What does an Augmented Reality menu bring to the table for a Dutch restaurant?

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Executive Summary

This study describes a first of its kind field experiment with a commercial Augmented Reality application. Augmented Reality (AR) is a technology that integrates 3D virtual objects into a real environment in real time (Azuma, 1997). Although AR has been around since the 1960's, the development of AR has not gained steam until 2009 – when large corporations started to invest in this technology. AR now has hundreds of millions of potential (or real) users of the technology (Moon, 2018; Mudrick, 2019) and is estimated to be a $75-$120 billion dollar market in 2023, with a potential to cannibalize the smartphone market (Digi-Capital, 2019). This anticipation and interested have been the reason for this study. Is AR really as impactful as it is said to be?

Surprisingly, researchers present a different picture of AR; Some wonder whether the benefits of AR are hedonic rather than functional (Javornik, 2016), while others are still wondering how the benefits of AR can be used to make value propositions (Ruyter et al. 2018). There is a gap in our understanding of how customers engage with AR applications and how this affects their behavior (Javornik, 2016; Flavian et al. 2019), and there is a striking lack of empirical studies, specifically ones that test AR applications in live environments (Yussof et al. 2019). This study is therefore positioned between these needs and aims to contribute to a better understanding of the impact of AR on user engagement and consumer behavior – supported with empirical evidence.

The objectives of this study then are threefold: First, to measure the effect of an AR application on orders placed by customers. Second, to see if this impact is mediated by user engagement and third, to be a first in testing an AR application in a live setting to provide empirical support for what has been studied in theory and lab studies before.

The live setting that was chosen for this study was a restaurant. Interestingly, restaurants engineer their menu to drive profitability and increase order value (Wansink et al. 2001). Recently, there have been studies in which AR applications were developed for restaurants, but only a single exploratory study focused on presenting the restaurant food. This study by Koui (2017) did not actually test the application in a restaurant. That is where this study comes in. Based on these findings, it was hypothesized that an AR restaurant menu application can be used to affect the customers' order value.

Other than order value, the aforementioned researchers wondered about the relationship between AR applications and user engagement. There have been studies that found an increase in order value, positive word-of-mouth and competitiveness when user engagement is increased (Chan et al. 2014, Kim and Baek, 2018). In this study, these elements are combined and the impact of AR applications on user

engagement and the consequent impact of order value is studied. The main research question then becomes: **How does an Augmented Reality application for restaurants affect user engagement, and how does this in turn affect the customer's order value?**

This research question was put to the test in a field experiment using an AR application developed for commercial usage in restaurants. Specifically, participants of the study were presented with virtual 3D models of the restaurant's dishes and allowed them to interact with these virtual dishes. This 3D presentation was used as the manipulation method in this study. The results of this manipulation were compared to a control group – participants that were presented the regular, paper menu from the restaurant that hosted this study – using randomization techniques to ensure internal validity of the experimental design. To make the field experiment work, the waiting staff were trained and provided with the necessary scripts. These scripts and the protocols used in this study allowed for minimal interference from the researcher – safeguarding external validity.

The strong suit of this study comes from the fact that user engagement and order value data was collected from real guests in a real restaurant. The user engagement data was operationalized using an adaptation of O'Brien et al. (2018)'s User Engagement Scale. The order value data and the user engagement data were then analyzed and compared in order to find the impact of AR on user engagement and order value.

The first impression from this data showed that participants found the AR menu to better represent the restaurant dishes and their portion size. Unfortunately, this did not translate into an increased order value or NPS score. Further analysis showed that Perceived Usability - a dimension of user engagement – did have a direct, positive impact on order value in the mediation model presented in this study. With these empirical findings, an initial bridge is formed between user engagement theory and the impact of AR applications. For businesses, the findings suggest that AR applications need to solve a real problem and be used in an environment where they are more likely to provide value. For restaurants, this could be quick-service and midscale restaurants, restaurants that make use of transliterated or foreign menu items. The AR menu could potentially work better when used as part of a seamless experience in which customers place their order and pay digitally – but this has to be investigated in follow-up research.

Follow-up studies could also help tackle the limitations of this study, by increasing sample size and sample diversity. Future studies can explore the different facets of this study in other restaurant and businesses types. What intrigues me is the potential to use AR menu applications with data analytics to investigate human food behavior. A dish that is viewed more often, repeatedly turned a certain way or spent more time on compared to other dishes is interesting and insightful for both businesses and researchers.

Preface

This has been a long journey. So long in fact, that is seems like I am a different person than the person who wrote the initial proposal for this study. This journey has humbled me. When I was younger, I never took people seriously when they talked about the mental strain and effort that is required to produce a study and report like this. I am now one of the them, and like them I have had immense support and help through the process.

I would like to express my gratitude to my professors. To Stephan and Laurens, whom have kept me sharp and helped me with planning and setting up the study smoothly. A special thank you to Laurens, who has mentored me throughout the process and removed all the pressure I managed to put on myself with every phone call and meeting. My gratitude also goes out to my other professors of the MoT programme. In this study, everything I have learned about the management of technology, adoption of new technologies, innovation, project management and researching has been put to the test.

Thank you to Danny van Stiphout and the rest of the team at WaterWolf Brasserie Badhoevedorp. You have been incredibly welcoming and kind – even though the research ended up being longer than expected. Thank you for bearing with me. Your food is wonderful as well, so I hope anyone reading this will know where to go next.

Thank you Khalid Boukdid, my FoodStory Co-Founder and friend. You have invested a ton in me and my development. Without you, this study would not have been possible. There have been tough times and you were always ready to help. I will never forget that.

Thank you to the friends that kept asking how it was going and offered mental support. I may not have mentioned you by name, but you know this is for you. Thank you.

A big thanks to my family. You are a big part of why I do this. I have always seen this as one of those steps you have to take. One of those things you have to cross off your list. I recognize how valuable my success is to you and that is probably why I have managed to see it through to the end. My dear mother and father, you have been so patient with me. We are finally here, mama.

Most importantly, I want to express my gratitude to my Maker. Sustainer of everything in existence and the only one I could share with what I cannot share with others. My prayer is what kept me sane through the dark days. Alhamdulillah.

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1. Introduction

In the 1960's a new technology was introduced: Augmented Reality (AR) (Sutherland, 1965; 1968). This technology integrates 3D virtual objects into a real environment in real time (Azuma, 1997). Its development happened mainly in research and niche contexts (Arth et al. 2015), and even the term Augmented Reality was not used until 1992 (Caudell and Mizell, 1992). From 2009 onwards however, large corporations started to invest in this technology. Augmented Reality is now available on at least a quarter of all smartphones, which according to estimations is approximately in the hundreds of millions of potential (or real) users of the technology (Moon, 2018; Mudrick, 2019).

Some parties expect Augmented Reality to be a $75-$120 billion dollar market in 2023, with a potential to cannibalize the smartphone market (Tech Pro Research, 2016; TechRepublic, 2016; Digi-Capital, 2019). According to Gartner's 2018 Hype Cycle for Emerging Technologies (Panetta, 2018), Augmented Reality is currently past the peak of inflated expectations that come along with emerging technologies and five to ten years away from mass adoption. These 'expert' forecasts show that Augmented Reality has a potential to become part of our daily lives (as smartphones are right now). This change of pace and the level of anticipation and interest in Augmented Reality have been the reason for this study. Is Augmented Reality as impactful as it is said to be? To formulate an answer to this question, first the concept of Augmented Reality should be properly defined.

1.1 What is Augmented Reality

To understand Augmented Reality, it helps to study the definition given by Milgram (Milgram and Kishino, 1994; Milgram et al. 1995). This definition is strongly supported (Azuma, 1997; Ullmer & Ishii, 2000; Bowman et al. 2004; Billinghurst et al. 2015). Milgram's definition helps to get an almost visual overview of what Augmented Reality is, which also avoids confusion with Virtual Reality.

Milgram (1995) says *"the commonly held view of a Virtual Reality ("virtuality") environment is one in which the participant observer is totally immersed in a completely synthetic world, which may or may not mimic the properties of a real-world environment, either existing or fictional, but which may also exceed the bounds of physical reality by creating a world in which the physical laws governing gravity, time and material properties no longer hold"* (Milgram, 1995 p.283).

This is in contrast with a real-world environment, which is constrained by the laws of physics. Using the laws-of-physics definition, Virtual Reality and Reality are opposites. Milgram says it is more convenient to view Virtual Reality and Reality as the opposite ends of a continuum, which is referred to as the Reality-Virtuality continuum. This continuum can be seen in Figure 1.1 below.

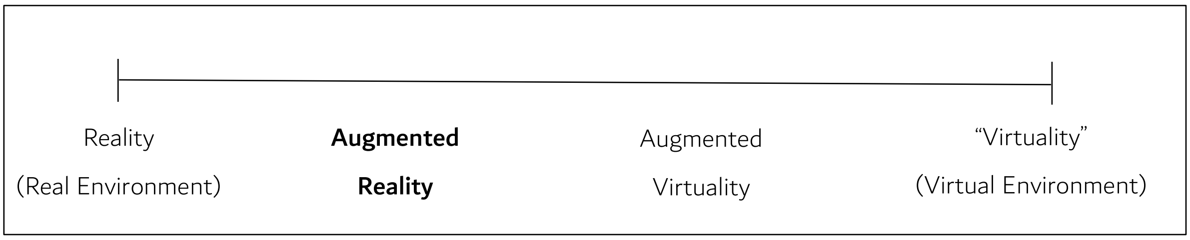

Figure 1.1. Milgram's Reality-Virtuality Continuum.

An example use of Virtual Reality is entertainment. Users can wear a Virtual Reality headset that blocks the real environment around them so they do not see it. Instead they are immersed in a 3D game or movie as if they were there. This means that what they see and hear is a virtual world in which it seems like they are there. They look around, move and what they see adjusts to the user movements so that it seems like they are in fact looking and moving around in the virtual world. 'Rise of the Tomb Raider VR' is a VR game in which you become the famous Lara Croft and go out exploring and solving puzzles and mysteries. Another example is 'Eagle Flight' in which you experience how it is to be an eagle and fly around hunting for prey in the city of Paris. You can even become Batman himself in 'Batman Arkham VR' (Oculus World, 2018).

Augmented Reality is closer to reality on the axis of Milgram's continuum. Augmented Reality is defined as reality - users look at the real environment - with added virtual information. Virtual information can be computer-generated, 3D imagery. For example, IKEA has developed an Augmented Reality application that lets their customers virtually place pieces of furniture in their room. Imagine that you are shopping for a new sofa. You open the IKEA app and select the sofa of your choice. The IKEA AR application "recognizes" the surface of your room and virtually places the sofa on it. When you look at your room through your smartphone, it seems like the sofa is actually in your room (IKEA, 2013).

1.2 Research gap and objectives

Augmented Reality has thus far been presented as a growing technology that is gaining momentum and is on its way to becoming mainstream in our daily lives. Gartner (Panetta, 2018) even places AR in a bracket of technologies now ready for 'productive' applications. On top of that, for AR to reach the estimated $75-$120 billion dollar market cap by 2023, it has to make sense for businesses to invest in the technology. This initial interest led to a search for research on AR applications that were already making an impact in the environment they were used in.

Surprisingly, at present researchers are mainly wondering whether the impact of AR on business is functional or more hedonic in nature (Javornik, 2016). Ruyter et al. wonder about the meaningful benefits of AR-based customer experience and how these benefits can be used to make value propositions (Ruyter et al. 2018). Researchers also mention that there is no solid understanding of how customers are engaged with Augmented Reality, how this affects their behavior (Javornik, 2016) and how AR can be used to drive customer behavior (Flavian et al. 2019). The first problem therefore is the ambiguity around the impact of Augmented Reality and how customers react to and engage with Augmented Reality applications.

Second, there is a striking lack of empirical studies, specifically studies that test Augmented Reality applications in live environments (Javornik, 2016). In a recent review by Yussof et al. (2019), only 22 papers were reviewed from between 2009 and 2018. Out of those again, only four were empirical studies related to Augmented Reality and a form of consumer engagement (Hopp and Gangadharbatla, 2016; Mauroner et al. 2016; Wang et al. 2015; Connolly et al. 2010). Each of these studies in turn (except for Wang et al.) also point to the limited body of empirical research.

It thus seems clear that there is a need for a better understanding of how Augmented Reality applications affect customer engagement and behavior. Also, it is totally unclear how Augmented Reality in turn affects the order a customer places with a business making use of the technology. This study is positioned between these two needs, and aims to contribute to a better understanding of the impact of Augmented Reality on user engagement and consumer behavior, supported with empirical evidence.

The main objectives of this study are then threefold. The main objective is to measure the effect of an Augmented Reality application on the order value of a customer, the second objective is to see if this impact is mediated by user engagement. The third objective is to be a first in testing an Augmented Reality application in a live setting to provide empirical support for what has been studied in theory and lab studies (experiment designs with findings based on reports from students or other invited participants; Javornik, 2016) before. This allows for capturing the context and external factors around the human interaction with the Augmented Reality technology, which are not captured in lab studies, and increases external validity (Rogers, 2012). A protocol is also supplied that can be used to set up follow-up studies to further close the empirical evidence gap.

1.3 Research focus

The domain of application that was chosen for the present study was that of restaurants. Interestingly, restaurants modify and engineer their menu to affect consumer behavior (Wansink et al. 2001; Shoemaker et al. 2005). Very recently, there have been studies in which Augmented Reality applications were developed for restaurants (Yuan, 2018; Shabani et al. 2019), but surprisingly, they did not focus on presenting restaurant dishes. A single study was found in which a menu application was developed, but that application was not actually tested in a restaurant (It was tested in an artificial laboratory setting;

Koui, 2017). Other than this obvious gap and the need to test an AR menu application in a real restaurant, there are a few more (logistical) benefits to this domain. A first important benefit in restaurants is the short feedback loop. The impact the menu manipulation has on the customer can be measured when the customer checks out and pays for their meal. Second, the dishes presented by the restaurant are small and compact and therefore easier to capture compared to larger sized, more complex objects (like IKEA furniture). Third, most people are familiar with food, which makes the restaurant environment one with a low entry barrier for the Augmented Reality technology.

1.4 Research questions

This study aims to research what impact using an Augmented Reality application has on the order value of a customer. When applied to the restaurant domain, the first research sub-question becomes:

A. How does an Augmented Reality menu application for restaurants affect the customer's order value?

This sub-question led to a research review on order value and how restaurant menus affect customer behavior. The answer to this question should give insight into the aforementioned question if AR has a hedonic or a functional impact (Javornik, 2016) and if this can be translated into a value proposition for businesses (Ruyter et al. 2018). An answer to this question can help in identifying if AR has a functional impact – and that restaurants could benefit from switching to an AR-based menu in their business.

B. How does an Augmented Reality application for restaurants affect user engagement?

This second sub-question led to a research review on user engagement, how it works and how it is measured. The aim of the second research question is to tackle the second ambiguity presented in Paragraph 1.2, which is the unclear understanding of how Augmented Reality affects customer or user engagement. In this study, the AR restaurant menu is used to manipulate participants in order to find out if there is a difference in user engagement.

There has been research on the relationship between user engagement and buying behavior, in that a higher level of user engagement leads to increased orders, positive word-of-mouth and increased competitiveness (Chan et al. 2014). When mobile applications are used to drive user engagement, a favorable attitude towards the brand and revenue growth are found (Kim and Baek, 2018). In this study, these two research sub-questions are combined to investigate the relationship between Augmented Reality, user engagement and order value. The main research question then becomes:

C. How does an Augmented Reality application for restaurants affect user engagement, and how does this in turn affect the customer's order value?

The last objective of this study is meant to tackle the gap in empirical evidence and to provide an example for future studies that are interested in researching the impact of AR in a restaurant or similar environments. This aim can also be presented as a research question.

D. How do you set up an experiment to test the impact of an Augmented Reality application in a restaurant?

This sub-question led to a research review and forms the basis of the experiment design for this study. The answer to this question is given in the form of a protocol that can be followed in future studies along with the information provided in the method section. A brief overview of the sub- and main research questions and their role in this study is presented in Table 1.1 below.

Table 1.1 – Research questions and the role they play in this study.

#	Research questions	Role in this study
A	How does an Augmented Reality menu application for restaurants affect the customer's order value?	Research study, data collection (receipts)
B	How does an Augmented Reality application for restaurants affect user engagement?	Research study, survey design + data collection
C	How does an Augmented Reality application for restaurants affect user engagement, and how does this in turn affect the customer's order value?	Main research question, mediation model analysis
D	How do you set up an experiment to test the impact of an Augmented Reality application in a restaurant?	Research study and field experiment design

1.5 Research method

The main and sub-research questions were put to the test in a field experiment using an AR application developed for commercial usage in the restaurant domain. Specifically, this AR menu application presented the participants with virtual 3D models of the restaurant's dishes and allowed them to interact with these dishes as if they were placed on the table. The engagement with these virtual dishes and this method of presentation was used as the manipulation method in this study. As a control for this field experiment, the participants' results were compared to results from participants that were presented the regular, paper restaurant menu – using the techniques of randomization to ensure internal validity of the experimental design (Sekaran and Bougie, 2016).

A restaurant was found that was willing to host the experiment. The dishes from this restaurant were digitally photographed, turned into realistic 3D models and uploaded into the AR application.

To make the field experiment work, the waiting staff then had to be trained and provided with the necessary scripts. Finally, data on user engagement and order value had to be collected, analyzed and compared in order to find the impact of AR on user engagement and consequently order value.

The strong suit of this study comes from the fact that the data collected in this study was collected from real restaurant guests in a real restaurant. The scripts and protocol used in this study allowed for minimal interference from the researcher. As a result, the external validity was safeguarded (Sekaran & Bougie, 2016).

1.6 Overview of thesis report

This thesis report starts with a literature review in Chapter 2. In this chapter, the three key components of this study are studied in detail, starting with a discussion on User Engagement, where it comes from, what it is and how it is measured. This is followed by Augmented Reality applications, a brief history on them and what has already been researched on Augmented Reality and user engagement. Finally, an overview is provided of the application domain: restaurants. Specifically, current and potential ways in which restaurant owners can better engineer their menus are discussed. The chapter concludes with what has been found in research when Augmented Reality applications are applied in the restaurant domain and the positioning of this study within that literature. In Chapter 3 the methods for this study are laid out and a description (supported with images) is given of the application developed and used in this study. The results of this study are reported in Chapter 4, and their scientific and practical relevance are discussed in Chapter 5. Chapter 5 also discusses the limitations of this study and ideas for future studies are shared. This study is concluded in Chapter 6.

2. Literature review

In this chapter a literature review is presented to answer the research question of this paper: How does an Augmented Reality application for restaurants affect user engagement, and how does this affect the customer's order value? This question consists of two parts, which is also how this chapter is organized. First, a brief review of Human-Computer Interaction (HCI) is given (user engagement is a branch of HCI), followed by a review of User Engagement literature. Third is a review of literature on the use of Augmented Reality applications to affect user engagement. The first part of this chapter is concluded with a hypothesis regarding the relationship between Augmented Reality applications and user engagement.

In the second part of this chapter, the second part of the research question is explored. A literature review is given on how pricing and specifically restaurant menus are engineered to improve the customer's order value. Next, literature is reviewed on how Augmented Reality applications are used in combination with food and in a restaurant setting. Finally, a second hypothesis is given regarding the relationship between Augmented Reality applications and order value and how user engagement plays a role in this relationship.

2.1 HCI, User Experience and User Engagement

Human-Computer Interaction (HCI) is a large field of academic research. HCI arose when technology like ATMs, personal computers and the internet were interacted with by everyday people that were not computer experts. Monk (1985) stated that the increased daily interactions with computer systems and other machines by non-experts led to an increased awareness that the design of these machines was critical for the machines to be accepted, used efficiently and sold to a greater number of people. HCI was an initiative of many scholars, most of them with a cognitive science background (Norman and Draper, 1986; Carroll, 2006).

Hewett et al. (1992) mention that there was no agreed upon definition back in 1992 due to the range of topics that HCI encompasses. As a working definition, they proposed that *"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."* (Hewett et al. 1992 p.5). This definition places an emphasis on the different parts of the design or 'computer' side of HCI (Hewett et al. are computer scientists).

Carroll (2006) (with a cognitive science background) mainly credits scholars from the field of Cognitive Science as the 'founders' of HCI and used the following definition: *"Human–computer interaction is an area of applied cognitive science and engineering design. It is concerned both with understanding how people make use of devices and systems that incorporate computation, and with designing new devices* *and systems that enhance human performance and experience."* (Carroll, 2006 p.1). Notice how the focus here is on human performance and experience, where the computer scientist definition just mentioned 'for human use'.

In later work, actual human-computer interaction became less important and the focus was turned towards *"the creation of intuitive, simple, transparent interaction designs which allow people to easily express themselves through various computationally enhanced tools and media"* (Bannon, 2011 p.17). According to Rogers (2012), the rapid pace of technological development made the HCI field burst. Challenges and problems that were once from other fields (like global poverty, food, religion) are now major research topics within HCI. Rogers et al. (2011) even considered renaming HCI into 'interaction design': *"designing interactive products to support the way people communicate and interact in their everyday and working lives."* (Rogers et al. 2011 p.9).

What all the above definitions have in common is an understanding of HCI as the study of relationships and interactions between humans and computers. Computers have to be designed to serve humans in their tasks and goals. Fischer (who has a user modeling background) sees this relationship as a collaboration between humans and computers, where collaboration means that *"two or more agents work together to achieve shared goals"* (Fischer, 2001 p.66; Terveen, 1995).

Fischer (2001) describes how initially HCI focused on interfaces (the computer side) to create more usable systems. Later, when interfaces were better understood, the focus shifted to the user. Enabling a user to fulfill an intended task is what makes an interface *useful* or *usable*.. According to Smith-Atakan *useful* means that the interface, system or technology supports user objectives. This means that the user can in fact achieve his tasks or goals. If the goal can be achieved in an easy and enjoyable manner then the interface is said to be *usable*. Smith also mentions a third term. A system is *accessible* if the full range of intended users are able to make use of the system to achieve their goals (Smith-Atakan, 2006).

User Experience

User experience is an expansion on the concept of usability referred to above (O'Brien and Toms, 2008; Filimowicz and Tzankova, 2018a). Researchers in the early days were of the opinion that aesthetics, pleasure and user emotions are as important as efficiency and effectiveness of a certain interaction (Tractinsky, 1997; Green and Jordan, 2003; Norman, 2004; Lavie and Tractinsky, 2004). Lavie and Tractinsky (2004) manipulated usability and aesthetic qualities of a design and found that users are willing to compromise in usability if they get a product that is more aesthetically appealing. Follow-up research found that also interactive metaphors (such as click animations) affect a user's judgement of the experience and override the experience caused by poor usability (Sutcliffe and Angeli, 2005; Hartmann et al. 2008).

User experience also encompasses fun and joy (Blythe et al. 2004). The entire life cycle of a product – from sales to setup to use, customer support and maintenance – can be 'experienced' (Thomas and Macredie, 2002). User experience has evolved towards domains where the traditional usability was initially not considered relevant. An example of this is gaming, where the experience is an end in itself and excitement and entertainment are the main goals. More definitions are found in other research for user experience (ISO, 1999; Law et al. 2009). What these definitions have in common is that user experience refers to a design concept in which products are more than functional. Instead, in the design of these products attention is given to interaction, context, emotion and aesthetics (Sutcliffe, 2009).

One aspect of user experience is *user engagement* . Sutcliffe (2009) claims that *user experience* should be reserved for the wider picture view of why people adopt and use a particular design over time (numerous sessions or even years). *User engagement* on the other hand is used when explaining how and why certain interfaces or interactive products attract people to use them in a single session. User engagement thus also describes how applications make interaction exciting and fun. The next paragraphs go further into detail.

User Engagement

Overbeeke et al. (2003) argue that - in a world full of choices and things that take away the attention of the user - user attention becomes an important resource. Designing an application that captures attention is only the first step. The attention has to be kept by engaging the user in order for the application to do its work (transfer information, upsell a customer on a website, convince a user to sign up for an event), User engagement can be critical for the proper functioning of businesses (Overbeeke et al. 2003).

Defining User Engagement

User engagement is a key concept in human-computer interaction that captures *"the quality of the user experience that emphasizes the positive aspects of the interaction, and in particular the phenomena associated with being captivated by technology"* (Attfield et al., 2011 p.1). A more specific definition is: *"Engagement is a quality of user experiences with technology that is characterized by challenge, aesthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest, and affect"* (O'Brien and Toms, 2008 p.949). According to O'Brien and Toms (2008), the theoretical underpinnings of user engagement lie in the combination of the following four theories.

- Flow theory, which states that when a user is in a 'flow' condition, they are involved in an activity to the point that everything else does not matter. This is because the activity is so enjoyable that people will do the activity for the sake of doing the activity (Csikszentmihalyi, 1990).

- Play theory, which describes how psychological and social needs are satisfied through physical activity (Rieber, 1996). Browsing, online decision making and increased satisfaction and frequency of use have been associated with play (Toms et al. 1998; Atkinson and Kydd, 1997).

- Aesthetic theory, which has been briefly touched upon in the previous section on User Experience, when Lavie and Tractinsky (2004) found that users compromise usability in return for more aesthetic appeal. Aesthetic experiences are intrinsically motivating, pleasurable and interesting (Jennings, 2000). An interface is 'aesthetic' when it conforms to design principles (e.g. balance, harmony, symmetry, proportion and unity) (Beardsley et al. 1982).

- Information interaction theory, which refers to the communication between a user and a computer interface (Shneiderman, 1997), and describes the process a user follows when interacting with information provided by an interface (Toms, 2002). Information interaction facilitates the other theories above, because it is the medium with which an aesthetic design is presented, or with which the user is brought into a state of flow or play (O'Brien and Toms, 2008).

Engaging interactions have elements from each of these theories. A practical example is when a user is shopping with an application. A captivating application that is easy and pleasurable to interact with, has a certain aesthetic appeal, and guides the user through the process will keep users' attention longer, where a non-captivating application might lead to users closing and deleting the application straight away (O'Brien and Toms, 2008).

Failing to engage the user leads to the user going elsewhere, meaning that the website, application of other interface fails to convert – especially when the competitor does have a more engaging application in place. The question that follows is how to design for and create engaging experiences. In order to know that, there has to be a way to measure and quantify user engagement.

Measuring User Engagement

User engagement can be measured using questionnaires or 'self-reporting'. Also interviews, behavioral observations (such as mouse clicks, scrolling behavior), neurophysiological sensors (that measure everything from heart rate to pupil dilation to blood flow) and environmental sensors (that measure interaction time, geographical location) or application-specific behaviors (like step count) are used to measure user engagement. (Attfield et al. 2011; Filimowicz and Tzankova, 2018b).

Researchers have tried to dive deeper into user engagement and have come up with factors that can be quantified to give an idea of the level of engagement the user has with the specific interface or application. Attfield et al. (2011) developed a self-report measure that captured engagement based on focused attention, positive affect, aesthetic appeal, endurability, novelty, richness, reputation and user context.

O'Brien and Toms (2008) have developed a similar User Engagement Scale (UES) with (partially) overlapping factors based on the four theories described above: Flow, Play, Aesthetic and Information Interaction. Based on experiments performed in multiple application areas, they came up with the following factors for User Engagement:

"Focused attention - feeling absorbed in the interaction and losing track of time.

Perceived usability - negative affect experienced as a result of the interaction and the degree of control and effort expended.

Aesthetic appeal - the attractiveness and visual appeal of the interface.

Endurability - the overall success of the interaction and users' willingness to recommend an application to others or engage with it in future.

Novelty - curiosity and interest in the interactive task

Felt involvement - the sense of being "drawn in" and having fun"

From this scale, a short form version was developed, in which the last three factors (endurability, novelty and felt involvement) were combined into a single "reward" factor. The final survey can be applied even in settings where there is not much time, or where filling in surveys can be experienced as a 'chore' (O'Brien et al. 2018).

User engagement is a branch of User experience and the more general domain of Human-Computer Interaction (HCI) research. User experience focuses on how the user experiences the computer interaction, and how the experience can be optimized. User engagement zooms into the issue how we engage with computer devices, and regard an interface as aesthetically appealing (conforms to design principles), physical (scrolling, tapping, moving), capturing attention and inducing a state of flow, and when the interface facilitates the interaction (for example, with an application that includes all these principles). These learnings helped to understand how engagement scales work, and the short-form User Engagement Scale was used to operationalize user engagement in this study.

2.2 Augmented Reality applications

This paragraph briefly discusses the history of Augmented Reality, followed by a review of literature that discusses how Augmented Reality applications were used to affect user engagement.

History of Augmented Reality

In 1965, Sutherland shared his vision for “The Ultimate Display” in a speech:

“If the task of the display is to serve as a looking-glass into the mathematical wonderland constructed in computer memory, it should serve as many senses as possible. So far as I know, no one seriously proposes computer displays of smell, or taste.” (Sutherland, 1965 p.1)

Between 1968 and 1992, the first tablet (1972), the first handheld phone (1973), laptop (1982) and smartphone (1992) were developed. Other enabling technologies that were developed are GPS (1993) and the camera phone (1997). It was only a matter of time before the technologies merged and became the first mobile phone with GPS (1999) and the first commercial camera phone by Sharp (2000) (Arth et al. 2015). The term “Augmented Reality” was not coined until 1992, when Caudell and Mizell (1992) tried to improve human-involved operations in aircraft manufacturing using a heads-up display, which seemed to reduce costs and improved efficiency (Caudell and Mizell, 1992).

Early ‘mobile’ Augmented Reality systems consisted of a handheld or head-mounted display that had to be tethered to a stronger, fixed workstation ((Fitzmaurice, 1993; Rekimoto and Nagao, 1995). The first mobile systems were similar - in that they were handhelds or head-mounted displays tethered to a stronger workstation – but had a mobile workstation, which was heavy and had to be carried around in a backpack (Feiner et al. 1997; Thomas et al. 1998).

In 1994, Milgram and Kishino presented their Reality-Virtuality Continuum which is now referred to as Milgram’s Continuum, to define Augmented or Virtual Reality (Milgram and Kishino, 1994; Milgram, 1995). Azuma (1997) presented the first survey on Augmented Reality literature and provided a definition in which Augmented Reality contains all of the following characteristics:

- It combines between real and virtual
- It is interactive in real time
- It is registered in 3D

According to this definition, an application that superimposes a 2D image or video (virtual object) on a real wall would not be considered Augmented Reality, because it would not have been registered in 3D. This definition of Azuma is also widely acknowledged in literature (Yuen et al. 2011; Lee, 2012; Billinghurst et al. 2015; Chen et al. 2016).

An important development was the introduction of *Simultaneous Localization and Mapping* (SLAM). SLAM-enabled AR applications use a single camera to 'map' the environment and remember the position of the camera (localization) in real-time. This removes the need for markers (Davison, 2003), and resulted 'markerless AR' research (Comport et al. 2003; Lee and Hollerer, 2007).

From 2009 onwards, development was driven by large companies that invested in (markerless) Augmented Reality technology, such as Microsoft with their Hololens (Savov, 2015), Apple with Metaio (Miller and Constine, 2015) and ARKit (Perez, 2018), Google with Google Glass (Goodrich et al. 2013), project Tango and ARCore (Kastrenakes, 2017), and Facebook with their two billion dollar acquisition of Oculus VR (Kovach, 2014) and their replication of Snapchat's AR filters and stories in the Facebook and Instagram apps (Ingram, 2017).

At present, mobile AR is available on a quarter of all smartphones (Mudrick, 2019), which according to some estimates could be around 500 million (Moon, 2018) to 900 million (Kohles, 2019) devices. In the consumer market, the most popular AR applications are games (25% of all downloads), followed by lifestyle (20%) and productivity apps (13%) (Mudrick, 2019). One of the most popular (and commercially successful) games on a global scale is Pokemon GO, which has crossed two billion dollars in in-app purchase revenue two years after release (Tassi, 2018). These trends and examples all show the importance of augmented reality for today's marketplace.

Augmented Reality and user engagement

The education sector is an interesting starting point to study the effect of Augmented Reality applications on user engagement. Hedberg et al. (2018) found that 45 out of 71 educational AR application papers reviewed from 2000-2017 report improved motivation and increased engagement. Bacca et al. (2014) reports that AR applications have been effective for improving learning performance, student motivation and student engagement.

Neal (2012) links AR applications to Flow theory (Csikszentmihalyi, 1990) and states that AR applications can bring the user in a flow state through ease of use, general usability and interface design. Being in a flow state is also associated with a positive perception of the experience and exploratory behavior, which may explain why most AR experience designers use the background or physical environment to provide emotional context (Neal, 2012). Similar observations have been made by Permadi and Rafi (2015).

Scholz and Smith (2016) build on Neil (2012) and Permadi and Rafi (2015) and have tried to come up with a framework that describes what makes Augmented Reality experiences engaging. Important are users that directly participate in the AR experience, the AR content (the virtual information that the users can perceive and interact with), bystanders that are not directly involved but can influence the user (because they observe the user's reactions), the AR targets (which is the object that is augmented with virtual information, like a product's packaging, the clothes of a customer or a restaurant table), and, finally, the background (which is the physical environment in which the AR experience takes place). To illustrate, in the IKEA AR application, a digital sofa or chair is placed in an environment where the real sofa could end up. An IKEA customer cannot just imagine, but already see how the sofa would look next to the existing armchair. In other words, a higher level of user engagement is reached when AR applications cause the user to feel more positive about the experience and cause them to explore it in more detail while being in control over the interaction with the interactive application interactive (Scholz and Smith, 2016).

Interactivity has also been associated with immersion. Immersion is a term from gaming research, which describes the perception of the user's involvement in a virtual environment (Shin, 2017). Immersion is used along with flow and spatial presence to describe the engagement of an AR experience. A high level of fidelity or 'realism' of the AR content contributes to a higher perception of immersion, but interactivity is considered to play a larger role along with the user's social experience of the interaction (Shin, 2017). Similar observations have been made by Cano et al. (2017) using an experimental setting with interactive 360º images on an iPad offered to online shopping customers.

In short, Augmented Reality applications are inherently immersive, and can be made interactive, involve the user, bystanders and emotional context from the physical environment. AR content registered in 3D also helps with the user' s understanding, perceived realism and immersion of the AR experience. Because of the interactive and immersive nature of AR, applications have been studied and were found to improve user engagement in different sectors. This leads to the first hypothesis of this study:

Hypothesis 1: The use of Augmented Reality applications has a positive impact on User Engagement.

In the second part of the literature study, the use of Augmented Reality to affect human-food interaction is reviewed, followed by an overview how Augmented Reality has been in used in restaurants. The chapter ends with a second hypothesis and conceptual model for this study.

2.3 Menu engineering in restaurants

Restaurants manipulate their menu in different ways to increase the guest's perceived value and affect their decision-making. These manipulations are what is known as *attribute framing*, which is one of the three categories of framing effects (Levin et al. 1998). Framing effects are studied in the field of judgement and decision-making psychology. Attribute framing researchers study how customers have irrational preferences in situations that are seemingly equal (Chater and Oaksford, 2008).

According to Levin (1987), the evaluation of consumer goods are mediated by attribute labels through positive or negative associations made by the customer. A famous example is when a customer is asked for their preference between 75% lean beef and 25% fat beef – which is technically the same product – and the customer prefers the 75% lean beef (Levin and Gaeth, 1988; Donovan and Jalleh, 1999). Levin et al. (1985) found that when customers were faced with this choice, they were more likely to purchase the beef that was framed as '75% lean'. The customers also made more favorable associations on scales of quality, taste and greasiness.

In a study by Pulos and Leng (2010), it was found that providing labels with nutritional information on the menu led to guests ordering food that had less calories. Shah et al. (2014) on the other hand say that unhealthy labels alone are not enough to change the guest's behavior. When combined with a financial surcharge however, the guest does make more health-conscious decisions. There is a link to the manipulated menus they have used in the full reference in Chapter 8 (Shah et al. 2014).

Another form of attribute framing is called 'descriptive labelling'. Wansink et al. (2001) have studied various forms of descriptive labelling:

- Geographic labels that couple dishes to a certain place. Examples are 'Gouda cheese' or 'Hollandse Nieuwe haring'

- Affective labels that are nostalgic or remind the guest of family, tradition or a positive experience. Examples are 'Grandma's apple pie' or 'classic Italian pizza'

- Sensory labels that help the customer imagine what the dish tastes like and how it feels in the mouth. Examples are 'super crunchy fried chicken' or 'cheesy mozzarella bites'.

- Brand labels that are often a cross-promotion and draw on the positive association a guest may have with the brand. Examples are 'Black Angus beef burgers', 'Doritos Locos tacos' or 'Oreo chocolate milkshake'.

Wansink et al. say that *"if descriptive menu-item labels are used sparingly and appropriately, they may be able to improve sales and post-consumption attitudes of both the food and the restaurant."* (Wansink et al. 2001 p.68). Shoemaker et al. (2005) studied the use of extensive descriptions that made use of sensory, affective and geographic labels and found that dishes that menus that had extensive descriptions for dishes increased the guest's perceived value. As the perceived value increased, so did the probability of purchase.

Nazlan (2017) writes about how availability cues lead to more purchases. An example of these cues in practice is when restaurants use bold text, illustrations or borders around the dishes they would like to draw attention to. These dishes are often premium or are more profitable. What this attention also does is 'prime' the guest to see the other dishes as a bargain if the first dish a customer sees is a relatively expensive dish (Simonson and Tversky, 1992).

Another cue is when a restaurant asks guests to write reviews about specific dishes, so that others who read those reviews come to the restaurant with that specific dish in mind. A third form of triggering availability cues is through advertising. Think about the wall-sized burgers in bus stops (Nazlan, 2017).

What restaurants with price-sensitive guests also do is to offer all items separately. Side dishes, sauces, fries or extras are offered separately on the menu. Each item then has a smaller, separate price. The restaurant then uses upselling strategies like asking if the guests would like extra portions or some warm or cold sauces with their steak for a few euro(cent)s extra. In high-end restaurants, the guests would be presented a single *table d'hote* for which the guest makes a single, larger payment. This combination price then contains all sides and accompaniments (Kahneman and Tversky, 1979).

Restaurants have an array of techniques and manipulations they can use to increase order value and to maximize profit. Figures 2.1 and 2.2 shows practical examples of menus that make use of some of these manipulations.

Figure 2.1 – Example of engineered restaurant menu (Fat Alice, 2019)

The design of the menu in Figure 2.1 contains four manipulations. First, the white box around the 'Tomahawk steak' draws the guest's attention using an availability cue. Second, The monetary signs were removed from the prices, making it look like the prices are just decimal numbers so that the association with money is weakened. Third, the sauces and sides ('X-tra porties') are offered for a smaller price separate from the main dish (e.g. 0,85 euro for the cold sauces). Fourth, a descriptive label is used for the 'Smokey Joe's Bbq sauce', which sounds more exciting and richer than 'garlic' or 'cocktail sauce'.

Figure 2.2 shows a different section of the same menu where availability cues and descriptive labels are used together. Descriptive labels here are ‘The New Yorker’ and ‘The Dubliner’. See Figure 2.2.

Figure 2.2 – Example of engineered restaurant menu (Fat Alice, 2019)

In short, restaurant menus can be manipulated to draw attention to specific dishes, to improve the perception of a specific dish, to cater to price-sensitive customers and to reduce the pain element of pricing. This is built on attribute framing research. The aim of restaurant menu engineering is to increase the order value and profitability. These findings support the idea that an Augmented Reality menu application can be used to manipulate customer behavior and that the manipulation could affect order value. The next section contains findings about what is already known about the introduction of Augmented Reality applications in human-food behavior.

2.4 Augmented Reality and human-food interaction

Our perception of food is complex and studied in several fields ranging from psychology to food science. Whenever we interact with food, our senses interact with the characteristics the food has due to the ingredients, processing and presentation – which in turn affect our perception of (the pleasantness of) food and our acceptability of its quality (Cardello, 1994; Imram, 1999).

Examples of sensory attributes that have an influence on our perception are taste and texture (Szczesniak, 1972; Schutz and Wahl, 1981), and more importantly visual sensations (Hetherington and MacDougall, 1992). Spence et al. (2016) link this importance to our survival – meaning that recognizing familiar and good quality food helped humans with feeding and foraging. In other research, it was found that visual cues (e.g. color and appearance) can have a halo effect on the perception from our other senses (Kostyla et al. 1978; Hutchings, 2011).

Spence et al. (2016) mention in their review that in the last 50 years the food landscape and the importance of how food looks has changed dramatically. This is due to the introduction of TV cooking shows with 'celebrity' chefs (Hansen, 2008), Photoshop, smartphone cameras and applications (Instagram) that allow anyone to make a picture of food look good. This has given rise to a public that is obsessed with photographing what they are about to eat and sharing the pictures on social media (Abbar et al. 2015). In turn, restaurants prepare and plate their food in a way that makes it shareable or 'instagrammable' (Saner, 2015), meaning that they try to present the food in such a way that it appeals to our visual sense.

Other than sensory attributes, there are numerous other factors that affect our perception, some of which are attitude, information provided on labelling, familiarity, brand loyalty and price (Krondl and Lau, 1978; Krondl et al. 1982). This paragraph reviews studies in which Augmented Reality is used to manage or alter food perception and consequently human-food interaction.

In their paper, Bruijnes et al. (2016) describe a number of student projects in which technology and human-food interaction come together. They are categorized as follows:

- Projects in which food is used as a medium, for example to communicate or to display data.

- Introducing technology in cooking and dining rituals. An example would be to use Augmented Reality to put people in the same room using telepresence. That way someone on a business trip can still dine together with their family. An example in food preparation is using Augmented Reality to teach cooking skills. The works in this area are designed to enhance existing social structures, like dinner time with the family. One of the student projects used a Hunger Games type of game that encouraged people to work together in order to eat, while the people did not know each other at first.

- Using technology to change eating behaviors: Almost all the work in this field is focused on the promotion of healthier eating behaviors. The work in this field is divided into three categories:
    - Teaching good eating habits to children.
    - General behavior change for healthy eating.
    - Changing eating behavior in a clinical setting - to treat obesity for example.

- Using technology to change flavor experiences. Augmented Reality can be used to change the appearance (like the color saturation) of food in real-time, which affects the perception of taste. Another example is to augment the sound of chewing, which changes the perception of food texture and hence the taste of the food. One of the student projects used shape and color to change the taster's perception of sweet and sour tastes. Bruijnes et al. (2016) mention a restaurant in which a seafood dish is presented together with an MP3-player that the restaurant guest can use to listen to ocean waves and seaside sounds – giving the guest the impression they are having seafood by the sea.

- Finally, technology can be used to simulate flavor, without actual consumption of food or drinks. An example of this is simulating flavors using electrodes placed on the taste buds on your tongue to digitally produce flavors like mint or lemon. An example of this is the study of Ohla et al. (2012), in which they have shown their participants food images that differed in caloric content while applying an electrical 'taste' current on the tongue. They have found that the electric 'taste' was rated more pleasant (although it was the same taste) when the participants were shown the high-caloric food images.

Taste perceptions and associations can be further investigated using mixed reality technology. This knowledge can help design fascinating food experiences and help us understand more about our perception of flavor (Bruijnes et al. 2016).

Some examples of the manipulation of flavor perception are given by Spence and Piqueras-Fiszman (2013). They – along with Hopp and Gangadharbatla (2016) and Horowitz (2013) - recognize that Augmented Reality technology is sometimes used for technology's sake, and they share examples of how Augmented Reality can offer more than (temporary) entertainment. When a person looks at food that is made to appear larger using Augmented Reality, people tend to eat less of it (Narumi et al. 2012; Choi et al. 2014). Other than size, the food can also be made to appear with a different texture, which can be used to help consumers eat healthy foods while being under the impression that they are eating a 'pleasure' food that is unhealthy (Okajima and Spence, 2011; Okajima et al. 2013).

Another example is that wine tastes sweeter when tasted in red ambient lighting compared to blue or white. At first the ambient lighting seems like a form of entertainment, but it can also be used to 'season' our food or drink virtually and remove the need to add sugar or other sweeteners. This shows that Augmented Reality can be used to treat obesity and other problems with overeating. The question remains however if this is as effective as other means of treating obesity and other eating disorders (Spence and Piqueras-Fiszman, 2013).

Even if Augmented Reality holds the potential to enhance a dining experience, Spence and Piqueras-Fiszman (2013) wonder if this technology is not an unwanted form of distraction. They mention that in the past it has been found that food consumption increases by as much as 15% when people are distracted by the radio or TV when eating. They also mention that the change in consumption when distracted by mobile devices at the dinner table is unknown. A final point they make is that food quality could suffer as technology becomes more and more important and integrated in our eating behavior. In an ideal situation technology should only help enhance our dining experience, but this can also be taken too far. In research settings, restaurants are looking more and more like research labs. Their tables and cutlery are wired up with sensors tracking the food intake and behavior. Cameras with face recognition 'read' the emotions expressed by diners. Actual restaurants would not accept this, because it might ruin the experience of their guests, but Spence and Piqueras-Fiszman can see how the benefits of technology will outweigh the costs eventually (Spence and Piqueras-Fiszman, 2013).

Narumi et al. (2012) performed an experiment where food consumption was controlled using Augmented Reality to change the apparent size of food. Our perception of satiety is ambiguous and we cannot accurately estimate the volume and nutritional value of food we consume. Context and the environment plays a role in these estimates. For example, when a person estimates the amount of soup in a bowl, the size of the bowl is used as a contextual reference. Narumi et al. suggest here that a big bowl that is half full of soup is perceived as less voluminous compared to a smaller bowl of soup that is full, even if the amounts are the same. Our ambiguous perception of volume or nutritional value makes it hard to estimate the right amount to serve. Consequently, this affects how much we eat. The good thing about this ambiguity is that it can be used in a positive way to control how much we eat (Narumi et al., 2012).

Narumi et al (2012) and Bruijnes et al. (2016) further identify numerous non-food factors that affect the food intake:

- The provided cutlery (e.g. weight, size)
- Plate, portion and packaging size
- Atmosphere (lighting, temperature and music)
- Social context and observation (when you are with other people versus alone)
- Food saliency (how top-of-mind food is and for example if sweets are placed in a transparent versus an opaque jar)
- Variety (increased food variety leads to more consumption).

In short, the way we perceive our food depends on our senses and specifically how we see the food with our eyes. Technology can be used to affect our senses and that in turn will affect how we perceive and experience our food. This altered experience or perception can be used to change our behavior (eat more or less, use more or less seasoning and eat with others using telepresence). Augmented Reality applications have been used to alter food perceptions, which leads to new experiences and changed behavior. This supports the idea that the Augmented Reality application that presents food can affect user engagement. This is further investigated in this study.

2.5 Augmented Reality in restaurants

Researchers have explored a number of ways in which Augmented Reality can provide value in restaurants. What these applications have in common is that there is an emphasis on providing timely, localized information, a 3D sensory experience or a combination of both.

An example of these applications are in the form of real-time recommendation systems (Balduini et al, 2012; Chatzopoulos and Hui, 2016), where customers can look around them through their phones and get restaurant recommendations. Another example is entertainment, where AR games can be played on the restaurant table (Ilhan and Çeltek, 2016; Shabani et al. 2019) or a story is told and projected on the table (Le Petit Chef, 2019). A third example is the translation of menu items and their prices to the customers own language and currency using AR (Yuan, 2018). Yuan has a four-step process in which Augmented Reality is used in different phases of the dining experience. First the tourist is introduced to the restaurant (similar to a recommendation system). When a tourist enters and would like to explore the menu AR is used to translate the menu. In the idle time in which the tourist is waiting for their food AR is used to inform and entertain the customer on the local food culture. Finally, AR is used during checkout to provide the receipt and price in the tourist's own language and currency (Yuan, 2018). What all these applications lack however is the use of AR to present the actual food.

A single exploratory study was found in which Emili Koui (2017) designed an Augmented Reality menu for her thesis. Her main point is that the visual composition of food on a plate affects the human perception of liking and willingness to pay. She describes a number of problems that occur in restaurants that make use of paper menus. One of the main problems is that these restaurants use images that often misrepresent the quality and quantity of the menu item, which leads to disappointed customers and finally a business loss for the restaurants. She also describes a number of barriers that make customers hesitant to try new culinary experiences. These barriers are portion size accuracy, ingredient identification, dietary preferences and finally the language barrier. These issues are mainly a problem for tourists and first-time fine dining customers.

Koui developed a prototype Augmented Reality menu in which customers can select their language and dietary preferences, after which the Augmented Reality menu helped with ingredient identification and a visual representation of what customers are about to order. She used an Augmented Reality menu as a way to manage expectations and avoid the problems described above. According to Koui, her project was successful, because it raised the perceived trust users have in the dishes they order. She does not describe any challenges, but does recognize how the integration of Augmented Reality in our daily lives can push business owners to increase their standards (Koui, 2017).

In short, Augmented Reality has been used for restaurants to make it easier to find the restaurant, to help the user read the restaurant menu, to entertain the guest while they are waiting for their food and to make the checkout easier. This solves a few problems that occur especially when guests are in need of translation or clear, timely information, but does not actually show the guest what they are ordering. A prototype of an Augmented Reality menu was designed by Koui (2017) that could allow guests to experience the food in 3D before they placed an order. It was hypothesized that this results in a higher level of trust between restaurants and their customers, but the prototype was not actually tested in a restaurant.

The first paragraphs of Chapter 2 discussed how Augmented Reality applications were used to affect user engagement and Paragraph 2.4 discussed how AR was used to affect human-food interaction. Paragraph 2.3 discussed how restaurants make use of their menu to affect their customers order value. Here, a combination of these two is studied, where the positive effect of AR applications on engagement is combined with the positive effect of menu engineering on order value. In Paragraph 2.5 a single exploratory study was found that combined the menu and the AR applications in a restaurant context. This leads to the second hypothesis.

Hypothesis 2: Augmented Reality applications have a positive effect on order value, mediated by user engagement.

The following conceptual model is a visual summary of this study. The dependent variable in this study is the order value, or more specifically: the price paid by the participant. The independent variable is the use of an Augmented Reality application. User engagement is the mediating variable here. The conceptual model can be seen in Figure 2.3.

Figure 2.3. Conceptual Model

To test both hypothesis 1 and 2, this study extends on Koui's (2017) exploratory study by:

- Similarly presenting Augmented Reality (3D) models of dishes, but in a live restaurant setting with real guests using a dedicated AR application.

- Omitting the dietary filter and language choice options and instead focus on directly showing the restaurant guest a 3D model of the food,

- Omitting the digital offboarding and ordering process and letting the waiting staff pick up orders – to make sure ordering happens the same way as with a regular paper menu.

- Actually collecting quantitative data on how Augmented Reality applications affect order value in restaurants.

- Also making use of a validated User Engagement Scale to quantify the effect of the Augmented Reality application on User Engagement. Koui (2017) has pointed out that the AR menu led to higher levels of trust, but it is unsure if this a significant effect.

- Providing a detailed protocol that can be used and followed to collect data in a restaurant with minimal bias in future research.

How this study is setup is presented in detail in Chapter 3.

3. Methods

3.1 Participants and design

This study was done in the form of a field experiment in a restaurant called De Waterwolf, located in Badhoevedorp and visited by local citizens, workers from Schiphol Airport, and tourists. Participants were randomly exposed to a regular paper menu or an Augmented Reality (AR) menu while ordering their brunch. Participation was on a voluntary basis; participants were told from the start that the data regarding their experience with the menu would be used for this thesis project in anonymized form. The initial sample consisted of 43 guests (16 men and 27 women, of which 62.8% between 35 and 64 years old). The data of participants with missing values (*N*=2; 4.65%) was omitted. The final sample then consisted of the data of 41 participants (15 men and 26 women, of which 63.4% between 35 and 64 years old). This sample was used for the analyses reported here.

3.2 Materials and procedures

This section describes how the field experiment was prepared and executed, starting with the AR menu development, followed by the execution. Section 3.3 will then go in detail about the measures.

Materials

3D model development

3D copies were made of a selection of dishes using a process called photogrammetry. First the selected dishes prepared by the cooks of the restaurant were photographed with a Canon DSLR camera. The camera was fixed in position, while the dish was placed on a rotating table inside a lightbox. 108 pictures were taken per dish from a low (camera same height as dish), middle (camera in a 45 degree angle above the dish) and high (camera in a 80 degree angle above the dish) position. Ideal ISO values and focal ratios were found manually for each dish.

Next, the Image-based Modeling feature of RealityCapture (photogrammetry software) was used to stitch the raw, unedited pictures together into a 3D model for each dish. Some of the 3D models required manual editing to fill up holes and make corrections, which was done in a software program called Zbrush.

Finally, the 3D models were compressed and simplified, which resulted in very small files (2-5 MB .FBX files) that could be used on mobile devices. These small, photorealistic 3D models were then loaded into a separate mobile application called 'Waterwolf AR' which was specifically programmed for this field study (see below).

AR menu application

'Waterwolf AR' was installed on an iPad and moved to a separate page to make sure there was no confusion with other applications. When tapped on, the Waterwolf AR application showed a loading screen for several seconds before the AR menu would be shown.

The user interface of the AR menu consisted of three elements: The full screen opened the iPad camera screen and overlaid what the camera captured with a 3D model of the selected dish. The bottom left part of the screen had a semi-transparent, purple box that contained the name and description of the selected dish. The name, price and description of all dishes were shown in a (also semi-transparent and purple) side bar on the right side of the screen as well. See Figure 3.1 for an overview of the user interface and the first dish that was presented to the participant. Note the high level of realism. The plate on which the dish was presented was captured together with the dish in order to add to the realism – and to match the plates used in the restaurant.

Figure 3.1 - 3D model of De Goede Buur Appeltaart dish and overview of the Waterwolf AR application participant interface. This is the first dish guests see. Note that the glass on the right, the tissue on the left and the items on top are all real objects.

The participant can interact with the application in several ways. The participant can tap on the dish names on the right side of the screen to view that dish and its description, move the dish around with one finger, turn the dish by moving two fingers to the left or right, and pinch with two fingers to zoom in and out of the dish. The zoom limit was 80%-120% of the original size, which resembled the size of the real dish if it were placed on the table and seen through the iPad camera. Finally, the participant can clear the screen (by tapping the cross icon) and tap on one of the dishes on the right side to view it again. Screenshots of the other dish 3D models used in this study can be found in Figures 3.2 through 3.7. Figure 3.8 shows the paper menu used by the restaurant.

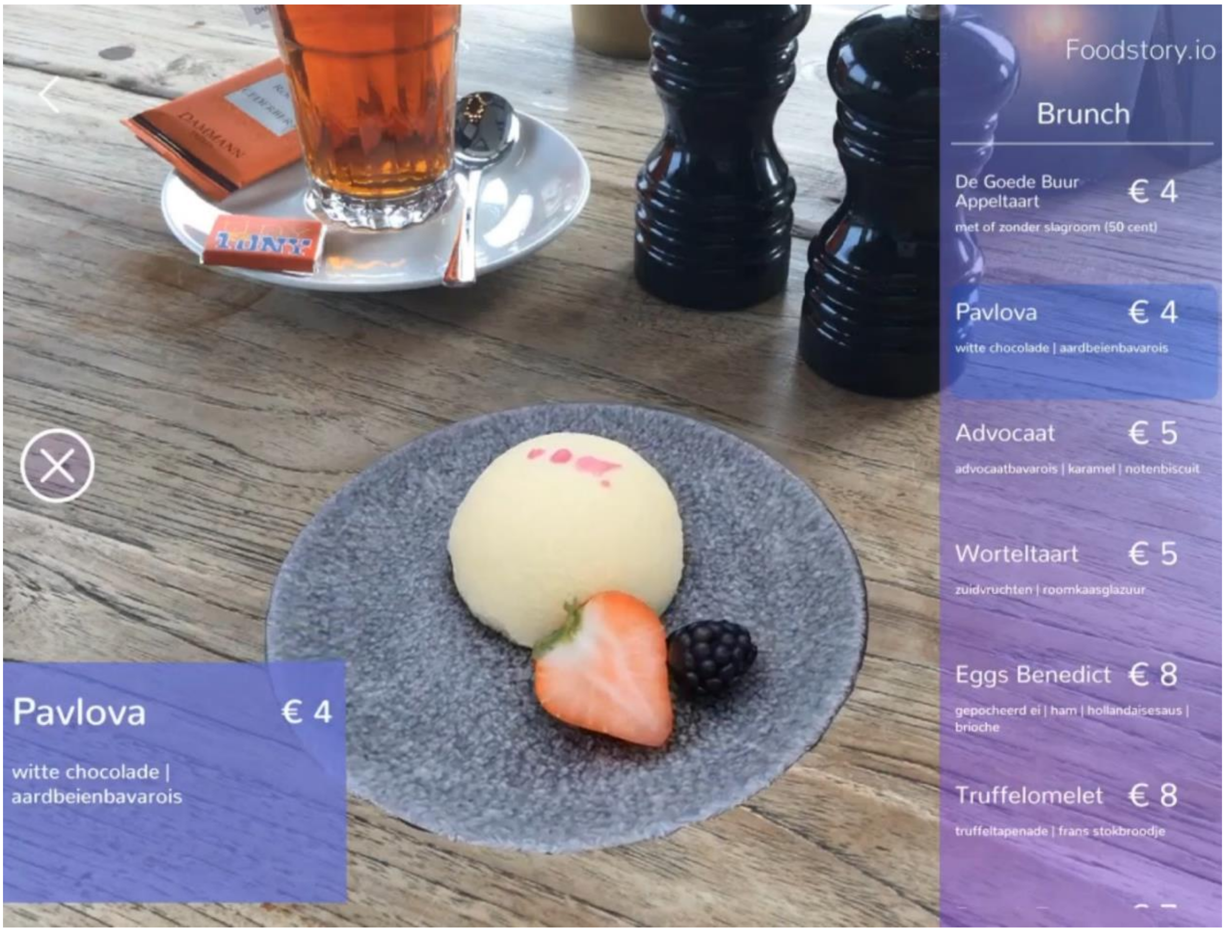

Figure 3.2 – 3D model of the Pavlova dish.

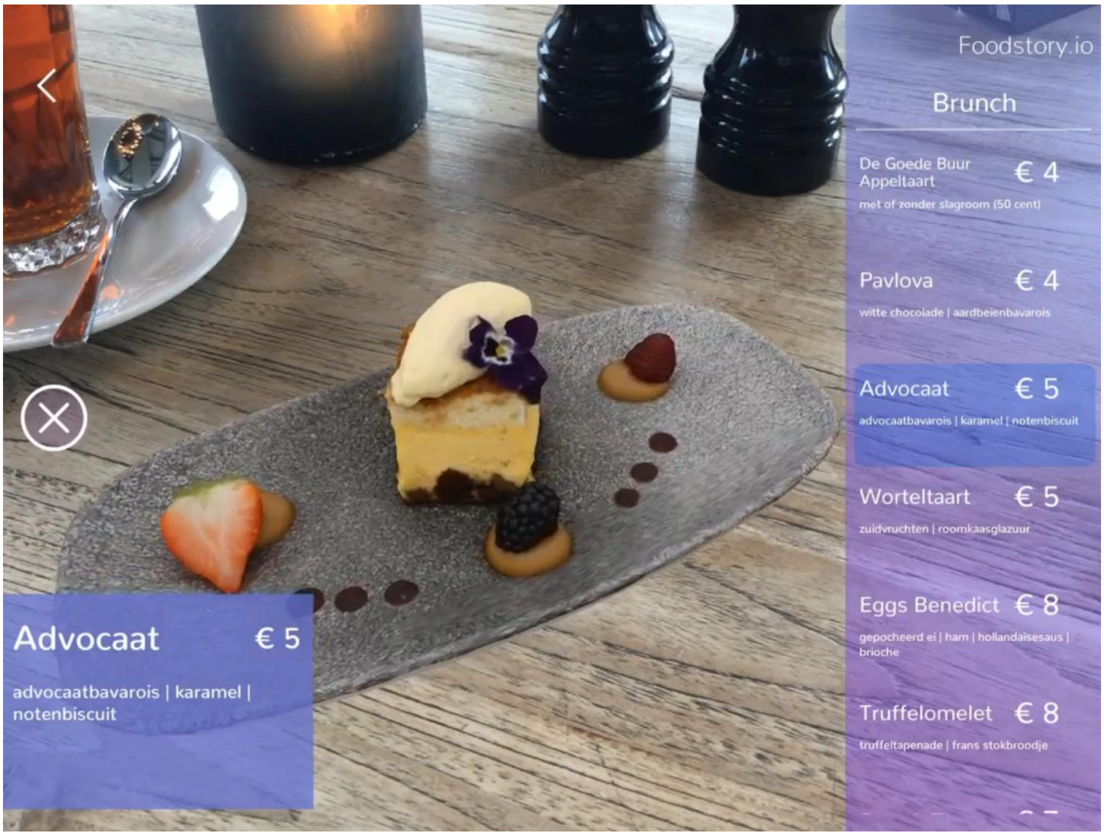

Figure 3.3 – 3D model of the Advocaat dish.

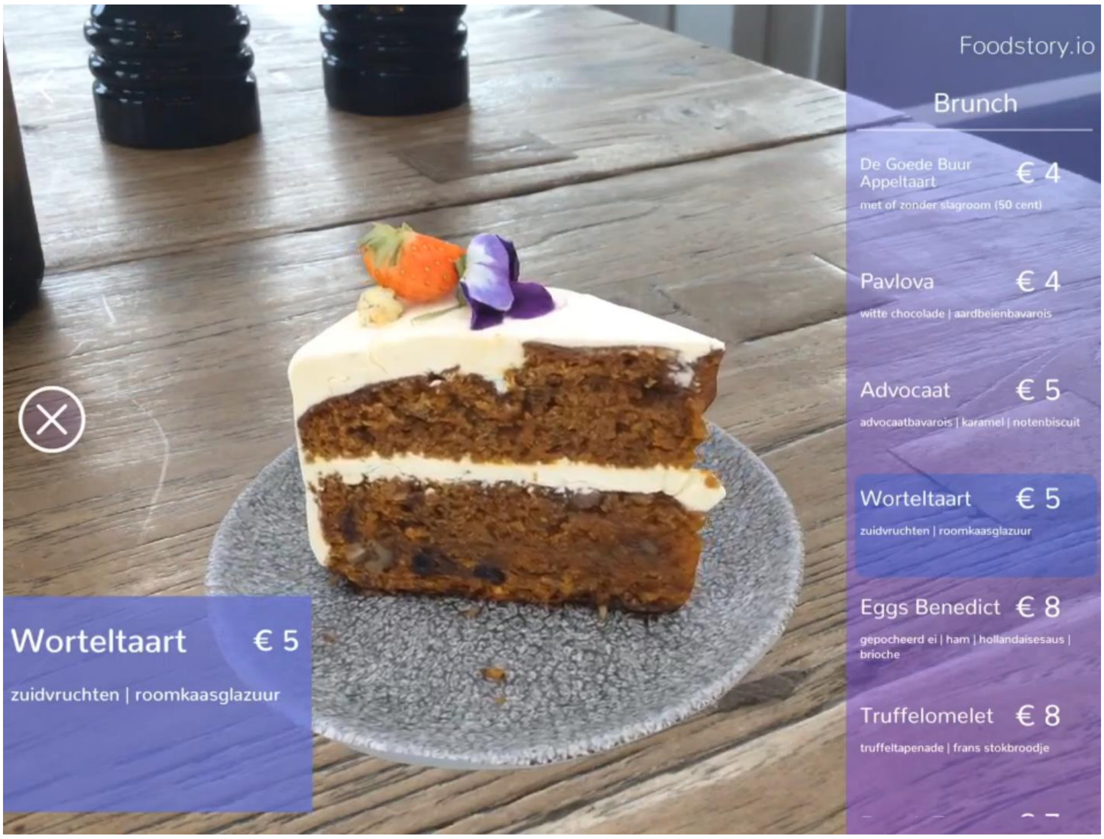

Figure 3.4 – 3D model of the Worteltaart dish.

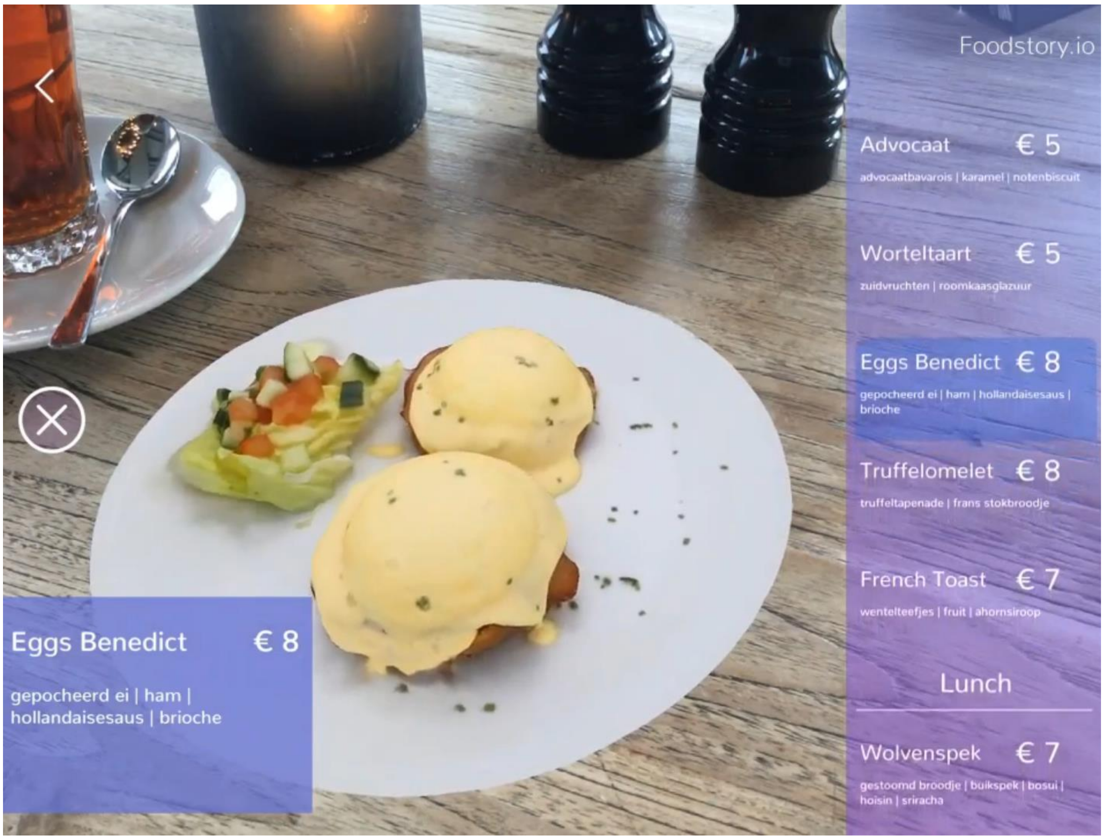

Figure 3.5 – 3D model of the Eggs Benedict dish.

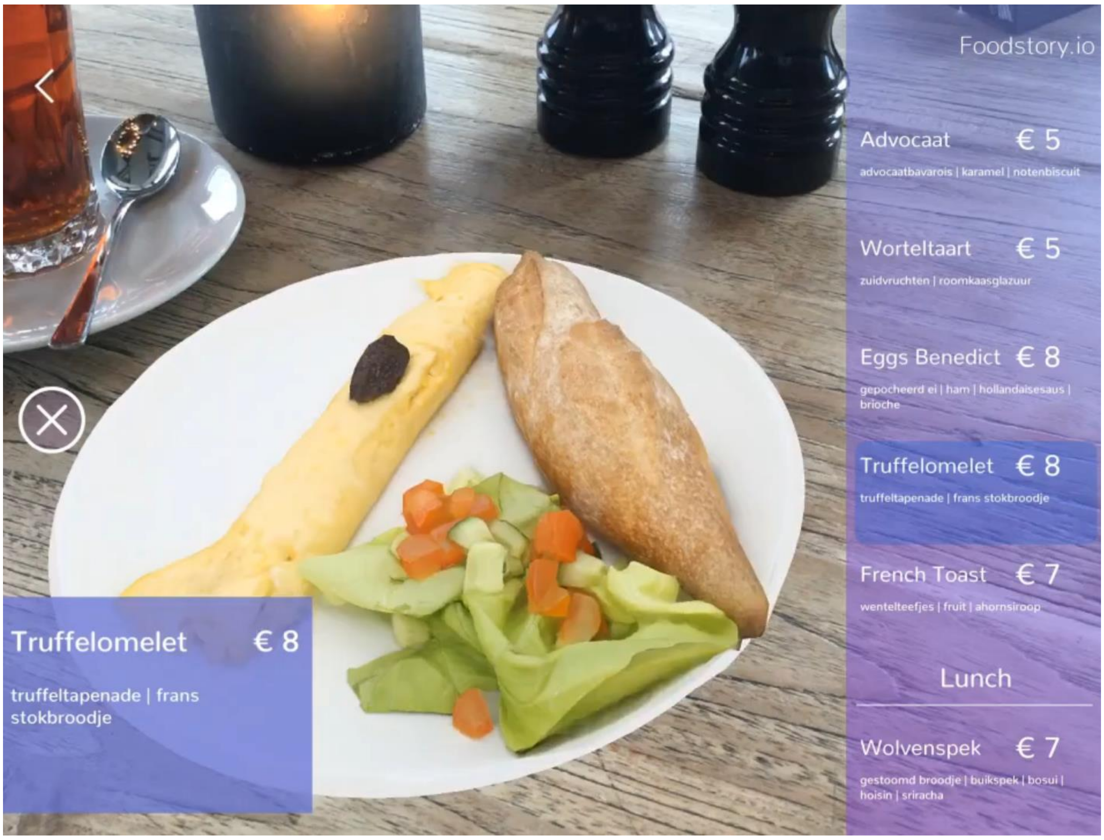

Figure 3.6 – 3D model of the Truffelomelet dish.

Figure 3.7 – 3D model of the French Toast dish.

HIER ALLEEN PINNEN

BRUNCH

ETEN OM VAN TE WATERTANDEN

vanaf 10u tot 12u

PATISSERIE

DE GOEDE BUUR APPELTAART		met of zonder slagroom (50 cent)	4
PAVLOVA		witte chocolade | aardbeienbavarois	4
ADVOCAAT		advocaatbavarois | karamel | notenbiscuit	5
WORTELTAART		zuidvruchten | roomkaasglazuur	5

BRUNCH

EGGS TO ORDER	keuze uit:	roerei | omelet | spiegelei | twee sneeën brood	5
	voeg toe:	ei | pancetta | ham | kaas | tomaat | snee brood	1
EGGS BENEDICT		gepocheerd ei | ham | hollandaisesaus | brioche	8
TRUFFELOMELET		truffeltapenade | frans stokbroodje	8
CROQUE MONSIEUR		ham | kaas | gruyère | bechamel	7
CROQUE MADAME		ham | kaas | gruyère | bechamel | gebakken ei	8
WOLVENCROQUE		ham | kaas | gruyère | bechamel | blauwe kaas	9
LOEI LEKKERE YOGHURT	keuze uit:	bio yoghurt | geitenyoghurt | sojayoghurt	5
	keuze uit:	banaan | kokos | chocolade | noten | fruit	
		zuidvruchten | ahornsiroop | havermout	
STAPEL AMERICAN PANCAKES		ahornsiroop | poedersuiker | slagroom | fruit	5
FRENCH TOAST		wentelteefjes | fruit | ahornsiroop	7

BAKKERIJ

CROISSANT	jam | roomboter	3
SCONES	jam | clotted cream	3
FLAPJACK	havermout | ahornsiroop | noten	3

KINDEREN

MINI BOLLETJES ZOET BELEG	twee witte bollen | pindakaas | hagelslag | jam	4
TOSTI	ham | kaas | tomatenketchup	4

vraag onze medewerkers om allergeneninformatie

Figure 3.8 – Overview of the incumbent, paper menu presented to guests. A selection was made from this card to create the 3D menu.

iPad

"Waterwolf AR" was developed and installed on an iPad (5th generation). The iPad was placed in a white, neutral casing that was used to hold the iPad in a 45 degree angle on the restaurant table. See Figure 3.9 for an impression of the participants point of view.

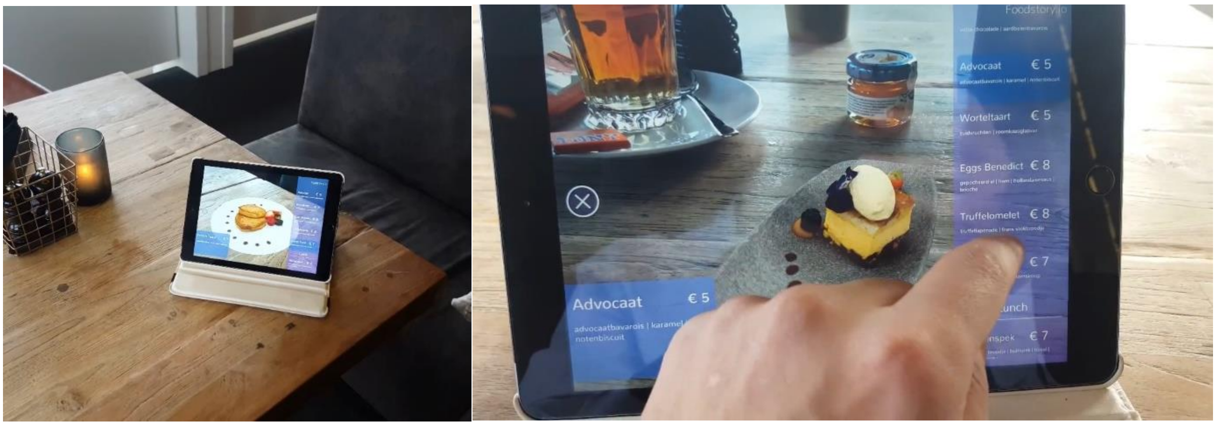

Figure 3.9 – Impression of the participant's point of view. Left: overview of the iPad on the restaurant table. Right: Participant interacting with the menu.

Procedure

The field experiment was performed over a course of 3 weeks. The AR and paper menus were presented every morning between 9 am and 12 pm (brunch hours) to guests in turn, meaning that guest 1 was presented the AR menu, guest 2 the paper menu and guest 3 the AR menu again. The exact sequence of events is noted below. This protocol dictated:

- How guests were randomly selected.
- How all the guests should be treated and talked to.
- What steps were required in order to collect the data – ideally – without introducing bias.

The random way guests were selected for the AR group or the regular paper group was there to avoid selection bias effects. This is to protect the internal validity of the study (Sekaran & Bougie, 2016).

Before the guests came in

The service personnel were asked to present the AR menu and the regular paper menu in turns, so if guest 1 was presented the AR menu, then guest 2 would be presented the paper menu. Guest 3 was then shown the AR menu again and so on. The instructions that were given to them were as follows;

- To present the AR menu, they placed the iPad with the screen facing the guest and loaded the first dish. If the dish was not centered or in view, they could reset the dish by pressing the X button and tapping on the first dish.

- If the AR menu was shown, they gave the guest the following information: "The Waterwolf is participating in research for a student's thesis project at the TU Delft. You can tap on the right side of the screen to view the different dishes. Afterwards I'd like to have your order. After you've eaten a short survey is handed to you by the student."
- When the paper menu was shown, the guest was given the following information: "The Waterwolf is participating in research for a student's thesis project at the TU Delft. After you've eaten a short survey is handed to you by the student."
- Guests that did not want to participate were not given the survey and a copy of their receipt was not collected.
- The service personnel was asked to be careful not to present the AR menu if a nearby table was presented the paper menu and vice versa.

In addition, the kitchen personnel were shown the AR menu to give them a visual reference of what the customer would expect if they had seen the AR menu.

Note that the guests that came in after that and decided to order something to eat were marked as participants and the menu they were exposed to was noted.

After the guests had eaten

After a participant had finished their meal, they were thanked for their participation and handed a postsurvey with a manipulation check, user engagement statements, attitude and demographic questions. No other instructions were given to them other than that the survey would be picked up after they left. There was a short explanation with instructions on the survey. Any questions they had were answered after the survey had been filled in.

Finally, when the participant had paid and left, a copy of their receipt was collected from the service personnel. At 12 pm the data collection was stopped for the day, the service and kitchen personnel and the owner were thanked and left until the next time. See Appendix 8.2 for the full post-survey.

Specific situations and how they were dealt with

- If a guest was familiar with the Waterwolf and ordered something before the menu was handed to them, they did not participate.
- If a guest asked if there were more dishes than the seven presented in the AR menu, they were handed the paper menu and no longer participated.
- If guest 1 entered and was presented the AR menu and guest 2 then joined guest 1 and asked for the paper menu, both guests did not participate.

3.3 Measures

Manipulation of restaurant menu

A single question – "*What type of menu was given to you for the brunch?*") was added as a manipulation check, Participants could answer this question with '*a printed, regular menu*' or '*a digital, 3D menu on the iPad*'. Participants in the first category were presented the paper menu as seen in Figure 3.8. Participants in the latter category were presented the AR menu on an iPad (Figure 3.9).

Self-reported User Engagement

For this study, the User Engagement Scale of O'Brien et al. (2018) was used. This is the short form version of the User Engagement Scale. This allows for quantification of the User Engagement score for both the Augmented Reality menu and the paper menu. These scores can then be used to analyze the relationship between the type of menu, User Engagement and order value. The scale consists of twelve statements that cover the four dimensions of user engagement (according to O'Brien et al).

Focused Attention – '*I lost myself in this experience*' and two other statements were used to measure the level of focused attention according to the participant.

Perceived Usability – '*I felt frustrated while using this application X*' and two other statements were used to measure the participant's perceived usability of the paper and AR menus. These questions were reverse-coded as per the instructions of O'Brien.

Aesthetic Appeal – '*This application X was attractive*' and two other statements were used to measure to what extent the menus were aesthetically appealing according to the participant.

Reward Factor – '*My experience was rewarding*' and two other statements were used to measure how rewarding or worthwhile the menus were according to the participant. The reward factor was a combination of endurability, novelty and felt involvement.

The full list of items is found in Appendix 8.1. The statements were translated into Dutch, randomized and applied to this specific study (so the statements in the present research were about the menu rather than an application X; e,g. "*I found this menu confusing to use*"). The exact statements used in this study can be found in Table 4.2 and in the questionnaire in Appendix 8.2 (statements 5-16).

The scores for the four subscales were determined by calculating the average value of the responses given for each subscale (by adding them up and dividing by three). Finally, an overall engagement score was calculated by adding up all scores and dividing by twelve.

Attitude towards accuracy of the menus

Two questions were added as attitude questions that measured the extent to which participants experienced the accuracy of the menu when it came to describing the actual dish (on a five-point scale, where '1' was '*The dish was not accurate at all'* and '5' was '*The dish was exactly as expected*') and the accuracy of the portion size of that dish (on a five-point scale, where '1' was '*The dish was much smaller than expected* and '5' was '*The dish was much larger than expected*').

Other attitude questions were added to measure the extent to which price was important for participants when they made their choice and to check whether this was the participant's first experience with the restaurant. These questions were asked to get a more detailed understanding of the sample characteristics.

Order value

A copy of the receipts was picked up after each of the participants left. These copies were used to determine what the participants had ordered to find the difference in order value between the AR and the paper menu. The price of the drinks and extras (meals for children) were subtracted from the total price on the receipt and the order value was found by dividing that price by the number of participants at that table. The receipts were only used to look at the prices of the dishes that were offered in the paper and Augmented Reality menu.

The average order value was then found for the AR and paper menu participants by adding up all order values and dividing by the respective number of participants in that group.

NPS score

Reichheld's Net Promoter Score (Reichheld, 2003) is based on the fact that loyalty or customer satisfaction leads to repurchase intentions. The Net Promoter Score measures the level of customer satisfaction in customers or in this study: restaurant visitors. Reichheld has provided very specific instructions for measuring and calculating the Net Promoter Score. For the sake of supplementary analysis we included the Net Promoter Score in this study and followed these instructions.

All participants were asked the question: '*How likely is it that you would recommend 'De Waterwolf Brasserie to a friend or colleague?* and could reply on a scale of 1 to 10. Participants that replied with a 6 or lower were marked as detractors and participants that replied with a 9 or 10 were marked as promoters. The Net Promoter score was determined by subtracting the percentage of detractors from the percentage of promoters. The NPS scores of participants in the Augmented Reality group and the paper menu group were then compared to see if the Augmented Reality application had any effect on customer satisfaction.

4. Results

This chapter presents the results of the field experiment that was conducted on-site. It captures the basic descriptive statistics (such as sample characteristics), the factor analysis on the self-report scale on User Engagement as well as the results of the hypotheses tests and follow-up tests that were performed after that.

4.1 Manipulation check

In an experimental design, a manipulation check offers a test of the validity of the experimental treatment. In this case, the test was about the type of menu received. Thus, participants were asked what type of menu they were presented in order to make sure participants understood the type of menu that was presented to them. All participants correctly answered what menu (either AR or the paper menu) had been presented to them (100%, $X^2 = 0$, $p < 0.001$), showing that the manipulation had worked.

4.2 Sample characteristics

Table 4.1 shows that the majority of the participants were in the 35-64 age group. In the AR menu sample, the participants were mostly (75%) female, whereas the sample was more homogenous in the paper menu condition. During the experiment, the restaurant had both new visitors as well as returning visitors. In the paper sample, most of the participants (14 versus 7) had visited the restaurant before. The participants generally sat alone or with one other participant at the table, which does not include children.

More people in the AR group (8 versus 4 in the paper group) marked their dish “Exactly as expected” and also more people from the AR group (13 versus 9 in the paper group) marked their portion size “As expected”. When it came to the important of price when choosing a dish, no participants from the paper group marked the price as “important” or “very important”. In the AR menu condition, 7 people reported having considered the price of the menu ‘important’ or higher.

Table 4.1 – Sample descriptions. N = 41 with N_{AR} = 20 and N_{paper} = 21.

Sample descriptions	Summary	N_{AR} (total = 20)	N_{Paper} (total = 21)
Gender	Male	5	10
	Female	15	11
Age	17 years and younger	0	1
	18-24	0	1
	25-34	4	4
	35-64	11	15
	65 years and older	5	0
Experience with restaurant	Visited this restaurant before	9	14
	First-time visitor	11	7
Number of participants at table	Single participant	6	5
	Two participants	7	5
	Three participants	0	2
Extent to which the dish met expectations	Not at all as expected	1	0
	Not as expected	2	4
	Neutral	4	5
	As expected	6	8
	Exactly as expected	8	4
Extent to which portion size met expectations	Much smaller than expected	0	0
	Smaller than expected	1	3
	As expected	13	9
	Bigger than expected	5	7
	Much bigger than expected	1	1
Importance of price	Not important at all	3	4
	Not important	4	7
	Neutral	6	10
	Important	6	0
	Very important	1	0

4.3 Pre-analysis of the data

Average order price

All hypotheses in the present study were formulated in connection with the construct "User Engagement". Still, for exploratory purposes, the general impact of menu type or order value in the absence of this construct was also investigated. The average order price was €5.40 for the AR menu and €5.43 for the paper menu, meaning that participants that were presented the paper menu spent 0.56% more than in the AR group. In other words, there was almost no difference between the two groups. With this outcome, a *t*-test will not find a significant effect.

Exploratory Factor Analysis

Hypotheses 1 and 2 made predictions on the User Engagement construct. Table 4.2 shows the different statements that form the User Engagement Scale that was administered as a self-report questionnaire to participants in this study (as explained in Section 3.3). This scale is based on the scale by O'Brien et al. (2018). The original, unapplied statements are found in Appendix 8.1. O'Brien et al. found that the User Engagement constructs has four dimensions. In this study an exploratory factor analysis was performed to see if these four factors (Focused Attention, Perceived Usability, Aesthetic Appeal and the Reward Factor) could also be found in the restaurant samples. In an exploratory factor analysis the covariation between a set of observed variables (the self-reports on the statements below) is modeled and it allows us to extract factors that may not be observed, but can be theoretically explained – like satisfaction, happiness or the perceived usability of our AR application (Bandalos and Finney, 2018).

The JASP software package (JASP Team, 2018) was used to perform the exploratory factor analysis. After loading the twelve questionnaire statements in, the results were rotated using oblique rotation. Rotation in exploratory factor analysis is used to make the results easier to interpret and different components easier to find. Oblique rotation was used because it gives a more clear result when the different components we are looking for can be intercorrelated – which is often the case in the social sciences (Osborne, J. W. (2015), and thus should also hold for the User Engagement Scale. After the rotation, the results with a component loading smaller than 0.300 were hidden from the output for greater clarity. The final output is always the number of principal components extracted from the scale – indicated by RC (Rotated principal Component) and a number. The number corresponds with the amount of components or dimensions that were found in the factor analysis.

In this case, three dimensions were found ($p<0.001$; Cronbach's α = 0.785). This is different from the four dimensions reported by O'Brien et al. (2018). The first factor according to O'Brien was Focused Attention (statements FA.1, FA.2 and FA.3 in Table 4.2). In Table 4.2 it can be seen that the first two items for FA loaded under RC3, while the third item loaded (weakly) under RC1. Similarly, Aesthetic Appeal (AE) and the Reward Factor (RW) also did not load under a single component. In theory it would be expected that all three items load strongly under a single factor. This version of the User Engagement Scale however did not behave as expected from theory for the FA, AE and RW factors. The Perceived Usability factor did load under a single factor (RC1) and this is in line with what O'Brien et al. (2018) have reported. Perceived Usability is then the only dimension that could be confidently used in the follow-up analyses.

Table 4.2 - Component Loadings

	RC 1	RC 2	RC 3	Uniqueness
FA.1 - 6. Ik vergat even mijzelf toen ik de menukaart bestudeerde.	.	-0.508	0.648	0.425
FA.2 - 12. De tijd vloog voorbij terwijl ik deze menukaart bestudeerde.	.	.	0.699	0.500
FA.3 - 7. Ik was verdiept in deze menukaart.	0.366	.	.	0.650
PU.1 - 11. Ik voelde me gefrustreerd .. bestuderen van deze menukaart.	0.742	.	-0.448	0.330
PU.2 - 5. Ik vond de menukaart verwarrend om te gebruiken.	0.593	.	.	0.703
PU.3 - 13. Het gebruik van deze menukaart is intensief/belastend.	0.922	.	.	0.233
AE.1 - 14. Deze menukaart was interessant.	.	0.952	.	0.180
AE.2 - 15. Deze menukaart zag er aantrekkelijk uit.	.	0.521	.	0.511
AE.3 - 9. Deze menukaart deed een beroep op mijn zintuigen.	0.354	.	.	0.752
RW.1 - 8. Het was de moeite waard om deze menukaart te gebruiken.	0.686	.	.	0.396
RW.2 - 10. Mijn ervaring met de menukaart was lonend.	.	0.371	0.446	0.603
RW.3 - 16. Ik vond deze ervaring interessant.	.	0.777	.	0.423

Four more Cronbach's α were calculated for each of the subscales from O'Brien's User Engagement Scale (Short-form). They can be found in Table 4.3.

Reliability Analysis

Table 4.3 - Scale Reliability Statistics

Subscale	Cronbach's α
Focused Attention	0.399
Perceived Usability	0,709
Aesthetic Appeal	0,676
Reward Factor	0,629

Cronbach's α is used as a reliability measure for items in a set that are reported on a scale. It measures the internal consistency of items in a set and represents the average intercorrelations among the items that measure a certain factor (Cronbach, 1951). A good internal consistency is found when Cronbach's α is closer to 1. Cronbach's α of 0.6 or lower are considered poor and an α of over 0.7 is acceptable (Sekaran & Bougie, 2016). From Table 4.2 and 4.3 it then follows that only Perceived Usability is a consistent and reliable dimension of User Engagement. This matches the consistency result from the factor analysis. Aesthetic Appeal is somewhat reliable as well with an α of 0.676 - and will also be included in the follow-up analyses in which the hypotheses are tested - but this dimension has shown in Table 4.2 not to be a reliable measure or dimension or User Engagement.

4.4 Follow-up analyses

T-test

A *t*-test did not reveal a significant effect of the experimental treatment, t (39) = 0.041, ns. The order value of participants who received an augmented menu card prior to ordering their meal did not differ from that of participants who received a paper menu prior to ordering (M = 5.40 , SD = 2.77 vs. M = 5.43, SD = 1.59). In other words, the AR menu did not lead to a significant increase in order value. Hypothesis 1 therefore had to be rejected.

Mediation Analysis

To test our hypotheses, also based on the results in Paragraph 4.3 a follow-up mediation analysis was performed. According to Hayes (2014), mediation analysis is *"used to quantify and examine the direct and indirect pathways through which an antecedent variable X transmits its effect on a consequent variable Y through an intermediary variable M."* (Hayes, 2014 p.3). The tool used for mediation analysis was the "PROCESS" macro for SPSS by Hayes (Hayes, 2017) which is used in numerous other studies (Leal-Rodríguez et al, 2014; Reese et al. 2015; Schönfeld et al. 2016; Palmer et al. 2016).

In this study, mediation analysis was used to quantify and examine the direct effect that the type of menu had on the order value, and the indirect effect the menu type had on order value, with user engagement factors as intermediary. In this mediation analysis, Perceived Usability and Aesthetic Appeal were selected as mediators to capture User Engagement, menu type was selected as independent or antecedent variable and order value as the dependent or consequent variable.

The analysis showed that the overarching mediation model was significant ($p < 0.05$, $R^2 = 0.20$). In this model the Perceived Usability factor had a direct, positive and significant impact on the order value (*coeff* = 1.38, *se* = 0.48, $t = 2.88$, $p < 0.01$). Unfortunately, this effect existed independent from the type of menu. Interestingly, the menu type had a marginally significant effect on the Aesthetic Appeal factor ($p = 0{,}078$, $R^2 = 0{,}078$). For this mediator, however, the appreciation of the Augmented Reality menu via Aesthetic Appeal unfortunately did not manifest in a higher order value. Transferred to the conceptual model (Figures 4.1 and 4.2):

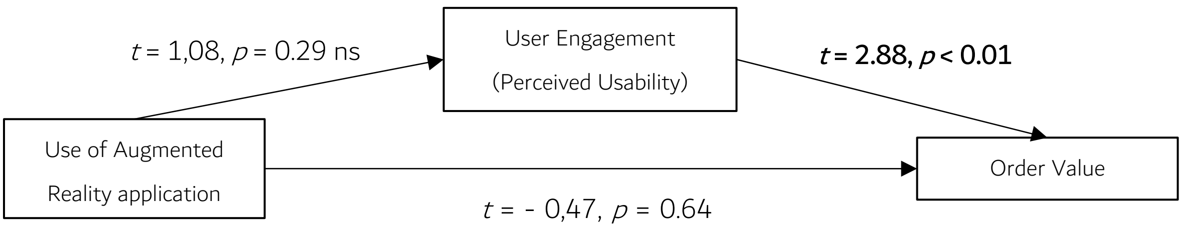

Figure 4.1 – Conceptual Model with Perceived Usability dimension of User Engagement. ns = not significant.

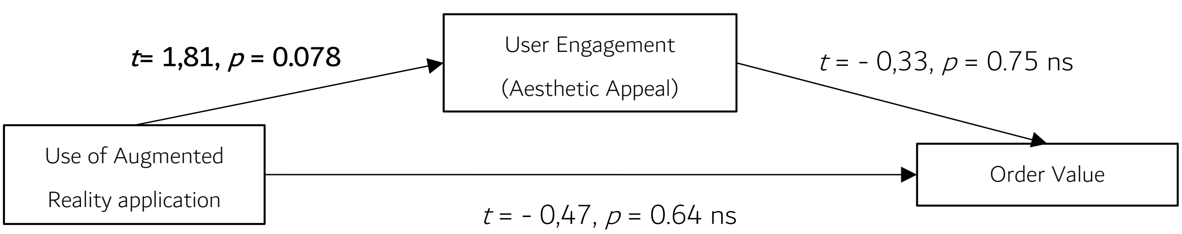

Figure 4.2 – Conceptual Model with Aesthetic Appeal dimension of User Engagement. ns = not significant.

The mediation analysis was then repeated after omitting the data of a single participant that presented his own feedback and initially asked if he could be interviewed rather than filling in the questionnaire himself.

After removal of this participant from analysis, the interesting but marginally significant effect of the menu type on Aesthetic Appeal was no longer found to be significant (p = 0.12, R^2 = 0.061). This seems to suggest that the single participant had liked the Augmented Reality menu more than others in the sample. The significance and explained effect size of the general mediation model on the other hand increased (p < 0.05, R^2 = 0.23), The Perceived Usability factor again had a direct, positive and slightly more significant impact on the order value (*coeff* = 1.52, *se* = 0.49, *t* = 3.11, p < 0.005). This lends support to hypothesis 2, albeit for a single factor (Perceived Usability) only. No support was found for the full mediation model including the full set of engagement dimensions. Figures 4.3 and 4.4 show the results after omitting the outlier data.

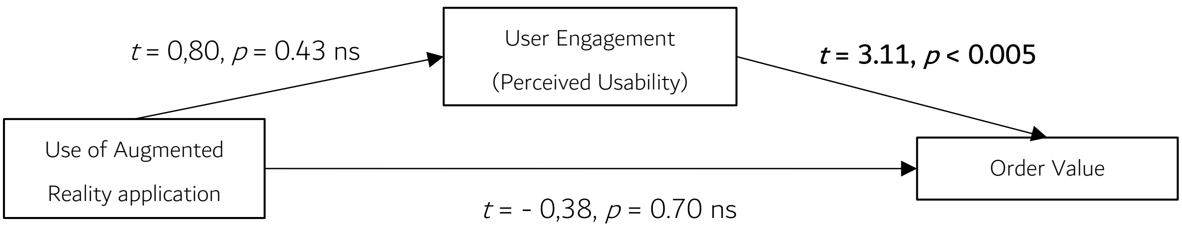

Figure 4.3 – Conceptual Model with Perceived Usability dimension of User Engagement after removal of outlier. ns = not significant.

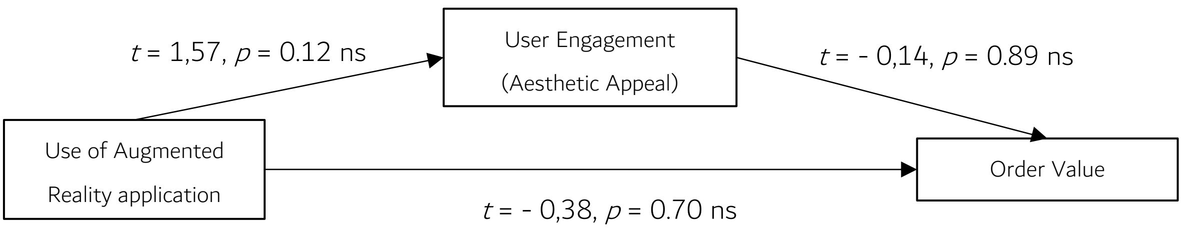

Figure 4.4 – Conceptual Model with Aesthetic Appeal dimension of User Engagement after removal of outlier. ns = not significant.

Net Promoter Score

As described in Chapter 3, the Net Promoter Score is a measure from the marketing literature used to measure customer satisfaction levels – because they are indicative of future repurchase intentions (Reichheld, 2003). It serves as a quick indicator for a company to find out how pleased the customer was with the product or service received. The Net Promoter Score (NPS) for the paper menu sample was -4,8. The NPS for the Augmented Reality menu was -5. The significance of changes in the NPS score is determined with a margin of error test. In this case, a 17-point difference was needed for this change to be significant (95% confidence interval). Therefore, no significant impact was found on the NPS. In other words, the AR menu application did not increase the customer satisfaction level, making it unlikely that there is an effect on future repurchase intentions.

Summary

In short, the AR menu application was found to better represent the dishes and their portion size compared to the paper menu, but this did not translate into a higher order value or a better NPS score. On the other hand, an exploratory factor analysis was performed in which Perceived Usability was found to be a reliable, consistent measure for User Engagement. In a follow-up analysis, Perceived Usability was also found to have a direct, positive effect on order value in the mediation model presented in Chapter 2. These results and their implications are discussed in Chapter 5.

5. Discussion and conclusion

This study aimed to measure the effect of an Augmented Reality application on the order value of a customer, and to see if this impact was mediated by user engagement. It was hypothesized that the use of an Augmented Reality application would indeed lead to a higher level user engagement and subsequently a higher order value. Although no significant relationship was found between the use of an Augmented Reality application and the level of user engagement, it was found that the presented mediation model was significant, with one of the user engagement factors indeed affecting the order value. This study was a first in combining between Augmented Reality and user engagement theory in a live experiment, and these early results show that it is worth exploring this combination in more detail. In the rest of this chapter, the scientific and practical relevance of the study is discussed, followed by the limitations of this study and directions for future research. The chapter will end with a conclusion.

5.1 Scientific Relevance

The scientific relevance of this study is fourfold. First, this study is potentially the first quantitative study in which an Augmented Reality application was developed and actually tested in a live environment. This study then serves as a stepping stone and empirical support for what is known in Flow theory (Csikszentmihalyi, 1990) and information interaction theory (which is where the Perceived Usability factor comes from) and how Augmented Reality applications play a role in affecting user engagement and order value.

Second, a significant median model was presented in Paragraph 2.5, in which the Perceived Usability factor was found to have a direct, positive impact on order value. Cano et al. (2017) found that Perceived Usability was high in users that were presented in both static images and 360-degree rotating images, but this study is the first to actually confirm this relationship in an Augmented Reality application. A reason for this could be that the Augmented Reality menu application developed in this study was designed with simplicity in mind. Permadi and Rafi (2015) mentioned that Perceived Usability is higher for users of mobile applications when the application is simple and without complex interactions. This has both scientific relevance for e/m-commerce research and a commercial relevance in that AR developers can build on these results in order to make their applications more engaging and usable. The direct, positive impact of Perceived Usability on order value found in this study supports hypothesis 2.

The third point is about increasing user engagement. Cano et al. (2017) mention that Augmented Reality applications are promising for increased user engagement. In the case of digital (tablet) menus, Oronsky and Chatoth (2007) and Beldona (2014) express that tablet menus are manipulated the same way paper menus are (with colours, design choices, font size etc.) which according to Aesthetic theory affect a customer's buying behavior. They are of the opinion that tablet menus can provide richer experiences and interactions. In this study however, no significant effect of the menu type was found on user engagement (rejecting hypothesis 1). It is possible that the User Engagement Scale used in this study did not capture this effect. In this study a manually translated version was used and the different user engagement factors did not all load properly. Therefore, the scale has to be further developed and validated in other languages. Perhaps several scales need to be developed depending on the application rather than a single-size-fits-all scale in order to avoid confusing user engagement statements.

5.2 Practical relevance

This study also carries practical lessons for Augmented Reality developers and businesses that would like to introduce Augmented Reality to improve profitability. An initial protocol was developed which can be used to set up follow-up field studies in restaurants and similar businesses.

For other applications, what can be learned here is that it is very important to offer a seamless experience. This study did not offer an important benefit that tablets have to offer: being able to order from the tablet and to pay within the tablet. In this study, the choice was made to pick up orders manually in order to keep this process similar to how orders are picked up with a paper menu, but this does not make optimal use of the tablet. The question that arises is whether this lack of a seamless experience has had an effect on the user engagement. This would have to be researched separately, because the situations that are being compared are the following: In the seamless experience, the guest engages with the menu and the Augmented Reality experience, after which they select and order their preferred dish from within the application. After a short while the real dish is brought to the table, where the expectations of the guest are neatly met. In the "seamed" experience that was used in this study, the guest interacts with the Augmented Reality application, after which the interaction changes because the guest has to turn their attention to the waiter to place their order. The question then is whether this break in the interaction affects the user engagement.

A first hypothesis is that user engagement is higher when there is no interruption, This is also in line with Flow theory (Csikszentmihalyi, 1990), a may explain why no significant effect on user engagement was found in this study. On the other hand, a restaurant can decide to make a tradeoff because they may believe the availability of a human waiter is better for the overall experience. This could depend on the type of restaurant, as higher end restaurant guests may appreciate the availability of a staff member to guide them through the ordering process, while guests eating out with the family may appreciate speed and efficiency and therefore rather go to a restaurant with the seamless experience. This is supported by

Suarez et al. (2019), who found that guests dining at quick-service and midscale restaurants are more likely to adopt tablet-based menus compared to guests dining at upscale restaurants.

From a purely monetary perspective, what can be said for restaurants is that the seamless experience may allow the restaurant to have less staff members, which allows them to cut costs and increase profitability. This benefit along with faster ordering with an application (because orders go straight to the kitchen) stem more from the fact that a tablet is used rather than from the Augmented Reality application. The power of an Augmented Reality application is in that the guest sees a virtual dish – and a moment later the same dish, but real. It would be interesting to research the reactions and attitudes of guests to this experience (table 4.1 indicates that there is a difference in perception when using an AR menu), especially when the time between the two moments is very short.

For longevity and sustained profitability in business, it is important to solve an actual problem. One of the problems the AR menu solves (removing uncertainty by showing the exact dish) may not have been a big issue for this specific restaurant. This is because the presented brunch dishes are common. Most restaurant guests have an idea what to expect when they order French toast, apple pie or an omelet. This may explain why no significant improvement in order value was found. In other businesses however, this could prove to be very valuable. Restaurants with a larger volume of tourists, first-time customers, or restaurants that have exotic items on their menu could benefit from using an Augmented Reality menu. Duangsaeng et al. (2017) mention that errors made in translated menus, odd spelling and transliterated menu items can make a menu difficult for visitors to understand. In an online survey by Harris Poll (OpenTable, 2016), it was also found that the most confusing menu items were either transliterated names (e.g. Okonomiyaki) or foreign names (e.g. En papillote). 53% of the respondents reported that photos and 30% reported that a glossary with menu terminology would make them more likely to orders a dish they are not familiar with. Finally, 37% of diners report that they choose a restaurant based on how familiar they are with the listed menu items. Augmented Reality menus could play a role in these restaurants by removing the language barrier and allowing people to see in 3D what they are about to order. This lesson can be extrapolated to other business types as well.

Finally, one of the things that went very well in this study is the usage of the application. The application was crystal clear and none of the participants had questions or trouble regarding how the application worked. No intervention was necessary that could have compromised the internal validity of the study. This is believed to be due to the fact that we built around what the participants were already familiar with. When people interact with images, they already know they can pinch to zoom and pan to move. Besides that, basic user experience principles were followed and only the core features and navigation were added. For AR developers and businesses that want to introduce Augmented Reality in their business, the advice here is to look at what the intended user is already doing and to build new applications around that.

5.3 Limitations

This study has a few limitations, some caused by the menu design, and others caused by the lack of a pilot test or the study design.

The menu design was not identical for the paper menu and the Augmented Reality menu, and the most important difference is that the paper menu had a few more dishes that guests could choose from. A few participants that ordered from the paper menu actually ordered these dishes and therefore they were not given a questionnaire and were excluded from the study. What is unclear however, is if the extra dishes had an effect on the choice the other participants made, even if they ordered a dish that was 'valid' (meaning it is available on both menu types). As the literature study has pointed out, restaurant menus are engineered to nudge customers towards certain choices, and in this specific study it is unclear if the extra dishes or the different design had an effect on dish choice and if there was an effect – the effect size. In a follow-up study, matching the menu design and available dishes should be prioritized.

My presence in the restaurant as a researcher may have also been a source of bias in the form of the Hawthorne effect. The Hawthorne effect is often defined as a bias due to the participants' knowledge that they are in an experiment – which in turn affects their behavior, effectively skewing the research results. More specifically, not just the participation, but the expectations and thoughts participants have about the experiment (Adair, 1984) or the fact they get special attention or react positively to the experiment stimulus (Wickström and Bendix, 2000) could affect their behavior during the study. In this study, the aim was to brief participants briefly and casually in order to avoid this bias. For this reason, the briefing was done by the restaurant personnel and I did not present the questionnaires until after they had finished their meal. It is possible however that the idea of taking part in an experiment about the menu could lead to participants studying the menu with more attention than they normally would. A second possibility is that they reply to the questionnaire differently, because they know I will collect the questionnaires and read their replies. In a follow-up study, it would be interesting to test the difference in replies when handing out and collecting the questionnaires is done by the service personnel as well.

Third, no pilot test was set up to test how many questionnaires could be collected. In practice, collecting questionnaires took about four times longer and there were days in which no questionnaires could be collected due to events. One example of this is that on the second Sunday of data collection, a long distance biking event was organized for seniors that had several stops including the restaurant this study took place in. To deal with the influx of visitors from the event, the restaurant did not provide items from the menu that day and instead a fixed meal and drink for the participants of the event. One week later on a Saturday, similar measures were taken due to a neighborhood clearance sale market. This has impacted the study because the final sample size was smaller than anticipated, and because no data was collected on these specific days - less weight was given to weekend days in the final sample. With a smaller sample size it is harder to represent the total population – for example by having a different demographic variation (Sandelowski, 1995). In this study, the Augmented Reality menu sample consisted mainly of women, while the paper menu sample was more homogenous. The total sample also consisted mostly of guests in the 35-64 age group. The sample age might be a good representation of this restaurant guests' actual age and be internally valid, but it does not make the findings generalizable to restaurants that attract older or younger guests.

Another effect of the missing pilot test is that the protocol set up for this study was not tested and refined. This resulted in a few potential participants being left out of the study. This study has effectively become a pilot study for follow-up studies interested in testing Augmented Reality applications in a live context. The protocol itself seemed to work very well and the different scripts and instructions were followed precisely. Based on the experience from this study however, a follow-up study would be set up during a different time-frame (dinner instead of brunch), which should have multiple benefits which is explained in the next paragraph.

5.4 Directions for future research

The most logical next step for follow-up research would be to tackle the limitations from this study, which is to match the AR and paper menu in design and dish choice and to set up an experiment in which data collection happens in the evening when guests are having dinner at the restaurant. Because this is a slightly different setup, a pilot test has to be setup to test the protocol and data collection again. There will likely be no drastic change to the experiment, but it will help improve the logistics of the study and remove unnecessary mistakes that could lengthen the study.

Collecting data during dinner time is expected to have several benefits. First, the restaurant is generally more crowded and it should help to collect data faster. Second, the sample could not only be bigger, but also more varied, which should make the study more robust and generalizable as it represents the population better. Third, the dinner dishes are expected to not be as familiar to the guests compared to the brunch dishes, which could potentially mean that the effect of the Augmented Reality menu is stronger.

Building on this, future research could aim to test this study in different environments (other restaurants or businesses) or to test the different facets of this study in more detail. Menu design, dish count, restaurant type and age group are all variables that can be varied (and combined) in order to learn more about the effect of using AR applications. For example, age and menu design come together in a study by Almanza et al. (2017) – in which it was found that older restaurant guests have trouble with menu readability when the menu design is crowded or makes use of a small font. It would be interesting to see how older guests react when they are instead presented with an Augmented Reality menu that has little to no text. It could prove to be more user friendly for them – if they appreciate the use of a tablet to view the menu. In another study by Fakih et al. (2016), they found that in mid- to high-scale restaurants, the preparation of the food and the ingredients were the strongest predictors of consumers' purchase intentions, while in lower tiered restaurants the product characteristics were a stronger determinant. It would be interesting to develop an AR menu that highlights these predictors – for example by highlighting the ingredients in premium dishes and providing background information about those ingredients and how the dish was prepared – and to find out if this leads to increased user engagement or an even stronger intent to purchase.

In the literature section of this study, some background was given on how menu design affects purchasing behavior. When using an Augmented Reality menu, it is important to distinguish between the effect of menu design and the effect of the Augmented Reality technology. This can be controlled for by using a single menu design on both the digital 3D menu and the paper menu in multiple restaurants. On the other hand, testing multiple designs in a single restaurant could give an idea of how big the design impact is when used with and without AR technoloy. This is similar to User Experience (UX) tests and could also teach us about best practices for Augmented Reality menu design.

Finally, analytics can be built into the Augmented Reality application that will give insight into guest behavior that we cannot learn through observation and questionnaires. In fact, using analytics to keep track of how people interact with a specific dish and how this differs between dishes can be very valuable for both researchers and companies. Paper menus are engineered to draw attention to specific dishes. An AR menu on the other hand could be used to track which dishes are always selected first, or selected more often – which could mean the dish name or thumbnail draw more attention compared to that of other dishes. This can then be used to further optimize the other dishes or the menu in general. If a restaurant wants to introduce a new burger, they can make several versions with different ingredients or different presentations and offer both in an AR menu. They can then keep track of which version is the most successful (most orders placed or most interacted with) and scrap the other versions from the menu. The same method can be used by other companies – for example by a dairy product company that wants to introduce a new yoghurt. They could make several versions that people can view and rate at home and add a questionnaire to understand the motivations behind the customer's preferences. For researchers, AR menu analytics can be used to learn about how we look at food and how we perceive it. If multiple participants turn the dish to view it from the same angle or zoom in to the same section, that would be interesting to study and ask questions about. With some research and luck, we'll find the answers and learn something new.

6. Conclusion

Augmented Reality applications are not new, but have steadily gained attention in the past few years and currently potentially valuable applications of Augmented Reality are being tested and experimented with. This study is a first in that it took place in a live setting where it measured the effect of an Augmented Reality application on the order value of a customer, and if this impact was mediated by user engagement.

No significant relationship was found between the use of an Augmented Reality application and the level of user engagement, but it was found that the presented mediation model was significant, with Perceived Usability indeed affecting the order value. With these findings, an initial bridge is formed between user engagement theory and empirical support is presented for how Augmented Reality applications affect human behavior in a restaurant setting.

For businesses and Augmented Reality developers, the most important piece of advice is that the developer should keep in mind that the Augmented Reality application will only be valuable if it solves a real problem and although Augmented Reality is inherently immersive, it may work better in places where there is a real need for it, because the alternative is confusing or does not provide enough information (like transliterated names in foreign-food restaurants).

Some limitations were found in this study that were mainly due to wrongly managed expectations. Follow-up studies could easily tackle these and further explore the potential of Augmented Reality applications.

7. References

Abbar, S., Mejova, Y., & Weber, I. (2015). You tweet what you eat: Studying food consumption through twitter. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3197–3206).

Adair, J. G. (1984). The Hawthorne effect: a reconsideration of the methodological artifact. *Journal of Applied Psychology, 69*(2), 334.

Almanza, B., Ma, J., Ghiselli, R., Lee, J.-E., Behnke, C., Sydnor, S., Kim, J. (2017). Do the physical facilities in restaurants match older Americans' preferences? *Journal of Foodservice Business Research, 20*(3), 321–335.

Arth, C., Grasset, R., Gruber, L., Langlotz, T., Mulloni, A., & Wagner, D. (2015). The History of Mobile Augmented Reality. *ArXiv Preprint ArXiv:1505*.01319.

Atkinson, M., Kydd, C. (1997). Individual characteristics associated with World Wide Web use: an empirical study of playfulness and motivation. ACM SIGMIS Database: *The Database for Advances in Information Systems, 28*(2), 53–62.

Attfield, S., Kazai, G., Lalmas, M., & Piwowarski, B. (2011). Towards a science of user engagement (position paper). In *WSDM workshop on user modelling for Web applications* (pp. 9–12).

Azuma, R. T. (1997). A survey of augmented reality. *Presence: Teleoperators and Virtual Environments, 6*(4), 355–385.

Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). International Forum of Educational Technology & Society Augmented Reality Trends in Education : A Systematic Review of Research and Applications. *Educational Technology, 17*(4), 133–149.

Balduini, M., Celino, I., Dell'Aglio, D., Della Valle, E., Huang, Y., Lee, T., … Tresp, V. (2012). BOTTARI: An augmented reality mobile application to deliver personalized and location-based recommendations by continuous analysis of social media streams. *Journal of Web Semantics*, *16*, 33–41.

Bandalos, D. L., & Finney, S. J. (2018). Factor analysis: Exploratory and confirmatory. In *The reviewer's guide to quantitative methods in the social sciences* (pp. 98-122). Routledge.

Bannon, L. J. (2011). Re-framing HCI: From Human-computer Interaction to Human-centred Interaction Design. In *Proceedings of the 9th ACM SIGCHI Italian Chapter International Conference on Computer-Human Interaction: Facing Complexity* (pp. 17–18). New York, NY, USA: ACM. https://doi.org/10.1145/2037296.2037304

Beardsley, M. C., Wreen, M. J., & Callen, D. M. (1982). The aesthetic point of view: Selected essays. Cornell University *Press Ithaca*, NY.

Beldona, S., Buchanan, N., & L. Miller, B. (2014). Exploring the promise of e-tablet restaurant menus. *International Journal of Contemporary Hospitality Management*, *26*(3), 367–382.

Billinghurst, M., Clark, A., Lee, G., & others. (2015). A survey of augmented reality. *Foundations and Trends in Human--Computer Interaction, 8*(2–3), 73–272.

Blythe, M. A., Overbeeke, K., Monk, A. F., & Wright, P. C. (n.d.). (2004) Funology-From Usability to Enjoyment. *Kluwer Academic Publishers*.

Bowman, D., Kruijff, E., LaViola Jr, J. J., & Poupyrev, I. P. (2004). 3D User interfaces: theory and practice, CourseSmart eTextbook. *Addison-Wesley.*

Bruijnes, M., Huisman, G., & Heylen, D. (2016). Tasty Tech: Human-food Interaction and Multimodal Interfaces. In *Proceedings of the 1st Workshop on Multi-sensorial Approaches to Human-Food Interaction* (p. 4:1--4:6). New York, NY, USA: ACM. https://doi.org/10.1145/3007577.3007581

Cano, M. B., Perry, P., Ashman, R., & Waite, K. (2017). The influence of image interactivity upon user engagement when using mobile touch screens. *Computers in Human Behavior, 77*, 406–412.

Cardello, A. V. (1994). Consumer expectations and their role in food acceptance. In *Measurement of food preferences* (pp. 253–297). Springer.

Carroll, J. M. (2006). Human--computer interaction. *Encyclopedia of Cognitive Science*.

Caudell, T. P., & Mizell, D. W. (1992). Augmented reality: an application of heads-up display technology to manual manufacturing processes. In *Proceedings of the Twenty-Fifth Hawaii International Conference on System Sciences (Vol. 2*, pp. 659–669 vol.2).

Chan, T. K. H., Zheng, X., Cheung, C. M. K., Lee, M. K. O., & Lee, Z. W. Y. (2014). Antecedents and consequences of customer engagement in online brand communities. *Journal of Marketing Analytics, 2*(2), 81–97.

Chatzopoulos, D., & Hui, P. (2016). Readme: A real-time recommendation system for mobile augmented reality ecosystems. In *Proceedings of the 24th ACM international conference on Multimedia* (pp. 312–316).

Chen, L.-C., Yang, Y., Wang, J., Xu, W., & Yuille, A. L. (2016). Attention to scale: Scale-aware semantic image segmentation. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 3640–3649).

Choi, J., Foth, M., & Hearn, G. (2014). Eat, cook, grow: Mixing human-computer interactions with human-food interactions. Accessed April 3rd, 2019. https://books.google.com/books?hl=en&lr=&id=tYIUAwAAQBAJ&oi=fnd&pg=PR5&dq=%22Eat,+cook,+grow:+Mixing+human–computer+interactions+with+human–food+interactions%22&ots=ySxAd7QTfa&sig=LUmLl3AKoYCae5SSF8So9VbYGHw

Comport, A. Marchand, M & Chaumette. F. (2003). A Real-Time Tracker for Markerless Augmented Reality. In *Proceedings of the 2nd IEEE/ACM International Symposium on Mixed and Augmented Reality* (pp. 36–45).

Connolly, P., Chambers, C., Eagleson, E., Matthews, D., & Rogers, T. (2010, October). Augmented reality effectiveness in advertising. *In 65th Midyear Conference on Engineering Design Graphics Division of ASEE, Oct* (pp. 3-6).

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika, 16*(3), 297-334.

Csikszentmihalyi, M. (1990). Flow. The Psychology of Optimal Experience. *New York (HarperPerennial).*

Davison. (2003). Real-time simultaneous localisation and mapping with a single camera. In *Proceedings Ninth IEEE International Conference on Computer Vision (Vol. 3*, pp. 1403–1410 vol.2). https://doi.org/10.1109/ICCV.2003.1238654

Digi-Capital (2019), For AR/VR 2.0 to live, AR/VR 1.0 must die. Accessed February 27th, 2019. https://www.digi-capital.com/news/2019/01/for-ar-vr-2-0-to-live-ar-vr-1-0-must-die/

Donovan, R. J., & Jalleh, G. (1999). Positively versus negatively framed product attributes: The influence of involvement. *Psychology & Marketing, 16*(7), 613–630.

Draper, S. W., & Norman, D. A. (1986). User centered system design. *New Perspectives on Human-Computer Interaction.*

Duangsaeng, W., & Chanyoo, N. (2017). Intelligibility of Thai English Restaurant Menus as Perceived by Thai and Non-Thai Speakers. *Journal of Language Teaching and Research, 8*(6), 1081–1089.

Fakih, K., Assaker, G., Assaf, A. G., & Hallak, R. (2016). Does restaurant menu information affect customer attitudes and behavioral intentions? A cross-segment empirical analysis using PLS-SEM. *International Journal of Hospitality Management, 57*, 71–83.

Fat Alice (2019). Menukaart. Fat Alice Nunspeet. Retrieved September 8th, 2019. http://fatalice-nunspeet.nl/menukaart/

Feiner, S., MacIntyre, B., & Höllerer, T. (1997). A Touring Machine: Prototyping 3D Mobile Augmented Reality Systems for Exploring the Urban Environment Columbia University Preservation. In *Personal Technologies (Vol. 1,* pp. 208–217).

Filimowicz, M., & Tzankova, V. (2018a). New Directions in Third Wave Human-Computer Interaction: Volume 1-Technologies. *Springer International Publishing.*

Filimowicz, M., & Tzankova, V. (2018b). New Directions in Third Wave Human-Computer Interaction: Volume 2 - Methodologies. *Springer International Publishing.*

Fischer, G. (2001). User modeling in human--computer interaction. *User Modeling and User-Adapted Interaction*, *11*(1–2), 65–86.

Fitzmaurice, G. W. (1993). Situated information spaces and spatially aware palmtop computers. *Communications of the ACM, 36*(7), 38–50.

Goodrich, R. Tom's Guide Staff (2013), Google Glass: What it is and how it works. *Tomsguide* Accessed April 9th 2019. https://www.tomsguide.com/us/google-glass,news-17711.html

Green, W. S., & Jordan, P. W. (2003). Pleasure with products: Beyond usability. *CRC press*.

Hansen, S. (2008). Society of the appetite: Celebrity chefs deliver consumers. *Food, Culture & Society, 11*(1), 49–67.

Hartmann, J., Sutcliffe, A., & Angeli, A. De. (2008). Towards a theory of user judgment of aesthetics and user interface quality. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *15*(4), 15.

Hayes, Andrew F. (2014), mobc2014. *YouTube*. Accessed March 25th, 2019. www.youtube.com/watch?time_continue=244&v=q3TCj0ymu_c

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.

Hedberg, H., Nouri, J., Hansen, P., & Rahmani, R. (2018). A Systematic Review of Learning Through Mobile Augmented Reality. *International Journal of Interactive Mobile Technologies (IJIM), 12*(3), 75. https://doi.org/10.3991/ijim.v12i3.8404

Hetherington, M. J., & Macdougall, D. B. (1992). Optical properties and appearance characteristics of tomato fruit (Lycopersicon esculentum). *Journal of the Science of Food and Agriculture, 59*(4), 537–543.

Hewett, T. T., Baecker, R., Card, S., Carey, T., Gasen, J., Mantei, M., … Verplank, W. (1992). *ACM SIGCHI Curricula for Human-Computer Interaction*. New York, NY, USA: ACM.

Horowitz, R. (2013). How Augmented Reality Ads Could Change Everything. Accessed February 6, 2019. https://www.cnet.com/news/how-augmented-reality-ads-could-change-everything/

Hopp, T., & Gangadharbatla, H. (2016). Novelty effects in augmented reality advertising environments: The influence of exposure time and self-efficacy. *Journal of Current Issues & Research in Advertising*, *37*(2), 113–130.

Hutchings, J. B. (2011). Food colour and appearance. *Springer Science & Business Media*.

IKEA (2013), Place IKEA furniture in your home with augmented reality. Accessed November 13th, 2018. https://www.youtube.com/watch?v=vDNzTasuYEw

Ilhan, I., & Çeltek, E. (2016). Mobile Marketing: Usage of Augmented Reality in Tourism. *Gaziantep University Journal of Social Sciences*, *15*(2).

Imram, N. (1999). The role of visual cues in consumer perception and acceptance of a food product. *Nutrition & Food Science, 99*(5), 224–230.

Ingram, M. (2017), Facebook Imitates Snapchat Again With Camera Filters and Stories. *Fortune*, Accessed April 9th, 2019. http://fortune.com/2017/03/28/facebook-imitates-snapchat-again/

ISO, I. (1999). 13407: Human-centred design processes for interactive systems. *Geneva: ISO*.

JASP Team (2018). JASP (Version 0.9)[Computer software]

Javornik, A. (2016). Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour. *Journal of Retailing and Consumer Services, 30*, 252–261. https://doi.org/10.1016/j.jretconser.2016.02.004

Jennings, M. (2000). Theory and models for creating engaging and immersive ecommerce Websites. In *dl.acm.org* (pp. 77–85). https://doi.org/10.1145/333334.333358

Kahneman, Daniel and Tversky, Amos, (1979), Prospect Theory: An Analysis of Decision under Risk, *Econometrica, 47*, issue 2, p. 263-91,

Kastrenakes, J. (2017). Google's Project Tango is shutting down because ARCore is already here. *The Verge*, Accessed April 9th, 2019. https://www.theverge.com/2017/12/15/16782556/project-tango-google-shutting-down-arcore-augmented-reality

Kim, S., & Baek, T. H. (2018). Examining the antecedents and consequences of mobile app engagement. *Telematics and Informatics, 35*(1), 148-158.

Kohles, C. (2019). 7 Statistics every App developer should know about augmented reality. *Wikitude*. Accessed April 9th, 2019. https://www.wikitude.com/blog-7-stats-app-developer-augmented-reality/

Kostyla, A. S., Clydesdale, F. M., & McDaniel, M. R. (1978). The psychophysical relationships between color and flavor. *Critical Reviews in Food Science & Nutrition, 10*(3), 303–321.

Koui, E. (2017). Avant l'appétit: An augmented reality interactive menu that elevates the gourmet food experience. *Rochester Institute of Technology.*

Kovach, S. (2014). Facebook Buys Oculus VR For $2 Billion. *Business Insider.* Accessed April 9th, 2019. https://www.businessinsider.com/facebook-to-buy-oculus-rift-for-2-billion-2014-3?IR=T

Krondl, M. M., & Lau, D. (1978). Food habit modification as a public health measure. *Canadian Journal of Public Health/Revue Canadienne de Sante'e Publique*, 39–48.

Krondl, M., Lau, D., Yurkiw, M. A., & Coleman, P. H. (1982). Food use and perceived food meanings of the elderly. *Journal of the American Dietetic Association, 80*(6), 523–529.

Lavie, T., & Tractinsky, N. (2004). Assessing dimensions of perceived visual aesthetics of web sites. *International journal of human-computer studies, 60*(3), 269-298.

Law, E. L.-C., Roto, V., Hassenzahl, M., Vermeeren, A. P. O. S., & Kort, J. (2009). Understanding, scoping and defining user experience: a survey approach. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 719–728).

Leal-Rodríguez, A. L., Ariza-Montes, J. A., Roldán, J. L., & Leal-Millán, A. G. (2014). Absorptive capacity, innovation and cultural barriers: A conditional mediation model. *Journal of Business Research*, *67*(5), 763-768.

Lee, T., & Hollerer, T. (2007). Handy AR: Markerless Inspection of Augmented Reality Objects Using Fingertip Tracking BT. *In 2007 11th IEEE International Symposium on Wearable Computers* (pp. 1–8).

Lee, K. (2012). Augmented reality in education and training. *TechTrends, 56*(2), 13–21.

Le Petit Chef (2019). In the footsteps of Marco Polo. Accessed February 25th, 2019. http://www.lepetitchef.com/

Levin, I. P., Johnson, R. D., Russo, C. P., & Deldin, P. J. (1985). Framing effects in judgment tasks with varying amounts of information. *Organizational behavior and human decision processes*, *36*(3), 362-377.

Levin, Irwin P. (1987), Associative Effects of Information Framing, *Bulletin of the Psychonomics Society, 25* (March),85-86

Levin, I. P., & Gaeth, G. J. (1988). How consumers are affected by the framing of attribute information before and after consuming the product. *Journal of Consumer Research, 15*(3), 374–378.

Mauroner, O., Le, L., & Best, S. (2016). Augmented reality in advertising and brand communication: an experimental study. *World Acad Sci Eng Technol Int J Soc Behav Educ Econ Bus Ind Eng, 10*, 422-425.

McCarthy Jerome, E. (1960). Basic Marketing-A Managerial Approach. *Irwin, Illinois*.

Milgram, P., & Kishino, F. (1994). a Taxonomy of Mixed Reality Visual Displays. *IEICE Transactions on Information Systems, 77*(12), 1321–1329.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995). Augmented reality: A class of displays on the reality-virtuality continuum. In *Telemanipulator and telepresence technologies* (Vol. 2351, pp. 282–293).

Miller, R. & Constine, J. (2015). Apple Acquires Augmented Reality Company Metaio. *Techcrunch*. Accessed April 9th, 2019. https://techcrunch.com/2015/05/28/apple-metaio/

Monk, A. (1985). *Fundamentals of human-computer interaction*. Academic Press. Retrieved from https://books.google.nl/books?id=L-IQAAAAMAAJ

Moon, D. (2018). Mobile AR is evolving faster than you think. *VentureBeat*. Accessed April 9th, 2019. https://venturebeat.com/2018/05/19/mobile-ar-is-evolving-faster-than-you-think/

Mudrick, C. (2019). The New Reality for Mobile Gaming: The VR/AR Opportunity. *Newzoo*. Accessed April 9th, 2019. https://newzoo.com/insights/articles/the-new-reality-for-mobile-gaming-the-vr-ar-opportunity/

Narumi, T., Ban, Y., Kajinami, T., Tanikawa, T., & Hirose, M. (2012). Augmented Perception of Satiety: Controlling Food Consumption by Changing Apparent Size of Food with Augmented Reality. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 109–118). New York, NY, USA: ACM. https://doi.org/10.1145/2207676.2207693

Nazlan, N. H. (2017). The Effects of Availability Heuristic Cues on Restaurant Purchase Decisions.

Neal, M. (2012). Creating and maintaining psychological flow state in augmented reality applications. In Proceedings of the International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government (EEE) (p. 1).

Norman, D. A. (2004). Emotional design: Why we love (or hate) everyday things. *Basic Civitas Books*.

O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. *Journal of the American Society for Information Science and Technology*, *59*(6), 938–955. https://doi.org/10.1002/asi.20801

O'Brien, H. L., Cairns, P., & Hall, M. (2018). A practical approach to measuring user engagement with the refined user engagement scale (UES) and new UES short form. *International Journal of Human-Computer Studies*, *112*, 28-39.

Oculus World (2018). Rise of Tomb Raider VR. Accessed November 15th, 2018. https://www.oculusworld.nl/oculus-apps/vr-games/rise-of-tomb-raider-vr/

Oculus World (2018). Batman Arkham VR. Accessed November 15th, 2018. http://www.oculusworld.nl/oculus-apps/vr-games/batman-arkham-vr/

Oculus World (2018). Eagle Flight VR. Accessed November 15th, 2018. http://www.oculusworld.nl/oculus-apps/vr-games/eagle-flight/

Ohla, K., Toepel, U., le Coutre, J., & Hudry, J. (2012). Visual-Gustatory Interaction: Orbitofrontal and Insular Cortices Mediate the Effect of High-Calorie Visual Food Cues on Taste Pleasantness. *PLoS ONE*, *7*(3), e32434. https://doi.org/10.1371/journal.pone.0032434

Okajima, K., & Spence, C. (2011). Effects of Visual Food Texture on Taste Perception. *I-Perception, 2*(8), 966–966. https://doi.org/10.1068/ic966

Okajima, K., Ueda, J., & Spence, C. (2013). Effects of Visual Texture on Food Perception. *Journal of Vision, 13*(9), 1078–1078. https://doi.org/10.1167/13.9.1078

OpenTable (2016), Menu Jargon Confounds Diners: Top Misunderstood Menu Terms Decoded. Accessed August 15th, 2019. https://blog.opentable.com/2016/top-misunderstood-menu-terms-decoded-survey-reveals-menu-jargon-confounds-american-diners/

Oronsky, C. R., & Chathoth, P. K. (2007). An exploratory study examining information technology adoption and implementation in full-service restaurant firms. *International Journal of Hospitality Management, 26*(4), 941–956.

Osborne, J. W. (2015). What is rotating in exploratory factor analysis. *Practical assessment, research & evaluation, 20*(2), 1-7.

Overbeeke, K., Djajadiningrat, T., Hummels, C., Wensveen, S., & Prens, J. (2003). Let's make things engaging. In *Funology* (pp. 7–17). Springer.

Palmer, A., Koenig-Lewis, N., & Asaad, Y. (2016). Brand identification in higher education: A conditional process analysis. *Journal of Business Research, 69*(8), 3033–3040.

Panetta, K (2018), 5 Trends Emerge in the Gartner Hype Cycle for Emerging Technologies, 2018. Accessed February 27th, 2019. https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/

Perez, S. (2018). ARKit-only apps top 13 million installs, nearly half from games. *Techcrunch*. Accessed April 9th, 2019. https://techcrunch.com/2018/03/28/arkit-only-apps-top-13-million-installs-nearly-half-are-games/

Permadi, D., Rafi, A. (2015). Developing a conceptual model of user engagement for mobile-based augmented reality games. *Jurnal Teknologi, 77*(29).

Pulos, E., & Leng, K. (2010). Evaluation of a voluntary menu-labeling program in full-service restaurants. *American Journal of Public Health*, *100*(6), 1035-1039.

Reese, E. D., Zielinski, M. J., & Veilleux, J. C. (2015). Facets of mindfulness mediate behavioral inhibition systems and emotion dysregulation. *Personality and Individual Differences*, *72*, 41-46.

Reichheld, F. F. (2003). The one number you need to grow. *Harvard Business Review*, *81*(12), 46–55.

Rekimoto, J., & Nagao, K. (1995). The world through the computer: Computer augmented interaction with real world environments. *Proceedings of the 8th Annual ACM Symposium on User Interface and Software Technology, 95* (pages, 29–36).

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development, 44*(2), 43–58.

Rogers, Y. (2012). HCI theory: classical, modern, and contemporary. *Synthesis Lectures on Human-Centered Informatics*, *5*(2), 1–129.

Rogers, Y., Sharp, H., & Preece, J. (2011). Interaction design: beyond human-computer interaction. *John Wiley & Sons*.

de Ruyter, K., Keeling, D. I., & Ngo, L. V. (2018). When nothing is what it seems: A digital marketing research agenda. *Australasian Marketing Journal (AMJ), 26*(3), 199-203.

Sandelowski, M. (1995). Sample size in qualitative research. *Research in nursing & health, 18*(2), 179-183.

Saner, E. (2015). Plate spinning: The smart chef's secret ingredient. *The Guardian*, 12th May. Accessed April 3rd, 2019. http://www.theguardian.com/lifeandstyle/shortcuts/2015/may/12/plate-spinning-smart-chefs-secret-ingredient-food-on-plate

Savov, V. (2015). Microsoft announces Windows Holographic with HoloLens headset. *The Verge*. Accessed April 9th, 2019. https://www.theverge.com/2015/1/21/7867593/microsoft-announces-windows-holographic

Scholz, J.,, Smith, A. N. (2016). Augmented reality: Designing immersive experiences that maximize consumer engagement. *Business Horizons, 59*(2), 149–161. https://doi.org/10.1016/j.bushor.2015.10.003

Schönfeld, P., Brailovskaia, J., Bieda, A., Zhang, X. C., & Margraf, J. (2016). The effects of daily stress on positive and negative mental health: Mediation through self-efficacy. *International Journal of Clinical and Health Psychology, 16*(1), 1-10.

Shin, D. (2017). How does immersion work in augmented reality games? A user-centric view of immersion and engagement. *Information Communication and Society, 1*–18. https://doi.org/10.1080/1369118X.2017.1411519

Shneiderman, B. (1997). Direct manipulation for comprehensible, predictable and controllable user interfaces. In IUI (Vol. 97, pp. 33–39).

Shoemaker, S., Dawson, M., & Johnson, W. (2005). How to increase menu prices without alienating your customers. *International Journal of Contemporary Hospitality Management, 17*(7), 553–568.

Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. *John Wiley & Sons*.

Shabani, N., Munir, A., & Hassan, A. (2019). E-Marketing via Augmented Reality: A Case Study in the Tourism and Hospitality Industry. *IEEE Potentials*, *38*(1), 43–47.

Shah, A. M., Bettman, J. R., Ubel, P. A., Keller, P. A., & Edell, J. A. (2014). Surcharges plus unhealthy labels reduce demand for unhealthy menu items. *Journal of Marketing Research*, *51*(6), 773-789. Accessed March 28th, 2019. https://journals.sagepub.com/doi/Figure/10.1509/jmr.13.0434

Simonson, I., & Tversky, A. (1992). Choice in context: Tradeoff contrast and extremeness aversion. *JMR, Journal of Marketing Research*, *29*(3), 281.

Spence, C., & Piqueras-Fiszman, B. (2013). Technology at the dining table. *Flavour*, *2*(1), 16. https://doi.org/10.1186/2044-7248-2-16

Spence, C., Okajima, K., Cheok, A. D., Petit, O., & Michel, C. (2016). Eating with our eyes: From visual hunger to digital satiation. *Brain and Cognition, 110*, 53–63.

Suarez, N., Berezina, K., Yang, W., & Gordon, S. (2019). Are restaurant customers ready for tablet-based menus? *International Journal of Contemporary Hospitality Management.*

Sutcliffe, A. (2009). Designing for user engagement: Aesthetic and attractive user interfaces. *Synthesis Lectures on Human-Centered Informatics*, *2*(1), 1–55.

Sutcliffe, A., & De Angeli, A. (2005). Assessing interaction styles in web user interfaces. In *IFIP Conference on Human-Computer Interaction* (pp. 405–417).

Sutherland, I. E. (1965). The ultimate display. *Multimedia: From Wagner to Virtual Reality,* 506–508.

Sutherland, I. E. (1968). A head-mounted three dimensional display. In *Proceedings of the December 9-11, 1968, fall joint computer conference, part I* (pp. 757-764). ACM.

Szczesniak, A. S. (1972). Consumer awareness of and attitudes to food texture II. Children and teenagers. *Journal of Texture Studies, 3*(2), 206–217.

Tassi, P. (2018). Pokémon GO' Has Just Crossed $2 Billion In Revenue Since Launch, Almost An Industry Best. *Forbes*. Accessed April 9th, 2019. https://www.forbes.com/sites/insertcoin/2018/09/25/pokemon-go-has-just-crossed-2-billion-in-revenue-since-launch-almost-an-industry-best

Tech Pro Research (2016). Research: Virtual and augmented reality in the enterprise. Accessed December 18th, 2017 from http://www.techproresearch.com/downloads/research-virtual-and-augmented-reality-in-the-enterprise/

TechRepublic (2016). Executive's guide to the business value of VR and AR. Accessed December 18th, 2017 from https://www.techrepublic.com/resource-library/whitepapers/executive-s-guide-to-the-business-value-of-vr-and-ar-free-ebook/

Terveen, L. G. (1995). Overview of human-computer collaboration. *Knowledge Based Systems*, *8*(2), 67–81.

Thomas, B., Demczuk, V., Piekarski, W., Hepworth, D., & Gunther, B. (1998). A wearable computer system with augmented reality to support terrestrial navigation. In *International Symposium on Wearable Computers, Digest of Papers* (Vol. 1998–October, pp. 168–171). https://doi.org/10.1109/ISWC.1998.729549

Thomas, P., & Macredie, R. D. (2002). Introduction to the new usability. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *9*(2), 69–73.

Toms, E. G., Wilson, T. D., & Allen, D. K. (1998). What motivates browsing? In *Exploring the contexts of information behaviour* (pp. 191–208). Taylor Graham.

Toms, E.G. (2002). Information interaction: Providing a framework for information architecture. *Journal of the American Society for Information Science and Technology, 53*(10), 855–862.

Tractinsky, N. (1997). Aesthetics and apparent usability: empirically assessing cultural and methodological issues. In *Proceedings of the ACM SIGCHI Conference on Human factors in computing systems* (pp. 115–122).

Ullmer, B., & Ishii, H. (2000). Emerging frameworks for tangible user interfaces. *IBM Systems Journal, 39*(3.4), 915–931.

Wang, C. H., Chiang, Y. C., & Wang, M. J. (2015). Evaluation of an augmented reality embedded on-line shopping system. *Procedia Manufacturing, 3*, 5624-5630.

Wansink, B., Painter, J., & Ittersum, K. V. (2001). Descriptive menu labels' effect on sales. Cornell Hotel and Restaurant Administration Quarterly, 42(6), 68-72.

Wickstrom G, Bendix T. (2000), The "Hawthorne effect" - what did the original Hawthorne studies actually show? *Scand J Work Environ Health, 26*(4):363-367.

Yuan, Y. (2018). Augmenting Food Experience While Traveling Abroad by Using Mobile Augmented Reality Application. In *International Conference on Cross-Cultural Design* (pp. 259–268).

Yuen, S. C.-Y., Yaoyuneyong, G., & Johnson, E. (2011). Augmented reality: An overview and five directions for AR in education. *Journal of Educational Technology Development and Exchange (JETDE), 4*(1), 11.

Yussof, F. M., Salleh, S. M., & Ahmad, A. L. (2019). Augmented Reality: A Systematic Literature Review and Prospects for Future Research in Marketing and Advertising Communication. In *Intelligent and Interactive Computing* (pp. 459-473). Springer, Singapore.

8. Appendices

8.1 Original short form User Engagement Scale

The short form User Engagement Scale items found in Table 4.2 were translated and applied from the following original statements (O'Brien et al. 2018).

FA.1 I lost myself in this experience.

FA.2 The time I spent using Application X just slipped away.

FA.3 I was absorbed in this experience.

PU.1 I felt frustrated while using this Application X.

PU.2 I found this Application X confusing to use.

PU.3 Using this Application X was taxing.

AE.1 This Application X was attractive.

AE.2 This Application X was aesthetically appealing.

AE.3 This Application X appealed to my senses.

RW.1 Using Application X was worthwhile.

RW.2 My experience was rewarding.

RW.3 I felt interested in this experience

8.2 Questionnaire

The questionnaire used in this field study is presented on the next two pages. The questionnaire is in Dutch and the questions are in the next specific order; Question 1 is a manipulation check. Questions 2-4 are 'attitude' questions. Questions 5-16 are translated, randomized questions from existing Participant Engagement Study research (a short form version). Question 17 is used to calculate the NPS score of the restaurant. Questions 18-20 are demographic questions.

The study was performed in May 2018. The restaurant was closed on Mondays and Tuesdays, so these days were not used for data collection.

Dank u wel voor het meedoen aan mijn afstudeeronderzoek van de Technische Universiteit Delft. Met deze enquête meet ik uw ervaring met de menukaart van de Waterwolf Brasserie. De verzamelde gegevens worden anoniem geanalyseerd. Bovendien is uw deelname volledig vrijwillig. Wanneer u nog vragen, opmerkingen of moeilijkheden hebt, kunt u mij daarover aanspreken. Het invullen van de vragenlijst duurt 5-8 minuten. U kunt nu beginnen met de eerste vraag.

1. Welk type menukaart heeft u voor de brunch gekregen?

○ Een gedrukte, papieren menukaart ○ Een digitale, 3d menukaart op de iPad

2. In hoeverre kwamen de gerechten overeen met uw verwachtingen? De gerechten waren…

Helemaal niet zoals verwacht ○ ○ ○ ○ ○ Exact zoals verwacht

3. In hoeverre kwamen de porties van de gerechten overeen met uw verwachtingen? De porties waren…

Veel kleiner dan verwacht ○ ○ ○ ○ ○ Veel groter dan verwacht

4. In hoeverre was de prijs belangrijk voor uw keuze van de gerechten? De prijs was…

Zéér onbelangrijk ○ ○ ○ ○ ○ Zéér belangrijk

De volgende uitspraken gaan over uw ervaring met de menukaart. Geef telkens aan in hoeverre u het eens of oneens bent met de gemaakte uitspraak.

5. Ik vond de menukaart verwarrend om te gebruiken.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

6. Ik vergat even mijzelf toen ik de menukaart bestudeerde.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

7. Ik was verdiept in deze menukaart.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

8. Het was de moeite waard om deze menukaart te gebruiken.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

9. Deze menukaart deed een beroep op mijn zintuigen.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

10. Mijn ervaring met de menukaart was lonend.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

11. Ik voelde me gefrustreerd tijdens het bestuderen van deze menukaart.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

12. De tijd vloog voorbij terwijl ik deze menukaart bestudeerde.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

13. Het gebruik van deze menukaart is intensief/belastend.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

14. Deze menukaart was interessant.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

15. Deze menukaart zag er aantrekkelijk uit.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

16. Ik vond deze ervaring interessant.

○ Zéér mee oneens ○ Mee oneens ○ Neutraal ○ Mee eens ○ Zéér mee eens

17. Hoe waarschijnlijk is het dat u de Waterwolf Brasserie aanbeveelt aan vrienden of collega's?

Helemaal niet waarschijnlijk	1	2	3	4	5	6	7	8	9	10	Buitengewoon waarschijnlijk
	○	○	○	○	○	○	○	○	○	○	

18. Is dit uw eerste bezoek aan dit restaurant?

○ Ja ○ Nee

19. Wat is uw geslacht?

○ Vrouw

○ Man

○ Anders

○ Zeg ik liever niet

20. Wat is uw leeftijd?

○ 17 jaar of jonger

○ 18-24 jaar

○ 25-34 jaar

○ 35-64 jaar

____

Einde van de enquête. Dank u vriendelijk voor het meedoen. Ik zal deze na uw vertrek op komen halen.