The Role of Perfectionism and Cognitive Processing Abnormalities in Dysmorphic Concern

by

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TABLE OF CONTENTS

ABSTRACT

Dysmorphic concern (DC), described in the literature as an excessive preoccupation with appearance-related concerns and camouflaging behaviours used to conceal the perceived flaws, is generally described as a broad, dimensional construct, found across several disorders and thought to be the core diagnostic feature of body dysmorphic disorder (BDD). BDD is a debilitating psychiatric disorder that generally emerges during early adolescence, consisting of obsessions (preoccupations with perceived facial feature and/or bodily imperfections) and compulsions (behaviours used to neutralise appearance-based anxiety). The current available DC and BDD research and models have highlighted the role of specific personality styles, environmental stressors, and cognitive processing abnormalities in contributing to the development and maintenance of symptoms. Treatment barriers in these populations are common, which significantly delay help-seeking behaviours.

There were two main aims of the current research. First, to explore the role of perfectionism and the four cognitive processes (i.e., global-local processing, selective, attention, interpretive biases, and memory deficits) as risk factors for DC and BDD, as suggested by the most recent cognitive-behavioural model of BDD. Guided by these results, the predictive power of selective attention and subtypes of perfectionism on symptoms of DC were investigated. Second, we used the results of this study to inform the selection and evaluation of a novel therapeutic approach to target symptoms of DC.

To address the first aim, we present a systematic review and meta-analysis involving the role of local processing, interpretive biases, memory deficits, and selective attention biases in contributing to BDD development and maintenance. Using multilevel modelling analyses, it was determined that, with the exception of local processing, the BDD and control groups significantly differed across all cognitive processes. Further, selective attention had the largest effect size difference. A second study was conducted, based on these findings and previous BDD research and models, recruiting fifty-seven male and female participants. A dot probe task was devised to measure selective attention consistent with DC, and after covarying for the effects of mood and stress, perfectionism and selective attention were examined as predictors of DC. Using Pearson *r* correlations and multiple regression analyses, the Doubts about Actions subscale from the Frost Multidimensional Perfectionism Scale and *DC-positive* word stimuli from the dot-probe task were found to be significant predictors of DC. Although methodology may have played a role, perfectionism explained more of the variance in DC symptomology. Informed by the results of this study and pre-existing meta-analytic findings highlighting the role of perfectionism as an important transdiagnostic factor, thirty-one participants with clinically significant DCs were recruited to take part in an internet-delivered cognitive-behavioural therapy program for perfectionism. Using a case series design and linear mixed modelling analyses, it was found that compared to assessment at baseline, scores on primary measures of perfectionism and secondary measures of depression, stress, body image disturbance, selective attention biases, and DC were reduced with small to large effect sizes at the end-of-treatment, which was maintained at one-month follow-up.

In summary, these findings indicate that future research investigating the role of selective attention and perfectionism in DC and BDD populations warrants further investigation. A variety of suggestions involving future assessment and treatment targets are presented in the Discussion.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university, and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

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Acronyms Used Throughout Dissertation

Acronym	Meaning
BDD	Body Dysmorphic Disorder
BMI	Body Mass Index
CBT	Cognitive-Behavioural Therapy
CBT-P	Cognitive-Behavioural Therapy for Perfectionism
CI	Confidence Interval
DASS-21	Short-Form Depression Anxiety Stress Scales
DC	Dysmorphic Concern
DCQ	Dysmorphic Concern Questionnaire
DMN	Default Mode Network
DSM	Diagnostic and Statistical Manual of Mental Disorders
EEG	Electroencephalogram
ERP	Exposure and Response Prevention
FMPS	Frost Multidimensional Perfectionism Scale
fMRI	Functional Magnetic Resonance Imaging
ICBT-P	Internet-Delivered Cognitive-Behavioural Therapy for Perfectionism
ITT	Intent-to-Treat
MBSRQ-AS	Multidimensional Body-Self Relations Questionnaire- Appearance Scale
MPS	Multidimensional Perfectionism Scale
MRI	Magnetic Resonance Imaging
NJRE	Not Just Right Experiences Questionnaire
OCD	Obsessive-Compulsive Disorder

PC	Personal Computer
RCFT	Rey Complex Figures Test
RCT	Randomised Controlled Trial
RT	Reaction Time

Chapter 1

Overview, aims, and structure

Dysmorphic Concern and Body Dysmorphic Disorder

Dysmorphic concern (DC) is characterised by the overconcern with appearance-based imperfections accompanied by reassurance-seeking, avoidance, and camouflaging behaviours (Cunningham, Griffiths, Baillie, & Murray, 2016; Senín-Calderón et al., 2017). DCs of clinical relevance were first known as dysmorphophobia, described as an atypical somatoform disorder in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) and later classified as body dysmorphic disorder (BDD) in the DSM-III-R (American Psychiatric Association [APA], 2013; Jorgensen, Castle, Roberts, & Groth-Marnat, 2001). There is a debate in past literature about whether DC is a symptom found across several disorders or whether it is a feature specific to BDD (Jorgensen et al., 2001). While over recent years, DC has been described as a continuous construct that can be found across several disorders, such as depression and eating disorders (Castle, Molton, Preston, & Phillips, 2004; Monzani et al., 2012; Oosthuizen, Lambert, & Castle, 1998), it is considered the primary diagnostic feature of BDD (Mancusoo, Knoesen, David, & Castle, 2010). Moreover, higher levels of DC predict a BDD diagnosis, which is made when symptoms generate significant distress and impairment in functioning (APA, 2013; Jorgensen et al., 2001; Monzani et al., 2012).

Existing along a continuum of symptom severity, BDD is characterised by repetitive behaviours or mental acts concerning preoccupations with perceived flaws in appearance (Cunningham et al., 2016). Common behaviours include mirror checking, camouflaging to conceal the perceived defect, mirror avoidance, and excessive grooming (Phillips, 2017). While the facial and head regions represent the most pervasive preoccupations, namely the nose, hair, and skin, some individuals also focus on body parts (Phillips, 2017). Individuals with BDD have been reported to focus on up to seven facial features and/or body parts throughout the duration of the disease (Phillips, Menard, Fay, & Weisberg, 2005). Women are thought to have a greater propensity to hyper-focus on areas such as the breasts, legs, and body weight, while men are thought to focus more consistently on height, genitals, hairline, and muscle build (Ipser, Sander, & Stein, 2009). More commonly detected among males, muscle dysmorphia is a specifier of BDD that presents as a preoccupation with body size and muscle mass (APA, 2013).

New evidence surrounding clinical and neuropsychological similarities, as well as commonalities in treatment response and symptomology between BDD and OCD, has led to the reclassification of BDD as an obsessive-compulsive and related disorder in the fifth edition of the DSM (APA, 2013; Fang & Wilhelm, 2015). BDD and OCD share similar brain abnormalities that impair frontal lobe functioning (Labuschagne, Rossell, Dunai, Castle, & Kyrios, 2013) and both groups present with preoccupations and compulsions. Moreover, given that DC exists along the obsessive-compulsive spectrum, it has been hypothesised to share similar underlying neurocognitive features with these disorders (Senín-Calderón et al., 2017). Furthermore, while BDD has similar underlying psychopathological mechanisms with eating disorders, when preoccupations are better explained by weight or body shape concerns, a diagnosis of BDD must be ruled out (APA, 2013).

With prevalence rates of approximately 1-3%, BDD is a cross-cultural phenomenon, affecting a multitude of races and ethnicities on a global scale (Phillips, 2017). Rates of BDD among student populations have an average of 6.4% (Pavan et al., 2008), while subclinical populations have reached prevalence rates of up to 18% in aesthetic medical settings (Altamura, Paluello, Mundo, Medda, & Mannu, 2001) and 13% in university settings (Biby, 1998). Furthermore, according to Cunningham and colleagues (2016) clinically significant levels of DC are thought to be pervasive, with some research reporting that upwards of 46% of young adults display appearance-based preoccupations.

The onset of symptoms typically occurs in adolescence (mean onset approximately 16 years), with few cases of childhood BDD (Kelly & Phillips, 2017). While some clinical research has detected higher rates in women, most of the BDD literature has denoted equal gender ratios (Fang & Wilhelm, 2015). Conversely, a 2017 update on BDD by Kelly and Phillips investigated five population-based studies, detecting a 3:2 female to male ratio. Furthermore, in subclinical populations, BDD psychopathology is thought to be higher in females (Krebs, Fernández de La Cruz & Mataix-Cols, 2017). This is consistent with a study by Bartsch (2007) who reported higher levels of DC in the female participants (Bartsch, 2007). Gender ratio variation across studies might in part, be explained by illness severity, referral biases, and inclusion criteria (Cororve & Gleaves, 2001).

Individuals with high degrees of DC often seek out cosmetic surgery or dermatological procedures to correct overvalued flaws. Such surgeries rarely meet with satisfaction; thus, the preoccupation is maintained, and/or the focus of attention shifts to a new area of the body (Phillips, 2017). According to Nugent (2009), upwards of 15% of patients interested in cosmetic enhancements meet symptom threshold for BDD. Moreover, individuals who do not have the financial resources to afford cosmetic procedures may attempt to engage in pernicious “self-surgeries” to correct the perceived anomaly. In some instances, this has resulted in severe bodily mutilation (O’Sullivan, Phillips, Keuthen, & Wilhelm, 1999). Further complicating this issue, due to feelings of shame and the accompanying secrecy surrounding appearance-based concerns, individuals rarely seek out mental health services and/or under-report disorder-specific symptoms when these services are sought (Buhlmann & Winter, 2011). This, coupled with inadequate screening practices in mental health settings, increases the risk of misdiagnoses (Buhlmann & Winter, 2011). When left untreated, BDD has a chronic course with low rates of spontaneous remission (Emmelkamp & Ehring, 2014). Therefore, identifying at-risk populations, such as those with clinically significant DCs, is crucial in preventing BDD onset. While no models of DC exist, there are some models of BDD which can inform potential risk and maintaining factors.

Models of BDD

Across the BDD models, genetic, personality, and cognitive factors are commonly identified (Fang & Wilhelm, 2015; Neziroglu, Roberts, & Yaryura-Tobias, 2004; Veale, 2001; Veale, 2004; Veale et al., 1996; Wilhelm, 2006; Wilhelm & Neziroglu, 2002; Wilhelm, Phillips, Fama, Greenberg, & Steketee, 2011). To date, genetic factors are thought to explain 43% of the variance in BDD symptomology; while no specific genetic markers have been identified (Krebs et al., 2017), there is thought to be a genetic link between BDD and OCD (Kelly & Phillips, 2017). Cognitive-behavioural models of BDD have also identified personality and cognitive-behavioural factors maintaining dysfunction. Across these models, perfectionism and selective attention are the most prevalent constructs highlighted (Fang & Wilhelm, 2015; Neziroglu et al., 2004; Veale, 2001; Veale, 2004; Veale et al., 1996; Wilhelm, 2006; Wilhelm & Neziroglu, 2002; Wilhelm et al., 2011). Moreover, in addition to selective attention, Fang and Wilhelm (2015) identify further cognitive deficits as being important, including global-local processing, interpretive biases, and memory deficits, predicated on a comprehensive body of empirical evidence. Recent research has also implicated perfectionism as an important transdiagnostic factor that can be targeted in therapy across a wide spectrum of psychopathology in both non-clinical and clinical populations (Limburg, Watson, Hagger, & Egan, 2017; Lloyd, Schmidt, Khondoker, & Tchanturia, 2015). Due to the chronic course and psychosocial repercussions of the disorder, it is crucial to gain a deeper understanding of the risk and maintaining factors, such that targeted prevention and treatment paradigms can be developed. While further investigation is required, based on the available BDD research and models, incipient literature has examined the role of cognitive-behavioural therapy (CBT) in alleviating symptoms of the disorder.

Psychotherapeutic Interventions

Cognitive-behavioural treatment approaches for BDD have included exposure and response prevention (ERP) and cognitive restructuring techniques, with some meta-analytic research finding equal efficacy of CBT and ERP (Neziroglu & Khemlani-Patel, 2002; Williams et al., 2006). CBT-BDD is a manualised treatment protocol that was developed and revised to target symptoms specific to the disorder; it incorporates elements of psychoeducation, ERP, cognitive restructuring, and perceptual retraining (Rosen, Reiter & Orosan, 1995; Wilhelm et al., 2011). A more recent development is BDD-NET, in which CBT-BDD is delivered using an online format (Enander et al., 2014; Enander et al., 2016). A meta-analysis involving randomised controlled trials (RCT) of CBT-based interventions for BDD, including CBT-BDD and BDD-NET, concluded that both face-to-face and online-delivery formats were effective treatment options. However, given that only one RCT has compared CBT-BDD against alternative approaches (Wilhelm et al., 2019), questions surrounding specificity were raised (Harrison, Fernández de La Cruz, Enander, Radua, & Mataix-Cols, 2016). There are significant treatment barriers specific to this population in terms of ambivalence in tackling the disorder (Buhlmann & Winter, 2011), which might render online transdiagnostic approaches a viable treatment option. Further benefits of online transdiagnostic approaches include lower costs, greater accessibility, and addressing symptom overlap across disorders (Andersson, Titov, Dear, Rozental, &

Carlbring, 2019; Craske, 2012). Additionally, it would be prudent to target the underlying risk and maintaining factors found across BDD and disorders with similar psychopathological mechanisms, such as eating disorders and OCD. Consistent with BDD, both perfectionism and cognitive factors, such as selective attention, have been identified in the eating disorder and OCD literature (Fang & Wilhelm, 2015; Hartmann, Thomas, Greenberg, Matheny, & Wilhelm, 2015; Kyrios, Hordern, & Fassnacht, 2015).

While emergent research on DC is in accordance with the BDD literature, which has identified common underlying factors predicting and maintaining symptomology (e.g., perfectionism and selective attention; Bartsch, 2007; Cunningham et al., 2016; Hanstock & O'Mahony, 2002; Jin et al., 2018; Kuennen & Waldron, 2007; Onden-Lim, Wu, & Grisham, 2012), to date there is no research investigating the use of CBT in DC populations. Thus, given that high levels of DC are thought to increase the risk for BDD (Mansuco et al., 2010; Monzani et al., 2012) and that they are thought to share similar personality and neurocognitive mechanisms (Bartsch, 2007; Senín-Calderón et al., 2017), early intervention in these populations is crucial in preventing an exacerbation in intensity and frequency of symptoms (Cunningham et al., 2016).

Aims of this Research

The main aim of this thesis was to further examine the role of two broad risk factors for DC. The first relates to the four cognitive mechanisms outlined in the most recent CBT model of BDD by Fang and Wilhelm (2015), and this thesis paid special attention to the relative contribution of selective attention. Second, given that it has been the most pervasive personality style described across the CBT-BDD models and that nascent research findings consider it an important transdiagnostic factor found to predict DC (Bartsch, 2007; Cunningham et al., 2016;

Hanstock & O'Mahony, 2002; Jin et al., 2018; Kuennen & Waldron, 2007; Limburg et al., 2017; Lloyd et al., 2015), this thesis also sought to explore the role of perfectionism in contributing to the aetiology and maintenance of DC.

Furthermore, while no research has investigated psychotherapeutic interventions for DC populations at risk for BDD, the BDD literature suggests that targeting perfectionism as a transdiagnostic risk factor using an online approach would have several advantages. Therefore, the benefits of internet-delivered CBT for perfectionism (ICBT-P) in improving primary symptoms of perfectionism and secondary psychopathological mechanisms in a population with clinically significant DCs were investigated. While efforts were made to enlist a clinical population from outside of the university (i.e., contacting local plastic surgery, cosmetic dermatology, and mental health clinics), recruitment was unsuccessful. This could be a result of factors specific to this population, such as inadequate screening practices in cosmetic and mental health settings, misdiagnoses, and limited patient insight and feelings of shame (Buhlmann & Winter, 2011; Nugent, 2009).

This thesis is comprised of novel research contributions. The first systematic review and meta-analysis on the cognitive processing abnormalities associated with BDD; the first study to concurrently examine self-reported perfectionism and dot-probe task scores as predictors of DC; the first study to examine the therapeutic benefit of ICBT-P in reducing various psychopathological mechanisms in a population with clinically significant DCs. Listed below are the specific aims and findings involving the four studies that form this thesis.

Summary of Chapters

While DC was the primary target of focus, the first study involved a systematic review and meta-analysis of the cognitive processing deficits associated with BDD, located in **Chapter**

3. The aim of this study was to examine the association between the cognitive elements outlined in the most recent, empirically informed BDD model by Fang and Wilhelm (2015) - global-local processing (in the current study, local processing was examined in isolation), interpretive biases, memory deficits, and selective attention - and symptoms of BDD. This study provides important insight into the cognitive mechanisms contributing to BDD symptomology, which subsequently informs the development of new prevention and treatment paradigms. The first of its kind, this paper was published in *Behaviour Research and Therapy* (Johnson, Williamson, & Wade, 2018).

To prevent the repetition of content, **Chapter 4** was generated to outline the measures used consistently across **Chapters 5-7.** The measures were selected based on items that adequately assessed the constructs of interest and data confirming their psychometric properties; this information is presented in detail in this chapter.

Informed by the results from the meta-analysis, previous BDD models, and DC research, the second study (**Chapter 5**) investigated the role of selective attention and perfectionism in predicting DC. Several methodological and statistical issues were raised by reviewers, and thus the third study sought to address these concerns in **Chapter 6** with an improved design. First, to capture a broader picture of DC psychopathology, a third DC-word type used in past literature was introduced to the dot-probe task. As a result, only fifty-seven of the 120 participants were included in **Chapter 6.** Second, to avoid spurious effects, the continuous relationship between perfectionism and selective attention on DC was considered simultaneously with clinically significant cut-off scores. Third, rather than combining them, the subscales from the Short Version of the Depression Anxiety and Stress Scales (DASS-21) were examined in isolation. Fourth, to ensure greater interpretability, we re-transformed the dot-probe scores back into mean reaction time scores. This was ones of the few studies to utilise a dot-probe task to assess specific aspects of selective attention (i.e., congruency, orientation, and disengagement) in a male and female DC population (N=57). The aim of this study was to yield novel insights into the psychopathology of DC, with the hope that future research would endeavour to replicate these findings in a clinical population. This paper was submitted for publication in *Australian Psychologist*.

Chapter 7 features the fourth research paper which was informed by the results from **Chapter 6**, the 2017 meta-analysis by Limburg et al. on perfectionism as a transdiagnostic factor, and the 2014 meta-analysis by Andersson, Cuijpers, Carlbring, Riper, and Hedman comparing ICBT and face-to-face CBT. The efficacy of ICBT-P in ameliorating primary symptoms of perfectionism and secondary symptoms of body image disturbance, depression, anxiety, stress, selective attention abnormalities, and DC was investigated in a population with clinically significant DCs (N=31). Both immediate and one-month post-treatment change was investigated.

To abridge the content of this thesis, the summary, synthesis, and integration of overall findings section (**See chapter 8**) links common underlying themes, describes and intertwines new research findings from the results of this thesis, and explores in greater detail the suggested future directions and limitations.

Structure and Presentation of the Dissertation

Three of the four studies conducted for the purposes of this thesis have been published in or submitted to scholarly, peer-reviewed journals. Although repetition will be limited, the introduction sections for the first (**See Chapter 3**), second (**See chapter 5),** third (**See chapter 6**), and fourth (**See chapter 7**) studies will require some repetition of content as a means of justifying study aims. Tables and figures pertaining to each study can be found within the body of the manuscript, prior to the reference section. Appendices have been placed in a separate section (**See chapter 9**), following the summary, synthesis, and integration of overall findings section (**See chapter 8**).

Chapter 2

Literature review[1]

[1] Content from the introduction sections published in *Behaviour Research and Therapy* (See **Chapter 9 Appendix A**; Johnson, Williamson, & Wade, 2018), revised and resubmitted for publication in *Australian Psychologist,* and published in *Body Image* (See **Chapter 9 Appendix A**; Johnson, Egan, Andersson, Carlbring, Shafran, & Wade, 2019) appear in the following literature review.

Dysmorphic Concern

Dysmorphic concern (DC) comprises of an attention bias toward imagined or minor appearance-based imperfections (Bartsch, 2007; Cunningham, Griffiths, Baillie, & Murray, 2016; Onden-Lim, Wu, & Grisham, 2012; Senín-Calderón et al., 2017). Over recent years, DC has been described as a broad, continuous construct that can be found across several populations, such as those with symptoms of depression, hazardous alcohol use, olfactory reference syndrome, illness anxiety disorder, eating disorders, and body dysmorphic disorder ({BDD}; Oosthuizen, Lambert, & Castle, 1998; Castle, Molton, Preston, & Phillips, 2004; Cunningham, Stapinski, Griffiths, & Baillir, 2017; Grant, Kim, & Eckert, 2002; Jorgensen, Castle, Roberts, & Groth-Marnat, 2001; Kollei, Schieber, de Zwaan, Svitak, & Martin, 2013; Mancuso, Knoesen, & Castle, 2010; Monzani et al., 2012; Rosen & Ramirez, 1998). Higher levels of DC in eating disorder populations have been found to predict heightened distress levels and an exacerbation in depressive, obsessive-compulsive, suicidal, disordered eating, and anxiety-related symptoms (Beilharz et al., 2019; Cerea, Bottesi, Grisham, & Ghisi, 2018; Dingemans, Rood, de Groot, & van Furth, 2012; Grant et al., 2002). Some research suggests that DC is paramount in body image disturbance populations, namely BDD and eating disorders (Beilharz et al., 2019; Jorgensen et al., 2001). Body image disturbance is characterised by distorted perceptions of one's outward appearance (Cash, Melnyk, & Hrabosky, 2004). In their 2001 study, Jorgensen and colleagues used simultaneous multiple regression analysis, finding that of the variables analysed (including depression and obsessive-compulsive disorder {OCD}), the body image disturbance measure was the strongest predictor of DC.

DC is considered the primary diagnostic feature of BDD (Mansuco et al., 2010), which can be differentiated by levels of severity, insight, and dysfunction (Cunningham et al., 2016).

Furthermore, DC is thought to fall within the obsessive-compulsive spectrum, with BDD on the extreme end (Senín-Calderón et al., 2017). Thus, it has been postulated to share similar underlying personality and neurocognitive risk and maintaining mechanisms with BDD (Bartsch, 2007; Senín-Calderón et al., 2017). Furthermore, higher levels of DC predict a BDD diagnosis, which is made when symptoms generate significant distress and psychosocial impairment (American Psychiatric Association [APA], 2013; Jorgensen et al., 2001; Monzani et al., 2012; Schieber, Kollei, de Zwaan, & Martin, 2018).

It has further been suggested that DC be extrapolated to represent social avoidance and behaviours aimed at managing perceived flaws, such as camouflaging the perceived defect and reassurance-seeking (Cunningham et al., 2016; Onden-Lim & Grisham, 2013; Senín-Calderón et al., 2017). In this context, DC might better resemble BDD psychopathology (Senín-Calderón et al., 2017). However, some research has reported that symptoms of DC found in BDD and eating disorders can often overlap, such as the propensity to engage in mirror checking behaviours (Rosen & Ramirez, 1998). Furthermore, high rates of co-morbidity can render it difficult to disentangle DCs found in BDD from those found in eating disorders (Grant et al., 2002; Kollei et al., 2012), causing some researchers to question the diagnostic boundaries of these conditions (Jorgensen et al., 2001). Moreover, while features of DC found across these disorders can overlap, certain distinctions can be made. For example, while preoccupations in BDD populations can involve weight concerns, the pathology is distinct in that, unlike individuals with eating disorders, those with BDD have a greater propensity to focus on the hair, skin, and facial features, to endorse a higher number of preoccupations, and to be less concerned with weight, shape, and dietary preoccupations (Buhlmann, Reese, Renaud, & Wilhelm, 2008; Fang & Wilhelm, 2015). Additionally, DC in individuals with anorexia nervosa has also been associated with the overestimation of body size, a feature not reported in the BDD literature (Beilharz et al., 2019).

Developed by Oosthuizen et al. (1998), one of the most widely used measures of DC is the Dysmorphic Concern Questionnaire (DCQ). Recent research has identified specified cut-off scores indicating clinically significant DC (Monzani et al., 2012). While it is not a diagnostic tool for BDD, a cut-off score of ≥ 11 (out of a total possible score of 21) is thought to represent clinically significant DC, increasing the risk of a BDD diagnosis (Mancuso et al., 2010; Monzani et al., 2012; Schieber et al., 2018; Stangier, Janich, Adam-Schwebe, Berger, & Wolter, 2003). Since BDD onset typically emerges during adolescence (Kelly & Phillips, 2017), identifying at-risk populations using psychometrically sound screening measures is an important endeavour to undertake (Senín-Calderón et al., 2017).

While most of the literature has focused on eating disorder psychopathology, there is a paucity of DC research investigating features of this trait characteristic of BDD (Bartsch, 2007). This is problematic given the broad, continuous nature of this construct. To date, no models of DC have been developed. Thus, given that DC is the primary diagnostic feature of BDD (Mancuso et al., 2010), that it has been postulated to fall within the obsessive-compulsive spectrum (Senín-Calderón et al., 2017), and that high levels of DC are thought to predict subclinical and/or clinical onset (Mancuso et al., 2010; Monzani et al., 2012; Schieber et al., 2018; Stangier et al., 2003), BDD models will be used to inform a deeper understanding of the potential underlying aetiological mechanisms contributing to DC psychopathology.

Models of BDD

According to Wilhelm and Neziroglu’s (2002) cognitive model of BDD, biological, cultural, and early childhood experiences increase vulnerability to the fear of negative evaluation, which subsequently increases the likelihood of developing BDD. The negative evaluation of flaws is thought to be exacerbated by perfectionistic thinking styles, in which self-worth is enmeshed in appearance-based preoccupations. Furthermore, the ways in which people with BDD process perceived flaws may lead to negative emotions, which trigger avoidance, reassurance-seeking, and ritualistic behaviours. The authors concluded that those with BDD have a propensity to misinterpret visual input, leading to maladaptive biases. Although this model summarises several external and internal factors that might lead to BDD onset, it lacks a comprehensive overview of the specific underlying aetiological mechanisms thought to underlie the condition.

In their 2004 two-factor behavioural model of BDD, Neziroglu, Roberts, and Yaryura-Tobias (2004) denoted that a biological predisposition interacts with operant conditioning, in which individuals are positively or intermittently reinforced for their appearance. Biological predispositions are postulated to interact with social learning experiences involving emotional or sexual abuse. Symptoms subsequently develop through classical conditioning, in which negative experiences, such as appearance-based teasing, act as the unconditioned stimulus, which then leads to an unconditioned response (e.g., feelings of shame or disgust). Moreover, a specific body part becomes the conditioned stimulus, ultimately leading to a conditioned negative emotional response. It was further noted that symptoms, which develop through classical conditioning, are maintained by operant conditioning. Neziroglu et al. (2004) theorised that avoidance and compulsions serve as an attempt to reduce the impact of negative emotions. Thus, symptoms of BDD persist due to negative reinforcement, increasing the likelihood of symptoms recurring. While other important aetiological processes are lacking, evidence supporting the role of exposure and response prevention (ERP) for BDD provides some support for this theoretical perspective (Williams, Hadjistavropoulos, & Sharpe, 2006).

A cognitive-behavioural therapy (CBT) model of BDD by Veale (2004), an extrapolation of an earlier 1996 model by Veale and colleagues and 2001 model by Veale, highlights the central role of imagery. Veale (2004) reported a relationship between the external representation of appearance, such as mirror checking, and the triggering of a distorted image of some body part. It was hypothesised that negative imagery ultimately leads to safety behaviours, negative mood, and rumination, all of which strengthen the negative appraisals. Furthermore, this model highlighted the importance of social comparison, in which there is an unfavourable comparison with the ideal. This process is thought to be influenced by perfectionistic appearance-based standards. Veale (2004) further postulated selective attention to be critical in the maintenance of the disorder, whereby increased recognition of the image exacerbates the negative consequences that arise by way of this awareness. Furthermore, through the process of awareness, individuals with BDD overestimate the importance of attractiveness, leading to negative interpretation bias. There is a substantial body of evidence implicating the role of perfectionism, selective attention, and interpretive biases in contributing to BDD psychopathology, which is described in greater detail below.

In addition to biological, cultural, and environmental factors, which increase the likelihood of placing a disproportionate amount of importance on outward appearance, the role of perfectionism in maintaining BDD psychopathology was further outlined by Wilhelm (2006). According to this model, hyper-fixations on perceived flaws are thought to be maintained by rigid perfectionistic standards of beauty. Compared to others without the disorder, the individual with BDD is thought to have a pathological aversion to being average looking, which manifests because of cognitive distortions. For example, instead of accepting normal appearance flaws, the individual with BDD might endorse the belief that having average looks equates to being ugly. This ultimately manifests in time-consuming compulsions directed at "correcting" the imperfections.

A more recent 2011 CBT model by Wilhelm, Phillips, Fama, Greenberg, and Steketee extrapolated on Veale's (2004) theory. The authors postulated a negative appearance bias, in which individuals with the disorder misinterpret visual input as a consequence of selectively attending toward specific facial features or body parts perceived as flaws. Symptoms are exacerbated because of the overvaluation of the importance of perceived anomalies, leading to the misattribution that self-worth is reliant on outward beauty (Wilhelm et al., 2011). Accordingly, when appearance-based flaws are perceived, the individual reacts with negative emotions and increased attention toward the imperfection, ultimately leading to compulsions aimed at neutralising negative emotional states (Wilhelm et al., 2011). Further, it was contended that due to intermittent relief from anxiety, negative reinforcement serves to maintain psychopathology.

A recent CBT model of BDD encompasses a more comprehensive paradigm related to the evidence-based aetiology of BDD. In addition to earlier experiences of teasing, sociocultural values, and genetic factors, Fang and Wilhelm (2015) posited that perfectionism, rejection sensitivity, and fear of negative evaluation from others may act as precursors to the development of four types of cognitive processing deficits (i.e., global-local processing, interpretive biases, memory deficits, and selective attention). The four cognitive deficits are thought to contribute to the development and maintenance of negative emotions, such as anxiety and disgust, which then trigger avoidance and compulsions. In line with Neziroglu et al. (2004), Fang and Wilhelm

(2015) further contended that these maladaptive behaviours maintain dysfunctional beliefs by way of negative reinforcement. Although avoidance and compulsions serve to reduce anxiety in the short-term, maladaptive beliefs are reinforced in the long term, as a failure to engage in ERP hinders learning from taking place. **Table 1** represents the key aspects of each BDD model and their common underlying themes. Aside from genetic and cultural factors, the predominant underlying aetiological factors predicting and maintaining psychopathology included cognitive processing deficits and perfectionism. These constructs are supported by nascent research findings, outlined in greater detail below.

Cross-Model Predisposing and Maintaining Factors

Global-Local Processing

Weak central coherence (i.e., poor global processing and superior local processing), a limited ability to understand context or to "see the big picture", is thought to influence selective attention toward perceived flaws in appearance rather than holistically processing body or facial stimuli (Feusner, Moller, et al., 2010). Studies using cognitive tasks like the Inverted Face Task (Thompson, 1980), Mooney Faces Task, Rey Complex Figures Test (RCFT; Osterrieth, 1944), a variation of an Inverted Face Task called the Famous Faces Task, as well as attractiveness ratings using high and low spatial frequency images, and functional magnetic resonance imaging (fMRI) technology have shown support for this hypothesis (Arienzo et al., 2013; Deckersbach et al., 2000; Feusner, Hembacher, Moller, & Moody 2011; Feusner, Moller, et al., 2010; Feusner, Moody, et al., 2010; Moody et al., 2017; Feusner, Townsend, Bystritsky, & Bookheimer, 2007; Jefferies, Laws, Hranov, & Fineberg, 2010; Jefferies, Laws, & Fineberg, 2012; Li, Lai, Bohon, et al., 2015; Toh, Castle, & Rossell, 2017a). However, other studies using the Benton Facial Recognition Task (Benton & Van Allen, 1968), a variation of the Inverted Face Task using houses and facial stimuli, the Navon task (Navon, 1977),

Table 1

Key Aspects and Common Underlying Themes Pertaining to the Models of BDD

Model	Predisposing and Maintaining Factors	Consequences
Veale et al., 1996	**Genetics** **Culture** Environmental factors (e.g., early childhood experiences, teasing) Aesthetic sensitivity Symmetry preference **Perfectionism** Rejection sensitivity **Selective attention**	Negative emotions Avoidance Compulsions
Veale, 2001	Imagery Aesthetic sensitivity Symmetry preference **Perfectionism** **Selective attention**	Negative emotions Avoidance Rumination Compulsions
Wilhelm & Neziroglu (2002)	**Genetics** **Culture** Environmental factors (i.e., childhood experiences) FNE **Perfectionism** **Misinterpretation of visual input** **Interpretive biases**	Negative emotions Avoidance Compulsions
Neziroglu et al. (2004)	**Genetics** Operant conditioning: positive/intermittent reinforcement for appearance Negative reinforcement Classical conditioning: appearance-based teasing Social learning (e.g., trauma)	Negative emotions Avoidance Compulsions
Veale (2004)	**Genetics** Imagery Aesthetic sensitivity Social comparison **Perfectionism** **Selective attention** **Interpretive biases**	Negative emotions Rumination Compulsions

Wilhelm (2006)	**Genetics** **Culture** Environmental factors (e.g., appearance-based teasing & family placing emphasis on importance of appearance) FNE **Perfectionism**	Negative emotions Compulsions
Wilhelm et al. (2011)	**Weak central coherence** **Selective attention** **Interpretive Biases** Negative reinforcement	Negative emotions Compulsions
Fang & Wilhelm (2015)	**Genetics** **Culture** Environmental factors (e.g., appearance-based teasing) Negative reinforcement FNE Rejection sensitivity **Perfectionism** **Weak central coherence** **Interpretive biases** **Memory deficits** **Selective attention**	Negative emotions Compulsions Avoidance

Note. Bolded areas indicate the most pervasive predisposing and maintaining factors mentioned across the BDD models; FNE= Fear of negative evaluation.

electroencephalogram (EEG), magnetic resonance imaging (MRI), fMRI, and the Composite task (Young, Hellawell, & Hay, 1987) have failed to detect significant differences between BDD and control groups (Buhlmann, McNally, Etcoff, Tuschen-Caffier, & Wilhelm, 2004; Li, Lai, Loo, et al., 2015; Moody et al., 2015; Monzani, Krebs, Anson, Veale, & Mataix-Cols, 2013). Research using a Navon task (Navon, 1977) and an Embedded Figures task (Witkin, 1971) found that compared to controls, the BDD group performed worse on both the global and local processing trials (Kerwin, Hovav, Hellemann, & Feusner, 2014). Furthermore, given that brain-imaging and the same or similar variations of cognitive tasks have been found to produce null findings as well as results both in support of and counter to the hypothesis, results across these studies suggest that the relationship of central coherence difficulties and associated global processing abnormalities (or conversely strengths in local processing) and BDD remain inconclusive.

There exists some research investigating the role of central coherence in DC populations, which has also produced mixed results. Duncum, Atkins, Beilharz, and Mundy (2016) failed to detect a local processing bias on an upright-inversion stimulus discrimination task between participants scoring high and low on the DCQ, concluding that visual processing abnormalities may not precede BDD onset. Conversely, Griffiths, Murray, and Touyz (2013) administered the Matching Familiar Faces task to a university population comprised of ninety-one males with varying degrees of muscle dysmorphic psychopathology. While the authors failed to detect a relationship between central coherence and muscularity-oriented disordered eating, a positive association between a weak central coherence and the desire for a muscular build was detected. Mundy and Sadusky (2014) administered the DCQ and an upright-inverted stimulus discrimination task to low and high-risk BDD groups (as determined by scores on the DCQ). It was found that compared to the low-risk group, individuals at high-risk for BDD demonstrated faster reaction times toward the inverted facial and bodily stimuli and greater accuracy for discriminating inverted body-related stimuli. It was concluded that compared to the low scoring group, the high-risk BDD group demonstrated less inversion effect, indicating a bias toward local processing. In a similar study, seventy-four participants were administered the DCQ, an inversion task, and a Navon task (Beilharz, Atkins, Duncan, & Mundy, 2016). The authors detected a positive association between the DCQ and accuracy scores for the stimuli depicting inverted faces and body parts and a negative association between the DCQ and accuracy scores for the stimuli depicting inverted facial faces following global processing retraining. Consistent with Mundy and Sadusky

(2014), the authors concluded that abnormalities to global-local processing may, in part, precede the onset of BDD.

Interpretive Biases

Interpretive biases are described as negative appraisals of body image that are thought to contribute to biases for ambiguous information and overvalued ideas about the importance of attractiveness. Interpretive biases, which are said to be influenced by specific triggers, such as stress, negative mood, comments by others, and physiological changes that occur during adolescence, may in part, account for why individuals with BDD are highly critical of their appearance (Fang & Wilhelm, 2015). While some studies have found that this population tends to misinterpret neutral facial expressions as expressing negative emotion (Buhlmann, Etcoff, & Wilhelm, 2006; Buhlmann, Gleiß, Rupf, Zschenderlein, & Kathmann, 2011; Buhlmann, McNally, Etcoff, Tuschen-Caffier, & Wilhelm, 2004; Labuschagne, Castle, & Rossell, 2011), results concerning the specific emotions underlying these maladaptive cognitions remain inconclusive. Although Buhlmann et al. (2006) found that compared to controls, BDD participants tended to misinterpret neutral expressions for anger and contempt, consistent with Buhlmann, Gleiß et al. (2011), the misinterpretation of neutral facial stimuli for disgust failed to reach significance. This is somewhat surprising given that all the BDD models identify disgust as one of the central emotions that drives avoidance and ritualistic behaviours (Neziroglu, Roberts, & Yaryura-Tobias, 2004; Veale, 2004; Wilhelm & Neziroglu, 2002). Furthermore, a 2002 study by Buhlmann, Wilhelm et al. found that compared to controls, BDD participants misinterpreted ambiguous situations (general, social, and body-related scenarios) as threatening. Results concerning the tendency of individuals with BDD to over-value the importance of attractiveness are also mixed. While some studies which have used the Go/No-go Association Task (Nosek &

Banaji, 2001), the Implicit Association Task (Greenwald, McGhee, & Schwartz, 1998), and a Values Scale to look at implicit attractiveness beliefs (Buhlmann, Teachman, & Kathmann, 2011; Buhlmann, Teachman, Naumann, & Fehlinger, 2009; Lambrou et al., 2011) have found significant differences between BDD and control groups, other studies using the same measures have failed to detect any differences across these groups (Buhlmann, Teachman, Gerbershagen, Kikul, & Rief, 2008; Hartmann et al., 2015).

There is some research investigating the utility of Interpretation Bias Modification training in the alleviation of BDD psychopathology. Summers and Cougle (2016) recruited a group of BDD participants, finding that compared to the placebo control training condition, those receiving active treatment had a reduction in threat biases and improvement in symptoms post-treatment. In a similar study by Summers and Cougle (2017), a group comprised mostly of university students were administered the self-report version of the BDD modification of the Yale-Brown Obsessive-Compulsive Scale, the not just right experiences questionnaire (NJRE) revised (described as an intolerance of imperfections), and an Interpretive Bias Modification training paradigm. Only those participants meeting clinical cut-off on the self-report screening questionnaire for BDD were included in the study. The authors concluded that NJREs moderated the effect of the training program on BDD psychopathology, such that those participants with high co-occurring NJREs received poorer treatment outcomes. A recent BDD study by Wilver and Cougle (2018) compared treatment efficacy of internet-delivered Interpretation Bias Modification and Progressive Muscular Relaxation, finding that while both groups experienced significant reductions in appearance-based biases and BDD symptom severity, there was no difference between the treatment methods. The authors noted that placebo or expectancy effects, the passage of time, and/or spontaneous recovery might have been factors contributing to equivalent improvements in symptomology across both treatment conditions.

To date, only one study has examined interpretation biases in a DC population. In their 2016 study, Premo, Sarfan, and Clerkin, administered the cognitive bias modification for interpretations program to a group of undergraduate students with elevated levels of BDD psychopathology, as assessed using the DCQ and the self-report version of the BDD modification of the Yale-Brown Obsessive-Compulsive Scale. While negative interpretations concerning BDD-relevant information improved after treatment, participants in both the comparison and positive training conditions benefited, which raised concerns about the specificity of the training program.

Memory Deficits

Results relating to memory deficits, thought to account for inaccurate coding of facial or bodily stimuli, are also mixed (Fang & Wilhelm, 2015). Some studies which have looked at verbal, visual, nonverbal, semantic, and spatial working memory (Deckersbach et al., 2000; Dunai, Labuschagne, Castle, Rossell, & Kyrios, 2010; Labuschagne et al., 2011; Rossell et al., 2014) have found significant group differences among BDD and controls, while others who have looked at verbal, visual, and semantic memory (Hanes, 1998) have failed to detect significant group differences. Furthermore, a study by Toh, Castle, and Rossell (2015) found that compared to controls, the BDD group showed poor immediate recall of words and stories but did not detect deficits to delayed memory, as measured by word, story, and figure recall on the Repeatable Battery for the Assessment of Neuropsychological Status (Rey, 1964).

Although spatial working memory was found to be intact, Blum, Redden, and Grant (2018) reported results consistent with the clinical research; compared to controls, subclinical

BDD participants performed worse on the One Touch Stockings of Cambridge task, a measure of spatial planning and working memory. The authors concluded that deficits in executive functioning might precede the onset of BDD. To date, no research has examined memory deficits in a DC population.

Selective Attention Biases

Selective attention is as a cognitive bias involving the allocation of attention toward specific environmental stimuli (Howell et al., 2016); this cognitive mechanism has been shown to maintain a broad range of psychopathology (McManus et al., 2010). Selective attention biases are thought to account for biased attention toward disorder-related or threat stimuli (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). In the case of BDD, this involves specific physical features. Neuropsychological research on eating disorders has described selective attention as enhanced distractibility (Tchanturia, Campbell, Morris, & Treasure, 2005). Thus, it has been proposed that individuals with BDD may attend to external stimuli that have become associated with their obsessions, or to perceived flaws in appearance, which are relevant (e.g., attractive) or threatening (e.g., hideous) to the disorder. Although some studies which have used Emotional Stroop tasks (Watts, McKenna, Sharrock, & Trezise, 1986), eye trackers, symmetry tasks, discrimination tasks, and perceptual modification tasks (Buhlmann, McNally, Wilhelm, & Florin, 2002; Greenberg, Reuman, Hartmann, Kasarskis, & Wilhelm, 2014; Grocholewski, Kliem, & Heinrichs, 2012; Kollei, Horndasch, Erim, & Martin, 2017; Lambrou, Veale, & Wilson, 2011; Stangier, Adam-Schwebe, Muller, & Wolter, 2008; Thomas & Goldberg, 1995; Toh, Castle, & Rossell, 2017b; Toh, Castle, & Rossell, 2017c; Yaryura-Tobias et al., 2002) have supported this hypothesis; other studies using facial discrimination tasks, symmetry tasks, Emotional Stroop tasks, and video face distortion tasks (Buhlmann, Rupf, Gleiss, Zschenderlein,

& Kathmann, 2014; Hübner,et al., 2016; Reese, McNally, & Wilhelm, 2010; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014) have failed to detect significant differences between BDD and control groups. There remains some uncertainty around whether BDD participants, compared to controls, have enhanced discriminatory abilities solely for their own facial stimuli or for objects or other people's faces. In their 2011 study, Lambrou and colleagues detected a response bias toward detecting symmetry changes to their own faces, which did not extend to the object and other-face control conditions, concluding that individuals with BDD selectively attended to self-referent information. Furthermore, selective attention biases in BDD groups have been found to be moderated by gender (Greenberg, Reuman, Hartmann, Kasarskis, & Wilhelm, 2014), consistent with the social phobia literature (Stangier, Adam-Schwebe, Müller, Wolter, 2008).

The Stroop task (Stroop, 1935) has been widely used to measure attention bias but due to methodological challenges of the paradigm (Jiang & Vartanian, 2018), and that the dot-probe task is considered to provide a more direct measure of attention bias (Wells & Matthews, 1994), computerised dot-probe paradigms have largely replaced Stroop tasks. While dot-probe tasks have been utilised across the eating disorder literature to explore the attentional mechanisms maintaining symptoms (Blechert, Ansorge & Tuschen-Caffier, 2010; Rieger et al., 1998; Rodgers & Dubois, 2016; Skinazi et al., 2018), there is limited published research on the use of dot-probe paradigms in populations endorsing DCs central to BDD.

One such study was conducted by Fang, Sawyer, Aderka, and Hofmann (2013) whereby a modified dot-probe paradigm devised to improve symptoms of social anxiety disorder was used to examine its impact on secondary symptoms of BDD. The authors found that compared to the placebo condition, this task generated significant reductions in BDD symptom severity scores. In a related study, Onden-Lim, Wu, and Grisham (2012) administered a dot-probe task comprised of appearance-related (i.e., 20 attractive versus 20 unattractive facial and body part stimuli), disgusting (e.g., excrement), and neutral images in a DC population. The authors found DC to be positively associated with selective attention toward faces and images of attractive and disgusting stimuli. However, it was concluded that specific underlying selective attention mechanisms, such as vigilance and disengagement, could not be determined. In support of these findings, Jin et al. (2018) used a combination of a modified dot-probe task and eye-tracking technology, finding that compared to the low-risk group, the group endorsing higher degrees of muscle dysmorphic symptomology displayed vigilance toward and difficulties disengaging from images depicting men with a larger build. To date, no additional research has used a dot-probe task to capture specific underlying selective attention mechanisms (i.e., vigilance and disengagement) in DC populations endorsing symptomology consistent with BDD. Moreover, the dot-probe tasks relevant to DC research have focussed primarily on probes and stimuli symptomatic of eating disorders (e.g., food and weight-based stimuli; Rieger et al., 1998; Shafran et al., 2007). This is problematic given that DC is a broad, continuous construct and is considered the primary diagnostic feature of BDD (Mancuso et al., 2010). It is important to address this gap in the literature, such that early intervention programs identifying at-risk populations (i.e., individuals with high degrees of DC), can be titrated to target the broader spectrum of DC psychopathology.

While exploring the underlying neurocognitive mechanisms maintaining psychopathology is crucial in developing a more thorough understanding of DC and BDD, it is also of interest to explore the underlying personality structures involved. Across the above-mentioned models of BDD, perfectionism is the most pervasive personality style described, which is predicated on an emergent body of evidence (Fang & Wilhelm, 2015).

Perfectionism

Two types of perfectionism are commonly identified in the literature: strivings and concerns (Stoeber & Otto, 2006). Perfectionistic strivings are the motivation to achieve uncommonly high standards, while perfectionistic concerns are characterised by concerns over mistakes and perceived failures (Stoeber & Damian, 2014). The ubiquitous nature of perfectionism found across various psychological disorders is evident in recent meta-analytic research of various non-clinical and clinical populations, including eating disorders and OCD (Limburg, Watson, Hagger, and Egan, 2017). Both types of perfectionism were found to be important transdiagnostic risk factors (Limburg et al., 2017) that were significantly associated with psychopathology. There is some discrepancy in the literature involving the specific subtypes of perfectionism characteristic of BDD, with one study (Hartmann, Thomas, Greenberg, Matheny, & Wilhelm, 2015) finding a BDD group to endorse higher perfectionistic strivings and concerns than controls, and another study (Buhlmann, Etcoff, & Wilhelm, 2008) identifying differences on perfectionistic concerns only.

Supported by nascent literature in this area (Bartsch, 2007; Cunningham et al., 2016; Hanstock & O'Mahony, 2002; Kuennen & Waldron, 2007), high levels of perfectionism are thought to predict DC. Bartsch (2007) found self-oriented and socially prescribed perfectionism to be significant predictors of DC in men and women; it was also reported that of the two groups, the women endorsed heightened DC psychopathology. In their 2016 study, Cunningham and colleagues recruited 106 undergraduate men who completed self-reported measures on emotion regulation, perfectionism, and depression. The authors found the relationship between self-oriented perfectionism and DC to be moderated by emotion regulation. In a similar study of 165 female university students, Hanstock and O'Mahony (2002) administered measures relating to

DC, acne-related concerns, and perfectionism, finding a positive association between socially prescribed perfectionism and appearance-related preoccupations. Aside from Kuennen and Waldron (2007) who investigated the relationship between the Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990) total score and muscle dysmorphic psychopathology, the literature has examined the associations between the Multidimensional Perfectionism Scale (MPS; Hewitt & Flett, Sarason, & Irwin, 1991) and DC psychopathology. Unlike the MPS, which has a focus more specific to socially prescribed perfectionism, the FMPS comprises of items that assess symptomology highly specific to DC, such as a need to check details (Stairs et al., 2012). Furthermore, given the multidimensional nature of the FMPS, it is not recommended to compute a total score (Hawkins, Watt, & Sinclair, 2006). Thus, it would be helpful to explore the use of various FMPS subscales in DC populations to better understand the specific underlying perfectionistic mechanisms that predict and maintain psychopathology

Link Between Selective Attention and Perfectionism

Although CBT treatment models for perfectionism denote the importance of targeting maladaptive selective attentional processes (Howell et al., 2016), to date, there remains limited research testing the relationship between selective attention and perfectionism. It has been postulated that the cognitive mechanisms underlying perfectionism include selective attention biases toward environmental threats signalling failure, while attention is directed away from achievements (Shafran, Cooper, & Fairburn, 2002). This type of selective attention is thought to be associated with the dimensions of perfectionism reflecting personal standards and doubts about actions (Shafran et al., 2002).

Drawing upon a social cognitive paradigm, Lundh and Öst (1996) detected a positive correlation between the Concern over Mistakes subscale and the total score of the FMPS and

Stroop interference words pertaining to social failures. To determine whether perfectionists selectively attend toward failure in the environment, Kobori and Tanno (2012) administered a modified version of the Stroop task to 245 undergraduate students displaying various degrees of self-oriented perfectionism. The authors found that compared to the neutral words, the high perfectionism group did not display selective attention biases toward the target word stimuli. Conversely, a 2016 study by Howell et al. used pre-defined cut-off scores on the Concern over Mistakes subscale to allocate participants to low and high perfectionism groups. It was found that compared to the low scoring group, participants endorsing high levels of perfectionism displayed selective attention biases toward perfectionism-relevant stimuli. The authors concluded that future research investigating the relationship between selective attention and perfectionism is warranted.

Nascent literature concerning the psychotherapeutic approaches to treating BDD has identified CBT as the gold standard treatment approach. For example, specific cognitive distortions, such as rigid perfectionistic thinking styles, which engender the overvaluation about the importance of appearance, are processes that can be targeted and modified in therapy (Fang & Wilhelm, 2015). Similarly, ERP techniques have been used to alleviate BDD-related avoidance and compulsions (Fang & Wilhelm, 2015). The Fang and Wilhelm (2015) BDD model shares similar features with CBT models for OCD, which describe similar underlying factors that can be targeted using CBT-based approaches. To date, no research has initiated treatment in non-clinical populations endorsing high degrees of DC. Thus, while CBT for eating disorders might also inform the development of treatment targets in this population, there remains a paucity of research exploring traits of DC specific to BDD. Thus, the psychotherapeutic interventions for BDD were investigated.

Psychotherapeutic Approaches

CBT for BDD

Prevalent psychological interventions for BDD include ERP without cognitive elements and CBT, which combines ERP and cognitive restructuring. ERP for BDD includes gradual exposure to anxiety-inducing situations, such as going out in public with minimal to no makeup on and preventing engagement in compulsive behaviours (Williams et al., 2006). Cognitive restructuring involves identifying cognitive distortions, such as the overvaluation of appearance, and challenging these beliefs. Informed by clinical and neurobiological research, a manualised treatment protocol known as CBT-BDD has been developed (Rosen, Reiter & Orosan, 1995) and revised (Wilhelm et al., 2011) to target symptoms specific to the disorder. It is comprised of psychoeducation around the nature of BDD, ERP, cognitive restructuring, and perceptual retraining techniques. Due to the complexity of BDD, this is a lengthily, specialised therapy, typically comprised of weekly sessions totalling six months in duration (Kelly & Phillips, 2017).

A 2006 meta-analysis by Williams et al. (2006) compared the use of psychotherapeutic and pharmacological interventions in alleviating symptoms of BDD. Drawing upon randomised controlled trials (RCT), case series, and cross-over trials, a total of four CBT, five ERP and one cognitive restructuring-only study were included in the meta-analysis. Psychotherapeutic approaches yielded large between-group effect size differences from control conditions. Consistent with a 2002 review by Neziroglu and Khemlani-Patel, Williams et al. (2006) further reported that there were no significant group differences between ERP and CBT. A 2009 Cochrane review by Ipser, Sander, and Stein, which included three RCTs of psychotherapy for BDD (CBT and ERP), also found a significant reduction in BDD symptom severity compared to control conditions. These results were further confirmed by a 2010 review by Prazeres, Nascimento, and Fontenelle (2013) who analysed the efficacy of CBT, cognitive restructuring only, and ERP for BDD. The authors included case series, open study, controlled trials, and meta-analytic approaches, concluding that both individual and group BDD therapy were superior to waitlist conditions.

A more recent meta-analysis involving the inclusion of RCTs investigated the efficacy of CBT in alleviating symptoms of BDD (Harrison, Fernández de La Cruz, Enander, Radua, & Mataix-Cols, 2016). The authors included interventions with various delivery methods, including individual and group face-to-face, as well as Internet-delivered CBT (ICBT). Within-group effect sizes measuring reductions in BDD symptom severity from baseline to end-of-treatment were large, ranging from d=1.30-2.69 with 95% confidence intervals (CI) provided by three studies ranging from -1.36: 11.34 to .95: 1.89. It was concluded that CBT is an effective treatment that can be used to improve symptom severity, which engenders long-term treatment gains. Moreover, a recent study comparing the efficacy of CBT-BDD against supportive psychotherapy reported that CBT-BDD produced greater symptom reduction at the end-of-treatment (least square means slopes: -18.6 ± 1.4 *versus* -12.1 ± 1.4 for CBT-BDD and supportive psychotherapy respectively), which was maintained at six-month follow-up (Wilhelm et a.l., 2019). The authors further reported an attrition rate of 27.9% in the CBT-BDD group at immediate post-treatment follow-up, with a completion rate of 63.9% at six-month follow-up (Wilhelm et al., 2019).

There exists only one published RCT evaluating the efficacy of CBT for BDD in an adolescent population (Mataix-Cols et al., 2015). BDD participants aged twelve to eighteen years were randomly assigned to either a CBT or control condition, which was comprised of weekly telephone monitoring and general psycho-education content. Compared to controls, the treatment group showed a large between-group effect size difference of *d*=1.13 (95% CI= .31: 1.96) at immediate post-treatment and *d*= .85 (95% CI= .02:1.69) at two-month follow-up (Mataix-Cols et al., 2015). Furthermore, in a follow-up study involving the Mataix-Cols et al. (2015) sample, Krebs et al. (2017) investigated whether treatment gains were maintained at one year following completion of CBT. The authors reported that half of the sample was still considered to be treatment responders at twelve- month follow-up.

While one existing BDD study reported treatment gains of up to two years following behavioural therapy for BDD (Mckay, 1999), few studies have explored the extended long-term (greater than one year) outcomes of CBT for BDD (Enander et al., 2019; Veale, Miles, & Anson, 2015). Veale and colleagues (2015) found that one to four years following the completion of CBT, BDD symptoms had stabalised, with relapse rates of 13%. However, as highlighted by Krebs et al. (2017), at the time of long-term follow-up assessments, 31% of the sample was on medication and 26% were enrolled in additional psychological therapy, rendering it difficult to understand the role of the original CBT in symptom alleviation. In a related study, Enander and colleagues (2019) explored the enduring effects of BDD-NET two years post-treatment. The authors reported that 69% of the participants were considered treatment responders (improvement in BDD symptom severity of at least 30%) and 56% were found to be in full remission. While these rates were higher than those reported by Veale et al. (2015), the participants accessing BDD-NET were self-referred and had lower baseline symptom severity scores (Enander et al., 2019). It was concluded that BDD-NET is an efficacious treatment for BDD that is better suited for those with mild to moderate symptom severity. Moreover, factors influencing treatment response in populations with clinically significant DCs include motivation, treatment expectancy, and insight (Greenberg, Phillips, Steketee, Hoeppner, & Wilhelm, in press).

In the meta-analysis by Harrison et al. (2016), it was noted that although the literature has highlighted the need for specificity of CBT, this conclusion has been based primarily on comparisons made against CBT for BDD and generic psychotherapy. In addition, only one of the studies included in the meta-analysis comprised of a credible control group. Corroborating this perspective, a recent study comparing the efficacy of CBT-BDD and supportive psychotherapy produced comparable reductions in BDD symptom severity at one of the two treatment sites (Wilhelm et al., 2019). To date, no dismantling studies have been reported to see which aspects of CBT are most effective. One maintenance factor not yet investigated in the treatment of BDD is perfectionism.

CBT for Perfectionism

A recent systematic review and meta-analysis of psychological therapies for perfectionism, comprised mainly of CBT-based approaches, detected significant reductions in perfectionistic thinking styles across multiple clinical disorders, including eating disorders and OCD (Lloyd, Schmidt, Khondoker, & Tchanturia, 2015). The pooled standardised mean difference scores were large for the FMPS Personal Standards and Concern over Mitakes subscales (Hedges g= .79{95% CI= .44:1.12} and 1.32 {95% CI= 1.02: 1.64} respectively). The authors further concluded that there was some evidence for the efficacy of these therapies in reducing secondary symptoms of anxiety, depression, OCD, and eating disorders. The results of this study were in support of the research by Limburg et al. (2017) who found perfectionism to be an important transdiagnostic risk factor across several non-clinical and clinical studies investigating a broad spectrum of psychopathology. These findings are consistent with Kyrios, Hordern and Fassnacht (2015) who conducted an OCD treatment study, concluding that of the variables analysed, only intolerance of uncertainty and perfectionism predicted post-treatment change. Further, given the significant improvements in eating disorder and OCD symptoms reported by Lloyd et al. (2015), ranging from small to large effect sizes (largest effect for OCD symptoms), it may be of interest to investigate the utility of CBT for perfectionism (CBT-P) in populations with clinically significant DCs.

While CBT-P has been found to reduce primary outcomes of perfectionism and secondary outcomes such as depression, anxiety, and disordered eating (Lloyd et al., 2015), no research has explored the impact on other secondary outcomes such as DC and body image disturbance. This is surprising, given the surmounting body of evidence for the role of perfectionism in predicting and maintaining symptoms of DC and BDD (Bartsch, 2007; Cunningham et al., 2016; Fang & Wilhelm, 2015; Hanstock & O'Mahony, 2002; Kuennen & Waldron, 2007). While one study has looked at CBT-P with BDD participants (Glover, Brown, Fairburn, & Shafran, 2007), only two individuals in the sample had comorbid diagnoses of BDD (R. Shafran, personal communication, February 20, 2018). Although the researchers found significant differences between the treatment and control groups, they did not consider improvements to BDD symptomology.

Due to shame and poor insight, individuals with BDD rarely present to health care settings for the treatment of symptoms, often leading to misdiagnoses of OCD, depression, and anxiety (Buhlmann & Winter, 2011). Thus, given the findings by Lloyd et al. (2015) involving potential secondary treatment gains, the transdiagnostic benefits of CBT-P may be a viable solution in targeting treatment barriers.

Internet-Delivered CBT

In addition to shame and poor insight, there is a multitude of factors that generate treatment barriers in BDD populations. These individuals often fail to seek help due to the desire for autonomy and poor access to health care services (Buhlmann & Winter, 2011; Harrison et al., 2016). Further, infrequent screening practices, treatment costs, and time-commitment associated with extended specialised therapy also contribute to access issues (Andersson et al., 2019; Buhlmann & Winter, 2011; Harrison et al., 2016). In their 2001 study, Grant, Kim, and Crow found that while sixteen of the 122 participants recruited through a psychiatric inpatient setting met criteria for BDD, no formal diagnoses had been made by the individual's treating healthcare practitioner. In addition, given the high comorbidity rates with depression, many people with BDD struggle with motivation (Phillips, 2017). According to Phillips (2017), individuals with BDD delay seeking help for their symptoms for upwards of fifteen years, resulting in poorer prognoses.

In response to treatment barriers, ICBT has been gaining increased attention (Andersson et al., 2019). Two meta-analyses (Andersson, Cuijpers, Carlbring, Riper, & Hedman, 2014; Carlbring, Andersson, Cuijpers, Riper, & Hedman-Lagerlöf, 2018) have compared the efficacy of therapist-guided ICBT against face-to-face CBT in treating a variety of mental health conditions, including body dissatisfaction. It was concluded that ICBT was as effective as the face-to-face delivery method. In their 2018 meta-analysis, Carlbring and colleagues reported a pooled effect size difference of Hedges g=.05 (95%CI= -.09:.20). In addition, ICBT has been found to work for BDD and eating disorders. A 2014 meta-analysis on the efficacy of E-therapy (online and app delivery methods) showed some support for prevention, treatment, and relapse prevention in eating disorders (Loucas et al., 2014). Additionally, one published piloted uncontrolled clinical trial investigating the utility of BDD-NET, a therapist-assisted internet-delivered CBT model for BDD (Enander et al., 2014) and one large follow-up RCT (Enander et al., 2016) have been investigated. Participants completed eight modules over the course of twelve weeks; modules were based on the CBT-BDD model. The authors reported significant, large effects in the alleviation of BDD symptoms, which were maintained at three and six-month follow-up (Cohen's *d*= 1.42 {95%CI= .95:1.89}). Additional improvements to depression, psychosocial functioning, and quality of life scores were reported. A follow-up study by Enander et al. (2019) also found enduring effects of BDD-NET at twenty-four months (Cohen's *d*= 1.95 {95% CI= 1.40:2.18). Furthermore, in the meta-analysis by Harrison and colleagues (2016), sensitivity analyses revealed consistent findings across various distribution methods, including ICBT. The authors also concluded that due to issues with motivation and insight, online delivery methods might be best suited for individuals with milder symptomology.

ICBT-P has also been gaining attention in the literature, producing clinically significant reductions in symptoms of perfectionism from pre to post-treatment, with effect sizes ranging from small to large on the FMPS Concern over Mistakes, Doubts about Actions, and Personal Standards subscales (Cohen's *d*= .32-1.00), and improvements to symptoms of anxiety and depression (Arpin-Cribbie et al., 2012; Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2012; Rozental et al., 2017; Shafran et al., 2017). ICBT has also been found to have enduring effects for a multitude of psychological disorders, such as OCD and depression (Andersson, Rozental, Shafran, & Carlbring, 2017). Thus, given that preliminary research has elucidated perfectionism as an important mechanism underlying DC and BDD psychopathology and that ICBT-P has generated secondary treatment gains with long-term benefits, investigation of online programs targeting perfectionism in these populations is warranted.

Attrition Rates

Attrition rates are inevitable for any therapy used to treat mental disorders. A recent 2015 meta-analysis by Fernandez, Salem, Swift, Ramtahal, and Nezu explored drop-out rates from 115 studies investigating CBT in the treatment of various psychological disorders. The authors reported average attrition rates of 15.9% at pre-treatment and 26.2% throughout treatment, with online CBT delivery methods having the highest rates of drop-out. According to Melville, Casey, and Kavanagh (2010), the literature's definitions of online intervention dropout can vary, with some research describing it as the unsuccessful completion of all phases of the treatment components. However, studies have more frequently described dropout as the non-completion of at least one assessment or treatment element from any phase of the research (i.e., pre-treatment assessments, treatment, post-treatment assessments, and follow-up assessments). Using the latter definition provided above, Melville et al. (2010) reported a mean dropout rate of 31% for online interventions targeting a wide range of psychopathology, including bulimia nervosa, insomnia, and complicated grief. A systematic review on Internet interventions for anxiety and depression also reported on drop-out rates, which were predicated on a definition consistent with the 2010 study by Melville and colleagues (Christensen, Griffiths, & Farrer, 2009). It was found that of the twenty-three studies included in the analyses, completion rates for online interventions for depression, generalised anxiety disorder, panic disorder, social phobia, and post-traumatic stress disorder were 43-99%, 44%, 80-90%, 90%, and 47-87% respectively. Further, a meta-analysis involving both clinical and non-clinical populations with symptoms of depression and anxiety reported drop-out rates ranging from 3-34% (Spek et al., 2006). A more recent meta-analysis by Andersson and colleagues (2018) reported an average attrition rate of 21% for the face-to-face and ICBT groups, with meta-analytic regression analyses revealing no significant group differences. Additionally, a meta-analysis investigating psychotherapeutic interventions for BDD by Williams et al. (2006) found that of the non-randomised controlled trials investigated, a treatment completion rate of 79% (ranging from 44.4%-100%) was detected in the intervention groups. The more recent systematic review and meta-analysis on CBT for BDD, which located six RCTs dated from 1996-2016 involving face-to-face CBT for BDD and one randomised ICBT for BDD study, detected an average completion rate (follow-ups included) of 91% (ranging from 65%-100%) for the face-to-face delivery methods and 89% for the ICBT program (Harrison et al., 2016). However, the authors concluded that the inclusion of RCT studies was likely to manifest in artificially high completion rates. Furthermore, Wilhelm et al. (2019) reported that 72.1% of participants completed the CBT-BDD program while 81.4% completed the supportive psychotherapy program. In the study by Egan et al. (2014) investigating CBT-P, there was an overall attrition rate of 25%, with face-to-face (22%) and online (19%) delivery methods producing similar results. These findings were consistent with the attrition rate (24%) reported in the CBT-P study by Radhu et al. (2014), but inconsistent with the RCT studies by Rozental et al. (2017) who reported a much lower attrition rate of approximately 14% and Shafran et al. (2017) who reported a high attrition rate of 50% for the ICBT-P programs. Attrition is an important aspect to evaluate when examining new treatments, to ensure it is at least commensurate with other therapies.

Conclusions

There are several conclusions which can be drawn from this literature review. First, while no models of DC exist to date, given that it falls within the obsessive-compulsive spectrum (Senín-Calderón et al., 2017) and that it is a predominant feature of BDD (Mancuso et al., 2010), DC is likely to share similar underlying personality and neurocognitive risk and maintaining mechanisms with BDD (Bartsch, 2007; Senín-Calderón et al., 2017). As such, in addition to preliminary DC research, the BDD literature was used to inform the development of this thesis. As a result, it was concluded that perfectionism and the four cognitive deficits outlined in the Fang and Wilhelm (2015) model of BDD would be the primary targets of research focus. The next chapter focuses solely on clarifying the contribution of the four different cognitive deficits – local processing, interpretive biases, memory deficits, and selective attention – to the differentiation between people with BDD *versus* controls, using a meta-analytic approach.

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Chapter 3

A Systematic Review and Meta-Analysis of Cognitive Processing Deficits Associated with Body Dysmorphic Disorder[2]

[2]This section was published and can be found in **Chapter 9 Appendix A**. Shevaugn Johnson contributed 70%, 95%, and 75%, Paul Williamson contributed 10%, 4%, and 10%, and Tracey Wade contribured 20%, 1%, and 15% to the research design, data collection and analysis, and writing and editing respectively.

Johnson, S., Williamson, P., & Wade, T.D. (2018). A Systematic Review and Meta-analysis of Cognitive Processing Deficits Associated with Body Dysmorphic Disorder. *Behaviour Research and Therapy, 107*, 83-94. https://doi.org/10.1016/j.brat.2018.05.013

Abstract

This systematic review and meta-analysis examined the evidence supporting the association between body dysmorphic disorder (BDD) symptomology and four types of cognitive processing abnormalities: local processing, interpretive biases, memory deficits, and selective attention. Twenty-three studies met inclusion requirements that examined differences in performance on cognitive tasks between BDD and control groups across the four categories. Multilevel modelling was used to calculate an overall effect size for each cognitive category. BDD and control groups differed significantly on measures of interpretive biases (*g*=.30, 95% CI=. 07: .54), memory deficits (*g*=.56, 95% CI=.26: .87), and selective attention (*g*=.60, 95% CI=.26: .93). Differences between the BDD and control groups on measures of local processing did not reach significance. These findings support the hypothesis that people with BDD may selectively attend to perceived threats or to disorder-related stimuli, misinterpret ambiguous stimuli as threatening, overvalue the importance of attractiveness, and have inaccurate coding and recall for facial or bodily stimuli. Recommendations for future research of these specific cognitive deficits in BDD include introducing the use of dot-probe paradigms and new treatment targets that can be used as adjuncts to current treatment modalities.

Keywords: body dysmorphic disorder; interpretive biases; local processing; memory deficits; meta-analysis; selective attention

Introduction

Progress in the treatment of body dysmorphic disorder (BDD) remains limited, restrained by the paucity of theoretical models of BDD, most of which are cognitive behavioural in nature. The most recent model encompasses a comprehensive paradigm related to the evidence-base that currently informs the aetiology of BDD (Fang & Wilhelm, 2015). Fang and Wilhelm (2015) suggest that perfectionism, rejection sensitivity, and fear of negative evaluation from others may act as precursors to the development of four types of cognitive processing deficits (described below and in **Table 1**), one of which includes selective attention that has been highlighted in previous models (e.g., Veale, 2004; Wilhelm, Phillips, Fama, Greenberg, & Steketee, 2011).

Aim of the Meta-Analysis

The main aim of the current meta-analysis was to investigate the empirical evidence supporting an association between the four cognitive processing deficits and symptoms of BDD. Specifically, the aim was to answer the following question: compared to controls, do clinically-diagnosed BDD participants display heightened local processing of stimuli, interpretive biases for misinterpreting neutral facial expressions as representing negative affect and overvaluing the importance of appearance, memory deficits, and selective attention biases for disorder-relevant and symmetrical stimuli? This meta-analysis is the first to investigate the strength of the proposed relationships between cognitive processing deficits and BDD, an important undertaking given the presence of so many conflicting findings across individual studies. Understanding the underlying mechanisms, which produce and maintain symptoms of BDD is crucial for the development of new and existing interventions.

Method

Search Strategy

Table 1

Summary of Deficits in Cognitive Processing in BDD

Cognitive Deficits	**Clinical Features**	**Cognitive Measures**
Local Processing	Preferential processing of local details, resulting in preoccupations with specific flaws in face or body parts	Composite Task Electroencephalogram Embedded Figures Task Famous Faces Task Functional Magnetic Resonance Imaging Inversion Task Inverted Face Task Magnetic Resonance Imaging Mooney Faces Task Navon Task Rey Osterrieth Complex Figures Test (copy) Short Form Benton Facial Recognition Task
Interpretation Bias	Overvalued ideas about attractiveness/ misinterpretation of neutral facial expressions as negative	Emotion Recognition Task Go/No-go Association Task Implicit Association Test Interpretation Questionnaire Values-Scale Questionnaire
Memory deficits	Inaccurate coding and recall of facial features or body parts	California Verbal Learning Test Category Fluency Task Controlled Oral Word Association Test Pattern Recognition Test Rey Osterrieth Complex Figures Test (recall) Sentence Verification Task Rey Auditory Verbal Learning Task Repeatable Battery of Neuropsychological Status (immediate and delayed recall) Spatial Span Test Spatial Working Memory Test
Selective attention	Fixation on threat and/or disorder-relevant stimuli/ biased attention to aesthetic details (e.g. symmetry)	Attractiveness ratings for high spatial frequency images Discrimination tasks (Aesthetic Perceptual Sensitivity; Aesthetic Evaluative Sensitivity; Aesthetic Emotional Sensitivity) Dot Symmetry Detection Task Emotional Stroop Task Eye Tracker Facial Discrimination Task Facial Symmetry Detection Task Video Face Distortion Task

No published protocol exists for this review and meta-analysis. The review process was conducted according to the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009), described in **Figure 1.** A PsycINFO (OvidSP) database search was conducted, covering professional and academic literature across psychology and other related disciplines, including medicine, mental health, nursing, nutrition and dietetics, physiology, and linguistics. The following terms were combined using the "AND" Boolean operator and searched in the database: *body dysmorphic disorder, dysmorphophobia, BDD, body image, body image disturbance,* AND *cognition, cognitive, cognitive task.* Additional articles from reference lists and extended searches, including those pertinent to the proposed theoretical model, were included in the present literature search. To reduce the likelihood of having included more frequently in our analyses studies that were selectively chosen for publication due to significant effect sizes (publication bias), we attempted to locate unpublished studies and dissertations that met our inclusion criteria. Additional searches were conducted in PsycINFO, PubMed (OvidSP), CINAHL, and MEDLINE to obtain data from dissertations. Furthermore, all corresponding authors whose studies met inclusion criteria were contacted to inquire about whether they were aware of any existing unpublished BDD studies that used cognitive tasks to assess the four cognitive processing abnormalities. However, no additional eligible studies could be located. Except for case studies, all designs and cognitive tasks used to assess the four cognitive deficit categories were included. A final search was conducted on November 20, 2017, and no additional studies that met our specified inclusion criteria were identified. The first author, using the inclusion-exclusion criteria described below, conducted all screening.

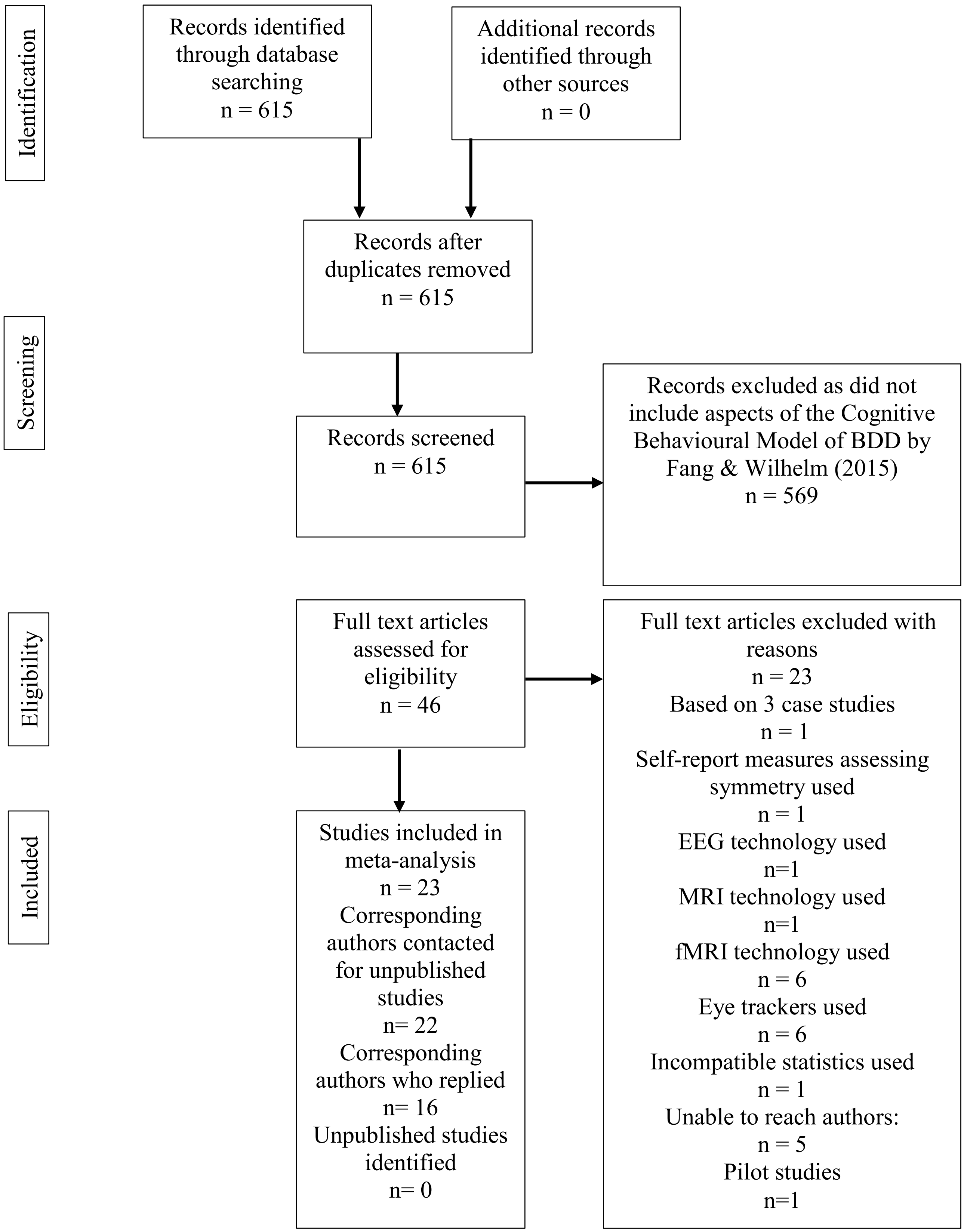

Figure 1. PRISMA diagram of the selection process of studies included in the meta-analysis.

Inclusion Criteria

To examine a homogeneous group to give the greatest clarity in the face of the varied and inconsistent results to date, only studies of clinical populations were included in the meta-analysis. We only selected BDD studies that compared differences in cognitive task performance. Furthermore, given that some cognitive tasks measure central coherence on a continuum, where one score is representative of both global and local processing, we were only able to calculate scores for one of these processes. Local processing was prioritised because it has been theorised that individuals with BDD hyper-focus on specific, focal aspects of appearance. Traditionally, it has been assumed that heightened local processing subsequently hinders global processing abilities. However, as evidenced by Kerwin, Hovav, Hellemann, and Feusner (2014) who found individuals with BDD to perform worse on both global and local trials, high performance on one may not be indicative of low performance on the other and *vice versa*. To avoid cherry picking, each condition of every task used to capture the four constructs of interest were included in the analyses. Studies dated from 1998 when the first such study appeared. Therefore, the inclusion criteria were as follows: (1) publication in English, (2) in a peer-reviewed journal, (3) studies using a clinical population of individuals with BDD where diagnoses were confirmed using the diagnostic and statistical manual of mental disorders (DSM) criteria, Body Dysmorphic Disorder Diagnostic Module, and/or a clinical interview, and (4) studies that assessed at least one of the four cognitive processing deficits using cognitive tasks. We contacted Buhlmann, McNally, Etcoff, Tuschen-Caffier, and Wilhelm (2004), Feusner, Moller et al. (2010), Hartmann et al. (2015), Kerwin et al. (2014), Monzani, Krebs, Anson, Veale, and Mataix-Cols (2013), and Toh, Castle, and Rossell (2017b) to obtain means and standard deviations not provided in the published online studies. The first author performed a quality assessment and data collection.

Exclusion criteria

Although one pilot study was identified (Yaryura-Tobias, Neziroglu, Chang, Lee, Pinto, & Donohue, 2002), given that under normal conditions, most BDD studies tend to be underpowered and that the inclusion of small studies increases the risk of selection bias, pilot studies were not considered. For reasons mentioned above, we also excluded scores that looked at global processing in isolation. We did not include the Hanes (1998) Stroop task, because the original task (Stroop, 1935) was used to compare difference scores between a BDD and control group for reading words and naming colours. Thus, this was a measure of interference using neutral words and was not used to detect differences across groups in selectively attending to threat or disorder-related stimuli. To maintain homogeneity and reduce variance, we included only cognitive tasks and therefore neuroimaging and eye tracker studies were excluded from the analyses. Furthermore, we excluded the Feusner, Moller et al. (2010) study from our analyses involving central coherence, which used an Inverted Face Task, as it was not possible to convert their results to a similar metric to the other studies without making several assumptions that would have been difficult to justify. We were also unable to obtain the means and standard deviations of the BDD and control groups from Jefferies, Laws, Hranov, and Fineberg (2010) who also used an Inverted face Task to look at global-local processing, Thomas and Goldberg (1995) who utilised a video face distortion task to look at selective attention, Buhlmann, Wilhelm, et al. (2002) who used ambiguous scenarios to look at negative interpretation bias, and Moody et al. (2017) who used attractiveness ratings following presentations of high spatial frequency images to analyse local processing.

Statistical Methods

Cohen's *d* values used for the meta-analysis were obtained with the means, standard deviations, and the N from the control and treatment groups using an online Practical Meta-Analysis Effect Size Calculator (https://www.campbellcollaboration.org/effect-size-calculato.html). Because we wanted a representation of the population that included individuals with and without a diagnosis of BDD, the pooled estimate of the standard deviation was used. Using Comprehensive Meta-Analysis Version 2 (Borenstein, Hedges, Higgins, & Rothstein, 2005), we employed a multilevel model with effect sizes (level 1) nested within studies (level 2) and random intercepts. This allowed us to use multiple outcomes from any one study while correcting for correlated observations in the data. This also allowed us to account for multiple comparisons, in which the same control group was used in the Toh, Castle, and Rossell (2015), Toh, Castle, and Rossell (2017a), and Toh, Castle, and Rossell (2017b) studies. Forest plots were generated with Hedge's *g* values and 95% confidence intervals (CI), which were calculated for each individual study, providing an assessment of heterogeneity for local processing, interpretive biases, memory deficits, and selective attention. Given that for some measures, a higher score indicates greater cognitive deficit, such as selective attention tasks, whereas the opposite is true for other measures, such as many of the memory deficit tasks, the sign of the correlation coefficients were all transformed so that a positive value for *g* indicated a greater cognitive deficit in the BDD group. Heterogeneity was also assessed with the Q statistic, a measure of weighted squared deviations around the mean (Laird, Tanner-Smith, Russell, Hollon, & Walker, 2017), and the I^2 statistic, where a value of 0% indicates no observed heterogeneity, 25% low heterogeneity, 50% moderate heterogeneity, and 75% high heterogeneity (Higgins & Thompson, 2002). As recommended by Moreno et al. (2009), we used regression-based adjustments for publication bias available with Egger's regression intercept.

Results

Studies Included in the Meta-Analysis

The search resulted in 615 published studies listed on May 10, 2017. Of these, 569 studies were removed after reviewing the publication and abstract. Although included in the systematic literature review, twenty-three of the remaining forty-six were excluded from the meta-analysis leaving twenty-three studies. Omitted studies used case studies that did not include quantitative data (N=1), self-report measures of cognitive impairment rather than performance-based tests (N=1), electroencephalogram (EEG) technology (N=1), magnetic resonance imaging (MRI) technology (N=1), functional magnetic resonance imaging (fMRI) technology (N=6), eye trackers (N=6), the use of statistical approaches which were not readily interpretable in terms of effect sizes (N=1), studies where data could not be readily converted into effect sizes and/or further data could not be obtained (N=5), and pilot studies (N=1).

A total of 518 BDD participants and 534 control participants (all except 20 participants from the Stangier, Adam-Schwebe, Müller, and Wolter (2008) study were healthy controls) were included in the analyses. Due to the paucity of available research in this field using a single task as a measure of each construct, a variety of different tasks were selected to measure similar constructs across the four cognitive categories. See the **Table 2** for a summary description of the studies discussed below.

Local processing. Our analyses included difference scores on the Short Form Benton Facial Recognition Task (Benton & Van Allen, 1968) between a BDD and control group from the Buhlmann et al. (2004) study. When analysing results from the Deckersbach et al. (2000)

study, we only analysed scores from the RCFT organisation copy condition, and not the accuracy copy condition, since only the organisation condition could be used to assess local processing. Given that it is the inverted condition from the Famous Faces Task, a variation of the Inverted Face Task, that is said to tap into local processing, only differences between the BDD and control group on inverted trials were included from the Jefferies, Laws, and Fineberg (2012) study. We included reaction time (RT) and accuracy scores on local trials of the Navon task (Navon, 1977) and Embedded Figures Task (Witkin, 1971) to assess local processing differences between BDD and control groups from the Kerwin et al. (2014) study. Monzani et al. (2013) hypothesised a face inversion effect in the BDD group, thus we looked at differences in space and part RT's to the inverted face condition of the Inversion Task, as well as differences in accuracy and RT's on local trials of the Navon and Composite (aligned face condition) tasks. Toh et al. (2017a) used the Mooney Faces Task to compare global-local processing difference scores between a BDD, OCD, and healthy control group. To capture differences in local processing between the BDD and healthy control group, we analysed the accuracy difference scores between the upright and inverted conditions for the facial and object stimuli. In the current meta-analysis, the mean weighted effect size for local processing was found to be small (g =. 35, 95% CI= -.25: .95).

Interpretive biases. Buhlmann et al. (2004) administered an Emotion Recognition Task (Ekman & Friesen, 1975) and compared differences in the ability to accurately identify facial expressions. To assess interpretive biases toward ambiguous stimuli, we compared differences between BDD and control groups in the tendency to misidentify neutral facial expressions for fear-based emotions, which included disgust. Due to insufficient reporting of data and the

Table 2

Studies Included in Meta-Analysis with Results Depicting Only the Scores Used in the Analyses

Reference	Groups (BDD in bold)	N	Age Mean (*SD*)	Design & Diagnostic Criteria	Outcome Measures	BDD with Control *Cohen's d* (95% CI)
Buhlmann et al., 2002	**15 F, 1 M** Control: 13 F, 3 M	16 16	33.5 (*10.2*) 33.9 (*13.3*)	2 x 5 ANOVA with FNE, SIAS, SPS as covariates. Age and education similar but no direct comparison provided. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS	Emotional Stroop	BDD negative: .85 (.08: 1.67) BDD positive: 1.06 (.26: .91)
Buhlmann et al., 2004	**12 F, 8 M** OCD: 12 F, 8 M Control: 13 F, 7 M	20 20 20	32.7 (*11.3*) 31 (*10.5*) 32.9 (*11.7*)	One-way ANOVA. Matched for age and education. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS	BFRT ERT	BFRT: -.16 (.45: -.77) ERT: Neutral as disgusted: .00 (-.61: .61)

Buhlmann et al., 2006	**14 F, 4 M** Control: 15 F, 3M	18 18	28.39 (*9.22*) 29 (*8.32*)	Repeated Measures ANOVA & MANOVA & t tests. Matched for age & gender. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS	Emotion Recognition Questionnaire & Hypothetical Scenario (Other versus self-referent). Participants matched emotion with scenario.	Self-referent neutral as contemptuous: 1.19 (.43: .2.08) Self-referent neutral as angry: .70 (.02: 1.50) Self -referent neutral as disgusted:.63 (-.06: 1.39)
Buhlmann et al., 2008	**12 F, 3 M** Subclinical: 17 F, 3 M Control: 16 F, 4 M	15 20 20	24.8 (*12*) 3.6 (*5.3*) 3.8 (*5.2*)	One-way ANOVA. Matched for age and sex. BDD diagnosis confirmed with German version of SCID	IAT	Attractive Important: -.37(-1.06: .30) Attractive Competent: .80 (.16: 1.50)
Buhlmann et al., 2009	**20 F, 1 M** Subclinical: 18 F, 3 M Control: 18 F, 3 M	21 21 21	28.24 (*8.44*) 28.19 (*9.85*) 27.47 (*9.09*)	t-test & SEM analyses. Matched for age. BDD diagnosis confirmed with German version of SCID & symptom severity assessed by	IAT	Attractive Important BDD vs Control : .00 (- .61 : .61)

				German-version of BDD-YBOCS		
Buhlmann, Gleiß et al., 2011	**23 F, 11 M** Dermatologic: 21 F, 13 M Control: 19 F, 15 M	34 34 34	32.3 (*8.3*) 31.9 (*11.8*) 30.8(*10.6*)	2x2 mixed factor general linear model. Matched for age and sex. BDD diagnosis confirmed with German version of SCID & symptom severity assessed by German-version of BDD-YBOCS	ERT	Neutral as disgusted: .43 (-.04: .95) Neutral as angry: .24 (-.22: .72)
Buhlmann, Teachman et al., 2011	**24 F, 12 M** Dermatologic: 23 F, 13 M Control: 21 F, 15 M	36 36 36	33.4 (*6*) 32.3 (*11.7*) 30.5 (*10.3*)	ANOVAs. Matched for age, sex, and education. BDD diagnosis confirmed with German version of SCID & symptom severity assessed by German-version of BDD-YBOCS	GNAT	Attractive Important: .65 (.16: 1.15)

Buhlmann et al., 2014	**26 F, 9 M** Dermatologic: 22 F, 13 M Control: 21 F, 14 M	35 35 35	33.23 (*9.19*) 32.68 (*10.51*) 30.00 (*10.25*)	One-way & Repeated Measure ANOVA's. Matched for age & gender. BDD diagnosis confirmed with German version of SCID & FKS & symptom severity assessed by German-version of BDD-YBOCS	ODT FDT	ODT: .04 (-.43: .49) FDT: .37 (.85: -.10)
Deckersbach et al., 2000	**17 F, 1 M** Control: 16 F, 1 M	17 17	35.3 (*12.5*) 34.2 (*12.8*)	ANOVA. Matched for sex, age, education handedness, verbal intelligence. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS	RCFT CVLT	RCFT (accuracy organisation): .82 (1.62: .12) RCFT (percent recall): .93 (1.76: .20) CVLT (percent recall): .10 (.80: -.56)

Dunai et al., 2010	**9 F, 5 M** Control: 9 F, 5 M	14 14	32.9 (13.5) 32.8 (13.6)	One-way ANOVA & Repeated Measures ANOVA. Matched for sex & age. BDD diagnosis confirmed with BDD-DM (modelled after SCID) & symptom severity assessed by BDD-YBOCS	SS SWM SOC PR	SS: .80 (1.67: .02) SWM bse: 1.22 (.37: 2.27) SWM wse: .32 (-.41: 1.09) SWM ss: .54 (-.20: 1.39) SOC #psol: 1.15 (2.14: .30) SOC #perfsol: 1.28 (2.34: .41) PR: -.02 (.72: -.77)
Hanes, 1998	**5 F, 9 M** OCD: 4 F, 6 M Schizophrenia: 4 F, 10 M Control: 12 F, 12 M	14 10 14 24	32.2 (*7.6*) 34.1 (*8.0*) 35.9 (*10.7*) 42.5 (*15.8*)	Analysis of covariance controlling for age, premorbid IQ and depression. BDD diagnosis made based on DSM-IV criteria.	Stroop RCFT NTL CFT RAVLT	RCFT (recall): -.10 (.54: -.75) NTL: .95 (.26: 1.76) CFT: - .18 (.82: -.45) RAVLT (recall): .10 (.75: -.52) RAVLT (delayed recall): -.12 (.49: - .77)
Hartmann et al., 2015	**17 F, 6 M** Anorexia nervosa: 22 F, 2 M Control: 15 F, 7 M	23 24 22	29.74 (*13.59*) 25.80 (*10.1* 29.05 (*10.70*)	ANOVA's. Diagnoses made based on DSM-IV-TR criteria & symptom severity	GNAT	Attractive Competent: .12 (- .45: .72) Attractive Important: -.06 (-.65: .52)

				assessed by BDD-YBOCS. Only participants with a score of ≥20 included.		
Hübner, et al., 2016	**21 F, 11 M** Control:18 F, 14 M	32 32 32	33.1 *(11.00)* 31.5 *(8.8)* 37.9 *(9.5)* 33.8 *(11.1)*	ANCOVA. Matched for age, sex, education and marital status. Covaried for mean RT to unchanged standard stimulus. BDD diagnosis confirmed with German version of SCID & symptom severity assessed using the FKS (German version)	FDT	PCR: -.12 (-.61: .36) SDS: .23 (-.26: .73)
Jefferies et al., 2012	**7 F, 5 M** Control: 10 F, 6 M	12 16	30.08 (*8.92*) 35.80 (*12.10*)	Two-way Repeated Measures ANOVA. BDD diagnosis made	FEEST FFT	FFT Inverted Condition: 1.71 (.75: 3.10)

				by clinical interview (not specified) & symptom severity assessed using BDD-YBOCS		
Kerwin et al., 2014	**10 F, 28 M** Control: 10 F, 7 M	18 17	28.6 (*6.7*) 28.1 (*5.4*)	ANOVA & Chi Square with YBOCS-BDD, BABS as covariates; matched for age, sex, education, handedness, visual acuity. BDD diagnosis confirmed with BDD-DM & symptom severity assessed by BDD-YBOCS	EFT Navon	EFT RT: - .06 (-.77: .65) EFT Error: -.85 (-.12: -1.67) Navon Local RT: -1.25 (-.49: -2.14) Navon Local PC: -.61 (.10: - 1.39)
Lambrou et al., 2011	**32 F, 18 M** Art control: 34 F, 16 M Non-art control: 32 F, 18 M	50 50 50	27.7 (*6.9*) 26.2 (*6.5*) 26.3 (*5.1*)	MANOVA One-way ANOVA Matched for age & gender. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS. Only participants	a) Aesthetic Perceptual Sensitivity Tasks: Perceptual Understanding Perceptual Accuracy b) Aesthetic Emotional Sensitivity Tasks:	Aesthetic Perceptual Sensitivity Tasks: Self: 1.62 (1.09: .2.27) Self: 1.71 (2.34: 1.15) Aesthetic Emotional Sensitivity Tasks:

with a score of ≥20 included.	Pleasure: Perceptual Selection	Self: 1.32 (.82: 1.85)
	Disgust: Perceptual Selection	Self: .90 (1.39: .47)
	c) Aesthetic Evaluative Sensitivity Tasks:	Aesthetic Evaluative Sensitivity Tasks:
	Aesthetic Standard: Attractiveness Standard/Perceptual Selection	Self: 1.19 (.70: 1.71)
	Aesthetic Standard: Self-ideal/Personal Standards	Self: .28 (-.10: .68)
	Aesthetic Standard: Self Actual vs Ideal/Personal Standards	Self: 1.71 (1.15: 2.34)
	Aesthetic Standard: Self-perfect vs Ideal/Personal Standards	Self: 1.12 (.68: 1.62)

Monzani et al., 2013	**14 F, 11 M** Control: 16 F, 9 M	25 25	29.4 (*7.5*) 30.4 (*9.4*)	2 x 2 ANOVA. Matched for age, sex, and education. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS. Only participants with a score of ≥24 included.	Inversion Task Composite Task Navon Task	Inverted Face Space Accuracy: .02 (-.54: .58) Inverted Face Part Accuracy: .22 (-.32: .80) Inverted Face Space RT: -.18 (.37: -.75) Inverted Face Part RT: -.24 (.30: -.56) Composite Aligned RT: -.35 (.20: - .93) Composite Aligned PC: .20 (-.35: .77) Navon RT Local: -.02 (-.56: .54)
Reese et al., 2010	**14 F, 6 M** OCD: 10 F, 10 M Control: 13 F, 10 M	20 20 20	30.05 (*7.66*) 34.80 (*15.48*) 37.95 (*13.26*)	One-way ANOVA Matched for age, education, and severity of BDD & OCD symptom severity. BDD diagnosis confirmed with SCID & symptom severity assessed by BDD-YBOCS. Only participants	FSD DSD	FSD& DSD: Overall Symmetry Preference: .20 (-.41: .85)

				with a score of ≥20 included.			
Rossell et al., 2014	**9 F, 5 M** Control: 9 F, 5 M	14 14	33.1 (*13.4*) 32.9 (*13.4*)	Repeated Measures ANOVA and One-way ANOVA. Matched for sex, age, and education. BDD diagnosis confirmed with BDD-DM & BDDQ (self-rated) & symptom severity assessed by BDD-YBOCS	Emotional Stroop SVT COWAT	Stroop RT Body: .28 (-.45: 1.06) Stroop Inhibition Body Animal: (1.32: -.24) SVT True Body: .56 (1.39: -.18) SVT True Neutral: .39(1.19: -.35) SVT Unlikely body: .58 (1.42: -.16) SVT Unlikely Neutral: .45 (1.25: - .30) SVT False Body: .58 (1.42: -.16) SVT False Neutral: -.14 (.61: -.90) COWAT Phonological Fluency Letter F: .24 (1.01: -.47) COWAT Phonological Fluency Letter A: .20 (.95: -.54) COWAT Phonological Fluency Letter S: .06 (.80: -.68) COWAT Semantic Fluency Animal: .90 (1.85: .12)	.52

						COWAT Semantic Fluency Food: 1.35 (2.49: .47) COWAT Semantic Fluency Body: 1.09 (2.08: .26)
Stangier et al., 2008	**21 F** Disfigured: 21 F Non-disfigured: 21 F	21 19 20	35.19 (*13.25*) 39.32 (*14.66*) 34 (*12.78*)	One-way ANOVA. Matched for age and education. Covaried for rating of the unchanged target stimulus. BDD confirmed with German version of BDD-DM & symptom severity assessed by German version of BDD-YBOCS	FDT	BDD vs Non-Disfigured: FDT: Accuracy Change Ratings: 1.01 (1.76: .32) Proportion of correct responses: 1.32 (58: 2.20)
Toh et al., 2015	**76.2% F, 23.8% M** OCD: 73.7% F, 26.3% M Control: 61.9% F, 38.1% M	21 19 21	34.3 (11.9) 37 (10.4) 35.7 (10.6)	One-way ANOVA. Matched for age and IQ. BDD diagnosis confirmed by BDD-DM & symptom severity assessed by BDD-YBOCS	RBANS Immediate Memory Visuospatial Construction Language Attention Delayed Memory	RBANS: Immediate memory: 1.22 (2.08: .49) Delayed memory: .58 (1.25: -.04)

Toh et al., 2017a	**76.2% F, 23.8% M** OCD: 73.7% F, 26.3% M Control: 61.9% F, 38.1% M	21 19 21	34.3 (*11.9*) 37.0 (*10.4*) 35.7 (*10.6*)	One-way ANOVA & mixed between-within subjects ANOVAs. Matched for age, sex & IQ. BDD confirmed with BDD-DM & MINI500 & symptom severity assessed by BDD_YBOCS	MFT	Faces: .60 (1.22: -.01) Objects: .83 (1.46: .20)
Toh et al., 2017b	**76.2% F, 23.8% M** OCD: 73.7% F, 26.3% M Control: 61.9% F, 38.1% M	21 19 21	34.3 (*11.9*) 37.0 (*10.4*) 35.7 (*10.6*)	Between-within subjects & One-way ANOVA. Matched for age, IQ, & gender. BDD diagnosis confirmed by BDD-DM & symptom severity assessed by BDD-YBOCS	Emotional Stroop Eye Trackers	Stroop: RT BDD Positive: .41 (-.18: 1.06) RT BDD Negative: .70 (.06: 1.39)

Note: F=female; M=male; FNE= Fear of Negative Evaluation Scale; SIAS= Social Interaction Anxiety Scale; SPS= Social Phobia Scale; SCID= structured clinical interview; BDD threat= interference score for BDD threat words (e.g., *ugly*) on Emotional Stroop task; BDD positive= interference score for BDD positive words (e.g., *attractive*) on Emotional Stroop task; BDD-YBOCS= Yale Brown Obsessive-Compulsive Scale Modified for

BDD; BFRT= Benton Facial Recognition Task; ERT= Emotion Recognition Task; IAT= Implicit Association Task; GNAT= Go/No Go Association Task; ODT=Object Discrimination Task; FDT= Facial Discrimination Task; FKS= Fragebogen körperdysmorpher Symptome/Body Dysmorphic Symptoms Inventory; RCFT= Rey Complex Figures Test; CVLT= California Verbal Learning Task; SS= Spatial Span Task; SWM bse= Spatial Working Memory Task between search error; SWM wse= within search error; SWM ss= search strategy; SOC #psol= Stocking of Cambridge Task number of problems solved; SOC #perf sol= number of perfect solutions; SOC tmem= total moves in excess of the minimum; PR= Pattern Recognition task; ; NTL= New Tower of London Task; CFT= Category Fluency Task; RAVLT= Rey Auditory Verbal Learning Task ; FEEST= Facial Expression of Emotions Stimulus Test; FFT= Famous Faces Task; EFT=Embedded Figures Task; PCR= percentage of correct responses; SDS= standardised discrepancy score; FSD= Facial Symmetry Detection; DSD= Dot Symmetry Detection; BDD-DM= Body Dysmorphic Disorder Diagnostic Module; COWAT= Controlled Oral Word Association Task; SVT= Sentence Verification Task; RBANS= Repeatable Battery for Neuropsychological Status; MFT= Mooney Faces Task.

inability to obtain further information, the stimuli “anger” and “scared” were not included in the analyses. Buhlmann, Etcoff, and Wilhelm (2006) created both a self and other-referent scenario, with facial stimuli depicting neutral, angry, disgusted, and surprised expressions. Participants were then asked to rate whether the facial expressions represented neutral, angry, disgusted, surpised, contemptuous, fearful, or happy emotions. We analysed group differences in accuracy ratings of the self-referent scenario for misinterpretations of neutral facial expressions as disgusted, angry, and contemptuous. Due to insufficient reporting of data and the inability to obtain further information, the stimulus “fear” was not included in the analyses. Buhlmann, Gleiß, Rupf, Zschenderlein, and Kathmann (2011) presented participants with angry, disgusted, happy, neutral, sad, scared, and surprised facial expressions. We compared difference scores between the BDD and control group in the misidentification of neutral facial expressions for disgusted and angry expressions. Due to insufficient reporting of data and the inability to obtain further information, the stimulus “scared” was not included in the analyses.

In the Buhlmann, Teachman, Gerbershagen, Kikul, and Rief (2008) study, the Implicit Association Task was used to measure differences between a BDD, subclinical, and control group in RT toward pairing the words “Attractive-Important”, “Attractive-Meaningless”, “Self-Good”, and “Self-Bad”. Our analyses included difference scores between the BDD and control group on the “Attractiveness Implicit Association Task” outcome, which compared differences in overall implicit attractiveness beliefs. We chose to analyse implicit measures of attractiveness because it has been suggested that one of the driving forces behind appearance-related obsessions and compulsions is an over-valued belief about the importance of beauty (Fang & Wilhlem, 2015; Phillips, 2005; Veale, 2004). In a similar Buhlmann, Teachman, Naumann, Fehlinger, and Rief (2009) study, the Implicit Association Task was used to measure implicit self-esteem and attractiveness beliefs in a BDD, subclinical, and control group. Implicit beliefs concerning attractiveness were measured by pairing the words "Attractive-Important" and "Attractive-Competent". We analysed difference scores on the "Attractive-Important" and "Attractive-Competent" trials between the BDD and control group. Buhlmann, Teachman, and Kathmann (2011) used the Go/No-go Association Task to measure implicit attractiveness beliefs in a BDD, dermatology, and control group. The words "Attractive", "Beautiful", "Good looking", and "Pretty" were paired with the words "Important", "Meaningful", "Crucial", and "Significant". We analysed difference scores between the BDD and control group using the "Attractive Important Go/No-go Association Task" scores, which assessed overall implicit attractiveness beliefs. In a similar study, Hartmann et al. (2015) compared implicit attractiveness beliefs among a BDD, anorexia nervosa, and control group on the Go/No-go Association Task, which paired the words "Attractive-Important" and "Attractive-Competent". We analysed differences in RT scores on the trials that paired "Attractive-Important" and "Attractive-Competent" between the BDD and control group. In the current meta-analysis, the mean weighted effect size for interpretive biases was small (g=. 30*,* 95% CI=. 07: .54).

Memory deficits. Deckersbach et al. (2000) compared difference scores between a BDD and control group on the RCFT and the California Verbal Learning Test (Delis, Kramer, Kaplan, & Ober, 1987). We compared differences between BDD and control groups in the average immediate and delayed recall scores (percent recall) of the RCFT and percent recall on the California Verbal Learning Test. Dunai**,** Labuschagne, Castle, Kyrios, and Rossell (2010) compared differences between a BDD, OCD, and control group on measures of spatial working memory, including the Spatial Span Test (De Luca et al., 2003), the Spatial Working Memory Test (De Luca et al., 2003), which included conditions that assessed within search errors, between search errors, and search strategy, and the Stocking of Cambridge task (Shallice, 1982), which included conditions that assessed number of problems solved, number of perfect solutions, and total moves in excess of the minimum. In addition, a Pattern Recognition Test (De Luca et al., 2003) was used to look at differences in visual pattern recognition memory. We analysed difference scores between the BDD and control group in performance on all measures and task conditions. Hanes (1998) compared difference scores between the groups on several tasks used to assess memory impairment, including the Rey Auditory Verbal Learning Test (Rey, 1964), the New Tower of London Task (Shallice, 1982), the Category Fluency Task, and the RCFT. We analysed difference scores between the BDD and control group on the delayed recall (memory) condition of the RCFT, and to all conditions of the Rey Auditory Verbal Learning Test, New Tower of London Task, and Category Fluency Task. Rossell, Labuschagne, Dunai, Kyrios, and Castle (2014) measured differences in semantic memory between the BDD and control group using a Sentence Verification Task (Clark & Chase, 1972) and the Controlled Oral Word Association Test (Ruff, Light, Parker, & Levin, 1996), which was used to assess phonological and semantic fluency. We analysed difference scores on all conditions of the Sentence Verification Task and Controlled Oral Word Association Test. In the study by Toh et al. (2015), we analysed difference scores between the BDD and control group on the overall "immediate memory" and "delayed memory" subtests of the Repeatable Battery for the Assessment of Neuropsychological Status (Randolph, Tierney, Mohr, & Chase, 1998). In the current meta-analysis, the mean weighted effect size for memory deficits was medium (g =. 56, 95% CI= .26: .87).

Selective attention. For Emotional Stroop tasks, only RT and Stroop inhibition/interference conditions were conditions were included, since attention control theories predict that accuracy conditions produce no differences between treatment and control groups on these measures (Eysenck, Derakshan, Santos, & Calvo, 2007). To determine differences between the BDD and control groups in selective attention to disorder-relevant or threat stimuli, we selected the mean Stroop interference scores to the *BDD-negative* and *BDD-positive* word conditions used in the Buhlmann, McNally, Wilhelm, and Florin (2002) study, RT to the body condition and inhibition effect of the body-animal condition from the Rossell et al. (2014) study, and RT to the *BDD-negative* and *BDD-positive* masked word conditions from the Toh et al. (2017b) study.

We analysed difference scores between the BDD and healthy control group on the Object Discrimination Task and Facial Discrimination Task (Erwin et al., 1992) in the Buhlmann, Rupf, Gleiss, Zschenderlein, and Kathmann (2014) study. Similarly, difference scores on the Facial Discrimination Task between the BDD and the non-disfigured dermatological group from the Stangier et al. (2008) study were analysed. For the Lambrou, Veale, and Wilson (2012) study, the *object* and *other face* conditions were considered control groups, and the authors compared differences between BDD, art and design controls, and non-art and design controls. Thus, we analysed difference scores between the BDD and non-art control groups on all measures used to assess symmetry preference only for the stimuli depicting the participant's own face. Symmetry preference was considered indicative of enhanced discriminatory abilities and was based on the frequency of selection, heightened accuracy, and less discrepancy in discriminating among symmetrical stimuli. The conditions included were as follows: *Aesthetic Perceptual Sensitivity (perceptual understanding; perceptual accuracy); Aesthetic Emotional Sensitivity (perceptual selection pleasure; perceptual selection disgust); Aesthetic Evaluative Sensitivity (aesthetic standard: attractiveness standard/perceptual selection; aesthetic standard: self-ideal/personal* *standards; aesthetic standard: self-perfect vs ideal/personal standards)*. When analysing results from the Reese, McNally, and Wilhelm (2010) study, we selected the overall symmetry preference condition, which considered total symmetry preference, as measured by RT's and accuracy scores for dot arrays and facial stimuli of other people. In the current meta-analysis, the mean weighted effect size for selective attention was found to be medium (g =. 60, 95% CI= .26: .93). The studies used to examine local processing, interpretive biases, memory deficits, and selective attention are listed in **Table 3** and **Figures 2-5**.

Heterogeneity

For the pooled effect size analysis, Q was found to be significant (Q= 57.23, p<. *001*), indicating that the observed variability in effect sizes across all studies included in the meta-analysis was unlikely due to sampling error alone. Furthermore, the overall I^2 was found to be 61.56%, indicating a moderate to high degree of heterogeneity. These findings may be explained by differences among the varying outcomes, and as a result, we conducted subgroup analyses by calculating Q and I^2 for each cognitive category separately, finding moderate to high degrees of heterogeneity for the categories of local processing and selective attention (See **Table 4** for Q and I^2 values of all cognitive categories). Potential sources of heterogeneity are outlined in detail below.

Publication Bias

Funnel plots were also created for local processing, interpretive biases, memory deficits, and selective attention (see **Figures 6 to 9**). A p value of <. 05 was indicative of publication bias, as it suggests there is a significant relationship between the effect size and precision (Laird et al, 2017). When all studies were combined into a single analysis, there was no indication of publication bias, as evidenced by Egger's regression intercept (*ERI*=. 50, p=. 40.). Furthermore,

Table 3

Meta-Analysis Statistics Used in the Analyses for Each Cognitive Category

Studies and mean weighted values	Outcome Measure	*g* (95% CI)	Standard Error	Variance	Z	p
Local Processing						
Buhlmann et al., 2004	BFRT	-.16 (-.76: .45)	.31	.10	-.50	.61
Deckersbach et al., 2000	RCFT	.80 (.12: 1.48)	.35	.12	2.30	.02
Jefferies et al., 2012	FFT	1.66 (.81-2.51)	.43	.19	3.84	.00
Kerwin et al., 2014	EFT, Navon	-.68 (-1.35: -.00)	.34	.12	-1.97	.05
Monzani et al., 2013	Navon, Composite, IFT	- .05 (-.60: .50)	.28	.08	-.18	.86
Toh et al., 2017	MFT	.70 (.09: 1.31)	.31	.10	2.24	.02
Mean weighted values		.35 (-.25: .95)	.31	.09	1.14	.25
Interpretive Biases						
Buhlmann et al., 2004	ERT	.00 (-.61: .61)	.31	.10	.00	1.00
Buhlmann et al., 2006	ERT self-referent	.82 (.15: 1.49)	.34	.12	2.41	.02
Buhlmann et al., 2008	IAT	.21 (-.46: .88)	.34	.12	.61	.54
Buhlmann et al., 2009	IAT	.00 (-.59: .59)	.30	.09	.00	1.00
Buhlmann, Gleiß et al., 2011	ERT	.33 (-.14: .80)	.24	.06	1.37	.17
Buhlmann, Teachman et al., 2011	GNAT	.64 (.17: 1.11)	.24	.06	2.69	.01
Hartmann et al., 2015	GNAT	.03 (-.54: .60)	.29	.09	.10	.92
Mean weighted values		.30 (.07-.54)	.12	.01	2.52	.01
Memory Deficits						
Deckersbach et al., 2000	CVLT, RCFT	.50 (-.17: .1.18)	.34	.12	1.46	.14
Dunai et al., 2010	PR, SWM, SOC, SS	.82 (.06: 1.58)	.39	.15	2.12	.03
Hanes, 1998	RAVLT, NTL, CFT, RCFT	.13 (-.52: .78)	.33	.11	.38	.70
Rossell et al., 2014	COWAT, SVT	.51 (-.23: 1.24)	.38	.14	1.34	.18
Toh et al., 2015	RBANS	.88 (.26: 1.51)	.32	.10	2.76	.01
Mean weighted values		.56 (.26: .87)	.16	.02	3.61	.00
Selective Attention						
Buhlmann et al., 2002	Emotional Stroop	.93 (.22: 1.64)	.36	.13	2.56	.01
Buhlmann et al., 2014	ODT, FDT	.20 (-.26: .67)	.24	.06	.85	.39
Hübner et al., 2016	FDT	.18 (-.31: .66)	.25	.06	.72	.47
Lambrou et al., 2011	APS, AES, AEmS	1.22 (.79: 1.65)	.22	.05	5.58	.00
Reese et al., 2010	FSD, DSD	.20 (-.41: .80)	.31	.10	.63	.53
Rossell et al., 2014	Emotional Stroop	.39 (-.34: 1.11)	.37	.14	1.05	.29
Stangier et al., 2008	FDT	1.14 (.49: 1.79)	.33	.11	3.44	.00
Toh et al., 2017a	Emotional Stroop	.54 (-.06: 1.15)	.31	.09	1.76	.08
Mean weighted values		.60 (.26: .93)	.17	.03	3.50	.00

Note: BFRT= Benton Facial Recognition Task; RCFT= Rey Complex Figures Test; FFT= Famous Faces Task; EFT=Embedded Figures Task; IFT=Inverted Face Task; MFT= Mooney Faces Task; FSD= Facial Symmetry Detection; DSD= Dot Symmetry Detection; FDT= Facial Discrimination Task; ODT=Object Discrimination Task; AES= Aesthetic Evaluative Sensitivity; AemS= Aesthetic Emotional Sensitivity; APS= Aesthetic Perceptual Sensitivity; FDT PCR= Facial Discrimination Task proportion of correct responses; FDT ACR= FDT accuracy change ratings; ERT= Emotion Recognition Task; IAT= Implicit Association Task; GNAT= Go/No-go Association Task; CVLT PR= California Verbal Learning Test percent recall; RCFT PR= Rey Complex Figures Test percent recall; SWM bse= Spatial Working Memory Test between search error; SWM wse= within search error; SWM ss= search strategy; SOC #psol= Stocking of Cambridge Task number of problems solved; SOC #perf sol= SOC number of perfect solutions; SOC tmem= SOC total moves in excess of the minimum; SST= Spatial Span Test; COWAT= Controlled Oral Word Association Test; RAVLT= Rey Auditory Verbal Learning Task; NTL= New Tower of London Task; CFT= Category Fluency Task; SVT= Sentence Verification Task; RBANS= Repeatable Battery for Neuropsychological Status.

Study name	Outcome measure	Hedges' g and 95% CI
Buhlmann et al., 2004	BFRT	
Deckersbach et al., 2000	RCFT	
Jefferies et al., 2012	FFT	
Kerwin et al., 2014	EFT, Navon	
Monzani et al., 2013	Navon, Composite, IFT	
Toh et al., 2017a	MFT	

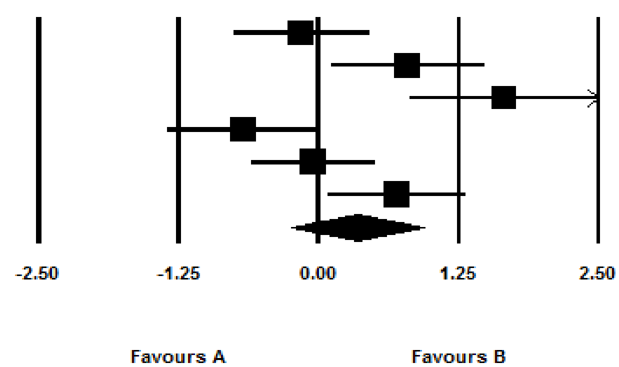

Figure 2. Forest plot displaying all local processing studies. BFRT= Benton Facial Recognition Task; RCFT= Rey Complex Figures Test; FFT= Famous Faces Task; EFT= Embedded Figures Task; IFT= Inverted Face Task; MFT= Mooney Faces Task.

Study name	Outcome Measure	Hedges' g and 95% CI
Buhlmann et al., 2004	ERT	
Buhlmann et al., 2006	ERT self-referent	
Buhlmann et al., 2008	IAT	
Buhlmann et al., 2009	IAT	
Buhlmann, Gleiß et al., 2011	ERT	
Buhlmann, Teachman et al., 2011	GNAT	
Hartmann et al., 2015	GNAT	

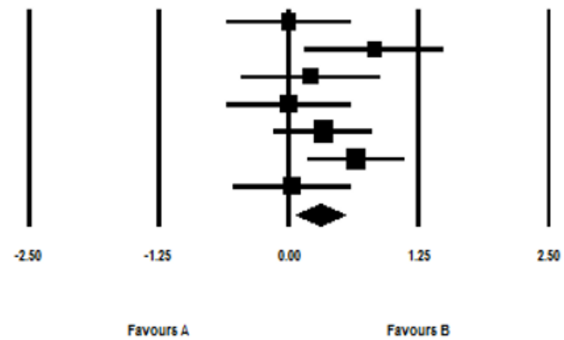

Figure 3. Forest plot displaying all interpretive bias studies. ERT= Emotion Recognition Task; IAT= Implicit Association Task; GNAT= Go/No-go Association Task.

Study name	Outcome Measure	Hedges' g and 95% CI
Deckersbach et al., 2000	CVLT, RCFT	
Dunai et al., 2010	PR, SWM, SOC, SS	
Hanes, 1998	RAVLT, NTL, CFT, RCFT	
Rossell et al., 2014	COWAT, SVT	
Toh et al., 2015	RBANS	

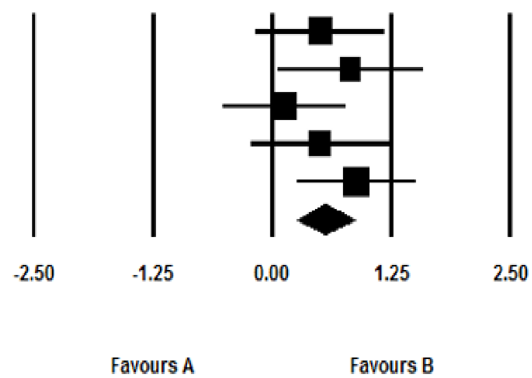

Figure 4. Forest plot displaying all memory deficits studies. CVLT= California Verbal Learning Test; RCFT= Rey Complex Figures Test; PR= Pattern Recognition Test; SWM= Spatial Working Memory Test; SOC= Stocking of Cambridge Task; SS= Spatial Span Test; RAVLT= Rey Auditory Verbal Learning Test; NTL= New Tower of London Task; CFT= Category Fluency Task; COWAT= Controlled Oral Word Association Test; SVT= Sentence Verification Task; RBANS= Repeatable Battery for Neuropsychological Status.

Study name	Outcome measure	Hedges' g and 95% CI
Buhlmann et al., 2002	Emotional Stroop	
Buhlmann et al., 2014	ODT, FDT	
Hübner et al., 2016	FDT	
Lambrou et al., 2011	APS, AES, AEmS	
Reese et al., 2010	FSD, DSD	
Rossell et al., 2014	Emotional Stroop	
Stangier et al., 2008	FDT	
Toh et al., 2017b	Emotional Stroop	

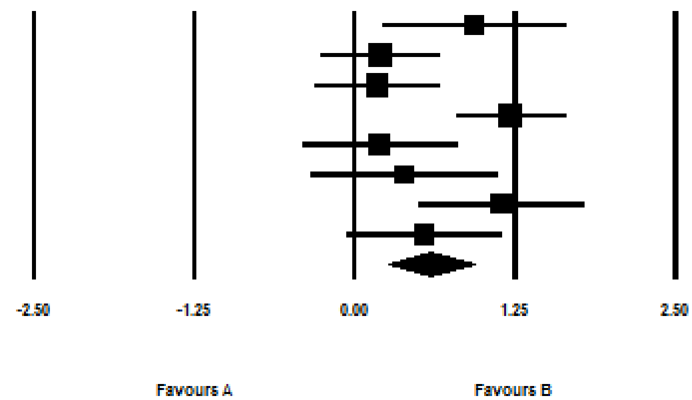

Figure 5. Forest plot displaying all selective attention studies. ODT= Object Discrimination Task; FDT= Facial Discrimination Task; APS= Aesthetic Perceptual Sensitivity; AES= Aesthetic Evaluative Sensitivity; AEmS= Aesthetic Emotional Sensitivity; FDT= Facial Discrimination Task.

Table 4

Analysis of Heterogeneity (Q; I^2) and Publication Bias (ERI) for Each Cognitive Category

Cognitive categories	Q-test [a]	I^2-test[a]	*ERI*[b]
Local Processing	25.35*	80.27*	9.49
Interpretive Biases	7.24	17.13	-1.87
Memory Deficits	3.22	.00	1.15
Selective Attention	19.33*	63.79*	-.32

Note: *p<.05; [a] indicates tests of heterogeneity; [b] indicates publication bias where *ERI*= Egger's regression intercept.

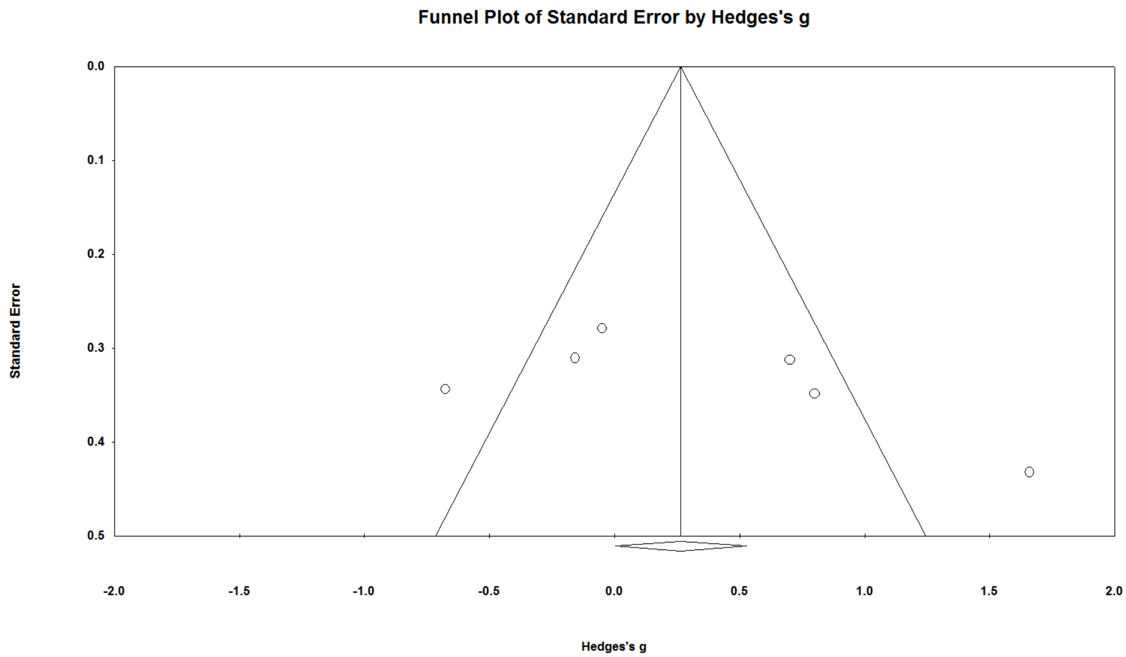

Figure 6. Funnel plot displaying all local processing studies.

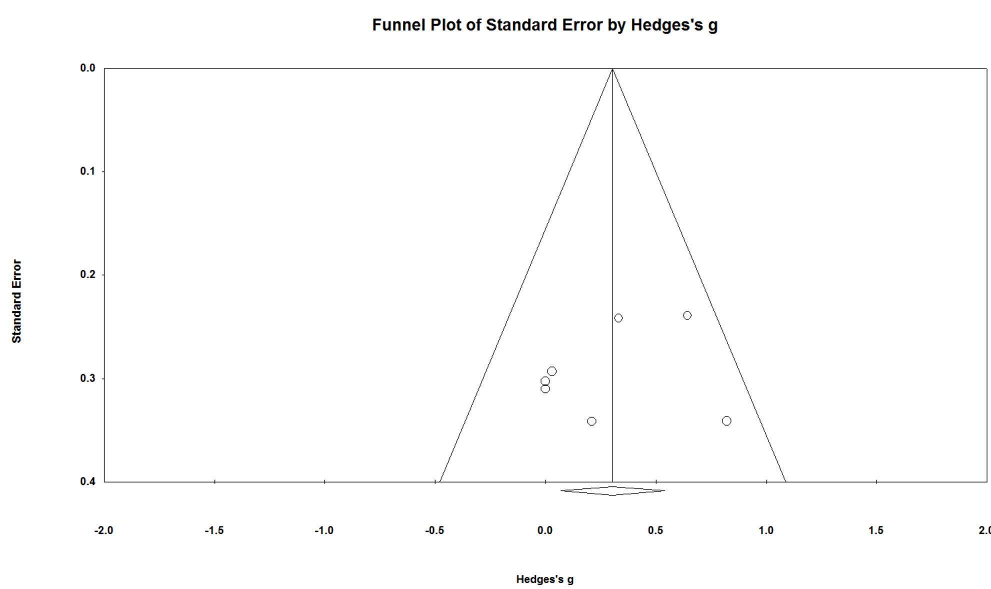

Figure 7. Funnel plot displaying all interpretive bias studies.

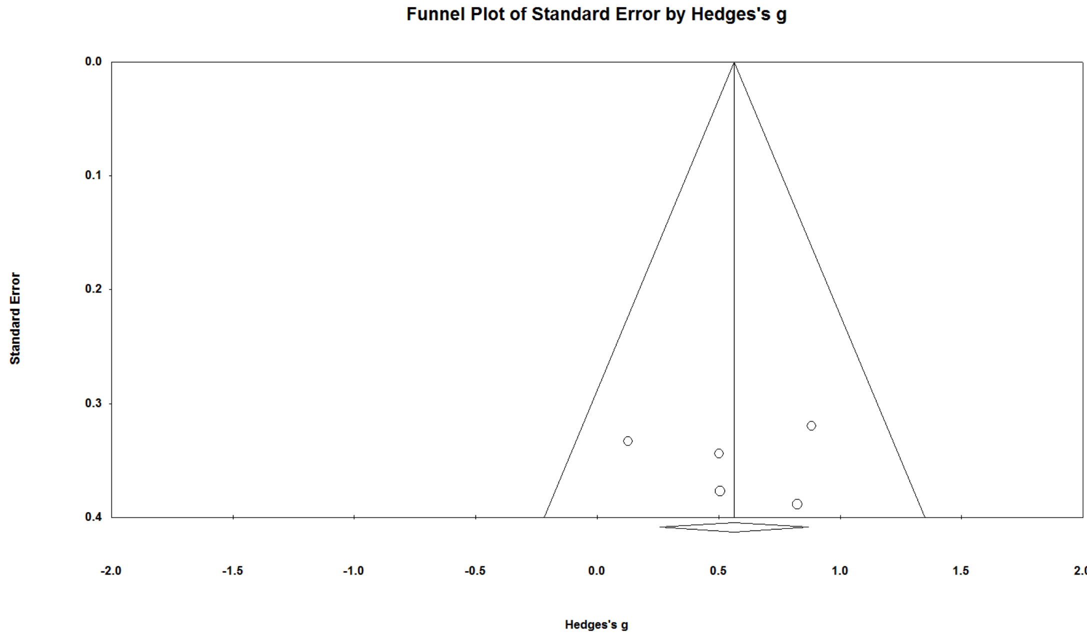

Figure 8. Funnel plot displaying all memory deficits studies.

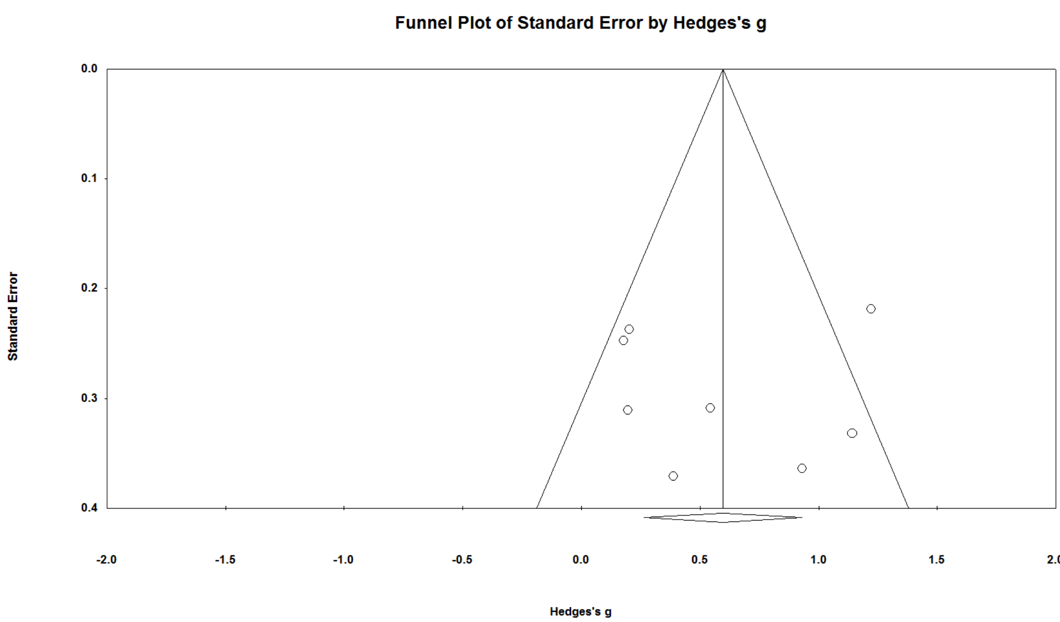

Figure 9. Funnel plot displaying all selective attention studies.

when studies were grouped on cognitive category and analysed separately, publication bias was not detected for any of the cognitive categories (See **Table 4** for *ERI* values across all cognitive categories).

Risk of Bias for Individual Studies

Based on the recommendations by the Cochrane review group, and biases relevant to non-intervention studies, biases related to individual studies (reporting, detection, and attrition biases) were considered (Lundh & Gøtzsche, 2008). Reporting bias, the biased selection of variables and results included in the analyses, could not be assessed, as protocols for studies were not available. Detection bias refers to systematic differences in how group outcomes are determined (Lundh & Gøtzsche, 2008). In all the included studies, the diagnosis was assessed with a diagnostic manual and/or clinical interview but only one of the studies included in the analyses (Hanes, 1998) reported blinding of the experimenter to participant diagnosis. Finally, attrition bias refers to systematic differences between groups due to participant dropout. Generally, drop out of participants was not explicitly stated apart from two studies (Hartmann et al., 2015; Kerwin et al., 2014).

Discussion

BDD is a complex disorder that can be hard to treat (Fang & Wilhelm, 2015), and further work is required to identify factors that may explain the symptomatology and can thus be targeted in interventions. Two models of BDD have emphasised the role of selective attention in exacerbating BDD symptomatology (Fang & Wilhelm, 2015; Veale, 2004). The more recent model has also suggested a role for central coherence, interpretive biases, and memory deficits.

Do Specific Cognitive Deficits Account for BDD Symptomology?

The twenty-three studies included in this meta-analysis provided eighty tests of four different categories of cognitive function. Three categories showed a significant difference between BDD and control groups, namely selective attention and memory deficits with medium effect sizes, and interpretive biases with a small difference. These results confirm the central role of selective attention highlighted in the Fang and Wilhelm (2015), Veale (2004), and Wilhelm, Phillips, Fama, Greenberg, and Steketee (2011) models and point to the importance of memory impairment and interpretive biases in explaining BDD psychopathology. Selective attention toward perceived threats, such as flaws in appearance, is hypothesised to be the trigger for feelings of anxiety and disgust, which then results in a range of behaviours to regulate emotion. Memory deficits are thought to account for inaccurate coding and recall of face or body stimuli. Moreover, abnormalities to memory function might interfere with problem-solving abilities (Newell & Simon, 1972), which could then exacerbate maladaptive coping strategies, such as seeking out cosmetic procedures or incessant mirror checking used to manage symptoms of anxiety. Moreover, the misinterpretation of ambiguous stimuli and overvaluation of the importance of beauty might also play an important role in the development and maintenance of BDD psychopathology. There were insufficient studies and power to separate the constructs of misinterpretation and overvaluation, and the relative contribution of these two constructs will require further analysis.

There was no support for abnormalities related to local processing in BDD, suggesting that this aspect of cognitive functioning is not useful to include in theories seeking to inform the development of interventions for BDD. However, null findings might be partly due to methodological challenges. For example, there appear to be some discrepancies concerning the predicted direction of the effect on facial recognition tasks (Buhlmann et al., 2004; Jefferies et al., 2012; Monzani et al., 2013), and some measures assessing central coherence assume that low scores on local processing necessitate high scores on global processing and *vice versa*. It is also possible that moderators play a role (i.e., subgroups within BDD populations may exhibit specific deficits), but addressing this question would require substantially more studies and those that include measurement of potential moderators that may influence cognitive functioning, such as medication status, severity of BDD, age, age of onset, and duration of BDD.

Analyses revealed significant heterogeneity for the categories of local processing and selective attention. Potential sources of heterogeneity might relate to differences in methodology. Three studies produced results outside the 95% CI and each is examined in turn. In the study by Jefferies et al. (2012), a methodology that taps into additional aspects of cognitive processing abnormalities might help to explain the large effect size observed. For example, given that the task used to measure local processing was made up of stimuli depicting images of famous people, and that celebrities are often perceived as being aesthetically appealing, it is possible that heightened symmetry detection for these images played a role in the superior processing of facial stimuli in the BDD group. Moreover, what follows is the overvaluation of outward appearance that may have also played a role in the superior processing of these images. Compared to controls, the BDD group may have tended to more readily attend to stimuli within their environment that relate to famous people perceived as attractive. Thus, the large effect size might be explained using a cognitive task that taps into various cognitive biases (local processing, selective attention, and interpretive biases), which may have resulted in superior facial recognition abilities.

Although some of the studies included in the local processing analyses controlled for the effects of medication (Deckersbach et al., 2000; Monzani et al., 2013) on cognitive performance, Kerwin et al. (2014) was the only study to exclude medicated BDD participants. It is possible that individuals with BDD who are not on medication have specific characteristics, such as greater symptom severity or lower socioeconomic status, that distinguish them from the medicated cohort, thereby reducing homogeneity of the sample. Another possible source of heterogeneity in this study involved the recruitment of participants from three different sources (dermatology, plastic surgery, and mental health clinics; posted advertisements; internet advertisements). Conversely, the other studies included under the local processing category recruited primarily through outpatient clinics or hospitals.

There were several important differences between the Lambrou et al. (2011) study and other studies included under the selective attention category. The main factor that distinguished the research by Lambrou et al. (2011) et al. from the other studies in this cognitive category was the inclusion of three separate measures of symmetry preference (i.e., selective attention) with various task conditions. Thus, it is possible that a broader construct of selective attention was captured by these measures. Furthermore, Lambrou et al. (2011) was the only study to use the BDD participant's own facial stimuli, detecting a response bias for self-referent information. This finding is consistent with the pilot study by Yaryura-Tobias et al. (2002) who found that compared to controls, the BDD group detected non-existing symmetry differences in facial stimuli and that this response-bias applied only to personally salient information. Thus, these results appear to suggest that the strength of the manipulation of cognitive tasks used to assess cognitive processing abnormalities in BDD may be influenced by the incorporation of self-referent stimuli. Furthermore, this may reflect an important underlying factor common across other cognitive deficits outlined in the Fang and Wilhelm (2015) BDD model. For example, although not included in the current meta-analysis due to the use of fMRI technology, Feusner, Hembacher, Moller, and Moody (2011) found that compared to controls, BDD participants were less able to deactivate the default mode network (DMN) when performing an executive task. The DMN is thought to be involved in self-referential thinking that is less active when engaged in tasks involving the use of executive functioning resources and most active during resting states (Whitfield-Gabrieli & Ford, 2012). Thus, Feusner et al. (2011) concluded that less deactivation during task performance in the BDD group might reflect the inability to inhibit self-related disorder-relevant thoughts. Furthermore, in the Buhlmann et al. (2006) study, the authors found that compared to the "other-referent" scenarios, the BDD group was more likely to misinterpret neutral facial expressions as contemptuous when given a self-referent scenario.

Limitations

There are several limitations that may influence the interpretation of results from the current meta-analysis. Firstly, many of the included studies failed to adjust for comorbid diagnoses of depression, eating disorders, and anxiety disorders and included participants who were receiving pharmacological interventions. This is problematic because it confounds the effects on cognitive performance with BDD symptomatology. However, due to the extreme shame and poor insight characteristic of individuals with BDD, they are often reluctant to participate in research, limiting the power of such studies, and making it difficult to adjust for other factors (Phillips, Didie, Feusner, & Wilhelm, 2008).

Furthermore, Stangier et al. (2008) did not include a healthy control group, thus we had to compare differences in selective attention between a BDD and a non-disfigured dermatological group. The authors also reported recruiting female participants exclusively, who may also have had lower levels of symptom severity. However, the results of the current meta-analysis did not detect significant heterogeneity with the inclusion of this study. Nevertheless, an important source of heterogeneity was that inclusion criteria for BDD varied among studies, (See **Table 2**).

The current meta-analysis included studies reporting inconsistencies in measuring central coherence. In the Buhlmann et al. (2002) study, the Benton Facial Recognition Task was used to measure global-local processing, and it was hypothesised that due to preferential processing of specific, local facial features, the BDD group would be less accurate at recognising faces, and low scores on this measure would be indicative of an affinity for local processing. This is inconsistent with hypotheses made when administering an Inverted Face Task and similar variations of this task, as researchers predicted that due to heightened local processing of facial stimuli, BDD participants would be better at recognising faces in an inverted position (Feusner, Muller, et al., 2010; Jefferies et al., 2012; Monzani et al., 2013). Furthermore, apart from the Navon Task, Embedded Figures Task, Composite tasks, and Mooney Faces Task, which provided independent scores on measures of global-local processing, the other cognitive tasks used to assess central coherence measured global-local processing on a continuum, with a single score representing these processes. In effect, cognitive measures, like the Inverted Face Task, assume that global-local processing is mutually exclusive. This appears to be problematic, as evidenced by the Kerwin et al. (2014) study which used the Navon task and found that compared to controls, the BDD group scored worse on both global and local trials. Thus, given that many of the tasks used to assess central coherence measured this construct continuously, we were unable to analyse central coherence and instead chose to focus on local processing in isolation. Consequently, it is possible that the non-significant effect observed in the local processing category could be attributed, in part, to inconsistencies in the methodology used to measure this construct. Further, the inclusion of a variety of different tasks used to measure similar constructs across the four cognitive categories might have confounded the overall findings reported in this meta-analysis. Upon the accumulation of more research in this field, future meta-analytic studies might consider using a stricter inclusion criterion for the cognitive tasks of interest.

It should also be noted that our Cohen's *d* estimates were calculated using the pooled standard deviation rather than the standard deviation of the control group. Thus, rather than evaluating group differences against natural variation in the cognitive tasks that are uncontaminated by variation resulting from BDD, estimates for the group differences will include more variability in cognitive tasks that come from both controls and BDD. In effect, in some sense, this confounds variability in the task with variability created by BDD. This conservative strategy will result in wider confidence intervals, which may have obscured some significant findings.

Finally, the current meta-analysis only included research published in English, which may have biased the results (Jüni, Holenstein, Jonathan, Bartlett, & Egger 2002). Furthermore, failure of most of the included research to blind experimenters to treatment groups, report attrition rates, and disclose all variables omitted from the analyses, may have led to a reporting of inaccurate effect sizes, thereby confounding the results. Future research should pay more attention to reporting possible sources of individual bias in BDD-related studies.

Future Directions

One of the issues encountered in conducting the meta-analysis was the lack of consistency in reporting results, and the heterogeneity of cognitive tasks utilised. Future research should incorporate reporting more consistent metrics, such as effect sizes, and indices required to calculate effect sizes (i.e., means and standard deviations) for all conditions of all cognitive tasks administered. For studies involving comparisons of groups (i.e., BDD *versus* control), it would be ideal for researchers to report on Cohen's *d*, as it provides a standardised difference between groups. To better assess individual biases across studies, future research should consider disclosing all questionnaires administered to participants, including those that were omitted from the analyses, blinding experimenters to treatment groups, and reporting attrition rates. It might also be advisable to test the proposed cognitive deficits outlined in the Fang and Wilhelm (2015) model before moving on to other constructs and to do this initially in non-clinical populations. The advantage of this approach is to determine whether there are suggestive differences that can profitably be followed up in a clinical population. It would also be useful to agree on a small group of important cognitive tasks to investigate, such that a critical mass of studies can accumulate and inform the area. For example, preliminary research appears to suggest that the inclusion of self-referent information when analysing group differences in cognitive task performance might be an important area warranting further investigation. Furthermore, to address the limitation of heterogeneity created as a result of including studies that evaluated BDD differently, future research might consider coming to a consensus on a uniform way of assessing symptomology. Given the small size of this field, it could be advisable to conduct a working party to discuss and agree on such issues, such as was achieved by the Obsessive-Compulsive Cognitions Working Party (Obsessions Compulsions Cognitions Working Group, 1997).

There has been much debate about which underlying cognitive processes are captured when administering the Emotional Stroop Task, with more recent theories suggesting that the task captures the parallel processing of irrelevant and relevant information (MacLeod, 1991). In effect, computerised dot-probe tasks have largely replaced the Stroop Task in recent literature, which includes versions comprised of emotionally salient words that are matched with neutral words.

According to Wells and Matthews (1994), the dot-probe paradigm is a more direct measure of attention bias than the Stroop paradigm, which has been used in the body image literature (Jin et al., 2018; Onden-Lim, Wu, & Grisham, 2012; Shafran, Lee, Cooper, Palmer, & Fairburn, 2007; Shafran, Lee, Cooper, Palmer, & Fairburn, 2008).

Given that Buhlmann et al. (2002) and Rossell et al. (2014) produced inconsistent results when using the Emotional Stroop task to assess selective attention in BDD populations, future studies using a dot-probe task might yield more consistent findings. Another potential advantage of using the dot-probe paradigm is that results can be compared with disorders that share similar underlying psychopathology, such as OCD and anorexia nervosa, where there is evidence of attention bias toward threatening stimuli (e.g., Amir, Najmi, & Morrison, 2009; Blechert, Ansorge, & Tuschen-Caffier, 2010).

Treatment implications. The results of this meta-analysis have implications for developing adjuncts to current treatment modalities for BDD. Implementation of cognitive bias modification techniques could be used to target specific maladaptive cognitions that maintain symptoms of BDD, as it has in related disorders. Cognitive bias modification has been used with some promise in anorexia nervosa (Cardi et al., 2015), where there is overvaluation of the importance of appearance (Hartmann et al., 2015), as there is in BDD. Attentional probe tasks have been used to retrain attention toward positive stimuli and to reduce negative interpretations of ambiguous information. Moreover, our findings are consistent with the existing preliminary evidence supporting a role of cognitive bias modification techniques in the alleviation of BDD symptomology (Fang, Sawyer, Aderka, & Hofmann, 2013; Premo, Sarfan, & Clerkin, 2016; Summers & Cougle, 2016). Our results suggest that a combination of cognitive bias modification for attention and interpretation (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2012) warrants further investigation. Furthermore, given that there is preliminary evidence for the efficacy of metacognitive therapy in alleviating symptoms of OCD (Moritz, Jelinek, Hauschildt, & Naber, 2010) and BDD (Rabiei, Mulkens, Kalantari, Molavi, & Bahrami, 2012), and that the mechanism of action involves increasing awareness of cognitive biases, the utility of Metacognitive Therapy in targeting BDD obsessions warrants further investigation. Cognitive remediation therapy could also be used to target memory impairment in BDD populations by strengthening executive functioning and mental flexibility (Fang & Wilhelm, 2015). Enhancing these processes may thereby serve to ameliorate problem-solving abilities and minimise reliance on BDD compulsions used to manage anxiety. Although traditionally, cognitive remediation therapy has been used as a treatment for psychotic disorders, brain injuries, and attention deficit hyperactivity disorder, a 2014 review by Tchanturia, Lounes, and Holttum found that this therapy was a promising new development in the treatment of anorexia nervosa and OCD. These results provide further justification for cognitive remediation therapy as an adjunct to traditional BDD treatment modalities.

Examination of the effectiveness of these approaches can also be used to inform the development of existing models (Craig et al., 2008). Given the difficulty of engaging BDD populations in treatment and research, the most efficient way to test and modify promising models may be to control for any foreseeable variables, to better establish any unknown group differences. Due to the paucity of existing research in this field, it might also be beneficial to first test specific aspects of this model in non-clinical populations who have significant concerns about appearance prior to evaluation in BDD populations. Results from these studies could then be used to inform treatment studies, which could later inform how models might be modified to reflect a greater understanding of the specific underlying cognitive and personality structures that maintain symptoms.

Conclusions

The results of the current meta-analysis suggest that specific cognitive processing abnormalities involving selective attention, interpretive biases, and memory deficits may play a key role in the development and maintenance of BDD psychopathology. Although local processing failed to produce significant differences between BDD and control groups, these results should be interpreted with caution. Some explanations for this null finding include possible moderators and methodological challenges. It is also worth noting that brain-imaging studies used to investigate this construct were not included in our analyses. Furthermore, given that selective attention produced the largest effect size difference between the BDD and control groups, researchers and clinicians might consider the use of dot-probe tasks to investigate selective attention in DC populations. The next few chapters now turn to methodology and two important risk and maintaining factors highlighted earlier: selective attention and perfectionism.

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Chapter 4:

Measures[3]

[3] Additional content from this chapter appears in the Measures section of **Chapter 7**, which has been published in *Body Image* (See **Chapter 9 Appendix A**; Johnson, Egan, Andersson, Carlbring, Shafran, & Wade, 2019)

To reduce repetition, measures used consistently across **Chapters 5, 6,** and **7** are described in detail in this section. Therefore, unless a measure is not present in this chapter (i.e., where it is unique to the individual study), **Chapters 5-7** will only report on internal reliability for the specific sample used in that study. The measures were selected because they provided psychometrically sound assessments of the constructs of interest (outlined in detail below).

Selective Attention

Dot-Probe Task

Developed by MacLeod, Mathews, and Tata (1986), the dot-probe paradigm is one of the most widely used measures of selective attention, in which attention is either allocated toward or averted away from the target stimuli. In traditional versions of the dot-probe detection task, two words are presented to opposite ends of the screen, in which one of the words is replaced by a dot. The participants are instructed to detect the dot as quickly as possible by pressing the corresponding key (Salemink, van den Hout, & Kindt, 2007). Participants displaying higher degrees of psychopathology are expected to respond faster to the dots replacing the target stimuli (Salemink et al., 2007). However, one of the limitations of this task is its inability to decipher whether attention bias reflects vigilance for (i.e., orientation) or difficulties disengaging from the target stimuli (Onden-Lim, Wu, & Grisham 2012). To bolster validity by exploring which subsets of visual attention predominate, Koster, Crombez, Verschuere, and De Houwer (2004) adapted the dot-probe task by incorporating trials comprised of neutral word pairs, enabling the differentiation of vigilance and disengagement. While the anxiety disorder literature postulates that anxious people do not demonstrate vigilance toward the target stimuli, but rather, display difficulties disengaging attention (Koster et al., 2004), the eating disorder literature has found evidence for both selective attention processes (Oldershaw et al., 2011).

Reliability and validity. While there has been speculation about the reliability of dot-probe tasks (Schmukle, 2005), Price et al. (2015) have made some recommendations for bolstering the consistency of the dot-probe paradigm. For example, to minimise unexplained variability, the authors suggested using horizontal stimulus presentations (i.e., stimuli presented to the left or right of the screen) in replace of vertical presentations (i.e., stimuli presented on the top and bottom of the screen). Furthermore, while it is of interest for researchers to calculate orientation and disengagement scores, compared to the disengagement scores, Price et al. (2015) found that the congruency trials (i.e., incongruent-congruent trials) had greater reliability, thus concluding that it is ideal to include these trials in dot-probe research. While the authors recognised that it is not always feasible, it was suggested that the dot-probe task should be administered multiple times over the course of a study, finding that two assessment points produced marginally more reliable results than one (with optimal reliability scores detected after five assessment periods). Moreover, while there are some discrepant findings, there is a substantial amount of literature supporting the validity of the dot-probe task, as evidenced by adequate differentiation of non-anxious from anxious participants (Bar-Haim et al., 2007; Price et al., 2015).

Current dot-probe task. The dot-probe task used in this research was developed by the author of this thesis, as no suitable format of dot-probe existed that was pertinent to DC and consistent with the resources available. The chosen words incorporated stimuli from the four published studies that used dot-probe and Emotional Stroop tasks to measure selective attention biases in DC (with a focus on BDD psychopathology) and BDD populations (Buhlmann, McNally, Wilhelm, & Florin 2002; Onden-Lim et al., 2012; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014; Toh, Castle, & Rossell, 2017). Additional stimuli were chosen based on common underlying themes related to these words. To establish whether there were attention biases for target stimuli and to disambiguate between biases in vigilance toward DC-target words (i.e., orientation) and biases in disengaging from stimuli, this research computed congruency, orientation, and disengagement scores (Koster et al., 2004; Salemink et al., 2007). Congruency scores were calculated by dividing the incongruent trials (where the dot follows the neutral word in a target-neutral word pair presentation) by the congruent trials (where the dot follows a target word in the target-neutral word pair presentation), in which a larger value indicated a larger discrepancy and a shorter RT to the DC-target words. To calculate orientation scores, mean RT to the neutral word pair (neutral-neutral word pair presentations) were divided by mean RT to the congruent trials. Orientation toward target word stimuli is captured by faster reaction times to the congruent trials compared to the neutral trials (Salemink et al., 2007). In effect, a larger value indicated a larger discrepancy and a shorter RT to the DC-target words. To calculate disengagement scores, mean RT to the neutral word pair trial presentations were divided by mean RT to the incongruent trials. Difficulties disengaging from target word stimuli are captured by a slower response to the incongruent trials compared to the neutral trials (Salemink et al., 2007). Thus, a smaller value indicated a smaller discrepancy and a longer RT to the DC-target words. In sum, three possible congruency scores (i.e., *congruency body, congruency negative, and congruency positive*), orientation scores (i.e., *orientation body, orientation negative,* and *orientation positive*), and disengagement scores (i.e., *disengagement body, disengagement negative,* and *disengagement positive*) were generated.

In this version of the dot-probe task, participants were required to read the instructions prior to receiving the twelve practice trials with paired neutral words. We presented participants with size twelve Ariel font words (a measured font height of 18mm) displayed in upper- and lower-case black letters (white background). Before each trial, a cross appeared in the middle of the screen to align the participant gaze, followed by a matched target and neutral word to the left and right of the screen. A dot then appeared to the left or right of the screen and participants were required to hit the corresponding "Z" or "/" key. We presented the fixation cross for 500 milliseconds (ms), which was followed by a blank screen with a presentation of 200ms. Moreover, we presented the word pairs and dots for 500 ms, with trial intervals fixed at 500 ms. Two blocks were generated, with the first block providing the twelve practice trials using city names. The second block contained two trials of buffer words (i.e., objects), followed by160 experimental word trials. Each word pair was presented eight times with four possible word combinations twice repeated, resulting in 160 experimental trials. The word trials were randomised using an algorithm that ensured the same word set was not sequentially presented and that the correct key response (i.e., "Z" as left and "/" as right) was limited to three successive responses in the block of trials. A dot probe-task was used throughout **Chapters 5-7 (**See **Appendix B** and **C** for the complete lists of dot-probe stimuli).

Demographics

Demographic information obtained included sex, race, date of birth, as well as family and personal mental health history (see **Table 1**).

Dysmorphic Concern

Dysmorphic Concern Questionnaire (DCQ)

Description. The Dysmorphic Concern Questionnaire (DCQ; Oosthuizen, Lambert, & Castle, 1998) is a seven-item measure, with each item scored on a four-point scale from 0 ("not at all") to 3 ("much more than most people"), where a higher score indicates greater concerns. The DCQ captures a variety of body image concerns, including symptomology consistent with BDD (i.e., appearance-related concerns) and olfactory reference syndrome (i.e., body

Table 1

Demographic Information Requested

Demographic information	Response Option
Date of Birth	Text Entry
Age	Text Entry
Diagnosis of BDD	Multiple Choice (yes/no)
Other Mental Health Diagnoses	Multiple Choice (yes/no); if yes: 1. Depression 2. Anxiety 3. PTSD 4. Schizophrenia 5. OCD 6. ED 7. Substance Abuse Disorder 8. Panic Disorder 9. Bipolar Disorder 10. Other (text entry)
Gender	Multiple Choice 1. Male 2. Female 3. Other
Height (cm)	Text Entry
Weight (kg)	Text Entry
Race	Multiple Choice 1. Caucasian 2. Asian 3. African 4. Other (text entry)
Family Mental Health Diagnoses	Multiple Choice (yes/no); if yes: 1. Depression 2. Anxiety

3. PTSD
4. Schizophrenia
5. OCD
6. ED
7. Substance Abuse Disorder
8. Bipolar Disorder
9. BDD
10. Other (text entry)

Note. BDD= body dysmorphic disorder; PTSD= post-traumatic stress disorder; OCD= obsessive-compulsive disorder; ED= eating disorder.

malfunction-related concerns; Monzani et al., 2012). However, in a twin study comprised of 185 participants, only six of those scoring above the clinical cut-off (≥11) had absent or minimal appearance-related concerns (Monzani et al., 2012). The authors concluded that high scores on the DCQ were related more closely to symptoms characteristic of BDD as compared to disorders comprised of body malfunction preoccupations (i.e., olfactory reference syndrome and/or health anxiety). Further, high scores on the DCQ (≥17) are thought to adequately distinguish individuals with BDD from eating disorders (Monzani et al., 2012).

In **Chapter 7**, any participants who scored a one or above on item 1 "*Have you ever been very concerned about some aspect of your physical appearance*" of the DCQ administered at Time 1, were prompted to respond to the following question: "*Which aspect(s) of your appearance concern you? (e.g., nose, skin, hair, muscles, etc.)*". Additionally, for all DCQ measures administered following the completion of pre-treatment measures, the DCQ instructions were modified to read "Please select the number that best corresponds to your agreement with each statement below. These questions refer to your experiences over the **PAST WEEK**". The DCQ was used throughout **Chapters 5-7** (See **Appendix D** for the original and modified versions of the DCQ).

Reliability and validity. The DCQ is thought to be a reliable measure of body image concern that can be used in both clinical and non-clinical populations, with internal consistency coefficients ranging from .73-.88 (Jorgensen, Castle, Roberts, & Groth-Marnat, 2001; Mancuso, Knoesen, David, & Castle, 2010; Monzani et al., 2012; Oosthuizen et al., 1998; Schieber, Kollei, de Zwaan, & Martin, 2018; Senín-Calderón et al., 2017; Stangier, Janich, Adam-Schwebe, Berger, & Wolter, 2003). Construct validity was further supported by examining mean DCQ difference scores between BDD and non-BDD diagnosed participants, finding that the BDD participants scored significantly higher on the DCQ. Convergent validity was supported by entering several correlated variables (DCQ total score as the dependent variable) into a hierarchical multiple regression, finding that only the Body Dysmorphic Disorder Examination scale added to the predictive power of the equation (Jorgensen et al., 2001). Stangier et al. (2003) administered the DCQ to a BDD, non-disfigured dermatology, and disfigured dermatology group. It was found that compared to the controls, the BDD group endorsed higher levels of DC. Moreover, when compared against the Body Dysmorphic Disorder-Diagnostic Module and Yale Brown Obsessive-Compulsive Scale modified for BDD, the authors detected high sensitivity of the DCQ when used in conjunction with assessments of defect severity. A cut-off score of ≥11 on the DCQ was considered an effective screening tool for BDD (100% sensitivity).

Similarly, Mancuso et al. (2010) administered the DCQ to a group of BDD and undergraduate participants with body image disturbance, finding that a cut-off score of ≥11 produced a high sensitivity (89%) and specificity (95%) for a likely BDD diagnosis. Discriminate validity of this measure was also assessed among the groups, finding higher levels of DC in the BDD group after controlling for the effects of social anxiety and depression (Mancuso et al., 2010). Schieber et al. (2018) also found evidence for convergent validity, in which DCQ scores were positively correlated with subjective impairment and the number of perceived flaws. The authors concluded that their findings provided normative DCQ data, which promotes valid interpretations of this measure that can be used in clinical settings.

Factor structure. Using a principal component analysis, Oosthuizen et al. (1998) administered the DCQ to Australian psychiatric inpatients, concluding that a one-factor structure explained most of the variance. Jorgensen et al. (2001) recruited a similar population of sixty-five psychiatric inpatients. To address the limitations of the data reduction technique used by Oosthuizen et al. (1998), the authors utilised a maximum likelihood factor analysis of the DCQ. After removing item 5, Jorgensen et al. (2001) reported a one-factor model produced optimal results, with factor loadings ranging from fair (.40) to good (.87).

Drawing upon a twin study comprised of 185 participants, Monzani et al. (2012) also reported a one-factor structure with factor loadings ranging from .59 -.84. Predicated on previous research, clinically significant DC was evidenced by a cut-off score of ≥11 (Monzani et al., 2012). Using exploratory and confirmatory factor analyses, Senín-Calderón et al. (2017) administered the DCQ to a Spanish population of 966 participants (Senín-Calderón et al., 2017), reporting that the DCQ produced a one-factor structure with factor loadings ranging from .54-.83. Convergent validity was evidenced by significant, positive correlations among the DCQ, IMAGEN subscales (various constructs relating to dissatisfaction), and Body Dysmorphic Disorder Examination Self-report measure (Senín-Calderón et al., 2017). In a study by Schieber et al. (2018) the DCQ was administered to a representative sample of a German population. The authors used exploratory factor analyses, in which a one-factor structure was supported with factor loadings ranging from .57 - .82. These findings were consistent with Monzani et al. (2012) and Senín-Calderón et al. (2017), who also found item 3 (relating to preoccupations with bodily malfunction) to have the lowest factor loading.

Perfectionism

Frost Multidimensional Perfectionism Scale (FMPS)

Description. The FMPS (Frost, Marten, Lahart, & Rosenblate, 1990) is comprised of thirty-five items that make up six dimensions of perfectionism: Doubts about Actions, Concern over Mistakes, Personal Standards, Parental Criticism, Parental Expectation, and Organisation. The Doubts about Actions subscale is characterised by marked indecisiveness regarding the quality of a person's actions and capabilities (Burgess, Frost, Dibartolo, Flett, & Hewitt, 2016). The Concern over Mistakes subscale is characterised by the overvaluation about the importance of making mistakes and misattributing mistakes as a failure. The Personal Standards subscale captures the extent to which individuals set unusually high-performance standards (Burgess et al., 2016). The Parental Criticism subscale measures the extent to which individuals believe that their parents negatively criticise them. The Parental Expectation subscale is characterised by the individual's perception that their parents have a propensity to place uncommonly high standards that the individual is expected to live up to (Burgess et al., 2016). Higher scores on each subscale reflect greater perfectionism.

Based on the results from Frost et al. (1990) described below and consistent with a BDD study by Buhlmann, Etcoff, and Wilhelm (2008), the contents of this thesis excluded the Organisation subscale from the analyses. To capture self-directed perfectionism, the Parental Criticism and Parental Expectation subscales were also excluded. The FMPS was used throughout **Chapters 5-7 (**See **Appendix E** for the condensed version of the FMPS).

Reliability and validity. There is some evidence supporting the reliability of the FMPS, with internal consistency coefficients ranging from .77- .93, with an overall reliability score of .90 for the total perfectionism scale (Frost et al., 1990). There is also some evidence supporting the validity of the FMPS. In their 1990 study, Frost and Marten recruited a non-clinical population with varying degrees of perfectionism, finding that compared to the low scoring group, the high perfectionism group performed worse on an evaluative task, negatively criticising their performance. Drawing upon both community and clinical samples, convergent validity of the FMPS with other perfectionism measures have also been demonstrated (Frost et al., 1990; Purdon, Antony, & Swinson, 1999). Validity was further supported in a later study by Frost et al. (1997), in which compared to the low scoring group, individuals scoring high for concern over mistakes ruminated about and overestimated the importance of making mistakes. Furthermore, the high scoring group also endorsed greater concern about being negatively evaluated by others.

Factor structure. Following reliability analyses of a pool of pre-existing and novel items, the FMPS was reduced from sixty-seven to forty-seven items, which were explored using principal-component factor analysis in a female undergraduate population (Frost et al., 1990). After removing items with the least amount of variance, a six-factor solution was derived. Most of the subscales were found to be highly correlated, apart from the Organisation subscale, which did not load on to the perfectionism construct (Frost et al., 1990). Moreover, the multidimensional structure of perfectionism was further supported by Frost, Heimberg, Holt, Mattia, and Neubauer (1993), in which the six factors were related to various aspects of psychopathology. For example, the Concern over Mistakes and Doubts about Actions subscales were found to be associated with psychopathology consistent with OCD. Using confirmatory factor analyses, the six-factor structure of the FMPS was further supported by Parker and Adkins (1995) who recruited 278 college students and Parker and Stumpf (1995) who recruited 855 academically gifted children. Conversely, some researchers have found evidence for a two, three, and four-factor structure of the FMPS (Burgess et al., 2016; Hawkins, Watt, & Sinclair, 2006).

Mood and Stress

Short-form version Depression Anxiety Stress Scales (DASS-21)

Description. The DASS-21 is a condensed version of Lovibond and Lovibond's (1995) long form DASS scale. It is made up of twenty-one items, with each item scored on a four-point scale from 0 "did not apply to me at all" to 3 "applied to me very much, or most of the time". While not a diagnostic tool, the DASS-21 is used to screen for depression, anxiety, and stress and can be used by individuals who are not trained in mental health. Unlike most measures of depression, the DASS-21 does not assess for somatic complaints, as research has shown that symptoms such as sleep, appetite, and energy dysregulation did not differentiate individuals with and without depression (Yıldırım, Boysan, & Kefeli, 2018). Higher scores on each subscale indicate greater psychopathology.

The current study investigated the use of the Depression, Anxiety, and Stress subscales as a means of covarying for these effects and investigating whether the treatment paradigm engendered secondary treatment gains. The DASS-21 was used throughout **Chapters 5-7** (See **Appendix F)**.

Reliability and validity. There is a substantial body of evidence confirming the reliability of the DASS-21 subscales, with internal consistency coefficients ranging from .89-.96, .83-.92, and .82-.97 for depression, anxiety, and stress respectively (Crawford & Henry, 2003; Page, Hooke, & Morrison, 2007; Ronk, Korman, Hooke, & Page, 2013). Crawford and Henry (2003) recruited a representative adult community sample of 1, 771 participants, finding support for convergent validity, whereby the DASS-21 Depression and Anxiety subscales correlated strongly with other well-known measures of these constructs. The authors further reported adequate discriminant validity. The Anxiety and Depression subscales have been shown to adequately differentiate anxious and depressed patient groups, providing evidence for contruct validity (Antony et al., 1998; Brown et al., 1997; Clara et al., 2001; Page et al., 2007). Sukantarat, Williamson, and Brett (2007) also found evidence for concurrent validity. Correlations ranged from moderate to good between the Hospital Anxiety and Depression scale and the DASS-21 subscales, which were maintained at three- and nine-month follow-up. Moreover, Sukantarat and colleagues (2007) recruited fifty-one inpatients from an intensive care unit, finding support for criterion validity, in which pooled data produced strong correlations between the Depression and Stress subscales at each time point. Concurrent validity was also supported in a study by Ng et al. (2007) who recruited 388 inpatients with a myriad of psychopathology. The DASS-21 was found to be significantly associated with the Clinical Global Impressions scales, Mental Health Questionnaire, and Health of the Nation Outcome Scales, and all subscale scores were significantly decreased from pre to post-treatment (Ng et al., 2007). Validity of the DASS-21 was also evidenced by accurate sensitivity in detecting anxiety and depression among a population of spinal cord injury (Mitchell, Burns, & Dorstyn, 2008) and geriatric patients with chronic pain conditions (Wood, Nicholas, Blyth, Asghari, & Gibson, 2010). Consistent with these findings, Ronk et al. (2013) recruited a normative sample of 10,000 outpatients and inpatients, finding high sensitivity of the DASS-21 in detecting treatment outcomes. Moreover, Yıldırım et al. (2018) investigated the psychometric properties of the DASS-21 Turkish version across controls and inpatients with diagnoses of depression and anxiety. The authors found evidence for concurrent validity, whereby compared to controls, patients with depressive and anxiety disorders scored significantly greater on all three DASS-21 subscales. Convergent validity was also evidenced by significant correlations between the DASS-21 and several measures of psychopathology (Yıldırım et al., 2018).

Factor structure. The three-factor structure of the DASS-21 has been supported by several studies. Drawing upon a student population, Lovibond and Lovibond (1995) utilised confirmatory factor analyses to compare a two and three-factor model, finding that the latter produced optimal results. These findings were later replicated by Brown et al. (1997) in individuals with anxiety disorders. In their 2003 study, Crawford and Henry performed a cross-sectional, correlational, and confirmatory factor analysis, finding that the three-factor structure provided the best fit (CFI=.93). In a similar study, Henry and Crawford (2005) recruited a non-clinical sample comprised of 1794 participants and used confirmatory factor analyses to test the validity of the three-factor structure. Results from this study supported Lovibond and Lovibond's (1995) method of selecting items for the DASS-21. Studies drawing upon normative samples have also used factor analyses to confirm the tripartite structure of the DASS-21 (Asghari, Saed, & Dibajnia, 2008; Daza, Novy, Stanley, & Averill, 2002; Mellor et al., 2015; Sinclair et al., 2012).

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Chapter 5

Dysmorphic Concern: The Impact of Selective Attention and its Comparative Associations with Perfectionism[4]

[4] This was the first draft of this paper, which received feedback from reviewers and was subsequently modified and updated in **Chapter 6.** Additional content from the statistical analyses section can be found in **Chapter 4**. The full list of dot-probe stimuli used in this study can be located in **Chapter 9** in **Appendix B**.

Abstract

There is a paucity of research exploring the underlying aetiological mechanisms contributing to dysmorphic concern (DC). In the present study, we used a dot-probe task to assess attention bias to the body and appearance-based target stimuli, one of the postulated psychopathological mechanisms contributing to DC. Limited research has examined associations between a dot-probe task and DC. Informed by current theories, we hypothesised that both attention bias to target word stimuli and perfectionism would be significantly associated with DC. One hundred and twenty participants completed the dot-probe task and self-report measures for DC and perfectionism. Regression analyses found that doubts about actions, or a perfectionistic need to check details, and attention toward appearance-based target words (e.g. *hideous, ugly, repulsive, grotesque*) predicted DC in men and women. Perfectionism had the strongest associations, which may serve to inform the development of future dot-probe stimuli in this population.

Keywords: body dysmorphic disorder; dot-probe task; dysmorphic concern; perfectionism; selective attention

Introduction

Dysmorphic concern (DC) comprises of an attention bias toward imagined or minor flaws in appearance (Bartsch, 2007; Cunningham, Griffiths, Baillie, & Murray, 2016) and behaviours aimed at managing the imperfections (Senín-Calderón et al., 2017). Computerised dot-probe tasks are considered to be a more robust measure of attention bias than the Stroop task (Wells & Matthews, 1994) and have largely replaced Stroop tasks in measuring selective attention in other areas of psychopathology. To date, however, limited research has investigated the use of the dot-probe paradigm in this population. Similarly, no DC research has investigated the multidimensional nature of the Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990).

The aim of this research was to compare the relative contribution of selective attention using a dot-probe task with various dimensions of perfectionism from the FMPS in predicting DC psychopathology. Moreover, given that little research has been conducted on the specific aspects of perfectionism associated with DC, the aim of this research was to first explore which dimensions of perfectionism predict clinically significant DCs using self-report measures; once this relationship has been more clearly established, these findings may inform the development of future dot-probe stimuli. This approach in populations with high levels of DCs can be informative with a poorly understood disorder such as BDD; it provides insight into the underlying personality and neurocognitive mechanisms that may be of pertinence to the clinical disorder. We hypothesise that clinically significant DCs will have significant unique positive associations with our perfectionism measures and faster responses to *DC-negative* and/or *DC-body* words (adapted from the DC and BDD literature) compared to neutral words; this would indicate a selective attention bias toward the target stimuli. Further, exploratory analyses will be conducted to determine whether perfectionism and selective attention interact to predict DC i.e., whether there is a cumulative effect of both risk factors and whether higher levels of both variables are associated with significantly higher levels of DC.

Method

Participants and Procedure

The sample included 120 (96 women, 80%) individuals aged 18 to 51 years (M=22.55, SD = 5.33) with a mean body mass index (BMI) of 23.51 (SD=6.73). Based on their scores from the Dysmorphic Concern Questionnaire (DCQ; Oosthuizen, Lambert, & Castle, 1998), participants were separated into two groups. Those scoring below eleven on the DCQ were considered controls while those scoring eleven or above were placed in the clinically significant DCs category (Monzani et al., 2012; Schieber, Kollei, de Zwaan, & Martin, 2018). We recruited participants online between August 2017 and November 2017 through a first-year university student participation scheme and advertisements posted at the university. Participants received payment of ten dollars to participate in the study. We conducted the cognitive task online in the university laboratory from a personal computer desktop with a screen size of 470 x 298 mm and a screen resolution (pixels) of 1680 width x 1050 height x 32 depth. Further, all measures were completed in the laboratory on the web-based survey Qualtrics from the same computer desktop. Total completion time was twenty minutes. We obtained informed consent from all individual participants included in the study and received ethics approval from the Social and Behavioural Research Ethics Committee (approval code 140.17). Participants had to meet the specified inclusion criteria, which was assessed by self-report single items: i) spoke English as preferred language, ii) were not dependent on illicit drugs or alcohol, iii) were not pregnant, iv) did not have visual or motor impairments and v) were not actively suicidal.

Measures

Dot-probe task. Stimuli consisted of twenty target words and twenty matched neutral words (see **Chapter 4** for more detail). Target words were divided into two categories: *DC-body* and *DC-negative*. The *DC-body* word category was comprised of body words (e.g. *nose, skin, hairline, acne*), while the *DC-negative* word category was comprised of appearance-related target words, which would be expected to correlate positively with DC (e.g. *hideous, ugly, repulsive, grotesque*). Examples of the target and matched stimuli for each category were: *nose (lamp), ears (note), disgusting (dishwasher) and ugly (oven;* See **Appendix B**)*.* All trials were counter-balanced, and words were matched for length, syllable, and on average frequency, using the computation analysis guide by Kucera and Francis (1967).

Demographics. Demographic information requested included date of birth, sex, race, as well as family and personal mental health history.

Also collected were the *Dysmorphic Concern Questionnaire (DCQ), FMPS, Short-form version Depression Anxiety Stress Scales (DASS-21).* Internal reliability for the current study is reported in **Table 1**.

Statistical Analyses

Mean reaction time (RT) for incongruent (where the dot follows a neutral word in a target-neutral word pair presentation), congruent (where the dot follows a target word in a target-neutral word pair presentation), and neutral trials (neutral-neutral word pair presentation) were calculated in order to assess selective attention and to disambiguate between biases in vigilance toward DC-target words (orientation) and biases in disengaging from stimuli (see **Chapter 4** for more detail). Given that ratio scores >1 are considered mathematically unbounded, natural logarithms of these scores were computed for congruency, orientation, and disengagement across the two-word conditions (i.e., *DC-body* and *DC-negative*) using the SPSS Ln (ratio) command.

All self-report measures were converted to mean item scores. To examine which variables had a significant association with the outcome variable (total DCQ or clinically significant DCs), we examined each variable in isolation while controlling for DASS-21 scores. To avoid Type I errors resulting from multiple comparisons, Bonferroni corrections were applied (alpha= .003). To examine unique associations between variables, we also computed a multivariate analysis. All variables that correlated with the total DCQ score generating p values of <.10 were included in the analyses.

Results

Characteristics of the Sample

See **Table 1** for means and standard deviations (women, men, clinically significant DCs, control, and overall) for all measures included in the analyses. Incorrect dot-probe responses, which accounted for .02% of the data, were not included in the analyses. After applying a 3 standard deviation cut-off score, no outliers were identified in the dot-probe analyses. Little's test of MCAR (Little, 1988) indicated that data from all measures was missing completely at random ($\chi 2$ [99, N = 154] = 77.67, p = .94). Most participants (60%) identified as being of Caucasian descent, 30% identified as Asian, 6% identified as African, and 10 % were identified as being of another race not listed. Depression and anxiety were the most commonly reported personal and family mental illnesses, with 22.25% of participants reporting suffering from a diagnosed mental illness (17.5%with depression and 16% anxiety) and 30% reporting that they had immediate

Table 1

Means and Standard Deviations for Variables Including Breakdown for Men/Women and Clinically Significant DCs/Controls (Significant Odds Ratios are Bolded)

Measures	Total (N=120) Mean (SD)	Men (N=24) Mean (SD)	Women (N=96) Mean (SD)	Odds Ratio (95% CI)	CSD (N=30) Mean (SD)	Control (N=90) Mean (SD)	Odds Ratio (95% CI)	Internal Reliability using Cronbach α and item-total correlation
1. Concern Over Mistakes	28.10 (8.28)	27.32 (6.86)	28.27 (8.60)	1.13 (.73-1.77)	32.21 (7.49)	26.55 (8.06)	**2.34 (1.48-3.70)**	.92, >.40
2. Doubts About Actions	12.88 (3.64)	12.86 (3.07)	12.89 (3.76)	1.01 (.64-1.59)	15.28 (3.10)	11.98 (3.42)	**3.41 (2.03-5.73)**	.76, >.40
3. Personal Standards	24.55 (5.82)	23.82 (4.87)	24.71 (6.02)	1.20 (.74-1.96)	27.09 (5.49)	23.60 (5.68)	**2.23 (1.37-3.64)**	.87, >.40
4. Congruency Body	.25 (.94)	.15 (.71)	.28 (.98)	1.19 (.69-2.05)	.20 (.80)	.28 (.98)	.90 (.60-1.37)	N/A
5. Congruency Negative	.15 (.00)	-.00 (.05)	.00 (.05)	21.43 (.00-95157.48)	.02 (.05)	-.00 (.04)	11292.88 (3.57-3.5741E+6)	N/A
6. Orientation Body	.18 (.38)	.28 (.46)	.15 (.35)	.50 (.20-1.23)	.15 (.18)	.19 (.43)	.70 (.23-2.16)	N/A
7. Orientation Negative	.18 (.38)	.29 (.47)	.16 (.35)	.50 (.20-1.23)	.16 (.17)	.19 (.43)	.79 (.28-2.27)	N/A
8. Disengagement Body	.17 (.38)	.28 (.46)	.15 (.35)	.49 (.20-1.21)	.13 (.17)	.19 (.43)	.61 (.18-2.06)	N/A
9. Disengagement Negative	.18 (.38)	.27 (.46)	.15 (.36)	.53 (.22-1.29)	.14 (.17)	.19 (.43)	.70 (.23-2.14)	N/A
10. DCQ	7.90 (5.04)	6.82 (4.56)	8.14 (5.12)	1.48(.80-2.75)	14.69(.20)	5.36(2.76)	N/A	.89, >.40
11. DASS-21	15.28 (12.12)	2.23 (1.56)	2.17 (1.77)	.98 (.78-1.24)	3.22 (2.01)	1.79 (1.44)	**1.60 (1.28-2.00)**	.95, >.40

Note. Only odds ratios associated with a t test that has a *p* value of <.003 has been bolded. CSD= clinically significant dysmorphic concerns;Incongruent trials= dot-probe task mean RT's converted to logarithm ratio scores where dot follows neutral word in target-neutral word pair trials; Congruent trials= dot-probe task mean RT's converted to logarithm ratio scores where dot follows target word in target-neutral word pair trials; Neutral trials= dot-probe task mean RT's converted to logarithm ratio scores where dot follows neutral words in neutral-neutral word pair trials; Congruency= dot-probe task mean RT's converted to logarithm ratio scores with paired neutral-target word trials with incongruent words/congruent words; Congruency Body= incongruent body words/congruent body words; Congruency Negative= incongruent negative words/ congruent negative words; Orientation Body= neutral trials/congruent body words; Orientation Negative= neutral trials/congruent negative words; Disengagement Body= neutral trials/incongruent body words; Disengagement Negative= neutral trials/incongruent negative words; DCQ= Dysmorphic Concern Questionnaire; DASS-21= Short form Depression, Anxiety, and Stress Scales.

family members who had been diagnosed with a mental illness (22% with depression, 20% with anxiety). There were no significant differences in any of the variables between men and women (See **Table 1**).

Analysis of Clinically Significant DCs as a Continuous Outcome Variable

Table 2 shows all Pearson *r* correlations. DCQ scores were significantly positively associated with the Concern over Mistakes, Doubts about Actions and Personal Standards subscales (r= .45, .50 and .38 respectively); the DCQ was also positively associated with the *congruency negative* score (r=. 19). There was a medium to a large association (r= .71) between Concern over Mistakes and Doubts about Actions, medium association (r= .52) between Personal Standards and Concern over Mistakes, and small association (r= .33) between Personal Standards and Doubts about Actions subscales. The orientation and disengagement scores were all highly and positively associated across all categories of words. Further, the DASS-21 total score was positively associated with all three FMPS subscales and total DCQ score. All other correlations failed to reach significance. Multiple regression analyses were computed, with the total DCQ score entered as the dependent variable, total DASS-21 score entered as the covariate, and the *congruency negative* score and three FMPS subscale scores entered as independent variables (see **Table 3**). The Doubts about Actions, Personal Standards, and DASS-21 scores were found to be significant predictors of DC.

Analysis of Clinically Significant DCs as a Dichotomous Outcome Variable

When predictor variables were entered separately into a logistic regression, all three FMPS subscales and the *congruency negative* words were found to be significant predictors of group outcome (p's ranging from .001-.007). The *congruency negative*, three FMPS subscales, and DASS-21 score were simultaneously entered as predictor variables. The Doubts about Actions and *congruency negative* scores were found to be significant predictors of group

Table 2

Pearson r Correlations for Perfectionism, Dot-Probe, Dysmorphic concern, Depression, Anxiety, and Stress Scores

Measures	1	2	3	4	5	6	7	8	9	10
1. Concern over Mistakes	1.0	-	-	-	-	-	-	-	-	-
2. Doubts About Actions	.71**	1.0	-	-	-	-	-	-	-	-
3. Personal Standards	.52**	.33**	1.0	-	-		-	-	-	-
4. Congruency Body Words	-.02	-.25	-.03	1.0	-	-	-	-	-	-
5. Congruency Negative Words	.13	.09	.05	-.09	1.0	-	-	-	-	-
6. Orientation Body	.04	.09	-.00	.04	.11	1.0	-	-	-	-
7. Disengagement Body	.02	.09	-.01	.05	.00	.99**	1.0	-	-	-
8. Orientation Negative	.04	.12	.02	.06	.06	.98**	.98**	1.0	-	-
9. Disengagement Negative	.05	.10	.01	.05	.06	.99**	.99**	.99**	1.0	-
10. DCQ	.45**	.50**	.38**	-.02	.19*	-.01	-.03	.01	.00	1.0
11. DASS-21	.43**	.55**	.19*	.01	.08	.01	.00	.03	-.01	.47**

Note. ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Table 3

Multiple Regression Analyses with Perfectionism, Dot-Probe, and DASS-21 Scores With p Values <0.10 Entered Simultaneously as Predictor Variables and DC as Outcome Variable

Variables	B	SE	Beta	t	*p*
Concern over Mistakes	.04	.08	.05	.52	.745
Doubts about Actions	.19	.08	.24	2.41	.017
Personal Standards	.19	.07	.22	2.87	.005
Congruency Negative	1.90	.98	.13	1.95	.053
Depression, Anxiety & Stress	.11	.00	.27	3.48	.001

outcome (clinically significant DCs *versus* control; **Table 4**). We conducted post-hoc analyses to investigate whether an interaction between perfectionism and the *congruency negative* score significantly differentiated the clinically significant DCs and control groups. Logistic regression analyses revealed that there was no interaction between the centered perfectionism and *congruency negative* score in predicting group membership.

Discussion

The primary aim of this study was to determine whether selective attention and perfectionism predicted clinically significant DCs. This was the first study to explore the associations between a dot-probe task, various dimensions of the FMPS, and DC. Selective attention, perfectionism, mood, and stress were found to be significant predictors of DC. Further, ontrary to the Bartsch (2007) study, we found no significant gender differences on any of the variables of interest; hence the sample was combined across men and women. Investigation of potential underlying neurocognitive and personality factors in populations with clinically significant DCs can generate useful hypotheses for testing in clinical populations. Thus, these findings may help to provide a better understanding of potential aetiological mechanisms

Table 4

Logistic Regression Analyses with Perfectionism and Dot-Probe Scores Entered Simultaneously as Predictor Variables, Clinically Significant DCs (Group) as Outcome Variable and DASS-21 Score as Covariate

Variables	*Entered singly*				*Entered simultaneously*			
	B	SE	Exp (B)	*p*	B	SE	Exp(B)	*p*
Concern over Mistakes	.58	.25	1.78	.023	-.27	.37	.76	.456
Doubts about Actions	.98	.29	2.66	.001	.98	.38	2.67	.010
Personal Standards	.71	.26	2.02	.007	.59	.31	1.81	.053
Congruency Negative	9.79	4.43	17855.73	.027	9.13	4.63	9197.91	.049

contributing to BDD onset, which remains an underdeveloped area of research.

Consistent with the Fang and Wilhelm (2015) BDD model, a meta-analysis (Johnson, Williamson, & Wade, 2018), and previous BDD research (Buhlmann, McNally, Wilhelm, & Florin, 2002; Toh, Castle, & Rossell, 2017), selective attention toward *DC- negative* words (e.g., *ugly*) was positively associated with DC and predicted group membership when entered singly and simultaneously in the logistic regression analyses. However, when entered into the multiple regression analysis, the *congruency negative* word condition failed to reach significance (*p*=.053). In the current study, the *DC-body* (e.g., *nose*) word condition was not associated with DCQ scores and did not predict clinically significant DCs. Our findings are consistent with the BDD literature, in which Emotional Stroop paradigms failed to detect significant group differences in the body target word conditions (Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014) but inconsistent with Onden-Lim and colleagues (2012) who detected a positive association between DC and the attractive stimuli (made up of facial features and body parts).

We did not detect significant group differences on subtypes of selective attention (i.e., orientation and disengagement). These findings are consistent with past research investigating vigilance and disengagement using the dot-probe task in both non-clinical and clinical populations, reporting inconsistent results (Schmukle, 2005). Overall our findings provide some support for the usefulness dot-probe paradigms in assessing selective attention biases in DC populations. However, more DC research should be done with an emphasis on clarifying the psychometric properties of this task. This was the first study to examine the relationship between various subscales of the FMPS and DC. While all three perfectionism subscales were found to have significant associations with DC, it was only the Doubts about Actions and Personal Standards subscales (reflecting perfectionistic strivings and concerns respectively) that were predictive of our continuous DC measure. Further, these two subscales were also predictive of our group variable (clinically significant DCs *versus* control) when entered singly into the logistic regression. Moreover, Doubts about Actions was found to be a unique predictor of group outcome when entered simultaneously with the other variables of interest. Factor analyses have found the Concern over Mistakes and Doubts about Actions subscales to reflect perfectionistic concerns. However, it is only the Personal Standards and Doubts about Actions subscales that load onto checking of detail (Stairs, Smith, Zapolski, Combs, & Settles, 2012). Thus, given that symptoms of DC involve obsessions surrounding perceived appearance-based imperfections, it is possible that detailed checking is a pervasive symptom characteristic of this population. Further, appearance-related obsessions drive compulsive behaviours, such as mirror gazing, which involves detail-oriented checking behaviours. Examples of these checking behaviours include facial feature measurements and excessive application of make-up (Veale & Riley, 2001). To this effect, the findings of the current study might be used to inform the development of stimuli selected when designing dot-probe tasks. For example, to further investigate the role of checking behaviours in maintaining psychopathology, it may be of interest to investigate selective attention toward perfectionistic detail-oriented checking. Overall, our findings provide further evidence for the association between perfectionism and DC, support for the efficacy of the FMPS in exploring perfectionism more specific to DC and may inform the development of stimuli that comprise dot-probe paradigms used in this population.

Limitations and Future Directions

The findings of this study should be interpreted in the context of the following limitations. First, the use of a cross-sectional design limits our ability to draw causal conclusions between the variables of interest. Further, our sample was comprised of university students, which limits the generalisability of our findings. On the dot-probe task, we found no significant differences in the *congruency body* scores between participants scoring high and low on the DCQ. This might, in part, be explained by the failure of this study to assess the imperfections specific to the individuals who participated. In effect, this might have reduced the strength of the associations. Although stimuli were informed by the BDD and DC literature, another major limitation of this study was the failure to pilot test the stimuli presented to participants. It is also important to note that we did not obtain information on education and intellectual quotient. In effect, we were unable to covary for these effects, which may have confounded dot-probe scores. Further, we did not include *DC-positive* words (e.g., *pretty*), in which selective attention biases for this word type has been detected in BDD and DC populations (Buhlmann et al., 2002; Onden-Lim et al., 2012). It is also important to note that while the *DC-negative* words predicted unique variance, this was the only aspect of the dot-probe task to engender significant differences between the two groups. While the results of this study suggest that the dot-probe paradigm might be a useful measure of selective attention in men and women with clinically significant DCs, only the Doubts about Actions subscale remained a significant predictor of DC in both multivariate analyses. One possible explanation for perfectionism being a more powerful predictor than selective attention is differences in methodology; self-reported perfectionism is a more direct measure of this construct, whereas the dot-probe task is an implicit measure of selective attention bias. Thus, compared to the cognitive task, it is likely that self-reported perfectionism produced larger effect sizes, rendering it a more powerful assessment tool.

Although more research is required to consolidate and extend these findings, this study provides some implications for devising new prevention and treatment strategies. First, given that perfectionistic checking behaviours and selective attention toward *DC- negative* words both predicted DC psychopathology, experimental designs targeting these specific pathological mechanisms could be tested in vulnerable populations. In this way, we can establish some indication of causality.

Second, future clinical research might consider the use of dot-probe paradigms in replace of the Emotional Stroop task in clinical populations. This might yield findings that are more consistent and provide valuable insights into the aetiology of BDD, which can inform new treatment approaches. For example, treatment strategies that target BDD symptomology could be achieved by modifying specific underlying neurocognitive mechanisms that serve to maintain symptoms, such as cognitive bias modification (Fang & Wilhlem, 2015). Both cognitive bias modification and perfectionism treatment programs have been tested online (Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2012; Rozental et al., 2017; Shafran et al., 2017; Summers & Cougle, 2016), which is useful for a population known to avoid mental health treatment (Buhlmann & Winter, 2011).

Third, although some research has detected an association between selective attention and perfectionism more generally, to date, no research has investigated the relationship between selective attention toward perfectionistic target stimuli and DC. In the current study, compared to selective attention, doubts about actions was more strongly and reliably associated with DC. Although differences in methodology may have played a role, in line with findings showing perfectionism to be an important transdiagnostic process (Limburg, Watson, Hagger, & Egan, 2017), perfectionistic doubts about actions, which loads highly onto detail-oriented checking behaviours (Stairs et al., 2012), may warrant further investigation. Given the limitations of self-report measures, such as reporting bias, future DC research might consider designing dot-probe paradigms that comprise of stimuli specific to this dimension of perfectionism; this would provide greater clarity as to whether there is a relationship between selective attention toward perfectionistic detail-oriented checking and DC. For example, it might be of interest to compare RT scores between participants scoring high and low on DC toward appearance-related checking stimuli such as "*mirror", "reflection",* "*facial symmetry",* or "*make-up".*

Fourth, while Toh et al. (2017) combined the *BDD-body* (e.g., *skin*) and *BDD-negative* (e.g., *hideous*) words under one category collectively referred to as the *BDD-negative* category, future DC studies using dot-probe paradigms could clarify discrepancies in the significance of DC-target words by including all word types (*DC-body, DC-negative,* and DC-*positive*) using three separate categories. Researchers might also request that participants identify facial features and/or body parts of concern, as well as detail-oriented checking behaviours (e.g., *"What kinds of strategies do you use to check your appearance? How frequently do you reapply your makeup? How frequently do you brush your hair?" "How frequently do you measure the* *symmetry of your face"*); this would inform the dot-probe target stimuli selected, thereby strengthening associations.

Conclusions

Drawing upon the most recent CBT model of BDD by Fang and Wilhelm (2015), meta-analytic findings from **Chapter 3**, and preliminary DC research, this study sought to explore the relative contributions of selective attention and various dimensions of perfectionism in predicting DC psychopathology, with the hope of informing the development of future methodological designs. Results from this study found perfectionism and selective attention to predict unique variance in DC psychopathology, where perfectionistic doubts about actions, a construct that loads onto details in checking, was the strongest predictor of the outcome variable. Results from this sample suggest that further DC research investigating selective attention biases toward DC-target stimuli, as well as perfectionistic detail-oriented checking could be fruitful.

To address some the above-mentioned limitations and reviewer criticisms concerning the omission of DC-positive words, dichotomising a continuous variable, difficulties interpreting ratio scores, and covarying for the effects of a total DASS-21 score, the next chapter will provide measures and analyses that have been adapted to improve the quality of content.

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Chapter 6

Perfectionism and Selective Attention Predict Dysmorphic Concern in an Australian University Population[5]

[5]This was the second draft of this paper, which has been resubmitted to *Australian Psychologist* after a first round of revisions. The order of authorship is Shevaugn Johnson, Paul Williamson, and Tracey Wade. Shevaugn Johnson contributed 70%, 70%, and 75%, Paul Williamson contributed 5%, 20%, and 10%, and Tracey Wade contribured 25%, 10%, and 20% to the research design, data collection and analysis, and writing and editing respectively. Additional content from the statistical analyses and discussion sections from this chapter can be found in **Chapters 4** and **5** respectively. An updated version of the full list of dot-probe stimuli can be found in **Chapter 9** in **Appendix C**.

Abstract

Limited research has explored the underlying aetiological mechanisms contributing to dysmorphic concern (DC). In the present study, we used a multidimensional measure of perfectionism and a dot-probe task, borrowed from the DC and body dysmorphic disorder literature, to assess associations between subtypes of perfectionism (i.e., concerns and strivings), selective attention toward target word stimuli (i.e., *DC-body, DC-negative,* and *DC-positive* words), and DC. This was the first study to simultaneously examine these predictors and to investigate specific underlying selective attention mechanisms using probes and stimuli relevant to DC. Informed by current theories, we hypothesised that perfectionistic concerns and/or strivings and attention bias to target stimuli would be significantly associated with DC. Fifty-seven students recruited from an Australian university completed the dot-probe task and self-report measures for perfectionism and DC. Regression analyses found that doubts about actions, or a perfectionistic need to check details, and attention toward the *DC-positive* words (e.g. *pretty, attractive, chiseled*) predicted DC in men and women. Perfectionism predicted most of the variance. These results may serve to inform the development of future dot-probe paradigms and early intervention programs targeting at-risk populations endorsing clinically significant DCs.

Keywords: body dysmorphic disorder; detail-oriented checking; dot-probe task; dysmorphic concern; perfectionism; selective attention

Introduction

High levels of dysmorphic concern (DC), comprised of preoccupations with imagined or minor flaws in appearance and found across several psychological disorders including olfactory reference syndrome, illness anxiety disorder, and eating disorders (Monzani et al., 2012), is thought to increase the risk for body dysmorphic disorder (BDD; Monzani et al., 2012). While most of the DC literature has focussed exclusively on diet and weight-related concerns (Bartsch, 2007), the current research explored DC consistent with BDD. This research focuses on two pertinent, postulated risk factors for DC implicated across models of BDD (Fang & Wilhelm, 2015; Veale, 2004; Wilhelm, 2006; Wilhelm & Neziroglu, 2002): selective attention and perfectionism (Arji, Borjali, Sohrabi, & Farrokhi, 2016; Bartsch, 2007; Cunningham, Griffiths, Baillie, & Murray, 2016; Jin et al., 2018; Onden-Lim, Wu, & Grisham, 2012).

To date, no research has explored the multidimensional nature of the FMPS in a DC population. Furthermore, no dot-probe paradigm has been used to examine the specific underlying mechanisms of selective attention contributing to the broader context of DC central to BDD. The aim of this research, therefore, was to examine the relative contribution of selective attention using a dot-probe task with various dimensions of perfectionism from the FMPS in predicting DC psychopathology. Furthermore, by clarifying which dimensions of perfectionism predict DC, we hope to inform the development of future dot-probe stimuli. Moreover, given that research in clinical populations has focused primarily on dot-probe stimuli specific to eating disorders and that DC is postulated to be a broad, dimensional construct, another aim of this research was to administer a dot-probe task comprised of DC stimuli consistent with BDD. Consequently, by identifying potential underlying risk factors that may precede the onset of clinical disorders, we hope to inform the development of early intervention programs. We hypothesise that DC will have significant unique positive associations with one or both of our perfectionism constructs (i.e., concerns and strivings) and faster responses to the *DC-body, DC-negative*, and/or *DC-positive* words (adapted from the DC and BDD literature) compared to the neutral words; this would indicate a selective attention bias toward the target stimuli.

Method

Participants and Procedure

Given that this was an exploratory study used to develop effect sizes for future studies, no power analyses were conducted, and a sample of convenience was collected. The sample included fifty-seven (fifty-two women, 91%) individuals aged eighteen to sixty-one years (M=22.35, SD = 7.24) with a mean body mass index (BMI) of 24.88 (SD=6.39). For a subset of the analyses, participants were divided into two groups (i.e., clinically significant DCs *versus* controls) based on their scores from the DCQ. We recruited participants between December 2017 and April 2018 through an online first-year university student participation scheme and flyers posted at the university. Informed consent was obtained electronically from all participants who took part in this study, which received approval from the Social and Behavioural Research Ethics Committee (approval code 140.17). Following completion of the study, participants were debriefed and compensated ten dollars for their time.

We conducted the cognitive task online in the university laboratory from a personal computer desktop with a screen size of 470 x 298 mm, a screen resolution (pixels) of 1680 width x 1050 height x 32 depth, and a twenty-two-inch monitor. Further, all measures were completed in the laboratory on the web-based survey Qualtrics from the same computer desktop. Total completion time was twenty minutes. Participants had to meet the specified inclusion criteria, which was assessed by self-report single items: i) spoke English as preferred language, ii) were not dependent on illicit drugs or alcohol iii) were not pregnant, iv) did not have visual or motor impairments and v) were not actively suicidal.

Measures

All self-report scores were converted to mean item scores, and no outliers were identified for these variables.

Dot-probe task. Forty target words and forty matched neutral words made up the stimuli selected. The chosen stimuli incorporated words from the four published studies that used an Emotional Stroop task and dot-probe task to measure selective attention biases in BDD and DC populations (Buhlmann, McNally, Wilhelm, & Florin, 2002; Onden-Lim, Wu, & Grisham, 2012; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014; Toh, Castle, & Rossell, 2017). Additional stimuli were chosen based on common underlying themes related to these words. Target words were divided into three categories: *DC-body, DC-negative, and DC-positive*. The *DC-body* category was comprised of body words (*e.g. nose, skin, hairline, acne*), while the *DC-negative* (*e.g. hideous, ugly, repulsive, grotesque*) and *DC-positive* (*e.g., pretty, beautiful, gorgeous, buff*) categories were comprised of appearance-related words. It was anticipated that all word types would correlate positively with DC. The following are examples of target and matched stimuli for each word type: *nose (lamp), ears (note), disgusting (dishwasher), ugly (oven), gorgeous (beverage), and sexy (bury).* The complete list of target and matched neutral words can be found in **Appendix B**. All trials were counter-balanced and words were matched for length, syllable, and frequency, informed by the American English guide by Kucera and Francis (1967). After applying a 3 standard deviation cut-off, no outliers were identified in the dot-probe analyses.

Demographics. Demographic information obtained included sex, race, date of birth, as well as family and personal mental health history.

Also collected were the *FMPS, Dysmorphic Concern Questionnaire (DCQ),* and *Short-form version Depression Anxiety Stress Scales (DASS-21).* The FMPS Concern over Mistakes, Doubts about Actions, and Personal Standard subscales generated Cronbach alpha values of .93, .76, and .85 respectively. The DCQ generated a Cronbach alpha value of .87 and the DASS-21 Depression, Anxiety, and Stress subscales generated Cronbach alpha values of .93, .83, and .90 respectively. All measures generated item-total correlations above .40, except for the DASS-21 Anxiety subscale (.35). However, this item was deemed conceptually relevant and was, therefore retained.

Statistical Analyses

We used a Pearson *r* bivariate correlation analysis to examine the relationships among the variables of interest. To examine unique associations between variables, we ran a simultaneous multiple regression analysis with all the variables that correlated with the total DCQ score with $p < .10$. To compute an effect size (Pearson's *r*) and 95% confidence intervals, an online Practical Meta-Analysis Effect Size Calculator (https://www.campbellcollaborat ion.org /effect-size-calculato.html) was used by inputting t-test results and sample size. For the multiple regression analysis, all predictor variables were mean-centered to simplify the creation of graphs. To consider the effects of a DCQ cut-off score of eleven (which corresponds to a mean item score of approximately 1.50), graphs were created to show the predicted effect of one predictor on the mean DCQ score conditional on the effects of another predictor. Observed minimum and maximum scores were used for the range of significant predictor variables.

Results

Characteristics of the Sample

Less than 5% of data were missing; incorrect dot-probe responses, which accounted for .02% of the data, were not included in the analyses. Most participants (66%) identified as being of Caucasian descent, 25% identified as Asian, 2% identified as African, and 7 % were identified as being of another race not listed. More than half of the sample (60%) were Australian citizens and all participants spoke English as their preferred language. Depression and anxiety were the most commonly reported personal and family mental illnesses, with 37% of participants reporting having been diagnosed with a mental illness (28% depression and 33% anxiety) and 47% reporting that they had immediate family members who had been diagnosed with mental illness (38% depression and 28% anxiety). There were no significant differences in any of the variables between men and women.

Correlations Among Variables

Table 1 shows all descriptive statistics and Pearson *r* correlations. DCQ scores were significantly positively associated with the Concern over Mistakes, Doubts about Actions, and Personal Standards subscales and the *congruency positive* score. There was a medium to a large association between Concern over Mistakes and Doubts about Actions, a medium association between Personal Standards and Concern over Mistakes, and a medium association between the Personal Standards and Doubts about Actions subscales. The *congruency negative* words were also positively associated with the Concern over Mistakes, Doubts about Actions, DASS-21 Anxiety, and Depression subscales. The *orientation negative* words were positively associated with the three DASS-21 subscales. The *congruency positive* and *congruency body* word scores were positively associated, while the *disengagement body* and *congruency body* word conditions were negatively correlated. The orientation and disengagement scores were all highly and positively associated across all categories of words. There were medium to large associations

Table 1

Descriptive Statistics and Pearson r Correlations for Perfectionism, Dot-Probe, Dysmorphic concern, Depression, Anxiety, and Stress Scores

Measures	*M* (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Concern over Mistakes	30.53 (8.31)	1.0	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Doubts about Actions	14.09 (3.39)	**.79****	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Personal Standards	25.96 (4.98)	**.55****	**.58***	1.0	-	-		-	-	-	-	-	-	-	-	-
4. Congruency Body	1.02 (.07)	.13	.09	.08	1.0	-	-	-	-	-	-	-	-	-	-	-
5. Congruency Negative	1.01 (.06)	**.36****	**.37****	.26	.16	1.0	-	-	-	-	-	-	-	-	-	-
6. Congruency Positive	1.00 (.07)	.05	-.01	.00	**.30****	.04	1.0	-	-	-	-	-	-	-	-	-
7. Orientation Body	1.31 (.39)	.19	.15	-.04	-.14	-.15	-.06	1.0	-	-	-	-	-	-	-	-
8. Disengagement Body	1.28 (.41)	.16	.13	-.04	**-.32****	-.17	-.11	**.98****	1.0	-	-	-	-	-	-	-
9. Orientation Negative	1.31 (.41)	.22	.20	.00	-.17	-.03	-.06	**.98****	**.97****	1.0	-	-	-	-	-	-
10. Disengagement Negative	1.30 (.41)	.15	.14	-.04	-.20	-.20	-.07	**.99****	**.98****	**.98****	1.0	-	-	-	-	-
11. Orientation Positive	1.31 (.42)	.18	.14	-.04	.14	-.13	.12	**.97****	**.96****	**.97****	**.97****	1.0	-	-	-	-
12. Disengagement Positive	1.30 (.42)	.17	.14	-.04	-.20	-.13	-.08	**.99****	**.98****	**.98****	**.99****	**.98****	1.0	-	-	-
13. DCQ	10.93 (4.91)	**.37****	**.53****	**.38****	.06	.21	**.27***	.19	.10	.15	.11	.15	.10	1.0	-	-
14. DASS-Anxiety[ab]	6.26 (4.51)	**.39****	**.54****	**.39****	-.18	**.26***	.05	.15	.21	.24	.19	.21	.20	**.58****	1.0	-
15. DASS-Depression[a]	6.77 (5.28)	**.49****	**.52****	**.32***	-.14	**.29***	.17	.18	.21	**.26***	.20	.26	.22	**.52****	**.61****	1.0

16. DASS- Stress	8.30 (4.91)	**.43***	**.52***	**.41****	-.06	.24	.14	.10	.10	.17	.12	.17	.13	**.63****	**.79****	**.78****

Note. ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed); [a] reflects scores transformed using the SPSS fractional rank command; [b] Indicates where one item from the DASS-21 Anxiety scale produced an item-total-correlation of .35 but was retained for conceptual relevance. M=Mean; SD= Standard Deviation; Concern over Mistakes= Mean scores from the Frost Multidimensional Perfectionism (FMPS) Concern Over Mistakes Subscale; Doubts about Actions= Mean scores from the FMPS Doubts about Actions Subscale; Personal Standards= Mean scores from the FMPS Personal Standards Subscale; Incongruent trials= dot-probe task mean reaction times (RT's) where dot follows neutral word in target-neutral word pair trials; Congruent trials= dot-probe task mean RT's where dot follows target word in target-neutral word pair trials; Neutral trials= dot-probe task mean RT's where dot follows neutral words in neutral-neutral word pair trials; Congruency= incongruent words/congruent words; Congruency Body= incongruent body words/congruent body words; Congruency Negative= incongruent negative words/ congruent negative words; Congruency Positive= incongruent positive words/ congruent positive words; Orientation Body= neutral trials/congruent body words; Disengagement Body= neutral trials/incongruent body words; Orientation Negative= neutral trials/congruent negative words; Disengagement Negative= neutral trials/incongruent negative words; Orientation Positive= neutral trials/congruent positive words; Disengagement Positive= neutral trials/incongruent positive words; DCQ= Mean scores from the Dysmorphic Concern Questionnaire; DASS-Anxiety= Mean scores from the Depression Anxiety and Stress Scales-Short Version (DASS-21) Anxiety Subscale; DASS-Depression= Mean scores from the DASS-21 Depression Subscale; DASS-Stress= Mean scores from the DASS-21 Stress Subscale.

between the DASS-21 subscale scores, which produced significant positive associations with all three FMPS subscales and the total DCQ score. All other correlations failed to reach significance.

Regression Analyses

Multiple regression analyses were run, with the total DCQ score entered as the dependent variable, three DASS-21 subscale scores entered as covariates, and the dot-probe *congruency positive* and three FMPS subscale scores entered as independent variables (see **Table 2).** The Doubts about Actions subscale and *congruency positive* word score were found to be significant predictors of DC. The results from the regression analysis are shown graphically for the two significant predictors, the *congruency positive* words and FMPS Doubts about Actions subscale (See **Figures 1** and **2**). To facilitate an interpretation that takes clinical significance[1] into account, the graph also shows the minimum scores for each significant predictor, at which it is predicted that participants will exceed the DCQ clinical cut-off at low (*M* – *SD*), medium (*M*), and high (*M* + *SD*) levels of the other predictor. For example, in **Figure 1**, participants with high scores on the FMPS Doubts about Actions subscale would be predicted to exceed the DCQ clinical cut-off if they had a *congruency positive* score of 0.86. In contrast, a *congruency positive* score of at least 0.98 would be required by participants with average scores on the FMPS Doubts about Actions subscale and an even higher *congruency positive* score of at least 1.11 (which is very close to the maximum congruency positive score of 1.17 observed) would be required by participants with low scores on the FMPS Doubts about Actions subscale. Hence, it is predicted

[1] An alternative approach is to dichotomise the DCQ scores into those exceeding the clinical cut-off and those who don't and instead, running a logistic regression analysis. However, that approach is both less sensitive and less statistically powerful since it does not use the continuum inherent in the DCQ measure. As such, it was decided to utilise the continuous nature of the measurement using multiple regression analysis, and to take the clinical significance into account by adding the clinical cut-off to the graphical representation of the analysis results.

Table 2

Multiple Regression Analyses with Perfectionism, Dot-Probe, and DASS-21 Scores With p Values <0.10 Entered Simultaneously as Predictor Variables and DC as Outcome Variable

Variables	B	SE	Beta	t	*p*	*r*	95% CI
Concern over Mistakes	-.15	.13	-.20	-1.17	.25	-.30	-.40: .11
Doubts about Actions	.35	.16	.40	2.19	.03	.28	.02: .50
Personal Standards	.06	.12	.06	.49	.62	.06	-.20: .32
Congruency Positive	2.34	1.04	.23	2.25	.03	.29	.03: .51
Anxiety[a]	.17	.20	.14	.83	.41	.11	-.15: .36
Depression[a]	-.02	.15	-.02	-.11	.91	-.01	-.27: .25
Stress	.36	.21	.35	1.71	.09	.22	-.04: .49

Note. [a] Reflects scores transformed using the SPSS fractional rank command; *r* = Pearson's *r*; 95% CI= 95.

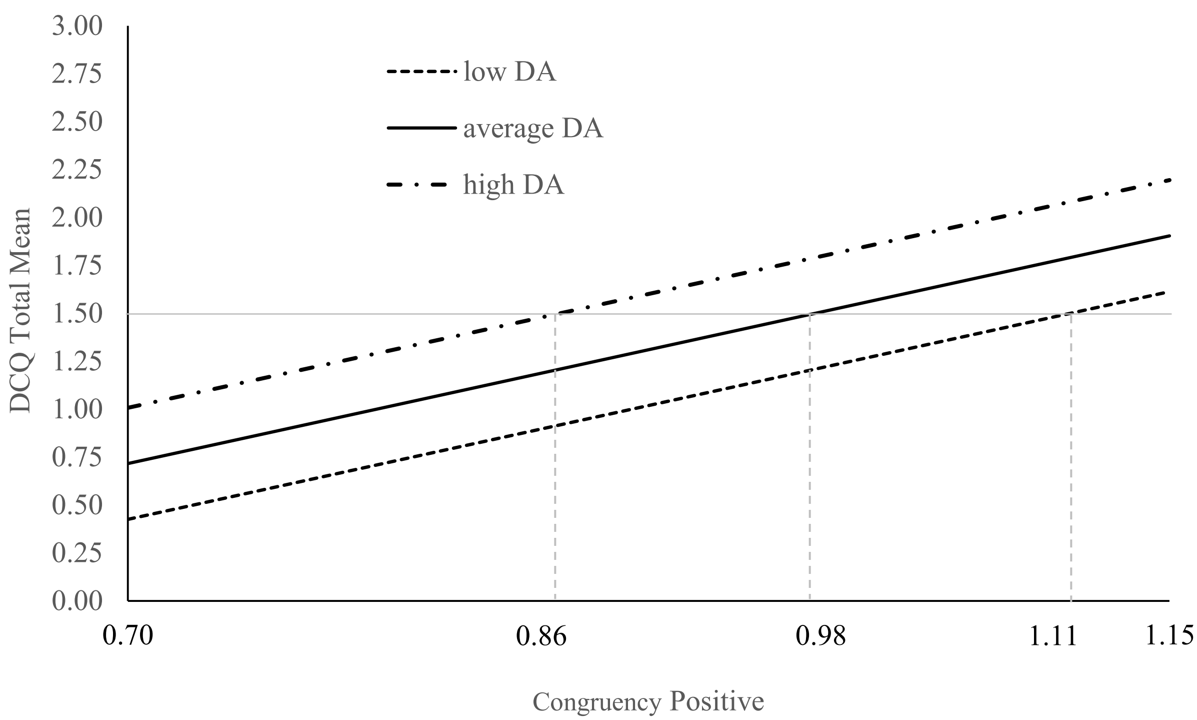

Figure 1. The predicted effect of *congruency positive* on the mean Dysmorphic Concern Questionnaire (DCQ) score conditional on the effect of Frost Multidimensional Perfectionism Doubts about Actions subscale (FMPS DA). Predicted lines are plotted at average scores on all other predictor variables. Observed minimum and maximum scores are used for the range of the dot-probe task *congruency positive* word score. The grey horizontal line indicates the clinical cut-off for the DCQ. The dashed vertical lines show the minimum *congruency positive* score at which it is predicted that participants will exceed the clinical cut-off at low (i.e., one standard deviation below the mean; low DA= low FMPS DA), average (i.e., mean; average DA= average FMPS DA), and high (i.e., one standard deviation above the mean; high DA= high FMPS DA) FMPS DA score.

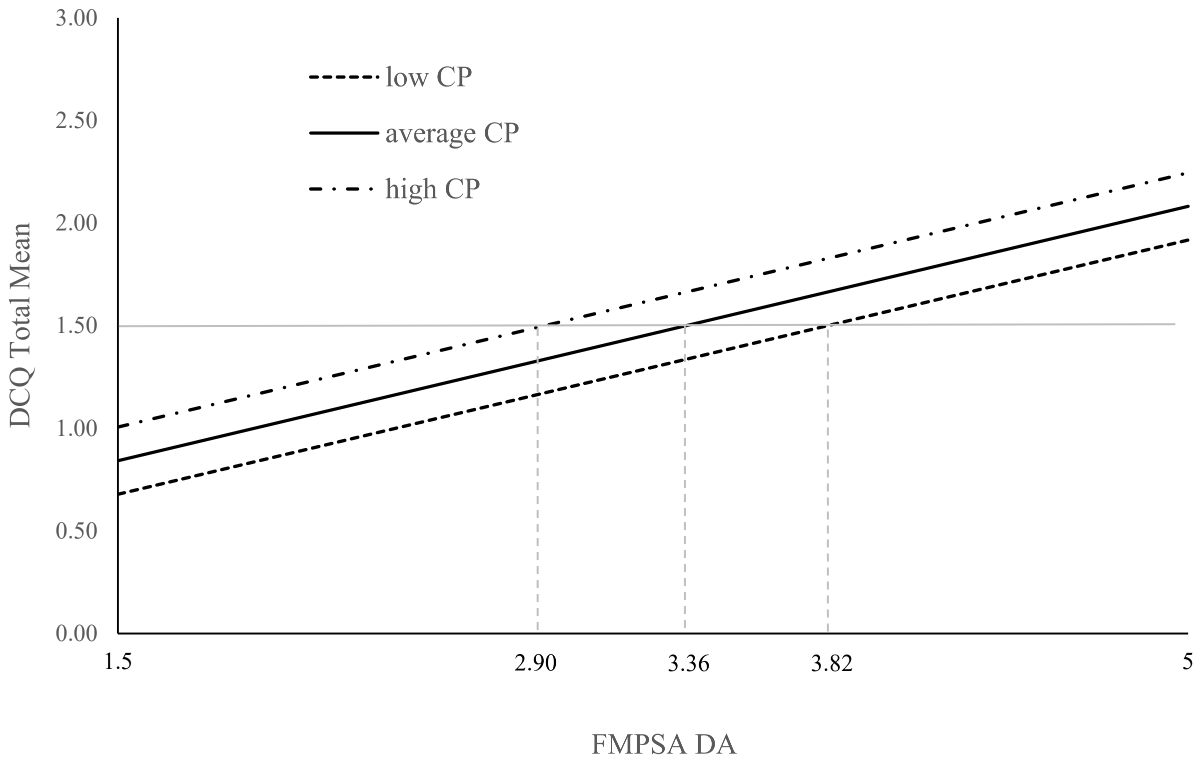

Figure 2. The predicted effect of the Frost Multidimensional Perfectionism Doubts about Actions subscale (FMPS DA) score on the mean Dysmorphic Concern Questionnaire (DCQ) score conditional on the effect of the dot-probe task *congruency positive* word score. Predicted lines are plotted at average scores on all other predictor variables. Observed minimum and maximum scores are used for the range of FMPS DA. The grey horizontal line indicates the clinical cut-off for the DCQ. The dashed vertical lines show the minimum *congruency positive* score at which it is predicted that participants will exceed the clinical cut-off at low (i.e., one standard deviation below the mean; low CP= low *congruency positive*), average (i.e., mean; average CP= average *congruency positive*), and high (i.e., one standard deviation above the mean; high CP= high *congruency positive*) *congruency positive* score.

that those with low scores on the FMPS Doubts about Actions subscale would be very unlikely to exceed the clinical DCQ cut-off even if they had high scores on congruency positive words.

Discussion

The primary aim of this study was to examine the associations between various dimensions of perfectionism, specific underlying selective attention mechanisms, and DC. To address a gap in the literature, this study also sought to further explore the use of dot-probe tasks comprised of DC stimuli central to BDD. The doubts about actions subscale of the FMPS and *congruency positive* word scores of the dot-probe task were found to be significant predictors of DC. Furthermore, contrary to the Bartsch (2007) study, we found no significant sex differences in any of the variables of interest; hence men and women were combined for the analyses. This was the first study to examine the relationship between various subscales of the FMPS and DC. While all three perfectionism subscales were found to have significant associations with DC, it was only the Doubts about Actions subscale reflecting perfectionistic concerns and checking of detail (Stairs et al., 2012), that was uniquely predictive. These findings are consistent with the BDD and eating disorder literature, in which doubts about actions were higher in the clinical groups compared to controls (Buhlmann, Etcoff, et al., 2008; Hartmann et al., 2015). Thus, it is possible that detailed checking is a pervasive symptom characteristic of DC populations that precede the onset of clinical disorders. However, inconsistent with the clinical research by Buhlmann, Etcoff et al. (2008) and Limburg et al. (2017), perfectionistic strivings did not predict DC. One possible explanation for this discrepancy is that perfectionistic strivings is characterised by extreme personal standards, which might be more pervasive among clinical populations with more severe symptomology. While more research is needed to extend and consolidate these findings, it may be of interest to investigate selective attention toward perfectionistic detail-oriented checking, such that the role of checking behaviours in DC can be more stringently determined. This might be achieved by using eye tracking technology, whereby two images with slight differences in detail are presented and participant gaze is monitored.

This was the first study to investigate specific underlying selective attention mechanisms (i.e., *congruency, orientation,* and *disengagement*) using stimuli that were not specific to eating disorders or muscle dysmorphia. Consistent with previous literature (Buhlmann et al., 2002; Fang & Wilhelm, 2015; Jin et al., 2018; Johnson, Williamson, & Wade, 2018), selective attention toward *DC-positive* words (e.g., *pretty*) predicted DC. In the current study, the *DC-body* (e.g., *nose*) and *DC-negative (*e.g., *ugly*) conditions were not associated with DCQ scores. These findings are consistent with the BDD literature, in which Emotional Stroop paradigms failed to detect significant group differences in the *BDD-body* word condition (Rossell et al., 2014), but inconsistent with Onden-Lim and colleagues (2012) who detected a positive association between DC and the attractive stimuli (comprised of facial features and body parts). Moreover, these results are inconsistent with Buhlmann et al. (2002) and Toh et al. (2017) who detected greater Stroop interference in the BDD group compared to controls on the *BDD-negative* word condition. However, these results must be interpreted with caution, given that Toh and colleagues (2017) combined the *BDD-negative* (e.g., *deformed*) and *BDD-body* (e.g., *skin*) word types to engender an overall category entitled *BDD-negative* words. In support of the current research, Buhlmann et al. (2002) reported that compared to the negative word type, the *BDD-positive* words produced a larger effect size difference. We did not detect significant group differences on subtypes of selective attention (i.e., orientation and disengagement**).** These findings are consistent with past research investigating vigilance and disengagement using this task in both non-clinical and clinical populations, reporting inconsistent results (Schmukle, 2005). Overall our findings provide some support for the usefulness of dot-probe paradigms in assessing selective attention biases in DC populations. However, more DC research should be done with an emphasis on clarifying the psychometric properties of this task.

To gain a better understanding of the relationship of selective attention and perfectionism from a clinical significance perspective, a graph depicting the simultaneous impact of selective attention and perfectionism on DCQ scores was generated. This demonstrated the additive effects of both the *congruency positive* word and Doubts about Actions subscale scores, whereby higher scores on both variables were associated with higher predicted scores on the DCQ. However, because these effects were additive, scores on either predictor, at which participants were predicted to exceed the DCQ clinical cut-off, were dependent on how they scored on the other predictor. Consequently, participants with a low score on one of these predictors required a much higher score on the other predictor to increase the likelihood of reaching clinical significance on the DCQ. For those scoring low on the Doubts about Actions subscale, it was predicted that participants would need to be very close to the maximum *congruency positive* score, thus showing that it was unlikely that those low on doubts about actions would end up with clinically significant DCs. In contrast, the minimum scores required on the Doubts about Actions subscale predicted to meet the DCQ clinical cut-off were all in the mid-range, with only small differences across the levels of *congruency positive* words. From a clinical perspective, these results suggest that low scores on the Doubts about Actions subscale might be somewhat protective against the negative effects of being high on the *congruency positive* words.

Overall, our findings provide further evidence for the association between perfectionism and DC and support for the efficacy of the FMPS in exploring perfectionism highly specific to DC. This could subsequently serve to inform the development of stimuli for dot-probe paradigms. While perfectionistic doubts about actions contributed more to the variance of DC than attention bias, it is difficult to interpret this finding given that we compared a self-report variable with an experimentally derived variable.

Limitations and Future Directions

This research should be interpreted in the context of the following limitations. The use of a cross-sectional design limits our ability to draw causal conclusions between the variables of interest. Further, the recruitment of university students limits the generalisability of our findings, as does the use of a non-clinical population. These results cannot be generalised to BDD populations, given that the DCQ assesses preoccupations with appearance, which are features of but not exclusive to BDD. Further, *DC-body* words were not predictive of DC symptomology and this might, in part, be explained by the failure of this study to assess the imperfections specific to the participants. In effect, this may have reduced the strength of the associations. Although stimuli were informed by the DC and BDD literature, another major limitation of this study was the failure to pilot test the stimuli selected. It is also important to note that we did not obtain information on education and intellectual quotient. In effect, we were unable to covary for these effects, which may have confounded dot-probe scores. It is also worth noting that because the DCQ is comprised of only seven items, each item has a significant impact on the final score (Schieber et al., 2018). Furthermore, item 3 assesses bodily malfunctions and has been found to have a low factor loading in factor analytic studies, which has led researchers to suggest a revision of this item (Schieber et al., 2018). Nevertheless, in the current study, although the item-total correlation was lowest for this item (.48), we cannot rule out the possibility that some participants endorsed symptomology consistent with olfactory reference syndrome or health anxiety. Furthermore, for the sake of limiting participant measures, we used a single item response option to assess substance dependence. Thus, it was not possible to ascertain with certainty whether we adequately excluded this population. Although more research is required to consolidate and extend these findings, this study provides some implications for devising new prevention and treatment strategies.

First, given that perfectionistic checking behaviours and selective attention toward *congruency positive* words both predicted DC psychopathology, experimental designs targeting these specific pathological mechanisms could be tested in vulnerable populations. In this way, we can establish some indication of causality. Second, upon further exploration of the psychometric properties of this task, future early intervention programs might consider the use of dot-probe paradigms to replace the Emotional Stroop task. This might yield findings that are more consistent and provide valuable insights into the aetiology of DC. Third, no research has investigated the relationship between selective attention toward perfectionistic target stimuli and DC. In the current study, the Doubts about Actions subscale was the only subtype of perfectionism to be associated with DC. Thus, this construct, which loads highly onto detail-oriented checking behaviours (Stairs et al., 2012), may warrant further investigation. These findings are consistent with the BDD literature that has highlighted the use of detail-oriented checking behaviours, such as mirror gazing and facial feature measurement (Veale & Riley, 2001). Fourth, given the limitations of self-report measures, such as reporting bias, future DC research might consider designing dot-probe paradigms that comprise of stimuli specific to this dimension of perfectionism; this would provide greater clarity as to whether there is a relationship between selective attention toward perfectionistic detail-oriented checking and DC. For example, comparisons could be made between DC and control group RT scores to appearance-related checking stimuli such as "*mirror", "reflection",* or *"facial symmetry".* Fifth, future studies using dot-probe paradigms could clarify discrepancies in the significance of DC-target words by including all word types (*DC-body, DC-negative,* and *DC-positive*) using three separate categories and request that participants identify facial and/or body part preoccupations; this would inform the dot-probe target stimuli selected, thereby strengthening associations. This could subsequently advise the development of treatment programs, such as cognitive bias modification, which has been used to improve symptoms of BDD (Fang et al., 2013; Premo, Sarfan, & Clerkin, 2016; Summers & Cougle, 2016; Wilver & Cougle, 2019). Furthermore, both cognitive bias modification and perfectionism treatment programs have been tested online (Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2012; Rozental et al., 2017; Shafran et al., 2017; Summers & Cougle, 2016), which is useful for a population known to avoid mental health treatment (Buhlmann & Winter, 2011; Phillips, 2017).

Conclusions

Drawing upon preliminary DC literature, the aim of this research was to explore the relative contributions of various dimensions of perfectionism and selective attention in predicting DC psychopathology, with the goal of informing the development of future methodological designs and intervention programs. Results from this study supported a relationship between perfectionism and selective attention with DC, where perfectionistic doubts about actions, a construct that loads onto details in checking, predicted more of the variance in DC psychopathology. Results from this sample suggest that further DC research investigating perfectionistic detail-oriented checking and selective attention biases toward *DC-positive* stimuli could be fruitful.

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Chapter 7

Internet-Delivered Cognitive-Behavioural Therapy for Perfectionism: Targeting Dysmorphic Concern[6]

[6]Additional content from the data analyses section of this chapter can be found in **Chapter 4.** This section was published and can be found in **Chapter 9 Appendix A**. The order of authorship is Shevaugn Johnson, Sarah Egan, Gerhard Andersson, Per Carlbring, Roz Shafran, and Tracey Wade. Shevaugn Johnson contributed 70%, 95%, and 70%, Sarah Egan contributed 5%, 0%, and 2%, Gerhard Andersson contributed 5%, 0%, and 2%, and Tracey Wade contributed 10%, 5%, and 22% to the research design, data collection and analysis, and writing and editing respectively.

Johnson, S., Egan S.J., Andersson, G., Carlbring, P., Shafran, R., & Wade, T.D. Internet-delivered cognitive-behavoiural therapy for perfectionism: Targeting dysmorphic concern, *Body Image, 30,* 44-55. https://doi.org/10.1016/j.bodyim.2019.05.002

Abstract

Perfectionism is an important transdiagnostic risk factor for several psychopathologies. As such, treatments targeting perfectionism have gained increased attention over recent years. While perfectionism is postulated to be an important underlying mechanism for dysmorphic concern, no research has explored the benefits of targeting perfectionism to reduce dysmorphic concern. The current study evaluated the use of Internet-delivered cognitive behavioural therapy for perfectionism (ICBT-P) with thirty-one participants (28 women) with high levels of dysmorphic concern to examine the impact on perfectionism, dysmorphic concern, body image disturbance, negative affect, and a dot-probe task assessing selective attention to appearance-based stimuli. Using a case series design, observations were collected at baseline, at the end of a four-week pre-treatment phase, after the eight-week ICBT-P, and one-month post-treatment. Intent-to-treat analyses showed significant improvement from baseline to end-of-treatment and follow-up on most of the variables, with a large effect size decrease in dysmorphic concern, and decreased vigilance for the *DC-body, DC-positive,* and *DC-negative* words. The results of this study support the use of ICBT-P as an efficacious treatment worthy of further examination in populations who experience high levels of dysmorphic concern.

Keywords: dysmorphic concern; cognitive-behavioural therapy; Internet; perfectionism; selective attention

Introduction

No research has examined the psychotherapeutic approaches to treating symptoms of DC. Thus, targeting the underlying risk and maintaining factors pervasive in this population, such as perfectionism and selective attention biases (Arji, Borjali, Sohrabi, & Farrokhi, 2016; Bartsch, 2007; Cunningham, Griffiths, Baillie, & Murray, 2016; Fang & Wilhelm, 2015; Jin et al., 2018; Onden-Lim, Wu, & Grisham, 2012), could be fruitful. Moreover, perfectionism has been found to be an important transdiagnostic risk factor that can be targeted in therapy (Limburg, Watson, Hagger, and Egan, 2017; Lloyd, S., Schmidt, U., Khondoker, M., & Tchanturia, 2015). Like many psychiatric populations, treatment barriers are common in individuals with BDD who are thought to experience clinically significant DC (Buhlmann & Winter, 2011). To address these barriers, Internet-delivered CBT (ICBT) has been extensively investigated over recent years (Andersson, Titov, Dear, Rozental, & Carlbring, 2019). One such approach, known as ICBT for perfectionism (ICBT-P), has been used successfully to target symptoms of perfectionism and secondary symptoms of depression and anxiety, core features of DC and BDD (Arpin-Cribbie, Irvine, & Ritvo, 2012; Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2012; Rozental et al., 2017; Shafran et al., 2017).

Given the postulated association between perfectionism and DC, and the gap in the literature assessing the impact of perfectionism on targeting symptoms of DC, the current study sought to evaluate the use of ICBT-P with respect to our primary outcomes, perfectionistic strivings and concerns, as well as our secondary outcomes, DC, body image disturbance, selective attention biases, and indicators of negative affect including depression, anxiety, and stress, using a case series design. Given that selective attention biases are also a risk factor for DC, we predicted that targeting perfectionism would also lead to a reduction in selective attention biases for DC-target word information. We hypothesised that compared to the baseline period, participants would show significant reductions in perfectionism (i.e., strivings and concerns) at the end-of-treatment, which would be maintained at one-month follow-up. Further, we predicted that compared to the baseline period, participants would also demonstrate significant treatment gains for all secondary outcomes at the end-of-treatment, which would be maintained at one-month follow-up.

Methods

Participants

Thirty-one participants (28 women) aged eighteen to thirty-nine with a mean age of 22.06 (5.54) years and mean BMI of 25.39 (SD=6.79) were recruited between August 2017 and March 2018 using an undergraduate university participation system and flyers posted at the university. Seventy-seven percent of the sample identified as Caucasian, 10% identified as Asian, 3% identified as African, and the remaining 10% identified as a race not otherwise listed. Furthermore, depression (35%) and anxiety (42%) were the most pervasive mental health problems endorsed by participants and the most commonly reported family mental health conditions (52% and 32% respectively). All participants gave informed consent electronically prior to commencing the study and were compensated $45 to take part in the entire study. This project was approved by the Social and Behavioural Research Ethics Committee (approval code 140.17). The following inclusion criteria were assessed using a single response option: i) spoke English as preferred language, ii) were not dependent on illicit drugs or alcohol, iii) were not pregnant, iv) did not have visual or motor impairments v) were not actively suicidal, vi) had not been given a diagnosis of BDD, and v) had clinically significant DCs (scoring ≥11 on the Dysmorphic Concern Questionnaire {DCQ}; Oosthuizen et al., 1998). To maintain a focus on DC consistent with BDD symptomology, we did not include individuals who exclusively endorsed weight concerns (Buhlmann, Reese, Renaud, & Wilhelm, 2008; Fang & Wilhelm, 2015). Further, given that muscle dysmorphia is a specifier of BDD and that areas above the neck are the most common preoccupations and are more prevalent in BDD than in eating disorders (Buhlmann et al., 2008; Fang & Wilhelm, 2015), we selected only those participants who identified a preoccupation with muscle mass, head shape, skin, hair, and/or at least one facial feature. Most participants endorsed three or more preoccupations with the legs (n=25), muscles (n=21), and skin (n=19) being the most common areas of concern.

Design

The current study employed a case series design where observations were collected on four occasions: at baseline (Time 1), at the end of a four-week pre-treatment phase (Time 2), at the end-of-treatment after completion of the online eight-week program (Time 3), and at one-month follow-up (Time 4). The following precautions were taken to limit bias: clearly defined objectives and protocols, specified inclusion/exclusion criteria, predetermined study duration and follow-up periods, and valid clinical outcome measures (Chan & Bhandari, 2011). All participants were first screened for study eligibility before undertaking an initial assessment. Assessments were completed at all time points (baseline, pre-treatment, end-of-treatment, one-month follow-up).

Measures

Demographics. Requested demographic information included sex, age, and race (see **Table 1**). Information on personal and familial mental health history was also requested.

Also collected were the *Frost Multidimensional Perfectionism Scale (FMPS; Frost, Marten, P., Lahart, C., & Rosenblate, 1990), Short-form version Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995), and Dysmorphic Concern Questionnaire (DCQ)*. Indicators of internal reliability are provided in **Table 1**. Due to limitations with

Cronbach's alpha assumptions (McNeish & Harlow, 2018), Coefficient H was computed as an indicator of internal reliability at all time points for all variables of interest using data from factor analyses. Additionally, a new questionnaire was used in this study, described below.

Multidimensional Body Self-Relations Questionnaire-Appearance Scales (MBSRQ-AS).

Description. The MBSRQ-AS measures body image disturbance and comprises of thirty-four items and five appearance-based subscales, which measure body and appearance-related satisfactions, weight-based concerns, and grooming behaviours (Brown, Cash, & Mikulka, 1990). The five subscales include an Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, Overweight Preoccupation, and Self-classified Weight measure. The Appearance Evaluation subscale measures satisfaction with overall appearance (Brown et al., 199). The Appearance Orientation subscale measures the extent to which individuals are preoccupied with their appearance. Higher scores on the Appearance Evaluation subscale indicate greater levels of satisfaction with overall appearance, and thus lower body image concerns (Brown et al., 1990). Higher scores on the Appearance Orientation subscale, however, indicate higher levels of preoccupation and are therefore indicative of greater body image disturbance (Brown et al., 1990). The Body Areas Satisfaction subscale measures levels of satisfaction concerning specific aspects of appearance. Thus, higher scores on this subscale indicate higher satisfaction with specific aspects of appearance and lower body image disturbance (Brown et al., 1990). The Overweight Preoccupation subscale measures dietary restrictions and weight-based anxiety; higher scores on this measure indicate greater body image dissatisfaction. Finally, the Self-Classified weight subscale measures self-appraisals of weight (Brown et al., 1990).

Based on the finding by Vossbeck et al. (2014) described below, the current study excluded the Self-Classified Weight subscale from the analyses (See **Appendix G** for the MBSRQ-AS items used in this study). Internal reliability of the Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, and Overweight Preoccupation subscales can be found in **Table 1.**

Reliability and validity. Research involving non-clinical and clinical populations of eating disorder and BDD participants has investigated the psychometric properties of the five MBSRQ-AS subscales, producing internal consistency scores ranging from weak to strong (Chronbach alpha's ranging from .47-.90; Hartmann et al., 2015; Hrabosky et al., 2009; Roncero, Perpiñá, Marco, & Sánchez-Reales, 2015; Rosen, Reiter, & Orosan, 1995; Vossbeck-Elsebusch et al., 2014). While most of the subscales produced good internal consistency scores, the Overweight Preoccupation and Self-Classified Weight subscales generated values falling below an adequate threshold. In a 2009 study by Untas, Koleck, Rascle, and Borteyrou 765 non-clinical participants were recruited from a French population, finding evidence for convergent validity of the MBSRQ-AS subscales with the Body Image Questionnaire. Convergent validity was further supported by Argyrides and Kkeli (2013) who recruited 1,312 Greek high school students, finding the MBSRQ-AS to be positively associated with a similar appearance-based measure. In their 2015 study, Hartmann and colleagues recruited sixty-nine BDD, anorexia nervosa, and healthy controls. The authors reported good convergent validity of the MBSRQ-AS with the Appearance Evaluation Scale (r= .41) and Body Areas Satisfaction Scale (r= .34) and good discriminant validity with constructs such as social desirability. Convergent validity was also supported in the study by Roncero et al. (2015) in which the five MBSRQ-AS subscales were found to be associated with the Diet factor from the Eating Attitudes Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982).

Factor structure. The five-factor structure of the MBSRQ-AS was supported using confirmatory factor analyses in a Spanish population (CFI= 0.95; RMSEA= .057; $\chi^2(517) = 2249.062$, $p < .001$; Roncero et al., 2015), generating moderate to high Pearson's r correlations among factors (Roncero et al., 2015). The structure has also been validated in participants with eating disorders using the German version of the MBSRQ-AS (Vossbeck-Elsebusch et al., 2014), with strong goodness of fit indices for all the factors, excluding the Self-Classified Weight subscale (CFI=.94, RMSEA=.08; $\chi^2(457) = 1837.72$, $p<.001$).

Dot-probe task. Stimuli consisted of forty target words and forty matched neutral words. Four published DC and BDD studies using dot-probe and Emotional Stroop tasks were used to generate most of the stimuli selected (Buhlmann, McNally, Wilhelm, & Florin, 2002; Onden-Lim, Wu, & Grisham, 2012; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014; Toh, Castle, & Rossell, 2017). Any additional stimuli were synonyms of these words. *DC-body* word stimuli included *eyebrows, nose,* and *teeth*. *DC-negative* words included *disgusting, deformity,* and *disfigured*. *DC-positive* words included *attractive, sexy,* and *handsome.* All word types were expected to correlate positively with DC. Examples of the target and matched stimuli for each category were: *eyebrows (backpack), deformity (parameter)* and *attractive (spectacles)*. Each trial was counterbalanced and Kucera and Francis' (1967) computational analysis of American English guide was used to match words for length, syllable, and frequency.

To address the limitations of multiple comparisons and the impact of task-related anxiety on disengagement from target stimuli on the dot-probe task (Frewen, Dozois, Joanisse, & Neufeld, 2008), we chose only to analyse the orientation scores for the three-word types (i.e., *DC-body, DC-negative,* and *DC-positive*). Orientation scores were calculated to capture vigilance toward the three-word types. This was measured by dividing neutral trials (in neutral-neutral word pair presentations) by congruent trials (where the dot follows the target word in a neutral-target word pair presentation). A higher value indicated greater vigilance toward the target word stimuli.

Intervention: overcoming perfectionism. The current study used the same ICBT protocol for clinical perfectionism (Egan, Wade, Shafran, & Antony, 2014), which has been evaluated previously (Rozental et al., 2017; Shafran et al., 2017). Overcoming Perfectionism is comprised of eight treatment modules; participants were instructed to complete the program at a rate of one module per week for a total of eight weeks. All information was accessed through a secure website. Content included reading material on the nature of CBT, clinical perfectionism, and factors maintaining symptomology. Further, homework assignments included behavioural experiments, cost-benefit analyses, cognitive restructuring, and graded exposure. The eight modules are outlined as follows: 1) *understanding perfectionism* 2) *your perfectionism cycle* 3) *surveys and experiments* 4) *new ways of thinking* 5) *useful skills for managing unhelpful perfectionism* 6) *self-criticism or self-compassion?* 7) *re-examining the way we define our self-worth* 8) *staying well: managing unhelpful perfectionism in the long-term*. Management of the online system was conducted by the first author. Participants were sent weekly reminder emails to complete the scheduled module one day before the due date. Before proceeding to the next module, it was ensured that each participant had completed all prior content. No further interaction with participants occurred throughout the completion of these modules.

Procedure

At Times 1 and 4, participants attended the university laboratory to complete the cognitive computer task and a series of online questionnaires administered on Qualtrics, which assessed levels of perfectionism, DC, body image disturbance, mood, and stress. Assessments were completed on a desktop personal computer (PC) with a twenty-two-inch monitor, a screen size of 470 x 298 mm, and a screen resolution (pixels) of 1680 width x 1050 height x 32 depth. Completion time for the cognitive task and web-based questionnaires was twenty minutes.

All participants were required to wait four weeks before completing the pre-treatment measures at Time 2 (excluding the cognitive task), which could be completed from any PC. Given the case series design, the waitlist period was included to allow us to compare within-group effect sizes to the treatment period, and a 4-week period was chosen to permit some indication of stability while not requiring participants to wait the entire 8-week length of the intervention. Completion time was approximately ten minutes. Following completion of the pre-treatment measures, participants commenced the eight-week online perfectionism program from a preferred PC. After completion of each weekly module (at a rate of one module per week, with completion times of approximately thirty minutes), participants were administered the seven-item DCQ questionnaire. Following completion of the eighth and final module (Time 3), participants were given the same measures administered at Time 2. After a one-month wait period, at Time 4, participants were asked to return to the university laboratory to complete the same cognitive computer task and baseline measures (excluding demographics) given at Time 1. Any participants who dropped out of the study after having commenced the treatment modules were given the option to wait one month from that time-period and return to the lab for the final assessment.

Data Analyses

To determine the suitability of parametric testing, normality was assessed across all time points using the Shapiro-Wilk test and visual inspection of histograms. Using all the data points from all time points as a single variable, we looked for outliers on each self-report variable of interest. Moreover, using this same method, we looked for outliers (scores deviating 3 standard deviations from the mean) on the dot-probe task. After restructuring the datasets such that all time points could be analysed as a single variable, no outliers were identified on any of the primary or secondary variables of interest.

In the current study, people who completed all treatment modules also completed all assessments, while those who did not complete all modules did not complete all assessments. The former were termed completers, and the latter were termed non-completers. Using logistic regression, comparisons were made between the two groups to ensure that data were missing at random.

To determine change over time with our treatment outcomes, multilevel modelling was employed, which uses maximum likelihood estimation to permit the inclusion of all cases with missing data into the analyses, thus representing intent-to-treat (ITT) analyses. We used a linear mixed model with fixed effects and an unstructured covariance matrix that applied a Bonferroni correction. The dependent variables represented the outcomes (i.e., perfectionism, body image disturbance, depression, anxiety, stress, and DC) at each time point analysed and the fixed variable was time. We also repeated the analyses while covarying for the effects of age (which could impact the dot-probe task) and BMI (which could impact the MBSRQ-AS or DCQ), which were entered as two additional fixed variables. To calculate within-group changes (Cohen's *d*) with completer and ITT samples (21 and 31 respectively), an online Psychometrica calculator (https://www.psychometrica.de/effect_size.html#repeated) was used which corrects for correlations over time. We then examined within-group effect sizes between three time points: 1) baseline to pre-treatment 2) baseline to end-of-treatment and 3) baseline to one-month follow-up. Using the same online calculator, we computed a subset of analyses for the ITT group such that we could compare within-group effect size differences on the DCQ from baseline to modules two through seven (See **Figure 2**).

Results

Preliminary Analyses

At Time 3, the DASS-21 Depression subscale was found to be positively skewed. Further, at Time 4, both the DASS-21 Depression and Stress subscales generated positive skews. In effect, log10 transformations were computed at all DASS-21 Depression and Stress time points, resulting in normal distributions. All other variables were found to be normally distributed. There were no significant differences between men and women on any of the variables of interest.

Non-Completion

In the current study, 32% of participants were considered non-completers (see **Figure 1** for reasons for attrition). This included two participants who dropped out over the first two treatment modules, but who agreed to return to the lab one month afterward to complete the final assessment phase. Logistic regression analyses revealed that no baseline variables predicted non-completion (see **Table 1**).

Additionally, a subset of analyses was computed such that comparisons could be made between the completers (n=21) and non-completers who finished a minimum of two treatment modules (n=4). Using the Psychometrica calculator, compared to the completer group (d = -

0.78), reductions in DCQ scores from baseline to module two were greater in the non-completer group (*d* = -6.00).

Symptom Change from Baseline to Pre-Treatment Period

Only the MBSRQ-AS Overweight Preoccupation subscale showed significant differences from baseline (Time 1) to the pre-treatment phase (Time 2), whereby scores increased after the four-week wait period. There were no significant differences from the baseline to the pre-treatment phase on any of the other variables analysed (See **Table 2**). No significant differences from baseline to pre-treatment were detected on any of the variables of interest when covarying for the effects of age and BMI (See **Table 3**). Completer analyses were also computed, which revealed a similar pattern of results.

Symptom Change from Baseline to End-of-Treatment and One-Month Follow-Up

Significant reductions in perfectionism, body image disturbance, depression, stress, and DC were demonstrated from baseline to the end-of-treatment phase; these results were maintained at one-month follow-up. A significant increase was also evident on the MBSRQ-AS Appearance Evaluation subscale from baseline to the one-month follow-up phase, which indicated a reduction in body image disturbance. For the dot-probe analyses, significant increases were evident in orientation scores for all word types (i.e., *DC-body, DC-negative,* and *DC-positive*) from baseline to one-month follow-up, indicating a reduction in vigilance toward the target stimuli. This suggests that selective attention is an epiphenomenon of DC and may not reuire treatment with interventions such as cognitive bias modification (Notebaert, Clarke, Grafton, & Macleod, 2015). From baseline to end-of-treatment phases, effect sizes ranged from small to large on the FMPS Concern over Mistakes, Doubts about Actions, and Personal Standards subscales (*d*= -0.84, -0.70, -0.37 respectively), ranged from small to medium for the

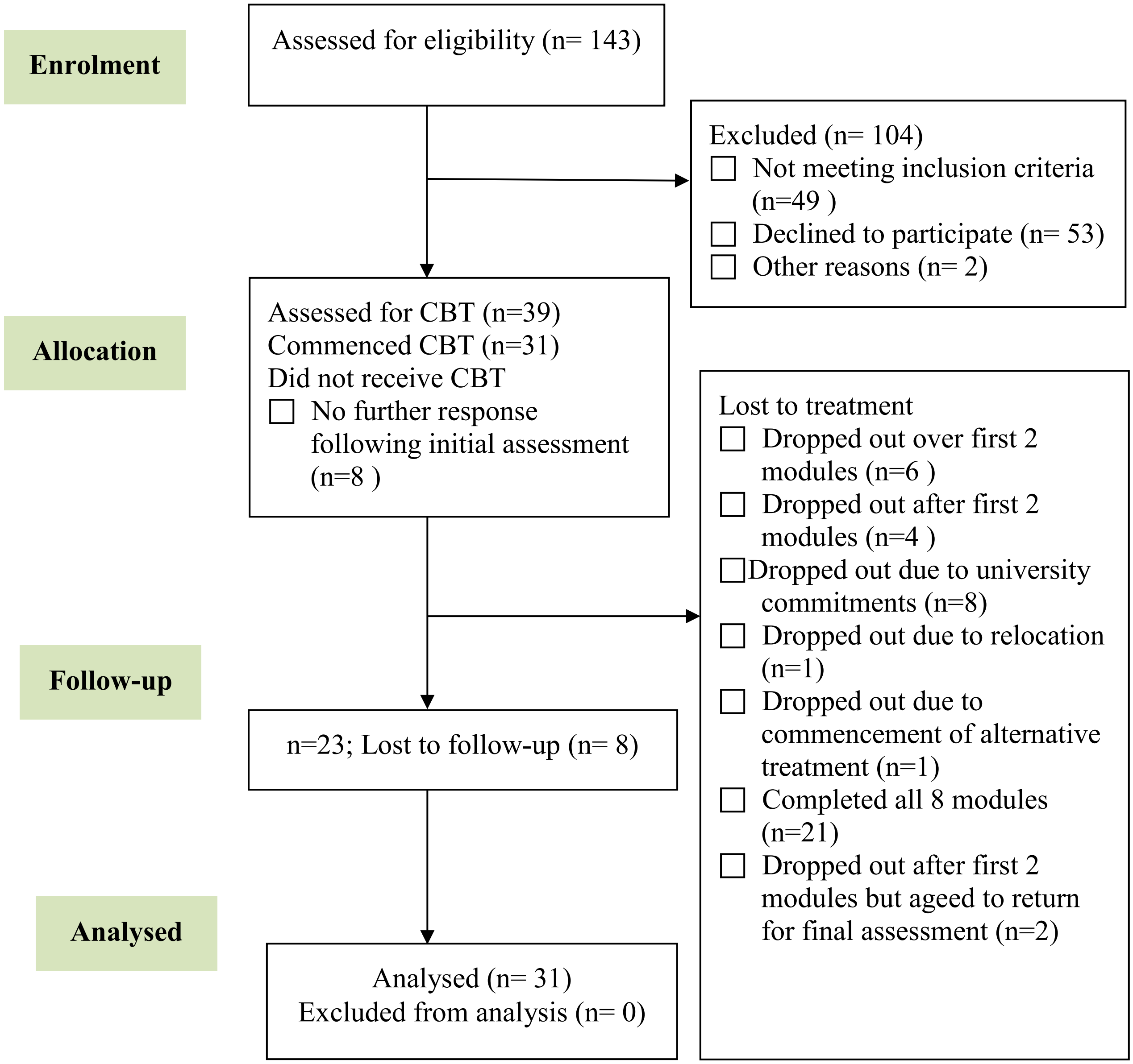


Figure 1. CONSORT flow chart for enrolment, allocation, follow-up, and analysis of participants involved in the online cognitive-behavioural therapy (CBT) for perfectionism program.

Table 1

Demographic information and logistic regression analyses to assess baseline predictors of attrition

Variable	Total Sample (*N=31; M(SD);* Range)	Completers (*N*=21; *M (SD);* Range)	Non-completers (*N*=10; *M (SD);* Range)	OR (95%) completer vs. non-completer	Internal reliability Using Coefficient H
Age	22.06 (5.54) 18-39	21.71 (5.09) 18-39	22.80 (6.61) 18-36	.97 (.84:1.10)	-
BMI	25.39 (6.79) 16-42	25.70 (6.63) 16-40	24.75 (7.43) 18-42	1.02 (.91:1.15)	-
Race					-
Caucasian	77%	55%	22%	-	-
Asian	.09%	.03%	.06%	-	-
African	.03%	.03%	0%	-	-
Other	.09%	.06%	.03%	-	-
Sex					
Male	.10%	.10%	0%	-	-
Female	90%	58%	32%	-	-
FMPS CM	32.26 (7.84) 11-44	33.24 (6.59)15-42	30.20 (10.07) 11-44	1.56 (.65:3.74)	.95
FMPS DA	15.00 (2.68) 8-20	15.19 (2.06) 12-19	14.60 (3.78) 8-20	1.40 (.44:4.43)	.83
FMPS PS	27.10 (4.28) 18-33	27.81 (4.19) 19-33	25.60 (4.30) 18-32	2.43 (.65:9.03)	.88
MBSRQ-AS AE	13.06 (3.98) 6-20	13.00 (3.18) 7-18	13.20 (5.51) 6-20	.98 (.31:3.08)	.91
MBSRQ-AS AO	46.64 (6.46) 33-60	45.81 (5.67) 33-54	48.40 (7.92) 36-60	.44 (.10:2.04	.84

MBSRQ-AS BAS	20.64 (4.45) 12-31	19.90 (3.48) 14-28	22.20 (5.94) 12-31	.33 (.06:1.70)	.85
MBSRQ-AS OWP	13.90 (3.29) 6-20	13.86 (2.63) 10-19	14.00 (4.55) 6-20	.95 (.37:2.40)	.85
DASS-21 Anxiety	7.71 (4.32) 1-15	7.52 (4.23) 1-14	8.10 (4.72) 1-15	.80 (.23:2.78)	.94
DASS-21 Depression	8.32 (5.05) 1-18	7.81 (5.15) 1-18	9.40 (4.90) 1-17	.69 (.24:1.97)	.86
DASS-21 Stress	10.35 (4.05) 2-19	10.48 (4.08) 4-19	10.10 (4.20) 2-16	1.18 (.31:4.45)	.89
Orientation Body	1.34 (.44) .83-2.56	1.41 (.48) .93-2.56	1.20 (.31) .83-1.80	4.16 (.40:43.26)	-
Orientation Negative	1.36 (.44) .83-2.62	1.42 (.49) .99-2.62	1.21 (.30) 1.83- .82	4.56 (.40: 43.26)	-
Orientation Positive	1.35 (.46) .83-2.66	1.42 (.51) .95-2.66	1.19 (.29) .83-1.75	5.19 (.42-63.54)	-
DCQ	11.58 (2.45) 8-18	11.43 (2.69) 8-18	11.90 (1.91) 9-15	.62 (.10-3.98)	.85

Note. BMI: Body Mass Index; FMPS, Frost Multidimensional Perfectionism Scale; FMPS CM, FMPS Concern over Mistakes subscale; FMPS DA, FMPS Doubts about Actions subscale ; FMPS PS, FMPS Personal Standards subscale; MBSRQ-AS, Multidimensional Body-Self Relations Questionnaire-Appearance Scales; MBSRQ-AS AE, MBSRQ-AS Appearance Evaluation subscale; MBSRQ-AS AO, MBSRQ-AS Appearance Orientation subscale; MBSRQ-AS BAS, MBSRQ-AS Body Areas Satisfaction subscale; MBSRQ-AS OWP, MBSRQ-AS Overweight Preoccupation subscale; DASS-21, Depression Anxiety and Stress Scale- Short Form; DASS-21Anxiety, DASS-21 Anxiety Subscale; DASS-21 Depression, DASS-21 Depression subscale; DASS-21 Stress, DASS-21 Stress subscale; Orientation Body, neutral trials (neutral-neutral word pairs)/ congruent trials for the dot-probe BDD-body word stimuli; Orientation Negative, neutral trials/ congruent trials for the dot-probe BDD-negative word stimuli; Orientation Positive, neutral trials/congruent trials for the dot-probe BDD-positive word stimuli; DCQ, Dysmorphic Concern Questionnaire.

Table 2

Change in Outcome Variables Over Time, Using Intent-To-Treat Analyses

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT (N=31)	M^a	SE	M^a	SE	D	95% CI	M^a	SE	d	95% CI	M^a	SE	d	95% CI	Main effect of Time (df), *p,* and post-hoc comparisons
FMPS CM	3.58	.16	3.61	.15	.05	-.44:.55	2.85	.18	-.84	.32:1.36	2.82	.17	-.81	.29:1.33	F=7.87 (3, 24), .001 T1, T2> T3, T4
FMPS DA	3.75	.12	3.63	.13	-.18	-.68:.31	3.21	.14	-.70	.18:1.21	3.28	.14	-.63	.12:.1.14	F=5.98 (3, 24), .003 T1, T2> T3, T4
FMPS PS	3.87	.27	3.73	.28	-.15	-.65: .35	3.38	.29	-.37	-.87:.13	3.42	.29	-.37	-.87:.14	F=5.54 (3, 22), .01 T1, T2> T3, T4
MBSRQ-AS AE	2.17	.12	2.23	.14	.13	-.37:.63	2.54	.15	.47	-.03:.97	2.67	.10	.89	.37:1.41	F=15.64 (3, 26), <.001 T1, T2< T4
MBSRQ-AS AO	3.89	.10	3.94	.10	.17	.66: -.33	3.53	.10	-.60	.09:1.11	3.44	.10	-.81	.29:.1.32	F= 7.78 (3, 24), .001 T1, T2> T3, T4
MBSRQ-AS BAS	2.29	.09	2.29	.10	.00	-.50:.50	2.71	.13	.68	.16:1.19	2.73	.12	.73	.21:1.24	F=6.72 (3, 23), .002 T1, T2< T3, T4
MBSRQ-AS OWP	3.48	.15	3.97	.21	.96	.43: 1.48	3.54	.25	.09	-.40:.59	3.46	.26	-.03	-53:.46	F=7.99 (3, 21), .001 T1< T2, T2> T4

DASS-21 Anxiety	1.10	.11	1.14	.12	.07	-.43:.57	1.00	.15	-.20	-.70:.03	.92	.15	-.32	-.82:.18	F=1.15 (3, 24), .35
DASS-21 Depression[b]	.33	.03	.34	.02	.07	-.43:.57	.24	.03	-.65	.14:1.16	.23	.03	-.86	.34:1.38	F=6.72 (3, 23), .002 T2> T3, T4 T1>T4
DASS-21 Stress[b]	.38	.02	.42	.02	.36	-.14:.86	.29	.03	-.80	.28:1.32	.28	.03	-.91	.39:1.44	F=10.28 (3, 22), <.001 T1, T2>T3, T4
Orientation Body	1.34	.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	.03	.81	.30:1.33	F=11.11 (1, 30), .002 T1>T4
Orientation Negative	1.36	.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	.13	.35	-.15:.85	F=10.61 (1, 29), .003 T1>T4
Orientation Positive	1.35	.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	.03	.91	.38:1.43	F=11.26 (1, 30), .002 T1>T4
DCQ	1.93	.07	1.82	.09	-.26	-.76:.24	1.03	.12	-1.35	.80:1.91	.90	.12	-1.72	1.14:2.30	F=21.57 (3, 26), <.001 T1, T2>T3, T4

Note. [a] indicates estimated mean values; [b] indicates data that was transformed; ITT, intent-to-treat; M, Mean; SE, Standard Error; d, within-time Cohen's d, 95% CI, 95% Confidence Intervals; df= degrees of freedom.

MBSRQ-AS Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, and Overweight Preoccupation subscales (*d*= 0.47, -0.60, 0.68, 0.09 respectively), ranged from small to large on the DASS-21 Anxiety, Depression, and Stress subscales (*d*= -0.20, -0.65, and -0.80 respectively), and was large for the DCQ (*d*= -1.35). DCQ scores were also tracked following the completion of each treatment module. Aside from the pre-treatment period, compared to the baseline, there were significant reductions in DC symptomology across all time points (See **Figure 2**). There was a large effect size difference (*d*= -1.72) from baseline to one-month follow-up. Compared to the effect size difference between baseline and end-of-treatment, effect sizes increased from baseline to one-month follow-up on the Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, Depression, and Stress subscales, and DCQ. ITT analyses were also conducted while covarying for the effects of age and BMI. While the analyses produced a similar pattern of results, compared to baseline, the Personal Standards subscale became significant at the end-of-treatment and one-month follow- up, the Appearance Evaluation subscale became significant at the end-of-treatment, and the Body Areas Satisfaction and Stress subscales were no longer significant at the end-of-treatment and one-month follow-up (See **Table 3**). A similar pattern of results was detected in the completer analyses on most of the variables of interest (See **Tables 4** and **5**). One important difference was that when completer analyses were run without covarying for age and BMI, the DCQ engendered small effect size decreases from baseline to end-of-treatment (*d*= -.30) and one-month follow-up (*d*= -. 39).

The Impact of Perfectionism on Dysmorphic Concern

As a post-hoc analysis and to investigate the impact of perfectionism on DC, regression analyses were computed whereby the change in perfectionism (i.e., FMPS Concern over

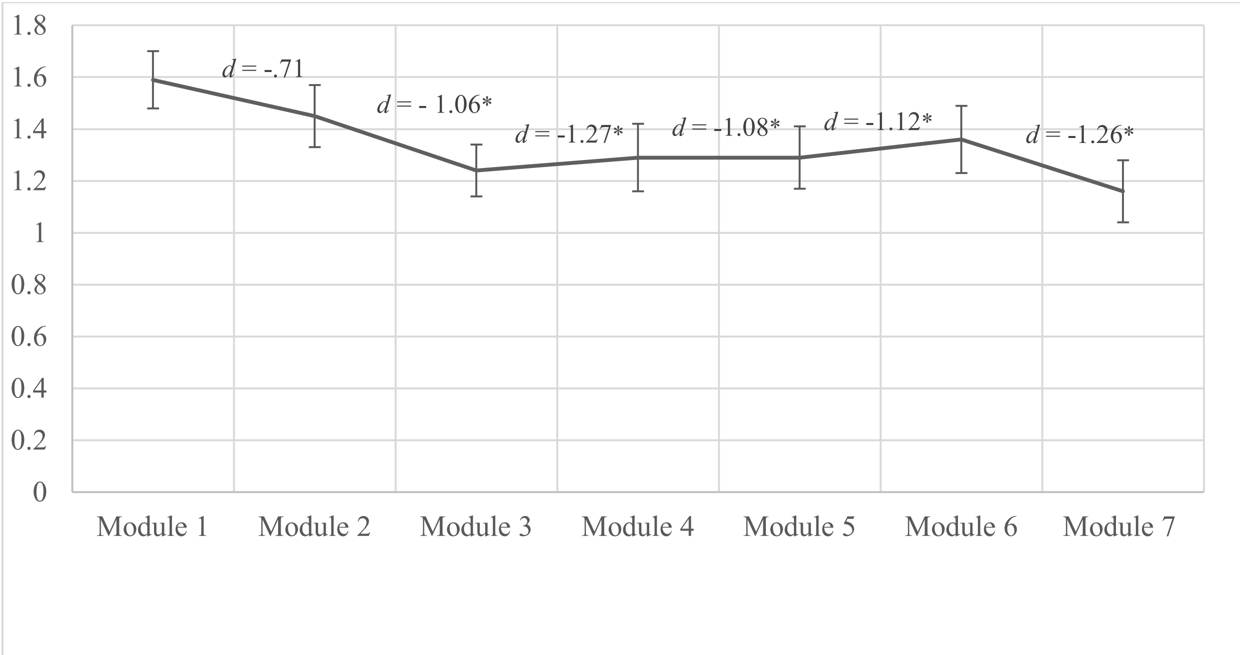
Table 3

Change in Outcome Variables Over Time (Covarying for Age and BMI), Using Intent-To-Treat Analyses

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT (N=31)	M[a]	SE	M[a]	SE	D	95% CI	M[a]	SE	d	95% CI	M[a]	SE	d	95% CI	Main effect of Time (df), *p,* and post-hoc comparisons
FMPS CM	3.59	.15	3.61	.14	.04	-.46:.54	2.84	.19	-.92	.40:1.45	2.82	.17	-.87	.35:1.40	F=8.09 (3, 24), .001 T1, T2> T3, T4
FMPS DA	3.75	.12	3.63	.13	-.19	-.68:.31	3.21	.14	-.70	.18:1.21	3.28	.14	-.63	.12:1.14	F=6.02 (3, 24), .003 T1, T2> T3, T4
FMPS PS	3.87	.11	3.73	.12	-.36	-.87:.14	3.38	.14	-.90	.38:1.42	3.42	.14	-.90	.37:1.42	F=5.55 (3, 22), .005 T1, T2> T3, T4
MBSRQ-AS AE[d]	2.16	.11	2.22	.13	.14	-.36:.64	2.54	.15	.54	.03:1.05	2.67	.09	.99	.47:1.52	F=15.85 (3, 26), <.001 T1, T2<T4
MBSRQ-AS AO	3.88	.10	3.94	.09	.20	-.30:.70	3.54	.10	-.56	.06:1.07	3.44	.11	-.79	.27:1.31	F=7.58 (3, 24), .001 T1, T2> T3, T4
MBSRQ-AS BAS[c]	2.29	.42	2.28	.42	-.00	-.50:.49	3.59	.43	.45	-.05: .95	2.74	.42	.16	-.34:.66	F=20.02 (3, 24), <.001 T1, T2< T3, T4
MBSRQ-AS OWP[d]	3.48	.65	3.57	.65	.04	-.46: .54	3.50	.69	.01	-.49:.50	3.43	.69	-.02	-.52:.48	F=.16 (3, 24), .92

DASS-21 Anxiety	1.10	.11	1.14	.12	.07	-.43:.57	1.00	.15	-.20	-.70:.30	.92	.15	-.32	-.82:.18	F=1.15 (3, 24), .35
DASS-21 Depression[b]	.33	.03	.34	.02	.07	-.43:.57	.24	.03	-.65	.14:1.16	.23	.03	-.86	.34:1.38	F=6.75 (3, 23), .002 T1>T4 T2> T3, T4
DASS-21 Stress[b]	.38	.04	.42	.04	.18	-.32:.68	.29	.05	-.40	-.90:.10	.28	.04	-.46	-.96:.05	F=10.31 (3, 22), <.001 T1, T2>T3, T4
Orientation Body	1.34	.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	.03	.81	.30:1.33	F=10.99 (1, 30), .002 T1> T4
Orientation Positive	1.36	.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	.03	.81	.30:1.33	F=10.50 (1, 29), .003 T1> T4
Orientation Negative	1.35	.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	.03	.91	.38:1.43	F=11.06 (1, 30), .002 T1> T4
DCQ	1.93	.07	1.82	.09	-.27	-.77: .23	1.04	.12	-1.35	.80:1.90	.90	.12	-1.72	1.14:2.31	F=9.42 (10, 22), <.001 T1, T2> T3, T4

Note. [a] indicates estimated mean values; [b] indicates data that was transformed [c] indicates variables where the covariate age was found to have a significant *p* value (<.05); [d] indicates variables where the covariate body mass index (BMI) was found to have a significant *p* value (<.05); ITT, intent-to-treat; M, Mean; SE, Standard Error; d, within-time Cohen's d; CI 95%, 95% Confidence Intervals; df= degrees of freedom.



Note. * indicates a significant *d* value from baseline to post-module completion of the DCQ

Figure 2. Within-group effect sizes (Cohen's *d*) between baseline and weekly intent-to-treat (ITT) Dysmorphic Concern Questionnaire (DCQ) scores for modules two to seven.

Table 4

Change in Outcome Variables Over Time, Using Completer Analyses

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT (N=31)	M[a]	SE	M[a]	SE	d	95% CI	M[a]	SE	D	95% CI	M[a]	SE	d	95% CI	Main effect of Time (df), *p,* and post-hoc comparisons
FMPS CM	3.69	.16	3.66	.18	-.07	-.67: .54	2.90	.19	-1.11	.47:.1.76	2.85	.18	-1.09	.44: 1.74	F=7.75 (3, 20), .001 T1, T2>T3, T4
FMPS DA	3.80	1.00	3.71	1.00	-.02	-.63: .59	3.24	1.01	-.11	-.71: .50	3.29	1.01	-.10	-.70: .51	F=6.75 (3, 20), .003 T1, T2>T3, T4
FMPS PS	3.97	.13	3.88	.13	-.24	-.85:.37	3.50	.16	-.89	.26: 1.52	3.52	.16	-.67	.29: 1.56	F=4.87 (3, 20), .001 T1, T2>T3, T4
MBSRQ-AS AE	2.16	.12	2.26	.15	.26	-.35:.87	2.56	.16	0.64	.01: 1.25	2.68	.11	.65	.48:1.78	F=14.25 (3, 20), <.001 T1, T2<T4
MBSRQ-AS AO	3.82	.27	3.88	.27	.09	-.52:.70	3.50	.27	-.24	-.85:.37	3.39	.27	-.35	-.96:.26	F=6.10 (3, 20), .004 T1, T2>T3, T4
MBSRQ-AS BAS	2.21	.22	2.25	.23	.05	-.56:.65	2.71	.25	.40	-.21:1.01	2.73	.25	.43	-.18:1.04	F=7.78 (3, 20), .001 T1, T2<T3, T4
MBSRQ-AS OWP	3.46	.14	3.93	.22	1.20	.54:1.85	3.46	.27	.00	-.60:.60	3.34	.30	-.25	-.86: .35	F=10.15 (3, 20), <.001 T1<T2, T2>T4
DASS-21 Anxiety	1.07	1.49	1.20	1.50	.02	-.59:.63	.99	1.50	-.01	-.55:.59	.88	1.50	-.03	-.64:.57	F=1.95 (3, 20), .15

DASS-21 Depression[b]	.31	.03	.35	.03	.34	-.27:.94	.23	.04	-.71	.08:1.33	.22	.04	-.94	.30: 1.57	F=8.51 (3, 20), .001 T1>T4, T2>T3, T4
DASS-21 Stress[b]	.39	.05	.43	.05	.17	-.43:.78	.30	.05	-.39	-1.00:.22	.28	.05	-.49	-1.10:.12	F=14.08 (3, 20), <.001 T1, T2>T3, T4
Orientation Body	1.41	.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	.03	1.03	.39:1.67	F=9.76 (1, 20), .005 T1> T4
Orientation Positive	1.43	.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	.14	1.05	.41:1.70	F=9.41 (1, 19), .006 T1> T4
Orientation Negative	1.43	.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	.03	1.05	.41:1.70	F=10.20 (1, 20), .005 T1> T4
DCQ	1.90	.38	1.83	.38	-.04	-.65: .57	1.06	.39	-.30	-.91: .31	.90	.39	-.39	-1.00:.22	F=17.07 (3, 20), <.001 T1, T2>T3, T4

Note. [a] indicates estimated mean values; [b] indicates data that was transformed; M, Mean; SE, Standard Error; d, within-time Cohen's d; 95% CI, 95% Confidence Intervals; df= degrees of freedom

Table 5

Change in Outcome Variables Over Time (Covarying for Age and BMI), Using Completer Analyses

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT (N=31)	M[a]	SE	M[a]	SE	d	95% CI	M[a]	SE	D	95% CI	M[a]	SE	d	95% CI	Main effect of Time (df), *p,* and post-hoc comparisons
FMPS CM	3.69	.17	3.66	.18	-.06	-.67:.54	2.90	.20	-1.04	.40:1.69	2.85	.19	-1.02	.38:1.67	F=7.75 (3, 20), .001 T1, T2> T3, T4
FMPS DA[e]	3.80	.14	3.71	.14	-.14	-.74:.47	3.24	.14	-.76	.13:.1.38	3.29	.14	-.72	.09:1.34	F=7.86 (3, 60), <.001 T1, T2> T3, T4
FMPS PS	3.97	.12	3.88	.13	-.26	-.87:.35	3.50	.16	-.96	.33:1.60	3.52	.16	-1.00	.36:1.64	F=4.87 (3, 20), .011 T1, T2> T3, T4
MBSRQ-AS AE[d]	2.16	.11	2.26	.14	.28	-.33:.89	2.56	.16	.69	.07: 1.32	2.68	.09	1.23	.57:1.89	F=14.25 (3, 20), <.001 T1, T2<T4
MBSRQ-AS AO	3.82	.10	3.88	.09	.24	-.37:.85	3.50	.10	-.64	.02:1.27	3.39	.11	-.94	.30:1.57	F=6.10 (3, 20), .004 T1, T2> T3, T4
MBSRQ-AS BAS	2.21	.31	2.25	.32	.03	-.57:.64	2.71	.33	.28	-.32: .89	2.73	.33	.30	-.31:.91	F=7.78 (3, 20), .001 T1, T2< T3, T4
MBSRQ-AS OWP[d]	3.46	.17	3.93	.24	.99	.35:1.63	3.46	.29	.00	-.61:.61	3.34	.32	-.21	-.82:.40	F=10.15 (3, 20), <.001 T1<T2, T2>T4
DASS-21 Anxiety	1.07	.14	1.20	.16	.10	-.51:.70	.99	.18	-.07	-.67:.54	.88	.17	-.15	-.75:.46	F=1.95 (3, 20), .15

DASS-21 Depression[b]	.31	.03	.35	.03	.34	-.27:.94	.23	.04	-.71	.08:1.33	.22	.04	-.94	.30:1.57	F= 8.51 (3, 20), .001 T1>T4 T2>T3, T4
DASS-21 Stress[b]	.39	.02	.43	.02	0.44	-.18:1.05	.30	.03	-.97	.33:1.61	.28	.03	-1.22	.56:1.88	F=14.08 (3, 20), <.001 T1, T2>T3, T4
Orientation Body	1.41	.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	.14	.49	-.12:1.10	F=9.75 (1, 20), .005 T1>T4
Orientation Positive	1.43	.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	.03	.94	.30:1.58	F=9.41 (1, 20), .006 T1>T4
Orientation Negative	1.43	.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	.11	.65	.02:1.27	F=10.18 (1, 20), .005 T1>T4
DCQ	1.90	.10	1.83	.11	-.15	-.76:.46	1.06	.12	-1.13	.48:1.78	.90	.12	-1.48	.80: 2.17	F=17.07 (3, 20), <.001 T1, T2>T3, T4

Note. [a] indicates estimated mean values [b] indicates data that was transformed [c]indicates variables where the covariate age was found to have a significant *p* value (<.05). [d]indicates variables where the covariate body mass index (BMI) was found to have a significant *p* value (<.05); [e] indicates where compound symmetry covariance matrix was used in replace of an unstructured covariance matrix due to wide standard error values; M, Mean; SE, Standard Error; d, within-time Cohen's d; 95% CI, 95% Confidence Intervals.

Mistakes, Doubts about Actions, and Personal Standards subscales) scores from baseline to end-of-treatment were entered as predictor variables and the DCQ score at the end-of-treatment or one-month follow-up was entered as the outcome variable (See **Table 4).** No significant associations were noted.

Discussion

This is the first study to investigate the efficacy of ICBT-P in targeting symptoms of DC and the first study to explore the transdiagnostic benefits of targeting perfectionism in this population. Except for anxiety scores, significant reductions in psychopathology were found at the end-of-treatment and maintained at one-month follow-up across all variables of interest. Furthermore, there were significant reductions between DCQ scores from the baseline and assessments following the completion of each treatment module. In the ITT group, effect size differences from baseline to end-of-treatment ranged from small to large for perfectionism, small to medium for body image disturbance, small to large for negative affect, and large for DC. From baseline to one-month follow-up, effect sizes ranged from small to large on orientation word scores. We saw no correlations between changes in perfectionism and changes in DC, which might indicate that there was an indirect effect of perfectionism (e.g., through a third variable such as body image disturbance) or that there was insufficient power to detect a direct effect. Our findings also suggest that improvements in DC can be achieved early on in therapy. It is also of interest to note that compared to the end-of-treatment phase, effect sizes were larger at one-month follow-up for many of the variables analysed. This indicated that not only did the treatment effects endure over time, but they also became larger (See **Tables 2** and **3**). Completer analyses were run, which generated a similar pattern of results. However, when age and BMI were not covaried for, the post-treatment DCQ scores generated a much smaller effect size decreases from baseline. Thus, it is possible that the covariates reduced some of the variance observed. Additionally, compared to the completer group, those who completed at least two treatment modules and then dropped out of the study had a much larger effect size decrease in DCs from baseline to module two, suggesting that reasons for non-completion might have also been influenced by a high perceived initial benefit of the treatment program.

The results from this case series were consistent with previous ICBT-P studies (Arpin-Cribbie et al., 2012; Radhu et al., 2012; Rozental et al., 2017; Shafran et al., 2017), as well as the BDD studies (Buhlmann et al., 2008; Hartmann et a., 2015) and meta- analytic study by Limburg and colleagues (2017), who found perfectionism to be an important underlying feature maintaining psychopathology. The results of the current study also reflect novel research findings, which indicate that targeting symptoms of perfectionism reduces vigilance toward DC-target word stimuli relative to a wait-list period. These findings are consistent with Shafran, Cooper, and Fairburn (2002) who postulate that the cognitive mechanism underlying perfectionism involves selective attention biases toward environmental threats signalling failure. In the case of individuals with clinically significant DCs, this might be reflected in attentional biases toward appearance-based stimuli. According to the BDD model by Wilhelm (2006), individuals with high degrees of DC engage in cognitive distortions whereby perceived imperfections trigger global negative self-evaluations (e.g., "if I am not attractive then I am a failure"). Similarly, in Veale's (2004) BDD model, heightened perfectionistic standards of beauty are thought to play an important role in maintaining symptoms of DC. It is of interest to note that this intervention manifested in greater improvements on the DCQ compared to the FMPS; perfection in this population may be primarily focused on appearance-based concerns.

Limitations

Future research is required to address the current study's limitations. First, a one-month follow-up period is insufficient to determine whether ICBT-P produced long-term reductions in the psychopathological mechanisms associated with DC. Second, although precautions were taken to limit study bias, the use of a case series design and the lack of a true control group increased the risk of bias and decreased generalisablity of the findings. For example, we cannot rule out the possibility that treatment effects were influenced by the passage of time and the expectation that symptoms would improve. Furthermore, due to the lack of a control group, it was not possible to ascertain whether treatment effects were a true reflection of the intervention or whether these effects were influenced by the regression towards the mean. The Medical Research Council does recommend when developing complex interventions, the use of pilot research such as case series designs prior to the implementation of RCTs (Craig et al., 2008); these designs can be used to develop effect size changes that can be used in future power analyses. Third, although men and women did not differ on any of the variables of interest, most participants were women (90%), which might also lower the generalisability of our findings. Fourth, to address a gap in the DC literature, specifications were put forth to recruit a population endorsing symptomology more specific to BDD. However, the DCQ captures symptomology consistent with other disorders, therefore, we cannot ascertain with certainty whether this intervention would be useful for patients with symptoms of BDD. Fifth, we did not pilot test the dot-probe stimuli or covary for the effects of intellectual quotient and education, which might have confounded the results. It is also worth noting that the 95% confidence intervals for the orientation word scores were large, indicating that there might have been issues with the reliability of the dot-probe task, a concern highlighted in earlier research (Schmukle, 2005). Finally, because this was an Internet intervention, a structured clinical interview was not undertaken. In effect, we were unable to ascertain whether any of our participants met criteria for a psychiatric diagnosis. Thus, failure to include a symptom severity measure of BDD was a further limitation of the current research, as levels of symptomatology may moderate response to the ICBT-P. In effect, to improve and titrate treatment options, referrals for a more comprehensive assessment could occur prior to enrolling participants in treatment programs. While these results cannot be translated directly to BDD populations, this study was consistent with the BDD-NET findings by Enander and colleagues (2016) and conformed to the 2005 NICE guidelines for BDD by trialling the use of ICBT unspecific to BDD psychopathology in a DC population. Better-powered studies are required to test models that can explain how perfectionism impacts our secondary outcomes.

Future Directions

The results of this case series might be used to inform the development of future dot-probe stimuli. For example, researchers might consider incorporating stimuli depicting asymmetrical facial features. Testing this in populations with clinically significant DCs can provide valuable insight into the aetiology of clinical disorders. Given that reliability issues with the dot-probe task has been noted (Schmukle, 2005), to bolster reliability, future research might consider winsorizing outliers in replace of using pre-determined standard deviation cut-off scores (Price et al., 2015). Nevertheless, targeting general symptoms of perfectionism led to a reduction in vigilance toward the DC-target word stimuli. Thus, future research might consider replicating this study in a clinical population with BDD. It might also be of interest to explore the transdiagnostic benefits of perfectionism treatment programs in other psychiatric populations known to display selective attention abnormalities, such as social phobia and eating disorders (Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Yair, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007). Furthermore, given that participants improved on measures of perfectionistic strivings and concerns, future DC research should endeavour to replicate these results, such that a more comprehensive understanding of the specific subtypes of perfectionism underlying DC can be achieved.

While more research is needed to replicate these findings, these results provide important insights into the development of novel CBT-based approaches. For example, for the purposes of DC research, it might useful to modify the current intervention program to include material that is specific to appearance-related imperfections. Finally, these preliminary results suggest that future DC research should be carried out to evaluate the efficacy of CBT-P against disorder-specific CBT-based approaches, such as CBT-BDD (Rosen, Reiter, & Orosan, 1995), using an RCT design (NICE, 2005). While replication is required in a clinical population, given the treatment barriers common in BDD populations (e.g., shame, poor screening practices, misdiagnoses, and access issues; Buhlmann & Winter, 2011), exploring options outside the context of intensive, specialised approaches, such as CBT-BDD (Harrison, Fernández de la Cruz, Enander, Radua, & Mataix-Cols, 2016), would be fruitful.

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Chapter 8

Summary, Synthesis, and Integration of Overall Findings

Summary of Aims and Findings

Given that no models of dysmorphic concern (DC) exist to date, and that DC is thought to share similar underlying personality and neurocognitive mechanisms with body dysmorphic disorder (BDD; Bartsch, 2007; Senín-Calderón et al., 2017), an initial aim of this thesis was to conduct the first meta-analysis of the four cognitive processing deficits outlined in the most recent cognitive-behavioural therapy (CBT) model of BDD by Fang and Wilhelm (2015). Multilevel modelling (accounting for multiple measures from the same study) was used to compare cognitive task scores between BDD and control groups on measures of local processing, interpretive biases, memory deficits, and selective attention, finding significant group differences across all cognitive categories, excluding local processing. In addition, selective attention produced the largest effect size difference between BDD and control groups. It was concluded that interpretive biases toward ambiguous stimuli and the overvaluation about the importance of attractiveness, memory deficits, and notably, selective attention toward disorder-relevant stimuli were important factors that may contribute to the development and maintenance of BDD.

Another important aim of this thesis was to further explore the role of key cognitive and personality factors (i.e., selective attention and perfectionism) in predicting and maintaining DC psychopathology. Although widely accepted as a superior measure of attention as compared to the Stroop paradigm, no published studies had evaluated this task in a BDD population. Similarly, very little DC research had investigated the use of this task in capturing selective attention biases. In effect, the third study produced novel research findings, after adjusting methodology from lessons learned from the second study. Using simultaneous multiple regression analysis, it was the first to investigate specific aspects of selective attention (i.e., congruency, orientation, and disengagement) using a dot-probe task in a DC population endorsing preoccupations unspecific to muscle dysmorphia. Moreover, this was the first study to separately investigate the three DC word types (i.e., *DC-body, DC-negative,* and *DC-positive*) used across the literature. It was confirmed that faster responses to the *DC-positive* words (e.g., *pretty*) predicted DC in men and women. To yield more consistent findings, it was recommended that future research use dot-probe tasks in replace of Stroop tasks. It was also recommended that participants identify at the outset which body parts are the focus of attention, such that the *DC-body* word stimuli would produce a stronger manipulation.

An additional novel contribution of this third study was the investigation of specific perfectionistic subscales in predicting DC. Compared to selective attention, perfectionistic detail-oriented checking predicted more of the variance in DC psychopathology. Thus, given the limitations of self-report measures, it was recommended that these results inform the development of future dot-probe tasks. It was suggested that future research investigate whether DC populations selectively attend to perfectionistic details in checking. Establishing the types of information attended to can inform the development of attentional probe tasks used to retrain maladaptive attentional styles; this might subsequently be used toward innovative prevention and treatment protocols for BDD. The impact of selective attention and perfectionism on DC was examined by generating a graph of the simultaneous multiple regression analysis while considering the clinical cut-off scores (≥11) on the Dysmorphic Concern Questionnaire (DCQ; Oosthuizen, Lambert, & Castle, 1998). These results indicated that lower scores on the *congruency positive* words (selective attention) might be protective against the effects of scoring higher on the Doubts about Actions subscale (perfectionistic detail-oriented checking) and *vice versa*. Consequently, these results suggest that by targeting one area of psychopathology (e.g., perfectionism), secondary treatment gains in another area (e.g., selective attention) might be achieved.

Informed by the third study, another key aim of this thesis was to explore the transdiagnostic treatment benefits of targeting perfectionism in a population with clinically significant DCs. Furthermore, due to the benefits of Internet-delivered approaches, such as greater accessibility and lower costs, study four was the first of its kind to evaluate the efficacy of Internet-delivered CBT for perfectionism (ICBT-P) in targeting various psychopathological mechanisms in a DC population. Using a case series design, treatment of perfectionism engendered reductions in perfectionistic strivings and concerns as well as secondary improvements across most of the psychopathological mechanisms assessed, including selective attention biases and DC, with an attrition rate of 32%. The relationship between perfectionism and DC was analysed in greater detail. The results indicated that there were no correlations between changes in perfectionism and changes in DC. Thus, it was concluded that this could be indicative of an indirect effect of perfectionism by way of a third variable, such as body image disturbance. Insufficient power might have also explained these results. In sum, it was concluded that ICBT-P might be a useful therapy for individuals with clinically significant DCs. Furthermore, future research using randomised controlled trials (RCT) might consider testing this approach in clinical populations and comparing its efficacy against CBT-BDD. This therapeutic approach would serve to foster autonomy and address other treatment barriers such as shame and poor access to resources common in BDD populations (Buhlmann & Winter, 2011).

Integration with Recent Research and Clinical Applications

Cognitive Processing Deficits in Body Dysmorphic Disorder

The results from the meta-analysis were consistent with the BDD models that identified interpretive biases, memory deficits, and selective attention as important cognitive deficits underlying BDD psychopathology (Fang & Wilhelm, 2015; Neziroglu et al., 2004; Veale, 2001; Veale, 2004; Veale et al., 1996; Wilhelm & Neziroglu, 2002; Wilhelm, Phillips, Fama, Greenberg, & Steketee, 2011). While no significant differences were detected between the BDD and control groups on cognitive tasks measuring local processing biases, some explanations for these null findings included a failure to consider brain imaging research, moderators, and methodology. Consistent with the obsessive-compulsive disorder (OCD) literature (Obsessions Compulsions Cognitions Working Group, 1997), the discrepancies across the cognitive tasks analysed highlighted the advantage of developing a working party to address the methodological issues. For example, when measuring central coherence, the Rey Complex Figures Test (RCFT) yielded more consistent findings across the studies included in the meta-analysis. This finding is consistent with the OCD literature, in which compared to healthy controls, OCD participants have displayed poorer copy organisation and recall scores on this task (Shin, Park, Park, Seol, & Kwon, 2006). This is also consistent with a 2018 study by Greenberg et al. that was released following the publication of our meta-analysis. The authors administered the RCFT to BDD and control participants, finding that compared to the controls, the BDD group displayed poorer copy and delayed recall scores, which were used to measure visuospatial organisation.

Consistent with the eating disorder and OCD literature (Cardi et al., 2015; Tchanturia, Lounes, & Holttum, 2014), these meta-analytic results supported the investigation of cognitive bias modification and cognitive remediation therapy in targeting interpretation biases and memory deficits. Furthermore, selective attention was found to produce the largest between- group effect size difference. This finding was consistent with the BDD models that have identified selective attention as the most pervasive cognitive mechanism underlying psychopathology (Fang & Wilhelm, 2015; Veale et al., 1996; Veale, 2001, Veale, 2004, Wilhelm et al., 2011). In accordance with the eating disorder literature (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007; Shafran, Lee, Cooper, Palmer, & Fairburn, 2008), it was concluded that cognitive tasks measuring specific underlying selective attention biases, such as the dot-probe paradigm, should be explored in populations endorsing clinically significant

DCs.

The Role of Selective Attention and Perfectionism in DC Psychopathology

BDD models and preliminary DC and BDD research have identified selective attention and perfectionism as important underlying mechanisms contributing to the developmental trajectory of clinically significant DCs. Consistent with the BDD literature, the third study found selective attention biases toward the *DC-positive* word condition in the high DC group, with no significant group differences found on the *DC-body* word condition (Buhlmann, McNally, Wilhelm, & Florin, 2002; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014; Toh, Castle, & Rossell, 2017). This finding was consistent with Buhlmann et al. (2002) who found the *BDD-positive* words to generate the largest between-group effect size difference. Furthermore, these results were consistent with the DC literature (Jin et al., 2018; Onden-Lim, Wu, & Grisham, 2012), in which compared to the low scoring groups, those with greater DCs displayed attentional biases toward the target stimuli. Furthermore, the body image literature emphasising eating disorder symptomology and one non-clinical muscle dysmorphic study have detected vigilance toward (i.e., orientation) and difficulties disengaging from the target stimuli using the dot-probe paradigm (Jin et al., 2018; Oldershaw et al., 2011). While it is worth noting that Jin et al. (2018) used a combined modified dot-probe and eye tracking methodological approach, the third study failed to replicate these findings. One possible explanation for these null results is the use of a between-group design, which introduces more variability. While efforts were made to increase the reliability of the dot-probe task, issues with the reliability of this task reported in the literature might have further compounded this issue (Schmukle, 2005). Nevertheless, results from this thesis were aligned with previous literature (Jin et al., 2018; Oldershaw et al., 2011) when a case series design was employed in the fourth study. It was found that compared to the baseline and pretreatment periods, the participants showed a reduction in vigilance toward the target stimuli, indicating improvements to selective attention biases toward all word types. Thus, it is possible that the use of a within-group design reduced variability, therefore, bolstering the overall power of the study.

Consistent with the preliminary BDD research (Buhlmann, Etcoff, & Wilhelm, 2008; Hartmann, Thomas, Greenberg, Matheny, & Wilhelm, 2015), the third study reported perfectionistic concerns (i.e., Doubts about Actions subscale) as a significant predictor of DC psychopathology. The failure of the FMPS Personal Standards subscale to predict DC was consistent with some of the ICBT literature (Arpin-Cribbie, Irvine, & Ritvo, 2012; Shafran et al., 2017) and a BDD study by Buhlmann et al. (2008). Conversely, these results were inconsistent with the BDD study by Hartmann et al. (2015) and a meta-analytic study investigating perfectionism as a transdiagnostic risk factor (Limburg, Watson, Hagger, & Egan, 2017), in which both subtypes of perfectionism (i.e., concerns and strivings) were found to underlie psychopathology. These results were also inconsistent with the current treatment study, which engendered reductions in both subtypes of perfectionism at immediate and one-month follow-up. Thus, given that this thesis was the first to explore various subscales of the Frost Multidimensional Perfectionism Scale (FMPS; Frost, Marten, Lahart, & Rosenblate, 1990) in a DC population, replication is required to elucidate these findings. Results from the current treatment study were also consistent with a meta-analytic study investigating CBT-P, in which secondary improvements to depressive, disordered eating, and OCD psychopathology were detected (Lloyd, Schmidt, Khondoker, & Tchanturia, 2015). Conversely, unlike Lloyd and colleagues (2015), the current treatment study did not engender improvements to symptoms of anxiety. In sum, the current cross-sectional and treatment studies suggest that perfectionism may be an important underlying predictor of DC, which can be targeted in therapy to improve a broad range of psychopathology.

Attrition

The attrition rate (32%) reported in the treatment study was comparable with a recent meta-analysis that investigated CBT-based approaches across various mental health conditions, which generated an overall attrition rate of 26% (Fernandez, Salem, Swift, Ramtahal, & Nezu, 2015). These findings were also comparable with an earlier study by Melville, Kasey, and Kavanagh (2010) who detected a 31% attrition rate for online interventions targeting a multitude of mental health conditions, including eating disorders. Similarly, a 2010 systematic review (Christensen, Griffiths, & Farrer, 2009) reported an overall attrition rate of approximately 29% for online interventions targeting a wide range of psychopathology. These results were also comparable to an earlier 2006 meta-analysis by Spek et al. who investigated ICBT in non-clinical and clinical populations with symptoms of depression and anxiety, detecting attrition rates of upwards of 34%. However, attrition rates of the current study were higher than the average overall attrition rate reported in a recent 2018 meta-analysis by Carlbring, Andersson, Cuijpers, Riper, and Hedman-Lagerlöf who compared face-to-face CBT and ICBT, finding no differences in rates of attrition between the two groups.

CBT-based interventions for BDD have reported attrition rates ranging from 0-56%, with meta-analytic results generating lower overall rates of attrition than what was found in the current treatment study (Harrison, Fernández de La Cruz, Enander, Radua, & Mataix-Cols, 2016; Williams, Hadjistavropoulos, & Sharpe, 2006). This discrepant finding is likely due to the inclusion of randomised controlled trials (RCT), which have a propensity to produce superficially high rates of completion (Harrison et al., 2016). Finally, the attrition rate reported in the current treatment study was consistent with the average attrition rate (27%) detected across the available ICBT-P studies (Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2014; Rozental et al., 2017; Shafran et al., 2017).

Directions for Future Research

Randomised Controlled Trials

While the National Institute for Health and Care Excellence (NICE, 2005) guidelines do not provide information on DC, they do outline research recommendations for the treatment of OCD and BDD. The NICE (2005) guidelines suggest using a double-blind RCT to investigate the efficacy of CBT alone and in conjunction with selective serotonin reuptake inhibitors. Furthermore, the guidelines recommend assessing the acceptability and cost-effectiveness of various CBT delivery-methods and to compare the results with psychological therapies unspecific to BDD. Prior to the development of complex interventions, it is recommended to pilot test the research using shorter, cost-effective approaches, such as case series designs (Craig et al., 2008), which can then enable calculation of effect sizes to plan for future more methodologically rigorous studies. Furthermore, to evaluate treatment efficacy, long-term follow-up periods of one, two, and five years have been recommended (NICE, 2005).

Due to factors such as cost, time, and limited resources, and in line with the above-mentioned recommendations, ICBT-P was evaluated using a case series design. Moreover, the current treatment study was the first to trial the use of ICBT-P in a DC population. These results supported the implementation of future research using RCTs to evaluate the efficacy of ICBT-P against disorder-specific CBT-BDD. The use of online transdiagnostic approaches has several benefits, such as easier implementation, broader dissemination, and the provision of autonomy, which are common treatment barriers reported in BDD populations, who are known to endorse clinically significant DCs (Buhlmann & Winter, 2011). The use of transdiagnostic treatment approaches mitigates the difficulties of implementing various treatment protocols for differential diagnoses (Craske, 2012) and addresses overlap occurring across various disorders (Egan, Wade, & Shafran, 2011). Furthermore, transdiagnostic approaches might be particularly useful in BDD populations, given that poor screening practices and misdiagnoses are commonly reported in the literature (Buhlmann & Winter, 2011). Future studies should endeavour to replicate these findings using RCT approaches and to evaluate treatment efficacy using long-term follow-up periods.

Cognitive Processing Deficits

The results of the meta-analysis and past OCD literature suggest that future DC and BDD research might consider prioritising the RCFT, such that the role of global-local processing biases in predicting and maintaining symptomology can be more stringently determined. This is an important nosological distinction warranting further investigation, as the current CBT-BDD treatment paradigm emphasises the necessity of perceptual retraining (Phillips, 2017). Elucidating this would be useful, given that CBT-BDD is a long and intensive program with few clinicians who have adequate training, which can act as deterrents in this population (Harrison et al., 2016). Unlike the other cognitive deficits outlined in the Fang and Wilhelm (2015) model, to date, no research has investigated the role of memory deficits in DC populations. Research of this nature could be used to gain insight into whether memory deficits precede the onset of BDD or are unique to clinical presentations. Consequently, this data could be used to ascertain whether targeting memory deficits in early intervention programs could be fruitful.

Selective Attention and Perfectionism

This thesis was the first to explore various subscales of the FMPS in a DC population, finding the Doubts about Actions subscale, which loads highly onto detail-oriented checking, to be the strongest predictor of DC. In addition to the Doubts about Actions subscale, the fourth study found significant reductions on the Personal Standards subscale post-treatment, which also loads highly onto detail-oriented checking (Stairs, Smith, Zapolski, Combs, & Settles, 2012). Consequently, based on these results, future DC research should endeavour to replicate these findings. Moreover, future research exploring perfectionism and selective attention in DC populations might consider incorporating dot-probe trials that capture this dimension of perfectionism. DC and BDD research might also consider combining eye-tracking technology with the dot-probe paradigm; this approach would serve to enhance the reliability of reaction time data (Price et al., 2015). This technique has been used successfully in one non-clinical muscle dysmorphic population that employed a modified dot-probe task (Jin et al., 2018) and one BDD study that administered a Modified Stroop task (Toh, Castle, & Rossell, 2017). Additionally, to further improve the reliability of this task, Price and colleagues (2015) recommend winsorizing outliers in replace of setting a priori standard deviation cut-off scores. Furthermore, to enhance the validity of the dot-probe task by ensuring that half the screen is not being ignored, researchers might consider incorporating discriminative choices as to whether the target probe matches the neutral probe (Yiend & Matthews, 2001). This design method would enable a more direct measure of attention bias.

While more research is needed to consolidate these findings, the current treatment study provides preliminary evidence for the transdiagnostic benefits of targeting perfectionism in DC populations, including secondary improvements to selective attention biases. While the meta-analytic and cross-sectional results supported the use of cognitive bias modification, the results from the case series indicated that selective attention is an epiphenomenon and therefore, might not require treatment targeting attentional retraining. Thus, future research might consider the use of CBT-P in populations displaying selective attention biases. Additionally, compared to perfectionism scores, the current treatment study engendered larger effect size decreases in symptoms of DC, suggesting that perfectionism in this population might be best represented by appearance-related concerns. This is consistent with a BDD model by Wilhelm (2006) who postulates that perfectionism relates to the drive for perfect symmetry and that anything short of this is deemed unacceptable. Thus, future ICBPT-P research might consider incorporating material relating to appearance-based concerns. Furthermore, given that we did not detect a direct relationship between perfectionism and DC, further work needs to be done to clarify this relationship. For example, it might be useful to conduct mediation analyses to gain a deeper understanding of whether other variables are influencing these results.

Limitations

Sample Characteristics and Design

While efforts were made to recruit a clinical population from within the community, the cross-sectional and treatment studies were comprised primarily of female university participants, lowering the generalisability of the findings. Furthermore, another limitation was the inclusion of a cross-sectional design. This limited our ability to establish true cause and effect and heightened the risk of inherent bias. Furthermore, while precautions were taken to limit selection bias, the lack of a true control group in the treatment study increased the risk of bias and further lowered the generalisability of the findings. Moreover, the use of a one-month follow-up period was insufficient to establish long-term treatment gains. Nevertheless, this was the first treatment study to investigate the efficacy of ICBT-P in a population with clinically significant DCs, and it was concluded that targeting perfectionism as a transdiagnostic factor might be a viable treatment option in these populations.

Measures

A potential limitation of this thesis was the inclusion of the DCQ. While high scores on this measure are thought to increase the likelihood of a BDD diagnosis, there is a debate in past literature about whether it is capturing symptoms of BDD specifically or whether it is measuring a broader construct applicable to a multitude of disorders (Jorgensen, Castle, Roberts, & Groth-Marnat, 2001), with recent research postulating the latter. Thus, a limitation of this research was that the DCQ captures body image concerns related but not exclusive to BDD. While recent literature suggests that extending DC to capture symptoms of social avoidance and compulsions more closely resembles features of BDD (Senín-Calderón et al., 2017), past research has postulated that characteristics of DC, such as appearance-related concerns, cannot reliably differentiate BDD from eating disorders (Rosen, & Ramirez, 1998). Thus, given that there is a gap in the literature involving DC central to BDD, in hindsight, it might have been prudent to use an alternative screening measure, such as the Body Dysmorphic Disorder Examination (Rosen & Reiter, 1996). However, when delivered using the interview format, this measure takes upwards of one hour to complete (Jorgensen et al., 2001). Moreover, self-report versions have been reported to be strenuous on attentional processes, which are postulated to be compromised in populations with clinically significant DCs (Fang & Wilhelm, 2015; Jin et al., 2018; Johnson, Williamson, & Wade, 2018; Jorgensen et al., 2001; Onden-Lim et al., 2012). Moreover, the Appearance Anxiety Inventory (Veale et al., 2014) measures symptoms of body image anxiety, with a focus more specific to BDD. However, while a recent study investigating the factor structure of this scale has since been released (Roberts et al., 2018), while this thesis was under construction, only one published study had investigated the psychometric properties of this measure (Veale et al., 2013) and no research had examined these properties using a non-clinical sample outside the context of a clinical environment. Moreover, while it is not as widely used as the DCQ, the Body Image Concern Inventory (Littleton, Axsom, & Pury, 2005) is considered a valid screening tool for BDD; it captures appearance-related obsessions and compulsions, as well as impairment in functioning (Ghadakzadeh, Ghazipour, Khajeddin, Karimian, & Borhani, 2011).

Consequently, while the DCQ might be less specific in measuring symptoms of BDD as compared to other screening measures, it is advantageous in that it is a widely used measure with extensive research supporting its psychometric properties. Furthermore, the DCQ is easily administered and interpreted, rendering it more suitable for online research. One pertinent limitation of this measure in the context of this research was the inclusion of the item assessing bodily malfunctions (used in the cross-sectional research). This item has been shown to have the lowest factor loading and is thought to be less associated with DC (Shieber, Kollei, de Zwaan, & Martin, 2018). Thus, future DC research should endeavour to modify this item such that it reflects psychopathology more consistent with DC (Schieber et al., 2018). It is also worth noting that in a study by Mancuso, Knoesen, and Castle (2010), the DCQ was administered to a sample of undergraduates and a cut-off score of nine was found to have the best sensitivity and specificity. Thus, while we also recruited university students, using a lower cut-off score increases the likelihood of false negative detection rates (Schieber et al., 2018). Therefore, because a cut-off score of eleven is the most commonly used value in the literature and is said to identify individuals with clinically significant DCs (Monzani et al., 2012; Schieber et al., 2018), this value was selected for the current research.

While efforts were made to increase the psychometric properties of the dot-probe task, another important limitation of this research was a failure to assess the reliability and validity of this measure. Research investigating vigilance and disengagement using this task in both non-clinical and clinical populations have reported inconsistent results (Schmukle, 2005). Thus, while methodology may have played a role, the inconsistencies reported in the literature were evident in this thesis where vigilance did not predict DC in the cross-sectional studies but was found to decrease from pre to post-treatment in the ICBT-P study. Moreover, while power might have influenced the results, unlike the second study, the third study failed to detect an attention bias toward the *DC-negative* word (e.g., *ugly*) stimuli. Another potential limitation was the application of pre-determined standard deviation cut-off scores to identify outliers. As highlighted by Price and colleagues (2015), the reliability of this task is bolstered when applying the winsorization method in replace of arbitrary cut-offs. In addition, due to the resources that were made available during the design phase of the dot-probe task, there were some potential limitations that could not be addressed retrospectively. For example, given that participants were presented words on the left or right of the screen and were not asked to make a discriminative choice concerning whether the target probe matched the original probe, it was difficult to ascertain with certainty whether the task was a true measure of attention bias (Yiend & Matthews, 2001).

Another limitation of this thesis was the use of a single item response option to assess substance dependence. The rationale behind this was to minimise the number of assessments provided to participants. Nevertheless, this is an insufficient method of assessing this condition. In effect, the results might have been confounded by failing to exclude some individuals who were dependent on drugs and/or alcohol.

Pragmatically, self-report measures are useful for research purposes because unlike diagnostic interviews, they are not time-consuming and can be more readily disseminated across large sample sizes. Furthermore, they are unavoidable when online research is conducted. Nevertheless, it is important to consider the limitations of self-report measures, such as biased responses favouring social desirability, inaccurate interpretations, and the propensity to respond in a consistent manner, irrespective of honest answering (Podsakoff & Organ, 1986). Moreover, the current research concluded that compared to selective attention, perfectionism was a superior predictor of DC, which subsequently informed the treatment study. This is problematic, given that compared to the dot-probe task used to investigate selective attention, self-report measures were used to draw conclusions about perfectionism. In effect, this resulted in a more direct measure of this construct and increased the risk of response bias.

Conclusions

This thesis generated the first studies to simultaneously evaluate perfectionism and selective attention biases, two postulated aetiological factors, in predicting and maintaining symptoms of DC.

Additionally, this was the first systematic review and meta-analysis to explore the cognitive processing deficits associated with BDD. Findings from the meta-analytic, cross-sectional, and treatment studies supported the role of selective attention biases in predicting and maintaining symptomology in populations with clinically significant DCs, namely BDD. Furthermore, both subtypes of perfectionism (strivings and concerns) were found to be associated with DC psychopathology. Targeting perfectionism using an ICBT-P approach led to a reduction in primary symptoms of perfectionism and secondary symptoms of body image disturbance, vigilance toward appearance-related stimuli, negative affect, stress, and DC. Replication is required to consolidate and extend these novel research findings. For example, it is recommended that by using an RCT design, future research compare the efficacy of ICBT-P against CBT-BDD in populations with clinically significant DCs.

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Chapter 9

Publications and Appendices

Appendix A

Published Versions of Manuscripts

Number of Words (text only) = 7,943
Number of Figures = 5
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A Systematic Review and Meta-analysis of Cognitive Processing Deficits Associated with Body Dysmorphic Disorder

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Abstract

This systematic review and meta-analysis examined the evidence supporting the association between body dysmorphic disorder (BDD) symptomology and four types of cognitive processing abnormalities: local processing, selective attention, interpretive biases, and memory deficits. Twenty-three studies met inclusion requirements that examined differences in performance on cognitive tasks between BDD and control groups across the four categories. Multilevel modelling was used to calculate an overall effect size for each cognitive category. BDD and control groups differed significantly on measures of selective attention (g=.60, 95% CI=.26: .93), interpretive biases (g=.30, 95% CI=. 07: .54), and memory deficits (g=.56, 95% CI=.26: .87). Differences between the BDD and control groups on measures of local processing did not reach significance. These findings support the hypothesis that people with BDD may selectively attend to perceived threats or to disorder-related stimuli, misinterpret ambiguous stimuli as threatening, overvalue the importance of attractiveness, and have inaccurate coding and recall for facial or bodily stimuli. Recommendations for future research of these specific cognitive deficits in BDD include introducing the use of Modified Dot Probe Paradigms and new treatment targets that can be used as adjuncts to current treatment modalities.

Keywords: body dysmorphic disorder; meta-analysis; local processing, selective attention; interpretive biases; memory deficits

Body dysmorphic disorder (BDD) is characterised by repetitive behaviours or mental acts concerning preoccupations with perceived flaws in appearance (Phillips, 2005). Common behaviours include mirror checking, camouflaging to conceal the perceived defect, mirror avoidance, seeking reassurance about appearance, and excessive grooming. The most common areas of focus include the nose, skin, and hair; however, some patients may also focus on areas of the body. For example, muscle dysmorphia is a specifier of BDD that presents as a preoccupation with muscle mass (American Psychiatric Association [APA], 2013).

BDD affects approximately 1-2% of the population (Bjornsson, Didie, & Phillips, 2010), and is thought to affect males and females equally. However, sufferers rarely seek out mental health services and therefore BDD remains a poorly understood and under-researched disorder, and incidence rates may be far greater than currently estimated (Bjornsson et al., 2010). Until the recent release of the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013), BDD was classified as a somatoform disorder. New evidence surrounding clinical and neuropsychological similarities between BDD and obsessive-compulsive disorder (OCD) has led to the reclassification of BDD under the obsessive-compulsive and related disorders category. For example, BDD and OCD have similar brain abnormalities that impair frontal lobe functioning (Labuschagne, Rossell, Dunai, Castle, & Kyrios, 2013). Research also shows commonalities in treatment response to cognitive behavioural therapy (CBT), exposure and response prevention, and selective serotonin reuptake inhibitors, suggesting neuroanatomical similarities between the two disorders (Labuschagne et al., 2013). Furthermore, there are similarities in the presenting symptoms, with the obsessions in both OCD and BDD resulting in compulsive checking and reassurance-seeking behaviours (Phillips, 2005).

Theoretical perspectives on the aetiology and maintenance of BDD

Progress in the treatment of BDD remains limited, restrained by the paucity of theoretical models of BDD, most of which are cognitive behavioural in nature. The most recent model encompasses a comprehensive paradigm related to the evidence-base that currently informs the aetiology of BDD (Fang & Wilhelm, 2015). In addition to earlier experiences of teasing, sociocultural values, and genetic factors, Fang and Wilhelm (2015) suggest that perfectionism, rejection sensitivity, and fear of negative evaluation from others may act as precursors to the development of four types of cognitive processing deficits (described below and in **Table 1**), one of which includes selective attention that has been highlighted in previous models (e.g., Veale, 2004). These deficits are hypothesised to contribute to the development and maintenance of negative emotions, such as anxiety and disgust, which then trigger behaviours characteristic of BDD, namely avoidance and compulsions. In line with Neziroglu, Roberts, and Yaryura-Tobias (2004), Fang and Wilhelm (2015) further contend that these maladaptive behaviours maintain dysfunctional beliefs by way of negative reinforcement. Although avoidance and compulsions serve to reduce anxiety in the short term, maladaptive beliefs are reinforced in the long term; BDD sufferers fail to learn that they would have managed despite engaging in these maladaptive behaviours.

Cognitive deficits associated with BDD

Central coherence. Weak central coherence, a limited ability to understand context or to "see the big picture", is thought to influence selective attention toward perceived flaws in appearance rather than holistically processing body or facial stimuli (Feusner, Moller, et al., 2010). Studies using cognitive tasks like the Inverted Face Task (Thompson, 1980), Mooney Faces Task, Rey Complex Figures Task (RCFT; Osterrieth, 1944), a variation of an Inverted Face Task called the Famous Faces Task, as well as attractiveness ratings using high and low spatial frequency images and functional magnetic resonance imaging (fMRI) technology have shown support for this hypothesis (Arienzo et al., 2013; Deckersbach et al., 2000; Feusner, Hembacher, Moller, & Moody 2011; Feusner, Moller, et al., 2010; Feusner, Moody, et al., 2010; Moody et al., 2017; Feusner, Townsend, Bystritsky, & Bookheimer, 2007; Jefferies, Laws, Hranov, & Fineberg, 2010; Jefferies, Laws, & Fineberg, 2012; Li, Lai, Bohon, et al., 2015; Toh, Castle, & Rossell, 2017a). However, other studies using the Benton Facial Recognition Task (Benton & Van Allen, 1968), a variation of the Inverted Face Task using houses and facial stimuli, the Navon task (Navon, 1977), electroencephalogram (EEG), magnetic resonance imaging (MRI), fMRI and the Composite task (Young, Hellawell, & Hay, 1987) have failed to detect significant differences between BDD and control groups (Buhlmann, McNally, Etcoff, Tuschen-Caffier, & Wilhelm, 2004; Li, Lai, Loo, et al., 2015; Moody et al., 2015; Monzani, Krebs, Anson, Veale, & Mataix-Cols, 2013). Research using a Navon task and an Embedded Figures task (Witkin, 1971) found that compared to controls, the BDD group performed worse on *both* the global and local processing trials (Kerwin, Hovav, Hellemann, & Feusner, 2014). Furthermore, given that brain-imaging and the same or similar variations of cognitive tasks have been found to produce null findings as well as results both in support of and counter to the hypothesis, results across these studies suggest that the relationship of central coherence difficulties and associated global processing abnormalities (or conversely strengths in local processing) and BDD remain inconclusive.

Selective attention biases. Selective attention biases are thought to account for biased attention toward disorder-related or threat stimuli (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). In the case of BDD, this involves specific physical features. Neuropsychological research on eating disorders has described selective attention as enhanced distractibility (Tchanturia, Campbell, Morris, & Treasure, 2005). Thus, it has been proposed that sufferers of BDD may attend to external stimuli that have become associated with their obsessions, or to perceived flaws in appearance, which are considered to be relevant (e.g., attractive) or threatening (e.g., hideous) to the disorder. Although so Hübner me studies which have used Emotional Stroop tasks (Watts, McKenna, Sharrock, & Trezise, 1986), eye trackers, symmetry tasks, discrimination tasks, and perceptual modification tasks (Buhlmann, McNally, Wilhelm, & Florin, 2002; Greenberg, Reuman, Hartmann, Kasarskis, & Wilhelm, 2014; Grocholewski, Kliem, & Heinrichs, 2012; Kollei, Horndasch, Erim, & Martin, 2017; Lambrou, Veale, & Wilson, 2011; Stangier, Adam-Schwebe, Muller, & Wolter, 2008; Toh, Castle, & Rossell, 2017b; Toh, Castle, & Rossell, 2017c; Thomas & Goldberg, 1995; Yaryura-Tobias et al., 2002), have supported this hypothesis; other studies using facial discrimination tasks, symmetry tasks, Emotional Stroop tasks, and video face distortion tasks (Buhlmann, Rupf, Gleiss, Zschenderlein, & Kathmann, 2014; Hübner,et al., 2016; Reese, McNally, & Wilhelm, 2010; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014) have failed to detect significant differences between BDD and control groups. There remains some uncertainty around whether BDD participants, compared to controls, have enhanced discriminatory abilities solely for their own facial stimuli or for objects or other people's faces. In their 2011 study, Lambrou and colleagues detected a response bias toward detecting symmetry changes to their own faces, which did not extend to the object and other-face control conditions, concluding that BDD sufferers selectively attended to self-referent information.

Interpretive biases. Interpretive biases describe negative appraisals of body image and are thought to contribute to biases for ambiguous information and overvalued ideas about the importance of attractiveness. Interpretive biases, which are said to be influenced by specific triggers such as stress, negative mood, comments by others, and physiological changes that occur during adolescence, may in part account for why BDD sufferers are highly critical of their appearance (Fang & Wilhelm, 2015). While some studies have found that BDD sufferers have a tendency to misinterpret neutral facial expressions as expressing negative emotion (Buhlmann, Etcoff, & Wilhelm, 2006; Buhlmann, Gleiß, Rupf, Zschenderlein, & Kathmann, 2011; Buhlmann, McNally, Etcoff, Tuschen-Caffier, & Wilhelm, 2004; Labuschagne, Castle, & Rossell, 2011), results concerning the specific emotions underlying these maladaptive cognitions remain inconclusive. Although Buhlmann et al. (2006) found that compared to controls, BDD participants had a tendency to misinterpret neutral expressions for anger and contempt, consistent with Buhlmann, Gleiß et al. (2011), the misinterpretation of neutral facial stimuli for disgust failed to reach significance. This is somewhat surprising given that all of the BDD models identify disgust as one of the central emotions that drives avoidance and ritualistic behaviours (Neziroglu et al., 2004; Veale, 2004; Wilhelm & Neziroglu, 2002). Furthermore, a 2002 study by Buhlmann, Wilhelm et al. found that compared to controls, BDD participants misinterpreted ambiguous situations (general, social, and body-related scenarios) as threatening.

Results concerning the tendency of BDD sufferers to over-value the importance of attractiveness are also mixed. While some studies which have used the Go/No-go Association Task (Nosek & Banaji, 2001), the Implicit Association Task (Greenwald, McGhee, & Schwartz, 1998), and a Values Scale to look at implicit attractiveness beliefs (Buhlmann, Teachman, & Kathmann, 2011; Buhlmann, Teachman, Naumann, & Fehlinger, 2009; Lambrou et al., 2011) have found significant differences between BDD and control groups, other studies using the same measures have failed to detect any differences across these groups (Buhlmann, Teachman, Gerbershagen, Kikul, & Rief, 2008; Hartmann et al., 2015).

Memory deficits. Results relating to memory deficits, thought to account for inaccurate coding of facial or bodily stimuli, are also mixed. Some studies which have looked at verbal, visual, nonverbal, semantic, and spatial working memory (Deckersbach et al., 2000; Dunai, Labuschagne, Castle, Rossell, & Kyrios, 2010; Labuschagne et al., 2011; Rossell et al., 2014) have found significant group differences among BDD and controls, while others which have looked at verbal, visual, and semantic memory (Hanes, 1998) have failed to detect significant group differences. Furthermore, a study by Toh, Castle, and Rossell (2015) found that compared to controls, the BDD group showed poor immediate recall of words and stories but did not detect deficits to delayed memory, as measured by word, story, and figure recall on the Repeatable Battery for the Assessment of Neuropsychological Status (Rey, 1964).

Aim of the meta-analysis

The main aim of the current meta-analysis was to investigate the empirical evidence supporting an association between the four cognitive processing deficits and symptoms of BDD. Specifically, we seek to answer the following question: compared to controls, do clinically-diagnosed BDD participants display heightened local processing of stimuli, selective attention biases for disorder-relevant and symmetrical stimuli, interpretive biases for misinterpreting neutral facial expressions as representing negative affect and overvaluing the importance of appearance, and memory deficits? This meta-analysis is the first to investigate the strength of the proposed relationships between cognitive processing deficits and BDD, an important undertaking given the presence of so many conflicting findings across individual studies. Understanding the underlying mechanisms, which produce and maintain symptoms of BDD is crucial for the development of new and existing interventions.

Method

Search strategy

No published protocol exists for this review and meta-analysis. The review process was conducted according to the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009), described in **Figure 1.** A PsycINFO (OvidSP) database search was conducted, covering professional and academic literature across psychology and other related disciplines, including medicine, mental health, nursing, nutrition and dietetics, physiology, and linguistics. The following terms were combined using the “AND” Boolean operator and searched in the database: *body dysmorphic disorder, dysmorphophobia, BDD, body image, body image disturbance,* AND *cognition, cognitive, cognitive task.* Additional articles from reference lists and extended searches, including those pertinent to the proposed theoretical model, were included in the present literature search. To reduce the likelihood of having included more frequently in our analyses studies that were selectively chosen for publication due to significant effect sizes (publication bias), we attempted to locate unpublished studies and dissertations that met our inclusion criteria. Additional searches were conducted in PsycINFO, PubMed (OvidSP), CINAHL and MEDLINE to obtain data from dissertations. Furthermore, all corresponding authors whose studies met inclusion criteria were contacted to inquire about whether they were aware of any existing unpublished BDD studies that used cognitive tasks to assess the four cognitive processing abnormalities. However, no additional eligible studies could be located. With the exception of case studies, all designs and cognitive tasks used to assess the four cognitive deficit categories were included.

The search resulted in 615 published studies listed on May 10, 2017. Of these, 569 studies were removed after reviewing the publication and abstract. Although included in the systematic literature review, twenty-three of the remaining forty-six were excluded from the meta-analysis, leaving twenty-three studies. Omitted studies used case studies that did not include quantitative data (N=1), self-report measures of cognitive impairment rather than performance-based tests (N=1), EEG technology (N=1), MRI technology (N=1), fMRI technology (N=6), eye trackers (N=6), the use of statistical approaches which were not readily interpretable in terms of effect sizes (N=1), studies where data could not be readily converted into effect sizes and/or further data could not be obtained (N=5), and pilot studies (N=1). A final search was conducted on November 20, 2017, and no additional studies that met our specified inclusion criteria were identified. The first author, using the inclusion-exclusion criteria described below, conducted all screening.

Inclusion Criteria. In order to examine a homogeneous group to give the greatest clarity in the face of the varied and inconsistent results to date, only studies of clinical populations were included in the meta-analysis. We only selected BDD studies that compared differences in cognitive task performance. Although one was identified (Yaryura-Tobias et al., 2002), given that under normal conditions, most BDD studies tend to be underpowered, pilot studies were not considered. Furthermore, given that some cognitive tasks measure central coherence on a continuum, where one score is representative of both global and local processing, we were only able to calculate scores for one of these processes. Local processing was prioritised because it has been theorised that BDD sufferers hyper-focus on specific, focal aspects of appearance. Traditionally, it has been assumed that heightened local processing subsequently hinders global processing abilities. However, as evidenced by Kerwin et al. (2014) who found BDD sufferers to perform worse on both global and local trials, high performance on one may not be indicative of low performance on the other and *visa versa*. To avoid cherry picking, each condition of every task used to capture the four constructs of interest was included in the analyses. Studies dated from 1998 when the first such study appeared. Therefore the inclusion criteria were as follows: (1) publication in English, (2) in a peer-reviewed journal, (3) studies using a clinical population of individuals with BDD where diagnoses were confirmed using the DSM criteria, Body Dysmorphic Disorder Diagnostic Module, and/or a clinical interview, and (4) studies that assessed at least one of the four cognitive processing deficits using cognitive tasks. We contacted Buhlmann et al. (2004), Feusner et al. (2010), Hartmann et al. (2015), Kerwin et al. (2014), Monzani et al. (2013), and Toh et al. (2017b) to obtain means and standard deviations not provided in the published online studies. To maintain homogeneity, neuroimaging studies and eye trackers were excluded from the analyses. Furthermore, we excluded the Feusner et al. (2010) study from our analyses involving central coherence, which used an Inverted Face Task, as it was not possible to convert their results to a similar metric to the other studies without making a number of assumptions that would have been difficult to justify. We were also unable to obtain the means and standard deviations of the BDD and control groups from Jefferies et al. (2010) who also used an Inverted face Task to look at global-local processing, Thomas and Goldberg (1995) who utilised a video face distortion task to look at selective attention, Buhlmann, Wilhelm, et al. (2002) who used ambiguous scenarios to look at negative interpretation bias, and Moody et al. (2017) who used attractiveness ratings following presentations of high spatial frequency images to analyse local processing. The first author performed a quality assessment and data collection.

Statistical methods

Cohen's *d* values used for the meta-analysis were obtained with the means, standard deviations, and the N from the control and treatment groups using an online Practical Meta-Analysis Effect Size Calculator (https://www.campbellcollaboration.org/effect-size-calculato.html). Because we wanted a representation of the population that included individuals with and without a diagnosis of BDD, the pooled estimate of the standard deviation was used. Using Comprehensive Meta-Analysis Version 2 (Borenstein, Hedges, Higgins, & Rothstein, 2005), we employed a multilevel model with effect sizes (level 1) nested within studies (level 2) and random intercepts. This allowed us to use multiple outcomes from any one study while correcting for correlated observations in the data. This also allowed us to account for multiple comparisons, in which the same control group was used in the Toh et al. (2015), (2017a), and (2017b) studies. Forest plots were generated with Hedge's *g* values and 95% confidence intervals (CI), which were calculated for each individual study, providing an assessment of heterogeneity for local processing, selective attention, interpretive biases, and memory deficits. Given that for some measures a higher score indicates greater cognitive deficit, such as selective attention tasks, whereas the opposite is true for other measures, such as many of the memory deficit tasks, the sign of the correlation coefficients were all transformed so that a positive value for *g* indicated a greater cognitive deficit in the BDD group. Heterogeneity was also assessed with the Q statistic, a measure of weighted squared deviations around the mean (Laird, Tanner-Smith, Russell, Hollon, & Walker, 2017), and the I^2 statistic, where a value of 0% indicates no observed heterogeneity, 25% low heterogeneity, 50% moderate heterogeneity, and 75% high heterogeneity (Higgins & Thompson, 2002). As recommended by Moreno et al. (2009), we used regression-based adjustments for publication bias available with Egger's regression intercept.

Results

Studies included in the meta-analysis

A total of 518 BDD participants and 534 control participants (all except 20 participants from the Stangier et al., 2008 study were healthy controls) were included in the analyses. Due to the paucity of available research in this field using a single task as a measure of each construct, a variety of different tasks were selected to measure similar constructs across the four cognitive categories. See the **Supplementary Table** for a summary description of the studies discussed below.

Local processing. The studies included in these analyses are listed in **Table 2** and **Figure 2**. Our analyses included difference scores on the Short Form Benton Facial Recognition Task between a BDD and control group from the Buhlmann et al. (2004) study. When analysing results from the Deckersbach et al. (2000) study, we only analysed scores from the RCFT organisation copy condition, and not the accuracy copy condition, since only the organisation condition could be used to assess local processing. Given that it is the inverted condition from the Famous Faces Task, a variation of the Inverted Face Task, that is said to tap into local processing, only differences between the BDD and control group on inverted trials were included from the Jefferies et al. (2012) study. We included RT and accuracy scores on local trials of the Navon task and Embedded Figures Task to assess local processing differences between BDD and control groups from the Kerwin et al. (2014) study. Monzani et al. (2013) hypothesised a face inversion effect in the BDD group, thus we looked at differences in space and part RT's to the inverted face condition of the Inversion Task, as well as differences in accuracy and RT's on local trials of the Navon and Composite (aligned face condition) tasks. Toh et al. (2017a) used the Mooney Faces Task to compare global-local processing difference scores between a BDD, OCD and healthy control group. To capture differences in local processing between the BDD and healthy control group, we analysed the accuracy difference scores between the upright and inverted conditions for the facial and object stimuli. In the current meta-analysis the mean weighted effect size for local processing was found to be small (*g* =. 35, 95% CI= -.25: .95).

Selective attention. The studies used to investigate selective attention are listed in **Table 2** and **Figure 3**. For Emotional Stroop tasks, only RT and Stroop inhibition/interference conditions were included, since attention control theories predict that accuracy conditions produce no differences between treatment and control groups on these measures (Eysenck, Derakshan, Santos, & Calvo, 2007). To determine differences between the BDD and control groups in selective attention to disorder-relevant or threat stimuli, we selected the mean Stroop interference scores to the BDD positive (e.g. *ugly*) and BDD negative (e.g., *attractive*) word conditions used in the Buhlmann et al. (2002) study, RT to the body condition (e.g., *nose*) and inhibition effect of the body-animal condition from the Rossell et al. (2014) study, and RT to the BDD-positive (e.g. *deformed*) and BDD-negative (e.g. *beautiful*) masked word conditions from the Toh et al. (2017b) study. We did not include the Hanes (1998) Stroop task, because the original task (Stroop, 1935) was used to compare difference scores between a BDD and control group for reading words and naming colours. Thus, this was a measure of interference using neutral words and was not used to detect differences across groups in selectively attending to threat or disorder-related stimuli.

We analysed difference scores between the BDD and healthy control group on the Object Discrimination Task and Facial Discrimination Task (Erwin et al., 1992) in the Buhlmann et al. (2014) study. Similarly, difference scores on the Facial Discrimination Task between the BDD and the non-disfigured dermatological group from the Stangier et al. (2008) study were analysed. For the Lambrou et al. (2012) study, the *object* and *other face* conditions were considered control groups, and the authors compared differences between BDD, art and design controls, and non-art and design controls. Thus, we analysed difference scores between the BDD and non-art control groups on all measures used to assess symmetry preference only for the stimuli depicting the participant's own face. Symmetry preference was considered indicative of enhanced discriminatory abilities and was based on the frequency of selection, heightened accuracy, and less discrepancy in discriminating among symmetrical stimuli. The conditions included were as follows: *Aesthetic Perceptual Sensitivity (perceptual understanding; perceptual accuracy); Aesthetic Emotional Sensitivity (perceptual selection pleasure; perceptual selection disgust); Aesthetic Evaluative Sensitivity (aesthetic standard: attractiveness standard/perceptual selection; aesthetic standard: self-ideal/personal standards; aesthetic standard: self-perfect vs ideal/personal standards)*. When analysing results from the Reese et al. (2010) study, we selected the overall symmetry preference condition, which took into account total symmetry preference, as measured by RT's and accuracy scores for dot arrays and facial stimuli of other people. In the current meta-analysis the mean weighted effect size for selective attention was found to be medium (g =. 60, 95% CI= .26: .93).

Interpretive Biases. The studies used to examine interpretive biases are listed in **Table 2** and **Figure 4**. Buhlmann et al. (2004) administered an Emotion Recognition Task (Ekman & Friesen,

1975) and compared differences in the ability to accurately identify facial expressions. In order to assess interpretive biases toward ambiguous stimuli, we compared differences between BDD and control groups in the tendency to misidentify neutral facial expressions for fear-based emotions, which included disgust. Due to insufficient reporting of data and the inability to obtain further information, the stimuli “anger” and “scared” were not included in the analyses. Buhlmann et al. (2006) created both a self and other-referent scenario, with facial stimuli depicting neutral, angry, disgusted, and surprised expressions. Participants were then asked to rate whether the facial expressions represented neutral, angry, disgusted, surprised, contemptuous, fearful, or happy emotions. We analysed group differences in accuracy ratings of the self-referent scenario for misinterpretations of neutral facial expressions as disgusted, angry, and contemptuous. Due to insufficient reporting of data and the inability to obtain further information, the stimulus “fear” was not included in the analyses. Buhlmann, Gleiß et al. (2011) presented participants with angry, disgusted, happy, neutral, sad, scared, and surprised facial expressions. We compared difference scores between the BDD and control group in the misidentification of neutral facial expressions for disgusted and angry expressions. Due to insufficient reporting of data and the inability to obtain further information, the stimulus “scared” was not included in the analyses.

In the Buhlmann et al. (2008) study, the Implicit Association Task was used to measure differences between a BDD, subclinical, and control group in RT toward pairing the words “Attractive-Important”, “Attractive-Meaningless”, “Self-Good”, and “Self-Bad”. Our analyses included difference scores between the BDD and control group on the “Attractiveness Implicit Association Task” outcome, which compared differences in overall implicit attractiveness beliefs. We chose to analyse implicit measures of attractiveness because it has been suggested that one of the driving forces behind appearance-related obsessions and compulsions is an over-valued belief about the importance of beauty (Fang & Wilhlem, 2015; Phillips, 2005; Veale, 2004). In a similar Buhlmann et al. (2009) study, the Implicit Association Task was used to measure implicit self-esteem and attractiveness beliefs in a BDD, subclinical, and control group. Implicit beliefs concerning attractiveness were measured by pairing the words "Attractive-Important" and "Attractive-Competent". We analysed difference scores on the "Attractive-Important" and "Attractive-Competent" trials between the BDD and control group. Buhlmann, Teachman et al. (2011) used the Go/No-go Association Task to measure implicit attractiveness beliefs in a BDD, dermatology, and control group. The words "Attractive", "Beautiful", "Good looking", and "Pretty" were paired with the words "Important", "Meaningful", "Crucial", and "Significant". We analysed difference scores between the BDD and control group using the "Attractive Important Go/No-go Association Task" scores, which assessed overall implicit attractiveness beliefs. In a similar study, Hartmann et al. (2015) compared implicit attractiveness beliefs among a BDD, anorexia nervosa, and control group on the Go/No-go Association Task, which paired the words "Attractive-Important" and "Attractive-Competent". We analysed differences in RT scores on the trials that paired "Attractive-Important" and "Attractive-Competent" between the BDD and control group. In the current meta-analysis the mean weighted effect size for interpretive biases was small (g=. 30, 95% CI=. 07: .54).

Memory Deficits. The studies used to analyse memory deficits in BDD are listed in **Table 2** and **Figure 5**. Deckersbach et al. (2000) compared difference scores between a BDD and control group on the RCFT and the California Verbal Learning Test (Delis, Kramer, Kaplan, & Ober, 1987). We compared differences between BDD and control groups in the average immediate and delayed recall scores (percent recall) of the RCFT and percent recall on the California Verbal Learning Test. Dunai et al. (2010) compared differences between a BDD, OCD, and control group on measures of spatial working memory, including the Spatial Span Test (De Luca et al., 2003), the Spatial Working Memory

Test (De Luca et al., 2003), which included conditions that assessed within search errors, between search errors, and search strategy, and the Stocking of Cambridge task (Shallice, 1982), which included conditions that assessed number of problems solved, number of perfect solutions, and total moves in excess of the minimum. In addition, a Pattern Recognition Test (De Luca et al., 2003) was used to look at differences in visual pattern recognition memory. We analysed difference scores between the BDD and control group in performance on all measures and task conditions.

Hanes (1998) compared difference scores between the groups on several tasks used to assess memory impairment, including the Rey Auditory Verbal Learning Test (Rey, 1964), the New Tower of London Task (Shallice, 1982), the Category Fluency Task, and the RCFT. We analysed difference scores between the BDD and control group on the delayed recall (memory) condition of the RCFT, and to all conditions of the Rey Auditory Verbal Learning Test, New Tower of London Task, and Category Fluency Task. Rossell et al. (2014) measured differences in semantic memory between the BDD and control group using a Sentence Verification Task (Clark & Chase, 1972) and the Controlled Oral Word Association Test (Ruff, Light, Parker, & Levin, 1996), which was used to assess phonological and semantic fluency. We analysed difference scores on all conditions of the Sentence Verification Task and Controlled Oral Word Association Test. In the study by Toh et al. (2015), we analysed difference scores between the BDD and control group on the overall "immediate memory" and "delayed memory" subtests of the Repeatable Battery for the Assessment of Neuropsychological Status (Randolph, Tierney, Mohr, & Chase, 1998). In the current meta-analysis the mean weighted effect size for memory deficits was medium (g =. 56, 95% CI= .26: .87).

Heterogeneity

For the pooled effect size analysis, Q was found to be significant (Q= 57.23, p<. *001*), indicating that the observed variability in effect sizes across all studies included in the meta-analysis was unlikely due to sampling error alone. Furthermore, the overall I^2 was found to be 61.56%, indicating a moderate to high degree of heterogeneity. These findings may be explained by differences among the varying outcomes, and as a result, we conducted subgroup analyses by calculating Q and I^2 for each cognitive category separately, finding moderate to high degrees of heterogeneity for the categories of local processing and selective attention (See **Table 3** for Q and I^2 values of all cognitive categories).

Potential sources of heterogeneity are outlined in detail below. See **Table 3** for Q and I^2 values**.**

Publication Bias

Funnel plots were also created for local processing, selective attention, interpretive biases, and memory deficits (see **Supplementary Figures 1 to 4**). A *p* value of <. 05 was indicative of publication bias, as it suggests there is a significant relationship between the effect size and precision (Laird et al, 2017). When all studies were combined into a single analysis, there was no indication of publication bias, as evidenced by Egger's regression intercept (*ERI*=. 50, *p*=. 40.). Furthermore, when studies were grouped on cognitive category and analysed separately, publication bias was not detected for any of the cognitive categories (See **Table 3** for *ERI* values across all cognitive categories).

Risk of bias for individual studies

Based on the recommendations by the Cochrane review group, and biases relevant to non-intervention studies, biases related to individual studies (reporting, detection, and attrition biases) were considered (Lundh & Gøtzsche, 2008). Reporting bias, the biased selection of variables and results included in the analyses, could not be assessed, as protocols for studies were not available. Detection bias refers to systematic differences in how group outcomes are determined (Lundh & Gøtzsche, 2008). In all of the included studies, the diagnosis was assessed with a diagnostic manual and/or clinical interview but only one of the studies included in the analyses (Hanes, 1998) reported blinding of the experimenter to participant diagnosis. Finally, attrition bias refers to systematic differences between groups due to participant dropout. Generally, drop out of participants was not explicitly stated apart from two studies (Hartmann et al., 2015; Kerwin et al., 2014).

Discussion

BDD is a complex disorder that can be hard to treat (Fang & Wilhelm, 2015), and further work is required to identify factors that may explain the symptomatology and can thus be targeted in interventions. Two models of BDD have emphasised the role of selective attention in exacerbating BDD symptomatology (Fang & Wilhelm, 2015; Veale, 2004). The more recent model has also suggested a role for central coherence, interpretive biases, and memory deficits.

Do Specific Cognitive Deficits Account for BDD Symptomology?

The twenty-three studies included in this meta-analysis provided 80 tests of four different categories of cognitive function. Three categories showed a significant difference between BDD and control groups, namely selective attention and memory deficits with medium effect sizes, and interpretive biases with a small difference. These results confirm the central role of selective attention highlighted in the Veale (2004) and Fang and Wilhelm (2015) models and also point to the importance of memory impairment and interpretive biases in explaining BDD psychopathology. Selective attention toward perceived threats, such as flaws in appearance, is hypothesised to be the trigger for feelings of anxiety and disgust, which then results in a range of behaviours to regulate emotion. Memory deficits are thought to account for inaccurate coding and recall of face or body stimuli. Moreover, abnormalities to memory function might interfere with problem-solving abilities (Newell & Simon, 1972), which could then exacerbate maladaptive coping strategies, such as seeking out cosmetic procedures or incessant mirror checking used to manage symptoms of anxiety. Moreover, the misinterpretation of ambiguous stimuli and overvaluation of the importance of beauty might also play an important role in the development and maintenance of BDD psychopathology. There were insufficient studies and power to separate the constructs of misinterpretation and overvaluation, and the relative contribution of these two will require further studies to be conducted.

There was no support for abnormalities related to local processing in BDD, suggesting that this aspect of cognitive functioning is not useful to include in theories seeking to inform the development of interventions for BDD. However, null findings might be partly due to methodological challenges. For example, there appear to be some discrepancies concerning the predicted direction of the effect on facial recognition tasks (Buhlmann et al., 2004; Jefferies, 2012; Monzani et al., 2013), and some measures assessing central coherence make the assumption that low scores on local processing necessitate high scores on global processing and *vice versa*. It is also possible that moderators play a role (i.e., subgroups within BDD populations may exhibit specific deficits), but addressing this question would require substantially more studies and those that include measurement of potential moderators that may influence cognitive functioning, such as medication status, severity of BDD, age, age of onset and duration of BDD.

Analyses revealed significant heterogeneity for the categories of local processing and selective attention. Potential sources of heterogeneity might relate to differences in methodology. Three studies produced results outside the 95% CI and each is examined in turn. In the study by Jefferies et al. (2012), a methodology that taps into additional aspects of cognitive processing abnormalities might help to explain the large effect size observed. For example, given that the task used to measure local processing was made up of stimuli depicting images of famous people, and that celebrities are often perceived as being aesthetically appealing, it is possible that heightened symmetry detection for these images played a role in the superior processing of facial stimuli in the BDD group. Moreover, what follows is the overvaluation of outward appearance that may have also played a role in the superior processing of these images. Compared to controls, the BDD group may have had a tendency to more readily attend to stimuli within their environment that relate to famous people perceived as attractive. Thus, the large effect size might be explained by the use of a cognitive task that taps into various cognitive biases (local processing, selective attention, and interpretive biases), which may have resulted in superior facial recognition abilities.

Although some of the studies included in the local processing analyses controlled for the effects of medication (Deckersbach et al., 2000; Monzani et al., 2013) on cognitive performance, Kerwin et al. (2014) was the only study to exclude medicated BDD participants. It is possible that non-medicated BDD sufferers have specific characteristics, such as greater symptom severity or lower socioeconomic status, that distinguish them from the medicated cohort, thereby reducing homogeneity of the sample. Another possible source of heterogeneity in this study involved the recruitment of participants from three different sources (dermatology, plastic surgery, and mental health clinics; posted advertisements; internet advertisements). Conversely, the other studies included under the local processing category recruited primarily through outpatient clinics or hospitals.

There were several important differences between the Lambrou et al. (2011) study and other studies included under the selective attention category. The main factor that distinguished the research by Lambrou et al. (2011) et al. from the other studies in this cognitive category was the inclusion of three separate measures of symmetry preference (i.e., selective attention) with various task conditions. Thus, it is possible that a broader construct of selective attention was captured by these measures. Furthermore, Lambrou et al. (2011) was the only study to use the BDD participant's own facial stimuli, detecting a response bias for self-referent information. This finding is consistent with the pilot study by Yaryura-Tobias et al. (2002) who found that compared to controls, the BDD group detected non-existing symmetry differences in facial stimuli and that this response-bias applied only to personally salient information. Thus, these results appear to suggest that the strength of the manipulation of cognitive tasks used to assess cognitive processing abnormalities in BDD may be influenced by the incorporation of self-referent stimuli. Furthermore, this may reflect an important underlying factor common across other cognitive deficits outlined in the Fang and Wilhelm (2015) BDD model. For example, although not included in the current meta-analysis due to the use of fMRI technology, Feusner et al. (2011) found that compared to controls, BDD participants were less able to deactivate the default mode network (DMN) when performing an executive task. The DMN is thought to be involved in self-referential thinking that is less active when engaged in tasks involving the use of executive functioning resources and most active during resting states (Whitfield-Gabrieli & Ford, 2012). Thus, the authors concluded that less deactivation during task performance in the BDD group might reflect the inability to inhibit self-related disorder-relevant thoughts. Furthermore, in the Buhlmann et al. (2006) study, the authors found that compared to the "other-referent" scenarios, the BDD group was more likely to misinterpret neutral facial expressions as contemptuous when given a self-referent scenario.

Limitations

There are several limitations that may influence the interpretation of results from the current meta-analysis. Firstly, many of the included studies failed to adjust for comorbid diagnoses of depression, eating disorders, and anxiety disorders and included participants who were receiving pharmacological interventions. This is problematic because it confounds the effects on cognitive performance with BDD symptomatology. However, due to the extreme shame and poor insight characteristic of BDD, sufferers are often reluctant to participate in research, limiting the power of such studies, and making it difficult to adjust for other factors (Phillips, Didie, Feusner, & Wilhelm, 2008).

Furthermore, Stangier et al. (2008) did not include a healthy control group, thus we had to compare differences in selective attention between a BDD and a non-disfigured dermatological group. The authors also reported recruiting female participants exclusively, who may also have had lower levels of symptom severity. However, results of the current meta-analysis did not detect significant heterogeneity with the inclusion of this study. Nevertheless, an important source of heterogeneity was that inclusion criteria for BDD varied among studies, (see **Supplementary Table**).

The current meta-analysis included studies reporting inconsistencies in measuring central coherence. In the Buhlmann et al. (2002) study, the Benton Facial Recognition Task was used to measure global-local processing, and it was hypothesised that due to preferential processing of specific, local facial features, the BDD group would be less accurate at recognising faces, and low scores on this measure would be indicative of an affinity for local processing. This is inconsistent with hypotheses made when administering an Inverted Face Task and similar variations of this task, as researchers predicted that due to heightened local processing of facial stimuli, BDD participants would be better at recognising faces in an inverted position (Feusner, Muller, et al., 2010; Jefferies et al., 2012; Monzani et al., 2013). Furthermore, apart from the Navon, Embedded Figures Task, Composite tasks, and Mooney Faces Task, which provided independent scores on measures of global-local processing, the other cognitive tasks used to assess central coherence measured global-local processing on a continuum, with a single score representing these processes. In effect, cognitive measures, like the Inverted Face Task, make the assumption that global-local processing is mutually exclusive. This appears to be problematic, as evidenced by the Kerwin et al. (2014) study which used the Navon task and found that compared to controls, the BDD group scored worse on both global and local trials. Thus, given that many of the tasks used to assess central coherence measured this construct continuously, we were unable to analyse central coherence and instead chose to focus on local processing in isolation. Consequently, it is possible that the non-significant effect observed in the local processing category could be attributed, in part, to inconsistencies in the methodology used to measure this construct. Further, the inclusion of a variety of different tasks used to measure similar constructs across the four cognitive categories might have confounded the overall findings reported in this meta-analysis. Upon the accumulation of more research in this field, future meta-analytic studies might consider using a stricter inclusion criterion for the cognitive tasks of interest.

It should also be noted that our Cohen's *d* estimates were calculated using the pooled standard deviation rather than the standard deviation of the control group. Thus, rather than evaluating group differences against natural variation in the cognitive tasks that is uncontaminated by variation resulting from BDD, estimates for the group differences will include more variability in cognitive tasks that come from both controls and BDD. In effect, in some sense, this confounds variability in the task with variability created by BDD. This conservative strategy will result in wider confidence intervals, which may have obscured some significant findings.

Finally, the current meta-analysis only included research published in English, which may have biased the results (Jüni et al., 2002). Furthermore, failure of most of the included research to blind experimenters to treatment groups, report attrition rates, and disclose all variables omitted from analyses, may have led to a reporting of inaccurate effect sizes, thereby confounding the results. Future research should pay more attention to reporting possible sources of individual bias in BDD-related studies.

Future directions

One of the issues encountered in conducting the meta-analysis was the lack of consistency in reporting results, and the heterogeneity of cognitive tasks utilised. Future research should incorporate reporting more consistent metrics, such as effect sizes, and indices required to calculate effect sizes (i.e., means and standard deviations) for all conditions of all cognitive tasks administered. For studies involving comparisons of groups (i.e., BDD *vs* control), it would be ideal for researchers to report on Cohen's *d*, as it provides a standardised difference between groups. In an effort to better assess individual biases across studies, future research should consider disclosing all questionnaires administered to participants, including those that were omitted from the analyses, blinding experimenters to treatment groups, and reporting attrition rates. It might also be advisable to test the proposed cognitive deficits outlined in the Fang and Wilhelm (2015) model before moving on to other constructs and to do this initially in non-clinical populations. The advantage of this approach is to determine whether there are suggestive differences that can profitably be followed up in a clinical population. It would also be useful to agree on a small group of important cognitive tasks to investigate, such that a critical mass of studies can accumulate and inform the area. For example, preliminary research appears to suggest that the inclusion of self-referent information when analysing group differences in cognitive task performance might be an important area warranting further investigation. Furthermore, to address the limitation of heterogeneity created as a result of including studies that evaluated BDD differently, future research might consider coming to a consensus on a uniform way of assessing symptomology. Given the small size of this field, it could be advisable to conduct a working party to discuss and agree on such issues, such as was achieved by the Obsessive Compulsive Cognitions Working Party (Obsessions Compulsions Cognitions Working Group, 1997).

There has been much debate about which underlying cognitive processes are captured when administering the Emotional Stroop Task, with more recent theories suggesting that the task captures the parallel processing of irrelevant and relevant information (MacLeod, 1991). In effect, computerised Dot-Probe Tasks have largely replaced the Stroop Task in the recent literature, which also includes modified versions in which emotionally salient words are matched with neutral words. According to Wells and

Matthews (1994), the Dot Probe Task is a more direct measure of attention bias than the Stroop paradigm. To date, selective attention toward disorder-relevant stimuli captured by Modified Dot Probe Tasks has been detected in eating disorder populations (Shafran, Lee, Cooper, Palmer, & Fairburn, 2007; Shafran, Lee, Cooper, Palmer, & Fairburn, 2008). Further, selective attention abnormalities have been reported in one non-clinical study involving the administration of a Dot Probe Task made up of BDD-relevant stimuli (Onden-Lim, Wu, & Grisham, 2012).

Given that Buhlmann et al. (2002) and Rossell et al. (2014) produced inconsistent results when using the Emotional Stroop task to assess selective attention in BDD populations, future studies using a Modified Dot Probe Task might yield more consistent findings. Another potential advantage of using the Dot Probe Paradigm is that results can be compared with disorders that share similar underlying psychopathology, such as OCD and anorexia nervosa, where there is evidence of attention bias toward threatening stimuli (e.g., Amir, Najmi, & Morrison, 2009; Blechert, Ansorge, & Tuschen-Caffier, 2010).

Treatment Implications. The results of this meta-analysis have implications for developing adjuncts to current treatment modalities for BDD. Implementation of cognitive bias modification techniques could be used to target specific maladaptive cognitions that maintain symptoms of BDD, as it has in related disorders. Cognitive bias modification has been used with some promise in anorexia nervosa (Cardi et al., 2015) where there is overvaluation of the importance of appearance (Hartmann et al., 2015) as there is in BDD. Attentional probe tasks have been used to retrain attention toward positive stimuli and to reduce negative interpretations of ambiguous information. Moreover, our findings are consistent with the existing preliminary evidence supporting a role of cognitive bias modification techniques in the alleviation of BDD symptomology (Premo, Sarfan, & Clerkin, 2016; Summers & Cougle, 2016). Our results suggest that a combination of cognitive bias modification for attention and interpretation (MacLeod, 2012) warrants further investigation. Furthermore, given that there is preliminary evidence for the efficacy of Metacognitive Therapy in alleviating symptoms of OCD (Moritz, Jelinek, Hauschildt, & Naber, 2010) and BDD (Rabei, Mulkens, Kalantari, Molavi, & Bahrami, 2012), and that the mechanism of action involves increasing awareness of cognitive biases, the utility of Metacognitive Therapy in targeting BDD obsessions warrants further investigation. Cognitive Remediation Therapy could also be used to target memory impairment in BDD populations by strengthening executive functioning and mental flexibility (Fang & Wilhelm, 2015). Enhancing these processes may thereby serve to ameliorate problem-solving abilities, and minimise reliance on BDD compulsions used to manage anxiety. Although traditionally, Cognitive Remediation Therapy has been used as a treatment for psychotic disorders, brain injuries, and attention deficit hyperactivity disorder, a 2014 review by Tchanturia, Lounes, and Holttum found that this therapy was a promising new development in the treatment of anorexia nervosa and OCD. These results provide further justification for Cognitive Remediation Therapy as an adjunct to traditional BDD treatment modalities.

Examination of the effectiveness of these approaches can also be used to inform the development of existing models (Craig et al., 2008). Given the difficulty of engaging BDD populations in treatment and research, the most efficient way to test and modify promising models may be to control for any foreseeable variables, so as to better establish any unknown group differences. Due to the paucity of existing research in this field, it might also be beneficial to first test specific aspects of this model in non-clinical populations who have significant concerns about appearance prior to evaluation in BDD populations. Results from these studies could then be used to inform treatment studies, which could later inform how models might be modified to reflect a greater understanding of the specific underlying cognitive mechanisms that maintain symptoms.

Conclusions

The results of the current meta-analysis suggest that specific cognitive processing abnormalities involving selective attention, interpretive biases, and memory deficits may play a key role in the development and maintenance of BDD psychopathology. Although local processing failed to produce significant differences between BDD and control groups, these results should be interpreted with caution. Some explanations for this null finding include possible moderators and methodological challenges. It is also worth noting that brain-imaging studies used to investigate this construct were not included in our analyses. Researchers and clinicians might also consider the use of Modified Dot Probe Tasks to investigate selective attention, and interventions such as Cognitive Bias Modification Therapy and Cognitive Remediation Therapy in order to target specific cognitive deficits that might be triggering and maintaining symptoms of BDD.

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Table 1

Summary of Deficits in Cognitive Processing in BDD

Cognitive Deficits	Clinical Features	Cognitive Measures
Local Processing	Preferential processing of local details, resulting in preoccupations with specific flaws in face or body parts	Composite Task Electroencephalogram Embedded Figures Task Famous Faces Task Functional Magnetic Resonance Imaging Inversion Task Inverted Face Task Magnetic Resonance Imaging Mooney Faces Task Navon Task Rey Osterrieth Complex Figures Task (copy) Short Form Benton Facial Recognition Task
Selective attention	Fixation on threat and/or disorder-relevant stimuli/ biased attention to aesthetic details (e.g. symmetry)	Attractiveness ratings for high spatial frequency images Discrimination tasks (Aesthetic Perceptual Sensitivity; Aesthetic Evaluative Sensitivity; Aesthetic Emotional Sensitivity) Dot Symmetry Detection Task Emotional Stroop Task Eye Tracker Facial Discrimination Task Facial Symmetry Detection Task Video Face Distortion Task
Interpretation Bias	Overvalued ideas about attractiveness/ misinterpretation of neutral facial expressions as representing negative emotions	Emotion Recognition Task Go/No-go Association Task Implicit Association Test Interpretation Questionnaire Values-Scale Questionnaire
Memory deficits	Inaccurate coding and recall of facial features or body parts	California Verbal Learning Test Category Fluency Task Controlled Oral Word Association Test Pattern Recognition Test Rey Osterrieth Complex Figures Task (recall) Sentence Verification Task Rey Auditory Verbal Learning Task

	Repeatable Battery of Neuropsychological Status (immediate and delayed recall) Spatial Span Test Spatial Working Memory Test

Table 2

Meta-analysis statistics used in the analyses for each cognitive category

Studies and mean weighted values	Outcome Measure	*g* (95% CI)	Standard Error	Variance	Z	p
Local Processing						
Buhlmann et al., 2004	BFRT	-.16 (-.76: .45)	.31	.10	-.50	.61
Deckersbach et al., 2000	RCFT	.80 (.12: 1.48)	.35	.12	2.30	.02
Jefferies et al., 2012	FFT	1.66 (.81-2.51)	.43	.19	3.84	.00
Kerwin et al., 2014	EFT, Navon	-.68 (-1.35: -.00	.34	.12	-1.97	.05
Monzani et al., 2013	Navon, Composite, II	-.05 (-.60: .50)	.28	.08	-.18	.86
Toh et al., 2017	MFT	.70 (.09: 1.31)	.31	.10	2.24	.02
Mean weighted values		.35 (-.25: .95)	.31	.09	1.14	.25
Selective Attention						
Buhlmann et al., 2002	Emotional Stroop	.93 (.22: 1.64)	.36	.13	2.56	.01
Buhlmann et al., 2014	ODT, FDT	.20 (-.26: .67)	.24	.06	.85	.39
Hübner et al., 2016	FDT	.18 (-.31: .66)	.25	.06	.72	.47
Lambrou et al., 2011	APS, AES, AEmS	1.22 (.79: 1.65)	.22	.05	5.58	.00
Reese et al., 2010	FSD, DSD	.20 (-.41: .80)	.31	.10	.63	.53
Rossell et al., 2014	Emotional Stroop	.39 (-.34: 1.11)	.37	.14	1.05	.29
Stangier et al., 2008	FDT	1.14 (.49: 1.79)	.33	.11	3.44	.00
Toh et al., 2017a	Emotional Stroop	.54 (-.06: 1.15)	.31	.09	1.76	.08
Mean weighted values		.60 (.26: .93)	.17	.03	3.50	.00
Interpretive Biases						
Buhlmann et al., 2004	ERT	.00 (-.61: .61)	.31	.10	.00	1.00
Buhlmann et al., 2006	ERT self-referent	.82 (.15: 1.49)	.34	.12	2.41	.02
Buhlmann et al., 2008	IAT	.21 (-.46: .88)	.34	.12	.61	.54
Buhlmann et al., 2009	IAT	.00 (-.59: .59)	.30	.09	.00	1.00
Buhlmann, Gleiß et al., 2011	ERT	.33 (-.14: .80)	.24	.06	1.37	.17
Buhlmann, Teachman et al., 2	GNAT	.64 (.17: 1.11)	.24	.06	2.69	.01
Hartmann et al., 2015	GNAT	.03 (-.54: .60)	.29	.09	.10	.92
Mean weighted values		.30 (.07-.54)	.12	.01	2.52	.01
Memory Deficits						
Deckersbach et al., 2000	CVLT, RCFT	.50 (-.17: .1.18)	.34	.12	1.46	.14
Dunai et al., 2010	PR, SWM, SOC, SS	.82 (.06: 1.58)	.39	.15	2.12	.03
Hanes, 1998	RAVLT, NTL, CFT, RCFT	.13 (-.52: .78)	.33	.11	.38	.70
Rossell et al., 2014	COWAT, SVT	.51 (-.23: 1.24)	.38	.14	1.34	.18
Toh et al., 2015	RBANS	.88 (.26: 1.51)	.32	.10	2.76	.01
Mean weighted values		.56 (.26: .87)	.16	.02	3.61	.00

Note: BFRT= Benton Facial Recognition Task; RCFT= Rey Complex Figures Task; FFT= Famous Faces Task; EFT=Embedded Figures Task; IFT=Inverted Face Task; MFT= Mooney Faces Task; FSD= Facial Symmetry Detection; DSD= Dot Symmetry Detection; FDT= Facial Discrimination Task; ODT=Object Discrimination Task; AES= Aesthetic Evaluative Sensitivity; AemS= Aesthetic Emotional Sensitivity; APS= Aesthetic Perceptual Sensitivity; FDT PCR= Facial Discrimination Task proportion of correct responses; FDT ACR= FDT accuracy change ratings; ERT= Emotion Recognition Task; IAT= Implicit Association Task; GNAT= Go/No-go Association Task; CVLT PR= California Verbal Learning Test percent recall; RCFT PR= Rey Complex Figures Task percent recall; SWM bse= Spatial Working Memory Test between search error; SWM wse= within search error; SWM ss= search strategy; SOC #psol= Stocking of Cambridge Task number of problems solved; SOC #perf sol= SOC number of perfect solutions; SOC tmem= SOC total moves in excess of the minimum; SST= Spatial Span Test; COWAT= Controlled Oral Word Association Test; RAVLT= Rey Auditory Verbal Learning Task; NTL= New Tower of London Task; CFT= Category Fluency Task; SVT= Sentence Verification Task; RBANS= Repeatable Battery for Neuropsychological Status

Table 3

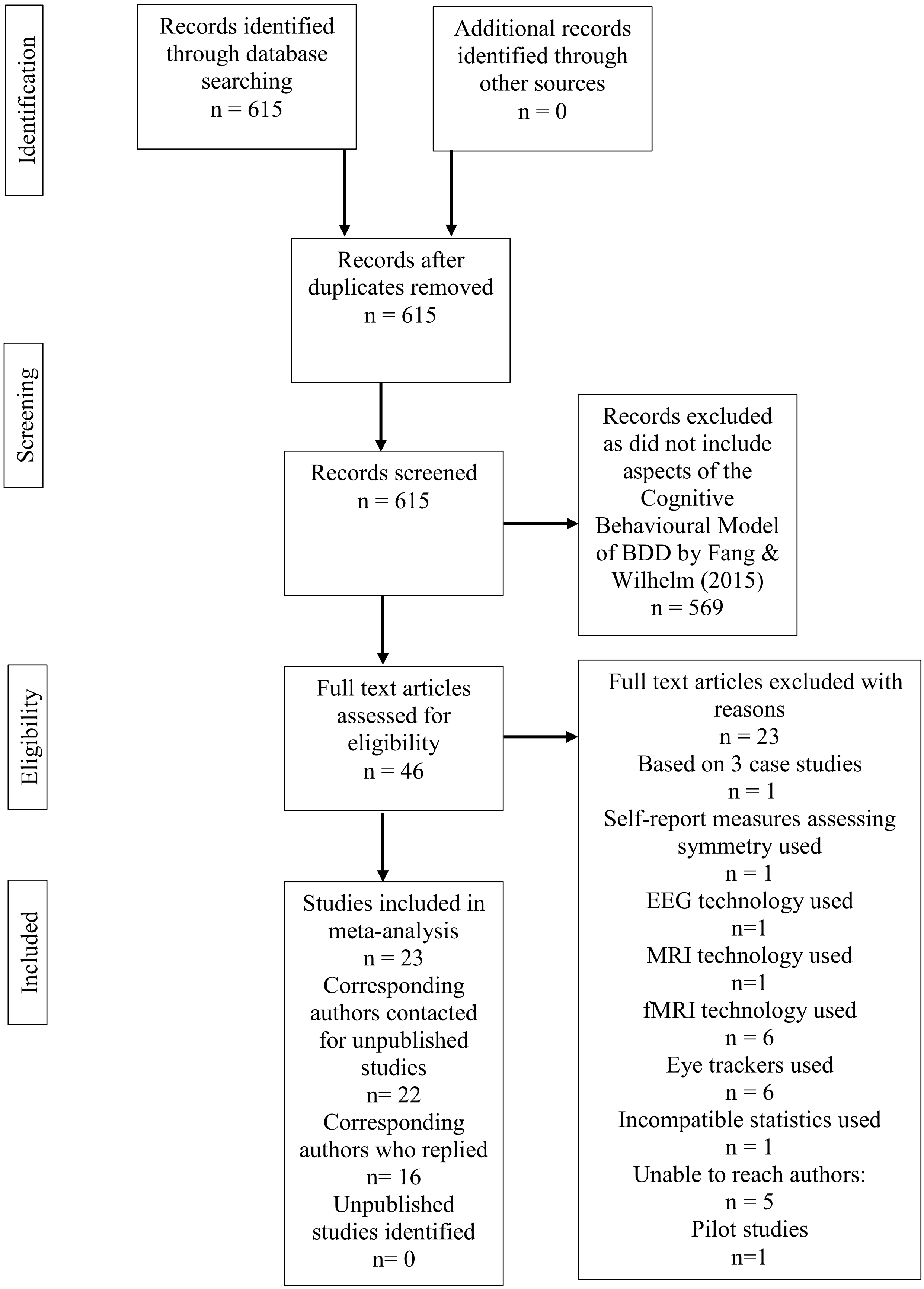
Analysis of heterogeneity (Q; I^2) and publication bias (ERI) for each cognitive category

Cognitive categories	Q-test [a]	I^2-test[a]	*ERI*[b]
Local Processing	25.35*	80.27*	9.49
Selective Attention	19.33*	63.79*	-.32
Interpretive Biases	7.24	17.13	-1.87
Memory Deficits	3.22	.00	1.15

Note: *p<.05; [a] indicates tests of heterogeneity; [b] indicates publication bias where *ERI*= Egger's regression intercept

Listing of titles for figures

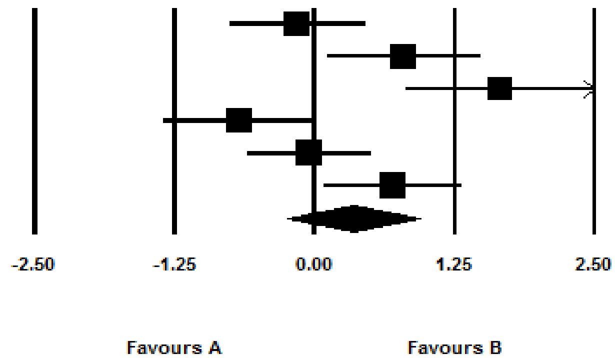
Figure 1



Identification
Screening
Eligibility
Included
Records identified through database searching n = 615
Additional records identified through other sources n = 0
Records after duplicates removed n = 615
Records screened n = 615
Records excluded as did not include aspects of the Cognitive Behavioural Model of BDD by Fang & Wilhelm (2015) n = 569
Full text articles assessed for eligibility n = 46
Full text articles excluded with reasons n = 23
Based on 3 case studies n = 1
Self-report measures assessing symmetry used n = 1
EEG technology used n=1
MRI technology used n=1
fMRI technology used n = 6
Eye trackers used n = 6
Incompatible statistics used n = 1
Unable to reach authors: n = 5
Pilot studies n=1
Studies included in meta-analysis n = 23
Corresponding authors contacted for unpublished studies n= 22
Corresponding authors who replied n= 16
Unpublished studies identified n= 0

Figure 2

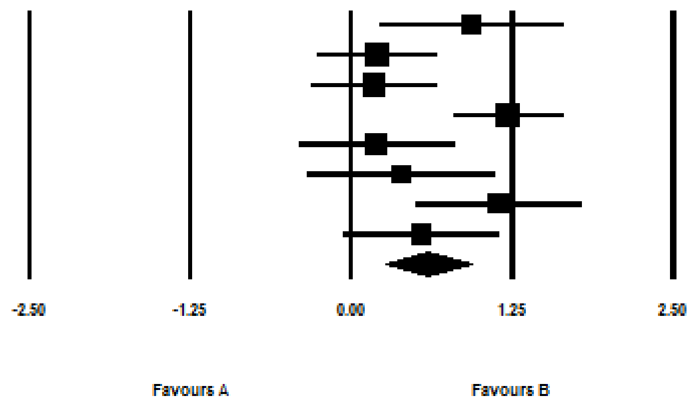
Study name	Outcome measure	Hedges's g and 95% CI
Buhlmann et al., 2004	BFRT	
Deckersbach et al., 200	RCFT	
Jefferies et al., 2012	FFT	
Kerwin et al., 2014	EFT, Navon	
Monzani et al., 2013	Navon, Composite, IF	
Toh et al., 2017a	MFT	



Note: BFRT= Benton Facial Recognition Task; RCFT= Rey Complex Figures Task; FFT= Famous Faces Task; EFT= Embedded Figures Task; IFT= Inverted Face Task; MFT= Mooney Faces Task

Figure 3

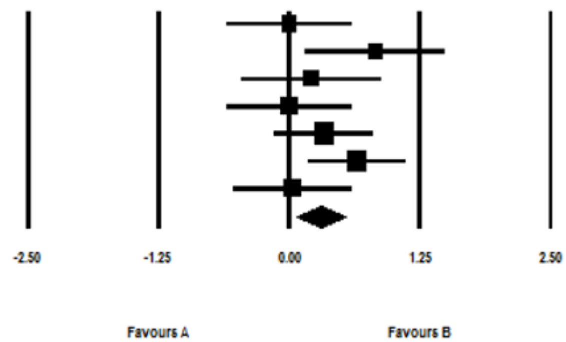
Study name	Outcome measure	Hedges's g and 95% CI
Buhlmann et al., 2002	Emotional Stroop	
Buhlmann et al., 2014	ODT, FDT	
Hübner et al., 2016	FDT	
Lambrou et al., 2011	APS, AES, AEmS	
Reese et al., 2010	FSD, DSD	
Rossell et al., 2014	Emotional Stroop	
Stangier et al., 2008	FDT	
Toh et al., 2017b	Emotional Stroop	



Note: ODT= Object Discrimination Task; FDT= Facial Discrimination Task; APS= Aesthetic Perceptual Sensitivity; AES= Aesthetic Evaluative Sensitivity; AEmS= Aesthetic Emotional Sensitivity; FDT= Facial Discrimination Task

Figure 4

Study name	Outcome Measure	Hedges's g and 95% CI
Buhlmann et al., 2004	ERT	
Buhlmann et al., 2006	ERT self-referent	
Buhlmann et al., 2008	IAT	
Buhlmann et al., 2009	IAT	
Buhlmann, Gleiß et al., 2011	ERT	
Buhlmann, Teachman et al., 201	GNAT	
Hartmann et al., 2015	GNAT	

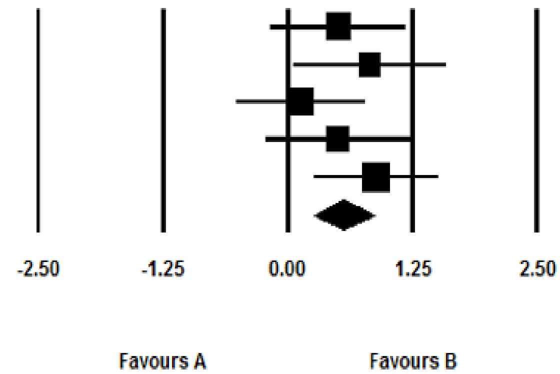


Note: ERT= Emotion Recognition Task; IAT= Implicit Association Task; GNAT= Go/No-go Association Task

Figure 5

Study name	Outcome Measure
Deckersbach et al., 200	CVLT, RCFT
Dunai et al., 2010	PR, SWM, SOC, SS
Hanes, 1998	RAVLT, NTL, CFT, RCF
Rossell et al., 2014	COWAT, SVT
Toh et al., 2015	RBANS

Hedges's g and 95% CI



Note: CVLT= California Verbal Learning Test; RCFT= Rey Complex Figures Task; PR= Pattern Recognition Test; SWM= Spatial Working Memory Test; SOC= Stocking of Cambridge Task; SS= Spatial Span Test; RAVLT= Rey Auditory Verbal Learning Test; NTL= New Tower of London Task; CFT= Category Fluency Task; COWAT= Controlled Oral Word Association Test; SVT= Sentence Verification Task; RBANS= Repeatable Battery for Neuropsychological Status

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6th April 2019

Internet-delivered cognitive behavioural therapy for perfectionism: Targeting dysmorphic concern

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Submitted to: *Body Image*

Abstract

Perfectionism is an important transdiagnostic risk factor for several psychopathologies. As such, treatments targeting perfectionism have gained increased attention over recent years. While perfectionism is postulated to be an important underlying mechanism for dysmorphic concern, no research has explored the benefits of targeting perfectionism to reduce dysmorphic concern. The current study evaluated the use of Internet-delivered cognitive behavioural therapy for perfectionism (ICBT-P) with 31 participants (28 women) with high levels of dysmorphic concern to examine the impact on perfectionism, dysmorphic concern, body image disturbance, negative affect, and selective attention towards appearance-based stimuli. Using a case series design, observations were collected at baseline, at the end of a 4-week pre-treatment phase, after the 8-week ICBT-P, and 1-month post-treatment. Intent-to-treat analyses showed significant improvement from baseline to end-of-treatment and follow-up on most of the variables, with a large effect size decrease in dysmorphic concern, and decreased selective attention to *BDD-body, BDD-positive,* and *BDD-negative* words. The results of this study support the use of ICBT-P as an efficacious treatment worthy of further examination in populations who experience high levels of dysmorphic concern.

Keywords: dysmorphic concern; cognitive-behavioral therapy; Internet; perfectionism; selective attention

1. Introduction

Dysmorphic concern (DC) is characterised by the overconcern with appearance-based imperfections, compulsions (e.g., mirror checking, reassurance-seeking), and impairment in functioning (Castle, Molton, Preston, & Phillips, 2004; Senín-Calderón et al., 2017). Such appearance-based preoccupations occur in around 30-46% of young adult populations (Cunningham, Griffiths, Baillie, & Murray, 2016). DC is a continuous construct relevant across several disorders, including depression, anxiety, eating disorders, and body dysmorphic disorder (BDD; Castle et al., 2004; Jorgensen, Castle, Roberts, & Groth-Marnat, 2001; Monzani et al., 2012; Oosthuizen, Lambert, & Castle, 1998). It has been postulated that DC exists along the obsessive-compulsive spectrum, with BDD at the extreme end (Littleton, Axsom, & Pury, 2005; Senín-Calderón et al., 2017). Furthermore, body image disturbance, or the distortion in perceptual and attitudinal views concerning some aspect of appearance (Cash, Melnyk, & Hrabosky, 2004), is a particularly important aspect of DC (Jorgensen et al., 2001). While symptoms of DC, such as body checking and reassurance-seeking, are often similar in BDD and eating disorders (i.e., body image disturbance populations; Rosen & Ramirez, 1998), some distinctions can be made, such as the propensity of individuals with BDD to endorse fewer weight, shape, and diet preoccupations (Fang & Wilhelm, 2015). Additionally, DC in individuals with anorexia nervosa has also been associated with the overestimation of body size, a feature not reported in the BDD literature (Beilharz et al., 2019). There is limited research investigating DC psychopathology consistent with BDD (e.g., a greater propensity to focus on facial features; Fang & Wilhelm, 2015), with a greater focus on eating disorders (Bartsch, 2007). Thus, given that DC is a trait common across a multitude of disorders and increases the risk for clinical diagnoses in populations experiencing body image disturbance (Monzani et al., 2012), targeting DC and the risk factors underlying this trait might serve to prevent clinical onset.

1.1. Perfectionism and selective attention as risk factors for dysphoric concern

Identifying and investigating transdiagnostic risk factors has gained traction over recent years (Craske, 2012; Matheny et al., 2017). A strength to this approach is that it addresses the overlap that occurs across disorders with similar psychopathological mechanisms (Egan, Wade, & Shafran, 2011), and thus may lead to more effective treatment when targeted in an intervention. One postulated transdiagnostic factor is perfectionism, which has been linked to eating disorders, high degrees of body dissatisfaction, obsessive-compulsive disorder (OCD), and BDD (Egan et al., 2011; Fang & Wilhelm, 2015; Limburg, Watson, Hagger, & Egan, 2017; Nichols, Damiano, Gregg, Wertheim, & Paxton, 2018). Treating perfectionism not only leads to large reductions in perfectionism but also moderate decreases in depression and anxiety (Lloyd, Schmidt, Khondoker, & Tchanturia, 2015). Wilhelm's (2006) model of BDD postulates that hyper-fixations on perceived appearance flaws are maintained by rigid perfectionistic standards of beauty, ultimately triggering compulsions directed at "correcting" the imperfections.

Research in BDD populations has produced mixed results concerning the most pertinent subtypes of perfectionism. One study (Hartmann, Thomas, Greenberg, Matheny, & Wilhelm, 2015a) showed people with BDD endorsed higher perfectionistic strivings (high personal standards) than controls but not perfectionistic concerns (concerns over mistakes and perceived failures), but another study found a BDD group endorsed both perfectionistic strivings and concerns (Buhlmann, Etcoff, & Wilhelm, 2008). This latter finding is consistent with the meta-analysis by Limburg et al. (2017), who found both subtypes of perfectionism to be transdiagnostic risk factors. In non-clinical populations, perfectionism is a risk factor for DC

(Bartsch, 2007; Cunningham et al., 2016; Hanstock & O'Mahony, 2002; Kuennen & Waldron, 2007), suggesting that perfectionism precedes the onset of clinical disorders, such as BDD. To date, no DC research has concurrently investigated the role of perfectionistic strivings and concerns in predicting and maintaining psychopathology. This is surprising, given that these subtypes of perfectionism are strongly related to perfectionistic detail-oriented checking (Stairs, Smith, Zapolski, Combs, & Settles, 2012), a postulated central feature of DC. Thus, while perfectionism appears to play an important role in maintaining symptoms across several psychological disorders, differences in pathology might be influenced by where attention is directed. For example, an individual with BDD might direct attention towards a specific facial feature, whereas an individual with OCD might be more likely to direct attention towards signals in the environment indicating contamination.

Selective attention is also an important underlying cognitive mechanism that maintains a broad array of psychopathology (Bar-Haim et al., 2007; Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Fang & Wilhelm, 2015; Johnson, Williamson, & Wade, 2018), and has been found to be an important risk factor for the development of DC (Onden-Lim, Wu, & Grisham, 2012), including among men at high risk of muscle dysmorphia (Jin et al., 2018). A recent meta-analysis (Johnson et al., 2018) found selective attention produced the largest effect size difference between BDD and control groups relative to central coherence, interpretive biases, and memory deficits. Consequently, these results suggest that individuals with high degrees of DC have a propensity to focus their attention towards perceived environmental threats, processes that can be targeted in therapy.

It has been postulated that the cognitive mechanisms underlying perfectionism include selective attention biases towards environmental threats signalling failure, while attention is directed away from achievements (Shafran, Cooper, & Fairburn, 2002). Although cognitive-behavioural therapy (CBT) treatment models for perfectionism denote the importance of targeting maladaptive selective attentional processes (Howell et al., 2016), to date, there remains limited research testing the relationship between selective attention and perfectionism. While correlational research has shown a relationship between these constructs (Lundh & Öst, 1996), studies using cognitive tasks have produced mixed results, with one study detecting a significant relationship between high perfectionism scores and attention bias for perfectionistic-relevant stimuli (Howell et al., 2016) and another study failing to corroborate these results (Kobori & Tanno, 2012). Consequently, more research is needed to clarify the relationship between selective attention and perfectionism.

1.2. Cognitive-behavioural therapy for perfectionism

CBT for perfectionism (CBT-P) reduces not only the primary outcome of perfectionism but also secondary outcomes such as depression and anxiety (Lloyd et al., 2015). To date, however, no research has examined the impact on other secondary outcomes such as DC and body image disturbance. While one study has looked at CBT-P with BDD participants (Glover, Brown, Fairburn, & Shafran, 2007), only two individuals in the sample had comorbid diagnoses of BDD (Shafran, personal communication, February 20, 2018). Although the researchers found significant differences between the treatment and control groups, they did not consider improvements to BDD symptomology.

Internet-delivered CBT (ICBT) has gained increased attention over recent years as a more accessible and lower cost alternative to CBT (Andersson, Titov, Dear, Rozental, & Carlbring, 2019). A 2018 meta-analysis by Carlbring, Andersson, Cuijpers, Riper, and Hedman-Lagerlöf compared the efficacy of therapist-guided ICBT against face-to-face CBT in treating a variety of mental health conditions, including body dissatisfaction, and concluded that ICBT was as effective as the face-to-face delivery method. In addition, ICBT has been found to work for BDD and eating disorders. A 2014 meta-analysis on the efficacy of E-therapy (online and app delivery methods) showed some support for prevention, treatment, and relapse prevention in eating disorders (Loucas et al., 2014). Additionally, a randomised controlled trial (RCT) conducted in a BDD population found that compared to supportive therapy, internet-based cognitive-behavioural therapy for BDD (BDD-NET) produced greater reductions in BDD symptom severity and secondary treatment gains on measures of depression, global functioning, and quality of life (Enander et al., 2016). Moreover, ICBT for perfectionism (ICBT-P) has produced clinically significant reductions in symptoms of perfectionism, and improvements to symptoms of anxiety and depression (Arpin-Cribbie, Irvine, & Ritvo, 2012; Egan et al., 2014; Radhu, Daskalakis, Arpin-Cribbie, Irvine, & Ritvo, 2012; Rozental et al., 2017; Shafran et al., 2017). ICBT has also been found to have enduring effects for a multitude of psychological disorders, such as OCD and depression (Andersson, Rozental, Shafran, & Carlbring, 2017).

1.3.Aims and hypotheses

Given the postulated association between perfectionism and DC, and the gap in the literature assessing the impact of perfectionism on targeting symptoms of DC, the current study sought to evaluate the use of ICBT-P with respect to our primary outcomes, perfectionistic strivings and concerns, as well as our secondary outcomes, DC, body image disturbance, selective attention biases, and indicators of negative affect including depression, anxiety, and stress, using a case series design. Given that selective attention biases are also a risk factor for DC, we predicted that targeting perfectionism would also lead to a reduction in selective attention biases for BDD-target word information. We hypothesised that compared to the baseline period, participants would show significant reductions in perfectionism (i.e., strivings and concerns) at the end-of-treatment, which would be maintained at one-month follow-up. Further, we predicted that compared to the baseline period, participants would also demonstrate significant treatment gains for all secondary outcomes at the end-of-treatment, which would be maintained at one-month follow-up.

2. Method

2.1. Participants

Thirty-one participants (28 women) aged 18 to 39 with a mean age of 22.06 (*SD* = 5.54) years and mean BMI of 25.39 (*SD* = 6.79) were recruited between August 2017 and March 2018 using an undergraduate university participation system and flyers posted at the university. Seventy-seven percent of the sample identified as Caucasian, 10% identified as Asian, 3% identified as African, and the remaining 10% identified as a race not otherwise listed. Furthermore, depression (35%) and anxiety (42%) were the most pervasive mental health problems endorsed by participants and the most commonly reported family mental health conditions (52% and 32%, respectively). All participants gave informed consent electronically prior to commencing the study and were compensated $45 to take part in the entire study. This project was approved by the Flinders University Social and Behavioural Research Ethics Committee (approval code 140.17). The following inclusion criteria were assessed using a single response option: (a) spoke English as preferred language, (b) were not dependent on illicit drugs or alcohol, (c) were not pregnant, (d) did not have visual or motor impairments, (e) were not actively suicidal, (f) had not been given a diagnosis of BDD, and (g) had clinically significant DC (scoring ≥ 11 on the Dysmorphic Concern Questionnaire [DCQ]; Oosthuizen et al., 1998). To maintain a focus on DC consistent with BDD symptomology, we did not include individuals who exclusively endorsed weight concerns (Buhlmann, Reese, Renaud, &

Wilhelm, 2008; Fang & Wilhelm, 2015). Further, given that muscle dysmorphia is a specifier of BDD and that areas above the neck are the most common preoccupations and are more prevalent in BDD than in eating disorders (Buhlmann et al., 2008; Fang & Wilhelm, 2015), we selected only those participants who identified a preoccupation with muscle mass, head shape, skin, hair, and/or at least one facial feature. Most participants endorsed three or more preoccupations with the legs ($n = 25$), muscles ($n = 21$), and skin ($n = 19$) being the most common areas of concern.

2.2. Design

The current study employed a case series design where observations were collected on four occasions: at baseline (Time 1), at the end of a 4-week pre-treatment phase (Time 2), at the end-of-treatment after completion of the online 8-week program (Time 3), and at 1-month follow-up (Time 4). The waitlist period was included to allow us to compare within-group effect sizes to the treatment period, and a 4-week period was chosen to permit some indication of stability while not requiring participants to wait the entire 8-week length of the intervention. The following precautions were taken to limit bias: clearly defined objectives and protocols, specified inclusion/exclusion criteria, predetermined study duration and follow-up periods, and valid clinical outcome measures (Chan & Bhandari, 2011). All participants were first screened for study eligibility before undertaking an initial assessment. Assessments were completed at all time points (baseline, pre-treatment, end-of-treatment, and one-month follow-up).

2.3. Measures

2.3.1. Perfectionism

Only the Concern over Mistakes (i.e., perfectionistic concerns), Doubts about Actions (i.e., perfectionistic concerns), and Personal Standards (i.e., perfectionistic strivings) subscales of the Frost Multidimensional Perfectionism Scale (FMPS; Frost, Marten, Lahart, & Rosenblate,

1990) were used. Items are rated on a 5-point scale, and item responses range from 1 to 5. Higher scores on each subscale indicate greater levels of perfectionism. Scores on the FMPS have been found to have good reliability and validity among young adult samples (Frost et al., 1990). Due to limitations with Cronbach's alpha assumptions (McNeish & Harlow, 2018), Coefficient H was computed as an indicator of internal reliability at all time points and the values for the FMPS Concern over Mistakes, Doubts about Actions, and Personal Standards subscales ranged from .95-.96, .83-.89, and .88-.93, respectively.

2.3.2. Appearance-based body image

The Multidimensional Body Self-Relations Questionnaire-Appearance Scales (MBSRQ-AS) measures body image disturbance and includes 34 items and five subscales (Brown, Cash, & Mikulka, 1990; Cash, 2000): Appearance Evaluation (satisfaction with overall appearance), Appearance Orientation (preoccupation with appearance), Body Areas Satisfaction (satisfaction with specific aspects of appearance), Overweight Preoccupation (dietary restrictions and weight-based anxiety), and Self-classified Weight (self-appraisals of weight). Items are rated on a 5-point scale, and item responses range from 1 to 5. Higher scores on the Appearance Evaluation and Body Areas Satisfaction subscales, representing greater levels of satisfaction with overall and specific aspects of appearance, reflect lower levels of body image disturbance. On the other hand, higher scores on the Appearance Orientation and Overweight Preoccupation subscales, reflecting appearance-related and weight-based preoccupations and compulsions, indicate greater levels of body image disturbance.

The MBSRQ-AS has been reported to have good psychometric properties in both non-clinical and clinical populations endorsing symptoms of eating disorders and BDD (Hartmann et al., 2015b; Hrabosky et al., 2009; Roncero, Perpiñá, Marco, & Sánchez-Reales, 2015; Rosen, Reiter, & Orosan, 1995). Furthermore, the 5-factor structure has been validated in non-clinical (Roncero et al., 2015) and eating disorder populations (Vossbeck-Elsebusch et al., 2014) using Spanish and German versions of the MBSRQ-AS. However, Vossbeack-Elsebusch et al. (2014) detected strong goodness of fit indices for all the factors, except the Self-Classified Weight subscale. Based on these findings, we excluded the Self-Classified Weight subscale from the analyses. In the present study, the Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, and Overweight Preoccupation subscales generated Coefficient H values that ranged from .91-.97, .84-.94, .85-.91, and .85-.92, respectively.

2.3.3. Depressive, anxiety, and stress psychopathology

Used to assess depression, anxiety, and stress, the Short-form version Depression Anxiety Stress Scales (DASS-21) is a condensed version of Lovibond and Lovibond's (1995) 42-item DASS scale and is comprised of 21 items. Items are rated on a 4-point scale, and item responses range from 0 to 3. Higher scores on each subscale reflect greater psychopathology. The DASS-21 has been reported to have good psychometric properties, and factor analyses have confirmed a 3-factor structure in a non-clinical sample of adults (Henry & Crawford, 2005). In the present study, this measure produced Coefficient H values that ranged from .94-.97, .86-.95, and .89-.94 for depression, anxiety, and stress, respectively.

2.3.4. Dysmorphic concern

The Dysmorphic Concern Questionnaire (DCQ) is thought to capture a variety of appearance-based concerns. It is comprised of seven items that are rated on a 4-point scale, and item responses range from 0 to 3. Higher scores are indicative of greater DC. Jorgensen and colleagues (2001) concluded that the DCQ adequately differentiated the BDD group from other psychiatric disorders. While a variety of cut-off scores have been proposed, a cut-off score of 11 is said to have high sensitivity (89%) and specificity (95%) for a diagnosis of BDD (Mancuso, Knoesen, & Castle, 2010). While other conditions (such as health anxiety) cannot be ruled out using this cut-off, earlier studies support this cut-off score as indicating significant appearance-based concerns (Monzani et al., 2012; Schieber, Kollei, de Zwaan, & Martin, 2018; Stangier, Janich, Adam-Schwebe, Berger, & Wolter, 2003). Further, compared to a cut-off score of 14 used in previous research, using a lower value reduces the probability of false negative detection rates (Schieber et al., 2018). Therefore, in the current study, we included only those participants who scored an 11 or above on the DCQ, indicating clinically significant DCs (Monzani et al., 2012; Schieber et al., 2018). Given that we were interested primarily in DC psychopathology relevant to BDD and that factor analyses have shown it to have the lowest factor loading (Monzani et al.,2012; Schieber et al., 2018; Senín-Calderón et al., 2017), Item 3 from the DCQ (assessing preoccupations with excessive body odour, flatulence, and sweating) was dropped from the analyses. In the current study, Coefficient H values ranged from .85-.98. Any participants who scored a one or above on Item 1 "*Have you ever been very concerned about some aspect of your physical appearance*" of the DCQ administered at Time 1, were prompted to respond to the following question: "Which aspect(s) of your appearance concern you? (e.g., nose, skin, hair, muscles, etc.)" Additionally, for all DCQ measures administered following the completion of pre-treatment measures, the DCQ instructions were modified to read "Please select the number that best corresponds to your agreement with each statement below. These questions refer to your experiences over the PAST WEEK."

2.3.5. Dot-probe task

Developed by MacLeod, Mathews, and Tata (1986), the dot-probe paradigm is one of the most widely used measures of selective attention, in which attention is either allocated towards or averted away from the target stimuli. In traditional versions of the dot-probe detection task, two words are presented to opposite ends of the screen, in which one of the words is replaced by a dot. Participants are required to detect the dot as quickly as possible by pressing the corresponding key (Salemink, van den Hout, & Kindt, 2007). Participants displaying higher degrees of psychopathology are expected to respond faster to the dots replacing the target stimuli (Salemink et al., 2007).

In the current study, after reading instructions, participants received 12 practice trials with paired neutral words. Presentation of words was made up of a size 12 Ariel font with upper- and lower-case black letters (white background), resulting in a measured font height of 18mm. A total of two blocks were created, with the first representing practice trials made up of city names and the other made up of two trials of object-related/buffer words. Subsequently, to ensure that the same word set was not presented sequentially and that the correct response (i.e., left or right) was limited to three successive responses per block trial, 160 experimental word trials were presented randomly using an algorithm. Word pairs were presented a total of eight times with four potential word combinations repeated twice (totalling 160 experimental trials). To align participant gaze, a fixation cross was presented for 500 milliseconds (ms), followed by a blank screen presented for 200 ms. Following the alignment of the participant gaze, a matched target and neutral word was presented on the left and right side of the screen. This was subsequently replaced with a dot that appeared on either the left or right side of the screen, prompting participants to select the corresponding right (“Z”) or left (“/”) key. The word pairs and dots were presented for 500 ms, with a fixed trial interval of 500 ms.

Stimuli consisted of 40 target words and 40 matched neutral words. Four published DC and BDD studies using dot-probe and Emotional Stroop tasks were used to generate most of the stimuli selected (Buhlmann, McNally, Wilhelm, & Florin, 2002; Onden-Lim et al., 2012; Rossell, Labuschagne, Dunai, Kyrios, & Castle, 2014; Toh, Castle, & Rossell, 2017). Any additional stimuli were synonyms of these words. The *BDD-body* word stimuli included *eyebrows, nose,* and *teeth*. The *BDD-negative* words included *disgusting, deformity,* and *disfigured*. The *BDD-positive* words included *attractive, sexy,* and *handsome.* All word types were expected to correlate positively with DC. Examples of the target and matched stimuli for each category were: *eyebrows (backpack), deformity (parameter),* and *attractive (spectacles)*. All target and matched neutral words can be found in the online data repository (https://doi.org/10.6084/m9.figshare.7304216). Each trial was counterbalanced using Kucera and Francis' (1967) guide to match words for length, syllable, and frequency.

To address the limitations of multiple comparisons and the impact of task-related anxiety on disengagement from target stimuli on the dot-probe task (Frewen, Dozois, Joanisse, & Neufeld, 2008), we chose only to analyse the orientation scores for the three word types (i.e., *BDD-body, BDD-negative, BDD-positive*). Orientation scores were calculated to capture vigilance towards the three word types. This was measured by dividing neutral trials (in neutral-neutral word pair presentations) by congruent trials (where the dot follows the target word in a neutral-target word pair presentation). A higher value indicated greater vigilance towards the target word stimuli.

2.3.6. Intervention: Overcoming perfectionism

The current study used the same ICBT protocol for clinical perfectionism (Egan, Wade, Shafran, & Antony, 2014), which has been evaluated previously (Rozental et al., 2017; Shafran et al., 2017). Overcoming Perfectionism is comprised of eight treatment modules; participants were instructed to complete the program at a rate of one module per week for a total of eight weeks. All information was accessed through a secure website. Content included reading material on the nature of CBT, clinical perfectionism, and factors maintaining symptomology. Further, homework assignments included behavioural experiments, cost-benefit analyses, cognitive restructuring, and graded exposure. The eight modules are outlined as follows: (1) *understanding perfectionism,* (2) *your perfectionism cycle,* (3) *surveys and experiments,* (4) *new ways of thinking,* (5) *useful skills for managing unhelpful perfectionism,* (6) *self-criticism or self-compassion?,* (7) *re-examining the way we define our self-worth,* and (8) *staying well: managing unhelpful perfectionism in the long-term*. Management of the online system was conducted by the first author. Participants were sent weekly reminder emails to complete the scheduled module one day before the due date. Before proceeding to the next module, it was ensured that each participant had completed all prior content. No further interaction with participants occurred throughout the completion of these modules.

2.4. Procedure

At Times 1 and 4, participants attended the university laboratory to complete the cognitive computer task and a series of online questionnaires administered on Qualtrics, which assessed levels of perfectionism, DC, appearance-based body image disturbance, mood, and stress. Assessments were completed on a desktop personal computer (PC) with a twenty-two-inch monitor, a screen size of 470 × 298 mm, and a screen resolution (pixels) of 1680 width × 1050 height × 32 depth. Completion time for the cognitive task and web-based questionnaires was 20 minutes.

All participants were required to wait four weeks before completing the pre-treatment measures at Time 2 (excluding the cognitive task), which could be completed from any PC. Completion time was approximately 10 minutes. Following completion of the pre-treatment measures, participants commenced the 8-week online perfectionism program from a preferred PC. After completion of each weekly module (at a rate of one module per week, with completion times of approximately 30 minutes), participants were administered the 7-item DCQ questionnaire. Following completion of the eighth and final module (Time 3), participants were given the same measures administered at Time 2. After a 1-month wait period, at Time 4, participants were asked to return to the university laboratory to complete the same cognitive computer task and baseline measures (excluding demographics) given at Time 1. Any participants who dropped out of the study after having commenced the treatment modules were given the option to wait one month from that time period and return to the lab for the final assessment.

2.5. Data analyses

To determine the suitability of parametric testing, normality was assessed across all time points using the Shapiro-Wilk test and visual inspection of histograms. Using all the data points from all time points as a single variable, we looked for outliers on each self-report variable of interest. Moreover, using this same method, we looked for outliers (scores deviating 3 standard deviations from the mean) on the dot-probe task. After restructuring the datasets such that all time points could be analysed as a single variable, no outliers were identified on any of the primary or secondary variables of interest.

In the current study, people who completed all treatment modules also completed all assessments, while those who did not complete all modules did not complete all assessments. The former were termed completers, and the latter were termed non-completers. Using logistic regression, comparisons were made between the two groups to ensure that data were missing at random.

To determine change over time with our treatment outcomes, multilevel modelling was employed, which uses maximum likelihood estimation to permit the inclusion of all cases with missing data into the analyses, thus representing intention-to-treat (ITT) analyses. We used a linear mixed model with fixed effects and an unstructured covariance matrix that applied a Bonferroni correction. The dependent variables represented the outcomes (i.e., perfectionism, body image disturbance, selective attention, depression, anxiety, stress, and DC) at each time point analysed and the fixed variable was time. We also repeated the analyses while covarying for the effects of age (which could impact the dot-probe task) and BMI (which could impact the MBSRQ-AS or DCQ), which were entered as two additional fixed variables. To calculate within-group changes (Cohen's *d*) with completer and ITT samples (21 and 31 respectively), an online Psychometrica calculator (https://www.psychometrica.de/effect_size.html#repeated) was used which corrects for correlations over time. We then examined within-group effect sizes between three time points: (1) baseline to pre-treatment, (2) baseline to end-of-treatment, and (3) baseline to one-month follow-up. Using the same online calculator, we computed a subset of analyses for the ITT group such that we could compare within-group effect size differences on the DCQ from baseline to Modules 2-7 (see Figure 1).

3. Results

3.1. Preliminary analyses

At Time 3, the DASS-21 Depression subscale was found to be positively skewed. Further, at Time 4, both the DASS-21 Depression and Stress subscales generated positive skews. In effect, log10 transformations were computed at all DASS-21 Depression and Stress time points, resulting in normal distributions. All other variables were found to be normally distributed. There were no significant differences between men and women on any of the variables of interest.

3.2. Non-completion

In the current study, 32% of participants were considered non-completers (see Figure 2 for reasons for attrition). This included two participants who dropped out over the first two treatment modules, but who agreed to return to the lab one month afterward to complete the final assessment phase. Logistic regression analyses revealed that no baseline variables predicted non-completion (see Table 1).

Additionally, a subset of analyses was computed such that comparisons could be made between the completers (n = 21) and non-completers who finished a minimum of two treatment modules (n = 4). Using the Psychometrica calculator, compared to the completer group (d = -0.78, 95% CI= -1.41: - 0.15), reductions in DCQ scores from baseline to Module 2 were greater in the non-completer group (d = -6.00, 95% CI= -7.40: -4.57).

3.3.Symptom change from baseline to pre-treatment period

Only the MBSRQ-AS Overweight Preoccupation subscale showed significant differences from baseline (Time 1) to the pre-treatment phase (Time 2), whereby scores increased after the 4-week wait period. There were no significant differences from the baseline to the pre-treatment phase on any of the other variables analysed (See Table 2). No significant differences from baseline to pre-treatment were detected on any of the variables of interest when covarying for the effects of age and BMI (See Table 3). Completer analyses were also computed, which revealed a similar pattern of results.

3.4.Symptom change from baseline to end-of-treatment and 1-month follow-up

Significant reductions in perfectionism, body image disturbance, depression, stress, and DC were demonstrated from baseline to the end-of-treatment phase; these results were maintained at 1-month follow-up. For the dot-probe analyses, significant increases were evident in orientation scores for two (*BDD-body* and *BDD-positive*) of the three word types from baseline to 1-month follow-up, indicating a reduction in vigilance towards the target stimuli. This suggests that selective attention is an epiphenomenon of DC and may not require treatment with interventions such as Cognitive Bias Modification (Notebaert, Clarke, Grafton, & Macleod, 2015). From baseline to end-of-treatment phases, effect sizes ranged from small to large on the FMPS Concern over Mistakes (*d* = -0.84, 95% confidence interval [CI] = -1.36, -0.32), Doubts about Actions (*d* = -0.70, 95% CI = -1.21, -0.18), and Personal Standards subscales (*d* = -0.37, 95% CI = -0.87, 0.13), ranged from small to medium for the MBSRQ-AS Appearance Evaluation (*d* = 0.47, 95% CI = -0.03, 0.97), Appearance Orientation (*d* = -0.60, 95% CI = -1.11, -0.09), Body Areas Satisfaction (*d* = 0.68, 95% CI = 0.16, 1.19), and Overweight Preoccupation (*d* = 0.09, 95% CI = -0.40, 0.59) subscales, ranged from small to large on the DASS-21 Anxiety (*d* = -0.20, 95% CI = -0.70, 0.03), Depression (*d* = -0.65, 95% CI = -1.16, - 0.14), and Stress subscales (*d* = -0.80, 95% CI = -1.32, -0.28), and was large for the DCQ (*d* = -1.35, 95% CI = -1.91, -0.80). From baseline to 1-month follow-up, effect sizes ranged from small to large for the Orientation Body (*d* = 0.81, 95% CI = 0.30, 1.33), Orientation Negative (*d* = 0.35, 95% CI = -0.15, 0.85), and Orientation Positive (*d* = 0.91, 95% CI = 0.38, 1.43) word scores.

DCQ scores were also tracked following the completion of each treatment module. Aside from the pre-treatment period, compared to baseline, there were significant reductions in DC symptomology across all time points (see Figure 1). Further, there was a large effect size difference (*d* = -1.72, 95% CI = -2.30, -1.14) from baseline to 1-month follow-up. Compared to the effect size difference between baseline and end-of-treatment, effect sizes were stronger in the expected direction from baseline to 1-month follow-up on the Appearance Evaluation, Appearance Orientation, Body Areas Satisfaction, Depression, Anxiety, and Stress subscales, and DCQ. ITT analyses were also conducted while covarying for the effects of age and BMI. While the analyses produced a similar pattern of results, compared to baseline, the Personal Standards subscale became significant at the end-of-treatment and 1-month follow-up, the

Appearance Evaluation subscale became significant at the end-of-treatment, the Orientation Negative word scores became significant at 1-month follow-up, and the Body Areas Satisfaction and Stress subscales were no longer significant at the end-of-treatment and 1-month follow-up (see Table 3). A similar pattern of results was detected in the completer analyses on all the variables of interest. All data relating to this study can be located by using the following reference: {dataset} Johnson et al. (2018).

3.5. The impact of perfectionism on dysmorphic concern

As a post-hoc analysis and to investigate the impact of perfectionism on DC, regression analyses were computed whereby the change in perfectionism (i.e., FMPS Concern over Mistakes, Doubts about Actions, and Personal Standards subscales) scores from baseline to end-of-treatment were entered as predictor variables and the DCQ score at the end-of-treatment or 1-month follow-up was entered as the outcome variable (see Table 4). No significant associations were noted.

4. Discussion

This is the first study to investigate the efficacy of ICBT-P in targeting symptoms of DC and the first study to explore the transdiagnostic benefits of targeting perfectionism in this population. Except for anxiety scores, significant reductions in psychopathology were found at the end-of-treatment and maintained at 1-month follow-up across all variables of interest. Furthermore, there were significant reductions between DCQ scores from the baseline and assessments following the completion of each treatment module. In the ITT group, effect size differences from baseline to end-of-treatment ranged from small to large for perfectionism, small to medium for body image disturbance, small to large for negative affect, and were large for DC. From baseline to 1-month follow-up, effect sizes ranged from small to large on orientation word scores. We saw no correlations between changes in perfectionism and changes in DC, which might indicate that there was an indirect effect of perfectionism (e.g., through a third variable such as body image disturbance) or that there was insufficient power to detect a direct effect. Our findings also suggest that improvements in DC can be achieved early in therapy. It is also of interest to note that compared to the end-of-treatment phase, effect sizes were larger at 1-month follow-up for many of the variables analysed. This indicated that not only did the treatment effects endure over time, but they also became larger (see Tables 2 and 3). Additionally, compared to the completer group, those who completed at least two treatment modules and then dropped out of the study had a much larger effect size decrease in DCs from baseline to Module 2, suggesting that reasons for non-completion might have also been influenced by a high perceived initial benefit of the treatment program. However, given that such a small sample size was used in the analyses, these results should be interpreted with caution.

The results from this case series were consistent with previous ICBT-P studies (Arpin-Cribbie et al., 2012; Radhu et al., 2012; Rozental et al., 2017; Shafran et al., 2017), as well as the BDD studies (Buhlmann et al., 2008; Hartmann et al., 2015a) and the meta-analytic study by Limburg and colleagues (2017), who found perfectionism to be an important underlying feature maintaining psychopathology. The results of the current study also reflect novel research findings, which indicate that targeting symptoms of perfectionism reduces vigilance towards BDD-target word stimuli relative to a wait-list period. These findings are consistent with Shafran et al. (2002) who postulate that the cognitive mechanism underlying perfectionism involves selective attention biases towards environmental threats signalling failure. In the case of individuals with clinically significant DCs, this might be reflected in attentional biases towards appearance-based stimuli. According to the BDD model by Wilhelm (2006), individuals with high degrees of DC engage in cognitive distortions whereby perceived imperfections trigger global negative self-evaluations (e.g., “if I am not attractive then I am a failure”). Similarly, in Veale’s (2004) BDD model, heightened perfectionistic standards of beauty are thought to play an important role in maintaining symptoms of DC. It is of interest to note that this intervention manifested in greater improvements on the DCQ compared to the FMPS; perfection in this population may be primarily focused on appearance-based concerns.

4.1.Limitations

Future research is required to address the current study’s limitations. First, a 1-month follow-up period is insufficient to determine whether ICBT-P produced long-term reductions in the psychopathological mechanisms associated with DC. Second, although precautions were taken to limit study bias, the use of a case series design and the lack of a true control group increased the risk of bias and decreased generalisablity of the findings. For example, we cannot rule out the possibility that treatment effects were influenced by the passage of time and the expectation that symptoms would improve. Furthermore, due to the lack of a control group, it was not possible to ascertain whether treatment effects were a true reflection of the intervention or whether these effects were influenced by the regression towards the mean. The Medical Research Council recommends that when developing complex interventions, the use of pilot research, such as case series designs, should be implemented prior to RCTs (Craig et al., 2008); these designs can be used to develop effect size changes that can be used in future power analyses. Third, although men and women did not differ on any of the variables of interest, most participants were women (90%), which might also lower the generalisability of our findings. Fourth, to address a gap in the DC literature, specifications were put forth to recruit a population endorsing symptomology more specific to BDD. However, the DCQ captures symptomology consistent with other disorders; therefore, we cannot ascertain with certainty whether this intervention would be useful for patients with symptoms of BDD. Fifth, we did not pilot test the dot-probe stimuli or covary for the effects of intellectual quotient and education, which might have confounded the results. It is also worth noting that the 95% CIs for the orientation word scores were large, indicating that there might have been issues with the reliability of the dot-probe task, a concern highlighted in earlier research (Schmukle, 2005). Finally, because this was an Internet intervention, a structured clinical interview was not undertaken. In effect, we were unable to ascertain whether any of our participants met criteria for a psychiatric diagnosis. Thus, failure to include a symptom severity measure of BDD was a further limitation of the current research, as levels of symptomatology may moderate response to ICBT-P. In effect, to improve and titrate treatment options, referrals for a more comprehensive assessment could occur prior to enrolling participants in treatment programs. While these results cannot be translated directly to BDD populations, this study was consistent with the BDD-NET findings by Enander and colleagues (2016) and conformed to the 2005 NICE guidelines for BDD by trialling the use of ICBT unspecific to BDD psychopathology in a DC population. Better-powered studies are required to test models that can explain how perfectionism impacts our secondary outcomes.

4.2.*Future directions*

The results of this case series might be used to inform the development of future dot-probe stimuli. For example, researchers might consider incorporating stimuli depicting symmetrical and asymmetrical facial features. Given the nature of DC preoccupations, this would strengthen the manipulation (Stangier, Adam-Schwebe, Müller, Wolter, & Watson, 2008) and capture the full spectrum of BDD-related stimuli (i.e., *BDD-body, BDD-negative*, and *BDD-positive* words). Testing this in populations with clinically significant DCs can provide valuable insight into the aetiology of clinical disorders. Given that reliability of the dot-probe task has been called into question (Schmukle, 2005), to bolster reliability, future research might consider winsorizing outliers in replace of using pre-determined standard deviation cut-off scores (Price et al., 2015). Nevertheless, targeting general symptoms of perfectionism led to a reduction in vigilance towards the BDD-target word stimuli. Thus, future research might consider replicating this study in a clinical population with BDD. It might also be of interest to explore the transdiagnostic benefits of perfectionism treatment programs in other psychiatric populations known to display selective attention abnormalities, such as social phobia and eating disorders (Brooks et al., 2011; Yair, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007). Furthermore, given that participants improved on measures of perfectionistic strivings and concerns, future DC research should endeavour to replicate these results, such that a more comprehensive understanding of the specific subtypes of perfectionism underlying DC can be achieved.

While more research is needed to replicate these findings, these results provide important insights into the development of novel CBT-based approaches. For example, for the purposes of DC research, it might useful to modify the current intervention program to include material that is specific to appearance-related imperfections. Finally, these preliminary results suggest that future DC research should be carried out to evaluate the efficacy of CBT-P against disorder-specific CBT-based approaches, such as CBT-BDD (Rosen et al., 1995), using an RCT design (NICE, 2005). Given the treatment barriers common in populations with high levels of DCs (e.g., shame, poor screening practices, misdiagnoses, and access issues; Buhlmann & Winter, 2011), exploring options outside the context of intensive, specialised approaches, such as CBT-BDD (Harrison et al., 2016), would be fruitful.

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Table 1

Logistic regression analyses to assess baseline predictors of attrition.

Variable	Total Sample *N = 31; M (SD);* Range	Completers *n* = 21; *M (SD);* Range	Non-completers *n* = 10; *M (SD);* Range	OR (95%) completer vs. non-completer
Age	22.06 (5.54), 18-39	21.71 (5.09) 18-39	22.80 (6.61), 18-36	0.97 (0.84: 1.10)
BMI	25.39 (6.79), 16-42	25.70 (6.63), 16-40	24.75 (7.43), 18-42	1.02 (0.91: 1.15)
FMPS CM	32.26 (7.84), 11-44	33.24 (6.59), 15-42	30.20 (10.07), 11-44	1.56 (0.65: 3.74)
FMPS DA	15.00 (2.68), 8-20	15.19 (2.06), 12-19	14.60 (3.78), 8-20	1.40 (0.44: 4.43)
FMPS PS	27.10 (4.28), 18-33	27.81 (4.19), 19-33	25.60 (4.30), 18-32	2.43 (0.65: 9.03)
MBSRQ-AS AE	13.06 (3.98), 6-20	13.00 (3.18), 7-18	13.20 (5.51), 6-20	0.98 (0.31: 3.08)
MBSRQ-AS AO	46.64 (6.46), 33-60	45.81 (5.67), 33-54	48.40 (7.92), 36-60	0.44 (0.10: 2.04)
MBSRQ-AS BAS	20.64 (4.45), 12-31	19.90 (3.48), 14-28	22.20 (5.94), 12-31	0.33 (0.06: 1.70)
MBSRQ-AS OWP	13.90 (3.29), 6-20	13.86 (2.63), 10-19	14.00 (4.55), 6-20	0.95 (0.37: 2.40)
DASS-21 Anxiety	7.71 (4.32), 1-15	7.52 (4.23), 1-14	8.10 (4.72), 1-15	0.80 (0.23: 2.78)
DASS-21 Depression	8.32 (5.05), 1-18	7.81 (5.15), 1-18	9.40 (4.90), 1-17	0.69 (0.24: 1.97)
DASS-21 Stress	10.35 (4.05), 2-19	10.48 (4.08), 4-19	10.10 (4.20), 2-16	1.18 (0.31: 4.45)
Orientation Body	1.34 (0.44), 0.83-2.56	1.41 (0.48), 0.93-2.56	1.20 (0.31), 0.83-1.80	4.16 (0.40: 43.26)
Orientation Negative	1.36 (0.44), 0.83-2.62	1.42 (0.49), 0.99-2.62	1.21 (0.30), 1.83-0.82	4.56 (0.39: 53.76)
Orientation Positive	1.35 (0.46), 0.83-2.66	1.42 (0.51), 0.95-2.66	1.19 (0.29), 0.83-1.75	5.19 (0.42: 63.54)
DCQ	11.58 (2.45), 8-18	11.43 (2.69), 8-18	11.90 (1.91), 9-15	0.62 (0.10: 3.98)

Note. BMI: Body Mass Index; FMPS, Frost Multidimensional Perfectionism Scale; FMPS CM, FMPS Concern over Mistakes subscale; FMPS DA, FMPS Doubts about Actions subscale; FMPS PS, FMPS Personal Standards subscale; MBSRQ-AS, Multidimensional Body-Self Relations Questionnaire-Appearance Scales; MBSRQ-AS AE, MBSRQ-AS Appearance Evaluation subscale; MBSRQ-AS AO, MBSRQ-AS Appearance Orientation subscale; MBSRQ-AS BAS, MBSRQ-AS Body Areas Satisfaction subscale; MBSRQ-AS OWP, MBSRQ-AS Overweight Preoccupation subscale; DASS-21, Depression Anxiety and Stress Scale-Short Form; DASS-21Anxiety, DASS-21 Anxiety Subscale; DASS-21 Depression, DASS-21 Depression subscale; DASS-21 Stress, DASS-21 Stress subscale; Orientation Body, neutral trials (neutral-neutral word pairs)/ congruent trials for the dot-probe BDD-body word stimuli; Orientation Negative, neutral trials/ congruent trials for the dot-probe BDD-negative word stimuli; Orientation Positive, neutral trials/congruent trials for the dot-probe BDD-positive word stimuli; DCQ, Dysmorphic Concern Questionnaire.

Table 2

Change in Outcome Variables Over Time, Using Intent-To-Treat Analyses.

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT ($N = 31$)	M^a	*SE*	M^a	*SE*	*d*	95% CI	M^a	*SE*	*d*	95% CI	M^a	*SE*	*d*	95% CI	Main effect of Time (df), *p*, and post-hoc comparisons
FMPS CM	3.58	0.16	3.61	0.15	0.05	-0.44, 0.55	2.85	0.18	-0.84	-1.36, -0.32	2.82	0.17	-0.81	-1.33, -0.29	$F = 7.87$ (3, 24), .001 T1, T2 > T3, T4
FMPS DA	3.75	0.12	3.63	0.13	-0.18	-0.68, 0.31	3.21	0.14	-0.70	-1.21, -0.18	3.28	0.14	-0.63	-1.14, -0.12	$F = 5.98$ (3, 24), .003 T1, T2 > T3, T4
FMPS PS	3.87	0.27	3.73	0.28	-0.15	-0.65, 0.35	3.38	0.29	-0.37	-0.87, 0.13	3.42	0.29	-0.37	-0.87, 0.14	$F = 5.54$ (3, 22), .01 T1, T2 > T3, T4
MBSRQ-AS AE	2.17	0.12	2.23	0.14	0.13	-0.37, 0.63	2.54	0.15	0.47	-0.03, 0.97	2.67	0.10	0.89	0.37, 1.41	$F = 15.64$ (3, 26), <.001 T1, T2 < T4
MBSRQ-AS AO	3.89	0.10	3.94	0.10	0.17	0.66, -0.33	3.53	0.10	-0.60	-1.11, -0.09	3.44	0.10	-0.81	-1.32, -0.29	$F = 7.78$ (3, 24), .001 T1, T2 > T3, T4
MBSRQ-AS BAS	2.29	0.09	2.29	0.10	0.00	-0.50, 0.50	2.71	0.13	0.68	0.16, 1.19	2.73	0.12	0.73	0.21, 1.24	$F = 6.72$ (3, 23), .002 T1, T2 < T3, T4
MBSRQ-AS OWP	3.48	0.15	3.97	0.21	0.96	0.43, 1.48	3.54	0.25	0.09	-0.40, 0.59	3.46	0.26	-0.03	-0.53, 0.46	$F = 7.99$ (3, 21), .001 T1 < T2, T2 > T4
DASS-21 Anxiety	1.10	0.11	1.14	0.12	0.07	-0.43, 0.57	1.00	0.15	-0.20	-0.70, 0.03	0.92	0.15	-0.32	-0.82, 0.18	$F = 1.15$ (3, 24), .35
DASS-21	0.33	0.03	0.34	0.02	0.07	-0.43, 0.57	0.24	0.03	-0.65	-1.16, -0.14	0.23	0.03	-0.86	-1.38, -0.34	$F = 6.72$ (3, 23), .002

Depression[b]															T2 > T3, T4 T1 >T4
DASS-21 Stress[b]	0.38	0.02	0.42	0.02	0.36	-0.14, 0.86	0.29	0.03	-0.80	-1.32, -0.28	0.28	0.03	-0.91	-1.44, -0.39	F = 10.28 (3, 22), < .001 T1, T2 > T3, T4
Orientation Body	1.34	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	0.03	0.81	0.30, 1.33	F = 11.11 (1, 30), .002 T1 > T4
Orientation Negative	1.36	0.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	0.13	0.35	-0.15, 0.85	F = 10.61 (1, 29), .003 T1 > T4
Orientation Positive	1.35	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	0.03	0.91	0.38, 1.43	F = 11.26 (1, 30), .002 T1 > T4
DCQ	1.93	0.07	1.82	0.09	-0.26	-0.76, 0.24	1.03	0.12	-1.35	-1.91, -0.80	0.90	0.12	-1.72	-2.30, -1.14	F = 21.57 (3, 26), < .001 T1, T2 > T3, T4

Note. [a] indicates estimated mean values; [b] indicates data that were transformed; ITT, intent-to-treat; M, Mean; SE, Standard Error; d, within-time Cohen's d, 95% CI, 95% Confidence Intervals; df= degrees of freedom.

Table 3

Change in Outcome Variables Over Time (Covarying for Age and BMI), Using Intent-To-Treat Analyses.

	Baseline (Time 1)		Pre-treatment (Time 2)				End-of-treatment (Time 3)				One-month follow-up (Time 4)				
ITT (N = 31)	M^a	SE	M^a	SE	d	95% CI	M^a	SE	d	95% CI	M^a	SE	d	95% CI	Main effect of time (df), p, and post-hoc comparisons
FMPS CM	3.59	0.15	3.61	0.14	0.04	-0.46, 0.54	2.84	0.19	-0.92	-1.45, -0.40	2.82	0.17	-0.87	-1.40, -0.35	F = 8.09 (3, 24), .001 T1, T2 > T3, T4
FMPS DA	3.75	0.12	3.63	0.13	-0.19	-0.68, 0.31	3.21	0.14	-0.70	-1.21, -0.18	3.28	0.14	-0.63	-1.14, -0.12	F = 6.02 (3, 24), .003 T1, T2 > T3, T4
FMPS PS	3.87	0.11	3.73	0.12	-0.36	-0.87, 0.14	3.38	0.14	-0.90	-1.42, -0.38	3.42	0.14	-0.90	-1.42, -0.37	F = 5.55 (3, 22), .005 T1, T2 > T3, T4
MBSRQ-AS AE[d]	2.16	0.11	2.22	0.13	0.14	-0.36, 0.64	2.54	0.15	0.54	0.03, 1.05	2.67	0.09	0.99	0.47, 1.52	F = 15.85 (3, 26), < .001 T1, T2 < T4
MBSRQ-AS AO	3.88	0.10	3.94	0.09	0.20	-0.30, 0.70	3.54	0.10	-0.56	-1.07, -0.06	3.44	0.11	-0.79	-1.31, -0.27	F = 7.58 (3, 24), .001 T1, T2 > T3, T4
MBSRQ-AS BAS[c]	2.29	0.42	2.28	0.42	-0.00	-0.50, 0.49	3.59	0.43	0.45	-0.05, 0.95	2.74	0.42	0.16	-0.34, 0.66	F = 20.02 (3, 24), < .001 T1, T2 < T3, T4
MBSRQ-AS OWP[d]	3.48	0.65	3.57	0.65	0.04	-0.46, 0.54	3.50	0.69	0.01	-0.49, 0.50	3.43	0.69	-0.02	-0.52, 0.48	F = 0.16 (3, 24), .92
DASS-21 Anxiety	1.10	0.11	1.14	0.13	0.07	-0.43, 0.57	1.00	0.15	-0.20	-0.70, 0.30	0.92	0.15	-0.32	-0.82, 0.18	F = 1.15 (3, 24), .35

DASS-21 Depression[b]	0.33	0.03	0.34	0.02	0.07	-0.43, 0.57	0.24	0.03	-0.65	-1.16, -0.14	0.23	0.03	-0.86	-1.38, -0.34	*F* = 6.75 (3, 23), .002 T1 > T4 T2 > T3, T4
DASS-21 Stress[b]	0.38	0.04	0.42	0.04	0.18	-0.32, 0.68	0.29	0.05	-0.40	-0.90, 0.10	0.28	0.04	-0.46	-0.96, 0.05	*F* = 10.31 (3, 22), < .001 T1, T2 > T3, T4
Orientation Body	1.34	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07	0.03	0.81	0.30, 1.33	*F* = 10.99 (1, 30), .002 T1 > T4
Orientation Negative	1.35	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.05	0.03	0.91	0.38, 1.43	*F* = 11.06 (1, 30), .002 T1 > T4
Orientation Positive	1.36	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.09	0.03	0.81	0.30, 1.33	*F* = 10.50 (1, 29), .003 T1 > T4
DCQ	1.93	0.07	1.82	0.09	-0.27	-0.77, 0.23	1.04	0.12	-1.35	-1.90, -0.80	0.90	0.12	-1.72	-2.31, -1.14	*F* = 9.42 (10, 22), < .001 T1, T2 > T3, T4

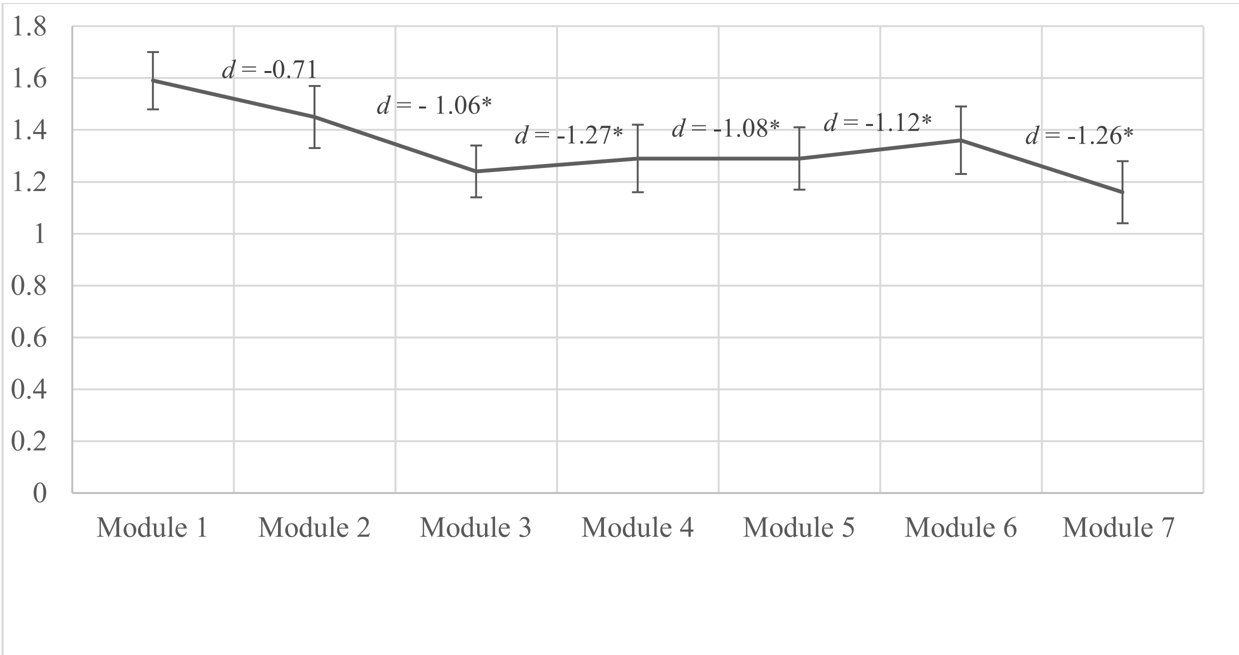
Note. [a] indicates estimated mean values; [b] indicates data that were transformed [c] indicates variables where the covariate age was found to have a significant *p* value (< .05); [d] indicates variables where the covariate body mass index (BMI) was found to have a significant *p* value (< .05); ITT = intent-to-treat; *M* = Mean; *SE* = Standard Error; d = within-time Cohen's d; CI = Confidence Intervals; df = degrees of freedom.

Table 4

Multiple regression analyses with DCQ at follow-up as outcome variable, covarying for baseline DCQ and change in perfectionism between baseline and follow-up.

Variables	B	SE	β	*t*	*p*
DCQ at T3[a]	-0.12	0.35	-.07	-0.34	.73
DCQ at T3[b]	0.07	0.29	.05	0.24	.81
DCQ at T3[c]	0.29	0.28	.20	1.02	.32
DCQ at T4[a]	-0.48	0.31	-.31	-1.54	.14
DCQ at T4[b]	0.05	0.28	.04	0.16	.87
DCQ at T4[c]	-0.04	0.26	-.03	-0.15	.88

Note. [a] indicates where the Frost Multidimensional Perfectionism Scale (FMPS) Concern over Mistakes (CM) subscale was entered as the dependent variable; [b] indicates where the FMPS Doubts about Actions (DA) subscale was entered as the dependent variable; [c] indicates where the FMPS Personal Standards (PS) subscale was entered as the dependent variable; Dysmorphic Concern Questionnaire (DCQ) at T3 = DCQ score at the end-of-treatment; DCQ at T4 = DCQ score at one-month follow-up; T3 = end-of-treatment period; T4 = 1-month follow-up period.



Note. * indicates a significant *d* value from baseline to post-module completion of the Dysmorphic Concern Questionnaire (DCQ)

Figure 1. Within-group effect sizes (Cohen's *d*) between baseline and weekly intent-to-treat DCQ scores for Modules 2-7.

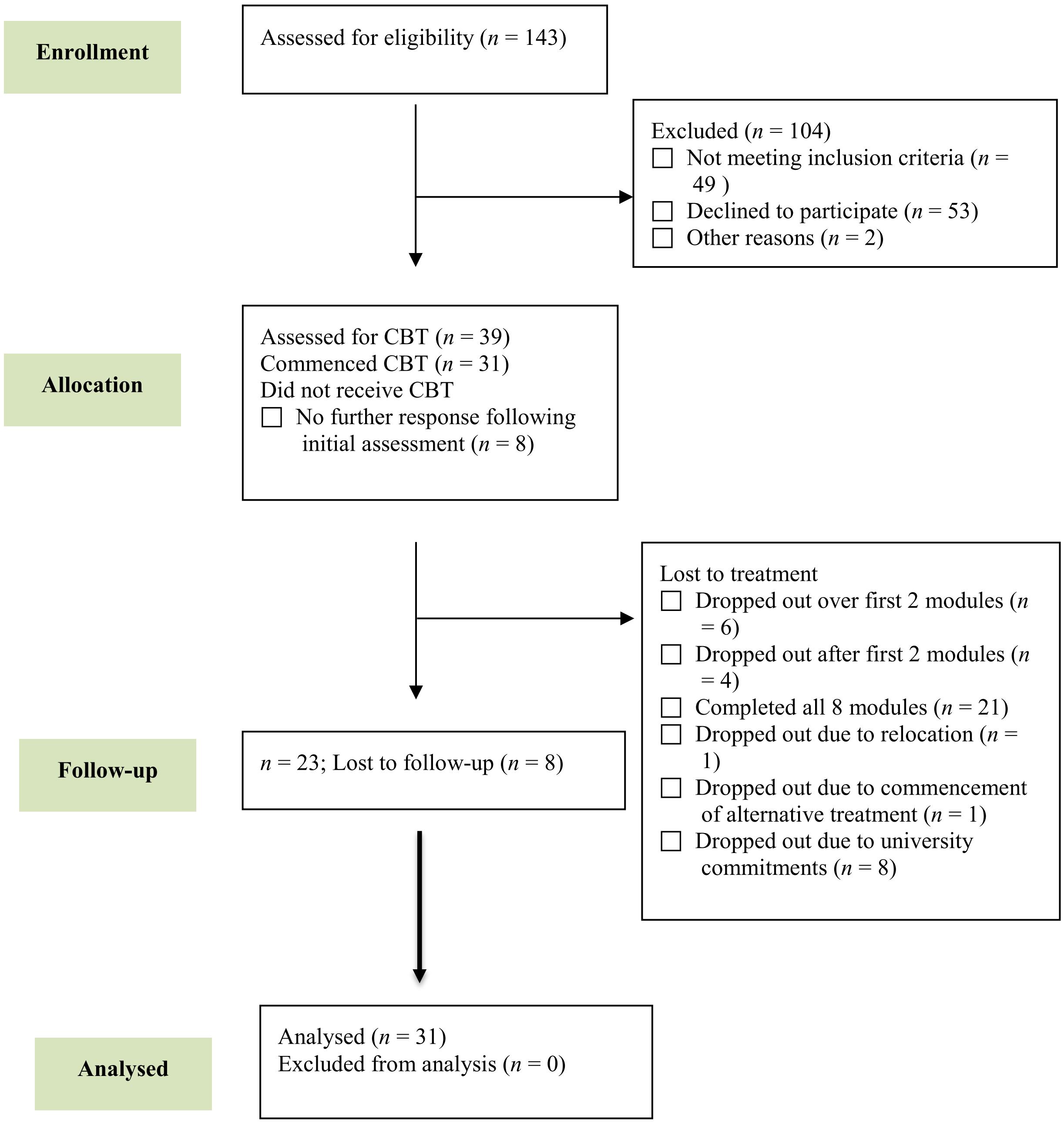


Figure 2. CONSORT flow chart for enrollment, allocation, follow-up, and analysis of participants involved in the Internet-delivered cognitive-behavioural therapy for perfectionism (ICBT-P) program.

Appendix B

Dot-Probe Stimuli Used in the Second Study

1. **Non-body target words (DC-negative words)**
    a. Deformed - Armchair
    b. Disfigured - Instrument
    c. Hideous - Musical
    d. Repulsive - Extension
    e. Ugly - Oven
    f. Disgusting - Dishwasher
    g. Unattractive - Intermittent
    h. Grotesque - Bedspread
    i. Imperfect - Telephone
    j. Unsightly - Container
    k. Plain - Glass

2. **Body target words (DC-body words)**
    a. Nose - Lamp
    b. Breast - Lights
    c. Ears -Note
    d. Eyebrows - Backpack
    e. Hairline - Painting
    f. Skin - Broom
    g. Chin - Chair
    h. Teeth - Drill
    i. Acne - Iron

Appendix C

Dot-Probe Stimuli Used in the Third and Fourth Studies

Red= Negative non-body target words (DC-negative words)
Black= Body target words (DC-body words)
Blue= Positive non-body target words (DC-positive words)

1. Deformity (3-02-002)-Parameter (7-01-004)
2. Disfigured (5-03-005) –Rebuilding (6-05-006)
3. Hideous (11-06-010)-Qualify (15-07-013)
4. Repulsive (4-03-003) –Reconcile (4-02-004)
5. Ugly (21-08-015) – Oven (7-05-005)
6. Disgusting (4-04-004)-Dishwasher (1-01-001)
7. Unattractive (3-03-003) – Intermittent (3-03-003)
8. Grotesque (9-04-008) – Bedspread (2-01-002)
9. Imperfect (4-04-004) –Refueling (2-02-002)
10. Defective (7-05-006) –Container (10-07-008)
11. Chin (27-08-018) –Leap (14-08-012)
12. Teeth (103-11-036) –Task (60-13-049)
13. Acne (1-01-001)- Omit (1-01-001)
14. Nose (60-10-042) -Lamp (18-07-010)
15. Breast (11-07-008) -Lounge (9-03-005)
16. Ears (38-11-033)-Note (127-14-095)
17. Eyebrows (9-04-007) –Backpack (1-01-001)
18. Hairline (1-01-001) -Flooding (2-02-002)
19. Skin (47-10-033) –Fort (55-11-020)
20. Head (424-15-190) – Flat (67-12-046)
21. Beautiful (127-15-080)- Presented (82-13-069)
22. Pretty (107-14-075)- Opened (131-15-093)
23. Sexy (2-02-002) - Bury (6-05-006)
24. Buff (5-03-004) – Bulb (7-04-006)
25. Cute (5-03-004) – Hood (7-05-006)
26. Lovely (44-12-032) – Buying (30-10-023)
27. Symmetrical (2-02-002)- Provocation (5-03-004)
28. Shapely (2-02-002) – Garbage (7-06-006)
29. Youth (82-14-044) – Break (88-13-077)
30. Ideal (61-11-040) - Seven (113-15-075)
31. Beauty (71-14-044)- Secret (78-15-056)
32. Gorgeous (7-05-007) – Beverage (5-03-004)
33. Attractive (1-01-001) –Spectacles (3-03-003)
34. Radiant (8-05-006) – Robotic (1-01-001)
35. Stunning (6-03-006)- Sighting (3-03-003)
36. Handsome (40-09-029)- Sporting (9-06-006)
37. Chiseled (2-02-002) – Fittings (1-01-001)
38. Fit (75-15-057) – Bed (127-13-070)
39. Alluring (1-01-001) – Spraying (8-03-004)
40. Glamorous (5-04-005)- Maximized (1-01-001)

Appendix D

DCQ original and modified

Dysmorphic Concern Questionnaire

Please circle the number that best corresponds to your agreement with each statement below. Use this rating system:

Not at all	Same as most people	More than most people	Much more than most people
0	1	2	3

1.	Have you ever been very concerned about some aspect of your physical appearance?	0	1	2	3
2.	Have you ever considered yourself deformed or misshaped in some way (e.g. nose/hair/skin/ organs/overall body build)	0	1	2	3
3.	Have you ever considered your body to be dysfunctional in some way? (e.g. excessive body odour, flatulence, sweating).	0	1	2	3
4.	Have you ever consulted or felt you needed to consult a plastic surgeon/ dermatologist/physician about these concerns?	0	1	2	3
5.	Have you ever been told by others/ doctor that you are normal in spite of you strongly believing that something is wrong with your appearance or bodily functioning?	0	1	2	3
6.	Have you ever spent a lot of time worrying about a flaw in your appearance/bodily functioning?	0	1	2	3
7.	Have you ever spent a lot of time covering up flaws in your appearance/bodily functioning?	0	1	2	3

Dysmorphic Concern Questionnaire (modified)

Please circle the number that best corresponds to your agreement with each statement below. Use this rating system:

Not at all	Same as most people	More than most people	Much more than most people
0	1	2	3

8. Have you ever been very concerned about some aspect of your physical appearance?	0	1	2	3
- Which aspect(s) of your appearance concern you? (e.g., nose, skin, hair, muscles, etc):				
9. Have you ever considered yourself deformed or misshaped in some way (e.g. nose/hair/skin/ organs/overall body build)	0	1	2	3
10. Have you ever considered your body to be dysfunctional in some way? (e.g. excessive body odour, flatulence, sweating).	0	1	2	3
11. Have you ever consulted or felt you needed to consult a plastic surgeon/ dermatologist/physician about these concerns?	0	1	2	3
12. Have you ever been told by others/ doctor that you are normal in spite of you strongly believing that something is wrong with your appearance or bodily functioning?	0	1	2	3
13. Have you ever spent a lot of time worrying about a flaw in your appearance/bodily functioning?	0	1	2	3
14. Have you ever spent a lot of time covering up flaws in your appearance/bodily functioning?	0	1	2	3

Appendix E

Frost Multidimensional Perfectionism Scale: Personal Standards, Concern over Mistakes, and Doubts about Actions Subscales

Please circle the number that best corresponds to your agreement with each statement below. Use this rating system:

Strongly Disagree 1 2 3 4 5 Strongly Agree

1. If I do not set the highest standards for myself, I am likely to end up a second-rate person.	1	2	3	4	5
2. It is important to me that I be thoroughly competent in everything that I do.	1	2	3	4	5
3. If I fail at work/school, I am a failure as a person.	1	2	3	4	5
4. I should be upset if I make a mistake.	1	2	3	4	5
5. I set higher goals than most people.	1	2	3	4	5
6. If someone does a task at work/school better than I, then I feel like I failed the whole task.	1	2	3	4	5
7. If I fail partly, it is as bad as being a complete failure.	1	2	3	4	5
8. I am very good at focusing my efforts on attaining a goal.	1	2	3	4	5
9. Even when I do something very carefully, I often feel that it is not quite right.	1	2	3	4	5
10. I hate being less than best at things.	1	2	3	4	5
11. I have extremely high goals.	1	2	3	4	5
12. People will probably think less of me if I make a mistake.	1	2	3	4	5
13. If I do not do as well as other people, it means I am an inferior human being.	1	2	3	4	5
14. Other people seem to accept lower standards from themselves than I do.	1	2	3	4	5
15. If I do not do well all the time, people will not respect me.	1	2	3	4	5
16. I usually have doubts about the simple everyday things I do.	1	2	3	4	5

17. I expect higher performance in my daily tasks than most people.	1	2	3	4	5
18. I tend to get behind in my work because I repeat things over and over.	1	2	3	4	5
19. It takes me a long time to do something "right."	1	2	3	4	5
20. The fewer mistakes I make, the more people will like me.	1	2	3	4	5

Appendix F

Short-form version Depression Anxiety Stress Scales (DASS-21)

Please indicate how much each of the following statements applied to you over the **PAST WEEK**.
There are no right or wrong answers. Do not spend too much time on any one statement.

	(circle one number <u>on each line</u>)	**Did not apply to me at all**	**Applied to me in some degree, or some of the time**	**Applied to me a considerable degree, or a good part of the time**	**Applied to me very much, or most of the time**
1	I was aware of dryness of my mouth	0	1	2	3
2	I couldn't seem to experience any positive feeling at all	0	1	2	3
3	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
4	I tended to over-react to situations	0	1	2	3
5	I found it difficult to relax	0	1	2	3
6	I felt that I had nothing to look forward to	0	1	2	3
7	I felt I wasn't worth much as a person	0	1	2	3
8	I felt that I was rather touchy	0	1	2	3
9	I felt scared without any good reason	0	1	2	3
10	I found it hard to wind down	0	1	2	3
11	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	0	1	2	3
12	I felt down-hearted and blue	0	1	2	3
13	I felt I was close to panic	0	1	2	3

14	I was unable to become enthusiastic about anything	0	1	2	3
15	I was in a state of nervous tension	0	1	2	3
16	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
17	I felt that life was meaningless	0	1	2	3
18	I found myself getting agitated	0	1	2	3
19	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
20	I experienced trembling (e.g. in the hands)	0	1	2	3
21	I found it difficult to work up the initiative to do things	0	1	2	3

Appendix G

Multidimensional Body-Self Relations Questionnaire- Appearance Scales (without the Self-Classified Weight Scale)

The following pages contain a series of statements about how people might think, feel or behave. Please indicate the extent to which each statement pertains to you personally.

1	2	3	4	5
Definitely Disagree	Mostly Disagree	Neither Agree nor Disagree	Mostly Agree	Definitely Agree

1. Before going out in public, I always notice how I look.
2. I am careful to buy clothes that will make me look my best.
3. My body is sexually appealing.
4. I constantly worry about being or becoming fat.
5. I like my looks just the way they are.
6. I check my appearance in a mirror whenever I can.
7. Before going out, I usually spend a lot of time getting ready.
8. I am very conscious of even small changes in my weight.
9. Most people would consider me good-looking.
10. It is important that I always look good.
11. I use very few grooming products.
12. I like the way I look without my clothes on.
13. I am self-conscious if my grooming isn't right.
14. I usually wear whatever is handy without caring how it looks.
15. I like the way my clothes fit me.
16. I don't care what people think about my appearance.
17. I take special care with my hair grooming.
18. I dislike my physique.
19. I am physically attractive.
20. I never think about my appearance.
21. I am always trying to improve my physical appearance.
22. I am on a weight-loss diet.

23. I have tried to lose weight by fasting or going on crash diets.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very often

Indicate how dissatisfied or satisfied you are with each of the following areas or aspects of your body:

1	2	3	4	5
Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied

26. Face (facial features, complexion

27. Hair (color, thickness, texture)

28. Lower torso (buttocks, hips, thighs, legs)

29. Mid torso (waist, stomach)

30. Upper torso (chest or breasts, shoulders, arms)

31. Muscle tone

32. Weight

33. Height

34. Overall appearance