Consumer Acceptance of 3D Food Printing at Home.

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Abstract

Although the development of the technology in 3D food printing is trending, little thought is given into consumers acceptation of a 3D food printer. This study examined to what extend the emotions disgust, fear and positive surprise were raised by technological and unexpected applications of a 3D food printer and how they influenced the consumer acceptance of 3D food printing. The study was done with an online experiment. The results did not show that a high degree of unexpected benefits leads to a higher level of positive surprise. Also did the result not support that a high degree of technology leads to a higher level of fear and disgust. The results did show that a higher level of disgust and fear leads to a lower acceptance of a 3D food printer. This study may prove a contribution to marketeers and technologist who want to market a 3D food printer for domestic use.

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Introduction

Imagine your fridge full of cartridges that make you breakfast, lunch and dinner. You filled the cartridges with recipes you found online and that looked very appealing to you. It is 6 o'clock in the afternoon and you would love to eat pizza for dinner. You walk to the fridge and take out the cartridge that is filled with the ingredients to make pizza. Next you put the cartridge into your 3D food printer and within half an hour the printer has made you a nice fresh pizza.

Although the development of the technology in 3D food printing is trending (Dankar, Haddarah, Omar, Sepulcre & Pujolà, 2018), it may be hard to imagine how this 3D food printing works. Three-dimensional (3D) printing is a process where products are designed via 3D programs CAD. Information about the 3D design is sent to the printer and the 3D printer prints the design layer by layer into the desired end product. (Rayna & Striukova, 2016). Consider pizza as an example to illustrate how it works in the food sector. First a design of the pizza is made. How will the pizza look like, for example in the shape of Italy. Secondly the 3D food printer is filled with the needed ingredients; dough, tomato sauce and cheese. The 3D printer first prints out layers of dough. Secondly a layer of sauce is printed and on the top to finish the pizza a layer of cheese is printed. These layers together build the pizza that is designed. (Lipton, Cutler, Nigl, Cohen, & Lipson, 2015).

Printing food at home via a 3D printer was from the beginning on a goal in the development of 3D printing of food (Lipton et al., 2015). Even though more technology development is needed, technologist see a great potential for 3D printing at home. (Lipton et al., 2015; Sun, Peng, Yan, Fuh, & Hong, 2015). First of all, technologist state that it delivers fun for the consumers. They can experiment with textures forms and food flavours (Sun et al., 2015). A 3D food printer can shape your pizza in the form of Italy while most of people are not skilled enough to make these kind of artworks themselves. Furthermore it can help people with their individual dietary's and personalised nutrition. A 3D food printer can control the needs and desires, with respect to ingredients and intake, of users. This kind of customization can lead to healthier diets and makes it easier to deal with allergies and intolerances (Lipton et al., 2015). A next issue that technologist mention is that a 3D printing can help limit food waste since the 3D printer can reuse materials that otherwise be thrown away (Davies, 2014). It can also contribute to limiting package waste because the cartridges are refillable (Mims, 2013). Lastly it simplifies the food supply chain according to Sun et al., (2015); When people have their

own 3D food printer at home they will have their product within a shorter time for a reasonable price and using less resources.

Technologists are very positive about the impact a 3D printer can have on the daily life of consumers. But it is essential to understand the needs and desires of your potential customers (Kotler and Keller, 2009). To date, little thought is given into if consumers actually want to eat food that is made by a 3D printer. Consumers have a natural preference for 'natural foods', but when fabricated food proves itself to be fresh, of high quality and of good nutritious value, people are willing to accept 3D printed food more (Lupton and Turner, 2016).

It is important to understand that consumers do not decide to buy a 3D printer only based on rational and cognitive trade-offs with positive attributes such as those identified by Lupton and Turner (2016). Much of the decision making process is based on emotional feelings that an object or in this case a 3D food printer evokes. (Bazerman, 2002). This means that when 3D food proves itself to be save and of high quality, there is no guarantee that people's emotions and feelings towards home 3D printing are in line with these claims and that people are willing to buy a 3D printer. Therefore more research is needed to understand what kind of emotions people associate with using a 3D printer and if people are willing to use a 3D food printer at home to make their daily meals. Questions like this can contribute to a better understanding of potential customers and a better chance for the 3D food printer to succeed on the market.

Therefore this research will answer the question;

To what extent are which emotions raised by technological and unexpected applications of 3D food printing at home and how do these influence the consumer acceptance of 3D printing of food.

Theoretical framework

Hypothesis and conceptual design

What emotions are is very hard to define (Scherer, 2005). But it is assumed that emotions trigger feelings and 'appraisal tendencies' to happen. This is an automatic intuitive process that influence perceptions and the decisions people make. Behaviour can thus be influenced by emotions and an individual can even be influenced in their response to an object or event that is not related to the initial cause of the emotion. (Lerner, 2000). This means that emotions that a 3D food printer evokes can influence how individuals think about the food a 3D food prints.

One approach to emotions is that of basic emotions. In this approach each emotion has a specific appraisal function. (Izard, 1992). Disgust is a basic emotion that evokes a feeling of aversion (Ekman, 1992). In a food-related context disgust means disliking the idea of eating particular food because is was in contact with a contaminating object and therefore an individual rejects the food (Rozin, 1987). This feeling of disgust is related to fear (Woody & Teachman, 2000). Accordig to Rachman (1998, p. 2-3) is fear "an emotional reaction to a specific, perceived danger". People can for example have a fear for contamination of food which causes a feeling of disgust towards this particular food. Both the emotions disgust as fear can lead towards rejection (Ekman, 1992; Lerner & Keltner, 2001).

Consumer rejection towards new food related technologies is often an obstacle in making a success out of these technologies (Cox, Evans & Lease, 2007). When new technologies are used for food production, concern can arise among consumers. Consumers fear that the risks involved with new technology are beyond their control since consumers often have no knowledge about the methods that are used to produce processed food. (Bruhn, 2007). Even when an innovation has great potential customers can reject the technology based on a 'technology paradox' the conflicting emotional reaction to innovations and the fear of being overwhelmed by unknown new technologies (Mick & Fournier, 1998). This means that emotions have an impact on the acceptance of a 3D food printer. Pliner and Pelchat (1991) for example found a relation between trying new foods and the emotion disgust. But also the emotion fear influences the acceptance of new food since new food did not prove itself to be safe. Therefore people rather eat food that they are familiar with because they know it is safe. (Kalat and Rozin, 1973). This means in the case of a 3D food printer that this new technology

of making food can evoke emotions of fear and disgust towards the 3D food printer because it is a new way of producing food.
Based on the theory mentioned above we state the following hypothesis:

Hypothesis 1.1: A strong association between a 3D food printer and high technology, will lead to a higher level of disgust.

Hypothesis 1.2: A strong association between a 3D food printer and high technology, will lead to a higher level of fear.

Hypothesis 2.1: A high level of disgust towards food generated by a 3D food printer will lead to a lower level of acceptance towards a 3D food printer.

Hypothesis 2.2: A high level of fear towards food generated by a 3D food printer will lead to a lower level of acceptance towards a 3D food printer.

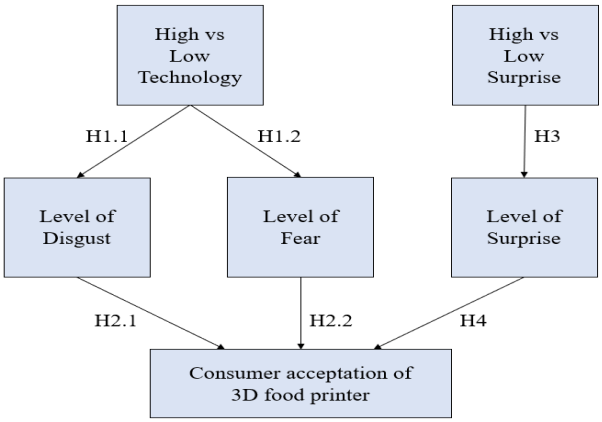
On the other hand, even though consumers do not ask for technologies, they do want product that serves them with specific benefits. Consumers base the acceptance of new technology not only on the risks they perceive but also the benefits that it gives. (Bruhn, 2007). This brings us to the third emotion that could arise in relation with the 3D food printer: positive surprise. New foods and technologies can bring value and benefits to customers which can lead to excitement to tasting new foods (Lupton, 1996). When an individual wants to try new food it can give them a feeling of being adventurous and sophisticated (Falk, 1994). When a consumers perceive the performances of a product as surprisingly positive, customer delight is triggered (Crotts and Magnini, 2011). This means that when a 3D printer can surprise people positively for example by creating a surprisingly new texture or new form of the food, that these unexpected benefits which can lead to a higher acceptation of a 3D food printer.

Therefore we state the following hypothesis:

Hypothesis 3: Unexpected benefits that a 3D food printer can offer leads to positive surprise

Hypothesis 4: positive surprise leads to a higher acceptation of a 3D food printer

Conceptual model



Method

Participants and design

This study was an online experiment in Dutch and had a sample of 118 participants[1] of which 35 man and 83 women. Most participants were between the age of 20 and 24 (see figure 2) and are high educated (see figure 3). Convenience sampling was used to recruit participants. A survey in Qualtrics was made and put on social media and it was requested to share this survey on their social media. The hypothesis were tested in a 2x2 design and four conditions were manipulated.

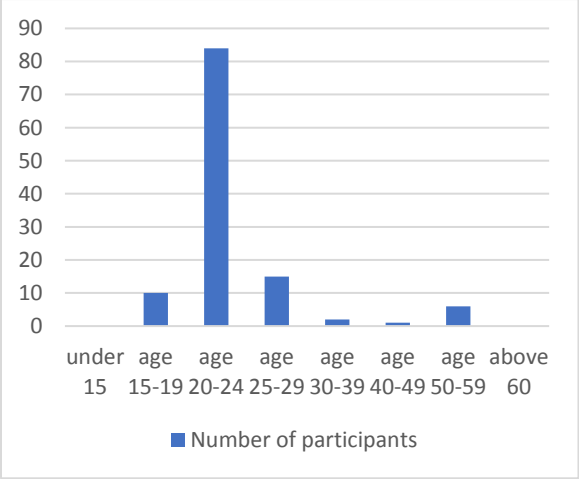


Figure 2: Age participants

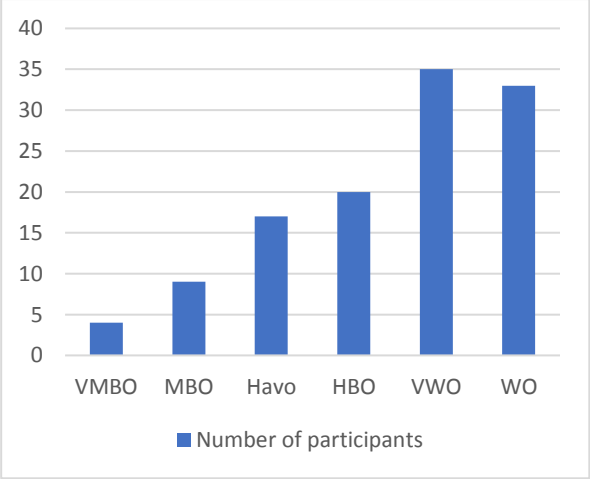


Figure 3: Level of education participants

[1] Two participants did not finish the online experiment. The data of these two participants is used wherever possible.

Manipulations

A pre-test was conducted among 8 participants to find out what names a 3D food printer could be named sounded high- or low-tech and to find out what benefits participants do or do not expect from a 3D food printer (see 1.1 appendix). It was found that participants perceived the word 3D printer as high-technology and piping meal bag as low-technology. Furthermore it was found that it was no surprise for consumers that a 3D printer can print chocolate, photos on pies, can help consumers get the right nutritious values and can make special textures and forms in food. It was a surprise for consumers that a 3D food printer is good for the environment, that it can help optimize your diet, that it is easy in use and that it can change puree into solid food.

Based on these two pre-tests 4 manipulations were made:

Manipulation 1: High technology/ High surprise

Er is een nieuwe technologie op de markt. Een 3D food printer. Deze 3 dimensionale printer bestaat uit cartridges die gevuld zijn met ingrediënten. Wanneer je online een gerecht hebt gedownload en naar de printer hebt gestuurd, kopieert de 3D foodprinter jou maaltijd op je bord.

Deze 3D printer kan momenteel al pizza printen en is ook nog eens goed voor het milieu aangezien er geen plastic verpakkingen nodig zijn. Het kan mensen helpen met hun dieet te optimaliseren. Specifieke behoeften kun je namelijk instellen in je 3D food printer. Het kan je dus helpen met een calorie arm of bijvoorbeeld een eiwitrijk dieet. En het is bovendien ook nog eens eenvoudig te bedienen.

Manipulation 2: High technology/ Low surprise

Er is een nieuwe technologie op de markt. Een 3D food printer. Deze 3 dimensionale printer bestaat uit cartridges die gevuld zijn met ingrediënten. Wanneer je online een gerecht hebt gedownload en naar de printer hebt gestuurd, kopieert de 3D foodprinter jou maaltijd op je bord.

Deze 3D food printer kan momenteel al chocolade printen. Maar het geeft ook toegang tot nieuwe texturen en vormen in voeding die voorheen niet mogelijk waren. Zo kun je bijvoorbeeld je foto op een taart laten printen. Maar ook een kleine Eiffeltoren printen van

chocolade. Bovendien kan het consumenten helpen om de juiste voedingsstoffen binnen te krijgen die nodig zijn om gezond te blijven.

Manipulation 3: Low technology/ High surprise

Er is een nieuwe technologie op de markt. Een maaltijd spuit die een maaltijd voor je kan bereiden. Je kiest van te voren een maaltijd uit die je wilt nuttigen en stelt deze maaltijd in. Vervolgens spuit de maaltijd spuit laagje voor laagje de ingrediënten die in de maaltijd spuit zijn gestopt tot een maaltijd.

Deze maaltijd spuit kan momenteel al een pizza bereiden en is ook nog eens goed voor het milieu aangezien er geen plastic verpakkingen nodig zijn. Het kan mensen helpen met hun dieet te optimaliseren. Specifieke behoeften kun je namelijk instellen in je maaltijd spuit. Het kan je dus helpen met een calorie arm of bijvoorbeeld een eiwitrijk dieet. En het is bovendien ook nog eens eenvoudig te bedienen.

Manipulation 4: Low technology/ Low surprise

Er is een nieuwe technologie op de markt. Een maaltijd spuit die een maaltijd voor je kan bereiden. Je kiest van te voren een maaltijd uit die je wilt nuttigen en stelt deze maaltijd in. Vervolgens spuit de maaltijd spuit laagje voor laagje de ingrediënten die in de maaltijd spuit zijn gestopt tot een maaltijd.

Deze maaltijd spuit kan momenteel al chocolade maken. Maar het geeft ook toegang tot nieuwe texturen en vormen in voeding die voorheen niet mogelijk waren. Zo kun je bijvoorbeeld je foto laagje voor laagje op een taart laten spuiten. Maar ook een kleine Eiffeltoren laten spuiten van chocolade. Bovendien kan het consumenten helpen om de juiste voedingsstoffen binnen te krijgen die nodig zijn om gezond te blijven.

Measures

To measure the acceptance of a 3D food printer by consumers, the Technology Acceptance Model of Davis (1989) was used. Davis states here that perceived usefulness and perceived ease of use leads to the attitude a person has towards using a new technology. This attitude towards using a new technology leads to whether a person decides to actually use a new technology or not. In other words, if consumers accept the new technology or not.

Attitude is measured on a 4 item scale based on the 5 item scale to measure attitude from Hubona & Geitz (1997) One item was left out because it had the exact same translation in Dutch than another item on the scale that was used, it was impossible to find a different translation in Dutch. For each item participants had to indicate how they felt about the item on a 7 point scale (extremely-quite-slightly-neutral-slightly-quite-extremely) and was phrased in the survey from positive (=1) to negative (=7).

The emotion disgust was measured based on a 4 item scale of Harmon-Jones, Bastian, & Harmon-Jones (2016).

Fear was measured on a 6 item scale based on the 7 item scale of McDonald, Glendon & Sparks (2011).) One item was left out because it had the exact same translation in Dutch than another item on the scale that was used, it was impossible to find a different translation in Dutch.

Positive surprise was measured on a 2 item scale which was based on the 3 item scale of McDonald et al., (2011) to measure surprise. One item was left out because it was a negative surprise item.

Happiness was measured as a distractive measurement and was measured based on the 4 item scale of Harmon-Jones et al., (2016).

All four emotions were measured on a 7 point scale ranged from totally not applicable to totally applicable.

Lastly the demographic aspects gender, age and educational background were asked.

Procedures

The survey was made in online in Qualtrics and started with an introduction text. In this text were participants thanked for participating and told that their answers to the questionnaire were anonymous and treated confidentially. Furthermore we informed participants that the survey would take five minutes and if there were any questions concerning this survey they could send it to the e-mail address that was provided. Before the survey started they had to confirm that they read the introduction text.

Hereafter were the participants randomized to one of the four conditions; high-tech/high surprise, high-tech/low surprise; low-tech/high surprise or low-tech/high surprise. After

reading this manipulation they had to answer a questionnaire. At last they were thanked again for participating in the study.

Results

The construct attitude was found to be reliable with a Cronbach's $\alpha = .925$. A factor analysis was conducted on the 16 items to establish which emotion can be turned into one variable. An oblique rotation was done. Four components had eigenvalues larger than Kaiser's criterion which is 1 (Field, 2009). And the scree plot also showed 4 components.

All four components were found to be reliable with a Cronbach's $\alpha > .80$, disgust $\alpha = .930$; fear $\alpha = .902$; positive surprise $\alpha = .840$ and happiness $\alpha = .858$. Average scores of items were used to make relevant components (see table 1). The first component, Disgust (eigenvalue = 6.087), explained 38% of the variance and consist of the items grossed out (.891), revulsion (.875), sickened (.831) and nausea (.779). It turned out that the items uneasy (.539) and distressed (.535) were also above the limit of .4 factor loading but it was decided to have a higher limit of .6 since the loadings are much lower than the other four items and the items do not fit with the rest. The items; concerned (.867), fear (.831), worried (.830) and scared (.806) are the second component named fear. Fear (eigenvalue = 3.277), explained 20.5% of the variance. The third component is positive surprise and consist of the items surprised (.882) and amazed (.895). Positive surprise (eigenvalue = 1.140), explained 7.1% of the variance. The last component is happiness and consist of happy (.864), enjoyment (.821), satisfaction (.876) and liking (.675). Happiness (eigenvalue = 1.340), explained 8.4% of the variance.

		N	**Mean Disgust**	**Mean Fear**	**Mean Happiness**	**Mean Surprise**
High technology	**High surprise**	33	2.406 (SE=0.237)	2.805 (SE=0.258)	4.023 (SE=0.219)	4.531 (SE=0.254)
	Low surprise	29	2.310 (SE=0.249)	2.741 (SE=0.269)	3.828 (SE=0.230)	4.397 (SE=0.267)
Low technology	**High surprise**	29	3.304 (SE=0.253)	2.741 (SE=0.274)	3.429 (SE=0.234)	4.589 (SE=0.271)
	Low surprise	33	2.681 (SE=0.249)	2.526 (SE=0.269)	3.724 (SE=0.230)	4.414 (SE=0.267)

Table 1: Mean and Standard error components

ANOVA

An ANOVA was done to test the hypotheses whether fear and disgust were influenced by the degree of high technology and if positive surprise was influenced by the degree of unexpected surprises. We also did an ANOVA on the variable happiness.

The degree of high technology had a significant effect on disgust (F (1,114) = 6.583, p = .01). The mean of disgust when the 3D food printer was presented as low technology was 2.992. The mean of disgust when the 3D food printer was presented as high technology was 2.358. This means that when the 3D food printer was presented as low technology it leads to a higher level of disgust (see figure 4). The effect of the degree of surprise on disgust (F (1,114) = 2.113, p = .15) and the interaction effect of disgust, the degree of technology and the degree of surprise (F (1,114) = 1.136, p = .29) were also measured but were not found to be significant.

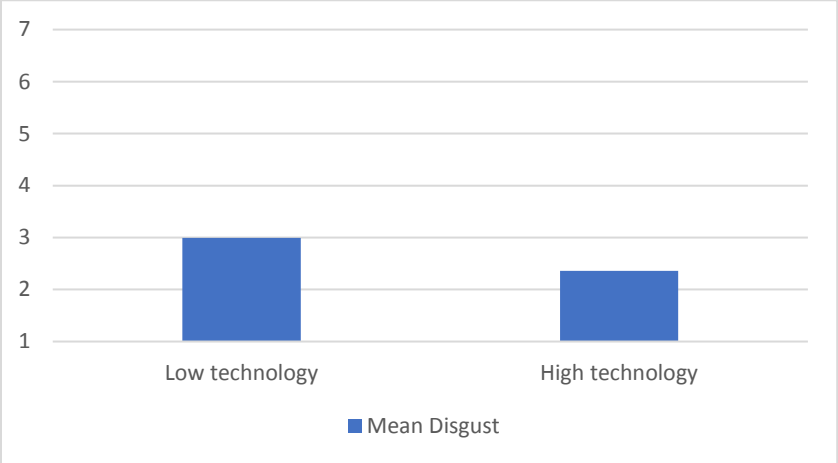


Figure 4: Mean disgust when 3D food printer was presented as high versus low technology

The degree of high technology had no significant effect on fear (F (1,114) = 0.273, p = .60). The effect of the degree of surprise on fear (F (1,114) = 0.272, p = .60) and the interaction effect of fear, the degree of technology and the degree of surprise (F (1,114) = 0.081, p = .78) were also measured but were not found to be significant.

The degree of surprise had no significant effect on positive surprise (F (1,114) = 0.020, p = .89). The effect of the degree of technology on positive surprise (F (1,114) = 0.343, p = .56)

and the interaction effect of positive surprise, the degree of technology and the degree of surprise (F (1,114) = 0.006, p = .94) were also measured but were not found to be significant.

The degree of high technology had no significant effect on happiness (F (1,114) = 2.334, p = .13). The effect of the degree of surprise on happiness (F (1,114) = 0.048, p = .83) and the interaction effect of happiness, the degree of technology and the degree of surprise (F (1,114) = 1.156, p = .29) were also measured but were not found to be significant.

Multiple Regression Analysis

A multiple regression analysis was done to find out if the emotions disgust, fear, positive surprise and happiness had an effect on attitude (see table 2). There are no correlations between predictors that are higher than .90. The VIF for the predictors disgust (VIF = 1.708, Tolerance = .585), fear (VIF = 1.519, Tolerance = .659), happiness (VIF = 1.323, Tolerance = .756) and positive surprise (VIF = 1.215, Tolerance = .823) are between 1 and 2 which is far below value of 10 and the tolerances all above .1. This means that the assumption of no perfect multicollinearity has been met. Also the assumption of homoscedasticity has been met.

The Durbin-Watson test gives a value of 1.872 which is close to the value of two that indicates that the errors in this model are independent of each other. Therefore the value of 1.872 is acceptable and it indicates that the errors in this model are almost independent.

The model in general is significant and quite generalizable (F (4,112) = 23.371, p > .001, R^2 = .455, adjusted R^2 = .435). Attitude was phrased in the survey from negative to positive. Therefore a positive effect on attitude means a lower acceptation of a 3D food printer and a negative effect on attitude means a higher acceptation of a 3D food printer.

When disgust, fear, happiness and positive surprise were not taken into account, there would be a predicted attitude of 4.74. Disgust has a strong significant effect on attitude (β = .226, t (112) = 2.738, p = .007). When the level of disgust goes up, the more negative attitude a respondent has. In other words, the higher the level of disgust is, the lower the acceptance of a 3D food printer is.

Fear has also a significant effect on attitude (β = .150, t (112) = 1.989, p = .049). When the level of fear goes up, the more negative attitude a respondent has. In other words, the higher the level of fear is, the lower the acceptance of a 3D food printer is.

On the emotion positive surprise no significant effect on attitude was found (β = -.046, t (112) = -0.676, p = .501). Therefore it is not proven that a higher level of unexpected surprise leads to a less negative attitude towards a 3D food printer.

Happiness has a significantly strong negative effect on attitude (β = -.466, t (112) = -5.788, p > .001). When the level of happiness goes up, the less negative attitude a respondent has. In other words, the higher the level of happiness is, the higher the acceptance of a 3D food printer is.

	β	t (112)	Sig.
Disgust	.226	2.738	P = .007
Fear	.150	1.989	P = .049
Positive Surprise	-.046	-0.676	P = .501
Happiness	-.466	-5.788	P < .000

Table 2: effect of disgust, fear, positive surprise and happiness on attitude

Conclusion and General discussion

Technologist see a bright future for 3D food printing at home (Lipton et al., 2015). However little thought is given to the consumer acceptance of this technological development. Consumers are often concerned about new ways of processing food and these new technologies evoke a range of emotions (Mick & Fournier, 1998). Emotions like fear and disgust can lead to rejection towards new food technologies (Ekman, 1992; Lerner & Keltner, 2001). In this study we started therefore with hypothesis 1.1 and 1.2 to examine if a strong association between a 3D food printer and high technology leads to a higher level of fear and disgust.

No support for hypothesis 1.1 was found. Surprisingly it was found that a strong association between a 3D food printer and high technology leads to a lower level of disgust instead of a higher level of disgust. Although a pre-test was conducted to establish which substitute words for 3D food printer were perceived as high technology and which words as low technology

were the manipulations maybe not suitable to induce the difference in level of disgust. A pastry bag may sound less technical than a 3D food printer but could also evoke an image of an kitchenware that is only used ones or twice a year and lies somewhere in a dusty kitchen cupboard and is hard to clean. A 3D food printer on the other hand may sound new and modern and could be seen as more hygienic than a pastry bag. Therefore it is suggested that in future research more research should be done to find another way to manipulate the high and low technology frame.

Secondly this study did not show significantly that a strong association between a 3D food printer and high technology leads to a higher level of fear. Hypothesis 1.2 is therefore not supported. It could be that a 3D food printer does not evoke the emotion fear by participants because both low as well high technology evoked always a low level of fear by participants.

Hereafter I examined hypothesis 2.1 and 2.2 if a higher level of fear or disgust towards food generated by a 3D food printer leads to a lower level of acceptance towards a 3D printer. Both hypothesis were accepted. The higher the level of fear or disgust is, the lower the acceptation of a 3D food printer is. The effect of the level of disgust on the acceptation of a 3D food printer was even higher than the effect on fear. This means that even though this study did not prove that a strong association between a 3D food printer and high technology leads to a higher level of fear and disgust, it did prove that the emotions disgust and fear both have an influence on the acceptation of 3D food printer at home. Further research should therefore be conducted to find out what about a 3D food printer could evoke the emotions disgust or fear and how these emotions can be limited in order to create a higher consumer acceptance.

Also the emotion happiness showed a significant effect on the acceptance of a 3D food printer for consumer use. The lower the level of happiness is, the lower the consumer acceptance is. No hypothesis was made about happiness as an emotion, but the study of Kulviwat, Bruner, Gordon, Kumar, Nasco & Clark (2007) supports this finding in their research about consumer acceptance of technology. They found that consumers accept technology base on the joy and pleasure that using the technology brings (Kulviwat et al., 2007). Further research should therefore focus on how to evoke an happy emotions in order to enlarge the success rate of a 3D food printer at home.

Hypothesis 3 was not supported; no significant effect was found to prove that unexpected benefits that a 3D food printer can offer leads to positive surprise. This could be due to too little differences between high and low surprise in the manipulation. Although a pre-test was

conducted to establish which benefits participants expected from a 3D food printer and which benefits were unexpected, did the mean values of positive surprise by unexpected surprise and the value of positive surprise by expected surprise not differ a lot. Therefore it is suggested that in future research more research should be done to establish a greater difference in the manipulation between high and low surprise.

It could also be that the participants did not see the expected and unexpected benefits that were provided in the manipulations as a benefit which could mean that no positive surprise took place. In the pre-test was only tested what participants expected that a 3D printer could perform. It was not tested if they perceived these performances as benefits. In further research it should therefore also be examined whether participants see these unexpected performances as benefits.

The last hypothesis; Positive surprise leads to a higher acceptation of a 3D food printer was also not supported. The scale that was used to measure positive surprise consisted of the two items amazed and surprised. It could be that amazed and surprised are not necessary seen as positive emotions by participants. Russel (1980) states that surprise is a neutral emotion. This could be an explanation why the hypothesis was not supported. It could be that participants experienced the emotions surprised and amazed differently, some in a positive way but others in a negative way. Further research should therefore find another way to measure positive surprise.

This together answered the research question; To what extent are which emotions raised by technological and unexpected applications of 3D food printing at home and how do these influence the consumer acceptance of 3D printing of food? It can be concluded that a higher level of disgust and fear leads to a lower acceptance of 3D printing of food. To what extent these emotions were raised did not become clear in this research.

There were some limitations in this research. Convenience sampling was used due to limited time and the target population was not specified. The respondents in this research were therefore not very diverse in there demographic characteristics. Most were between the age of 20-24, were women and high educated and master the Dutch language. The sample is therefore probably not representative for countries outside the Netherlands, other age groups or lower educated people. The higher the age people the lower change that they adopt new technologies (Gilly & Ziethaml, 1985). This could mean that older generations could have a lower acceptance towards a 3D food printer. As people age they also become more cautious

(Botwinick, 1973). This could indicate that on a higher age people experience a higher level of fear toward a 3D printer. Therefore it is suggested to do this research on a larger scale with more participants in different age groups.

It was chosen to execute the survey in Dutch because most of the potential participants lived in the Netherlands and were native Dutch speakers. When providing them the survey in English it could be that people would have not fully understood the questions or manipulations that were provided which could have influenced the emotions that were evoked and the level of acceptance of a 3D food printer. This also meant that the scales to measure attitude, disgust, fear, positive surprise and happiness were translated into Dutch. The scale on attitude and fear therefore both contained one item less compared to their original scale because it was impossible to find different translations in Dutch. There is also a chance that items that were used do not have the exact same meaning in English as they have in Dutch. This could have influenced the reliability of scales that were used.

With regard to the factor analysis a factor loading of .6 was chosen as a limit instead of the limit of .4 loading that is often used. This was chosen because all factor loading were quite high above the limit of .4 except for two factor loadings that would have belonged to the component disgust. It was chosen not to include them into the component since the factor loadings were on average .3 lower than the rest of the loadings. Also the items uneasy and distressed did not match the other items grossed out, revulsion, sickened and nausea.

To date, little thought is given into if consumers actually want to eat food that is made by a 3D printer. However it is extremely important to understand the needs and desires of potential customers when bringing a new technology on the market (Kotler and Keller, 2009). This study may prove a contribution to marketeers and technologist who want to market a 3D food printer for domestic use. It is found that the emotions fear and disgust influences the consumer acceptance of a 3D food printer. When bringing a 3D food printer on the market for domestic use it is therefore very important to take these emotions into account. Marketeers and technologist have to find a strategy that minimalizes the emotions fear and disgust towards a 3D food printer in order to create a higher acceptation among potential customers.

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Appendix

1.1 Pre-test

Zou je onderstaande woorden kunnen ranken van meest high-tech woorden naar low-tech woorden?

1. Maaltijd kopieer apparaat
2. Food processor
3. Maaltijd bereider
4. Maaltijd spuit
5. 3 dimensionale maaltijd maker
6. Supplementen spuit
7. 3D food printer
8. Maaltijd bouwer
9. Geautomatiseerde slagroom spuit

Volgorde cijfers van meest high-tech naar low-tech:

Haal het woord weg dat niet van toepassing is. Denk je dat een 3D printer…

1. Snel is met voeding printen? Ja/Nee
2. Kan helpen met slik en kauw problemen? Ja/Nee
3. Zichzelf schoon kan maken Ja/Nee
4. Al chocolade kan printen? Ja/Nee
5. Goed is voor het milieu? Ja/Nee
6. Puree om kan zetten in vast voedsel? Ja/Nee
7. Goedkoop is? Ja/Nee
8. Kan helpen met de juiste voedingswaarde binnen krijgen? Ja/Nee
9. Zelf maaltijden ontwerpt? Ja/Nee
10. Een foto van je hoofd op een taart kan printen? Ja/Nee
11. Een kant en klare maaltijd maakt die je meteen kunt eten? Ja/Nee
12. Bijzondere texturen in voeding kan maken? Ja/Nee

13. Kan helpen met het op maat maken van je dieet? Ja/Nee
14. Makkelijk te bedienen is? Ja/ Nee
15. Al pizza kan printen? Ja/Nee
16. Groenten kan printen? Ja/Nee
17. De Eifel toren kan bouwen van voeding? Ja/Nee
18. Lang meegaat? Ja/Nee
19. Voeding bereid die gezonder is voor je dan traditioneel koken? Ja/Nee
20. Vlees kan printen? Ja/Nee