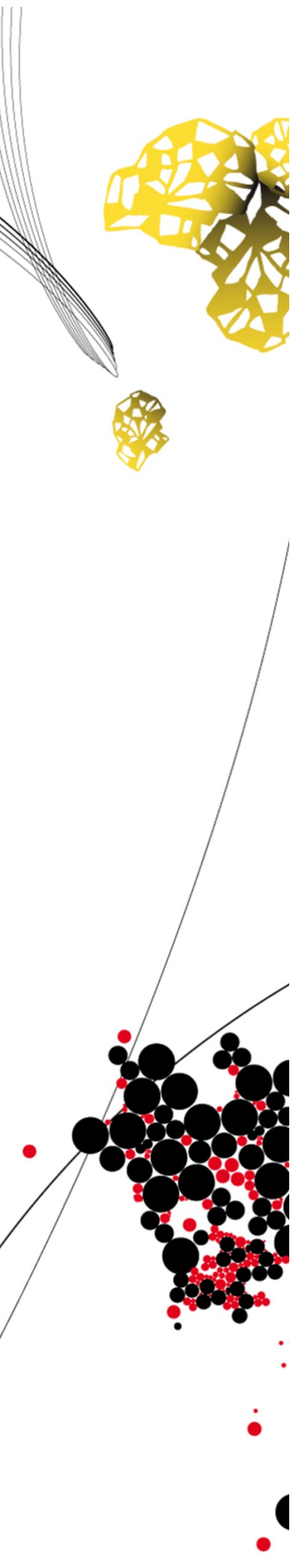

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Attitude towards sustainable meat production technology – in-vitro-meat

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Abstract

Meat is related to ethical, ecological and health-related issues. To accommodate the increasing demand for meat, several alternatives, such as in-vitro-meat (IVM) have been conceived. Currently, IVM is rather unknown since it is not commercially available yet. However, public opinions about IVM already exist, which imply that it has ecological benefits on the one hand, but that it is unnatural on the other hand. This research deals with the question of how IVM is perceived in general and whether a positive animal welfare video can influence the public opinion towards IVM. In total, 209 German participants were suitable to be considered for this research. The participants were divided into an experimental group that watched the video before filling in the questionnaire and a control group that watched the video afterwards. Statistical analyses have shown that the video did not have a significant effect on the public opinion on IVM. However, individuals, who were affected by the video intensively, thought significantly more positive about IVM, than individuals who were not affected by the video. Furthermore, this research revealed that vegetarians perceive IVM more positively than non-vegetarians. Subsequently, these results are discussed in this paper and compared to prior research. Finally, limitations and strengths of this research are elaborated.

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Introduction

Overview

The amount of people questioning meat consumption in Germany grows steadily. Meanwhile, 4.3% of the German population follow a vegetarian diet (Mensink, Barbosa, & Brettschneider, 2016) for ethical, ecological and/or health-related reasons. However, while meat consumption is being criticized more and more in Europe, the worldwide demand for meat is increasing (McLeod, 2011). Since there are those ethical, ecological, and health-related issues in which meat plays a negative role, a growing meat industry would cause several problems. In order to meet the increasing demand, alternatives to conventional meat are necessary.

In the following, it will be explained to what extent meat-related problems may occur and why this poses the need to find alternatives to meat. Subsequently, in-vitro-meat (IVM) will be introduced as an alternative to meat and obstacles to replace conventional meat with IVM will be discussed. Finally, the goal of this research is to discover the attitude of Germans towards IVM.

Ethical factors

Ethical considerations seem to be the most important factor regarding the decision to refuse conventional meat. An argument to support this statement is the fact that 63% of the German vegetarians refuse meat for ethical reasons (Mitte & Kämpfe-Hargrave, 2007). These relate to the question of how animals are treated. There is unanimity among researchers, that the present methods of livestock meat production are ethically questionable (Pluhar, 2010) as, for example the removal of chicken picks, cow horns and tails, as well as pig tails without anesthetizing the animal, which is legal if it is considered as necessary (Tierschutzgesetz, 2017). The reason for this necessity is the prevention of cannibalism among animals, which occurs when a huge crowd of animals are cramped in a small space. As a result of this, it is recommended to stop the most extreme ways of animal farming including battery cages, gestation crates and the foie gras production (World Hunger Note, 2008).

Furthermore, there is the issue of killing animals in general. In 2016, 12.5 million cows, 24.4 million pigs and 1.6 million sheep have been slaughtered. Moreover, 1.51 tons of chicken meat have been produced (Bundesamt für Statistik, 2016). In total, about 750 million animals are killed every year in Germany (Chemnitz & Benning, 2013). Even though there are voices saying that it is ethically acceptable to kill animals under the purpose to eat them,

there are also opinions implying that – since meat is not needed in order to keep a balanced diet (Craig & Mangels, 2009) - it is not justifiable to kill animals for nutritional reasons. Peter Singer, who is seen as one of the founders of the animal rights movement, argued that the suffering of any being has to be taken into account. Furthermore, he stated that excluding non-human beings from the principle of equality is as unreasonable as excluding other people because of their skin color, religion, culture or gender (Singer, 1974). Singer calls this discrimination based on the speciesism.

Prior research revealed that the meat demand decreases when consumers are exposed to awareness campaigns of animal welfare (Tonsor & Olynk, 2011). Furthermore, the meat demand decreases generally when consumers are consciously reminded that meat comes from animals (Kraut & Hohle, 2016). In addition to these ethical factors there are ecological issues as well.

Ecological factors

Conventional meat production has several negative consequences for the environment. According to FAO (2006), 14.5% of all human-induced greenhouse gas (GHG)-emissions are attributed to livestock meat production. Beyond that, research from Tuomisto & de Mattos (2011) revealed that livestock meat production is responsible for 18% of all human-induced GHG-emissions, making it even more influential than global traffic, which causes 15% of all human-induced GHG-emissions (FAO, 2006). Prior research has shown that a vegan diet causes an average of 2.89 kg CO_2 emissions every day, while a diet including more than 100g meat every day causes an average of 7.19 kg CO_2 emissions (Scarborough, Appleby, Briggs, Travis, Bradbury, & Key, 2014).

Livestock meat production is also responsible for the consumption of many resources, such as soy since 98% of the soy meal production is used for feeding animals (Hartman, West & Herman, 2011). Furthermore, 36% of the calories produced by the worldwide crop harvest (which equals to 24% of the plants), are used as fodder and 12% of these could be used as food for humans. It is estimated that 70% more calories would be available for humans if all calories go directly into the human diet (Cassidy, West, Gerber, & Foley, 2013). Additionally, 30% of the global land and 8% of the water are used for livestock meat production (Tuomisto & de Mattos, 2011).

Health-related factors

Next to ethical and ecological reasons to refuse conventional meat, people also consider health-related consequences. Prior research revealed that 20% of the German vegetarians refuse to consume meat for health reasons (Mitte & Kämpfe-Hargrave, 2007). Research has shown that red meat consumption (including beef, pork or lamb) can be related to maturity-onset-diabetes, cardiovascular diseases and certain types of cancer. Moreover, one additional sausage every day increases the risk to die earlier by 20% (Pan et al, 2012).

Furthermore, multi-resistant germs can arise in animal farms, which is related to the use of antibiotics. In 2015, 805 tons of antibiotics have been used in the meat industry in Germany (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, 2016). It is estimated that between 7.500 and 15.000 people in Germany annually die as a consequence of multiresistent germs (ECDC, 2011). Moreover, 60% of all known human diseases and 75% of all dangerous diseases are zoonotic, meaning that they are transferable from animals to humans (Steinfeld, Gerber, Wassenaar, Castel, & den Haan, 2006; Jones, et al, 2013).

These ethical, environmental and health-related issues indicate that the current methods of meat production are not sustainable. To overcome these issues, several alternatives to conventional meat have been conceived.

Alternatives

The most common products that serve as alternatives to conventional meat are based on soy, including, for example Tofu or Tempeh, wheat, such as Seitan, milk proteins or Quorn®, which all are considered to be eco-friendly (Hoek, Luning, Stafleu, & de Graaf, 2004). Prior research indicated that meat alternatives have to mimic meat in its look, odor, consistency and flavor in order to be perceived as good alternatives by the consumers (Bredahl, Grunert, & Fertin, 1998; Verbeke, Pérez-Cueto, de Barcellos, Krystallis, & Grunert, 2010). For this reason, serious attempts were made to make these products as similar to meat as possible. There are several enterprises trying to create plant-based meat that has comparable properties to conventional meat, but is completely vegetarian. Patrick Brown, the CEO of “Impossible Food” stated in an interview ("Am wichtigsten ist der Geruch nach Blut", 2017) that it is possible to imitate meat by adding hemoglobin to other plant-based products. Furthermore, he expects that his plant-based ground meat should be in the supermarkets between 2019 and 2020. However, plant-based meat alternatives are currently unpopular since all plant-based meat alternatives still lack similarity to conventional meat, even though there is progress (Elzerman, 2006).

For this reason, this research focuses on IVM as this alternative does not face the problem of dissimilarity to conventional meat. IVM grows out of stem cells in a laboratory (Post, 2012). For this procedure, stem cells are extracted from animals that do not have to die for this process. Even though IVM is not produced industrially yet, there are already estimations about its efficiency. These estimations propose that IVM will need 99% less land and 82-96% less water than conventional meat (Tuomisto & de Mattos, 2011). However, these numbers have to be seen critically since energy costs might actually be higher than estimated because the process of cultivation needs warmth and thus requires energy (Mattick, Landis, Allenby, & Genovese, 2016).

IVM still faces several challenges. Initially, the majority of studies needed regarding cellular agriculture still has to be conducted but there is a lack of attention and therefore financial support for these kinds of studies is missing. It is assumed that only five research projects are exclusively dealing with cellular agriculture (Rorheim, Mannino, Baumann & Caviola, 2016).

Furthermore, there are several risks regarding IVM. First of all, there is the possibility that genetic engineering has to take place in order to develop IVM (Rorheim et al, 2016). The optimal foundation for the culture medium seems to consist of macro-algae that are difficult to produce in a sufficient number enabling industrial IVM-production to take place. However, progress in research is taking place regarding these macro-algae since data is collected in the fields of biofuel (Slade & Bauen, 2013) and animal food (Van der Weide, Schipperus, & Van Dijk, 2014). Next to these concerns, it is also questionable whether people will completely accept and buy IVM when it is on the market.

Perception of in-vitro meat

Qualitative research revealed that IVM is rather unknown (Verbeke, Sans, & Van Loo, 2015) and one of the biggest issues regarding IVM is its unnaturalness (Steenhuis, 2011; Laestidius & Caldwell, 2015; Welin, 2013). The perceived unnaturalness leads to less acceptance of health risks associated with IVM even if it was the case that these health risks would not be higher than the risks of conventional meat (Siegrist & Sütterlin, 2016). Furthermore, critics state that IVM will create a distance between humans and nature because no farm animals would be needed if IVM replaced conventional meat. (Welin, 2013). Additionally, tissue engineering might foster cannibalism since human IVM could theoretically be produced as well using this technology (Peterson, 2006; McIlroy, 2006).

Yet, people value that IVM provides less harm towards animals, the environment, and

public health. Even though quantitative research confirmed that IVM is unknown among the general public, around 75% of the participants of these studies indicated that they would not refuse to try it (Post, 2014; Verbeke et al., 2015).

Theory of planned behavior

One possible theory to explain why individuals behave the way they do is the theory of planned behavior (Ajzen, 1991), which already has been used to explain meat consumption (Povey, Wellens, & Conner, 2001; Carfora, Caso, & Conner, 2017). The theory of planned behavior states that there are three proximal determinants which are essential for performing a certain behavior (Ajzen, 1991), such as buying IVM. The three determinants are attitude, subjective norm and perceived behavior control. While attitude refers to the beliefs and opinions of an individual, the subjective norm includes a person's perception on the behavior of the social environment (Ajzen, 1991). The perceived behavioral control describes whether a person thinks that he or she is able to perform the desired behavior. Next to the proximal determinants, there are also distal determinants, which do not influence the behavior directly, but indirectly by influencing the proximal determinants. One example could be the variable "knowledge" which can influence the proximal determinant attitude. Furthermore, there are ultimate determinants, which cannot be changed, but still have an influence on the proximal and distal determinants, for instance age, gender or nationality are typical ultimate.

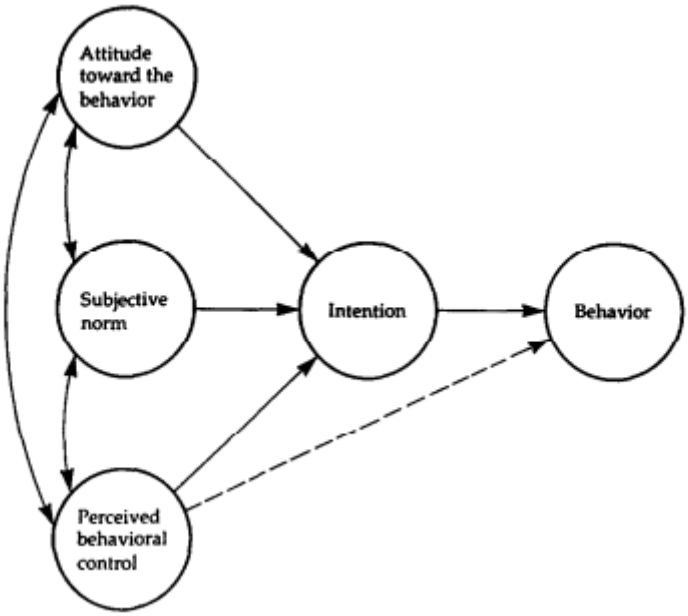

Figure 1. Theory of planned behavior (Ajzen, 1991)

Applied to IVM, the desired behavior would be that people buy IVM. To change the previous behavior, consumers need to have a positive attitude, a positive subjective norm and a positive perceived behavioral control towards buying IVM. Therefore, consumers have to be convinced that IVM is good so that they have a positive attitude towards it. Having a positive subjective norm means that consumers think that it is normal to buy IVM. Furthermore, they need to feel able to buy IVM. However, it has to be considered that IVM is not available on the consumer market yet, so this research deals with the intention to buy IVM by providing the hypothetic case that IVM was available.

Prior research has stated that all three factors are important to follow a certain diet, while subjective norm was the weakest predictor (Povey, Wellens, & Conner, 2001). According to Povey et al. (2001), perceived behavioral control was the strongest predictor for vegetarian and vegan diets which was explained with the additional effort that vegan and vegetarian diets require. Since IVM does not require any change in the diet, but rather aims at replacing meat one-on-one, this research focuses on the attitude towards IVM. Furthermore, other research indicated that attitude is the only important predictor of meat consumption (Zur & Klöckner, 2014). Simultaneously, more positive attitudes towards meat decrease the willingness to reduce meat consumption (Graça, Calheiros, & Oliveira, 2015). For this reason, this research deals with the attitude towards conventional meat as well as to the attitude towards IVM.

Attitude Change

Ajzen and Fishbein (2000) stated that attitudes are volatile as it is either possible to influence attitudes by providing information or automatically, by affect. Furthermore, research has indicated that affect is directly connected to the buying behavior of meat consumers: While buying meat, people try to separate the meat from what it actually is, namely animals. This effect is called dissociation (Kunst & Hohle, 2016). Prior research recommended to integrate several factors in animal welfare campaigns, such as moral or health-related aspects or certain attitudes (Zur & Klöckner, 2014). However, animal welfare related information seems to have the strongest impact on meat consumption (Cordt, Nitzko, & Spiller, 2014). Furthermore, the issue of the unnaturalness of IVM could be resolved by exposing consumers to the unnatural circumstances of the livestock meat production to question the perceived unnaturalness of IVM (Rorheim et al., 2016).

Since research has shown that gender plays an important role in meat related issues, the gender of an individual has to be considered as well when aiming to change an

individual's attitude. Research indicated that meat consumption is related to perceived masculinity (Ruby & Heine, 2011; Thomas, 2016). Furthermore, research already revealed that there are gender differences in the perception of IVM (Wilks & Phillips, 2017) indicating that men perceive IVM more positively than women.

Another important aspect regarding attitude change is positivity. Prior research revealed that group members feel more positive when their leader also shows a positive mood as well (Ty, Côté, & Saavedra, 2005). Furthermore, in a research about attitude change, a positive mood of the participants led to more persuasion than a negative mood (Wegener, Petty, & Klein, 1994). For this reason, a positive atmosphere is used to change an individual's attitude more effectively.

Additionally, emotions play an important role when it comes to attitude change. Research about environmental attitudes revealed that an emotional 360° video leads to a stronger attitude change than a video that does not cause emotions (Fonseca & Kraus, 2016). The same research has further shown that a greater immersion leads to a stronger attitude change by comparing an immersive virtual reality video presented via a head mounted display with a less immersive video shown on a tablet.

In this research, it is decided to use a video to change the attitude towards IVM since prior research has shown that animal welfare videos can influence the demand for animal-related products, such as milk (Tonsor & Wolf, 2012). The video that was shown to the participants in this research contained information on the circumstances in livestock meat production as well as happy pigs that are playing on grass. Via affect, the video should decrease the attitude towards meat.

Research question

Subsequently, this study aims at answering the following questions:

1. To what extent does showing an animal welfare video influence the perception of IVM, the attitude towards IVM and the willingness to buy IVM?
2. To what extent do affect and vegetarianism moderate the effect of the video?
3. To what extent are the perception, the attitude and the willingness to buy IVM, related to gender and eating habits?

Additionally, 5 hypotheses are established regarding these research questions:

1. The group that watches the video is more likely to have a positive perception, attitude and willingness to buy IVM.

2. The effect of the video is stronger for participants, who are affected more intensively. There is an expected interaction between affect and effect.
3. There is an interaction effect between the treatment and eating habits.
4. Vegetarians have a more positive attitude, perception and willingness to buy IVM than omnivores.
5. Men perceive IVM more positively than women and have a stronger intention to buy it.

Methods

Participants

Through the means of a convenience sample, 285 participants were recruited. This was done via a link to the online experiment that was shared through the researcher's and his acquaintances' social media connections. Certain requirements had to be fulfilled to be considered in this research since the participants had to be adults (18 years or older), Germans and the manipulation had to be understood correctly. The data of 47 participants could not be processed because they did not complete the survey. Additionally, three participants could not fill in the survey because they were underage. Furthermore, the data of 26 participants was extracted because the presented video was not understood correctly. In total, 209 (Male: N=83, 39.7%, Female: N=126, 61.3%) participants were suitable to be considered in this research. The average age of the participants was 29.45 and ranged from 18 to 80.

Design

This study, which was approved by the ethical commission of the University of Twente, had a true-experimental only-posttest-design. The independent variable in this study is the treatment (experimental group: watching an animal welfare video before the questionnaire is filled in, versus control group: showing an animal welfare video after the questionnaire is filled in) and the dependent variables were the perception, attitude and willingness to buy IVM. The participants were assigned to the conditions randomly using a randomizer in the online survey software Qualtrics. A randomization check has shown that the participants were distributed randomly among the conditions regarding gender [$X^2(1) = .30$, $p = .32$], vegetarianism [$X^2(1) = 3.68$, $p = .06$], age [$t\ (207) = .50$, $p = .62$], political affiliation [$t\ (207) = .77$, $p = .44$] and political affiliation regarding values [$t\ (207) = .51$, $p = .61$]. The experimental condition consisted of a video showing happy pigs followed by a

questionnaire on IVM. In the control condition the participants firstly filled in the questionnaire and watched the video afterwards. The participants in the control condition did not know that they were going to watch a video after they filled in the questionnaire. At the end of the survey, the participants in both conditions had to evaluate the video.

Instruments

To figure out the perception of IVM, an online questionnaire using Qualtrics (Attachment 1) was conducted. This survey was based on a questionnaire used in a prior research about people's attitude towards IVM (Wilks & Phillips, 2017). Slight changes between the original questionnaire and the one used in this research occurred, inter alia, due to the translation from English to German. At the beginning of the questionnaire used in this research, the participants were asked to state background information, including gender, educational level, political affiliation and eating habits. Furthermore, the questionnaire asked for prior knowledge about IVM and provided background information about what IVM is. At the end of the research, thus either after filling in the questionnaire or after watching the video, the participants were asked how they experienced the video in order to measure the affect caused by the video.

The questionnaire measured three variables including the participants' perception, attitude and willingness to buy IVM. In order to do that, 5-point-likert-scales were used with several statements. On all of these scales, 1 was the most positive and 5 was the most negative choice towards IVM. The variable "perception" compared the perception of IVM to conventional meat regarding several aspects, including under more naturalness, ethicalness or healthiness and it was found to be strongly reliable (*Cronbach's* α = .72).

Similar aspects were measured exclusively regarding IVM in the attitude variable. Those aspects were represented in several items, such as ethicalness, promotion of cannibalism or respect towards the nature. This variable also showed a strong coefficient regarding the internal consistency (*Cronbach's* α = .76).

The variable "willingness to buy" consisted of three items relating to the possible future behavior of the participants, including whether participants would try IVM, buy IVM regularly and pay a higher price for IVM than for conventional meat. This variable also had a strong reliability (*Cronbach's* α = .77).

Procedure

To figure out the perception of IVM, an online questionnaire using Qualtrics (Attachment 1) was conducted. At first, the participants had to click on a link that directed them to the online experiment. Then, an informed consent had to be accepted and the age had to be stated. Participants younger than 18 were excluded from the data analysis and immediately directed to the end of the survey due to a lack of legal capacity. The remaining participants began to either fill in the questionnaire or watch the video depending on their assigned condition. The procedure was continued by an evaluation of the video and a debriefing. The debriefing provided the researcher's e-mail address giving participants the opportunity to ask questions.

Analysis

Before statistical analyses were conducted, reversed items had to be rescaled and average scores of the variables had to be computed. Afterwards, a reliability analysis was conducted to determine the internal consistency. Even though a Kolmogorov-Smirnov-test has shown that the data on the variables perception [D (209) = .09, $p < .01$], attitude [D (209) = .07, $p = .01$] and willingness to buy [D (209) = .15, $p < .01$] was not distributed normally, parametric tests were conducted since non-parametric tests tend to lack test power. Furthermore, the sample size was sufficient to assume a normal distribution, which can be assumed if $N > 50$ (Bortz & Schuster, 2010). Even though data is not always distributed normally, the data can be treated as if it was distributed normally. To answer the question whether the video had an effect on people's perception of IVM, attitude towards IVM and willingness to buy IVM, a t-test with the score on "perception" as dependent variable and the treatment as independent variable was conducted to compare the means of the two conditions.

To test the second hypothesis, which states that affect influences the effect of the video, only participants, who watched the video before filling in the questionnaire, were selected. Then, a linear regression was conducted with perception, attitude and willingness as dependent variables and affect as independent variable.

To test the third hypothesis, which states that the video has a smaller effect on vegetarians and vegans, an ANOVA was conducted with the treatment as fixed factor, the eating behavior as moderator and the total scores of the three variables (perception, attitude and willingness to buy) as dependent variables.

A t-test was conducted to test the fourth hypothesis whether vegetarians think more positively about IVM than omnivores with the eating habits as independent variable and

perception, attitude and willingness to buy as dependent variables.

The fifth hypothesis regarding gender differences was answered by conducting a t-test with gender as independent and the perception of IVM, attitude towards IVM and willingness to buy IVM as dependent variables.

Results

Descriptive statistics

Table 1. *Descriptive Statistics*

	Experimental Condition (N = 105)		Control Condition (N = 104)			
Construct	*Mean*	*SD*	*Mean*	*SD*	*t*	*p*
Perception of IVM	2.81	.56	2.79	.53	.19	.43
Attitude towards IVM	2.67	.61	2.71	.67	-.27	.40
Willingness to buy IVM	2.58	.98	2.68	1.02	-.71	.29

a. Experimental Condition = Video first, Control Condition = questionnaire first

b. note: *SD* = standard deviation,

For each of the 209 respondents, average scores were computed on the variables perception, attitude and willingness to buy. As illustrated in Table 1, people had a neutral attitude towards IVM in general and the two conditions do not seem to differ from each other. On the variable perception, the least reached score was 1.71 (N = 1; 0.5%) and the highest reached score was 4.29 (N = 1; 0.5%) out of five. The scores on the variable "attitude" differed from 1.13 (N = 1; 0.5%) to 4.5 (N = 1; 0.5%). Finally, on the variable "willingness to buy" the scores ranged from 1 (N = 3; 1.9%) to 5 (N = 10; 4.8%).

Inferential Statistics

To test the first hypothesis whether people who watch a video have a more positive opinion towards IVM, a t-test showed that there is no difference between participants who watched the video before filling in the questionnaire and participants who did not watch the video before filling in the questionnaire [t (207) = .19, p = .43]. This means that the group that watched the video did not prefer IVM over conventional meat significantly more than the group that did not watch the video. Moreover, no significant differences were found on both attitude [t (207) = -.27, p = .40] and willingness to buy [t (207) = -.71, p = .29]. This means that the video neither had any effect on the participant's attitude towards IVM in general nor on their intention to buy IVM. Therefore, the first hypothesis is rejected.

To test the second hypothesis whether affect influences the effect of the video, a regression has shown that affect moderates the effect of the video on the participants' perception [R^2 = .10, B1 = -.19, t (103) = -3.37, p < 0.01] and on their attitude [R^2 = 0.04, B1 = -0.14, t (103) = -2.16)] significantly. However, there was no interaction between affect and effect regarding the willingness to buy [R^2 = 0.02, B1 = -0.14, t (103) = -1.41, p = 0.16)]. This means that participants, who were affected by the video, perceive IVM more positively compared to conventional meat and had a more positive attitude towards IVM in general than participants, who were not affected by the video. Simultaneously, there is no difference in willingness to buy. The second hypothesis is thus partially retained.

Moreover, to test the third hypothesis whether this effect is lower for vegetarians, an ANOVA has shown that there is no interaction effect between condition and vegetarianism on perception [F (1, 205) = .41, p = .53], on attitude [F (1, 205) = 0.04, p = 0.84] and on willingness to buy [F (1, 205) = 0.04, p = 0.84)]. This means that the effect of the video was not influenced by the eating habits of the participants and the third hypothesis is rejected.

Furthermore, in order to test the fourth hypothesis whether vegetarians have a more positive opinion towards IVM, a t-test revealed that vegetarians had a significantly more positive perception of IVM compared with conventional meat (M = 2.59, SD = 0.48) than non-vegetarians [M = 2.85, SD = 0.54, t (207) = 2.88, p < .01], as well as a significantly more positive attitude towards IVM in general (M = 2.5, SD = 0.74) than non-vegetarians [M = 2.75, SD = 0.6), t (207) = 2.32, p = .02]. However, vegetarians were significantly less likely to buy IVM (M = 2.98, SD = 1.19) than non-vegetarians [M = 2.53, SD = 0.92, t (207) = 2.68, p = .01].

The fifth hypothesis whether there are gender differences was tested with a t-test, which has shown that there was no difference between men and women on all three dependent

variables namely perception [t (207) = 1.56, p = .12], attitude [t (207) = .34, p = .74] and willingness to buy [t (207) = 1.45, p = .14].

Discussion

Conclusion

The current research examined how in-vitro-meat (IVM) is perceived in Germany and whether a video that shows happy animals influences the perception of IVM via affect. Answering the first research question whether an animal welfare video influences the perception of IVM, the attitude towards IVM and the willingness to buy IVM, it can be stated that no influence was found. Furthermore, in response to the second research question whether this effect is moderated by affect and eating habits, it can be stated that eating habits do not moderate the effect of the video, but the affect does. Finally, answer the third research question whether there are gender differences in the opinion towards IVM, it can be stated that men and women have the same opinion towards IVM.

Explanations

In contrast to the first hypothesis, participants who watched the video were not significantly more positively disposed towards IVM than people who did not watch the video before filling in the questionnaire. Based on the assumption that people who are more positively disposed towards IVM would be prone to refuse conventional meat. This finding was not expected. Prior research has demonstrated that showing animal welfare campaign media decreases the willingness to buy conventional meat (Tonsor & Olynk, 2011). Additionally, establishing a connection between meat and animals reduced the willingness to buy conventional meat as well (Kunst & Hohle, 2016). It was assumed that individuals, who have a negative attitude towards IVM, are more open towards IVM, since research indicated that vegetarians have a more positive attitude towards IVM than omnivores (Wilks & Phillips, 2017). Considering these inconsistencies with previous research, it is possible that an unsuccessful manipulation caused these non-significant findings. The video shown in this research might have been too monotonous and did not emphasize the negative aspects of conventional meat sufficiently. It might be that a shocking video that reveals the circumstances of animals in livestock meat production could affect the participants more strongly. For this purpose, virtual reality could be used to show an animal's perspective of a slaughterhouse. To receive more participants, such a research could be presented online by showing a 360° video. However, since research has shown that a greater immersion leads to a

more significant attitude change (Fonseca & Kraus, 2016), it is recommended to use virtual reality devices. The animal welfare organization “Animal Equality” already developed a movie called “iAnimal” that is designed for virtual reality devices and exposed it to volunteers (Huffington Post, 2016). Conducive to forming new hypotheses regarding the effect of animal welfare media on the attitude towards IVM, it would be interesting to conduct a follow-up research that investigates the influence of a virtual reality device with such a movie towards the IVM-attitude. In order to conduct such a follow-up study, an additional research investigating the question whether a low attitude towards conventional meat leads to a more positive opinion towards IVM could be helpful. If such a research showed that the attitude towards conventional meat would not be related to the attitude towards IVM, this would imply that animal welfare videos aiming at decreasing the positive attitude towards conventional meat, would not have an effect on the attitude towards IVM either.

In accordance with the second hypothesis, participants, who were affected by the video, had a more positive perception of IVM and a more positive attitude towards IVM. These findings are in line with prior research which revealed that emotional videos lead to a stronger attitude change than videos that do not aim at causing emotions (Fonseca & Kraus, 2016). These findings strengthen the recommendation to conduct a follow-up research with an emotional and shocking video.

Yet, contrary to the third hypothesis, the video did not affect vegetarians differently than omnivores. This may be related to the failed manipulation as well. There might have been no difference between vegetarians and omnivores because the video did not have any effect at all. Vegetarians already tend to have a more negative attitude towards conventional meat since 65% of the vegetarians refuse meat for ethical reasons (Mitte & Kämpfe-Hargrave, 2007). Therefore, in a follow-up research with a significant main effect of the video, there still is the possibility of an interaction effect.

Moreover, in conformity with the fourth hypothesis, vegetarians were disposed more positively towards IVM than omnivores. At the same time, they were less likely to buy IVM. These findings are in accordance with prior research that indicated that vegetarians and vegans are less likely to try IVM, but simultaneously perceive IVM more positively than not-vegetarians (Wilks & Phillips, 2017). This may be related to the fact that vegetarians refuse to buy meat in general and are thus not in need of an alternative. At the same time it is assumed that vegetarians have a negative attitude towards conventional meat and want to reduce the global amount of consumed meat.

Contrary to the fifth hypothesis whether men have a more positive perception, attitude

and willingness to buy IVM than women, no differences at all were found. Prior research instead found these gender differences (Wilks & Phillips, 2017). However, it has to be stated that the research by Wilks & Philips (2017) showed small effect sizes and simultaneously a greater sample size than the current research. This might explain the different findings.

A further explanation for the results could be the minor changes applied to the questionnaire. At first, the scales for political affiliation were changed from seven point Likert-scales to five point Likert scales. This was done in order to establish congruence in the scales to make correlation-analyses more reliable. Furthermore, one question of the manipulation check was removed since it was too difficult to answer. This was done, because the question was about the final credits of the video that tended to be ignored. If the question was retained, 88 participants would have failed the manipulation check. However, it may be that the video was too long, so that the participants' concentration decreased in the end of the video. Afterwards, it was a good decision to exclude this question from the manipulation check because more participants could be included. Therefore, the reliability of the analyses increased. Moreover, the manipulation check already consisted of two other questions that could only be answered when the video was watched. Another change that was applied to the questionnaire was related to the variable "willingness to buy". This variable consisted of two items that were not suitable to the eating habits of every participant because it was asked whether participants would substitute meat or meat-alternatives with IVM. For this reason, the answer option "Not suitable since I do not consume meat (alternatives) was added to these two items. Since not every participant consumed meat or meat-alternatives, these two items had to be excluded from the variable "willingness to buy". Therefore, this variable consisted of only three items. This resulted in a higher standard deviation of the average scores and thus in a lower probability of finding significant results because a higher standard deviation leads to a lower test statistic. In retrospect, it would have been better not to add this answer option to the two items to get data that can be analyzed better.

Limitations & Strengths

Next to the video, a second weak point of the study was a sampling bias. More than 90% of the participants completed at least the German "Abitur", which is the highest secondary school leaving examination in Germany. Furthermore, there were much more women than men and predominantly young people under thirty participated. This may have led to a more positive perception of IVM because previous research indicated that younger individuals are more open towards new experiences (Donnellan & Lucas, 2008). However,

Wilks & Phillips (2017) found no relation between age and the perception of IVM.

Nevertheless, the research had strong points as well. The participants were distributed randomly among the conditions and the questionnaire was approved in a prior research (Wilks & Phillips, 2017). Additionally, there was a sufficient amount of participants (N=209) that facilitated generalizing the findings. Furthermore, this research explores a relatively new topic and lays the cornerstone for follow-up research.

Final statement

In conclusion, this research has shown that IVM is a generally positively perceived alternative to conventional meat which should be replaced due to ethical, ecological and health-related issues. However, further research is needed to establish theories about changing the attitude towards IVM.

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Appendix

1. Questionnaire

Einstellung gegenüber nachhaltiger Fleischproduktionstechnologie: In-Vitro-Fleisch

Der Zweck dieser Studie Diese Studie beschäftigt sich mit der Wahrnehmung von In-Vitro-Fleisch. Die Ziele dieser Studie werden am Ende deutlicher erläutert. Nutzen und Risiken bei der Teilnahme Dadurch, dass Sie an dieser Studie teilnehmen, helfen Sie der Wissenschaft, besser zu verstehen, wie die Öffentlichkeit neue potenzielle Methoden der Fleischproduktion wahrnimmt. Es gibt keine Risiken bei der Teilnahme dieser Studie, die über die des Alltags hinausgehen. Teilnahme und Abbruch Die Teilnahme an dieser Umfrage ist gänzlich freiwillig und anonym. Außerdem können Sie zu jeder Zeit aufhören. Was umfasst diese Studie? Die Teilnahme erfordert Antworten auf Online-Fragen und dauert ungefähr 10 Minuten. Da diese Umfrage sich mit Meinungen beschäftigt, gibt es keine richtigen oder falschen Antworten. Wir bitten Sie daher, die Umfrage so ehrlich wie möglich auszufüllen und bei Unsicherheiten so gut wie möglich zu schätzen. Datenschutz und Sicherheit Alle Informationen, die in dieser Studie gesammelt werden, sind selbstverständlich vertraulich. Sie werden nicht aufgefordert, Ihren Namen oder irgendwelche anderen Daten anzugeben, mit denen Sie identifiziert werden können. Alle Fragebögen werden nummeriert, wobei diese Nummern in keiner Weise mit den Teilnehmern dieser Umfrage verbunden sind. Die Daten werden nur durch das Forschungsteam eingesehen und werden nicht verfügbar gestellt für irgendeine Person außerhalb dieses Teams. Die Daten aus dieser Studie werden ausschließlich zu Forschungszwecken benutzt.

Ich habe die Bedingungen der Studie gelesen und verstanden. Ich verstehe, dass die Teilnahme zu 100% freiwillig und anonym ist und ich zu jeder Zeit aufhören kann.

- Ja (1)
- Nein (2)

Condition: Nein Is Selected. Skip To: End of Survey.

Wie alt sind Sie?

_____ Ich bin (1)

Condition: Ich bin Is Less Than 18. Skip To: End of Survey.

Was ist Ihr Geschlecht?

- Männlich (1)
- Weiblich (2)

In der Politik wird in der Regel zwischen “Links” und “Rechts” unterschieden. Wo würden Sie sich einordnen?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Links:Rechts (1)	-	-	-	-	-

Im Hinblick auf Werte wird in der Regel zwischen liberalen und konservativen Werten unterschieden. Wo würden Sie sich einordnen?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Liberal:Konservativ (1)	-	-	-	-	-

Was ist ihr höchster beendeter Schulabschluss?

- Kein Schulabschluss (1)
- Grundschule (2)
- Hauptschule (3)
- Mittlere Reife (4)
- Fachabitur (5)
- Studium (7)
- Doktor/Professor (8)
- Anderer, nämlich (9) _____

Wie ernähren Sie sich im Hinblick auf tierische Produkte?

- Omnivor (Ich esse alles) (1)
- Ich esse nur weißes Fleisch (2)
- Pescetarisch (Fisch, aber kein anderes Fleisch) (3)
- Vegetarisch (kein Tier) (4)
- Vegan (keine tierischen Produkte) (5)
- Anders, nämlich (6) _____

Wie oft essen Sie Fleisch (dazu zählen alle Tiere, wie z.B. Schweine, Rinder, Fische, Geflügel etc.)?

- Täglich oder fast täglich (1)
- 2-3 mal die Woche (2)
- Maximal 1 mal die Woche (3)
- Maximal 1 mal im Monat (4)
- Nie (5)

Haben Sie schon mal von In-Vitro-Fleisch gehört?

- Ja (1)
- Nein (2)
- Ich weiß nicht (3)

Wissen Sie, was In-Vitro-Fleisch ist?

- Ja, definitiv (1)
- Ja, ich denke schon (2)
- Ich bin mir unsicher (3)
- Nein, ich denke nicht (4)
- Nein, definitiv nicht (5)

In-Vitro-Fleisch ist tierisches Fleich, das niemals ein Teil eines lebenden Tieres war, sondern stattdessen im Labor aus Muskelstammzellen heranwächst. Diese Stammzellen werden den Tieren ohne Zufügung von Schmerzen entnommen. In-Vitro-Fleisch wird auch als kultiviertes Fleisch, oder umgangssprachlich auch als Laborfleisch bezeichnet. Im August 2013 haben Wissenschaftler den ersten In-Vitro-Fleisch-Burgerpatty kreiert und probiert. Momentan ist er nicht käuflich zu erwerben, doch es werden viele Studien durchgeführt, um es in Zukunft als Fleischproduktionstechnologie einzuführen.

Die nächsten Fragen vergleichen Ihre Wahrnehmung von In-Vitro-Fleisch mit Ihrer Wahrnehmung von konventionell erzeugtem Fleisch.

Was denken Sie: Wie gesund ist In-Vitro-Fleisch verglichen mit konventionellem Fleisch?

- Viel gesünder (1)
- Etwas gesünder (2)
- Wedernoch (3)
- Etwas ungesünder (4)
- Viel ungesünder (5)

Was denken Sie: Wie natürlich ist In-Vitro-Fleisch verglichen mit konventionellem Fleisch?

- Viel natürlicher (1)
- Etwas natürlicher (2)
- Weder noch (3)
- Etwas unnatürlicher (4)
- Viel unnatürlicher (5)

Was denken Sie: Wie umweltfreundlich ist In-Vitro-Fleisch verglichen mit konventionellem Fleisch?

- Viel umweltfreundlicher (1)
- Etwas umweltfreundlicher (2)
- Weder noch (3)
- Etwas umweltschädlicher (4)
- Viel umweltschädlicher (5)

Was denken Sie: Ist In-Vitro-Fleisch ethisch vertretbarer als konventionelles Fleisch?

- Viel vertretbarer (1)
- Etwas vertretbarer (2)
- Weder noch (3)
- Etwas weniger vertretbar (4)
- Viel weniger vertretbar (5)

Was denken Sie: Wie ansprechend ist In-Vitro-Fleisch verglichen mit konventionellem Fleisch?

- Viel ansprechender (1)
- Etwas ansprechender (2)
- Weder noch (3)
- Etwas weniger ansprechend (4)
- Viel weniger ansprechend (5)

Was denken Sie: Wie gut schmeckt In-Vitro-Fleisch verglichen mit konventionellem Fleisch?

- Viel besser (1)
- Etwas besser (2)
- Weder noch (3)
- Etwas schlechter (4)
- Viel schlechter (5)

Wie hoch schätzen Sie das Risiko für vom Tier auf den Menschen übertragbare Krankheiten bei In-Vitro-Fleisch im Vergleich zu konventionellem Fleisch ein?

- Viel höher (1)
- Etwas höher (2)
- Weder noch (3)
- Etwas geringer (4)
- Viel geringer (5)

Für die nächsten Fragen stellen Sie sich bitte vor, dass In-Vitro-Fleisch in Supermärkten und bei Metzgern erhältlich ist.

Wie würden sich Ihrer Meinung nach global gesehen die Preise für In-Vitro-Fleisch-Produktion gegenüber denen von konventioneller Fleischproduktion verhalten?

- Wesentlich günstiger als konventionelles Fleisch (1)
- Etwas günstiger als konventionelles Fleisch (2)
- Weder günstiger noch teurer als konventionelles Fleisch (3)
- Etwas teurer als konventionelles Fleisch (4)
- Viel teurer als konventionelles Fleisch (5)

Wären Sie bereit, In-Vitro-Fleisch zu probieren?

- Ja, auf jeden Fall (1)
- Ja, wahrscheinlich schon (2)
- Ich bin mir unsicher (3)
- Nein, wahrscheinlich nicht (4)
- Nein, auf gar keinen Fall (5)

Wären Sie bereit, In-Vitro-Fleisch regelmäßig zu kaufen, wenn es bezahlbar ist?

- Ja, auf jeden Fall (1)
- Ja, wahrscheinlich schon (2)
- Ich bin mir unsicher (3)
- Nein, wahrscheinlich nicht (4)
- Nein, auf gar keinen Fall (5)

Wären Sie bereit, In-Vitro-Fleisch als Ersatz für konventionelles Fleisch zu konsumieren?

- Ja, auf jeden Fall (1)
- Ja, wahrscheinlich schon (2)
- Ich bin mir unsicher (3)
- Nein, wahrscheinlich nicht (4)
- Nein, auf gar keinen Fall (5)
- Nicht zutreffend (Ich konsumiere kein konventionelles Fleisch) (6)

Inwiefern würden Sie In-Vitro-Fleisch anderen Fleischersatzprodukten (wie z.B. Soja) vorziehen?

- Wesentlich mehr (1)
- Etwas mehr (2)
- Weder noch (3)
- Etwas weniger (4)
- Wesentlich weniger (5)
- Nicht zutreffend (Ich konsumiere keine Fleischersatzprodukte) (6)

Wenn Sie In-Vitro-Fleisch kaufen würden, wären Sie bereit einen höheren Preis zu zahlen als für konventionelles Fleisch?

- Ja, auf jeden Fall (1)
- Ja, wahrscheinlich schon (2)
- Ich bin mir unsicher (3)
- Nein, wahrscheinlich nicht (4)
- Nein, auf gar keinen Fall (5)

Warum würden Sie In-Vitro-Fleisch nicht probieren wollen?

1 In-Vitro-Fleisch ist unnatürlich (1)
2 In-Vitro-Fleisch kann Kannibalismus fördern (2)
3 Die traditionelle Landwirtschaft könnte unter In-Vitro-Fleisch leiden (3)
4 In-Vitro-Fleisch ist unnötig (4)
5 Es ist ein zu großer Eingriff in die Natur (5)
6 Ich glaube nicht, dass es adäquat Fleisch ersetzen kann (6)
7 Ich greife lieber auf pflanzliche Alternativen zurück (7)
8 Aus einem anderen Grund, nämlich: (8) _____
9 Ich habe keine Bedenken, In-Vitro-Fleisch zu probieren (9)

Welche Arten von Fleisch essen Sie momentan? (Mehrere Antworten möglich)

10 Fisch und Meeresfrüchte (1)

11 Geflügel (2)

12 Schwein (3)

13 Rind (4)

14 Pferd (5)

15 Hund und/oder Katze (6)

16 Keine (7)

Welche Arten von Fleisch wären Sie bereit zu essen, wenn es mit In-Vitro-Methoden hergestellt würde? (Mehrere Antworten möglich)

17 Fisch und Meeresfrüchte (1)

18 Geflügel (2)

19 Schwein (3)

20 Rind (4)

21 Pferd (5)

22 Hund und/oder Katze (6)

23 Keine (7)

Bitte geben Sie an, inwieweit Sie den folgenden Aussagen zustimmen.

	Stimme überhaupt nicht zu (1)	Stimme nicht zu (2)	Teils, Teils (3)	Stimme zu (4)	Stimme voll und ganz zu (5)
In-Vitro-Fleisch ist unnatürlich (1)	-	-	-	-	-
In-Vitro-Fleisch ist respektlos gegenüber der Natur (2)	-	-	-	-	-
In-Vitro-Fleisch wird die Anzahl glücklicher Tiere auf der Welt vergrößern (3)	-	-	-	-	-
In-Vitro-Fleisch wird die Möglichkeit fördern, dass Menschenfleisch gegessen werden kann (das heißt, dass Kannibalismus auftreten könnte) (4)	-	-	-	-	-
In-Vitro-Fleisch ist ethisch vertretbar (5)	-	-	-	-	-

In-Vitro-Fleisch wird das Wohlergehen der Tiere verbessern (6)	-	-	-	-	-
In-Vitro-Fleisch wird in der Lage sein, die Hungerprobleme auf der Welt zu lösen (7)	-	-	-	-	-
In Zukunft wird In-Vitro-Fleisch eine realisierbare Alternative zu konventionellem Fleisch darstellen (8)	-	-	-	-	-

Haben Sie abschließende Gedanken oder Anmerkungen zum Thema In-Vitro-Fleisch, die Sie uns gerne mitteilen möchten?

Nun folgt ein Video, das Schweine zeigt: .

Was ist das Besondere an den Schweinen Lilly und Sally?

- Sie leben in Massentierhaltung (1)
- Sie sind Haustiere (2)
- Sie wurden aus der Massentierhaltung befreit (3)

Was ist die Kernaussage des Videos?

- Die Lebensbedingungen für Schweine in der Massentierhaltung sind miserabel, weshalb es besser ist, wenn Schweine in freier Wildbahn leben. (1)
- Schweinefleisch ist ungesund und kann zu diversen Krankheiten führen. (2)
- Die Schweinefleischproduktion ist für Treibhausgasemissionen verantwortlich, weshalb man besser auf In-Vitro-Fleisch zurückgreifen sollte. (3)

Wozu wird am Ende des Videos animiert?

- Tierpatenschaft (1)
- Weniger Fleisch essen (2)
- Einer Tierschutzorganisation beitreten (3)

Abschließend bitten wir Sie, das Video, das Sie gesehen haben, zu bewerten.

	Stimme überhaupt nicht zu (1)	Stimme nicht zu (2)	Teils, Teils (3)	Stimme zu (4)	Stimme voll und ganz zu (5)
Ich habe das Video gerne gesehen (1)	-	-	-	-	-
Ich fand das Video langweilig (2)	-	-	-	-	-
Ich fand das Video emotional (3)	-	-	-	-	-
Das Video hat meine Einstellung gegenüber (Schweine-)Fleisch geändert. (4)	-	-	-	-	-
Das Video hat mein Kaufverhalten geändert (5)	-	-	-	-	-

Hintergrund dieser Studie Das Ziel dieser Umfrage war, die allgemeine, öffentliche Wahrnehmung von In-Vitro-Fleisch herauszufinden. Des Weiteren soll getestet werden, ob ein Informationsvideo über Fleisch und Tierschutz die Wahrnehmung von In-Vitro-Fleisch beeinflusst. Durch ein gewisses Verständnis, wie die Öffentlichkeit denkt, wollen wir eventuelle Barrieren identifizieren, die es verhindern, dass dieses Produkt in die Gesellschaft integriert wird, wenn es dann käuflich erwerblich ist. Wenn Sie mehr über In-Vitro-Fleisch

lernen müssen, finden Sie mehr Informationen unter diesem Link: http://culturedbeef.net/what-is-it/ Bei weiteren Fragen zu dieser Studie oder bei Fragen über die Ergebnisse dieser Studie können Sie einfach eine E-Mail an l.borgdorf@student.utwente.nl schicken. Vielen Dank für Ihre Teilnahme!