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The insectivore's dilemma, and how to take the West out of it

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ABSTRACT

A number of health and agricultural organizations have been encouraging Westerners to integrate insects into their diet, without success. Appealing to consumer's reason and responsibility, as they do, is likely to reinforce a dilemma in the mind of consumers: many know that they can, in principle, eat insects, and perhaps that they should eat some, but very few are willing to eat them. Here we argue that current strategies are on the wrong track in identifying the key obstacle to overcome as a question of the negative representation of insects. Decades of laboratory research, as well as years of experience in gastronomy, suggest that people's food choices are relatively immune to rational changes of representation, and instead tend to be driven by taste preferences and exposure. Here we suggest an alternative sensorially-driven strategy, which stands a much greater chance of making people eat insects on a regular basis. The turn – or better said return – to entomophagy in this sense, needs to be driven by a psychologically realistic motivation and gastronomic interest.

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"The concept of what is not acceptable as food in English culture is well conveyed by the schoolboy's question "What is worse that finding a maggot in your apple?" – "Finding half a maggot.""

[(Holt, 1885/1992, Why not eat insects?, p. 6).]

'The boy held up his scorpion to show the room, but stopped short of putting it in his mouth – 'How do I eat it? Do I eat the sting?' The girl took a small bite of hers. 'What does it taste like?' her hosts wanted to know – 'Nothing I have ever tried'. She ate the rest. Then the boy bit into his. 'What does it taste like?' everyone asked – 'Chicken'."

[(Loo & Sellbach, 2013, p. 23).]

1. Introduction

In 2010, a widely cited document published by the United Nations' Food and Agriculture Organization stressed "*the exceptional nutritional benefits of many forest insects, and* (...) *the potential to produce insects for food with far fewer negative environmental impacts than for many mainstream foods consumed today*". Stronger claims have been voiced since, for instance stressing that eating insects might be "the last great hope to save the planet" (Martin, 2014). Yet, except as a challenge to the minor celebrities in some popular TV shows[1] or as a subject for the media to get their teeth into,[2] the eating of insects has not, as yet, gained a wider audience in the Western world. The UN report, quoted by many newspapers, seems to have failed to convince us "*that the insects are safe and attractive for human consumption*" (see Durst, Johnson, Leslie, & Shono, 2012, p. iii). Not mentioning the safety issue, the sore point is obviously the attractiveness of insects, or rather their lack of attractiveness. This is one of the key problems that UN officials currently do not appear to have an adequate solution for.

Their principle strategy at the moment seems to be to stress both the environmental and nutritional benefits that could convince Westerners to start integrating insects into their diet. This ambition is carried by the press, still without much sign of success. While the BBC's website pedagogically stresses that the 'UN urges people to eat insects to fight world hunger',[3] El Mundo[4] declares insects "the food of the future" and Le Monde sees the worm-quiche as the new meat.[5] The title of a recent piece in *The Observer* tried to make the consumption of insects an unavoidable rational choice by noting that 'Of course, we don't want to eat insects, but can we afford not to?'.[6] The failure of these strategies, we argue here, is predictable: simply stressing the sustainability and nutritional value of insects as a source of food (see, for instance, Table 1) is unlikely to provide sufficient motivation to drive through a change in diet. Decades of research have repeatedly shown that changing people's *existing* food choices by means of rational discourse normally fails: how, then, could encouraging *new* choices by means of rational discourse alone be expected to work?

Table 1
Protein content of common insects from dry weight basis (from Ramos-Elorduy, 1998).

Common English name	Protein percentage
Leafhoppers	56.22
Yellow mealworm beetle larvae	47.76
House fly larvae	54.17
House fly pupae	61.54
Damer larvae	56.22
June beetle larvae	42.62
Agave billbug larvae	55.56
Honey bee larvae	41.68
Water boatmen and backswimmer eggs	49.30
Water boatmen adults	63.80
Stink bugs	53.80
Leafcutting ants	44.10
Paper wasp pupae	58.30
Red-legged locusts	57.93
Corn earworms	75.30
White agave worms	41.98
Red agave worms	30.28–51.00
Treehoppers	44.84–59.57

More humane strategies based on exemplarity are also likely to fail. Highlighting the fact that insects are eaten in many countries across the world is one of the arguments that will often be heard when any discussion of entomophagy occurs. If *they* do it, why not us? But once again, this strategy is unlikely to make consumers eager to adopt a whole new category of food into their own diet. Food is a domain in which people – including those from the same culture or region – are inclined to be relativists: that insects are to some people's taste does not mean that others should necessarily eat them. As somewhat hidden by recent books stressing the omnivorous nature of humans (e.g., Allen, 2012; Pollan, 2006), food choices are deeply varied and culturally-determined. Even within the same country, ethnic groups divide on the issue of whether or not they consider insects as a food source, thus suggesting that there is indeed no such thing as a simple 'entomophagist' diet across the vast array of non-Western countries.

The most promising strategy, as we want to argue here, is not to resort to arguments or examples from other cultures: it is to make Westerners enjoy the eating of insects. Humans want pleasurable dishes to eat, to share, and increasingly to talk about and photograph.[7] The main problem that needs to be addressed regarding insects is simple to state: how can we make insects pleasurable to eat, or rather how can we make Westerners realize just how pleasurable they *can be* to eat?

Addressing this problem, however, is not so simple, and will require a combination of different kinds of expertise. Our intention here is at least to cross three different perspectives in the human, culinary, and experimental sciences. The motivation comes from the observation that, of the few studies to have looked at Western attitudes toward eating insects, most miss the point of entomophagy by looking at raw or exotic insects, which are likely

[1] In the bushtucker trial that formed a part of the TV show 'I'm a celebrity get me out of here', contestants are challenged to eat various insects such as crickets, green ants, mealworms, witchetty grubs, roasted spiders or tarantulas, and cockroaches (with the insects being prepared in various ways such as cooked into biscuits, blended into drinks, eaten alive or dead). Besides insects, these trials also include eating parts of the body considered as 'taboo', such as the brains, eyes, genitalia, tongues or tails of various animals. According to the ITV website, this part of the show is the one that generates the greatest number of viewer responses (from http://en.wikipedia.org/wiki/I'm_a_Celebrity...Get_Me_Out_of_Here!_(UK_TV_series)#Bush_Tucker_trial). Although, ironically, the witchetty grubs had to be taken off the menu last year as there was a nationwide shortage of the grub due to bad weather (see Smith, 2013).

[2] See the press coverage of the UN report above (e.g., in El Mundo, Le Monde, The Guardian and all the main European Newspapers) and of the 'ants with cabbage and crème fraiche' served by Noma chefs during their visit to London in 2012 (e.g., in Bloomberg, http://www.bloomberg.com/news/2012-07-30/london-cocktail-marathon-awaits-olympics-drinkers-review.html; The Independent http://www.independent.co.uk/life-style/food-and-drink/news/worlds-best-restaurant-comes-to-town-and-its-serving-ants-7995007.html; The Telegraph, http://www.telegraph.co.uk/foodanddrink/restaurants/9458708/A-taste-of-Noma-at-Claridges-London-restaurant-review.html or The Financial Times http://www.ft.com/cms/s/2/4874fc62-cbb7-11e1-911e-00144feabdc0.html#axzz36JdzdP23).

[3] http://www.bbc.co.uk/news/world-22508439.

[4] http://www.elmundo.es/economia/2014/07/10/53be5ab1268e3e60638b4574.html.

[5] http://www.lemonde.fr/planete/article/2011/01/20/la-quiche-aux-vers-une-alternative-a-la-viande_1467974_3244.html. Only Die Welt agreed that insects could not so easily be the 'new meat' (http://www.welt.de/wissenschaft/article106139107/Warum-Insekten-nicht-unser-neues-Fleisch-werden.html).

[6] http://www.theguardian.com/lifeandstyle/2013/mar/02/europeans-eat-insects.

[7] http://www.telegraph.co.uk/foodanddrink/9828766/Eat-and-then-tweet-the-modern-way-to-dine-out-thats-driving-chefs-to-distraction.html.

to be considered as disgusting or unfamiliar, instead of looking at the potential of attractive dishes cooked with well-known clean forest insects. Most of the insects eaten in the world are picked up locally and added to complex or interesting preparations, which make them a true competitor to other food choices, and often a more attractive choice to eat than the other available options. Insects are not eaten out of necessity, but for their desirable taste properties: this obvious fact is seemingly missed by most of the current research and policies.

This ignorance leads to what we call the "insectivores' dilemma": we are told that we should be reasonable and eat insects (Section 1) while the options we are presented with are simply not appealing at all, and are even appalling to most of the populace (Section 2). Trying to put more weight on the first branch, we argue, is unlikely to succeed. The best strategy here may well be to make the second branch of the dilemma disappear, and with it, to get rid of the inner conflict that food institutions cultivate in us. The first argument is to show that Westerners' attitudes toward eating insects should not so quickly be classified as exemplifying a form of disgust. They may be better classified as representing a form of acquired distaste, grounded in a lack of exposure not only to the taste or flavor of insects, but also to the visual, tactile, olfactory and even auditory, properties of edible insects (Section 3). If we can identify elements that would make an insect-based food more acceptable, or appealing even, to neophobic and neophilic consumers alike, there would be a way out of our current dilemma (Section 4). This strategy would also deliver a better understanding of the anthropology, psychology and governance of our food choices (Section 5).

2. The first branch of the dilemma: "Thou shall eat insects"

It is obvious that attitudes toward eating insects are *culturally relative*. What is less evident, though, is the interpretation given of this relativity: insects are eaten and even valued as delicacies in many cultures and countries. Grasshoppers, witchetty grubs, locusts, dung beetles, bamboo borers, weaver ants, honeybees (including the brood, eggs, larvae, and pupae), wasps, termites, crickets, and cicadas are among the most popular of the many edible species. Entomophagy (from *entomos*, insect and *phagein*, to eat) is currently practiced by numerous ethnic groups in South and East Asia as well as many African, South and Central American countries. What is more, there is evidence that it has played a continuous part in the diet since the time of the early hominids. How come, then, that the very idea of eating an insect, even during an exotic trip, fills the majority of Westerners and members of other ethnic groups with a sense of revulsion? Many researchers have been encouraged to consider that the culturally relative rejection of entomophagy must involve some cognitive component: instead of being a basic physiological reaction driven by the mere physical presentation of an object, the revulsion toward eating insects occurs if the object is represented in a negative way, or as a source of risk within a certain cultural group (e.g., Rozin & Fallon, 1987; Tybur, Lieberman, Kurzban, & DeScioli, 2013).

This scientific interpretation has a wider effect on food policies: if the refusal to eat insects comes from a certain cultural representation of insects as bad, risky, etc., it seems sufficient to change people's representations of entomophagy in order to make them eat insects. Changing a representation can then be achieved through pedagogy and public lectures, such as those given by Marcel Dicke, who was awarded the NWO-Spinoza award (the Dutch equivalent of the Nobel prize) for his own public engagement work in this area.

In recent years, public engagement in favor of the consumption of insects has put forward several kinds of arguments, ranging from the economic through to the fact that we need to be more 'world-conscious'. The idea here is that insects can be mass-produced in a sustainable manner, and can be much cheaper to produce than meat and fish. At a time when numerous scandals and sanitary crises all point to the dangers of current farming and the industrial practices that lie behind many of our large-scale supplies of meat,[8] it is said to be irrational not to turn to a seemingly healthier source of protein and fats in insects. In the absence of many studies on large scale insect-faming, the ecological and economical argument are made rather in the abstract, based on the fact that insects present a much better input:protein-output ratio than do cows or other farmed animals. These arguments are reinforced by the prediction that meat prices are likely to rise by 18–26% between now and 2025, and that insect farming will necessarily emerge as a cheaper option.

These arguments are, though, problematic: for instance, who really knows whether the factory farming of insects might not, in due course, introduce its own environmental problems? Most mass produced insects are raised in heated rooms and then freeze dried, and so actually end up being massively energy consuming. In other words, the feed conversion rate should not be confused with questions of sustainability (see Oonincx et al., 2010 for an illustration). More to the point, many of the sustainability arguments miss the richness of the cultural practices surrounding the consumption of insects, noticeably the fact that most of the insects eaten in the world today are not farmed, but harvested in the wild, or else actively managed by the communities in which they are consumed (Bharucha & Pretty, 2010). People do not simply buy insects in a shop, but tend to go out and pick them up (or catch them) in the forest, or acquire them from someone they know (e.g., Obopile & Seeletso, 2013).

The arguments have also had limited success, as stressed by Loo and Sellbach's pessimistic verdict (2013, p. 25): "the argument that insects are a good source of protein has had limited success in terms of shifting public attitudes and can end up intensifying, rather than diminishing, disgust." The idea of large insect farms, for instance, might scare people more than reassure them. The impact of public engagement for this specific domain should at least be tested empirically before we start to invest too heavily in it (see Pitt & Shockley, 2014, for similar worries concerning entomology outreach events in general). The answer to the question of whether such educational programmes are necessary, useless, or somewhat useful, is actually rather difficult to establish. What we doubt is whether these programmes will ever in-and-of-themselves prove to be sufficient in such a sensitive food domain.

These doubts are substantiated by the fact that labels and rational instructions have been shown to be insufficient to change people's behaviors, for instance, to make consumers eat less salt, less fat, or foods containing less sugar (see Drichoutis, Lazaridis, & Nayga, 2006; Hieke & Taylor, 2012; Winkler, 2014, for recent reviews). As Rotfeld puts it, verbal information presented alongside food products only becomes useful if it relies on a background motivation to use it, and if it resonates with some pre-existing nutritional knowledge: "Labels can help some people sometimes in some cases, if they have the knowledge or motivation to use the information, which may or may not be in a format they can understand" (Rotfeld, 2009, p. 375). Both the motivation and the background education might be absent when it comes to the consumption of insects. In one of the few fMRI studies to indirectly cast light on insect eating behavior, it has been shown that a willingness to eat insect in Westerners might not come with a durable disappearance of aversion: Western participants in this study were asked to imagine themselves belonging to the Nochami tribe, who,

[8] See http://www.oecd.org/site/oecd-faoagriculturaloutlook/48184304.pdf.

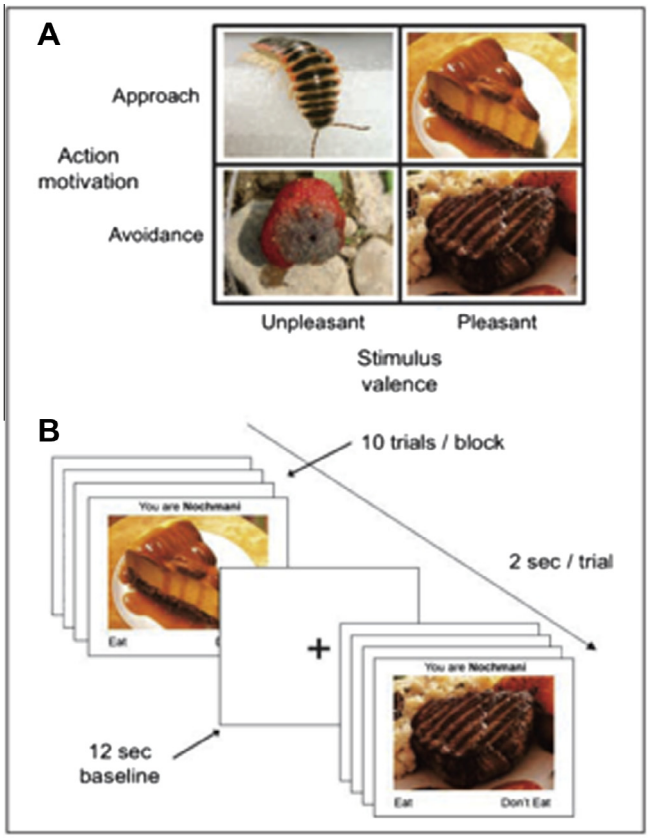

Fig. 1. Design used in one of the few fMRI studies looking at insect eating behavior. Participants were asked to imagine themselves belonging to a group who disliked meat but liked insects. The study revealed a distinction between the valence of the stimuli (insects remained unpleasant for Westerners, and meat remained pleasant) and the motivation to eat (Westerners would choose to approach insects and avoid meat). (Reproduced from Berkman & Lieberman, 2010.)

as they were told, disliked meat but liked insects (see Berkman & Lieberman, 2010, and Fig. 1). This study revealed a distinction between the valence of the stimuli (insects remained unpleasant for Westerners, and meat remained pleasant) and the motivation to eat (when acting as a member of the Nochami tribe, Westerners would choose to approach insects and avoid meat).

Before educational programmes can work, it is therefore essential to create the right conditions in which consumers can develop a genuine appeal for insects as a food.[9] Creating these conditions might even encourage a switch (or nudge) that does not necessarily require an explicit re-orientation of attitudes, beliefs, and behaviors. Using perceptual cues to guide choices in context instead of formulating explicit rules has certainly been shown to be a successful strategy in numerous other domains (e.g., Marteau, Hollands, & Fletcher, 2012; Thaler & Sunstein, 2008) and can be adapted to the consumption of insects.

3. The second branch of the dilemma: "Insects are disgusting"

The skepticism toward the success of rational approaches does not just come from the lack of background motivation or knowledge that they could resonate with. It is not just that the audience is not receptive, but that it is even repulsed by the very idea of eating insects. The mere evocation of the eating of insects can cause a strongly affectively-laden reaction, often made manifest by a disgusted face: the upper lip raises, the nose wrinkles, and the mouth opens in a gape like fashion (Ekman, 1993). Does this frequent reaction teach us something important about insects? Is there something deeply rooted in our psychology which makes them an object of disgust? This, at least, would seem to be the dominant interpretation that the majority of researchers have come up with to try and explain the reluctance of Westerners to eating insects. What is less clear is what hinges on this attitude toward entomophagy being classified as a form of disgust rather than another form of food rejection. With disgust attitudes being studied in ever greater depth over the last few decades, we want to argue that the diagnosis is not neutral: it leads to a biased way of looking at correctives, and ultimately reinforces the dilemma rather than helping to trace a pathway out of it.

To consider the attitude toward insects as a case of disgust means that it is distinguished from a mere distaste. Distaste, noticeably our innate distaste for bitter foods, is supposed to protect us from toxic foods by making us actively reject them and 'spit them out'. A disgusting food can also be rejected, but the function of disgust is less clear, and still a matter of controversy (Kelly, 2011; Tybur et al., 2013). However, broadly-speaking, disgust would seem to have evolved to help the organism or group to minimize the risk of infection and contamination. This function explains why disgust differs from a mere automatic reaction like distaste: whereas toxic compounds can be relatively well identified through some of their sensory characteristics (for instance, bitterness), factors of infection or contamination present a wide variety of sensory profiles. Identifying potential factors of infection requires a cognitive assessment of risk rather than merely the detection of certain specific sensory properties.

What kind of assessment is supposed to be at stake, then, when it comes to eating insects? The answer to this question is not always clear from the literature, as very few studies have considered this specific case, focusing instead on disgust in general. Insects have usually been included together with faeces, vomit, and rotten food, as generating a form of 'core disgust' while injuries, blood, and bodily deformities lead to another variety of disgust encompassed under the header of 'body violation disgust'. Finally, events and actions that lead to social and moral transgressions (such as crimes and sacrilegious acts) are thought to lead to 'moral disgust'.[10] Although they present some neurological and subjective overlaps, these various forms of disgust have been shown to present some important physiological and neurological differences as well: for instance, core disgust activates the ventral anterior region of the insula more strongly, whereas body violation disgust activates a more dorsal mid-insular area instead (see Harrison, Gray, Gianaros, & Critchley, 2010).

These three kinds of activation encourage the view that the differences between different forms of disgust originate from the specific aspect of the threat which is being assessed in each case: core disgust occurs when something is represented as a vector of dirt and disease, body violation disgust when something is considered as a threat to the integrity of the body, while moral disgust comes with the representation of something, or someone, being considered as a threat to the moral or social order.

To be right about eating insects falling under the header of core disgust, it would then mean that this practice would be considered as a source of disease by Westerners. But do we know this to be the case? To date, several studies have shown that Westerners tend to consider insects, and invertebrates in general, as vectors of disease

[9] The Food Insect Newsletter represents a good example of this enterprise: see http://www.foodinsectsnewsletter.org/; see also http://www.mangeons-des-insectes.com/blog/entomophagie-blog.

[10] Some authors have also raised the possibility of an aesthetic disgust that may be generated by certain kinds of artistic objects and performance. However, at least as far as we are aware, this category has not been investigated empirically (Korsmeyer, 2011).

(e.g., Curtis & Biran, 2001; Davey et al., 1998; Prokop, Usak, & Fančovičová, 2010) but the set of insects considered and the methods that have been adopted mean that the evidence on this point remains weak. Here it is worth noting that few neuroscientific studies interested in disgust have involved any actual insects being put into the mouths of the participants (not to mention bitten, chewed, and ultimately swallowed). Most of the studies that have been published to date have simply measured the disgust that is generated by viewing static pictures or films of insects.[11]

One of the studies most directly relevant to any consideration of the Western aversion to the consumption of insects comes from a famous experiment carried out by Rozin, Millman, and Nemeroff back in (1986). This article, which has been quoted hundreds of times, is now something of a textbook classic. Paul Rozin, it should be said, pioneered the distinction between mere distaste reactions and disgust, and was interested in understanding disgust in general, rather than the attitude toward the consumption of insects in particular (see Tybur et al., 2013, for a recent discussion).

In their study, Rozin and his colleagues explored what they called 'the laws of sympathetic magic' that are supposed to govern human disgust in general. One of them is known as the 'law of contamination' after the work conducted by anthropologists Sir James Frazer (1890) and Marcel Mauss (1902) on traditional cultures. It predicts that disgust reactions will not only occur for disgusting objects but also for those objects that have been in contact with the primary object of disgust. The reason why this psychological law is said to constitute a piece of 'magical thinking' is that it remains true even if the contact event occurred sometime in the distant past, or if all the effects of the initial contact are known to have been erased. In this sense, disgust leads one to be irrational, that is, to reject something as contaminating or dangerous even once they know that it is no longer contaminating or dangerous. For instance, a shirt once worn by a mass murderer will be considered appalling even if it has been washed or worn by others since (e.g., Gallace & Spence, 2014; Hood, Gjersoe, Donnelly, Byers, & Itajkura, 2011).[12] If the law of contamination is a key constituent of disgust, and if insects are indeed an object of disgust, the prediction is that eating insects follows this law: foods that have been in contact with insects, which are seen as negative, will remain disgusting even if the effects of the contact have been erased.

Rozin et al. (1986) confirmed this hypothesis in a two-step study. Because of its impact on the subsequent thinking about insects by academics and policy makers alike, it is important to examine it in detail. First, Rozin et al. presented 50 students with a glass of apple juice and a glass of grape juice. The students had to indicate how much they liked each of the drinks. After the students had given their preference ratings, the experimenter removed a paper towel covering a tray, exposing a dead cockroach in a small plastic cup. The experimenter then explained that the cockroach had been sterilized and was perfectly safe, before dropping it into one of the two glasses, using a pair of forceps. The participants were asked to count the insect's legs (to make sure that they were paying attention to the proceedings). After 5 s, the insect was removed from the glass, using a clean spoon. The operation was repeated for the other glass, say the grape juice glass if the apple juice had been used first. Using a new pair of forceps, the experimenter then dropped a birthday candleholder into the glass and once again removed it after 5 s. The participants had to repeat the evaluation of the two glasses by sipping the juices. The results revealed a dramatic effect of the actual contact between the fruit juice and the sterilized insect, whereas no such effect was observed with the candleholder. The effects of contagion were thus confirmed.

Rozin and his colleagues hypothesized that the disgust felt toward eating insects, or anything related to them, was strong enough to follow a second law of sympathetic magic, namely, the law of similarity. According to the law of similarity, positive or negative attitudes toward certain substances extend to those items that look similar, even if this similarity is known to be irrelevant or shallow. In order to test this hypothesis, after the two glasses which had been in contact with the insect and the candleholder were removed, two fresh glasses of apple and grape juice were poured from the containers in front of the participant. The evaluation procedure was repeated once again. The effects noted in the first phase extended to a certain extent to the new drinks poured afterwards ('the conditioning phase'), highlighting a small drop in the evaluation of the fruit juice that had been used in the previous phase with the insect (albeit with very important individual differences showing that the law of similarity was not so strong).

The importance of Rozin's study should not be underestimated. On the one hand, it is one of the few experimental designs to have looked into the reluctance of Westerners toward the consumption of insects. On the other, it has a wide impact in classifying this reluctance as a form of disgust, driven in part by an inherently cognitive component, and in part by feelings following irrational, magical laws.

This twofold conclusion seems to have spread, and explains our current dilemma: if people's reluctance to eat insect is mostly cognitive, it would seem that policies should try and change them through rational argument. However, if researchers are right, and if the reluctance to eat insects is a form of disgust, then it is largely immune to reason and a rational strategy is predicted to fail.

4. Changing our research categories before changing the attitudes of consumers

As has just been shown, the idea that people's attitudes toward insect consumption is cognitive and comes down to a case of irrational disgust is at the core of what we see as our contemporary insectivore's dilemma. Either we believe that this idea is right, and we should give up on the hope of changing people's attitudes, or if we want to stick to this hope, we need a radical revision of our strategies. This is this second branch that we wish to recommend here.

4.1. Do we really think that insects are disgusting?

A first step is to challenge the idea that people's reluctance to eat insects is necessarily a case of cognitive and non-rational disgust.

In favor of their conclusion, Rozin and his colleagues stressed that the participants in their study recognized that their reactions were irrational. Despite the knowledge that the cockroach constituted no threat of microbial contamination whatsoever, they still felt different toward the juice into which the cockroach had been dropped. Notice though that this is not as irrational as it might at first seem, since sterilization presumably removes microbial but not necessarily chemical contamination. Regardless of its sterility, the cockroach could still leak 'bug juice', which would give a different taste to the solution. Another possibility, and one that should be minimized when it comes to social experiments, is that participants complied with the experimenter's expectations, and felt that the rejection was exactly what the experimenters were hoping for (e.g., Rosenthal, 1964, 1966, 1967).

The irrationality conclusion might have been reached too quickly, and so, in turn, the claim that there is a transitive chain

[11] See Spence (2011) for evidence that such an approach can be limited.

[12] This law has also been tested in domains other that disgust: it can reduce attraction (a product that has been touched by someone else will be considered as less attractive than one which has not been touched by another consumer, see Argo, Dahl, & Morales, 2006) or increase it. Note that a shirt once worn by Elvis Presley, or a glove worn by Padre Pio remain attractive, even if it they have been washed several times since (see Gallace & Spence, 2014).

or causal magic in people's attitudes. Assuming this magical thinking means that people believe that the kinds of dirty foods that the animals they eat have themselves eaten could somewhat contaminate them. Why would this not generalize to other animals? After all, nowadays Westerners are so keen to eat lobster and other seafood which basically feed on dirt – or have no problem eating pigs who typically eat slops. What's more, many insects – like grasshopper and ants – essentially eat the same diet as sheep. Beliefs about causal magic seem not to be at the core of Westerners' horror at the very idea of eating an insect.

More than an excessively quick conclusion to irrationality, it is the generalization of the conclusion to all kinds of insects which needs to be challenged.[13] Different results would presumably have been observed had a bee, a wasp, a midge, a weaver ant, or a cricket been dropped into the glass instead: just think of how, in the summer, such insects are often taken out of the glasses into which they have fallen, and the drinks themselves are often still consumed without a thought. Another example is the attraction for tequila bottles containing 'worms' (in fact, lepidopera larvae): people tend to assume that the practice of keeping a worm in the bottle belongs to a long tradition, and characterizes the best tequila, when this trend was in reality introduced in the 1960's to amuse Western tourists (Cedeño, 1995).

4.2. Understanding the folk-category of insects

One limit of much of the research that is conducted currently comes from the kinds of insects that are typically considered. Insects such as cockroaches or flies constitute only a small subset of people's folk category of insects, and a proper investigation should start with a better understanding of this folk entomology. Insects like cockroaches are seen as the most repulsive, and yet, in reality, they are only vectors of bacterial disease because of their contact with other contaminated objects (such as flies on faeces or vomit). The insects which most directly constitute threats as potential vectors of viral disease, such as mosquitos, are, by contrast, not always treated as being especially repulsive. Many other species are also commonly assimilated to insects, and rejected on other grounds than contamination: in most human societies, the folk category of 'insects' extends to organisms other than those of the Linnaean class Insecta, such as spiders, lizards, scorpions, or even bats, snakes, toads, and slugs (e.g., Costa-Neto, 2000; Posey, 1984; see also Shepardson, 2002, on children's conception of insects and Table 2). This inclusion brings additional layers to the rejection of insects, broadly understood: spiders, for instance, are listed as one of the top five most feared animals in the UK, although British species are generally neither venomous nor harmful (Davey, 1994). Many insects, such as maggots, are sources of repulsion because of their association with death or bodily violation, as they can sometimes be seen in contact with dead bodies and wounds, while others are considered as socially inappropriate, being a sign of a lack of personal hygiene, self-respect, or otherwise indicative of a 'bad life' (such as louses, bedbugs, or, in a sense, also cockroaches).

4.3. Avoiding unwanted associations

The folk-category of insects provides us with an important lesson: the negative representations of insects currently seen in the Western world do not specifically target the oral consumption of insects. Rather they apply to the mere presence and visual appearance of certain insects, or even come from some visual associations made with them. A good explanation of the rejection of insects as foods can be found in what we call the 'environmental confound': as stressed above, many insects used in experiments or mentioned by the press are insects which are represented as living in dirty urban environments or as being in contact with dirty or dangerous substances (flies), or invertebrates assimilated to insects and considered as being dangerous (such as scorpions and spiders). The role of visual similarities and imagination here is crucial to understand the reactions of Westerners, and misses the point: the refusal to eat such creatures would, or so we would like to argue here, extend beyond the realm of insects and be true of any mammal that was *known* or imagined to live in the same place (take pigeons or squirrels) or to be as dangerous. In the same way, nobody would eat a piece of their favorite chocolate if they believed that it had just been dropped in the bin, or an unknown red berry if they knew that the poison had been taken out of it.

What's more, the focus on those insects that one imagines to be in contact with dirty environments or those insects having negative connotations misses out on many of the insects. Insects are not necessarily objects of disgust, and some come with positive, or at the very least neutral, representations in Western cultures – for instance, ants, bees, butterflies, and ladybirds.[14] More importantly, Westerners do not mind eating those foods that come from – at least some – insects, given their affection for honey, propolin, Royal jelly, and other bee-related products.[15]

The prediction that eating ants and grasshoppers should generate less of a negative reaction from Westerners has been confirmed by a recent survey by Rozin, Ruby, and Chan (submitted), and extends to Indian consumers as well. In this sense, the refusal to eat insects should be seen as driven not just by negative cultural representations but principally by an acquired distaste, made of an aversion to (imagined) novel sensory properties.

Table 2
Extension of children's understanding of the category of insects. A core aspect of the insectivore's dilemma comes from Westerner having folk-category of insects, which stresses visual similarities in shape and size and therefore extends to scorpio, spiders, etc.

Grade level	Themes of children's explanations about instances
Kindergarten	Small, shaped like a bug, legs, some have antenna
First grade	Small, bug shaped, legs, some have antenna, fly
Second grade	Small, two body parts, eyes, legs, wings, some have antenna, crawl, hop, fly
Third grade	Smalls, lots of legs, wings, some fly, hop, crawl, 6 legs, 3 body parts, antenna, eat leaves, flowers, live on/in ground
Fourth grade	Small, legs, leap, hop, fly, 3 body parts, 6 legs, antenna, some with wings, suck blood, eat flowers, bite people, pincher moth, found in woods, grass and on ground
Fifth grade	6 legs, antenna, 3 body parts, some have wings, hard covering (exoskeleton), eat blood, flowers and garbage

5. A better understanding of the Western attitudes toward entomophagy

5.1. Not all aspects of insects are repulsive

An important difference between insects and other objects of core disgust to which insects have been associated (i.e., faeces, rotten foods, and vomit) seems to have been missed by the majority of researchers. Arguably, all of the sensory properties or manifestations of disgusting objects elicit a disgust reaction: that is,

[13] This generalization was encouraged by further interpretations of the study conducted by Paul Rozin and his colleagues, although they did not directly intend it.

[14] The latter two turn out not to be all that tasty after all, but the others are.

[15] Whereas the success of honey might come from its sweetness, some bee-related products like Propolin cannot owe their success to their sweetness. Even if some insects taste sweet or are incorporated into sweet preparations, the 'reinforcement' of sweetness does not seem to work as well as in other cases.

seeing, smelling, touching, and tasting vomit are, for example, all disgusting, as is hearing the sound of someone else retch. Seeing an ant, by contrast, is not disgusting, nor is smelling it, but eating it would still be judged as revolting to many of us. The sight of some insects can actually be neutral if not agreeable (think of a bee, a butterfly) while tasting them is most certainly not. One core aspect of the revulsion that many Westerners feel toward insects seems, therefore, to be targeting not all their sensory properties but the fact of eating them.

Most researchers have simply not looked at the complex interaction between this reluctance to taste or eat insects and visual expectations. They simply accept that if an insect is disgusting, then it is disgusting all the way from the way it looks through to the way that it might taste. One prediction here is that something that looks like an insect and yet is known to taste good would still be an object of disgust (a prediction verified with faeces-shaped chocolates[16]). In a study nuancing this claim, social psychologist Chris Hsee has shown that the look of a cockroach-shaped chocolate does not deter people from choosing it against a better-looking, but smaller, chocolate (Hsee, 1999): those consumers who were offered a choice of two chocolates as a reward, a 0.5 oz heart-shaped chocolate which was priced at 50 p and a 2 oz chocolate, in the shape of a cockroach priced at 2 dollars, would more often choose the latter option. 68% of the 141 participants who took part in this study said that they would choose the insect-shaped chocolate as their lottery prize, although only 46% of them said they would like it more than the other. Although Hsee was interested in challenging utilitarian claims about people's choices, and not insect-eating *per se*, the results of his study suggest that the disgusting look of an insect might not mean that people will refuse to eat it, if the expected taste reward is suitably high.

5.2. From hard-wired to acquired distaste

Another misleading inference which leads to a possible misinterpretation of the Westerners' repulsion toward insect consumption as an example of disgust comes from the fact that insects obviously do not fall into the more basic form of food rejection, which is considered as a hard-wired distaste. Distaste has been defined as "a form of motivated food rejection triggered by the ingestion of unpleasant-tasting substances, prototypically those that are bitter" (Chapman & Anderson, 2012, p. 62). As distaste is observed in neonates (Berridge, 2000; Morris, 1967; Steiner, 1973; Steiner, Glaser, Hawilo, & Berridge, 2001) as well as in many non-human species (Grill & Norgren, 1978), it is considered to be a hard-wired reaction. The function of distaste is clearly to avoid the ingestion of potential toxins. Most toxic compounds can be detected via some characteristic bitter sensation thanks to the bitter receptors that we have evolved (Garcia, Hankins, Denton, & Coghlan, 1975). This detection leads to a characteristic behavioural response (ejection) and to a facial expression evoking oral rejection (tongue protrusion, frowning face, inverted mouth shape) at least in neonates.

Now, obviously there is no hard-wired distaste reaction for the taste or flavor of insects: the revulsion felt by a section of the population is not shared by the rest, and must have evolved out of a general initial *taste for insects*. Our remote ancestors, whose diet must have been similar here to the diet of other primates, probably consumed insects on a regular basis (see Raubenheimer & Rothman, 2013; Van Itterbeeck & van Huis, 2012). Furthermore, Westerners already eat a certain amount of insect matter in other food products, although often without realizing it: the attractive food-coloring cochineal, for example, initially came from crushed insect matter (Wilson 2009); meanwhile, many sweets, chewing-gums, and jelly-beans are covered with a shiny substance made of shellac, a resin produced in South East Asia by lac insects, 25% of which is composed of "insect debris" and other impurities collected with the resin. It has been estimated that around 300,000 insects are killed for every kilogram collected. Most importantly, insects are an inevitable presence in the grains, fruits, and vegetables that compose the Western diet, and this presence is fully recognized and authorized by Food Standards. For instance, the American Food and Drugs Agency (FDA) authorizes peanut butter to have 30 insect fragments per 100 g.[17] Importantly, Rozin et al. (submitted) also found that between 55% and 70% of Americans were ready to accept 0.1% or more of insect flour in a cookie or their favorite food.

One question then is why the repulsion that many Westerners feel toward insects could not be classified as a form of acquired sensory distaste, or rather of multisensory-driven distaste.

As stressed earlier, the usual inference made by researchers is that the cultural relativity of revulsion has to come from a cultural *representation*. The intellectualist interpretation certainly owes much to the fact that the first researchers to look at insect consumption, or to inspire psychological research, were anthropologists fascinated by food taboos. What was seen as interesting was the power of conceptual and cultural representations to influence behavior: although this is certainly a very important component of the problem, we would argue that it is not the main one, and certainly not one that we can – or should – act on.

The first thing to stress here is that the cultural relativity of a certain behavior is perfectly compatible with its being sensorially-grounded: after all, turning to the enjoyment of food, we also find some innate, universal attraction for sweetness and many culturally-specific attractions driven both by exposure and cultural standards. As much as there can be acquired taste, there can also be acquired distaste. A combination of lack of exposure and cultural components related to the consumption of insects in various food contexts can perhaps explain why it is that this acquired distaste for insects develops when it does. It also opens up new ways of bringing a multisensory appeal to insects.

6. Changing acquired distaste

If the hypothesis that we are forwarding here turns out to be correct, and if the revulsion felt toward insects really is a form of acquired distaste, then the way to introduce insects into the Western diet will likely come from sensory, rather than rational, strategies. We should also not necessarily adopt a conservative strategy, based on what people think they like (e.g., Rozin et al. submitted), but test new ways to make people change their mind. The challenge, as we see it, is to find ways to prepare insects so that they are appealing as foods to today's Western consumers. In today's consumption society, this appeal will necessarily need to compete with other appealing foods. As stressed by Harris (1999), the reluctance to eat insects in many modern societies is partly explained by the availability of other nutritious foods such as meat, which has become more appealing.

Our contention is that making forgotten or lesser-known foods into realistic food sources will be best met if researchers team up with chefs and experts in gastronomic science. Several culinary research teams have already started to tackle the challenge, and introduce insects on to their menu. The Noma chefs 'popped up' at Claridge's hotel in London while the UK was hosting the 2012

[16] See for instance the real-life example of the Belgian Dominique Persoone http://www.dominiquepersoone.be/dominique-persoone-chocolate.asp?taal=.

[17] See http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/sanitationtransportation/ucm056174.htm.

Anty-Gin and Tonic
Bespoke gin of wood ants (Formica rufa) and botanicals with carmine and tonic with The Cambridge Distillery

Chimp Stick
Liquorice root with seeds, fruits, herbs, and ants (Formica rufa and Lasius fuliginosus)

Moth Mousse
Wax moth larvae mousseline (Galleria mellonella) and morels

Cricket Broth
House cricket broth (Acheta domestica) with grasshopper garum (Locusta migratoria)

Wormhole
Oatmealworm stout (Tenebrio molitor) with Siren Craft Brewery

Roasted Locust
Butter-roasted desert locust (Schistocerca gregaria) with wild garlic and ant emulsion (Formica rufa)

Bee Brood
Honeybee drone comb (Apis mellifera)

The Whole Hive
Beeswax ice cream, honey kombucha sauce, 'bee bread', propolis tincture, and crisp honey

Mead
Lindisfarne Mead from St Aidan's Winery

Fig. 2. The Pestival Menu – served by The Nordic Food Lab in London, 2013. Menu courtesy of Ben Reade (http://nordicfoodlab.org/blog/2013/5/pestival).

Summer Olympics and proposed ants and crème fraiche to the diners. "Who's the Pest?", a two-night culinary event was also organized by the Nordic Food Lab, Pestival and the Wellcome Collection in London in 2013.[18] At the latter event, the audience was served delights such as a French-style mousseline containing wax moth larvae with morel mushrooms, butter-roasted crickets, and a tangy ant-gin cocktail were served (see Fig. 2; see http://nordicfoodlab.org/blog/2013/5/pestival).

Another experiment took place with children in Melbourne Museum, back in 2012. Called 'Bugs for Brunch',[19] the event started with a series of visual presentations: children and their parents were presented with images of people eating bugs; they looked through bug recipe books and watched a Pad Thai dish being made with mealworms. Afterwards, they were served a full menu of insect dishes (see Fig. 3). According to the press coverage: "*They couldn't get enough and every plate was empty by the end*". Although the motivation behind these attempts might vary, they provide great insights into how to make eating insects acceptable – and also to make them rewarding to eat. This kind of positive reinforcement, we reckon, is the most promising way to change people's food choices in the future.

[18] See http://www.pestival.org/news/09052013195103-a-guardian-film-about-nordic-food-lab-and-pestival-collaboration-/.
[19] See http://museumvictoria.com.au/about/mv-blog/mar-2012/bugs-for-brunch/.

MENU

Honeycomb
The comb is part of the bees' home and the honey is bee vomit.

A bottle of cochineal (E120)
Made from cochineal beetles, this red colouring is enjoying a revival amongst parents because artificial reds cause hyperactivity in children.

Polenta (250 grams)
Can contain up to 10 insects per packet, according to the American Food Standards. (There are currently no Australian regulations governing insect content in packaged foods so the keepers have borrowed the American ones).

A chocolate bar
Up to 80 microscopic insect fragments allowed.

A tarantula in a jar, with holes
Tarantulas are yummy to eat and taste especially good when roasted to remove the hairs. But this tarantula cannot be eaten because it is still alive. It was raised in the museum rather than in a factory and so

does not meet food standards and has become one of the keepers' friends.

Live mealworms on a plate, crickets in tupperware & whitchetty grubs asleep on a tray
These bugs are also friends and so cannot be eaten. But some others quite like them that grew up in a factories and come to the table as…

Chocolate chip cookies
Here the mealworms are finely ground and cannot be seen.

Grasshopper lollies
Each grasshopper comes suspended in a transparent green candy on a stick.

A Red back spider in a jar, with holes
The red back is poisonous. The brightly coloured spot on its back is a warning.

Bogon moths in a bowl
These insects are yummy to eat, but they don't meet food regulations. They were collected from a windowsill some months ago and frozen for the occasion.

Insect phad thai
This tasty Thai inspired stir-fry has factory-farmed mealworms in it. The keepers cook *pad thai* for their guests. Unfortunately it cannot be served (even though it is seen, smelt and heard) because the museum is not licensed to serve hot food to children.

Platters of crickets & mealworms
To be eaten whole or combined with dipping sauce.

Three Scorpions
For three brave children!

Fig. 3. Menu served to children in Melbourne Museum, in 2012, as part of 'Bugs for Brunch' (http://museumvictoria.com.au/about/mv-blog/mar-2012/bugs-for-brunch/).

These attempts help to raise important questions regarding the sensory factors that affect the reception of insects as foods: how do a product's multisensory characteristics (that is, its taste and flavor, but also its visual appearance, sound, and oral texture) interact

with the consumer's background expectations to make it appealing or not (see Costell, Tárrega, & Bayarri, 2010, for a review)? Our main concern here is to stress how this understanding be turned into novel multisensory strategies to manage people's expectations toward insects as a food source.

6.1. Finding the right categorization

We need to agree that the first challenge awaiting the introduction of unfamiliar foods concerns their categorization. The successful introduction of a new food item or product often rests on the capacity to find the appropriate category that makes sense to the consumer (Loken, Barsalou, & Joiner, 2008). In the present case, the usual category under which insects are proposed to fit by policy-makers is the one of 'animal protein'. Because of their high protein content, and as mentioned in the arguments above, insects are even discussed as 'meat substitutes'. Regrettably, this presentation comes with expectations that the new meat substitute will have the visual appearance, smell, texture and, of course, flavor of meat (see Post, 2012, for a review) – all of which might be impossible to achieve with insects (Harrison-Dunn, 2014). These leave, as an alternative, the possibility that insects could be added to meat, in a way which does not affect the flavor of the meat. Other approaches have, however, also be championed.

Insects might not just be seen as one item to be placed under an existing familiar food category, such as meat. Trying to extend an existing food category to include insects, misses the fact that the real challenge is category distinction, and not category extension: people's initial single category of insects has to allow for a distinction to be made between inedible and edible insects, and the latter set has then to be seen as a source of rich variety, open for distinct food experiences, and pleasures.

The reluctance to experiment with eating insects seems to be driven by a kind of naive entomology that Westerners have: although there are around a million different species of insects, Westerners seem to ignore this variety and expect all the insects to taste the same. The first thing that is needed in order to change the attitude of Westerners toward insects is probably to make them realize that not all insects are the same, and that they do not simply constitute a single category of 'bugs' (Kellert, 1993).[20]

The naive category of 'insects' is inconsistent – and yet quite often uncritically adopted by researchers who are trying to interpret Western attitudes: centipedes, spiders, and worms are all objects of similar repulsion to Westerners, although they do not fit in the zoologist's definition of insects as invertebrates with six legs and external mouths. Is the object of revulsion then not so much the class of all insects but rather the category of invertebrates (see Townsend, 2012)? But then what about the fact that many of those who refuse to eat woodlice would happily eat shrimps and crabs, although the three are closely related cousins, of the same crustacean subphylum?

The sensory characteristics of edible insects are as diverse as represented by going from foie gras to potato chips. In fact, it has been estimated that somewhere between 1200 and 2000 varieties of insect are eaten somewhere in the world (see Ceurstemont, 2013; Ramos-Elorduy, 2009). The most comprehensive listing that we are aware of includes 1900 varieties.[21] The same is true for birds or mammals: we do not think about ourselves as mammal eaters or bird eaters, we eat some birds, and some mammals. The more that people are educated, the more they recognize their personal taste. Some prefer grouse to chicken, and some bear to beef.

The differentiation between insects is needed in order to avoid the negative associations that many people have with some non-edible insects from spreading to the edible varieties. By recognizing the variety of insects, we also need to be aware of the variety of associations with (visual) environments. Here, the potential for introducing other classes of insect that one might never see except used in cooking seems to us an opportunity to create new associations, and not draw on previous ones.

In addition, insects should not just be seen indifferently as 'meat' or valued for their protein content. According to anthropologists, some of the species of insect that found acceptance by humans were those that were eaten in conjunction with the picking of fruit (Andrews, Martin, Aiello, & Scandrett, 1991; Dudley 2000). Such insects were either sweet or at least associated with a sweet foodstuff. This, then, raises the question of whether the acceptance of insects would be any more successful were they to be introduced as desserts? According to the same authors, greasy, lipid-containing insects would have been the second group to find acceptance. Reim (1962) observed that among Australian Aborigines, whose other food items were deficient in fat (O'Dea et al., 1991), lipid-containing insects and grubs were a favorite, while protein-rich species like locusts and grasshoppers played almost no role whatsoever.

6.2. Finding the right presentation

An important component in the revulsion toward entomophagy is explained by people's folk category of insects, which is strongly based on visual characteristics such as their shape and size (Shepardson, 2002). One obvious strategy would be to use insects merely as a food supplement and try to hide their presence or shape: this is, for instance, the strategy used by the company Six Foods, which provide cricket crisps and cookies almost visually identical to other crisps and cookies. This is also what Blakely (2014) recommended in a recent article published in *The Times* newspaper.

The hiding strategy might solve the problem of exposure, but will present new problems. Mere hiding can be seen as dishonest, the last thing our food system needs more of! If the presence of insects will need to be made explicit on the label, this strategy will likely lead us back to the problems of the rational strategy. What's more, these indirect strategies are unlikely to make people learn to differentiate between different kinds of insects and their distinctive flavors.

What we recommend is rather to experiment with the best explicit way to present insects on a plate. The techniques used in high gastronomy and validated by experiments (see Deroy, Michel, Piqueras-Fiszman, & Spence, 2014; Spence, Piqueras-Fiszman, Michel, & Deroy, 2014; Spence & Piqueras-Fiszman, 2014, for recent overviews) represents, a wonderful opportunity to overcome background negative attitudes, and to try to work with those sensory properties that are associated with the consumption of insects that would turn them into the promising source of nutrition that they can be.

The first thing to stress here is the importance of cooking and recipes: there is all the difference in the world between eating a raw insect and consuming a cooked one. It is therefore surprising to see that the work done since Rozin et al.'s (1986) seminal study typically examining the willingness to consume raw insects: would not the same reluctance also be observed with raw chicken, for instance? We are used to seeing differences in attitudes between the raw and the cooked, the former being seen as more likely sources of contamination. For instance, cooking reduces the risk of contamination in pork (Douglas, 1972; Lévi-Strauss, 1969). The involvement of other ingredients and processes in cooking can affect the acquired distaste as multiple levels. Cooking insects in a traditional recipe, mixed together with other familiar ingredients can certainly be expected to reduce the aversion for novelty which partly constitute the acquired distaste. In one of the few studies to

[20] True bugs are only one order among insects, the Hemiptera.

[21] See http://www.wageningenur.nl/upload_mm/7/e/6/c79e66db-00d5-44c9-99cb-f38943723db6_LIST%20Edible%20insects%201st%20of%20April.pdf.

Fig. 4. Example of visual presentation used by chocolatier Sylvain Musqar in Paris with permission, Getty Images.

have been conducted so far, Belgian consumers were shown to more readily to accept insects (mealworms and house crickets in this case) when they were prepared in a familiar manner, and associated with known flavors (see Caparros Megido et al., 2013). Progressively then, insects can be seen as a novel addition to a familiar dish. This strategy is also more likely to be implemented in individual homes, and not just in restaurants. Being personally involved with the preparation of insects, or an insect dish, seems to reduce the degree of disgust that many people feel (Loo & Sellbach, 2013): one interpretation here is that the representation of cooking as a social activity reduces the idea that insects are socially inappropriate and puts them, on the contrary, at the centre of cultural culinary practice.

A second aspect of presentation, not costly to implement but well worth experimenting with, comes from the area of naming: according to one anecdote, it was simply by calling frogs' legs "Cuisses de nymphe a l'aurore" (Nymphs' thighs with Aurore sauce) that the French chef Georges Auguste Escoffier managed to overcome the English veto on eating these batrachians (see Lang, 1975, p. 72). A more recent salient example comes from the re-naming of the ugly looking Patagonian toothfish as "Chilean sea bass", which led to a significant increase in sales[22] (Dolnick, 2008; Jones, 2013). Certainly, recent studies in cognitive psychology and sensory science have confirmed the fact that changing the name of a food can exert a profound influence on people's expectations and hence their overall liking of the food (see Spence & Piqueras-Fiszman, 2014, Chapter 3, for a review).

Several naming strategies have been used in previous events with insects and proved quite successful. Instead of choosing elaborate names, like Escoffier, some chefs have presented insects as a variation of some known recipes and dishes. The stress on familiar names (like 'insect pad thai'), and on the cooking process, is likely to be a good way to reduce neophobia. Relying on exotic names might also constitute a promising strategy to facilitate the acceptance of novel flavors.[23] Other chefs and food experimentalists have tried to use metaphors, novel expressions, and puns ('Chimp stick', 'Antygin and tonic'; see Fig. 2), which could be useful when marketing to kids or in certain other contexts. Another, even more direct strategy, would be to use the names of individual species. We never eat mammal, we eat cow, sheep or pig: perhaps in much the same way, insects should be identified by their names, such as house crickets (as home is familiar) or wax moth larvae (galleria Mollonella).[24] These descriptive strategies should then be compared in a systematic manner, by presenting the same dish with different labels to similar consumers and measuring the effect on the acceptability and liking of the dish.

Last but by no means least, some important factors regarding the visual and tactile properties of insects should be taken into account (e.g., Köster, 2009). Before testing solutions, it is important to stress the specific challenges presented by insects and reflect on the right psychological and sensory components at stake. Here, once again, there needs to be some more systematic exploration of chefs' intuitions – for instance, the use of 'non-edible' colors such as gold for insects, adopted by chocolatier Sylvain Musqar in Paris (see Fig. 4), both acknowledges their distinct status, as non-usual foods, while stressing their status as decorative and rare. Using gold for fine foods also plays with a long tradition in Europe, going back at least to the 16th century.

7. Conclusions: a new insectivore's gastronomy

The refusal of Westerners to eat insects has most often been studied alongside the kind of fear and disgust that the contact with living insects is supposed to generate because of their connection with dead animals and the related fear of contagion (Rozin & Haidt, 2013, for a review). The main take-home message of this – admittedly limited – research has been that the negative attitudes of Westerners toward entomophagy corresponds to a form of cognitive disgust, whereby insects are considered as a source of contamination and associated to threatening elements such as dirt, death, and disease.

Although the same research predicts that such disgust is deeply rooted in people's psyche and largely irrational, the general hope has been that ascribing insects to positive categories, such as 'source of proteins and good fat', 'sustainable', or 'enjoyed in many cultures' will be sufficient to overturn these attitudes. However, rational arguments in-and-of themselves are unlikely to introduce change in the culture and in our insect- or insect-related food behaviors. Insects have to find their own place, not as a substitute for chicken, or hidden in a cookie, but as insects, celebrated for what they are (see Table 3, for summary). It is our contention that serious research is needed in terms of thinking about the acceptability of insects as a sustainable food source in a way that is based on, and informed by, the real science of food perception, as well as new trends of eating observed in many of today's most popular restaurants. This again stresses that finding innovative solutions for today's food challenges cannot be a matter of policy only, nor of more industrially-driven food science: they call for a closer

Table 3
Three different strategies to promote insect's consumption. Although the strategy we recommend might reach early adopters first, it is likely to open new ways to make insects appealing to Western palates and to offer a response to the growing disdain toward insect consumption in growingly Westernised traditional societies.

	Pedagogy	Hiding	Entomo-gastronomy
Mean	Rational arguments	Addition of insect matter	Making insects appealing to eat
Example	FAO, Marcel Dicke	Cricket chips (http://www.bostonmagazine.com/restaurants/blog/2014/04/22/six-foods/)	Nordic Food Lab; Jose Andres, Grant Atchaz, Jozef Youssef
Starting point	Insects as a general category	Insects as a general category	Various categories of insects, with distinct sensory properties
Goal	Change of diet	Affordability	Informed and motivated food choice
Limits	Lack of motivation	Lack of transparency	Need of further experimental work

[22] See for instance http://www.brandingmagazine.com/2012/09/21/brand-names-matter/.

[23] See also Wansink (2002), on the use of the so-called 'variety meats' during the Second World War.

[24] These have been referred to in menus as Galleria by Florence Dunkel of the Insects Newsletter.

collaboration between cognitive neuroscience, human sciences and gastronomic science in order to understand the many aspects of our relations to foods.

Changing Western attitudes, even modestly, has a wider impact. As pointed out by several specialists, the consumption of insects is declining in many countries, partly because of the adoption of Western cultural standards where entomophagy is seen as unacceptable or 'uncivilised' (e.g., DeFoliart, 1999; Looy, Dunkel, & Wood, 2013). Hence, even the occasional consumption of insects by Westerners, if it comes with a positive re-evaluation of their status as a nutritious food source would mean a big change – one that potentially reached far beyond these occasional consumers.

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