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Who will eat insects?

How the intention to eat innovative insect food is not connected to sustainability knowledge and commitment of Swedish students

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Abstract: Using a quantitative survey based on the theory of planned behaviour, we assessed whether the commitment of students within the field of sustainability has any impact on their intention towards eating insect-based products as a more sustainable protein-source than meat. The results show no significant relationship between the students' discipline and their willingness to consume insect-food. Food neophobia, vegetarianism or limited accessibility of the products are identified as possible reasons for this, which has various implications for further research and the marketing of insect-products.

Keywords: sustainable food; future consumption; insect-based products; consumption change; global environmental change

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INTRODUCTION

With a world population of 7,8 billion and an average population increase of 81 million people per year (Worldometer, 2020), the demand for food keeps increasing. Today 11% of the world population are undernourished (World bank, 2017), yet our diets are not sustainable on a global scale and the planetary boundaries are pushed beyond the edge due to food production (Willet et al., 2019). Climate change and the loss of biodiversity both call for a declining trend of agricultural land use at the same time as the growing world population will in the long run be in need of more food production, which is likely going to be hampered by climate change (Jerneck et al. 2011, Schmidhuber & Tubiello 2007). Tackling this challenge is, among others, a task for science and technology. Part of the solution could be to move from a resource intensive diet where the protein is based on birds and mammals to a protein-source that requires much less land and water use and emits less greenhouse gases: a protein based on insects. According to Chang, Ma, & Chen (2019), insects require 40-80% less land use and emit 1000–2700 less grams of greenhouse gases per kilogram of edible food. A study by Payne, Scarborough, Rayner & Nonaka (2015) also assigns healthier nutrient values to some insect food when comparing them to beef and poultry.

Despite the insects richness in protein, fat, minerals and vitamins (Food Processing Technology, 2018), many still react in disgust when thinking of eating insects (Roma, Ottomano Palmisano & De Boni, 2020). As western societies have rarely eaten insects as part of their traditional diet, few consider them edible (Roma et al., 2020). Still, there is an increasing supply of insect-based food (Engström, 2019), where insects can be part of a range of different products such as pasta, burgers or protein bars (see figure 1). As the consequences of climate change increases, humankind faces three options: mitigation, adaptation or suffering (Smith, 2008). Insect food offers potential as both a mitigation and an adaptation option. By changing food habits to include more insects and less red meat actions are being taken to decrease the amount of greenhouse gases released to the atmosphere and hence contribute to mitigation. As food becomes more scarce, insect food will also become an adaptation option to secure peoples' health. From this perspective, there is much reason to believe insect food will become a future addition to diets around the world. Thus, there lies great value in researching consumers' changing attitudes towards eating insects. As research in several contexts has provided evidence that a higher environmental concern leads to more environmentally friendly intentions (Axsen 2012;

Eom, Kim, & Sherman, 2018; Kaiser, Wölfing & Fuhrer, 1999), knowledge within and commitment to sustainability could be a potential driver for this specific consumption change. Our research will therefore test this assumption by comparing students with a focus on sustainability in their studies to students without this focus, to investigate whether there is any difference in their intention towards eating insect food. Based on the theory of planned behaviour and a questionnaire from previous research conducted by Chang et al. (2017), a survey on the students at Lund University was conducted to find an answer to the research question:

What impact does studying sustainability have on students' intention towards eating insect food?

In order to answer this question, this paper will first look into the theoretical background of consumption behaviour (chapter 2) before elaborating on its research methods (chapter 3) and presenting (chapter 4) and discussing (chapter 5) its results.

Figure 1. *Insect food considered in this paper.*

This figure demonstrates what types of products this research refers to when talking about insect food. (Picture taken from Morrison, O., 2019)

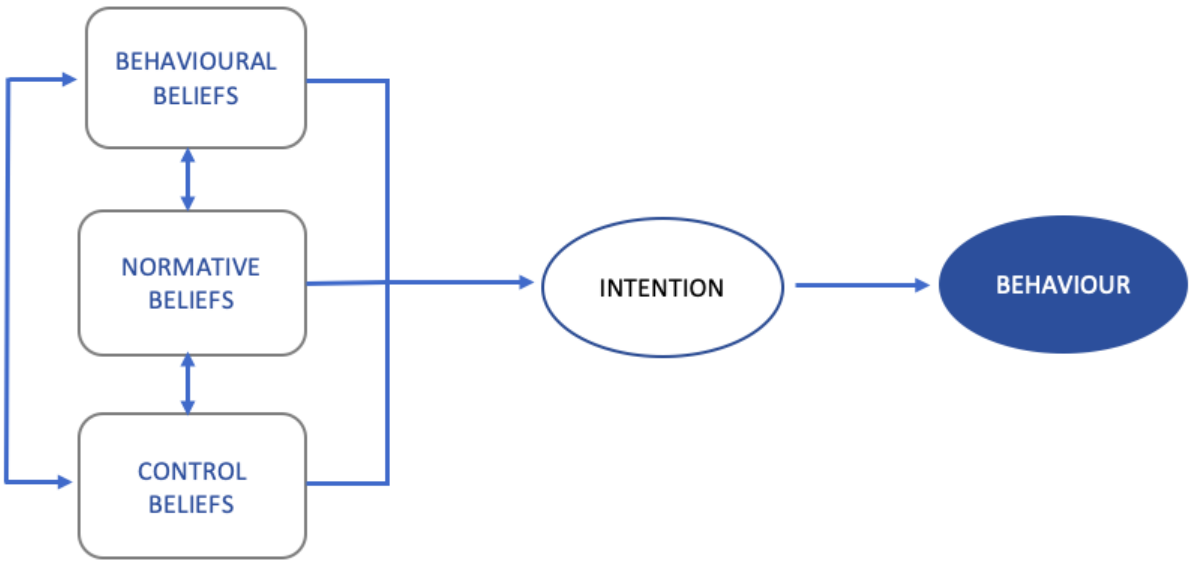
THEORY

As intention can be influenced by an array of different factors and seems like an abstract and hard to measure construct, there are a variety of different theories about it. However, a common and often referred to theoretical framework in measuring intention is the "Theory of planned behaviour (TPB)" by Ajzen (1991), which has even been used in research on environmental behaviour (Gifford, 2014). It assumes that an individual's actual behaviour is determined by the individual's intention since intention can be seen as the 'immediate antecedent' of any behaviour (Ajzen, 2002, p.665). Thus, an intention can be used as an indicator of how likely a person is to engage in an actual behaviour. Simplified this means, the stronger the intention the more likely is the actual performance of the behaviour (Ajzen, 1991).

According to the TPB, intention consists out of the three following groups of beliefs: Behavioural, normative and control beliefs (Ajzen, 2002; see figure 2). *Behavioural beliefs,* also described as "attitude" (Ajzen 1991, p. 182), encompass beliefs about the consequences of the intended behaviour and therefore the perception of the behaviour can be either positive or negative. *Normative beliefs* refer to 'normative expectations' of society. Thus, describes a person's subjective perception or anticipation of how accepted an intended behaviour is going to be by society and can for instance result in feelings of social pressure. Perception about factors that might be beneficial or detrimental are described as *control beliefs*, and ultimately determine the degree of perceived difficulty and effort that is required to actually act on an intention (Azjen, 2002). It describes the "perceived behavioural control" that a person believes to have over the intended action.

Thus, the TPB refers to the degree that individuals believe they have control over the outcome and their own actions and is closely related to how capable they feel to perform the behaviour (Ajzen, 2002, Puente-Díaz & Cavazos-Arroyo, 2017). The more confident they feel over performing the behaviour (i.e. having the right amount of resources such as money, time, skills, etc.) the more likely is the performance of the behaviour.

Figure 2. *Theory of Planned Behaviour, illustration based on Ajzen (1991)*



Visualisation of the different beliefs that influence intention as a precondition of behaviour.

As other theoretical approaches to environmental psychology, the TPB has been criticised for failing to include the context of the behaviours it describes in an effective way. This includes for instance financial, political and legal influences, which are summarised as "situational factors" in literature on the issue (Kollmuss & Agyeman, 2002). Instead it tries to integrate these external factors into the studied individuals' control beliefs (Kollmuss & Agyeman, 2002) or relies on researchers extending it for their purposes (Sniehotta, Presseau & Araújo-Soares 2014). Research on pro-environmental behaviour change however has generally shown that "context matters" and that it often has deeper influences on the behaviour than attitudes or beliefs (Schultz 2014, p. 113). Despite these shortcomings, the TPB still offers a solid and comprehensible framework for predicting intentions and behaviours, which is well established in research (Ajzen, 2014; Kollmuss & Agyeman, 2002), including the study by Chang et al. (2019), which investigated insect-consumption and served as a methodological paragon for this study.

METHOD

As our research question aims to compare the general intention of two different populations, conducting a survey was chosen as a suitable method. Given the limitations in time and access to research software, an anonymous online-survey in Google forms using a snowball-method (Schnell, 2012) was chosen to generate the biggest possible amount of respondents within the available time frame. As the resources of this study are too small to do a fully representative survey among a broader population, Lund university students were chosen as a convenient group as they show similar characteristics and hence constrain the demographic differences between the groups. In this way, the group focusing on sustainability and the group of regular students can be compared with a minimised amount of disturbing factors. A known issue with online-surveys is that there is no way for the interviewer to make sure all respondents interpret the questions in the same way (Wagner-Schelewsky & Hering, 2019). That is why a small-scale pretest (Weichbold, 2019) was conducted to improve the formulation of the questions (see Table 1 and Chang et al. (2019) for final version) according to the received feedback. Additionally, to create a common understanding of the term "insect food" among all respondents, Figure 1 was included into the questionnaire. Additionally, participants were asked to assign themselves to the study groups and were asked whether or not their studies had a major focus on sustainability. Apart from that, the survey was kept as short as possible, to avoid effects of respondent-exhaustion that are another common weakness of online-surveys (Schnell, 2012).

The measurement of the three dimensions of intention is done with fully verbalised 7-point Likert scales of approval. The used items are a slightly changed version of the Chang et al. (2019) survey on eating insect food, which, in turn, was mainly based on the research conducted by Menozzi, Sogari, Veneziani, Simoni, & Mora (2017). The survey hence measures a total of seven items as presented in Table 1. Calculating the mean value of these seven variables for each dimension and group of respondents will lead to six final dependent variables as presented in Table 2, which can be compared to the independent variables, i.e. the respondents' study subject.

Table 1 Items used to measure the three dimensions of intention. An asterix implies a slight change in wording compared to the original item by Chang et al. (2019).

Dimension of Intention	Code	Item
Behavioural beliefs	B_1	Eating insect food is pleasant.
Behavioural beliefs	B_2	Eating insect food is relevant.
Behavioural beliefs	B_3	Eating insect food is tasty.
Normative Beliefs	N_1	*I would buy insect food because: doctors and nutritionists recommend it.
Normative Beliefs	N_2	*I would buy insect food because: environmental groups recommend it.
Control Beliefs	C_1	*Insect food is easily available to me
Control Beliefs	C_2	*I am in charge of my own purchases of insect food

Table 2 Variables measured by the questionnaire.

Variable name	Variable description	Calculation
B_S	Behavioural beliefs of sustainability students towards eating insect food.	Mean value of all answers to B_1-B_3 for sustainability students
B_R	Behavioural beliefs of regular students towards eating insect food.	Mean value of all answers to B_1-B_3 for regular students
N_S	Normative Beliefs of sustainability students towards eating insect food.	Mean value of all answers to N_1 and N_2 for sustainability students
N_R	Normative Beliefs of regular students towards eating insect food.	Mean value of all answers to N_1 and N_2 for regular students
C_S	Control Beliefs of sustainability students towards eating insect food.	Mean value of all answers to C_1 and C_2 for sustainability students
C_R	Control Beliefs of regular students towards eating insect food.	Mean value of all answers to C_1 and C_2 for regular students

As the TPB splits behavioural intentions into three dimensions, these six variables are used to formulate three concrete and statistically testable hypotheses in order to operationalise the research question in conformity with the theory. These hypotheses and the respective null hypothesis for each of them are presented in table 3.

Table 3 The research project's (null-)hypotheses

Hypothesis	**Null Hypothesis**
H1: Sustainability students have significantly more positive behavioural beliefs towards eating insect food than regular students ($B_S > B_R$)	$H1_0$: Sustainability students have equal or more negative behavioural beliefs towards eating insect food than regular students ($B_S \leq B_R$)
H2: Sustainability students have significantly more positive normative beliefs towards eating insect food than regular students ($N_S > N_R$)	$H2_0$: Sustainability students have equal or more negative normative beliefs towards eating insect food than regular students ($N_S \leq N_R$)
H3: Sustainability students have significantly more positive control beliefs towards eating insect food than regular students ($C_S > C_R$)	$H3_0$: Sustainability students have equal or more negative control beliefs towards eating insect food than regular students ($C_S \leq C_R$)

For data analysis, all hypotheses can be tested statistically by conducting a t-test for independent samples in the open-access software PSPP. If the test shows a statistically significant value below p=0.05 for a variable and if the Sustainability students' group shows a higher overall value, the respective null hypotheses can be rejected. To provide additional data about the sample, which might be of use during this discussion, a question about the respondents' nationality and an option to give written general remarks on the survey, were included into the survey. Those questions however, serve as supplements to better understand possible differences between the two samples, rather than directly contributing to the variables mentioned above.

RESULTS

The survey generated a total population of 104 complete responses from Lund university students. 44 respondents were students *without* a study focus on sustainability ("regular students") and 60 were students *with* this focus ("sustainability students"). As depicted in Figures 3 and 4, the sample of regular students shows a high prevalence of Swedish nationals, making up more than half of the sample, while the group of sustainability students is much more diverse, with a slight German dominance making up a quarter of all respondents.

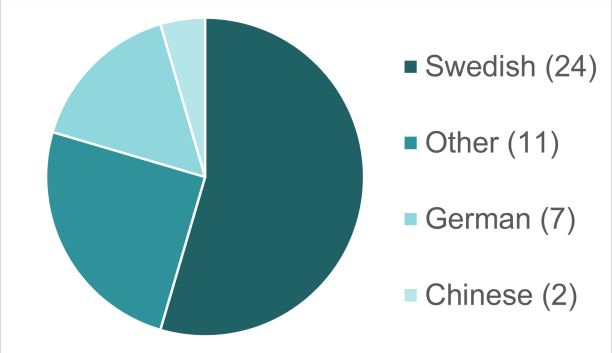


Figure 3. *Respondent nationalities of regular students. Others include Croatia, Denmark, Finland, Greece, Italy, Japan, Scotland, Slovakia, the Netherlands, the UK and one unassigned answer.*

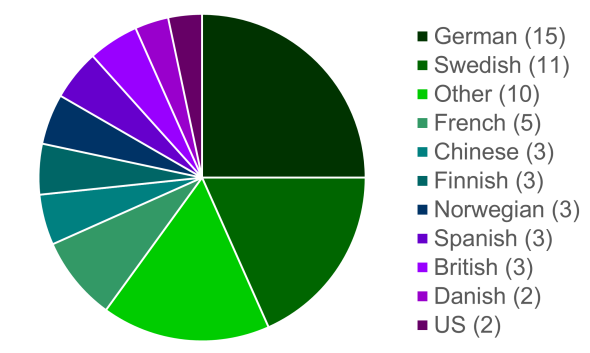
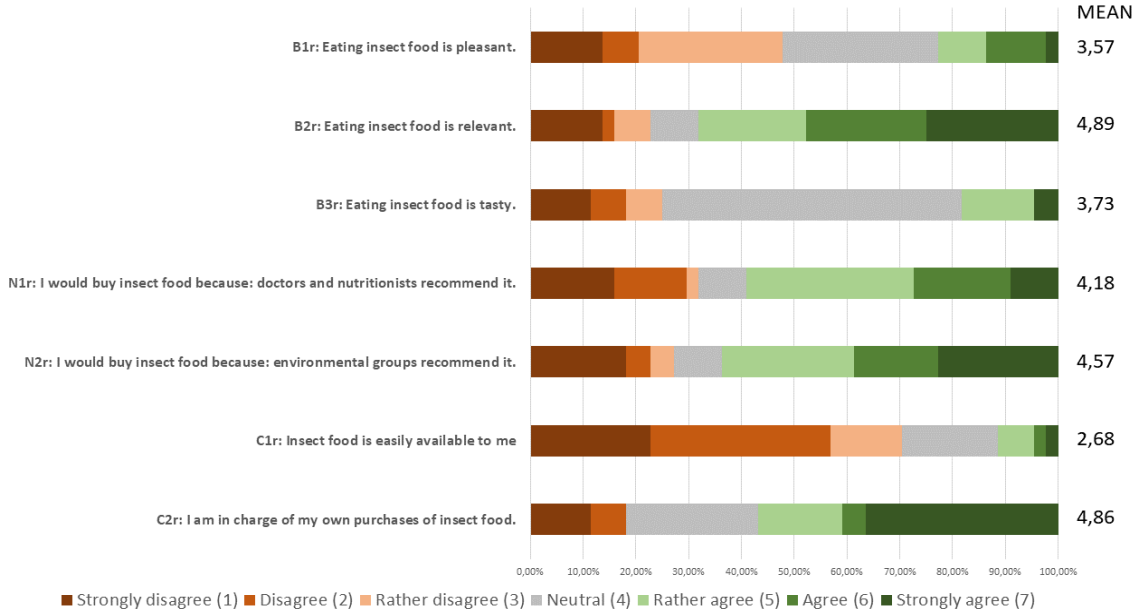


Figure 4. *Respondent nationalities of Sustainability students. Others include Australia, Croatia, England, Estonia, Greece, Iceland, India, Lithuania, the Netherlands, and Portugal.*

Figure 5 then shows the overall distribution of responses and the mean values of the answers from students without a sustainability focus, while Figure 6 depicts the same for sustainability students.

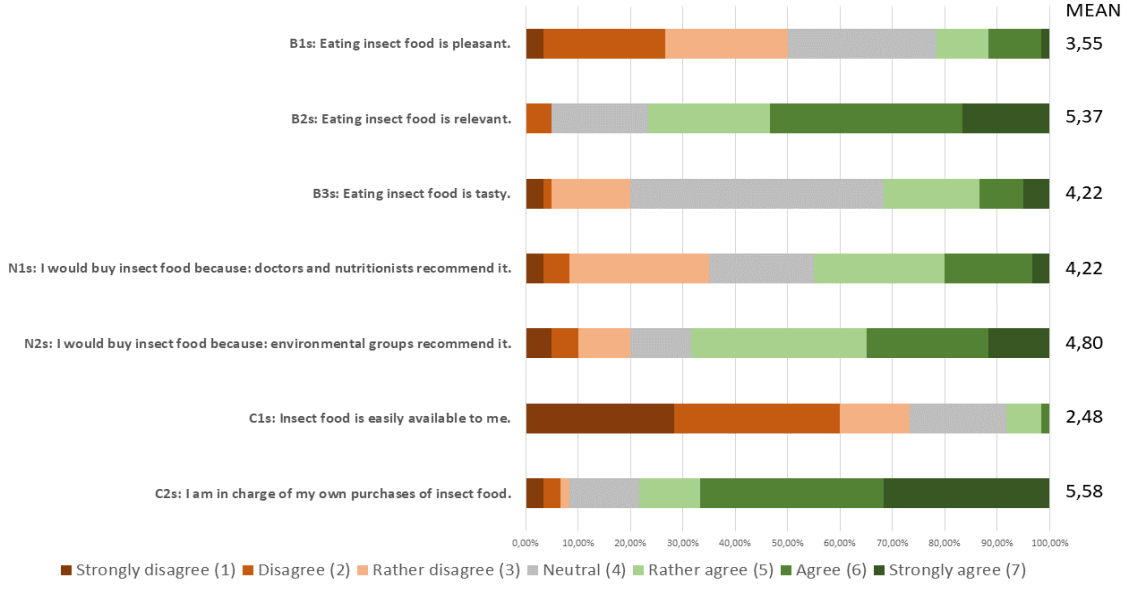
Some of the main findings include that regular students agreed to the statement "*I would buy insect food because: environmental groups recommend it*" with a mean value of 4,57, similarly the mean value of sustainability students was 4,80. With a mean value of 4,89 regular students agreed to the statement that "*eating insect foods is relevant*". In comparison, the percentage of sustainability students agreeing to the same statements was slightly higher with a mean value of 5,37. To the statement "*insect food is readily available to me*", regular student obtained a mean value of 2,68 and sustainability students achieved 2,48.

Figure 5. *Distribution of responses from regular students.*



The different colours in the figure represent the regular students' approval to the statements of the questionnair's items, measured as numbers on the likert-scale.

Figure 6. *Distribution of responses from sustainability students.*



The different colours in the figure represent the sustainability students' approval to the statements of the questionnair's items, measured as numbers on the likert-scale.

Based on these results calculations of mean values for the three dimensions (B, N and C) of intention were made in PSPP. Table 4 shows the mean values of these variables for each group of respondents. It also shows the p-values of a direct comparison between those two in a Welch-t-test. The Welch-t-test was chosen because the variances of the groups differed according to a Levene-test (see appendix 2). Hence, the p-values for different variances are used here. These p-values show the likelihood for the difference between both groups to be coincidental.

Table 4. Values of the variables presented in Table 2 and the result of their comparison in a Welch-t-test.

Regular Students	Sustainability Students	p-value in Welch-t-test
$B_R = 4.060$	$B_S = 4.377$	0.236
$N_R = 4.375$	$N_S = 4.508$	0.697
$C_R = 3.773$	$C_S = 4.033$	0.289

The p-values for testing the null hypotheses all exceed 0,2. Hence, even though all values for sustainability students were higher, no significant statistical differences between sustainability students and regular students could be detected and no null hypothesis can be rejected. In general, this means that no higher intention of sustainability students to eat insect food could be detected despite their higher involvement in sustainability issues.

In addition to this, several respondents made use of the option to make written remarks to the survey. These included veganism/vegetarianism or financial issues as reasons for not consuming insect food on several occasions or stated that the respondents never tried insect food before, partially because of limited availability of insect-based products. All written remarks can be viewed in the data file in the appendix of this study (see appendix 3).

DISCUSSION

Through this research, no correlation could be proven between students' knowledge within and commitment to sustainability and their intention to eat insect food. There are several possible reasons for this result. Firstly, it needs to be stated that the two samples are not entirely homogeneous (e.g. in nationality) and that there might be a number of disturbing factors influencing the results. Whether the differences in cultural backgrounds have an impact on the intention towards consuming insect food cannot be assessed within the scope of this project but might be of interest to future research. Food neophobia is an additional disturbing factor, which was not included in this study but was part of previous research (Chang et al. 2019; Dupont & Fiebelkorn 2020) and that might be keeping sustainability students from being more eager to eat insect food. The remarks made by some respondents imply other possible disturbing factors (e.g. vegetarianism or financial barriers), whose impact on the intentions would need to be further assessed. A high amount of "neutral" answers to item B_3 "Eating insect food is tasty.", as well as direct comments about never having tried insect food could be observed. This implies that a lacking accessibility to insect food might be another disturbing factor as respondents without any experience with insect food might likely have reported neutral opinions rather than strong attitudes.

Due to the shortcomings of the TPB, this study does not include such "situational factors" (see chapter 2) and they were not considered much in this survey. An analysis using different approaches towards measuring attitudes, such as sociological approaches, which are more inclusive towards such factors (Kollmuss & Agyeman 2002), would hence maybe have led to more informative results. Their application in future research might solve this problem.

As a last factor, research with a larger study group would need to be done to ensure that there actually is no difference in intention between the two groups. Asking a broader population instead of just students would also lead to more relevant results. Due to limitations in resources such as survey-software-accessibility, a survey of this scale was not viable for this study but might be of interest to a larger scale project.

There are several practical implications that can be drawn from these results. As no difference between the two groups could be statistically proven, targeting sustainability students might not lead to a higher general consumption of insect food. Instead, more

value lies in finding other potential factors apart from a commitment to sustainability, which could impact the intention of consuming insect food. Further studies should, therefore, also consider the potential impacts of the supply-side of insect food on consumer intention. A change in the current lack of accessibility and relative expensiveness which is likely to change in the future due to more efficient technologies in rearing, processing and packaging (Gahukar, 2011), could potentially be of great influence on consumer behaviour. Thus, since insect food has the great potential in contributing to a sustainable future due to its significantly less resource intensiveness than meat-based protein production (Food Processing Technology, 2018; Gahukar, 2011), identifying the main drivers of consumers' intentions towards eating insects in further research is integral.

Even though the results between the groups are similar, they show that there are some differences between the dimensions of intention. The behaviour and normative beliefs have a mean value that is neutral or above neutral for both the study groups, while control beliefs are barely neutral or even negative (see table 4). Because of this detected difference, further research on how to elevate the consumers' intention could focus on control beliefs and finding possible levers to increase those.

CONCLUSION

To conclude, our study has not shown a statistically proven difference between students of sustainability and regular students in the intention to consume insect food. Hence, studying a sustainability related program does not seem to have any direct impact on the students' intention towards eating insect food. A number of disturbing factors that could possibly explain this non-difference was identified. They include the mixed cultural backgrounds of our samples and the influence of vegetarianism as well as financial, or infrastructural factors, which are only covered by the TPB to a small extent. Psychological barriers such as food neophobia are another common factor in research on insect consumption that was not taken into account here. Further research on the issue could try to include such factors by operationalising more complex theoretical models and conducting larger scale surveys accompanied by qualitative research on the mechanisms of such factors and barriers to insect consumption in Europe.

But even though our research has not led to the results predicted by the underlying theoretical assumptions, many practical implications can be drawn from it nevertheless. The overall attitude towards insect food is in general leaning to positive rather than negative as shown by the results. Insects food thereby still offer potential of being part of the solution in replacing global meat consumption. For growing the consumption of insect food, our results imply that focusing on a specific group of sustainability-oriented people would not lead to better results than focusing on the mass market.

At the same time, researchers on behavioural change can learn from our results to pay special attention to control beliefs and/or factors outside of the scope of the TPB, in order to learn more about how to promote the consumption of more sustainable diets and help them have a large scale impact. Facing the global sustainability challenges of climate change and biodiversity loss as well as challenges connected to public health, such research remains urgently needed.

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