Appetite 70 (2013) 31–36

Contents lists available at SciVerse ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

A bitter sweet asynchrony. The relation between eating attitudes, dietary restraint on smell and taste function

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ARTICLE INFO

Article history:
Received 11 March 2013
Received in revised form 13 June 2013
Accepted 15 June 2013
Available online 25 June 2013

Keywords:
Eating attitudes
Restraint
Odour
Taste
Forbidden food
Gender

ABSTRACT

Research has demonstrated that individuals with eating disorders have an impaired sense of smell and taste, though the influence of eating attitudes, dietary restraint and gender in a non-clinical sample is unknown. In two studies (study 1: 32 females, 28 males; study 2: 29 females) participants completed questionnaires relating to Eating Attitudes (EAT) and dietary restraint (DEBQ) followed by an odour (study 1: isoamyl acetate, study 2: chocolate) threshold and taste test. In study 2 we also measured the number of fungiform papillae taste buds. Study one revealed that increases in pathological eating attitudes predicted poorer olfactory sensitivity (males/females) and lower bitterness ratings for the bitter tastant (females only), suggestive of poorer taste acuity. In study two we found that both eating attitudes and restraint predicted poorer sensitivity to an odour associated to a forbidden food (chocolate) and that increasing eating attitudes predicted higher sweetness ratings for the bitter tastant. Interestingly increases in restraint were associated with an increased number of fungiform papillae which was not related to bitter or sweet intensity. These findings demonstrate that in a young healthy sample that subtle differences in eating pathology and dietary restraint predict impaired olfactory function to food related odours. Further that perception of bitter tastants is poorer with changes in eating pathology but not dietary restraint.

Introduction

In western societies, eating related disorders are among the most frequently reported health problems in young females (Grave, 2011). The seriousness of conditions such as anorexia nervosa is underlined by the fact it has the highest mortality rate (≈20%) of any psychiatric illness (Vitiello & Lederhendler, 2000). The precise causes of eating related disorders are still unknown but are likely a combination of psychological, environmental and biological factors (Grave, 2011). To further understand this complex condition, the role of smell and taste function has also been investigated. At the clinical end of the spectrum, work has shown evidence for anorexics to have an impaired sense of smell (Aschenbrenner et al., 2008; Rapps et al., 2010; Roessner, Bleich, Banaschewski, & Rothenberger, 2005) and taste (Aschenbrenner et al., 2008; Casper, Kirschner, Sandstead, Jacob, & Davis, 1980; Rodin, Bartoshuk, Peterson, & Schank, 1990). However, in non-clinical samples it is unclear whether more general attitudes relating to eating behaviour are also associated with differences in smell and taste function. Attitudes relating to eating behaviour can be measured with instruments such as the Eating Attitude Test (EAT) (Garner & Garfinkel, 1979) which contain a series of questions relating to eating behaviour, with scores over a certain threshold, typical of individuals with eating disorders. Using the EAT, work has shown across a sample of hospitalised anorexic, bulimic and control subjects that EAT scores were negatively associated to olfactory function; that is, those with more disordered attitudes toward eating had a poorer sense of smell (Aschenbrenner et al., 2008).

Apart from the link between the chemical senses and pathological eating attitudes, it is also important to examine more subtle differences such as dietary restraint.

Dietary restraint is believed to be an important component of the maintenance and perhaps development of eating related disorders (Brewerton, Dansky, Kilpatrick, & O'Neil, 2000; Polivy & Herman, 1993). Very few studies have examined smell and taste function in this population, though one study reported no differences in response to a neutral odour between restrained and unrestrained eaters (Kemmotsu & Murphy, 2006). From a different perspective, work has examined the effect of food odour cues (pizza or cookies) on subsequent hedonics and consumption of those same foods (Fedoroff, Polivy, & Herman, 2003). Results revealed that restrained eaters consumed more of the food that was congruent with the odour cue, i.e. more pizza was eaten when preceded by the pizza compared to cookie odour cue. This pattern was not

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http://dx.doi.org/10.1016/j.appet.2013.06.084

observed in unrestrained eaters and therefore suggests that restrained individuals were more sensitive to food odours, at least in their effects on subsequent food consumption. We are not aware of any research examining differences in taste in these populations.

To summarise, there is evidence for poorer olfactory/gustatory function in anorexics/bulimics, but it is unclear whether differences in Eating Attitudes (EAT) and dietary restraint might predict smell & taste function in a non-clinical sample. We also wished to examine whether associations are evident in both male and female samples. Historically, eating disorders and dietary restraint are thought of as applicable to mainly females, but there is evidence of a convergence of eating disorder prevalence between males and females (Woodside et al., 2001); which therefore make it important to look at both genders.

Additionally, the above research (Aschenbrenner et al., 2008; Kemmotsu & Murphy, 2006; Rapps et al., 2010; Roessner et al., 2005) has not examined olfactory sensitivity using a food related odour, which given the topic under investigation would seem particularly important.

In the present study, individuals completed measures of eating pathology (EAT) and dietary restraint (DEBQ) followed by an olfactory threshold test to a food related odour (banana/pear: isoamyl acetate) and finally a taste test to bitter and sweet tastants. We tentatively predict that for females, increases in EAT and DEBQ will be associated with poorer olfactory and gustatory function. Since we are not aware of any previous research in males, our aim is mainly exploratory. Finally, we included measures of BMI and hunger state, since research has shown that these factors can influence olfactory sensitivity (Stafford & Welbeck, 2011).

In study 2, we extended the research to examine the effect of using a food odour (chocolate) with particular relevance to those with eating disorders (Knight & Boland, 1989) as there is reason to believe that sensitivity to these odours might actually increase with eating pathology.

Methods

Study 1

Participants

Sixty students (32 females, 28 males) from the University of Portsmouth participated in the study and were aged between 18 and 32 years ($M = 20.4$ years, SD = 2.2 years). An online booking system was used to advertise the study which was described as examining factors that influence our sense of smell and taste.

Individuals who were pregnant or had allergies to certain odours/taste were advised not to participate. The study protocol was given ethical approval from the department's ethics committee (British Psychology Society guidelines).

Design

The study used a correlational design with the main variables being EAT, DEBQ and the various olfactory and gustatory measures.

Eating attitudes test: The EAT-26 (Garner & Garfinkel, 1979) was used to assess aberrant attitudes toward food and eating. The questionnaire comprises of 26 items (e.g. "Aware of the calorie content of foods that I eat") and participants signify their level of agreement on a 6-point likert scale from 'Always' to 'Never'. Higher scores are indicative of dieting behaviour and scores above '20' associated with an eating disorder.

Dutch Eating Behaviour Questionnaire: Restraint was determined using the restraint sub-scale of the Dutch Eating Behaviour Questionnaire (Van Strien, Frijters, Bergers, & Defares, 1986). This entailed participants to rate their agreement to ten questions by ticking a box on a 5-point likert scale from never (1) to very often (5). The minimum and maximum values a participant could score are 1 and 5.

Hunger: Hunger was measured using a Visual Analogue Scale (VAS), with a 100 mm unmarked line labelled "not at all" and "extremely" at either end, with the adjective "hunger" centred above the line.

Olfactory threshold test: The odour used for the threshold test was isoamyl acetate, a food associated (smell of banana/pear) odour used frequently in olfactory food related work (Albrecht et al., 2009), which was diluted in mineral oil (Nujol). The odourant was prepared using 11 250 ml squeeze bottles(CJK Packaging, UK), in 11 dilution steps, starting at 0.06% (Step 1) with each successive step diluted by a factor of two, to the lowest (Step 11). All chemicals were supplied by Fisher Scientific (UK). Prior to the start of testing, participants were familiarised with the odour of the strongest concentration, by squeezing the bottle under the participant's nose (≈2 cm) and gently waving it between each nostril to ensure optimal inhalation. The experimenter wore cotton gloves (Boots, Portsmouth) to reduce any cross contamination of odours. Participants then completed VAS on the pleasantness, sweetness, bitterness and intensity of the odour. To test for olfactory threshold, participants were presented with three bottles (2 of which were blanks, containing mineral oil only) at the weakest concentration. Following presentation of the last bottle of the triplet (counterbalanced), participants were asked which bottle contained the odour (1, 2 or 3). If the participant answered correctly (and it was the lowest concentration), they were presented with the same triplet again (in a different order) and the task repeated until they made a mistake, which resulted in the triplet containing the next (higher) concentration step being presented. Participants threshold was established when they had made three consecutive correct responses. The method of threshold testing used was similar to a previous study (Lam, Sung, Abdullah, & van Hasselt, 2006).

Gustatory test: Taste was examined using a kit which is part of a larger test from the 'Sniffin sticks' battery (Burghart Instruments, West Germany) which has been used widely in research (Hummel, Kobal, Gudziol, & Mackay-Sim, 2007; Seo & Hummel, 2009). In the test here, two bottles were used with spray attachments: one bottle containing a sweet solution (1 g sucrose in 10 g water) and the other containing a bitter solution (0.005 g quinine hydrochloride in 10 g water).

Participants were presented with each tastant (counterbalanced order) which was sprayed directly onto the tongue by the experimenter. After each taste, they completed the same VAS ratings and sipped some water before the next taste.

Procedure

All testing took place at the University's department of psychology. Participants were instructed not to consume anything (apart from water) within 2 h of their appointed time, since this may have affected their sense of smell and taste. Upon arrival, participants provided informed consent and then had their height and weight measurements taken. Next, participants completed the EAT and DEBQ questionnaires followed by the hunger VAS. Participants then performed the olfactory and gustatory tests and finally were given a full debriefing. Participants received course credit for participating in the study.

Data analyses

Preliminary analyses for the taste ratings revealed associations for the bitter tastant only. We therefore completed hierarchical linear regression analyses separately for odour threshold and bitter