



Individual differences in selective attentional bias for healthy and unhealthy food-related stimuli and social identity as a vegan/vegetarian dissociate “healthy” and “unhealthy” orthorexia nervosa

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ABSTRACT

Previous work identified the operation of an attentional bias (AB) towards healthy food related stimuli among those with increasing tendencies towards orthorexia nervosa (ON) using a modified Stroop task. The current work aimed to replicate and extend our understanding of this effect by incorporating alternative measures of AB (i.e., the dot probe task) and ON (i.e., the Teruel Orthorexia Scale [ToS]) in a sample of self-defined vegans/vegetarians. The theoretical assertion of the ToS is the conceptual broadening of orthorexia with differentiable dimensions - one characterised as a “healthy” preoccupation with healthy food/eating patterns (HeOr) and the other by a more underlying pathology (OrNe). This study also aimed to examine the pattern of responding across these two dimensions according to factors known to predict ON. Eighty-six participants (mean age = 33.0 years; 20 males, 66 females) completed measures of obsessive compulsivity, perfectionism, state/trait anxiety and ToS as well as a dot probe designed to measure AB for healthy and unhealthy-related food stimuli, threat ratings of each of words utilized and perceived identity centrality as a vegan/vegetarianism. Results showed a dissociation of predicted determinants for “healthy” ON (HeOr) and pathological ON (OrNe). HeOr was predicted by increasing identity centrality whereas OrNe was predicted by increased OCD and perfectionism, and increased interference for healthy-related food words (in particular slowed disengagement) and not unhealthy related food words. Threat-related ratings of unhealthy food words was shown to be common across both dimensions. This pattern highlights cognitive and individual differences-based correlates of pathological and non-pathological ON.

1. Introduction

Orthorexia nervosa (ON) is an eating disorder concerned with personal obsession for ‘proper nutrition’ (Bratman, 2017). It is characterised by obsessive adherence to a diet of healthy foods, preoccupation with food purity, severe dietary restrictions, excessive time shopping and preparing food, eating alone, perfectionism, perceived superiority over others when adherent and feelings of guilt after food transgressions (Barnes & Caltabiano, 2017; Cena et al., 2019; Dunn & Bratman, 2016). Whilst early work argued that individuals with ON behavioral characteristics are more concerned with the quality of food in their diet rather than the quantity of food (e.g., Chaki, Pal, & Bandyopadhyay, 2013), more recently evidence has suggested associations with dieting behaviours (including strict eating schedules, more restrictive food intake regimes and the avoidance of types of foodstuffs) (Missbach et al., 2015; Mitrofanova, Pummell, Martinelli, & Petróczi, 2021; Reynolds, 2018;

Varga, Dukay-Szabó, Túry, & van Furth Eric, 2013). ON does not appear to be age-related (Hyrynik et al., 2016) and evidence around gender disparities is equivocal (Sanlier, Yassibas, Bilici, Sahin, & Celik, 2016; Segura-García, Papaiani, Caglioti, et al., 2012).

While ON is not currently recognized as an eating disorder, significant impairments including detriments in poor quality of life, interpersonal relationships, mental health (including obsessive compulsiveness), and malnourishment, have been reported (Bartel, Sherry, Farthing, & Stewart, 2020; Koven & Abry, 2015). In a recent meta-analysis, Zagaria, Vacca, Cerolini, Ballesio, and Lombardo (2022) showed that while a moderate relationship between ON and eating disorder symptomology was apparent, the size of pooled variance across the datasets utilized was small. Such observations have resulted in an ongoing debate over the inclusion of ON in classification indices (Varga, Dukay-Szabó, Túry, F., & van Furth Eric, 2013), existing as part of the eating disorders spectrum (see Bartel et al., 2020) but may also be

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distinct from other eating disorders (see Zagaria et al., 2022). It has been argued that ON shares common psychosocial features with other eating disorders, such as anorexia nervosa. These include perfectionism (e.g., see McComb & Mills, 2019; Pratt, Madigan, & Hill, 2021; Bartel et al., 2020) and increased trait anxiety evidence through the experienced desire to adhere to a strict self-imposed diet and those concern-based feelings, manifested as guilt, that arise as a result of not conforming (see Koven & Abry, 2015). Individuals with ON behavioral characteristics also present with obsessive-compulsive tendencies including intrusive and recurrent thoughts about health and food (characterized as ego-syntonic or consistent with one's ideal self-image), the ritualised arrangement of food and an excessive concern over food impurity and contamination (McComb & Mills, 2019; Koven & Abry, 2015; Dunn & Bratman, 2016; Bartel et al., 2020). With the ever-increasing presence of healthy eating messages and communications in mass and social media which arguably present similar features (Turner & Lefevre, 2017), there is a clear need to understand potential cognitive and social psychological processes involved in ON and in particular those that may delineate ON-related thinking characteristics (see Albery, Michalska, Moss, & Spada, 2020).

1.1. Orthorexia nervosa and vegan/vegetarianism

One population that has been the subject of ON-related enquiry concerns those who have adopted a vegetarian/vegan eating lifestyle (e.g., Brytek-Matera, Czepczor-Bernat, Jurzak, Kornacka, & Kołodziejczyk, 2019; Heiss, Coffino, & Hormes, 2019; Dittfeld, Gwizdek, Jagielski, Brzęk, & Ziara, 2017; Barthels, Meyer, & Pietrowsky, 2015). In a recent quasi-systematic review, Brytek-Matera (2021) showed that of fourteen studies identified, eleven reported a relationship between a vegetarian diet and self-reported ON tendencies. It should be noted that there is no evidence to date to suggest causality given that work has been characterized by cross-sectional methodologies. Nevertheless, one interpretation of this correlation is motivational in nature to the extent that the adoption of a vegetarian diet may provide a more socially acceptable method to disguise incumbent disordered eating patterns (Barnett, Dripps, & Blomquist, 2016; Dittfeld et al., 2017). Other work, however, has argued that dietary restraint in adhering to a vegetarian diet may be artifact of the elimination of meat products from one's diet rather than restraint *per se* (Timko, Hormes, & Chubski, 2012).

1.2. Information processing biases in orthorexia nervosa

To date little empirical work has been undertaken to examine the role of information processing biases in the occurrence of ON. One such bias concerns how our attentional system is "biased" towards the processing of certain environmental stimuli (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; see; Hardman et al., 2021) with evidence suggesting that such an attentional bias towards relevant cues is important in the establishment and maintenance of eating disorders, obesity and consumptive behaviour (e.g., Albery et al., 2016; Hardman et al., 2021; Schmitz, Naumann, Trentowska, & Svaldi, 2014). This biased attentional processing has been argued to create a strengthening of dopaminergic ("pleasure"-based) neurobiological pathways and craving-induced sensitization (Berridge, 2009; Field et al., 2016; Nijs & Franken, 2012). This, in turn, may stimulate an increasing saliency of concern-related stimuli and an increasing "need" to consume (e.g., particular food stuffs) to minimise experienced negative affective states and increase the experience of positive states (Kemps, Tiggemann, Martin, & Elliott, 2013; Paslakis, Kühn, Schaubschläger, Schieber, Röder, Rauh, & Erim, 2016; Nijs & Franken, 2012). The expression of attentional bias has been viewed as both a stable trait-like indicator of a preoccupation with food (e.g., Appelhans, French, Pagoto, & Sherwood, 2016), and/or as a fluctuating in-the-moment evaluation of the incentive value of a food-related cue (i.e., the expression of AB may be more transient, Field et al., 2016). Whilst

such work has been the subject of study in numerous food-related studies (see Stott, Fox, & Williams, 2021 for meta-review; see Hardman et al., 2021 for meta-analysis), only one has examined the operation of attentional bias in ON specifically (i.e., Albery et al., 2020).

Using a modified Stroop paradigm, Albery et al. (2020) examined the patterns of attentional bias for both food-related healthy and food-related unhealthy words as a function of ON (measured via the ORTO-15, Donini, Marsili, Graziani, Imbriale, & Cannella, 2005). People with increased ON tendencies showed increased attentional bias for food-related healthy words but *not* for unhealthy food-related stimuli suggesting attentional preference for healthy food-related stimuli as a cognitive marker for incrementally discriminating increasing ON. It was suggested that the lack of an effect for unhealthy words argues against the idea that these types of cues could be "threatening" in nature and avoided. In contrast, detailing the specificity of the bias for healthy food-related stimuli as a function of ON was explained as *not* threat-based concern but potentially more *desire*-based. The authors argued that further work was required to examine this pattern of association using alternative measures of both ON and attentional bias indices to further validate and establish any observed relationships.

The current study extends this initial work by employing the dot probe task (MacLeod, Mathews, & Tata, 1986) as an alternative measure of attentional bias. This task involves the simultaneous brief presentation of two stimuli (one task-relevant and one neutral) on opposite sides of a computer screen. One stimulus is then replaced by a dot and respondents are asked to respond as quickly and accurately as possible to the position of the dot (i.e., left or right). If attention is directed to the location of a task-relevant stimulus (in this case healthy or unhealthy words) [i.e., congruent trials] reaction times should be faster than if the dot appeared in the opposite location (in our case matched neutral words) [i.e., incongruent trials]. The difference between reaction times [RTs] for congruent vs. incongruent trials provides the generic measure of attentional bias.

In line with Albery et al. (2020), it was predicted that there would be significant difference in the size of the observed attentional bias for healthy and unhealthy stimuli and that this would vary as a function of degree of ON. More specifically, those with increasing ON tendency will show increasing attentional bias for healthy relative to unhealthy food words. The inclusion of neutral trials in the dot probe task also allows for the calculation of *attentional orientation* (the direction of attention [RTs to neutral trials minus - RTs for congruent trials]), and *attentional disengagement* (changing the focus of attention [RTs for incongruent trials minus mean RTs for neutral trials]) (Cisler & Koster, 2010). To the extent that those Valente, Syurina, & Donini, 2019 with increased ON should show greater attentional preference for healthy food-related cues it was predicted that these individuals would orientate faster to associated cues and be slower to disengage from them. Based on Albery et al.'s (2020) finding of increased attentional bias in ON to be implicated *only* for healthy food-related stimuli and not unhealthy stimuli, it was also predicted that there would be no effect of orienting towards or disengagement from unhealthy food cues. Nevertheless, to more fully delineate the idea that the threat-based processing of both healthy and unhealthy stimuli could drive any observed bias, participants rated the threat-relatedness of healthy and unhealthy words used in the present study.

1.3. Measurement of orthorexia nervosa

Diagnostic tools designed to measure ON are limited to the extent that they emerge from differing understandings of the phenomena (). Whilst the ORTO-15 (Donini et al., 2005) has been the most used measure of ON to date it has faced sustained criticism for its psychometric quality (Heiss et al., 2019; Meule et al., 2020; Missbach et al., 2015; Opitz, Newman, Mellado, Robertson, & Sharpe, 2020; Roncero, Barrada, & Perpiñá, 2017) including the validity of its use in meat avoiding samples (Heiss et al., 2019).

Alongside the ORTO-15 alternative measures have been developed including, the Bratman Orthorexia Test (Bratman & Knight, 2000), the Düsseldorf Orthorexia Scale (Barthels, Meyer, & Pietrowsky, 2015) and the Teruel Orthorexia Scale (TOS; Barrada & Roncero, 2018; Depa, Barrada, & Roncero, 2019). TOS is distinct from other measures in so far as it extends the conceptualization of ON beyond problematic aspects of healthy eating to consider those non-problematic aspects (i.e., healthy orthorexia). For the TOS healthy orthorexia (HeOr), relates to a healthy interest in and adherence to healthy eating and forms a fundamental as part of one's relevant identity (Barthels, Barrada, & Roncero M, 2019). It operates independently of any underlying psychopathology (e.g., Zickgraf & Barrada, 2021). More problematic healthy eating, or orthorexia nervosa (OrNe), is characterised by a pathological obsession in adherence to a healthy diet, and both negative emotional and social impacts associated with any deviance from self-imposed healthy eating standards. Whilst these dimensions show relatedness, research has identified dissociable factors (e.g., Strahler, Wachten, Nuehofer & Zimmermann, 2022; Zickgraf & Barrada, 2021). For example, Barthels et al. (2019) reported that HeOr was positively associated with positive affect, while OrNe was negatively associated with positive affect and positively associated with negative affect. In addition, Zickgraf and Barrada (2021) showed that OrNe was associated with worse diet quality and nutrition knowledge intake as well as other negative health behaviours (i.e., drinking, smoking, exercise) whereas HeOr was associated with better diet quality and nutrition knowledge but not the likelihood of adopting other unhealthy behaviours (e.g. smoking). Finally, Strahler, Wachten, Nuehofer, & Zimmermann, 2022) recently showed emotion regulation difficulties to correlate with OrNe but not HeOr. In this way, HeOr appears related to well-being, and may act protectively against emotional distress, whereas OrNe is linked to increased psychological distress via decreased positive mood and greater experience of emotional distress (see also Barrada & Roncero, 2018).

The current study employed the TOS to examine the pattern of attentional processing for healthy and unhealthy food words according to HeOr and OrNe. Although previous work has argued that food-related attentional preference is associated with the motivational value of food including proximally experienced craving and hunger (see Field et al., 2016; Hardman et al., 2021), no work has explicitly examined how attentional biases may relate to "healthy orthorexia" *per se*.

1.4. Social identities and health behaviours

An expanding literature has shown that social identities are important for the operation of health-related behaviours (see Haslam, Haslam, Jetten, Cruwys, & Steffens, 2021) whether they be adaptive (e.g., recovery in problem drinkers and smokers [Buckingham, Frings, & Albery, 2013; Frings & Albery, 2021; Frings & Albery, 2015; Callaghan et al., 2021]) or maladaptive (e.g., excessive Facebook use [Albery, Nosa, Spada, & Frings, 2021], risky drinking practices [Hertel, Baldwin, Peterson, & Lindgren, 2021], smoking [Meijer, Vangeli, Gebhardt, & van Laar, 2020]; gambling [Montes, 2020]; substance use [Montes & Pearson, 2021]). Indeed, recent work has begun to propose identity-based interventions as a vehicle for health-related behaviour change (see Steffens, LaRue, Haslam, Walter, Cruwys, Munt, Haslam, Jetten & Tarrant, M., 2021). This type of framework has also been adopted to understand vegetarian-based choices (see Rosenfeld & Burrow, 2017; Rosenfeld, Rothgerber, & Tomiyama, 2020; Plante, Rosenfeld, Plante, & Reysen, 2019). For instance, it has been argued that self-identification as a vegan/vegetarian acts not just as a label associated with one's food preferences but that an affiliation with one's group also influences one's values and beliefs sets associated with the self (Nezlek & Forestell, 2020). This suggests that an individual's identity as a vegan/vegetarian may act as central to their self-concept, such that relevant decisions and behaviours are driven by a strong desire to identify as a member of this group (see Frings & Albery, 2015, 2021; Frings, Wood, & Albery, 2021). Identity has also been conceptualized as

interacting directly with social cognitive attentional processes such as attentional orientation and disengagement (Frings & Albery, 2021). Theoretically, if one's identity as a vegan/vegetarian is salient and accessible it may drive attentional allocation and thoughts about healthy food and eating and as such may be apparent in tendencies towards ON (see Brytek-Matera, 2021; Depa et al., 2019). Importantly, if dietary based identities are a driving factor in this way, they should predict variance in orthorexia above and beyond individual level factors such as perfectionism, trait anxiety, and OCD.

1.5. Summary

The purpose of the current study was to contribute to the growing knowledge base of the underlying mechanisms of ON by building on the attentional bias work of Albery et al. (2020) and consider the potential role of social identity as a vegan/vegetarian whilst accounting for perfectionism, trait anxiety and OCD as previously identified factors associated with ON. The TOS (Barrada & Roncero, 2018) was used to determine a potential dissociable pattern of such responses according to ON tendencies deemed as either non problematic (HeOr) or problematic (OrNe). Based on the one study to have examined such biases in ON (i.e., Albery et al., 2020), it was predicted that attentional biases would be associated with OrNe for healthy food-related cues only. Importantly, it was also predicted that the magnitude of the attentional bias for healthy food-related stimuli would increase relative to OrNe. Given that HeOr is argued to represent as less pathological preoccupation with food stuffs (e.g., Zickgraf & Barrada, 2021), we did not predict a significant association between attentional bias and "healthy orthorexia".

2. Method

2.1. Participants

Eighty-six self-identified vegan/vegetarian participants (mean age = 33.0 years, SD = 10.9 years) took part in the study. Participants were recruited from the undergraduate and postgraduate student population of the host university in return for an established course credit scheme. The sample comprised 20 males [mean age = 33.3 years, SD = 11.1 years] and 66 females [mean age = 32.9 years, SD = 10.9 years].

2.2. Materials

2.2.1. Deriving words for use in the healthy and unhealthy food dot probe task

Two groups of five participants who self-identified as vegan/vegetarian were recruited for a two-stage pilot phase. Participants were sampled on an opportunistic basis. In the first stage five participants generated as many words as possible in 3 min for the categories 'healthy' and 'unhealthy' food. Participants were given 2 min per category. A total of 112 words (66 healthy and 46 unhealthy) were generated. Words generated by three or more participants (>60% of the sample N, 14 healthy and 11 unhealthy words), were used in the second stage. At this point, five different participants rated each word for their category representativeness using a 7-point Likert -type scale (anchored at 1 = 'unrepresentative' and 7 = 'totally representative'). The final set of eight words for each category consisted of those endorsed as increasingly representative by at least 80% of the raters (4 of 5 individuals). The Subtlex-UK database (Van Heuven, Mandera, Keuleers, & Brysbaert, 2014) was used to generate neutral (non-health-related) words to match with the food-related words according to frequency of use, word length and number of syllables. Resulting healthy food-related word pairs were: apple-global, banana-medium, broccoli-illusion, carrot-awake, chickpeas-trailers, kale-hoax, lentils-sensors, and spinach-neutral. Generated unhealthy food-related word pairs were bacon-legend, burgers-barrels, cake-wrote, cheese-leaves, chips-facts, crisps-chess, pizza-begun, sweets-worlds. In addition, thirteen neutral-neutral

matched word pairs were derived from Subtlex for use in the calculation of orientation and disengagement indices (see [Koster, Crombez, Verschueren, & De Houwer, 2004](#)); bubble-ladder, lunar-flyer, giraffe-puppet, cabinet-location, road-bank, foot-glass, doodle-manual, neat-melt, seesaw-funfair, laptop-wizard, doorway-drummer, tentant-benches, sheet-socks.

2.2.2. Current hunger

Participants rated their current levels of hunger in response to two statements on a 5-point Likert scale (1 = 'strongly disagree' to 5 = 'strongly agree') before and after administration of the Dot Probe task to establish any change in self-reported hunger which may result from any priming effects that may be inherent in the task; "at the moment I feel hunger" and "at the moment I do not feel hungry" (see [Tapper, Pothos, & Lawrence, 2010](#)).

2.2.3. Identity centrality

The three-item centrality subscale of the multicomponent in-group identification scale (see [Leach et al., 2008](#)) was used. Participants responded to the statements "The fact that I am a vegan/vegetarian is an important part of my identity", "I often think about the fact that I am vegan/vegetarian", and "Being a vegan/vegetarian is an important part of how I see myself" seven-point Likert type scales (1 = 'strongly disagree' to 7 = 'strongly agree'). Higher scores are indicative of greater levels of identity centrality. In the current study the Cronbach $\alpha = 0.79$.

2.2.4. Orthorexia nervosa

Participants completed the Teruel orthorexia scale (TOS; [Barrada & Roncero, 2018](#)) which consists of 17 items to detail two dimensions; (a) healthy orthorexia (HeOr) (nine items e.g. "I feel good when I eat healthy food") and (b) orthorexia nervosa (OrNe) (eight items e.g. "I feel guilty when I eat food that I do not consider healthy"). Responses were made on a four-point Likert scale (0 = 'completely disagree' to 4 = 'completely agree'). In the current study the Cronbach's for the HeOr subscale was $\alpha = 0.74$, and for the OrNe subscale $\alpha = 0.82$.

2.2.5. Perfectionism

The nine-item concern over mistakes subscale of the Frost multidimensional perfectionism scale (FMPS; [Frost et al., 1990](#)) was used. Participants responded to statements such as "I hate being less than the best at things" on a 5-point Likert scale (1 = 'strongly disagree', 5 = 'strongly agree'). Increased scores indicate a greater tendency to experience negative emotions due to minimal mistakes being interpreted as failures. Current study Cronbach's $\alpha = 0.91$.

2.2.6. Obsessive compulsiveness

Participants completed the obsessive compulsive inventory-revised (OCI-R; [Foa et al., 2002](#)) comprising 18 items (e.g. "I find it difficult to control my own thoughts") and reported on 5-point Likert type scales (0 = 'not at all', 4 = 'extremely'). Higher scores were indicative of increased levels of distress caused by obsessive-compulsive symptoms during the past month. Current study Cronbach's $\alpha = 0.92$.

2.2.7. State-trait anxiety

Participants completed the short version of the Spielberger state-trait anxiety inventory ([Zsido, Teleki, Csokasi, Rozsa, & Bandi, 2020](#)) comprising 5 items of state anxiety (e.g. "I feel nervous") and 5 items of trait anxiety (e.g. "Some unimportant thought run through my mind and bothers me"). The state and trait items were presented separately and responses were made on a 4-point Likert scale (1 = 'not at all', 4 = 'very much so'). Higher scores indicate greater levels of current (state) and general (trait) anxiety. Current study Cronbach's $\alpha = 0.86$ for the state subscale and $\alpha = 0.85$ for the trait subscale.

2.2.8. Word threat rating

Participants rated how threatening they found each of the 16 food-

related words (8 healthy and 8 unhealthy) used in the Dot Probe task on a 5-point Likert scale (1 = 'not at all threatening' to 5 = 'very threatening'). Current study Cronbach's $\alpha = 0.96$.

2.2.9. Attentional bias

To measure preferential allocation of attention to healthy/unhealthy food-related words the Dot Probe task was utilized. The task involved 16 (eight healthy, eight unhealthy) food-related word pairs and 13 neutral-neutral words pairs. Accuracy and reaction time (milliseconds) for each trial was recorded. Computations of attentional bias, orientation score and disengagement score were calculated for both the healthy and unhealthy word types (see [Cisler & Koster, 2010](#)) (see [Table 1](#)). One percent of dot probe task response times were shown to be less than 250 ms and greater than 1000 ms and were removed from subsequent analyses (see [Rodebaugh et al., 2016](#)).

General attentional bias was calculated by subtracting mean RTs for congruent trials from mean RTs for incongruent trials (greater attentional bias for congruent trials indicated by positive values). Orientation towards task-relevant stimuli was calculated by subtracting mean RTs for congruent trials from mean RTs for neutral-neutral trials (positive values indicating greater orientation), and disengagement from task-relevant stimuli was calculated by subtracting mean RTs for neutral-neutral trials from mean RTs for incongruent trials (positive values indicating slower disengagement).

2.3. Design

A 3 (Word Type: Healthy, Unhealthy, Neutral) x 2 (Word Position: Left, Right) x 2 (Probe Position: Congruent, Incongruent) x 2 (Block: Healthy-block, Unhealthy-block) x 2 (Presentation Order: dot probe-questionnaires, questionnaires-dot probe) mixed factorial design was used. Word Type, Word Position, Probe Position and Block were within-participant factors and Presentation Order a between-participant factor.

2.4. Procedure

Following consent, participants stated their age and gender, confirmed they did not have a diagnosed eating disorder and that they self-identified as a vegan/vegetarian. Participants initially rated their current level of hunger and then completed the identity centrality questionnaire and the TOS. Participants then completed the Dot Probe task to measure attentional bias for healthy and unhealthy food-related words. Participants were instructed to complete the task as quickly and accurately as possible. To begin, participants completed eight practice trials in which non-word letter strings (e.g. AAAA, VVVV) were displayed on the left and right of the screen. Participants then completed a block of healthy food and unhealthy food Dot Probe trials in a counterbalanced order. Each of the two blocks contained 64 trials of healthy/unhealthy words presented with their neutral paired words and 12 trials of neutral-neutral words giving a total of 152 trials per participant. In all trials a black fixation cue (+) appeared in the centre of the screen for 750 ms. This was followed by simultaneous presentation of two words on the horizontal axis for 500 ms. A target dot then appeared behind either the left or right positioned word. Participants were instructed to focus on the central fixation cue throughout the trial and indicate the position of the target dot as quickly as possible by pressing the 'f' key on the keyboard (left location) or the 'j' key (right location). The word position (left/right) and the target position (congruent/incongruent) were presented in a counterbalanced order. All word pairs were randomly presented within each block, and participants were reminded of the task instructions prior to each block.

Participants then completed the concern over mistakes (FMPS subscale), OCI-R, state-anxiety inventory and trait-anxiety inventory questionnaires in a counterbalanced order. For half of the participants the Dot Probe task was completed after the four questionnaires. Finally, participants rated their current level of hunger again, completed the

Table 1

Mean correct reaction times (milliseconds) and standard deviations for congruent, incongruent, and neutral trials and attentional bias indices for healthy and unhealthy food words.

Word Type		Trial Type			Attentional Bias Indices		
		Congruent	Incongruent	Neutral	Attentional Bias	Orientation Bias	Disengagement Bias
Healthy	\bar{X}^1	385	395	394	10	8	2
Food	SD ²	63	66	66	19	23	23
Unhealthy Food	\bar{X}	391	394	393	3	3	0
	SD	51	55	54	17	29	30

Note: ¹Mean; ²Standard deviation.

word threat rating questionnaire and were then debriefed. The study was programmed and presented via the Gorilla platform (www.gorilla.sc) and received ethical approval from the Ethics Panel of the host University.

2.5. Statistical analysis

Analyses were conducted in two phases. The first phase examined differences in attentional bias indices for healthy-food and unhealthy-food related words. The second phase explored the pattern of associations for attentional bias indices, identity centrality, OCD, perfectionism and healthy and unhealthy work ratings with HeOr and OrNe measures using Pearson's r correlation coefficients and multiple linear regressions where appropriate.

3. Results

3.1. Attentional bias, orientation bias and disengagement bias for healthy and unhealthy stimuli

To examine whether there were differences in (a) attentional bias, (b) orientation bias and (c) disengagement bias between healthy and unhealthy food words a series of two-way ANOVAs with Attentional Bias Word Type as a within-participant factor and Presentation Order as a between-participant factor were conducted. In addition, one sample t -tests were used to test whether the size of each of the biases for healthy and unhealthy words separately were significantly different from zero (the score indicative of no attentional bias) (see [Table 1](#) for means and standard deviations).

3.1.1. Attentional bias

Results showed a significant main effect for Attentional Bias Word Type, $F(1, 84) = 8.40, p = .005, \eta_p^2 = 0.09$. Participants showed significantly increased attentional bias for healthy compared to unhealthy food words indicative of an attentional preference for healthy words. The main effect for Presentation Order and the Presentation Order x Attentional Bias Word Type interaction effect were not shown to be significant, $F(1, 84) = 0.92, p = .341, \eta_p^2 = 0.01$, and $F(1, 84) = 0.16, p = .692, \eta_p^2 = 0.00$, respectively suggesting that order of presentation of the word type block did not influence any observed differences. In addition, one sample t -tests showed that the bias for healthy food words differed significantly from zero (the score indicative of no attentional bias), $t(85) = 5.01, p < .001$, Cohen's $d = 0.54$, whereas the effect was not significant for unhealthy food words, $t(85) = 1.61, p = .100$, Cohen's $d = 0.18$. The size of the bias was *only* shown to be significant for healthy foods.

3.1.2. Orientation bias

No main effects for Presentation Order and the Presentation Order x Orientation Word Type were shown, $F(1, 84) = 0.54, p = .46, \eta_p^2 = 0.01$ and $F(1, 84) = 3.55, p = .06, \eta_p^2 = 0.04$, respectively. The main effect for Orientation Bias Word Type showed increased bias for healthy compared to unhealthy foods, but this failed to reach statistical significance, $F(1, 84) = 3.72, p = .057, \eta_p^2 = 0.04$. However, the size of the bias

was shown to be significantly different from zero for healthy foods, $t(85) = 4.13, p < .001$, Cohen's $d = 0.45$, and not for unhealthy foods, $t(85) = 0.84, p = .405$, Cohen's $d = 0.09$.

3.1.3. Disengagement bias

No main effects for Disengagement Bias Word Type and Presentation Order, $F(1, 84) = 0.04, p = .842, \eta_p^2 = 0.00$, and $F(1, 84) = 0.00, p = .951, \eta_p^2 = 0.00$, respectively, nor for the Presentation Order x Disengagement Word Type interaction effect, $F(1, 84) = 2.71, p = .104, \eta_p^2 = 0.03$, were shown. In addition, participants showed no significant disengagement bias for either healthy or unhealthy foods, $t(85) = 0.61, p = .542$, Cohen's $d = 0.07$, and $t(85) = 0.26, p = .797$, Cohen's $d = 0.03$, respectively.

This pattern of responding suggests a general attentional bias for healthy as opposed to unhealthy food-related stimuli and that this bias is increasingly characterized by increased initial orientation towards that cue.

3.2. Predicting the HeOr and OrNe scales of the TOS

The next stage of the analysis was to determine whether and which of the included measures explained significant variability in the two factors determined by the ToS, namely, HeOr and OrNe. Initial Pearson's r correlation coefficients between the two criterion variables (HeOr and OrNe) and *a priori* stated predictor variables were calculated for justification of inclusion in subsequent multiple regression analyses predicting (a) HeOr and (b) OrNe. The Holm-Bonferroni correction for multiple tests was applied ($ps < .03$). Prior to analyses relevant assumptions for multiple regressions were tested. Firstly, a sample size of 86 was sufficient given two (HeOr) and five (OrNe) independent variables were entered into subsequent analyses ([Tabachnick, Fidell, & Ullman, 2019](#)). In addition, [Table 2](#) shows that intercorrelations between predictor variables (all $rs < 0.6$) and collinearity statistics were within acceptable limits, indicative of low multicollinearity [tolerances > 0.10 : average VIF < 10]. Finally, scatterplots suggested that normality, linearity, and homoscedasticity assumptions were met. All reported regressions adopted 5000 Bootstrap sampling procedures.

3.2.1. Correlations for inclusion in regression analyses

[Table 2](#) shows identity centrality and unhealthy word threat ratings were the only variables significantly correlated with HeOr score ($ps < .05$) and included in further analysis. For OrNe, attentional bias and disengagement bias for healthy food words, perfectionism, OCD, trait anxiety and unhealthy word threat rating were significantly correlated and included in further analysis ($ps < .05$). No significant relationships were shown between OrNe and attentional bias/orientation bias/disengagement bias for unhealthy food words, orientation bias for healthy food words nor for healthy food word ratings (all $ps > .05$). Attentional bias and disengagement bias measures were included in separate regression analyses predicting OrNe. In addition, HeOr and OrNe were shown to have a significant positive bi-variate relationship ($r = 0.41, p < .05$). Neither age (HeOr: $r = 0.13, p = .25$; OrNe: $r = 0.05, p = .62$) nor gender (HeOr: $r_s = 0.03, p = .80$; OrNe: $r_s = 0.07, p = .54$) correlated with criterion variables and were not included in subsequent

Table 2

Means and standard deviations and intercorrelations (Pearson's *r*) for HeOr, OrNe, perfectionism, OCD, state anxiety, trait anxiety, threat ratings (healthy and unhealthy), identity centrality, attentional bias score, orientation bias score, and disengagement bias scores.

	M ¹	SD ²	Measure															
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1. HeOr	2.6	0.4	.41**	.07	.11	.09	.25*	-.08	.08	-.16	-.10	.04	.27*	.01	.19	.06	-.12	
2. OrNe	1.8	0.5		.30**	.06	.08	.13	.35**	.46**	.11	.24*	.21	.41**	-.01	.10	.28**	-.07	
3. AB healthy	10.2	18.9			.18	.03	.01	.11	.15	-.06	.06	.00	.22*	.43**	.02	.50**	.10	
4. AB unhealthy	3.0	16.8				.15	.15	.21	.28**	.12	.29**	.20	.24*	-.02	.33**	.19	.33**	
5. Hunger Change	-0.2	0.5					.05	.16	.01	.10	-.02	-.04	.03	.14	-.01	-.11	.11	
6. Identity Centrality	14.1	4.2						.09	-.03	-.21*	-.08	.07	.11	-.01	.06	.02	.04	
7. Perfectionism	23.2	7.7							.43**	.33**	.59**	.05	.15	.01	.07	.10	.07	
8. OCD	30.5	10.9								.34**	.60**	.25*	.37**	.08	.14	.06	.05	
9. State Anxiety	2.3	2.3									.54**	.32**	.33**	-.01	.04	-.05	.04	
10. Trait Anxiety	3.7	3.7										.18	.26*	-.04	.16	.09	.03	
11. WTR health	5.08	5.08											.61**	-.04	.02	.04	.11	
12. WTR unhealthy	7.18	7.18												.13	-.01	.08	.18	
13. Orientation health	8.34	23.33													.03	-.57**	-.04	
14. Orientation unhealth	2.96	29.35														-.00	-.78**	
15. Disengagement health	1.87	23.43																.13
16. Disengagement unhealth	0.04	30.21																

n = 86; *Holm-Bonferroni correction applied, *p* < .03; ***p* < .01. Note 1: ¹Mean; ²Standard deviation.

Note 2: AB-health = Attentional Bias for healthy foods; AB-unhealth = Attentional Bias for unhealthy foods, WTR health = healthy word threat rating; WTR unhealth = unhealthy word threat rating.

analyses.

3.2.2. Predicting HeOr

Together identity centrality and unhealthy word threat ratings were shown to significantly predict HeOr, *F* (2,83) = 5.65, *p* < .01, *R*² = 0.12, adj *R*² = 0.10, *f*² = 0.14, accounting for 12% of its variance. Both identity centrality and unhealthy word threat rating were shown to be significant independent predictors of HeOr, uniquely accounting for 5% and 6% of the variance in HeOr respectively (see Table 3).

3.2.3. Predicting OrNe

Attentional bias and disengagement bias for healthy food words, perfectionism, OCD, trait anxiety and unhealthy word threat ratings were shown to predict OrNe, *F* (6,80) = 8.45, *p* < .001, *R*² = 0.39, adj *R*² = 0.35, *f*² = 0.64. Disengagement bias for healthy foods words, perfectionism, OCD and unhealthy word threat rating were shown to be significant independent predictors of OrNe (*ps* < .05). No effect was shown for the attentional bias index (see Table 4).

4. Discussion

The current study extended work reported in Albery et al. (2020) by employing an alternative measure of attentional bias for healthy and unhealthy food-related stimuli to examine preferential attention in self-identifying vegans/vegetarians (a population previously argued to have inflated tendencies towards ON) (see Brytek-Matera, 2021). Based on the Albery et al. (2020) findings, which utilized the modified Stroop task as a measure of attentional bias, we predicted that an attentional bias would be apparent for health-related and not unhealthy-related

Table 3

Summary of linear multiple regression analysis for variables predicting HeOr ("Healthy orthorexia") scores.

Variable	β	<i>t</i>	sr ²	Bootstrap 95% CIs
Identity centrality	.22	2.14*	.05	.001, .039
WTR unhealthy	.24	2.35*	.06	.004, .023

Note. *N* = 86; **p* (bootstrap) < 0.05; sr² = semi-partial; WTR unhealthy = mean unhealthy food word ratings; Bootstrap (5000 samples) 95% CIs.

Table 4

Summary of linear multiple regression analyses for variables predicting OrNe ("unhealthy orthorexia") scores.

Variable	β	<i>t</i>	sr ²	Bootstrap 95% CIs
AB health	.08	0.75	.01	-.001, .007
Disengagement bias - health	.21	1.95*	.03	.001, .007
Perfectionism	.25	2.27*	.04	.002, .029
OCD	.37	3.31**	.08	.006, .026
WTR unhealthy	.26	2.68**	.06	.009, .030
Trait anxiety	-.22	1.73	.03	-.060, .004

Note 1: *N* = 86; Bootstrap (5000 samples) 95% CIs; **p* (bootstrap) < 0.05, ***p* (bootstrap) < 0.01; sr² = semi-partial.

Note 2: WTR unhealthy = unhealthy food word ratings; OCD = obsessive compulsive inventory-revised; Perfectionism = Frost multi-dimensional perfectionism scale; Trait anxiety = Spielberger state-trait anxiety inventory; AB Health = Health congruent - health incongruent; disengagement bias health = incongruent health - neutral.

food words in a dot probe task. In other words, the magnitude of the bias for health-related words would be significantly increased relative to unhealthy words and that the size of the bias would be significantly greater than zero (where no bias is apparent) for healthy and not unhealthy-related words. These effects were shown and replicate those reported in Albery et al. (2020) utilizing an alternative measure of AB in a population (i.e., vegans/vegetarians) previously underexplored in AB research.

A second aim of the current work was to take advantage of those indices of components of attentional bias afforded by dot probe-related computations. We calculated not only a generic attentional bias measure, but also those reflecting the speed at which people were responding initially to presented stimuli (orientation) and the speed with which people were able to disengage from those stimuli (slowed disengagement) (see Cisler & Koster, 2010 for relevant computations). Our findings showed that participants in general did not show significantly slowed disengagement bias from the healthy food stimuli relative to the unhealthy food stimuli. However, individuals were more inclined to orient towards healthy food-related words relative to unhealthy words. The increased size of the orientation bias for healthy food word bias relative to the unhealthy orientation bias bordered significance (*p*

= .057) and differed significantly from zero (the point of no bias) for the healthy food words only. This suggests that in a population of current vegans/vegetarians there was an attentional preference for healthy-related food words, and not for unhealthy ones, characterized by an increasing initial orientation towards those cues.

Whilst this suggests an initial orientation pattern of attentional responding for healthy food stimuli *only* the question then becomes, do ON-related tendencies influence this pattern of responding? We were concerned with whether the pattern of attentional responding was related to the degree of ON-related tendencies reported. In line with the recommendation to test the replicability of the modified Stroop effect found in Albery et al. (2020) by utilizing an alternative measure of attentional bias, and the argument that the ORTO-15 as used in the original study may be psychometrically unstable (Opitz et al., 2020), we incorporated the dot probe task (as the attentional bias index) and the Truel orthorexia scale (TOS; Barrada & Roncero, 2018) as the measure of ON related tendencies.

On this basis we predicted that increasing HeOR would be accounted for by increasing saliency (centrality) of one's social identity as a vegan/vegetarian. In contrast, OrNe would *not* be predicted by identity centrality but by other factors that have been utilized to define the more pathological aspects of ON. Specifically, we hypothesized that increased OCD, increased perfectionism and increased trait anxiety would be related to increasing OrNe and not HeOr. In addition, based on our earlier findings that AB for health-related food words measured via the Stroop task was associated with increasing ON as measured by the ORTO-15 (see Albery et al., 2020), we predicted that AB indices (measured via the dot probe) would add further explanatory variance in accounting for OrNe and not the HeOr.

Our findings confirmed that identity centrality predicted HeOr, that increased OCD and increased perfectionism predicted increased OrNe (no effects were shown for trait anxiety). In terms of the AB indices whilst the general measures of AB and slowed disengagement from healthy food stimuli were both correlated with OrNe, only the latter provided significant independent explanatory variability for increasing OrNe. This finding extends those reported in Albery (2020) by locating attentional bias effects on OrNe specifically in a slowed disengagement from healthy food related stimuli. Finally, we also showed that explicit judgments of the threat-relatedness of unhealthy words predicted both OrNe and HeOr.

In general, this pattern of findings provides evidence that the distinction between healthy and unhealthy ON, as conceptualized in the TOS, is useful to the extent that different factors account uniquely for either. That the centrality of one's identity as a vegan/vegetarian *only* predicts a healthy interest in one's foodstuffs and consumption patterns (HeOR) whereas individual difference-based factors (perfectionism, OCD) and cognitive biases (i.e., slowed disengagement) are *only* aligned with the more compulsive or pathological indicators of ON (i.e., OrNe) reinforces this distinction. In this way OrNe is similar to other compulsive behaviours by emphasizing both individual difference-based and cognitive correlates (specifically disengagement bias) (Field et al., 2016; Field, Munafò, & Franken, 2009; Werthmann, Jansen, & Roefs, 2015) and is usefully distinguished from the characteristics emphasizing a healthy interest in food/eating which is not associated to these factors (see Albery et al., 2020).

Importantly, that a significant but moderate positive correlation between OrNe and HeOr was shown suggests (a) that both healthy and unhealthy characteristics of orthorexia may be present in any given individual and (b) that showing tendencies for an increasing healthy interest in food (HeOr) is related to increasing pathological tendencies (OrNe). This further clarifies the previously proposed conceptual utility of specifying orthorexia according to "healthy orthorexia" and orthorexia nervosa as distinguishable latent constructs (i.e., Strahler, et al., 2022; Zickgraf & Barrada, 2021; Zickgraf, Ellis, & Essayli, 2019; Barrada & Roncero, 2018; Depa et al., 2019). However, the causal nature of the relationship, if any, between HeOR and OrNe is yet to be determined.

Applying theoretical approaches directed at understanding the development of other compulsive/addictive behaviours may facilitate testable predictions. One approach, incentive sensitization theory, emphasizes the distinction between two related reward-based mechanisms, intense pleasure or "liking" and "wanting" or incentive salience, as fundamental in the expression of developing compulsion (see Berridge & Robinson, 2016; Robinson, Fischer, Ahuja, Lesser, & Maniates, 2016). So, the question becomes, is OrNe a "wanting"-based characteristic and HeOr a more pleasure-based liking of healthy foods? That HeOr was *not* associated with key individual difference-based and cognitive markers previously associated with pathological wanting or desire (slowed disengagement, compulsivity, perfectionism, compulsivity) and OrNe suggests an avenue for future work.

In terms of the relationship between the operation of cognitive markers and ON tendencies this study highlights that the specific tendency in one's ability disengage from healthy food cues adds explanatory power in addition to that afforded by other key individual difference-based factors (i.e., perfectionism, OCD). This argues that this information processing bias is one of several essential ingredients which (a) act independently in accounting for degree of ON and (b) may mix to produce increasing/decreasing ON experience. However, the question remains whether the relationship between each of the key elements and ON tendencies is linear or more curvilinear in its operation. Future work should explore whether, for instance, a consistent slowing in disengagement from healthy stimuli is associated with an equivalent increase in ON severity or, alternatively, whether such an increase is more critical at different phases on ON severity. These ideas become even more apparent given recent argument that AB for food and other substance-related cues appear to fluctuate in individuals over time and is tied to momentary evaluations of such stimuli in situ (see Amir, Zvielli, & Bernstein, 2016; Field et al., 2016). These evaluations can be positive (e.g., when the incentive value [pleasure] of a drug is high), negative (e.g., stimuli are aversive) or a mixture of the two (i.e., some form of motivational conflict) (Appelhans et al., 2016; see; Hardman, Jones Burton et al., 2021).

The finding that attentional bias was restricted to the processing of healthy food-related stimuli and not unhealthy food-related stimuli, and that this observation was associated with increasing pathological indicators of ON (i.e., OrNe), further replicates our previous findings (see Albery et al., 2020). Albery et al. (2020) suggested that the lack of an AB effect for unhealthy words argues against the idea that these types of cues could be "threatening" in nature (Albery et al., 2020). The current study included self-report threat-related indicators of all the health and non-health-food related words utilized to examine the possibility. For both HeOr and OrNe threat-related ratings of the unhealthy words contributed significant explanatory variance suggesting how one consciously perceives unhealthy food-related stimuli, and not healthy food-related cues, is important as an independent predictor of both components of orthorexia specified by the ToS. For HeOr scores the threat experienced by unhealthy food-related words may be compensated for by increased identity centrality as a vegan/vegetarian. Similarly, for increasing OrNe, the result of an initial threat-based processing of unhealthy food may be an exaggeration in disengagement from more desirable cues (i.e., healthy food words) possibly to dampen any experienced negative arousal. In other words, that an individual may have increasing tendencies towards more pathological thinking vis-à-vis healthy foods, eating behaviour etc., may result from the threat posed by more undesirable stimuli and how the attentional system may systematically adapt to manage this experienced threat by focusing (or fixating) on healthy food-related cues only. Future work should formally test the idea that individuals scoring high in "healthy orthorexia" or "unhealthy orthorexia" use differential strategies to compensate from any threat experienced as a result of exposure to unhealthy food-related stimuli.

Whilst the current study identifies components to distinguish "healthy orthorexia" from orthorexia nervosa, several limitations should be overcome in future empirical work. The first is to note that the power

of identity centrality as a vegan/vegetarian in the prediction of increasing HeOr may be an artifact of the population studied. To fully examine the power of identity in the operation of “healthy ON” future work should include alternative eating-related identity options e.g., comparing those who chose not to eat meat and those who have a more omnivorous pattern, etc. Secondly, the inclusion of individuals who self-identified as vegans or vegetarians and who rated their identities according to being “vegan/vegetarian” might actually mask many important differences in the centrality of one’s particular identity. For instance, we can not reliably indicate whether there were any differences in identity ratings nor orthorexia tendencies between vegans or vegetarians or whether these groups differ systematically from other eating groups (omnivores, etc.). Third, that one’s vegan/vegetarian identity appears important for variability in “healthy orthorexia” requires further qualification based on recent work suggesting that social and personal identities operate both explicitly and implicitly (see Cummins, Lindgren, & De Houwer, 2021; Frings & Albery, 2015, 2021; Frings, Melichar, & Albery, 2016). Fourth, our work demonstrated the utility of using alternative measures of attentional bias (i.e., the dot probe) with related indices suggesting the important role of slowed disengagement from healthy food related words in accounting for variability in orthorexia nervosa. This effect should be replicated utilizing more direct measures of attentional bias (e.g., eye tracking-based) to further examine orientation and disengagement processes.

Overall, this pattern of evidence suggests a dissociation of predicted determinants for “healthy” ON (HeOr) and pathological ON (OrNe). More precisely, HeOr is characterized by the importance of one’s identity as, in this instance, a vegan/vegetarian, while OrNe varies as a function of one’s attentional preference for healthy food, and particularly one’s capacity to disengage from these cues once encountered, as well as individual differences in perfectionism and obsessive compulsive thought indices.

Author contributions

IA and ES designed the study; ES recruited for the study. IA, DF, ES and GB analyzed the data and all authors interpreted of the data. IA drafted the manuscript and ES, MS, GB and DF commented on drafts.

Ethical statement

The Ethics Panel of London South Bank University approved the study. This study was performed fulfilling the principles of the British Psychological Society.

Informed consent

Informed consent was obtained from all participants included in the study.

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Declaration of competing interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

Data availability

Data will be made available on request.

References

- Albery, I. P., Michalska, M., Moss, A. C., & Spada, M. (2020). Selective attentional bias to food-related stimuli in healthy individuals with characteristics towards orthorexia nervosa. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 25(5), 1225–1233.
- Albery, I. P., Nosa, S., Spada, M. M., & Frings, D. (2021). Differential identity components predict dimensions of problematic facebook use. *Computers in Human Behavior Reports*, 3, Article 100057.
- Albery, I. P., Wilcockson, T., Frings, D., Moss, A. C., Caselli, G., & Spada, M. M. (2016). Examining the relationship between selective attentional bias for food-and body-related stimuli and purging behaviour in bulimia nervosa. *Appetite*, 107, 208–212.
- Amir, I., Zvielli, A., & Bernstein, A. (2016). (De) coupling of our eyes and our mind’s eye: A dynamic process perspective on attentional bias. *Emotion*, 16(7), 978.
- Appelhans, B. M., French, S. A., Pagoto, S. L., & Sherwood, N. E. (2016). Managing temptation in obesity treatment: A neurobehavioral model of intervention strategies. *Appetite*, 96, 268–279.
- Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & Van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, 133(1), 1.
- Barnes, M. A., & Caltabiano, M. L. (2017). The interrelationship between orthorexia nervosa, perfectionism, body image and attachment style. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 22(1), 177–184.
- Barnett, M. J., Dripps, W. R., & Blomquist, K. K. (2016). Organivore or organorexic? Examining the relationship between alternative food network engagement, disordered eating, and special diets. *Appetite*, 105, 713–720.
- Barrada, J. R., & Roncero, M. (2018). Bidimensional structure of the orthorexia: Development and initial validation of a new instrument. *Anales De Psicología/Annals of Psychology*, 34(2), 283–291.
- Bartel, S. J., Sherry, S. B., Farthing, G. R., & Stewart, S. H. (2020). Classification of orthorexia nervosa: Further evidence for placement within the eating disorders spectrum. *Eating Behaviors*, 38, Article 101406.
- Barthels, F., Barrada, J. R., & Roncero, M. (2019). Orthorexia nervosa and healthy orthorexia as new eating styles. *PLoS One*, 14(7), Article e0219609.
- Barthels, F., Meyer, F., & Pietrowsky, R. (2015). Orthorexic eating behavior. A new type of disordered eating. *Ernährungs Umschau*, 62(10), 156–161.
- Berridge, K. C. (2009). ‘Liking’ and ‘wanting’ food rewards: Brain substrates and roles in eating disorders. *Physiology and Behavior*, 97(5), 537–550.
- Berridge, K. C., & Robinson, T. E. (2016). Liking, wanting, and the incentive-sensitization theory of addiction. *American Psychologist*, 71(8), 670–679.
- Bratman, S. (2017). Orthorexia vs. theories of healthy eating. *Eating and weight disorders-studies on anorexia, Bulimia and Obesity*, 22(3), 381–385.
- Bratman, S., & Knight, D. (2000). *Health food junkies: Overcoming the obsession with healthful eating*. New York: Broadway Books.
- Brytek-Matera, A. (2021). Vegetarian diet and orthorexia nervosa: A review of the literature. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 26(1), 1–11.
- Brytek-Matera, A., Czepczor-Bernat, K., Jurzak, H., Kornacka, M., & Kołodziejczyk, N. (2019). Strict health-oriented eating patterns (orthorexic eating behaviours) and their connection with a vegetarian and vegan diet. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 24(3), 441–452.
- Buckingham, S. A., Frings, D., & Albery, I. P. (2013). Group membership and social identity in addiction recovery. *Psychology of Addictive Behaviors*, 27(4), 1132.
- Callaghan, L., Yong, H. H., Borland, R., Cummings, K. M., Hitchman, S. C., & Fong, G. T. (2021). What kind of smoking identity following quitting would elevate smokers relapse risk? *Addictive Behaviors*, 112, Article 106654.
- Cena, H., Barthels, F., Cuzzolaro, M., Bratman, S., Brytek-Matera, A., Dunn, T., ... Donini, L. M. (2019). Definition and diagnostic criteria for orthorexia nervosa: A narrative review of the literature. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 24(2), 209–246.
- Chaki, B., Pal, S., & Bandyopadhyay, A. (2013). Exploring scientific legitimacy of orthorexia nervosa: A newly emerging eating disorder. *Journal of Human Sport Exercise*, 8(4), 1045–1053.
- Cisler, J. M., & Koster, E. H. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review*, 30(2), 203–216.
- Cummins, J., Lindgren, K. P., & De Houwer, J. (2021). On the role of (implicit) drinking self-identity in alcohol use and problematic drinking: A comparison of five measures. *Psychology of Addictive Behaviors*, 35(4), 458.
- Depa, J., Barrada, J. R., & Roncero, M. (2019). Are the motives for food choices different in orthorexia nervosa and healthy orthorexia? *Nutrients*, 11(3), 697.
- Dittfeld, A., Gwizdek, K., Jagielski, P., Brzęk, A., & Ziora, K. (2017). Ocena związku pomiędzy ortoreksją a wegetarianizmem z użyciem BOT (“Bratman Test for Orthorexia”). *Psychiatria Polska*, 51(6).
- Donini, L. M., Marsili, D., Graziani, M. P., Imbriale, M., & Cannella, C. (2005). Orthorexia nervosa: Validation of a diagnosis questionnaire. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 10(2), e28–e32.
- Dunn, T. M., & Bratman, S. (2016). On orthorexia nervosa: A review of the literature and proposed diagnostic criteria. *Eating Behaviors*, 21, 11–17.
- Field, M., Munafò, M. R., & Franken, I. H. A. (2009). A meta-analytic investigation of the relationship between attentional bias and subjective craving in substance abuse. *Psychological Bulletin*, 135(4), 589–607.
- Field, M., Werthmann, J., Franken, I., Hofmann, W., Hogarth, L., & Roefs, A. (2016). The role of attentional bias in obesity and addiction. *Health Psychology*, 35(8), 767–780.
- Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The obsessive-compulsive inventory: Development and validation of a short version. *Psychological Assessment*, 14(4), 485.

- Frings, D., & Albery, I. P. (2015). The social identity model of cessation maintenance: Formulation and initial evidence. *Addictive Behaviors, 44*, 35–42.
- Frings, D., & Albery, I. P. (2021). An identity-based explanatory framework for alcohol use and misuse. In D. Frings, & I. P. Albery (Eds.), *The handbook of alcohol use* (pp. 329–352). Academic Press.
- Frings, D., Melichar, L., & Albery, I. P. (2016). Implicit and explicit drinker identities interactively predict in-the-moment alcohol placebo consumption. *Addictive Behaviors Reports, 3*, 86–91.
- Frings, D., Wood, K. V., & Albery, I. P. (2021). New converts and seasoned campaigners: The role of social identity at different stages in the addiction recovery journey. *Drugs: Education, Prevention & Policy, 28*(5), 496–503.
- Frost, R. O., & Marten, P. A. (1990). Perfectionism and evaluative threat. *Cognitive Therapy and Research, 14*(6), 559–572.
- Hardman, C. A., Jones, A., Burton, S., Duckworth, J. J., McGale, L. S., Mead, B. R., ... Werthmann, J. (2021). Food-related attentional bias and its associations with appetitive motivation and body weight: A systematic review and meta-analysis. *Appetite, 157*, Article 104986.
- Haslam, C., Haslam, S. A., Jetten, J., Cruwys, T., & Steffens, N. K. (2021). Life change, social identity, and health. *Annual Review of Psychology, 72*, 635–661.
- Heiss, S., Coffino, J. A., & Hormes, J. M. (2019). What does the ORTO-15 measure? Assessing the construct validity of a common orthorexia nervosa questionnaire in a meat avoiding sample. *Appetite, 135*, 93–99.
- Hertel, A. W., Baldwin, S. A., Peterson, K. P., & Lindgren, K. P. (2021). Identification with drinking predicts increases in drinking behaviors (but not vice versa). *Addictive Behaviors, 116*, Article 106796.
- Hyrnik, J., Janas-Kozik, M., Stochel, M., Jelonek, I., Siwicz, A., Krysta, K., et al. (2016). Prevalence of orthorexia nervosa among polish adolescents—Assessment made by the ORTO-15 Questionnaire. *European Psychiatry, 33*(S1), S430. S430.
- Kemps, E., Tiggemann, M., Martin, R., & Elliott, M. (2013). Implicit approach–avoidance associations for craved food cues. *Journal of Experimental Psychology: Applied, 19*(1), 30.
- Koster, E. H., Crombez, G., Verschuere, B., & De Houwer, J. (2004). Selective attention to threat in the dot probe paradigm: Differentiating vigilance and difficulty to disengage. *Behaviour Research and Therapy, 42*(10), 1183–1192.
- Koven, N. S., & Abry, A. W. (2015). The clinical basis of orthorexia nervosa: Emerging perspectives. *Neuropsychiatric Disease and Treatment, 11*, 385.
- Leach, C. W., Van Zomeren, M., Zebel, S., Vliek, M. L., Pennekamp, S. F., Doosje, B., ... Spears, R. (2008). Group-level self-definition and self-investment: A hierarchical (multicomponent) model of in-group identification. *Journal of Personality and Social Psychology, 95*(1), 144.
- MacLeod, C., Mathews, A. M., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15–20.
- McComb, S. E., & Mills, J. S. (2019). Orthorexia nervosa: A review of psychosocial risk factors. *Appetite, 140*, 50–75.
- Meijer, E., Vangeli, E., Gebhardt, W. A., & van Laar, C. (2020). Identity processes in smokers who want to quit smoking: A longitudinal interpretative phenomenological analysis. *Health, 24*(5), 493–517.
- Meule, A., Holzapfel, C., Brandl, B., Greetfeld, M., Hessler-Kaufmann, J. B., Skurk, T., ... Voderholzer, U. (2020). Measuring orthorexia nervosa: A comparison of four self-report questionnaires. *Appetite, 146*, Article 104512.
- Missbach, B., Hinterbuchinger, B., Dreiseitl, V., Zellhofer, S., Kurz, C., & König, J. (2015). When eating right, is measured wrong! A validation and critical examination of the ORTO-15 questionnaire in German. *PLoS One, 10*(8), Article e0135772.
- Mitrofanova, E., Pummell, E., Martinelli, L., & Petróczy, A. (2021). Does ORTO-15 produce valid data for 'orthorexia nervosa'? A mixed-method examination of participants' interpretations of the fifteen test items. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 26*(3), 897–909.
- Montes, K. S. (2020). Does gambling identity predict unique variance in negative gambling-related outcomes: An examination of direct and interactive associations. *Journal of Gambling Studies, 36*(4), 1361–1377.
- Montes, K. S., & Pearson, M. R. (2021). I am what I am: A meta-analysis of the association between substance user identities and substance use-related outcomes. *Psychology of Addictive Behaviors, 35*(3), 231.
- Nezlek, J. B., & Forestell, C. A. (2020). Vegetarianism as a social identity. *Current Opinion in Food Science, 33*, 45–51.
- Nijls, I. M., & Franken, I. H. (2012). Attentional processing of food cues in overweight and obese individuals. *Current Obesity Reports, 1*(2), 106–113.
- Opitz, M. C., Newman, E., Mellado, A. S. A. V., Robertson, M. D., & Sharpe, H. (2020). The psychometric properties of orthorexia nervosa assessment scales: A systematic review and reliability generalization. *Appetite, 155*, Article 104797.
- Paslakis, G., Kühn, S., Schaubschläger, A., Schieber, K., Röder, K., Rauh, E., et al. (2016). Explicit and implicit approach vs. avoidance tendencies towards high vs. low calorie food cues in patients with anorexia nervosa and healthy controls. *Appetite, 107*, 171–179.
- Plante, C. N., Rosenfeld, D. L., Plante, M., & Reysen, S. (2019). The role of social identity motivation in dietary attitudes and behaviors among vegetarians. *Appetite, 141*, Article 104307.
- Pratt, V. B., Madigan, D. J., & Hill, A. P. (2021). Perfectionistic self-presentation and orthorexia in exercisers. *Eating and weight disorders-studies on anorexia, Bulimia and Obesity, 1*–5.
- Reynolds, R. (2018). Is the prevalence of orthorexia nervosa in an Australian university population 6.5. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 23*(4), 453–458.
- Robinson, M. J. F., Fischer, A. M., Ahuja, A., Lesser, E. N., & Maniates, H. (2016). Roles of “wanting” and “liking” in motivating behavior: gambling, food, and drug addictions. *Current Topics in Behavioral Neuroscience, 27*, 105–136.
- Rodebaugh, T. L., Scullin, R. B., Langer, J. K., Dixon, D. J., Huppert, J. D., Bernstein, A., ... Lenze, E. J. (2016). Unreliability as a threat to understanding psychopathology: The cautionary tale of attentional bias. *Journal of Abnormal Psychology, 125*(6), 840.
- Roncero, M., Barrada, J. R., & Perpiñá, C. (2017). Measuring orthorexia nervosa: Psychometric limitations of the ORTO-15. *Spanish Journal of Psychology, 20*.
- Rosenfeld, D. L., & Burrow, A. L. (2017). Vegetarian on purpose: Understanding the motivations of plant-based dieters. *Appetite, 116*, 456–463.
- Rosenfeld, D. L., Rothgerber, H., & Tomiyama, A. J. (2020). From mostly vegetarian to fully vegetarian: Meat avoidance and the expression of social identity. *Food Quality and Preference, 85*, Article 103963.
- Sanlier, N., Yassibas, E., Bilici, S., Sahin, G., & Celik, B. (2016). Does the rise in eating disorders lead to increasing risk of orthorexia nervosa? Correlations with gender, education, and body mass index. *Ecology of Food and Nutrition, 55*(3), 266–278.
- Schmitz, F., Naumann, E., Trentowska, M., & Svaldi, J. (2014). Attentional bias for food cues in binge eating disorder. *Appetite, 80*, 70–80.
- Segura-García, C., Papaiani, M. C., Caglioti, F., Procopio, L., Nisticò, C. G., Bombardiere, L., et al. (2012). Orthorexia nervosa: A frequent eating disordered behavior in athletes. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 17*(4), e226–e233.
- Steffens, N. K., LaRue, C. J., Haslam, C., Walter, Z. C., Cruwys, T., Munt, K. A., et al. (2021). Social identification-building interventions to improve health: A systematic review and meta-analysis. *Health Psychology Review, 15*(1), 85–112.
- Stott, N., Fox, J. R., & Williams, M. O. (2021). Attentional bias in eating disorders: A meta-review. *International Journal of Eating Disorders, 54*(8), 1377–1399.
- Strahler, J., Wachten, H., Neuhofer, S., & Zimmermann, P. (2022). Psychological correlates of excessive healthy and orthorexic eating: Emotion regulation, attachment, and anxious-depressive-stress symptomatology. *Frontiers in Nutrition, 9*.
- Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2019). *Using multivariate statistics* (7th ed.) (Boston, MA: Pearson).
- Tapper, K., Pothos, E. M., & Lawrence, A. D. (2010). Feast your eyes: Hunger and trait reward drive predict attentional bias for food cues. *Emotion, 10*(6), 949.
- Timko, C. A., Hormes, J. M., & Chubski, J. (2012). Will the real vegetarian please stand up? An investigation of dietary restraint and eating disorder symptoms in vegetarians versus non-vegetarians. *Appetite, 58*(3), 982–990.
- Turner, P. G., & Lefevre, C. E. (2017). Instagram use is linked to increased symptoms of orthorexia nervosa. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 22*(2), 277–284.
- Valente, M., Syurina, E. V., & Donini, L. M. (2019). Shedding light upon various tools to assess orthorexia nervosa: a critical literature review with a systematic search. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 24*(4), 671–682.
- Van Heuven, W. J., Mandera, P., Keuleers, E., & Brysbaert, M. (2014). SUBTLEX-UK: A new and improved word frequency database for British English. *Quarterly Journal of Experimental Psychology, 67*(6), 1176–1190.
- Varga, M., Dukay-Szabó, S., Túry, F., & van Furth Eric, F. (2013). Evidence and gaps in the literature on orthorexia nervosa. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 18*(2), 103–111.
- Werthmann, J., Jansen, A., & Roefs, A. (2015). Worry or craving? A selective review of evidence for food-related attention biases in obese individuals, eating-disorder patients, restrained eaters and healthy samples. *Proceedings of the Nutrition Society, 74*(2), 99–114.
- Zagaria, A., Vacca, M., Cerolini, S., Ballesio, A., & Lombardo, C. (2022). Associations between orthorexia, disordered eating, and obsessive–compulsive symptoms: A systematic review and meta-analysis. *International Journal of Eating Disorders, 55*(3), 295–312.
- Zickgraf, H. F., & Barrada, J. R. (2021). Orthorexia nervosa vs. healthy orthorexia: Relationships with disordered eating, eating behavior, and healthy lifestyle choices. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity, 1*–13.
- Zickgraf, H. F., Ellis, J. M., & Essayli, J. H. (2019). Disentangling orthorexia nervosa from healthy eating and other eating disorder symptoms: Relationships with clinical impairment, comorbidity, and self-reported food choices. *Appetite, 134*, 40–49.
- Zsido, A. N., Teleki, S. A., Csokasi, K., Rozsa, S., & Bandi, S. A. (2020). Development of the short version of the spielberger state–trait anxiety inventory. *Psychiatry Research, 291*, Article 113223.