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The effect of communication and implicit associations on consuming insects: An experiment in Denmark and Italy

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A B S T R A C T

It has been widely noted that the introduction of insects in Westerns' diet might be a promising path towards a more sustainable food consumption. However, Westerns' are almost disgusted and sceptical about the eating of insects. In the current paper we report the results of an experiment conducted in two European countries—Denmark and Italy—different for food culture and familiarity with the topic of eating insects. We investigated the possibility to foster people's willingness to eat insect-based food through communication, also comparing messages based on individual vs. societal benefits of the eating of insects. Communication proved to be effective on intention and behaviour, and the societal message appeared to be more robust over time. The communication effect is significant across nation, gender, and previous knowledge about the topic. In addition, we investigated the impact of non-conscious negative associations with insects on the choice to eat vs. not eat insect-based food. Implicit attitudes proved to be a powerful factor in relation to behaviour, yet they did not impede the effectiveness of communication.

1. Introduction

Ecological footprint is the load imposed on nature by a population or an individual, and it can be expressed as the portion of Earth's surface which is necessary to sustain the resource consumption and waste by that population or individual (Wackernagel & Rees, 1996). Food consumption—and meat consumption in particular—account for a large part of the ecological footprint of people with a carnivorous diet (FAO, 2005, 2006). In most countries, developed or not, livestock and fish are an important source of proteins. According to FAO (2006), 70% of all agricultural land and products are destined to livestock, and this measure in absolute terms has to double between 2000 and 2050 (from 229 million tonnes to 465 million tonnes) in order to satisfy the increasing world demand. Feeding the more and more demanding world population will determine an unsustainable pressure on land, oceans, water and energy. Therefore, the environmental issues, in particular those connected with cattle breeding, need prompt attention, and alternative protein sources could be promoted, such as algae (Fleurence, 1999), vegetables and mushrooms (Asgar, Fazilah, Huda, Bhat, & Karim, 2010) and mini-livestock (Paoletti, 2005).

Among the different possible protein sources, recent research has been showing a growing interest in the introduction of edible insects into the Western diet, which could be a solution to environmental and nutrition world problems (Looy, Dunkel, & Wood, 2014; Rumpold & Schlüter, 2013).

According to the FAO (2006), the benefits of the introduction of insects in the human diet are twofold. On the one side, there are individual benefits stemming from the excellent nutritional profile of many edible insects (Rumpold & Schlüter, 2013). For example, the oils extracted from several insects are richer in unsaturated fatty acids than meat, and frequently contain Omega 3, the nutritional importance of which is well recognized for human health, mainly for the healthy development of children and infants (DeFoliart, Dunkel, & Gracer, 2009).

On the other side, there are relevant societal benefits, in terms of feed conversion efficiency, greenhouse gas emissions, freshwater consumption, food waste reduction, animal welfare, and prevention of zoonotic infection risk (van Huis et al., 2013). For example,

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species such as mealworm larvae, crickets and locusts compare favourably with beef cattle in their GreenHouse Gas (GHG) emissions (lower by a factor of 100). Insects are a more environmentally friendly source of animal protein also in terms of urine and manure production, energy depletion and land use (Oonincx et al., 2010; Oonincx & de Boer, 2012).

Despite all these individual and societal benefits, several studies show people's generally low willingness to introduce insect to the Western diet (Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013, Verbeke, 2015), and there is still a lack of research about the psychological drivers and barriers which influence the willingness to eat insects. The discrepancy between the benefits of eating insects and the aversion of Westerners toward them suggests an important research question: Is it possible to positively affect the individual intention to eat insect-based food through communication of the individual and/or societal benefits connected to this new form of food consumption?

The idea of changing food preferences and aversions through communication has a prominent role in consumer behaviour research in relation to a large array of topics and disciplines (Aldridge, Dovey, & Halford, 2009; Larson & Story, 2009). However, few studies have addressed the issue of encouraging people in the Western countries to accept entomophagy, and while the educational experiences that have been carried out have increased the awareness of entomophagy, they did not significantly affect attitudes (Looy & Wood, 2006; Wood & Looy, 2000).

Therefore, our major aim was to investigate if it would be possible to positively affect people's willingness to eat insect-based food through communication (Del Giudice, La Barbera, Vecchio, & Verneau, 2015), also comparing different communication messages (individual vs. societal benefits of eating insect). To the best of our knowledge, the current study is the first to investigate this possibility with an experimental methodology. In addition, if an effect on intention occurs, we aim to test its stability over time, and to evaluate its transmission to actual behaviour. Also these two points have not been investigated before.

Previous research has highlighted the significant effect of several factors, such as gender and familiarity with the topic. We studied the main effect of these two factors, and of different nationality of the participants in the experiment as well. Moreover, we also explored the moderating role of the same factors on the effectiveness of communication.

It is also important to note that, although scholars have underlined the role of affective and non-conscious psychological processes as the basis of the aversion to insects as food, research has empirically studied the drivers and barriers only in terms of deliberate/explicit processes (Strack & Deutsch, 2004), using self-report measures. Therefore, it will be crucial for a more comprehensive understanding to explore the implicit processes as well, and we do address this issue in the current study using a measure of implicit associations (Greenwald, McGhee, & Schwartz, 1998).

In recent years, research in social psychology has focused on automatic or implicit processes, which are assumed to affect behaviour by operating outside of conscious awareness (Banaji, 2001; Bargh & Ferguson, 2000; Blair, 2001). Strack and Deutsch (2004) distinguish the *impulsive system* and the *reflective system*: In the latter, the link between cognitive beliefs and behaviour is mediated by reasoning, behavioural decision and intention; in the former, implicit associations between categories and concepts (such as "insect" or "elderly", and "bad" or "good") take place, which are directly linked to behaviour.

Recourse to implicit measures, in addition to traditional ones, has been shown to improve the prediction of behaviour (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Vantomme, Geuens, DeHouwer, & DePelsmacker, 2006). The most commonly adopted and reliable instrument developed to tap into implicit association is the Implicit Association Test (IAT - Greenwald et al., 1998).

In the next section, we provide a brief overview of the existing research on the eating of insects, then we describe the procedure and results of an experiment conducted in Denmark and Italy—two European countries different in terms of food consumption characteristics and culture—for addressing the questions discussed above.

1.1. Why are insects not eaten in western countries?

The practice of eating insects, known as entomophagy, is an old-age phenomenon, well documented also in Europe during the Greek and Roman ages (Bodenheimer, 1951). Nowadays, insects are an important protein sources in several areas of Central and Western Africa, South East Asia, and Central and South America (Bahuchet & Garine, 1990; Zent & Simpson, 2009).

Western consumers' willingness to introduce insects and/or insect-derived proteins into their diet is generally low, and insect-based food is regarded with scepticism and disgust (Vanhonacker et al., 2013). From a psychological point of view, "Deeply embedded in the Western psyche is a view of insects as dirty, disgusting, and dangerous" (Looy et al., 2014). Disgust about something is a cultural construction, which is socialized to all members of a group, and indicates clearly the physical or cultural threat related to some object or action (Herz, 2012; Mignon, 2002). Disgust can also be easily generalized from one entity to others through contamination (Rozin & Fallon, 1987). Because Westerners tend to have a stereotyped and undifferentiated perception of insects (Kellert, 1993), the association of some insects with feces and decaying matter could have led to psychological contamination of all insects, making the entire category disgusting (Looy et al., 2014).

At the group level of analysis, food-related practices are part of the socialization of children, and contribute to the foundation of one's own cultural identity (Fieldhouse, 2013; Kiefner-Burmeister, Hoffmann, Meers, Koball, & Musher-Eizenman, 2014). Food practices shared by a group or a community also contribute to define its identity and distinguish it from other groups. Research has shown, for example, that different groups choose a subset of the edible substances available to consolidate and distinguish their identity, and often ridicule the outgroup food habit (Pyke, 1968; Diamond, 1992). Westeners' tend to consider the eating of insects as a primitive people's practice (Ramos-Elorduy, 1997), and use insect metaphors in relation to social groups which are seen as "less human" (i.e., de-humanized, see Haslam, 2006). Therefore they cannot eat insects without feeling threatened in their own identities and self-esteem.

There have been few studies that addressed consumers' attitudes towards eating insects or insect-based food. In a recent study in Belgium, Vanhonacker et al. (2013) found a very low willingness to eat insects. In a study conducted in the Netherlands (de Boer, Schösler, & Boersema, 2013), 79% of participants indicated the insect-based snack as the one they would least like to taste, compared to other snacks based on environmentally-friendly proteins, such as hybrid meat, lentils, beans, and seaweed. Recent studies (Hartmann, Shi, Giusto, & Siegrist, 2015; Schösler, de Boer, & Boersema, 2012) also showed that food products with processed (not visible) insects – such as pizza with insect proteins or cookies based on cricket flour – were evaluated better than other options with visible insects by Western people. This difference between processed and not-processed insects was not relevant in the case of Chinese people instead.

Scholars have identified several factors affecting individuals' willingness to eat insect based food. Gender and age are relevant factors – male and young individuals show more positive attitudes – whereas education level does not show clear effects (Schösler et al., 2012; Verbeke, 2015). Familiarity with the topic of eating insects has been shown to be a powerful driver (Hartmann et al., 2015): In the study by Verbeke (2015), participants self-reporting awareness of what the eating of insects is about were those with more positive intentions towards eating insects. Recent studies also found Food Neophobia (Pliner & Hobden, 1992) to be an important factor influencing consumers' willingness to eat insect based food (Hartmann et al., 2015; Hoek et al., 2011; Verbeke, 2015), along with a number of studies that have proposed Food Neophobia as an important obstacle to the readiness to try novel foods (Siegrist, Hartmann, & Keller, 2013).

2. Materials and methods

2.1. Overview of experimental procedure

In each session, upon arrival participants met in a computer lab. Each participant was identified with an ID number to guarantee his/her anonymity and for the follow up. A "Insects vs. flowers" IAT was administered. After that, students were invited to watch a short video of an expert interview (see Appendix 1).

The between-subjects design consists of three conditions, in which students watch one of the following videos:

1. societal benefits of introducing insects' proteins into human diet;
2. individual benefits of introducing insects' proteins into human diet;
3. benefits of introducing tablets in school (control condition).

Participants were randomly assigned to the experimental conditions. After watching the video, items on familiarity and intention were administered. After that, participants received a chocolate bar enriched with proteins from crickets.

About two weeks after the end of all the experimental sessions, participants were contacted by telephone, and a short questionnaire was administered. They were asked 1) if they actually ate the choco-bar (behaviour), and, if yes, how much of it they ate; 2) the same three items on intention administered during the experimental session.

2.2. Participants

A total of 282 university students participated to the experiment. Half of the sample was recruited in Denmark (65 females, $M_{age} = 23.35$, $SD_{age} = 3.40$), and the other half of 141 subjects (74 females; $M_{age} = 23.87$, $SD_{age} = 4.25$) was recruited in Italy. The samples did not present significant differences as regards gender, X^2 (282) = 1.149, p > 0.10, age, t (280) = 1.129, p > 0.10, and distribution of students to the experimental groups, $X^2 < 1$, which was randomly made. Two weeks after the experiment a brief follow up interview was carried out. We were able to collect the responses of 264 participants, 136 Danish (61 females, $M_{age} = 23.33$, $SD_{age} = 3.43$) and 128 Italians (71 females, $M_{age} = 23.94$, $SD_{age} = 4.33$). The overall attrition rate (i.e., the percentage of participants to both sessions in relation to those who participated only to the first session) was 93.6% (96.4% for Danish, 90.8% for Italians).

2.3. Measures

2.3.1. Implicit association test

In our experiment, in order to assess participants' implicit associations with insects, a standard "Insects vs. Flowers" IAT was administered. Participants were asked to categorize stimuli belonging to the target categories (Insect or Flower) and stimuli belonging to two opposite attribute categories (Positive and Negative). They executed the task using the keyboard keys "A" and "L". In the next two phases, target categories and attribute categories shared the same response key (e.g. Positive and Flower); subsequently, the matching of categories was inverted (e.g. Negative and Flower share the same response key). A longer reaction time indicates that for the respondent it is more difficult to associate the target and attribute category; by contrast, a shorter reaction time means that the two categories are easily associated, indicating that the corresponding association is held by the respondent.

In this study, the presentation of the combination of target and attribute categories was counterbalanced so that half of the participants were presented with "Insect and Positive" first, and the other half with "Insect and Negative" first. A feedback after categorization errors (a red cross) was given to participants, who were required to provide a correct response after any error. The IAT score was obtained using the D2 method proposed by Greenwald, Nosek and Banaji (2003).

Tested for reliability, the IAT proved adequate ($\alpha_{danish} = .71$; $\alpha_{italian} = .75$). In this study, positive values of the IAT indicate positive implicit associations about insects, whereas negative values indicate negative implicit associations.

2.3.2. Familiarity

We used the measure by Verbeke (2015) to assess participants' familiarity with introducing insect into the human diet. The item "Have you ever heard of the eating of insects?" was administered. Participants answered choosing among the following: 1.Yes, I have heard of the eating of insects and I know what it means; 2. I have heard of the eating of insects but actually don't know what it means; 3. No, I have never heard of the eating of insects. For the analysis, we dummy coded the item (0 = No, I have never heard; 1 = otherwise).

2.3.3. Intention

Three items (adapted from Balderjahn, Peyer, & Paulssen, 2013) were administered, asking participants' about their intention 1) to introduce insect proteins in their diet; 2) to suggest this to friends and relatives; 3) to buy products with insect proteins rather than traditional protein sources, if available on the market. The instrument was administered at the time of the experiment (intention1) and two weeks later (intention2). Participants answered on a 7-point scale. Items were averaged in a single score (intention 1: $\alpha_{Danish} = .92$; $\alpha_{Italian} = .87$; intention2: $\alpha_{Danish} = .90$; $\alpha_{Italian} = .91$).

2.3.4. Behaviour

Participants received a chocolate bar with peanuts enriched with proteins from crickets (53 g) as a reward for their participation in the experiment. The label of the product clearly reported all the ingredients, among them cricket proteins, and this was underlined by pictures of crickets on the packaging. We choose this kind of product because, as we reported before, previous research found a somewhat lower aversion of people to products with processed insect proteins, compared to product characterized by visible insects. Two weeks after the experiment, as explained in the Procedure section, participants were asked if they actually ate the product.

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3. Results

3.1. Intention analysis

Table 1 provides bivariate correlations between the measures used in the experiment. Consistently with the theory, the IAT significantly correlated with behaviour, but not with intention. Previous knowledge (familiarity) presented the opposite pattern of correlation, that is, it was significantly correlated with intention but not with behaviour. As expected, intention 1 and intention 2 were strongly intercorrelated, and both were correlated significantly with behaviour.

The overall mean difference between intention 1 and intention 2 was not significant, $t < 1$. In order to investigate the effect of communication, nationality, familiarity, gender and their interaction on participants' intention 1 and intention 2, a series of ANOVAs was ran.

The main effect of message on intention 1 was significant F (2, 276) = 8.97, $p < 0.001$, $d = .48$: the mean score of intention was higher for the social benefit group and the individual benefit group compared to the control group, t (188) = 3.95, p < 0.001 and t (185) = 2.78, p < 0.01, respectively, whereas no significant difference was found between the former two groups, t (185) = 1.03, p > 0.10. The main effect of message was significant also on intention 2, F (2, 261) = 4.53, $p = 0.012$, $d = .37$. In this case, however, the mean score of intention was higher for the social benefit group compared to the control group, t (174) = 2.99, p < 0.01, but a significant difference was found neither between the social and individual groups, t (176) = 1.22, p > 0.1, nor between the individual and the control condition, t (172) = 1.74, p = 0.083 (see Table 2).

The main effect of nation on intention 1 was also significant, F (1, 276) = 15.74, $p < 0.001$, $d = .46$: the mean score of intention was higher for the Danish ($M = 4.37$, $SD = 1.59$) compared to the Italians ($M = 3.55$, $SD = 1.99$). The effect of nation on intention 2 was also significant F (1, 258) = 7.07, $p < 0.01$, $d = .31$: the mean score was higher for the Danish participants ($M = 4.43$, $SD = 1.87$) compared to the Italian participants ($M = 3.84$, $SD = 1.84$). The interaction between message and nation was not significant, $F_{intention1}$ (2, 276) = 1.69, $p = 0.187$, $F_{intention2}$ (2, 258) = 1.38, $p = 0.252$.

The main effect of familiarity on intention 1 was significant F (1, 276) = 9.71, $p < 0.01$, $d = .35$: the mean score of intention was higher for participants with high familiarity ($M = 4.23$, $SD = 1.88$) compared with those with low familiarity ($M = 3.65$, $SD = 1.75$). The main effect of familiarity on intention 2 was also significant F (1, 258) = 8.74, $p < 0.01$, $d = .35$: the mean score of intention was higher for participants with high familiarity ($M = 4.43$, $SD = 1.18$) compared with those with low familiarity ($M = 3.82$, $SD = 1.92$). No significant interactive effect was exerted by message and familiarity on intention 1, F (2, 276) = 2.73, $p > 0.05$, and intention 2, $F < 1$.

A significant effect of gender was also found on intention 1, F (1, 276) = 6.42, $p = 0.012$, $d = .29$: the average scores of male participants ($M = 4.23$, $SD = 1.75$), were higher than those of females ($M = 3.68$, $SD = 1.89$). However, this effect was not significant in the case of the intention self-reported at the follow-up, F (1, 258) = 2.00, $p > 0.10$. In both cases, gender had no significant interaction with nation and group, Fs < 1.

Table 1
Summary of intercorrelations, means and standard deviations.

Measure	1	2	3	4	5
1. IAT	0 (1)				
2. Familiarity	−.093	.53 (.50)			
3. Intention1	.043	.156**	3.96 (1.84)		
4. Intention2	.019	.159**	661**	4.14 (1.92)	
5. Behaviour	.148*	.104	340**	329**	.86 (.35)

Note. The table shows Pearson's r correlation coefficients. Diagonal cells report the means (standard deviations in parentheses).
* = p < 0.05; ** = p < 0.01; *** = p < 0.001.

Table 2
Differences in intention between experimental conditions.

	Intention 1	Intention 2
Experimental condition	M (SD)	M (SD)
Social benefit	4.37^{a} (1.62)	4.74^{c} (1.57)
Individual benefit	4.09^{a} (1.80)	4.45^{cd} (1.73)
Control	3.42^{b} (1.91)	4.03^{d} (1.85)

Note. Entries are means and standard deviations (in parentheses). Mean scores with different superscript letters are significantly different at < .05 level.

3.2. Behaviour analysis

In the brief follow up interview, we asked participants if they ate the chocolate bar: 227 participants reported eating it (129 Danish, 98 Italians).

A Generalised SEM (STATA 13) was carried out for investigating the effects of the messages on behaviour (eating or not the chocolate bar) *via* intention. Drawing on the double-path model by Strack and Deutsch (2004), we tested the significance of the direct effect of the two messages on intention, and the significance of the indirect effect on behaviour through intention (reflective system). In line with the theoretical model, instead, we did not expect a direct effect of communication on behaviour.[1] Moreover, the implicit associations were added as a predictor of behaviour (impulsive system). The conceptual model is depicted in Fig. 1.

For the factor message, two dummy variables were included in the model. The variable "social" had value 1 for the social benefit message condition and value 0 otherwise. The variable "individual" had value 1 for the individual benefit message condition and the value 0 otherwise. Maximum likelihood method was used with a logit model for taking into account the dichotomous nature of the criterion variable. Results are provided in Table 3.

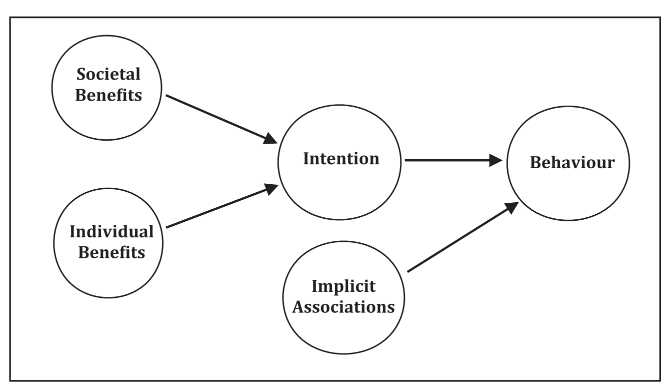

Fig. 1. The effect of messages, intention, and implicit associations on behaviour.

[1] The direct effects of messages on behaviour were also tested, and as expected they were not significant (Zs < 1). Therefore, these effects have been excluded from the final model.

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Table 3
Generalized structural equation model.

	Coefficients	SE	z	p
Direct effects				
Intention ← social benefit	1.021	.259	3.95	< .001
Intention ← individual benefit	.762	.261	2.92	.003
Intention ← constant	3.365	.183	18.40	< .001
Behaviour ← IAT	.780	.389	2.01	.045
Behaviour ← intention	.571	.116	4.91	.< .001
Behaviour ← constant	−.456	.401	−1.14	.255
Indirect effects				
Behaviour ← social benefit	.583	.190	3.08	.002
Behaviour ← individual benefit	.435	.173	2.51	.012
Log likelihood = −652.11378				

The effects of both messages on intention were significant, confirming the Anova results, as well as the effect of intention on behaviour. The indirect effects of both messages on behaviour were also significant. Finally, the effect of implicit associations on behaviour was significant.[2]

Results were supported by the predicted value (PPV) assessment: the model correctly predicted actual eating/non eating behaviour of the 86.7% of the participants. As shown in Table 4, the proposed logit model is able to represent with good accuracy both cases of eating ($y = 1$) and not eating ($y = 0$), whereas the baseline model can only predict one of the two modes. The model also shows a balanced distribution of the misclassified values.

4. Discussion

In this study, we have investigated whether information about the individual and social benefits of eating insects has an impact on people's intention to eat insect-based food, as well as on their actual behaviour. We have also investigated whether these effects are contingent on a number of factors, notably nation (as a proxy for food culture), familiarity with the benefits of eating insects, gender and people's implicit attitude to insects. Our main result is that providing information about the benefits of eating insects does raise intention to eat insects, and that this intention does carry over to behaviour. It also seems that the effect on intention persists at least for two weeks after the experiment.

This main result is qualified in a number of ways. While the two types of messages – about individual and about social benefits – had similar effects when intention was measured immediately after exposure, the effect of the information on social benefits appeared to be more stable over time than the effect of information on individual benefits.

As expected, our results underline the significant role of gender and familiarity, which is in line with Verbeke's (2015) result that males and people with a higher degree of familiarity are already more positive with regard to eating insect-based food. Nevertheless, it is important to highlight that the communication effects on intention remain stable across these two factors, and across nationality as well.

The other major result of the study is the significant effect of implicit associations on eating behaviour. Coherent with theory (Strack & Deutsch, 2004), implicit associations have been shown to influence directly the behaviour, without the mediation of deliberative/conscious psychological processes. To our best knowledge, although the role of affective and non-conscious processes has often been emphasized as important in previous research on the eating of insects, this is the first empirical evidence about this point.

Given that this was a single-exposure experiment, the fact that an exposure to information can have an effect on both intention and behaviour is encouraging for the potential role of information in encouraging people to eat insect-based food. The provision of information about the benefits of eating insect-based food is an attempt to change behaviour that functions *via* conscious learning and the volitional formation of intentions. As the resistance towards eating insect-based food is at least partly rooted in negative affective reactions acquired in early phases of socialization, such that these reactions can be assumed to be largely automatic, one could at the outset be sceptical about the potential of an information-based approach to change intentions and especially about the potential of such intentions to lead to actual behaviour. While our results on the effect of people's implicit attitudes towards insects do indicate that strong implicit negative attitudes could form a barrier against the eating behaviour, they also show that this barrier does not impede to communication strategies to be effective in promoting insect eating behaviour. In the model presented, indeed, communication has been shown to exert a significant effect on behaviour *via* intention also controlling for the effect of implicit associations.

As noted the effect on intentions did carry over to actual behaviour. The high share of respondents in the study actually eating the chocolate bar with the insect protein is in itself an interesting result. As respondents took the chocolate bar home and could freely decide to throw it out or eat it, the high level of eaters cannot be attributed to experimental demand effects. The high level of eaters may be partly due to the fact that this was a processed product, so that the insect-based ingredient was not visible as such. This explanation would be in line with Schösler et al. (2012) finding higher acceptance for a pizza with insect-based proteins than for a salad with fried mealworms, and also with Hoek et al.'s (2011) results about consumer categorization of meat substitutes (see also Hartmann et al., 2015). However, the packaging of our test product clearly stated that this product contained cricket protein, and this statement was underlined by pictures of crickets, reminding respondents of the insect content also during consumption. Our results thus suggest that there is a potential for experimental consumption of insect-based food when it is accompanied by information about the benefits of eating such food.

Our results also underline the importance of food culture. Levels of both intentions and behaviour were higher in the Danish than in the Italian sample. A possible explanation for this difference is the pace of change of the two food cultures. The Danish food culture is not usually regarded as a very strong food culture, but has over the past decades experienced considerable changes in eating patterns, with some of the most innovative approaches to cooking and meals winning wide international acclaim (Byrkjeflot, Pedersen, &

Table 4
Predicted value assessment.

	Calculated Y			
		Y = 0	Y = 1	Total
Observed Y	Y = 0	15	22	37
	Y = 1	13	214	227
	Total	28	236	264

[2] The variable used as outcome in the model was a dichotomous one, which represented the selected behaviour, namely participants' choice of eating versus not eating the chocolate bar with cricket proteins. Nevertheless, the choice of eating the bar could be due to the mere curiosity towards a new food, yet in principle the person who responded yes to the question about eating the bar could have tasted it and then thrown it away, thus not denoting a significant involvement. For addressing this issue, we tested the same model illustrated in Fig. 1 with a different outcome variable, namely the item "How much of the chocolate bar did you eat?", scoring from 1 (Not at all) to 5 (All). The model fit was excellent: NFI = .951; NNFI = .959; CFI = .979; RMSEA = .050. Previous results were fully confirmed.

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Svejenova, 2013). In contrast, Italian food culture is widely regarded as one of the strongest in Europe, with a long-established reputation for combining gastronomic and nutritional qualities. People that have grown up and live in a strong and widely praised food culture may be less susceptible to trying new and different products than people who live in a rapidly changing food culture.

The study has a range of important limitations. It is based on a student sample, implying that respondents are both young and well-educated. Verbeke (2015) found that younger people are more willing to adopt insect-based foods. He found no effect for education, but other research suggests that both age and education are related to willingness to try new food (Siegrist et al., 2013). The experiment was based on a single exposure to the experimental stimulus and measurement of effects was limited to the two data collection points, right after exposure and two weeks later. It is possible that the effect decays over time, and it is also possible that repeated exposure could strengthen the effect. The present study thus can be seen as a proof of principle study, demonstrating that the provision of information can indeed have an effect on both intentions and behaviour regarding the consumption of insect-based food. Finally, in the follow-up we tried to collect information about participants' actual eating behaviour. Nonetheless, our criterion variable was self-reported. Therefore, we cannot exclude some effect due to social desirability.

The study and its results point at several avenues for future research. As regards the implicit associations measurement, we used a standard “Flower vs. Insect” IAT, because it has been already widely used and tested for validity. The reliability of the test was very important since this was the first attempt to investigate the relations between implicit associations and the eating of insect-based food. It could be argued that a measure of implicit attitude towards insects as food could have a more direct link with the eating of insect itself, and this could be a very intriguing avenue for future research. However, using that kind of measure would pose several challenges, which need to be addressed. First, the contrast category choice – “flower” in the case of the standard Insect vs. Flowers IAT – would be not trivial. Second, also the stimuli selection should be conducted carefully, because they would not likely be words, but rather pictures of food-based insects (and pictures representing the contrast category as well), which could imply several intervening variables, such as individuals' taste and emotional activation. Third, as we discussed, Western individuals do not consider insects as food at all; therefore, one should not assume that they hold implicit associations with insects as food.

May be most importantly, replications with other populations, especially older and less educated people, would be desirable. Replications with alternative stimuli for the informational treatment would increase the external validity of the results. Multiple exposures and effect measurements could shed more light in the persistence of the effects over time. And very importantly, it would be desirable to see how the results on behaviour are related to the type of food under study. We indicated that the high rate of consumption among the respondents may be related to the type of product involved; this proposition should be supported by studies varying the type of food in a systematic way.

Appendix 1. Expert Interviews

Interview 1. Societal benefits of introducing insects' proteins into human diet

Person 1 (Interviewer): There is a growing interest about food containing proteins derived from insects. For example, this is a chocolate bar with nuts, enriched with cricket proteins (s/he shows the chocobar). Now we are going to ask the opinion of the expert. Dear Prof. (Italian or Danish surname), according to you, what are the advantages of introducing insect proteins in the human diet?

Person 2 (Expert): Consuming insects has a number of advantages for the environment. Rearing insects requires very few amount of non-renewable resources and produces little environmental contamination. For example, insects require significantly less water than cattle rearing. A lack of water is already constraining agricultural output in many parts of the world. It is estimated that, in about ten years, one-third of the world population will be living in regions with absolute water scarcity, and two-thirds will likely be under stress. Moreover, the insects production chain requires less energy and land use than livestock, and at the same time they emit few Green House Gas, such as ammonia and CH4, which highly contributes to the Green House Effect. Finally, different from livestock rearing which requires a large amount of cereals for feeding, insects are reared exploiting waste material that would otherwise go unused.

Person 1 (Interviewer): Thank you very much Professor for sharing your knowledge with us. (Greetings).

Interview 2. Individual benefits of introducing insects' proteins into human diet

Person 1 (Interviewer): There is a growing interest about food containing proteins derived from insects. For example, this is a chocolate bar with nuts, enriched with cricket proteins (s/he shows the chocobar). Now we are going to ask the opinion of the expert. Dear Prof. (Italian or Danish surname), according to you, what are the advantages of introducing insect proteins in the human diet?

Person 2 (Expert): Consuming insects has a number of advantages for human health. Many edible insects provide satisfactory amounts of energy and protein, with a very good nutritional profile for humans. For example, edible insects are a considerable source of fat. The oils extracted from several insects are richer in unsaturated fatty acids than meat, and frequently contain Omega 3, whose nutritional importance is well recognized for human health, mainly for the healthy development of children and infants. Also for minerals, most edible insects show a good nutritional profile. For example, they boast equal or higher iron contents than beef, and are good sources of zinc, whose deficiency is a relevant health problem, especially for child and maternal health. Finally, vitamins essential for stimulating metabolic processes and enhancing immune system functions are present in most edible insects, and for several species their content is higher than in meet.

Person 1 (Interviewer): Thank you very much Professor for sharing your knowledge with us. (Greetings).

Interview 3. Benefits of introducing tablets in school (control condition).

Person 1 (Interviewer): There is a growing interest about using tablets in school. For example, this is a tablet, which can be used for several applications (s/he shows the tablet). Now we are going to ask the opinion of the expert. Dear Prof. (Italian or Danish surname), according to you, what are the advantages of introducing tablets in school?

Person 2 (Expert): Using tablets has a number of advantages for human learning. Schools already using tablets are reporting remarkable results in how children learn, research, interact and capture their studies. For example, students are more likely to share information and projects with each other, and with their teachers and parents. Teachers can more easily monitor progress, and give feedback on work quickly. Certain apps enable teachers to create a permanent record of each child's achievements. Also the touchscreen provides greater options for students who might

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struggle with traditional learning methods, easily supporting different audio, visual and kinesthetic styles. For example, students can easily increase font size. Finally, there is a variety of apps that support difficulties such as dyslexia, without a teacher having to book extra resources, and make it easier for teachers to personalize lessons to individual student needs.

Person 1 (Interviewer): Thank you very much Professor for sharing your knowledge with us. (Greetings).

References

Aldridge, V., Dovey, T. M., & Halford, J. C. (2009). The role of familiarity in dietary development. *Developmental Review, 29*(1), 32–44.

Asgar, M. A., Fazilah, A., Huda, N., Bhat, R., & Karim, A. A. (2010). Nonmeat protein alternatives as meat extenders and meat analogs. *Comprehensive Reviews in Food Science and Food Safety, 9*(5), 513–529.

Bahuchet, S., & Garine, I. (1990). The art of trapping in the rainforest. In C. M. Hladik, S. Bahuchet, & I. Garine (Eds.), *Food and nutrition in the african rainforest* (pp. 25–49). Paris: UNESCO.

Balderjahn, I., Peyer, M., & Paulssen, M. (2013). Consciousness for fair consumption: conceptualization, scale development and empirical validation. *International Journal of Consumer Studies, 37*(5), 546–555.

Banaji, M. R. (2001). Implicit attitudes can be measured. In H. L. Roediger, J. S. Nairne, I. Neath, & A. Surprenant (Eds.), *The nature of remembering: Essays in honor of Robert G. Crowder* (pp. 117–150). Washington, DC: American Psychological Association.

Bargh, J. A., & Ferguson, M. J. (2000). Beyond behaviorism: on the automaticity of higher mental processes. *Psychological Bulletin, 126*(6), 925.

Blair, I. V. (2001). Implicit stereotypes and prejudice. In G. B. Moskowitz (Ed.), *Cognitive social psychology: The princeton symposium on the legacy and future of social cognition* (pp. 359–374). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Bodenheimer, F. S. (1951). *Insects as human food*. The Hague: W Junk.

de Boer, J., Schösler, H., & Boersema, J. J. (2013). Motivational differences in food orientation and the choice of snacks made from lentils, locusts, seaweed or "hybrid" meat. *Food Quality and Preference, 28*(1), 32–35.

Byrkjeflot, H., Pedersen, J. S., & Svejenova, S. (2013). From label to practice: the process of creating new nordic cuisine. *Journal of Culinary Science & Technology, 11*(1), 36–55.

DeFoliart, G. R., Dunkel, F. V., & Gracer, D. (2009). *The food insects newsletter—Chronicle of changing culture*. Salt Lake City: Aardvark Global Publishing.

Del Giudice, T., La Barbera, F., Vecchio, R., & Verneau, F. (2015). Anti-waste labeling and consumers' willingness to pay. *International Journal of Food and Agribusiness Marketing*. http://dx.doi.org/10.1080/08974438.2015.1054057.

Diamond, J. (1992). *The third chimpanzee*. New York: HarperCollins.

FAO. (2005). *Pollution from industrialized livestock production. Livestock policy briefs* (Vol. 2) (Rome, Italy).

FAO. (2006). *The state of food insecurity in the world* (Rome).

Fieldhouse, P. (2013). *Food and nutrition: customs and culture*. Springer.

Fleurence, J. (1999). Seaweed proteins: biochemical, nutritional aspects and potential uses. *Trends in Food Science & Technology, 10*(1), 25–28.

Greenwald, A., McGhee, D. E., & Schwartz, J. K. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology, 74*, 1464–1480.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of personality and social psychology, 85*(2), 197.

Greenwald, A. G., Poehlman, T. A., Uhlmann, E. L., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *Journal of personality and social psychology, 97*(1), 17.

Hartmann, C., Shi, J., Giusto, A., & Siegrist, M. (2015). The psychology of eating insects: a cross-cultural comparison between Germany and China. *Food Quality and Preference, 44*, 148–156.

Haslam, N. (2006). Dehumanization: an integrative review. *Personality and Social Psychology Review, 10*, 252–264.

Herz, R. (2012). *That's disgusting: Unraveling the mysteries of repulsion*. WW Norton & Company.

Hoek, A. C., Luning, P. A., Weijzen, P., Engels, W., Kok, F. J., & de Graaf, C. (2011). Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance. *Appetite, 56*(3), 662–673.

van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., et al. (2013). *Edible insects: Future prospects for food and feed security*. FAO Forestry Paper 171. Rome: Food and Agriculture Organization of the United Nations.

Kellert, S. R. (1993). Values and perceptions of invertebrates. *Conservation Biology: The Journal of the Society for Conservation Biology, 7*, 845–855.

Kiefner-Burmeister, A. E., Hoffmann, D. A., Meers, M. R., Koball, A. M., & Musher-Eizenman, D. R. (2014). Food consumption by young children: a function of parental feeding goals and practices. *Appetite, 74*, 6–11.

Larson, N., & Story, M. (2009). A review of environmental influences on food choices. *Annals of Behavioral Medicine, 38*, S56–S73.

Looy, H., Dunkel, F. V., & Wood, J. R. (2014). How than shall we eat? Insect-eating attitudes and sustainable foodways. *Agriculture and Human Values, 31*, 131–141.

Looy, H., & Wood, J. R. (2006). Attitudes toward invertebrates: are educational" Bug Banquets" effective? *The Journal of Environmental Education, 37*(2), 37–48.

Mignon, J. (2002). L'entomophagie: une question de culture? *Tropicultura, 20*, 151–156.

Oonincx, D. G. A. B., & de Boer, I. J. M. (2012). Environmental impact of the production of mealworms as a protein source for humans – a life cycle assessment. *PLoS One, 7*. http://dx.doi.org/10.1371/journal.pone.0051145.

Oonincx, D. G. A. B., Van Itterbeeck, J., Heetkamp, M. J. W., Vanden Brand, H., vanLoon, J. J. A., & van Huis, A. (2010). An exploration on greenhouse gas and ammonia production by insect species suitable for animal or human consumption. *PloS One, 5*. http://dx.doi.org/10.1371/journal.pone.0014445.

Paoletti, M. G. (2005). *Ecological implications of minilivestock: Potential of insects, rodents, frogs and snails*. Science, Enfield.

Pliner, P., & Hobden, K. (1992). Development of a scale to measure the trait of food neophobia in humans. *Appetite, 19*, 105–120.

Pyke, M. (1968). *Food and society*. London: Murray.

Ramos-Elorduy, J. (1997). Insects: a sustainable source of food? *Ecology of Food and Nutrition, 36*, 247–276.

Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological Review, 94*(1), 23–41.

Rumpold, B. A., & Schlüter, O. K. (2013). Potential and challenges of insects as an innovative source for food and feed production. *Innovative Food Science & Emerging Technologies, 17*, 1–11.

Schösler, H., de Boer, J., & Boersema, J. (2012). Can we cut meat out of the dish? Constructing consumer-oriented pathways towards meat substitution. *Appetite, 58*, 39–47.

Siegrist, M., Hartmann, C., & Keller, C. (2013). Antecedents of food neophobia and its association with eating behavior and food choices. *Food Quality and Preference, 30*, 293–298.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*, 220–247.

Vanhonacker, F., Van Loo, E. J., Gellynck, X., & Verbeke, W. (2013). Flemish consumer attitudes towards more sustainable food choices. *Appetite, 62*, 7–16.

Vantomme, D., Geuens, G., DeHouwer, J., & DePelsmacker, P. (2006). Explicit and implicit determinants of fair-trade buying behaviour. In *Advances in consumer research* (pp. 699–703). Association for Consumer Research.

Verbeke, W. (2015). Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Quality and Preference, 39*, 147–155.

Wackernagel, M., & Rees, W. (1996). *Our ecological footprint*. Gabriola Island: New Society Publishers.

Wood, J. R., & Looy, H. (2000). My ant is coming to dinner: culture, disgust, and dietary challenges. *Proteus-Shippensburg, 17*(1), 52–56.

Zent, E. L., & Simpson, B. B. (2009). The importance of traditional ecological knowledge for palm-weevil cultivation in the Venezuelan Amazon. *Journal of Ethnobiology, 29*(1), 113–128.