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Comparing Social and Intellectual Appeals to Reduce Disgust of Eating Crickets

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Abstract

Objective. *Research on disgust, to date, has focused on general sensitivity. This experiment looks at disgust specific to eating crickets, how it can be reduced, and whether this varies with age and gender.*

Methods. *A convenience sample of 352 participants completed an online questionnaire and were randomly assigned into groups who viewed an intellectual appeal (text) or a social appeal (video). As a measure of disgust they rated their likelihood of eating a whole cricket, and also a bar which contained cricket flour, before and after this intervention.*

Results. *Members of the social appeal group had a significantly greater change in likelihood of eating a cricket bar ($p = .028$, $BF_{10} = 3.92$), but not a whole cricket ($p = .316$, $BF_{10} = 0.13$). Compared to male participants, female participants rated themselves less likely to eat a whole cricket ($p < .001$, $BF_{10} = 4828.84$) or a cricket bar ($p = .001$, $BF_{10} = 181.18$). Older participants were less likely to eat a whole cricket ($p = .01$, $BF_{10} = 4.98$) or a cricket bar ($p = .005$, $BF_{10} = 34.12$).*

Conclusions. *Results support the role of social influence in disgust of eating crickets. The use of social appeals, therefore, appears the most effective for efforts to promote the eating of insects as an alternative food source.*

Keywords: Psychology; Aversion; Emotion; Influence; Entomophagy.

Introduction

Edible insects, such as crickets, are easy to raise, require little space, are efficient at creating protein compared to conventional meat, produce minimal CO_2, and are highly nutritious. In a world of growing food concerns[1] edible insects are a viable solution for the future.[2,3,4] For the average Westerner, however, the thought of eating an insect is disgusting. The psychology of disgust must be understood for entomophagy, the eating of insects, to be seriously considered. This study hopes to give greater insight into the nature of disgust and why some cases elicit disgust while others do not.

What is Disgust?

The emotion of disgust is a basic reaction of avoidance, from a sour taste, bad smell, or another person. Disgust is an emotion which is universal across all humans, although the triggers differ across individuals and cultures. It was listed as one of the core emotions by Darwin[5] and later as a universal facial expression by Ekman and Friesen.[6] Darwin noted "disgust primarily arises in connection with the act of eating or tasting".[7] Items which may cause disease when ingested are considered disgusting and are avoided as food. For example the smell, sight, or taste of sour milk typically elicits this disgust reaction, triggering an avoidance, or if already ingested, it can result in a retching reaction to expel the offending foodstuff. This is a relatively simple model; it explains why foods that make an individual sick are considered disgusting.

[1] Stian Reklev, "U.N. Warns Food Security a Risk to Asia-Pacific," *Reuters*, 10 March 2014, http://www.reuters.com/article/2014/03/10/us-unitednations-food-security-idUSBREA2908Z20140310.
[2] Arnold van Huis, "Potential of Insects as Food and Feed in Assuring Food Security," *Annual Review of Entomology* 58, no. 1 (2013), doi:10.1146/annurev-ento-120811-153704.
[3] Arnold van Huis et al., *Edible Insects: Future Prospects for Food and Feed Security*. (Rome: Food and Agriculture Organization of the United Nations (FAO), 2013).
[4] Heather Looy, Florence V. Dunkel, and John R. Wood, "How Then Shall We Eat? Insect-Eating Attitudes and Sustainable Foodways," *Agriculture and Human Values* 31, no.1 (2013), doi:10.1007/s10460-013-9450-x.
[5] Charles Darwin, *On the Expression of the Emotions in Man and Animals* (London, England: John Murray, 1872), 257-262.
[6] Paul Ekman and Wallace V. Friesen, "Constants across Cultures in the Face and Emotion," *Journal of Personality and Social Psychology* 17, no. 2 (1971), doi:10.1037/h0030377.
[7] Charles Darwin, *On the Expression of the Emotions in Man and Animals*, 258.

It remained as such until Paul Rozin advanced the topic,[8,9] and the focus shifted to a model of a behavioural immune system[10,11] where any potential source of pathogen triggers an avoidance reaction. The typical physical reaction when disgusted is to recoil from the offending source with a facial expression that retracts the upper lip, constricts the nostrils, and narrows the eyes.[12] This reaction reduces the possibility of a foreign element being taken into the body. With this model, disgust is an emotion that protects individuals from any potential source of disease. A person who has visible sores elicits disgust, as do images of rats or other vermin known to carry disease.

More recent work[13,14] considered the emotion of disgust in a moral context, though how exactly the emotion and the idea of morality interact is of some debate.[15] Disgust in this model, named the Rozin, Haidt, & McCauley (RHM) model, has evolved to protect not just the body, but also the soul. Individuals are disgusted by the immorality of politicians, sexual deviancy, and acts of dishonesty.

From an evolutionary perspective, this approach makes sense; those members of a group who act in a manner counter to the interests of the group are shunned and excluded. Haidt[16] makes the case that the disgust/sanctity moral foundation allows extreme and sometimes irrational beliefs to be maintained. The ideology of one's group is held sacred while the ideology of an opposing group is repellent and disgusting.

In an experiment studying disgust, researchers[17] surreptitiously exposed participants to a disgust trigger, a bad smell. Participants were then asked to make an assessment of another's actions. Researchers found those exposed to the trigger were significantly more likely to judge others as immoral. In another study, a bitter taste was found to increase the likelihood of a negative moral judgement, while a sweet taste decreased it.[18]

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[8] Paul Rozin, Linda Millman, and Carol Nemeroff, "Operation of the Laws of Sympathetic Magic in Disgust and Other Domains," *Journal of Personality and Social Psychology* 50, no. 4 (1986), doi:10.1037/0022-3514.50.4.703.

[9] Paul Rozin and April E. Fallon, "A Perspective on Disgust," *Psychological Review* 94, no. 1 (1987): 23, doi:10.1037/0033-295X.94.1.23.

[10] Justin H. Park, Jason Faulkner, and Mark Schaller, "Evolved Disease-Avoidance Processes and Contemporary Anti-Social Behavior: Prejudicial Attitudes and Avoidance of People with Physical Disabilities," *Journal of Nonverbal Behavior* 27, no. 2 (2003), doi:10.1023/A:1023910408854.

[11] Megan Oaten, Richard J. Stevenson, and Trevor I. Case, "Disgust as a Disease-Avoidance Mechanism," *Psychological Bulletin* 135, no. 2 (2009), doi:10.1037/a0014823.

[12] Rachel Herz. *That's Disgusting: Unraveling the Mysteries of Repulsion* (London: W. W. Norton & Company, 2012), 30.

[13] Jonathan Haidt, Clark McCauley, and Paul Rozin, "Individual Differences in Sensitivity to Disgust: A Scale Sampling Seven Domains of Disgust Elicitors", *Personality and Individual Differences* 16, no. 5 (1994), doi:10.1016/0191-8869(94)90212-7.

[14] Jonathan Haidt, *The Righteous Mind: Why Good People Are Divided by Politics and Religion.* (London: Penguin books, 2013).

[15] Yoel Inbar and David Pizarro, "Pollution and Purity in Moral and Political Judgment," in *Advances in Experimental Moral Psychology: Affect, Character, and Commitments*, eds. Hagop Sarkissian and Jennifer Cole Wright (Continuum Press, 2014).

[16] Jonathan Haidt, *The Righteous Mind*, 170-177.

[17] Simone Schnall et al., "Disgust as Embodied Moral Judgment," *Personality and Social Psychology Bulletin* 34, no. 8 (2008), doi:10.1177/0146167208317771.

[18] Kendall J. Eskine, Natalie A. Kacinik, and Jesse J. Prinz, "A Bad Taste in the Mouth Gustatory Disgust Influences Moral Judgment," *Psychological Science* 22, no. 3 (2011), doi:10.1177/0956797611398497.

This research has two important implications; first, that disgust acts at an unconscious level to influence decision making. Secondly, that disgust is infectious: decisions were contaminated by disgust at the odour. This view of contamination was confirmed by Rozin, Millman, and Nemeroff[19] who described it as a "law of sympathetic magic" a form of magical thinking. In one example, participants were asked whether they would drink a glass of orange juice in which a sanitised cockroach had been dipped. Most, unsurprisingly, refused. In a second experiment participants who had been willing to wear a hypothetical piece of clothing, refused to after hearing that it had belonged to Hitler or a serial killer.[20]

The Development of Disgust

The emotion and response of disgust is universal. The sources of disgust, however, are not constant. Cultural and individual differences are apparent. Cheese, for example, is a staple of Western cuisine. In Asia, many consider the idea of consuming rotted animal lactation disgusting.[21] Similarly, some Westerners have a dislike of cheese while some Asians quite enjoy it. The development of such cultural and individual preferences is likely to be a result of a number of mechanisms beyond simple physiology.

Young children have a simple response to food; there is a preference for sweetness and a distaste for bitter foods.[22] This response to bitter food is an evolutionary protection; the bitterness is due to alkaloids which are often poisonous and are present in rotten food.[23] At a young age, this is the only trigger of a disgust reaction. During the transition to solid food, infants will initially only favour salty or sweet tastes, but repeated exposure to new foods increases acceptance and their early food environment creates familiarity for later life.[24] Recent research considering infant preferences[25] found infants have a noticeable preference for foods from plants over non-plants, but only when they witness an adult eating these. Experimenters found that both elements were required for an infant to have a preference. This research gives some insight into the development of food selection preferences, part innate, part environment, and part social.

[19] Paul Rozin, Linda Millman, and Carol Nemeroff, "Operation of the Laws of Sympathetic Magic."
[20] Carol Nemeroff and Paul Rozin, "The Contagion Concept in Adult Thinking in the United States: Transmission of Germs and of Interpersonal Influence," *Ethos*, no. 2 (1994): 158, doi:10.2307/640495.
[21] Rachel Herz, *That's Disgusting*, 2.
[22] Julie A Mennella, M Yanina Pepino, and Danielle R Reed, "Genetic and Environmental Determinants of Bitter Perception and Sweet Preferences," *Pediatrics* 115, no. 2 (2005), doi:10.1542/peds.2004-1582.
[23] Rachel Herz, *That's Disgusting*, 31.
[24] Leann L. Birch, and Jennifer O. Fisher. "Development of Eating Behaviors Among Children and Adolescents." *Pediatrics* 101, no. Supplement 2 (1998), http://pediatrics.aappublications.org/content/101/Supplement_2/539.short.
[25] Annie E. Wertz, and Karen Wynn, "Selective Social Learning of Plant Edibility in 6- and 18-Month-Old Infants," *Psychological Science* 24, no. 4 (2014), doi:10.1177/0956797613516145.

Recent work[26,27,28] emphasised evolutionary development and social learning in disgust. Disgust is a learned emotion, rather than an inherent one, which develops from basic biological responses.[29] As a child develops, they develop disgust attitudes,[30] and food habits[31] similar to their parents which will influence their adult life. This theory explains how insects can be considered disgusting even though an individual may never have tasted an insect. If an adult expressed disgust towards an insect, then an infant viewing the adult will learn to mimic this disgust. This theory also explains why something considered disgusting in one culture is not necessarily considered disgusting in another.

Measuring Disgust

The majority of disgust-related research has used the disgust sensitivity scale as a measure of overall disgust. It was developed by Haidt, McCauley, and Rozin in 1994[32] with the aim of creating a self-reported questionnaire of how sensitive to disgust an individual is in general. The scale is a combination of eight domains of disgust; food, animals, body products, sex, body envelope violations, death, hygiene, and magical thinking. These domains were developed by compiling a large list of disgust triggers and then using factor analysis to refine the list into group domains. The scale was revised in 2007 following suggestions from Olatunji, Sawchuk, Jong, and Lohr[33] to become the disgust sensitivity scale revised (DS-R). The DS-R has only three domains; core disgust, animal reminder disgust, and contamination disgust. For the purposes of this study the phrase 'disgust sensitivity scale' has been used for all versions of the scale for simplicity. Research using the disgust sensitivity scale has found it negatively correlates with age,[34] positively correlates with political conservatism,[35] and that females have a significantly higher rating than males.[36]

What the scale does not address, however, is how different items elicit different levels of disgust for a single person, and how attitudes of disgust can change over time. A smoker, who later quits, may now find their old habit to be disgusting. A vegetarian who once ate meat with gusto may find the very thought of it now turns their stomach.

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[26] Paul Rozin, Jonathan Haidt, and C. R. McCauley, "Disgust," in *Oxford Companion to Affective Sciences*, eds. David Sanders and Klaus R. Scherer, (Oxford University Press, 2009).
[27] Hanah A. Chapman, and Adam K. Anderson, "Things Rank and Gross in Nature: A Review and Synthesis of Moral Disgust," *Psychological Bulletin* 139, no. 2 (2013): 300–327, doi:10.1037/a0030964.
[28] Joshua M. Tybur et al., "Disgust: Evolved Function and Structure," *Psychological Review* 120, no. 1 (2013), doi:10.1037/a0030778.
[29] Rachael E. Jack, Oliver G. B. Garrod, and Philippe G. Schyns, "Dynamic Facial Expressions of Emotion Transmit an Evolving Hierarchy of Signals over Time," *Current Biology* 24, no. 2 (2014), doi: 10.1016 /j.cub.2013.11.064.
[30] Paul Rozin, April Fallon, and Robin Mandell, "Family Resemblance in Attitudes to Foods," *Developmental Psychology* 20, no. 2 (1984), doi:10.1037/0012-1649.20.2.309.
[31] Gerda I Feunekes et al., "Food Choice and Fat Intake of Adolescents and Adults: Associations of Intakes within Social Networks," *Preventive Medicine* 27, no. 5 (1998), doi:10.1006/pmed.1998.0341.
[32] Jonathan Haidt, Clark McCauley, and Paul Rozin, "Individual Differences in Sensitivity to Disgust."
[33] Bunmi O. Olatunji et al., "Disgust Sensitivity and Anxiety Disorder Symptoms: Psychometric Properties of the Disgust Emotion Scale," *Journal of Psychopathology and Behavioral Assessment* 29, no. 2 (2007), doi: 10.1007/s10862-006-9027-8.
[34] John F. Quigley, Martin F. Sherman, and Nancy C. Sherman, "Personality Disorder Symptoms, Gender, and Age as Predictors of Adolescent Disgust Sensitivity," *Personality and Individual Differences* 22, no. 5 (1997), doi:10.1016/S0191-8869(96)00255-3.
[35] Yoel Inbar et al., "Disgust Sensitivity, Political Conservatism, and Voting," *Social Psychological and Personality Science* 3, no. 5 (2011), doi:10.1177/1948550611429024.
[36] Jonathan Haidt, Clark McCauley, and Paul Rozin, "Individual Differences in Sensitivity to Disgust."

A small number of cases have considered specific instances of change. Paul Rozin[37] studied how medical students rated a set of bodily-related disgust questions before and after their first dissection of a corpse and found a significant decrease in that disgust. Research relating to spider phobias[38,39] showed how disgust, in addition to fear, played a role in the phobia. Following intervention, patients displayed significantly less disgust towards spiders, although not a change in the disgust sensitivity scale. Fessler and Navarrete[40] found that the death disgust sensitivity subscale of disgust sensitivity reduced rather than increased with age. The explanation proposed in these cases was that increased exposure to the source of the disgust reduced the disgust through habituation.

How to Influence a Disgust Attitude

The benefits of entomophagy from an intellectual perspective are evident. Insects as a food source are healthy, ecologically sound, and economically beneficial.[41,42,43] It is unlikely that presenting this information to an individual is going to overcome their disgust of eating an insect. Previous studies found habituation to be effective,[44,45,46] yet, in these cases participants have had a personal motivation to do so, either to overcome a phobia or complete medical school. While many individuals might be willing to allow themselves be convinced, most would be unlikely to eat multiple meals of insects in an effort to habituate to eating insects. As such, in a real world setting, if the case is to be made for entomophagy, a different approach needs to be taken.

[37] Paul Rozin, "Hedonic 'adaptation': Specific Habituation to Disgust/death Elicitors as a Result of Dissecting a Cadaver," *Judgment and Decision Making* 3, no. 2 (2008), http://www.sjdm.org/journal/jdm7802.pdf.
[38] J. A. J. Smits, M. J. Telch, and P. K. Randall, "An Examination of the Decline in Fear and Disgust during Exposure-Based Treatment," *Behaviour Research and Therapy* 40, no. 11 (2002), doi:10.1016 /S0005-7967(01)00094-8.
[39] Peter J De Jong, Helena Andrea, and Peter Muris, "Spider Phobia in Children: Disgust and Fear before and after Treatment," *Behaviour Research and Therapy* 35, no. 6 (1997), doi:10.1016/S0005-7967(97)00002-8.
[40] Daniel M.T. Fessler, and C. David Navarrete, "The Effect of Age on Death Disgust: Challenges to Terror Management Perspectives," *Evolutionary Psychology* 3 (2005), doi: 10.1177/147470490500300120.
[41] Arnold van Huis et al., *Edible Insects*.
[42] Arnold van Huis, "Potential of Insects as Food and Feed in Assuring Food Security."
[43] Heather Looy, Florence V. Dunkel, and John R. Wood, 'How Then Shall We Eat'
[44] J. A. J. Smits, M. J. Telch, and P. K. Randall, "An Examination of the Decline in Fear and Disgust during Exposure-Based Treatment."
[45] Peter J De Jong, Helena Andrea, and Peter Muris, "Spider Phobia in Children: Disgust and Fear before and after Treatment."
[46] Daniel M.T. Fessler, and C. David Navarrete, "The Effect of Age on Death Disgust: Challenges to Terror Management Perspectives."

Research on influencing children's attitudes towards healthy eating is similar in nature to that of influencing disgust. The goal is to convince them to eat more fruit and vegetables, which some children might argue to be disgusting. Healthy eating interventions with children have been successful in convincing them to eat their fruit and vegetables. Lakshman, Sharp, Ong, and Forouhi[47] used a card game to teach and successfully improve healthy eating in students. Lowe, Horne, Tapper, Bowdery, and Egerton[48] used videos showing heroic children to increase the consumption of fruit and vegetables in students. Baranowski et al.[49] used a children's multimedia game to do something similar. In the above three examples, researchers used a combination of engaging teaching methods to educate students on the benefits of healthy eating and peer examples to show examples of other children eating healthily. Arguably, the researchers, as adults, may also have influenced the students by being an authority figure and, as more students were swayed, the social norm of the classroom became pro-healthy eating.

The difficulty of the approach is that individuals must first break the existing social norm to create a new one. In the case of the children, the possibly peer-influenced social norm of not eating fruit and vegetables was overcome by video and game examples of a new social norm. That new social norm was then supported by adult confirmation acting as an authority. In the case of eating crickets, a similar approach may have some success. Looking at previous examples, it is reasonable to assume that exposure to a new social norm, where consumption of crickets is acceptable, would reduce cricket-related disgust. If the studies teaching children to eat fruit and vegetables had instead introduced those same children to cartoons where cricket meat was eaten, and adults had supported eating of crickets, would there be a similar increase in school yard children snacking on crickets? Would this approach be effective on everyone?

The Current Study

The current study proposes to fill a gap in the existing research by considering a specific instance of disgust, rather than general disgust sensitivity, and studying the nature of a change in that disgust attitude. Participants were asked to self-rate their likelihood of eating a whole cricket or cricket-based product. Participants were then exposed to either a social appeal of a video of individuals enjoying a cricket-based product or a non-social appeal, in this case an intellectual appeal of informative text. An intellectual appeal was selected as a contrasting method of persuasion to compare the social appeal against, rather than just comparing the before and after for the social appeal. Participants were then asked to re-rate their likelihood to determine if there has been any change.

[47] Rajalakshmi R. Lakshman et al., "A Novel School-Based Intervention to Improve Nutrition Knowledge in Children: Cluster Randomised Controlled Trial," *BMC Public Health* 10, no. 1 (10 March 2010), doi: 10.1186/1471-2458-10-123.

[48] C F Lowe et al., "Effects of a Peer Modelling and Rewards-Based Intervention to Increase Fruit and Vegetable Consumption in Children," *European Journal of Clinical Nutrition* 58, no. 3 (2004), doi: 10.1038/sj.ejcn.1601838.

[49] Tom Baranowski et al., "Squire's Quest! Dietary Outcome Evaluation of a Multimedia Game," *American Journal of Preventive Medicine* 24, no. 1 (2003), doi:10.1016/S0749-3797(02)00570-6.

Hypotheses

This study hypothesises that a group given a social appeal, in the form of a video of people enjoying crickets, will have a significantly greater increase in self-reported likelihood of eating a cricket or cricket-based product than a group given an intellectual appeal, in the form of informational text. The study also seeks to confirm if gender and age differences will be evident in relation to disgust specific to eating crickets.

Method

Participants

The participants were 354 volunteers who completed an online questionnaire. Participants were a convenience and snowball sample recruited through social media including Facebook, Twitter and Reddit. Participants received no reward for taking part in the study. The questionnaire received a total of 770 unique visits with a completion rate of 58%. During the questionnaire, participants were randomly allocated into two groups which received different appeal types: a social appeal or an intellectual appeal. Of those participants, two recorded an age of below 18 and were removed from the sample for ethical reasons. Age ranged from 18 to 68. The social and intellectual appeal group demographics were similar enough in nature to assume no group bias was present. The sample and group demographics are summarised in table 1.

Table 1: Demographic of Overall Sample and Randomised Groups

	Participants		**Age**		**Female**		**Male**	
Group	n	%	M	SD	n	%	n	%
Social appeal group	202	57.4%	36.32	11.69	124	61.4%	78	38.6%
Intellectual appeal group	150	42.6%	33.78	11.88	87	58%	63	42%
Total	352	100%	35.24	11.82	211	59.9%	141	40.1%

Research Design

An experimental two-way, mixed design was used. The unrelated measures independent variable was appeal type, with two groups (social appeal and intellectual appeal). There were two dependent variables: change in likelihood of eating a whole cricket; and change in the likelihood of eating a cricket-based bar.

Materials

Demographic measures of age and sex were recorded. As a measure of disgust, participants were asked to self-report their likelihood of eating a whole cricket or a cricket bar. This was recorded on a rating of 1 to 10, where 1 represented 0 to 10% and 10 represented 90% to 100%. This simple approach was taken for a number of reasons.

As an abstract concept, disgust is difficult to rate. Does the subject of disgust elicit in the participant a weak or strong reaction? As an abstract and often unconscious emotion, it is not something that a participant can reliably rate. A participant can, however, rate their intention to act. As this intention is influenced by the emotion of disgust, with efforts made to control for confounding variables, this can be considered a good indication of disgust.

To motivate action over inaction, the suggestion will be made that the participant is hungry. To reduce the influence of cultural norms, the situation will be set in a foreign country. To remove initial social influences, the situation will have the participants alone and presented the food from a vending machine rather than a human. Although the Intellectual and Social appeals do have some overlap, for example the video does contain a small amount of information and both are presented through a digital medium, they should be distinct enough for operational purposes.

Although the rating is a scale from 0% to 100%, it seems needless to require the participant to consider whether they are 32% or 33% likely to eat a cricket. As such, the scale was simplified to be a choice of one of ten options where 1 represents 0% to 10%, and 10 represents 90% to 100%.

Procedure

Respondents were first presented with an information page giving participants a brief outline of the questionnaire. Those with a phobia of insects or under 18 were advised they should not complete the survey.

Next participants were given the following scenario: "You find yourself hungry in a foreign country. You are on your own in a room where a food dispenser machine is available but only has cooked crickets." The intention of this scenario was to remove the potential confounding variable of social embarassment or desirability. An image of crickets cooked in soy sauce was presented along with the text. Participants were asked to indicate how likely they would be to eat a whole cricket from the machine. A score of 1 indicated a 0% to 10% likelihood while a rating of 10 indicated a 90% to 100% likelihood. Participants were then given the following scenario "On further inspection you find that the food dispenser does not contain individual cooked crickets but contains bars that contain flour made from crickets." Participants were asked to indicate how likely they would be to eat a bar from the machine using the same rating system as in the previous question. An image of a cricket-based bar was also presented. Participants were then randomised into two separate groups.

Group A were presented with a short text (333 words) explaining some of the health, environmental, and livelihood benefits to eating crickets, summarised from a Food and Agriculture UN report.[50] For operational purposes this acted as the Intellectual appeal using only text. Group B were presented with a one minute video of individuals in a gym eating, enjoying, and talking about a bar made from cricket flour.[51] This video of individuals enjoying the cricket-based bar acted as the social appeal for the experiment.

Participants were then asked to again score their likelihood of first eating the cricket bar and then their likelihood of eating a whole cricket, the images for each type was shown again as a reminder. A free text option allowed respondents to include any additional comments they felt were appropriate. Finally, participants were presented with debrief text and provided the option to submit their data or not.

[50] Arnold van Huis et al. *Edible Insects*.
[51] "Outlaw Way Training Camp Taste Test.mov," YouTube video, 1:02, posted by Greg Sewitz, January 27, 2012, https://www.youtube.com/watch?v=NKx9uhzAfyc.

Change in likelihood of eating a cricket was scored by subtracting post-intervention likelihood of eating a whole cricket from pre-intervention likelihood of eating a whole cricket. Change in likelihood of eating a cricket bar was scored in a similar manner by subtracting post-intervention likelihood of eating a cricket bar from pre-intervention likelihood of eating a cricket bar.

Results

The differences between initial and final ratings in participants' likelihood of eating a whole cricket and a cricket bar were calculated (see table 2) and are displayed in figure 1. All scale variables to be tested were checked for normality. All variables had skewness and kurtosis z scores outside of the -1.96 to 1.96 range. Shapiro-Wilk's tests for each of the variables were found to have $p < .001$. As such, variables were determined to not be normally distributed and non-parametric tests were used for analysis. For each analysis a Bayesian factor was calculated using the JASP software package.

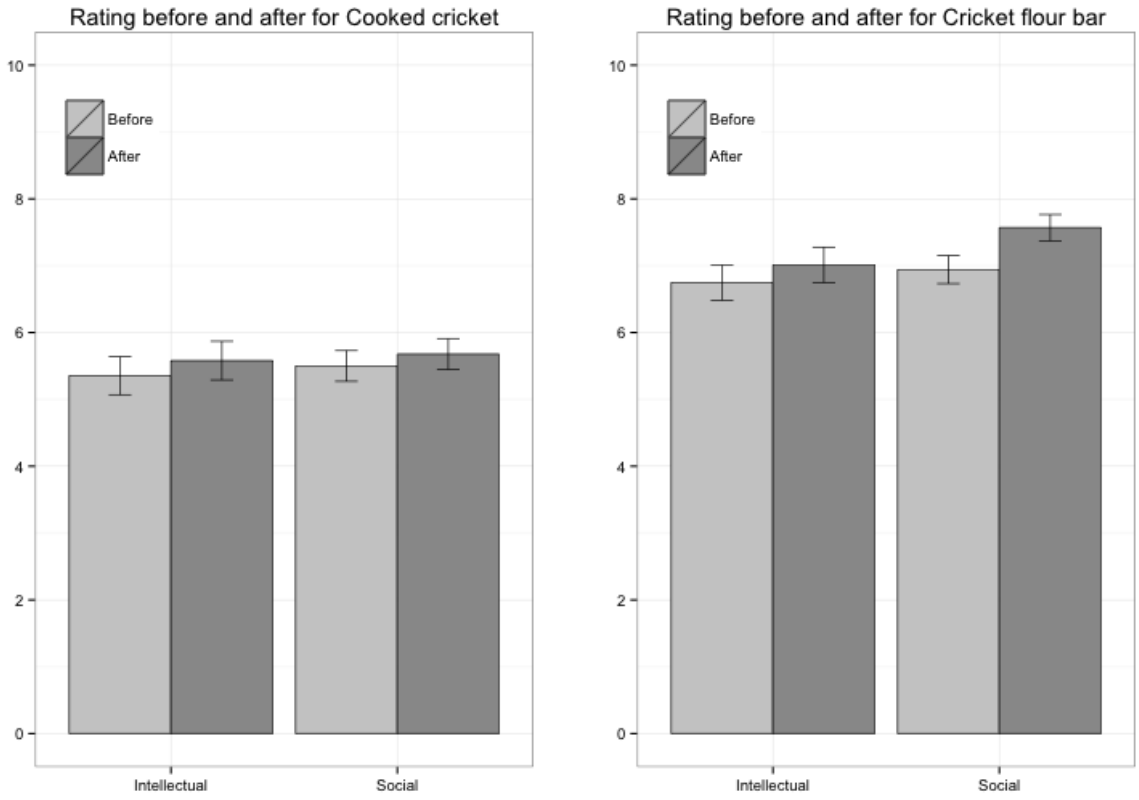

Figure 1: Mean rating before and after for Cooked cricket and Cricket flour bar for participants who were exposed to an Intellectual appeal or a Social appeal

Table 2: Summary of Means, Standard Deviations, and Confidence Intervals

	Overall		Social Appeal		Intellectual Appeal	
	M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI
Whole cricket						
Initial rating	5.44 (3.35)	[5.09, 5.79]	5.5 (3.27)	[5.05, 5.95]	5.35 (3.47)	[4.79, 5.91]
Final rating	5.64 (3.4)	[5.28, 5.99]	5.68 (3.29)	[5.22, 6.14]	5.58 (3.54)	[5.01, 6.15]
Change in rating	0.2 (0.99)	[0.1, 0.3]	0.18 (0.82)	[0.06, 0.29]	0.23 (1.06)	[0.06, 0.4]
Cricket bar						
Initial rating	6.86 (3.07)	[6.54, 7.18]	6.94 (2.96)	[6.53, 7.35]	6.75 (3.22)	[6.23, 7.27]
Final rating	7.33 (3)	[7.02, 7.65]	7.57 (2.79)	[7.18, 7.96]	7.01 (3.25)	[6.49, 7.54]
Change in rating	0.47 (1.25)	[0.34, 0.61]	0.63 (1.26)	[0.45, 0.8]	0.27 (1.22)	[0.07, 0.46]

Inferential Statistics

A Mann-Whitney U test was used to test the hypothesis that there would be a significant difference between the change in self-reported likelihood of eating a whole cricket before and after by participants exposed to the intellectual appeal and the social appeal. The intellectual appeal condition had a mean rank of 181.32 and mean change of 0.23 (SD = 1.06) from 5.35 to 5.58, which was slightly greater than the social appeal condition which had a mean rank of 172.92 and mean change of 0.18 (SD = 0.82) from 5.5 to 5.68, however the intellectual appeal condition and the social appeal condition did not differ significantly (Z = -1, p = .316, JZS BF_{10} = 0.13).

A Mann-Whitney U test was used to test the hypothesis that there would be a significant difference between the change in self-reported likelihood of eating a cricket-based bar before and after given by participants exposed to the intellectual appeal and the social appeal. Change was significantly larger (Z = -2.19, p = .028, JZS BF_{10} = 3.92) in the social appeal condition with a mean rank of 185.12 and mean change of 0.63 (SD = 1.26) from 6.94 to 7.57 than the intellectual appeal condition which had a mean of rank 164.78 and mean change of 0.27 (SD = 1.22) from 6.75 to 7.01.

A Kendall's tau b correlation found that there was a significant weak negative association between age and initial rating likelihood of eating a cricket (tau b(352) = -0.1, p = .01, two-tailed, JZS BF_{10} = 4.98) and likelihood of eating a cricket-based bar (tau b(352) = -0.11, p = .005, two-tailed, JZS BF_{10} = 34.12).

A Mann-Whitney U test showed a significant difference between males (M = 6.45, SD = 3.11) and females (M = 4.76, SD = 3.35) on the self-reported likelihood of eating a whole cricket before appeal (Z = -4.613, p < .001, JZS BF_{10} = 4828.84). Similar results were found for the cricket bar before appeal, and revealed that the male (M = 7.63, SD = 2.63) and female (M = 6.34, SD = 3.24) groups did differ significantly (Z = -3.46, p = .001, JZS BF_{10} = 181.18).

Participant Comments

Of the 352 participants, 188 (53.4%) entered comments. Comments were summarised and coded based on emergent themes. A summary of the most frequent themes present in the open-ended response section are included in table 3, for themes with less than 5 occurences, only those of particular interest were included.

Table 3: Summary of the most frequent themes

n	%	Summary of relevant themes
45	24%	indicated a prior experience of eating insects, of those one had studied entomology in college, and another was an entomologist by profession
17	9%	made an expression of general openness to new experiences
16	9%	were vegetarians
15	8%	expressed texture as a reason for the disgust
15	8%	expressed visual factors as a reason for the disgust
11	6%	claimed they would have to be hungry before they would try
10	5%	indicated the preparation of the food as a major factor, of which six were disgusted by the vending machine mentioned in the scenario
7	4%	expressed a cultural or societal factor in their disgust
4	2%	indicated a fear of insects
2	1%	mentioned a disgust of almond butter which was mentioned as a flavour for the bar in the video
1	1%	found the individuals in the video disgusting

Discussion

For participants in this experiment, seeing others sample and enjoy a cricket-based food was more persuasive than learning how nutrious or healthy it might be. Older participants were less likely to try the new food and female participants rated themselves on average 17% less likely to try crickets than male participants did. Possible interpretations for these findings are discussed in more detail below.

Social versus Intellectual Appeal

Participants who saw the social appeal had a significantly greater change in the likelihood of eating a cricket bar than those participants who saw the intellectual appeal. However, those same participants did not have a significantly greater change in the likelihood of eating a whole cricket. The most obvious explanation for this was that the video used did not have whole crickets visible but instead only showed the cricket bar.

Nonetheless, it is questionable whether only showing a social appeal of a video showing individuals enjoying whole crickets, rather than a cricket bar, would result in a significantly greater change in the likelihood of eating a whole cricket when compared to the change in likelihood of eating a cricket-based bar. While the whole cricket shares all the qualities of the cricket bar apart from texture and appearance, it is likely that those qualities would create a greater resistance. If a whole cricket is less disgusting, all qualities of a cricket bar will also be less disgusting but the reverse is not necessarily true.

Some of the comments support this explanation, focusing on the visual and texture features of the whole cricket as a source of disgust: "If I closed my eyes so I wouldn't have to see the bugs... I'm sure I could get through a bite or two." "I find the appearance of bugs deeply off-putting. However, so long as they are processed into a form that isn't obviously bug like, I probably wouldn't care." In today's society of convenience and processed food, this particular element may be a recent cultural development of disgust.

Age and Gender

A weak negative correlation was found between age and the pre-appeal rating of the whole cricket. This is in the opposite direction to the correlation[52] found with the Disgust Sensitivity scale. This result supports the theory that the reduction in disgust with age found in a previous study[53] is specific to the death domain of the DS-R rather than generalising to the domains of animal or food disgust as ellicited by eating a cricket. The weak negative correlation suggests that the older an individual is the more disgusted they are by unknown foods. This may reflect years of preferred diet creating greater resistance or may be due to differing norms across cohorts. This finding may not be universal, in some developing countries entomophagy was common but attitudes have shifted to western values,[54] there older cohorts may be more open to eating insects than younger cohorts.

[52] John F. Quigley, Martin F. Sherman, and Nancy C. Sherman, "Personality Disorder Symptoms, Gender, and Age as Predictors of Adolescent Disgust Sensitivity," *Personality and Individual Differences* 22, no. 5 (1997), doi:10.1016/S0191-8869(96)00255-3.
[53] Daniel M.T. Fessler and C. David Navarrete, "The Effect of Age on Death Disgust: Challenges to Terror Management Perspectives."
[54] Arnold van Huis et al. *Edible Insects*.

Differences in gender for Disgust sensitivity score[55] were strongly supported in the specific instance of eating crickets. It seems likely that this disgust difference is related to gender specific norms rather than any biological difference but this distinction cannot be drawn from the data collected. Due to the employed rating system of 1 to 10, it is possible that the difference in average rating between genders of 1.69 may be artifically large as participants were unable to rate a difference of less than 10%. Previous research does however support the idea that there is a difference in disgust between genders, an fMRI study found gender differences in self-rated disgust but no difference in brain activity.[56] This supports the idea of social or cognitive rather than biological differences. It is likely that men learn gender roles where expressions of disgust are less acceptable and as a consequence have more opportunities to habituate to potentially disgusting experiences. This does suggest opportunities for further research focusing on subdomains of disgust that would be traditionally considered acceptable for females and not males.

Participant comments

From a review of the comments entered, it appears that attitudes towards entomophagy have already begun to shift with 12.8% of all participants indicating that they have eaten insects at some point in their life. Of the sample, 17.3% of participants, 61 of the 352, provided an initial rating of 90% to 100% likelihood of eating a whole cricket. For the cricket bar, 30.1%, 106 of the 352, of participants provided an initial rating of 90% to 100%. In addition to showing an increased acceptance of entomophagy, this posed some difficulty for analysis as these participants, having rated the highest possible score, were unable to be positively motivated and have their score increase. A post-hoc analysis of the data removing these participants and those who indicated a dietary restriction such as vegetarianism found no difference in significance.

Comments noted visual and textural disgust aspects as the main elicitors of disgust in eating crickets, with 15 comments mentioning visuals and 15 mentioning texture (of which one comment mentioned both). This would appear to relate to the animal related disgust of the disgust sensitivity scale. At least one participant, who had already tried crickets, noted that the legs were a potential choking hazard and should be peeled off before eating. The approach of removing these elements, by turning the cricket into processed flour and then a bar, appears to be a good one.

[55] Jonathan Haidt, Clark McCauley, and Paul Rozin, "Individual Differences in Sensitivity to Disgust."
[56] Anne Schienle, Axel Schäfer, Rudolf Stark, Bertram Walter, and Dieter Vaitl. "Gender Differences in the Processing of Disgust- and Fear-Inducing Pictures: An fMRI Study," *NeuroReport* 16, no. 3 (2005), doi: 10.1097/00001756-200502280-00015.

Of the sample, another 10 indicated that preparation and presentation would be an important factor, expressing concerns over how clean and safe the food was. This would appear to relate to the pathogen-related disgust, where concern of disease is not related to the cricket but instead to whether it has come into contact with any potential contaminants following the behavioural immune system model of disgust.[57,58] As an example, one participant, noted that smaller crickets should be avoided as the oil they are cooked in doesn't drain out sufficiently, and poor quality fats can cause stomach upsets.

The range of comments such as the disgust of almond butter, of vending machines, and of the individuals in the video revealed a number of unexpected uncontrolled variables which may have influenced the results. Future research on this topic could attempt to control for more of these variables to determine if the results remain valid.

In addition to the comments relating to the visual and textural elements, 2 participants indicated that they would be happy to eat the cricket bars if they did not know the contents included cricket. Visually and texturally, the bars do not elicit the same disgust reaction. This situation is reminiscent of the food additive E120 which is a commonly used red food dye made by crushing cochineal beetles into a fine powder. From habituation studies[59,60,61,62] it can be seen that exposure to the source of disgust can reduce it. In habituation research however the participant is aware of the presence of the source of disgust. When vegetarians were made aware of the nature of E120, it caused outcry and anger, rather than acceptance.[63]

Another example of this can be seen in public outcry against the "lean finely textured beef" product which recently has become more commonly known as "pink slime".[64] The product consisted of the entrails and cast off meat products that were placed in a centrifuge to separate fat from meat. The product was then cleansed of bacteria using ammonia, after which it was washed, and added to ground meat to bulk it out. When American consumers discovered they had been eating pink slime, there was a general revulsion towards it, despite consumers previously enjoying the product which was in use up to 10 years before the revelation.[65] Companies that had been using the product immediately pulled it and announced that their products did not contain it. From these examples, beyond the ethical implications, it is clear that surreptitiously adding cricket meat into the food supply would not alter attitudes towards it.

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[57] Justin H. Park, Jason Faulkner, and Mark Schaller, "Evolved Disease-Avoidance Processes and Contemporary Anti-Social Behavior: Prejudicial Attitudes and Avoidance of People with Physical Disabilities," *Journal of Nonverbal Behavior* 27, no. 2 (2003), doi:10.1023/A:1023910408854.

[58] Megan Oaten, Richard J. Stevenson, and Trevor I. Case, "Disgust as a Disease-Avoidance Mechanism."

[59] Paul Rozin, "Hedonic 'adaptation': Specific Habituation to Disgust/death Elicitors as a Result of Dissecting a Cadaver."

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[61] Peter J De Jong, Helena Andrea, and Peter Muris, "Spider Phobia in Children: Disgust and Fear before and after Treatment."

[62] Daniel M.T. Fessler and C. David Navarrete, "The Effect of Age on Death Disgust: Challenges to Terror Management Perspectives."

[63] Aaron Smith, "Starbucks to Phase out Bug Extract as Food Dye," *CNNMoney*, 19 April 2012, http://money.cnn.com/2012/04/19/news/companies/starbucks-bugs/index.htm.

[64] M. Alex Johnson, "McDonald's Drops Use of Gooey Ammonia-Based 'Pink Slime' in Hamburger Meat," *NBC News*, 30 January 2012, http://usnews.nbcnews.com/_news/2012/01/31/10282876-mcdonalds-drops-use-of-gooey-ammonia-based-pink-slime-in-hamburger-meat.

[65] Joel L. Greene, "Lean Finely Textured Beef: The 'Pink Slime' Controversy", Congressional Research Service, published April 6, 2012, http://www.nationalaglawcenter.org/wp-content/uploads/assets/crs

Conclusion

One of the key findings of this experiment is that individuals appear to be more influenced in their attitude of disgust by the actions of others than by information appealing to reason. In the case of entomophagy, it follows that seeing others eating insects reduces the inherent disgust. Future research could look at the vehicle of the social appeal to see if specific social models, especially desirable role models such as celebrities, consuming insect-based products would have the greatest influence on social attitudes.

Qualitative elements from the research, point to appearance and texture as primary disgust elicitors, indicating that processing is an important step for acceptance. Given the findings relating to gender and age, targeting the young male demographic would have the greatest success. Once an established foothold has been made in this group, they would serve as a social role model reducing levels of disgust across all groups and promoting insects as an acceptable food source.

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