Filthy fruit! Confirmation bias and novel food

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ABSTRACT

Fruit and vegetable consumption is worldwide too low, resulting in poor diet quality and health-related problems. A cognitive factor that might contribute to this low consumption is confirmation bias. Confirmation bias has been established in anxiety research and comprises the tendency to search for reinforcing negative information, while ignoring counter attitudinal information. If applicable to food, asking for negative food information reinforces the negative attitude and decreases the willingness to try (novel) food. The aim of the current study was twofold. First, to examine if confirmation bias translates to food stimuli. Second, to investigate if this bias is exaggerated in persons with higher levels of food neophobia. To this end, 117 participants (age M = 21.45, SD = 4.48) carried out an online study. They filled in the food neophobia scale (FNS) and performed a search for additional information scale (SAIS) task. Four novel fruits were used, two looking tasteful (pomelo and rose apple) and two looking non-tasteful (black sapote and noni fruit). Participants rated their willingness to eat these fruits and subsequently could indicate how eager they were to receive positive or negative information regarding that fruit. The results indicated that the participants were more willing to try the tasteful looking fruits than the non-tasteful. Additionally, higher levels of food neophobia coincided with less willingness to eat all fruits. Confirmation bias was observed, more negative information was requested for the non-tasteful than for the tasteful fruits. This bias was not related to levels of food neophobia. These results are important as confirmation bias might make people even more negative towards novel foods and could contribute to even less fruit and vegetable consumption, especially when they look less appetizing.

1. Introduction

The benefits of eating a diet rich in fruits and vegetables are beyond dispute. Fruits and vegetables contain—among others—essential nutrients, vitamins, minerals and fibres and sufficient intake decreases a range of health-related problems such as cardiovascular diseases and obesity. The recommended daily guide is to consume at least 400 g of fruits and vegetables per day (World Health Organization, 2003).

Even though the universal message concerning fruits and vegetables (F/V) is clear, eat them daily; to consume a variety; and to eat “plenty,” “a lot,” or “more” (Herforth et al., 2019), most children, adolescents and adults do not meet these guidelines (e.g., Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Rosi et al., 2019). There are multiple barriers for not consuming the suggested amount of F/V in adults (e.g., not used to eating vegetables; fast food is convenient) and children (e.g., tempted to eat other foods/candy) (Nicklas et al., 2013). However, even if accessible, other obstacles need to be taken. One factor that plays a role in the rejection or acceptance of available fruits and vegetables is food neophobia. Food neophobia is characterized by the rejection or avoidance of novel food on sight, even before tasting it (Cooke, Wardle, & Gibson, 2003). This visual rejection might have an evolutionary purpose as it may function to protect young children against the risk of poisoning (Cashdan, 1998), but becomes maladaptive if it extends into adulthood and/or results in poorer dietary quality.

The definition of neophobia is the fear of anything new. This suggests a link between food neophobia and anxiety disorders. Several researchers have indeed drawn this parallel between the symptoms of food neophobia and (the treatment of) anxiety disorders in children (Farrow & Coulthard, 2012; Galloway, Lee, & Birch, 2003; Maratos & Sharpe, 2018, pp. 305–328; Nicholls, Christie, Randall, & Lask, 2001), adolescents (Maiz & Balluerka, 2018) and adults (Maratos & Sharpe, 2018, pp. 305–328; Marcontell, Laster, & Johnson, 2003). Not only do these disorders exist along a continuum and often coexist; the symptoms and their treatment bear similarities as well. Presentation of food stimuli to food neophobics results in physiological responses indicative of fear (adults, Raudenbush & Capiola, 2012); intake of new food is feared and...
avoided (children, Dovey, Staples, Gibson, & Halford, 2008) and anxiety
treatments are often successfully applied to food neophobia (e.g., by
using exposure in children Lafrarie, Rioux, Giboreau, & Picard, 2016; or
cognitive-behavioural treatment in adults Marcontell, Laster, & John-
son, 2002). Additionally, the DSM-5 criteria for specific phobia, cate-
gorized as an anxiety disorder, also apply to food neophobia. For
example, a persistent marked fear for a specific object (intake of new
food), avoidance of (eating) the object, and the fear or avoidance
causing distress (American Psychiatric Association, 2013).

The similarities between fear and food neophobia in information
processing deficits have received considerable less attention. Research
has indicated that anxious persons display cognitive biases favouring the
processing of threat-related information. Anxious (adult) persons have
robust attention biases to irrelevant threats (Okon-Singer, 2018), have a
tendency to interpret ambiguous information in a threatening manner
(Schoth & Lioi, 2017), and recollect more threatening information from
memory (Mitte, 2008). However, the literature on biased information
processing in food neophobia is scarce. To our knowledge, only one
study has addressed this topic. Maratos and Staples (2015)
emphasized the predominance of the visual domain in food neophobia
and examined attentional bias to familiar and unfamiliar fruit and
vegetables in children. The results indicated that children displayed an
attentional bias towards novel compared to familiar food. Additionally,
this bias was mostly visible in children with high levels of food ne-
ophobia. This indicates that use of knowledge from anxiety research may
prove valuable in increasing our understanding of information pro-
cessing biases underlying food neophobia.

A bias that had recently (re)gained interest in anxiety research is
confirmation bias. This is the tendency to search for information that
confirms the threat-related beliefs, while ignoring information that
disconfirms threat (Harvey, Watkins, & Mansell, 2004; Remmerswaal,
Muris, & Huijding, 2015). The obtained information can in turn rein-
force the negative beliefs and fears, resulting in the maintenance of the
anxiety problems (e.g., Dibbets & Meesters, 2017; Remmerswaal,
Huijding, Bouwmeester, Brouwer, & Muris, 2014). When applied to food
neophobia, fear of novel food can result in asking your fussy eating
partner if the novel recipe of your mother is indeed as nasty tasting as it
looks.

This verification over falsification strategy is not restricted to pa-
tients, but exists to some extend in everyone, and even can be triggered
by the mere visual perception of threat. A novel animal that looks
dangerous (e.g., aye aye) can result in children asking for more negative
description (e.g., “I need to breath”) and half of the items concerned positive information (e.g. “How
tasty”). The fruits differed regarding the availability (0 = rose apple and pomelo, 1 = black sapote and noni fruit), the majority of the participants were psychology students (92%), 87 persons categorized themselves as female, 27 as male and 3 as other. Participation was rewarded with course credits.

2.2. Materials

2.2.1. Food neophobia scale (FNS)
The FNS is a 10-item questionnaire to measure the trait food neo-
phobia (Pliner & Hobden, 1992). An example of an item is: “I am afraid
of the food. I have never had before.” Responses to the questions can be
recorded on a seven-point scale ranging from strongly disagree to
strongly agree. The (reversed) items can be summed up with higher
scores representing higher levels of food neophobia (range: 10–70). The
questionnaire has satisfactory test-retest reliability and internal consis-
tency, Cronbach’s alpha for the current study was 0.87.

2.2.2. Food stimuli
Pictures of four different, relatively unknown, fruits were used: a
pomelo, a rose apple, the black sapote and noni fruit (Fig. 1). In a separate
study (n = 16) the four fruits were rated on visual analogue scales (0–100) on several aspects: familiarity and willingness
to eat (not at all—very much), valence (very negative—very positive),
tastefulness (very untasty—very tasty). The fruits differed regarding the
last three aspects, Fs(3, 45) > 13.78, p < .001. Participants were more
willing to eat the rose apple and pomelo than the black sapote and noni
fruits (ps < .015); rated these fruits as more positive, (ps < .027) and
as more tasteful (ps < .05; pomelo = rose apple > black sapote = noni
fruit).

2.2.3. Rating food stimuli
For each food the willingness to try the food was measured using a
visual analogue scale (VAS) ranging from not at all to absolutely
(VASwilling, 0–100). Additionally, participants had to indicate if they
were familiar with the food (yes/no) and if they tried this food (yes/no).
If familiar, an open-end question invited the participants to indicate the
fruit species.

2.2.4. Confirmation bias task
The Search for Additional Information Scale (SAIS) is frequently
applied as a measure of confirmation bias (Muris, Huijding, Mayer, van
As, & van Alem, 2011; Muris et al., 2009). Participants were asked whether
kind of additional information they would like to know about each fruit. For each fruit a list of 14 statements was provided (see supplementary
material); half of the items referred to negative information (e.g. “How
much do you want to know if most people dislike the texture of the
fruit’), and half of the items concerned positive information (e.g. “How
much do you want to know if most people enjoy eating the food”).
The order of items was at random. Fruit order was semi-randomly presented with presentation order (i.e., first, second, third or last) being equally
distributed. Participants had to indicate how much they wanted to know
about the specific fruit and each fruit was presented on the VAS scale ranging from “Not at all” (0) to “Very much” (100). This resulted in a mean positive and negative sum
score per fruit. All Cronbach’s alphas were >.83.

2.2.5. Check questions
Four questions were included to check if participants carried out the
research seriously. For example “I drink 20 cups of lemon juice a day”
with the answer options “I agree” or “I do not agree” or “I need to breath
to stay alive” with a VAS scale ranging from “Not at all” (0) to “Very
much” (100). The questions were placed between other questions with similar response options. Only participants that correctly responded to all the questions (yes/no and VAS indicators > 75) were included in the data analyses.

2.3. Procedure

The entire experiment was run online using Qualtrics (www.qualtrics.com). The participants read the general information and continued if they selected the agreement button. Next demographic information was gathered (gender and age). An information screen indicated that the questions were time-locked and that there was no need to rush. Then the willingness to eat the novel fruit (VASwilling) and familiarity were tested. This was repeated for the remaining three fruits (order counterbalanced). In the same sequence the confirmation bias task, the SAIS, was presented. Finally, food neophobia levels were assessed with the FNS and the participants received a debriefing.

2.4. Statistical analyses

The questionnaire, SAIS and VAS data were analyzed parametrically (repeated measures ANOVA); the fruit recognition data was analyzed by means of non-parametric tests (Cochran’s Q, McNemar, Chi-square). To assess the influence of food neophobia on search for information, FNS scores were entered as covariate (continuous predictor) in the SAIS analyses. Main effects were not reported in case of an interaction. Bonferroni corrections were made in case of multiple comparisons. In case of violation of sphericity, Greenhouse-Geisser corrections were made. The rejection criterion was set at \( p < .05 \).

3. Results

3.1. Food stimuli

Table 1 summarizes the questionnaire data. A repeated measures ANOVA with fruit as within-subjects factor indicated a main effect of fruit, \( F(2.77, 321.54) = 157.71, p < .001, \eta^2 = 0.58 \), on willingness to eat. Pairwise comparisons indicated that participants were more willing to eat the pomelo than the remaining three foods, \( p < .001 \), and more willing to eat the rose apple than the black sapote and noni fruit, \( p < .01 \). No difference was detected between the black sapote and noni fruit, \( p = 1.00 \). The familiarity of the fruits differed, Cochran’s Q(3) = 78.41, \( p < .001 \). The pomelo was more familiar than the other three fruits, McNemar, \( p < .001 \), no other familiarity differences were observed, \( p > .21 \). Note that for the pomelo no difference in willingness to eat was observed between persons that indicated to be familiar with the fruit and people that reported to be unfamiliar with the pomelo, \( F < 1 \). Also the number of times that each fruit was tried differed, Cochran’s Q(3) = 58.83, \( p < .001 \). The pomelo was tried more often than the other three fruits, McNemar, \( p < .001 \), the rose apple was more often tried than the black sapote, McNemar, \( p = .036 \), no other differences were observed, \( p > .29 \). Only participants that indicated to be familiar with a fruit were subsequently asked to label the fruit. Correct identification differed among the fruits, \( \chi^2(3) = 7.68, p = .06 \). The pomelo was more often correctly identified than the other three fruits, \( \chi^2(1) = 7.68, p < .036 \), no other differences were detected, \( p = 1.00 \).

3.2. Food stimuli and neophobia

Pearson’s correlations between willingness to eat, VASwilling, and the FNS score indicated that higher levels of food neophobia coincided with less willingness to eat each of the fruits, pomelo \( r(117) = -0.52 \), rose apple \( r(117) = -0.31 \), black sapote \( r(117) = -0.43 \), and noni fruit \( r (117) = -0.43, p < .005 \).

3.3. Confirmation bias

Fig. 2 depicts the search for positive and negative information for

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Table 1

| Fruit          | Mean (SD)  | Range | Familiar Yes/No | Tried Yes/No | Recognized correct/incorrect |
|---------------|------------|-------|-----------------|--------------|-------------------------------|
| FNS           | 28.64 (9.98) | 10-57 |                  |              |                               |
| VASwilling    |            |       |                 |              |                               |
| Pomelo        | 79.21 (20.47) | 18-100 | 47/70           | 36/81        | 14/33                         |
| Rose apple    | 67.61 (25.06) | 0-100 | 13/104          | 13/104       | 0/13                          |
| Black sapote  | 35.26 (29.42) | 0-100 | 4/113           | 3/114        | 2/2                           |
| Noni fruit    | 35.09 (25.06) | 0-100 | 7/110           | 4/113        | 0/7                           |

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1. The data were not normally distributed; running non-parametrical tests yielded similar results.

Fig. 1. Fruits used during the experiment. From left to right: pomelo, rose apple, black sapote and noni fruit.

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Fig. 2. Individual VAS scores (wanting to know: 0 “not at all” to 100 “very much”) and means of the SAIS task.
each fruit. A repeated measures ANOVA with fruit (pomelo, rose apple, black sapote and noni fruit) and information type (positive and negative) as within-subjects factors was run. This analysis revealed a fruit x interaction, \( F(1.86, 215.30) = 16.24, p < .001, \eta^2_p = 0.12 \). Follow up analyses per information type indicated no differences for search for positive information, \( F < 1 \), but an effect of fruit for negative information, \( F(1.82, 210.78) = 19.37, p < .001, \eta^2_p = 0.14 \). Pairwise comparisons indicated that participants were more eager to know the negative information for the black sapote and noni fruit than for the pomelo and rose apple, \( ps < .005 \), additionally higher scores were observed for the rose apple than for the pomelo, \( p = .001 \). No difference was detected between the negatively valued black sapote and noni fruit, \( p = 1.00 \). Analyses per fruit indicated that more negative than positive information was requested for the black sapote, \( F(1, 116) = 11.04, p = .001, \eta^2_p = 0.087 \), and the noni fruit, \( F(1, 116) = 6.48, p = .012, \eta^2_p = 0.053 \). For the pomelo more positive than negative information was requested, \( F(1, 116) = 12.94, p < .001, \eta^2_p = 0.10 \). No difference for information request was observed for the rose apple, \( F(1, 116) = 1.83, p = .18, \eta^2_p = 0.016 \).

### 3.4 Confirmation bias and food neophobia

A repeated measures ANOVA with fruit and information type as within-subjects factors and FNS as covariate was carried out. This analysis revealed no main or interaction effect of FNS, \( Fs < 1.72, ps > .18, \eta^2_p < 0.015 \). No correlations were observed between FNS and information search, \( |r|s < 0.17, ps > .07 \).

### 4. Discussion

The present study examined food-related confirmation bias and food neophobia. To this end, non-clinical adults carried out an online study in which they were invited to indicate their eagerness to receive positive and negative information about four unknown fruits. Two of these fruits looked tasteful; the other two did not. Additionally, they indicated their familiarity with the fruits, their willingness to eat the fruits and filled in the Food Neophobia Scale as a marker for trait food neophobia.

Participants indicated that they were less willing to eat the nasty-looking black sapote and noni fruit than the pomelo and rose apple. The attitude towards the foods was reflected in the subsequent search for additional information scale task, SAIS. More negative information was requested for the nasty-looking fruits than for the tasty-looking foods. This observation is in line with previous anxiety research on confirmation bias in children (Dibbets et al., 2014; Dibbets & Meesters, 2017, 2020; Muris et al., 2009; Remmerswaal et al., 2014; Remmerswaal, Muris, Mayer, & Smeets, 2010).

The food neophobia results were only partly in line with our expectations. As in previous research, strong correlations between the willingness to eat a novel food and the FNS scores were observed (Choe & Cho, 2011; Damsbo-Svendsen, Frost, & Olsen, 2017; Raudenbush & Frank, 1999). That is, higher levels of food neophobia coincided with lower willingness to try the novel food, regardless of its appearance. Contrary to the attentional bias study of Maratos and Staples (2015), no exaggerated bias related to higher levels food neophobia was found. There are several explanations for this absence of an exaggerated bias. First, contrary to the study of Maratos and Staples, 2015, we used an (young) adult sample. It is known that the expression of food neophobia behaviour decreases with age, with a peak between the ages of 2 and 6 years (Dovey et al., 2008). The relatively low levels of food neophobia in adolescents and adults make it more difficult to establish a relation between food neophobia and information processing biases in our sample. Secondly, most of the foods used were novel (but see below for the pomelo). The attention bias observed was calculated by the attention towards novel food minus the attention towards familiar food. High food neophobic children attended more to unfamiliar stimuli, whereas low food neophobic children attended more to familiar stimuli. In the present study, most of the participants rated the foods as unfamiliar, masking potential contrast effects. Third, one of the foods was more familiar than the remaining three foods (pomelo, 40 % indicated being familiar with this fruit), this might have interfered with the willingness to try this food and the search for additional information as for some participants the taste was already known. Fourth, only pictorial stimuli were used. Though informative, the indicated willingness to eat a certain food does not necessarily translate to its consumption or requesting specific (positive or negative) information. A valuable addition to this type of research would be to include a food consumption test and/or to actually present the food and examine the request for additional information. For a next study, we would advise to include highly familiar tasty- and non-tasty-looking fruits (or vegetables), to include a different age category and to use real foods next, or instead of, food pictures. Especially, the inclusion of young primary/elementary school children might be useful as food neophobia levels tend to be high in the age group (Dovey et al., 2008). An alternative would be to select participants with high and low levels of food neophobia. These adjustments provide the opportunity to explicitly contrast effects of familiar versus unfamiliar food and increase the likelihood of finding a broader range in food neophobia tendencies.

The current study is the first to examine if confirmation bias tendencies—as observed in anxiety research—can also be observed in food-related information processing. We observed larger eagerness to obtain negative information concerning nasty-looking food than for tasteful looking food, indicative of confirmation bias. These results resemble previous anxiety research on confirmation bias; threatening stimulus material results in subsequent search for negative information. In anxiety research, this negative information reinforces the threat-related attitude, resulting in the strengthening and maintenance of fear and the accompanying avoidance behaviour. Likewise, if mostly negative information is requested for non-tasteful looking food, the negative attitude will be reinforced; diminishing chances of consumption of this food and thereby hinder the opportunity to disconfirm this attitude. This parallel opens the opportunity to apply cognitive bias modification techniques (MacLeod & Mathews, 2012) to increase novel F/V consumption. For example, persons can be trained to select positive statements regarding novel food. This in turn, might help to change existing attitudes and result in trying unfamiliar food. In sum, the results of the present study provide more insight in food-related information processing biases and can help to explore further techniques to increase F/V consumption.

### Data availability statement

Anonymised data from this study is available after publication and upon request from the corresponding author.

### Ethical statement

The study was approved by the Faculty of Psychology and Neuroscience Research Ethics Committee at xxxxxxxx (approval code: 159-15-12-2015_S18).

### Declaration of competing interest

The authors have no competing interests to declare.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2021.105607.
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