Flinders University

Shortening and Managing the Impact of Lengthy Treatment Waitlists for People with Non-underweight Eating Disorders

By

Ella Keegan

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Abstract

People with eating disorders are often placed on long waitlists for treatment. This is problematic as increased time on waitlists has been shown to predict dropout from eating-disorder-focused cognitive behavioural therapy (CBT-ED). The COVID-19 pandemic has exacerbated this issue with numerous studies showing increased waiting times for treatment. Thus, the overarching aim of this thesis was to determine strategies to respond to lengthy waitlists in a pandemic world. This involved two specific aims. The first aim was to identify strategies to shorten waitlists for treatment. Given waitlists are unfortunately a fact of life, the second aim was to identify strategies to manage the impact of lengthy waitlists on dropout. Three potential strategies were examined among participants aged 15 and above: (1) waitlist interventions; (2) shorter treatment; and (3) precision medicine.

Shorter treatment was evaluated using a meta-analysis (**Chapter 3**) and the main PhD study (**Chapter 8**). Results demonstrated that 10-session cognitive behavioural therapy (CBT-T) reduced eating disorder symptoms, clinical impairment, and negative affect. Additionally, results were largely maintained over follow-up. Non-completion, abstinence, and remission rates were comparable to those observed for longer CBT-ED.

To inform a precision medicine approach, we examined potential baseline moderators and predictors of outcome and retention in two studies (**Chapters 5** and **8**). For anorexia nervosa, having low central coherence produced better outcomes in treatment. In contrast, high central coherence produced better outcomes for non-underweight eating disorders. Additionally, people with non-underweight eating disorders with low set shifting did better in treatment. Finally, those who were overweight were more likely to complete treatment, and people with atypical anorexia nervosa were less likely to complete or respond favourably to CBT-T.

While there are many potential targets for waitlist interventions, our resources enabled us to evaluate two. A meta-analysis (**Chapter 4**) revealed that central coherence and set shifting inefficiencies are as relevant to non-underweight eating disorders as they are to anorexia nervosa.

This suggested that people with non-underweight eating disorders might benefit from cognitive remediation therapy (CRT), a treatment for anorexia nervosa that targets central coherence and set shifting and improves retention. Thus, we developed and refined a CRT intervention for non-underweight eating disorders (CRT-Brief) based on stakeholder feedback obtained in a qualitative feasibility study (**Chapter 6**). We then conducted a randomised controlled trial (**Chapter 8**) comparing two waitlist interventions (CRT-Brief and brief contact) to control among participants waitlisted for CBT-T. Both waitlist interventions doubled retention in CBT-T.

Results support the use of shorter treatment as a strategy to shorten waitlists by enabling more people to be seen more quickly, providing justification for a randomised controlled trial comparing CBT-T to longer CBT-ED. Results also suggest that waitlist interventions are a viable strategy to obviate the impact of lengthy waitlists by improving retention in subsequent treatment. Further work is required before a precision medicine approach can be adopted as a strategy to shorten waitlists for eating disorders, and there is an urgent need for research aimed at identifying useful treatments for atypical anorexia nervosa.

Declaration

I certify that this thesis: (1) does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; (2) will not be submitted for any other future degree or diploma without the permission of Flinders University; and (3) does not contain any material previously published or written by another person except where reference is made in-text.

Ella Keegan

BPsych(Hons)

Acknowledgements

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Commonly Used Abbreviations

Abbreviation	Definition
AN	Anorexia nervosa
BN	Bulimia nervosa
AAN	Atypical anorexia nervosa
OSFED	Other specified feeding or eating disorder
BED	Binge eating disorder
CBT-ED	Eating-disorder-focused cognitive behavioural therapy
CBT-T	10-session cognitive behavioural therapy
BMI	Body mass index
WCST	Wisconsin Card Sorting Test
RCFT	Rey Complex Figure Test
EDE-Q	Eating Disorder Examination-Questionnaire
CIA	Clinical Impairment Assessment
DASS-21	Depression Anxiety and Stress Scale-Short form
CRT	Cognitive remediation therapy
RCT	Randomised controlled trial
SSI	Single session intervention

Chapter 1

Overview and Aims of the Research

Background

Eating disorders are serious and complicated mental disorders that are characterised by persistent disturbances in thoughts and behaviours relating to food, eating, and body weight or shape (American Psychiatric Association [APA], 2022). A recent systematic review (Galmiche et al., 2019) indicated that the lifetime prevalence for females is 1.4% for anorexia nervosa (AN), 1.9% for bulimia nervosa (BN), 2.8% for binge eating disorder (BED), and 4.3% for other specified feeding or eating disorder (OSFED; formally referred to as eating disorder not otherwise specified). In Australia, eating disorders affect approximately one million people (4% of the population) each year (Deloitte Access Economics, 2012), and have increased two-fold from 1998 to 2008 (Galmiche et al., 2019).

Unlike most other mental disorders, some aspects of eating disorders (e.g., dietary restriction, excessive exercise, fasting, and weight loss) are seen to be desirable and have high levels of societal and social endorsement (e.g., proliferation of fad diets, exercise regimes, and unrealistic expectations of body shape and size). This societal endorsement can translate to a lack of encouragement from significant others (i.e., parents, partners, and friends) to seek help for eating problems, and may explain why denial or minimisation of symptoms is one of the strongest barriers to help-seeking (Radunz et al., 2022). Those people who do seek treatment wait for an average of 2.5 to 6 years to do so (Austin et al., 2020), and often present because of comorbidities rather than the eating disorder itself (Fursland & Watson, 2014; Johnson et al., 2002; Micali et al., 2015).

Eating disorders can have a significant impact on the individual, their significant others, and society more broadly. For the individual, eating disorders impair physical health, psychosocial functioning, and quality of life (APA, 2022; Gibson et al., 2019; van Hoeken & Hoek, 2020). They are also associated with increased rates of somatic and psychiatric comorbidity as well as mortality (Papadopoulos et al., 2009; van Hoeken & Hoek, 2020).

Moreover, eating disorders can create tension in the family environment, and significant others often worry about the consequences of the eating disorder on their loved one (van Hoeken & Hoek, 2020). Significant others can also lose income due to providing informal care, and experience further financial strain and worry regarding the cost of treatment (Deloitte Access Economics, 2012; Fox et al., 2017; van Hoeken & Hoek, 2020). Eating disorders are also costly for society more broadly. For example, the total socioeconomic cost of eating disorders in Australia is estimated to be $69.7 billion per year (Deloitte Access Economics, 2012). This cost includes healthcare expenses, lower employment participation, loss of earnings, less tax revenue, and more sick leave (Deloitte Access Economics, 2012). Thus, timely access to effective treatment is clearly important for people with eating disorders, their significant others, and society.

One psychological treatment recommended across all eating disorder diagnoses is eating-disorder-focused cognitive behavioural therapy (CBT-ED; National Institute for Health and Care Excellence [NICE], 2017). CBT-ED is an umbrella term that refers to the use of evidence-based CBT techniques for people with eating disorders. While CBT-ED typically lasts 20 to 40 sessions (NICE, 2017), there are also shorter versions, such as 10-session cognitive behavioural therapy (CBT-T; Waller et al., 2019). Waitlists for CBT-ED tend to be long, making it difficult for people to access treatment in a timely manner. This is problematic as increased time on waitlists has been shown to predict dropout from CBT-ED (Carter et al., 2012). This issue has been exacerbated during the COVID-19 pandemic, with numerous studies showing an increase in the prevalence of eating disorders, demand on eating disorder services, and waiting times for treatment (Iacobucci, 2021; National Eating Disorder Collaboration, 2020; Nuffield Trust, 2022).

Aims of the Current Research

Given the seriousness, prevalence, and costs of eating disorders as well as the impact of waitlists on dropout, the overarching aim of this thesis was to determine strategies to respond to lengthy treatment waitlists in a pandemic world. This involved two specific aims. The first aim was to identify strategies to shorten waitlists for eating disorder treatment. While this aim is most desirable, waitlists are unfortunately a fact of life. Thus, the second aim was to identify strategies to manage the impact of lengthy waitlists on dropout from subsequent treatment.

To achieve the aims of this thesis, six approaches were used: (1) systematic reviews; (2) meta-analyses; (3) secondary data analyses; (4) a qualitative feasibility study; (5) an RCT; and (6) primary data analyses. The research described in this thesis focused on people aged 15 years and above. The research also predominantly focused on people with non-underweight eating disorders for two reasons. First, time constraints of the PhD project limited our ability to treat and conduct research among people with AN, given this takes many weeks (NICE, 2017) and dropout rates are high (e.g., Byrne et al., 2017). Second, there is a critical need for research among people with non-underweight eating disorders, especially among those with atypical AN (AAN) which is now more prevalent in the community than AN (Harrop et al., 2021). While BED is a non-underweight eating disorder, these individuals were not included in the main PhD study as participants came from a university training clinic which does not treat BED. The studies conducted to address the aims of this thesis are presented in chapters, which are summarised below.

Summary of Chapters

The topics introduced in this overview are expanded on in a literature review (**Chapter 2**). This includes eating disorder diagnoses, the rationale for focusing on non-underweight eating disorders, evidence-based treatments for people with non-underweight

eating disorders, lengthy waitlists, and the impact of the COVID-19 pandemic on eating disorder prevalence and services. Potential strategies to shorten and manage the impact of lengthy treatment waitlists are also discussed in-depth.

One potential strategy to shorten waitlists (Aim 1) is to provide an effective shorter CBT-ED treatment, to enable more people to be seen more quickly. Consequently, a systematic review and meta-analysis (**Chapter 3**) was conducted to evaluate CBT-T, the shorter CBT-ED treatment with the most evidence. While a randomised controlled trial (RCT) directly comparing CBT-T to longer CBT-ED is required, our meta-analysis suggested that shorter CBT-ED treatment is a viable strategy to shorten waitlists, as people with non-underweight eating disorders had good outcomes in half the time currently recommended in treatment guidelines (NICE, 2017). This study has been published in *Clinical Psychologist* (Keegan, Waller et al., 2022).

Another potential strategy to shorten waitlists (Aim 1) is to take a precision medicine approach in which treatment is tailored to individuals based on their characteristics at baseline. Taking such an approach has the potential to shorten waitlists by: (1) only placing people on waitlists for treatments they are likely to benefit from; (2) omitting elements of treatment that are unnecessary to the individual potentially shortening treatment; and (3) modifying treatment to maximise outcomes potentially reducing repeat presentations. Precision medicine requires an understanding of moderators and predictors of treatment outcomes and retention (Agras et al., 2000; Kraemer et al., 2002). Thus, the study described in **Chapter 5** used a sample of convenience to examine baseline central coherence and set shifting as moderators and predictors among people with AN, with the intention to subsequently replicate some of the analyses among people with non-underweight eating disorders. This study has been published in the *Journal of Eating Disorders* (Keegan, Byrne et al., 2022).

Chapters 4 and **6** relate to the second aim of managing the impact of lengthy waitlists on dropout from subsequent treatment. One potential strategy to do so is to provide intervention while people are waitlisted for treatment. A potential target for a waitlist intervention is executive functioning inefficiencies in the areas of central coherence and set shifting. These inefficiencies are well documented in AN, but less attention has been paid to them in non-underweight eating disorders. Thus, we conducted a systematic review and meta-analysis comparing central coherence and set shifting between people with non-underweight eating disorders and people with AN (**Chapter 4**), which has been published in the *International Journal of Eating Disorders* (Keegan et al., 2021). The effect sizes for people with non-underweight eating disorders did not significantly differ from those for people with AN. This comparability suggested that people with non-underweight eating disorders might benefit from CRT, an adjunct treatment for people with AN which was designed to target central coherence and set shifting and has been shown to increase retention in treatment (Hagan et al., 2020). Consequently, we developed a single session CRT waitlist intervention (CRT-Brief) for people with non-underweight eating disorders (**Chapter 6**). This short chapter outlines the process taken to develop and refine CRT-Brief, based on stakeholder feedback obtained in a qualitative feasibility study.

Chapter 8 describes an RCT addressing both the first and second PhD aims. While waitlisted for CBT-T, participants were randomised to one of two waitlist interventions (CRT-Brief or brief contact) or to waitlist as usual. This study added to the growing evidence base for CBT-T and supported the use of shorter CBT-ED as a strategy to shorten waitlists. It also provided some support for waitlist intervention as a viable strategy to manage the impact of lengthy waitlists by retaining people in treatment. Moderators and predictors of treatment outcomes and non-completion were also examined. This study was initially prepared as two manuscripts, one of which has been published in the *International Journal of Eating*

Disorders (Keegan & Wade, 2023). A comprehensive outline of the neuropsychological and questionnaire measures used in this study is provided in **Chapter 7**. For each measure, a detailed description and information regarding psychometric properties is provided. Additional information regarding factor structure is also provided for questionnaire measures.

Finally, the key findings from the research outlined in this thesis are summarised and integrated in a General Discussion (**Chapter 9**). This chapter also discusses clinical implications, overall limitations, and directions for future research.

Reader Navigation

All studies described in this thesis, besides the qualitative feasibility study, have been published or submitted to peer-reviewed journals, and two of the studies have been presented at national conferences. The recommended changes from reviewers have been incorporated into the thesis. The versions presented in this thesis are similar to the published papers. However, the Introduction sections have been shortened to reduce repetition, and additional information from supplementary analyses and materials has been included in the chapters. The Discussion sections for each chapter are focused on explaining the results, placing these in a wider context, and outlining specific limitations. All clinical implications and directions for future research are examined in the General Discussion (**Chapter 9**). Though efforts have been made to reduce repetition of content, there is some repetition across the Introduction sections of chapters to justify the aims of the studies, and across the Discussion sections when addressing the implications of findings. The literature review (**Chapter 2**) has not been published in its current form but includes content from the Introduction sections of the published and under review papers.

Additionally, I took the primary role in the research design, data collection and analysis, and writing and editing in all the studies presented in this thesis. However, I have used the word "we" throughout this thesis to recognise the input from my supervisors and co-

authors. Tables and Figures are included in the main body of each chapter, appearing when they are first referenced. There is one reference list for the whole thesis, which appears after the General Discussion. American Psychological Association referencing (7th Edition; 2020) was used for in-text citations and references. Appendices follow the reference list.

Finally, it is important to note that the qualitative feasibility study and RCT were commenced in the first year of the PhD project to allow the time required for data collection. CRT was selected as a waitlist intervention based on the literature available at the time which proposed that CRT worked by improving central coherence and set shifting, and our finding that central coherence and set shifting performance did not significantly differ between non-underweight eating disorders and AN. As such, we had selected CRT as a waitlist intervention prior to conducting the study described in **Chapter 5** which showed that people with low central coherence improved more rapidly in CBT-ED than those with high central coherence.

Publications and Presentations Arising from the Thesis

Keegan, E., & Wade, T. D. (2023). The Role of Readiness and Confidence to Change in Outpatient Treatment of Bulimia Nervosa and Atypical Anorexia Nervosa. *International Journal of Eating Disorders.*

Keegan, E., Waller, G., & Wade, T. D. (2022). A systematic review and meta-analysis of a 10-session cognitive behavioural therapy for non-underweight eating disorders. *Clinical Psychologist*, *26*(3), 241-254. https://doi.org/10.1080/13284207.2022.2075257

Keegan, E., Byrne, S., Hay, P., Touyz, S., Treasure, J., Schmidt, U., McIntosh, V. V. W., & Wade, T. D. (2022). An exploratory examination of executive functioning as an outcome, moderator, and predictor in outpatient treatment for adults with anorexia nervosa. *Journal of eating disorders*, *10*(1), 1-9. https://doi.org/10.1186/s40337-022-00602-0

Keegan, E., Byrne, S., Hay, P., Touyz, S., Treasure, J., Schmidt, U., McIntosh, V., Wade, T. D. (2022) *An Exploratory Examination of Executive Functioning as an Outcome, Moderator, and Predictor in Outpatient Treatment for Adults with Anorexia Nervosa.* Oral presentation at the Australian Psychological Society College of Clinical Psychologists Conference, Brisbane, Australia.

Keegan, E., Tchanturia, K., & Wade, T. D. (2021). Central coherence and set-shifting between nonunderweight eating disorders and anorexia nervosa: A systematic review and meta-analysis. *International Journal of Eating Disorders*, *54*(3), 229-243. https://doi.org/10.1002/eat.23430

Keegan, E., Tchanturia, K., & Wade, T.D. (2021). *Central coherence and set-shifting between non-underweight eating disorders and anorexia nervosa: A systematic*

review and meta-analysis. Online oral presentation at the Australian and New Zealand

Academy for Eating Disorders Conference, Perth Australia.

Keegan, E., Waller, G., Tchanturia, K., & Wade, T. D. Decreasing Waitlists and Managing

the Impact of Lengthy Waitlists: A Randomised Controlled Trial of Strategies Worth

Investigating for People with Non-Underweight Eating Disorders. *Behaviour*

Research and Therapy. [under review].

Funding

Chapter 2

Literature Review[1]

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[1] This chapter contains content from the Introduction sections of three published papers that are provided in **Appendices A** to **C**.

Keegan, E., Waller, G., & Wade, T. D. (2022). A systematic review and meta-analysis of a 10-session cognitive behavioural therapy for non-underweight eating disorders. *Clinical Psychologist, 26*(3), 241-254. https://doi.org/10.1080/13284207.2022.2075257

Keegan, E., Tchanturia, K., & Wade, T. D. (2021). Central coherence and set-shifting between nonunderweight eating disorders and anorexia nervosa: A systematic review and meta-analysis. *International Journal of Eating Disorders, 54*(3), 229-243. https://doi.org/10.1002/eat.23430

Keegan, E., Byrne, S., Hay, P., Touyz, S., Treasure, J., Schmidt, U., McIntosh, V. V. W., & Wade, T. D. (2022). An exploratory examination of executive functioning as an outcome, moderator, and predictor in outpatient treatment for adults with anorexia nervosa. *Journal of eating disorders, 10*(1), 1-9. https://doi.org/10.1186/s40337-022-00602-0

Diagnostic Criteria for Eating Disorders

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition Text Revision (DSM-V-TR; APA, 2022) lists the following specified eating disorders: AN, BN, and BED. AN is characterised by an intense fear of gaining weight or becoming fat and restrictive energy intake resulting in significantly low weight. There are two types of AN – AN restricting type (ANR) and AN binge-eating/purging type (ANBP). People with ANR lose weight by dieting, fasting, and/or engaging in driven exercise. These individuals do not engage in objective binge eating (i.e., consuming a large amount of food while feeling out of control) or purging behaviours (e.g., diuretics, self-induced vomiting, or laxative misuse). In contrast, people with ANBP engage in recurrent episodes of objective binge eating and purging behaviours while remaining at a low weight. BN is also characterised by episodes of objective binge eating and purging behaviours. However, people with BN are not at a low weight, distinguishing them from people with ANBP. BED is characterised by episodes of binge eating but in contrast to ANBP and BN, people with BED do not engage in purging behaviours.

When symptoms do not meet the full diagnostic criteria for one of the specified eating disorders but are causing significant distress or impairment, a diagnosis of OSFED is made. Examples of OSFED include BN of low frequency/limited duration (binge eating and purging behaviours less than once a week and/or for less than 3 months), purging disorder (recurrent purging behaviours in the absence of binge eating), and AAN (where the individual meets all criteria for AN but is not in the low weight range despite significant weight loss). This thesis predominantly focuses on people with non-underweight eating disorders, that is, BN, BED, and OSFED. The one exception to this is **Chapter 5** which used a sample of convenience and focused on people with AN. The full diagnostic criteria for the non-underweight eating disorders are provided in **Table 2.1**.

Table 2.1

Full DSM-V-TR Criteria for Non-Underweight Eating Disorders (APA, 2022)

Disorder	Diagnostic Criteria

BN	A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:
	    1. Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than what most individuals would eat in a similar period of time under similar circumstances.
	    2. A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).
	B. Recurrent inappropriate compensatory behaviors in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, or other medications; fasting; or excessive exercise.
	C. The binge eating and inappropriate compensatory behaviors both occur, on average, at least once a week for 3 months.
	D. Self-evaluation is unduly influenced by body shape and weight.
	E. The disturbance does not occur exclusively during episodes of anorexia nervosa.
	Specify if:
	In partial remission: After full criteria for bulimia nervosa were previously met, some, but not all, of the criteria have been met for a sustained period of time.
	In full remission: After full criteria for bulimia nervosa were previously met, none of the criteria have been met for a sustained period of time.
	Specify current severity:
	The minimum level of severity is based on the frequency of inappropriate compensatory behaviors (see below). The level of severity may be increased to reflect other symptoms and the degree of functional disability.
	Mild: An average of 1–3 episodes of inappropriate compensatory behaviors per week.
	Moderate: An average of 4–7 episodes of inappropriate compensatory behaviors per week.
	Severe: An average of 8–13 episodes of inappropriate compensatory behaviors per week.
	Extreme: An average of 14 or more episodes of inappropriate compensatory behaviors per week.

BED   A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:

         1. Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than what most people would eat in a similar period of time under similar circumstances.

         2. A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).

     B. The binge-eating episodes are associated with three (or more) of the following:

         1. Eating much more rapidly than normal.

         2. Eating until feeling uncomfortably full.

         3. Eating large amounts of food when not feeling physically hungry.

         4. Eating alone because of feeling embarrassed by how much one is eating.

         5. Feeling disgusted with oneself, depressed, or very guilty afterward.

     C. Marked distress regarding binge eating is present.

     D. The binge eating occurs, on average, at least once a week for 3 months.

     E. The binge eating is not associated with the recurrent use of inappropriate compensatory behavior as in bulimia nervosa and does not occur exclusively during the course of bulimia nervosa or anorexia nervosa.

Specify if:

In partial remission: After full criteria for binge-eating disorder were previously met, binge eating occurs at an average frequency of less than one episode per week for a sustained period of time.

In full remission: After full criteria for binge-eating disorder were previously met, none of the criteria have been met for a sustained period of time.

Specify current severity:

The minimum level of severity is based on the frequency of episodes of binge eating (see below). The level of severity may be increased to reflect other symptoms and the degree of functional disability.

Mild: 1–3 binge-eating episodes per week.

Moderate: 4–7 binge-eating episodes per week.

Severe: 8–13 binge-eating episodes per week.

Extreme: 14 or more binge-eating episodes per week.

OSFED   This category applies to presentations in which symptoms characteristic of a feeding and eating disorder that cause clinically significant distress or impairment in social, occupational, or other important areas of functioning predominate but do not meet the full criteria for any of the disorders in the feeding and eating disorders diagnostic class. The other specified feeding or eating disorder category is used in situations in which the clinician chooses to communicate the specific reason that the presentation does not meet the criteria for any specific feeding and eating disorder. This is done by recording "other specified feeding or eating disorder" followed by the specific reason (e.g., "bulimia nervosa of low frequency").

Examples of presentations that can be specified using the "other specified" designation include the following:

1. Atypical anorexia nervosa: All of the criteria for anorexia nervosa are met, except that despite significant weight loss, the individual's weight is within or above the normal range. Individuals with atypical anorexia nervosa may experience many of the physiological complications associated with anorexia nervosa.
2. Bulimia nervosa (of low frequency and/or limited duration): All of the criteria for bulimia nervosa are met, except that the binge eating and inappropriate compensatory behaviors occur, on average, less than once a week and/or for less than 3 months.
3. Binge-eating disorder (of low frequency and/or limited duration): All of the criteria for binge-eating disorder are met, except that the binge eating occurs, on average, less than once a week and/or for less than 3 months.
4. Purging disorder: Recurrent purging behavior to influence weight or shape (e.g., self-induced vomiting; misuse of laxatives, diuretics, or other medications) in the absence of binge eating.
5. Night eating syndrome: Recurrent episodes of night eating, as manifested by eating after awakening from sleep or by excessive food consumption after the evening meal. There is awareness and recall of the eating. The night eating is not better explained by external influences such as changes in the individual's sleep-wake cycle or by local social norms. The night eating causes significant distress and/or impairment in functioning. The disordered pattern of eating is not better explained by binge-eating disorder or another mental disorder, including substance use, and is not attributable to another medical condition or to an effect of medication.

Notes. BN = bulimia nervosa; BED = binge eating disorder; OSFED = other specified feeding or eating disorder.

This thesis focused on people with non-underweight eating disorders for two reasons. First, treatment and research with people who are underweight is challenging and outside the scope of a PhD thesis. For example, treating AN takes a long time (up to 40 sessions; NICE, 2017) and dropout rates are high with around 40% of adults not completing stand-alone outpatient treatments (Byrne et al., 2017). There is also an increased risk of people needing to exit treatment due to medical instability, as AN can significantly impair physical health (Gibson et al., 2019) and has a mortality rate six times higher than that of the general population (Papadopoulos et al., 2009).

Second, this thesis focused on people with non-underweight eating disorders as research among this population, particularly among people with OSFED, is critically important. OSFED is prevalent, accounting for up to 53% of all community cases (Machado et al., 2013) and making up around 32% of people presenting for eating disorder treatment (Trompeter et al., 2021). AAN is now occurring more frequently in the population than AN, but less people with AAN are referred or admitted for eating disorder treatment (Harrop et al., 2021). Data also suggests that OSFED does not differ from other eating disorders in terms of risk factors, impairment, or psychological and physiological complications (Fairweather-Schmidt & Wade, 2014; Mustelin et al., 2016; Wade & O'Shea, 2015; Walsh et al., in press; Withnell et al., 2022). Despite this, these disorders are often referred to as "sub-clinical" or "sub-threshold," which runs the risk of trivialising their clinical significance and limiting interest in producing adequately powered intervention studies. Thus, to counter this, much of the research in this thesis focuses on these disorders.

Evidence-Based Psychological Treatments for Non-Underweight Eating Disorders

The NICE guidelines (2017) recommend that people with non-underweight eating disorders are initially offered guided self-help, that is working through the self-application of CBT materials with a non-expert guide. The length of guided self-help varies in practice,

ranging from four to nine 20-minute sessions over a period of 16 weeks (NICE, 2017), 12 x 20-minute sessions (Wilson & Zandberg, 2012), or 10 to 20 sessions lasting 25 to 50 minutes for up to 40 weeks (National Eating Disorder Collaboration, n.d.). For people with BN, individual CBT-ED comprising 20 sessions over 20 weeks is recommended as a second step if after four weeks guided self-help is unacceptable, contraindicated, or ineffective (NICE, 2017). For people with BED, group CBT-ED comprising 16 sessions over four months is recommended as a second step (NICE, 2017). However, if group CBT-ED treatment is unavailable or declined, then 16 to 20 individual CBT-ED sessions are recommended for people with BED. For OSFED, NICE (2017) recommends the treatment that is most congruent with the individual's symptoms.

The Royal Australian and New Zealand College of Psychiatrists (RANZCP) similarly recommends guided self-help and CBT-ED as frontline treatments for people with non-underweight eating disorders (Hay et al., 2014). These guidelines also recommend interpersonal psychotherapy and dialectical behavioural therapy for people with BN and BED, as well as mindfulness for people with BED. However, they note that these approaches should only be offered if a CBT-trained therapist is not available, as the evidence is somewhat limited (Hay et al., 2014).

The NICE (2017) and RANZCP (2014) recommendations are supported by meta-analytic evidence. For instance, Linardon, Wade, and colleagues (2017) and Linardon (2018) showed that CBT-ED is the most effective psychological treatment for people with non-underweight eating disorders. In these meta-analyses, CBT-ED outperformed all active psychological treatments, including interpersonal psychotherapy (Linardon, Wade et al., 2017). Moreover, the effectiveness of CBT-ED was greatest for manualised CBT-BN and CBT-E (Linardon, Wade et al., 2017).

Thus, taken together, up to 20 sessions of CBT-ED are typically recommended for people with non-underweight eating disorders (Hay et al., 2024; NICE, 2017). This is substantially longer than recommendations for other mental disorders such as depression and anxiety (NICE, 2011; 2022). Furthermore, eating disorder clinicians routinely extend the length of treatment and provide far more than the recommended 20 sessions (Cowdrey & Waller, 2015). Consequently, CBT-ED is usually very expensive to deliver, waitlists tend to be long (e.g., 136 to 155 days pre-COVID-19; Fursland et al., 2018), meaning that people with non-underweight eating disorders are typically unable to access the treatment that they require in a timely fashion.

Treatment Waitlists

This is problematic as increased time spent on waitlists has been shown to predict dropout from CBT-ED. Carter and colleagues (2012) investigated the roles of individual patient characteristics and process-based factors in dropout from 189 people on the waitlist for outpatient CBT-ED for AN ($n = 34$; 18%), BN ($n = 76$; 40.2%), and EDNOS ($n = 79$; 41.8%).They found that people who dropped out of treatment spent a significantly longer time on the waitlist than those who completed treatment. Carter and colleagues explained these findings in terms of motivation to change. Specifically, when an individual with an eating disorder seeks treatment, their motivation to change is likely high. Thus, those who are seen relatively soon after referral may be able to capitalise on this initial motivation and have the momentum to engage with and remain in treatment. However, those who are placed on a lengthy waitlist may be offered treatment at a time when they are no longer motivated, given that motivation fluctuates markedly in people with eating disorders.

The Impact of the Global Pandemic

The COVID-19 pandemic further compounded the issue of lengthy waitlists for eating disorder treatment. COVID-19 was declared a global pandemic by the World Health

Organisation in March 2020. For many people, the pandemic created a high level of fear regarding issues such as the lack of an effective vaccination or treatment, potential socioeconomic consequences, and personal safety. Efforts to slow the spread of the virus included mandatory lockdowns, quarantines, and social distancing. While effective, these measures left many people isolated and had a negative impact on mental health (Usher et al., 2020). For instance, loneliness and time spent in quarantine have been shown to predict adverse psychiatric outcomes during the pandemic (Xiong et al., 2020), and more time spent on screens and social media predicted deterioration of mental health (Caffo et al., 2021). Compared to before the pandemic, the general population has been shown to have lower psychological well-being and higher symptoms of depression and anxiety (Vindegaard & Benros, 2020; Xiong et al., 2020).

The COVID-19 pandemic has had a particularly detrimental effect on people with or at risk of developing an eating disorder. Containment measures have been particularly challenging for these people as they have resulted in difficulty accessing "safe foods," social isolation, lack of routine and structure, limited access to usual personal and professional supports, a sense of loss of control, and less accountability to others (Brown et al., 2021; Cooper et al., 2022; Hunter & Gibson, 2021; Monteleone et al., 2021; Touyz et al., 2020). Additionally, many people spent more time on screens and social media during the pandemic, which has been shown to have a harmful impact on body image and disordered eating (de Valle et al., 2021). Numerous studies conducted during the pandemic showed increased eating disorder prevalence, relapse, and symptoms such as restriction, body image concerns, binge eating, driven exercise, and self-induced vomiting (Branley-Bell & Talbot, 2020; Castellini et al., 2020; Graell et al., 2020; Miskovic-Wheatley et al., 2022; Phillipou et al., 2020; Termorshuizen et al., 2020). More specifically, it is estimated that the overall incidence of eating disorders increased by 15.3% in 2020 (Tacquet et al., 2022).

Consequently, the demand for eating disorder services markedly increased, further lengthening waitlists. For instance, in Australia, paediatric presentations of AN increased by 63% (Springall et al., 2022), and information gathered from 25 eating disorder services has revealed increased demand for community and inpatient programs, with people waiting many months to access care and treatment (National Eating Disorder Collaboration, 2020). This reflects international figures showing quadrupled waiting times for treatment since 2019/2020 (Nuffield Trust, 2022), a 270% increase in people waiting for urgent treatment, and a 315% increase in people waiting for routine treatment (Iacobucci 2021). Admissions among people with AN also increased during the pandemic, and in some cases more than doubled (Ayton et al., 2021; Goldberg et al., 2022; Hensen et al., 2021). Given the impact of lengthy waitlists on dropout (Carter et al., 2012), it is clearly important to: (1) shorten waitlists to enable more people to promptly access treatment, and (2) identify cost-effective strategies to manage the impact of waitlists to retain people in treatment.

Potential Strategies to Respond to Lengthy Waitlists

This thesis proposed three potential strategies to respond to lengthy treatment waitlists, with a view of retaining people with non-underweight eating disorders into treatment from waitlists, better preparing people for treatment, making treatment shorter, and having robust fit-for-purpose treatments that can be matched to baseline profiles to improve outcomes. The three strategies were: (1) low-cost waitlist intervention; (2) shorter CBT-ED treatment; and (3) precision medicine. Each of these strategies is discussed in more detail in the following sections of this literature review.

Strategy 1: Waitlist Intervention

To manage the impact of lengthy waitlists, a potential strategy is to provide short, low-intensity interventions while people are waitlisted for treatment. Doing so may help to keep people on waitlists and increase the chance of people entering treatment when it

becomes available. Waitlist interventions may also retain people in treatment and better prepare them to get the most out of treatment. Moreover, for some, a waitlist intervention may be sufficient treatment, shortening waitlists for other clients.

Several case series have investigated waitlist interventions for people with eating disorders. For example, Wade, Byrne, and colleagues (2022) evaluated an online 12-session guided self-help intervention among families with a child with AN who were waitlisted for treatment ($N = 13$). Large effect sizes were observed for weight gain and decrease in eating disorder behaviours. Moreover, self-reports revealed improvements in children's general mood and behaviours as well as parents' knowledge, skills, and confidence in managing their child with AN. Similarly, Fursland and colleagues (2018) evaluated the use of a face-to-face single session intervention (SSI) comprising assessment and psychoeducation prior to placing participants ($N = 448$) on a waitlist for outpatient treatment. The SSI increased the likelihood of people entering treatment, and significantly decreased eating disorder psychopathology, clinical impairment, and depression during the waitlist period. It also decreased behavioural symptoms and those with AN gained weight. To date, no RCT of waitlist interventions for people with eating disorders have been reported, although one (Vollert et al., 2019) is currently being conducted evaluating the use of eight sessions of online guided self-help among females waitlisted for outpatient treatment.

Given resource restrictions, SSIs on waitlists are more realistic, such as the face-to-face version provided by Fursland and colleagues (2018). SSIs have a long history in emergency settings (e.g., Paul & van Ommeren, 2013) but little robust evaluation of these approaches exists, and they have been used relatively sparsely in eating disorders. One recent example is Schleider and colleagues (2022) who evaluated the utility of SSIs for adolescent depression. Participants ($N = 2452$) were randomised to one of three SSIs: behavioural activation, growth mindset, or supportive control. Relative to control, those who received the

active SSIs reported improvements in perceived agency as well as decreased depression symptom severity, restrictive eating, and hopelessness. Similarly, Ching and colleagues (2022) found small to medium reductions in anxiety and depression symptoms following an SSI promoting growth mindsets among young people ($N = 29$) awaiting mental health services.

While there are many potential targets for waitlist interventions for eating disorders (e.g., perfectionism, social media use, and distress tolerance), our resources enabled us to select just two. It is likely that any waitlist intervention that is effective will be one that keeps individuals linked with the service or has wide-reaching impact in terms of broad learning or generalisable skills. Thus, one of our waitlist interventions targeted executive functioning (central coherence and set shifting) using CRT which has been shown to retain people in treatment (Hagan et al., 2020), and the other provided brief contact in the form of a short, supportive email and psychoeducation which has been shown to decrease disordered eating (Zhou et al., 2020).

Executive Functioning in Eating Disorders

A large body of research has examined executive functioning among people with AN and established that they have inefficiencies in two key areas: central coherence and set shifting (Lang, Lopez, et al., 2014; Wu et al., 2014). Inefficiencies in central coherence can manifest as overly detail-focused thinking at the expense of the bigger picture (Happé & Booth, 2008), and inefficiencies in set-shifting as rigid, inflexible thinking with difficulty in changing responses when rules in the environment change (Lezak et al., 2012). Much less attention has been paid to central coherence and set shifting among people with non-underweight eating disorders, despite evidence of inefficiencies among this group (Lang, Lopez, et al., 2014; Wu et al., 2014).

The two most recent and comprehensive meta-analyses examining executive functioning among people with eating disorders were conducted by Lang, Lopez, and colleagues and Wu and colleagues in 2014. Lang, Lopez, and colleagues conducted three separate meta-analyses. The first ($N = 5$) examined central coherence measured using the Group/Embedded Figures Test among people with AN, BN, and those recovered from an eating disorder. They found that all three eating disorder groups had poorer central coherence than healthy controls (significant for people with AN and those recovered from an eating disorder and marginally significant, $p = .08$, for people with BN). The second ($N = 7$) examined central coherence using the Rey Complex Figure Test (RCFT) among the same three groups. This meta-analysis showed that all three eating disorder groups had significantly poorer central coherence than healthy controls. The third ($N = 8$) examined central coherence measured using Object Assembly among people with AN and showed that their performance was significantly poorer than that of healthy controls.

Wu and colleagues (2014) conducted one meta-analysis ($N = 48$). They examined set shifting measured using a range of neuropsychological measures including the Wisconsin Card Sorting Test (WCST) among people with AN, BN, and BED. They found that all three eating disorder groups had significantly poorer set shifting than healthy controls, and that the effect sizes did not significantly differ between people with non-underweight eating disorders and people with AN. Therefore, a meta-analysis is required to expand on Lang, Lopez, and colleagues (2014) by testing whether central coherence differs between people with non-underweight eating disorders and people with AN, and to provide an updated examination of both central coherence and set shifting across eating disorder diagnoses.

CRT

To target these inefficiencies in people with AN, CRT has been developed and widely evaluated. CRT is an adjunct treatment that can be delivered in either a group or an individual

format (Genders & Tchanturia, 2010). Rather than discussing eating disorder-related symptoms or themes directly, CRT uses cognitive training exercises to "think about thinking" (Tchanturia et al., 2014). CRT has been widely evaluated among people with AN and has received positive qualitative feedback from clients, parents, and clinicians (Easter & Tchanturia, 2011; Giombini, Turton et al., 2017; Giombini, Nesbitt et al., 2018; Giombini et al., 2022; Whitney et al., 2008). For people with AN, CRT has been shown to improve set shifting, central coherence, quality of life, eating disorder psychopathology, and motivation to change (Abbate-Daga et al., 2012; Brockmeyer et al., 2013; Dingemans et al., 2014; Tchanturia et al., 2014), and there is preliminary evidence that it improves retention in treatment (Hagan et al., 2020).

As people with non-underweight eating disorders have also been shown to have central coherence and set shifting inefficiencies (Lang, Lopez, et al., 2014; Wu et al., 2014), they too may benefit from CRT. Despite this, only four studies (summarised in **Table 2.2**) have examined the use of CRT in samples that included people with non-underweight eating disorders. Moreover, all these studies used mixed samples, precluding clear conclusions about the usefulness of CRT for people with non-underweight eating disorders and demonstrating a need for a study evaluating CRT predominantly among this group. In addition to targeting executive functioning, CRT may be particularly useful as a waitlist intervention given that it has been shown to improve retention in treatment and motivation to change which likely fluctuates during time spent on lengthy waitlists.

Table 2.2

Summary of Studies Evaluating CRT in Samples Including People with Non-Underweight Eating Disorders

Study	*N*	Population	CRT format	Key findings
Dingemans et al. (2014)	82	"Severe or enduring" eating disorders (12% BN)	10 individual sessions	Participants who received CRT in addition to treatment as usual had greater improvements in quality of life and eating disorder psychopathology than those who received treatment as usual alone.
Raman et al. (2018)	80	People with a BMI > 30 (70% BED)	8 individual sessions	Participants who received CRT had greater improvements in set shifting and reductions in binge eating than those in the control condition.
Mac Neil et al. (2016)	38	Outpatients (6% BN and 70% OSFED)	16 group sessions	Self-reported set-shifting and life satisfaction significantly increased from pre- to post-CRT. Participants also reported that they were satisfied with the CRT group.
Roberts (2018)	15	Day program participants (26.7% BN)	8 group sessions	Self-reported central coherence and set shifting improved from pre- to post-CRT.

Notes. BN = bulimia nervosa; BED = binge eating disorder; OSFED = other specified feeding or eating disorder; BMI = body mass index; CRT = cognitive remediation therapy.

Brief Contact

Our second choice for a waitlist intervention was "brief contact." Rather than providing formal treatment, brief contact interventions take the form of short supportive letters, postcards, or phone calls inviting people to reengage with clinical services, expressing support, or providing brief psychoeducation. Consequently, they may help keep people placed on lengthy waitlists engaged with services. Moreover, they do not require a trained mental health clinician to implement, making them another cost-effective option that is worthy of investigation among people with non-underweight eating disorders.

Brief contact interventions have previously been evaluated for self-harm and suicide. For example, Carter and colleagues (2005) investigated the effectiveness of sending postcards to participants 1-, 2-, 3-, 4, 6-, 8-, 10-, and 12-months post-discharge following hospitalisation for deliberate self-poisoning. The postcards read: "Dear [Name], It has been a short time since you were here in Newcastle Mater Hospital, and we hope things are going well for you. If you wish to drop us a note we would be happy to hear from you. Best wishes, Dr [Name]." This brief contact intervention reduced repetitions of deliberate self-poisoning (Carter et al., 2005), and this was maintained over a two-year period (Carter et al., 2007). More broadly, there is meta-analytic evidence to suggest that brief contact interventions significantly reduce suicidal ideation and attempts among people with a range of mental disorders (Tay & Li, 2022).

Psychoeducational content that holds promise for a brief contact intervention is a centre for Clinical Interventions Handout titled "Eating Disorders and Neurobiology." This handout highlights the adaptability of neurobiology, genes, and brain pathways with adequate nutrition (see **Appendix B**). Zhou and colleagues (2020) evaluated the use of this handout among young women at risk of developing an eating disorder. Participants were asked to spend at least 10 minutes reading the handout and were required to correctly answer 14

comprehension questions to increase engagement with the content. This was shown to decrease disordered eating when compared to a control condition in which participants were asked to let their mind wander for 10 minutes (Zhou et al., 2020). Thus, this psychoeducational content could be modified for a brief contact intervention for people with eating disorders by removing the comprehension questions and adding a brief, supportive message similar to that used by Carter and colleagues (2005).

Strategy 2: Shorter CBT-ED Treatment

A potential strategy to shorten waitlists is to provide shorter CBT-ED treatment. While 20 sessions of CBT-ED are recommended for people with non-underweight eating disorders, there is no evidence to suggest that this is the optimal number required to successfully treat people. To the contrary, there is evidence to suggest that longer time in treatment does not equate to better treatment outcomes (Rose & Waller, 2017). Rose and Waller also examined curve fit estimates, which indicated that gains in CBT-ED were made by Sessions 8 to 12, after which there was no further reliable improvement. This aligns with findings for a range of mental disorders such as mild-to-moderate depressive and anxiety disorders. For these disorders, the optimal length of treatment is four to six sessions, after which additional sessions do not result in better treatment outcomes (Delgadillo et al., 2014). Moreover, there is evidence to suggest that up to 80% of the decrease in severity of depression occurs by the fourth session of CBT (Ilardi & Craighead, 1994), and change in symptoms at this point predicts remission (Persons & Thomas, 2019).

Given there is no evidence to support 20 sessions being the optimal CBT-ED dose alongside the imperative to use resources wisely, it is clearly important to evaluate the potential of shorter CBT-ED treatments. Doing so would address NICE (2017) research recommendations to evaluate whether shorter treatments for people with eating disorders (<20 sessions) could be as effective as longer treatment (p. 40). This is an important research

endeavour as a shorter treatment should be more cost-effective to deliver and shorten waitlists by enabling more people to be treated more quickly.

CBT-T

Apart from guided self-help approaches, CBT-T has generated the most empirical support as an effective and shorter adaptation of CBT-ED for people with non-underweight eating disorders (Waller et al., 2019). CBT-T is a manualised transdiagnostic outpatient treatment that is guided by a clear session-by-session protocol and checklist to allow flexible delivery without omitting key elements of treatment. It is, therefore, suitable to be delivered by novice therapists, such as trainee psychologists, under supervision. CBT-T retains many of the core elements of longer CBT-ED such as nutritional change, collaborative in-session weighing, cognitive restructuring, and relapse prevention. There are five phases of treatment which are shown in **Table 2.3.** Consistent with longer CBT-ED, the initial phases of CBT-T involve psychoeducation, establishing regular and adequate eating, and eliminating binge eating and compensatory behaviours. Thoughts, beliefs, and rules about food and body image are tackled later in treatment, using behavioural experiments, surveys, mirror exposure, and imagery rescripting. Comprehensive relapse prevention work is conducted during the final two sessions, and follow-ups are offered at 1- and 3-months post-treatment.

Table 2.3

Phases of CBT-T Treatment (Adapted from Waller et al., 2019)

Phase	Sessions	Targets
1	1 to 4	Early dietary change and exposure: Provide education; change biology; reduce anxiety; reduce binge/purge behaviour.
2	3 to 6	Behavioural experiments regarding food: Cognitive change.
3	5 to 7	Exposure and cognitive restructuring regarding emotions: Reduce emotionally driven bulimic behaviours (if applicable).
4	5 to 9	Body image work using surveys, exposure, and behavioural experiments: Reduce maintaining behaviours; enhance body image acceptance.
5	9 to 10	Relapse prevention and implementing the therapy blueprint: Maintain changes; plan follow-up; attribute changes to the client's effort and hard work.

Compared to longer CBT-ED, CBT-T includes exposure based on inhibitory learning principles and a wider range of body image work. CBT-T also places a greater emphasis on early behavioural change. Specifically, clients are initially offered only four sessions and are informed that this can be extended to a total of 10 sessions if they quickly adopt regular eating with sufficient carbohydrate intake. Progress is collaboratively reviewed in Session 4 and clients who are actively engaging and making the required changes to their eating are offered an additional six sessions. Clients who have been unable to make the required changes are collaboratively discharged and provided with information about other treatment approaches. They are also offered the opportunity of trying CBT-T again once they feel able to engage in the required changes. The overall non-completion rate in CBT-T therefore comprises two groups – those who are collaboratively discharged, and those who prematurely discharge without collaborative agreement with their therapist. This stance is informed by the

importance of early change in predicting outcomes (Chang et al., 2021; Linardon et al., 2016; Vall & Wade, 2015), which is discussed later in this literature review.

Evaluations of CBT-T

To date, CBT-T has been evaluated in 10 studies (Birtwell et al., 2021; Moore, Hinde et al., 2021; Moore, Turner et al., 2021; Pellizzer et al., 2019a; Pellizzer et al., 2019b; Rose et al., 2021; Russell, 2020; Tatham et al., 2020; Wade, Ghan et al., 2021; Waller et al., 2018). Detailed demographic information for each study as well as effect sizes for each outcome are provided in **Chapter 3**. Study designs comprised six case series, three cohort studies, and one RCT. Of the 10 studies, seven were conducted in the United Kingdom and three in Australia. Sample sizes ranged from 16 to 139 and most participants were diagnosed with BN or BED. Overall, the studies demonstrated large to very large reductions in eating disorder symptoms and clinical impairment from pre- to post-treatment. Secondary outcomes, such as anxiety and depression, also improved over the course of CBT-T. Together, these studies demonstrate that CBT-T is a promising treatment for non-underweight eating disorders. While no direct randomised comparisons have been made between CBT-T and longer CBT-ED treatments, there are now enough evaluations of CBT-T from a variety of settings to conduct a systematic review and meta-analysis of within-group effect sizes. Synthesising such data may provide valuable justification for further work assessing those effects within more robust designs, such as RCTs.

Strategy 3: Precision Medicine

Another potential strategy to shorten waitlists is to take a precision medicine approach in which treatment is tailored to individuals based on their characteristics at baseline. To take a precision medicine approach, an understanding of moderators and predictors is required. Moderators provide information regarding which treatment works best for an individual and under which conditions (Kraemer, 2002) and predictors provide information regarding an

individual's likely prognosis (Agras et al., 2000). Taking such an approach may have the potential to shorten waitlists by: (1) only placing people on waitlists for treatments they are likely to benefit from; (2) modifying treatment to maximise outcomes, potentially reducing repeat presentations; and (3) shortening treatment by omitting aspects that the individual does not require.

In eating disorders, severity and duration are commonly thought to predict treatment outcome. Consequently, for people with "severe and enduring" eating disorders treatment often focuses on building skills to improve quality of life and social functioning rather than on recovery (Broomfield et al., 2017). This is concerning as a meta-analysis has found no evidence that duration influences treatment outcomes (Radunz, Keegan et al., 2020), and the evidence for severity is inconsistent with some studies showing no association with outcome (Raykos et al., 2018). Numerous other variables have been examined as moderators and/or predictors of outcome and non-completion for people with eating disorders. These variables have included baseline central coherence and set shifting, objective binge eating and purging frequencies, BMI, motivation, and early change in eating disorder symptoms (Gregertsen et al., 2019; Keegan, Byrne, et al., 2022; Linardon, de la Piedad Garcia, et al., 2017; Vall & Wade, 2015; Wade, Ghan et al., 2021). However, despite this extensive investigation, little consistency has emerged in the literature (de la Piedad Garcia, et al., 2017). Thus, our understanding of moderators and predictors for people with eating disorders is currently in its infancy (Linardon, de la Piedad Garcia, et al., 2017), limiting our ability to tailor treatment to individuals based on their characteristics at baseline.

The one exception to this is early change in eating disorder symptoms. Meta-analyses synthesising over 20 years of evidence have established that early change is the most robust and replicable predictor of outcome across different diagnostic groups and different treatment settings (Chang et al., 2021; Linardon et al., 2016; Vall & Wade 2015). This value of early

change has been demonstrated at post-treatment and follow-up, among both children and adults, across eating disorder diagnoses, for inpatient, day patient, and outpatient treatments, and for a range of eating disorder symptoms from weight gain to decreases in binge eating and purging (Bell et al., 2017; Chang et al., 2021; Vall & Wade, 2015).

While early change is a consistent predictor, it does not have pre-treatment predictive value. This differs somewhat from findings for depression in youth, where baseline severity can be predictive of outcome (Courtney et al., 2022). Given the lack of consistency in the literature, as well as the lack of pre-treatment predictive value of early change, there is a clear need for treatment studies to routinely investigate variables as moderators and predictors. It is recommended that variables selected for analysis should be theoretically or empirically driven (Linardon, de la Piedad Garcia, et al., 2017). This need for evaluations to be guided by evidence and theory is echoed in a Medical Research Council document (Skivington et al., 2021), which highlights the importance of conducting research to better understand the conditions in which interventions are effective.

Conclusions

This literature review established that eating disorders are serious mental disorders that require timely access to treatment. People with eating disorders are often placed on unacceptably long waitlists for treatment. This issue has been compounded during the COVID-19 pandemic with studies showing increased eating disorder prevalence and relapse rates (Branley-Bell & Talbot, 2020; Castellini et al., 2020; Graell et al., 2020; Miskovic-Wheatley et al., 2022; Phillipou et al., 2020; Taquet et al., 2022; Termorshuizen et al., 2020), as well as demand on eating disorder services (Ayton et al 2021; Goldberg et al., 2022; Hensen et al., 2021; Iacobucci 2021; National Eating Disorder Collaboration, 2020; Nuffield Trust, 2022). Placing people on lengthy waitlists is problematic as increased time spent on waitlists has been shown to predict dropout from subsequent CBT-ED (Carter et al., 2012).

Therefore, the overarching aim of this thesis was to determine strategies to respond to lengthy treatment waitlists in a pandemic world. This involved looking at potential strategies to: (1) shorten waitlists (shorter CBT-ED and precision medicine); and (2) manage the impact of lengthy waitlists on dropout (waitlist intervention).

Chapter 3

A Systematic Review and Meta-Analysis of a 10-Session Cognitive Behavioural Therapy

for People with Non-Underweight Eating Disorders[2]

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[2] The study described in this chapter was published. Ella Keegan contributed 80%, 80%, and 60%, Glenn Waller contributed 0%, 20%, and 20%, and Tracey Wade contributed 20%, 0%, and 20% to the research design, data collection and analysis, and writing and editing, respectively.

Keegan, E., Waller, G., & Wade, T. D. (2022). A systematic review and meta-analysis of a 10-session cognitive behavioural therapy for non-underweight eating disorders. *Clinical Psychologist, 26*(3), 1-14. https://doi.org/10.1080/13284207.2022.2075257

Abstract

One potential strategy to shorten waitlists (Aim 1) is to provide shorter CBT-ED treatment. The present study evaluated CBT-T, the shorter CBT-ED treatment with the most empirical evidence. To do so, we conducted a systematic review using four electronic databases and contacted researchers in the field for unpublished data. Random effects meta-analyses were conducted to pool within-group effect sizes. From pre- to post-treatment, medium to very large effect sizes were observed for eating disorder psychopathology, clinical impairment, depression, anxiety, and weekly frequencies of objective bingeing and vomiting. The non-completion rate for CBT-T was 39%, and 65% of completers had a good outcome. Furthermore, the effect of CBT-T appeared to last following the completion of treatment, with eating disorder psychopathology remaining below the norm for women without an eating disorder at follow-up. While results should be interpreted as preliminary due to several limitations, the present study suggests that CBT-T is a promising treatment for people with non-underweight eating disorders, which can produce good outcomes in half the time currently recommended in treatment guidelines. The present study, therefore, supports the use of shorter treatment as a strategy to shorten waitlists. It also provides valuable justification for future RCTs directly comparing short and long forms of CBT-ED, as well as examining who does best with which version.

Introduction

This chapter relates to the first specific PhD aim: shortening waitlists for eating disorder treatment. One potential strategy to shorten waitlists is to provide shorter CBT-ED treatment. Excluding guided self-help, the shorter version of CBT-ED with the most empirical evidence is CBT-T (Waller et al., 2019). While no direct randomised comparisons have been made between CBT-T and longer CBT-ED, there are now enough evaluations of CBT-T from a variety of settings to conduct a systematic review and meta-analysis of within-group effect sizes. We note that Cuijpers and colleagues (2017) have expressed several concerns about the inclusion of within-group effect sizes in meta-analyses. First, case series evaluations are unable to account for any spontaneous recovery or alternative explanations for change. Second, the population of these studies may differ from those entering RCTs where allocation to a less effective alternative is a possibility. Additionally, clients who are deemed to have more severe eating disorders can be offered longer courses of CBT-ED over CBT-T (e.g., Tatham et al., 2020). Third, scores on outcome measures at pre- and post-treatment are not independent of each other. Fourth, there can be large differences between within-group effect sizes across studies, introducing considerable heterogeneity. However, where there is sufficient evidence of pre-post outcomes within groups, such data can provide valuable justification for further work assessing those effects within more robust designs, such as RCTs. Therefore, the present study was intended to provide formative evidence to justify the development of future controlled studies.

The present study evaluated the effect of CBT-T from pre- to post-treatment on eating disorder psychopathology, clinical impairment, depression, anxiety, and weekly frequencies of objective bingeing and vomiting. We also examined the percentage of participants who did not complete CBT-T and the percentage of completers who had a good outcome. To determine whether outcomes lasted beyond the end of treatment, we examined the effect of

CBT-T on eating disorder psychopathology from pre-treatment to follow-up. The limitations outlined above were minimised in the following ways. First, we compared the baseline characteristics of participants in the studies included in our systematic review and meta-analysis to those in RCTs and longer forms of CBT-ED. Second, we accounted for the correlation between pre- and post-treatment scores on each continuous outcome measure when calculating effect sizes, to manage non-independence. In line with best practice, we used the exact value of the correlation for each study rather than assuming a fixed value or using a value based on previous reports. Third, variables showing significant heterogeneity were interpreted with caution. Thus, our robust methodology allowed the presentation of reliable within-group effect sizes that were suitable for synthesising in a meta-analysis.

Method

The present study was conducted in line with the preferred reporting items for systematic review and meta-analysis (PRISMA Statement; Moher et al., 2009).

Search Strategy

The primary search strategy involved searching for relevant papers in four electronic databases: Scopus, Medline, PsychINFO, and ProQuest Dissertations & Theses Global. The following search terms were searched for in the title and abstract of papers: ((CBT-T OR "brief cognitive behavioural therapy" OR "10-session cognitive behavioural therapy") AND (eat* AND disord*)). The final database search was conducted on the 30th of August 2021. The secondary search strategy aimed to identify further papers from the reference lists and forward citation searches of relevant papers identified in the primary search. We also located grey literature by contacting researchers in the field for unpublished data.

Inclusion Criteria

The following inclusion criteria were applied: (1) English language; (2) participants aged 15 years and over; (3) administered CBT-T; (4) conducted assessments at pre- and post-

treatment; and (5) assessed any of the following variables: eating disorder psychopathology, clinical impairment, depression, anxiety, weekly objective bingeing frequency, weekly vomiting frequency, non-completion, and/or good outcome. Case studies were excluded due to the impossibility of calculating an effect size.

Data Extraction Process

The PhD Candidate and a research assistant independently extracted the information required for the qualitative synthesis and to calculate effect sizes. The information extracted by the PhD Candidate and the research assistant aligned 94%. This percentage was calculated by dividing the number of extractions that aligned out of the total number of extractions and multiplying by 100. When the information extracted by the PhD Candidate and the research assistant was not identical, it was double checked by the PhD Candidate. When papers did not report the information required to calculate effect sizes, the PhD Candidate requested it from the corresponding authors of those papers. The PhD Candidate also requested the correlation between pre- and post-treatment and pre-treatment and follow-up for all continuous variables. These data were provided in all cases. Demographic information, such as the age, sex, and race of participants, was also extracted from each paper.

Calculation of Effect Sizes

All effect sizes were calculated using Comprehensive Meta-Analysis software (CMA; Version 3.3; Borenstien et al., 2021). When studies reported standard error instead of standard deviation, the standard deviation was calculated by multiplying the standard error by the square root of the sample size. In some studies, the number of participants who completed measures was different from the number of participants who completed CBT-T. In these cases, the number of participants who completed CBT-T was used so that our effect sizes would reflect the impact of doing the treatment as opposed to a mixed sample in which some people had completed treatment and some people had not. The same approach was taken for

follow-up data. Cohen's (1992) benchmarks were used to interpret effect sizes as small (0.20), medium (0.50), or large (0.80).

For continuous variables (i.e., eating disorder psychopathology, clinical impairment, depression, and anxiety), both within-group intent-to-treat and within-group completer effect sizes were calculated. The within-group intent-to-treat effect sizes were calculated as Hedges' *g* using the number of participants who were randomised to/started CBT-T, the adjusted pre- and post-treatment means, the pre- and post-treatment standard deviations, and the correlation between pre- and post-treatment. The within-group completer effect sizes were also calculated as Hedges' *g* with the same method described above but using the number of participants who completed CBT-T and unadjusted means. Some of the authors of the original papers did not adjust for the correlation between pre- and post-treatment. Therefore, in some cases, our reported effect sizes are slightly different from those reported in the original published papers.

For count variables (i.e., weekly frequencies of objective bingeing and vomiting), within-group completer effect sizes were calculated as Hedges' *g*. The same method described for continuous variables was used. However, it would not have been appropriate to adjust for the correlation between pre- and post-treatment for count variables.

For binary variables (i.e., non-completion and good outcome), effect sizes were calculated as percentages. For non-completion, the percentage of participants who did not complete treatment was calculated from the number who were randomised to/started CBT-T. For good outcome, the percentage of participants who had a post-treatment eating disorder examination questionnaire (EDE-Q) global score ≤ 2.77 was calculated from the number of participants who completed treatment.

Finally, for follow-up data, within-group intent-to-treat effect sizes for eating disorder psychopathology were calculated. These effect sizes were calculated as Hedges' *g* using the

number of participants who were randomised to/started CBT-T, the adjusted pre-treatment and follow-up means, the pre-treatment and follow-up standard deviations, and the correlation between pre-treatment and follow-up. Intent-to-treat follow-up data were available for six studies. For each study, the final follow-up was selected.

Meta-Analyses

The meta-analyses were performed using CMA (Borenstein et al., 2009). Separate random effect meta-analyses were performed to obtain: (1) the pooled within-group intent-to-treat and completer effect sizes for each continuous variable from pre- to post-treatment; (2) the within-group completer effect sizes for the count variables from pre- to post-treatment; (3) the overall percentage of participants who did not complete CBT-T; and (4) the overall percentage of completers who had a good outcome. For the main outcome variable, eating disorder psychopathology, a random effect meta-analysis was also conducted to determine whether the effect of CBT-T was lasting, and a sensitivity analysis was conducted to determine whether the results were influenced by the quality of the original studies synthesised in the meta-analyses.

Heterogeneity

Heterogeneity was examined using the Q-test and I^2 statistic. A significant Q-test provides evidence of heterogeneity, and the I^2 statistic indicates the percentage of total variance between studies that is due to heterogeneity compared to chance (Cuijpers, 2016). For I^2, percentages of 25, 50, and 75 are interpreted as indicating low, moderate, and high heterogeneity, respectively (Higgins et al., 2003).

Publication Bias

Egger's regression intercept was used to assess publication bias (Moreno et al., 2009). Egger's regression intercept examines the relationship between effect sizes and standard error of effect sizes, to determine whether study effect size and study precision are significantly

related (Laird et al., 2017). A significant regression intercept indicates the likely presence of publication bias (Laird et al., 2017).

Quality Assessment

The PhD Candidate and a research assistant independently assessed the quality of all studies included in the meta-analysis using the CONSORT 2010 checklist (Schulz et al., 2010). As the meta-analysis included case series, cohort studies, and an RCT, eight items that applied to all the study designs were selected from the original 25 items. The selected items were: eligibility criteria for participants (Item 4a); settings and locations where data were collected (Item 4b); description of the intervention with sufficient details to allow replication (Item 5); defined outcome measures including how and when they were assessed (Item 6a); how sample size was determined (Item 7a); the number of participants who received treatment and were analysed for the primary outcome (Item 13a); losses and exclusions with reasons (Item 13b); and baseline demographic information and clinical characteristics (Item 15). Items were scored 'Y' when fully conforming to CONSORT, 'N' when not conforming to CONSORT, and 'P' when partially conforming to CONSORT. The ratings from the PhD Candidate and research assistant aligned 100%. For the sensitivity analysis, high quality was defined as papers that fully conformed to CONSORT on six or more items.

<div align="center">

Results

</div>

Study Selection

Initially, 38 published papers were identified through database searching. An additional two unpublished papers were provided by lead researchers in the field when the PhD Candidate contacted them for unpublished data. The search results from each electronic database and the unpublished papers were imported into Covidence systematic review management software.

All papers were then cross-referenced, and duplicate papers were removed. After removing duplicates, 25 papers remained. The PhD Candidate and a research assistant independently screened all titles and abstracts to determine whether papers broadly related to the research question, excluding 13 papers. Next, the full texts of the remaining 12 potentially relevant papers were retrieved and read independently to determine whether they met the full inclusion criteria. Two of these papers (Pellizzer et al., 2018 & 2019c) were excluded due to overlapping samples, leaving 10 papers that met the inclusion criteria for the systematic review and meta-analysis. Throughout this process, discrepancies were discussed until a consensus was reached. The agreement rate was 95% for title and abstract screening and 100% for full text. A PRISMA flow diagram of the study selection process is provided in **Figure 3.1**.

Figure 3.1

PRISMA Flow Diagram
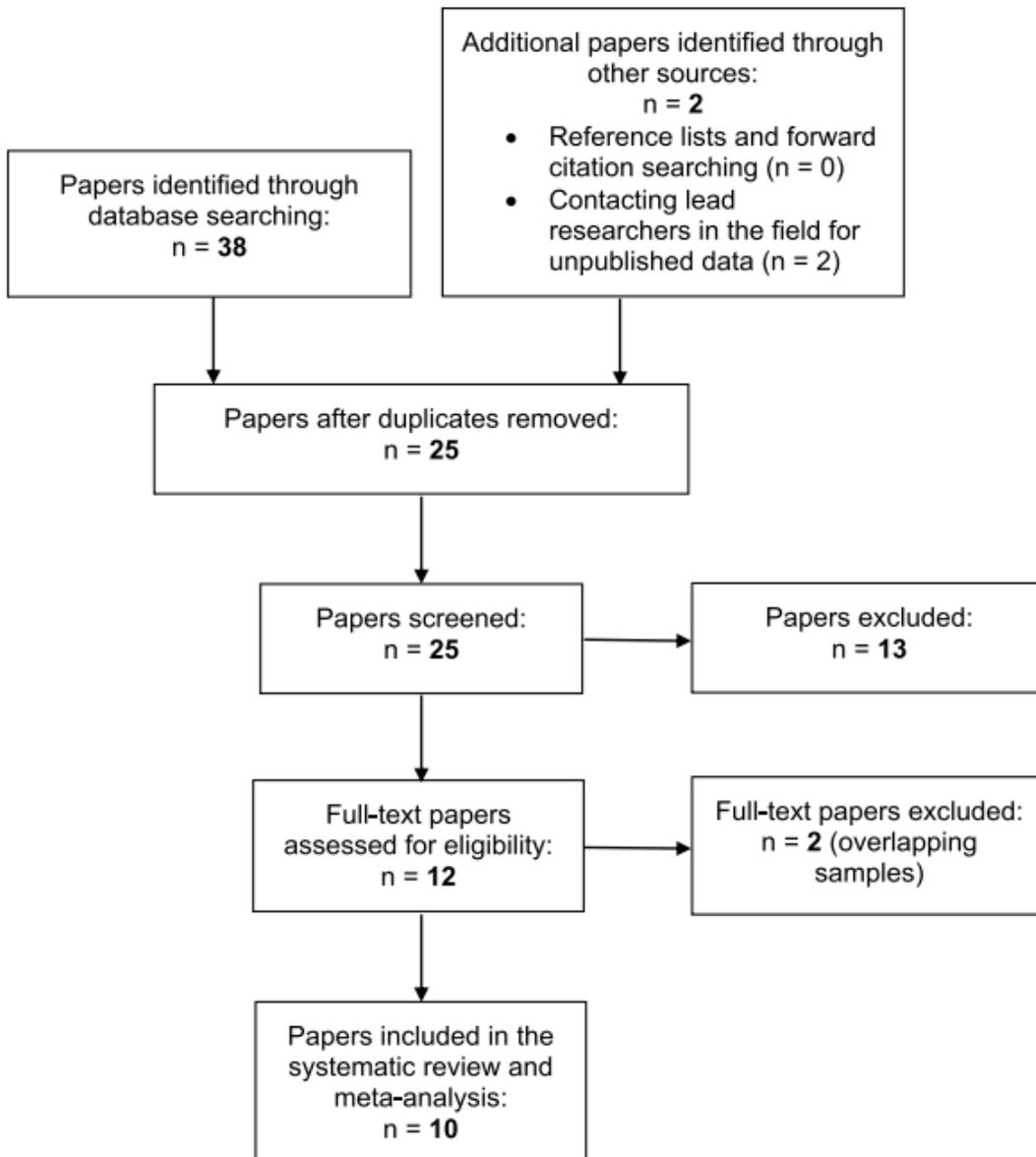
Description of Studies

An overview of the 10 studies examined in this systematic review and meta-analysis is shown in **Table 3.1**. Of these studies, seven were published papers, one was a Masters thesis, and two were unpublished manuscripts. The study designs comprised six case series, three cohort studies, and one RCT. Seven of the studies were conducted in the United Kingdom and three in Australia. Sample sizes ranged from 16 to 139 (total pre-treatment $N = 565$ and total completer $N = 346$). While participants were primarily white females, the range of non-underweight eating disorder diagnoses were represented across the studies.

Table 3.1

Summary of the 10 Studies Included in the Systematic Review and Meta-Analysis

Study	Study design	Original N	Completer N (% completed)	Follow-up	Demographic Information
Birtwell et al. (2021)[a]	Case series	45	25 (56)	3 months	M^{age}: 30.44 (9.83); Diagnosis: 9 OSFED, 16 BN; Sex: 96% female; Race, Ethnicity, and SES: NR
Moore, Hinde et al. (2021)[b]	Case series	53	41 (77)	3 months	M^{age}: 35.20 (12.30); Diagnosis: BED; Sex: 77% female; Race, Ethnicity, and SES: NR
Moore, Turner et al. (2021)[a]	Cohort	139	78 (56)	Post-treatment	M^{age}: 35.24 (12.27); Diagnosis: BN, BED, OSFED; Sex: 93% female; Race, Ethnicity, and SES: NR
Pellizzer et al. (2019a)[b]	Case series	52	32 (62)	3 months	M^{age}: 26.42 (9.62); Diagnosis: 29 BN, 17 OSFED, 2 AN, 2 UFED, 2 BED; Sex: 90% female; Race: 82.70% Caucasian; Ethnicity and SES: NR
Pellizzer et al. (2019b)[b]	Case series	26	13 (50)	3 months	M^{age}: 28.73 years (9.57); Diagnosis: 24 BN, 1 OSFED, 1 UFED; Sex: 96% female; Race: 100% Caucasian; Ethnicity and SES: NR
Rose et al. (2021)[b]	Case series	40	26 (65)	Post-treatment	Age: 18 to 51; Diagnosis: 35 BN/atypical BN, 5 AAN; Sex: 90% female; Race: 90% White British, 5% other European White, 5% mixed White and Asian; Ethnicity and SES: NR
Russell (2020)[c]	Retrospective cohort study analysis	16	9 (56)	1 month	M^{age}: 23.40; Diagnosis: 1 AN, 4 BN, 1 BED, 10 OSFED; Sex: 94% female; Race: 87.50% white,

					6.25% Asian, 6.25% other; Ethnicity, and SES: NR
Tatham et al. (2020) [b]	Cohort comparison	55	31 (56)	6 months	M[age]: 29.40 (10.20); Diagnosis: 15 OSFED, 32 BN, and 8 BED; Sex: 95% female; Race, Ethnicity, and SES: NR
Wade et al. (2021) [b]	RCT	46	27 (59)	3 months	M[age]: 26.90 (10.90); Diagnosis: DSM-5 eating disorder with BMI >17.5; Sex: 91% female; Race, Ethnicity, and SES: NR
Waller et al. (2018) [b]	Case series	93	64 (69)	3 months	M[age]: 27.40 years (8.70); Diagnosis: 51 BN, 25 BED, 17 OSFED; Sex: 97% female; Race, Ethnicity, and SES: NR

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder; OSFED = other specified feeding or eating disorder; UFED = unspecified feeding or eating disorder; SES = socioeconomic status; NR=not reported.
[a] = unpublished manuscript; [b] = published paper; [c] = Masters thesis.

Pre-Treatment Severity

We determined whether the participants included in our meta-analysis were different from: (1) those participating in RCTs receiving a form of CBT-ED (where allocation to a less effective alternative is a possibility) or (2) those receiving longer CBT-ED (which is sometimes offered over CBT-T when people are deemed to have more severe eating disorders). To do so, pre-treatment eating disorder psychopathology, measured using the global score of the EDE-Q (Fairburn & Beglin, 2008), was compared between participants in our meta-analysis, participants in RCTs receiving a form of CBT-ED, and participants receiving longer CBT-ED. As shown in **Table 3.2**, 40% of the CBT-T studies had an entry mean that was equal to or higher than the highest entry means for RCTs and studies of longer CBT-ED. Additionally, the number of standard deviations above the norm was very similar for studies of CBT-T (1.34 to 2.38), RCTs (1.34 to 2.11), and studies of longer CBT-ED (1.35 to 2.12). Therefore, pre-treatment severity was not consistently or substantially different between participants in our meta-analysis, participants in RCTs receiving a form of CBT-ED, or participants receiving longer CBT-ED.

Table 3.2

Pre-Treatment Severity (Assessed Using Global EDE-Q Scores) Among Participants in

RCTs, Participants Receiving Longer CBT-ED, and Participants Receiving CBT-T

Study	Pre-treatment *M* (*SD*)	*SDs* above the norm
RCTs of CBT-ED		
de Jong et al. (2020)	4.10 (1.00)	2.06
Fairburn et al. (2009)	4.15 (0.97) [a]	2.10
	4.04 (0.88) [b]	2.02
Jenkins et al. (2021)	4.11 (1.14) [c]	2.07
	4.16 (1.13) [d]	2.11
Wade et al. (2021)	3.92 (1.09) [e]	1.34
	4.04 (1.08) [f]	2.02
Longer CBT-ED		
Allen et al. (2012)	4.10 (0.22)	2.06
Byrne et al. (2011)	3.96 (1.28)	1.95
Garte et al. (2015)	3.89 (1.10)	1.90
La Mela et al. (2013)	3.21 (NR)	1.35
Signorini et al. (2018)	4.03 (1.30)	2.01
Turner et al. (2015)	4.17 (1.29)	2.12
Watson et al. (2012)	4.05 (1.19)	2.02
CBT-T		
Birtwell et al. (2021)	4.50 (0.80)	2.38
Moore, Hinde et al. (2021)	3.28 (1.15)	1.41
Moore, Turner et al. (2021)	4.09 (0.94)	2.06
Pellizzer et al. (2019a)	3.81 (1.08)	1.83
Pellizzer et al. (2019b)	4.42 (0.97)	2.32
Waller et al. (2018)	4.11 (1.20)	2.07
Tatham et al. (2020)	4.44 (1.56)	2.34
Wade et al. (2021)	3.92 (1.09)	1.34
Rose et al. (2021)	3.81 (1.13)	1.83
Russell (2020)	4.17 (0.98)	2.12

Notes. M = mean; *SD* = standard deviation; NR = not reported. The mean norm for women without an eating disorder = 1.52 (*SD* = 1.25; Mond et al., 2006).
[a] = CBT-ED focused form; [b] = CBT-ED broad form; [c] = face-to-face guided self-help; [d] = email guided self-help; [e] = CBT-T; [f] = CBTm.

Summary of Measures

A range of measures were used across the included studies. All 10 studies measured eating disorder psychopathology using the global score of the EDE-Q (Fairburn & Beglin, 2008). Clinical impairment was measured in five studies, all of which used the Clinical Impairment Assessment (CIA; Bohn et al., 2008). Depression was measured in seven studies. Four of these studies measured depression using the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) and three using the Depression, Anxiety, and Stress Scale short form (DASS21; Lovibond & Lovibond, 1995). Anxiety was measured in six studies; three used the Generalized Anxiety Disorder questionnaire (GAD-7; Spitzer et al., 2006) and three used the DASS-21. Weekly objective bingeing frequency was measured in eight studies. This was obtained from food diaries in five studies and from the Eating Disorder-15 (ED-15; Tatham et al., 2015) in three studies. Weekly vomiting frequency was measured in seven studies. This was obtained from food diaries in four studies and the ED-15 in three studies. Bingeing and vomiting frequencies were obtained from food diaries and the ED-15. For all studies, we defined non-completion as the percentage of participants who did not complete the 10 sessions of CBT-T unless an earlier finish was agreed upon as treatment had met its targets. Finally, for all studies, we calculated the percentage of completers who had a good outcome, that is, a post-treatment EDE-Q global score ≤ 2.77 (Mond et al., 2006).

Quality Assessment

The results from the quality assessment of studies included in the meta-analysis are provided in **Table 3.3**. The average quality rating was 5.9 out of 8, indicating high quality. Furthermore, interrater reliability for quality ratings was excellent (100% alignment). All 10 studies reported a description of the intervention with sufficient detail to allow replication and defined outcome measures including how and when they were assessed. Nine out of 10 studies reported eligibility criteria for participants, and the number of participants who

received treatment and were analysed for the primary outcome. Additionally, most studies

reported losses and exclusions with reasons and baseline demographic information and

clinical characteristics. In contrast, information regarding the settings and locations where

data were collected was somewhat vague, and only four studies reported how sample size

was determined.

Table 3.3

Results from the CONSORT Quality Assessment for the Studies Included in the Meta-

Analyses

Study	4a	4b	5	6a	7a	13a	13b	15	Score
Birtwell et al. (2021)	N	Y	Y	Y	N	Y	Y	P	5
Moore, Hinde et al. (2021)	**Y**	**P**	**Y**	**Y**	**Y**	**Y**	**P**	**Y**	**6**
Moore, Turner et al. (2021)	Y	P	Y	Y	N	Y	P	P	4
Pellizzer et al. (2019a)	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**8**
Pellizzer et al. (2019b)	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**7**
Rose et al. (2021)	Y	P	Y	Y	Y	P	P	Y	5
Russell (2020)	Y	P	Y	Y	N	Y	P	Y	5
Tatham et al. (2020)	Y	N	Y	Y	N	Y	Y	N	5
Wade et al. (2021)	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**8**
Waller et al. (2018)	**Y**	**P**	**Y**	**Y**	**N**	**Y**	**Y**	**Y**	**6**

Notes. Y = conforming to CONSORT, N = not conforming to CONSORT, and P = partially conforming to CONSORT. **Bolded** = a high-quality study that was included in the sensitivity analysis.

Meta-Analyses

Treatment Outcomes and Non-Completion

We found large to very large reductions in eating disorder symptoms and clinical impairment from pre- to post-CBT-T. We also found medium to large reductions in all secondary outcomes. While 39% of participants dropped out of CBT-T, 65% of completers had a good outcome. Significant heterogeneity was found for four outcomes (intent-to-treat and completer clinical impairment, completer anxiety, and good outcome). **Table 3.4** displays the results from the meta-analyses and **Tables 3.5** and **3.6** display the effect sizes for each individual study. **Figure 3.2** displays the forest plot for intent-to-treat eating disorder psychopathology from pre- to post-treatment, and **Figure 3.3** the forest plot for intent-to-treat clinical impairment from pre- to post-treatment.

Table 3.4

Results from the Meta-Analyses

Variable	*N* studies (*N* participants)	Pooled effect size Hedges' *g* (95% CI), *p*	Heterogeneity *Q, p, I²*	Publication bias Egger's regression intercept (95% CI), *p*
Intent to Treat				
Eating disorder psychopathology	8 (504)	-1.49 (-1.68 to -1.31), <.001	12.43, .09, 43.67	-1.82 (-5.30 to 1.66), .25
Clinical impairment	5 (219)	-1.22 (-1.58 to -0.86), <.001	14.22, .01, 71.87	-3.64 (-12.68 to 5.39), .29
Depression	6 (310)	-0.82 (-0.96 to -0.69), <.001	6.34, .28, 21.09	1.68 (-8.88 to 5.51), .55
Anxiety	5 (270)	-0.51 (-0.67 to -0.36), <.001	6.64, .16, 39.76	-4.63 (-6.91 to -2.36), .01
Completer				
Eating disorder psychopathology	10 (346)	-1.69 (-1.86 to -1.52), <.001	8.02, .53, 0.00	-1.80 (-2.89 to -0.71), .01
Clinical impairment	5 (129)	-1.38 (-2.03 to -0.72), <.001	25.08, <.001, 84.05	-4.45 (-15.20 to 6.31), .28
Depression	7 (228)	-0.94 (-1.14 to -0.75), <.001	10.92, .09, 45.06	-2.69 (-9.14 to 3.76), .33
Anxiety	6 (202)	-0.72 (-0.92 to -0.52), <.001	11.82, .04, 57.69	-2.46 (-9.24 to 4.32), .37
Objective bingeing: weekly frequency	8 (306)	-1.20 (-1.43 to -0.97), <.001	11.73, .11, 40.30	1.19 (-3.64 to 6.01), .57
Vomiting: weekly frequency	7 (265)	-0.78 (-0.95 to -0.60), <.001	5.96, .43, 0.00	0.77 (-3.09 to 4.63), .63
Binary Outcomes (%)				
Non-completion	10 (565)	39% (34 to 44), <.001	12.30, .20, 26.83	-0.31 (-3.54, 2.93), .83
Good outcome	10 (346)	65% (56 to 72), <.001	19.12, .02, 52.93	2.83 (0.32 to 5.34), .03

Table 3.5

Within Group Intent-to-Treat and Completer Effect Sizes for Continuous Variables

Variable	Intent-to-treat Hedges' *g* (95% CI)	Completer Hedges' *g* (95% CI)	Measure
Eating disorder psychopathology			
Birtwell et al. (2021)		-2.10 (-2.75, -1.44)	EDE-Q
Moore, Hinde et al. (2021)	-1.42 (-1.80, -1.04)	-1.61 (-2.07, -1.15)	EDE-Q
Moore, Turner et al. (2021)	-1.50 (-1.74, -1.26)	-1.60 (-1.94, -1.27)	EDE-Q
Pellizzer et al. (2019a)	-1.90 (-2.40, -1.41)	-2.25 (-2.97, -1.54)	EDE-Q
Pellizzer et al. (2019b)	-2.18 (-3.07, -1.29)	-2.27 (-3.58, -0.96)	EDE-Q
Waller et al. (2018)	-1.57 (-1.94, -1.20)	-1.55 (-1.96, -1.14)	EDE-Q
Tatham et al. (2020)	-1.26 (-1.55, -0.97)	-1.45 (-1.85, -1.04)	EDE-Q
Wade et al. (2021)	-1.69 (-2.13, -1.26)	-2.05 (-2.70, -1.41)	EDE-Q
Rose et al. (2021)	-1.04 (-1.48, -0.59)	-1.96 (-2.73, -1.19)	EDE-Q
Russell (2020)		-2.03 (-3.41, -0.64)	EDE-Q
Clinical impairment			
Pellizzer et al. (2019a)	-1.57 (-2.05, -1.10)	-1.89 (-2.59, -1.20)	CIA
Pellizzer et al. (2019b)	-2.01 (-2.85, -1.18)	-2.08 (-3.27, -0.89)	CIA
Tatham et al. (2020)	-0.87 (-1.24, -0.51)	-0.33 (-0.75, 0.09)	CIA
Wade et al. (2021)	-1.31 (-1.63, -0.99)	-1.58 (-2.03, -1.12)	CIA
Rose et al. (2021)	-0.78 (-1.14, -0.41)	-1.35 (-1.91, -0.80)	CIA
Depression			
Birtwell et al. (2021)		-1.00 (-1.41, -0.58)	PHQ-9
Moore, Hinde et al. (2021)	-0.82 (-1.07, -0.56)	-0.83 (-1.12, -0.54)	PHQ-9
Pellizzer et al. (2019a)	-0.88 (-1.32, -0.43)	-0.66 (-1.19, 0.13)	DASS-21
Pellizzer et al. (2019b)	-1.02 (-1.32, -0.73)	-0.92 (-1.31, -0.54)	DASS-21
Waller et al. (2018)	-1.00 (-1.31, -0.70)	-1.51 (-1.94, -1.08)	PHQ-9
Wade et al. (2021)	-0.69 (-0.92, -0.46)	-0.71 (-1.01, -0.41)	DASS-21
Rose et al. (2021)	-0.60 (-0.91, -0.29)	-1.08 (-1.52, -0.63)	PHQ-9
Anxiety			
Birtwell et al. (2021)		-0.72 (-0.97, -0.47)	GAD-7
Moore, Hinde et al. (2021)	-0.56 (-0.81, -0.30)	-0.60 (-0.89, -0.32)	GAD-7
Pellizzer et al. (2019a)	-0.36 (-0.55, 0.17)	-0.42 (-0.66, 0.17)	DASS-21
Pellizzer et al. (2019b)	-0.83 (-1.21, -0.44)	-0.89 (-1.43, -0.35)	DASS-21
Waller et al. (2018)	-0.40 (-0.63, -0.16)	-1.08 (-1.40, -0.77)	GAD-7
Wade et al. (2021)	-0.68 (-1.01, -0.34)	-0.75 (-1.19, -0.31)	DASS-21

Notes. EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; PHQ-9 = Patient Health Questionnaire; GAD-7 = Generalised Anxiety Disorder Questionnaire; DASS-21 = Depression, Anxiety, and Stress Scale-Short form.

Table 3.6

Effect Sizes for Count and Binary Variables

| Variable	Effect size (95% CI)	Measure
Weekly objective bingeing frequency		
Birtwell et al. (2021)	-0.82 (-1.39, -0.25)	ED-15
Moore, Hinde et al. (2021)	-1.80 (-2.31, -1.29)	Food diaries
Moore, Turner et al. (2021)	-1.13 (-1.47, -0.79)	Food diaries
Pellizzer et al. (2019a)	-1.33 (-1.87, -0.79)	Food diaries
Pellizzer et al. (2019b)	-0.93 (-1.71, -0.14)	Food diaries
Waller et al. (2018)	-1.41 (-1.80, -1.03)	Food diaries
Wade et al. (2021)	-0.75 (-1.30, -0.21)	ED-15
Rose et al. (2021)	-1.20 (-1.79, -0.62)	ED-15
Weekly vomiting frequency		
Birtwell et al. (2021)	-0.38 (-0.93, 0.18)	ED-15
Moore, Turner et al. (2021)	-0.83 (-1.16, -0.50)	Food diaries
Pellizzer et al. (2019a)	-0.74 (-1.24, -0.24)	Food diaries
Pellizzer et al. (2019b)	-0.63 (-1.40, 0.13)	Food diaries
Waller et al. (2018)	-0.85 (-1.21, -0.49)	Food diaries
Wade et al. (2021)	-0.55 (-1.09, -0.02)	ED-15
Rose et al. (2021)	-1.28 (-1.87, -0.69)	ED-15
Good outcome (%)		
Birtwell et al. (2021)	56.00 (36.60, 73.70)	Post-Tx EDE-Q <2.77
Moore, Hinde et al. (2021)	70.73 (55.20, 82.60)	Post-Tx EDE-Q <2.77
Moore, Turner et al. (2021)	47.44 (36.70, 58.50)	Post-Tx EDE-Q <2.77
Pellizzer et al. (2019a)	81.25 (64.10, 91.30)	Post-Tx EDE-Q <2.77
Pellizzer et al. (2019b)	76.92 (47.80, 92.40)	Post-Tx EDE-Q <2.77
Waller et al. (2018)	64.06 (51.70, 74.80)	Post-Tx EDE-Q <2.77
Tatham et al. (2020)	51.61 (34.50, 68.30)	Post-Tx EDE-Q <2.77
Wade et al. (2021)	62.96 (43.80, 78.80)	Post-Tx EDE-Q <2.77
Rose et al. (2021)	76.92 (57.20, 89.20)	Post-Tx EDE-Q <2.77
Russell (2020)	77.78 (42.10, 94.40)	Post-Tx EDE-Q <2.77
Non-completion (%)		
Birtwell et al. (2021)	44.44 (30.80, 59.00)	<10 CBT-T sessions
Moore, Hinde et al. (2021)	22.64 (13.30, 35.80)	<10 CBT-T sessions
Moore, Turner et al. (2021)	43.88 (35.90, 52.20)	<10 CBT-T sessions
Pellizzer et al. (2019a)	38.46 (26.30, 52.20)	<10 CBT-T sessions
Pellizzer et al. (2019b)	50.00 (31.70, 68.30)	<10 CBT-T sessions
Waller et al. (2018)	31.18 (22.60, 41.30)	<10 CBT-T sessions
Tatham et al. (2020)	43.64 (31.20, 56.90)	<10 CBT-T sessions
Wade et al. (2021)	41.30 (28.10, 55.90)	<10 CBT-T sessions
Rose et al. (2021)	35.00 (21.90, 50.80)	<10 CBT-T sessions
Russell (2020)	43.75 (22.50, 67.60)	<10 CBT-T sessions

Notes. For count variables (weekly objective bingeing and vomiting frequencies), effect sizes are presented as Hedges' *g* for completers. For binary variables (good outcome and non-completion), effect sizes are presented as percentages. ED-15 = Eating Disorder-15; Tx = treatment; EDE-Q = Eating Disorder Examination-Questionnaire.

Figure 3.2

Forest Plot Showing the Within Groups Intent-to-Treat Effect Sizes for Global Eating

Disorder Psychopathology from Pre- to Post-Treatment
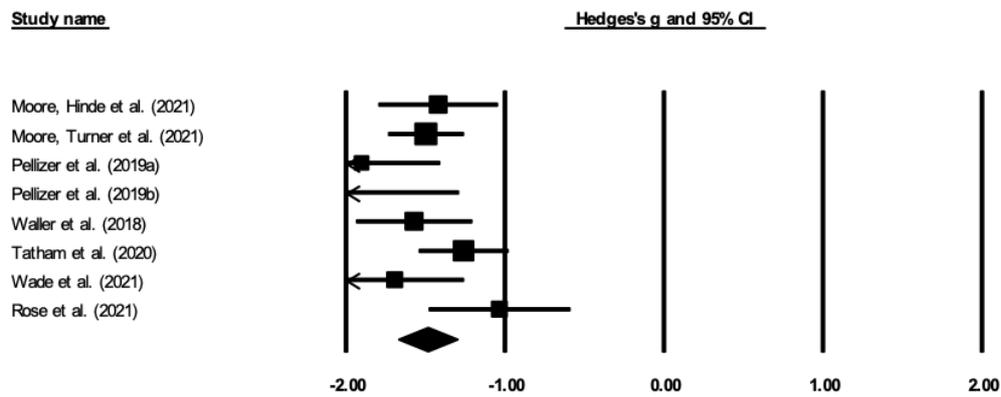
Figure 3.3

Forest Plot Showing the Within Group Intent-to-Treat Effect Sizes for Clinical Impairment

from Pre- to Post-Treatment
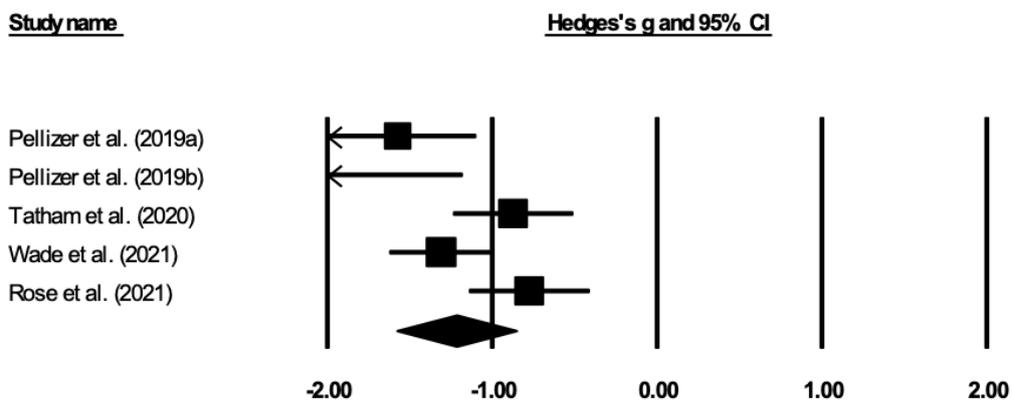
Follow-Up

For the main outcome variable, eating disorder psychopathology, we conducted a random effect intent-to-treat meta-analysis including the six studies (325 participants) that had follow-up data. Final follow-up points were selected, resulting in the inclusion of five 3-month follow-ups and one 6-month follow-up. The pooled effect size was very large and significant (Hedges' g = -1.58, 95% CI: -1.82 to -1.34, $p < .001$) showing that eating disorder psychopathology decreased substantially from pre-treatment to follow-up (see **Figure 4**). There was evidence of heterogeneity (Q (5) = 13.37, p = .02; I^2 = 62.60) but publication bias was not indicated by Egger's regression intercept (-4.26, 95% CI: -11.78 to 3.27, p = .19). The effect sizes for each individual study are provided in **Table 7**.

Figure 3.4

Forest Plot Showing the Within Groups Intent-to-Treat Effect Sizes for Eating Disorder Psychopathology from Pre-Treatment to Follow-up
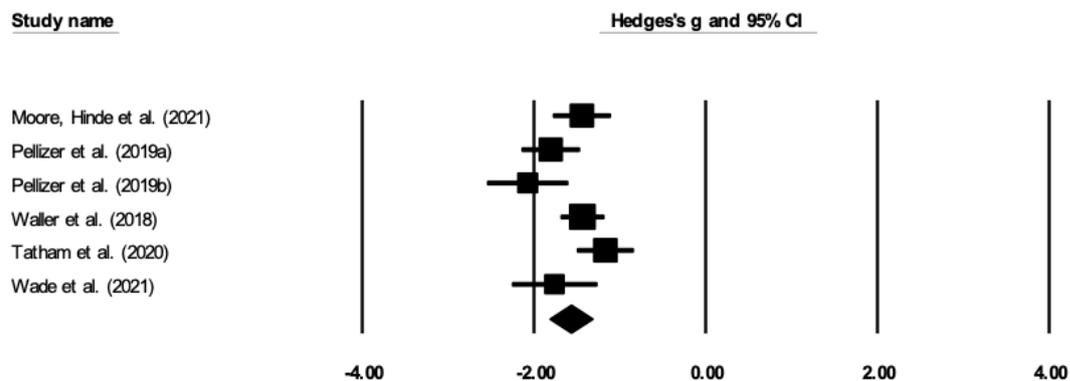
Table 3.7

Within Group Intent-to-Treat Effect Sizes for Eating Disorder Psychopathology from Pre-

Treatment to Follow-up

Study	Hedges' g (95% CI)	Follow-up period
Moore, Hinde et al. (2021)	-1.44 (-1.79 to -1.10)	3 months
Pellizzer et al. (2019a)	-1.80 (-2.15 to -1.46)	3 months
Pellizzer et al. (2019b)	-2.07 (-2.55 to -1.59)	3 months
Waller et al. (2018)	-1.44 (-1.70 to -1.17)	3 months
Tatham et al. (2020)	-1.17 (-1.50 to -0.83)	6 months
Wade et al. (2021)	-1.76 (-2.26 to -1.26)	3 months

Notes. CI = confidence interval.

Sensitivity Analysis

A sensitivity analysis was conducted for the main outcome variable, eating disorder psychopathology, using an intent-to-treat random effect meta-analysis that included only the high-quality studies (i.e., those with a quality rating of six or more). Five studies (270 participants) were included in the sensitivity analysis, all of which were published. The pooled effect size was very large (Hedges' g = -1.64, 95% CI: -1.84 to -1.44, p <.001) and comparable to the pooled effect size obtained for all studies. Thus, our results do not appear to be influenced by the quality of studies included in the meta-analyses.

Discussion

The present study provided a formative evaluation of CBT-T, a short intensive form of CBT-ED. Our study, therefore, addresses the NICE (2017) research recommendation of evaluating shorter treatments for people with eating disorders. Overall, our results provide preliminary evidence to suggest that CBT-T is a promising treatment for people with non-underweight eating disorders, and that most of these individuals can have a good outcome in half the time currently recommended in treatment guidelines, supporting the use of shorter treatment as a strategy to shorten waitlists.

Treatment Outcomes

Despite most studies included in our meta-analysis assessing effectiveness in real-world settings, which tend to be less controlled and have smaller effect sizes than RCTs (e.g., Byrne et al., 2011; vs. Fairburn et al., 2015), we observed significant medium to very large effects (completer and intent-to-treat) for all treatment outcome variables. Eating disorder psychopathology significantly decreased from pre- to post-CBT-T, with very large effect sizes observed across all the studies included in the meta-analysis. Furthermore, for all the studies, both intent-to-treat and completer means for global eating disorder psychopathology were below the cut-off of one standard deviation above the norm for women without an eating disorder (2.77; Mond et al., 2006) following treatment. The effect of CBT-T also appears to last after treatment has ended, with global eating disorder psychopathology remaining below the cut-off at follow-up (3- to 6-months post-treatment), and very large reductions in eating disorder psychopathology observed from pre-treatment to follow-up. Additionally, pre-treatment severity was very similar among participants in our meta-analysis compared to participants in studies of longer CBT-ED including RCTs (e.g., Allen et al., 2012; Byrne et al., 2011; de Jong et al., 2020; Fairburn et al., 2009; Garte et al., 2015; La Mela et al., 2013; Signorini et al., 2018; Turner et al., 2015; Watson et al., 2012). In summary, the present study suggests that CBT-T is an effective treatment for many clients with non-underweight eating disorders regardless of pre-treatment severity.

Non-completion

Our study also suggests that shorter treatment for non-underweight eating disorders produces comparable non-completion rates to those reported for both RCTs and uncontrolled trials of longer CBT-ED (for a systematic review, see Atwood & Friedman, 2020). However, a direct head-to-head comparison is required before firm conclusions can be drawn given the wide variety of definitions of dropout used in studies of CBT for eating disorders (Linardon,

Hindle et al., 2018). As discussed in **Chapter 2** of this thesis, the overall non-completion rate in CBT-T comprises two groups – those who are collaboratively discharged, and those who prematurely discharge without collaborative agreement with their therapist. Despite this, our non-completion rate was within the range of those reported for studies of longer CBT-ED that do not use this approach.

Limitations

Despite the strong preliminary evidence for the use of CBT-T as an alternative, shorter treatment for people with eating disorders, our findings should be interpreted as preliminary given a variety of limitations. First, the relatively small number of studies and participants in each sample did not allow us to undertake subgroup analyses. Second, the longest follow-up period in the studies included in this meta-analysis was six months. Thus, longer-term follow-up is required to allow comparison with longer forms of CBT-ED. Third, all the studies included in this meta-analysis were conducted in Australia and the United Kingdom. Additionally, 60% of the studies were conducted by the developers of CBT-T. Fourth, we are unable to rule out the possibility that the change observed was confounded by competing explanations for change, such as spontaneous recovery (Cuijpers et al., 2017). However, we note that while migration between eating disorder diagnoses is common (Milos et al., 2005), spontaneous recovery over waitlist conditions has not been evident (Fairburn et al., 2009; Steele & Wade, 2008). Fifth, significant heterogeneity was found in five meta-analyses (intent-to-treat and completer clinical impairment, completer anxiety, good outcome, and eating disorder psychopathology from pre-treatment to follow-up). These results should, therefore, be interpreted with some caution. Finally, most participants were diagnosed with BED or BN meaning we have limited information regarding the effectiveness of CBT-T for people with other non-underweight eating disorders such as AAN.

Conclusions

The present study has important clinical implications for the treatment of people with non-underweight eating disorders and future research programs. While preliminary, the findings suggest that CBT-T is a promising treatment for people with non-underweight eating disorders, and that these individuals can have lasting and clinically significant reductions in symptoms in half the time currently recommended by NICE (2017), regardless of pre-treatment severity. The present study therefore supports the use of shorter treatment as a cost-effective strategy to shorten waitlists by enabling more people to be seen more quickly. Our results strongly support the suggestion that a vigorous research program, including direct randomized comparisons between CBT-T and longer forms of CBT-ED, should be conducted to determine whether this shorter treatment for non-underweight eating disorders can be justifiably recommended in treatment guidelines. Given the different approaches to managing early progress between the shorter and longer therapies, a comparison of intent-to-treat outcomes will be most meaningful.

Chapter 4

A Systematic Review and Meta-Analysis of Central Coherence and Set Shifting Among

Non-Underweight Eating Disorders and Anorexia Nervosa[3]

Abstract

People with eating disorders have been shown to have inefficiencies in two key areas of executive functioning: central coherence and set shifting. This systematic review and meta-analysis compared these previously documented inefficiencies between people with non-underweight eating disorders (i.e., BN and BED) and people with AN. Random-effects meta-analyses were performed on 16 studies (total sample size of 1112 participants) for central coherence and 38 studies (total sample size of 3505 participants) for set shifting. Random effects meta-regressions were used to test whether the effect sizes for people with non-underweight eating disorders were significantly different from the effect sizes for people with AN. People with AN (Hedges' $g = -0.53$, 95% CI: -0.80 to -0.27, $p < .001$) and BN (Hedges' $g = -0.70$, 95% CI: -1.14 to -0.25, $p = .002$), but not BED, had significantly poorer central coherence than healthy controls. Similarly, people with AN (Hedges' $g = -0.38$, 95% CI: -0.50 to -0.26, $p < .001$) and BN (Hedges' $g = -0.55$, 95% CI: -0.81 to -0.29, $p < .001$), but not BED, had significantly poorer set shifting than healthy controls. However, overall, the effect sizes for people with non-underweight eating disorders did not significantly differ from those for people with AN. Clinically, this suggests that people with non-underweight eating disorders might benefit from CRT.

Introduction

This chapter relates to the second specific PhD aim: managing the impact of lengthy waitlists on dropout from subsequent treatment. One potential strategy to manage the impact of lengthy waitlists is to provide intervention while people are waitlisted for treatment. It is likely that any waitlist intervention that is effective will be one that has wide-reaching impact for the individual in terms of broad learning or generalisable skills. Thus, one potential target for a waitlist intervention is executive functioning, specifically central coherence and set shifting. CRT is an adjunct treatment for people with AN that targets these areas of executive functioning and has been shown to improve retention in treatment. This chapter sought to determine whether the executive functioning of people with non-underweight eating disorders is comparable to that of people with AN, to determine whether people with non-underweight eating disorders may also benefit from CRT.

People with eating disorders have been shown to have inefficiencies in two key areas of executive functioning: central coherence and set shifting (Lang, Lopez et al., 2014; Wu et al., 2014). While several authors have previously summarized the literature on central coherence and set shifting in people with eating disorders, these authors either: (1) only looked at central coherence across eating disorder diagnoses (Lang, Lopez et al., 2014; Lopez, Tchanturia et al., 2008); (2) only looked at set shifting across eating disorder diagnoses (Roberts et al., 2007; Wu et al., 2014); (3) only looked at executive functioning among people with AN (Saure et al., 2020); (4) did not use a meta-analytic approach (Idini et al., 2012; Kanakam & Treasure, 2013; Smith et al., 2018; van Elburg & Treasure, 2013); (5) were not published in English (Solano-Pinto et al., 2018); or (6) a combination of the above (Christensen et al., 2019; Cury et al., 2020; Fuglset, 2019; Jáuregui-Lobera, 2014; Lang, Stahl et al., 2014; Lang et al., 2016; Miles et al., 2020; Reville et al., 2016; Stedal et al., 2012; Van Autreve & Vervaet, 2015; Van den Eynde et al., 2011; Voon, 2015; Westwood et

al., 2016). Therefore, to date, no study has looked at both central coherence and set shifting across the range of eating disorder diagnoses.

The present study updated and refined the two most recent and comprehensive meta-analyses examining executive functioning in people with eating disorders (Lang, Lopez, et al., 2014 and Wu et al., 2014, described in **Chapter 2**). To do so, we conducted a systematic review and meta-analysis to: (1) examine central coherence and set shifting performance in people with eating disorders compared to healthy controls; and (2) test whether the performance of people with non-underweight eating disorders (BN and BED) is comparable to that of people with AN. Our study, expanded on Lang, Lopez, and colleagues (2014) by testing whether central coherence differs between people with non-underweight eating disorders and people with AN, and to the best of our knowledge is the first to examine both central coherence and set shifting across the range of eating disorder diagnoses.

Method

Search Strategy

The present study was conducted and reported in line with the PRISMA statement (Moher et al., 2009). The primary search strategy involved searching for relevant published papers within three electronic databases: PsychINFO, Scopus, and Medline. The following terms were searched for in the title and abstract of papers: ("eating disorder*" OR bulimi* OR anorexi* OR ednos OR "eating disorder not otherwise specified" OR OSFED OR "Other Specified Feeding and Eating Disorder" OR binge OR binges OR binging OR "binge eating disorder") AND ("set shifting" OR flexib* OR rigid* OR perseveration) OR ("central coherence" OR "local processing" OR "global processing"). To add to the papers already identified in Lang, Lopez, and colleagues (2014) and Wu and colleagues (2014), The PhD Candidate searched for published papers on set shifting from November 2013 onward and papers on central coherence from January 2014 onward. The final database search was

conducted on the 14th of July 2020. The secondary search strategy involved identifying published papers from the reference lists and forward citation searches of relevant papers and recent reviews that were identified in the primary search. Grey literature was also obtained by searching ProQuest Dissertations and Theses Global (using the same search terms) and contacting researchers in the field for unpublished data and manuscripts.

Inclusion Criteria

Papers had to meet the following criteria for inclusion: (1) published in English; (2) used a neuropsychological measure of central coherence and/or set shifting; (3) compared participants with an eating disorder diagnosis to a healthy control comparison group; and (4) majority of participants aged above 16 years or mean age in the adult range. To reduce heterogeneity and refine the previous meta-analyses, we excluded papers from Lang, Lopez, and colleagues (2014) and Wu and colleagues (2014) that did not meet the above criteria, for example, included child, adolescent, or recovered participants.

Summary of Measures

Across all the papers that met our inclusion criteria, four measures of central coherence and three measures of set shifting were reported. For central coherence, the measures were the RCFT, Object Assembly, the Group Embedded Figures Test, and the Embedded Figures Test. For set shifting, the measures were the WCST, Trail Making Test, and Verbal Fluency Test. To reduce heterogeneity and ensure comparability, we included papers that used the most commonly reported measure of central coherence (the RCFT) and set shifting (the WCST), and used these measures when papers included more than one measure of central coherence and/or set shifting.

Data Extraction Process

The PhD Candidate extracted the information required for the qualitative synthesis and to calculate effect sizes for the meta-analyses from all eligible papers, and a PhD

candidate-level screener independently extracted this information from 10 randomly selected papers. The information extracted by the two screeners aligned 100%. To calculate effect sizes as Cohen's *d*, the sample sizes, means, and standard deviations (or standard errors when standard deviations were not reported) were extracted for the eating disorder and healthy control groups. When papers did not report this information, the PhD Candidate requested it from the corresponding authors of those papers. This information was provided in 85% of cases. Demographic information such as the age, sex, and race of participants was also extracted from each paper.

Calculation of Effect Sizes

We calculated effect sizes as Cohen's *d* using the online Campbell Calculator (https://campbellcollaboration.org/escalc/html/EffectSizeCalculator). When papers/unpublished data sets included more than one eating disorder group compared to the same healthy control group, we calculated a separate effect size for each eating disorder group and treated them as separate studies (shown in tables as (1), (2), etc.). To calculate these effect sizes, we followed the Cochrane Collaboration's recommendations and used the mean and standard deviation from the healthy control group but divided the sample size by the number of eating disorder groups to avoid double counting the healthy controls. When healthy control group samples could not be divided equally, we took the conservative approach and rounded down. When studies reported the standard error instead of the standard deviation, the standard deviation was calculated by multiplying the standard error by the square root of the sample size. We used Cohen's (1992) benchmarks to interpret effect sizes as small (0.20), medium (0.50), or large (0.80). Negative effect sizes indicated poorer central coherence/set-shifting in the eating disorder group compared to the healthy control comparison group.

Meta-Analyses

Comprehensive Meta-Analysis Software Version 3.3 (CMA; Borenstein et al., 2009) was used to perform all the analyses. To correct for biases due to small samples in the primary studies, we presented our results as Hedges' g which was converted from Cohen's d in CMA. We performed two random-effects meta-analyses to obtain the overall effect sizes for people with eating disorders compared to healthy controls for both central coherence and set shifting. Given the small number of studies examining BED we conducted mixed-effects subgroup analyses, rather than direct comparisons of diagnostic groups, to obtain the effect sizes for each eating disorder diagnosis compared to healthy controls for both central coherence and set shifting. To test whether the effect sizes for people with non-underweight eating disorders were significantly different from the effect sizes for people with AN, we conducted moderator analyses using random effects meta-regressions with AN as the reference category. For set shifting, we also tested whether the effect sizes for ANR and ANBP significantly differed using a random-effects meta-regression. It was not possible to test this for central coherence as no studies differentiated between AN subtypes.

Heterogeneity

We evaluated heterogeneity using the Q and I^2 statistics. A significant Q-test provides evidence of heterogeneity, and the I^2 statistic indicates the percentage of total variance between studies that is due to heterogeneity as opposed to sampling error (Higgins et al., 2003). I^2 can range from 0% (*no heterogeneity*) to 100% (*high heterogeneity*). Percentages of 25, 50, and 75 indicate low, moderate, and high levels of heterogeneity, respectively (Higgins et al., 2003).

Following Cuijpers' (2016) recommendations, we examined the sources of heterogeneity by performing subgroup analyses. Subgroup analyses divide the total number of studies into two or more sub-groups and calculate the Q and I^2 statistic for each subgroup.

The subgroups chosen were eating disorder diagnosis (AN, BN, and BED) and WCST type (manual and electronic). Eating disorder diagnosis was chosen to examine potential differences in central coherence and/or set shifting performance between diagnostic groups. WCST type was chosen as there is evidence that the computerized versions are not equivalent to the manual pen and paper version (e.g., Filippetti et al., 2020; Feldstein et al., 1999; Steinmetz et al., 2010).

Publication Bias

We assessed publication bias using Egger's regression intercept (Moreno et al., 2009). When publication bias is present, there is often an absence of small studies with small effects (Sterne & Egger, 2001). Egger's regression intercept determines whether study effect size and study precision (i.e., sample size/variability) are significantly related, by assessing the relationship between the effect sizes and the standard error of the effect sizes (Laird et al., 2017). Publication bias is indicated by a significant regression intercept (Laird et al., 2017).

Quality Assessment

The PhD Candidate assessed the quality of all papers where the calculation of Cohen's *d* was possible using five items from the Transparent Reporting of a Multivariable Prediction Model for Individual Prognosis or Diagnosis (TRIPOD) Statement (Moons et al., 2015). While the TRIPOD Statement is a 22-item checklist that covers items deemed essential for adequately reporting cross-sectional studies, five items that were relevant to all the studies included in our meta-analyses were selected. These items assessed the description of the eligibility criteria (Item 5b); definition of the outcome/s (Item 6a); explanation of how the sample size was arrived at (Item 8); description of how missing data were handled (Item 9); and reporting the number of participants and outcome events in the analysis/analyses of interest (Item 14a). If all 22 items had been included, the quality ratings would have been substantially poorer. However, this would not have been informative as it would be reflecting

ratings for items that did not apply to the primary studies. For each paper included in the meta-analysis, the PhD Candidate scored each item "Y" when conforming to TRIPOD or "N" when not conforming to TRIPOD. For the sensitivity analyses, low quality was defined as papers that did not conform to TRIPOD on three or more items.

Results

Study Selection

Initially, 2651 published papers were identified through database searching. An additional 106 published papers were identified from previous reviews, reference lists, and forward citation searches. In terms of grey literature, 45 dissertations were identified by searching ProQuest Dissertations and Theses Global, and two datasets were identified by contacting researchers in the field for unpublished data. These two datasets were included as they met full criteria. The remaining published papers and theses were imported into Covidence systematic review management software. After removing duplicates, 1170 papers and theses remained. The PhD Candidate and a PhD candidate–level screener independently assessed all titles and abstracts against the inclusion criteria to determine whether they broadly related to the research question, excluding 1053. Next, the full texts of 117 potentially relevant papers and theses were retrieved and read independently to determine whether they met the full inclusion criteria. Seventy-four were excluded due to the various reasons outlined in **Figure 4.1** (e.g., no healthy control comparison group or sampling overlap). The agreement rate between the PhD Candidate and PhD-level screener was 97% for title and abstract screening and 95% for full text. Throughout this process, discrepancies were discussed until a consensus was reached. The remaining 43 papers and theses were then added to the two datasets. **Figure 4.1** presents a flow diagram of the study selection process.

Figure 4.1

PRISMA Flow Diagram
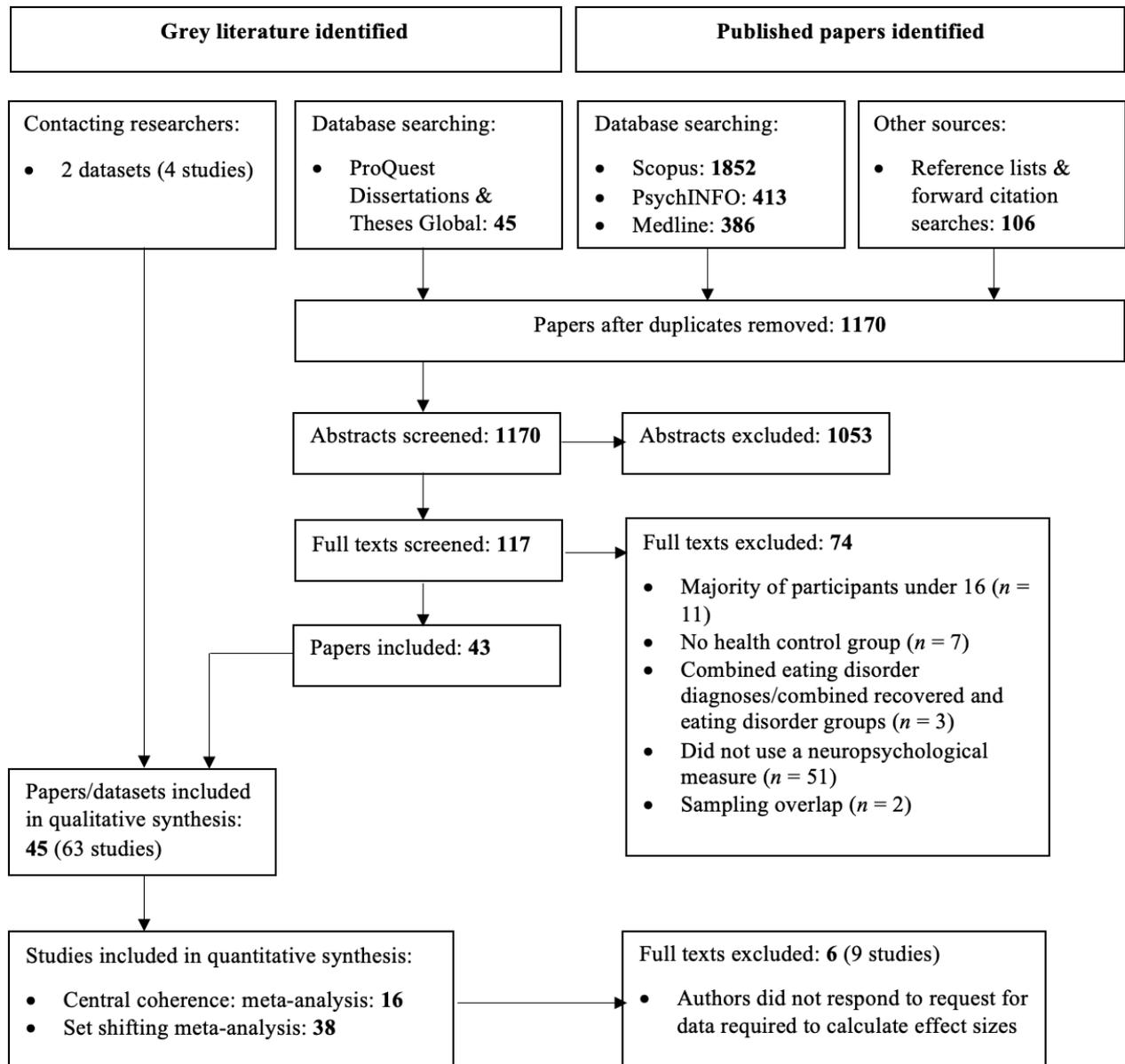
The Qualitative Synthesis

In total, 45 papers/data sets, comprising 63 studies, were examined. Of these studies, 57 (90.48%) were derived from published papers and six (9.52%) from grey literature. We were unable to calculate Cohen's *d* for nine studies (shown in **Table 4.1**) as the authors did not respond to our request for data. Seven of these studies looked at central coherence with four showing that people with eating disorders had significantly poorer central coherence than healthy controls [Hamatani et al., 2018; Roberts et al., 2013 (1), (2); Weider et al., 2016 (1)]. The remaining two studies examined set shifting and showed that people with eating disorders had significantly poorer set shifting than healthy controls [Roberts et al., 2010 (1), (2)].

Table 4.1

Summary of the 9 Studies Where Calculation of Cohen's d was not Possible

Study	Diagnosis (*n*)	Demographic information	Measure
Hamatani et al., 2018	AN (22) HC (33)	Median[age]: AN 32 (QD = 8), HC 28 (QD = 9); female; race: Asian; ethnicity & SES: NR	RCFT
Heled et al., 2014	AN (30) HC (44)	18 to 35 years; female; race, ethnicity, & SES: NR	RCFT
Roberts et al., 2010 (1)	ANR (35) ANBP (33) HC (44)	Aged 16 to 60 years; female; race: White; ethnicity & SES: NR	WCST
Roberts et al., 2010 (2)	BN (30) HC (44)	Aged 16 to 60 years; female; race: White; ethnicity & SES: NR	WCST
Roberts et al., 2013 (1)	ANR (35) ANBP (33) HC (44)	Aged 16 to 60 years; female; race: White; ethnicity & SES: NR	RCFT
Roberts et al., 2013 (2)	BN (30) HC (44)	Aged 16 to 60 years; female; race: White; ethnicity & SES: NR	RCFT
Talbot et al., 2015	AN (24) HC (43)	16 years or over; 97% female; race, ethnicity, & SES: NR	RCFT
Weider et al., 2016 (1)	AN (41) HC (20)	M[age]: AN 28.24 (10.65), HC 28 (10); 95% female; race, ethnicity, & SES: NR	RCFT
Weider et al., 2016 (2)	BN (40) HC (20)	M[age]: BN 28 (9), HC 28 (10); 95% female; race, ethnicity, & SES: NR	RCFT

Notes. AN = anorexia nervosa; BN = bulimia nervosa; ANR = anorexia nervosa restricting subtype; ANBP = anorexia nervosa binge-eating/purging subtype; HC = healthy controls; SES = socio-economic status; NR = not reported; RCFT = Rey Complex Figure Test; WCST = Wisconsin Card Sorting Test.

Studies Included in the Meta-Analyses

The central coherence meta-analysis included 16 studies with a total sample size of 1112 participants (shown in **Table 4.2**). Of these studies, nine (56.25%) were not included in the Lang, Lopez, and colleagues (2014) meta-analysis, and seven (43.75%) showed that people with eating disorders had poorer central coherence than healthy controls as the 95% confidence intervals did not cross zero. The set shifting meta-analysis included 38 studies with a total sample size of 3505 participants (shown in **Table 4.3**). Of these studies, 21 (55.26%) were not included in the Wu and colleagues (2014) meta-analysis, and 13 (39.23%) showed that people with eating disorders had poorer set shifting than healthy controls as the 95% confidence intervals did not cross zero.

The Central Coherence Meta-Analysis

Overall Pooled Effect Size

The meta-analysis included the 16 studies shown in **Table 4.2** and **Figure 4.2**. The pooled overall effect size was moderate and significant (Hedges' g = -0.50, 95% CI: -0.69 to -0.31, p < .001). It showed that people with eating disorders had significantly poorer central coherence than healthy controls. There was evidence of moderate-to-high heterogeneity across all the studies included in the meta-analysis (Q (15) = 34.20, p = .003; I^2 = 56.14). To explore the sources of this heterogeneity, we performed a subgroup analysis and calculated Q and I^2 separately for each eating disorder diagnosis. This revealed that there continued to be evidence of moderate-to-high heterogeneity among the studies of AN (Q (8) = 17.34; p = .03, I^2 = 53.78) and BN (Q (3) 8.82; p = .03, I^2 = 65.97) but no evidence of heterogeneity among the studies of BED (Q (2) = 0.56, p = .76; I^2 = 0.00).

Table 4.2

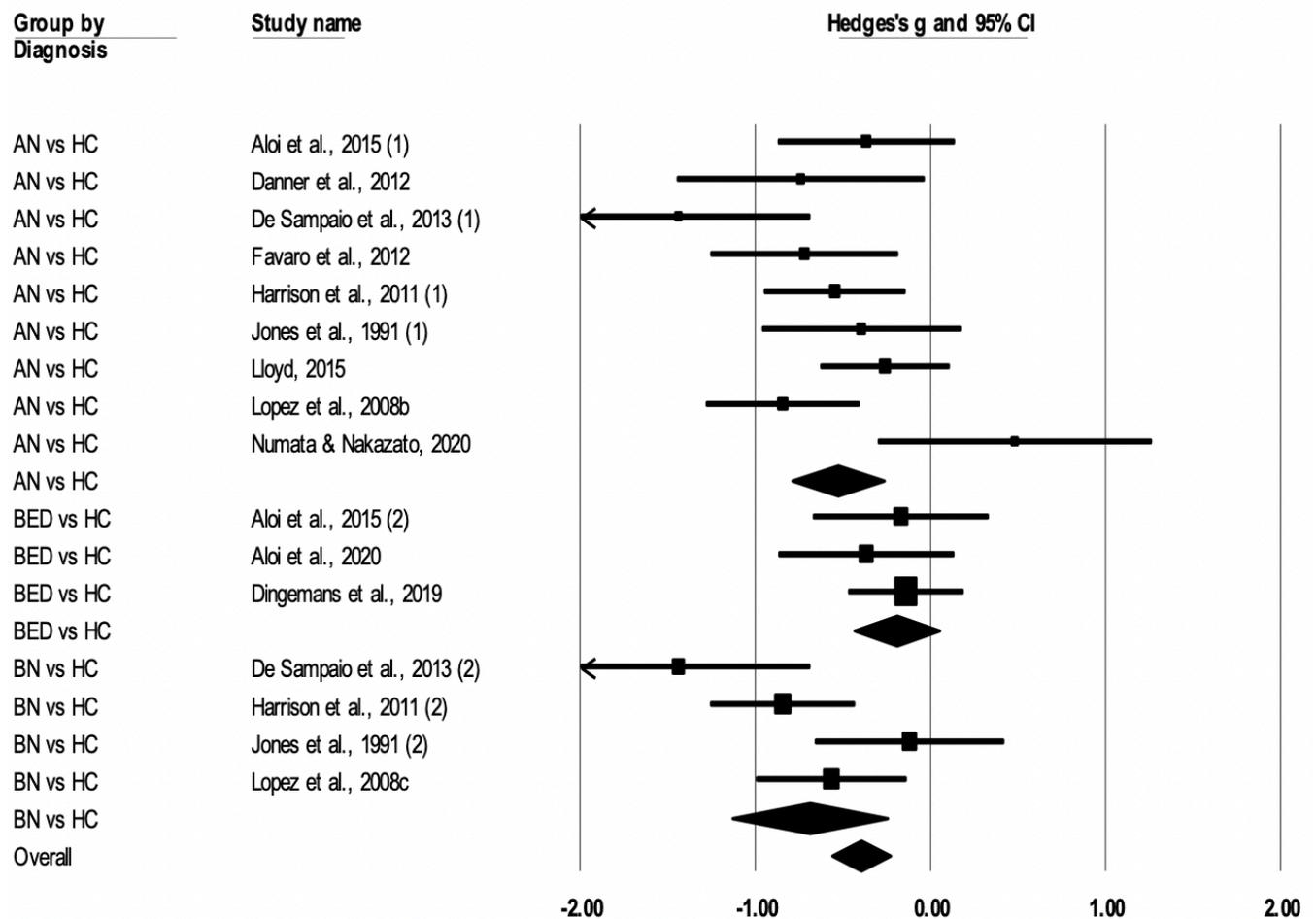*Summary of the 16 Studies Included in the Central Coherence Meta-Analysis*

Study	Diagnosis (*n*)	Demographic information	Cohen's *d* (95% CI)
Aloi et al., 2015 (1) *	AN (45) HC (22)	M^{age}: AN 23 (6), HC 26 (4); female; race: White; ethnicity & SES: NR	-.37 (-.89, .14)
Aloi et al., 2015 (2) *	BED (45) HC (22)	M^{age}: BED 31 (11), HC 26 (4); female; race: White; ethnicity & SES: NR	-.17 (-.68, .34)
Aloi et al., 2020*	BED (35) HC (26)	18 to 65 years; males & females; race: White; ethnicity & SES: NR	-.37 (-.88, .14)
Danner et al., 2012	AN (16) HC (15)	M^{age}: AN 26 (5), HC: 26 (5); female; race, ethnicity, & SES: NR	-.76 (-1.49, -.03)
De Sampaio et al., 2013 (1)	AN (24) HC (12)	M^{age}: AN 25 (8), HC: 25 (7); female; race, ethnicity, & SES: NR	-1.47 (-2.24, -.70)
De Sampaio et al., 2013 (2)	BN (24) HC (12)	M^{age}: BN: 24 (6), HC: 25 (7); female; race, ethnicity, & SES: NR	-1.47 (-2.24, -.70)
Dingemans et al., 2019 *	BED (90) HC (56)	M^{age}: BED 33 (9), HC 37 (12); sex: BED 88% female, HC 88% female; race, ethnicity, & SES: NR	-.14 (-.47, .20)
Favaro et al., 2012 *	AN (29) HC (26)	M^{age}: AN 26 (7), HC 27 (7); female; race, ethnicity, & SES: NR	-.73 (-1.28, .19)
Harrison et al., 2011 (1)	AN (50) HC (45)	16 to 55 years; female; race, ethnicity, & SES: NR	-.55 (-.96, -.14)
Harrison et al., 2011 (2)	BN (50) HC (45)	16 to 55 years; female; race, ethnicity, & SES: NR	-.85 (-1.28, -.43)
Jones et al., 1991 (1) *	AN (30) HC (19)	M^{age}: AN 24 (5), HC 25 (4); female; race: White; SES: largely middle-to-upper-middle class; ethnicity: NR	-.40 (-.98, .18)

Jones et al., 1991 (2) *	BN (38) HC (19)	M^{age}: BN 24 (4), HC 25 (4); female; race: White; SES: largely middle-to-upper-middle class; ethnicity: NR	-.12 (-.67, .43)
Lloyd, 2015 *	AN (41) vs HC (84)	Unpublished PhD thesis	-.26 (-.64, .11)
Lopez, Tchanturia, Stahl, Booth et al., 2008	AN (42) HC (42)	M^{age}: AN 28 (10), HC 26 (6); female; race, ethnicity, & SES: NR	-.85 (-1.30, -.40)
Lopez, Tchanturia, Stahl, & Treasure, 2008	BN (42) HC (42)	M^{age}: BN: 27 (7), HC: 26 (6); female; race, ethnicity, & SES: NR	-.57 (-1.00, -.13)
Numata & Nakazato, 2020 *	AN (12) HC (12)	Unpublished raw data	.50 (-.31, 1.31)

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder; HC = healthy control; SES = socio-economic status; NR = not reported; a negative Cohen's *d* indicates that the eating disorder group performed worse than the healthy control group. * Indicates that the study was not included in the Lang, Lopez et al. (2014) central coherence meta-analysis.

Figure 4.2

Forest Plot of the Comparison of Central Coherence Between People with Eating Disorders

and Healthy Controls for Each Study Shown in Table 4.2

Group by Diagnosis	Study name	Hedges's g and 95% CI
AN vs HC	Aloi et al., 2015 (1)	
AN vs HC	Danner et al., 2012	
AN vs HC	De Sampaio et al., 2013 (1)	
AN vs HC	Favaro et al., 2012	
AN vs HC	Harrison et al., 2011 (1)	
AN vs HC	Jones et al., 1991 (1)	
AN vs HC	Lloyd, 2015	
AN vs HC	Lopez et al., 2008b	
AN vs HC	Numata & Nakazato, 2020	
AN vs HC		
BED vs HC	Aloi et al., 2015 (2)	
BED vs HC	Aloi et al., 2020	
BED vs HC	Dingemans et al., 2019	
BED vs HC		
BN vs HC	De Sampaio et al., 2013 (2)	
BN vs HC	Harrison et al., 2011 (2)	
BN vs HC	Jones et al., 1991 (2)	
BN vs HC	Lopez et al., 2008c	
BN vs HC		
Overall		

Moderator Analysis

A subgroup analysis for eating disorder diagnosis revealed that central coherence did not significantly differ between people with BED and healthy controls ($n = 3$; Hedges' $g = -0.20$, 95% CI: -0.44 to 0.05, $p = .11$). However, when compared to healthy controls, people with AN ($n = 9$; Hedges' $g = -0.53$, 95% CI: -0.80 to -0.27, $p < .001$) and BN ($n = 4$; Hedges' $g = -0.70$, 95% CI: -1.14 to -0.25, $p = .002$) had significantly poorer central coherence performance. A meta-regression revealed that the effect sizes did not significantly differ

between people with non-underweight eating disorders and people with AN (Q (2) = 3.05, p = .22).

Publication Bias

Publication bias was not indicated by Egger's regression intercept (-1.75, 95% CI: -5.08 to 1.57, p = .28).

The Set-Shifting Meta-Analysis

Overall Pooled Effect Size

The meta-analysis included the 38 studies shown in **Table 4.3** and **Figure 4.3**. The pooled overall effect size was small-to-moderate and significant (Hedges' g = -0.39, 95% CI: -0.50 to -0.29, p < .001). It showed that people with eating disorders had significantly poorer set shifting than healthy controls. There was evidence of moderate heterogeneity across all the studies included in the meta-analysis (Q (37) = 78.21, p < .001; I^2 = 52.69). To explore the sources of this heterogeneity, we performed subgroup analyses and calculated Q and I^2 separately for each eating disorder diagnosis and WCST type. This revealed that there continued to be evidence of moderate-to-high heterogeneity across the studies of AN (Q (27) = 52.70; p = .002, I^2 = 48.77) and BN (Q (6) = 15.35, p = .02, I^2 = 60.91) but no evidence of heterogeneity across the studies of BED (Q (2) = 1.33, p = .52; I^2 = 0.00). There was also evidence of moderate-to-high heterogeneity across the studies using the computerized version of the WCST (Q (20) = 61.14, p < .001; I^2 = 67.29) but no evidence of heterogeneity across the studies using the manual WCST (Q (16) = 15.51, p = .49; I^2 = 0.00).

Table 4.3

Summary of the 38 Studies Included in the Set Shifting Meta-Analysis

| Study	Diagnosis (*n*)	Demographic information	Cohen's *d* (95% CI)	WCST Type
Abbate-Daga et al., 2011	AN (30) HC (30)	M^{age}: AN 24 (6), HC 25 (3); female; race: White; ethnicity & SES: NR	-.64 (-1.16, -.12)	Manual
Abbate-Daga et al., 2014 *	AN (94) HCs (59)	M^{age}: AN 25 (7), HC 25 (3); female; race: White; ethnicity & SES: NR	-.33 (-.66, -.01)	Manual
Aloi et al., 2015 (1) *	AN (45) HC (22)	M^{age}: AN 23 (6), HC 26 (4); female; race: White; ethnicity & SES: NR	-.38 (-.90, .13)	Manual
Aloi et al., 2015 (2) *	BED (45) HC (22)	M^{age}: BED 31 (11), HC 26 (4); female; race: White; ethnicity & SES: NR	-.33 (-.84, .18)	Manual
Alvarez-Moya et al., 2009	BN (15) HC (15)	M^{age}: BN 34 (9), HC 36 (14); female; race, ethnicity, & SES: NR	-.71 (-.1.45, .02)	Manual
Arbel et al., 2013 *	AN (25) HC (25)	M^{age}: AN 24 (6), HC 23 (2); female; race, ethnicity, & SES: NR	-.55 (-1.11, .02)	Computerised
Buzzichelli et al., 2018 *	AN (85) HCs (71)	M^{age}: AN 24 (7), HC 25 (3); female; race: White; ethnicity & SES: NR	-.43 (-.75, -.11)	Manual
Cavedini et al., 2004	AN (59) HC (82)	M^{age}: AN 23 (4), HC 31 (11); 75% female; race, ethnicity, & SES: NR	-.22 (-.56, .12)	Manual
Danner & Schröder, 2020 (1) *	AN (199) HC (52)	Unpublished raw data	-.04 (-.35, .26)	Computerised
Danner & Schröder, 2020 (2) *	BN (73) HC (52)	Unpublished raw data	-.21 (-.56, .15)	Computerised
Dingemans et al., 2019 *	BED (91) HC (56)	M^{age}: BED 33 (9), HC 37 (12); sex: BED 88% female, HC 88% female; race, ethnicity, & SES: NR	.03 (-.30, .36)	Computerised
Fagundo et al., 2012	AN (35) HC (137)	18 to 60 years; female; race, ethnicity, & SE:	-.94 (-1.32, -.56)	Manual

Fassino et al., 2002	AN (20) HC (20)	M^{age}: AN 24 (7), HC 23 (3); female; race, ethnicity, & SES: NR	-.62 (-1.25, .02)	Manual
Galderisi et al., 2011	BN (83) HC (77)	M^{age}: BN 24 (4), HC 24 (3); female; race, ethnicity, & SES: NR	-.28 (-.59, .03)	Manual
Galimberti et al., 2013	AN (29) HC (29)	M^{age}: AN 24 (7), HC 29 (12); female; race, ethnicity, & SES: NR	-.70 (-1.23, -.17)	Manual
Giel et al., 2012 *	AN (15) HC (35)	M^{age}: AN 24 (6), HC 30 (11); female; race, ethnicity, & SES: NR	.26 (-.34, .87)	Computerised
Gillberg et al, 2007	AN (47) HC (51)	M^{age}: AN 25 (95% CI: 24 to 25), HC 24 (95% CI: 24 to 25); sex, race, ethnicity, & SES: NR	-.34 (-.74, .06)	Computerised
Grant & Chamberlain, 2020 *	BED (17) HC (17)	18 to 29 years; 94% female; race, ethnicity, & SES: NR	-.09 (-.76, .58)	Computerised
Harrison et al., 2011 (1) *	AN (50) HC (45)	16 to 55 years; female; race, ethnicity, & SES: NR	-.76 (-1.18, -.34)	Computerised
Harrison et al., 2011 (2) *	BN (50) HC (45)	16 to 55 years; female; race, ethnicity, & SES: NR	-.98 (-1.40, -.55)	Computerised
Lao-Kaim et al., 2015 *	AN (16) HC (16)	AN 18 to 41 years, HC 22 to 46 years; female; race, ethnicity, & SES: NR	-.33 (-1.03, .36)	Manual
Lloyd, 2015 *	AN (41) vs HC (84)	Unpublished PhD thesis	-.22 (-.59, .16)	Computerised
Nakazato et al., 2010	AN (24) HC (28)	M^{age}: AN 28 (11), HC 27 (6); race, ethnicity, & SES: NR	-.72 (-1.28, -.16)	Computerised
Numata & Nakazato, 2020 *	AN (12) HC (12)	Unpublished raw data	-.76 (-1.59, .07)	Computerised
Paslakis et al., 2019 *	AN (51) HC (106)	18 to 60 years; female; race, ethnicity, & SES: NR	-.29 (-.63, .04)	Manual
Pignatti & Bernasconi, 2013 (1)	AN (23) HC (10)	M^{age}: AN 29 (7), HC 28 (7); female; race, ethnicity, & SES: NR	-.70 (-1.45, .07)	Manual

Pignatti & Bernasconi, 2013 (2)	BN (17) HC (10)	M^age: BN 30 (6), HC 28 (7); female; race, ethnicity, & SES: NR	-.89 (-1.71, -.08)	Manual
Sato et al., 2013	AN (15) HC (15)	M^age: AN 23 (7), HC 22 (3); females; race: Asian; ethnicity & SES:NR	-.08 (-.80, .64)	Computerised
Segura-Serralta et al., 2020 (1) *	AN (66) HC (33)	M^age: AN 23 (8), HC 30 (12); female; race, ethnicity, & SES: NR	-.20 (-.62, .22)	Computerised
Segura-Serralta et al., 2020 (2) *	BN (31) HC (33)	M^age: 25 (7), HC 30 (12); females; race, ethnicity, & SES: NR	-.24 (-.73, .25)	Computerised
Steinglass et al., 2006	AN (15) HC (11)	M^age: AN 26 (6), HC 24 (3); female; race, ethnicity, & SES: NR	-.88 (-1.70, -.07)	Manual
Steward et al., 2019 *	AN (51) HC (51)	M^age: AN 27 (9), HC 27 (7); female; race, ethnicity, & SES: NR	-.51 (-.91, -.12)	Computerised
Talbot et al., 2015 *	AN (24) HC (43)	16 years or over; AN 96% female, HC 98% female; race, ethnicity, & SES: NR	.44 (-.07, .94)	Computerised
Tchanturia et al., 2012 (1)	AN (171) HC (99)	M^age: AN 25 (8), HC 28 (9); female; race, ethnicity, & SES: NR	-.70 (-.95, -.44)	Computerised
Tchanturia et al., 2012 (2)	BN (82) HC (99)	M^age: BN 27 (8), HC 28 (9); females; race, ethnicity, & SES: NR	-.81 (-1.12, -.51)	Computerised
Thompson, 1993	AN (10) HC (10)	M^age: AN 26, HC 23; female; race, ethnicity, & SES: NR	-.50 (-1.39, .39)	Manual
Van Autreve et al., 2013 *	AN (51) HC (26)	M^age: AN 23 (8), HC 19 (2); female; race, ethnicity, & SES: NR	-.22 (-.69, .26)	Computerised
Wittorf et al., 2012	AN (15) HC (55)	M^age: AN 24 (6), HC 32 (11); 81% female; race, ethnicity, & SES: NR	.22 (-.35, .79)	Computerised

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder; HC = healthy control; SES = socio-economic status; NR = not reported; a negative Cohen's *d* indicates that the eating disorder group performed worse than the healthy control group; * Indicates that the study was not included in the Wu et al. (2014) set shifting meta-analysis.

Figure 4.3

Forest Plot of the Comparison of Set Shifting Between People with Eating Disorders and

Healthy Controls for Each Study Shown in Table 4.3
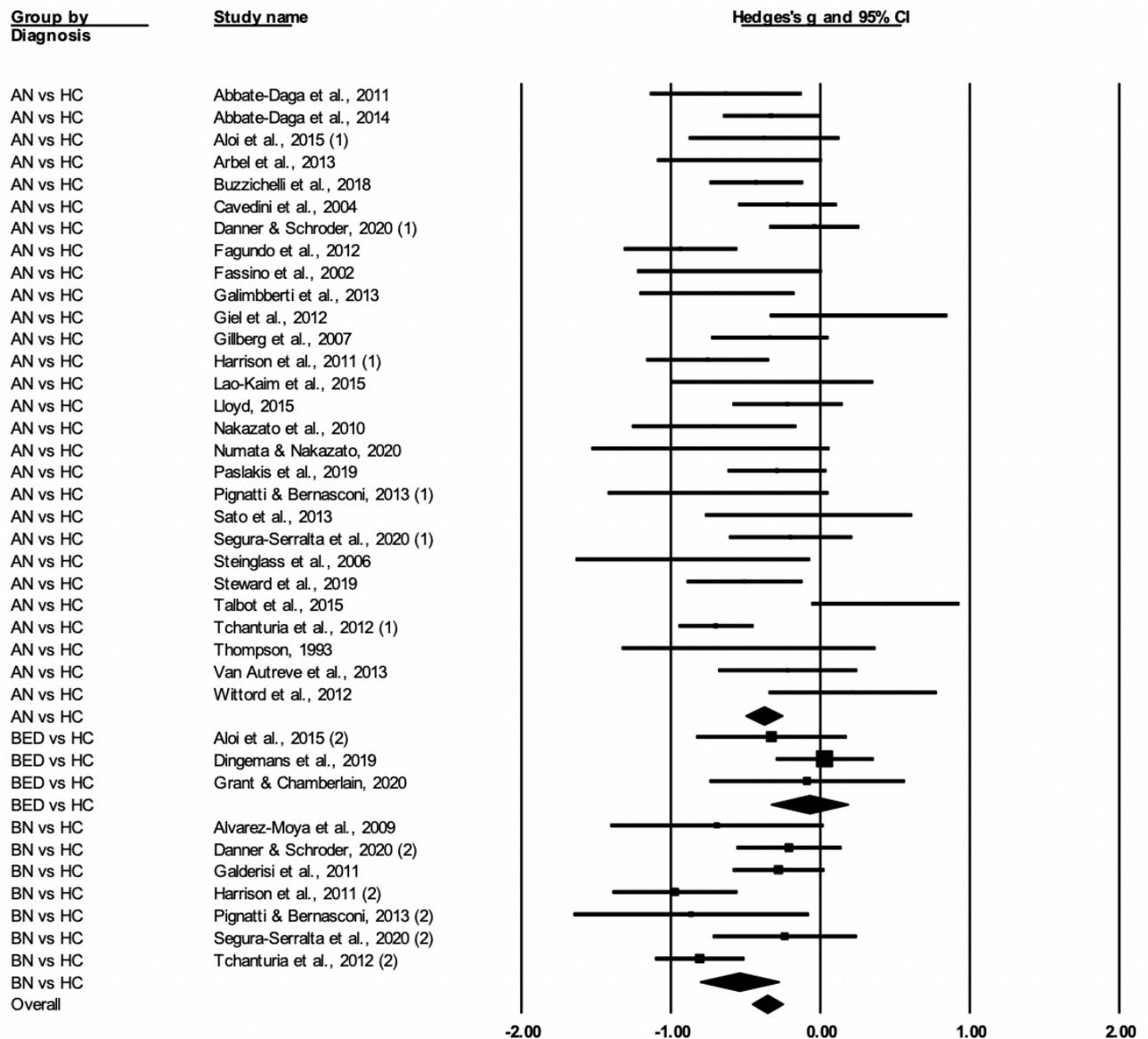
Moderator Analysis

The subgroup analysis for eating disorder diagnosis also revealed that set shifting did not significantly differ between people with BED and healthy controls ($n = 3$; Hedges' $g = -0.08$, 95% CI: -0.33 to 0.18, $p = .55$). However, when compared to healthy controls, people with AN ($n = 28$; Hedges' $g = -0.38$, 95% CI: -0.50 to -0.26, $p < .001$) and BN ($n = 7$; Hedges' $g = -0.55$, 95% CI: -0.81 to -0.29, $p < .001$) had significantly poorer set shifting performance. A meta-regression revealed that the effect sizes did not significantly differ between people with non-underweight eating disorders and people with AN ($Q (2) = 3.86$, $p = .15$).

Publication Bias

Publication bias was not indicated by Egger's regression intercept (-0.08, 95% CI: -1.66 to 1.51, $p = .92$).

Supplementary Analysis

A random-effects meta-regression was conducted to test whether set shifting performance differed between AN subtypes. This analysis included 13 studies with a total sample size of 916 participants. The results revealed that the effect sizes for ANR and ANBP did not significantly differ ($Q (1) = 0.05$, $p = .83$). The data used in the analysis are shown in **Table 4.4**.

Table 4.4

Summary of the 13 Studies Included in the Supplementary Analysis Comparing Set-Shifting

Between AN Subtypes

Study	Diagnosis (*n*)	Cohen's *d* (95% CI)
Abbate-Daga et al., 2011	ANR (30) HC (30)	-.64 (-1.16, -.12)
Buzzichelli et al., 2018	ANR (85) HC (71)	-.43 (-.75, -.11)
Cavedini et al., 2004 (1)	ANR (26) HC (41)	-.19 (-.69, .30)
Cavedini et al., 2004 (2)	ANBP (33) HC (41)	-.24 (-.74, .25)
Danner & Schröder, 2020 (1)	ANR (117) HC (52)	.02 (-.31, .34)
Danner & Schröder, 2020 (2)	ANBP (82) HC (52)	-.10 (-45, .25)
Fassino et al., 2002	ANR (20) HC (20)	-.62 (-1.25, .02)
Sato et al., 2013 (1)	ANR (9) HC (7)	.05 (-.94, 1.04)
Sato et al., 2013 (2)	ANBP (6) HC (7)	-.44 (-1.54, .67)
Segura-Serralta et al., 2020 (1)	ANR (41) HC (22)	-.26 (-.78, .26)
Segura-Serralta et al., 2020 (2)	ANBP (25) HC (22)	-.25 (-.82, .33)
Van Autreve et al., 2013 (1)	ANR (31) HC (13)	-.24 (-.89, .41)
Van Autreve et al., 2013 (2)	ANBP (20) HC (13)	-.16 (-.86, .54)

Notes. ANR = anorexia nervosa restricting type; ANBP = anorexia nervosa binge-eating/purging type; HC = healthy control.

Quality Assessment

      Figure 4.4 presents a visual summary of the quality assessment of the papers included in the meta-analyses and **Table 4.5** presents the results. Quality was low for the following two items: explanation of how the sample size was arrived at (Item 8) and description of how missing data were handled (Item 9). These items conformed to TRIPOD in only 15.38 and 7.69% of papers, respectively. Quality was good for reporting of the number of participants and outcome events in the analysis/analyses of interest (Item 14a; conforming to TRIPOD in 76.92% of papers). Finally, quality was excellent for the following two items: description of the eligibility criteria (Item 5b) and definition of the outcome/s (Item 6a; both conforming to TRIPOD in 100% of papers). Seven papers/eight studies [Aloi et al., 2015 (1), (2); Aloi et al., 2020; Cavedini et al., 2004; Danner et al., 2012; Fassino et al., 2002; Favaro et al., 2012; Thompson, 1993] were defined as low quality. These paper/studies were, therefore, excluded from the sensitivity analyses.

Figure 4.4

Quality Assessment for Each Item as the Percentage Across all Published Papers Included in the Meta-Analyses
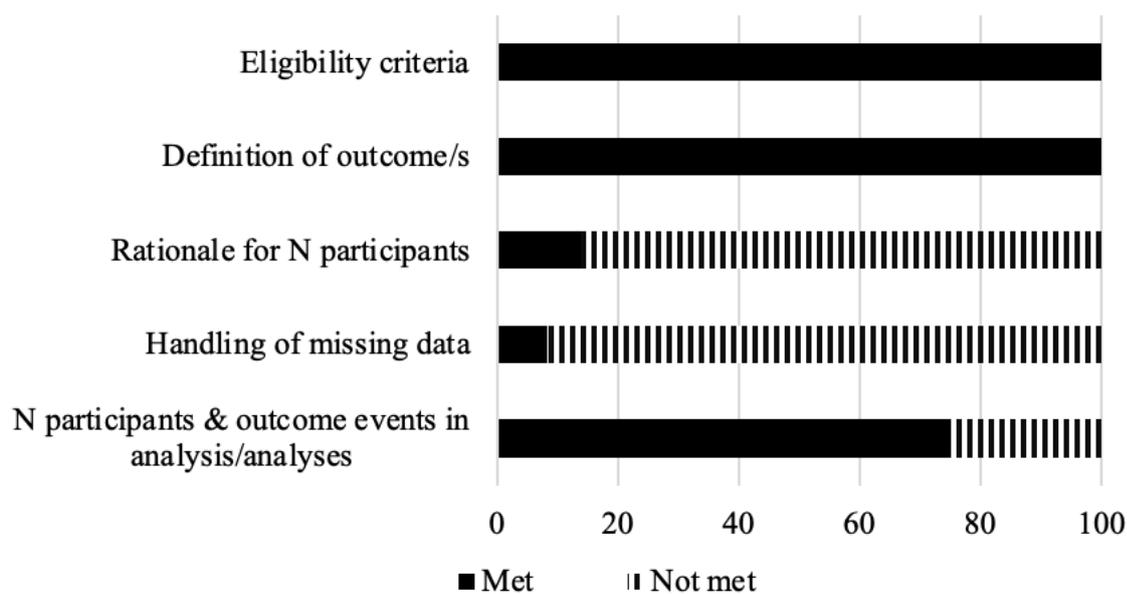
Table 4.5

Results from the TRIPOD Quality Assessment of the 36 Published Papers Included in the Meta-Analyses

TRIPOD Item	5b Eligibility criteria	6a Definition of outcome/s	8 Rationale for N participants	9 Handling of missing data	14a N participants & outcome events in analysis/analyses	Quality High/Low
Abbate-Daga et al., 2014	Y	Y	N	N	Y	High
Abbate-Daga et al., 2011	Y	Y	Y	N	Y	High
Aloi et al., 2015 (1), (2)	Y	Y	N	N	N	Low
Aloi et al., 2020	Y	Y	N	N	N	Low
Alvarez-Moya et al., 2009	Y	Y	N	N	Y	High
Arbel et al., 2013	Y	Y	N	N	Y	High
Buzzichelli et al., 2018	Y	Y	N	N	Y	High
Cavedini et al., 2004	Y	Y	N	N	N	Low
Danner et al., 2012	Y	Y	N	N	N	Low
De Sampaio et al., 2013 (1), (2)	Y	Y	N	N	Y	High
Dingemans et al., 2019	Y	Y	Y	N	Y	High
Fagundo et al., 2012	Y	Y	N	N	Y	High
Fassino et al., 2002	Y	Y	N	N	N	Low
Favaro et al., 2012	Y	Y	N	N	N	Low
Galderisi et al., 2011	Y	Y	N	Y	Y	High
Galimberti et al., 2013	Y	Y	N	N	Y	High
Giel et al., 2012	Y	Y	Y	N	N	High
Gillberg et al., 2007	Y	Y	N	Y	Y	High
Grant & Chamberlain, 2020	Y	Y	N	N	Y	High
Harrison et al., 2011 (1), (2)	Y	Y	N	N	Y	High

Jones et al., 1991 (1), (2)	Y	Y	N	N	N	High
Lao-Kaim et al., 2015	Y	Y	N	N	Y	High
Lopez, Tchanturia, Stahl, Booth et al., 2008	Y	Y	Y	N	Y	High
Lopez, Tchanturia, Stahl, & Treasure, 2008	Y	Y	Y	N	Y	High
Nakazato et al., 2010	Y	Y	N	N	Y	High
Paslakis et al., 2019	Y	Y	N	N	Y	High
Pignatti & Bernasconi, 2013 (1), (2)	Y	Y	N	N	Y	High
Sato et al., 2013	Y	Y	N	N	Y	High
Segura-Serralta et al., 2020 (1), (2)	Y	Y	N	N	Y	High
Steinglass et al., 2006	Y	Y	N	N	Y	High
Steward et al., 2019	Y	Y	N	N	Y	High
Talbot et al., 2015	Y	Y	N	N	Y	High
Tchanturia et al., 2012 (1), (2)	Y	Y	N	Y	Y	High
Thompson, 1993	Y	Y	N	N	N	Low
Van Autreve et al., 2013	Y	Y	N	N	Y	High
Wittorf et al., 2012	Y	Y	N	N	Y	High

Notes. Y = conformed to TRIPOD; N = did not conform to TRIPOD. The quality assessment was only conducted for published papers.

Sensitivity Analyses

Sensitivity analyses were conducted including only the high-quality studies. For central coherence, the sensitivity analysis including 11 of the original 16 studies produced a comparable pooled effect size (Hedges' g = -0.53, 95% CI: -0.80 to -0.28, p < .001). Similarly, for set-shifting, the sensitivity analysis including 33 of the original 38 studies produced a comparable pooled effect size (Hedges' g = -0.40, 95% CI: -0.52 to -0.28, p < .001). Therefore, both sensitivity analyses indicated that the pooled effect sizes for central coherence and set shifting were not influenced by study quality.

Discussion

The aim of the present study was to provide a systematic review and meta-analysis examining central coherence and set shifting inefficiencies (measured using the RCFT and WCST) between people with non-underweight eating disorders and people with AN (both compared to healthy controls). Our study provides an update of the two most recent and comprehensive meta-analyses on central coherence and set shifting across eating disorder diagnoses (Lang, Lopez et al., 2014; Wu et al., 2014), and includes several studies that were not included in either of these meta-analyses.

Executive Function Across Diagnostic Groups

In line with these previous meta-analyses, our results revealed that, overall, people with eating disorders had significantly poorer central coherence and set shifting than healthy controls. When examined further, there was evidence of central coherence and set shifting inefficiencies among people with AN and BN but not among people with BED. Our findings for AN and BN align with Lang, Lopez, and colleagues (2014) and Wu and colleagues (2014). However, our finding for BED is contrary to Wu and colleagues who also found evidence of set shifting inefficiencies among this group. This inconsistency in results may have arisen because Wu and colleagues used several measures of set shifting whereas we

examined just the WCST. This inconsistency may also have occurred due to a lack of power to detect where the BED group truly lies, as Wu and colleagues included only two studies with a BED sample and the present study included only three BED studies.

We also found that the effect sizes for people with both non-underweight eating disorders did not significantly differ from the effect sizes for people with AN. This aligns with Wu and colleagues (2014) who found that set-shifting performance did not significantly differ between eating disorder diagnoses. This finding suggests that, while executive functioning inefficiencies may be a consequence of starvation and malnutrition, they may also be a predisposing trait. Indeed, inefficient central coherence and set shifting has been shown among those recovered from AN and unaffected relatives of people with AN and BN (Fuglset, 2019; Galimberti et al., 2013; Roberts et al., 2010). This finding also shows that the executive functioning of people with BED did not significantly differ from that of either healthy controls *or* people with AN, further suggesting that there was not sufficient power to determine where this group truly lies. This lack of definitive evidence regarding executive functioning among people with BED aligns with a recent meta-analysis (Cury et al., 2020) and highlights a need for further studies among this group.

Limitations

The results should be interpreted in the context of the following limitations. Participants were primarily white females, meaning that we cannot determine whether our findings generalize to a more diverse sample of people with eating disorders. Additionally, while it was a strength that we used just the RCFT and WCST to reduce heterogeneity in our analyses, we cannot determine whether the same pattern of results would be observed if other traditional neuropsychological measures or new paradigms (e.g., Berner et al., 2019) were examined. The results for AN, BN, and the computerised version of the WCST should also be interpreted with some caution due to the marked heterogeneity observed. This heterogeneity

may be explained as follows. First, the heterogeneity among the studies of AN may be because our meta-analyses included a mix of both in- and out-patient populations with AN. Second, the heterogeneity among the studies of BN may have occurred because BN is a heterogeneous disorder that can be manifested in a variety of ways (Duncan et al., 2005; Myers et al., 2006; Stice et al., 2008). Third, the heterogeneity among studies using the computerized WCST may have arisen because there are several computerized versions of the WCST, none of which have been shown to be equivalent to the manual version (Feldstein et al., 1999). Finally, the diagnostic groups reported in the primary studies only allowed us to examine BN and BED as opposed to the full range of non-underweight eating disorders.

Conclusions

The present study has greatly improved our understanding of executive functioning among people with non-underweight eating disorders. We showed that inefficiencies in central coherence and set shifting (measured using the RCFT and WCST) are clearly present among people with BN, and that central coherence and set shifting performance does not significantly differ between people with non-underweight eating disorders (BN and BED) and people with AN. These findings have important clinical implications for the treatment of people with non-underweight eating disorders, suggesting that they too may benefit from adjunct CRT. The present study therefore provides valuable justification for future work developing CRT interventions for people with non-underweight eating disorders.

Chapter 5

An Exploratory Examination of Executive Functioning as an Outcome, Moderator, and Predictor in Outpatient Treatment for Adults with Anorexia Nervosa[4]

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[4] The study described in this chapter was published. Ella Keegan contributed 80%, 80%, and 70% and Tracey Wade contributed 20%, 20%, and 20% to the research design, data analysis, and writing and editing, respectively. All other authors contributed 10% to writing and editing.

Keegan, E., Byrne, S., Hay, P., Touyz, S., Treasure, J., Schmidt, U., V. M. McIntosh, & Wade, T. D. (2022). An exploratory examination of executive functioning as an outcome, moderator, and predictor in outpatient treatment for adults with anorexia nervosa. *Journal of eating disorders*, *10*, 1-9. https://doi.org/10.1186/s40337-022-00602-0

Abstract

People with AN often exhibit inefficiencies in executive functioning (central coherence and set shifting) that may negatively impact on treatment outcomes. It is unclear from previous research whether these inefficiencies can change over treatment. We aimed to (1) investigate whether executive functioning can improve over treatment; (2) determine whether baseline executive functioning moderates treatment outcome; and (3) examine whether baseline executive functioning predicts early change (i.e., increase in BMI over the first 13 weeks of treatment) or remission. Linear mixed model and logistic regression analyses were conducted using data from the Strong Without Anorexia Nervosa trial (Byrne et al., 2017). This study was an RCT of three outpatient treatments for people with AN: Enhanced Cognitive Behavioural Therapy, Maudsley Model Anorexia Nervosa Treatment for Adults, and Specialist Supportive Clinical Management. While set shifting clearly improved from baseline to post-treatment, the results for central coherence were less clear cut. People with low baseline central coherence had more rapid reductions in eating disorder psychopathology and clinical impairment than those with high baseline central coherence. Baseline executive functioning did not predict early change or remission. Results suggest that the detail-focused thinking style commonly observed among people with AN may aid treatment outcomes. Future more adequately powered work is required to replicate this study and examine whether the same pattern of results is observed among people with non-underweight eating disorders.

Introduction

This chapter relates to the first specific PhD aim: shortening waitlists for eating disorder treatment. One potential strategy to shorten waitlists is to take a precision medicine approach in which treatment is tailored to the individual client based on their symptoms at baseline. To take such an approach, an understanding of moderators and predictors of treatment outcomes and retention is required (Agras et al., 2000; Kraemer et al., 2002). Thus, the present study sought to identify such variables using a sample of convenience comprising people with AN. We appreciate that this is a focus on AN which is not the focus of the thesis or the final treatment study. However, this was useful data as it enabled us to further explore the role of executive functioning among people with AN so that we could temper our general discussion based on this understanding.

AN is a serious mental health condition that can significantly impair physical health (Gibson et al., 2019), disrupt psychosocial functioning (Treasure et al., 2015), and has a mortality rate six times higher than that of the general population (Papadopoulos et al., 2009). It is also notoriously difficult to treat, with 40% of adult clients not completing stand-alone outpatient treatments, and only 28% reaching remission at 12-month follow-up (Byrne et al., 2017). It is possible that some of these poor treatment outcomes may be due to the inefficiencies in central coherence and set shifting that are commonly observed among people with AN (**Chapter 4**; Keegan et al, 2021; Lang, Lopez et al., 2014; Wu et al., 2014). Currently, it is unclear whether these inefficiencies can change over the course of treatment. For instance, some research has shown that central coherence and set shifting changed inconsistently or not at all over treatment (Schmidt, Magill et al., 2015; Schmidt, Oldershaw et al., 2012; Tchanturia et al., 2004). However, other research has found that central coherence and set shifting can improve over treatment, for example, when targeted with CRT (for a systematic review, see Tchanturia et al., 2014).

The present study utilised data from the Strong Without Anorexia Nervosa (SWAN) trial (Byrne et al., 2017). We conducted exploratory, secondary data analyses to: (1) make sense of the inconsistent findings by investigating whether executive functioning can change over treatment; (2) determine whether baseline executive functioning moderates treatment outcome; and (3) examine whether baseline executive functioning predicts early change in BMI or remission. Based on Tchanturia and colleagues (2014), we predicted that executive functioning would improve over treatment. In the absence of evidence, we also predicted that people with high executive functioning would have better outcomes, show early change, and reach remission as they would be more able to flexibly make changes in treatment and view their challenges and reasons for recovery in a big picture way.

Method

The SWAN Trial

The SWAN trial was a multi-site RCT involving five treatment sites across three Australian states. Participants were randomly allocated to receive either Specialist Supportive Clinical Management (SSCM; $n = 39$), Maudsley Model Anorexia Nervosa Treatment for Adults (MANTRA; $n = 41$) or Enhanced Cognitive Behavioural Therapy (CBT-E; $n = 40$). In SSCM, the first half of sessions combines clinical management and supportive psychotherapy, whereas the second half of sessions focuses on content dictated by the client (Jordan et al., 2020; McIntosh et al., 2005, 2006). MANTRA targets factors maintaining AN, specifically, thinking style, socio-emotional impairments, close others' unhelpful responses to the illness, and positive beliefs about AN (Schmidt & Treasure, 2006; Schmidt et al., 2014). CBT-E for underweight clients involves motivational work, weight restoration, tackling eating disorder psychopathology, maintaining changes, and developing strategies to overcome setbacks (Fairburn, 2008). Independent ratings demonstrated that all three treatments were highly distinguishable (Andony et al., 2015). In all three treatments,

participants were allocated 25 to 40 sessions. The number of sessions allocated was based on participants' pre-treatment BMI (<16 = 40 sessions; $16 \geq 17.5$ = 30 sessions; and $17.5 \leq 18.5$ = 25 sessions) to allow the time required to restore weight. The trial found no significant differences in outcomes between treatments, with significant improvements observed across all three (Byrne et al., 2017).

Participants

The overall SWAN sample comprised 120 participants (95.8% female) who have been described previously and more fully in Byrne and colleagues (2017). They had a mean age of 26.19 years (SD = 9.47) and a mean baseline BMI of 16.70 kg/m^2 (SD = 1.22). To be eligible for participation, they had to meet the DSM-5 criteria for AN (APA, 2013). Due to a large amount of missing data, our sample comprised a subset of participants from the original SWAN sample. Specifically, analyses included only participants who had both baseline and post-treatment data. The pattern of missing data for central coherence and set shifting is described in the results section. For central coherence, data from 41 participants (97.6% female) was analysed. These participants had a mean age of 24.24 years (SD = 9.86) and a mean BMI of 16.72 (SD = 1.11). For set shifting, data from 37 participants (97.3% female) was analysed. These participants had a mean age of 25.41 years (SD = 10.40) and a mean BMI of 16.77 (SD = 1.12). The basic demographic information for participants included in the present study was very similar to those included in the original SWAN sample.

Measures

Participants completed the WCST (Heaton et al., 1993) and the RCFT (Osterrieth, 1944; Rey, 1941) at baseline and post-treatment. Treatment outcome measures were completed at baseline, mid-treatment, post-treatment, 6-month follow-up, and 12-month follow-up.

Executive Functioning

Central coherence was measured using the RCFT (Osterrieth, 1944) and set shifting was measured using the WCST (Heaton et al., 1993). For comprehensive descriptions of these two neuropsychological tests and their psychometric properties, see **Chapter 7**.

Treatment Outcomes

BMI. Participants' height was measured in metres (m) at baseline. Their weight was measured in kilograms (kg) at baseline, each treatment session, and each assessment time-point. BMI was calculated as kg/m^2.

Eating Disorder Psychopathology. The global score of the EDE interview (Fairburn et al., 1993) was used to measure eating disorder psychopathology over the past 28 days. This semi-structured interview was administered by the Clinical Coordinator at each site. In the present study, internal consistency was $\alpha = .92$.

Clinical Impairment. The CIA (Bohn et al., 2008; Bohn & Fairburn, 2008) was used to assess psychosocial impairment caused by eating disorder psychopathology over the past 28 days. For a comprehensive description of this measure and its psychometric properties, see **Chapter 7**. In the present study, internal consistency was $\alpha = .92$.

Early Change

Following Wade, Allen, and colleagues (2021), we assessed early change using change in BMI over the first 13 sessions of treatment as this represented the first "halfway point" in the 25 to 40 sessions offered in the SWAN trial. While shorter timeframes have been used (e.g., four sessions in family-based treatment; Doyle et al., 2009; Madden et al., 2015), 13 sessions accounted for the less intense nature of outpatient treatment for adults with AN and allowed more time for changes to be observed. Wade, Ghan, and colleagues (2021) analysed the SWAN trial data using latent growth mixture modelling. They identified four latent classes over the first 13 sessions: (1) higher BMI with steeply increasing weight; (2)

higher BMI with moderately increasing weight; (3) middle BMI with no change in weight; and (4) low BMI with no change in weight. We defined early change as the class with steeply increasing weight over the first 13 treatment sessions.

Remission

Following Byrne and colleagues (2017), remission was defined as having a BMI greater than 18.5, a global EDE score less than 1.8, and no binge/purge behaviours.

Statistical Analyses

We conducted all analyses using IBM Statistical Package for the Social Sciences (Version 22; IBM Corp, 2013). Logistic regression analyses were conducted to determine whether baseline variables predicted missing baseline or post-treatment data for both central coherence and set shifting. We applied Bonferroni corrections for all comparisons. We conducted two linear mixed model (LMM) analyses to investigate whether executive functioning can change over treatment and whether change over treatment differed between groups. Both analyses had time and group as fixed effects and the interaction between these variables. One of these LMM analyses had central coherence as the outcome variable and the other had set shifting. To investigate whether baseline executive functioning moderated treatment outcome, we conducted a separate LMM analysis for each treatment outcome variable. These LMM analyses had fixed effects of time and baseline central coherence or set shifting and the interaction between these variables. Group was not included as a fixed effect in any of the analyses examining early change or treatment outcomes because LMM analyses require a minimum of 10 cases for each effect examined. When significant interactions were observed, we categorised participants as having low or high baseline executive functioning using a median split. Finally, to investigate whether baseline executive functioning predicted early change or remission, we conducted logistic regression analyses.

Results

Missing Data

Central Coherence

Of the 120 participants, 41 had both baseline and post-treatment data, 43 were

missing both baseline and post-treatment data, 1 was missing only baseline data, and 35 were

missing only post-treatment data. Baseline EDE predicted missing baseline central coherence

data, such that those with higher eating disorder psychopathology were less likely to have

missing baseline central coherence data. However, as shown in **Table 5.1**, no baseline

variables predicted whether post-treatment central coherence data were missing. We can,

therefore, conclude that post-treatment central coherence data were missing at random.

Table 5.1

Logistic Regression Analyses Predicting Missing Baseline and Post-Treatment Executive Functioning Data from Baseline Variables

	Baseline			Post-treatment		
	Missing M (SD)	Not missing M (SD)	OR (95% CI)	Missing M (SD)	Not missing M (SD)	OR (95% CI)
Central coherence						
Duration	8.29 (5.78)	5.93 (8.47)	0.97 (0.92, 1.02)	7.35 (9.51)	4.76 (7.41)	0.96 (0.91, 1.02)
AN subtype [a]	ANR: 19 (43.2) ANBP: 25 (56.8)	ANR: 34 (44.7) ANBP: 42 (55.3)	0.94 (0.44, 1.99)	ANR: 17 (48.6) ANBP: 18 (51.4)	ANR: 17 (41.5) ANBP: 24 (58.5)	1.33 (0.54, 3.31)
BMI	16.80 (1.26)	16.65 (1.19)	0.90 (0.66, 1.24)	16.57 (1.27)	16.72 (1.11)	1.11 (0.76, 1.64)
EDE	2.97 (1.37)	3.52 (1.39)	**1.33 (1.01, 1.74) ***	3.57 (1.51)	3.48 (1.30)	0.96 (0.69, 1.33)
CIA	32.97 (9.42)	32.84 (11.45)	1.00 (0.96, 1.04)	31.35 (12.39)	34.14 (10.56)	1.02 (0.98, 1.07)
Set shifting						
Duration	5.75 (4.57)	6.75 (8.76)	1.02 (0.95, 1.09)	8.21 (9.31)	5.24 (8.00)	0.96 (0.90,1.02)
AN subtype [a]	ANR: 16 (51.6) ANBP: 15 (48.4)	ANR: 37 (41.6) ANBP: 52 (58.4)	1.50 (0.66, 3.41)	ANR: 23 (44.2) ANBP: 29 (55.8)	ANR: 14 (37.8) ANBP: 23 (62.2)	1.30 (0.55, 3.08)
BMI	16.68 (1.28)	16.71 (1.19)	1.02 (0.72, 1.44)	16.66 (1.25)	16.77 (1.12)	1.08 (0.76, 1.55)
EDE	2.93 (1.47)	3.46 (1.36)	1.31 (0.97, 1.76)	3.43 (1.47)	3.49 (1.22)	1.03 (0.75, 1.41)
CIA	33.75 (10.30)	32.62 (10.94)	0.99 (0.95, 1.03)	31.80 (11.53)	33.75 (10.13)	1.02 (0.98, 1.06)

Notes. For post-treatment, the analyses were only conducted for those who also had baseline data. OR = odds ratio; CI = confidence interval; AN = anorexia nervosa; ANR = anorexia nervosa restricting subtype; ANBP = anorexia nervosa binge purge subtype. BMI = body mass index; EDE = Eating Disorder Examination-Interview; CIA = Clinical Impairment Assessment.

[a] The descriptive statistics for AN subtype are presented as frequency (percentage).

* Those with higher eating disorder psychopathology at baseline were less likely to have missing baseline central coherence data.

Set Shifting

Of the 120 participants, 37 had both baseline and post-treatment data, 28 were missing both baseline and post-treatment data, 3 were missing only baseline data, and 52 were missing only post-treatment data. As shown in **Table 5.1**, no baseline variables predicted whether set shifting data were missing at baseline or post-treatment. Therefore, we can conclude that both baseline and post-treatment set shifting data were missing at random.
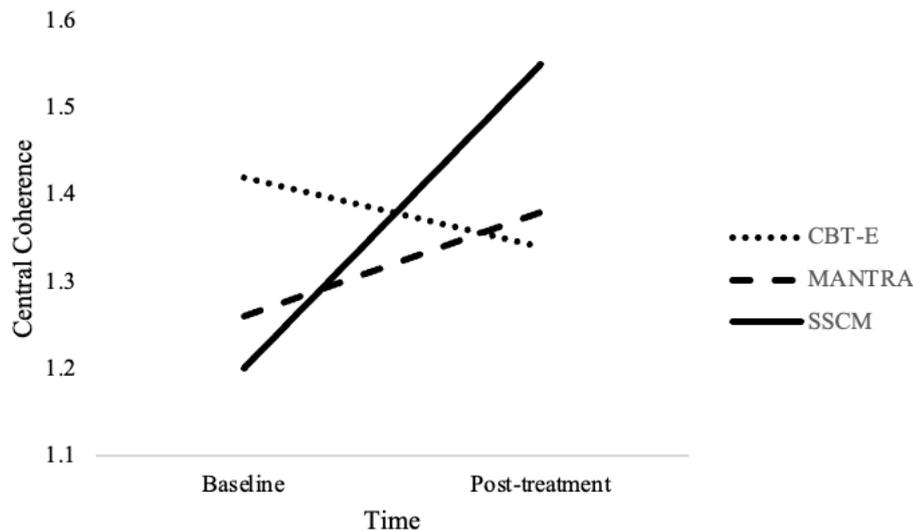
Aim 1: Executive Functioning as an Outcome

Central Coherence

There was a significant main effect of time, $F(1, 38) = 4.76$, $p = .04$, indicating that central coherence improved from baseline ($M = 1.30$, $SD = 0.31$) to post-treatment ($M = 1.42$, $SD = 0.34$). The effect size, adjusted for correlated data (Lakens, 2013), showed that this was a small-to-medium effect (-0.32, 95% CI: -0.11 to -0.76). While there was no main effect of group, $F(2, 38) = 0.20$, $p = .82$, there was a significant interaction between time and group, $F(2, 38) = 4.86$, $p = .01$. As shown in **Figure 5.1**, this interaction indicated that over time central coherence improved in MANTRA and SSCM but there was no meaningful change in CBT-E. The rate of improvement over time was greatest in SSCM.

Figure 5.1

Mean Central Coherence by Time (Baseline, Post-Treatment) and Group (CBT-E, MANTRA, SSCM)

Set Shifting

There was a significant main effect of time, $F(1, 34) = 9.08$, $p = .005$, indicating that set shifting improved from baseline ($M = 9.58$, $SD = 7.42$) to post-treatment ($M = 5.91$, $SD = 2.25$). The adjusted effect size showed that this was a small-to-medium effect (-0.37, 95% CI: -0.83 to -0.09). There was no main effect of group, $F(2, 34) = 0.18$, $p = .84$, nor interaction between time and group, $F(2, 34) = 0.89$, $p = .42$.

Aim 2: Executive Functioning as a Moderator of Treatment Outcome

There was a significant interaction between baseline central coherence and time. With the exception of BMI, the interaction indicated that those with low baseline central coherence improved more from baseline to 12-month follow-up than those with high baseline central coherence. More specifically, the adjusted effect sizes showed that those with low baseline central coherence (-0.97, 95% CI: -1.64 to -0.29) had a greater decrease in eating disorder psychopathology than those with high baseline central coherence (-0.65, 95% CI: -1.29 to -0.02). They also had a greater decrease in clinical impairment (-1.39, 95% CI: -2.12 to -0.66)

than those with high baseline central coherence (-0.41, 95% CI: -1.06 to 0.23). Baseline set

shifting did not moderate any treatment outcome variables. **Table 5.2** provides the inferential

statistics and **Table 5.3** the descriptive statistics.

Table 5.2

Linear Mixed Model Analyses Showing Baseline Central Coherence Moderated Change Over

Time in Treatment Outcome Variables

	Main effects F (df), p		Interaction F (df), p
	Time	Executive functioning	Time x executive functioning
Central coherence			
BMI	13.32 (4, 10.92), <.001	0.99 (31, 9.00), .55	**3.89 (133, 8.27), .02**
EDE	91.28 (4, 7.60), <.001	1.27 (31, 8.43), .38	**4.98 (115, 7.60), .01**
CIA	9.90 (4, 7.18), .005	1.53 (31, 6.61), .30	**10.99 (97, 6.67), .004**
Set shifting			
BMI	6.30 (4, 21.23), .002	0.67 (14, 21.94), .78	1.60 (55, 20.59), .12
EDE	23.48 (4, 22.57), <.001	0.65 (14, 21.56), .80	1.32 (55, 21.01), .25
CIA	20.91 (4, 13.33), <.001	0.75 (14, 21.00), .70	2.24 (51, 11.31), .07

Notes. BMI = body mass index; EDE = Eating Disorder Examination-Interview; CIA = Clinical Impairment Assessment.

Table 5.3

Means (Standard Deviations) for Treatment Outcomes by Time and Executive Functioning (Low, High)

	Baseline	Mid-treatment	Post-treatment	6-month follow-up	12-month follow-up
Central Coherence					
BMI					
Low	16.58 (1.18)	18.12 (1.90)	18.81 (2.86)	19.27 (2.99)	18.96 (2.48)
High	16.87 (1.05)	17.63 (1.44)	18.34 (1.56)	18.35 (1.67)	18.72 (2.00)
EDE					
Low	3.63 (1.27)	2.31 (1.29)	1.66 (1.21)	1.78 (1.50)	1.42 (1.11)
High	3.32 (1.33)	2.38 (1.15)	1.73 (1.41)	1.85 (1.42)	1.54 (1.40)
CIA					
Low	34.55 (9.51)	23.69 (14.12)	15.76 (12.47)	17.81 (14.30)	21.13 (14.11)
High	33.71 (11.81)	26.56 (10.58)	19.61 (12.24)	20.38 (14.84)	18.53 (17.27)
Set Shifting					
BMI					
Low	16.39 (1.19)	17.97 (1.94)	19.05 (2.41)	19.15 (2.87)	19.25 (2.44)
High	17.10 (0.97)	18.21 (1.46)	18.84 (2.48)	18.95 (2.27)	18.84 (2.55)
EDE					
Low	3.68 (1.21)	2.27 (1.05)	1.50 (1.21)	1.73 (1.38)	1.31 (1.11)
High	3.32 (1.24)	2.47 (1.33)	2.01 (1.20)	2.09 (1.28)	1.81 (1.23)
CIA					
Low	34.64 (9.64)	24.00 (12.35)	15.63 (11.74)	17.83 (14.90)	18.58 (14.69)
High	32.95 (10.75)	25.13 (13.74)	22.19 (14.34)	23.18 (15.38)	23.65 (16.60)

Notes. BMI = body mass index; EDE = Eating Disorder Examination-Interview; CIA = Clinical Impairment Assessment.

Aim 3: Executive Functioning as a Predictor of Early Change and Remission

Neither baseline central coherence nor set shifting predicted early change or remission at post-treatment, 6-month follow-up, or 12-month follow-up. **Table 5.4** provides the descriptive and inferential statistics.

Table 5.4

Logistic Regression Analyses Predicting Early Change and Remission from Baseline Executive Functioning, and Mean (Standard Deviation) Baseline Executive Functioning for Early Change (vs. No Early Change) and Remission (vs. No Remission)

	Baseline M (SD)		OR (95% CI)
	Early change	No early change	
Central coherence	1.27 (0.34)	1.38 (0.23)	2.93 (0.18, 47.31)
Set shifting	9.13 (6.87)	11.71 (9.23)	1.04 (0.94, 1.15)
	Remission	No remission	
Central coherence			
Post-treatment	1.33 (0.29)	1.27 (0.34)	1.70 (0.21, 13.44)
6-month follow-up	1.22 (0.30)	1.32 (0.33)	0.38 (0.05, 3.28)
12-month follow-up	1.27 (0.29)	1.30 (0.35)	0.76 (0.10, 5.54)
Set shifting			
Post-treatment	11.15 (8.16)	8.79 (6.82)	1.05 (0.95, 1.15)
6-month follow-up	13.11 (8.85)	8.50 (6.51)	1.08 (0.98, 1.19)
12-month follow-up	11.00 (7.76)	8.82 (7.21)	1.04 (0.95, 1.14)

Notes. M = mean; SD = standard deviation; OR = odds ratio; CI = confidence interval.

Discussion

We conducted exploratory, secondary data analyses to investigate whether executive functioning can change over the course of treatment, determine whether baseline executive functioning moderated treatment outcomes, and examine whether baseline executive functioning predicted early change or remission. While participants were a subset of those from a previous investigation (Byrne et al., 2017), this is likely to be a representative sample as central coherence and set shifting data were missing at random with one exception – those with higher eating disorder psychopathology at baseline were less likely to have missing baseline central coherence data. This may reflect the fact that the data came from a treatment study and those with more severe eating disorder symptoms were attending all treatment/assessment sessions as they needed support. This can be viewed as a strength as our results may extrapolate to those with more severe symptomatology.

Executive Functioning as an Outcome

In line with research showing that executive functioning can change over treatment (Giombini, Moynihan et al., 2017; Giombini et al., 2022; Tchanturia et al., 2014), we found that set shifting clearly improved from baseline to post-treatment. The results for central coherence were less clear cut, with central coherence only improving in MANTRA and SSCM. The lack of meaningful change in CBT-E may be because CBT-E is very focused on specific steps, whereas the other two treatments focus on "big issues" which may encourage bigger picture thinking. Additionally, MANTRA explicitly targets thinking styles, so we might expect to see central coherence most improved in this group. Rather, we found that central coherence improved more over treatment in SSCM. As mentioned, a core element of SSCM is supportive psychotherapy with the entire second half of each session focused on content dictated by the client (Jordan et al., 2020; McIntosh et al., 2005, 2006). It is possible that having to think through everything that is going on in one's life and prioritise which

topics, issues, or concerns are most important to discuss in session each week may promote bigger picture thinking. Moreover, focusing on content that is most salient to the individual may enable them to work through the specific stuck points that are consuming their attention and getting in the way of viewing their challenges and life in a big picture way.

Executive Functioning as a Moderator

We found that people with low baseline central coherence had a greater decrease in eating disorder psychopathology and clinical impairment from baseline to 12-month follow-up than those with high baseline central coherence. A possible explanation for this finding is that the big picture of recovery may seem daunting and interfere with treatment progress, whereas an ability to focus on the details of changes that need to happen each week (e.g., changes in eating step by step) is what is needed and helpful for more rapid improvement. This finding supports the proposition that the detail-focused thinking style commonly observed among people with AN can be both a vulnerability and a strength. More specifically, while a tendency to thinking in terms of details could pose a vulnerability for the development and maintenance of AN (e.g., fixating on details about food and weight), it could also break down the process of recovery into smaller, less overwhelming, and more achievable steps.

Executive Functioning as a Predictor

We found that baseline central coherence and set shifting did not predict early change or remission. This finding suggests that other variables may be more important or influential than baseline executive functioning. For example, baseline variables such as BMI, motivation, eating disorder psychopathology, depression diagnosis, self-esteem, and AN subtype have previously been shown to predict how well people with AN do in treatment (Gregertsen et al., 2019; Vall & Wade, 2015; Wild et al., 2016).

Limitations

The present study had several limitations. First, participants were primarily white females. Thus, results are unable to be extrapolated to a more diverse sample of people with AN. Second, like many RCTs, strict exclusion criteria were applied (e.g., severe physical or mental illness such that outpatient treatment was inappropriate, current severe substance dependence, current use of atypical antipsychotics because of the weight gain properties of these drugs). Consequently, the sample may not be representative of all people presenting for outpatient treatment of AN. Third, there was a substantial amount of missing data, particularly for the neuropsychological measures which were lengthy and required an in-person appointment in contrast to the completion of online questionnaires. This missing data limited our power to investigate moderation and may have also introduced bias. However, overall, the subset of participants included in our analyses were representative of the whole sample. This missing data likely arose as this was a multi-site trail with a severely unwell population. Finally, results and p values should be interpreted with some caution due to the small sample size and exploratory nature of the study.

Conclusions

Replication is required before definitive conclusions can be made about whether set shifting can improve over treatment and whether baseline central coherence moderates treatment outcomes. Given the inconsistent findings regarding whether executive functioning can improve over the course of treatment, it would be beneficial for future treatment studies to routinely assess executive functioning. If central coherence was consistently shown to moderate treatment outcomes, this information could be used to inform a precision medicine approach for people with AN. Given that people with non-underweight eating disorders, such as BED and BN, have central coherence and set shifting inefficiencies that are comparable to those observed among people with AN (Keegan et al., 2021; **Chapter 4**), it would be of

interest to examine whether the same pattern of results is obtained in the non-underweight group. Finally, the results suggest some hypotheses for further testing in an adequately powered study. Specifically, while a detail-focused thinking pattern can pose a vulnerability for the development and maintenance of AN, it also offers a pathway to a focused drive and determination that can be weaponised against the eating disorder when directed towards recovery.

Chapter 6

Qualitative Feasibility Study of a Single Session Waitlist Intervention: CRT-Brief

Introduction

This chapter relates to the second specific PhD aim: managing the impact of lengthy waitlists on dropout from subsequent treatment. One potential strategy to overcome this issue may be to provide intervention while people are waitlisted for treatment. As discussed, there is preliminary evidence that CRT improves retention in treatment (for a systematic review, see Hagan et al., 2020), but only four studies (Dingemans et al., 2014; Mac Neil et al., 2016; Raman et al., 2018; Roberts, 2018) have examined its use in samples including people with non-underweight eating disorders. We developed a manualised CRT waitlist intervention (CRT-Brief) for people with non-underweight eating disorders. In doing so, we considered the context in which the intervention would be implemented, engaged stakeholders, and refined the intervention, as recommended by the Medical Research Council (Skivington et al., 2021).

Method and Results

Considering the Context

To take limitations on resources and clinicians' time into account, CRT-Brief was developed to be an SSI with accompanying homework. It was developed from material typically covered in 10 sessions of individual CRT (Tchanturia et al., 2010) and comprised four cognitive training exercises. Two of these exercises (Complex Pictures and How to...) aimed at improving central coherence; the other two (Switching Ability and Embedded Words) targeted set shifting. We also developed homework for participants to complete independently, four exercises per week, while waitlisted for treatment. Finally, we created a participant booklet and a clinician manual, based on the original manual (Tchanturia et al., 2010). The participant booklet included the instructions and materials for the CRT session and homework. The clinician manual included the aims of the chosen cognitive training exercises, materials for the CRT session, and the session content. It also included reflection

questions, for example, *"Were you aware of your thinking style while doing the exercise?"* and *"Can you relate this thinking style to other areas of your life?"* as well as prompts to encourage thinking and discussion.

Stakeholder Engagement

To obtain stakeholder feedback on CRT-Brief, we conducted a qualitative feasibility study ($N = 8$) at the Statewide Eating Disorder Service (SEDS) in April 2020. SEDS is a specialised service that provides assessment, information, and treatment for South Australians with eating disorders as well as their families and carers. The eight participants (100% female) were attending a voluntary Day Program, described in Wade and colleagues (2020). Ages ranged from 15 to 30 years, and diagnoses included AAN and BN.

The SSI was conducted by the PhD Candidate and a senior clinical psychologist from SEDS. In the session, participants were introduced to CRT and completed the four cognitive training exercises. Following each exercise, participants were asked reflection questions relating to the exercise and their thinking styles and discussion was encouraged. At the end of the session, the homework was explained, and participants were asked to provide anonymous written feedback on the session and participant booklet. One week later, participants were asked to provide feedback on the homework.

Stakeholder Feedback

Overall, the feedback on the SSI and participant booklet was positive. All participants reported that the exercise instructions were clear and made sense. They also reported that they *"really enjoyed"* the session and said that it was *"interesting,"* *"brain activating,"* and *"fun."* Participants liked that CRT-Brief did not discuss eating disorder related themes or symptoms, for example, "*I liked that it didn't challenge eating disorder things – it was a lot brighter.*" However, some participants also commented that they were not *"super sure of the*

purpose" and that they would have liked the session to directly discuss how CRT applied to their eating disorder.

Feedback on the homework was more varied. Four of the eight participants reported finding the homework *"overwhelming"* and did not do it. One of these participants also mentioned that it reminded her of schoolwork and struggling with perfectionism with homework, and that she did not complete it due to this association. The remaining four participants all reported trying out the homework. All these participants completed at least one of the exercises following the session, but most completed several. These participants reported finding the exercises *"fun"* for the most part, and not challenging or overwhelming. In line with the feedback on the SSI, one of these participants commented that it would be helpful for the link to be made about how CRT could be applied to their eating disorder. Findings were consistent across the age range.

Refining the Intervention

Based on this stakeholder feedback, we made several changes to CRT-Brief. First, to help participants understand the purpose of CRT, we added a more comprehensive introduction. This introduction explained set shifting and central coherence, how people with eating disorders can have difficulties with these two areas of executive functioning, and how big picture and flexible thinking can be improved by practising cognitive training exercises and reflecting on thinking. Second, to make the link with eating disorders explicit, we also added the following open-ended reflection questions to each cognitive exercise: *"How can you apply what you have learnt to the problems you are currently experiencing with eating?"* and *"What is one way that thinking more [flexibly/in terms of the bigger picture] might improve the problems you are having with eating?"* Finally, we reduced the length of the homework to one exercise per week, given that half of the sample reported finding it

overwhelming and no participants completed all of it. The refined materials for CRT-Brief are provided in **Appendix A**.

Discussion

The present study related to the aim of managing the impact of lengthy waitlists on dropout from subsequent treatment. As there is some evidence that CRT can improve retention (Hagan et al., 2020), we developed CRT-Brief, a single session waitlist intervention for people with non-underweight eating disorders. In line with Medical Research Council recommendations (Skivington et al., 2021), we obtained stakeholder feedback on CRT-Brief and made several significant changes to the SSI and homework as a result. The refined intervention had a clearer rationale and link to eating disorders, and a more achievable homework load, highlighting the value of integrating stakeholder feedback when developing interventions.

Chapter 7

Measures[5]

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[5] Some of the content in this chapter appears in the Measures sections of three published papers that are provided in **Appendices A** to **C**.

Keegan, E., Waller, G., & Wade, T. D. (2022). A systematic review and meta-analysis of a 10-session cognitive behavioural therapy for non-underweight eating disorders. *Clinical Psychologist, 26*(3), 241-254. https://doi.org/10.1080/13284207.2022.2075257

Keegan, E., Tchanturia, K., & Wade, T. D. (2021). Central coherence and set-shifting between nonunderweight eating disorders and anorexia nervosa: A systematic review and meta-analysis. *International Journal of Eating Disorders, 54*(3), 229-243. https://doi.org/10.1002/eat.23430

Keegan, E., Byrne, S., Hay, P., Touyz, S., Treasure, J., Schmidt, U., McIntosh, V. V. W., & Wade, T. D. (2022). An exploratory examination of executive functioning as an outcome, moderator, and predictor in outpatient treatment for adults with anorexia nervosa. *Journal of eating disorders, 10*(1), 1-9. https://doi.org/10.1186/s40337-022-00602-0

Overview

This chapter provides an outline of the neuropsychological and questionnaire measures that were used in the main PhD study (**Chapter 8**). For each measure, a detailed description is provided as well as information regarding psychometric properties. Additionally, for questionnaire measures, information regarding factor structure is discussed. To avoid repetition, the measures featured in this chapter are described only briefly in other chapters. The measures were selected due to evidence of their strong psychometric properties, discussed in this chapter, and to allow comparability with prior research.

Performance-Based Neuropsychological Measures

Central Coherence

Description

      The Rey Complex Figure Test (RCFT), developed by Rey (1941) and standardised by Osterrieth (1944), was used to measure central coherence. In this test, the participant copies a complex figure comprising 18 elements (see **Figure 7.1**). The RCFT was originally designed to examine visual memory and spatial coherence among people with brain injuries (Lezak et al., 2012). Thus, traditionally, participants were instructed to produce the complex figure by copying (copy trial) and from memory (recall trial). Now, when assessing central coherence, the most direct measure is considered to come from just the copy trial (Booth, 2006). Thus, the research described in **Chapter 8** uses just the copy trial and Booth's (2006) scoring system.

Figure 7.1

Numbered Elements of the Complex Figure (Meyers & Meyers, 1995)
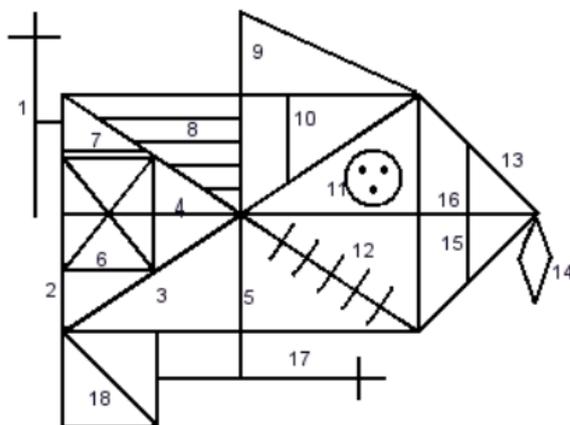
Procedure

      The procedure for the copy trial is as follows. The examiner instructs the participant to copy the complex figure as accurately as possible onto a blank A4 sheet of paper. The sheet of paper is in the same orientation as the stimulus card depicting the complex figure.

With the participant's consent, administration is video recorded to increase scoring accuracy and reliability. The participant is not allowed to rotate the stimulus card, erasers and rulers are not permitted, and there is no time limit (Booth, 2006). If the participant asks for an eraser, they are encouraged to cross out their mistake and continue. The complex figure remains in view for the entire trial.

Scoring

        Order of Construction Index. This index examines the first six elements that the participant *completely* copies. Points are awarded as follows: "global external" (Elements 2 and 13) = 4 points; "global internal" (Elements 3, 4, 5, and 16) = 3 points; "local perimeter" (Elements 1, 9, 14, 17, and 18) = 1 point; or "local internal" (Elements 6, 7, 8, 10, 11, 12, and 15) = 0 points. No points are awarded for partially drawn elements. A weighted index score is calculated by taking the average of the six scores, and then dividing the average score by 3.2. This score can range from 0 to 1. Higher scores indicate that the participant copied more global (as opposed to detailed) elements of the figure in the initial stages of their drawing.

        Style Index. This index examines the style in which the participant copies six key global elements of the figure. The key global elements comprise the large rectangle, diagonal cross, extended horizontal line, extended vertical midline, sides of the large triangle, and small rectangle (see **Figure 7.1**). Attention is paid to whether the participant copies these elements in a continuous or fragmented way. Points are awarded as follows: coherent (i.e., copied with a continuous stroke or consecutive strokes) = 2 points; partially fragmented (i.e., copied with one interruption) = 1 point; or highly fragmented (i.e., copied with two or more interruptions) = 0 points. A weighted index score is calculated by taking the average of the six scores, and then dividing the average score by 2. This score can range from 0 to 1. Higher scores indicate a more coherent, continuous drawing style.

Central Coherence Index. The measure of central coherence is the central coherence index (CCI). This index is calculated by adding the weighted score from the Order of Construction Index to the weighted score from the Style Index. The resulting CCI can range from 0 to 2. Higher scores indicate better central coherence (Booth, 2006). Median splits were used to define low and high central coherence in the absence of evidence-based cut off scores.

Reliability

Using Booth's (2006) scoring system, the RCFT has demonstrated strong to excellent inter-rater reliability for the CCI (rs ranging from .70 to .97; Harrison et al., 2011; Lopez et al., 2008; Zuchova et al., 2013).

Set Shifting

Description

The Wisconsin Card Sorting Test (WCST; Heaton et al., 1993) was used to measure set shifting. There are both manual and electronic versions of the WCST. The manual version was used in the research described in this thesis.

Procedure

In this test, participants are instructed to match stimulus cards to one of four key cards. The sorting rule can be the colour, form, or number of symbols on the cards. The participant is not told the sorting rule. Instead, the experimenter says whether each trial is "correct" or "incorrect" and the participant must infer the sorting rule from this feedback. Each time the participant correctly sorts 10 cards in a row they complete a "category" and the sorting rule changes. The participant is not told that the sorting rule has changed and must instead infer the new rule from the experimenter's feedback.

Scoring

The participant's responses can be correct or incorrect and unambiguous (matching only one characteristic of the key card, e.g., only colour) or ambiguous (matching two or three characteristics). Set shifting performance is measured using perseverative errors. A higher number of perseverative errors indicates poorer set-shifting (Heaton et al., 1993). Median splits were used to define low and high set shifting in the absence of evidence-based cut off scores.

A "perseverated to principle" is established and in effect when a participant persists in responding to colour, form, or number. When a perseverated to principle is in effect, all responses (correct and incorrect) that match the principle are scored as perseverative errors. The perseverated to principle is established in three situations. The first situation occurs before completing a category. In this situation, the first unambiguous error establishes the principle and subsequent unambiguous errors matching it are scored as perseverative errors. The second situation arises after completing a category. Here, the previously correct sorting rule becomes the perseverated to principle and unambiguous errors matching it (including the first) are scored as perseverative errors. The final situation occurs if a participant makes three unambiguous errors to a sorting rule that is neither correct nor the perseverated to principle currently in effect, and where all responses between the first and third unambiguous errors match this rule. This rule becomes the perseverated to principle and responses are scored as perseverative errors from the second unambiguous error onwards.

There are also several more complex situations where ambiguous responses can be scored as perseverative errors. For instance, one ambiguous response can be scored as a perseverative error if it matches the perseverated to principle that is currently in effect and if the trial directly before and directly after it are unambiguous perseverative errors. Similarly, multiple ambiguous responses can be scored as perseverative errors if all responses between

two unambiguous perseverative errors match the perseverated to principle that is currently in effect.

Reliability

Inter-rater reliability for perseverative errors has been shown to be excellent for both clinicians experienced in neuropsychological assessment and novice scorers (*r*s ranging from .92 to .97; Axelrod et al., 1992).

The Validity of Performance-Based Neuropsychological Measures

Several concerns have been raised about the use of performance-based neuropsychological tests. For instance, practice effects are commonly observed (Bartels et al., 2010; Calamia et al., 2012), threatening internal validity. Additionally, self-report measures are more strongly correlated with real life functioning and/or degree of functional impairment than are performance-based measures (for a review, see Toplak et al., 2013). The two types of measures (performance-based and self-report) assess performance differently, with self-report measures assessing abilities in typical conditions and performance-based measures in optimal conditions (Toplak et al., 2013), limiting external validity. Despite this, performance-based neuropsychological tests are typically used in the eating disorder literature (for systematic reviews and meta-analyses, see Keegan et al., 2021; Lang, Lopez, et al., 2014; Lang & Tchanturia, 2014; Roberts et al., 2007). Moreover, a recent systematic review and meta-analysis found that the RCFT and WCST were the most commonly used performance-based measures in studies examining set shifting and central coherence among people with an eating disorder diagnosis and healthy controls (Keegan et al., 2021). Thus, to allow comparability, the research described in **Chapter 8** followed common practice and used these two measures.

Self-Report Questionnaire Measures

Global Eating Disorder Psychopathology

Description

The 28-item Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 2008) was used to measure eating disorder psychopathology over the past 28 days. Of the 28 items, six measure behavioural diagnostic symptoms, for example, "Over the past 28 days, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape, or amount of fat, or to burn off calories?" These items are rated as frequencies. The remaining 22 items measure cognitive and behavioural symptoms of eating disorders, for example, "Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?" These items are rated on 7-point Likert scales assessing either frequency (0 = *No days* to 6 = *Every day*; 0 = *None of the times* to 6 = *Every time*) or intensity (0 = *Not at all* to 6 = *Markedly*). These 22 items produce four subscale scores (Restraint, Eating Concern, Shape Concern, and Weight Concern) and a global score (the average of the four subscale scores). The global score can range from 0 to 6, and higher scores indicate greater eating disorder psychopathology. The EDE-Q is widely used to assess and monitor eating disorders in clinical practice and treatment outcome studies (Rand-Giovannetti et al., 2020).

Factor Structure

The EDE-Q was based directly on a semi-structured interview of eating disorder psychopathology, the Eating Disorder Examination (Fairburn et al., 2008). No factor analysis was conducted when the EDE-Q was initially developed (Fairburn & Beglin, 1994), and the original 4-factor structure (Restraint, Eating Concern, Shape Concern, and Weight Concern) was theoretically derived. The first study evaluating the factor structure of the EDE-Q was conducted by Peterson and colleagues (2007) using a sample of women with bulimic

symptoms ($N = 203$). Exploratory factor analysis (EFA), extracting four factors, was performed. Factor loadings ranged from 0.27 to 1.03 and correlations among the factors ranged from 0.07 to 0.49 (Peterson et al., 2007). Overall, the Eating Concern and Restraint subscales were supported, but most items from the Weight Concern and Shape Concern subscales loaded onto one factor (Peterson et al., 2007).

Since this time, numerous studies have evaluated the factor structure of the EDE-Q, using participants from a wide variety of populations (for a review, see Jenkins & Rienecke, 2022). Of these studies, only two (Franko et al., 2012; Villarroel, et al., 2011) have supported the 4-factor structure originally proposed by Fairburn and Beglin (1994). Additionally, in line with Peterson and colleagues (2007), several studies have found that most items in the Weight Concern and Shape Concern subscales load onto one factor in the best-fitting solution (see Jenkins & Rienecke, 2022). While there is mixed evidence for a global index, the review concluded that a 7-item version of the EDE-Q proposed by Grilo and colleagues (2015) produced better and more consistent results in terms of model fit. Given the lack of consensus regarding the factor structure of the 22-item EDE-Q, we report only the EDE-Q global score throughout this thesis. This approach also aligns with many other treatment studies that report only the EDE or EDE-Q global score (e.g., Fairburn et al., 2009; Wade et al., 2011; Tatham et al., 2020; Pellizzer et al., 2019a), and thereby allows greater comparability with prior research in the field.

Reliability

The EDE-Q global score has demonstrated excellent internal consistency (Cronbach's alphas ranging from .93 to .95; Aardoom et al., 2012; Calugi et al., 2017; Ro et al., 2015). It has also demonstrated excellent test-retest reliability over periods of 7 to 22 days (rs ranging from .80 to .93; Calugi et al., 2017; Ro et al., 2015).

Validity

In support of concurrent validity, the EDE-Q global score has been shown to discriminate well between people with an eating disorder and healthy controls (Aardoom et al., 2012; Berg et al., 2012; Ro et al., 2015). It has also been shown to correlate with the global score from the EDE interview ($r = .84$; Mond et al., 2004). Moreover, the frequencies of objective and subjective binge eating episodes reported on the EDE-Q have been shown to correlate with frequencies of these behaviours reported in food diaries (Berg et al., 2012). The EDE-Q has also demonstrated evidence of ecological validity. For instance, Mason and colleagues (2018) used ecological momentary assessment over a two-week period in a sample of adults with and without BED ($N = 50$) and found that baseline EDE-Q global scores predicted both cognitive and behavioural eating disorder symptoms in daily life. Finally, in support of predictive validity, the EDE-Q has also been shown to predict treatment outcomes. For example, Masheb and Grilo (2008) found that lower EDE-Q global scores at baseline predicted lower post treatment binge frequencies as well as eating disorder psychopathology in a sample of adults with BED ($N = 75$).

Clinical Impairment

Description

The 16-item self-report Clinical Impairment Assessment (CIA; Bohn et al., 2008; Bohn & Fairburn, 2008) was used to measure psychosocial impairment caused by eating disorder psychopathology over the past 28 days. Items (e.g., "Over the past 28 days, to what extent have your eating habits, exercising or feelings about your eating, shape or weight affected your ability to make everyday decisions?") are rated on 4-point Likert scales ranging from 0 (*Not at all*) to 3 (*A lot*). Scores are summed to produce a global score. The global score can range from 0 to 48, with higher scores indicating greater psychosocial impairment

and a global score of 16 indicating an eating disorder (Bohn et al., 2008). The CIA was designed to complement and be administered directly after the EDE-Q (Bohn et al., 2008).

Factor Structure

Bohn and colleagues (2008) found support for a three-factor model, using principal components analysis. This model accounted for 77% of the variance and loadings ranged from 0.45 to 0.86 (Bohn et al., 2008). The three factors related to three domains of impairment: personal, social, and cognitive (Bohn et al., 2008). Item response theory showed that the overall measure as well as each domain were unidimensional, supporting the use of the global and domain-specific scores (Bohn et al., 2008). The original factor structure has been replicated among people with eating disorders and healthy controls in several studies using CFA (Calugi et al., 2018: RMSEA = 0.07; CFI = 0.97; Martin et al., 2015: RMSEA = 0.06; CFI = .99) and principal components analysis (Reas et al., 2010: only 3 eigenvalues > 1). However, other research supports a bifactor model comprising a general factor that influences scores on all items and three unreliable subfactors (Maraldo et al., 2021: RMSEA = 0.13; CFI = 0.92 in a clinical sample; Raykos et al., 2019: RMSEA: .04; CFI: .99 in a community sample and RMSEA = .05; CFI = .99 in a clinical sample). Given the CIA is a unidimensional measure and subscales are unreliable, we report only CIA global scores throughout this thesis.

Reliability

The CIA global score has good internal consistency (Cronbach's alphas ranging from .88 to .97; Bohn et al., 2008; Calugi et al., 2018; Jenkins, 2013). It also has demonstrated good test-retest reliability over periods of three to 24 days (*r*s ranging from .74 to .86; Bohn et al., 2008; Calugi et al., 2018).

Validity

The CIA global score has been shown to correlate with the EDE-Q global score (*r*s ranging from .72 to .89; Bohn et al., 2008; Calugi et al., 2018; Raykos et al., 2019), the EDE global score (*r*s ranging from .54 to .62; Raykos et al., 2019), clinicians' ratings of impairment (*r* = .68; Bohn et al., 2008), and a measure of general psychopathology (*r* = .76; Calugi et al., 2018). The CIA global score also discriminates well between people with eating disorders and healthy controls (Bohn et al., 2008; Jenkins et al., 2013; Raykos et al., 2019; Vannucci et al., 2012).

Negative Affect

Description

The 21-item Depression Anxiety and Stress Scale-Short form (DASS-21; Lovibond & Lovibond, 1995) was used to measure general negative affect. Items (e.g., "I was unable to become enthusiastic about anything") are rated on four-point Likert scales which range from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much or most of the time*). This self-report questionnaire produces three subscales (Depression, Anxiety, and Stress) which can be categorised as normal, mild, moderate, severe, or extremely severe. Scores on these three subscales are summed and multiplied by two to produce a total score. The total score can range from 0 to 126, and higher total scores indicate greater general negative affect (Lovibond & Lovibond, 1995).

Factor Structure

Antony and colleagues (1998) examined the factor structure of the DASS-21 in a clinical sample (*N* = 258). EFA supported a three-factor model (depression, anxiety, and stress) that explained 67% of the variance. Support for a three-factor model was also found by Clara and colleagues (2001) using CFA and a sample of psychiatric outpatients (*N* = 439). Clara and colleagues also found that the DASS-21 demonstrated improved fit than the

original 42-item version of the DASS. Using CFA and a nonclinical sample ($N = 1794$), Henry and Crawford (2005) found that the model with the best fit indices was quadripartite and included an additional (general distress) factor. All items loaded onto this factor with loadings of at least .36 (Henry & Crawford, 2005). Similarly, Osman and colleagues (2012) found support for a bifactor model that included a general factor (negative emotions), using EFA and CFA in two samples of university students ($N = 887$ & $N = 410$). Thus, as the DASS-21 appears to tap a general factor reflecting distress or negative emotions, and to avoid over-testing, we report only DASS-21 total scores throughout this thesis. The exception is the baseline demographic information in **Chapter 8**, in which subscales are reported in order to give a finer grained description of psychopathology in the sample in the absence of a structured diagnostic assessment.

Reliability

The DASS-21 total score has demonstrated good internal consistency (Cronbach's alphas ranging from .88 to .94; Asghari & Dibajnia, 2008; Henry & Crawford, 2005; Tran et al., 2013; Wang et al., 2016). It has also demonstrated good test-retest reliability over periods of two-weeks to six-months (*r*s ranging from .46 to .74; Bottesi et al., 2015; Wang et al., 2016).

Validity

The DASS-21 total score has also been shown to discriminate well between clinical and non-clinical populations, and to correlate with other validated measures of depression, anxiety, stress, mixed depression and anxiety, and negative affect (Antony et al., 1998; Beaufort et al., 2017; Bottesi et al., 2015; Henry & Crawford, 2005; Osman et al., 2012).

Chapter 8

Shortening and Managing the Impact of Lengthy Waitlists:

A Randomised Controlled Trial of Strategies Worth Investigating for People with Non-Underweight Eating Disorders[6]

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[6] Some of the analyses described in this chapter have been published. Ella Keegan contributed 80%, 80%, and 80% and Tracey Wade contributed 20%, 20%, and 20% to the research design, data collection and analysis, and writing and editing, respectively.

Keegan, E., & Wade, T. D (2023). Motivation to Change: A Moderator of Outcomes in 10-Session Cognitive Behavioural Therapy. *International Journal of Eating Disorders*.

Abstract

People with non-underweight eating disorders are often placed on lengthy waitlists for CBT-ED, which is associated with increased dropout. To shorten waitlists, this study evaluated shorter CBT-ED (CBT-T) and sought to identify moderators and predictors of treatment outcomes and retention. We also evaluated waitlist interventions as a potential strategy to manage the impact of lengthy waitlists. The 85 participants were referred to FUSED for CBT-T and randomised to one of two waitlist interventions (CRT-Brief or brief contact) or to waitlist control. From pre- to post-CBT-T, medium to large effect size decreases were observed for intent-to-treat eating disorder psychopathology: -1.15 (-1.60 to -0.70), clinical impairment: -1.18 (-1.56 to -0.79), and negative affect: -0.74 (-1.10 to -0.39). At post-CBT-T, 81% of completers had a good outcome (EDE-Q global score ≤ 2.77) and 51% were in remission. At 3-month follow-up, decreases were observed for the first two variables, but effect sizes had halved. We identified three baseline moderators of treatment outcomes (central coherence, set shifting, and confidence to change) and one predictor of retention (BMI). People with AAN benefited significantly less over time than people with other eating disorder diagnoses. Of the 82 people who started CBT-T, 45 (54.88%) did not complete. While not statistically significant, receiving either waitlist intervention doubled retention in CBT-T. The present study provides support for shorter CBT-ED as a strategy to shorten waitlists and waitlist intervention as a strategy to manage the impact of lengthy waitlists by improving retention.

Introduction

Treatment for people with non-underweight eating disorders typically comprises up to 20 sessions (NICE, 2017), despite no evidence that this is the optimal dose. Furthermore, clinicians routinely extend the length of treatment and provide far more than the recommended 20 sessions (Cowdrey & Waller, 2015). Consequently, CBT-ED is usually very expensive to deliver, waitlists tend to be long, and people with non-underweight eating disorders are typically unable to access the treatment that they require in a timely fashion. This is problematic as time spent on waitlists has been shown to predict dropout from CBT-ED (Carter et al., 2012).

The body of work for this PhD was brought together in an RCT investigating ways to shorten waitlists (Aim 1) and manage the impact of lengthy waitlists on dropout from subsequent treatment (Aim 2). To shorten waitlists, we evaluated shorter CBT-ED treatment and sought to identify moderators and predictors of treatment outcomes and retention to inform a precision medicine approach. As establishing replicability is a key step in developing new therapies (Open Science Collaboration, 2015), we evaluated CBT-T, the shorter CBT-ED treatment (excluding guided self-help) with the most evidence. Additionally, as variables selected for analysis should be theoretically or empirically driven (Linardon, de la Piedad Garcia et al., 2017), we examined central coherence, set shifting, objective binge eating and vomiting frequencies, BMI, and motivation (i.e., readiness and confidence to change) as these baseline variables have been shown to be significant moderators and/or predictors in previous eating disorder research (Gregertsen et al., 2019; Keegan, Byrne et al., 2022; Linardon, de la Piedad Garcia et al., 2017; Wade, Ghan et al., 2021). We also examined diagnosis as a potential moderator and predictor as little is known about AAN, other than it now appears to be more prevalent in the community than AN (Harrop et al.,

2021). To manage the impact of lengthy waitlists, we evaluated the use of two waitlist interventions, CRT-Brief and brief contact, compared to waitlist as usual.

Method

Design and Procedure

The present study was conducted at the Flinders University Services for Eating Disorders (FUSED), an outpatient university training clinic located in Adelaide, South Australia. People who had self-referred or been referred to FUSED were placed on an initial waitlist before assessment, with a mean wait duration of 60.86 days ($SD = 58.54$; range: 2 to 449). As therapist availability appeared, people were invited to a face-to-face assessment, during which the information required for diagnosis and to determine eligibility was gathered using a semi-structured clinical interview following a standardised outline (Wade & Pellizzer, 2018). The interview covered current eating patterns, bingeing, compensatory behaviours, body image concerns, co-morbidities, suicidal ideation, self-harm, development of the eating problems, and treatment history. People were also given information about CBT-T, the non-negotiables of treatment, and the main changes that they would need to make during CBT-T based on the symptoms that they reported during the assessment. Diagnoses and eligibility were discussed and confirmed in supervision. Following the initial assessment, people who were ineligible were directed to other, more appropriate resources and/or services. Those who were eligible, were given one week to decide whether they would like to participate and the link to the baseline questionnaire assessment.

People who decided to participate returned to FUSED one week later for a second assessment and were randomised to one of three waitlist conditions: CRT-Brief, brief contact, or control (waitlist as usual). Block randomisation was conducted in Excel (block size = 4 participants) by the PhD Candidate who generated sealed envelopes containing group allocation for therapists to open at the start of the second assessment. Following

randomisation, all participants completed the RCFT and the manual WCST, and those in the CRT-Brief waitlist condition were provided CRT-Brief by the PhD Candidate or a trainee psychologist. At the end of the second assessment, all participants were placed on a one-month waitlist for CBT-T. During this time, participants in the CRT-Brief condition were emailed weekly reminders to complete homework. After two weeks, participants in the brief contact condition were sent a short, supportive email and psychoeducational content. At the end of the waitlist period, participants in all three waitlist conditions were offered CBT-T.

Participants

The 85 participants were drawn from consecutive referrals to FUSED between June 2020 and March 2022. Over the COVID-19 pandemic, participants were seen face-to-face with precautions such as social distancing and face masks. Referrals came from the following sources: SEDS ($n = 52$; 61.2%), self-referrals ($n = 21$; 24.7%), other health professionals ($n = 9$; 10.6%), and general practitioners ($n = 3$; 3.5%). The following inclusion criteria were applied: (1) aged ≥ 15 years; (2) a BMI ≥ 18.5; (3) a DSM-5 diagnosis of an eating disorder (APA, 2013); (4) willing for FUSED to communicate with their general practitioner; and (5) agreed to commit to treatment. People with a BMI less than 18.5 were included if they were medically stable and not currently losing weight. At baseline, BMI ranged from 17.96 to 52.78. As a non-funded student training clinic, FUSED did not accept referrals for people with substance dependence, active psychosis, high suicidality, or difficulty understanding or speaking English. To manage spiralling waitlists, people with BED and those already receiving treatment for an eating disorder were also excluded.

Detailed demographic information and clinical characteristics for the 85 participants are provided in **Tables 8.1** and **8.2**, respectively. There were no significant baseline differences between the three waitlist conditions when tested with one-way ANOVAs and Pearson Chi-Square analyses. The mean scores on the DASS-21 subscales indicated that the

sample met the cut offs for severe levels of depression and anxiety and moderate levels of

stress at baseline (Lovibond & Lovibond, 1995). The participant flow through the

intervention is shown in **Figure 8.1.**

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Table 8.1

Baseline Demographic Information

Characteristic Frequency (%)	Whole sample (N = 85)	CRT-Brief (n = 30)	Brief contact (n = 28)	Control (n = 27)	X^2 (df), p
Age (years) [a]	26.70 (8.80)	23.32 (4.47)	28.77 (8.45)	30.10 (12.06)	F= 2.58 (2, 34), .09
Gender					3.92 (4), .42
Female	81 (95.3)	28 (93.3)	26 (92.9)	27 (100)	
Male	3 (3.5)	2 (6.7)	1 (3.6)	0 (0)	
Transgender [b]	1 (1.2)	0 (0)	1 (3.6)	0 (0)	
Ethnicity					4.95 (8), .76
Caucasian	72 (84.7)	26 (86.7)	22 (78.6)	24 (88.9)	
Aboriginal/Torres Strait Islander	1 (1.2)	1 (3.3)	0 (0)	0 (0)	
Asian	6 (7.1)	2 (6.7)	2 (7.1)	2 (7.4)	
African	2 (2.4)	1 (3.3)	1 (3.6)	0 (0)	
Middle Eastern	1 (1.2)	0 (0)	1 (3.6)	0 (0)	
Not reported	3 (3.5)	0 (0)	2 (7.1)	1 (3.7)	
Education level					11.65 (10), .31
Still at school	14 (16.5)	5 (16.7)	7 (25)	2 (7.4)	
Left school at age 15 or less	3 (3.5)	0 (0)	1 (3.6)	2 (7.4)	
Left school after age 15	23 (27.1)	7 (23.3)	9 (32.1)	7 (25.9)	
Trade/Apprenticeship	1 (1.2)	1 (3.3)	0 (0)	0 (0)	
Certificate/Diploma	21 (24.7)	11 (36.7)	4 (14.3)	6 (22.2)	
Bachelor's degree or higher	20 (23.5)	6 (20)	5 (17.9)	9 (33.3)	
Not reported	3 (3.5)	0 (0)	2 (7.1)	1 (3.7)	

Work status					14.27 (12), .28
Full-time employed	9 (10.6)	2 (6.7)	3 (10.7)	4 (14.8)	
Part-time employed	13 (15.3)	6 (20)	3 (10.7)	4 (14.8)	
Casual employment	18 (21.2)	7 (23.3)	6 (20.4)	5 (18.5)	
Unemployed	18 (21.2)	4 (13.3)	5 (17.9)	9 (33.3)	
Home duties	1 (1.2)	0 (0)	0 (0)	1 (3.7)	
Retired	1 (1.2)	0 (0)	0 (0)	1 (3.7)	
Student	22 (25.9)	11 (36.7)	9 (32.1)	2 (7.4)	
Not reported	3 (3.5)	0 (0)	2 (7.1)	1 (3.7)	

Notes. Differences between waitlist conditions were tested for using a one-way ANOVA for age and Chi-square analyses for all other variables.

[a] Descriptive statistics are presented as means (standard deviations).

[b] = Male-to-female transgender.

Table 8.2

Baseline Clinical Characteristics

Characteristic Mean (*SD*)	Whole sample (*N* = 85)	CRT-Brief (*n* = 30)	Brief contact (*n* = 28)	Control (*n* = 27)	*F* (df), *p*
BMI	26.42 (8.28)	25.46 (7.72)	27.99 (9.46)	25.88 (7.60)	0.76 (2, 82), .47
Central coherence [a]	1.35 (0.38)	1.34 (0.44)	1.39 (0.38)	1.33 (0.32)	0.18 (2, 69), .84
Set shifting [b]	19.58 (17.31)	24.03 (18.72)	14.50 (13.37)	20.07 (18.52)	2.24 (2, 81), .11
Duration (years)	8.52 (8.67)	7.82 (8.04)	7.24 (6.57)	10.62 (10.88)	1.15 (2, 79), .32
Global EDE-Q	4.31 (1.11)	4.24 (1.15)	4.53 (0.93)	4.17 (1.23)	0.84 (2, 82), .43
Behavioural frequencies [c]					
Objective binge episodes	7.99 (9.36)	10.23 (9.44)	6.37 (8.94)	7.11 (9.53)	1.24 (2, 81), .25
Vomiting episodes	7.88 (11.99)	9.80 (13.83)	7.43 (11.39)	6.22 (10.43)	0.66 (2, 82), .52
Laxatives	2.11 (6.39)	2.17 (5.50)	2.07 (6.82)	2.07 (7.08)	0.00 (2, 82), .99
Driven exercise	5.71 (7.77)	5.83 (7.29)	5.79 (8.25)	5.52 (8.05)	0.01 (2, 81), .99
Global CIA	33.61 (7.51)	33.57 (7.85)	34.79 (7.63)	32.44 (7.07)	0.66 (2, 82), .52
DASS-21 total	69.62 (26.08)	70.33 (23.59)	72.43 (26.16)	65.93 (29.02)	0.44 (2, 82), .65
Depression [d]	12.58 (5.47)	12.73 (5.38)	12.36 (4.84)	12.62 (5.76)	0.03 (2, 78), .97
Anxiety [d]	9.93 (4.66)	11.18 (5.16)	9.74 (4.30)	8.81 (4.31)	1.84 (2, 79), .17
Stress [d]	12.74 (4.42)	12.90 (3.77)	13.52 (4.84)	11.81 (4.67)	0.99 (2, 78), .38
Readiness to change (0 – 10)	6.62 (2.24)	6.56 (1.91)	6.73 (2.57)	6.58 (2.27)	0.05 (2, 80), .95
Confidence to change (0 – 10)	5.24 (2.08)	5.16 (1.86)	5.14 (2.02)	5.43 (2.39)	0.16 (2, 80), .85
Diagnosis: *n* (%)					X^2 (10) = 8.82, .55
AN	4 (4.7)	1 (3.3)	1 (3.6)	2 (7.4)	
BN	34 (40)	17 (56.7)	9 (32.1)	8 (29.6)	
OSFED (AAN)	33 (38.8)	9 (30)	12 (42.9)	12 (44.4)	
OSFED (low frequency BN)	7 (8.2)	2 (6.7)	2 (7.1)	3 (11.1)	

OSFED (purging disorder)	3 (3.5)	1 (3.3)	1 (3.6)	1 (3.7)	
UFED	4 (4.7)	0 (0)	3 (10.7)	1 (3.7)	
Self-harm: n (%)	12 (14.1)	4 (13.3)	4 (14.3)	4 (14.8)	X^2 (2) = 0.03, .99
Suicidal ideation: n (%)	24 (28.2)	7 (23.3)	6 (21.4)	11 (40.7)	X^2 (2) = 3.08, .21

Notes. Differences between waitlist conditions were tested for using Pearson Chi-Square analyses for eating disorder diagnosis, self-harm, and suicidal ideation. One-way ANOVAs were used to test for differences between waitlist conditions for all other variables. BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; DASS-21 = Depression, Anxiety, and Stress Scale-Short form.

[a] Measured using the Central Coherence Index from the Rey Complex Figure Test.
[b] Measured using perseverative errors from the Wisconsin Card Sorting Test.
[c] Behavioural frequencies reflect the past month and were obtained from the EDE-Q.
[d] Depression, Anxiety, and Stress scores were obtained from the DASS-21.

Figure 8.1

CONSORT Flow Diagram
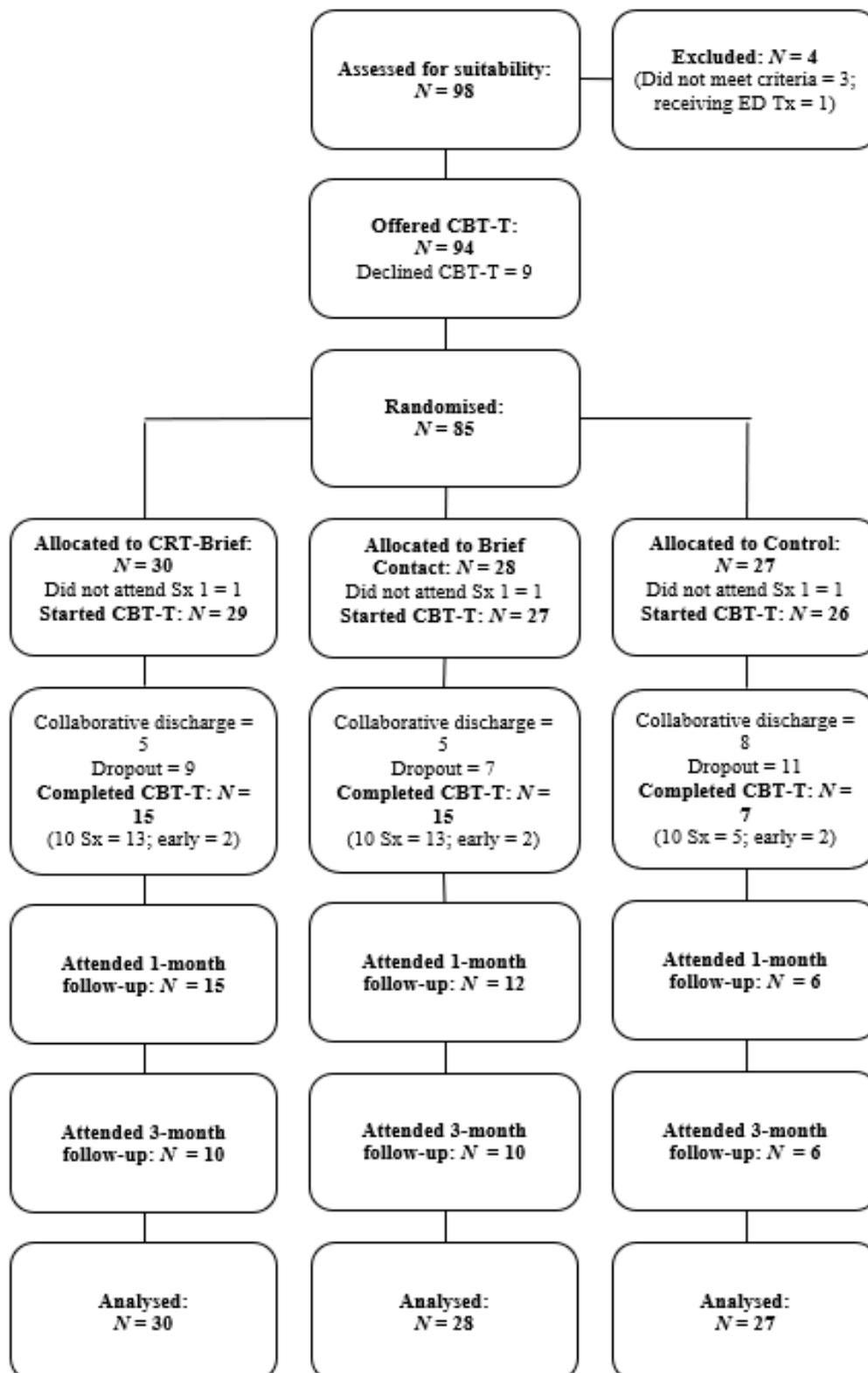
Sample Size Calculation

Our main outcome was global eating psychopathology, measured using the global score of the EDE-Q (Fairburn & Beglin, 2008). On this outcome, Fursland et al (2018) observed a small (.32) within-group effect size following a single session waitlist intervention. Thus, we predicted a small effect between our active waitlist conditions (CRT-Brief and brief contact) and the control condition. A longitudinal power analysis was performed on an intent-to-treat basis using a power level of 0.80 and an alpha of .05 (Hedeker et al., 1999). This revealed that a sample of 213 participants (71 per waitlist condition) was required. The final sample comprised 85 participants, where data collection ceased within the duration of the PhD study. A post-hoc power-analysis showed that the study was powered to detect a medium (.51) effect size (Hedecker et al., 1999) for our main outcome variable.

Ethics Approval and Pre-Registration

Ethics approval was obtained from the Social and Behavioural Research Ethics Committee at Flinders University, South Australia (Project Number: 8613). All participants gave written informed consent prior to participation. For underage participants, assent was obtained as well as consent from parents/guardians. The study was also pre-registered with the Australian New Zealand Clinical Trials Registry (Trial ID: ACTRN12621000435886).

Waitlist Conditions

CRT-Brief

Participants in this condition received CRT-Brief, the single session waitlist intervention with accompanying homework (described in **Chapter 6**). The CRT-Brief session was provided at the start of the waitlist period (at the end of the second assessment) to allow time for homework completion. Participants in this condition were emailed weekly reminders to complete homework throughout the waitlist period.

Brief Contact

Halfway through the waitlist period, participants were sent a short supportive email and brief psychoeducation. The email read: "Hello [Name], We hope you are well. Attached to this email is a handout that you might like to read. It discusses eating disorders, and the ability of the brain to recover and regenerate with regular eating. Kind regards, FUSED." The psychoeducation was the Centre for Clinical Interventions handout "Eating Disorders and Neurobiology" (provided in **Appendix B** and discussed in the literature review of this thesis). The handout emphasises that recovery is possible with adequate re-nourishment and comprises five sections: "Science and Eating Disorders," "The Role of Genetics in Eating Disorders," "The Gene-Environment Interaction," "How Eating Disorders Affect the Brain," and "What does all this mean for Recovery?" As mentioned, it has been found to decrease disordered eating and improve body acceptance among young women at risk of developing an eating disorder, with medium to large effects (Zhou et al., 2020).

Control

The control condition was waitlist as usual. FUSED did not contact participants in this condition during the waitlist period.

Therapists and Adherence to Treatment

CBT-T was delivered by the PhD Candidate and seven trainee psychologists who were completing either their Masters or PhD in clinical psychology at Flinders University. Throughout the study, all therapists received expert bi-weekly supervision from Professors Tracey Wade and Glenn Waller, who developed CBT-T. During supervision, adherence was closely monitored using the detailed CBT-T protocol (https://sites.google.com/sheffield.ac.uk/cbt-t/resources?authuser=0).

Measures

Participants completed neuropsychological and questionnaire measures throughout the RCT as shown in **Table 8.3**. The measures were selected due to their strong psychometric properties. For detailed descriptions of the measures as well as information regarding psychometric properties and factor structure, see **Chapter 7**.

Table 8.3

Assessment Schedule for the RCT

Measure	Baseline (Assessment)	Pre-Tx (Session 1)	Mid-Tx (Session 4)	Post-Tx (Session 10)	FU1	FU3
RCFT	✓			✓		
WCST	✓			✓		
BMI	✓	✓	✓	✓	✓	✓
EDE-Q	✓	✓	✓	✓	✓	✓
CIA	✓	✓	✓	✓	✓	✓
DASS-21	✓	✓	✓	✓	✓	✓
Motivation	✓					
Confidence & suitability		✓				

Notes. Tx = treatment; FU1 = 1-month follow-up; FU3 = 3-month follow-up; RCFT = Rey Complex Figure Test; WCST = Wisconsin Card Sorting Test; BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; DASS-21 = Depression, Anxiety, and Stress Scale-Short form.

Executive Functioning

Set shifting was measured using the Wisconsin Card Sorting Test (WCST; Heaton et al., 1993) and central coherence using the Rey Complex Figure Test (RCFT; Osterrieth, 1944). A recent meta-analysis found that these two tests were the most commonly used measures in studies examining set shifting and central coherence among people with an eating disorder and healthy controls (Keegan et al., 2021).

BMI

Height (m) and weight (kg) were used to calculate BMI as kg/m^2. Height was measured at baseline and weight was measured at baseline, each CBT-T session, and each

follow-up appointment. As per the CBT-T protocol, weight was shared with participants each week as part of treatment (Waller et al., 2019).

Eating Disorder Psychopathology and Behavioural Frequencies

The global score of the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 2008) was used to measure eating disorder psychopathology over the past 28 days. The frequencies of objective binge eating, self-induced vomiting, laxative misuse, and driven exercise were obtained from Items 15 to 18 of the EDE-Q. In the present study internal consistency was $\alpha = .78$.

Clinical Impairment

The Clinical Impairment Assessment (CIA; Bohn et al., 2008; Bohn & Fairburn, 2008) was used to assess psychosocial impairment caused by eating disorder psychopathology over the past 28 days. In the present study, internal consistency was $\alpha = .87$.

Negative Affect

The total score from the Depression Anxiety and Stress Scale-Short form (DASS-21; Lovibond & Lovibond, 1995) was used to measure general negative affect. In the present study, internal consistency was $\alpha = .94$.

Motivation

We assessed two aspects of motivation (readiness and confidence) using two questions: "How ready are you to change?" and "If you decided to change, how confident are you that you would succeed?" Answers were provided on 10-point Likert scales. These questions are sensitive to changes in motivation over time and have been shown to predict outcomes in guided self-help as well as inpatient treatment (e.g., Steele et al., 2011; Wade et al., 2009).

Perceived Confidence and Suitability of the Treatment

Perceived confidence and suitability were assessed in CBT-T Session 1 using two questions: "How confident are you in this approach?" and "How suitable is this approach to you?" Answers were given on 100-point visual analogue scales.

Statistical Analyses

All analyses were conducted using IBM Statistical Package for the Social Sciences (Version 22; IBM Corp, 2013). Logistic regression analyses were conducted to determine whether baseline variables or waitlist condition predicted missing data. Missing data were not imputed as all participants had data from at least two time points. Non-completion was defined as starting CBT-T but not completing all 10 sessions (unless an earlier finish was collaboratively agreed between the therapist and client as treatment had met its targets). One-way ANOVAs and Pearson Chi-Square analyses were used to test for baseline differences between those who completed CBT-T, were collaboratively discharged, and were prematurely discharged.

Change Over Time

Linear mixed model (LMM) analyses were used to investigate whether continuous variables changed over time or differed between waitlist conditions. All LMM analyses were adjusted for baseline observations and constituted 3 (waitlist condition: CRT-Brief, brief contact, control) by 5 (time: pre-treatment, mid-treatment, post-treatment, 1-month follow-up, 3-month follow-up) analyses. LMM analyses assume data are missing at random, and were not used to analyse BMI, as directional change is not predicted in people with non-underweight eating disorders. Generalised linear mixed model (GLMM) analyses were used to investigate whether count variables changed over time or differed between waitlist conditions. All GLMM analyses used a negative binomial distribution and link = log and constituted 3 (waitlist condition: CRT-Brief, brief contact, control) by 5 (time: pre-treatment,

mid-treatment, post-treatment, 1-month follow-up, 3-month follow-up) analyses. Bonferroni corrections were applied for all comparisons.

Binary Outcomes

For completers, we calculated abstinence, good outcome, and remission at post-treatment, 1-month follow-up, and 3-month follow-up. Abstinence was defined as being free from all bulimic behaviours, that is, objective binge eating, vomiting, laxative misuse, and driven exercise (Items 15 to 18 from the EDE-Q). Good outcome was defined as having an EDE-Q global score of no more than one standard deviation above the norm for women without an eating disorder (2.77; Mond et al., 2006). Remission was defined as being free from binge eating and compensatory behaviours and having a good outcome. Completer Pearson Chi-Square analyses were also used to test whether abstinence, good outcome, or remission differed between waitlist conditions at post- treatment, 1-month follow-up, or 3-month follow-up.

Moderators and Predictors

To investigate potential baseline moderators of change over time in eating disorder psychopathology, a separate LMM analysis was conducted for each potential baseline moderator. When significant interactions were observed, participants were categorised as being low or high on the baseline variable using a median split to graph the interaction. Potential baseline predictors of retention, abstinence, good outcome, and remission were investigated using logistic regression analyses. When investigating potential moderators and predictors, BMI was dichotomised as overweight (BMI >25) versus not (BMI <25) and diagnosis as AAN versus other diagnoses.

Calculation of Effect Sizes

Within-group effect sizes were calculated as Cohen's *d* and were adjusted for the correlation between observations (Lakens, 2013). As per convention, effect sizes were interpreted as 0.2 = small, 0.5 = moderate, and 0.8 = large (Cohen, 1992).

Results

Preliminary Analyses

Normality

Prior to analysis, data were checked for normality using visual inspection of distributions and formal inference tests to ensure suitability of parametric statistics (Tabachnick & Fidel, 2012). All variables were normally distributed at baseline, pre-treatment, and mid-treatment. Departures from normality were observed at post-treatment (DASS total, global EDE-Q, and global CIA) and 1-month follow-up (global CIA). Further inspection of the data revealed that transformations across all time points for these variables did not improve normality. Thus, the analyses used untransformed data, as recommended by Tabachnick and Fidel (2012).

Missing Data

Executive Functioning Data. Participants were classified as having complete executive functioning data (baseline and post-treatment) or missing executive functioning data (missing baseline and/or post-treatment). Of the 85 participants, 28 had complete executive functioning data and 57 did not. Waitlist condition did not predict whether participants were missing RCFT (*Wald*(2) = 2.59, *p* = .27) or WCST data (*Wald*(2) = 1.94, *p* =.38). Additionally, there were no significant baseline predictors of missing RCFT or WCST data (see **Table 8.4**). Therefore, executive functioning data were missing at random.

Table 8.4

Logistic Regression Analyses to Assess Potential Predictors of Missing Executive Functioning Data

Baseline variable	Complete RCFT data M (SD)	Missing RCFT data M (SD)	OR (95% CI)	Complete WCST data M (SD)	Missing WCST data M (SD)	OR (95% CI)
Age	27 (6.75)	26.48 (9.75)	0.99 (0.92 to 1.07)	27.30 (7.06)	26.45 (9.56)	0.99 (0.91 to 1.07)
BMI	27.89 (8.46)	25.71 (8.16)	0.97 (0.92 to 1.02)	27.95 (8.42)	25.67 (8.17)	0.97 (0.92 to 1.02)
Duration (years)	9.29 (9.26)	8.17 (8.44)	0.99 (0.94 to 1.04)	8.59 (9.18)	8.49 (8.50)	1.00 (0.95 to 1.05)
Global EDE-Q	4.17 (1.11)	4.38 (1.10)	1.19 (0.79 to 1.79)	4.08 (1.26)	4.43 (1.02)	1.33 (0.88 to 2.00)
Objective binges	7.43 (8.90)	8.27 (9.64)	1.01 (0.96 to 1.06)	7.43 (9.00)	8.27 (9.64)	1.01 (0.96 to 1.06)
Vomits	7.54 (11.22)	8.05 (12.44)	1.00 (0.97 to 1.04)	7.57 (11.20)	8.04 (12.45)	1.00 (0.97 to 1.04)
Laxative misuse	0.71 (2.21)	2.79 (7.59)	1.09 (0.95 to 1.23)	0.71 (2.21)	2.79 (7.59)	1.09 (0.95 to 1.23)
Driven exercise	5.63 (7.45)	5.75 (7.98)	1.00 (0.94 to 1.06)	5.63 (7.45)	5.75 (7.98)	1.00 (0.94 to 1.06)
Global CIA	33.79 (8.07)	33.53 (7.29)	1.00 (0.94 to 1.06)	33.61 (8.12)	33.61 (7.26)	1.00 (0.94 to 1.06)
DASS-21 total	66.77 (25.26)	72.55 (26.12)	1.01 (0.99 to 1.03)	64.79 (26.16)	72.00 (25.93)	1.01 (0.99 to 1.03)
Days on waitlist	47.50 (31.85)	67.42 (67.22)	1.01 (1.00 to 1.02)	48.11 (31.78)	67.12 (67.32)	1.01 (1.00 to 1.02)

Notes. RCFT = Rey Complex Figure Test; WCST = Wisconsin Card Sorting Test; *M* = mean; *SD* = standard deviation; OR = odds ratio; CI = confidence interval; BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; DASS-21 = Depression Anxiety and Stress Scale-Short form.

Questionnaire Data. Participants were categorised as having completed questionnaires at all six assessment points or having missing data at one or more assessment points. Overall, 15 participants had completed all questionnaire assessments and 70 had missing data. Waitlist condition did not predict whether participants were missing questionnaire data, *Wald*(2) = 2.81, *p* =.25. Additionally, as shown in **Table 8.5**, there were no significant baseline predictors of missing data. Therefore, questionnaire data were missing at random.

Table 8.5

Logistic Regression Analyses to Assess Potential Predictors of Missing Questionnaire Data

Baseline variable	Complete Data M (SD)	Missing Data M (SD)	OR (95% CI)
Age	24.50 (5.18)	27.13 (9.34)	1.04 (0.92 to 1.19)
BMI	25.20 (7.98)	26.69 (8.37)	1.03 (0.95 to 1.12)
Duration (years)	6.96 (6.90)	8.84 (9.00)	1.03 (0.95 to 1.12)
Global EDE-Q	4.32 (0.96)	4.31 (1.14)	0.99 (0.59 to 1.64)
Objective binges	4.47 (5.90)	8.75 (9.82)	1.07 (0.98 to 1.16)
Vomits	4.40 (10.43)	8.63 (12.23)	1.04 (0.98 to 1.11)
Laxative misuse	0.60 (1.60)	2.43 (6.98)	1.09 (0.90 to 1.33)
Driven exercise	4.27 (5.23)	6.03 (8.22)	1.04 (0.95 to 1.13)
Global CIA	34.33 (6.97)	33.46 (7.66)	0.98 (0.91 to 1.06)
DASS-21 total	64.27 (18.17)	70.77 (27.44)	1.01 (0.99 to 1.03)
Days on waitlist	54.00 (38.10)	62.33 (62.17)	1.00 (0.99 to 1.02)

Notes. M = mean; *SD* = standard deviation; OR = odds ratio; CI = confidence interval; BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; DASS-21 = Depression Anxiety and Stress Scale-Short form.

Participant Flow

Suitability and Acceptability

As shown in **Figure 8.1**, 98 people were originally assessed for eligibility to participate in the study. Of these people, three were excluded as they did not have an appropriate diagnosis and one was excluded because they were already receiving eating disorder treatment. The remaining 94 people were eligible. Therefore, suitability for CBT-T was high (95.92% of those assessed). Acceptability of the treatment was assessed by considering the number of people who started CBT-T compared to the number of people who were offered CBT-T. Unacceptability was demonstrated by 12 people. Of these people, nine actively declined CBT-T prior to randomisation. The remaining three people passively declined CBT-T after randomisation by not attending the first session. Thus, 82 people commenced CBT-T (87.23% of those who were suitable), suggesting relatively high acceptability. Moreover, participants who attended the first treatment session provided high ratings of their confidence in CBT-T ($M = 73.39$; $SD = 14.48$) as well as the suitability of CBT-T for treating their eating disorder ($M = 76.30$; $SD = 14.42$).

Non-Completion Rates

There were no significant differences between waitlist conditions in terms of the number of people who completed treatment, collaboratively discharged, or prematurely discharged, $X^2(4) = 5.33$, $p = .26$. As shown in **Table 8.6**, the only significant difference at baseline was that those who completed CBT-T had a higher average BMI than those who were collaboratively discharged. While not significant, non-completers spent a third more time on the initial waitlist (69 days) than those who completed treatment (46 days). Of the 82 people who started CBT-T, 45 (54.88%) did not complete. Of these people, 18 (40%) were discharged at Session 4 due to lack of early change (collaborative discharge) and 27 (60%) ceased treatment without discussion with their therapist (premature discharge). On average,

those who collaboratively discharged attended 4.89 sessions (*SD* = 1.49; range: 3 to 9). Those

who prematurely discharged attended 3.81 sessions (*SD* = 2.39; range: 1 to 9).

Table 8.6

Baseline Characteristics of Participants who Completed, Collaboratively Discharged, and

Prematurely Discharged

Baseline variable	Completed (*n* = 37) *M (SD)*	Collaboratively discharged (*n* = 18) *M (SD)*	Prematurely discharged (*n* = 27) *M (SD)*	*F* (df), *p*
Age	27.10 (6.47)	22.38 (4.15)	26.61 (10.39)	0.94 (2, 33), .40
BMI	28.50 (8.92)	21.79 (2.12)	25.85 (8.56)	4.47 (2, 79), .01*
Central coherence	1.37 (0.41)	1.26 (0.27)	1.38 (0.40)	0.49 (2, 67), .62
Set shifting	17.97 (15.17)	15.56 (12.43)	23.07 (21.22)	1.22 (2, 78), .30
Duration (years)	9.25 (8.88)	5.80 (5.65)	7.93 (5.80)	1.33 (2, 76), .27
Global EDE-Q	4.11 (1.18)	4.70 (0.90)	4.27 (1.14)	1.69 (2, 79), .19
Objective binges	7.54 (8.77)	6.83 (9.03)	8.30 (10.28)	0.14 (2, 79), .87
Vomiting episodes	7.08 (10.34)	9.44 (11.33)	8.44 (14.97)	0.25 (2, 79), .78
Laxatives	0.84 (2.17)	4.56 (9.78)	2.44 (7.49)	2.07 (2, 79), .13
Driven exercise	5.44 (7.02)	9.28 (10.46)	4.33 (6.35)	2.35 (2, 78), .10
Global CIA	33.62 (7.90)	34.11 (6.93)	32.78 (7.81)	0.18 (2, 79), .84
DASS-21 total	65.30 (25.21)	69.67 (30.45)	74.00 (24.04)	0.88 (2, 79), .42
Days on waitlist	46.89 (29.08)	67.56 (97.69)	70.56 (44.98)	1.67 (2, 79), .20

Notes. BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire; CIA = Clinical Impairment Assessment; DASS-21 = Depression Anxiety and Stress-Short form. * Post hoc testing revealed that the significant difference was between completers and those who were collaboratively discharged.

Treatment Completers

Participants who completed treatment attended an average of 9.57 sessions ($SD =$ 1.24; range: 4 to 10). Six completers (16.22%) did not require all 10 sessions, as treatment met its targets early. Early completion did not significantly differ between waitlist conditions, $X^2(2) = 0.01$, $p = .99$. While there were no significant differences between waitlist conditions, descriptive statistics showed that those in CRT-Brief (51.72%) and brief contact (55.56%) were twice as likely to complete treatment than those in the control condition (26.92%), as can be seen in **Figure 8.1**.

Treatment Outcomes

Both completer and intent-to-treat analyses showed significant main effects of time for all continuous variables (**Table 8.7**). These indicated that eating disorder psychopathology, clinical impairment, and negative affect significantly decreased over time (**Table 8.8**). From pre- to post-treatment, effect sizes were very large for eating disorder psychopathology and clinical impairment and medium to very large for negative affect. Moreover, the mean EDE-Q and CIA global scores began in the clinical range and fell below the clinical cut-offs (EDE-Q: 2.77; CIA: 16) at post-treatment and both follow-up points. As shown in **Table 8.7**, there were no significant main effects of group nor interactions between time and group for any variables. BMI data was available for 32 of the 37 completers. From pre- to post-treatment, BMI increased among 21 participants from 28.71 ($SD = 9.76$) to 29.42 ($SD = 9.79$), decreased among 10 participants from 29.87 ($SD = 8.38$) to 29.11 ($SD = 8.26$), and did not change for one participant (BMI = 20.15 at pre- and post-treatment). In terms of behavioural frequencies, there were significant main effects of time for intent-to-treat vomiting and driven exercise. As shown in **Table 8.9**, these indicated that vomiting and driven exercise decreased over time, with small effects. No other main effects or interactions were significant (see **Table 8.7**).

Table 8.7

Outcomes from Linear Mixed Model Analyses and Generalised Linear Mixed Model Analyses of Treatment Outcome Variables

Outcome variable	Main effects		Interaction
	Time F(df), p	Group F(df), p	Time x group F(df), p
Completer			
EDE-Q	22.17 (4, 23.72), <.001	0.13 (2, 29.16), .88	0.17 (8, 23.45), .99
CIA	20.85 (4, 25.91), <.001	1.37 (2, 30.38), .27	0.40 (8, 25.79), .91
DASS	7.41 (4, 25.86), .001	1.55 (2, 29.79), .23	1.68 (8, 25.56), .15
Bingeing	…………………………..……*Did not converge*………..…………………………..		
Vomiting	…………………………..……*Did not converge*………..…………………………...		
Laxatives	0.07 (4, 140), .99	2.18 (2, 140), .12	0.01 (8, 140), .99
Driven exercise	1.67 (4, 140), .16	1.67 (2, 140), .19	0.23 (8, 140), .99
ITT			
EDE-Q	34.16 (4, 29.53), <.001	0.25 (2, 48.27), .78	0.39 (8, 28.77), .92
CIA	28.25 (4, 32.84), <.001	1.83 (2, 46.35), .17	0.82 (8, 32.98), .59
DASS	11.08 (4, 27.60), <.001	1.89 (2, 47.01), .16	1.13 (8, 28.35), .38
Bingeing	…………………………..……*Did not converge*………..…………………………...		
Vomiting	9.27 (4, 212), <.001	1.24 (2, 212), .92	0.66 (8, 212), .73
Laxatives	…………………………..……*Did not converge*………..…………………………...		
Driven exercise	3.10 (4, 212), .02	0.47 (2, 212), .63	0.74 (8, 212), .65

Notes. EDE-Q = Eating Disorder Examination-Questionnaire global score; BMI = body mass index; CIA = Clinical Impairment Assessment global score; DASS-21 = Depression Anxiety and Stress Scale-Short form total score; ITT = intent-to-treat. Frequencies of bingeing, vomiting, laxatives, and driven exercise were obtained from Items 15 to 18 of the EDE-Q and reflect the past month.

Table 8.8

Change Over Time in Continuous Variables and Within-Group Effect Sizes

Outcome variable	Baseline covariate	Assessment Point					Cohen's *d* (95% CI) [a]		
		Pre-Tx M (SE)	Mid-Tx M (SE)	Post-Tx M (SE)	FU1 M (SE)	FU3 M (SE)	Pre- to post-Tx	Pre-Tx to FU1	Pre-Tx to FU3
Completer									
EDE-Q									
Whole sample		3.68 (0.14)	2.23 (0.20)	1.44 (0.24)	1.51 (0.24)	1.60 (0.37)	-1.52 (-2.12 to -0.92)	-1.62 (-2.23 to -1.02)	-0.73 (-1.28 to -0.18)
CRT-Brief	4.14	3.79 (0.20)	2.36 (0.29)	1.65 (0.35)	1.55 (0.35)	1.64 (0.51)			
Brief contact		3.76 (0.20)	2.21 (0.29)	1.48 (0.35)	1.62 (0.37)	1.53 (0.52)			
Control		3.50 (0.31)	2.11 (0.44)	1.21 (0.52)	1.36 (0.53)	1.64 (0.85)			
CIA									
Whole sample		28.27 (1.50)	20.11 (1.76)	11.42 (1.92)	12.65 (2.29)	9.84 (3.12)	-1.42 (-1.96 to -0.88)	-0.84 (-1.35 to -0.33	-0.65 (-1.17 to -0.14)
CRT-Brief	33.65	30.87 (2.21)	21.72 (2.57)	15.88 (2.85)	15.12 (3.31)	12.40 (4.26)			
Brief contact		28.75 (2.21)	20.21 (2.53)	11.06 (2.85)	13.98 (3.50)	13.26 (4.31)			
Control		25.19 (3.24)	18.39 (3.85)	7.32 (4.13)	8.86 (4.91)	3.85 (7.14)			
DASS									
Whole sample		60.04 (2.29)	43.03 (3.35)	32.88 (4.90)	34.24 (5.62)	28.31 (6.99)	-1.05 (-1.61 to -0.50)	-0.60 (-1.12 to -0.09)	-0.52 (-1.05 to 0.01)
CRT-Brief	64.80	68.98 (3.38)	45.46 (4.91)	43.27 (7.29)	35.60 (8.09)	34.13 (9.79)			
Brief contact		57.47 (3.38)	40.40 (4.84)	33.93 (7.17)	41.94 (8.57)	44.96 (9.85)			
Control		53.67 (4.95)	43.23 (7.31)	21.43 (10.54)	25.17 (12.06)	5.84 (15.72)			

ITT

EDE-Q									
Whole sample		3.97 (0.07)	2.50 (0.16)	1.75 (0.21)	1.79 (0.21)	1.93 (0.32)	-1.15 (-1.60 to -0.70)	-1.22 (-1.68 to -0.76)	-0.51 (-0.90 to -0.12)
CRT-Brief	4.25	4.06 (0.12)	2.71 (0.24)	2.00 (0.33)	1.90 (0.32)	1.84 (0.44)			
Brief contact		3.85 (0.13)	2.47 (0.25)	1.70 (0.33)	1.85 (0.34)	1.54 (0.49)			
Control		4.01 (0.13)	2.33 (0.31)	1.56 (0.44)	1.61 (0.44)	2.43 (0.70)			
CIA									
Whole sample		31.13 (0.81)	21.24 (1.36)	13.09 (1.75)	13.63 (2.14)	13.50 (2.95)	-1.18 (-1.56 to -0.79)	-0.72 (-1.08 to -0.36)	-0.43 (-0.78 to -0.08)
CRT-Brief	33.58	31.41 (1.36)	24.31 (2.14)	17.86 (2.66)	17.77 (3.12)	16.66 (4.04)			
Brief contact		29.97 (1.41)	21.70 (2.17)	12.34 (2.69)	14.67 (3.39)	12.64 (4.58)			
Control		32.01 (1.44)	17.70 (2.73)	9.07 (3.64)	8.45 (4.46)	11.21 (6.42)			
DASS									
Whole sample		65.31 (1.60)	48.64 (2.68)	39.00 (4.38)	39.42 (5.09)	36.27 (6.75)	-0.74 (-1.10 to -0.39)	-0.45 (-0.78 to -0.11)	-0.29 (-0.63 to 0.04)
CRT-Brief	67.29	71.24 (2.68)	52.23 (4.22)	50.49 (6.65)	43.35 (7.42)	46.99 (9.53)			
Brief contact		59.72 (2.78)	43.84 (4.31)	36.61 (6.75)	44.81 (8.12)	46.38 (10.50)			
Control		64.96 (2.82)	49.86 (5.33)	29.90 (9.09)	30.11 (10.60)	15.44 (14.45)			

Notes. M = estimated mean; *SE* = standard error; Tx = treatment; FU1 = 1-month follow-up; FU3 = 3-month follow-up; EDE-Q = Eating Disorder Examination-Questionnaire; BMI = body mass index; CIA = Clinical Impairment Assessment; DASS-21 = Depression Anxiety and Stress Scale-Short form; ITT = intent-to-treat.

[a] As there were no significant interaction between time and group, effect sizes are calculated as Cohen's *d* for the whole sample and are adjusted for the correlation between observations.

Table 8.9

Change Over Time in Count Variables and Within-Group Effect Sizes

Behavioural frequency	Assessment point					Cohen's *d* (95% CI) [a]		
	Pre-Tx *M (SE)*	Mid-Tx *M (SE)*	Post-Tx *M (SE)*	FU1 *M (SE)*	FU3 *M (SE)*	Pre- to post-Tx	Pre-Tx to FU1	Pre-Tx to FU3
Completer								
Bingeing								
Whole sample	6.68 (8.33)	1.79 (3.27)	0.81 (1.40)	0.87 (1.74)	2.86 (6.41)	-0.64 (-1.10 to -0.17)	-1.06 (-1.54 to -0.58)	-0.41 (-0.87 to 0.05)
CRT-Brief	9.30 (9.00)	2.40 (3.19)	1.33 (1.92)	1.54 (2.37)	3.46 (5.65)			
Brief contact	5.89 (8.42)	1.45 (3.56)	0.62 (0.96)	0.55 (0.94)	3.40 (8.71)			
Control	4.59 (6.86)	1.33 (3.00)	0.17 (0.41)	0.00 (0.00)	0.20 (0.45)			
Vomiting								
Whole sample	6.87 (11.80)	1.48 (4.41)	0.03 (0.18)	0.23 (0.81)	1.39 (3.94)	-0.42 (-0.88 to 0.04)	-0.48 (-0.94 to -0.02)	-0.70 (-1.17 to -0.24)
CRT-Brief	8.83 (15.61)	0.55 (2.24)	0.00 (0.00)	0.07 (0.27)	2.92 (5.48)			
Brief contact	6.50 (10.47)	3.00 (6.49)	0.08 (0.28)	0.55 (1.29)	0.00 (0.00)			
Control	5.07 (7.47)	0.50 (1.45)	0.00 (0.00)	0.00 (0.00)	0.20 (0.45)			
Laxatives								
Whole sample	0.73 (0.47)	0.52 (0.35)	0.53 (0.37)	0.52 (0.36)	0.58 (0.50)	-0.04 (-0.49 to 0.42)	-	-.02 (-0.48 to 0.43)
CRT-Brief	1.72 (1.45)	1.02 (0.90)	1.02 (0.96)	1.02 (0.90)	1.40 (1.50)			
Brief contact	0.48 (0.43)	0.37 (0.34)	0.40 (0.39)	0.37 (0.39)	0.37 (0.43)			
Control	0.48 (0.61)	0.37 (0.52)	0.37 (0.52)	0.37 (0.52)	0.37 (0.73)			

Driven Exercise								
Whole sample	4.60 (3.06)	1.30 (0.91)	1.63 (1.14)	1.60 (1.11)	1.33 (1.06)	-0.14 (-0.59 to 0.32)	-0.12 (-0.58 to 0.33)	-0.11 (-0.57 to 0.34)
CRT-Brief	5.95 (4.64)	3.02 (2.42)	3.53 (2.95)	2.72 (2.18)	1.27 (1.20)			
Brief contact	4.83 (3.77)	1.28 (1.03)	1.55 (1.29)	1.15 (1.02)	1.82 (1.68)			
Control	3.38 (3.35)	0.57 (0.66)	0.79 (0.88)	1.30 (1.41)	1.03 (1.50)			
ITT								
Bingeing								
Whole sample	6.68 (8.33)	1.79 (3.27)	0.81 (1.40)	0.87 (1.74)	2.86 (6.41)	-0.64 (-0.94 to -0.33)	-1.06 (-1.38 to -0.74)	-0.39 (-0.67 to -0.07)
CRT-Brief	9.30 (9.00)	2.40 (3.19)	1.33 (1.92)	1.54 (2.37)	3.46 (5.65)			
Brief contact	5.89 (8.42)	1.45 (3.56)	0.62 (0.96)	0.55 (0.93)	3.40 (8.71)			
Control	4.59 (6.86)	1.33 (3.00)	0.17 (0.41)	0.00 (0.00)	0.20 (0.45)			
Vomiting								
Whole sample	6.99 (3.61)	1.76 (1.01)	0.37 (0.27)	0.62 (0.42)	1.06 (0.75)	-0.14 (-0.45 to 0.16)	-0.17 (-0.47 to 0.14)	-0.16 (-0.46 to 0.14)
CRT-Brief	8.84 (5.51)	1.49 (1.06)	0.77 (0.67)	0.40 (0.35)	3.22 (2.59)			
Brief contact	7.03 (4.46)	3.43 (2.41)	0.40 (0.36)	1.27 (1.12)	0.83 (0.77)			
Control	5.49 (3.52)	1.07 (0.92)	0.16 (0.24)	0.47 (0.57)	0.45 (0.59)			
Laxatives								
Whole sample	1.86 (5.71)	0.31 (1.96)	0.03 (0.18)	0.00 (0.00)	0.29 (1.33)	-0.22 (-0.52 to -0.08)	-	-0.18 (-0.48 to 0.12)
CRT-Brief	1.77 (5.40)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.62 (1.94)			
Brief contact	2.07 (6.41)	0.00 (0.00)	0.08 (0.28)	0.00 (0.00)	0.00 (0.00)			
Control	1.74 (5.50)	1.33 (4.03)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)			

Driven Exercise								
Whole sample	5.49 (2.30)	3.19 (1.49)	1.74 (0.98)	1.59 (0.90)	1.39 (0.82)	-0.15 (-0.45 to 0.15)	-0.14 (-0.44 to 0.16)	-0.12 (-0.42 to 0.18)
CRT-Brief	5.06 (2.68)	2.81 (1.71)	3.53 (2.58)	2.71 (1.88)	1.13 (0.84)			
Brief contact	5.69 (3.07)	1.44 (0.90)	1.55 (1.13)	1.15 (0.91)	1.74 (1.40)			
Control	5.76 (3.15)	8.00 (5.77)	0.97 (1.01)	1.30 (1.32)	1.36 (1.49)			

Notes. M = estimated mean; SE = standard error; Tx = treatment; FU1 = 1-month follow-up; FU3 = 3-month follow-up.
Descriptive statistics for Completer bingeing and vomiting and ITT bingeing and laxatives are presented as means (standard deviations) as GLMM analyses could not converge for these variables.
[a] As there were no significant interactions between time and group, effect sizes are calculated as Cohen's d for the whole sample and are adjusted for the correlation between observations. Pre-treatment to 1-month follow-up effect sizes for laxatives are not reported, as these observations would not correlate.

Abstinence, Good Outcome, and Remission Rates

As shown in **Table 8.10**, there were no significant differences between conditions for abstinence, good outcome, or remission at post-treatment or either follow-up.

Table 8.10

Abstinence, Good Outcome, and Remission Rates Among Completers at Post-Treatment, 1-Month Follow-Up, and 3-Month Follow-Up

	Whole sample	CRT-Brief	Brief contact	Control	X^2(df), p
Post-Tx					
Abstinence	19/37 (51.35)	7/15 (46.67)	6/15 (40.00)	6/7 (85.71)	3.63 (2), .16
Good outcome	30/37 (81.08)	11/15 (73.33)	12/15 (80.00)	7/7 (100)	1.75 (2), .42
Remission	19/37 (51.35)	7/15 (46.67)	6/15 (4.00)	6/7 (85.71)	3.63 (2), .16
FU1					
Abstinence	13/33 (39.39)	4/15 (26.67)	4/12 (33.33)	5/6 (83.33)	4.96 (2), .08
Good outcome	25/33 (75.76)	11/15 (73.33)	8/12 (66.67)	6/6 (100)	1.92 (2), .38
Remission	13/33 (39.39)	4/15 (26.67)	4/12 (33.33)	5/6 (83.33)	4.96 (2), .08
FU3					
Abstinence	11/26 (42.31)	5/10 (50.00)	4/10 (40.00)	2/6 (33.33)	0.01 (2), .99
Good outcome	21/26 (80.77)	9/10 (90.00)	8/10 (80.00)	4/6 (66.67)	0.43 (2), .81
Remission	11/26 (42.31)	5/10 (50.00)	4/10 (40.00)	2/6 (33.33)	0.01 (2), .99

Notes. Descriptive statistics are presented as *n* (%). Percentages are calculated using the number of participants who completed treatment and each follow-up. FU1 = 1-month follow-up; FU3 = 3-month follow-up.

Analyses of Potential Baseline Moderators

Inferential statistics for all moderation analyses conducted are provided in **Table 8.11**.
There was a significant interaction between time and baseline central coherence. As shown in
Figure 8.2, people with high and low central coherence had similar reductions in eating
disorder psychopathology until the final follow-up. At this point, people with high central
coherence appeared to maintain their progress whereas those with low central coherence did
not.

Table 8.11

Outcomes from Linear Mixed Model Analyses Investigating Potential Baseline Moderators of
Change Over Time in Eating Disorder Psychopathology

	Main effects		Interaction
Potential moderator	Baseline variable F(df), p	Time F(df), p	Baseline variable x time F(df), p
Central Coherence	0.05 (1, 43.93), .83	37.62 (5, 12.19), <.001	3.40 (156, 7.88), .03
Set Shifting	0.80 (1, 62.85), .38	41.55 (5, 61.90), <.001	12.26 (107, 37.96), <.001
Binge frequency	0.99 (18, 55.63), .49	24.85 (5, 37.12), <.001	1.43 (57, 37.22), .13
Vomit frequency	1.28 (18, 50.26), .24	22.33 (5, 34.54), <.001	3.25 (61, 34.63), <.001
BMI	0.48 (1, 64.35), .49	41.72 (5, 33.16), <.001	1.43 (5, 33.16), .24
Diagnosis	10.17 (1, 65.62), .002	35.57 (5, 32.66), <.001	1.55 (5, 32.66), .20
Readiness	1.37 (14, 52. 08), .20	20.67 (5, 33.05), <.001	1.72 (55, 26.99), .06
Confidence	0.80 (15, 55.38), .68	31.89 (5, 27.75), <.001	2.33 (60, 27.05), .01

Notes. BMI = body mass index; binge and vomit frequencies were obtained from Items 15
and 16 of the Eating Disorder Examination-Questionnaire and reflect the past month. BMI
was dichotomised as overweight vs. normal and underweight. Diagnosis was dichotomised as
AAN versus other diagnoses

Figure 8.2

Eating Disorder Psychopathology by Time and Baseline Central Coherence (Low, High) with

Standard Error Bars
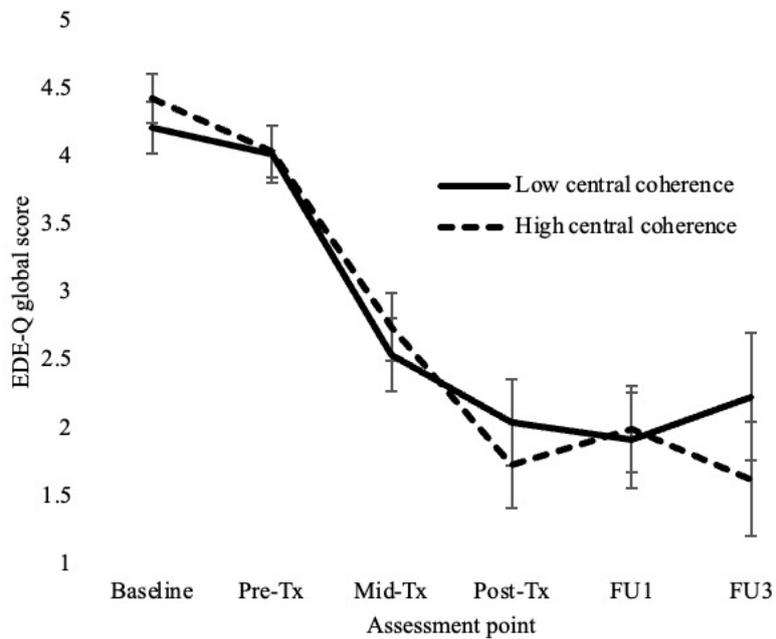
There was also a significant interaction between time and baseline set shifting, shown in **Figure 8.3**. This indicated that people with high and low set shifting had similar reductions in eating disorder psychopathology until mid-treatment. However, people with low set shifting decreased more by post-treatment (compared to those with high set shifting) and maintained this progress over both follow-ups.

Figure 8.3

Eating Disorder Psychopathology by Time and Baseline Set Shifting (Low, High) with Standard Error Bars
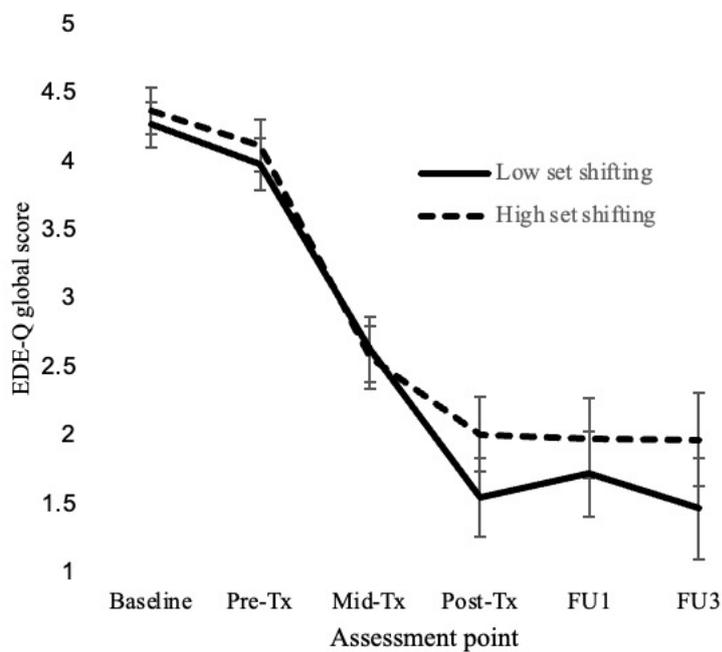
There were significant main effects of time and diagnosis but no significant interaction between diagnosis and time. The main effects showed that eating disorder psychopathology decreased significantly over time but remained significantly higher among people with AAN ($M = 3.26$; $SD = 1.21$) than people with other diagnoses ($M = 2.43$; $SD = 1.15$), as shown in **Figure 8.4**.

Figure 8.4

Eating Disorder Psychopathology by Time and Diagnosis (AAN versus Other Diagnoses) with Standard Error Bars
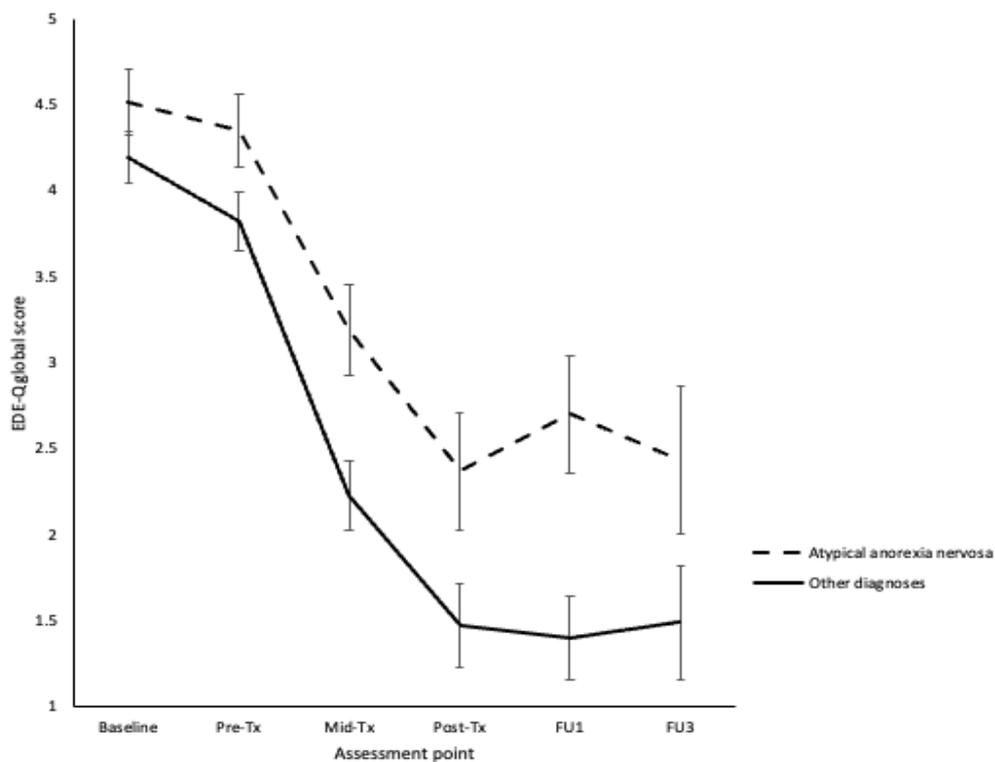
Finally, there was a significant interaction between time and baseline confidence to change. As shown in **Figure 8.5**, people with high and low confidence had similar reductions in eating disorder psychopathology throughout treatment. Those with high confidence were always slightly better off until the final follow-up at which point people with low confidence had caught up with those with high confidence.

Figure 8.5

Eating Disorder Psychopathology by Time and Baseline Confidence (Low, High) with Standard Error Bars
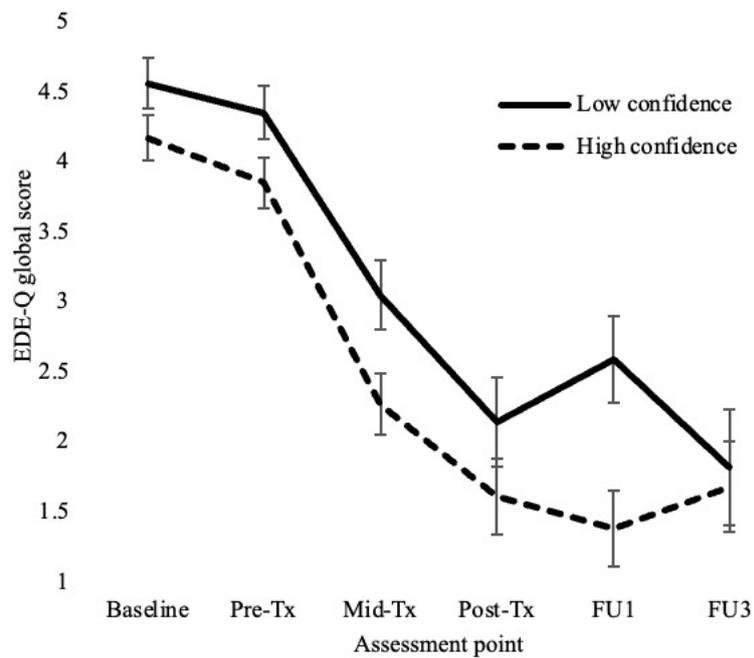
Analyses of Potential Baseline Predictors

Baseline BMI was a significant predictor of retention. This indicated that people who were normal or underweight were significantly less likely to complete treatment ($n = 17$; 45.9%) than those who were overweight ($n = 20$; 54.1%). Additionally, people with AAN were much less likely to complete treatment (33.3%) than those with other diagnoses (53.1%), a difference that was not statistically significant ($p = .08$). As shown in **Table 8.12**, no other baseline variables were significant predictors of retention, abstinence, good outcome, or remission.

Table 8.12

Outcomes from Logistic Regression Analyses Investigating Potential Baseline Predictors of Non-Completion and Post-Treatment Abstinence,

Good Outcome, and Remission

Potential predictor	Retention OR (95% CI)	Post-Tx abstinence OR (95% CI)	Post-Tx good outcome OR (95% CI)	Post-Tx remission OR (95% CI)
Central Coherence	0.77 (0.22 to 2.67)	0.65 (0.12 to 3.57)	0.14 (0.01 to 3.02)	0.65 (0.12 to 3.57)
Set Shifting	1.01 (0.98 to 1.04)	1.06 (0.99 to 1.13)	1.02 (0.95 to 1.11)	1.06 (0.99 to 1.13)
Binge frequency	1.00 (0.96 to 1.05)	1.00 (0.92 to 1.08)	1.13 (0.92 to 1.37)	1.00 (0.92 to 1.08)
Vomit frequency	1.01 (0.98 to 1.05)	1.01 (0.94 to 1.07)	0.97 (0.90 to 1.05)	1.01 (0.94 to 1.07)
BMI	**0.24 (0.09 to 0.63)**	0.86 (0.23 to 2.29)	1.96 (0.29 to 13.51)	0.86 (0.23 to 3.29)
Diagnosis	2.26 (0.91 to 5.65)	0.44 (0.10 to 1.99)	0.20 (0.03 to 1.47)	0.44 (0.10 to 1.99)
Motivation				
Readiness	0.99 (0.97 to 1.01)	0.99 (0.95 to 1.02)	1.02 (0.97 to 1.06)	0.99 (0.95 to 1.02)
Confidence	0.99 (0.97 to 1.01)	0.97 (0.93 to 1.01)	1.03 (0.98 to 1.08)	0.97 (0.93 to 1.01)
EDE-Q	1.30 (0.88 to 1.94)	0.81 (0.46 to 1.44)	0.51 (0.17 to 1.47)	0.81 (0.46 to 1.44)

Notes. OR = odds ratio, CI = confidence interval; Tx = treatment; BMI = body mass index; EDE-Q = Eating Disorder Examination-Questionnaire global score; binge and vomit frequencies were obtained from Items 15 and 16 of the EDE-Q and reflect the past month. BMI was dichotomised as overweight vs. normal and underweight. **Bolded** = significant predictor.

Discussion

The present study aimed to evaluate strategies to (1) shorten waitlists for people with non-underweight eating disorders and (2) manage the impact of lengthy waitlists on dropout from subsequent treatment. Our findings further highlighted the importance of this research endeavour by showing that non-completers spent a third more time on the initial waitlist than those who completed CBT-T. Overall, the present study adds to the growing evidence base for CBT-T, improves our understanding of moderators, predictors, and executive functioning among people with non-underweight eating disorders, and provides preliminary support for the use of waitlist interventions to retain people with non-underweight eating disorders in treatment.

Shorter CBT-ED Treatment

In the present study, CBT-T demonstrated high levels of suitability and acceptability, and participants provided high ratings of their confidence in the treatment. From pre- to post-treatment, very large reductions were observed in eating disorder psychopathology for both completer (-1.52) and intent-to-treat (-1.15) analyses. This aligns with completer and intent-to-treat effects sizes reported in our recent meta-analysis of CBT-T (-1.69 and -1.49, respectively; Keegan, Waller et al., 2022; **Chapter 3**). Positive results were also observed for secondary outcomes. For instance, very large reductions were observed in clinical impairment from pre- to post-treatment for both completer and intent to treat analyses (-1.42 and -1.18, respectively), in line with those reported in our meta-analysis of CBT-T (-1.38 and -1.22, respectively; Keegan, Waller et al., 2022; **Chapter 3**). Similarly, completer and intent-to-treat analyses showed medium to very large decreases for negative affect from pre- to post-treatment (-1.05 and -0.74, respectively), similar to the reductions in depression and anxiety in our meta-analysis of CBT-T (Keegan, Waller et al., 2022; **Chapter 3**). Finally, eating disorder psychopathology and clinical impairment remained below the clinical cut offs at both follow-ups.

Our findings were also positive for completers at post-treatment. For instance, 81.08% of completers had a good outcome, which compares favourably to good outcome rates reported in our

meta-analysis of CBT-T (65%; Keegan, Waller et al., 2022; **Chapter 3**). Additionally, our

abstinence rate (51.35%) was between those achieved in other studies of CBT-T (46.9 to 76.9%;

Pellizzer et al., 2019a; 2019b), and higher than the 35.4% reported in a meta-analysis synthesising

RCTs of CBT-ED (Linardon & Wade, 2018). Finally, 51.35% of completers were in remission,

which is towards the upper end of the range reported in previous studies of CBT-T (23.1% to

53.8%; Rose et al., 2021; Pellizzer et al., 2019b).

Findings for non-completion rates were less positive, as was retention of effect size changes

over follow-up. Specifically, our overall non-completion rate (54.88%) was substantially higher

than the pooled non-completion rate reported in our meta-analysis of CBT-T (39%; Keegan, Waller

et al., 2022; **Chapter 3**) and just above the range (20 to 54%) reported in RCTs of longer CBT-ED

(Atwood & Friedman, 2020). A possible explanation for the higher non-completion rate is the high

proportion of people with AAN (38.8% in the present study compared to 7% or less in previous

examinations; Wade, Ghan et al., 2021; Pellizzer et al., 2019a). Indeed, while not statistically

significant, people with AAN were less likely to complete CBT-T than people with other eating

disorder diagnoses. Relatedly, CBT-T had significantly less impact on eating disorder

psychopathology for people with AAN compared to people with other diagnoses. These findings,

therefore, extend on the work described in **Chapter 3** which largely applied to people with BN and

BED by providing valuable information about the impact of CBT-T for people with AAN.

Taken as a whole, the present study adds to the growing evidence base for CBT-T. While an

RCT directly comparing CBT-T to longer CBT-ED is required, our findings suggest that people

with non-underweight eating disorders can be treated in half the time currently recommended in

treatment guidelines (NICE, 2017). The present study, therefore, provides preliminary support for

the use of shorter CBT-ED as a viable strategy to shorten waitlists, by enabling more people to be

treated more quickly.

Precision Medicine

We also sought to identify moderators and predictors of treatment outcomes and retention to inform a precision medicine approach. Three baseline moderators were identified (central coherence, set shifting, and confidence to change). At 3-month follow-up, people with high central coherence maintained their reductions in eating disorder psychopathology whereas people with low central coherence did not. This suggests that, for people with non-underweight eating disorders, an ability to think in terms of the bigger picture is useful in maintaining progress after treatment has ended. This finding contrasts with findings for AN, where people with low baseline central coherence improved more from baseline to 12-month follow-up than those with high baseline central coherence (Keegan, Byrne, et al., 2022; **Chapter 5**).

Our finding that set shifting moderated treatment outcomes also contrasted to findings for AN, where no moderation was observed (Keegan, Byrne et al., 2022; **Chapter 5**). We found that people with low set shifting had greater reductions in eating disorder psychopathology by post-treatment than those with high set shifting and maintained this progress over both follow-ups. A possible explanation is that less flexible thinking is beneficial for people with non-underweight eating disorders, as it enables them to rigidly stick to the non-negotiables of treatment that are required for lasting recovery, such as regular and adequate eating.

We also found that confidence to change moderated treatment outcomes. People with high confidence were always slightly better off until the final follow-up at which point people with low confidence caught up. A better powered study might find that differences are maintained over follow-up, as suggested by previous research in this area (Iyar et al., 2019; Steele et al., 2011).

Only one significant predictor of retention was identified in the present study. Specifically, we found that people who were overweight were more likely to complete CBT-T than those who were not overweight. This aligns with previous research showing that lower BMI predicted dropout for people with AN (e.g., Gregertsen et al., 2019). A possible explanation for this finding is that people who were normal or underweight were more ambivalent about giving up the eating disorder

as it was allowing them to maintain their weight whereas those who were overweight were less ambivalent as the eating disorder was not giving them any perceived benefits.

Together, our findings suggest that people who are overweight, confident to change and think in a less flexible, big picture way appear best suited to CBT-T, but replication is required. Our findings for central coherence and set shifting also suggest that executive functioning inefficiencies manifest differently in people with non-underweight eating disorders compared to people with AN, despite occurring at comparable levels (Keegan et al., 2021; **Chapter 4**).

Waitlist Intervention

There was no evidence to suggest that receiving waitlist intervention produced substantial improvements whilst on the waitlist or improved outcomes in subsequent eating disorder treatment. However, there was some evidence that receiving waitlist intervention improved retention in CBT-T. Specifically, participants in the CRT-Brief and brief contact waitlist conditions were twice as likely to complete treatment than those in the control condition, providing preliminary support for waitlist intervention as a strategy to manage the impact of lengthy waitlists. Additionally, the minimal waitlist intervention (brief contact) did as well as a more intensive intervention involving an in-person session and homework tasks (CRT-Brief). Together, these findings provide further support for waitlist (Fursland et al., 2018; Wade et al., 2022) and brief contact interventions (Tay & Li, 2022), and extend the use of brief contact interventions from self-harm and suicide to eating disorders. The present study also filled a substantial gap in the literature by being the first to evaluate CRT in a sample predominantly comprising people with non-underweight eating disorders. There was also preliminary evidence that CRT-Brief improved retention in treatment, as it has been shown to do among people with AN (Hagan et al., 2020).

Limitations

The main limitation of the present study is that it was underpowered due to COVID-19 disruptions and the study ending within the PhD project. More adequately powered studies are required to determine whether waitlist intervention minimises the impact of lengthy waitlists by

improving retention. It is also possible that 10 sessions of CBT-T are not always needed, given that 16.22% of completers in the present study did not require all 10 sessions. Future dismantling studies should, therefore, seek to identify the active ingredients of CBT-T to enable efficient, cost-effective delivery. Additionally, our moderator and predictor findings should be interpreted with some caution as they may be artefacts of over-testing given the number of variables examined.

Conclusions

The present study has important research and clinical implications. CBT-T demonstrated comparable outcomes to those reported in studies of longer CBT-ED, suggesting that shorter treatment is a viable strategy to shorten waitlists without sacrificing benefits to clients. Preliminary support was found for the use of waitlist intervention as a cost-effective strategy to overcome the impact of lengthy waitlists, although replication in an adequately powered study is required. Results highlight that further work is needed before a precision medicine approach can be adopted to shorten waitlists, as consistent moderators and predictors of treatment outcomes and retention have not been identified. The present study is also the first to examine the impact of CBT-T for people with AAN compared to other eating disorder diagnoses and demonstrated an urgent need for future larger scale treatment studies aimed at identifying helpful interventions for this little understood population.

Chapter 9

General Discussion[7]

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[7] This chapter contains content from the Discussion sections of three published papers.

Keegan, E., Waller, G., & Wade, T. D. (2022). A systematic review and meta-analysis of a 10-session cognitive behavioural therapy for non-underweight eating disorders. *Clinical Psychologist, 26*(3), 241-254. https://doi.org/10.1080/13284207.2022.2075257

Keegan, E., Tchanturia, K., & Wade, T. D. (2021). Central coherence and set-shifting between nonunderweight eating disorders and anorexia nervosa: A systematic review and meta-analysis. *International Journal of Eating Disorders, 54*(3), 229-243. https://doi.org/10.1002/eat.23430

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Chapter Overview

Given the seriousness, prevalence, and costs of eating disorders alongside the impact of lengthy waitlists on dropout (Carter et al., 2012; Deloitte Access Economics, 2012; Galmiche et al., 2019; Papadopoulos et al., 2009; van Hoeken & Hoek, 2020), the overarching aim of this thesis was to identify strategies to respond to lengthy treatment waitlists in a pandemic world. This involved identifying strategies to shorten waitlists (Aim 1) and to manage the impact of lengthy waitlists on dropout from subsequent treatment (Aim 2). Findings from the main PhD study (**Chapter 8**) further highlighted the importance of this research endeavour by showing that non-completers spent a third more time on the initial waitlist than people who completed CBT-T. This chapter summarises the key findings from the five PhD studies and integrates these with previous research. Clinical implications of the key findings are also discussed, as well as limitations and directions for future research. This thesis made significant original contributions to knowledge by being the first to demonstrate that: (1) central coherence does not significantly differ between people with AN and BN; (2) people with AAN are less likely to complete or benefit from treatment; (3) single session CRT is an acceptable intervention for people with non-underweight eating disorders; and (4) single session CRT and brief contact interventions have potential to improve retention in treatment for people with non-underweight eating disorders.

Summary and Integration of Key Findings

One potential strategy to shorten waitlists (Aim 1) is to provide shorter CBT-ED treatment. Thus, we evaluated the efficacy of one such shorter treatment, CBT-T, using a systematic review and meta-analysis and the main PhD study. Results from the systematic review and meta-analysis (**Chapter 3**) were promising, with medium to very large effect size decreases observed from pre- to post-treatment for eating disorder psychopathology, clinical impairment, depression, anxiety, and weekly frequencies of objective bingeing and vomiting. Additionally, benefits appeared to last after CBT-T had ended, as eating disorder psychopathology remained below the clinical cut off score

(2.77; Mond et al., 2006) at follow-up. The overall non-completion rate for CBT-T was 39%, and 65% of completers had a good outcome.

Similar results were observed in the main PhD study (**Chapter 8**). From pre- to post-CBT-T, medium to large effect size decreases were observed for eating disorder psychopathology, clinical impairment, and negative affect. Frequencies of vomiting and driven exercise also significantly decreased over time, although these were small effects. Additionally, at post-CBT-T, 81% of completers had a good outcome and 51% were in remission. The overall non-completion rate (54.88%) was also substantially higher than the pooled non-completion rate in the meta-analysis of CBT-T, and effect sizes for continuous treatment outcome variables halved over the follow-up period. While not statistically significant, people with AAN were less likely to complete CBT-T.

Another potential strategy to shorten waitlists (Aim 1) is to take a precision medicine approach in which treatment is tailored to the individual client based on their characteristics at baseline. To take such an approach, an understanding of moderators and predictors of treatment outcomes and retention is required. Thus, we conducted secondary data analyses using a sample of convenience to investigate the potential role of baseline executive functioning among people with AN and replicated some of these analyses in a sample of people with non-underweight eating disorders. The secondary data analyses (**Chapter 5**) identified one significant baseline moderator of outcome (central coherence) and no significant baseline predictors. The potential role of executive functioning was also examined among people with non-underweight eating disorders, as well as the potential roles of other empirically driven variables (**Chapter 8**). These primary data analyses identified three significant baseline moderators of outcome (central coherence, set shifting, and confidence to change) and one significant baseline predictor of non-completion (BMI). In addition, CBT-T had significantly less impact on disordered eating for people with AAN compared to people with other eating disorder diagnoses. This finding regarding AAN extended on the findings for the

systematic review and meta-analysis (**Chapter 3**) as these mainly applied to people diagnosed with BN and BED.

The second aim of this thesis was to identify strategies to manage the impact of lengthy waitlists on dropout from subsequent treatment. A potential strategy is to provide contact or low-intensity interventions while people are waitlisted for treatment. One option for a waitlist intervention is CRT, an adjunct treatment that targets executive functioning and has been shown to improve retention among people with AN (see Hagan et al., 2020). To determine whether people with non-underweight eating disorders might also benefit from CRT, we conducted a systematic review and meta-analysis comparing central coherence and set shifting performance between people with AN and people with non-underweight eating disorders (**Chapter 4**). Overall, central coherence and set shifting performance did not significantly differ between people with AN and people with non-underweight eating disorders, suggesting that people with non-underweight eating disorders may also benefit from CRT.

Based on this finding, we developed and refined a single session CRT intervention (CRT-Brief) using stakeholder feedback obtained in a qualitative feasibility study (**Chapter 6**). We also developed a brief contact intervention comprising psychoeducation and a short supportive message. These two waitlist interventions (CRT-Brief and brief contact) were then compared to waitlist as usual among people waitlisted for CBT-T in an RCT (**Chapter 8**). While not statistically significant, results revealed that receiving either waitlist intervention doubled retention in CBT-T.

Integration with Prior Research and Clinical Implications

Strategy 1: Waitlist Intervention

There was some evidence that receiving waitlist intervention improved retention in CBT-T, with participants in the CRT-Brief and brief contact waitlist conditions being twice as likely to complete treatment than those in the control condition. This finding provides preliminary support for waitlist intervention as a viable and cost-effective strategy to somewhat obviate the impact of lengthy waitlists on dropout from subsequent treatment. Moreover, improving retention provides

clients with the opportunity to benefit from treatment, potentially reducing repeat presentations and shortening waitlists for other clients. While not statistically significant, doubling retention is clinically important, as one out of four clients can be expected to dropout from CBT-ED (Linardon, Hindle et al., 2018). This finding provides additional support for the use of waitlist interventions among people with eating disorders, in line with the positive results found in previous case series evaluations (Fursland et al., 2018; Wade, Byrne, et al., 2021).

We also found that the minimal waitlist intervention (brief contact) was as effective as a more intensive intervention involving a therapist, in-person session, and homework tasks (CRT-Brief). This finding highlights that waitlist interventions do not need to be resource-intensive or delivered by expert clinicians to be beneficial. This is consistent with research conducted among people with obesity where minimal support (text messages not requiring a response) was found to be as effective in maintaining weight loss as more intensive support including therapist involvement (Zwickert et al., 2016). This finding also provides further support for brief contact interventions (Tay & Li, 2022), and extends the use of these interventions from self-harm and suicide to eating disorders.

This thesis also filled a substantial gap in the literature by being the first to develop and evaluate a CRT intervention in samples predominantly comprising people with non-underweight eating disorders (**Chapters 6** and **8**). Overall, we received positive qualitative feedback on CRT-Brief in the feasibility study. This is consistent with qualitative research, which has demonstrated that CRT is well-received by clients, parents, and eating disorder clinicians (Easter & Tchanturia, 2011; Giombini, Turton et al., 2017; Giombini, Nesbitt et al., 2018; Giombini et al., 2022; Whitney et al., 2008). Further, the evidence that CRT-Brief improved retention in treatment is consistent with Hagan and colleagues (2020) who found preliminary evidence that CRT improves retention in treatment. These findings also aligned with the positive results from the studies of CRT in mixed samples that included some people with non-underweight eating disorders (Dingemans et al., 2014; Raman et al., 2018; Mac Neil et al., 2016; Roberts, 2018), and extended these results by allowing us

to clearly conclude that CRT is useful among the non-underweight population. While replication in an adequately powered study is required, our results suggest that clinicians should offer CRT as an adjunct treatment or waitlist intervention across the range of eating disorder diagnoses, rather than restricting its use to the treatment of people with AN.

Strategy 2: Shorter CBT-ED Treatment

This thesis also addressed the NICE (2017) research recommendations by evaluating shorter treatment (CBT-T) for people with eating disorders. Overall, results from both the systematic review and meta-analysis of CBT-T and the main PhD study added to the growing evidence base for CBT-T and provided support for the use of shorter treatment as a viable and effective strategy to shorten waitlists. The findings from both these studies demonstrate that CBT-T is a promising treatment for people with non-underweight eating disorders, and that most of these individuals can be treated and have good outcomes in half the time currently recommended in treatment guidelines (NICE, 2017). Providing CBT-T instead of longer courses of CBT-ED would have a substantial economic impact for the individual, their significant others, and society more broadly. For instance, it has the potential to halve the cost of treatment and enable people with eating disorders and their carers to return to work sooner.

We also found that pre-treatment eating disorder psychopathology was very similar among participants in our systematic review and meta-analysis compared to participants in studies of longer CBT-ED including RCTs (e.g., Allen et al., 2012; Byrne et al., 2011; de Jong et al., 2020; Fairburn et al., 2009; Garte et al., 2015; La Mela et al., 2013; Signorini et al., 2018; Turner et al., 2015; Watson et al., 2012). Currently, people who are considered to have more severe eating disorders are often offered longer courses of CBT-ED over CBT-T (e.g., see Tatham et al., 2020). Our finding suggests that this practice is unsupported and highlights that clinicians should offer CBT-T to people with non-underweight eating disorders regardless of their severity at baseline.

Our meta-analysis (**Chapter 3**) also supported the use of the early review point in CBT-T. Despite the overall non-completion rate in CBT-T comprising those who collaboratively discharge

and those who prematurely discharge (Waller et al., 2019), the pooled non-completion rate observed in the systematic review and meta-analysis was within the range of dropout rates for studies of longer CBT-ED that do not use this approach (for a systematic review, see Atwood & Friedman, 2020). While preliminary, this finding should reduce therapist anxiety regarding the importance of pushing for early change and implementing such a decision point. This finding also suggests that early progress reviews might be worth considering in the treatment of other eating disorders (e.g., AN) and psychological disorders (e.g., depression and anxiety), as they do not appear to increase dropout. Rather, they have the potential benefits of reducing therapist frustration and potential sense of failure among clients who are not benefiting, as well as speeding treatment access for clients who would otherwise be forced to remain on waitlists.

The finding that people with AAN were less likely to respond favourably to CBT-T than those with other eating disorders (**Chapter 8**) is concerning as AAN is rising in prevalence and now appears to be more common in the community than AN (Harrop et al., 2021). Despite this, less people with AAN are referred or admitted for eating disorder treatment (Harrop et al., 2021), and the present findings suggest that even when they are, they are less likely to benefit from or remain in treatment. There are several possible explanations for this finding. For instance, people with AAN may encounter greater ambivalence when engaging in behavioural change during treatment, as this typically involves cessation of further weight loss and potential weight gain into the overweight and even obese weight categories. This may be particularly challenging for people with AAN as these individuals have likely received societal reinforcement for losing weight from a range of people across medical, familial, and social networks. In the same vein, efforts to restore lost weight during eating disorder treatment may be met with disapproval due to misconceptions surrounding the relationship between health and BMI as well as weight stigma (Puhl & Suh, 2015). The present study, therefore, highlights that there is a clear need for future studies to identify helpful interventions for people with AAN and the conditions under which current treatments improve outcomes among these individuals.

Strategy 3: Precision Medicine

Potential moderators and predictors of treatment outcomes and retention were examined with the aim of shortening waitlists by enabling clinicians to move towards a precision medicine approach where the components of treatment provided can be tailored to individual clients based on their characteristics at baseline. For people with AN, those with low baseline central coherence had more rapid reductions in eating disorder psychopathology and clinical impairment than those with high baseline central coherence (**Chapter 5**). In contrast, for people with non-underweight eating disorders, those with high baseline central coherence appeared to do better in treatment (**Chapter 8**). Together, these findings suggest that the detail-focused thinking style commonly seen in eating disorders can be both a vulnerability and a strength. For example, focusing on helpful details such as the changes that need to happen each week could enable people to break down the process of recovery into smaller, less overwhelming, and more achievable steps. Conversely, for other people focusing on unhelpful details (e.g., regarding food, calories, weight, etc) may maintain the problems they are having with eating, and progress may instead be maintained by considering the bigger picture, such as their reasons for recovery.

Our findings for set shifting also differed between diagnoses. Specifically, while set shifting did not moderate outcomes for people with AN, people with non-underweight eating disorders who had low baseline set shifting appeared to do better in treatment. This finding for non-underweight eating disorders aligns with Dingemans and colleagues (2014) where people with "severe or enduring" eating disorders (12% of whom had BN) with low set shifting benefited more than those with no inefficiencies. A potential explanation for this finding is that less flexible thinking is beneficial for people with non-underweight eating disorders, as it enables them to rigidly stick to the non-negotiables of treatment that are required for lasting recovery, such as regular and adequate eating. Together, the findings from **Chapters 5** and **8** suggest that baseline central coherence and set shifting have a different impact on people with AN compared to people with non-underweight eating disorders, despite meta-analytic evidence that inefficiencies occur at comparable levels

(**Chapter 4**). However, the differences between diagnoses should not be overinterpreted at this stage due to the underpowered analyses. Moreover, replication is required given that these variables have only been examined as moderators of treatment outcome in two published studies (Dingemans et al., 2014; Keegan, Byrne et al., 2022).

Other moderators examined included confidence to change and BMI at baseline. For people with non-underweight eating disorders, baseline confidence to change moderated outcome. Those with high confidence were always slightly better off until the final follow-up at which point people with low confidence caught up. This finding contrasts with previous research in this area in which differences were maintained over the follow-up period (e.g., Steele et al., 2011; Iyar et al., 2019), and may reflect a power issue rather than a true finding. Alternatively, these individuals may catch up over the follow-up period as they have had more time to experience success and gather evidence in their abilities. Finally, baseline BMI predicted completion for people with non-underweight eating disorders, such that those who were overweight were more likely to complete CBT-T. This finding aligns with previous research showing that lower BMI predicted dropout for people with AN (Gregertsen et al., 2019).

Taken as a whole, the lack of consistent moderators and predictors identified in this thesis and in the literature more broadly (Linardon, De la Piedad Garcia et al., 2017) demonstrates that our ability to determine which treatment works best for an individual and under which conditions is in its infancy. This differs from findings for depression in youth, where baseline severity can be predictive of outcome (Courtney et al., 2022). It also indicates that the use of precision medicine as a strategy to shorten waitlists for people with eating disorders is currently unsupported.

Limitations

The findings presented in this thesis should be interpreted in the context of several limitations. One limitation across several studies in this thesis was sample size. For instance, in **Chapter 3** the total pre-treatment ($N = 565$) and completer ($N = 346$) samples were sufficient for the meta-analyses but not sufficient to undertake subgroup analyses. Additionally, the main PhD

study (**Chapter 8**) was significantly underpowered due to COVID-19 disruptions and the study ending within the PhD project, limiting our ability to draw firm conclusions about the impact of receiving waitlist intervention on retention in treatment and the usefulness of current interventions for people with AAN. The power issues were compounded by a large amount of missing data. Moreover, missing data together with significant heterogeneity (e.g., **Chapters 3** and **4**) may have introduced bias. There was also a lack of diversity among participants included in the research. For instance, most participants in **Chapters 3, 4, 5**, **6**, and **8** were young women and all studies were conducted in Australia or the United Kingdom. Additionally, of the studies included in the meta-analysis of CBT-T, none reported ethnicity or socio-economic status and only four reported the race of participants. When race was reported, a lack of diversity was apparent with most participants being white. This was echoed in the main PhD study (**Chapter 8**) as well as the secondary data-analyses (**Chapter 5**). Thus, we cannot determine whether our results generalise to a more diverse sample of people with eating disorders. Relatedly, exclusion criteria (e.g., no active psychosis, high suicidality, or difficulty understanding or speaking English) in **Chapters 5**, **8,** and many of the studies included in the meta-analyses means our results may not reflect all people presenting for outpatient eating disorder treatment.

Directions for Future Research

The work described in this thesis highlights several directions for future research. For instance, replication in adequately powered studies is required to allow firm conclusions about the usefulness of waitlist, brief contact, and CRT interventions as strategies to somewhat manage the impact of lengthy treatment waitlists by improving retention among people with non-underweight eating disorders. If replicated, our findings suggests that waitlist interventions are worth further evaluation in different contexts, such as in child and adolescent mental health services as well as the treatment of other mental disorders such as anxiety and depression. It would also be of interest to examine predictors and moderators to determine for whom and under what conditions waitlist interventions are effective. Relatedly, CRT is thought to work by improving central coherence and

set shifting (Tchanturia et al., 2010). However, to the best of our knowledge, no studies have investigated whether central coherence and/or set shifting mediate CRT's effects. Thus, there is a clear need for studies investigating the mechanisms for CRT.

Our positive findings for CBT-T (**Chapters 3** and **8**) also provide valuable justification for a vigorous research program involving adequately powered RCTs and dismantling studies evaluating this shorter CBT-ED treatment. This should include an RCT directly comparing CBT-T to longer CBT-ED, to determine whether this shorter treatment can justifiably be recommended in treatment guidelines for people with non-underweight eating disorders. Future studies of CBT-T should also include longer-term follow-up, given the longest follow-up period was 3-months in the main PhD study and 6-months in the studies included in the meta-analysis. This would allow comparison of remission levels and predictors with those of longer forms of CBT-ED. It would also be useful for future studies to examine CBT-T in more diverse samples of people with eating disorders (e.g., males, different ethnicities, and younger adolescents with eating disorders), given the somewhat restricted range of participants in the research described in this thesis. Future work is also required to determine how CBT-T can be implemented in countries that do not have the same depth of tradition of shorter therapies (e.g., the United States and Germany) or of CBT (e.g., France and Denmark). Finally, it is also possible that CBT-T could be made shorter given that 16.22% of completers did not require all 10 sessions (**Chapter 8**). This would align with findings for other mental disorders (e.g., mild-to-moderate depression and anxiety) which have even shorter optimal lengths of treatment (e.g., four to six sessions; Delgadillo et al., 2014). Therefore, future dismantling studies should seek to identify the active ingredients of CBT-T to enable efficient, cost-effective delivery.

Our results together with prior research regarding the seriousness of AAN (Fairweather-Schmidt & Wade, 2014; Mustelin et al., 2016; Wade & O' Shea, 2015; Walsh et al., in press; Withnell et al., 2022), also highlight an urgent need for research aimed at better understanding this population. For example, adequately powered studies investigating useful interventions for people

with AAN are required, given our findings that people with AAN were less likely to complete or benefit from CBT-T (**Chapter 8**). Future studies should also routinely examine diagnosis as a moderator of outcome and a predictor of retention to determine the usefulness of existing interventions for this population. Finally, future work is needed to identify the barriers to help-seeking for people with AAN, given they are less likely to receive or be referred for eating disorder treatment (Harrop et al., 2021).

Given the inconsistencies between **Chapters 5** and **8** regarding the impact of baseline executive functioning and the lack of consistency in the literature more broadly (Linardon, de la Piedad Garcia, et al., 2017), there is also a clear need for treatment studies to routinely investigate theoretically or empirically supported variables as moderators and predictors of outcome and retention before a precision medicine approach can be adopted for eating disorders. Determining the impact of baseline central coherence and set shifting is important given CRT improves performance in these areas. If people with AN with low central coherence and people with non-underweight eating disorders with low set shifting do better in treatment as found in **Chapters 5** and **8**, this would highlight that CRT may be contraindicated as providing it may have a negative impact on outcomes in subsequent treatment. Thus, future treatment studies should routinely measure central coherence and set shifting, given these variables have only been investigated as moderators in two published studies (Keegan, Byrne et al., 2022; Dingemans et al., 2014) with conflicting results.

Conclusions

This thesis made several significant original contributions to knowledge. Specifically, our research was the first to clearly demonstrate that central coherence does not significantly differ between people with AN and BN (**Chapter 4**), and that people with AAN are less likely to complete or benefit from CBT-T (**Chapter 8**). Our research was also the first to demonstrate the acceptability of CRT among people with non-underweight eating disorders and the potential of CRT and brief contact interventions to improve retention in treatment when offered as waitlist interventions (**Chapters 6** and **8**). These novel findings are significant to the eating disorder field as

they suggest that clinicians should offer people with non-underweight eating disorders CRT, extend the use of brief contact interventions from self-harm and suicide to eating disorders, and support the use of waitlist interventions as a viable strategy to manage the impact of lengthy waitlists on dropout from subsequent treatment. We also clearly demonstrated that CBT-T produced good outcomes in half the time currently recommended in treatment guidelines (**Chapters 3** and **8**), supporting the use of shorter adaptions of CBT-ED as a cost-effective strategy to shorten waitlists. Finally, this thesis highlights that further work is required before a precision medicine approach can be adopted to shorten treatment waitlists for people with eating disorders (**Chapter 8**), and that there is an urgent need for research aimed at identifying helpful interventions and barriers to help-seeking for people with AAN.

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Appendix A

CRT-Brief Materials

CRT-BRIEF
Participant Booklet
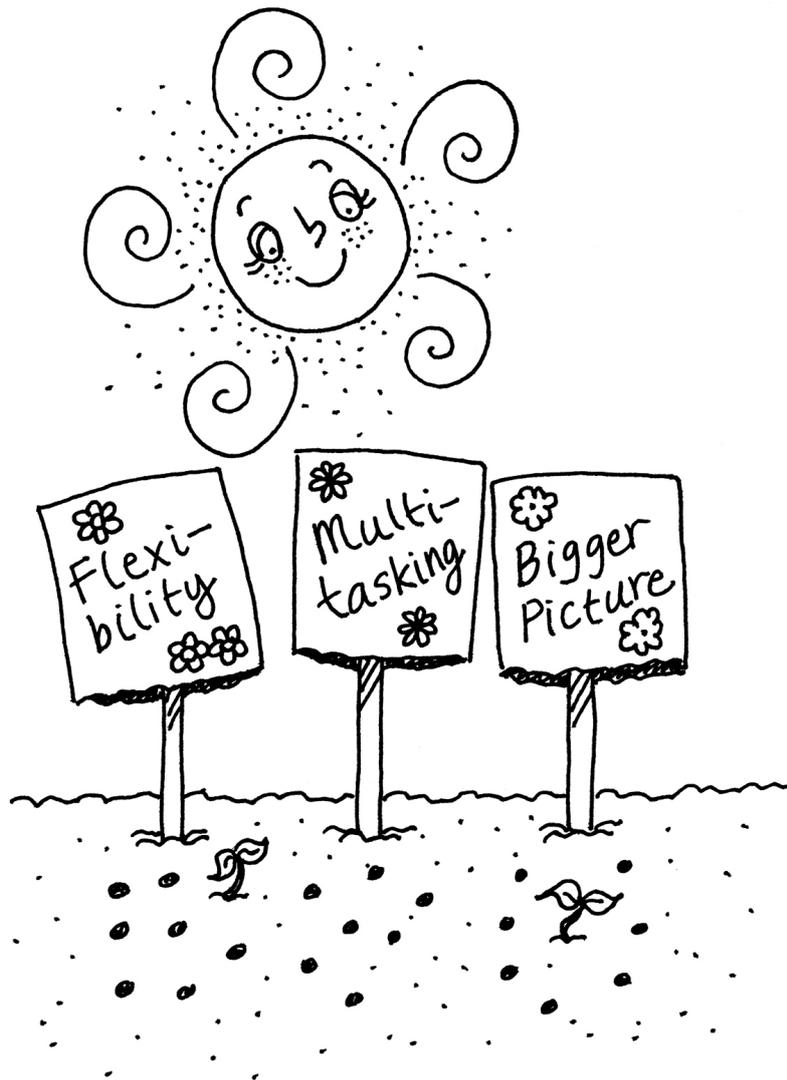
Developed by Ella Keegan and Matthew Flinders Distinguished Professor Tracey Wade in consultation with Professor Kate Tchanturia

Introduction

Some people find it very easy to accommodate new information and switch between different ideas and concepts - these people are generally good at multi-tasking. This is called set-shifting. Research indicates that people with eating disorders can find set-shifting difficult and prefer to focus on one thing at a time and to not to be interrupted until they complete a task. This has the downside of leading to less flexible thinking and being more dependent on habits than other people. Rigid rules or habits can get in the way of new opportunities and experiences: they can monopolize time which could be used for other useful things; they may also isolate people or make it difficult to solve problems.

People with eating disorders can also exhibit an excessively detailed information processing style, with neglect of holistic or "big picture" thinking - focusing too much on the details can also cause problems, making it difficult to see the "forest for the trees." Keeping the bigger picture in mind is important so that all the smaller, detailed steps go in the right direction.

Luckily, the adult brain is capable of change. It is shaped by how we use it and practising cognitive exercises can result in increased activation, and even size, of relevant brain areas. Instead of targeting eating disorder symptoms directly, cognitive remediation therapy (CRT) uses cognitive exercises to target the process, rather than the content, of thought. It aims to exercise and strengthen brain connections to improve your ability to think flexibly and in terms of the big picture. CRT also encourages you to reflect on how you think, what thinking strategies you use to complete the cognitive exercises, and how thinking strategies discussed in CRT can be translated to your daily life. You can also complete behavioural exercises to practise thinking flexibly and in terms of the big picture.

CRT has been shown to improve performance on cognitive exercises and self-reported cognitive strategies. CRT has also received positive feedback from both therapists and patients. **Investing your time into practising these exercises is like any skill – the more you do it, the healthier your brain will get.**

Generally, we do not go around thinking about how we are thinking. Like the person in a foreign country who keeps repeating the same words only louder each time still to be misunderstood by the locals, we tend to think in much the same way even when it isn't getting us what we want. The solution is to spot and change mental default settings. CRT can help people with eating disorders to do this by:

Reflecting on thinking strategies (thinking about thinking)
Acknowledging our thinking strengths
Challenging existing thinking styles
Exploring new thinking styles
Improving flexible thinking
Improving decision-making and planning skills
Improving integrated thinking
Bridging thinking skills to small behavioural exercises
Managing traits and breaking small habits

CRT Session

Exercise 1: COMPLEX PICTURES

Instructions:
- Please describe the complex picture (below) for me to draw.
- Do not allow me to see the complex picture.

Reflection questions:
- What did you think of this exercise?
- Were you aware of your thinking style while doing the exercise?
- Can you relate this thinking style to other areas of your life?
- Did your thinking style differ from your usual thinking style?
- What might you change when describing another picture to someone?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?
- What is one way that thinking more in terms of the bigger picture might improve the problems you are having with eating?

Exercise 2: HOW TO…

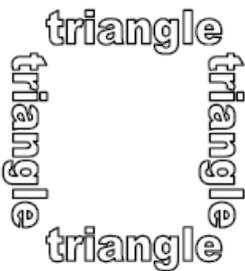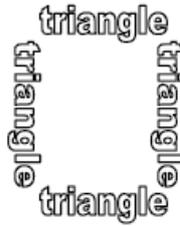**Instructions:**
Please choose a exercise that you know how to do well and describe it to me in a concise way.

Tips:
- Think about the main message you are trying to convey.
- What materials or equipment are required?
- What are the chronological steps?
- Think about the time connectives that can be used to link your steps (e.g., first, then, after this, during this time).
- Short sentences can be helpful.

Example: How to plant a sunflower
You will need a pot, soil, a sunflower seed, and a watering can. These are the steps you need to follow to plant a sunflower. First, fill the pot nearly to the top with some soil. Dampen the soil with a little water from the watering can. Place the sunflower seed onto the soil. Next, cover the seed with some more soil. Finally, pour a little more water onto the soil. Remember to water your sunflower once a day to help it grow! You will start to see the sunflower growing within two or three weeks.

Reflection questions:
- Did you find it difficult to convey the information or did you lose sight of the bigger picture (i.e., describing the exercise)?
- Do you have any examples of your own of times when you found it difficult to convey information or lost sight of the bigger picture?
- What are the advantages and disadvantages of detailed focused thinking and bigger picture thinking?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?
- What is one way that thinking more in terms of the bigger picture might improve the problems you are having with eating?

Exercise 3: SWITCHING ABILITY

Instructions:
- Start by saying what each picture is.
- When I say "switch," switch to saying the word that is overlaid on each picture.
- When I say "switch" again, switch back to saying what each picture is and so on.

vase

pencil

watch

lamp

mobile phone

balloon

table

telephone

umbrella

chair

book

watering can

train

Bus

table
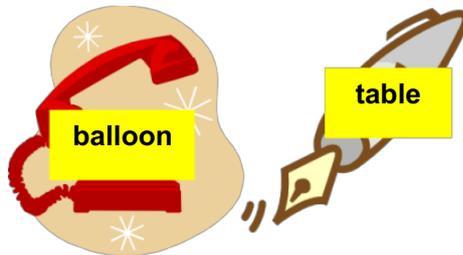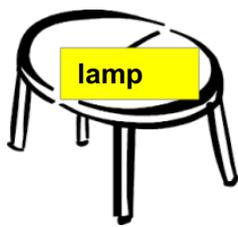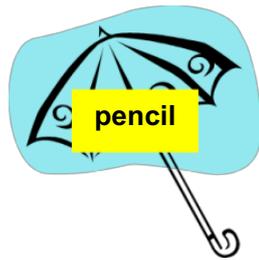
Instructions:

- Start by saying the name of each shape.
- When I say "switch," switch to saying the word in which each shape is written.
- When I say "switch" again, go back to saying the name of each shape and so on.

Reflection questions:

- How hard did you find this exercise?
- Did you use any tricks/techniques for keeping your mind focused on the right exercise?
- If so, are these techniques you are familiar with?
- Have you learnt anything new about your thinking style?
- How can you use this experience in everyday activities?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?
- What is one way that thinking more flexibly might improve the problems you are having with eating?

Exercise 4: EMBEDDED WORDS

4a) Instructions: In the text below, circle hot words while at the same time crossing out animal words:

fire violin Rome sticky tape rock bear zebra sun tissue one cat glue brimstone super mouse American flag diamond York switch mole witch dance velcro three kitchen burn computer holiday ice-cream note barcode pen grass blue four granite rabbit pillow ruler hen scald Roman road swerve tennis wolf flame glass Canada toffee lamb mountain barber's pole sun Africa sea drum paperclip treacle lava cola month triangle five blanket bed molten metal cloud paper France pie maths subway pomp music fur piano keyboard pills cow wallet glue wrist tiger clown jam milk watch sand lake chilli pepper stone kitten map quaver baboon stick phone French flag guitar goat wallpaper paste square bag carrot flipper horizon swimming Brazil deer brick hot tarmac hamster antelope balloon conductor kangaroo nice radio Cuba underwear honey alphabet car keys clipboard

4b) Instructions: In the text below, cross out words describing clothing while at the same time underlining words related to cold temperature:

snow slacks newspaper top crisp freezer skirt books editor shoes incur trousers licence change vest doors font drawing sitting underpants icicle revolve pyjamas chilly sweatshirt t-shirt shout tonight ice cooker even costume happen nippy sleet assumption gate gloves temperature freeze point camera attire dress flower notification past slippers coat leave shudder garden pants swim blue danger socks pathway insert hat jacket suit trainers retainer glacier jeans hover shelves swing shorts sweater game raincoat slacks week permafrost December pushchair fridge winter sell shirt wonder frostiness outfit glasses type Antarctic giving cool bus box roof underclothes hustle iceberg ivy scarf chill gown regent avalanche undershirt stockings tie envelope stitch Melbourne red premises stove charge talent telephone hammer icy shelter icecap frost icebox mouse hail face bitter cabinet party boil boots medal money cap shiver belt cassette remote cable quiver

Reflection questions:
- How hard did you find this exercise?
- How did you decide what words to cross out depending on the rule? For example, how did you decide if a word was an animal or a hot word?
- Was there a time you noticed you were stuck and the old rule got in the way of the exercise? If so, how did you move past it?
- When might it be useful to do two things at the same time or use two rules at the same time?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?

HOMEWORK TIMETABLE

Week 1: Prioritising Exercise (p. 10)

Week 2: Up and Down Exercise (p. 11)

Week 3: Illusions Exercise (pp. 12-13)

Week 4: Behavioural Exercise (p. 14)

WEEK 1: PRIORITISING EXERCISE

Instructions:
How would you go about planning one of the events listed below? Think about the most important job down to the least important job and write them down. So, for example, what would be the first thing you would do?

Events:
- Planning a train journey to another part of the country
- Buying a present for a friend
- Booking a holiday
- Organising your birthday party
- Having friends over for the weekend
- Looking for a new job
- Decorating a room in your home

Reflection questions:
- How did you find this exercise?
- Did you enjoy it?
- Did you find it easy to prioritise?
- Did you keep hold of the event you were planning or did you lose sight of it at any point?
- Can you remember the last time you did something similar to planning one of these events? If so, how did you find it?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?

WEEK 2: UP AND DOWN EXERCISE

Instructions:
The window cleaner is going up and down the ladder (below). The aim is to move through the sequence of pictures using the big arrows in the boxes as indicators as to whether the window cleaner is moving up or down. When the arrow appears, please say either 'up' or 'down' depending on the direction the arrow is pointing; then count on. If the arrow points up, count upwards; if the arrow points down, count backwards. So, for example, you should start counting from the top left hand corner counting from 1, count on, 2, 3 until you come to the first arrow which points down and then instead on saying '4' say 'down' (which means you then continue counting backwards), so the next picture will be 2 and so on.
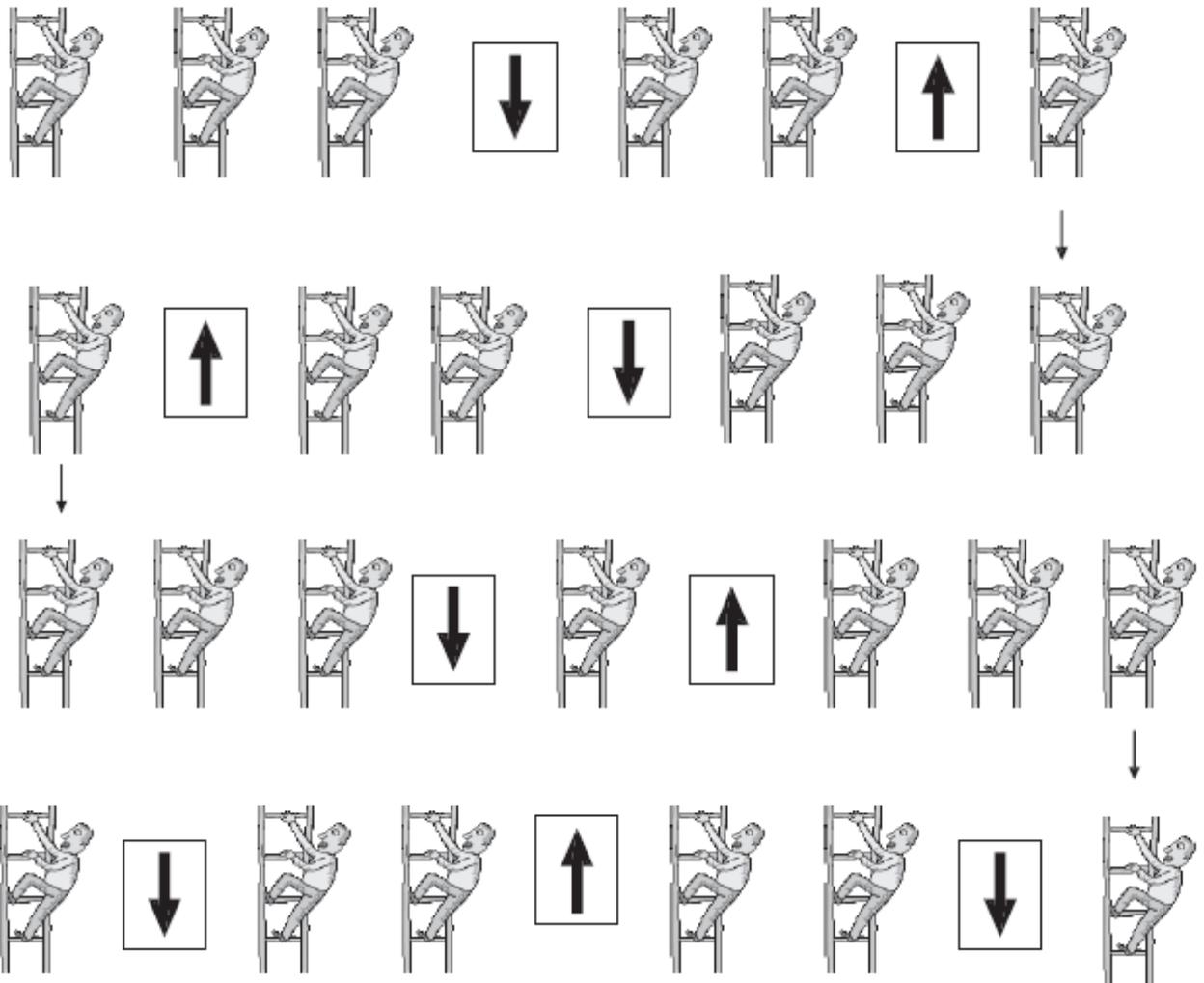
Reflection questions:
- Did you find it easy or difficult to switch between counting up and down?
- Did you use any techniques to focus on the direction you were counting in?
- Did you learn anything new about your thinking style?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?

WEEK 3: ILLUSIONS EXERCISE

Instructions:
- Spend a few minutes looking at the image of the Mona Lisa (below) and describe what you see.
- The image of the Mona Lisa includes other images. Explore the image and see if you can find at least six of them.
- If you would like some help finding the images, they are circled on Page 13.

Reflection questions:

- Did you see more than one image almost immediately?
- Did you push yourself to find the images as quickly as possible?
- Did you use any techniques to find the other images (e.g. moving the paper around)?
- Were you able to interchange between the images easily?
- How can you use this experience in everyday activities? For example:
    - Have you disagreed about something with somebody and been unable to see their perspective? Were you eventually able to see their point of view?
    - Is it sometimes hard to change your mind about things?
    - Is it sometimes useful to step back from a situation to see the whole situation rather than just parts?
- How can you apply what you have learnt to the problems you are currently experiencing with eating?

As shown in the circles, the image of the Mona Lisa includes images of three faces, one cat, and two rabbits.

WEEK 4: BEHAVIOURAL EXERCISES

Making small behavioural changes can reinforce the ways of thinking that we discussed in the CRT session and may improve your ability to think more flexibly and in terms of the bigger picture. See if you can make <u>one</u> small behavioural change from each list below. Try to choose exercises that you normally would not do, or that are different to how you would normally do things.

List 1: Bigger picture thinking:
- Brainstorm five ways that you could do a day-to-day exercise, then use the one you think will be most efficient.
- Think of something that you do every day. In the long term, will doing this be good for you? If the answer is no, what could you do instead?
- Go for a walk and notice the bigger picture (e.g., the whole park) rather than the details (e.g., the leaves on a tree).

List 2: Flexibility:
- Wear your hair differently (e.g., put your part on the other side, wear it up or down, in plaits, or blow-dried in a different way).
- Change routines in the morning (e.g., clean teeth before/after shower).
- Choose different brands whilst shopping (e.g., a different brand of washing up liquid, moisturiser, or breakfast cereal).
- Listen to a different radio station, read a different newspaper/magazine, or watch a different TV program.
- Change routines for the journey from your house to school/work/university (e.g., use different buses or walk/drive a different route).
- If you are working with text on the computer, use a different font for the day.
- When reading an email or piece of work, switch between checking for grammatical errors and content errors.

CRT-BRIEF
Therapist Manual
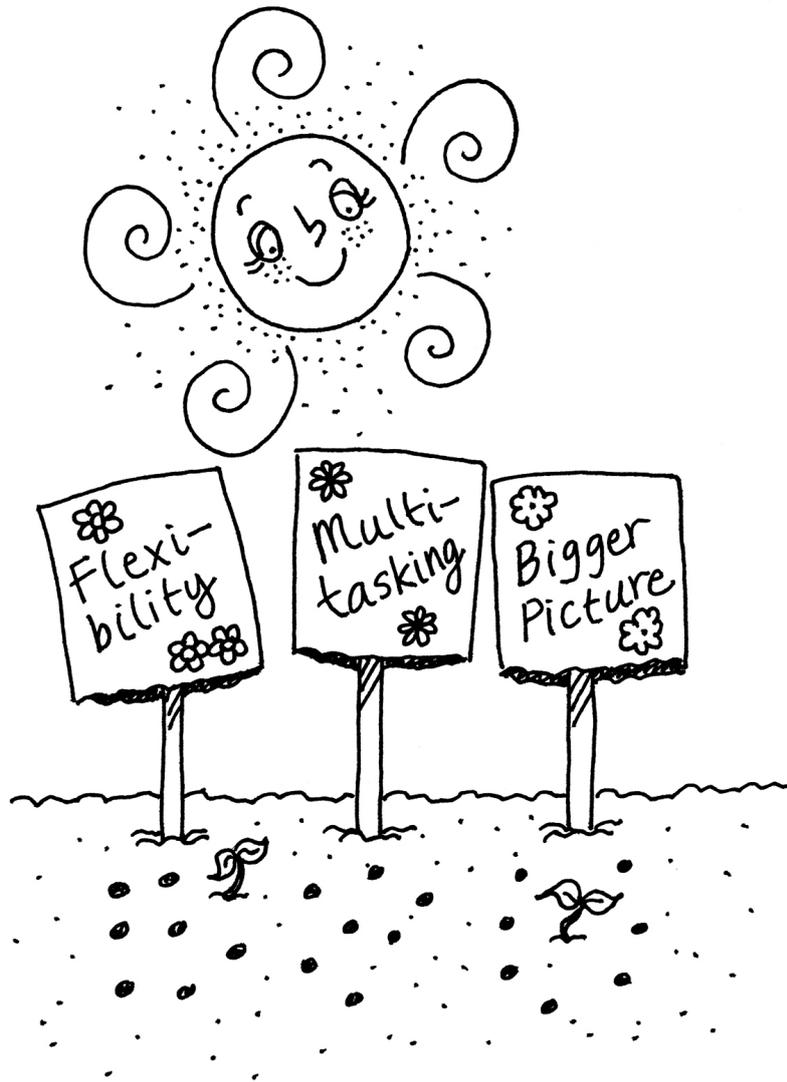
Developed by Ella Keegan and Matthew Flinders Distinguished Professor Tracey Wade in consultation with Professor Kate Tchanturia

Aims of Exercises
(Not to be shared with participant)

Complex Pictures
The aim of this exercise is to encourage the participant to practise thinking in terms of the bigger picture rather than focusing on the components of the picture as separate entities. Describing a picture for somebody else to draw (who cannot see it) is hard if the tendency is to start with the details (for example describing four individual lines rather than saying a square). This type of thinking can be related to other areas of the participant's life where details get in the way of seeing the bigger picture and inconsequential matters supersede more important matters. It is important that this exercise focuses on training to integrate details not training for perfection on the exercise.

How To…
The aim of this exercise is for the participant to practice expressing themselves in a succinct way. A good deal of our interactions involve getting messages across so that people can understand what we are thinking. Depending on the message being conveyed, this exercise can sometimes be trickier than at other times. This exercise can help the participant to think about the main points and the bigger picture that they are trying to convey.

Switching Ability
These exercises are designed to train the participant to practise switching between different aspects of stimuli or between different rules for the exercise, quickly and accurately. The aim is to help the participant increase mental control over what they focus on and to increase how fluidly they can move between ideas and exercises.

Embedded Words
The aim of this exercise is for the participant to practise identifying particular categories of information amongst irrelevant information. This exercise practises thinking in a way that requires seeing the bigger picture and the detail. It also practises flexible thinking by encouraging switching between different sets of information swiftly and accurately.

Introduction

Some people find it very easy to accommodate new information and switch between different ideas and concepts - these people are generally good at multi-tasking. This is called set-shifting. Research indicates that people with eating disorders can find set-shifting difficult and prefer to focus on one thing at a time and to not to be interrupted until they complete a task. This has the downside of leading to less flexible thinking and being more dependent on habits than other people. Rigid rules or habits can get in the way of new opportunities and experiences: they can monopolize time which could be used for other useful things; they may also isolate people or make it difficult to solve problems.

People with eating disorders can also exhibit an excessively detailed information processing style, with neglect of holistic or "big picture" thinking - focusing too much on the details can also cause problems, making it difficult to see the "forest for the trees." Keeping the bigger picture in mind is important so that all the smaller, detailed steps go in the right direction.

Luckily, the adult brain is capable of change. It is shaped by how we use it and practising cognitive exercises can result in increased activation, and even size, of relevant brain areas. Instead of targeting eating disorder symptoms directly, cognitive remediation therapy (CRT) uses cognitive exercises to target the process, rather than the content, of thought. It aims to exercise and strengthen brain connections to improve your ability to think flexibly and in terms of the big picture. CRT also encourages you to reflect on how you think, what thinking strategies you use to complete the cognitive exercises, and how thinking strategies discussed in CRT can be translated to your daily life. You can also complete behavioural exercises to practise thinking flexibly and in terms of the big picture.

CRT has been shown to improve performance on cognitive exercises and self-reported cognitive strategies. CRT has also received positive feedback from both therapists and patients. **Investing your time into practising these exercises is like any skill – the more you do it, the healthier your brain will get.**

Generally, we do not go around thinking about how we are thinking. Like the person in a foreign country who keeps repeating the same words only louder each time still to be misunderstood by the locals, we tend to think in much the same way even when it isn't getting us what we want. The solution is to spot and change mental default settings. CRT can help people with eating disorders to do this by:

Reflecting on thinking strategies (thinking about thinking)
Acknowledging our thinking strengths
Challenging existing thinking styles
Exploring new thinking styles
Improving flexible thinking
Improving decision-making and planning skills
Improving integrated thinking
Bridging thinking skills to small behavioural exercises
Managing traits and breaking small habits

CRT Session

Exercise 1: COMPLEX PICTURES

Instructions:
- Please describe the complex picture (below) for me to draw.
- Do not allow me to see the complex picture.

Reflection questions:
- What did you think of this exercise?
- Were you aware of your thinking style while doing the exercise?
- Can you relate this thinking style to other areas of your life? Prompts:
  - o Have you ever tried to describe to someone a film you had seen or a book that you had enjoyed?
  - o Have you ever been surprised to find that someone sees you differently than you see yourself?
  - o Do you find it difficult to think about your future? Do you get caught up in the details of daily life?
- Did your thinking style differ from your usual thinking style?
- What might you change when describing another picture to someone?
- How can you apply what you have learnt to the problems you are currently experiencing with eating? Prompt: thinking about the big picture (e.g., overall nutrition) rather than details (e.g., fat content).
- What is one way that thinking more in terms of the bigger picture might improve the problems you are having with eating?

Exercise 2: HOW TO…

Instructions:

Please choose a exercise that you know how to do well and describe it to me in a concise way.

Tips:
- Think about the main message you are trying to convey.
- What materials or equipment are required?
- What are the chronological steps?
- Think about the time connectives which can be used to link your steps (e.g., first, then, after this, during this time).
- Short sentences can be helpful.

Example: How to plant a sunflower:

You will need a pot, soil, a sunflower seed, and a watering can. These are the steps you need to follow to plant a sunflower. First, fill the pot nearly to the top with some soil. Dampen the soil with a little water from the watering can. Place the sunflower seed onto the soil. Next, cover the seed with some more soil. Finally, pour a little more water onto the soil. Remember to water your sunflower once a day to help it grow! You will start to see the sunflower growing within two or three weeks.
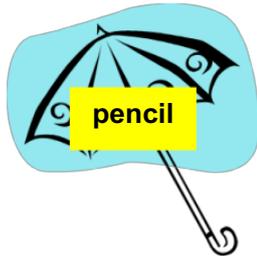
Reflection questions:
- Did you find it difficult to convey the information or did you lose sight of the bigger picture (i.e., describing the exercise)?
- Do you have any examples of your own of times when you found it difficult to convey information or lost sight of the bigger picture? Prompts: describing a film or book to someone or writing an essay for school/university.
- What are the advantages and disadvantages of detailed focused thinking and bigger picture thinking? Prompt: accuracy vs. all of the small steps going in the right direction.
- How can you apply what you have learnt to the problems you are currently experiencing with eating? Prompt: looking at the big picture that you are a whole person not one detail e.g. the shape of your stomach.
- What is one way that thinking more in terms of the bigger picture might improve the problems you are having with eating?

Exercise 3: SWITCHING ABILITY

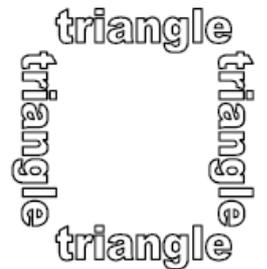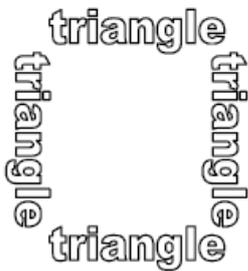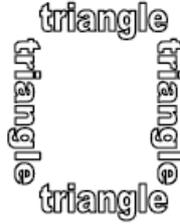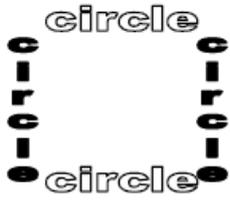(2 minutes for objects and 2 minutes for shapes)

Instructions:

- Start by saying what each picture is.
- When I say "switch," switch to saying the word that is overlaid on each picture.
- When I say "switch" again, switch back to saying what each picture is and so on.

vase

pencil

watch

lamp

mobile phone

balloon

table

telephone

umbrella

chair

book

watering can

train

Bus

table

Instructions:

- Start by saying the name of each shape.
- When I say "switch," switch to saying the word in which each shape is written.
- When I say "switch" again, go back to saying the name of each shape and so on.

circle circle circle circle circle

circle circle circle

triangle triangle triangle triangle

square

square

triangle

circle circle circle

triangle

square

triangle

triangle triangle triangle triangle

square

circle circle circle

triangle triangle triangle triangle

Reflection questions:

- How hard did you find this exercise?
- Did you use any tricks/techniques for keeping your mind focused on the right exercise?
- If so, are these techniques you are familiar with?
- Have you learnt anything new about your thinking style?
- How can you use this experience in everyday activities? Prompts: it can be useful to switch attention quickly:
  - In social situations, for example, at a party where you may have short conversations with a number of people.
  - When you're driving and have to attend to the road ahead, traffic signals, operating the car etc.
- How can you apply what you have learnt to the problems you are currently experiencing with eating? Prompt: if you don't think flexibly you can develop rigid rules and behaviours around eating.
- What is one way that thinking more flexibly might improve the problems you are having with eating?

Exercise 4: EMBEDDED WORDS

4a) Instructions: In the text below, circle hot words while at the same time crossing out animal words:

fire violin Rome sticky tape rock bear zebra sun tissue one cat glue brimstone super mouse American flag diamond York switch mole witch dance velcro three kitchen burn computer holiday ice-cream note barcode pen grass blue four granite rabbit pillow ruler hen scald Roman road swerve tennis wolf flame glass Canada toffee lamb mountain barber's pole sun Africa sea drum paperclip treacle lava cola month triangle five blanket bed molten metal cloud paper France pie maths subway pomp music fur piano keyboard pills cow wallet glue wrist tiger clown jam milk watch sand lake chilli pepper stone kitten map quaver baboon stick phone French flag guitar goat wallpaper paste square bag carrot flipper horizon swimming Brazil deer brick hot tarmac hamster antelope balloon conductor kangaroo nice radio Cuba underwear honey alphabet car keys clipboard

4b) Instructions: In the text below, cross out words describing clothing while at the same time underlining words related to cold temperature:

snow slacks newspaper top crisp freezer skirt books editor shoes incur trousers licence change vest doors font drawing sitting underpants icicle revolve pyjamas chilly sweatshirt t-shirt shout tonight ice cooker even costume happen nippy sleet assumption gate gloves temperature freeze point camera attire dress flower notification past slippers coat leave shudder garden pants swim blue danger socks pathway insert hat jacket suit trainers retainer glacier jeans hover shelves swing shorts sweater game raincoat slacks week permafrost December pushchair fridge winter sell shirt wonder frostiness outfit glasses type Antarctic giving cool bus box roof underclothes hustle iceberg ivy scarf chill gown regent avalanche undershirt stockings tie envelope stitch Melbourne red premises stove charge talent telephone hammer icy shelter icecap frost icebox mouse hail face bitter cabinet party boil boots medal money cap shiver belt cassette remote cable quiver

Reflection questions:
- How hard did you find this exercise?
- How did you decide what words to cross out depending on the rule? For example, how did you decide if a word was an animal or a hot word? Prompts: making an executive decision, going back and checking, going with your first instinct?
- Was there a time you noticed you were stuck, and the old rule got in the way of the exercise? If so, how did you move past it? (prompts same as above).
- When might it be useful to do two things at the same time or use two rules at the same time? Prompts: cooking, driving, socialising.
- How can you apply what you have learnt to the problems you are currently experiencing with eating? Prompt: thinking more flexibly about food – e.g., not thinking of foods as good or bad.
- What is one way that thinking more flexibly might improve the problems you are having with eating?

→**TALK THROUGH HOMEWORK TIMETABLE**

Appendix B

Centre for Clinical Interventions Handout

Eating Disorders & Neurobiology

Science and Eating Disorders

Eating disorders are severe mental illnesses with the potential for serious medical consequences. Our current knowledge, thanks to a growing body of scientific evidence, is helping us to better understand the neurobiology of these disorders: how they develop and how we can best support people to recover.

People with eating disorders and their loved ones may wonder how the disorder developed or blame themselves. Science can help dispel harmful myths and improve our understanding of the complexity of eating disorders. Through research we have come to understand that there is no single cause of eating disorders—for example, you don't have to have other psychological problems or trauma. However, it is common for eating disorders to develop after a period of caloric restriction or inadequate nutritional intake (intentionally or through stress/illness).

The Role of Genetics in Eating Disorders

Mood, personality, anxiety and impulse regulation, as well as appetite, body weight and metabolism have a strong genetic basis (i.e., are heritable). On average, about half the risk of developing an eating disorder comes from genetic influence, but this risk differs from person to person. People with higher heritability need only a slightly toxic environment for an eating disorder to manifest itself, while in a protected environment, may not go on to develop an eating disorder.

Consider an orchid and a dandelion - an orchid needs an optimal environment to flourish, whereas a dandelion survives in spite of environmental challenges. Similarly, people with a genetic vulnerability to developing an eating disorders can thrive in positive environments but are more vulnerable to harmful environments, such as those that might trigger weight loss or stress.

"Epigenetics" is the study of biological mechanisms that cause our underlying genetic predispositions to be "switched on" or "switched off". In certain environments, especially where there is a lot of stress and/or inadequate nutrition, the risk is higher — the genes might get "switched on". As international eating disorders expert Professor Cynthia Bulik explains: "Genes load the gun, environment pulls the trigger".

The Gene-Environment Interaction

Western culture places a high value on thinness and muscularity and many people engage in dieting or excessive exercise to become thinner or more muscular. For some, these behaviours are only minimally harmful, For those who carry the genetic risk, these environmental influences can trigger their genes to "switch on" and result in an eating disorder. In another scenario, two individuals might get ill with a stomach bug resulting in modest weight loss. One person may naturally regain the lost weight with no long-term consequences, while in the other, the development of an eating disorder may be triggered. Thus, inadequate nutrition serves as the catalyst for the expression of an underlying genetic vulnerability.

How Eating Disorders Affect the Brain

Some people worry that eating disorders are caused by a chemical imbalance in the brain, but there is no evidence for this. However, research has shown that brain activity can be affected by even modest dieting, and a young person's developing brain is particularly vulnerable. When a person is malnourished, their brain is not adequately fueled, and this may mean they struggle to make decisions, solve problems and regulate their emotions. (See our handout on *Starvation Syndrome*). They may also experience perceptual disturbances in the way they see themselves; for example, looking in the mirror and see themselves as much larger than they actually are. Also, although eating disorders aren't *caused* by a chemical imbalance in the brain, restricted eating, malnourishment, and excessive weight loss can result in problematic changes to our brain chemistry. For example, the brain produces less serotonin, which results in increased symptoms of depression.
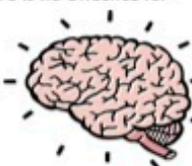
What Does All This Mean For Recovery?

The good news is that the effects of starvation can be reversed with adequate re-nourishment. Brain-imaging studies show that brain activity in people with eating disorders can change. The brain, like a muscle, is constantly changing and adapting as a result of our environment and how it is used, or "exercised". It can be "exercised" through learning and practicing new ways of thinking and interacting with others. With practice, people with improved eating disorders. show brain activity that looks more like that of people who had never had an eating disorder.

However the brain needs to be adequately nourished in order to make these challenging changes. A starved brain won't function optimally so the first priority in treatment is nutritional rehabilitation. This can be challenging, as increasing food intake can be scary for someone with an eating disorder. Also the brain tends to '"lag behind" the body in terms of recovery and it can take time for people recovering from an eating disorder for their brain to "catch up", when they regain their capacity for abstract reasoning and rational thinking.

A particular challenge we face is that our society remains a potentially triggering environment, with images of unachievable bodies and inaccurate and conflicting messages about diets and exercise ever present. Therapy not only needs to address the person's genetic vulnerabilities, but also to help them develop skills to manage environmental influences (e.g., managing stress and avoiding dieting).

Recovery from an eating disorder *is* possible. With adequate re-nourishment and learning, the brain and body can return to healthy functioning. Adequate nutritional intake and supportive environments will promote thriving across all life domains.

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• Psychotherapy • Research • Training