A randomized controlled trial of group cognitive remediation therapy for anorexia nervosa: Effects on set-shifting tasks for inpatient adults and adolescents

Laura E. Sproch PhD | Kimberly P. Anderson PhD | Martin F. Sherman PhD | Steven F. Crawford MD | Harry A. Brandt MD

1Department of Psychology, The Center for Eating Disorders at Sheppard Pratt, Baltimore, Maryland
2Department of Psychology, Loyola University Maryland, Baltimore, Maryland
3Department of Psychiatry, The Center for Eating Disorders at Sheppard Pratt, Baltimore, Maryland

Correspondence
Kimberly P. Anderson, Department of Psychology, The Center for Eating Disorders at Sheppard Pratt, 6535 North Charles Street, Suite 300, Baltimore, MD 21204. Email: kanderson@sheppardpratt.org

Abstract
Objective: The aim of this randomized controlled trial with a parallel design was to evaluate the effect of brief, cognitive remediation therapy (CRT) for anorexia nervosa (AN) on set-shifting.

Method: Two hundred seventy-five inpatient adults and adolescents with AN (mean age = 23.1; SD = 12.7) were randomly assigned (using simple randomization procedures) to either a CRT or control condition. All participants received treatment as usual; however, the CRT condition completed five CRT group sessions in lieu of other group therapies provided on the unit. Set-shifting abilities were evaluated by: (a) neuropsychological measures and (b) experimental cognitive behavior therapy thought records. Blinding of group assignment occurred during baseline assessment and ended following group commencement.

Results: Data from 135 CRT and 140 control condition participants were analyzed. On all neuropsychological measures, results revealed no between group condition effects, but did show statistically significant time effects, with medium to large effect sizes. Thought record analysis revealed a significant condition by age interaction effect where adults in the CRT condition generated significantly more alternative thoughts and had stronger believability of alternative thoughts than children, a trend that was not found in the control condition. This yielded moderate to large effect sizes of 0.56 and 0.72, respectively.

Discussion: Based on traditional neuropsychological measures, these findings do not suggest a differential effect of CRT for AN in the format applied. However, results suggest that CRT may have some increased beneficial cognitive effect for adults, as compared to children, based on thought record analysis.

KEYWORDS
anorexia nervosa, cognitive flexibility, cognitive remediation, eating disorder, set-shifting, thought record, treatment
Anorexia nervosa (AN) is a devastating illness with high rates of morbidity and mortality and only a 49% likelihood of good outcome at 5 years post-treatment (Carter et al., 2011; for review, see Watson & Bulik, 2013). If not treated successfully, its effects can become chronic, having significant impact on physical and psychological functioning (Fichter, Quadflieg, Crosby, & Koch, 2017; for review, see Mezczekalski, Podfigurna-Stopa, & Katulsli, 2013). High dropout rates have been identified as a major barrier to treatment success (DeJong, Broadbent, & Schmidt, 2012). As a result, there have been efforts to develop novel interventions (for review, see Brockmeyer, Friederich, & Schmidt, 2018), some of which complement the extant therapies and aim to improve adherence and effectiveness.

According to cognitive behavior therapy (CBT), a leading evidence-based treatment for eating disorders (EDs; National Institute for Health and Care Excellence, 2017), cognitive change supports behavioral change (Beck, 1976). In this regard, flexibility of thought is necessary for symptom improvement, treatment engagement, and motivation to change (Beck & Dozois, 2011). Set-shifting, one critical executive function, is defined as the ability to shift cognitions or behaviors due to changing demands of a task or one’s environment (Lezak, 1983). For patients with AN, inflexible cognitive distortions drive and perpetuate the disease (Fairburn, 2008). Persistence in the rigidity of thoughts related to weight and shape concerns predicts negative treatment outcome (Vall & Wade, 2015). This conceptual framework suggests that cognitive inflexibility may be a central factor in the chronicity of AN (Treasure & Schmidt, 2013). Research has shown that compared to healthy controls, adults with AN have poorer performance on neuropsychological measures of set-shifting (Tchanturia et al., 2012; for review, see Westwood, Stahl, Mandy, & Tchanturia, 2016). More research is needed to clarify if patients with AN have relative and significant set-shifting impairments compared to other clinical samples and across all age ranges. In this regard, some research suggests that younger patients with AN display cognitive inefficiencies similar to adults (Lang et al., 2015), while others do not (Kjaersdam Telléus et al., 2014).

One therapeutic approach that has been designed specifically to rehabilitate set-shifting weaknesses is cognitive remediation therapy (CRT). In CRT’s application for AN (Tchanturia, 2015; Tchanturia, Davies, Reeder, & Wykes, 2010), the targets of treatment are the underlying cognitive inefficiencies (e.g., cognitive rigidity) rather than the primary ED symptoms. For adult patients with AN, noncontrolled studies showed improved performance on set-shifting measures following CRT (Leppanen, Adamson, & Tchanturia, 2018; for reviews, see Tchanturia, Lounes, & Holttum, 2014); however, randomized controlled trials have demonstrated limited sustained CRT effects on set-shifting, psychopathology, quality of life, and attrition (Tchanturia et al., 2014).

For younger patients with AN, although set-shifting inefficiencies have not been consistently demonstrated (Bentz et al., 2017), it remains important to include them in CRT treatment studies. Such research may advance our understanding of possible moderator variables of differential CRT response (Bentz et al., 2017), the impact that CRT has on the motivation and engagement required for AN treatment for younger patients (Lask & Roberts, 2015), and the long-term benefit of CRT. Despite this, fewer studies have addressed the application of CRT for young patients with AN and findings have been mixed (for review, see Tchanturia, Giombini, Leppanen, & Kinnaird, 2017). Some recent evidence suggests improved set-shifting abilities for adolescents with AN following CRT (Harrison et al., 2018), which supports further investigation using randomized controlled trials (Herbrich et al., 2017; Lock, Fitzpatrick, Agras, Weinbach, & Jo, 2018; Timko, Goulazian, Fitzpatrick, & Rodriguez, 2018).

Due to the conflicting results described above, the first aim of the following study was to clarify the potential effect of CRT for AN on set-shifting, as measured by traditional neuropsychological measures. The second aim was to assess the potential impact of CRT on a cognitive-based individual therapy strategy for AN. Although it is known that CRT may help to improve set-shifting abilities, evidence of specific effects on associated ED problems has not yet been found. It seems that a logical, intermediary step is to examine if CRT impacts an individual’s use of specific cognitive strategies employed in a concurrent treatment. To accomplish this, we assessed the possible effect of CRT, as compared to a control (CN) condition, on the quality of CBT thought records. Thought records have traditionally been used as a tool in CBT to enhance cognitive flexibility by encouraging patients to consider alternative ways of thinking during troubling situations (Beck, 1995; Greenberger & Padesky, 1995, 2016). Thus, we believe that testing the effects of CRT on thought record completion is beneficial in understanding how this treatment could potentially affect cognitive modification skills.

## METHOD

### 2.1 Participants

This was a randomized, parallel-group study conducted between January 2015 and March 2017. Participants were 275 patients (see Figure 1) ranging in age from 12 to 87 years, recruited while in inpatient treatment at a specialized ED unit within a large, generalized psychiatric facility in the United States. Patients were eligible for the study if they were (a) diagnosed with AN or atypical AN according to the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association, 2013) following a psychiatric evaluation by an ED-specialized psychiatrist, (b) admitted to an inpatient psychiatric facility in the United States. Patients were eligible for the study if they were (a) diagnosed with AN or atypical AN according to the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association, 2013) following a psychiatric evaluation by an ED-specialized psychiatrist, (b) admitted to an inpatient level of care, and (c) 12 years of age or older. Patients were excluded from the study if they were unable to complete neuropsychological testing or met diagnostic criteria for a pervasive developmental disorder, mental retardation, psychotic disorder, brain injury, or substance abuse disorder.

This study was approved by the Institutional Review Board (IRB) of the institution (IRB ref: 545852-11). All adult patients signed consent to be a part of the study. All minor patients gave assent and
2.2 | Procedure

Patients were recruited to enter this study on admission to the inpatient unit. All consenting patients were randomly assigned to either a CRT or CN condition. They were informed of their treatment assignment after completion of baseline assessments. Given the nature of the treatment, blinding of therapists and patients was not possible. Neuropsychological measures were administered to both groups following admission to the inpatient hospital and again following the final CRT group (for the CRT condition) or approximately 3 weeks after the date of their initial testing (for the CN condition). The average time between day of admission and initial testing was 4.37 days and between admission and second testing was 28.94 days. Neuropsychological testing took approximately 45 min to complete and was conducted by a psychology member of the research assessment team who was not one of the CRT group leaders. Both the CRT and CN groups took part in the standard inpatient treatment protocol starting upon admission; however, the CRT condition had 5 hr of programming modifications. These modifications consisted of participation in 1-hr sessions of a group application of CRT. CRT was delivered twice a week for 2 weeks and then once in Week 3. During this time, the CN condition completed group therapy as usual. Thus, CRT participants did not receive extra therapy time and dose of therapy was kept constant between conditions. Only groups that did not have a primary focus on cognitive modification were chosen (e.g., movement, leisure exploration, or occupational therapy skills groups) to ensure equivalent doses of cognitive-based treatments for both groups.

Prior to the start of data collection, a pilot procedure was run for approximately 3 months to assure procedural familiarity and feasibility. In this pilot procedure, eight sessions of CRT were administered; however, this dosage was not feasible due to length of stay precluding completion for many participants. Therefore, the dosage decreased to five sessions. No other significant procedural changes were made.

2.3 | Randomization

Using Microsoft Excel 2010, patients were randomly assigned, following simple randomization procedures, to one of two conditions. Due to the nature of the study, the design was limited to simple randomization procedures to assure a consistent flow of participants into the experimental condition and to retain at least two patients in the experimental group at all times. Our simple randomization allowed for the study to run continually and to accommodate for instances when the unit census was low. A very large sample size was employed in order to accommodate for the inability to use a more sophisticated procedure.

Consent collection, participant number assignment, and randomization were conducted by separate individuals not involved in the treatment or outcome measurement of the study. Patients were assigned participant numbers based on time sequence of consent collection, based on timing of admission. For the 1:1 allocation of the
patients, only participant numbers were used. Given the design of the study, patients and therapists were naturally aware of patients' conditions.

2.4 | Measures

2.4.1 | Wisconsin card sorting test

The Wisconsin card sorting test (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993) is a widely used measure of set-shifting. The full 128-item paper-and-pencil version of the test was administered. The following quantitative measures of the WCST were examined: number of trials administered, total number correct, total number of errors, perseverative errors, and percent perseverative errors.

2.4.2 | The comprehensive trail making test

The comprehensive trail making test (CTMT; Reynolds, 2002) was designed to enhance the original Trail Making Test (Reitan, 1958) and is a measure of cognitive flexibility assessing set-shifting. The standard paper-and-pencil version of the test was used. The CTMT composite index and set-shifting (i.e., a difference score between a simple sequencing factor and a complex sequencing factor; Reynolds, 2002) scores were examined.

2.4.3 | CBT thought records

Thought records, the contemporary term typically used for Beck’s original daily record of dysfunctional thoughts (Beck, 1979), are specific therapeutic tools designed to promote cognitive restructuring. Thought records are used to modify the content or credibility of specific thoughts, and ultimately increase flexibility. In general, thought records require an individual to identify an automatic thought, evaluate the thought, modify the thought, identify alternative rational thoughts, and rate the believability of thoughts (Beck & Haigh, 2014; Greenberger & Padesky, 2016). Although thought records are not a standardized measure of set-shifting, in clinical CBT work, they are often used as an informal measurement of cognitive flexibility and progress with thinking patterns (Greenberger & Padesky, 2016).

One experimental thought record (design based on Greenberger & Padesky, 1995; see Figure 2) was collected from all patients at the end of the trial. Prior to thought record completion, individual therapists provided education, explaining each step in the completion of the thought record. Specific examples were presented and questions were answered until it was clear that the patient understood the process. The following information was evaluated: the quantity of alternative thoughts identified, the change in believability of the original thought pre- and postcompletion of the thought record (identified as a percentage by the patient on the record), and the believability of the most believable alternative thought (also identified as a percentage). Information was self-identified by the patient and required no scoring judgment.

2.5 | Treatments

2.5.1 | Standard treatment

All patients received standard inpatient treatment and were followed closely by a multidisciplinary treatment team. Treatment included intensive food and meal exposures, psychiatric evaluation and medication management, and intensive psychotherapy. CBT was the standard therapeutic model for individual and group therapies, based on classic ED manuals (Fairburn, 2008; Fairburn, Marcus, & Wilson, 1993; Garner, Vitousek, & Pike, 1997), modified for a higher level of care. All patients received five CBT groups and two sessions of individual therapy per week. Other group and individual therapy modalities included interpersonal therapy, dialectical behavior therapy, and motivational interviewing. Family therapy, occupational therapy, dietary counseling, and art therapy were also provided.

FIGURE 2  Experimental cognitive behavior therapy thought record form completed by participants at the conclusion of the study
2.5.2 | Cognitive remediation therapy

All patients in the multiage CRT group completed five 1-hr sessions of CRT two times per week. Patients began in the experimental treatment as soon as they were admitted into an inpatient level of care. Each group followed the standard CRT protocol for AN (Tchanturia et al., 2010). The protocol included CRT education, behavioral experiment review, introduction of group modules, practice of specific cognitive skills (using cognitive exercises that targeted cognitive flexibility and big picture thinking), discussion regarding cognitive styles, and identification of behavior change goals. Because the group included both adolescents and adults, activities and recommendations from CRT protocols developed for younger patients (Maiden, Baker, Espie, Simic, & Tchanturia, 2014; Lindvall Dahlgren, Owen, & Lask, 2011) were incorporated into the standard protocol. Group application of the protocol was based on Tchanturia, Larsson, and Brown (2016)'s implementation of group CRT. There was no indication of difficulty with administration of CRT to a combined age group in terms of patient engagement or therapist group management. Group leaders discussed the process of managing age disparity during supervision as needed. The therapeutic style of the group facilitators was motivational and session time was balanced between completing exercises to practice cognitive flexibility and reflecting on learning from the exercises.

Treatment fidelity was maintained using the best practice guidelines from the National Institute of Health Behavior Change Consortium (Bellg et al., 2004). Number, frequency, length, and duration of sessions were fixed. The CRT groups were facilitated by masters-level therapists trained in CRT by licensed clinical psychologists (i.e., the first and second authors) who completed a CRT training seminar by Kate Tchanturia, PhD, the developer of CRT for AN. Therapists used a treatment manual and treatment application was externally monitored by the supervisor. Prior to the start of initiating CRT, therapists were required to exhibit protocol competence by videotaping four group therapy sessions of which the clinical supervisor critically reviewed and completed standard treatment fidelity checks. Group therapists then received ongoing CRT supervision and random treatment fidelity checks. Deviations from the protocol were discussed directly in, and ameliorated through, supervision.

2.6 | Statistical analyses

All statistical analyses were conducted using SPSS version 25.0.0.1. Independent-groups t tests and χ² tests were performed to determine whether randomization generated two equivalent treatment groups (CRT vs. CN) at pretest. Results of a power analysis (G*Power version 3.1.9.2) indicated that a sample size of 275 would provide 95% power to detect a moderate effect size of 0.50 (Cohen's d statistic, two-tailed, α = .05) between two groups (Cohen, 1988). In order to evaluate group differences (between Time 1 and Time 2) in set-shifting, a linear mixed-effects repeated measures modeling analysis was utilized. CBT thought records were examined utilizing a 2 × 2 (two treatment groups and two age groups) factorial analysis of variance. Intent-to-treat analyses were used for all statistical tests.

Data distributions were examined and log transformations were applied when necessary. However, analyses were conducted utilizing both the raw untransformed scores and transformed scores. In all cases, the findings did not differ between the untransformed and transformed scores (this was expected in light of the very large sample size per treatment group) and thus all findings reported are from the raw scores.

3 | RESULTS

There were no statistically significant baseline group differences in mood and anxiety/trauma (as diagnosed following the admission psychiatric evaluation), as well as gender, ethnicity, age, duration of illness, baseline body mass index (BMI), end of study BMI, number of inpatient days, and number of days between testing (see Table 1). However, the CRT group had slightly more years of education than did the CN group (M = 11.9 [SD = 3.7] vs. M = 11.0 [SD = 3.7], respectively). With regard to age, 61 adolescents (45% of CRT condition) were assigned to CRT and 71 adolescents (51% of CN condition) were assigned to the CN group.

In order to determine if there were differential effects of CRT (n = 135) vs. CN (n = 140) on the WCST subscales, the interaction term from the 2 (CRT vs. CN) × 2 (children vs. adults) × 2 (Time 1 vs. Time 2) linear mixed-effects repeated measures modeling analysis was examined (see Table 2). On all subscale measures of the WCST, there was no evidence of differential treatment effects over time nor were there any differential age effects over time. However, statistically significant time effects with moderate effect sizes (Cohen, 1988) were found on number of trials administered (d = 0.45), total number of errors (d = 0.51), number of perseverative errors (d = 0.48), and percent perseverative errors (d = 0.48) regardless of condition. Specifically, scores on each of these measures decreased from Time 1 to Time 2.

Similar linear mixed-effects repeated measures modeling analyses were conducted on the CTMT subscale (see Table 2). On both CTMT measures (composite index and set-shifting score), there was no evidence of differential treatment effects over time. However, similar to the WCST findings, for both the CN and CRT conditions, there were statistically significant time effects on the CTMT composite index and set-shifting scores with a very large effect size for the composite index (d = 1.11) and a weak effect size for the set-shifting scores (d = 0.20). More specifically, the composite index and set-shifting scores increased from Time 1 to Time 2. Of note, there was a statistically significant age by time interaction on the composite index in that the time effect was greater for the children than for the adults. Mean difference between Time 1 and Time 2 was 10.53 and 7.09 for children and adults, respectively, F(1, 204.62) = 10.32, p < .001.

An examination of the results for the thought record scores (change in believability of original thoughts, believability of alternative thoughts, and quantity of alternative thoughts) revealed no
statistically significant condition effects (see Table 3). Moderate and weak age effects emerged for believability of alternative thoughts ($d = 0.43, 95\% \text{ CI } [0.14, 0.71]$) and quantity of alternative thoughts ($d = 0.26, 95\% \text{ CI } [−0.03, 0.54]$), with the adults on average scoring higher on these thought record measures; however, these main effects were modified by the interaction between condition and age. More specifically, adults from the CRT group scored higher on the believability of alternative thoughts than did the children from the CRT group ($d = 0.72, 95\% \text{ CI } [−0.03, 0.54]$; see Figure 3). A similar finding occurred on the quantity of alternative thoughts, where adults from the CRT group generated more alternative thoughts than did the children in the CRT group ($d = 0.56, 95\% \text{ CI } [0.15, 0.97]$), whereas there was no age difference on this measure in the CN group ($d = 0.05, 95\% \text{ CI } [−0.36, 0.45]$; see Figure 4).

### 4 | DISCUSSION

This study evaluated the implementation of brief CRT in group format for AN on an inpatient psychiatric unit specializing in the treatment of EDs. The primary objective was to measure differences between a CRT and CN condition on set-shifting using traditional neuropsychological measures. The secondary objective was to measure set-shifting using a more clinically relevant, though non-traditional, method. In this regard, the ability to generate alternative thoughts and flexibly shift believability of thoughts on an experimental CBT thought record was assessed. To our knowledge, this is the largest AN sample included in a CRT study. There are three central conclusions.

First, across all neuropsychological measures, a time effect was found in that patients, across both treatment arms, exhibited improved set-shifting from pre- to post-testing. We do not anticipate that this was related to weight change as no differences in set-shifting abilities based on BMI were found, consistent with previous research (Danner et al., 2012; Leppanen et al., 2018). The changes over time may be better explained by practice effects (Bartels, Wegrzyn, Wiedl, Ackermann, & Ehrenreich, 2010) or set-shifting improvements as a result of enhanced cognitive skills gained in inpatient treatment. This first finding emphasizes that despite previous noncontrolled studies suggesting the utility of CRT for the treatment of AN (for review, see Tchanturia et al., 2014), due to the nature of time effects regardless of treatment condition, randomized controlled trials are imperative to make reliable and valid conclusions.

A second critical finding is that CRT did not have a differential effect on set-shifting, as measured by two classic neuropsychological measures. These results are consistent with other randomized
<table>
<thead>
<tr>
<th>Condition</th>
<th>Children</th>
<th>Adults</th>
<th>Time</th>
<th>F statistic</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT M (SE)</td>
<td>CN M (SE)</td>
<td>CRT M (SE)</td>
<td>CN M (SE)</td>
<td>[T1 M (SE) vs. T2 M (SE)]</td>
<td></td>
</tr>
<tr>
<td>Number of trials administered</td>
<td>93.66 (1.88)</td>
<td>95.09 (1.84)</td>
<td>93.49 (1.93)</td>
<td>95.27 (1.78)</td>
<td>43.60*** [94.38a (1.31) vs. 85.16b (1.45)]</td>
</tr>
<tr>
<td>T2</td>
<td>84.73 (2.04)</td>
<td>85.59 (2.04)</td>
<td>83.36 (2.10)</td>
<td>86.95 (2.00)</td>
<td>0.45 (95% CI [0.30, 0.59])</td>
</tr>
<tr>
<td>Total number correct</td>
<td>69.15 (0.86)</td>
<td>68.96 (0.94)</td>
<td>69.58 (0.89)</td>
<td>68.53 (0.81)</td>
<td>0.28 [69.06 (0.60) vs. 68.62 (0.69)]</td>
</tr>
<tr>
<td>T2</td>
<td>68.62 (0.97)</td>
<td>68.55 (0.96)</td>
<td>68.27 (0.99)</td>
<td>68.07 (0.95)</td>
<td>0.08 (95% CI [−0.10, 0.27])</td>
</tr>
<tr>
<td>Total number of errors</td>
<td>24.45 (1.78)</td>
<td>25.99 (1.75)</td>
<td>23.71 (1.83)</td>
<td>26.73 (1.69)</td>
<td>52.03*** [25.22a (1.25) vs. 17.08b (1.35)]</td>
</tr>
<tr>
<td>T2</td>
<td>16.60 (1.91)</td>
<td>17.56 (1.89)</td>
<td>15.69 (1.95)</td>
<td>18.48 (1.86)</td>
<td>0.51 (95% CI [0.33, 0.69])</td>
</tr>
<tr>
<td>Perseverative errors</td>
<td>12.49 (0.92)</td>
<td>13.24 (0.90)</td>
<td>12.25 (0.95)</td>
<td>13.48 (0.87)</td>
<td>47.032*** [12.86a (0.64) vs. 8.74b (0.70)]</td>
</tr>
<tr>
<td>T2</td>
<td>8.64 (0.99)</td>
<td>8.85 (0.98)</td>
<td>8.23 (1.01)</td>
<td>9.26 (0.96)</td>
<td>0.48 (95% CI [0.34, 0.62])</td>
</tr>
<tr>
<td>Percent perseverative errors</td>
<td>12.07 (0.64)</td>
<td>12.47 (0.62)</td>
<td>11.86 (0.66)</td>
<td>12.67 (0.60)</td>
<td>56.08*** [12.27a (0.45) vs. 9.02b (0.49)]</td>
</tr>
<tr>
<td>T2</td>
<td>9.02 (0.69)</td>
<td>9.02 (0.68)</td>
<td>8.71 (0.70)</td>
<td>9.33 (0.67)</td>
<td>0.48 (95% CI [0.33, 0.63])</td>
</tr>
<tr>
<td>Composite index</td>
<td>42.60 (1.06)</td>
<td>43.47 (1.05)</td>
<td>44.22a (1.08)</td>
<td>41.86a (1.03)</td>
<td>269.87*** [43.04a (0.75) vs. 51.85b (0.79)]</td>
</tr>
<tr>
<td>T2</td>
<td>51.24 (1.12)</td>
<td>52.46 (1.12)</td>
<td>54.75a (1.14)</td>
<td>48.95b (1.10)</td>
<td>1.11 (95% CI [0.97, 1.25])</td>
</tr>
<tr>
<td>Set-shifting score</td>
<td>−1.77 (0.88)</td>
<td>−1.35 (0.87)</td>
<td>−1.51 (0.90)</td>
<td>−1.63 (0.86)</td>
<td>7.02** [−1.56a (0.62) vs. −3.68b (0.71)]</td>
</tr>
<tr>
<td>T2</td>
<td>−3.09 (1.01)</td>
<td>−4.27 (1.01)</td>
<td>−2.62 (1.02)</td>
<td>−4.74 (0.99)</td>
<td>0.20 (95% CI [0.04, 0.36])</td>
</tr>
</tbody>
</table>

Note: Cell means with identical superscripts are statistically equivalent whereas cell means with different superscripts are statistically different.

Abbreviations: CN, control condition; CRT, cognitive remediation therapy condition.

**p < .01; ***p < .001.
controlled trials of CRT (Dingemans et al., 2014; Lock et al., 2018) and suggest that CRT applied in a brief, group format may not have obvious impacts on set-shifting. It should be pointed out that tests were administered in the standard paper-and-pencil format making comparisons with studies using electronic versions of the tests problematic (Bauer et al., 2012). It is interesting to note; however, that these results are discrepant with patients’ self-reported impressions of increased mental flexibility as described on treatment evaluation forms. This disagreement between self-report and performance-based assessment has been identified previously (Stedal & Dahlgren, 2015). Overall, there is inconsistency in the research regarding CRT’s effect on set-shifting. While most research has not shown a differential set-shifting effect, some studies (Brockmeyer et al., 2014; Lock et al., 2013) have found differences on particular set-shifting measures. This raises a question about the strength of CRT’s effect on set-shifting if improvements are not found consistently across measures. Evidence does not exist to suggest that any set-shifting changes are maintained long term.

A third finding is that there was a significant age by condition effect on the quantity and believability of alternative thoughts on experimental CBT thought records, with moderate to large effect sizes. This suggests that following CRT, adults were better able to consider thinking alternatively when confronted with ineffective thinking patterns than children, which was not found in the CN condition. This may be due to several factors. First, in comparing our patients’ neuropsychological measure scores to demographically corrected normative data (Heaton et al., 1993; Reynolds, 2002), children exhibited better normative baseline set-shifting abilities compared to adults. At baseline, adolescents performed in the average to above average range on most set-shifting measures and adults performed in the low average to average range. This is discrepant with past research suggesting that children may have better set-shifting abilities compared to adults (Shott et al., 2012; Westwood et al., 2016). In light of evidence that patients with greater set-shifting inefficiencies may be more likely to benefit from CRT (Dingemans et al., 2014), the improved flexibility demonstrated on thought records by adults, who demonstrate weaker set-shifting abilities than adolescents, is not surprising. Additionally, age differences could be attributed to the applicability of this treatment approach for children; however, specialized protocols amended for younger patients were incorporated (Maiden et al., 2014; Lindvall Dahlgren et al., 2011).

### TABLE 3  Means, SEs, and statistical test values on thought record measures

<table>
<thead>
<tr>
<th></th>
<th>CRT</th>
<th>CN</th>
<th>F ratio</th>
<th>Condition x age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Children</td>
<td>Adults</td>
<td>Total</td>
</tr>
<tr>
<td>Change in believability of original thought</td>
<td>23.79 (2.53)</td>
<td>21.52 (3.73)</td>
<td>26.06 (3.41)</td>
<td>19.86 (2.50)</td>
</tr>
<tr>
<td>Believability of alternative thought</td>
<td>69.83 (2.68)</td>
<td>59.99 a (3.96)</td>
<td>79.67 b (3.60)</td>
<td>71.73 (2.67)</td>
</tr>
<tr>
<td>Quantity of alternative thoughts</td>
<td>3.82 (0.18)</td>
<td>3.33 a (0.26)</td>
<td>4.31 b (0.24)</td>
<td>3.83 (0.18)</td>
</tr>
</tbody>
</table>

Note: Cell means with identical superscripts are statistically equivalent whereas cell means with different superscripts are statistically different.

Abbreviations: CN, control condition; CRT, cognitive remediation therapy condition.

*p < .08; *p < .05; **p < .01.

![Figure 3](image3.png)

**FIGURE 3**  Mean strength of believability of alternative thoughts generated (measured by percentage) on cognitive behavior therapy thought records. Error bars represent SEs

![Figure 4](image4.png)

**FIGURE 4**  Mean number of alternative thoughts generated on experimental cognitive behavior therapy thought records. Error bars represent SEs
Furthermore, there was no indication in this study that the mixed age group posed unique challenges to treatment delivery and instead therapists found the age diversity to be useful, as it offered different perspectives during discussion. Regardless of the explanation for differences between adults and children, these results suggest that the use of novel measures tapping cognitive rigidity may reveal effects not detected by traditional neuropsychological tests.

One consideration of our findings is that we applied a brief, five session application of CRT in this study. Thus, it may be that the dose was insufficient to produce changes in set-shifting as measured by neuropsychological tests. At this point, there are not clearly established guidelines for the optimal number of group sessions required to receive a full therapeutic effect of CRT and studies vary in the number of sessions administered. However, there is evidence that the utilization of group CRT, with as few as four sessions, is practical and effective for intensive treatment of AN (Tchanturia et al., 2016). Additional sessions may have affected the results; however, it is our opinion that this is unlikely given that the results from five sessions did not approach significance.

There are a number of limitations of this study, including limits of generalizability due to the study being conducted at only one treatment center, lack of ethnic diversity of the sample, and an inability to conduct blinded outcomes. The potential effect of psychotropic medication and the presence of mood and anxiety disorders were not controlled for in this study. Despite this, we believe that our very large sample, and lack of significant comorbidity differences found between conditions, should have equally distributed these factors between treatment groups. The multiage CRT intervention has not yet been tested and could be considered a limitation; however, we found this format to be resourceful and well accepted by patients. The study does not include follow-up findings and some research has shown potential delayed effects of CRT on ED outcomes (Dingemans et al., 2014), though not on neuropsychological measures. Finally, to our knowledge, an experimental thought record has never been previously applied as an outcome measure. It was our intention to determine how CRT may affect engagement in an evidence-based treatment using this behavioral/cognitive tool. This initial application is exploratory and proper validation is necessary before additional conclusions from this self-report measure could be made. Moreover, the examination of patients’ use of experimental thought records may be considered a strength of the study. In this regard, others have recommended the use of novel measures in assessing outcomes associated with CRT, particularly for children (e.g., Dahlgren & Ra, 2014).

The impact of CRT on AN is still unclear. Despite initial findings from noncontrolled studies suggesting the clinical utility of the treatment on cognitive flexibility, results from the current study indicate that there is no differential effect on set-shifting for brief, multiage, group CRT as compared to treatment as usual. Despite this, our findings suggest that there may be some impact on cognition for adults in CRT that is not captured in traditional neuropsychological measures. We can only hypothesize about the source of this finding and additional research would be required to clarify this outcome. Such research may need to extend beyond traditional neuropsychological outcomes to evaluate more of the clinical effects (e.g., behavioral flexibility) of CRT with follow-ups. We also recommend that further research on CRT evaluates a cost-benefit analysis of this treatment and assesses the application of CRT for a subset of individuals displaying significant normative set-shifting inefficiencies.

**ORCID**

Laura E. Sproch [https://orcid.org/0000-0002-1264-5581]

**REFERENCES**


How to cite this article: Sproch LE, Anderson KP, Sherman MF, Crawford SF, Brandt HA. A randomized controlled trial of group cognitive remediation therapy for anorexia nervosa: Effects on set-shifting tasks for inpatient adults and adolescents. Int J Eat Disord. 2019:1–11. https://doi.org/10.1002/eat.23143