Fruit delivery personalization by automated decision-making for sustainability

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Abstract

This research investigates the world of smart home. Where in the year 2035 an automated and personalized fruit delivery system will help to reduce fruit waste. This is done with three phases. An exploratory hands-on survey, a test period with a prototype basic fruit delivery system and a test period with a personalized fruit delivery system. The goal is to find the parameters that such a system would need in order to reduce the waste of fruit and to be a good experience for the user. This research also helps to get a wider understanding of implanting personalized delivery systems in other food categories and to implementing this service in other places than the home.

Keywords

Automated decision making, fruit waste, future shopping, fruit bowl, food delivery, service.

Introduction

The UN has set as goal to lower the global food waste with 50% in the period from 2015 till 2030 (SDG 12 .3)(United Nations, 2019).The government of the Netherlands has taken over this goal, together with all the members of the EU (Rijksoverheid, 2013). In the Netherlands between 1.814 and 2.509 kiloton food is wasted throughout the food chain, from production till consumption in 2017. The estimated food waste in households is 34.3 kg per year, this means that they account for 23 to 32% of the total waste in the food chain (Stichting Voedingscentrum Nederland, 2019).

So, the households play an important part in lowering this food waste. The two main reasons to lower this food waste is the environmental impact of food waste and the wallet of the consumer. The roll in climate change of not consumed food in the Netherlands was in 2017 16 to 22% of the total environmental impact of food. Where 'food' accounts for an estimate of 30% of the total emission of climate gasses, by human activity (WUR, 2018). The Dutch organization 'Voedingscentrum' estimates the average cost of food waste for a household to be 120 euro (Stichting Voedingscentrum Nederland, 2019).

The top 5 of food categories in the Netherlands in 2019 is consecutively; bread & dough products, diary, vegetables, fruit and potatoes (Stichting Voedingscentrum Nederland, 2019). In this paper the focus will be on fruit, which accounts for 9% of the total food waste in the Netherlands. Testing with fruit gives the benefit that it is most of the time consumed without preparation. This give less noise in the results. And the results can be used to look at other food categories to.

This paper will investigate a home delivery grocery automated decision-making service. A home delivery service for fruit already exists. The two most common forms are a local delivery system that is organized by the local greengrocer. The other form is a national delivery system of fresh fruit by companies like HelloFresh (HelloFresh, 2022). This paper will look into a variation on such a service where the decision for the fruit that will be delivered is provided a smart fruit bowl that monitors how much fruit is consumed. The goal is to find out wat to consider in providing such a service whereby the food waste is minimized. In this paper, knowledge will be gathered to answer the question: **"What should be considered in a home delivery grocery automated decision-making service when trying to minimize fruit waste in the year 2035?"** The way the research is set up results in knowledge about the different factors and parameters such a personalized delivery service would overcome the goal of reducing fruit waste. The paper is based on the 'Research Through Design'- principle. The research is aided by the making of prototypes to gain knowledge.

Related works

Smart home

Currently, technology with the label 'smart' has focused on the personalization aspect, however the smart homes is lacking in this department. Households are treated as an individual decision-making entity.

While there are big differentials within a household, like age, gender and even species. According to Dahgren (Dahlgren K et al. 2021) the key to future smart homes is automated decision making (ADM). The lack of individual personalization in the smart home can lead to significant oversights. The lack of integration between platforms further hinders the 'smart' in smart home where it may actually have a negative impact on consumers experience. It will be interesting to look at how to incorporate personalization within a smart home, with the inhabitants and making sure that is does not negatively impact the experience.

Digital technologies is a critical enabler of recycling (Kristoffersen, E. 2020). Currently, there is very little systematic guidance for improving resource efficiency or to reach the potential circular solutions offer. Data from digital technologies can be utilized to enhance smart resource management in the circular economy by creating, extracting, analysing and exchanging data (Chen, X. 2022). Data enabled products empowers users to close the gap between unknowingness and the companies that sell their products with a large data system behind it. Most companies main goal are to develop a product or service to earn more and more profits. This process of making profits often excluded the resulting waste used and consumed by the products or service, never coming back to the original manufacturer to leave the consumer to deal with it (Rizvi, S et al. 2021).

Food

A specific focus point within a smart home is interesting to focus on is food. The current state of smart homes have not yet provided a means to grasp the state of food and the amount saved in a kitchen. The study by Zhongxu Dong (Zhongxu Dong et al, 2020) tested if it was possible to prevent food waste for a noticeable amount in households. The study automated the management of a household refrigerator by integrating it with the Internet of Things framework and Artificial Intelligence. It takes the information about the stored food and labels it with type, barcode and expiration date, so it can prevent food waste with that data.

Even more specific, you can focus on fruit. Perishables account for 35 percent of the total sales for grocery retailers in Europe (Kiil K. et al, 2018). There is a significant difference in the shelf life for perishables when compared to other food products. Which relates to food waste, where there is a higher reported food waste for fruit and vegetables (Kaipia, R. et al 2013).

Consumers are primarily concerned with the physical state of fruit, followed by institutional, food safety and quality when deciding whether to discard food. Besides the primary drivers of food discarding, there are other cases to result in food waste. There are cases where poor planning and preparation routines result in food going bad or simply thrown away because it exceeded the date on the label (Davenport, M. 2019). This often happens when consumers are trying to prevent a shortage in items by purchasing it in bigger volumes (Shekhar, C et al. 2021). This leaves items unused for a long time, which results in the food going bad or expiring the date on the label. As mentioned before, manually keeping an overview of your inventory and planning when to use what can be quiet overwhelming. When this fails it results in a shortage in food or more likely, food waste. Shekhar et al (2021) suggests that a smart-inventory management system can play a useful role in automatically maintaining the inventory of your food and make decisions about when to order new food in advance. The ordering of the food should be based on the quantity and more interesting the pattern of its consumption. There are a couple of sensors that can be used for keeping track of inventory. A RFID tag, load cell or ultrasonic sensor. Food are items that quickly move in and out the inventory space. According to Ranjana, P et al (2021) a weight based sensor would work perfectly in a non-intrusive way. A loadcell works perfectly for this as it weights the items precisely by a computer program, which can make logical decisions about the food inventory.

One of the core reasons smart home still struggle is the lack of individual personalization. The key to solve this is automated decision making. Automated decision making depends on a lot of data, which this research will have to collect to provide a understanding how an automated decision making service should work. The data will have to be created, extracted, analysed and converted into delivery options. However, the current state of smart homes cannot yet provide data about the state or inventory of food, let alone fruit. Another thing to keep in mind is that there is a significant difference between packaged food and perishables. The shelf life of perishables when compared to other food products is way lower. In combination with poor planning it will result in fruit going bad and being thrown away. This is to be expected because manually keeping an overview of your inventory and planning is quiet overwhelming. This research will tackle that problem of manually keeping an overview of what fruit you need.

User study setup

Goal

The purpose of this research is to find out how the experience of an automated decision-making system for fruit delivery is perceived in comparison with a not personalized fruit delivery system. This will help to find out if and how an automated decision-making system can help to reduce food waste. An essential element of such a system is that it is perceived as a pleasant experience for the user, because this makes a successful implementation more likely.

For now, there is already a fruit delivery system in the market, by providers like farmers or HelloFresh. But these are non-customizable fruit delivery systems, where the only thing you can choose from is the amount of weight of fruit

Setup of user studies

The user study setup consists of three phases in which data is generated. Starting with a probe research questionnaire. Followed up by a baseline test with eight participants and concluded with a personalized version of the first baseline test with the same participant group. The data generated in the first probe questionnaire is the base input for the baseline test.

Prototype design process

The design process started by singling out the needs for our art effect. We started by defining our research method (see research method). In order to obtain the data, we wanted the prototype to be able to carry out the following tasks. We wanted the sensor to measure the amount of eaten fruit, when it was eaten and what was eaten. To do this, the sensor needed to carry out the following acts in the following order. First it needs to detect when there is a change in fruit on the bowl. We achieved this by using a weight sensor. The weight sensor is triggered by a change in weight on the bowl. We used a load cell for this. Then the sensor needs to take a picture to show what fruit was picked. We did to let the camera running all of the time and therefore used the weight sensor as a trigger to make picture. If we had let it run all the time, we would have infringed too much on the user's privacy and the code would have been much more complex. The sensor was placed at such a height that it would only capture the fruit bowl and nothing else. This was essential for getting our ERB approved, because we worked with automated camara's. Then the sensor needed to link the time to the captured data and store it locally on a SD card. We used a data shield for this. We needed to store the data locally, because we could not send the

Figure 1. building process of the prototypes

data captured trough non-TU/e certified servers. Because we wanted to place this at participants houses, we could not have hosted an OOCII server and send trough American servers would have been seen as a data leak. The last task was to communicate that data was captured. We achieved this trough a small led strip. It turns on every time a participant takes fruit.

Although the ascetics came second to the technical function, this was also a important part of the design. As we wanted to place it in participants houses, we wanted to make it blend in as if the sensor was part of their interior. It needed to be nice to look at while it showed transparently what type of data was gathered and with what sensors. We needed an arm to hold the camara. This arm was intergraded organically in the design and we wanted to integrate organic forms in the sensor because it needed to fit in with the fruit on the bowl. This led to our final prototype (Figure 2).

Production process

We started by sketching and creating models in 3D program. By the midterm demo day we created our first physical prototype in order to better communicate what we were planning to do and how we would conduct our research. In this prototype we did not take in to account the size of the real sensors. We lasercutted the 3D model. Then gave it a dark brown layer of lacquer. We tested the look and feel of the prototype on the demo day and got a lot of nice feedback. For the final design we had to create more space for the Arduino, data shield and load cell. To make it look less bulky we had to shift the place of the fruit bowl to the front instead of placing it in the center. This meant that instead of an full arc to hold the camara, a single arm was used. After we had the first one working. We made three identical copies (Figure1).

Figure 2. prototype as placed in the research setup

Prototype

The tests have been done with a working prototype. This prototype is a smart fruit basket, including a loadcell to measure weight difference, a LED-strip, a data-logging shield which includes a real-time-clock, an SD-card and SD-card reader and at last an Arduino Uno powered with mains power. The prototype works as follows: the researchers will place the fruit in the basket at the beginning of the research period in the home environment of the participants. And every time that a piece of fruit is taken from the fruit basket, the loadcell will measure the weight difference. When a difference is measured, the LED-strip lights up to indicate that a measurement will be taken. This is also an indicator for the participant to take a picture of the fruit bowl in its current state. The measurement of the mass that is on the bowl will be timestamped to indicate when the participants have taken a piece of fruit from the bowl.

Procedure probe

The probe research has been setup in a way that a baselevel of knowledge could be generated for the implementation in the first in-home prototype baseline test with the smaller participant group. The participant group for this probe research were students on the campus of the Eindhoven University of Technology. We have conducted the research with Dutch speaking students. The students have been asked to answer a series of dilemmas (Appendix I) in which there were only two options given. The participants have been approached by two of the researchers with a laptop and asked to answer the series of questions. All answers were generated in a hands-on manner and collected with the use of questionnaire software. The answers of the participants were analyzed by generating pie diagrams and graphs to summarize the findings of the probe.

Procedure baseline

The data generated from the probe test gave the basis for the decisions for the baseline test. The prototype was placed in the home of eight participants and was first placed for three days. Before the test the participants were asked to give consent (Appendix III). In the morning of the first day, one of the researchers came to the home of the participant. The prototype has been given to the participant and the researcher and participant placed together the prototype on the place where the fruit normally is placed if this was possible to place the prototype. Otherwise, the participant and the researcher have taken a look together for the best alternative. It is important to mention that the prototypes have been placed in the personal rooms of the participants. After this, the researcher has placed the fruit for the three days on the prototype. For the first test period a palette of six portions of fruit has been placed. These fruits were the same for every participant, so not specified per person and were based on the most eaten fruit species in the Netherlands (Voedingscentrum, 2022) The participant received two apples, two bananas and two tangerines. All the fruit was ripe to eat. This was the most natural way to give the fruit and could be adjusted for the second test period. The participant was also instructed to only take the fruit they wanted to consume. This means that they were instructed to not eat more or less fruit than usual and that it was no problem if some of the fruit was left over after the period of three days.

After the participants were instructed, the prototype was in the home setting for three days. The moment on which the participants took something from the prototype was registered by the prototype. The participants were instructed to take a picture of the fruit bowl every time they took something off it. The data of these moments have been analyzed to get a clear view on the eating pattern of the participants. This also has contributed to the key questions in the interview.

From these three days an analysis has been made by one of the researchers. This data has been combined with an interview about which was conducted after the first test period. The

interview was a semi structured interview with the goal to find out why they eat the fruit at the moment they did and what factors influenced this decision. (Appendix IV)

Procedure personalized test

With the information from the first interview a customized package of fruit has been assembled, this was also done by one of the researchers. This work done by the researchers is an alternative for a computer system that will most likely make this decision in the future. The factors which played a role in the personalized selection of the fruit were: Fruit species, fruit amount and amount of different species of fruit.

The custom amount and kind of fruit was placed in the morning of the beginning of the second test period. After this test period the prototype was collected again, and a second interview was done by the researcher. This interview also was a semi structured interview(Appendix V), with the goal to find out how the user experienced the first test period compared to the second test period. And which factors were considered in the right way and which not or which were completely missed.

Findings

Findings from probe test

The number of participants of the probe test was 64. All the results are included in Appendix I. The most relevant results are shown the figures below :

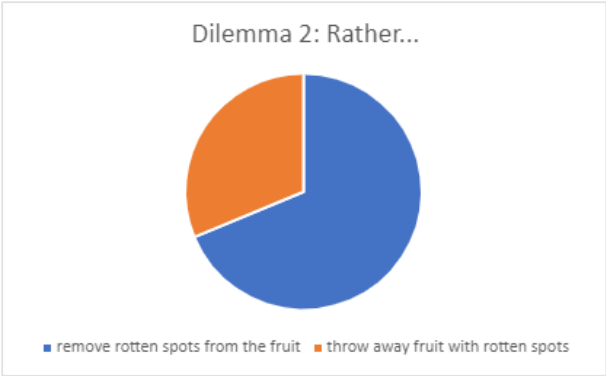*Figure 3. Pie diagram of dilemma 1*

Figure 4. Pie diagram of dilemma 2

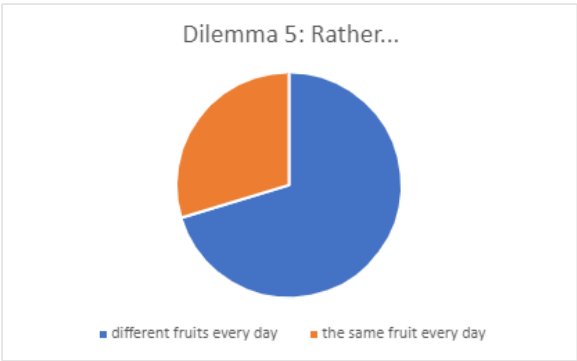*Figure 5. Pie diagram of dilemma 3*

Figure 6. Pie diagram of dilemma 5
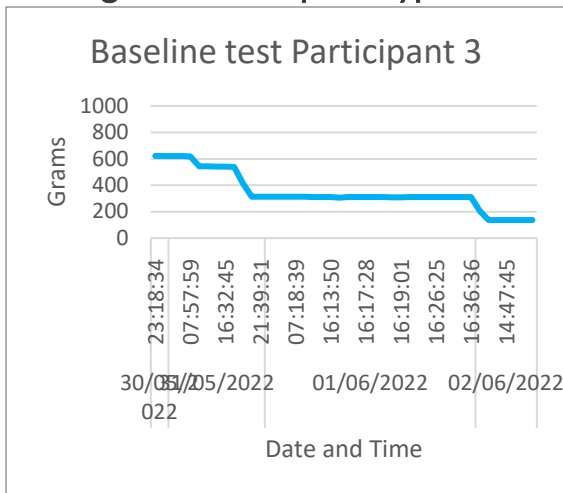
Findings from data prototype
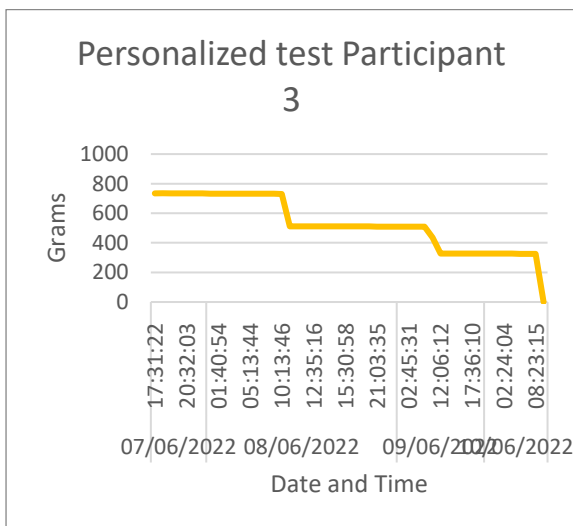

Figure 7 Baseline test participant 3

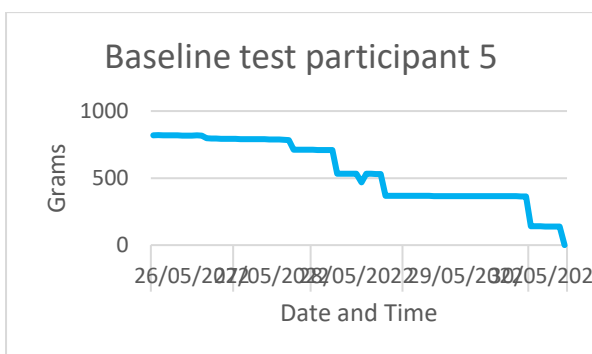Figure 8 Personalized test Participant 3
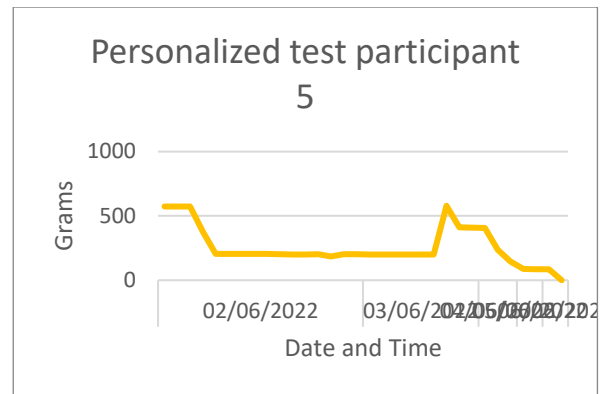

Figure 9 Baseline test participant 5

Figure 10 Personalized test Participant 5

In figure 11 up and until figure 16, the most interesting data from the prototype can be seen. The difference between the baseline test and the personalized can be seen by the different colors and title. Next to this, the vertical axes give the information about the amounts of grams concerning the fruit bowl. On the horizontal axes the date and time can be seen to show the weight of the bowl with respect to the time.

Findings from interviews

There are two interviews conducted per person. First the biggest trends from the interviews are formulated. Secondly personas are made to better show the different points of view there are on the topic of automated decision-making systems and fruit waste. The quotes below are directly from the interviews. From categorizing the answers from the interview using an affinity diagram, the following themes were found. The next dilemma that stood out was if the participants would remove a rotten spot from fruit or throw it away. The majority answered to rather remove the rotten spot than to throw it away. This led to investigating what the reason behind this was. The majority of the participants answered that they rather buy fruit every week then fruit every week. This led to the assumption that people also would like to have fruit preferably not every day. Therefor in the test, the fruit is also only delivered only at the beginning of the three days. The preferences from most of the participants towards different fruit every day let to the decision to include three different kinds of fruit for the first three test days. Because then the participants would have the opportunity to eat everyday different fruit.

Kind of fruit

Most of the participants said that the kind of fruit matters to them. Some participants where fine with the standard package of fruit. However, some stated that they would like to have more seasonal fruit, for a better taste or for a lower impact in the environment. Also,

one of the participants mentioned that kind or brand per fruit mattered, in this case the brand of apple.

"In deze periode van het jaar eet ik eigenlijk nooit mandarijnen, ze waren daarom ook niet zo lekker" (I never eat mandarins at this time of year, that's why they weren't that tasty)

Available fruit
Also, the participants give different preferences for the availability of kind of fruit. Some are fine with three kinds where others prefer to always have at least three options.

Autonomy
Most of the participants like to also still have some option to change the fruit that is delivered to them. Or at least they like to have some transparency in the way that the system has determined to give a certain fruit sort. Things that influence the fruit consumption, that where not considered but that were mentioned by the participants are sport, amount of time they are at home, guests they have and hot weather.

"Ik zou wel van te voren willen weten wat geleverd wordt" (I would like to know in advance what will be delivered)

Delivery
A lot of the participants were concerned about, if they would use such a service, that being at home when the fruit would be delivered could become a problem. One of the participants also came with the idea to deliver fruit when the delivering party sees that you are at home and not that you must stay at home because the fruit will be delivered.

Cost
Some participants also mentioned that the willingness to use a service like the one that was tested, also depends on the cost of the service and the price difference with buying it in a store. However, for the rest of this research, cost is not considered because it falls outside the scope of this paper.

"Ik blijf natuurlijk student dus het moet natuurlijk niet heel veel duurder zijn dan gewone uitgaven"(I am still a student, so I don't want it to be much more expensive than my usual expenses)

Side effects
Some of the participants that mentioned that they did not ate fruit regularly before the test, mentioned that they ate more fruit during the test caused by the prototype and fruit that was visible during the test period.

"Ik heb meer fruit gegeten, ongeveer twee stuks fruit per dag. Ik voel me daar goed bij" (I have eaten more fruit, about two pieces of fruit a day. I am feeling good about it.)

"Ik had hiervoor geen fruitschaal, misschien ga ik nu zelf ook een fruitschaal halen." (I didn't have a fruit bowl before, maybe I'll get a fruit bowl myself now.)

Fruit waste
Most of the time there was less fruit remaining at the end of test period two compared to test period one. This was not only due to the difference in amount of fruit but also because it was more personalized. Also, a participant mentioned that he had not eaten all the fruit in the test period of three days but that the fruit had not gone bad and that he would still eat it if the test period was longer.

"Alles is op!!!!"

"There is nothing left!!!"

"Dit is wel representatief wat ik normaal eet" (This is representative of what I normally eat)

"Op de manier dat het fruit in de supermarkt wordt verkocht in grote aantallen werkt niet voor mij" (The way the fruit is sold in the supermarket in large numbers doesn't work for me.)

Discussion
Probe test
The probe test is used to make assumptions about the behavior of people around fruit and a fruit delivery system. Those assumptions are tested in the research part with the prototype. The first thing that stood out was that the participants did prefer buying their own fruit. The assumption that followed from this was that there are obstacles for students to start using a fruit delivery service. The interviews in the prototype test investigates further what those obstacles are and what the reasons for the obstacles are.

Data prototype
The data from the prototype was initially intended to be the main factor on what fruit should be delivered for the personal test, however during the test it played more a supporting role for the interviews. The qualitative data from the interviews delivered a clearer picture of what should fruit should be delivered to the participants for the personal test.

Applications and factors within fruit home delivery

An important output factor for a fruit delivery system would be de kind of fruit. Input for this could be which fruit is consumed and which is left over. Also, a manual input can be an option, where the user tells the system via an app or something ells, what the user likes and dislikes and if they want to change what will be delivered to them. The reason to include manual input is that the participants stated that they like to still have control over the kind of fruit that is deliver to them. There are also factors that where not considered in determining how much fruit to deliver. Most likely there will always things that the system will not know. Preferably another input for this is the season and temperature because that effects the fruit people want to eat.

With a fruit bowl that registers which fruit is eaten and how much and wat kind of fruit is still in the bowl, it has the potential to communicate this to the delivery company. In this way they can change the amount of fruit that is delivered based on the amount of fruit that is still in the bowl. Combined with the customized amount and customized kind of fruit, this has the potential to minimize the fruit waste in the future. This should be further tested to confirm this hypothesis in a quantitative study.

The study is conducted with students. But realizing this service with students as target group can have some big implications. The irregularity in their behavior that came to the attention in the interviews. This will make it harder to predict how much fruit they will eat, and the students usually only buy fruit for them self or together with their partner. Therefore, the impact of the behavior of the person is much bigger on the fruit consumption than when this service is used for more than one or two people at the same time. So, a target group with more people and more rhythm are for example families with children or businesses that give (free) fruit to their employees. This would also correlate with the lack of individual personalization in the smart home, what also can apply to office spaces. From this research there can be a potential in introducing this service to families or businesses, but more research is needed to check this assumption.

Applications and factors outside fruit home delivery

But this study also shows that a personalized delivery system, when implemented in the right way, has a potential to be successful and has the potential to reduce food waste. This knowledge can also be used to design a system for other kinds of food. Later in this paper it is described what kind of future research is needed to make this successful.

The role of the prototype in the research

The prototype in this research is used to make the experience so close to a real fruit delivery system with a smart fruit basket, as possible. The design of the fruit basket is made in a way to create something that can be perceived as a real product. Due to the time and resources available for this research, the design is a prototype made from MDF and cut out with a lasercutter. A good experience and interaction will help with the research but is not the focus of the research.

Biases

As mentioned earlier we have only done research with students in Eindhoven. This means that regional differences in preferences and behavior can have an influence on the results research. The participants are not selected in a random way and are therefore not representative for students. Another factor that influenced the results is that we tested for three days. Therefore, it can be the case that a random event in the lives of the participants has a big influence on the results. What also has an influence on the results is that the participants were asked to take the photos of the fruit themselves. This results in a less smooth experience compared to the situation were the fruit bowl make the pictures on their own. Two of the prototypes has filled or filled partly to record the data in a useful way. This means the data of five of the participants can only be used. However, the data of the interviews of all the participants is used. At last, the factor that most likely has an influence on the results was that there was already a relation between the researchers and the participants, by most of the participants it was a roommate. This makes the change on socially desirable answers bigger. Therefore, the interview answers can be more positive than the actual opinion is. All those factors must be considered when evaluating the scientific value of this paper.

Persona's

After we conducted our research, we could divide our test group in two main sections. The first one is people who already have a standardized consummation pattern. The second one contains people who did not have standardized consummation pattern.

Group 1

The first group of users are people who have their consummation and the acquiring of the product baked

in their habits and routine. For example, in the case of fruit, the test subject goes to the store on Monday and buy's a specific set of fruit. Then they eat the fruit on standardized moments in the week. These people often know exactly how much fruit they are going to eat in the span of a week. They often eat all their fruit and have almost never a shortage of it. Therefore, this service is not really for them. The added value of such a service is way less as for the second group of users. We got back from these people that they would not implement such a service yet. Their lifestyle can be described as structured and based on habits.

Group 2

The second group of users are users who do not have a standardized consummation pattern. These users do not buy and consume the product on a daily or weekly bases. In the case of fruit, they often buy it when they "feel like it". This causes them to often buy more than they can eat. This eventually leads to the waste of, in our case, fruit. But this principle could be applied to almost all products that are consumed and have a short lifetime. These are products such as meat, dairy and vegetables. These people gain more from our service then the people who had a standardized consummation pattern. We found that people who did not already have a standardized consumption pattern quite liked the service. They often ate more fruit than they would normally do. They felt quite content with that. We also found that these people did not have a significant difference in waste at the end of the test.

Future works

Out of this research there are a ton of new research opportunities. To make the knowledge more widely applicable, a study in the same style and service could be done. But then, instead of fruit the researcher would change fruit to some other products. This could anything that could go to waste. Also, the setting and participant group could be changed. We theorize that a service such as ours could prevent waste on a much bigger level, if it is applied in an environment where lots of people come together. By this we mean things like a big work office where the company provides fruit for its employees. We think that as the number of people eat from the same fruit bowl the data becomes more constant and better predictable. Because if one person suddenly drops out this does not have to mean that the fruit provided is not immediately wasted.

Furthermore, for this research the qualitative data was mainly used for choosing which fruit would be delivered for the personalized fruit delivery. The data coming from the prototype, while useful for interpretation and the interview, it did not provide enough data to make choices about the amount of fruit. For future research it would be valuable to stretch the user test for more than 3 days. At least more than one week would already give way more valuable data that can be used to give a reasonable assumption of what fruit to deliver for the personalized test. Also, diversifying the test fruit batch for the first test would result in less dependency on the interview, which ultimately would have to be ruled out. When the personalized test is done the data will also have to be re-evaluated and tested again for a second personalized test. This step should eventually be repeated multiple times to reach a satisfying result for the consumer.

Conclusion

There are a lot of things to consider in a home delivery grocery automated decision-making service when trying to minimize fruit waste in 2035. The desire of autonomy of users should be considered. Both because a lack of it will most likely lead to frustration and because no prediction system is perfect, and faulty predictions can lead to frustration and waste of fruit. Input factors for the system should at least be the amount and sort of fruit that is consumed, the day of the week and the season of the year, the personal preferences for the kind of fruit per season. And preferably also when someone is not home and what someone want to change. The output will be when to deliver, how much to delivery and what kind of fruit to deliver. But the application of automated delivery decision-making service has also potential outside the home, it can be applied to places with more people like an office.

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Appendix I

1. Liever...

- zelf fruit kopen
- of fruit laten bezorgen

2. Liever...

- rotte plekjes uit het fruit halen
- fruit met rotte plekjes weggooien

3. Liever...

- elke week fruit kopen
- elke dag fruit kopen

4. Liever...

2 soorten fruit in huis | 5 soorten fruit in huis

5. Liever...

elke dag ander fruit | elke dag het zelfde fruit

6. Liever...

bekend fruit eten | nieuw fruit eten

7. Liever...

- fruit op (te weinig fruit)
- fruit over (teveel fruit)

8. Liever...

- geen gepersonaliseerde service (meer privacy)
- gepersonaliseerde service (minder privacy)

Appendix II
Subject information for participation in scientific research

Consumer behaviour around fruit

Introduction

Dear Sir/Madam,

You are asked to take part in a scientific study.

Participation is voluntary. Participation requires your written consent. Before you decide whether you want to participate in this study, you will be given an explanation about what the study involves. Please read this information carefully and ask the investigator for an explanation if you have any questions. You may also discuss it with your partner, friends or family.

1. General information

This study has been designed and is being carried out by Kees Brouwer, Jasper Scheffer

Geert Hansma and Jelmer de Hoop at the Eindhoven University of Technology, Department of Industrial Design. This project is supervised by Ph.D. Researcher Emilia Viaene at the Future Everyday group of this department.

For this study 8 participants are required. And 8 participants are expected to participate in the Netherlands.

2. Purpose of the study

The goal of the study is to contribute to a sustainable future. And the possible harm for society by implementing automated decision making in the home will be investigated. But in this research, this cannot be experienced.

3. What participation involves

During the study, the following will happen:

The research will consist of three parts. The first part is a short questionnaire. The estimated time to fill this out is 5 minutes. The second part is a diary. You will have to fill in a one page list of questions

about your food consumption, storage and waste. And you are asked to make photos of your fruit. We will ask you to do this every day for 7 days in a row. For the last part we will ask you to do an interview with us about the results of the research. We estimate that this interview will take 20 minutes.

The detailed instructions will be given to you during the research.

4. What is expected of you

In order to carry out the study properly it is important that you follow the study instructions.

It is important that you contact the researchers:

- if you no longer want to participate in the study.
- if your contact details change.
- If you find any difficulty's during the study.

1. If you do not want to participate or you want to stop participating in the study

It is up to you to decide whether or not to participate in the study. Participation is voluntary.

If you do participate in the study, you can always change your mind and decide to stop, at any time during the study. You do not have to say why you are stopping, but you do need to tell the investigator immediately.

The data collected until that time will still be used for the study.

If there is any new information about the study that is important for you, the investigator will let you know. You will then be asked whether you still want to continue your participation.

2. End of the study

Your participation in the study stops when:

- you choose to stop
- the end of the diary has been reached
- the researchers consider it best for you to stop
- the supervising coach, the course's responsible lecturer, or the Ethical Review Board, decides to stop the study.

The study is concluded once all the participants have completed the study.

3. Usage and storage of your data

Your [audio recordings(?)/photo's of the fruit and storage] will be collected, used and stored for this study. The collection, use and storage of this data is required to answer the questions asked in this study and to publish the results. We ask your permission for the use of your data

Confidentiality of your data To protect your privacy, your data will be given a code. Your name and other information that can directly identify you, will be omitted. Data can only be traced back to you with the encryption key. The encryption key remains safely stored locally. The data that is used to communicate about the data will only contain the code, not your name or other data with which you can be identified. The data cannot be traced back to you in reports and publications about the study.

Access to your data for verification

Some people can access all the data at the research location. Including the data without a code. This is necessary to check whether the study is being conducted in a good and reliable manner. Persons who have access to your data for review are: the supervising coach of this study, the course's responsible lecturer. They will keep your data confidential. We ask you to consent to this access.

This data may also be of importance for other scientific research in the field of AI (learning systems) in domestic everyday life.To this end, your data will be stored for maximum 3 years. You can indicate on the consent form whether or not you agree with this. If you do not agree with this, you can still participate in the current study.

Withdrawing consent

You can withdraw your consent to the use of your personal data at any time. This applies to this study and also to storage and use for future research. The study data collected until the moment you withdraw your consent will still be used in the study.

More information about your rights when processing data

For general information about your rights when processing your personal data, you can consult the website of the Dutch Data Protection Authority.

If you have questions or complaints about the processing of your personal data, we advise you to first contact the research location. You can also contact the Data Protection Officer of the institution [Appendix A] or the Dutch Data Protection Authority.

4. Any questions?

If you have any questions, please contact j.t.d.hoop@student.tue.nl .

If you have any complaints about the study, you can discuss this with the researchers. If you prefer not to do this, you may contact the supervising coach, or the complaints officer of Eindhoven University of Technology. All the relevant details can be found in **Appendix A**: Contact details.

5. Signing the consent form

When you have had sufficient time for reflection, you will be asked to decide on participation in this study. If you give permission, we will ask you to confirm this in writing on the appended consent form. By your written permission you indicate that you have understood the information and consent to participation in the study. The signature sheet is kept by the investigator. Both the Investigator and yourself receive a signed version of this consent form.

Thank you for your attention.

Appendices to this information

A.   Contact details

B.   Overview/description of study procedures

C.   Informed Consent Form(s)

Appendix A: contact details for participants

Students/researchers: second years students, Industrial Design Department:

Kees Brouwer - k.j.brouwer@student.tue.nl

Jasper Scheffer - j.t.scheffer@student.tue.nl

Geert Hansma - g.g.hansma@student.tue.nl

Jelmer de Hoop - j.t.d.hoop@student.tue.nl

Supervising coach: Emilia Viaene, Ph.D. Candidate, Industrial Design Department – Future Everyday Group, email: e.m.j.j.b.viaene@tue.nl, telephone: +32 478834596

For other complaints/questions about (the processing of) personal data, you can contact the Data Protection Officer (DPO) via +31 (0)40 247 3809 and/or e-mail address dataprotectionofficer@tue.nl

Appendix C: Subject Consent Form

Consumer behaviour around fruit

- I have read the subject information form. I was also able to ask questions. My questions have been answered to my satisfaction. I had enough time to decide whether to participate.
- I know that participation is voluntary. I know that I may decide at any time not to participate after all or to withdraw from the study. I do not need to give a reason for this.
- I give permission for the collection and use of my data to answer the research question in this study.
- I know that some people may have access to all my data to verify the study. These people are listed in this information sheet. I consent to the inspection by them.

- I   □ **do**

□ **do not**
consent to keeping my personal data longer and to use it for future research in the field of AI(learning systems) in domestic everyday life.

- I   □ **do**

□ **do not**
 consent to being contacted again after this study for a follow-up study.

- I want to participate in this study.

Name of study subject:

Signature: Date: __ / __ / __

I hereby declare that I have fully informed this study subject about this study.

If information comes to light during the course of the study that could affect the study subject's consent, I will inform him/her of this in a timely fashion.
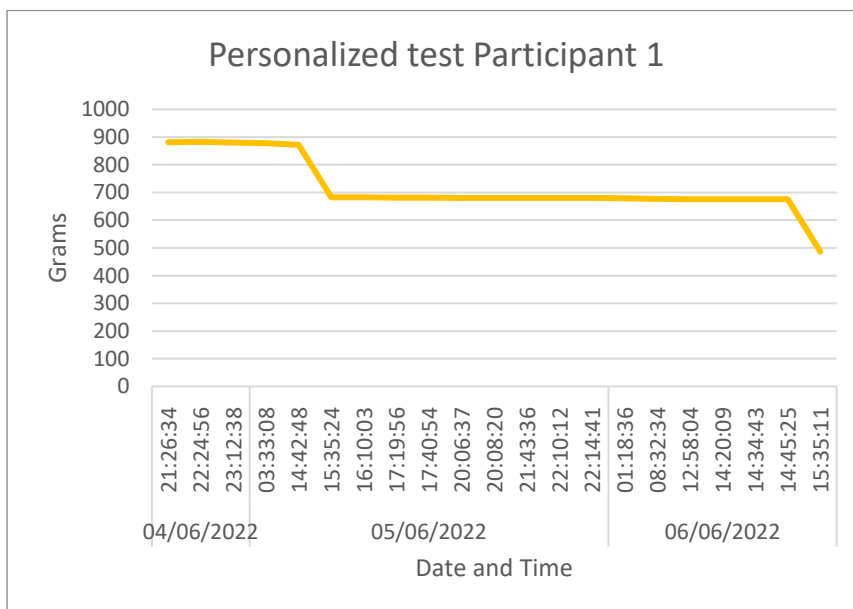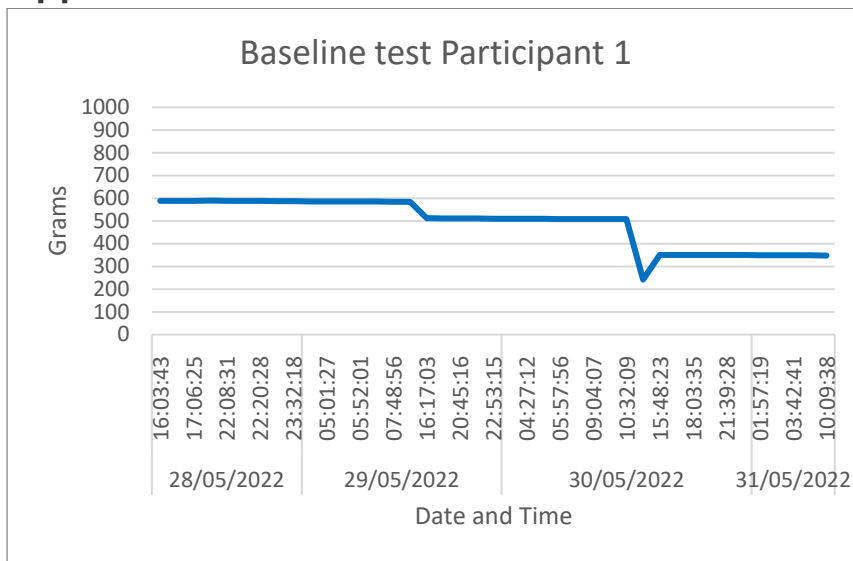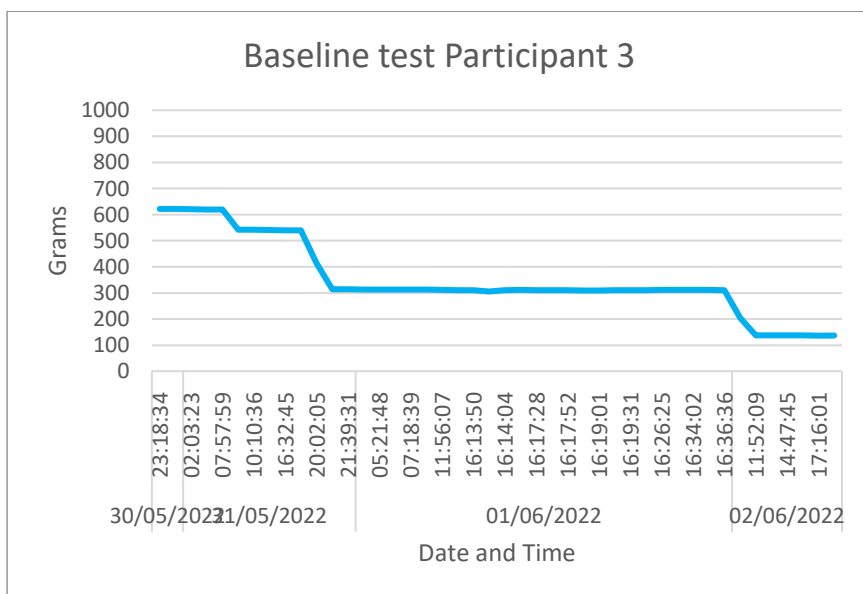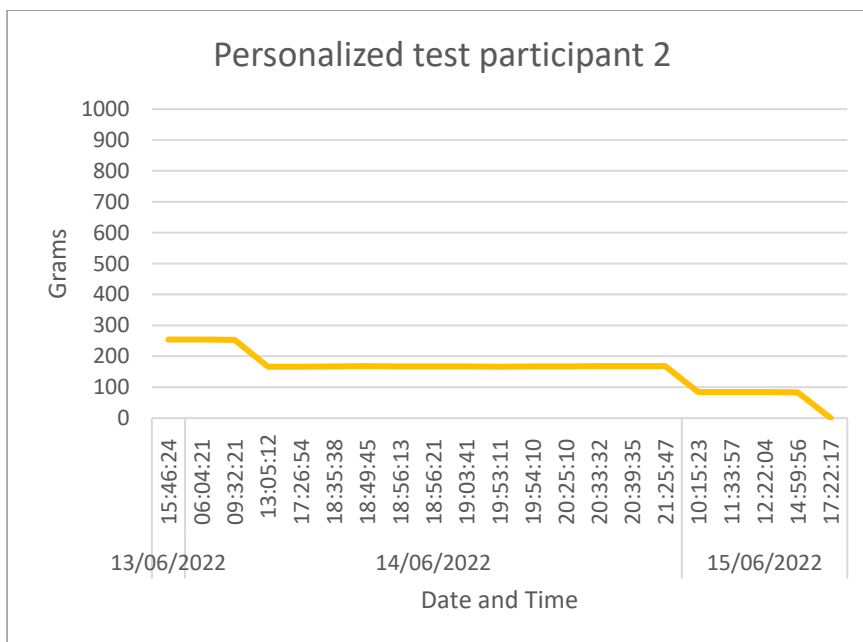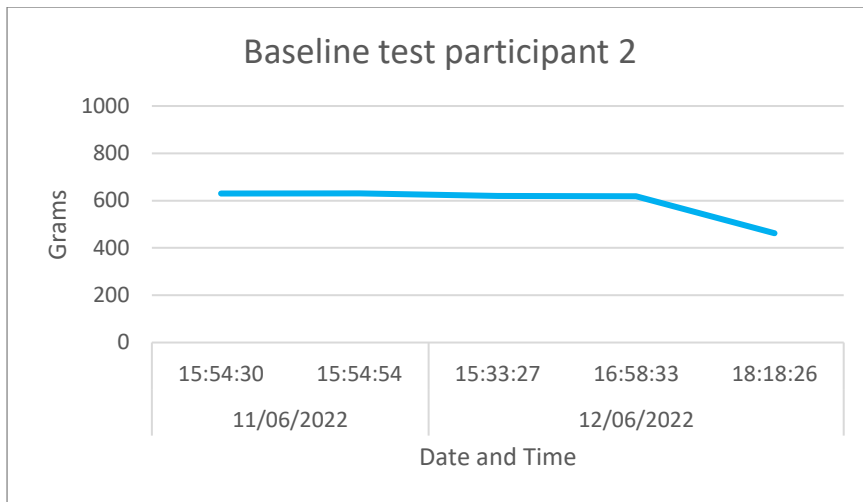
Name of investigator(s):

Signature: Date:__ / __ / __

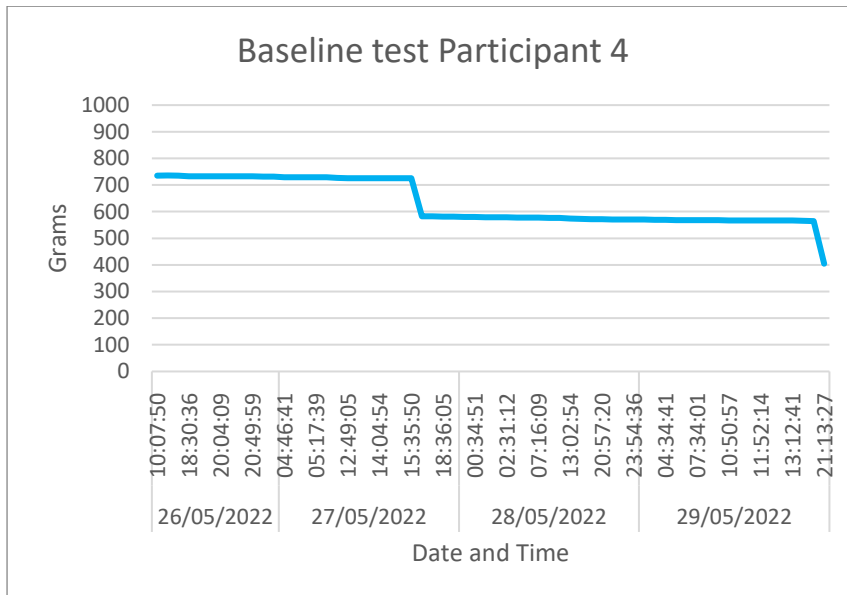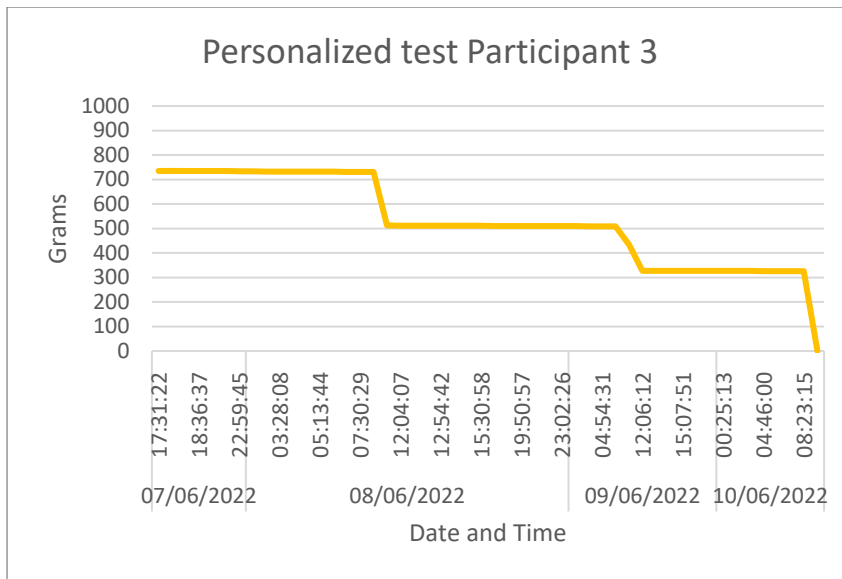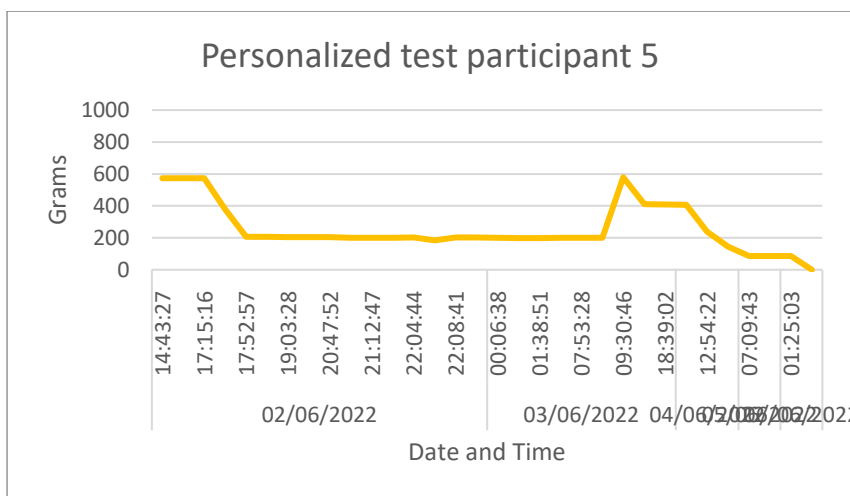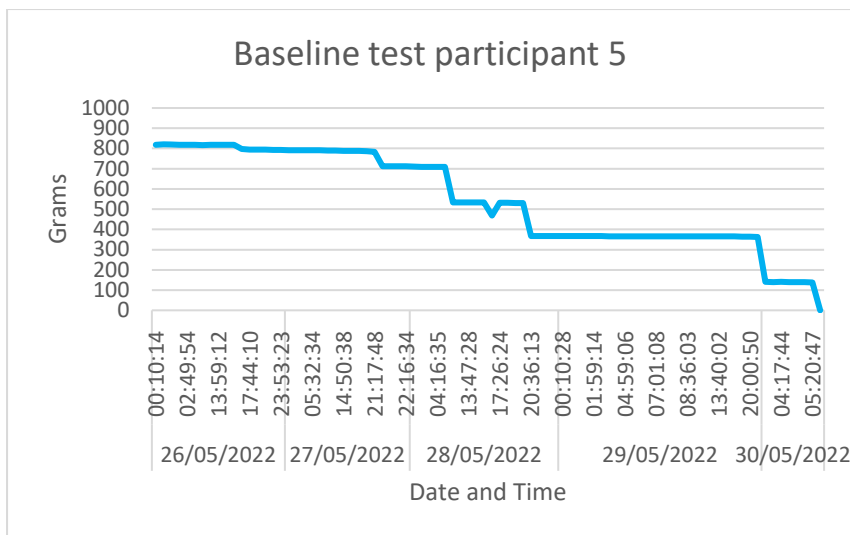*The study subject will receive the full information sheet, together with an original of the signed consent form.*

Appendix III

Baseline test Participant 1

Personalized test Participant 1

Baseline test participant 2

Personalized test participant 2

Baseline test Participant 3

Personalized test Participant 3

Baseline test Participant 4

Personalized test Participant 4

Baseline test participant 5

Grams — Date and Time

26/05/2022 27/05/2022 28/05/2022 29/05/2022 30/05/2022

Personalized test participant 5

Grams — Date and Time

02/06/2022 03/06/2022 04/06/2022

Appendix IV
First Interview Questions

1. Waren er enige problemen tijdens het onderzoek met de fruitmand?
2. Wat vond je over de ervaring van het prototype?
3. Hoe vaak was je thuis tijdens het onderzoek?
4. Heb je tijdens het onderzoek fruit gegeten naast het fruit dat is aangeleverd?
5. Welk fruit miste je op de schaal?
6. Heb je tijdens het onderzoek meer of minder fruit gegeten dan dat je normaal zou doen?
7. Wat vond je van de variatie van het fruit?
8. Heb je een nieuw stuk fruit gegeten dat je normaal niet zo vaak eet?
9. Was er fruit dat niet meer lekker was of beschimmelt raakte?
10. Waar haal je normaal je fruit?
11. Heb je het fruit zelf opgegeten?
12. Op welke tijdsdeel van een dag zou je het liefst een nieuwe levering fruit willen krijgen?
13. Mis je een manier van input?
14. Wat zou je vinden van een service gebaseerd op dit prototype, die voor jou fruit levert?
15. Heb je nog iets toe te voegen?

Appendix V

Second Interview Questions

1. Waren er enige problemen tijdens het onderzoek met de fruitmand?
2. Wat vond je over de ervaring van het prototype?
3. Was je ervaring anders dan de vorige keer?
4. Had je het idee dat de fruitsoorten en hoeveelheden beter bij je pasten?
5. Hoe vaak was je thuis tijdens het onderzoek?
6. Heb je tijdens het onderzoek fruit gegeten naast het fruit dat is aangeleverd?
7. Is er iets blijven liggen en waarom?
8. Welk fruit miste je op de schaal?
9. Heb je tijdens het onderzoek meer of minder fruit gegeten dan dat je normaal zou doen?
10. Wat vond je van de variatie van het fruit?
11. Heb je een nieuw stuk fruit gegeten dat je normaal niet zo vaak eet?
12. Was er fruit dat niet meer lekker was of beschimmelt raakte?
13. Heb je het fruit zelf opgegeten?
14. Mis je een manier van input?
15. Heb je nog iets toe te voegen?