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Non-verbal evaluation of acceptance of insect-based products using a simple and holistic analysis of facial expressions

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ABSTRACT

The aim of our study was to assess consumers' non-verbal reactions to insect-based products and to evaluate if consumers who had never eaten insects before had flavor expectations.

To achieve our objective we used flavored potato chips presented either as "protein enriched" or as "insect protein enriched" products. Hundred consumers participated in the study according to a between-subject design. The flavors were chosen according to a pre-test survey about insect flavor expectations: strawberry and blackcurrant were selected as "incongruent" flavors, chicken and barbecue as "congruent" flavors.

The products were tasted while consumers were videotaped. An innovative coding method was used to process the non-verbal data: the duration and valence (positive or negative) of each expression as well as exploratory behavior were coded. Additionally the international positive and negative affect schedule short-form (I-PANAS-SF) was used and liking was evaluated for each product.

Just before eating the product, consumers in the insect condition showed significantly longer negative expressions than consumers in the control condition. During eating, consumers in the insect condition expressed shorter positive reactions. However chips presented as insect-based products were also associated with higher positive affect scores and no difference was found in liking. Congruent flavors generated significantly more negative expressions, higher negative affect scores and lower liking scores than incongruent flavors, but no interaction was found between these flavors and the insect information.

Consequently we can conclude that consumers reject the idea of tasting chips but seem to accept it after the first bite, indicating that western society might be willing to take a first step towards insect consumption, at least as processed food.

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1. Introduction

Emotions are central to the process of judgment and decision-making while eating (Rozin & Fallon, 1987). Emotional reactions towards products are likely to be a factor of choice more important than rational evaluation of sensory attributes (Köster, 2003; Mojet & Köster, 2005). For this reason being able to measure emotions is essential to understand consumers' choices. They can be evaluated using different measures that can be declarative, non-verbal or physiological. Among declarative methods, questionnaires have been recently adapted to the evaluation of emotions when consumers are eating (Chrea et al., 2009; King, Meiselman, & Carr, 2012; Porcherot et al., 2010), but some researchers have questioned their validity and proposed alternative methods. In order to reduce response and rationalization biases, non-verbal methods have become very popular these last ten years to measure affective reactions towards food products.

A wide diversity of methods is now available, such as the evaluation of facial expressions and/or body language (Ekman & Friesen, 1978), speech analysis (prosody) (Schuller, Rigoll, & Lang, 2004), physiological methods (e.g. electrodermal activity, pupillometry, heart beat) (Bechara, Damasio, Tranel, & Damasio, 2005), and brain imaging (e.g. electroencephalography, functional magnetic resonance imaging) (Damasio et al., 2000).

Non-verbal methods are seen as more spontaneous and less biased than declarative methods, but are harder to implement and the interpretation of the results is more difficult (Ekman, 1992). However there is a consensus on the fact that choice of a method over another depends on the aim of the study and on the context in which experiments are conducted.

In this study we investigated the possibility of measuring facial expressions when tasting food. Such approaches have been very scarcely used in food evaluation so far (Danner, Sidorkina, Joechl,

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& Duerrschmid, 2013; de Wijk, He, Mensink, Verhoeven, & de Graaf, 2014; Garcia-Burgos & Zamora, 2013; Garcia-Burgos & Zamora, 2015; He, Boesveldt, de Graaf, & de Wijk, 2016; Leitch, Duncan, O'Keefe, Rudd, & Gallagher, 2015). Yet they have practical advantages (no specific equipment required, no intervention needed during the experiment, can be implemented in a natural context, consumer can move freely). Automated tools (such as Noldus FaceReader) are available for coding facial expressions. However, they are not yet well suited for analyzing facial expressions while eating, mainly because of chewing movements. As a result, there certainly is a need to explore other methods, notably with simpler coding systems. Besides, one potential pitfall in the use of such methods is that consumers show few facial expressions when eating, which may limit their potential added-value (Danner et al., 2013; Zeinstra, Koelen, Colindres, Kok, & de Graaf, 2009). Here, we thus decided to test the method with a potentially intense stimulus for the tested population: insects as food.

As a response to the environmental impact of meat consumption, the scientific community is indeed increasingly looking at insects as a valuable and sustainable source of proteins (Belluco et al., 2013; Premalatha, Abbasi, Abbasi, & Abbasi, 2011). Entomophagy – the use of insects as human food – is thus encouraged. Insects are however unusual to western consumers and are likely to cause disgust (Rozin & Fallon, 1987; Tan, Fischer, van Trijp, & Stieger, 2016). In this study, insects were chosen as potential disgust elicitors with the aim of triggering strong and spontaneous reactions.

The aim of our study was to assess consumers' emotional and non-verbal reactions to insect-based products. In addition to this, we were eager to evaluate if consumers who had never eaten insects before had flavor expectations and, should they exist, how these flavor expectations would affect consumers' emotional reactions?

In order to test the reactions towards insect-based products we chose to use chips that were presented to the participants as products enriched with insect proteins. Chips were chosen because their crispy texture could be evocative of insects. In addition, chips can be easily flavored. This allows to compare the "insect protein-enriched" and the "protein-enriched" conditions. We flavored the products in order to get unusual flavors that would make these unusual and so-called insect-based products more credible. Because most French consumers have never tasted insects at the time of this study, we selected various types of flavors. Chicken and barbecue flavors were selected as potentially congruent flavors and strawberry and blackcurrant as potentially incongruent flavors.

Once facial expressions are recorded, they can be interpreted thanks to several coding methods. The most established methods, such as FACS or MAX (Ekman, 1978; Izard, 1979), are based on a tedious expert coding of non-verbal expressions. These methods provide very precise results while being time-consuming. In this study, we decided to test a more simple and holistic measure of facial expressions as a trade-off between accuracy and ease of use: the facial expression coding system (FACES) (Kring & Sloan, 2007). This original method has never been used in a food context before.

This method is based on the dimensional theory of emotions and uses a holistic evaluation of facial expressions, simply classifying expressions as either "positive" or "negative". FACES has been validated with emotion-eliciting video clips but has not been used in ordinary contexts (Kring & Sloan, 2007). It is worth noting that the FACES method shouldn't been confused with FACS (Ekman, 1978) that has been widely used in many fields of application, including marketing and sensory evaluation, to assess non-verbal reactions to a stimulus. Although FACS has been validated in many contexts, it requires an extremely precise and tedious expert manual coding (Donato, Bartlett, Hager, Ekman, & Sejnowski, 1999).

As a complement to dimensional non-verbal measures we decided to use the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF) (Karim, Weisz, & Rehman, 2011; Watson & Clark, 1994). We also asked participants to rate each product for their overall liking. Eventually, we measured food related personality traits according to several questionnaires (Haidt, McCauley, & Rozin, 1994; Pliner & Hobden, 1992; Van Trijp & Steenkamp, 1992).

2. Materials and methods

2.1. Design and general procedure

We used a between-subjects design to compare flavored chips presented either as "protein-enriched products" (i.e. control condition) or as "insect protein-enriched products" (referred to as the "insect" condition). Besides, we selected congruent or incongruent flavors as a secondary factor (selection of flavors is detailed in the Product section below).

Declarative measures (affective questionnaires and liking scales) were used as well as facial expression coding in order to have a wide record of participants' emotions and reactions during the whole session (Fig. 1).

2.2. Sessions

Participants attended an individual single tasting session of about fifteen minutes during which four chips were presented. Sessions were conducted between 9:00 and 18:00 in a home lab kitchen at AgroParisTech (Massy). Upon arrival, they filled in and signed a consent form for the filming of the sequence. They sat at a dining table in the kitchen and were left alone while tasting the samples. A laptop computer was installed in front of the participants in order to provide the self-administered questionnaire and to film them discretely with the front webcam. Another ceiling mounted camera was filming the participants. The combined use of these two cameras allowed both a good picture of consumers' faces while eating and a wider view of their movements during the session.

While being filmed, the participants were informed upon arrival that they were about to eat either "insect protein enriched chips" or "protein enriched chips" depending on the group they were assigned to. The information was given at the very last moment when the cameras were already recording (when they sat and were ready to start the experiment) in order to ensure we could capture the most spontaneous reactions.

The first product was then brought to the participants. They were told to eat as much as they liked, and to take their time before answering a few questions on a laptop computer. They then had to call the experimenter to get the next product.

After tasting each product, participants were asked to rate their feelings using an I-PANAS-SF questionnaire with a deliberately generic sentence ("indicate to what extent you feel this way right now") (Karim et al., 2011; Kuesten, Chopra, Bi, & Meiselman, 2014; Thompson, 2007; Watson, 1994; Watson, Clark, & Tellegen, 1988) as well as their liking for the products using a 9-point hedonic scale. The questionnaires were self-administered on the laptop computer.

At the end of the session, participants were asked to fill additional questionnaires about food neophobia (Pliner & Hobden, 1992), variety seeking behavior (Van Trijp & Steenkamp, 1992) and disgust sensitivity (Haidt et al., 1994; Olatunji et al., 2007).

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