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Title:
Supporting shopping activities with mobile phone technologies: Understanding and affecting customers' behaviour

Theme:
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Project Group:
f11d616a

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Abstract:

The contents of this study is comprised of two articles and a summary of the overall project. In order to understand customers' behaviour, two shopping processes, conventional and self-service shopping, are defined. We attempt to analyse and understand these shopping processes in order to support them with mobile phone technologies. Furthermore, we examine how one can affect customers' shopping behaviour with a mobile phone application in the conventional shopping process. Features and technologies, needed to support the activities of the shopping processes, are identified to discover possible technological challenges during development.
To affect customers' shopping behaviour, we present TaKO, a persuasive mobile phone application. TaKO implements two persuasive principles, reduction and suggestion, in an attempt to affect the customer's shopping behaviour. TaKO supports customers during decision making by providing quick product health assessment and suggestions to healthier products. The field studies conducted, showed that customers' shopping behaviour did get affected by the reduction technique as it helped them quickly assess the products' healthiness and make them reflect on this. Furthermore, we discovered that it is difficult to find the right moment to use suggestions to affect customers behaviour.

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Preface

This master thesis is written by three software engineering students, currently attending tenth semester at Aalborg University. The course of the project was commenced on the 1st of February 2011 and the master thesis was handed in on the 16th of June 2011.

We would like to use this opportunity to thank everyone from Harald Nyborg and Føtex for their help and effort. Furthermore, we would also like to thank our supervisor Jan Stage for his advice and guidance during this semester. Lastly, we would like to thank all our participants for helping us in the time of need.

Two types of source references are used throughout the master thesis. A reference placed at the end of a sentence or section, refers to the given section, and if the reference is in a sentence, it refers to the particular sentence or word. Sources to the references used throughout this report can be found at the end of each part the master thesis in the bibliography.

Aalborg, June 2011
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Contents

1 Introduction

The mobile phone has become an important device for most people and it used to be a single purpose device for communication. However, the mobile phone has become a versatile device due to the vast number of applications available, such as mobile banking, localisation, gaming, etc. Studies show that most people carry a mobile phone and the number of subscriptions is still increasing [1]. Other studies show that many people consider the mobile phone a necessity. In fact, 75% of all mobile phone owners would not go outside their home without their mobile phone [2]. With the increasing proliferation, the mobile phone has much potential to be used in in-store shopping contexts [3].

We want to know if the mobile phone can be used in a shopping context to support customers while shopping. We want to examine if by using a mobile phone to support customers' shopping activities it is possible to affect their shopping behaviour. For this we have to understand what is required to develop such a mobile phone application and to understand shopping processes. The overall research question for this study is to understand shopping processes in order to support shopping activities with mobile phone technologies and affect customers' shopping behaviour in an in-situ grocery shopping context.

To understand the shopping context in where a mobile phone application can be used, we examine two shopping processes, self-service and conventional shopping. The first research question concerns the understanding and analysis of two shopping processes, conventional and self-service shopping, and the identification of features that are needed to support these activities and which technological challenges exist in implementing them with current mobile phone technology.

One area of shopping we find interesting is grocery shopping [4]. The statistics show that overweight and obesity issues are becoming a part of the western society, e.g., 46% of the Danish population is overweight and 13% is obese [5] [6]. These facts have created a general focus on healthy living and healthier diets. Research from Croll et. al. [7] shows that even with general awareness of what is required to live a healthy life it is still difficult to follow healthy eating recommendations.

There have been some attempts to change customers' shopping behaviour, by using technology, such as iCart [8] [9]. iCart is a trolley-mounted system which helps customers identify how healthy a product is and can recommend health-

ier products, should the customers put an unhealthy product in the shopping trolley. Another example of using mobile technology in a shopping context is iGrocer [10] which is a mobile phone application helping customers prepare and plan their weekly grocery shopping.

We want to see if by using a mobile phone application and two persuasive design principles, reduction and suggestion, we can affect customers' shopping behaviour. The second research question is whether we can affect customers' shopping habits towards a healthier behaviour. For this purpose we develop TaKO, a persuasive mobile phone application.

This summary is comprised of the following chapters. Chapter 2 gives an overview of the two articles and a summary of each article. Chapter 3 presents the research methods used in this study and, finally, chapter 4 consists of the conclusion, limitations and future work.

2
Article Overview

The work done in the two articles and their contributions to the answer of the research questions is described in this chapter.

2.1 Article 1: Understanding shopping processes

This article focuses on analysing and understanding two shopping processes, conventional and self-service shopping processes. Furthermore, we identify features for a mobile application that can support the activities of the self-service shopping process. Finally, technological challenges that exist in implementing these features with the current mobile phone technology, are described. The article pinpoints interesting activities that are relevant to support with mobile phone technology. A field study, consisting of observations, customer interviews and a focus group with the employees from Harald Nyborg, is conducted to identify needs, problems and annoyances of both customers and employees.

Figure 2.1 shows the conventional and the self-service shopping process with features and the activities they support. These features are defined such that they all support one or more of the activities we have focused on. Also, functions to enable the customers to use these features are defined. Furthermore, the technological challenges encountered when implementing these features are described. This is done for each feature and where applicable, multiple alternatives are shown with emphasis on the most suitable technology.

In conclusion, this article shows that the current mobile phone technology is sufficient for implementing the required features for this type of application. The defined features are all possible to implement, however features that require Near Field Communication (NFC) are not easily implemented as NFC is not proliferated and thus entails more uncertainty.

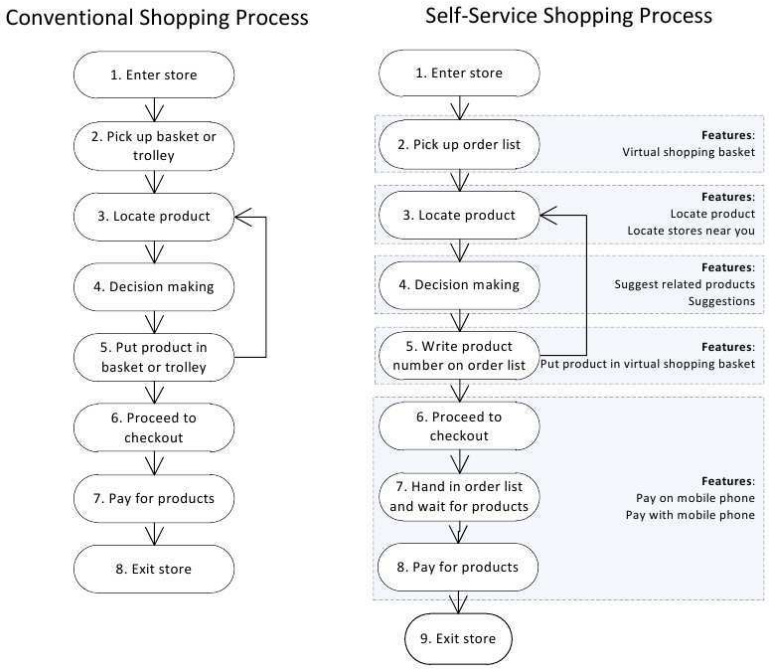

Figure 2.1: Conventional shopping process and the supported self-service shopping process.

2.2 Article 2: A persuasive mobile phone application

In this article we attempt to affect shopping behaviours and presents an interaction design and implementation used in the development of a mobile phone application. Fogg's design principles [11], reduction and suggestion, are used in an attempt to affect customers' shopping behaviour. The research question in this article is whether we can affect customers' shopping habits towards a healthier behaviour. For this purpose we develop TaKO, a persuasive mobile phone application used to affect customers' shopping behaviour in the conventional shopping process.
The development of TaKO lasted 10 weeks. An external barcode scanner was integrated into TaKO. In order to create the extensive database we manually scanned over 4600 products in a local supermarket and each product was mapped to a product in the nutrition database, retrieved from [12].

Three field studies are conducted, an in-shop, a longitudinal and a distributed evaluation. The in-shop evaluation is conducted as a replication of the iCart [8] study. We examine how iCart approaches persuasion and change some factors in order to see if this altered approach presents different results. The distributed evaluation is conducted over two months as TaKO is available on Android Market and users are free to use the application as they like. TaKO gathers data anonymously from the participants and logs the data such that we can analyse

the use of TaKO in order to see if any changes in the participants shopping behaviour over time occur. Furthermore, a longitudinal evaluation is conducted over a period of three weeks to see if we can observe a different effect when the participants use TaKO for a longer period of time.

The study shows that reduction was successful in enabling the participants of the evaluations to quickly assess products' healthiness. This made several participants reflect about the healthiness of their groceries and this fits well with Fogg's reduction principle. Suggestions, on the other hand, did not have a significant impact, however the participants requested a more specific suggestion in order to have an effect on them. The results indicate that it is difficult to affect our participants' shopping behaviour due to their preferences and specific requirements for products. The opportune moment to present the suggestions was thought to be when the participants took the product of the shelf, but the results indicate that this moment is much earlier. This work shows promise for TaKO and the interaction design principles, reduction and suggestion and warrants future work for further evaluation.

3
Research Methods

In this study we have used a number of research methods to collect data for analysis. The followings sections describe the research methods used.

3.1 Observations

We have used observations to observe how customers behaved while shopping in the self-service and the conventional shopping process.

Method: We have used observations since it is a fast and unobtrusive way of gathering data on customers' behaviour in in-store shopping. We observed customers while shopping and took note of things like, whether they used the catalogue or not.

Limitation: According to Lazar et. al. [13], observations are prone to bias and misinterpretations. To avoid this the observer must strive to only record what is seen and try not to interpret what is seen. Observations require skills in order to be truly unbiased.

Procedure: In our observations we gathered facts such as how many customers used a shopping list or whether the customers used the catalogue during shopping or not. These observations are generally not subject to misinterpretations as they do not require much interpretation to comprehend.

3.2 Interviews

Combined with observations we conducted interviews with random customers in the self-service shopping and the participants from the in-shop and longitudinal evaluation.

Method: Interviews were done in order to understand their shopping behaviour and their experiences with the relevant shopping processes. The ability to get detailed feedback from the participants made interviews a suitable choice of research method. The interviews were semi-structured with the planned questions being general and then supplied with more specific questions during the interviews. Additionally, the questions were open-ended encouraging the participants to be more detailed and prolonged in their answers.

Limitations: The pitfall of interviews is that they can be difficult to conduct and require skills and experience. Lazar et. al. [13] states that since interviews can take a long time to conduct and the analysis afterwards is time consuming it is often a good idea to combine interviewing with other methods such as observations and focus groups.

Procedure: While Lazar et.al. [13] states that when one is not experienced at conducting or analysing interviews one should aim at doing fully structured interviews. We still chose to make a semi-structured interview as we wanted to ask follow-up questions on their answers and have the ability to ask questions that were thought of during the interview. We decided to combine interviews with observations and surveys in order to get more data that does not require as much time to analyse afterwards.

3.3 Focus Group

We conducted a focus group with employees to understand their needs and which problems they experienced with the self-service shopping process and with customers' behaviour.

Method: The focus group was used to obtain a broad range of opinions and insights. It can inspire an ongoing conversation in the group and therefore yield a lot data in a relative short time. This is a very good supplement to interviews as the discussions can raise issues that are difficult to raise in a one-on-one interview.

Limitations: Lazar et. al. [13] states that when conducting focus groups it is advisable to conduct at least two sessions as it increases the chance of success and that the number of participants should be five to seven people at most.

Procedure: Our focus group was conducted only once with 11 employees participating. This could have been split into two smaller focus groups and then the participants might have been more active and the feedback more useful. The focus group should have been conducted at a better time such that the participants would not be distracted by other things. The semi-structured focus group was conducted during breakfast before the shop was about to open and this was not the best time as the participants were eating during the focus group and therefore not fully focused. However, we still managed to get some useful feedback from the participants.

3.4 Survey

Surveys were used to provide a useful overview and did not require time consuming analysis.

Method: We used the survey from iCart for the in-shop and the longitudinal evaluation. The strength of surveys is to get a large number of responses [13], however we only used it for the participants in the mentioned evaluations.

Limitations: According to Lazar et. al. [13], surveys have some major drawbacks, as they often do not allow for follow-up questions should they reveal interesting data. Another drawback is that surveys can lead to biased data, due to misinterpretation.

Procedure: The surveys were used as an additional data to the qualitative data, since the data collected from surveys is not as in-depth as in the other research methods, but they provide useful data for overview. In order to allow follow-up questions we also conducted interviews with the participants and to prevent biased data we used the interviews to ask the participants of further details regarding any anomalies in their answers.

3.5 Limitations

The major limitations of our research methods was that we did not conduct the focus group according the theory of Lazar et. al. [13] and this resulted in the focus group yielding less data than we probably would have gotten if it was conducted according to the theory. The focus group should have been split into two smaller focus groups and they should have taken place on a more appropriate time.

Another limitation was the surveys. We used the same survey from the iCart project as the questions were quite relevant to our study. However they could have been made from scratch in order to adapt the question better to our study. This could have resulted in questions that were more related to TaKO and our study.

4
Conclusion

In this master thesis we have examined how one can affect the shopping behaviour of customers by using mobile phone technologies. In order to do this we have conducted two studies; one where we examined shopping processes and determine which technological challenges exist in developing a mobile phone application that can support these shopping processes. In the other study, we have conducted three evaluations where we use a mobile phone application in a longitudinal evaluation to see if we can change customers' shopping habits towards a healthier behaviour.

The first research question concerns the understanding and analysis of two shopping processes. We identified the difference between the two shopping processes and which features are needed to support the activities of a self-service shopping process. Furthermore, the technological challenges that exist in implementing these features with current mobile phone technology, were described. The yield of this study shows that it is feasible to develop a mobile phone application for shopping contexts with existing technologies. It also identifies which shopping activities are suitable for supporting and which features and functions are appropriate and finally, which technological challenges are to be expected when developing an application for supporting shopping processes.

The second research question concerns whether it is possible to affect customers' shopping habits towards a healthier behaviour. For this purpose we developed TaKO, a mobile phone application used in the conventional shopping process. Three field studies were conducted with TaKO and the findings from these studies show that while participants' shopping behaviour is difficult to affect, TaKO made the participants reflect on what they purchase. The reduction principle used in TaKO with the Eat Most classification had an impact on all participants. They found it useful to quickly assess the products' healthiness. Most participants stated that if the suggestions were more specific and relevant, they would be inclined to follow the suggestions more often. The findings indicate that the suggestions were not used at an opportune moment, as defined by Fogg. Since many participants stated that they already knew which products to purchase before they entered the store, we believe this opportune moment is earlier.

The overall research question concerns whether it is possible to support customers' shopping activities with mobile phone technologies and affect their shopping behaviour. The study has shown that it is feasible to develop a mobile

phone application that can support customers while shopping. We have provided features that support shopping activities and explored which technological challenges to expect when implementing these features. The results from the field studies show that it is possible to affect customers' shopping behaviour. The participants stated that they would be inclined to change their original choice of product if the suggestions were more personalised and the suggested products were more specific.

When evaluating the results of our study, some limitations of the study should be taken into account. During the initial analysis we conducted some interviews of customers in a self-service shopping process. According to Lazar et. al. [13] it is recommended to conduct fully structured interviews when the interviewer is not experienced in conduction interviews. The focus group that was conducted did not yield as much data as it could have since it was obstructed by multiple disturbances. First, it was conducted during breakfast and this meant the participants were eating during the focus group, leaving them not very focused. The focus group was quite large, 11 participants and this should have been split up into two smaller focus groups as suggested by Lazar et. al. [13].
In future work the application used for this evaluation should be improved with most requested features by the participants. The suggestions should be improved such that the suggested products are similar to the scanned product along with the suggestions being more personalised. Experimental work will also be needed to demonstrate the applicability of the identified features in a real-life shopping context. The findings of this work show that the system has promise and therefore warrants further evaluation on a larger scale with more participants to get more representative data. We used two of Fogg's design principles, reduction and suggestion. Fogg states that suggestions should be used at an opportune moment, and based on the findings, we misjudged this moment and the opportune moment should be earlier. We propose an improvement to TaKO that will allow customers to prepare a shopping list from home since this is where our participants decided which products to purchase and explore if this is a suitable moment to display suggestions.

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Understanding shopping processes and identifying features and technological challenges to support self-service shopping with mobile phones

Torhallur Kirke, Alen Rokic & Carl Rasmus van der Burg

16-06-2011

Abstract

Mobile phones have become more important for people over the years. Where the main purpose of a mobile phone used to be to communicate with other people, the mobile phone has become a multi-purpose device with a similar capability as that of a computer. New technologies are introduced in mobile phones furthering the increasing versatility of the mobile phone. In this article we look into how these technologies can be utilised to support the activities customers goes through while shopping in stores. After the initial analysis we look into what the conventional shopping process looks like and then we examine the more modern self-service shopping process to find out which activities can be supported by mobile phones. Features are then defined to support the shopping activities in the conventional shopping process and finally we identify the technologies required to implement these features.

1. Introduction

New technologies present the opportunity to affect peoples' daily activities. Most people carry a mobile phone and the trend shows an increasing growth of mobile phone subscriptions in the last decade [5]. 75% of mobile phone owners would not leave their home without it and 25% would rather lose their wallet than their mobile phone [17]. This shows how important a device the mobile phone is for people, and with more advanced mobile technology being introduced, the mobile phone makes an interesting platform for reaching the customers [10].

The primary feature in mobile phones is communication, however, advanced features are becoming available as technologies progress. With the advent of smartphones, the capabilities are extended to include things like location-based services, mobile banking, augmented reality, social networking, gaming etc. Especially the ability to use applications on smartphones has transformed the mobile phone from a single-purpose device used for communication to a multi-purpose device used for various purposes. Recent advancements in mobile communication technologies has also enabled mobile phone users to establish connections and exchange information between mobile devices by bringing them close to each other [12], making the modern mobile phone a powerful device.

An interesting aspect to explore is whether this technological innovation in mobile phones can be used in a shopping context. The purpose of this article is to understand and analyse two shopping processes, conventional and self-service, and to identify features that are needed to support the shopping activities in the self-service shopping process and which technological challenges exist in implementing them with current mobile phone technology.

The contents of this article is presented in the following sections. Section 2 explains the related work. Section 3 identifies what a modern shopping process is and which activities it consists of. Section 4 is about the field study that we conducted in a store that uses self-service shopping. After this, the features to support self-service shopping are identified in section 5. Section 6 is about which technologies are required to implement those features in mobile technologies. Finally, the conclusion and limitations are presented together with future work.

2. Related Work

The research community has shown an increasing interest in using technology to support shopping activities. In this area we have found some interesting articles which are summarised in this section.

Irene et al. [1] seek to trigger remote purchasing of groceries via a new form of human computer interaction in ubiquitous computing. They have conceived a remote grocery shopping process based on touch enabled technologies. A customer can prepare a shopping list on an NFC enabled mobile phone by touching on Radio-Frequency IDentification (RFID) tags attached on items. He opens the refrigerator, touches the RFID tag on the remaining corn flakes, enters wanted quantity and touches the "buy" icon on the fridge and the order is sent. The results of their evaluation with 25 test subjects show that 70% of users declared that a touch-based interaction is ease of use and more than 55% were highly satisfied with it.

iGrocer is another attempt to use mobile phone technologies in grocery shopping [16]. This smart grocery shopping assistant makes use of a mobile phone with a barcode scanner accessory to provide personalised shopping lists, nutritional profile and "add by recipe" among other things. Its recommendations are based on the user's health profile and the nutrition content of a food item. No evaluation was conducted with the system.

Mobile Sales Assistant seeks to increase customers shopping experience in stores by allowing customers to check the stock availability of products by scanning Near Field Communication (NFC) tags with their NFC-equipped mobile phone. The tags are attached to products and allow the customer to get the information directly on their mobile phone. The customers do not need to wait for sales personnel since the requests from the mobile phone are sent directly to the store's ERP system. The application provides a benefit for both retailers and customers. [14]

In another paper, two researches are primarily focusing on consumer perceptions of new services and applications. They developed a pervasive retail system called MyGrocer [9]. The idea is, that a customer picks up a shopping cart with a tablet PC and an RFID sensor, which detects products placed in the cart. Every time a product is added to the cart, it is automatically removed from the shopping list on the screen. The system can show description of a product, detailed information, the total cost of the cart's contents, provide navigation assistance and other features. A large part of the test subjects said that MyGrocer significantly improved their shopping experience, while also being enjoyable and exciting. Constant awareness of total cost, price comparison, navigation system, and smart checkout, were the features that participants found most attractive.

3. A Modern Self-Service Shopping Process

We have examined a modern shopping process which we define as self-service shopping process. This process is used in IKEA and Harald Nyborg. This section describes how the self-service shopping differs from a conventional shopping process and examines the relevant activities that are interesting to support with mobile phone technology.

The conventional shopping process is known from the supermarkets and retail stores, such as stores that sell clothing and fashion, electronics, home appliances, sports equipment, etc. Not all retail stores use this shopping process, e.g. jewelry stores. The activities the customers goes through in a conventional shopping process are depicted in figure 1.

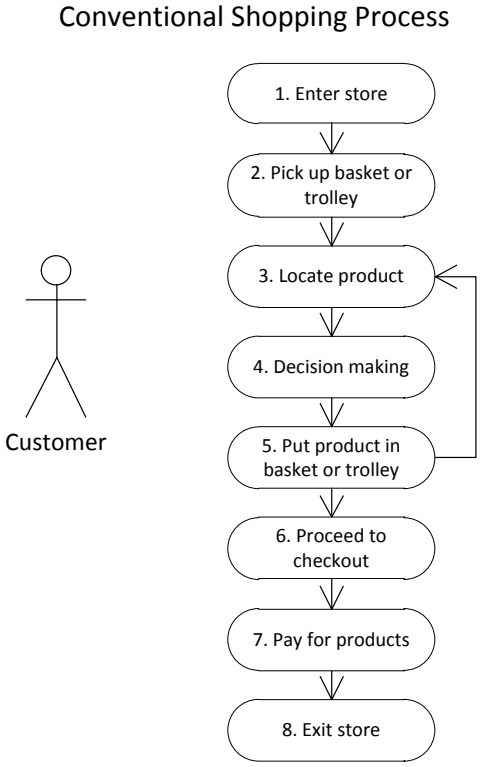

Figure 1: Conventional shopping process.

A description of the activities the customer goes through is as follows.

A customer enters the store. He picks up a basket or takes a trolley and starts looking for products that are displayed in the store. When the product has been located the customer chooses to either put this product in the basket/trolley or not. When the customer has made the decision, he can than proceed to locate other products he is interested in, thus there is an iteration. At the end, he proceeds to the checkout counters where he might stand in the queue. When it is his turn, he pays for the products with cash or credit card, picks up his products and leaves the store.

On the other hand, the self-service shopping process is characterised by the following. Just as in the conventional shopping process, the customer enters the store, but instead of picking up a basket or taking a trolley, he picks up a pencil and a sheet of paper located close to the entrance. This is an essential alteration of the conventional process. The paper is an order list and is characterised by being a special form where the customer must write down certain information and hand in the order list in order to buy products. There is a short description on the paper itself on how to shop in the store. The information he must fill in is things like product number, quantity, product name, and price. The essential difference in the self-service process is the order list which now can be considered as an abstract basket or trolley. The same applies for the product, which is abstract on the order list, and first becomes concrete in a later activity.

When the product has been located the customer is again left with the choice to buy this product or not. If he decides to buy it, instead of putting it in the basket, he must write down necessary information on the paper and this information is shown next to the product. It is necessary to point out a drawback at this stage, and it is that the customer cannot see if the desired product is on stock, since there currently is no indication of it. In the conventional process the customer can see, if there are more products of a certain item on the shelf. When all the desired products have been written down, he then proceeds to checkout and hands in the order list to the store clerks, where he gets a queue number. He waits while his products are fetched from the stock and when the queue number is called out, he is ready to pay. After payment, he picks up the purchased products and leaves the store. The self-service process is depicted in figure 2 and the grey boxes represent differences to the conventional process.

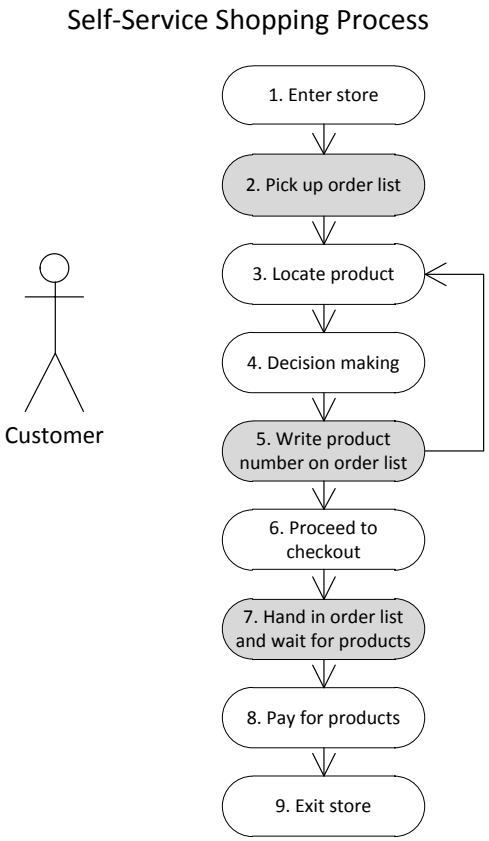

Figure 2: Self-service shopping process.

There are some advantages in both shopping processes. In grocery stores, it is desirable for customers to examine the products before purchasing them [8]. For instance when buying fresh food, it is desirable to take a look at the food in order to "feel" its quality and thus it is a compelling argument to use the conventional shopping process. The advantage of the self-service shopping process used in Harald Nyborg and IKEA is that, it is not necessary to exhibit all products of a certain type since they are exactly the same. It is enough to exhibit a single product of each category the customers can look at, and thus the self-service shopping process is more suitable for this kind of store. This gives the advantage of that the store can have a larger selection of products on display and have one or more external warehouses for storage.

4. Field Study in Harald Nyborg

We conducted a field study in Harald Nyborg, which constisted of customer interviews, observations and a focus group in order to understand the customers' as well employees' experience with this kind of shopping process. Each procedure is described and interesting results are listed.

4.1 Customer interviews

The interviews were all semi-structured and the questions asked were about their experience with the current process and their experience with mobile phones in general. Seven interviews were conducted with customers. Two of the customers had little experience with the current process while the others had more experience. The age span was 22-82 years, and the mean age was 46 years (SD = 19.49). Some of interesting results are listed below:

- Two customers did not know how to use the order list
- Two customers did not know what the shopping list was for
- Shopping list was often prepared from home

4.2 Observations

We observed the customers in the store, while they were shopping in order to get closer to reality, and thus reveal the pros and cons of the shopping process. Interesting results from the observations were:

- The order list was difficult to find
- Products were difficult to find
- The average age was high

4.3 Focus group

A focus group was convened with the employees. The purpose of it was to understand the needs, frustrations and concerns the employees might have with the shopping process as well generate ideas for improvements. 11 employees from the store participated and the questions were semi-structured. The analysed data from the audio recordings revealed some drawbacks with the current shopping process. The key elements that employees experienced are listed below:

- Interpreting the customers' handwriting from the order lists
- Mistyping product numbers when entering them in their system

The findings from the the field study gave an insight of the self-service shopping process and were used to compose use cases in the Cockburn format [2]. These use cases were used to elicited the features in the following section.

5. Supporting Shopping with Mobile Phones

In this section we look into which features are required in order to enable a mobile phone to support the previously listed shopping activities. These features are meant to support the activities in the self-service shopping process. The features are based on the data generated from the field study and the use cases. The activities we have chosen to support are:

- Pick up order list
- Locate product
- Decision making
- Write product number on order list
- Pay for products

Figure 3 presents an overview of the proposed features in this section and which activities they support. The proposed features are explained in the following sections.

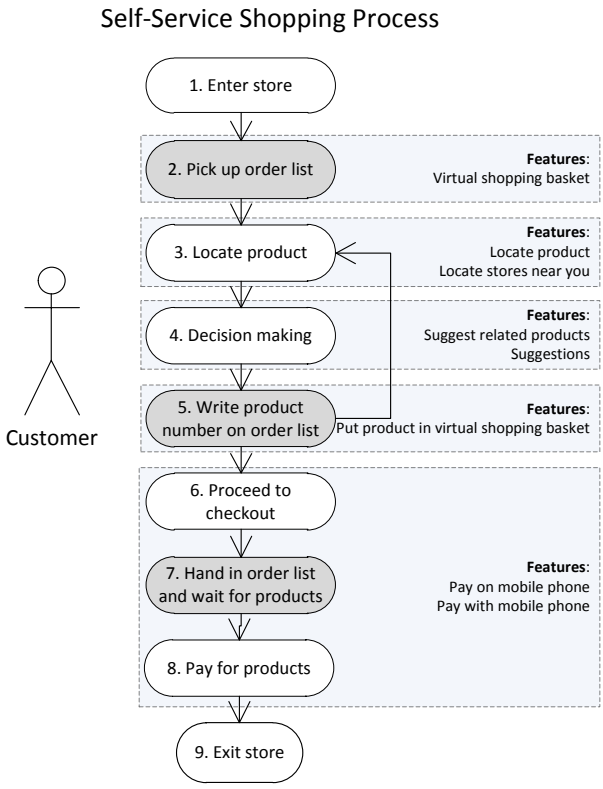

Figure 3: Supported activities.

5.1 Pick Up Order List

In the self-service shopping the customers pick up an order list on which the product numbers of desired products are written. In order to support this activity with mobile technology we need a feature that is mapped one-to-one from the physical order list to a virtual shopping basket. This virtual shopping basket contains abstract products matching the physical products in the shopping trolley. The order list from the self-service shopping will be

made obsolete, since the virtual shopping basket will contain the purchased products. The virtual shopping basket could serve as a convenient feature that provides information, e.g., total cost and could contain a shopping list that customers can prepare from home. A purchased product could then automatically be marked with a check mark on this shopping list when added to the virtual shopping basket. The virtual shopping basket should also provide functionality to add or remove products.

Supported activity:

- Pick up order list

Feature:

- Virtual shopping basket

Functions:

- Add/remove product to/from the virtual shopping basket
- Calculate the total cost
- Add/remove product to/from the shopping list

5.2 Locate Product

When customers browse a store looking for products, they might have to spend a little time trying to locate the specific product. This can be supported by mobile phone technology with a feature allowing the customer to use the mobile phone to locate the product. The data from the observations indicated that some customers had difficulty finding products in the store. To address this issue, the application could provide information about where the products are placed in the store. This could be achieved by showing a digital map over the store and directions to a specific product or product type. Additionally, it could be enhanced with the ability to find the desired product in other stores close to the customers' current location.

Supported activity:

- Locate product

Feature:

- Locate product
- Locate stores near you

Functions:

- Navigate to a product
- Display a map of the store showing the product's location
- Navigate to a nearby store
- Display a map showing the location of nearby stores

5.3 Decision Making

In this activity we examine how the application helps customers decide which products to buy. A common way to achieve this is by displaying related products in order to help the customers decide which products to purchase. Harald Nyborg's web shop displays related products as well as accessories when a customer clicks on a certain product, which is used to remind customers of other products that might be useful to buy as well. For instance, for a Hitachi drilling machine, it displays accessories such as drill bits in different lengths and under related products, there are products like screwdriver bits and other drilling machines. In the catalogue, accessories and related products are not shown per product, but shown for a product category.

The mobile application should suggest related products and accessories and also provide the ability to compare two products side-by-side in order to support the decision making process when standing in the store. Additionally, another way of helping the customers make a decision on which product to buy is to recommend other products to the customers. As an example, if a customer wants to buy a specific drilling machine, the mobile phone application could suggest other drilling machines

that are on sale or perhaps the application could suggest that the customer buys some drill bits.

Supported activity:

- Decision Making

Feature:

- Suggest related products

Functionality:

- Suggest accessories and related products
- Display two products side-by-side

5.4 Write Product Number on Order List

From our focus group analysis we discovered that a problem for employees in the self-service shopping process is that they had problems reading the customers' handwritings from the order list and they also mistyped the product numbers into their system. This activity can be automatised making the process of manually writing the product numbers on the order list and the manual transferral from order list to the system obsolete. We want to add a method of adding products that fully eliminates any manual typing of product numbers. To enable this, there needs to be some kind of product identification and use of technology that can scan the product number from a product. The next section examines which mobile phone technologies can enable this feature to be implemented.

Supported activity:

- Write product number on the order list

Feature:

- Put product in the virtual shopping basket

Functions:

- Add product to the virtual shopping basket

5.5 Pay for Products

Payment could be done on the mobile phone by entering payment credentials, similar to purchasing products online. We refer to this as pay on the mobile phone. Additionally, payment could be done by using the mobile phone itself as a credit card, by swiping it across a checkout counter provided for this purpose, referred to as pay with the mobile phone. The process where the customers proceed to checkout as well the activity where they hand in the order list are implicitly supported as the customers can pay without going to a checkout counter and the order list is handed in digitally. We look at the available technologies for implementing these features in the following section.

Supported activities:

- Proceed to checkout
- Hand in the order list and wait for products
- Pay for products

Feature:

- Pay on the mobile phone
- Pay with the mobile phone

Functions:

- Pay by entering credit card information
- Pay by swiping device across a scanner

Now that we have defined the features and coherent functions, we need to examine the underlying mobile phone technologies in order to implement these features.

6. Technologies in Mobile Phones

In this section we consider each of the defined features and examine the technological challenges there exists in implementing the features with the current technologies in mobile phones.

6.1 Virtual shopping basket

In order to add a product to the virtual shopping basket on a mobile phone, an approach needs to be taken, such that a user does not need to manually type product numbers. This requires technology that can provide product identification, so that the mobile phone can identify the product. This means that both the mobile phone and the product itself must be augmented with technology.

Technology already exists that can provide this ability. NFC is a novel technology developed especially for mobile phones and relies on touch-based interaction. It allows users to exchange information between NFC-enabled devices by holding them close to each other. The original goal for NFC is, that it needs to be human-centric and thus it needs to be easy, intuitive and fast. NFC is often mentioned in the context of smart objects, which are objects that have been augmented with RFID tags.

Using technology to tag objects is described in Want et. al. [20] and is the precursor for the research that tries to bridge the physical and virtual worlds. For instance, a box of cereal can be augmented with an RFID tag and scanned with a computational device that displays information about the product. This touch-based interaction between a user and a smart object is considered natural, quick, error resistant and secure [15].

NFC operates in three modes. First there is the Read/Write mode, where an NFC device can read or write data from a tag. Peer-to-Peer mode is where two NFC-devices are exchanging data. It is similar to Bluetooth, but without the need for pairing devices. Third mode is the Card Emulation, where an NFC device can emulate a smart card, meaning that it can act as payment card and be used for purchasing products.

The lack of NFC integration in mobile phones has hindered the proliferation of NFC. Besides proliferation, other limitations of NFC are the cost and work associated with equipping all products in a store with NFC-compatible tags. Another technology that has seen a much greater proliferation is the integration of a camera in mobile phones.

An already existing tag on products in stores is the well known barcode. Applications exist that can read barcodes by using the integrated camera. Although the products are already equipped with barcodes, there are some limitations. In order to scan a barcode with the mobile phone's camera, the customer is required to hold the camera at a proper distance and angle, which might vary by the size of the barcode, in order to get a successful scanning. Light reflection can also affect the scanning. Furthermore, it is not easy to scan barcodes that are not printed on a flat surface, such as a can or a plastic bag. NFC on the other hand does not have these limitations and tagging items with NFC tags can prevent theft [7]. Products could also be tagged with Quick Response (QR) codes which can be read by a mobile phone camera, however, they pose some of the same limitations as barcodes. Table 1 summarises the technologies for this feature.

6.2 Locate product

Localisation of products requires specific hardware present in the mobile phone in order to be functional. Localisation can be done indoors and outdoors. Indoor navigation is needed for localising products in stores by providing path guidance to customers, but it is a complex task that involves augmenting indoor space with special purpose technology like transmitters with ultrasound, as used in Cricket [13]. As an example, to locate a product it would require the mobile phone to connect to a wireless network and therefore requires that the phone supports Wi-Fi which most modern mobile phones do [18]. Indoor localisation can also be done with another technology available on mobile phones, Bluetooth [4]. Location information for outdoor navigation is provided using the Global Positioning System (GPS), and thus localisation of other stores requires a built-in GPS receiver in the mobile phone. Using GPS for indoor environments is not possible since the received signals from GPS satellites are too weak to provide an accurate lo-

	User interaction	Error prone
Enter product manually	High	High
Scan barcode with camera	Medium	Medium
Scan QR code with camera	Medium	Low
Scan product with NFC	Low	Very low

Table 1: Technologies for put product in shopping basket available on mobile phones.

cation [3]. The technologies available on modern mobile phones are summarised in table 2. So in order to use localisation it would require the mobile phone to offer wireless networking in form of Wi-Fi or Bluetooth and have a GPS receiver.

6.3 Decision making

To be able to display related products and suggestions, no specific technologies in mobile phones are required if the collection of products is stored on the mobile phone itself. If this database of products is stored externally on some server, the mobile phone will need wireless networking capabilities. Screen size and resolution of the mobile phone can have an impact on usability of this feature. For instance to provide the ability to compare two products side-by-side, a larger screen would be useful to have.

6.4 Payment

The card emulation mode of NFC is suitable for providing the ability to pay for products with the mobile phone itself. MasterCard and Visa are both companies that have been involved with projects where NFC is used for payments, MasterCard's PayPass [11] and Visa's payWave [19], respectively. Google has plans to run a trial in New York and San Francisco where there will be cash registers with NFC built-in so that owners of NFC-enabled phones like Google's own Nexus S could pay by touching the register with the mobile phone [6]. But it could also be implemented without the use of NFC and thus can be implemented in software which then requires some data transfer technology, e.g., wireless networking. Table 3 summarises the technologies for payments.

To illustrate how the defined features can be used in a mobile application that can support the self-service shopping process, we describe a scenario:

> A customer is looking at products in a store and notices one with a special offer. He picks it up and touches it with his mobile phone. The appropriate application is launched and the screen now displays various information such as price, point of origin, description, pictures, recommended products etc. He decides to purchase it, so he presses a button which adds it to his virtual shopping basket. He then decides to look at one of the related products in order to find its location in the store. The mobile phone displays a map of the store with a red dot of the product's location. When all the desired products have been added to virtual shopping basket, he sends the contents of the virtual shopping basket to the checkout counter. When the products are ready to be picked up he touches an NFC-enabled counter with his mobile phone and completes the purchase.

7. Conclusion

In this paper we have have described the self-service and conventional shopping processes in order to understand the activities customers go through when shopping in stores that use these shopping processes. Furthermore, we have analysed the self-service shopping process and identified features and technological challenges needed to support the self-shopping process with mobile phones. These were identified on the basis of the analysis of the self-service shopping process used in Harald

	Indoor	Outdoor	Accuracy
Positioning with Wi-Fi	√		8m
Positioning with Bluetooth	√		10m
Positioning with GPS		√	1-10m

Table 2: Localisation technologies available on mobile phones. [4] [18]

	with phone	on phone
Using Wi-Fi for payment		√
Using Bluetooth for payment		√
Using NFC for payment	√	

Table 3: Technologies available for payment on and with mobile phones.

Nyborg. Several problems were discovered in the field study at Harald Nyborg and features were proposed to address these problems. Furthermore, we have identified technological challenges that exist when implementing these features on a mobile phone with the current mobile phone technologies. The locate products and decision making features are relatively simple to implement with current technologies, while the two features virtual shopping basket and pay for products rely on NFC technology which lacks proliferation, and thus entails more uncertainty. Even though the current smartphones are getting NFC capabilities, NFC lacks proliferation and infrastructure.

A limitation in this paper is that we only conducted observations and interviews with seven customers which makes it difficult to generalise the severity of the problems. Another limitation is that we have not considered any negative side effects the mobile phone technologies can have on users' shopping experience, e.g., battery drain, learning curve of new technology and new way of shopping. In order to test the applicability of the identified features and technologies in a self-service shopping process, experimental work is needed.

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TaKO: A persuasive mobile phone application to affect in-situ grocery shopping behaviour

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Abstract:

With the advance of smartphones in recent years the applications for mobile phones are gaining more popularity. This presents the opportunity to use them for shopping purposes and persuasions by trying to convince the user to change his mind about choice of products. This article focuses on using mobile phones to affect people's choices towards healthier behaviour. We have developed TaKO, an Android application, which can be used while grocery shopping. Two persuasive design principles are used, reduction and suggestion. Three field studies have been made to analyse the effects of TaKO; A longitudinal, an in-shop and a distributed evaluation. Results indicate that decision making in grocery shopping is very complex. The reduction with the Eat Most classification was successful and received positive feedback from the participants. We discovered that the suggestions were not presented at the right moment which did not have the desired effect, however, the suggestions made the participants reflect upon their decisions.

1. Introduction

In the recent years overweight and obesity in western society have increased, e.g. over 46% of the Danish population is overweight and more than 13% is obese [18] [10]. This has brought focus on healthy living such as exercise and eating habits.

Studies have shown that consumer behaviour is not easily altered or affected [16], even though some people are aware of what healthy and unhealthy food is [2] and are able to understand the nutritional labels on food products [8] [9]. Despite the knowledge people have, they find it difficult to follow healthy eating recommendations and some people frequently consume food that they perceive as unhealthy [2]. This does not mean nutritional labels do not have an effect. Studies show that nutritional labels make consumers avoid the unhealthy nutrients in food products and that this effect can be even greater if the labels are combined with an information campaign [6].

Several systems have been developed and tested in order to support customers while grocery shopping such as iGrocer [17] and iCart [13] [12]. iGrocer is a grocery shopping system implemented on a mobile phone to "help customers prepare and plan for the weekly grocery purchase" and iCart is an interactive shopping trolley that attempts to convince customers to buy healthier food while they are grocery shopping. It would be interesting to use the approach of iCart on a mobile device to see if it could have an effect on customers behaviour. Fogg [11] defines suggestions as an interactive computer-product that suggests a behaviour at an opportune moment. iCart's suggestions are presented when the customer puts a product into the trolley. We consider this to not be the opportune moment and the suggestions have to be presented before a product is put into the trolley.

In this paper we examine if it is possible to affect customers' shopping habits towards a healthier behaviour. For this purpose we present TaKO, a mobile phone application to support customers while grocery shopping.

Section 2 presents related work. Section 3 describes the interaction design of TaKO and its implementation. The three field studies with TaKO and findings are described in sections 4, 5 and 6. Furthermore, the discussion is described in section 7 and, finally, the conclusion, limitations and future work is described.

2. Related work

In this section we look at the approach others have taken when trying to alter people's decision-making in a shopping context.

iCart [13] [12] is persuasive application designed to run on a touch-screen mounted on a shopping trolley. Its purpose is to assist customers when they are making decisions about what food to buy. iCart helps customers assess the nutrition value for food products by providing a simple classification consisting of three categories. To affect the customer to a healthier food selection it displays suggestions for healthier food. A field study was conducted in a supermarket which showed that simple classification of food item was effective in showing the participants if a product is healthy or less healthy. On the other hand the suggestions for healthier products did not had an affect on participants due to various preferences they have for food products. Some would not purchase light products and while others preferred biodynamic products.

Another attempt to affect the decision-making when shopping for groceries is Grocery Hunter. It is a mobile interactive game that encourages children to make smart choice of food selection when they are accompanying their parents in grocery stores. Children play the game on a Pocket PC and through this fun game, they learn about food nutritions and healthy food. The focus is on encouraging healthy eating habits for children with ages from 7 to 11. The evaluation showed that the effect the game had on children was that they enjoyed using the Grocery Hunter and that it kept their attention and engagement. Furthermore, they stated that the game would benefit them to make informed decisions when shopping with their parents. [15]

Jennifer et. al. have developed an application that uses shopping receipts to generate suggestions about healthier food based on previously purchased products. It analyses nutrient content for each purchased item and suggests foods that are high in nutrients which is deficient in recently purchased item. The suggestions are presented in the form of a printed shopping list, that can be taken to the store. A survey with 57 participants was conducted in order to determine the relationship between food consumption and purchasing. When participants reported that they ate more of a food item, they also purchased more of that product. [14]

Felfernig et. al. look into the complexity of creating knowledge-based recommendation systems. They base their work on personalised product ranking and contextual product presentations. The recommendation techniques are suitable for persuading customers to purchase other products than those they intended to purchase. [7]

3. Development of TaKO

We designed and implemented a persuasive mobile phone application called TaKO and the important aspects is explained in this section. In the development of TaKO we produced over 5500 lines of code over 10 weeks. The source code for TaKO is freely available at Google Code under the project name project-destructinator.

3.1 Interaction Design

From Kallehave et. al. [13] we learned that customers are under time pressure when shopping for groceries, they choose products by habit, and they have difficulty assessing nutritional levels for products, when they want to find out if a product is healthy or not. Thus we strove for a simple design and intuitive interaction. Furthermore, we used two persuasive design principles, reduction and suggestion.

Use of the reduction design principle The reduction principle is defined, by Fogg [11], as "Using comput-

ing technology to reduce complex behaviour to simple tasks increases the benefit/cost ratio of the behaviour and influences users to perform the behaviour." In our context, the complex nutritional labels are reduced to a simple rating by using the Eat Most classification from the Danish Veterinary and Food Administration [19]. As Fogg states, for a system to be motivating at all, it needs to be credible in order to change opinions and attitudes. The credible Eat Most food classification is therefore used.

Danish Veterinary and Food Administration provides an algorithm to calculate a rating for the Eat Most classification, where there are three possible outcomes: Eat Most, Eat Less, and Eat Least. Thus the action of assessing a product's nutrition values is simplified, with this rating, by providing a classification label, see figure 1. To make it easier for customers to distinguish between the labels, the Eat Most is coloured with green, Eat Less with yellow, and Eat Least with red, to mimic the symbolism of a semaphore. A red Eat Least label should alert the customer, that the product is unhealthy, while a green Eat Most label should tell the customer that the product is healthy By making customers aware of a product's health value, we try to motivate them to choose healthier products.

Figure 1: The Eat Most classification label.

Another example of reduction can be found in the virtual shopping basket, as seen in figure 2. Customers can assess the overall health score, which is based on the contents of the virtual shopping basket in regards to the Nordic recommended nutritional intake [4]. This score is shown as a coloured circle which can be red, yellow or green based on the recommended nutritional rating. Furthermore, it shows a score from 1-100 so the users can quickly assess the general distribution of nutrients.

Use of the suggestion principle In order to persuade customers to choose healthier products, the suggestion principle is used. The principle of suggestion is

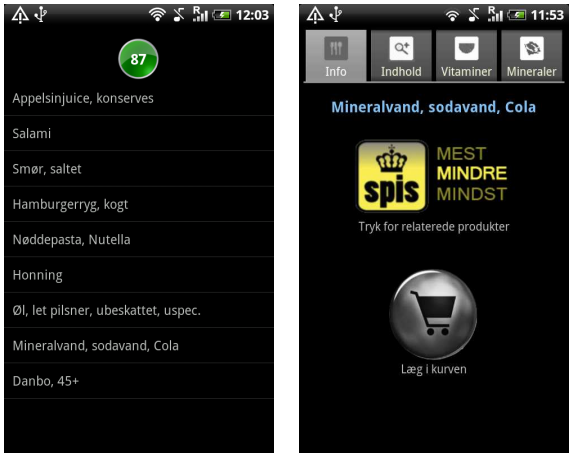

Figure 2: Virtual shopping basket and product screens.

defined by Fogg et. al. [11] as "A computing technology will have greater persuasive power if it offers suggestions at opportune moments". In our context, we consider the right moment to be before the product is put into the shopping basket, and thus we offer to see a list of suggestions for alternative products by tapping the classification label. The vast number of products in a supermarket can be overwhelming for customers to grasp when they are thinking about better alternatives, and thus TaKO reduces this complexity by showing a list of alternatives, which can be seen in figure 3. Another type of suggestions are pop-ups that are shown when a customer scans a product with a Eat Least or Eat Less rating. The pop-ups can be suggestions for a healthier product or a warning about the unhealthy nutritional contents of the scanned product.

For those customers who still want to examine the nutrition values, we provide quick access tabs categorised into nutritional details, vitamins and minerals. The design principles of [20] were adopted in the construction of the graphical user interface, such as providing appropriate feedback to users' actions.

3.2 Implementation

TaKO was developed in Java for Android and is available on Android Market. First of all, we needed barcodes from products, that we could map to the nutrition

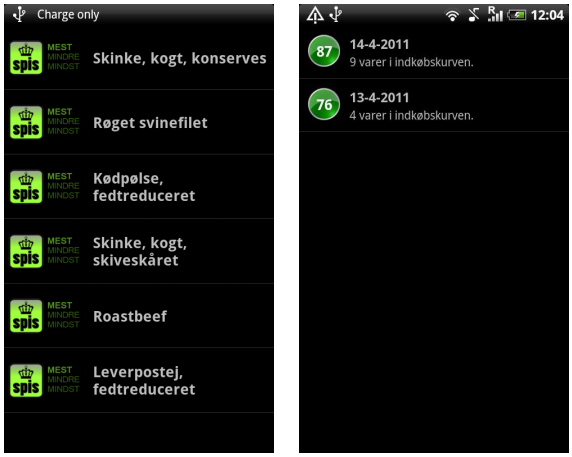

Figure 3: Suggested alternatives and history screens.

database available at [5]. This database with approximately 1050 different products contains detailed nutrition values per 100 gram for the most common food and drink products, that are found in Danish supermarkets. The products in the database are not specific products, but more like general product types, e.g., instead of displaying *Coca Cola Light* it displays *Cola, Sugarfree*. The database was converted to a SQLite format and over 4600 barcodes, which were scanned manually in a local supermarket with an application, were added. The application was developed for this purpose. Each barcode from a product was mapped to the appropriate product name in the nutrition database. The functionality of barcode scanning is provided from the open source project Zebra Crossing [3] and modified, such that it could be integrated in TaKO, for seamless interaction when used by customers.

TaKO have several features available to the user. The most important features are the barcode scanner and the product information screen, can be seen in figure 2. The product information screen consists of four tabs with information about the scanned product. The main tab shows the product's name, the Eat Most classification label and a button to put it into the virtual shopping basket. The other tabs contain detailed information about the product such as nutritional information, vitamins and minerals. Other features consist of a virtual shopping basket screen, which contains the products the customer has added to the basket along with a health score, a history screen which shows a list of virtual shopping baskets with the number of products they contain and the health score so the customer can get an overview of previous purchases. The last features are the related products screen, as seen in figure 3 and suggestions. The related products screen can be accessed through the product information screen to see a list of healthier alternatives. Furthermore, we developed a WCF webservice programmed in C#, used for logging the customers' interactions with TaKO.

4 In-shop Evaluation

This evaluation is a replication of the iCart [13] study.

4.1 Method

The evaluation took two days and was conducted as a field study which took place in Føtex, a big Danish supermarket. Five participants were recruited via personal networks and posters in public places. In order to participate in the evaluation, the participants had to have a main or co-responsibility for the grocery shopping in their household. The professions of participants varied a lot.

- Age span: 25 - 58
- Gender distribution: 3 males / 2 females
- Mean age: 33, SD = 12.78

TaKO was installed on a mobile phone which was provided for the participants. Furthermore, an observer with a video camera recorded the process. A questionnaire was sent to the participants prior to the evaluation as well as a questionnaire was used after the evaluation. A shopping list with 11 items was given to all participants, which they should use for shopping during the evaluation. The list consisted of general food categories as well as specific products. Furthermore, an introduction text was read to all the participants. Before the evaluation, the participants were not told any specific information about the purpose of TaKO in order

to avoid the risk of participants knowing the fact that the system motivates them to buy healthier products, which might make them behave differently.

During the evaluation itself one of project-group members would act as a test leader, who was in contact with the participants, which were told to think-aloud during the evaluation. The other members were responsible for the equipment and observing. After the evaluation a semi-structured interview was performed.

The collected data consisted of observations, questionnaires, interviews, video recordings and logs from TaKO itself. TaKO has a logging system, that captures every interaction. It registers when participants scan a product and when they tap the screen to view alternative products or other information about the product. The collected data was analysed in order to identify interesting patterns.

4.2 Results from the in-shop evaluation

All participants found the specified shopping list realistic and most products from the list were products they would purchase on a real shopping trip. The initial analysis of the data showed that the participants primarily used the fat ingredient of a product to assess its healthiness. Besides fat, carbohydrates, calories and sugar were also important factors when assessing products healthiness. Three participants also stated that even though the ingredients were important factors the price still determined which product was purchased. As one participant says *"I would buy ecological products if I could afford it, but I would not pay if the price is tripled."*

While the healthiness of groceries is important for many of the participants the price still, in many cases, determines which product is purchased. Furthermore, two of the participants have children and both stated that the decision of which product to buy is often based on what the children want and need.

The reduction principle

Most participants liked the Eat Most classification as it was easy to understand and very quick to assess the product's healthiness. One participant was surprised that a pack of sliced cheese was rated as green as his initial thought was that the cheese was not very healthy. As he said *"Eat most. I didn't expect that."* and seemed very surprised. The participant said in the post interview that he would use his own assessment over the application's assessment. Four participants stated that TaKO gave them information on the products' healthiness that they did not know prior to the evaluation.

The suggestion principle

The suggestions that the participants got from TaKO during the evaluation were either completely ignored or they did not trust that the suggested product was healthier. As one participant said *"I have a hard time believing that the suggestion is healthy just because the application says so"*.

Although no participant was affected in their decision on which product to choose, one participant said *"It made me reflect on it, not necessarily change my choice of product, but it does make me reflect on it on some way."* None of the participants chose to view the related products or the nutritional information on TaKO during the evaluation, however two participants said that TaKO helped them understand the nutritional labels on the products better and three participants stated that the suggestions of healthier products were very useful. This indicates that the reduction part in TaKO can be used as a utility to quickly assess the health value of a product and that our participants like to be presented with options for related products.

Some participants stated that if TaKO could suggest more specific and similar products they would consider the suggestion and even be influenced enough to purchase it. Since TaKO can only make suggestion on product types, e.g., rice in general and not a specific brand of rice, the participants often felt the suggestion to be unrelated and pointless. However, if TaKO could be more specific, e.g., suggest Klovborg 30+ instead of just Danbo, 30+, they would consider the suggestion as it points to a specific product.

5 Longitudinal Evalution

This study is a longitudinal study that runs for three weeks since we consider that one time field study is insufficient to discover changes in participants' behaviour.

5.1 Method

The evaluation was conducted as a field study which took place in Føtex, a big Danish supermarket. Five participants were recruited via personal networks, group emails and posters in public places. In order to participate in the evaluation, the participants had to have a main or co-responsibility for the grocery shopping in their household, own a smartphone running Android and having TaKO installed. Prior to starting the evaluation, a semi-structured interview was performed and the participants were asked to provide demographic information. The professions of participants varied a lot.

- Age span: 21 - 50
- Gender distribution: 2 males / 3 females
- Mean age: 29, SD = 10.87

Then a basic introduction of how to use the system was given and the same usage instructions can be found in TaKO. The evaluation ran over three weeks in which three times the participants would have to go grocery shopping while being observed. The participants were encouraged to use TaKO in between the three shopping trips. Every observation consisted of the participants going grocery shopping while one group member acted as an interviewer, one as observer taking notes and the last recorded the session on video. After the shopping, a semi-structured interview was performed in a quiet area of the store.

The collected data consisted of video recordings, observations, interviews and logs from TaKO itself. The data was used in the analysis in order to identify interesting patterns and to see if the persuasive methods had an effect on the participants' shopping behaviour.

5.2 Results from the longitudinal evaluation

From the three week period we have gathered qualitative results from the five participants. All of them thought that TaKO was functioning well and that it was easy to use. This section summarises the findings related to the two design principles as well other aspects regarding TaKO.

The reduction principle

The implementation of this principle proved to be successful as several participants stated that it provided a quick assessment value of a product and they especially noticed the colour of the label after a product was scanned. *"I noticed if it was green or red, and I especially notice colours, so I really don't care what the text says."*. In several cases during the observation in the store, participants uttered a few comments regarding the label. *"This one is healthy. I like that."*. *"One gets a guilty conscience when scanning such one."*, said about a Cheddar which came up as red on the screen. One participant expressed that she especially noticed when the label was red, which had an effect on her. *"When it says that I should eat less of it, I memorise it and think of it when I pick it up later."*. Another said: *"The one I look at most is Eat Least, Eat Less, and Eat Most."* These statements confirm the design's ability to retain our participants' attention. This indicates that the design choice of using a credible classification, such as Eat Most, using pictures and mimicking semaphore symbolism with the three colours, green, yellow and red, had an effect on our participants. Since this was the most noticeable aspect of TaKO, the effect it had on our participants is, that it made them reflect more on the products they purchased and that this reflection was not only a short term reflection while shopping, but that its repercussion was that they also were reflecting about the products at home while eating or preparing a meal.

The other part of the reduction is the overall health score of one's virtual shopping basket. We were surprised that the score in this basket was used a lot. Two participants were actually competing to get the highest score. One participant said: *"I have purchased healthy products, but it only gave a score of 74."*, to which the other participant proudly responded: *"I got 80 or something."*. Another participant took it less seriously, because she knew that the loose vegetables, did not have a barcode and therefore could not affect the score.

The suggestion principle

We wanted to find out if the implementation of the suggestion principle had an effect on the participants. The opinions about this are varied and in most cases the suggestion part was less successful. We found out that persuading participants to buy healthier products, was difficult, since people vary a lot. They all have their own preferences for food, brand, taste, habits etc. Most of our participants purchased the products they usually buy and only one impulse buy was recorded during the observations. Most participants had a shopping list in hand or had it memorised, and since customers who know precisely what to buy, they are less likely to make an impulsive purchase [1].

Many stated that they already made the decision at home for what products to buy, and that the occasional pop-ups with warnings and suggestions could not change their mind. *"I am a habit person. I like pears and bananas. It can not make me have a change of heart."*. Their preferences made the suggestions less successful, as one participants states: *"I like butter. Even if there was this picture of whatever, I would still choose it."* Another important factor is their desire for certain foods which is difficult to alter with suggestions. *"The things I buy, are the things I wish to buy." "It is the desire, that determines what one buys. If I want to eat liver paste, well than I will buy liver paste."*

Although suggestions did not affect their decisions about what food to buy, all stated that it made them reflect about what food they buy, especially if a product turned up red on the screen. One participant was very fond of the pictures that came up occasionally as she thought the pictures had an impact on her, and said that after scanning a bag of jasmine rice a picture of an obese guy was shown and that made her change from using jasmine rice to parboiled rice at home. As previously mentioned, the design choice to use pictures in suggestions, also proved to be an effective part when attempting to affect their behaviour. Other participants stated that pictures next to related products would be a good idea and is another area where it is interesting to put effort on, in a future work.

On some occasions TaKO suggested a healthier product in a completely different category, e.g. scanning some rice could suggest some oatmeal instead. This was critised by several participants. Many expressed that in order to change their decision, the suggestions from TaKO should be for a similar but healthier product. *"I would probably say, that if I scanned some rice, and it said, buy this rice instead they are healthier, than I would probably do it."*

Experience with TaKO

Two of the participants strongly expressed that their shopping experience with TaKO was fun. Even though it took longer to shop, the longer time spent was not noticed. *"I think it is fun! I don't think shopping is fun in general, and I always try to give the responsibility to my husband, but this is fun. I wonder what picture will appear now."* The other participant strongly expressed enthusiasm for using TaKO. *"What is essential for me, is that it is fun to shop NOW."*

Regarding the time spent, one participant was positively surprised about how long she was shopping: *"Last time I shopped for 45 minutes, and I thought, did I really spend this much time?"*. We were surprised that the user experience of TaKO was an aspect that received positive response, since we did not focus on the user experience during the design phase. This enthusiasm shows that TaKO has the potential to make a shopping trip more experience-oriented and that this an area of TaKO that would be beneficial to improve on in a future work.

Even though their shopping behaviour were not changed from a short period of using TaKO several thought that it made them reflect more of their purchased products and that the application could potentially change their behaviour on a long term use.

Improvements to TaKO

The participants mentioned some improvements that they deemed important and that could have an impact on their decision making. The score in the virtual shopping basket could be made public, e.g. be integrated with Facebook as one participant suggested what TaKO could write on his wall: *"Well, I was shopping today and TaKO gave me 80 points."*. The other mentioned feature, was the ability to compare two similar products

side by side, e.g. to compare basic things like fat content. Some suggested that it should be simpler to access the barcode scanner and that it could be convenient to have a shopping list on the phone, where items can be checked automatically when they are added to the virtual shopping basket. Some thought it was not handy to hold a mobile phone, a shopping list and a basket at the same time while shopping, and thought it could be a good idea if the system was somehow mounted to a shopping cart. To increase the shopping experience some desired more information to be available, such as a short history of a product, whether or not it is organic, more pictures for suggestions etc.

6 Distribution-based Evaluation

The distribution-based study is a fairly simple study. We released the application to the public and monitored how it was used in order to compare the usage of TaKO with the previously mentioned studies.

6.1 Method

The settings are unknown since we in this study have little information about the users and their whereabouts. 196 people downloaded the application from Android Market and 109 people used the application. These 109 people were considered participants. Android Market was used to distribute the application to the participants. The application was out for 2 months while we collected data from everyone who downloaded and used it.

Data was collected through the applications log mechanism. The data from the logs was analysed to see if the participants behaviour matched the behaviour in the field other studies mentioned previously.

6.2 Results from the distribution-based evaluation

This evaluation is different from the other two, since this is a quantitative evaluation. Because of the likelihood that many of the participants may have scanned a few products just to try the application, without it being in a shopping process, we have decided to exclude all data where a person has used the application only once and scanned 5 products or less. This left us with eight people that seem likely to have used the application as intended. Out of these eight people only three of them have put any items in the basket. One did not put any items in the basket, but scanned 18 items of which 5 were not recognised in the TaKO's database. These items look like they are from a regular shopping list. One person has only put one item in the basket out of 13 things he has scanned. Another person put four items out of nine scanned in the basket. This person scanned three different types of meat two times each, and chose to put the healthiest one in the basket. This indicates that the person was comparing these three types. The last person put four items in the basket out of seven scanned.

7. Discussion

Reflecting on our findings from the evaluations we deem that the implementation of the reduction and suggestion principles were effective, since most participants felt that they were affected in some way as they got more information regarding the products' healthiness. Due to the positive responses on the Eat Most classification and the health score in the virtual shopping basket we consider that Fogg's reduction principle had a confirmed validity.

The theory states that the suggestions should be made at an opportune moment. We considered this moment to be right after a customer has scanned a product and this is were TaKO differs from iCart's approach. We wanted to move this moment to an earlier stage and thus we performed evaluations to see, if this had an affect on customers. Both the results from iCart and TaKO shows that it is difficult to affect the customers to choose healthier products with suggestions, and while we consider that the suggestion principle was implemented correctly, the question is whether the theory holds for a grocery shopping context. Fogg's definition of suggestions is open for interpretation and does not specifically define the opportune moment to present suggestion. From this we deem two aspects that would be interesting to further investigate, where the moment lies and the validity of the suggestion principle.

First, we think that the way the suggestions are displayed should be modified to match the proposal our participants had, where they stated that suggestions should be more personalised and similar to the currently scanned product. That way, the moment of displaying suggestions is still kept the same as it currently is now in TaKO. The second approach is to move this moment to an earlier phase. We propose to move it to the moment where the customers are planning their shopping list at home, like Jennifer et. al. [14] approach. For instance, TaKO could provide the customers with the ability to make a shopping list from the database of products and while the customers are selecting a product, suggestions for that selected product should be displayed. Thus TaKO would attempt to affect their decision making earlier instead of now where most of our participants have already decided what to purchase when based on the shopping list they have brought with them.

Another interesting area where a new approach can be taken is the overall health score of the virtual shopping basket. Two of the participants used this score as a competition, where they were competing for who would get a higher score. This can be taken to a higher level. Just as Grocery Hunter is a game used for affecting children to buy healthy food, TaKO could also incorporate elements from the gaming world. For instance, there could be a highscore of customers score on the mobile phone and that this highscore could be uploaded to their Facebook. Since the effects of Grocery Hunter were that the children enjoyed interacting with it and stated that it could benefit them to make more informed choices, it would be interesting to explore and estimate what effects the incorporation of elements from gaming in TaKO would have on participants.

8. Conclusion

We developed a mobile application, TaKO, that attempts to affect customers' grocery shopping habits towards a healthier behaviour. We made an effort to test the impact of it, by conducting three field studies. Two persuasive design principles were used in order to help the customers choose healthy products, reduction and suggestion. The field studies showed that the reductions had an effect on the participants. The participants were quick to notice the Eat Most label in which case they started reflecting upon their choice of product. One participant stated, that the red Eat Least label gave him a guilty conscience for choosing an unhealthy Cheddar cheese. Other participants were surprised to learn that products they thought were healthy were unhealthy and vice versa. Furthermore, the health score in the shopping basket was noticed by most participants and some of the participants did use it to compete to get the highest score.

The suggestions on the other hand were less successful. The studies indicated that affecting the participants' behaviour towards a healthier one is a complex task, since the participants had rather specific preferences and requirements for their grocery products. Many of the participants had already made their choice before even coming to the store which indicates that for suggestions to have an effect, they have to be presented earlier to the customers. Several of the participants criticised the suggestions and stated that instead of being broad, they requested that TaKO should suggest a healthier product for the recently scanned product in order to have an affect on them. However, they also stated that the suggestions made them reflect over some of the choices they made.

Based on the findings, we have identified some limitations as well as some improvements for TaKO. First, the current database of products contains information for common grocery products found in the Danish supermarkets, and thus imposes a limitation when suggesting a specific product. Furthermore, an effort to expand TaKO's database should be done in order to make TaKO more useful. Regarding the longitudinal study, it is difficult to conclude if a three week field study is sufficient to affect the participants' behaviour as several of the participants expressed that a long-term use of TaKO could potentially have an effect on their grocery shopping. Another limitation regarding the studies is that we only had five participants for each of the in-store evaluations which makes it difficult to project the results to the general population. Thus, future work should strive to implement a more complete database as well as the features the participants requested, and conduct longer studies with more participants in order to see if significant changes in behaviour can be achieved. Other future work would be to implement a 'prepare shopping list' feature and present suggestions while the

customers prepare their shopping list. Furthermore, it could be interesting to see what effect the health score from the shopping basket could have if used in a social context.

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