Are socio-emotional and neurocognitive functioning predictors of therapeutic outcomes for adults with anorexia nervosa?

Anna Oldershaw1,2 | Tony Lavender1 | Ulrike Schmidt2,3

1 Salomons Centre for Applied Psychology, Canterbury Christ Church University, Tunbridge Wells, UK
2 Section of Eating Disorders, Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King’s College London, London, UK
3 Eating Disorders Unit, South London and Maudsley NHS Foundation Trust, London, UK

Correspondence
Anna Oldershaw, Salomons Centre for Applied Psychology, Canterbury Christ Church University, Tunbridge Wells, UK. Email: annaoldershaw@hotmail.com

Funding information
National Institute of Health Research and Health Education England Training Fellowship, Grant/Award Number: (Integrated Clinical Academic Fellowship-Clinical Lectureship ICA-CL-2015-01-005)

Abstract
Background: Emotional, social, and neurocognitive factors are theorised to maintain anorexia nervosa (AN). Yet whether they predict outcomes or relate to clinical change remains unclear.

Methods: Seventy-one consecutive adult outpatient eating disorder service referrals presenting with AN, who participated in a randomised controlled trial comparing 2 psychotherapies, were assessed for emotional processing, social cognition, and neurocognition pretherapy and posttherapy. Intention-to-treat analysis employed maximum-likelihood methods to model missing data. Baseline self-reported emotional processing, social cognitive, or neurocognitive task performance was entered into forward stepwise regression models with post-treatment clinical outcomes (weight, eating disorder psychopathology, psychosocial functioning) as dependent variables. Correlation analyses examined relationships between clinical and self-report/task score change.

Results: Self-reported emotional avoidance (behavioural/cognitive avoidance, low acceptance) and submissive behaviour predicted clinical outcomes. Social cognitive (emotion recognition, emotional theory of mind) and neurocognitive performance (set-shifting, detail focus) had limited predictive ability.

Conclusions: Emotional avoidance and submissiveness may represent maintenance factors for AN.

KEYWORDS
anorexia nervosa, emotion, neurocognition, social, outcome

1 | INTRODUCTION

Anorexia nervosa (AN) is an eating disorder (ED) characterised by self-starvation and hyperactivity driven by weight, shape, and eating concerns (American Psychiatric Association, 2013; Treasure et al., 2015; Zipfel, Giel, Bulik, Hay, & Schmidt, 2015). It is increasingly recognised that people with AN have extensive difficulties in the socio-emotional and neurocognitive domains. These difficulties are distinct from mood disorder symptoms; rather they relate to difficulties in emotional processing, social cognition, and neurocognition. For example, people with AN report maladaptive schemata (e.g., defectiveness/shame and subjugation); they have poor awareness of their emotions and a stronger reliance on maladaptive emotion regulation strategies than have
healthy controls (HC; e.g., avoidance, external/social comparison, submissiveness, worry/rumination, and emotion suppression), with less reported use of adaptive ones (e.g., cognitive reappraisal and goal-directed behaviour; Davies et al., 2016; Lavender et al., 2015; Oldershaw, Lavender, Sallis, Stahl, & Schmidt, 2015). People with AN also appear to have difficulties in interpreting social meanings and intentions of others from their vocal expression and body language (Kucharska-Pietura, Nikolaou, Masiak, & Treasure, 2004; Oldershaw et al., 2012; Zucker et al., 2013) and from facial expressions, although the evidence is divergent (cf. Adenzato, Todisco, & Ardito, 2012; Caglar-Nazali et al., 2014; Dapelo, Surguladze, Morris, & Tchanturia, 2016; Oldershaw, Hambrook, Stahl, et al., 2011). Unsurprisingly therefore, people with AN also show social problem-solving difficulties (Sternheim et al., 2012).

Another area of empirical and treatment innovation is the role of neurocognitive difficulties for people with AN. Neuropsychological inefficiencies are common in AN, including poor cognitive set-shifting (Wu et al., 2014) and weak central coherence (extreme attention to detail at the expense of the bigger picture; Lang, Lopez, Stahl, Tchanturia, & Treasure, 2014), with difficulties of similar magnitude to those observed in autism spectrum disorder (ASD; Oldershaw, Hambrook, Tchanturia, Treasure, & Schmidt, 2011; Westwood, Eiser, et al., 2016; Westwood, Stahl, Mandy, & Tchanturia, 2016; Westwood, Mandy, & Tchanturia, 2017).

Poorer emotional processing is associated with greater illness chronicity (Harrison, Tchanturia, Naumann, & Treasure, 2012). Improvement in specific areas of emotional processing is associated with recovery, including reduced maladaptive emotion beliefs and increased identification of emotion, reduced emotional avoidance, and increased expression within key interpersonal relationships (Oldershaw et al., 2015). Some social cognitive abilities, such as theory of mind, may also improve following recovery (Conner, Troop, Landau, Campbell, & Treasure, 2007; Harrison, Tchanturia, & Treasure, 2010; Oldershaw et al., 2012; Oldershaw, Hambrook, Stahl, et al., 2011). Improvements may link to neural changes related to restoration of weight or compensatory neural adaptations promoting recovery. For example, neural adaptations promoting better social self-evaluation (as opposed to other-evaluations) are observed for those recovered from AN versus those currently ill (McAdams et al., 2016).

Similarly, there are significant differences observed between people currently ill with AN and those recently recovered from AN on measures of cognitive flexibility, such as set-shifting tasks (Harper, Brodrick, Van Enkevort, & McAdams, 2017). Poor cognitive flexibility has been shown to relate to longer and more severe AN symptomatology (Westwood, Eisler, et al., 2016; Westwood, Stahl, et al., 2016), and 10 years after recovery from AN, healthy set-shifting is observed (Gillberg, Råstam, Wentz, & Gillberg, 2007). Enhanced detail focus has been shown to persist in recovered AN samples relative to HCs (Harrison, Treasure, & Tchanturia, 2011; Lang et al., 2014; Lang et al., 2016; Tenconi et al., 2010), even 10 years later (Gillberg et al., 2007); thus detail focus is purported to be a trait factor in people with AN and may not be expected to change even following recovery.

These findings of identified difficulties across emotional processing, social cognition, and neurocognition domains, as well as possible improvements to certain facets once recovered, have important implications for the treatment of AN. Talking therapies are widely seen as the treatment of choice for AN, with treatment of adults, where the disorder is typically well established or longstanding, regarded as particularly difficult to treat. The last 5 years has seen a vast improvement in available treatment evidence for adults with AN, with a number of large scale trials of different psychological interventions published (Brockmeyer, Friederich, & Schmidt, 2017). Several of the treatments targeted in recent trials, such as cognitive behavioural therapy for eating disorders, Maudsley Model of Anorexia Nervosa Treatment for Adults (MANTS), and focal psychodynamic therapy, are now recommended by National Institute for Health and Care Excellence guidelines as first-line treatments for AN in the United Kingdom (National Institute for Health and Care Excellence, 2017) and focus on putative illness, maintaining factors such as socio-emotional and neurocognitive factors (Zipfel et al., 2015; Schmidt et al., 2015; Byrne et al., 2017).

However, we still know very little about what predicts treatment outcome in AN. A recent comprehensive systematic review and meta-analysis of predictors of treatment outcome in EDs identified a range of baseline predictors (Vall & Wade, 2015), but emotional processing, social cognitive, or neurocognitive factors were not included in the meta-analyses due to a lack of suitable studies. Stice (2002) defines a maintenance factor as a factor that predicts symptom persistence over time versus remission amongst people who are initially symptomatic. It could be a causal maintenance factor if an increase or decrease in the variable leads to a change in symptom expression. Studies investigating change to emotional, social, and neurocognitive variables have been largely restricted to cross-sectional designs, limiting conclusions that can be drawn. It has been suggested that not understanding how change is facilitated is a barrier to developing evidence-based interventions for AN to date (Wollburg, Meyer, Osen, & Löwe, 2013).
On the basis of prominent theoretical models of AN (Corstorphine, 2006; Fairburn, Cooper, & Shafran, 2008; Treasure & Schmidt, 2013; Waller, Kennerley, & Ohanian, 2010; Wildes, Ringham, & Marcus, 2010), this study hypothesises that baseline emotional processing, social cognitive, and neurocognitive functioning would predict clinical outcomes following therapy. Moreover, given data suggesting that difficulties are exacerbated in the “ill state,” or that their amelioration relates to recovery from AN, it was hypothesised that socio-emotional/neurocognitive change during psychological therapy would relate to clinical change. As such, we seek to preliminarily investigate whether these factors may be candidates for maintenance factors.

2 | METHODS

2.1 | Participants

Seventy-one consecutive referrals to an outpatient ED service were recruited into the study.

2.2 | Inclusion criteria

Participants were (a) aged > 18, (b) with body mass index (BMI) < 18.5 kg/m² and without amenorrhoea or that their amelioration relates to recovery from AN, it was hypothesised that socio-emotional/neurocognitive change during psychological therapy would relate to clinical change. As such, we seek to preliminarily investigate whether these factors may be candidates for maintenance factors.

2.2 | Inclusion criteria

Participants were (a) aged > 18, (b) with body mass index (BMI) < 18.5 kg/m² and without amenorrhoea or (c) diagnosed with AN or eating disorder not otherwise specified, AN type (EDNOS-AN) by a trained ED specialist according to Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition) criteria (American Psychiatric Association, 2000). Inclusion of EDNOS-AN followed meta-analyses, which concluded that AN with a more lenient weight criterion (BMI ≤ 18.5 kg/m²) and without amenorrhoea is comparable with diagnostic AN (Thomas, Vartanian, & Brownell, 2009) and that EDNOS is the most common ED classification (Walsh & Sysko, 2009). Thus, these inclusion criteria enabled a representative sample of outpatient referrals.

2.3 | Exclusion criteria

Exclusion criteria were (a) drug/alcohol dependency, (b) severe co-morbid psychiatric disorder, (c) learning disabilities, (d) literacy preventing utilisation of manual-based therapy, (e) receipt of MANTRA within the last year, and (f) pregnancy. No lower BMI limit was set, but exclusion and inpatient care recommended where severe medical risk was diagnosed by a psychiatrist.

Written informed consent was obtained at baseline and verbal consent at follow-ups. The study was guided by the British Psychological Society’s (BPS’s) Code of Conduct for Research (British Psychological Society, 2018). Ethical approval was granted by the Joint South London and Maudsley and King’s College London Research Ethics Committee.

2.4 | Design

This study employed data from a randomised controlled trial (Schmidt et al., 2012), comparing two psychological interventions: the MANTRA and Specialist Supportive Clinical Management (SSCM). Participants were randomly assigned to receive one of the treatments. Both involved 20 once-weekly individual sessions of therapy over 6 months and four once-monthly follow-up sessions. Of the 71 participants included in this study, 34 participants were randomised to MANTRA and 37 to SSCM. The mean number of sessions attended in MANTRA was 14.4 (SD = 7.0) and in SSCM was 14.2 (SD = 9.5). As our research question related to baseline predictors of clinical outcomes, and the therapeutic groups did not differ on these variables (see Schmidt et al., 2012), this study pools baseline and outcome scores from both groups; thus, analyses were completed without employing group comparison. Assessments were completed at baseline before psychological therapy began (T0) and 6 months later once therapy was complete (T1).

2.5 | Measures

2.5.1 | Demographic and clinical variables

Key variables were collected including age, ethnicity, medical history, weight, and BMI (kg/m²).

The Eating Disorder Examination Schedule (12th Edition, EDE; Fairburn & Cooper, 1993) is an investigatory-based interview designed to measure ED psychopathology present within the past 28 days. Scores range from 0 to 6, with higher scores indicating greater (more frequent or more severe) ED psychopathology. Items generate four subscale scores calculated as the mean score for related items: restraint, eating concern, shape concern, and weight concern. A “global” score can also be calculated by determining the mean of the four subscale scores. In this study, the global score was employed, again ranging from 0 to 6.

The Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) measured co-morbid symptoms of anxiety and depression to provide greater indication of the clinical presentation of the sample. It is a widely used self-report measure consisting of 14 items: seven tapping depression and seven anxiety. Participant rate items on the basis of feelings and behaviour during the previous week; items are scored 0–3, generating a maximum score of 21 for each subscale.
The Clinical Impairment Assessment (Bohn et al., 2008) examined the impact of the ED on psychosocial functioning. It comprises 16 items and is rated according to difficulties experienced within the past 28 days. Items are rated by participants on a Likert scale from 0 (not at all) to 3 (a lot). Scores are added to generate a total score ranging from 0 to 48, with higher scores indicating a greater level of psychosocial impairment.

As we were interested in whether emotional processing, social cognition, and neurocognition might be maintenance factors for the ED, clinical variables pertinent to ED pathology in AN (weight, ED symptomatology, and impact of ED on psychosocial functioning) were selected as the key outcome variables of interest.

2.5.2 Emotional processing questionnaires

Emotional processing was assessed via the following self-report questionnaires. These sought to capture participant experience and management of emotion, both interpersonally (i.e., within relationships) and intrapersonally (e.g., distraction).

The Beliefs about Emotions Scale (BES; Rimes & Chalder, 2010) assesses maladaptive emotion beliefs, particularly in regard to the experience and expression of emotion, for example, “It is stupid to have miserable thoughts” (experience) or “It would be a sign of weakness to show my emotions in public” (expression). The BES contains 12 items that are rated across possible seven responses from totally agree to totally disagree. Higher scores represent greater maladaptive emotion beliefs.

The Silencing the Self Scale (STSS; Jack & Dill, 1992) is a 31-item questionnaire designed to tap schemata concerning beliefs about how to obtain and maintain intimacy in relationships. The STSS comprises four subscales:

- STSS1—externalised self-perception (social comparison);
- STSS2—care as self-sacrifice (submissiveness by prioritising other’s needs to secure attachments);
- STSS3—silencing the self (emotion suppression to avoid conflict);
- STSS4—divided self (compliance despite inner anger/hostility).

Subscales STSS1 and STSS2 were considered to measure control over social interactions, and subscales STSS3 and STSS4 were considered to measure control over expression within relationships. Each item is rated for agreement on a 5-point scale (1 = strongly disagree; 5 = strongly agree). Scores range from 31 to 155, with higher scores indicating greater control over social interaction and expression of emotion in relationships.

The Distress Tolerance Scale (DTS; Corstorphine, Mountford, Tomlinson, Waller, & Meyer, 2007) is a 20-item self-report measure of distress tolerance, defined as the ability to endure and accept negative affect so that problem solving can take place (Linehan, 1993). It comprises three subscales assessing tolerance and control of emotional experience both intrapersonally and interpersonally. The subscales are as follows:

- DTS1—anticipate and distract (cognitive avoidance of emotion), for example, “I don’t let myself think about things that would depress me.”
- DTS2—avoidance of affect (behavioural avoidance of trigger situations), for example, “I avoid situations that I know will make me nervous.”
- DTS3—accept and manage (adaptive accepting and managing emotion), for example, “If I find I am getting too anxious, I will do something to soothe myself (e.g., listen to music, read a book).”

Items were scored from 1 (never) to 5 (always). Higher scores indicated poorer distress tolerance, except for DTS3 “accept and manage” subscale, which is reverse scored so that lower scores represent more pathological responses (poorer acceptance of emotion).

2.5.3 Social cognition tasks

Social cognition was assessed via the following experimental tasks. These specifically sought to assess participant emotional theory of mind (eToM) ability, that is, the ability to recognise, imagine, and infer emotion in others from visual, audio, and written cues.

The Reading the Mind in the Eyes Task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) measures participants’ ability to recognise emotion from the eye region of the face. Thirty-six different black and white images of eyes were presented individually on a computer screen along with four possible emotion words representing complex emotional and mental states. The participant must judge what emotion the person is feeling from the expression in their eyes and select the best matching word. One point is given for each correct answer (maximum score = 36); therefore, higher scores indicate better emotion recognition.

The Reading the Mind in Films (RMF; Golan, Baron-Cohen, Hill, & Golan, 2006) measures complex eToM. Stimuli were presented on a laptop and run using DMDX software. Twenty-two short film clips were presented, each containing one social scene. Participants were required to determine how an identified protagonist is
Neurocognitive functioning was measured using two set-shifting tasks (measuring ability to switch and adapt to new rules) and one measure of detail focus.

The Wisconsin Card Sorting Task (Psychological Assessment Resources, 2003) was administered via computer to assess set-shifting (ability to switch and adapt to new rules). The task requires participants to match different test cards featuring pictures of shapes to one of four key cards that remain constant during the task. Participants are not told how to match the cards, but they are given feedback after each one; the word “right” or “wrong” is presented audibly and on-screen. There are three criteria that can be used to match the cards: colour, shape, or number. After a fixed number of correct matches, the matching criteria change and participants must adjust to the new rules in order to continue to correctly match. The number of perseverative errors (i.e., the number of times one persists with an old matching rule once a new rule has been introduced) gives a reflection of set-shifting ability, with more errors reflecting poorer set-shifting ability.

The Brixton Spatial Anticipation Task (Burgess & Challice, 1997) was included as a second measure of set-shifting. It involves predicting movement of a circle whose pattern of movement periodically changes. More errors reflect poorer adaptation to new patterns (i.e., poorer set-shifting).

The Trail Making Task (TMT; Kravariti, Morris, Rabe-Hesketh, Murray, & Frangou, 2003) comprises Trail A (connecting dots alphabetically) and Trail B, which introduces numbers and requires connections alternating between numerical and alphabetical orders (1-A-2-B-3-C, etc). Trail B completion time indicates ability to shift from the old rule and also between numbers and letters, with longer times indicating greater difficulty in adapting.

2.6 Data analyses

An intention-to-treat analysis was employed, using maximum-likelihood methods to model missing data. After testing parametric assumptions, skewed variables were transformed and retested. The detail-focus measure (GEFT) remained nonnormally distributed, necessitating nonparametric analyses.

Exploratory forward stepwise regressions determined whether baseline scores predicted clinical outcomes by testing variables one by one and including them in the model, where statistically significant. Baseline emotional processing (BES, STSS, DTS), social cognition (Reading the Mind in the Eyes, RMF, LEAS), or neurocognitive functioning (Wisconsin Card Sorting Task, Brixton Spatial Anticipation Task, Group Embedded Figures Task) were entered into a forward stepwise regression model to investigate their predictive value of clinical outcomes (weight, ED psychopathology, and psychosocial functioning) following treatment. Baseline (T0) emotional processing, social cognition, and neurocognitive scores were independent variables, with a T1 clinical variable as the dependent variable (DV) and its respective baseline value as covariate. Therefore, three regression models were built, one for each of the three clinical DVs.

As variables were measured on different scales, the standardised regression coefficient (β) is reported, denoting the change in standard deviations of the DV associated with a one standard deviation change in the independent variable. $R^2$ indicates the amount of variance explained and change in $R^2$ ($ΔR^2$) for each model step were included. The stepwise procedure was selected over hierarchical modelling as there was no sufficient evidence to make specific a priori hypotheses regarding the order of variables to enter. Forward regression was chosen as it can be considered more stringent than the backwards method, but “suppressor effects” can increase risk of Type II error (Field, 2005).
To establish how change in specific emotional processing, social cognition, or neurocognition variables related to clinical change, change variables were calculated ([posttreatment score] - [pretreatment score]) and Pearson’s r or Spearman’s r_s correlations completed, as appropriate.

Tests were two tailed with significance set at α = .05, unless otherwise stated. Values .05 < p < .1 were considered to indicate a data trend (cf. Staykov et al., 2011). Cohen’s d effect sizes are reported and defined as small (d < 0.1), medium (0.1 ≤ d < 0.4), or large (0.4 ≤ d; Cohen, 1992). All analyses were performed using the statistical package SPSS version 17 (SPSS Inc., Chicago, IL).

### 3 | RESULTS

Table 1 provides pretreatment (T0) and posttreatment (T1; 6 months later) scores. Tables 2–4 provide the results of each of the three regression models.
3.1 Clinical and descriptive statistics

Participants were predominantly female (93%) and of White British ethnicity (73.2%), with a mean age of 26.6 (SD = 7.9). Average illness duration was 80.6 months (SD = 71.8), with over half of participants (59%) having received previous treatment.

3.2 Predictors of clinical outcomes

3.2.1 Emotional processing

Weight (kg)

Posttreatment weight was significantly predicted by baseline “avoidance of affect” (DTS2), accounting for a small 3% of the variance (β = −.18, p < .01, R² = .03), with greater emotional avoidance associated with lower weight.

ED psychopathology (Eating Disorder Examination Questionnaire)

Posttreatment ED pathology was significantly predicted by baseline levels of “care as self-sacrifice” (STSS2; β = .24, p < .05, R² = .05), a need to “anticipate and distract” from emotion (DTS1; β = .62, p < .001, R² = .10), and emotional “acceptance and management” (DTS3; β = −.40, p < .01, R² = .07). Greater ED pathology was associated with greater self-reported submissiveness, cognitive emotional avoidance, and less adaptive emotional acceptance and management at baseline; together, these variables accounted for 22% of the variance.

Psychosocial function (Clinical Impairment Assessment)

Baseline care as self-sacrifice behaviour (STSS2; β = .22, p < .05, R² = .04) and avoidance of affect (DTS2; β = .35, p < .01, R² = .10) accounted for 14% of the variance in posttreatment psychosocial function. Poorer emotional processing was linked to poorer posttreatment psychosocial functioning in all cases.

3.2.2 Social cognition

Weight (kg)

Baseline performance of eToM as measured by the RMF task significantly predicted posttreatment weight, although it only accounted for 3% of the variance (β = −.20, p < .01, R² = .03), and poorer scores were associated with better weight outcomes.

ED psychopathology and psychosocial functioning

No social cognition variables predicted posttreatment ED psychopathology or psychosocial functioning.

3.2.3 Neurocognitive functioning

Weight (kg)

Posttreatment weight was predicted by baseline set-shifting on the TMT (β = −.22, p < .01, R² = .04) and baseline detail focus (β = −.18, p < .05, R² = .03), together accounting for 7% of the variance. Poorer set-shifting and poorer detail focus before treatment were both associated with poorer posttreatment weight.

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.66</td>
<td>4.49</td>
<td>.77***</td>
</tr>
<tr>
<td>Weight T1</td>
<td>1.02</td>
<td>0.10</td>
<td>.77***</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>15.60</td>
<td>6.86</td>
<td></td>
</tr>
<tr>
<td>Weight T1</td>
<td>1.01</td>
<td>0.10</td>
<td>.77***</td>
</tr>
<tr>
<td>TMT T1</td>
<td>−8.73</td>
<td>3.34</td>
<td>−.19**</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>20.20</td>
<td>6.98</td>
<td></td>
</tr>
<tr>
<td>Weight T1</td>
<td>1.05</td>
<td>0.10</td>
<td>.80***</td>
</tr>
<tr>
<td>TMT T1</td>
<td>−10.07</td>
<td>3.31</td>
<td>−.22**</td>
</tr>
<tr>
<td>RMF T1</td>
<td>−0.34</td>
<td>0.15</td>
<td>−.16*</td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>24.90</td>
<td>6.97</td>
<td></td>
</tr>
<tr>
<td>Weight T1</td>
<td>1.02</td>
<td>0.09</td>
<td>.77***</td>
</tr>
<tr>
<td>TMT T1</td>
<td>−9.80</td>
<td>3.18</td>
<td>−.22**</td>
</tr>
<tr>
<td>RMF T1</td>
<td>−0.42</td>
<td>0.15</td>
<td>−.20**</td>
</tr>
<tr>
<td>DTS2 T1</td>
<td>−1.04</td>
<td>0.41</td>
<td>−.18**</td>
</tr>
<tr>
<td>Step 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>25.20</td>
<td>6.74</td>
<td></td>
</tr>
<tr>
<td>Weight T1</td>
<td>0.10</td>
<td>0.09</td>
<td>.75***</td>
</tr>
<tr>
<td>TMT T1</td>
<td>−7.52</td>
<td>3.22</td>
<td>−0.17*</td>
</tr>
<tr>
<td>RMF T1</td>
<td>−0.49</td>
<td>0.15</td>
<td>−.24**</td>
</tr>
<tr>
<td>DTS2 T1</td>
<td>−1.13</td>
<td>0.40</td>
<td>−.20**</td>
</tr>
<tr>
<td>GEFT T1</td>
<td>−0.08</td>
<td>0.03</td>
<td>−.18*</td>
</tr>
</tbody>
</table>

Note. R² = .60 for Step 1; ΔR² = .04 for Step 2; ΔR² = .03 for Step 3; ΔR² = .03 for Step 4; ΔR² = .03 for Step 5 (ps < .05). TMT = Trail Making Task; RMF = Reading the Mind in Films; DTS = Distress Tolerance Scale (DTS2: Avoidance of affect); GEFT = Group Embedded Figures Task.

*p < .05.

**p < .01.

***p < .001.
In contrast to findings for weight, poorer baseline set-shifting measured by the Wisconsin Card Sorting Task predicted better posttreatment ED symptoms (global EDE; $\beta = -0.23$, $p < .01$, $R^2 = 0.05$).

Psychosocial functioning (Clinical Impairment Assessment)
No neurocognitive variables predicted psychosocial functioning.

**TABLE 3**  Stepwise regression investigating which baseline socio-emotional and neurocognitive variables predict eating disorder pathology after treatment

<table>
<thead>
<tr>
<th>Variables</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.46</td>
<td>0.25</td>
<td>.53***</td>
</tr>
<tr>
<td>EDE global T1</td>
<td>0.63</td>
<td>0.12</td>
<td>.53***</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.13</td>
<td>0.26</td>
<td>.31**</td>
</tr>
<tr>
<td>EDE global T1</td>
<td>0.62</td>
<td>0.12</td>
<td>.58***</td>
</tr>
<tr>
<td>DTS1 T1</td>
<td>0.13</td>
<td>0.04</td>
<td>.31**</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.33</td>
<td>0.25</td>
<td>.52***</td>
</tr>
<tr>
<td>EDE global T1</td>
<td>0.63</td>
<td>0.11</td>
<td>.52***</td>
</tr>
<tr>
<td>DTS1 T1</td>
<td>0.24</td>
<td>0.05</td>
<td>.57***</td>
</tr>
<tr>
<td>DTS3 T1</td>
<td>-0.19</td>
<td>0.07</td>
<td>-0.36**</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.25</td>
<td>0.25</td>
<td>.43***</td>
</tr>
<tr>
<td>EDE global T1</td>
<td>0.52</td>
<td>0.12</td>
<td>.43***</td>
</tr>
<tr>
<td>DTS1 T1</td>
<td>0.26</td>
<td>0.05</td>
<td>.62***</td>
</tr>
<tr>
<td>DTS3 T1</td>
<td>-0.20</td>
<td>0.06</td>
<td>-0.40**</td>
</tr>
<tr>
<td>STSS2 T1</td>
<td>0.00</td>
<td>0.00</td>
<td>.24*</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.60</td>
<td>0.27</td>
<td>.42***</td>
</tr>
<tr>
<td>EDE global T1</td>
<td>0.50</td>
<td>0.11</td>
<td>.42***</td>
</tr>
<tr>
<td>DTS1 T1</td>
<td>0.29</td>
<td>0.05</td>
<td>.68***</td>
</tr>
<tr>
<td>DTS3 T1</td>
<td>-0.23</td>
<td>0.06</td>
<td>-0.45***</td>
</tr>
<tr>
<td>STSS2 T1</td>
<td>0.00</td>
<td>0.00</td>
<td>.24**</td>
</tr>
<tr>
<td>WCST T1</td>
<td>-0.28</td>
<td>0.11</td>
<td>-0.23**</td>
</tr>
</tbody>
</table>

Note. $R^2 = .27$ for Step 1; $\Delta R^2 = .10$ for Step 2; $\Delta R^2 = .07$ for Step 3; $\Delta R^2 = .05$ for Step 4; $\Delta R^2 = .05$ for Step 5 ($ps < .05$). EDE = Eating Disorder Examination; DTS = Distress Tolerance Scale (DTS1: Anticipate and distract; DTS3: Accept and manage); STSS = Silencing the Self Scale (STSS2: Care as self-sacrifice); WCST = Wisconsin Card Sorting Task.

* $p < .05$.
** $p < .00$.
*** $p < .001$.

3.3 | Relationships between change in clinical variables and putative maintenance factors over time

3.3.1 | Emotional processing

Due to inflated chance of Type I error with multiple correlations, significance levels were corrected using Bonferroni corrections and set at $\alpha = .013$ for the STSS ($\alpha = .05/4$ subscales) and $\alpha = .017$ for the DTS ($\alpha = .05/3$ subscales).

Weight (kg)
Increased weight related to a reduction in participants’ self-reported reliance on anticipate and distract from emotion (DTS1; $r = -.32$, $p < .01$, $d = 0.68$).

ED psychopathology (Eating Disorder Examination Questionnaire)
A reduction in ED psychopathology was associated with a decrease in self-reported dysfunctional emotion beliefs (BES; $r = .44$, $p < .000$, $d = 0.85$) and decreased “silencing the self” (STSS3; $r = .39$, $p < .001$, $d = 0.85$) and decreased “divided self” (STSS4; $r = .39$, $p < .001$, $d = 0.85$).

Psychosocial functioning (Clinical Impairment Assessment)
A decrease in psychosocial difficulties related to a reduction in self-reported silencing the self (STSS3; $r = .35$, $p < .003$, $d = 0.75$).

3.3.2 | Social cognition

Weight (kg)
Weight gain correlated with improved eToM on the RMF task ($r_s = .23$, $p < .05$, $d = 0.47$).

ED psychopathology (Eating Disorder Examination Questionnaire)
There were no correlations between ED symptom change and change in social cognitive performance.

Psychosocial functioning (Clinical Impairment Assessment)
An increase in self-reported psychosocial functioning was associated with increased ability to infer emotion for others in imagined situations (LEAS other; $r = .23$, $p < .05$, $d = 0.47$).

3.3.3 | Neurocognitive functioning

Weight (kg)
There were no correlations between weight change and change in neurocognitive performance.
ED psychopathology (Eating Disorder Examination Questionnaire)
Increase in ED symptoms related to an improvement in set-shifting ability as measured by the TMT ($r = - .36$, $p < .005$, $d = -0.77$).

Psychosocial functioning (Clinical Impairment Assessment)
There were no correlations between change in psychosocial functioning and change in neurocognitive performance.

<table>
<thead>
<tr>
<th>Variables</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\hat{\beta}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.25</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>CIA T1</td>
<td>0.61</td>
<td>0.13</td>
<td>.48***</td>
</tr>
</tbody>
</table>

Step 2
| Constant    | -0.33| 0.3  |       |
| CIA T1      | 0.60 | 0.13 | .48***|
| DTS2 T1     | 0.23 | 0.07 | .32** |

Step 3
| Constant    | -0.81| 0.37 |       |
| CIA T1      | 0.54 | 0.13 | .43***|
| DTS2 T1     | 0.25 | 0.07 | .35** |
| STSS2 T1    | 0.001| 0.0  | .22*  |

Note. $R^2 = .23$ for Step 1; $\Delta R^2 = .10$ for Step 2; $\Delta R^2 = .04$ for Step 3 ($p s < .05$).
CIA = Clinical Impairment Assessment; DTS = Distress Tolerance Scale (DTS2: Avoidance of affect); STSS = Silencing the Self Scale (STSS2: Care as self-sacrifice).

*p $< .05$.
**$p < .01$.
***$p < .001$.

**DISCUSSION**

This study investigated the role of several emotional processing, social cognition, and neurocognitive variables as potential maintenance factors for adult AN, by examining their ability to predict outcomes following 6 months of therapy.

4.1 | Emotional processing as a maintenance factor

The hypothesis that emotional processing would predict outcome was supported, but by specific variables only. Baseline *behavioural* emotional avoidance of affect predicted small amounts of posttreatment weight and psychosocial function, whereas baseline *cognitive* emotional avoidance through anticipating and distracting, emotion acceptance and management, and care as self-sacrifice (submissive behaviour) together predicted a quarter of the variance in posttherapy ED symptoms. Care as self-sacrifice (submissive behaviour) and behavioural avoidance of affect predicted 14% of posttreatment psychosocial function. These findings indicate that, of the variables tested here, emotional avoidance and submissive behaviour are the strongest predictors of ED pathology posttreatment. Further, more adaptive emotion beliefs, reduced emotion suppression, and cognitive avoidance of affect related to improvements in ED symptoms and/or weight gain. Reduced emotion suppression linked to psychosocial functioning improvement.

The notion that emotion avoidance (including both behavioural and cognitive) and lack of emotion acceptance may maintain AN is consistent with and extends previous research in the field. For example, behavioural avoidance of emotion accords with findings from a systematic review, which suggests that people with anorexia deliberately avoid situations that may evoke emotion more than HCs do (Oldershaw et al., 2015). Cognitive avoidance of emotion as a potential maintenance factor supports the theory that focussing on weight and shape concerns affords people with AN the ability to better avoid emotions (Sternheim, Startup, Saedi, et al., 2012). It is consistent with reports that people with AN employ cognitive avoidance more than do people with avoidant personality disorder and social phobia and HCs (Wildes et al., 2010). These data therefore align with hypotheses that AN is functional for the sufferer in that it affords them a means of emotional avoidance.

A maintaining influence of submissive behaviour upon AN contrasts with persistent elevated submissiveness following recovery (Connan et al., 2007; Oldershaw et al., 2012). Earlier reports do suggest however that submissiveness attenuates following recovery; this may indicate that submissiveness maintains the disorder only at very high levels. It is in keeping with conclusions following comparison of neural activity of those currently ill versus those who are recovered, which propose that working to improve social self-evaluation represents an opportunity to improve outcomes from AN (McAdams et al., 2016).

Overall, these results offer initial empirical confirmation of theoretical models positing that emotional avoidance and lack of emotion acceptance are central to the maintenance of AN (Corstorphine, 2006; Schmidt & Treasure, 2006; Waller et al., 2010; Wildes et al., 2010). Implication of submissive behaviour as a possible maintenance factor supports the MANTRA maintenance model, which cites the importance of fear of criticism and rejection in maintaining AN (Schmidt & Treasure, 2006).
4.2 Social cognition as a maintenance factor

Social cognition variables measured here did not appear to be good predictors of clinical outcome or strongly related to clinical change. Poorer eToM at baseline on one task (RMF) was weakly related to better weight outcomes, although greater change in RMF correlated with greater weight gain. Furthermore, increased ability to predict the emotions of others was related to a decrease in psychosocial functioning. Although on the surface these may appear curious findings, they are perhaps consistent with the hypothesis posted above. That is, the more one is aware of the emotions of others, the more emotionally overwhelmed one feels; thus, greater ED behaviours are necessary to avoid affect. This is perhaps consistent with other reports that social behaviours have an emotion regulation function (Oldershaw et al., 2015).

4.2.1 Neurocognition as a maintenance factor

The hypothesis that baseline neurocognition would predict clinical outcome was supported only marginally: A small amount of posttreatment weight (7%) was predicted by one set-shifting measure together with a measure of detail focus. The small predictive effect of executive functioning for current ED has been demonstrated elsewhere (Gillberg et al., 2010). These data suggest there may be a marginal influence of set-shifting and detail focus on maintenance of AN, but no neurocognition change for any variable correlated with clinical change. This lack of direct association between clinical and neurocognitive variable change is in keeping with other reports (Mikos et al., 2008), but the overall finding is contrary to our hypotheses. This may in part be due to the nature of the sample because most neurocognitive research demonstrating severe difficulty is completed in samples with lower weight than those included here, and indeed, these scores are largely less extreme than those reported in other studies (Harrison et al., 2010; Tchanturia et al., 2011; Tenconi et al., 2010). Therefore, neurocognitive factors may lack relevance across the broader range of presentations associated with AN, and there may be clusters or a spectrum of neurocognitive and social cognitive abilities across those who present with AN from those with a balance of strengths of weaknesses to those with a presentation more like ASD (Renwick et al., 2015).

Furthermore, the limited amount of change during the course of psychological therapy should be noted and may have limited the significance of any relationships with clinical change. It should also be noted that the findings concern only a specific sample of people with AN who met strict inclusion criteria; therefore, we must be cautious about how widely the findings can be generalised. Potential mood disorder confounds were not included and require exploration in future research.

Multiple imputation of missing data using maximum-likelihood method has limitations: With small samples (N < 100), it can underestimate means and overestimate standard deviations (Jain & Wang, 2008), affecting statistical significance. Forward stepwise regressions can be considered more stringent than other methods, but “suppressor effects” increase risk of Type II error (Field, 2005). Although this was an exploratory analysis, there were a large number of analyses completed, and this may have impacted the viability of using significance set at the 5% level. When looking at clinical change correlations, the direction and causality of results cannot be determined; that is, does weight gain and reduced starvation lead to improvement or does improvement in socio-emotional variables reduce illness difficulties and lead to weight gain?

Self-report measures may assess mood states or self-perception rather than actual underlying processes and thus could have been usefully confirmed with experimental measures (cf. Davies, Schmidt, Stahl, & Tchanturia, 2011). Social compliance was observed herein, which could affect responses or cause performance fatigue to be ignored. Moreover, given the social nature of difficulties identified, it is unclear whether variables directly influence AN prognosis via “real-world” processes or through interference with treatment implementation and the therapeutic relationship, or both.

4.4 Clinical implications

The findings herein could usefully highlight the most important targets for therapeutic interventions. Submissiveness and emotional avoidance (both cognitive and behavioural) and a lack of emotion acceptance gained the most support as maintaining factors for AN. Challenging perceptions of emotions and what it means to have emotions, such as in approaches like MANTRA (Schmidt & Treasure, 2006), may be useful to work with cognitive emotional avoidance. Therapies that incorporate more experiential means to achieve acceptance and willingness to experience emotion may assist with behavioural emotional avoidance difficulties; for example, elements of mindfulness-based cognitive therapy (Teasdale et al., 2000) or acceptance and commitment therapy.
(Hayes, Luoma, Bond, Masuda, & Lillis, 2006) are potentially indicated and may have some promise with AN (Berman, Boutelle, & Crow, 2009). Likewise, emotion-focussed therapy seeks to enable recognition and acceptance of emotion yet also improves expression and transformation of emotional experience to promote utilisation of emotions in an adaptive and assertive way, thus may also benefit submissive and suppression behaviours (Dolhanty & Greenberg, 2009; Greenberg, 2004).

4.5 | Research implications

Further research is required. Replication in a larger sample with longer follow-up would enable confirmation of findings and allow subgroup analyses to delineate whether there are subgroups of people for whom some variables are more influential in predicting or maintaining symptoms than for others, such as those with ASD traits, for whom social cognitive and neuropsychological variables are differentially affected (Gillberg et al., 2010; Renwick et al., 2015). Further investigation into what mediates the link between social cognitive difficulties and ED behaviours could explore whether what is observed is a function of being emotionally overwhelmed and subsequent emotional avoidance. Clinical research is also importantly indicated, focussing on the benefits of prioritising the explicit targeting of emotional avoidance and social behaviours, such as submissiveness, within therapy.

5 | CONCLUSION

Emotional avoidance (behavioural/cognitive avoidance, low acceptance) and submissive behaviour may represent maintenance factors for AN. Other socio-emotional processing variables, social cognition (emotion recognition and eToM), and neurocognitive functioning (set-shifting and detail focus) appear less relevant. These findings have important implications for further refinement and focussing of psychological treatment interventions for adults with AN.

ACKNOWLEDGEMENT

Anna Oldershaw is funded by a National Institute of Health Research and Health Education England Training Fellowship (Integrated Clinical Academic Fellowship-Clinical Lectureship ICA-CL-2015-01-005). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health.

ORCID

Anna Oldershaw http://orcid.org/0000-0002-9473-5715
Ulrike Schmidt http://orcid.org/0000-0003-1335-1937

REFERENCES


**How to cite this article:** Oldershaw A, Lavender T, Schmidt U. Are socio-emotional and neurocognitive functioning predictors of therapeutic outcomes for adults with anorexia nervosa?. *Eur Eat Disorders Rev.* 2018;1–14. [https://doi.org/10.1002/erv.2602](https://doi.org/10.1002/erv.2602)