor analysis was necessary because the original SPIN might contain items that are not related to public display use. By extracting different factors, we identified a certain group of items that loaded highly on one factor, and indicated that public display use is correlated with social anxiety. The selected items of FACTOR1I were items 3,4,8,9,10 (cf. Appendix).

For both SPIN18 and FACTOR1I we summed up the item's values for every participant. SPIN18_SCORE and FACTOR1I_SCORE offer one numeric value that indicates the level of social anxiety for every participant. We will use those in the following to run a variance analysis. Before that, one can find the mean and the SD for both SPIN18_SCORE and FACTOR1I_SCORE in Table 6.8 and Table 6.9 respectively. Since the item number is lower in FACTOR1I, the mean of FACTOR1I_SCORE is lower, too, in comparison to the SPIN18_SCORE.

Table 6.8: Mean and SD of SPIN18_SCORE for every condition.

	Mean SPIN18_SCORE	SD SPIN18_SCORE
Percentage-Counter	17.29	7.85
Star-Rating	27.14	12.81
Call-to-action	19.60	8.14
Control	15.50	3.11

As the tables show the Star-Rating seems to have the highest mean anxiety scores for both SPIN18_SCORE and FACTOR1I_SCORE. In other words, the Star-Rating is most successful in drawing in higher anxious persons. However, the standard deviation is also higher for the Star-Rating in both SPIN18_SCORE and FACTOR1I_SCORE. This might be because of low numbers in data points. Since it only makes sense to investigate the anxiety scores of people that at least approached the display (because otherwise they are not under the influence of the display's engagement power), we had to exclude the people that stopped, and just walked by. That is why the total amount of participants decreased from 31 to 23. In the control group, for example, are just four data points available. That is why the following analysis of variance has to be taken with a grain of salt.

Table 6.9: Mean and SD of FACTOR1I_SCORE for every condition.

	Mean FACTOR1I_SCORE	SD FACTOR1I_SCORE
Percentage-Counter	5.43	3.26
Star-Rating	9.29	4.19
Call-to-action	3.80	2.95
Control	3.00	3.56

First, we run an one-way ANOVA with the choice of the condition as a factor and the numeric variable SPIN18_SCORE. The results for the ANOVA can be found in Table 6.10. As the table reveals the ANOVA is not significant, $F(3, 19) = 1.8643$, $p = 0.1699$. This means that the choice of condition does not have an impact on mean values of SPIN18_SCORE.

Table 6.10: Anova on the impact of the choice of condition on SPIN18_SCORE

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Condition	3	485.2534	161.7511	1.8643	0.1699
Residuals	19	1648.4857	86.7624		

Second, we run an one-way ANOVA with the choice of the condition as a factor and the numeric variable FACTOR1I_SCORE. The results for the ANOVA can be found in Table 6.11. As the table reveals the ANOVA is significant, $F(3, 19) = 3.5957$, $p = 0.0327$. This means that the choice of condition does have an impact on mean values of FACTOR1I_SCORE.

Table 6.11: Anova on the impact of the choice of condition on FACTOR1I_SCORE

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Condition	3	137.3615	45.7872	3.5957	0.0327

Residuals	19	241.9429	12.7338
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Finally, it is interesting to know why the ANOVA was significant for FACTOR1I_SCORE as the dependent variable and the choice of condition as the independent variable. Therefore, we run three T-Tests in which we compare each of the experimental conditions with the control condition. The respective scores of FACTOR1I_SCORE are used for each condition. Again, it needs to be mentioned that the control condition offers only four data points.

6.6.1 Percentage-Counter

In this section we try to find out whether the choice of condition (i.e. being in the Percentage-Counter condition or the Control condition) does have an impact on the FACTOR1I scores of the people that touched the display in the respective condition. The result of the T-Test is $t(5.89) = -1.1222$, $p = 0.3055$, which means that the difference in means is not statistically significant. Therefore, whether people were exposed to the Percentage-Counter condition or in the Control condition, does NOT have an impact on the FACTOR1I scores of the people that touched the display in the respective condition.

6.6.2 Star-Rating

In this section we try to find out whether the choice of condition (i.e. being in the Star-Rating condition or the Control condition) does have an impact on the FACTOR1I scores of the people that touched the display in the respective condition. The result of the T-Test is $t(7.34) = -2.6382$, $p = 0.0321$, which means that the difference in means is statistically significant. Therefore, whether people were exposed to the Star-Rating condition or in the Control condition, does have an impact on the FACTOR1I scores of the people that touched the display in the respective condition.

6.6.3 Call-to-action

In this section we try to find out whether the choice of condition (i.e. being in the Call-to-action condition or the Control condition) does have an impact on the FACTOR1I scores of the people that touched the display in the respective condition. The result of the T-Test is $t(5.87) = 0.3612$, $p = 0.7306$, which means that the difference in means is not statistically significant. Therefore, whether people were exposed to the Call-to-action condition or in the Control condition, does NOT have an impact on the FACTOR1I scores of the people that touched the display in the respective condition.

Chapter 7

Discussion

In the beginning, the results of this study are discussed with reference to the hypotheses that were introduced in Chapter 3. Afterwards, we discuss the efficacy of the Bandwagon Effect by comparing the implicit Percentage-Counter and the explicit Star-Rating condition with the control group and the Call-to-action condition. Consequently, we describe the need for socially-safe interaction. Last but not least, we discuss the limitations of this study as well as future research.

7.1 Hypotheses' Review

7.1.1 Hypothesis 1

Hypothesis 1: Both the implicit Percentage-Counter as well as the explicit Star-Rating will cause more people to touch the display in comparison to the Control condition.

The chi-squared test revealed a statistically significant difference in frequency distributions for the explicit Star-Rating and the Control condition, but not for the implicit Percentage-Counter. The non-significant result of the test of the implicit Percentage-Counter and the control group is $\chi^2(1) = 3.6908$, $p = 0.0547$. The significant result of the test of the explicit Star-Rating and the Control condition is $\chi^2(1) = 7.6874$, $p = 0.0056$. The first hypothesis, therefore, is only partly supported. Only the explicit Star-Rating caused more people to touch the display.

7.1.2 Hypothesis 2

Hypothesis 2: The explicit Star-Rating will cause more people to touch the display in comparison to the implicit Percentage-Counter condition.

The results that partly supported hypothesis 1 can be used to support hypothesis 2. While the explicit Star-Rating was able to cause more people to touch the display, this is not true for the implicit Percentage-Counter. That is why it seems that the explicit Star-Rating seems to be the better approach in causing people to touch a public

display. This might be because the Engagement Power of the explicit Star-Rating seems to be higher than for the implicit Percentage-Counter. In comparison to the Control condition, the explicit Star-Rating was able to transfer significantly more people from the state of being intrigued to the state of touching the display ($\chi^2(1) = 4.3386$, $p = 0.0373$). The implicit Percentage-Counter was not able to do that ($\chi^2(1) = 3.4459$, $p = 0.0634$). This implies that the explicit Star-Rating's higher engagement power has finally caused more people to touch the display. All in all, this hypothesis, therefore, is supported by our results.

7.1.3 Hypothesis 3

Hypothesis 3: The ratio of how many people passed by, stopped to look at (i.e. being intrigued), and touched the display is not different throughout our conditions. Those ratios will be independent from the total amount of interaction that we will register.

As mentioned in the Result section, without a throughout video analysis we are not going to be able to identify approaching behavior. That is why we focus on people that passed by, stopped to look at, and touched the display.

This hypothesis has to be rejected. The explicit Star-Rating, for example, seems to have caused more people to touch the public display than the control group ($\chi^2(1) = 7.6874$, $p = 0.0056$) without increasing the number of people that stopped to look at the display ($\chi^2(1) = 2.7997$, $p = 0.0943$). That is why the ratios of how many people passed by, stopped to look, and touched the display was not similar for the explicit Star-Rating in comparison to the Control condition. Similar results can be found for the Call-to-action condition. All in all, the hypothesis has to be rejected with the results given.

7.1.4 Hypothesis 4

Hypothesis 4: People are much more likely to touch the display in the Call-to-action condition than in the Control condition.

We found that more people seem to touch the display in the Call-to-action condition than in the Control condition, $\chi^2(1) = 5.5191$, $p = 0.0188$. The hypothesis, therefore, can be supported.

7.1.5 Hypothesis 5

Hypothesis 5: Anxious people are more likely to touch the display in the experimental conditions in comparison to the Control condition. In other words, the SPIN score for people interacting with the display in the experimental conditions is higher than in the Control condition.

The one-way ANOVA with the FACTOR1I_SCORE as the dependent variable and the choice of condition as the independent variable revealed that there is a difference

in mean anxiety scores between conditions, $F(3, 19) = 3.5957$, $p = 0.0327$. This implies that there seems to be a difference in means of anxiety scores between the experimental conditions and the Control condition. However, there is only a significant mean difference between the Star-Rating and the Control condition, $t(7.34) = -2.6382$, $p = 0.0321$. The tests for the Percentage-Counter and the Call-to-action condition showed non-significant results, $t(5.89) = -1.1222$, $p = 0.3055$ and $t(5.87) = 0.3612$, $p = 0.7306$. That is why the hypothesis can only be partly supported. Only the Star-Rating is able to cause higher anxious participants (i.e. people with higher FACTOR1I scores) to touch the display than the Control condition.

7.2 Effects of Interfaces That Implemented Bandwagon Effect

In this section, the impact that each Bandwagon Effect condition (i.e. implicit Percentage-Counter and explicit Star-Rating) has on interaction behavior of users.

7.2.1 Implicit Percentage-Counter

The implicit Percentage-Counter seems to not be an effective way to cause people to interact with a public display. As the results have shown, the Percentage-Counter is not able to draw in a significantly higher number of people to touch the display than the interface in the Control condition. Additionally, the Percentage-Counter fails to be more attractive than the Control condition (i.e. same Attraction Power). This means that the Percentage-Counter is not able to intrigue significantly more people than the Control condition. Furthermore, the Percentage-Counter fails to cause more already intrigued people to touch the display (i.e. same Engagement Power). Last but not least, the Percentage-Counter is neither able to hold people longer in front of the display than the Control condition, nor is it able to draw in higher anxious people.

7.2.2 Explicit Star-Rating

The explicit Star-Rating seems to be our most promising interface condition. As the results have shown, the Star-Rating is able to draw in a significantly higher number of people to touch the display than the Control condition. On one side, the Star-Rating fails to be more attractive (i.e. same Attraction Power) than the Control condition. This means that the Star-Rating is not able to intrigue significantly more people than the Control condition. On the other side, however, the Star-Rating is able to cause more, already intrigued people to touch the display (i.e. higher Engagement Power). However, the Star-Rating is not able to hold people longer in front of the display than the Control condition. Last but not least, it is able to draw in higher anxious people than the Control condition. This means that higher anxious people (i.e. people with higher anxiety scores measured by FACTOR1I) were more likely to touch this interface in this condition than in the Control condition.

7.3 The Snob-Effect

As shown above, we could find support for hypothesis 2 (i.e. the explicit Star-Rating is more efficient than the implicit Percentage-Counter). Those findings that explicit recommendation systems seem to be more efficient than implicit ones are congruent with past research (eg. (Fu & Sim, 2011; Knobloch-Westerwick et al., 2005)). According to Leibenstein (1950), this might be the case because the Snob Effect works against the Bandwagon Effect in implicit recommendation systems, and mitigates its' effects. Indeed two participants of our survey (N = 31) stated in an open-answer question that they did not touch the display because they had not wanted to be “part of the 74.6% of the people that touched the display”. By not touching the display, those individuals were exclusive against the majority group of people that touched the display. These workings can be seen as effects by the Snob Effect. Since we have not found any indication of the Snob Effect in our explicit Star-Rating, the Snob Effect might be the cause why the explicit Star-Rating was more successful than the implicit Percentage-Counter.

7.4 Efficacy of the Bandwagon-Effect

As shown above, the implicit Percentage-Counter was not successful to cause more people to interact with our display. On the other side, however, the explicit Star-Rating was successful. That is why we will focus the following discussion on the Bandwagon Effect implemented by the explicit Star-Rating.

In order to understand the effects of the Bandwagon Effect, there is a need to look at reference pointers that allow you to compare the efficacy of your interfaces with already established ones. The Call-to-action condition is such a reference pointer. Those Call-to-actions, such as the one we used in our interface, have shown to be effective in communicating affordances of the display to users, and in increasing overall interaction with the display (Coenen et al., 2017). Therefore, we look at the results of the Call-to-action condition and compare those results to the explicit Star-Rating condition.

The Call-to-action interface won similar results to the explicit Star-Rating. As the Star-Rating, it caused more people to touch the display than the Control condition. Similarly, it had higher Engagement Power, and the same Attraction Power in comparison to the Control condition. The Call-to-action condition was not able to hold people longer in front of the display than the Control condition. The main and only difference between the Call-to-action condition and the explicit Star-Rating, was, however, that the explicit Star-Rating was able to draw in more anxious people than the Control condition while the Call-to-action condition was not able to do so. Nevertheless, both conditions seemed to be equally successful in causing people to touch a public display. That is why the question shifts from “What condition is superior to the other?” to “How does each condition cause participants to touch a display?”.

7.4.1 Call-to-actions' efficacy

As mentioned above, the Call-to-action condition is efficient in communicating display affordances to the user. Therefore, users are better able to understand what they are able to do with the display. This fact finally translates into more people interacting with the display. The effectiveness of Call-to-actions signs, therefore, lies in the clear communication of the display's affordances.

Contrary to the original assumption, the Call-to-action condition seemed to not be able to draw in higher anxious people. This observation opposes our original thought because we expected that less ambiguity in our display would leave less room for misunderstandings and thus social embarrassment. However, this was not what we found. The mean anxiety level for our condition was about the same (i.e. a T-Test found no difference in means) for the Call-to-action condition ($m = 3.80$) and the Control condition ($m = 3.00$). We still argue that part of the Call-to-actions' success lies in the lowered ambiguity that it causes. That means by clearly communicating what users are able to do (eg. calling users to touch the display) there is smaller room for misinterpretation. However, the lowered ambiguity did not seem to cause more higher anxious people to touch the display.

7.4.2 Explicit Star-Ratings' Efficacy

As indicated above, a reason for the explicit Star-Rating conditions' success lies in the ability to draw in higher anxious people. That means that the user group of this interface, while larger than other condition user groups, also encompassed a higher proportion of anxious people. To conclude that the Star-Rating is successful in mitigating the fear of social embarrassment by leveraging the Bandwagon Effect is, however, not appropriate yet. There are two key questions that need to be answered first.

Does the Star-Rating Leverage the Bandwagon Effect?

The first question is whether the Star-Rating is actually leveraging the Bandwagon Effect. In other words, can the success of the explicit Star-Rating condition be explained by the Bandwagon Effect? Or are there other effects that have not been taken into account?

One of those effects might be the visual appearance of the display. As it can be seen in Figure 4.9, the Star-Rating is the most colorful interface, and offers the most additional shapes (eg. stars). The hypothesis at this point is that the more colorful, visual appealing interface might have caused more (higher anxious) people to interact with the display. However, this hypothesis can be overthrown. Even though the Star-Rating is the most visual appealing interface, its Attraction Power was not significantly higher than the Control condition, $\chi^2(1) = 2.7997$, $p = 0.0943$. That means that the Star-Rating was not able to intrigue more people than other display conditions. In other words, the success of the Star-Rating does not seem to be built on the visual appearance of the interface.

Another effect might be the additional affordance of rating the display itself. While all the other conditions only indicate that the display is interactive and can be touched, the Star-Rating indicates that something (i.e. the UWaterloo Community) can be rated on by users. This additional affordance might have caused some people to touch the display. We argue, however, this would not explain why the explicit Star-Rating was successful in drawing in higher anxious people than the Control condition. Nevertheless, we cannot exclude that the success of the Star-Rating was (partly) caused by the extra affordance of the condition to rate the interface. Further research is needed here.

Does the Bandwagon Effect Mitigate the Fear of Social Embarrassment?

The explicit Star-Rating seemed to cause more people with higher, social anxiety scores to touch the display than the interface in the Control condition. The hard question to answer, however, is if it is the Bandwagon Effect that caused this phenomenon. The original idea that we had was that the Bandwagon Effect causes an incentive for people to touch the display because other people have done so, too. Additionally, it might be interesting to people to join the group that interacted with the display before. By doing so, they would jump on the bandwagon.

From our point of view, it is difficult to show that the Bandwagon Effect mitigated the fear of social embarrassment. None of our survey's participants that were exposed to the explicit Star-Rating indicated that they interacted with the display because other people have done so before. Additionally, nobody stated in the open-answer part of the survey that the knowledge that others already interacted with the display caused them to feel less anxious about the display.

Nevertheless, there are no other differences between the condition's interfaces that have not been discussed yet. By ruling out all possible alternative explanations, the Bandwagon Effect is the only remaining cause that might be able to explain why the explicit Star-Rating was able to attract higher anxious people than the Control condition, $t(7.34) = -2.6382$, $p = 0.0321$. In addition to that, the Percentage-Counter also showed an increased mean in anxiety scores ($m = 5.43$) in comparison to the control group ($m = 3.00$). This difference in means was not significant though, $t(5.89) = -1.1222$, $p = 0.3055$, but it indicates that the Bandwagon Effect that we implemented as different forms in both the implicit Percentage-Counter as well as the explicit Star-Rating helps mitigate the fear of social embarrassment in users in public display usage.

Finally, there is further research needed here. The findings on the anxiety scores are based on a low number of participants ($N = 23$). It will be interesting to see if similar implementations of the Bandwagon Effect are able to create the same results as we found.

7.5 The Need for Socially-Safe Interaction

After a thorough literature analysis and the design and elaboration of this study, we would like to introduce the concept of socially-safe interaction. What we mean by this concept is that interaction with a public display (and other public devices, too) needs to include low potential for social embarrassment (or other forms of social punishments and negative feelings) in order to be socially-safe. The more socially-safe an interaction is, the less potential for social embarrassment exists, and the more people will interact with the system.

A key question is what interaction can be considered socially-safe. A good example can be taken from Coenen et al. (2017). They showed that different interaction modalities (eg. waving hands, or standing on certain positions) were related to different amounts of interactions. They found that higher attention-seeking interaction modalities caused less people to interact with the display. In other words, interaction modalities that do not seek a lot of attention can be considered more socially-safe. For example, standing on certain physical positions (i.e. on interactive floor mats) is more socially-safe than waving hands, because waving hands causes more attention.

Socially-safe, however, does not only refer to the interaction modality. The content of the public display is also relevant. If it offers clear affordances, displays are socially-safer and, therefore, overall interaction will be higher (cf. (Coenen et al., 2017)). That would explain the appealing of Call-to-action signs, because they reduce situational ambiguity.

Even though we found much support for the need of socially-safe interaction, interaction that is ambiguous (and therefore less socially-safe) might be appealing to very curious people (eg. children or engineering students). This might be because curious people might get interested in things that are unknown or ambiguous to them. That is why such an ambiguous display might attract more curious people than displays with very clearly defined affordances. As seen in our study, the general amount of interaction with the display was high in comparison to other studies. The reason for this increased amount of interaction can be found in the fact that the study was run on mostly engineering students who almost all have used public displays before.

Due to different characteristics of different user groups, we think designers should spend thought into the question of what user groups they are going to deploy the system to. For some user groups, some ambiguity might be interesting. For most user groups, however, we argue that the more socially-safe the display is, the more interaction will be seen between people and the display.

7.6 Limitations

The first and biggest limitation of our study is the low number of participants that filled out the survey. That is why all the findings on anxiety scores have to be seen with skepticism. This is particularly true when we compare the mean anxiety scores to each other for every interface condition. Unfortunately, there were just four participants

that interacted with the display in the Control condition. In future research, it will be interesting to see if our findings can be replicated.

The second limitation is our very homogeneous population that we deployed our display to. As described above, most of the participants were male, between 18-24 years old, engineering students, and have used a public display before. It will be interesting to see if other, more mixed populations would react differently in comparison to our population. Nevertheless, this limitation is not necessarily bad because engineering students might be more curious about and definitively more familiar with different kinds of technology than the average population. Still being able to find some effects on this population might just be the tip of the iceberg. While we were able to show some of the effects of social concerns, the impact of those on a more general population might be even bigger, but yet unknown.

The third limitation is our physical display itself. It is placed on a mobile, handy scaffold that makes it movable. This handiness comes for a price - the physical device really stands out and seeks attention. That is why we expect that most of the participants have seen the display. At least all participants of our survey stated that they have seen the display. This fact should not limit us in our interpretation on the effect and overcoming of the fear of social embarrassment. However, we cannot make any comments on public display blindness.

Another limitation of our study are the fake numbers that we used in the implicit Percentage-Counter and in the explicit Star-Rating. Even though we tried to build up an argument why we should pick those numbers, we did not test them. Participants might have reacted differently if they had been exposed to different numbers. In particular, participants that were exposed to the implicit Percentage-Counter might have reacted differently if they had been exposed to a lower number. This might be true because a lower number might cause less snobs to avoid the displays.

The fifth limitation of our study is the deception that we used in our experiment. The fake numbers that we used in our implicit Percentage-Counter as well as our explicit Star-Rating were both fixed (i.e. they did not change any time) and invented (the real numbers of the amount of interaction is much lower). Participants might have found out that the numbers were not real, got annoyed by it, and told their fellow students. In any case, this deception might actually have scared people to interact with public displays in the future, because they got deceived. We argue, however, that this deception was a necessary step in order to test our experimental conditions.

7.7 Future Research

Future research should tackle the limitations of this study. A study with a bigger sample size, a heterogeneous population, and a display that is integrated into its surrounding is valuable to validate the results of this study. Furthermore, it might be interesting to test real, dynamic numbers for both the implicit Percentage-Counter and the explicit Star-Rating.

Apart from improvements that compensate the limitation of this study, it is interesting to see what happens if elements of our interfaces are combined into one.

An interface that contains a Star-Rating, a Percentage-Counter and Call-to-action signs might be interesting to test, and even be able to outperform all of our current interfaces.

Furthermore, the Bandwagon Effect should be investigated more rigorously. Interesting research topics to ponder are other ways to implement the Bandwagon Effect in display interfaces, to investigate the effect strength of the Bandwagon Effect on social concerns, and how both the implicit Percentage-Counter as well as the explicit Star-Rating can be improved.

Last but not least, it would be valuable to come up with a classification system that classifies interaction modalities, display elements, and display characteristics (such as display type and position) according to their “social safety”. Such a catalog would help designers to develop public display systems that as many people as possible interact with. By doing so, both money and time does not need to be wasted on public deployments that nobody interacts with, because they demand users to expose themselves to a high risk of social embarrassment.

Conclusion

Public displays are under-used, and far below their potential in user reach. One cause for this under-use might be social concerns such as the fear of social embarrassment that hinder passersby from becoming active, and engaging with the display. To overcome this issue we thought of potential design options, and finally introduced the bandwagon effect. It describes the tendency of an individual to buy more of a certain good if other people have done so before. We thought that the bandwagon effect might help in overcoming the fear of social embarrassment because people realize that people have interacted with the display before. This would take away their concerns as well as making them wanting to join the group of people that interacted with the display.

From a design perspective, however, it was challenging to implement the bandwagon effect into an interface design. A way that we chose to go was the implementation as explicit and implicit recommendation systems that indicate that people have used this display before. That is why we came up with the implicit Percentage-Counter, and the explicit Star-Rating. In addition to that we designed a Call-to-action and a Control condition in order to test and relativise the success of the bandwagon.

Throughout four days in which we deployed each of our four conditions for one hour on a public display in an university building of the University of Waterloo, we gained valuable data. While people were passing by the system they might see, stop to look, approach, or touch the system. We passively observed the coordination of the experiment and video recorded it for further video analysis. Additionally, the Microsoft kinect tracked the amount of users that passed by the display. Last but not least, we asked selected passersby to fill out a survey that we designed that asks them how they interacted with the display, and their level of social anxiety. This anxiety level was measured by the SPIN.

The results supported the hypothesis that the bandwagon effect helps to mitigate the fear of social embarrassment. On one side, the explicit Star-Rating condition showed most success by causing more people to touch the display than the Control condition. This might be caused by its higher Engagement Power as well as the ability to draw in higher anxious people. On the other side, the implicit Percentage-Counter was not an effective way to implement the bandwagon effect. It did not cause more people to interact with the display.

When comparing the Call-to-action condition and the explicit Star-Rating, one can realize that both display conditions were able to cause more people to interact with the display than in the Control condition. Furthermore, they showed similar

Engagement Power. Nevertheless, the explicit Star-Rating was able to draw in more people with higher social anxiety scores.

Furthermore, we call for socially-safe interactions that make people comfortable to interact with public displays. Last but not least, we discussed the limitations of this study, and discussed (design) option to overcome them.

Appendix A

Survey

Research Study Participation Invitation

Title of Project:

Investigating Attraction of Animation on Large Displays in a Public Setting

Student Investigators:

Marvin Pafla, BCS, University of Konstanz in Germany
(Exchange student at University of Guelph)
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Faculty Supervisor:

Dr. Stacey Scott,
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Summary of the Project:

Large interactive displays capable of delivering dynamic content to broad audiences are becoming increasingly common in public areas for information dissemination, advertising, and entertainment purposes. A major design challenge for these systems is to entice and engage people passing by the display to interact with the system. This project aims to investigate the effectiveness of different interfaces to attract people's attention and engage them in interactions with public large displays. To better understand the different visual designs being tested during our field study, we will gather feedback in the form of a short survey completed by people who have passed by and/or engaged with the display and ask about their experiences viewing or using the display. In particular, we are interested in finding out if people are socially inhibited to use a public display. That is why we ask people to fill out the Social Phobia Inventory (SPIN) in order to evaluate their levels of social anxiety in public places.

Procedure:

Your participation in this study will involve completing an electronic survey on the provided digital tablet regarding your interaction with the display.

Completing the survey will take approximately 5 minutes.

You may decline to answer questions if you wish. **You may withdraw your participation at any time without penalty by advising one of the student investigators.**

You must be 18 years old or older to participate in this study.

Risks, Benefits, and Remuneration:

There are no known or anticipated risks from participation in this study. Also, there are no direct benefits to you for participating in this research. However, the results of this research may contribute to the knowledge base of Human Computer Interaction research and to lead to the development of improved usability and effectiveness of future interactive large displays deployed in public settings.

In the appreciation of the time you have given to this study, you will receive a \$5 on-campus retail vendor gift card. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Confidentiality and Data Security:

All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study; however, with your permission anonymous quotations from any free-form textual answers you provided may be used. In these cases participants will be referred to as Participant 1, Participant 2, ... (or P1, P2, ...). Data collected during this study will be retained for a minimum of five years in locked drawers or on password protected computers in a secure location accessible only to researchers associated with this project. Electronic data will be de-identified before being stored. Survey data collection will be conducted using the SurveyMonkey® online survey tool (www.SurveyMonkey.com)

You will be explicitly asked for consent for the use of your survey responses for the purpose of reporting the study's findings. If consent is granted, these data will be used only for the purposes associated with teaching, scientific presentations, publications, and/or sharing with other researchers and **you will not be identified by name.**

Contact Information and Research Ethics Clearance

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 20740). However, the final decision to participate is yours. Should you have any questions for the Committee please contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions or if you would like additional information to assist you in reaching a decision about participation, please ask one of the student investigators now. Also you may contact one of my supervisors, Prof. Stacey Scott, (Computer Science Dept. University of Guelph) email: stacey.scott@uoguelph.ca)

Thank you for your assistance in this project.

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

Project: Investigating Attraction of Animation on Large Displays in a Public Setting

I have read the information presented in the information letter about a study being conducted by Marvin Pafla conducted under the supervision of Professors Stacey Scott (Computer Science Dept. University of Guelph).

I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I may allow data from my completed survey to be included in presentations and publications related to this project, with the understanding that any quotations will be anonymous.

I am aware that I may withdraw my consent for any of the above statements or withdraw my study participation at any time without penalty by advising the researcher.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 20740). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact Marvin Pafla (mpafla@mail.uoguelph.ca), or Dr. Stacey Scott (stacey.scott@uoguelph.ca).

* 1. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Yes.

No.

* 2. I agree to let my survey responses during the study be directly quoted, anonymously, in presentation of the research results.

Yes.

No.

* 3. Did you see the large display in the hallway you just passed through?

Yes.

No.

4. Why do you think you did not see the display? (Select all answers that apply)

I don't know.

I was busy.

I didn't think it was interesting.

I was paying attention to something else.

I didn't want to embarrass myself.

Other (please specify)

5. What drew your attention to the display? (Select all answers that apply)

I saw someone using the display.

The colourfulness of visual content.

The "UWaterloo Community" title.

The physical display device.

Moving objects in the user interface.

Other (please specify)

* 6. Did you stop to look at the display?

- Yes.
- No.
- I slowed down.

7. Why didn't you stop? (Select all answers that apply)

- It didn't seem interesting.
- I was in a hurry.
- I felt uncomfortable stopping in the middle of the hallway.
- I don't know.
- I didn't want to embarrass myself.
- Other (please specify)

* 8. Did you approach the display?

- Yes.
- No.

9. Why didn't you approach the display? (Select all answers that apply)

- I was in a hurry.
- People were blocking the way.
- I didn't think it was interactive.
- I don't know.
- I didn't want to embarrass myself.
- Other (please specify)

* 10. Did you touch the display?

Yes.

No.

11. Why didn't you touch the display? (Select all answers that apply)

I wasn't interested anymore.

I didn't want to embarrass myself.

Other people blocked the way.

I wasn't sure what would happen.

I don't know.

Other (please specify)

* 12. Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem, and be sure to answer all items.

	Not at all.	A little bit.	Somewhat.	Very much.	Extremely.
I am afraid of people in authority	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am bothered by blushing in front of people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Parties and social events scare me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I avoid talking to people I don't know	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being criticized scares me a lot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 13. Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem, and be sure to answer all items.

	Not at all.	A little bit.	Somewhat.	Very much.	Extremely.
Fear of embarrassment causes me to avoid doing things or speaking to people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sweating in front of people causes me distress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I avoid going to parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I avoid activities in which I am the centre of attention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Talking to strangers scares me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 14. Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem, and be sure to answer all items.

	Not at all.	A little bit.	Somewhat.	Very much.	Extremely.
I avoid having to give speeches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would do anything to avoid being criticized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heart palpitations bother me when I am around people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am afraid of doing things when people might be watching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 15. Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem, and be sure to answer all items.

	Not at all.	A little bit.	Somewhat.	Very much.	Extremely.
Being embarrassed or looking stupid is among my worst fears	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I avoid speaking to anyone in authority	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trembling or shaking in front of others is distressing to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I fear to embarrass myself in front of public displays	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you a lot for participating. This survey will help our research. Please hand back the tablet.

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