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**Differential disgust responding in people with cancer and implications for
psychological wellbeing**

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Abstract

Objectives: Evidence suggests that disgust responses, known to negatively affect psychological wellbeing, may differ in people with cancer. We performed the first quantitative investigation of three discrete types of disgust trait - disgust propensity, sensitivity, and self-directed disgust - in people diagnosed with a broad range of cancers (versus cancer-free controls), and explored their associations with psychological wellbeing.

Design: In a cross-sectional survey design, 107 participants with heterogeneous cancer diagnoses, recruited from cancer charities and support groups, were matched with cancer-free controls by age and gender.

Outcome measures: Measures of the three disgust traits were taken alongside measures of anxiety and depression.

Results: Disgust sensitivity and physical self-disgust were significantly higher in the cancer than control sample, while disgust propensity and behavioural self-disgust were lower. The disgust traits had a different pattern of associations to psychological wellbeing across the two groups, with disgust sensitivity predicting depressive symptoms to a significantly greater extent in the cancer than control group.

Conclusions: People with cancer differ from matched controls in their disgust responses and these responses have significant predictive relationships with aspects of their psychological wellbeing. The results suggest that emotion-based interventions may be useful for improving psychological wellbeing in people with cancer.

Keywords: cancer, disgust propensity, disgust sensitivity, oncology, psychological wellbeing, self-disgust.

Introduction

Disgust is a universal human emotion (Ekman, 1992), theorised to be an evolved derivative of distaste, which prevents an organism from ingesting potentially harmful substances (Rozin & Fallon, 1987). The emotion is thought to have been evolutionarily ‘co-opted’ to protect against broader pathogenic threats to the body from potentially infectious stimuli (Curtis, Aunger, & Rabie, 2004), and wider interpersonal and social elicitors that violate sociocultural norms of purity and sanctity (e.g., sexual violations; Chapman & Anderson, 2012). Given its particular relevance in facilitating good health, the disgust response has an important role to play in understanding psychological reactions to disease, including chronic illnesses such as cancer (e.g., Reynolds, Consedine, Pizarro, & Bissett, 2013).

There are at least two reasons why disgust responses may be particularly relevant in the context of cancer. First, people with cancer may be exposed to a variety of disgust-eliciting experiences, both from the disease itself and the side-effects of treatment. These include, but are not limited to, significant bodily changes (e.g., malignant wounds, Lund-Nielsen, Müller, & Adamsen, 2005; cancer-related lymphedema, Beck, Wanchai, Stewart, Cormier, & Armer, 2012; colostomy, Reynolds, McCambridge, Bissett, & Consedine, 2014; disfigurement, Costa, Nogueira, de Souza Lima, Mendonça, & Leles, 2014; and hair loss, Batchelor, 2001), behavioural side-effects (e.g., incontinence, Reynolds, McCambridge, & Consedine, 2015; sickness and nausea, Hesketh, 2008), and shifts in self-identity (e.g., loss of masculinity, Chapple & Ziebland, 2002, or femininity, Schover, 1994; and the salience of mortality, Goldenberg, Arndt, Hart, & Routledge, 2008).

Second, cancer and certain cancer treatments may produce significant changes in one’s biological functions, such as immunosuppression (e.g., Medler, Cotechini, & Coussens, 2015). Major biological changes, for example those associated with menstrual phase (Fessler

& Navarrete, 2003), pregnancy (Fessler, Eng & Navarrete, 2005), and ageing (Fajula, Bonin-Guillaume, Jouve, & Blin, 2013) are associated with a differential pattern of disgust responding. Therefore, potential differences in one's disgust responses as a *consequence* of cancer can be hypothesised.

Differences in disgust responses as a result of cancer may have serious psychological and behavioural health implications. Unregulated disgust reactions have been shown to be associated with the avoidance of cancer screening behaviours (Reynolds et al., 2013; Reynolds et al., 2014), wound care (Gaird, Clarke, & Butler, 2011), and social avoidance in the context of bowel/health problems (Reynolds, Lin, Zhou, & Consedine, 2015).

Heightened disgust responses have also been shown to be associated with mental health problems, such as anxiety (Cisler, Olatunji, & Lohr, 2009) and depression (Alanazi, Powell, & Power, 2015), and, thus, may be one of the factors contributing to poorer psychological adaptation to cancer. Several disgust traits have been shown to predict symptoms of mental health in cancer-free samples. For example, being more prone to disgust predicts greater symptoms of anxiety (Cisler et al., 2009), while finding the disgust response more aversive has been associated with certain forms of anxious responding (van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006) and depression (Ille, Schony, Kapfhammer, & Schienle, 2010). Self-directed disgust is also a significant vulnerability factor for subsequent depressive symptoms (Overton, Markland, Taggart, Bagshaw, & Simpson, 2008; Powell, Simpson, & Overton, 2013).

While people's disgust responses (i.e., the intercept) may be affected by cancer and thus influence wellbeing, it is also plausible that the *relationship* between one's disgust responses and mental health outcomes (i.e., the slope) may differ in a cancer group. Psychological wellbeing in people who are well is influenced by a wide range of psychosocial factors (Diener, Suh, Lucas, & Smith, 1999). However, in a serious health

condition like cancer, we anticipate that the factors influencing wellbeing will narrow somewhat to become more focused on physical health. There is evidence that cancer, and other chronic physical illnesses, can become all-consuming (e.g., Gibson, et al., 2016; Shragge, Wismer, Olson, & Baracos, 2007). For example, cancer patients often have difficulty focusing attention away from the disease, tend to ruminate on it (e.g., Bishop & Warr, 2003; Chan, Ho, Tedeschi, & Leung, 2011) and have cancer-related negative intrusive thoughts (e.g., Brenne, Loge, Kaasa, Heitzer, Knudsen, & Wasteson, 2013; Walker, Nail, Larsen, Magill, & Schwartz, 1996). Thus, we expect that changes engendered by cancer and its treatment - that are disgust-provoking (Powell, Azlan, Simpson, & Overton, 2016) and germane to the diagnosis - may result in disgust reactions having a stronger influence on current psychological wellbeing in people with cancer (vs. cancer-free controls). Few studies, however, have examined the prediction of disgust responses on the psychological wellbeing of individuals with cancer, and those that have had a restricted focus on disgust proneness in colorectal cancer scenarios only (e.g., Reynolds et al., 2013; Reynolds et al., 2014; Smith, Lowenstein, Rozin, Sherriff, & Ubel, 2007). Disgust responses, however, are likely to be relevant to many types of cancer. Given the above literature, significant associations between disgust responses and symptoms of depression and anxiety can be expected in a cancer sample, and these may differ from a control sample.

In this study we tested the above hypotheses, by i) exploring the expression of three discrete disgust traits ('disgust propensity', 'disgust sensitivity', and 'self-disgust') in a heterogeneous cancer sample, in comparison to a cancer-free, age- and gender-matched control comparison group; and ii) quantitatively investigating their independent predictive relationships with participants' symptoms of anxiety and depression in the two groups. We will first introduce the three disgust traits before outlining our predictions.

Disgust Propensity

Perhaps the most studied of the disgust traits is ‘disgust propensity’ (DP), which describes an individual’s tendency to experience disgust (van Overveld et al., 2006). Individuals differ in the extent to which they report finding relevant stimuli (e.g., faeces) disgusting and several self-report instruments have now been developed to assess inter-individual propensity to disgust across a number of domains, such as contamination-based and animal-reminder disgust (see van Overveld et al., 2006). A heightened disgust proneness has been highlighted as a correlate of poorer psychological health by over two decades of work (Davey, 2011), and as a marker for mental health problems, including specific phobias (Matchett & Davey, 1991), contamination-based obsessive-compulsive disorder (OCD; Woody & Tolin, 2002), and generalised anxiety disorder (Cisler et al., 2009).

In colorectal cancer, higher levels of DP have been associated with avoidance of hypothetical treatment stimuli (i.e., a colostomy bag), delay in help seeking for bowel symptoms, and a lower projected treatment adherence due to disgust-based side-effects (Reynolds et al., 2014). It has also been shown to be associated with greater perceived stigma and lower life satisfaction in people with a colostomy (Smith et al., 2007), and prospectively predicts worse quality of life three months later in individuals with anal incontinence (Reynolds et al., 2015). However, despite its potential relevance to all cancers, DP has not yet been studied outside of the colorectal context.

Disgust Sensitivity

The development of psychological problems may not only depend on how often people experience disgust (i.e., DP), but also on how they *appraise* the experience. ‘Disgust sensitivity’ (DS) can be defined as the degree to which the disgust response is unpleasant or distressing to an individual (van Overveld et al., 2006). This trait has been demonstrated as psychometrically separable from DP (Fergus & Valentiner, 2009), and has independent links

with mental health problems (Olatunji, Cisler, Deacon, Connolly, & Lohr, 2007; van Overveld et al., 2006). For example, a study with people with emetophobia (fear of vomiting) found that DS was a better predictor of anxious symptoms than DP (van Overveld, de Jong, Peters, van Hout, & Bouman, 2008). Moreover, when exploring posttraumatic stress in soldiers deployed to Afghanistan, DS was found to moderate the link between peritraumatic disgust and symptom severity (Engelhard, Olatunji, & de Jong, 2011). Indeed, work is increasingly exploring the role of cognitive appraisals in disgust experiences as a pathway to psychological distress (e.g., de Jong, van Overveld, & Peters, 2011; Teachman, 2006). Given the possible greater exposure to, and particularly aversive nature of, the disgust-eliciting stimuli that cancer patients may have to encounter, it is highly likely that the way an individual appraises these experiences will be important for their psychological adjustment. Nevertheless, no study to date has explored the psychological profile or correlates of DS in a cancer sample.

Self-Disgust

A third way disgust responses may be detrimental to psychological wellbeing is if they are directed towards oneself (Overton, et al., 2008). ‘Self-disgust’ (SD) can be defined as a schematic appraisal of physical and/or behavioural aspects of the self as objects of disgust (Powell, Simpson, & Overton, 2015a). Heightened SD has been associated with a range of mental health problems, including depression (Overton et al., 2008), sexual dysfunction (de Jong & Borg, 2015), eating disorders (Fox, Grange, & Power, 2015) and OCD (Olatunji, Cox, & Kim, 2015). Powell et al. (2013), for example, found SD to be a stable predictor of depressive symptoms measured twelve months later, when controlling for prior levels of depression, with disgust towards physical appearance making the strongest contribution.

Disgust and SD have an intimate link with one's body image (Powell, Simpson, & Overton 2015b). For example, disgust has been linked to body dissatisfaction and appearance concerns (e.g. Griffiths & Page, 2008; O'Brien et al., 2013; Park, Schaller, & Crandall, 2007). Hence, physiological changes as a result of both the cancer itself and treatment (e.g., hair loss, surgical alterations, unpleasant odours etc.) have the potential to generate a disgust response that is not easy to evade (Reynolds et al., 2015). Indeed, physical SD has been recognised qualitatively in patients with cancer (e.g., Björklund, Sarvimäki, & Berg, 2010), and may be particularly pronounced after treatments such as surgery (e.g., Hopwood, Fletcher, Lee, & Al Ghazal, 2001) and chemotherapy (e.g., Rosman, 2004). Self-disgust for behavioural and/or characterological aspects of the self may also be affected by cancer due to behavioural consequences of the disease (e.g., sexual problems, incontinence, and other physiological symptoms that visibly impair behaviour; Larsson, Hedelin, & Athlin, 2003). As well as affecting psychological health, increased physical SD may have practical implications in a cancer context, for example by leading to avoidance in wound-care (Goode, 2004).

The Present Research

Disgust reactions have been notably absent from systematic investigations into the wellbeing of people with cancer. In the present study, we examined the expression of three discrete disgust traits, and their relative associations with anxious and depressive symptoms, in cancer patients and a matched cancer-free control group. We made the following predictions:

- 1) Disgust propensity and sensitivity would be significantly different in people with cancer than controls. The increased exposure to, and aversive nature of, disgust elicitors in cancer, as well as immunosuppression effects, may cause DP and DS to *increase*. However, past evidence has also shown that DP may *decrease* as a consequence of repeated exposure to

disgust elicitors through habituation (e.g., Rozin, 2008), while no work has investigated the effect of exposure on DS, so a non-directional prediction was adopted.

2) Self-disgust would be significantly higher in people with cancer than controls.

Based on the physical changes to the body that are apparent in cancer, and which have the potential to elicit disgust (Björklund et al., 2010), as well as the potential to see one's body as diseased and contaminated by cancer (Vidya & Nasira, 2014), we expected to observe higher physical SD in the cancer sample. Due to the behavioural consequences of cancer and its treatment that may elicit disgust (e.g., incontinence, vomiting), and the positive correlation with physical SD, we also expected to observe the same pattern in behavioural SD (Powell et al., 2016).

3) Cancer patients' disgust traits, particularly DS (appraising disgust negatively) and SD, would be independently positively associated with symptoms of anxiety and depression, and these disgust responses would matter significantly more for cancer patients' than controls' psychological wellbeing. Symptoms of anxiety and depression have been shown to have a stronger relationship with DS and SD than DP (Powell et al., 2016), and so we expected the former traits to have the stronger association. Given the nature of the eliciting stimuli (i.e., cancer and its side-effects), we made a directional prediction that the disgust traits in people with cancer would have a larger relationship with symptoms of depression and anxiety than the same relationships in controls.

Method

Participants

One hundred and seven participants who reported a cancer diagnosis were matched by age and gender with 107 controls who reported never being diagnosed with cancer. Most participants were women (72.0%), with ages ranging from 19 to 84 years ($M = 55.36$, $SD = 13.05$). Participants had various types of primary cancer, the most common being breast

(30.6%), head and neck (21.6%), and gynaecological cancers (18.0%; both genders considered together). A breakdown of cancer type by gender can be found in Table 1. Three participants reported more than one type of primary cancer. Time since cancer diagnosis averaged 4.99 years ($SD = 4.93$). The majority of participants (81.0%) had received multiple treatments for their cancer, with surgery (81.0%), radiotherapy (54.0%), and chemotherapy (44.1%) being the most common.

Procedure

Ethical approval was granted by the host research institution prior to data collection. As part of a larger survey into psychological responses to cancer, cancer charities and support groups were approached with a link to an online survey. For the control sample, an advert was distributed via the volunteer emailing list at the lead author's host institution and via online older adult social groups. Volunteers completed the measures listed below in a counterbalanced order and were fully debriefed.

Measures

Trait self-disgust. Participants' trait SD was measured using the Self-Disgust Scale (SDS; Overton et al., 2008). For each of the 18 items, participants rate how much they agree it is descriptive of them on a 7-point Likert scale (1=*strongly agree*, 7=*strongly disagree*). The measure has been found to have a two-factor structure, with five items representing disgust towards physical aspects of the self, and five items representing disgust towards behaviour (Overton et al., 2008). In the cancer sample, the Cronbach's alpha for physical SD was .89 and .83 for behavioural SD. In the control sample alphas were .84 for physical SD and .86 for behavioural SD.

Disgust propensity and sensitivity. Participants' DP (how easily people are disgusted) and DS (how unpleasant the experience of disgust is to the individual) were measured using the 16-item Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; van Overveld et al.,

2006). Participants read 12 statements and choose the answer which is most appropriate to them, on a 5-point Likert scale (1=*never*, 5=*always*). Based on psychometric evaluations of the DPSS-R (Olatunji et al., 2007; Goetz, Coughle, & Lee, 2013), a recommended, reduced 10-item solution (six items for DP and four for DS) was used for analyses. In the cancer sample, the Cronbach's alpha for DP was .81 and .82 for DS. In our control sample, alphas were .85 for DP and .78 for DS.

Anxiety and depression. Levels of anxiety and depression in participants were measured using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The scale consists of 14 items with seven items measuring anxiety and another seven items measuring depressive symptoms. Each item is rated on a 4-point scale (0–3 *with varying labels*) according to the severity of difficulties experienced. In our control sample, the alpha coefficient for HADS was .87 (anxiety) and .82 (depression). In our cancer sample, the alpha coefficient for HADS was .88 (anxiety) and .85 (depression).

Statistical analysis

All analyses were conducted on SPSS v. 20 (IBM Corp., Armonk, NY, US). To test predictions 1 and 2, bivariate differences between means in cancer patients and controls were tested using paired *t*-tests. As recommended by Breslow and Day (1980), conditional logistic regression (binomial) was then used to estimate the likelihood of classifying participants into either the cancer or control group dependent on their disgust traits, given the need to evaluate multiple possible disgust variants, when controlling for other variables (i.e., the other disgust traits, depression, and anxiety). Before entering variables into the regression models below, we examined item intercorrelations for evidence of multicollinearity (i.e., $r_s \geq .80$, Tabachnick & Fidell, 2001), and values of the variance inflation factor (VIF) ranged between 1.02 and 3.22 indicating no serious multicollinearity problems (i.e., $VIF \geq 10$, Tabachnick & Fidell, 2001).

To test prediction 3, correlations (Spearman's *rs*) were conducted to initially examine the associations between disgust traits and the psychological wellbeing measures. Multiple regression analyses were then conducted to examine the independent predictive relationship between the three disgust traits and psychological wellbeing (anxiety and depression), controlling for potential covariates (age, gender, and ethnicity), in each sample. The predictors were entered with age, gender, and ethnicity (1=*White British*, 0=*Otherwise*). One-tailed *t*-tests were used to compare whether the regression slopes from the disgust traits to each dependent variable were significantly greater in the cancer than control group.

Bootstrapping was used to account for data with a non-normal distribution. Bootstrapping provides a non-parametric robust alternative to parametric estimates when the assumptions of those methods may be violated (e.g., Fox, 2008). The significance of all regression path coefficients was assessed by computing bias-corrected and accelerated bootstrap estimates with 95% confidence intervals (BCa 95% CIs). Ten thousand resamples were used for the bootstrapped estimates (Mallinckrodt, Abraham, Wei, & Russell, 2006).

Results

Descriptives and differences in disgust profiles

The cancer sample was age- and gender-matched with the control sample. A χ^2 test was used to examine differences in ethnicity between the groups. Significantly more participants identified themselves as 'White British' in the cancer sample than in the controls, $\chi^2(1) = 6.12$, BCa 95% CI [-.34, -.11], $p < .05$, $\Phi = .24$. Accordingly, this variable was included as a control variable in all multivariate analyses. Disgust propensity was significantly higher in women ($M = 15.08$, $SD = 4.14$) than men ($M = 12.67$, $SD = 3.78$) in the cancer sample, $t(105) = 2.77$, BCa 95% CI [4.07, .77], $p < .01$, $d = 0.61$, as was DS (women: $M = 9.79$, $SD = 3.77$; men: $M = 6.67$, $SD = 2.20$), $t(105) = 4.26$, BCa 95% CI [4.26, 1.99], $p < .001$, $d = 1.01$. Self-disgust was significantly higher in women ($M = 29.35$, $SD =$

13.49) than men ($M = 24.70$, $SD = 8.91$) in the control sample, $t(105) = 1.74$, BCa 95% CI [8.96, 8.96], $p < .05$, $d = .41$. No other gender differences emerged.

As demonstrated in Figure 1, the means of most of the disgust traits and mental health symptoms were higher in the cancer than control sample, except for DP. In bivariate tests, cancer patients reported significantly higher levels of physical SD ($M = 13.85$, $SD = 7.93$) than controls ($M = 11.71$, $SD = 5.58$), $t(106) = 2.36$, BCa 95% CI [0.43, 3.83], $p < .05$, $d = 0.31$; significantly higher levels of DS ($M = 8.92$, $SD = 3.68$) than controls ($M = 7.79$, $SD = 3.16$), $t(106) = 2.43$, BCa 95% CI [0.22, 2.07], $p < .05$, $d = 0.33$; and significantly lower levels of DP ($M = 14.40$, $SD = 4.17$) than controls ($M = 16.03$, $SD = 4.07$), $t(106) = -3.16$, BCa 95% CI [-2.63, -0.62], $p < .01$, $d = 0.40$. However, there was no difference between cancer patients ($M = 11.56$, $SD = 6.26$) and controls ($M = 11.51$, $SD = 5.89$) in terms of behavioural SD, $t(106) = 0.06$, BCa 95% CI [-1.40, 1.50], $p = .95$, $d = 0.01$. There was a trend for greater symptoms of anxiety in the cancer group ($M = 7.93$, $SD = 4.78$) than in the controls ($M = 6.93$, $SD = 4.10$), $t(106) = 1.67$, BCa 95% CI [-0.13, 2.14], $p = .10$, $d = 0.22$. Depression was significantly higher in the cancer group ($M = 5.27$, $SD = 4.27$) than controls ($M = 4.13$, $SD = 3.33$), $t(106) = 2.17$, BCa 95% CI [0.10, 2.16], $p < .05$, $d = 0.30$.

The results of the conditional logistic regression (Table 2), stratified by the cancer-control set, showed that all the disgust traits were significantly independently associated with having a cancer diagnosis, even after controlling for levels of anxiety and depression. Cancer patients were 1.13 times as likely to exhibit higher physical SD and 1.30 times as likely to exhibit higher DS as the control sample. On the other hand, cancer patients were 0.88 times as likely to exhibit higher behavioural SD and 0.76 times as likely to exhibit higher DP as the controls. Accordingly, all results of the bivariate t -tests were maintained in the multivariate logistic regression, when conditioning on the other disgust traits and mental health symptoms,

except for behavioural SD, which was significant only after controlling for the other constructs.

Links between disgust traits and psychological wellbeing

Initial correlational analyses showed that there were significant associations between all the study variables for cancer patients and controls (see Table 3). In particular, all the disgust traits were found to be significantly correlated with levels of anxiety and depression, indicating that they may have important associations with psychological wellbeing in individuals with (and without) cancer. We also observed significant negative associations between years since diagnosis in the cancer patients and DS, DP, anxiety, and depression, indicating that these constructs may lessen in cancer survivors over time.

The results of the regression analyses showed different patterns for the cancer and control samples (see Table 4). In cancer, with anxiety as the dependent variable, physical SD, $\beta = 0.28$, BCa 95% CI [.02, .30], $p < .05$; DS, $\beta = 0.27$, BCa 95% CI [.07, .61], $p < .05$; and behavioural SD, $\beta = 0.26$, BCa 95% CI [.03, .39], $p < .05$, significantly predicted anxiety, whereas, in controls, only behavioural SD, $\beta = 0.29$, BCa 95% CI [.02, .37], $p < .05$, statistically significantly predicted anxiety. In cancer, with depression as the dependent variable, physical SD, $\beta = 0.60$, BCa 95% CI [.20, .43], $p < .001$, and DS, $\beta = 0.24$, BCa 95% CI [.03, .50], $p < .05$, emerged as significant predictors, however, only physical SD, $\beta = 0.54$, BCa 95% CI [.14, .52], $p < .01$, was found to significantly predict depression in controls. Tests of the regression slopes between the two samples, showed that DS was a significantly stronger predictor of depressive symptoms in the cancer than control group, $t(210) = 1.69$, $p < .05$ (one-tailed).

Discussion

Qualitative studies have shown that people being treated for cancer frequently report themes related to contamination and disgust (e.g., Fu et al., 2013). This study was the first to

compare quantitatively the disgust profiles of individuals diagnosed with cancer against age- and gender-matched controls. The contribution of the paper can be broken down into two sections, which we discuss below.

Disgust profiles in individuals with cancer

First, we predicted that cancer patients would show a different disgust profile to that of matched controls, differing significantly in their trait levels of DP and DS, and having significantly greater SD. In line with predictions, DP and DS were found to significantly differ across the groups, with DS higher in the cancer sample and DP higher in the controls (despite being positively correlated). That DP was significantly lower in people with cancer is inconsistent with the hypothesis that DP increases during states of biological vulnerability (e.g., pregnancy, Fessler et al., 2005). Instead, one possible reason for lower DP in cancer is a decreased propensity to experience disgust due to habituation and exposure (e.g., Olatunji, Tart, Ciesielski, McGrath, & Smits, 2011; Rozin, 2008). Indeed, other recent work has shown that proneness to disgust may *reduce* rather than increase as a function of exposure to disgust stimuli, potentially as an adaptive means of facilitating contact, for example in mothers (i.e., in order to care for their offspring) versus childless women (Prokop & Fančovičová, 2016). Thus, if cancer patients are exposed to an increased frequency of disgust elicitors (i.e., as a result of their illness and its treatment) we may expect their DP to be decreased as a result of this. Supporting this idea, a significant negative correlation was observed between time (years) since cancer diagnosis and DP, yet this pattern was also apparent for DS (and anxiety and depression), suggesting that if any kind of habituation is occurring it is not specific to DP. Complementary explanations are, of course, possible including a current lack of exposure to disgust elicitors relative to prior exposure, or that participants may have made changes in their behaviour following a cancer diagnosis that reduced their exposure to (external) disgust elicitors, and thus DP and/or DS.

Conversely to DP, however, DS was found to be higher in people with cancer compared to controls. Disgust sensitivity is associated with an overestimation of the unpleasant consequences of experiencing disgust (e.g., van Overveld et al., 2006). Higher DS in the cancer sample may be explained by a number of factors, including a heightened state of vulnerability (e.g., associated with immunosuppression). Given its link to sources of disease, people with cancer (and a compromised immune system) may find the disgust emotion particularly unpleasant and anxiety-provoking to experience. Work has shown that DS is significantly linked to hypochondriasis and health anxiety (Davey & Bond, 2006), so a fear of future illness may explain the particularly negative appraisal of disgust experiences in the cancer group. Secondly, to the extent that cancer and its treatments are threatening to the individual, and elicit aversive disgust responses, repeated exposure to these kinds of threats may lead to a conditioned response to find the experience of disgust as more aversive and threatening than cancer-free controls.

As expected, physical SD was also significantly higher in the cancer than control group. As well as seeing the self as a physically diseased object, greater levels of physical SD in the cancer sample may be explained by the physiological changes that are common in cancer and its treatment (all treatments for cancer impact on physical appearance to a degree, Wallace, Harcourt, Rumsey & Foot, 2007). The majority of participants in this sample (81.0%) reported having had surgery, which may cause profound physical changes, some of which are known to elicit disgust (e.g., colostomy, Smith et al., 2007). These findings confirm and extend previous qualitative studies, where cancer patients have described experiencing thoughts and feelings of disgust towards themselves, particularly relating to their appearance (e.g., as a result of disfigurement, Costa et al., 2014; scars or skin changes, Hopwood et al., 2001; malignant wounds, Lo et al., 2008; and hair loss, Rosman, 2004).

An unexpected finding was that behavioural SD did not differ across the two groups, and was found to be significantly diminished in the cancer group when controlling for the other observed traits. Given their high positive correlation, it is at present unclear why behavioural SD did not show the same pattern of results as physical SD. While these results were not hypothesised, there are several promising avenues for further exploration. For example, it is possible that the cancer participants in our sample may have engaged in healthier behaviours since their diagnosis (e.g., Blanchard et al., 2003), resulting in less disgust towards their behaviour. It is also possible that the presence of a serious health condition makes (affective) judgements about behaviour less important or salient to the cancer sample. However, more evidence is needed to help ascertain the reason(s) behavioural SD displayed a differential pattern to physical SD in this sample.

Links between disgust traits and psychological wellbeing

Multivariate regression analyses showed that DS and SD, and not DP, had significant independent associations with psychological wellbeing in patients with cancer, supporting our initial predictions. Furthermore, our prediction that disgust traits would have a stronger relationship with wellbeing in the cancer than control sample received partial support. First, different patterns were observed across the two samples. In the cancer sample, DS and (physical and behavioural) SD significantly independently predicted levels of anxiety, while physical SD and DS predicted levels of depression. By contrast, in the controls, only behavioural SD independently predicted levels of anxiety, and physical SD alone significantly predicted symptoms of depression. When controlling for the influence of the other traits, DP was not found to significantly predict anxiety or depression in either sample. Second, tests of the differences in the regression slopes between the cancer and control samples showed that disgust sensitivity was statistically a stronger predictor of depressive symptoms in the cancer than control sample. These findings, along with the higher levels of

DS found in the cancer sample, suggest that DS may be particularly important in predicting psychological wellbeing in people with cancer.

One possible mechanism by which DS may be conducive to states of anxiety and depression in the cancer sample is via a conditioned inclination to overestimate the threat of disgust-related stimuli leading to states of anxiousness or defeat. As noted, disgust may be perceived as particularly threatening to people with cancer due to the increased frequency, and aversive nature, of the disgust-eliciting stimuli to which cancer patients may be exposed, or its association with sources of ill health. The findings are broadly consistent with prior work, showing that DS is an important predictor of anxiety (e.g., Cisler et al., 2009) and may be heightened in people with clinical diagnoses of depression (Ille et al., 2010). However, our findings extend earlier work by suggesting that DS may operate as a stronger predictor of psychological wellbeing (depression) for some groups (i.e., cancer patients) than others (i.e., healthy controls).

Physical SD was a strong predictor of both anxiety and depression in cancer patients, and depression in the control sample. This result supports the proposition that the aetiology of depression might not involve a greater proneness to externally-oriented disgust (i.e., DP), but may instead be associated with socially-learned disgust reactions towards aspects of the self (or self-disgust; e.g., Overton et al., 2008; Powell et al., 2013; Power & Dalgleish, 2008), and particularly physical aspects of the self. Behavioural SD, on the other hand, did not predict depression after controlling for the other disgust traits (cf., Powell et al., 2013), but did predict anxiety in both groups. The unpleasant behavioural consequences of having cancer (e.g., urine/faecal incontinence) may expose individuals to a higher risk of contamination and infection (e.g., Gea-Banacloche & Segal, 2011), which may increase their level of anxiety, but not depression, associated with behaviours perceived as disgusting. This explanation follows a theoretical model for co-morbidity between anxiety disorders and

major depression (Gray & McNaughton, 2000), which suggests that an avoidable potential threat can lead to anxiety, whereas an unavoidable potential threat may lead to depression (Middeldorp, Cath, Van Dyck, & Boomsma, 2005).

Finally, that DP was found to have no significant predictive role in psychological wellbeing (when controlling for the other disgust traits) appears to contradict past work by Reynolds et al. (2015), which found DP to be positively linked with quality of life in a sample with anal incontinence. Reynolds et al. (2015), however, did not control for other disgust traits in their models, suggesting that they may have suffered from omitted variable bias (e.g., Ashenfelter & Greenstone, 2004). Our findings suggest that the target (SD) and appraisals of disgust (DS) may be more important in determining current psychological wellbeing in cancer patients than measures of DP alone.

Clinical Implications

The findings from this research suggest that focusing on disgust responses, particularly (physical) SD and DS, could well be beneficial therapeutically to people with cancer who are exposed to a range of potentially disgust-inducing stimuli. The development of depression and anxiety potentially might be diminished by greater attention to the degree of SD and DS experienced by cancer patients, and interventions intended to reduce levels of these maladaptive responses (e.g., Powell et al., 2015b). Recent experimental work has shown that the self-affirmation of valued character traits may be a promising tool for reducing in-the-moment feelings of self-directed disgust (Powell et al., 2015b).

‘Compassion-focused therapy’ is another approach formulated to work with people with high levels of self-criticism, hatred, and disgust (Gilbert, 2015). Nonetheless, research on the effective regulation and treatment of disgust is in its infancy and there are plentiful opportunities for future work in this area; what is critical is the acknowledgement that certain facets of disgust (i.e., physical SD, DS) may be particularly detrimental for psychological

wellbeing in cancer patients and that there is a need to explore therapeutically emotional factors, and not just cognitions, in the production and maintenance of mental health problems in people with chronic illnesses, such as cancer.

Limitations

While the current report represents a useful addition to understanding how disgust traits predict psychological wellbeing in cancer patients, there are limitations worth noting. Firstly, we used general rather than domain-specific measures of DP, which limits the identification of certain disgust subtypes that may be driving the overall reduction in DP observed. The reduction of disgust through habituation usually displays some degree of domain specificity (e.g., Rozin, 2008) and it would be interesting in a future study to assess differences in cancer using measures that tap into disgust subtypes (e.g., the Disgust Scale-Revised [DS-R], Olatunji et al., 2007). Our own recent work suggests that ‘core’ disgust elicitors (conceptualised by Rozin et al., 2008, as related to food/eating and body waste products) are likely to be particularly problematic for people with cancer (Powell et al, 2016).

A second potential limitation of the present study is that our patient population was diverse, covering most common types of cancer (e.g. breast, prostate, head and neck). While this increases its generalisability, we were not able to test for differences in disgust traits across subtypes of cancer due to insufficient statistical power. Thus, there remains the possibility that the results were driven by specific cancer types and future work could look more closely at disgust responses in specific subtypes of cancer. The same is also true of gender – three quarters of our participants were female and the majority of the cancers were female-specific. Given the differences we found between males and females in both the cancer and control samples in terms of their disgust responses, future work could explore whether the present findings hold for a predominantly (or exclusively) male sample.

A final limitation was that we had an exclusive focus on disgust and ignored other negative emotions (such as anger and fear, both of which have been linked to depression; Gilbert, & Irons, 2004; Pine, Cohen, & Brook, 2001). It will be useful in future studies to incorporate other affective constructs into the models to examine the extent to which the relationships we see are specific to disgust.

In conclusion, the results of this study showed that certain facets of disgust (i.e., physical SD, DS) may be higher in cancer patients and may be important correlates of their current levels of anxiety and depression. Therefore, an emotional profiling of disgust responses following a cancer diagnosis and/or during cancer treatment may be an effective method for identifying cancer patients who have a higher tendency to develop anxiety and depression during their cancer experiences.

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Table 1

Primary cancer diagnosis (cancer sample) by gender

Male		Female	
Primary cancer	N (%)	Primary cancer	N (%)
Head and neck	13 (40.1)	Breast	34 (42.0)
Prostate	7 (21.9)	Gynaecological	20 (24.7)
Brain	4 (12.5)	Head and neck	11 (13.6)
Skin	2 (6.3)	Brain	5 (6.2)
Blood	1 (3.1)	Colorectal	4 (4.9)
Colorectal	1 (3.1)	Bone	2 (2.5)
Lung	1 (3.1)	Lung	2 (2.5)
Testicular	1 (3.1)	Skin	1 (1.2)
Unspecified	2 (6.3)	Non-Hodgkin Lymphoma	1 (1.2)
		Blood	1 (1.2)

Note. One hundred and seven participants, however the absolute counts are greater because three participants reported more than one type of primary cancer.

Table 2

Factors associated with cancer based on final conditional logistic regression model

Factor	<i>B</i>	Wald test	Odds Ratio	BCa 95% CI <i>B</i>	
				LL	UL
Ethnicity	-1.03	7.36	0.36**	-1.75	-0.46
Anxiety	.01	0.07	1.01	-0.09	0.11
Depression	.07	1.23	1.07	-0.07	0.23
Physical self-disgust	.12	7.53	1.13**	0.03	0.24
Behavioural self-disgust	-.13	8.23	0.88**	-0.24	-0.05
Disgust propensity	-.27	25.40	0.76***	-0.39	-0.19
Disgust sensitivity	.27	15.99	1.30***	0.12	0.49
Total R^2 (Nagelkerke R^2)					.30
<i>N</i>					107

Note. One hundred and seven participants in each group. $\chi^2(7) = 55.12$, $p < .0001$. BCa 95% CI = Bias-corrected and accelerated bootstrapped 95% confidence interval (10,000 resamples); *LL* = lower limit of *B*; *UL* = upper limit of *B*. Asterisked predictors are significant at ** $p < .01$ and *** $p < .001$.

Table 3

Bivariate correlation coefficients (Spearman's rho) among study variables in cancer patients (above diagonal) and matched controls (below diagonal)

Variable	1	2	3	4	5	6	7
1. Physical self-disgust	1	.78**	.30**	.30**	.59**	.67**	-.13
2. Behavioural self-disgust	.74**	1	.21*	.25*	.60**	.56**	-.12
3. Disgust propensity	.33**	.30**	1	.56**	.30**	.28**	-.21*
4. Disgust sensitivity	.31**	.35**	.47**	1	.43**	.36**	-.22*
5. Anxiety	.45**	.47**	.37**	.42**	1	.68**	-.22*
6. Depression	.64**	.53*	.34**	.30**	.58**	1	-.30**
7. Years since cancer diagnosis	—	—	—	—	—	—	1

Note. One hundred and seven participants in each group. Asterisked coefficients are significant at * $p < .05$ and ** $p < .01$.

Table 4

Multiple regression analyses predicting psychological wellbeing in cancer and healthy controls

Variable	Anxiety							Depression						
	Cancer			Controls			Slope	Cancer			Controls			Slope
	<i>B</i> [BCa 95% CI]	SE <i>B</i>	β	<i>B</i> [BCa 95% CI]	SE <i>B</i>	β		<i>t</i>	<i>B</i> [BCa 95% CI]	SE <i>B</i>	β	<i>B</i> [BCa 95% CI]	SE <i>B</i>	
Gender	-.18 [-1.94, 1.74]	.95	-.02	.37 [-.94, 1.71]	.65	.04	0.48	-1.56 [-2.87, -0.05]	.70	-.16	.04 [-1.00, 1.13]	.50	.01	1.86 [†]
Age	-.02 [-.09, .02]	.03	-.06	-.01 [-.06, 0.03]	.02	-.03	0.28	-.01 [-.06, 0.03]	.03	-.03	.03 [-.01, 0.06]	.02	.11	1.11
Ethnicity	.36 [-1.34, 2.25]	.84	.04	-.87 [-2.34, 0.69]	.71	-.08	1.12	.15 [-1.11, 1.51]	.61	.02	-.08 [-1.60, 1.35]	.66	-.01	0.26
SD (P)	.17 [.02, .30]	.07	.28*	.13 [-.09, 0.36]	.11	.18	0.28	.32 [0.20, 0.43]	.06	.60***	.32 [0.14, 0.52]	.09	.54**	0.00
SD (B)	.20 [.03, .39]	.09	.26*	.21 [0.02, 0.37]	.10	.29*	0.07	.06 [-.09, 0.20]	.08	.08	.07 [-.08, 0.22]	.08	.12	0.09
DP	-.01 [-.23, .18]	.10	-.01	.06 [-.15, 0.30]	.11	.06	0.45	-.02 [-.22, 0.18]	.09	-.02	.06 [-.09, 0.20]	.08	.07	0.70
DS	.35 [.07, .61]	.14	.27*	.26 [-.03, 0.55]	.14	.20	0.45	.28 [0.03, 0.50]	.13	.24*	-.03 [-.032, 0.24]	.13	-.03	1.69 [†]
Total <i>R</i> ²	.42			.34				.55			.39			
<i>F</i>	11.74***			8.95***				19.63***			10.54***			

Note. One hundred and seven participants in each group. SD (P) = Physical Self-disgust; SD (B) = Behavioural Self-disgust; DP = Disgust Propensity; DS = Disgust Sensitivity; BCa 95% CI = Bias-corrected and accelerated bootstrapped 95% confidence interval (10,000 resamples); LL = lower limit; UL = upper limit; SE *B* = bootstrapped standard error. Superscripted estimates are significant at [†] $p < .05$ (one-tailed) * $p < .05$ (two-tailed); ** $p < .01$ (two-tailed) and *** $p < .001$ (two-tailed).

Figure legend

Figure 1

Mean scores of disgust propensity, sensitivity, physical self-disgust, and behavioural self-disgust from various scales in cancer patients and controls. Participants with cancer ($n = 107$) reported significantly higher physical self-disgust and disgust sensitivity to cancer-free controls ($n = 107$). Participants with cancer reported significantly lower disgust propensity to controls. There was no significant difference between cancer and controls in behavioural self-disgust. Error bars represent the standard error of the mean. DP = Disgust Propensity; DS = Disgust sensitivity; SD (P) = Physical Self-Disgust; SD (B) = Behavioural Self-Disgust. Symbols denote significance at $*p < .05$; $**p < .01$

