How people's food disgust sensitivity shapes their eating and food behaviour

Journal Article

Author(s):
Egolf, Aisha; Siegrist, Michael; Hartmann, Christina

Publication date:
2018-08-01

Permanent link:
https://doi.org/10.3929/ethz-b-000268620

Rights / license:
Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International

Originally published in:
Appetite 127, https://doi.org/10.1016/j.appet.2018.04.014
How people's food disgust sensitivity shapes their eating and food behaviour

Aisha Egolf*, Michael Siegrist, Christina Hartmann

ETH Zurich, Department of Health Science and Technology (D-HEST), Consumer Behaviour, Universitätstrasse 22, Zurich 8092, Switzerland

ABSTRACT

Although research regarding disgust has increased enormously in the last decades, to date there is a lack of published research about the influence of food disgust on various food-related behaviours. Our study aimed to provide an understanding about the relationships between food disgust sensitivity and eating preferences (texture-based food rejection), habits (variety seeking), and behaviours (picky eating) as well as food waste frequency. Additionally, sociodemographic characteristics associated with food disgust sensitivity were examined. German-speaking Swiss adults (N = 1181) completed a paper-and-pencil questionnaire. Next to the Food Disgust Scale (FDS), the questionnaire included several established eating behaviour scales, such as the Adult Picky Eating Questionnaire, a scale regarding seeking food variety and a food frequency questionnaire. In addition, food waste frequency was also assessed by self-report. Multiple regression analyses showed that with increasing age, food disgust sensitivity scores increased and women showed higher FDS scores than men. Moreover, while picky eating and the rejection of certain food textures were both positively associated with higher FDS scores, seeking variety in foods was negatively associated with food disgust sensitivity. Significant correlations between FDS scores and the frequency of consuming certain foods were observed (e.g. vegetables, seafood). Finally, people with higher FDS scores reported a higher frequency of wasting food than people with lower FDS scores. The results indicate that individual food disgust sensitivity plays a role in various food domains.

1. Introduction

1.1. Disgust

In the last two decades, scientific interest in disgust and its impacts on human attitudes and behaviours has increased rapidly. Disgust is defined as a broad adaptive functional system protecting against pathogen infections (Curtis, de Barra, & Aunger, 2011) and is therefore also called the behavioural immune system (Terrizzi, Shook, & McDaniel, 2013). Even though disgust is seemingly elicited by many different vectors like rotten foods, bodily liquids, and faeces (Curtis et al., 2011; Rozin, Haidt, & McCauley, 2008), it is assumed that the disgust function originated in the prevention of oral ingestion of toxic or offensive agents (Darwin, 1872; Rozin & Fallon, 1987). On the one hand, disgust has a functional effect on eating behaviour that prevents the eating of risky foods like foods with a potential high pathogen load. On the other hand, it is conceivable that a high disgust sensitivity is associated with more restrictive eating behaviour. In line with this assumption, it was shown that disgust is related to eating disorders like anorexia nervosa and bulimia (Aharoni & Hertz, 2012; Davey, Buckland, Tantow, & Dallos, 1998; Troop, Treasure, & Serpell, 2002).

Interestingly, no one has yet systematically examined how disgust influences everyday eating behaviour in a general non-clinical population. One reason for this lack of this research has been the unavailability (until recently) of a domain-specific disgust scale focusing on food (Hartmann & Siegrist, 2018). Commonly-used disgust scales (e.g. the Disgust Scale by Haidt, McCauley, & Rozin, 1994) include many different domains such as disgust related to sex, animals and rotten foods. By contrast, Hartmann and Siegrist’s (2018) recently-developed Food Disgust Scale (FDS) measures domain-specific food disgust sensitivity, that is people’s sensitivity to react with disgust to certain food-related (offensive) stimuli. Next to that the FDS includes items related to pathogens, to poor hygiene and human contamination, it also includes non-pathogen items that are, for example, related to the process of aging (e.g. ‘To eat apple slices that turned brown when exposed to air’) and thus enable measurement of food disgust oversensitivity. Because of its focus on food items, the FDS seems better suited to investigate eating and food behaviours than other disgust scales. In a validation study of the FDS by Ammann, Hartmann, & Siegrist, (in press) food disgust sensitivity predicted the amount of consumption for different food products (e.g. meat) presented with written scenarios aiming to induce disgust. The present study aimed to examine whether
food disgust has functional or dysfunctional effects on eating habits (variety seeking), preferences (texture-based food rejection), behaviours (picky eating), actual food choices, and food behaviours like food waste frequency. In addition, we investigated the associations between food disgust sensitivity and predictive factors like sociodemographic variables and digestive complaints.

1.2. Predictors of food disgust sensitivity

Previous studies have shown that disgust seems to decrease with age and is more pronounced in women than in men (Curtis, Anuger, & Rabie, 2004; Fessler, Arguello, Mekdara, & Macias, 2003). However, it is unclear if these associations hold true for the domain-specific food disgust or only for an overall disgust measure. Other demographics, such as education or income, have rarely been investigated in relation to disgust. Results of a previous study indicated negative associations with overall disgust, but the effects were rather small (e.g. Berger & Anaki, 2014). Income and education are assumed to result in more exposure to various foods (e.g. Meiselman, King, & Gillette, 2010; Siegrist, Hartmann, & Keller, 2013). Therefore, such individuals are likely used to having contact with a greater variety of food disgust-elicitors, which also might lead to lower food disgust sensitivity. According to this explanation income and/or education are negatively associated with food disgust sensitivity. Another possibility could be that people with higher incomes can afford to be disgust sensitive. For example, they are economically capable of throwing away foods that are no longer absolutely fresh; they have no financial need to eat them and therefore do not get used to disgust cues. In this case, income would be positively associated with food disgust sensitivity.

Furthermore, food disgust sensitivity may be influenced by experiences with food-related diseases or digestive complaints after eating certain foods. Taste aversions to foods that have caused nausea have been reported in humans (Pelchat & Rozin, 1982). Animal studies indicate that such conditioned taste aversions are accompanied by conditioned disgust reactions to the aversive foods (Garcia, 1989; Parker, 2003). Conditioned taste aversions seem to develop prominently after eating animal-based foods (Fessler & Arguello, 2004; Logue, Ophir, & Strauss, 1981), which might be due to a higher risk of bacterial contamination of animal-based foods compared to plant-based foods. It comes as no surprise that food poisonings after eating animal-based foods are more common than after eating plant-based products (Sokett, 1995). Independent of the food source, Hartmann and Siegrist (2018) found a positive correlation between food disgust sensitivity and people's reported number of food poisoning incidents within the last five years. However, it cannot be determined from that study whether past food poisoning experiences increased food disgust sensitivity or whether people with a higher food disgust sensitivity have a physical vulnerability to infections transmitted by foods. Therefore, as a next step in this line of research, we examined whether food disgust sensitivity is associated with frequent or regular digestive problems like having a sensitive stomach. We hypothesised that these frequent experiences with digestive complaints are positively linked to food disgust sensitivity.

1.3. Eating habits, preferences and behaviours

Disgust prevents an organism from coming in contact with potential harmful objects. Correspondingly, food disgust prevents ingestion of potential harmful foods. Thus, it is reasonable that it interferes with habits that promote risk taking like variety seeking in foods. Van Trijp and Steenkamp (1992) define the concept as a tendency to seek variation in stimulation through variation in food consumption. Next to eating new and unfamiliar food products, seeking variety in foods also includes looking for diversity by often alternating the consumption of familiar foods (Lähteenmäki & Arvola, 2001). Generally, dietary variety increases the probability of adequate nutrient intake (Foote, Murphy, Wilkens, Basiotis, & Carlson, 2004) and variety seeking is positively related to variations in consumption of fruits, vegetables and all kinds of foods (Van Trijp & Steenkamp, 1992). Haidt et al. (1994) observed a negative association between the overall Disgust Scale and experience seeking. They argued that disgust is a defensive emotion that makes people cautious of new foods, sexual activities or any new unusual experience that could pose a risk of contamination. Likewise, each additional unfamiliar food source may potentially increase the risk of eating harmful, contaminated foods (Al-Shawaf, Lewis, Alley, & Buss, 2015; Rozin, 1976; Scheibehenne et al., 2014). Therefore, we hypothesised that food disgust sensitivity is a negative predictor for variety seeking, which has not been examined so far.

In terms of food preferences, we investigated whether food disgust is associated with texture-based food rejection since that seems to be an important reason for experiencing disgust in the general population (Kushner, 2011). The texture of food can indicate a state of decay that is potentially harmful (Martins & Pliner, 2006; Szczesniak & Kahn, 1971). A crispy texture usually elicits the perception of freshness, whereas softness is associated with decay and spoilage (Szczesniak & Kahn, 1971). Oaten, Stevenson, and Case (2009) found that the tactile sense by which texture is experienced has a privileged connection to the brain region (the insula) associated with disgust. People high on the FDS may be more sensitive to the textural properties and reject foods because of certain textural characteristics. We hypothesise that food disgust sensitivity is a positive predictor of food rejection due to certain textural properties.

Picky eating behaviour is defined as an aversion to a variety of either familiar or unfamiliar foods which results in limited dietary variety (Dovey, Staples, Gibson, & Halford, 2008; Mascola, Bryson, & Agra, 2010; for a review, see; Taylor, Wernimont, Nothstone, & Emmett, 2015). For a long time, picky eating was researched only in children, but studies examining adult picky eating are slowly emerging in published research. Initial results indicate that adults who are picky eaters report having a restricted diet and strong dislikes of certain foods, especially fruits and vegetables (Thompson, Cummins, Brown, & Kyle, 2015; Zickgraf & Schepps, 2016). Furthermore, adult picky eaters claim to prefer sweet, salty, junk food, fried food and other energy-dense foods (Kumar et al., 2016) and describe themselves as unhealthy eaters (Kauer, Pelchat, Rozin, & Zickgraf, 2015). Next to the described specific food choices, picky eating was consistently shown to be associated with texture-based food rejection (Kauer et al., 2015; Van der Horst, Deming, Lesnaukas, Carr, & Reidy, 2016; Zeinstra, Koelem, Kok, & de Graaf, 2010) as well as food neophobia – the aversion of eating new foods (Dovey, Staples, Gibson, & Halford, 2008; Kauer et al., 2015; Zickgraf, Franklin, & Rozin, 2016); the latter has already been shown to be correlated with domain-specific food disgust sensitivity (Hartmann & Siegrist, 2018). Nevertheless, it is unclear what specific factors underlie the manifestation of picky eating behaviour. Certain factors, such as sensory hypersensitivity and parental pressuring feeding style, are discussed for children and adults (Galloway, Fiorito, Lee, & Birch, 2005; Kauer et al., 2015). Previous studies also reported that overall disgust sensitivity (Kauer et al., 2015), food disgust sensitivity (Hartmann & Siegrist, 2018) and picky eating in adults are positively associated. However, the picky-eating construct in the studies of both Kauer et al. (2015) and Hartmann and Siegrist (2018) was assessed only with four items each and in the latter case, only a correlational analysis was carried out. Therefore, another aim of the present study was to examine the predictive power of food disgust sensitivity on picky eating with a newer, comprehensive picky eating measurement tool (Ellis, Galloway, Webb, & Martz, 2017) in a multiple regression analysis that enables to control for sociodemographic variables.

1.4. Food choices

The study examined whether food disgust sensitivity was associated not only with specific psychological eating constructs, such as picky...
eating, but also with everyday food choices and the frequency of consuming particular foods. Certain food properties are associated with disgust reactions (Martins & Pliner, 2005, 2006), which might be particularly pronounced in high disgust-sensitive persons, hence preventing consumption. For example, some food products have a naturally slimy texture (e.g. eggs, seafood, innards), and others have a particularly high bacterial contamination risk (e.g. meat, fish, seafood). Furthermore, unprocessed animal flesh (e.g. pork) has stronger reminders of eating living creatures (and the associated bloody slaughter of animals) than processed animal flesh (e.g. sausages) (Hartmann & Siegrist, 2018; Martins & Pliner, 2006; Rozin et al., 2008). These aspects may elicit disgust reactions in high disgust-sensitive people and likely lead to avoidance of such food products (animal-based foods in particular). Therefore, we expected a negative association between food disgust sensitivity and consumption frequency of unprocessed meat (e.g. pork, beef) and no association with processed meat (e.g. sausages). Moreover, we hypothesised that food disgust sensitivity is negatively related to the consumption frequency of fish, seafood, and eggs, but it is not related to the consumption frequency of either sweets and savouries or fruits and vegetables.

1.5. Food waste

In industrialised countries, consumers’ food waste accounts for the largest percentage of food losses in the value chain (Parfitt, Barthel, & Macnaughton, 2010), and it is mostly avoidable (Beretta, Stoessel, Baier, & Hellweg, 2013; WRAP, 2009) because people cook, prepare or serve too much food or because it is not used in time (WRAP, 2009). Several factors have been identified as associated with food waste on the consumer side ranging from sociodemographic variables to motivators and attitudes (Graham-Rowe, Jessop, & Sparks, 2014; Visschers, Wickli, & Siegrist, 2016). From an evolutionary perspective, the relationship between disgust and food waste seems reasonable. Food disgust as a disease-avoidance mechanism is triggered by cues that indicate potential contamination and inedibility. Therefore, people with high levels of food disgust sensitivity probably react more strongly to cues that indicate the process of decay or ageing of food and thus to foods that do not look fresh but might still be edible. Consequently, people with high levels of food disgust sensitivity may throw away foods more readily and produce more food waste than people with low levels of food disgust sensitivity. We therefore expected a positive association between food disgust sensitivity and food waste.

1.6. Aims of the present study

Our study aimed to provide an understanding of the factors predicting food disgust sensitivity and its impact on different food-related behaviours. In particular, the influence of sociodemographic variables and digestive complaints on food disgust sensitivity were examined. The impact of food disgust sensitivity on eating habits, preferences and behaviours were investigated focusing on variety seeking, texture-based food rejection and adult picky eating. We hypothesised that food disgust sensitivity would be a positive predictor of texture rejection and adult picky eating but a negative predictor of seeking variety in foods. Food disgust sensitivity and consumption frequency of certain foods was also analysed. Finally, the contribution of food disgust sensitivity to food waste frequency was investigated.

2. Method

2.1. Participants

A survey was sent by mail to 2800 randomly selected addresses from the telephone book of the German-speaking part of Switzerland. To compensate for the underrepresentation of younger people, who are less frequently registered in the telephone book, we ordered an additional 700 addresses of people belonging to the 20–39 age range from a panel listed by a commercial provider (Schober Group Switzerland). From the total of 3500 questionnaires, 1206 people completed the survey (34.5% response rate). Questionnaires with missing key variables (age and gender) and with more than 50% missing values were excluded. Additionally, participants under 20 years of age were not included. After data cleaning, the final sample consisted of 1181 participants. The mean age of the sample recruited from the telephone book (N = 990) was 60.34 (SD = 15.20) years, and 43.2% were men. The mean age of the second sample (N = 191) was 33.23 (SD = 8.46) years, and 36.6% were men. Table 1 displays the sociodemographic characteristics of the final study sample.

2.2. Questionnaire/measures

The paper-and-pencil questionnaire included questions regarding the following constructs: food disgust sensitivity, texture-based rejection, adult picky eating, seeking variety in foods, food waste behaviour, frequency of digestive complaints and frequency of consuming certain foods. Sociodemographic variables were also assessed.

2.2.1. Food Disgust Scale

The short version of the FDS (Hartmann & Siegrist, 2018) was used to assess individual disgust predispositions towards certain food-related (offensive) stimuli. The short scale consists of eight items originating from different types of food disgust: animal flesh, poor hygiene, human contamination, decaying fruits, decaying vegetables, fish, mould and living contaminants. For example, two items asked about a respondent’s perception of how disgusting it would be to eat hard cheese from which

---

**Table 1**

Characteristics of the study sample.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Gender</th>
<th>Age range</th>
<th>Educational level</th>
<th>Income level</th>
<th>Residence</th>
<th>Having children</th>
<th>Age range</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>42.2%</td>
<td>20–39 years</td>
<td>Low</td>
<td>City</td>
<td>23.8%</td>
<td>33.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>57.8%</td>
<td>40–64 years</td>
<td>Middle</td>
<td>Suburbs</td>
<td>31.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65–79 years</td>
<td>High</td>
<td>Rural</td>
<td>44.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80 + years</td>
<td>Missing</td>
<td>Missing</td>
<td>0.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>City</td>
<td>23.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Middle</td>
<td>Suburbs</td>
<td>31.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>Rural</td>
<td>44.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Missing</td>
<td>Missing</td>
<td>0.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>City</td>
<td>23.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Middle</td>
<td>Suburbs</td>
<td>31.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>Rural</td>
<td>44.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Missing</td>
<td>Missing</td>
<td>0.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 1181. Educational level was classified into three categories: (low) primary and secondary school; (middle) vocational, middle and higher vocational school; and (high) higher secondary school, college and university. Income level (Swiss Francs [CHF]) was classified into the following categories: (low) less than 3000 CHF, 3001–5000 CHF; (middle) 5001–7000 CHF; and (high) 7001–9000 CHF, 9001–11,000 CHF and 11,001 CHF and above.
mould was cut off’ or ‘to eat with dirty silverware in a restaurant’. The items were rated on a 6-point scale, ranging from 1 (not disgusting at all) to 6 (extremely disgusting). Mean values were calculated by averaging all eight items ($M = 3.45$, $SD = 0.93$). Cronbach’s alpha was .73, which was comparable to the values observed by Hartmann and Siegrist (2018).

### 2.2.2. Sociodemographic measures

Age, gender, income, education, residence and having children were assessed. Income (in CHF) was measured with six levels (less than 3000; 3001–5000; 5001–7000; 7001–9000; 9001–11,000; and 11,001 and above). Level of education was measured as follows: primary school, lower secondary school, vocational, middle and higher vocational schools, higher secondary school and college or university. For residence, the participants indicated whether they lived in a city, the suburbs or a rural area. The participants were also asked if they had children; ‘yes’ was coded as 1, or ‘no’ was coded as 0.

### 2.2.3. Digestive complaints

Each participant indicated whether he or she had a sensitive stomach using a dichotomous rating scale with a ‘yes’ (1) or a ‘no’ (0) answer. This item was adapted from a scale by Kals and Odenthal (1996). Sixteen percent of respondents indicated that they have a sensitive stomach. Participants were also asked to indicate how often they experienced gastrointestinal symptoms after consuming animal-based foods. Due to the higher risk of bacterial contamination in animal-based foods (versus plant-based foods), we expected the respondents to report having gastrointestinal complaints after consuming animal-based products rather than after eating vegetables. Thus, three items for meat, fish and milk were constructed. Participants were instructed not to take into account gastrointestinal complaints because of food intolerances (e.g. lactose intolerance), food allergies (e.g. peanut allergy) or stress-induced gastrointestinal complaints since these are not of pathogenic origin, and we did not expect a relationship to disgust with these kinds of complaints. The response options were ‘never’, ‘rarely’, ‘sometimes’, ‘often’, ‘very often’ and ‘do not know’. The ‘do not know’ option was coded as a missing value, and the other options were coded from 1 to 5 in ascending order. A mean score was calculated across items for meat, fish and dairy products ($M = 1.36$, $SD = 0.56$; Cronbach’s $\alpha = 0.67$).

### 2.2.4. Eating habits, preferences, and behaviours

The Van Trijp and Steenkamp (1992) variety seeking scale for food included ten items, such as ‘I think it is fun to try out food that one is not familiar with’ or ‘While preparing foods or snacks, I like to try out new recipes’. The items were rated on a 5-point Likert scale, ranging from 1 (do not agree at all) to 5 (fully agree). An average score was calculated across all items ($M = 3.41$, $SD = 0.94$; Cronbach’s $\alpha = 0.91$).

The items measuring texture-based rejection were constructed according to those used by Kauer et al. (2015) and Zeinstra et al. (2010). For example, one item asked if the respondent almost always reject slimy foods. Other textures that were asked in the same fashion included chewy, slippery, gelatinous, creamy and granular. These items were rated with ‘yes’ (1) or ‘no’ (0), and a sum score was calculated ($M = 1.33$, $SD = 1.35$; Cronbach’s $\alpha = 0.64$).

Picky eating was measured with the Adult Picky Eating Questionnaire (APEQ; Ellis et al., 2017) which consists of 16 items and four subscales (meal representation, food variety, meal disengagement and taste aversion). The items (e.g. ‘I eat a limited number of items from each food group’ or ‘I eat foods in a specific sequence’) were rated with five response options (never, rarely, sometimes, often and always), coded from 1 (never) to 5 (always). For our study, a mean scale score across all items was calculated ($M = 2.13$, $SD = 0.43$; Cronbach’s $\alpha = 0.73$).

### 2.2.5. Food choices

A short food frequency questionnaire (FFQ), adapted from the work of Hartmann, Siegrist, and van der Horst (2013), was used to assess the frequency of consuming beef and veal, pork, poultry, processed meats (e.g. cold cuts, sausages), special meats (e.g. venison, lamb, ostrich), fish, seafood (e.g. mussels, shrimps), eggs (e.g. scrambled, boiled, omelette), sweets (e.g. cookies, chocolate, pastry) and savouries (e.g. chips, nuts, salty snacks). The items were rated on a 6-point scale, as follows: several times a day (code 14), daily (code 7) 5–6 times per week (coded as 5.5), 3–4 times per week (coded as 3.5), 1–2 times per week (coded as 1.5), 1–3 times per month (coded as 0.5) and less or never (coded as 0).

Fruit, salad and vegetable consumption was assessed with consumption frequency and number of portions using the same response scale as the other food products (excluding the ‘several times a day’ option). For the number of portions, the participants indicated the number of portions of fruits (one portion = one fruit), salad (one portion = one handful) and vegetables (one portion = one handful) that they usually consumed per day when they ate these foods. The consumption frequency and the consumption portion were multiplied to estimate the amount of consumed fruits, salad and vegetables per week (Siegrist et al., 2013). The salad and the vegetable scores were combined, yielding a total vegetable score.

### 2.2.6. Food waste

Food waste frequency was assessed with eight items (e.g. ‘How often do you throw away foods that are leftovers?’ or ‘How often do you throw away food that is expired?’). The items were constructed based on the Visschers et al. (2016) food waste scale. Item content was adapted according to our research purpose. The following response options were maintained: 6–7 times per week (coded as 6.5), 3–5 times per week (coded as 4), 1–2 times per week (coded as 1.5), 2–3 times per month (coded as 0.625), about once a month (coded as 0.25) and less or never (coded as 0.1). The scale score represented the sum score ($M = 2.03$, $SD = 1.95$; Cronbach’s $\alpha = 0.66$).

### 2.3. Statistical analysis

Correlational analyses (Pearson correlation) between the short FDS and predictor variables, such as sociodemographic factors and food-related digestive complaints, were conducted. Significant variables were included in further analysis. Additionally, we examined whether there were significant relationships between the short FDS and eating and food behaviours such as texture-based rejection, adult picky eating, variety seeking, and food waste frequency.

In a multiple linear regression analysis, the predictive power of the sociodemographic factors (i.e., gender, age and income) for food disgust sensitivity was examined. Moreover, two variables (gastrointestinal complaints and having a sensitive stomach) were included in the model.

In order to examine the relationships between food disgust sensitivity and eating habits, preferences, and behaviour as well as food waste, four separate hierarchical regression models were calculated with the dependent variables (variety seeking, texture-based rejection, adult picky eating and food waste frequency). In all hierarchical regression models, age, gender and income were included as control variables. To examine how much additional variance food disgust sensitivity can explain above and beyond the sociodemographic variables, age, gender and income were entered in the first step and food disgust sensitivity in the second step in all regressions.

To examine the relationship between food disgust sensitivity and food consumption frequencies, correlational analyses were conducted. Spearman’s rho was used because the distributions of the food frequency items were skewed. Because men and women differ in their consumption frequency for various food products like vegetables and meat (e.g. Elfhag, Tholin, & Rasmussen, 2008; Hartmann, Dohle, &
Table 2
Correlation coefficients (Pearson) for food disgust sensitivity (FDS short) and the investigated study variables.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDS short</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.12**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Gender</td>
<td>.12**</td>
<td>-.10*</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Education</td>
<td>-.19**</td>
<td>-.15**</td>
<td>-.11**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Income</td>
<td>-.11**</td>
<td>-.25**</td>
<td>-.09*</td>
<td>.42**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Having children</td>
<td>.03</td>
<td>.33**</td>
<td>&lt; .01</td>
<td>.07</td>
<td>&lt; .01</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Having a sensitive stomach</td>
<td>.13**</td>
<td>.05</td>
<td>.05</td>
<td>.05</td>
<td>.04</td>
<td>.06</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Gastrointestinal complaints</td>
<td>.15**</td>
<td>.05</td>
<td>.06</td>
<td>.03</td>
<td>.03</td>
<td>.09*</td>
<td>.32**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Texture-based rejection</td>
<td>.41**</td>
<td>.24**</td>
<td>.02</td>
<td>-.14**</td>
<td>-.19**</td>
<td>-.07</td>
<td>-.09*</td>
<td>.14**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Adult picky eating</td>
<td>-.36**</td>
<td>-.24**</td>
<td>-.08*</td>
<td>-.13**</td>
<td>-.16**</td>
<td>&lt; .01</td>
<td>.13**</td>
<td>.19**</td>
<td>.44**</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Variety seeking</td>
<td>-.21**</td>
<td>-.09*</td>
<td>.05</td>
<td>.18**</td>
<td>.16**</td>
<td>.01</td>
<td>.04</td>
<td>.05</td>
<td>-.30**</td>
<td>-.32**</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Food waste frequency</td>
<td>.09*</td>
<td>-.25**</td>
<td>.03</td>
<td>.13**</td>
<td>.14**</td>
<td>&lt; .01</td>
<td>.08S</td>
<td>.21**</td>
<td>-.02</td>
<td>.10**</td>
<td>.01</td>
<td>–</td>
</tr>
</tbody>
</table>

Note. N varies between 1102 and 1181 due to missing values. Gender: 0 = males, 1 = females. Having children and having a sensitive stomach: 0 = No, 1 = Yes. Bold = significant at the level of p < .01.

*p < .05, **p < .01.

Siegrist, 2015; Hartmann et al., 2013) and women typically report higher disgust sensitivity, partial correlations controlled for gender were also conducted to rule out alternative explanations of the observed effects.

Considering the rather large sample size and that effects between food frequency measures and psychological variables are usually not very high (e.g. Elfhag et al., 2008; Hartmann et al., 2013; Hartmann et al., 2015; Siegrist et al., 2013), the significance level was set at p = .01 for all tests. Calculations were done by using RStudio version 1.0.136 (RStudio, Inc., Boston, MA, 2016).

3. Results

3.1. Predictors of food disgust sensitivity

Table 2 displays the correlation coefficients for the FDS score and the predictors of food disgust sensitivity. As shown, the FDS score was significantly correlated with age, gender, education, income, having a sensitive stomach and the gastrointestinal complaints score.

Table 3 presents the results of the multiple regression analysis predicting food disgust sensitivity with age, gender, income, having a sensitive stomach and gastrointestinal complaints. The model was significant, F(S, 1101) = 15.33, p < .001; and explained 6.5% of the variance. As shown in Table 3, age and gender were significantly predictive of food disgust sensitivity. Particularly, age was positively correlated with FDS scores, indicating that older people had higher FDS scores than younger people. Gender was also a positive predictor; women had higher FDS scores than men. People who reported higher levels of food disgust sensitivity also self-reported having sensitive stomachs and higher frequencies of gastrointestinal complaints after eating animal-based foods than people reporting lower levels of food disgust sensitivity.

Table 3
Results of multiple regression analysis, with food disgust sensitivity (FDS short) as the dependent variable and sociodemographic factors and digestive complaints as the independent variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.83</td>
<td>.15</td>
<td>-.01</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age</td>
<td>&lt; .01</td>
<td>&lt; .01</td>
<td>.12</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Gender</td>
<td>.22</td>
<td>.06</td>
<td>.12</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Income</td>
<td>.05</td>
<td>.02</td>
<td>.07</td>
<td>.016</td>
</tr>
<tr>
<td>Having a sensitive stomach</td>
<td>.20</td>
<td>.08</td>
<td>.08</td>
<td>.008</td>
</tr>
<tr>
<td>Gastrointestinal complaints</td>
<td>.20</td>
<td>.05</td>
<td>.12</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Note. N = 1106. Gender: 0 = males, 1 = females. Having a sensitive stomach: 0 = no, 1 = yes. R2 = 0.65. Bold = significant at the level of p < .01.

3.2. Eating habits, preferences and behaviours

Correlational analyses among variety seeking in foods, texture-based rejection, adult picky eating, and food disgust sensitivity are shown in Table 2. All variables were significantly related to food disgust sensitivity.

Table 4 displays the regression analyses predicting variety seeking with age, gender, income and FDS. The basic model without food disgust sensitivity (not presented in Table 4) was significant, F(3, 1130) = 12.80, p < .001; and explained 3.3% of the variance in variety seeking. Adding food disgust sensitivity to the regression model significantly explained an additional 4.0% of the variance, Fchange(1, 1129) = 49.17, p < .001. The final model was significant, F(4, 1129) = 22.30, p < .001; and explained 7.3% of the variance (Table 4). Next to age, gender and income, food disgust sensitivity was predictive and negatively associated with variety seeking. People reporting higher levels of food disgust sensitivity claimed lower levels of variety seeking in foods than people reporting lower levels of food disgust sensitivity.

The hierarchical regression model predicting texture-based rejection with age, gender and income was significant, F(3, 1129) = 29.65, p < .001; and explained 7.3% of the variance. The change in R2 for the inclusion of food disgust sensitivity to the basic model with age, gender and income was significant, Fchange(1, 1128) = 201.83, p < .001; and explained an additional 21.4% of the variance. The final model was significant, F(4, 1128) = 76.65, p < .001; and explained 21.4% of the variance (Table 4). Next to age, gender and income, food disgust sensitivity was significant predictors of texture-based rejection. The positive effect of food disgust sensitivity on texture-based rejection indicated that people reporting higher levels of food disgust sensitivity more often rejected foods with a certain texture than people reporting lower levels of food disgust sensitivity.

The hierarchical regression analysis predicting adult picky eating by age, gender and income was significant, F(3, 1128) = 30.35, p < .001; and explained 7.5% of the variance. The change in R2 for the inclusion of the food disgust sensitivity to the basic model with age, gender and income was significant, Fchange(1, 1127) = 157.73, p < .001. Thus, the food disgust sensitivity explained the additional 11.4% variance in adult pick eating compared to the basic model without the FDS. The final regression model was significant, F(4, 1127) = 65.36, p < .001; explaining 18.8% of the variance (Table 4). In addition to the age, gender and income variables, the FDS score was a strong predictor of adult picky eating. People with high FDS scores also had higher scores on the APEQ than people with low FDS scores.
3.3. Food choices

Table 5 presents the frequency of food consumption by men and women per week. On average, women consumed more fruits and vegetables than men, while men reported higher frequencies of consumption of most of the animal-based foods. Consumption frequency for fish, seafood, special meats, and innards were lower than for other products in both genders. Table 6 displays the results of the correlational analysis between food disgust sensitivity and the food frequency questionnaire. Significant correlations after controlling for gender remained for the consumption frequency of vegetables, eggs, special meats (e.g., venison, lamb, ostrich) and seafood. The direction of the correlations indicates that people reporting higher food disgust sensitivity tended to consume less vegetables, eggs, special meats (e.g., venison, lamb, ostrich) and seafood.

3.4. Food waste

As can be seen in Table 2, the correlational coefficient between FDS scores and food waste was significant. The hierarchical regression model predicting food waste frequency with age, gender and income was significant, \( F(3, 1144) = 29.28, p < .001 \); and explained 7.1% of the variance. The inclusion of FDS to the regression model significantly explained additional 1.8% in the variance of food waste, \( F\text{ change}(1, 1143) = 22.11, p < .001 \). The final model with age, gender, income and FDS as predictors was significant, \( F(4, 1143) = 27.89, p < .001 \); and explained 8.9% of the variance (Table 7). Age, income and food disgust sensitivity were significant predictors. The FDS score was a positive predictor of food waste frequency; people with high FDS scores reported producing more often food waste.

4. Discussion

Our study aimed to provide initial insights into the contributions of food disgust sensitivity to the daily eating behaviour of the general population. Moreover, predictors of food disgust sensitivity, such as sociodemographic characteristics and digestive irritabilities, were examined. Exploring how food disgust sensitivity influences eating behaviour is not only important for a better understanding of eating behaviours, such as adult picky eating, it is also essential for marketing new food products and for the development of interventions related to food waste reduction.

4.1. Predictors of food disgust sensitivity

The results revealed that women had higher levels of food disgust sensitivity than men, which is consistent with the findings of previous research.

Table 7

Results of the hierarchical multiple regression analyses (final model) predicting food waste frequency from sociodemographic variables and food disgust sensitivity (FDS short).

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>( \beta )</th>
<th>p-value</th>
<th>B</th>
<th>SE B</th>
<th>( \beta )</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.42</td>
<td>.33</td>
<td></td>
<td></td>
<td>1.50</td>
<td>.07</td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age</td>
<td>-.03</td>
<td>&lt; .01</td>
<td>-.25</td>
<td>&lt; .001</td>
<td>-.26</td>
<td>&lt; .01</td>
<td>-.08</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Gender</td>
<td>.25</td>
<td>.11</td>
<td>-.06</td>
<td>&lt; .026</td>
<td>.04</td>
<td>.08</td>
<td>.14</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Income</td>
<td>.10</td>
<td>.04</td>
<td>.08</td>
<td>&lt; .006</td>
<td>.06</td>
<td>.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDS short</td>
<td>.28</td>
<td>.06</td>
<td>.14</td>
<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: \( N = 1147 \). Gender: 0 = males, 1 = females. FDS: Food Disgust Scale. \( R^2 = 0.89 \). Bold = significant at the level of \( p < .01 \).
studies concerning disgust (Curtis et al., 2004; Fessler et al., 2003; Haidt et al., 1994; Tybur, Lieberman, & Griskevicius, 2009). One explanation for this could be related to their evolutionary-determined role in reproduction (Curtis et al., 2004, 2011; Fessler et al., 2003; Tybur et al., 2009). Because of their role as offspring carriers, it is more important for women to reduce their risk of infections via incorporation of or contact with potential disease vectors.

Age was positively associated with food disgust sensitivity but had rather limited contributions in terms of explaining variations in food disgust sensitivity compared to gender. In a study by Berger and Anaki (2014) the effect of age varied according to the investigated disgust domain; they found both positive and negative associations. In contrast, using different disgust measures and study samples, previous researchers found that disgust consistently declines with age (Curtis et al., 2004; Druschel & Sherman, 1999; Fessler & Navarrete, 2005; Quigley, Sherman, & Sherman, 1997). Old age is associated with vulnerability to (infectious) diseases (Richard, Garibaldi, Brenda, & Nurse, 1986), and elderly people perceive themselves as more vulnerable to diseases (Prohaska, Leventhal, Leventhal, & Keller, 1985). Thus, it seems reasonable to assume that food disgust increases with age (Oaten et al., 2009). However, mere exposure to disgust elicitors has been shown to be associated with reduced disgust sensitivity to these elicitors (e.g. Rozin, 2008; for a review, see; Oaten et al., 2009). Therefore, Oaten et al. (2009) suggested that the increased level of disgust sensitivity that comes with age in response to increased vulnerability to disease would be masked by the mere exposure history of older people, which may have contributed to the rather small effect of age on disgust in our data.

Another study measuring food disgust sensitivity with a picture scale confirmed a positive association with age (Ammann et al., 2018). Either way, longitudinal studies are needed to investigate whether overall and food-specific disgust sensitivity significantly changes with age and what life circumstances are associated with such changes.

Finally, people with high levels of food disgust sensitivity report a higher frequency of gastrointestinal complaints after eating animal-based foods like meat, fish and dairy products. A small percentage of the respondents (around 16%) also reported having a sensitive stomach, which was also associated with higher FDS scores. On the one hand, disgust typically activates components of the digestive system such as nausea and vomiting (Van Overveld, de Jong, & Peters, 2009), and people with high levels of disgust sensitivity might experience a state of disgust more often, sometimes accompanied by digestive irritabilities. On the other hand, nausea and illness after the ingestion of certain foods can result in an aversion towards the food, which is expressed as disgust (Curtis et al., 2013; Garcia, 1989; Parker, 2003). The direction of the relationship cannot be determined with the present data, but there seems to be an association between a high level of food disgust sensitivity and irritability in the digestive system apart from food intolerance.

4.2. Eating habits, preferences and behaviours

The results concerning variety seeking suggest that people with high levels of food disgust sensitivity tend to seek less variety in foods. This finding fits well with the observation that disgust is negatively related to experience seeking (Haidt et al., 1994). Theoretically, variety seeking is assumed to be driven by different motivators (e.g. novelty seeking, boredom/saturation) (Van Tripj & Steenkamp, 1992) that promote risk taking in food consumption. Food disgust is a defensive mechanism avoiding risk taking. Variety seeking and food disgust likely interfere with each other, probably resulting in a trade-off between seeking variety in potentially harmful foods and reducing exposure to food risks (Rozin, 1977). However, we suggest a stronger inhibiting effect of food disgust sensitivity on variety seeking than variety seeking on food disgust sensitivity. Protecting an organism from physical damage is probably more important for direct survivorship than health gains associated with variety seeking in foods (e.g. higher fruit and vegetable consumption; Van Tripj & Steenkamp, 1992). Nevertheless, it might be possible that variety seeking indirectly reduces food disgust sensitivity by a mere exposure effect to food-related disgust elicitors.

Our data also indicate that people with high levels of food disgust sensitivity are more likely to reject foods with a certain textural property, such as chewy, slippery or creamy, which supports the observations of other studies (Kauer et al., 2015; Kushiner, 2011). During the food evaluation process before consumption, textural properties of foods are accessible even before tasting the foods. Moreover, slimy surfaces or changes in texture seem to be typical disgust elicitors because they often indicate the presence of pathogens and potentially harmful foods (Martins & Pliner, 2006; Szczesniak & Kahn, 1971). Given the protective function of disgust in disease avoidance, it is not surprising that sensitivity to certain textural properties and food disgust sensitivity are strongly related.

In relation to adult picky eating, the observed positive association with food disgust is in line with previous research by Kauer et al. (2015) who suggested that food rejections in picky eating may be based on a hypersensitivity to certain sensory properties (e.g. texture, taste, appearance). Picky eaters also tend to reject foods with lumps and things in them (e.g. sauces with pieces, brownies with nuts) (Kauer et al., 2015), which may activate association to contamination and decay in people high on disgust, respectively picky eaters. However, if increased food disgust is responsible for higher sensitivity in the sensory system and food preferences shown by picky eaters cannot be determined by the present study. Furthermore, it is also conceivable that picky eating and disgust reinforce each other. A high disgust sensitivity in early childhood may prevent children from trying new and diverse foods, which may contribute to lower amounts of fruit and vegetable consumption in picky eating children (Galloway et al., 2005). As a consequence, their intake of fibre is seemingly reduced (Galloway et al., 2005), and this may lead to digestive problems (Bosaeus, 2004) and a bidirectional association between picky eating and constipation (Tharner et al., 2015). Abdominal pain due to constipation might in turn be falsely associated with the foods just eaten (Dovey et al., 2005) resulting in a disgust reaction towards and avoidance of those foods, probably leading to recurrent digestive complaints. In the long run, food disgust sensitivity may increase, producing an even more pronounced food rejection behaviour. It is important to note that there are diverse factors influencing picky eating (e.g. Galloway et al., 2005) and many children recover from picky eating (Mascola et al., 2010). Nevertheless, our data showed that digestive problems are associated with picky eating in adults too (see Table 2 in results section).

4.3. Food choices

Our data showed relevant associations between frequencies of consuming certain food products and food disgust sensitivity. People high on food disgust sensitivity reported to consume lower frequencies of vegetables, eggs, special meats (e.g. venison, lamb, ostrich) and seafood than people low on food disgust sensitivity. The observed relationships between food disgust sensitivity and eggs and seafood seem plausible because both of these food products have a high contamination risk and special kinds of textures (e.g. slimy, slippery, chewy) that might be associated with decay and spoilage (Martins & Pliner, 2006; Szczesniak & Kahn, 1971). Contrary to our hypothesis, food disgust was not notably related to consumption of meat products or fish. Paradoxically, Fessler et al. (2003) found that overall disgust sensitivity (as well as food and hygiene subscales) was positively associated with overall meat consumption, which the authors could not really explain. However, food disgust may be associated with the avoidance of specific food preparations under a certain category; for example, instead of avoiding fish in general, people may only avoid specific kinds of fish preparations (e.g. a whole fish with its head versus fish sticks).

It is noteworthy that the size of the correlation coefficients not only indicates a relationship between food disgust sensitivity and the
frequency of consuming certain food products, it also highlights that the newly developed Food Disgust Scale (Hartmann & Siegrist, 2018) does not measure food preferences. Correlation coefficients between food preferences and food consumption are usually higher (e.g. median correlation coefficient of 0.40 in Drewnowski & Hann, 1999) than our observed correlations.

4.4. Food waste

Previous research regarding food waste predictors showed that sociodemographic factors influence food waste (Brook Lyndhurst, 2007; Osner, 1982; Quested, Marsh, Stunell, & Parry, 2013; Visschers et al., 2016; WRAP, 2009). In the present study, food disgust sensitivity significantly explained additional variance over and above the sociodemographic factors (age, gender and income). The results showed that food waste may partially be related to the protective function of disgust. In particularly, when consumers are oversensitive to certain food-related cues, they seem to throw away food more often.

Even though the ability to experience disgust is innate, the disgust cues most likely are learned during childhood and adolescence (Rozin et al., 2008). Nevertheless, as our data indicate, food disgust sensitivity seems quite stable during adulthood. Thus, it is probably difficult to change consumers’ food disgust sensitivity, and they might be unable to overcome their rejection tendencies. Therefore, interventions or campaigns could focus on the processing of aged, but edible, foods in a way that the disgust-eliciting cues are not visible anymore. For future research, an interesting topic could be the relationship between food disgust sensitivity and avoidable food waste at the point of purchase. Food disgust sensitivity may also be associated with the refusal to buy foods that show imperfections in appearance or that are near the use-by date, which both cause eminent amounts of food waste (Canali et al., 2016; FAQ, 2011).

4.5. Limitations

This study has some limitations. First, the proportion of people belonging to the 20–39 age range were a bit underrepresented compared to the general Swiss population (21.3% vs. 26.8% census); women were slightly overrepresented as well (57.8% vs. 50.4% census) (Bundesamt für Statistik, 2016). The present study used self-report questionnaires to assess eating preferences and behaviours, which may not reflect exact food consumption frequencies or food waste frequency. Participants might have underestimated their food consumption and food waste frequency and/or might have answered in a social desirable manner. Nevertheless, FFQs are established assessment tools to measure food consumption frequency (Cade, Thompson, Burley, & Warm, 2002). Since there is no published comprehensively evaluated scale to measure food waste frequency so far, we used an adapted version of an ad-hoc scale developed by Visschers et al. (2016). Even though Cronbach’s α (= 0.66) was lower than preferable, item analysis indicated unidimensionality of the construct.

4.6. Conclusion

In summary, food disgust appears to be influenced by sociodemographic characteristics, such as age and gender and by digestive complaints. Our data indicates that individual food disgust sensitivity plays a role in various food domains, which had not previously been systematically investigated. Higher food disgust sensitivity was associated with the rejection of certain food textures and with picky eating. It was also associated with lower variety seeking in foods. Overall, the results show that food disgust sensitivity has both functional and dysfunctional effects on eating behaviour. Of course, it has functional properties in terms of avoiding the consumption of potentially toxic substances, but it also exerts dysfunctional effects when it contributes to the rejection of valuable food resources and the production of food waste. Our findings allow a better understanding of eating and food behaviours, which can provide direction for interventions concerning food waste, for example.

Funding source

This research was supported by the Swiss National Science Foundation (project number 100014 165630).

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.appet.2018.04.014.

References


