Received: 4 March 2020 | Revised: 26 March 2020 | Accepted: 26 March 2020

DOI: 10.1002/eat.23276

ORIGINAL ARTICLE

International Journal of EATING DISORDERS WILEY

Improving emotion recognition in anorexia nervosa: An experimental proof-of-concept study

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Abstract

Objective: Previous research has found increasing evidence for difficulties in emotion recognition ability (ERA) and social cognition in anorexia nervosa (AN), and recent models consider these factors to contribute to the development and maintenance of the disorder. However, there is a lack of experimental studies testing this hypothesis. Therefore, the present proof-of-concept study examined whether ERA can be improved by a single session of a computerized training in AN, and whether this has short-term effects on eating disorder symptoms.

Method: Forty inpatients (22.20 ± 7.15 years) with AN were randomly assigned to receive a single session of computerized training of ERA (TERA) or a sham training (training the recognition of different types of clouds). ERA, self-reported eating disorder symptoms, and body mass index (BMI) were assessed within 3 days before and after training.

Results: After training, both groups showed improved ERA, reduced self-reported eating disorder symptoms, and an increased BMI. As compared to patients in the control group, patients who received TERA showed greater improvements in ERA and self-reported eating disorder symptoms.

Discussion: ERA can be effectively trained in patients with AN. Moreover, short-term improvements in self-reported eating disorder symptoms provide tentative support for the hypothesis that difficulties in ERA contribute to the maintenance of AN, and that specific trainings of ERA hold promise as an additional component in AN treatment. Future studies are needed to replicate these findings in larger samples, and to investigate long-term effects and transfer into real-world settings.

KEYWORDS

eating disorders, emotion perception, emotion recognition training, emotional theory of mind, social cognition, training of emotion recognition ability

1 | INTRODUCTION

Anorexia nervosa (AN) is a severe eating disorder that mostly emerges during adolescence followed by an often chronic course (Eddy et al., 2017; Steinhausen, Grigoroiu-Serbanescu, Boyadjieva, Neumärker, & Winkler Metzke, 2008), leading to high impairment (Reas & Rø, 2018) and mortality rates (Arcelus, Mitchell, Wales, & Nielsen, 2011; Himmerich et al., 2019). Accordingly, AN is described as one of the mental disorders most difficult to treat (Halmi et al., 2005). Despite established psychotherapeutic treatments, fewer than 50% of patients fully recover (Brockmeyer, Friederich, & Schmidt, 2018). High rates of attrition (Calugi, Dalle Grave, Sartirana, & Fairburn, 2015; Craig, Waine, Wilson, & Waller, 2019) and relapse (Khalsa,

Portnoff, McCurdy-McKinnon, & Feusner, 2017) emphasize the need for novel treatments. However, refinement and development of novel treatment modules is hampered by the limited knowledge of causal mechanisms involved in the etiology and maintenance of the disorder (Brockmeyer et al., 2018; Jansen, 2016; Pennesi & Wade, 2016).

Current models emphasize the importance of social cognition deficits in AN, including emotion recognition abilities (ERA; Brockmeyer et al., 2016; Cagar-Nazai et al., 2014; Harrison, Sullivan, Tchanturia, & Treasure, 2010; Kucharska-Pietura, Nikolaou, Masiak, & Treasure, 2004; Oldershaw et al., 2011; Renwick et al., 2015; Russell, Schmidt, Doherty, Young, & Tchanturia, 2009). Although findings may depend to some degree on the paradigm and the stimuli used (Nalbant, Kalaycı, Akdemir, Akgül, & Kanbur, 2019; Wyssen et al., 2019), and although ERA may be particularly poor in patients who also have autism spectrum disorder (Dinkler et al., 2019), several systematic reviews and meta-analyses found robust evidence for reduced ERA in AN, especially regarding the recognition of complex emotions (Cagar-Nazai et al., 2014; Oldershaw et al., 2011).

These difficulties in social cognition are associated with a poorer prognosis (Zipfel, Lowe, Reas, Deter, & Herzog, 2000; Zucker et al., 2007) and assumed to serve as both a precursor and maintenance factor of AN (Harrison, Tchanturia, & Treasure, 2010; Kothari, Barona, Treasure, & Micali, 2015; Oldershaw, Hambrook, Tchanturia, Treasure, & Schmidt, 2010). In line with that, recent studies suggest that social cognition deficits are not only a consequence of starvation but a trait (Kothari et al., 2015; Oldershaw et al., 2011). For instance, children with a familial risk of developing AN show social cognition deficits (Kanakam, Krug, Raoult, Collier, & Treasure, 2013; Kothari et al., 2015). In addition, difficulties in emotion recognition tend to persist, albeit to a smaller extent, after recovery from AN (Brockmeyer et al., 2012; Harrison et al., 2010; Oldershaw et al., 2011). Even in healthy individuals, ERA deficits contribute to problems in social interactions, frustration, and negative affect (Hall, Andrzejewski, & Yopchick, 2009; Schlegel, Boone, & Hall, 2017; Schlegel, Grandjean, & Scherer, 2013). In the course of AN, restrictive eating might reflect a maladaptive coping mechanism for such aversive states, itself being negatively reinforced by an attenuation of aversive emotions (Brockmeyer et al., 2012, 2016, 2019; Brockmeyer, Holtforth, Bents, Herzog, & Friederich, 2013; Kaye et al., 2003; Treasure, Corfield, & Cardi, 2012). Potentially, this blunted emotional reactivity that is caused by starvation also hampers emotion recognition in others since it is (partly) based on emotional simulation or mimicry (i.e., person A understands better what person B feels when person A experiences a mental representation of person B's emotions in him-/herself; Iacoboni, 2009; Preston & de Waal, 2002). This may then further increase interpersonal distress, resulting in a vicious cycle in which patients eat less to down-regulate negative emotions resulting from interpersonal distress (Brockmeyer et al., 2016; Oldershaw et al., 2011; Treasure et al., 2012). Hence, improving socioemotional processing in patients with AN might represent a potential avenue to enhance treatment outcome (Brockmeyer et al., 2016; Oldershaw et al., 2011; Treasure et al., 2012).

So far, studies designed to specifically enhance ERA in patients with AN are scarce and failed to elicit significant ERA improvements (Davies et al., 2012; Kim, Eom, Yang, Kang, & Treasure, 2015). For instance, ERA in patients with AN was neither improved by cognitive remediation and emotion skills training nor by administration of oxytocin (Davies et al., 2012; Kim et al., 2015). However, recently a computerized training of ERA (TERA) has been developed (Schlegel, Vicaria, Isaacowitz, & Hall, 2017). This audiovisual training comprises an instruction part and a practice-with-feedback component, both teaching participants to recognize and differentiate emotions (Schlegel et al., 2017). In four consecutive studies, Schlegel et al. (2017) found that a single session of TERA enhanced ERA in healthy individuals over a period of 4 weeks. To date, the TERA has not been used with clinical samples.

Furthermore, previous research on ERA in AN is mostly cross-sectional and correlational (Bora & Köse, 2016; Cagar-Nazai et al., 2014; Oldershaw et al., 2011). There is a scarcity of experimental studies, that is, those that include randomization to a control group to systematically manipulate ERA in order to evaluate whether ERA can be improved in patients with AN and whether improved ERA affects AN symptoms. Therefore, in the present study, we followed an experimental psychopathology/experimental medicine approach (Field et al., 2019; Jansen, 2016) and aimed to isolate ERA as a hypothesized key process in AN to examine its unique influence on AN symptoms within a mechanistic framework. If improving ERA changes AN symptoms, this would provide proof-of-concept support for the role of ERA in the maintenance of AN and would suggest ERA to be a relevant target in AN treatment. We thus hypothesized that training of ERA (TERA) in patients with AN would lead to greater improvements in ERA and self-reported AN symptoms than a sham training. Given the short time period of the study (max. 6 days) and the strict dietary plans during inpatient treatment for all patients, we did not expect countable effects on the magnitude of weight gain. However, change in body mass index (BMI) was still assessed as a potential outcome.

2 | METHODS

2.1 | Study design

In this experimental study, participants were randomly assigned to receive a single session of either TERA or a sham training of the ability to recognize different types of clouds (control group). Change in ERA was the primary outcome. Changes in self-reported eating disorder symptoms and BMI served as secondary outcomes. Outcomes were assessed within 1 to 3 days before the training and within 1 to 3 days after the training. The study was approved by the local ethics committee of the Institute of Psychology at the University of Goettingen.

2.2 | Sample

Previous studies in healthy individuals found large effect sizes for the superiority of TERA over a sham training regarding improvements in ERA (Schlegel et al., 2017). However, since TERA has not been previously examined in clinical samples, we chose a more conservative approach and expected only a medium effect size (Cohen, 1992). An a priori power calculation indicated a total sample size of n = 34

participants in order to detect a medium effect size in a 2 × 2 mixed analysis of variance (ANOVA) with two groups (with 80% power and 0.05 two-tailed significance level). A data loss up to 10% due to technical errors and dropouts was assumed (i.e., a = 10%). Applying an attrition correction factor of $1/(1 - a)$ resulted in a sample size of at least n = 38 participants, which was rounded up to n = 40 (i.e., n = 20 per group) in order to be more conservative.

Thus, the sample consisted of 40 women with AN who were receiving inpatient treatment in a specialized eating disorders clinic at the time of study participation. Participants had to be 16 years or older and to meet DSM-5 criteria of AN (APA, 2013) to be eligible for the study. Exclusion criteria were: comorbid psychosis, borderline personality disorder, bipolar disorder, substance use disorder, or insufficient knowledge of the German language to complete the tasks and questionnaires. Comorbid diagnoses were given based on therapists' clinical judgement following ICD-10 criteria (World Health Organization, 1992). Participants received financial compensation (€25) for their participation. All participants provided written informed consent. In addition, participants younger than 18 years provided written assent with parental consent.

2.3 | Measures

2.3.1 | Emotion recognition ability

The computer-based Geneva Emotion Recognition Test (GERT; Schlegel, Grandjean, & Scherer, 2014) includes 83 short video clips (1–3 s) borrowed from the Geneva Multimodal Emotion Portrayals database (GEMEP; Bänziger, Mortillaro, & Scherer, 2012) that display 14 different emotions (pride, joy, amusement, pleasure, interest, relief, anger, fear, despair, irritation, anxiety, sadness, disgust, and surprise). Each clip shows the head and upper body of one out of 10 actors (5 women, 5 men; younger, middle-aged, and older individuals were included) expressing one of the described emotions while saying a pseudolinguistic sentence (a sentence without meaning). The emotions were acted out under the supervision of a professional film director, embedded in real-life scenarios in order to ensure high authenticity of the portrayals. All clips contain multimodal nonverbal cues (i.e., prosody, facial expression, gestures, posture), adding to the ecological validity of the task. After each video clip, participants choose which of the 14 emotions was expressed. The GERT score is calculated as the mean of all correct responses and can range from zero to one. It takes approximately 20 minutes to complete the test. Previous studies have demonstrated the good internal consistency and construct validity of the GERT (Costabile et al., 2018; Schlegel et al., 2014; Schlegel et al., 2017; Schlegel, Fontaine, & Scherer, 2019). Importantly, the GERT also comprises a range of stimuli (i.e., 47 of the 83) that are not used in the training.

2.3.2 | Eating disorder symptoms

Eating disorder symptoms were assessed by means of the German short version of the Eating Disorders Examination Questionnaire (EDE-Q8, Kliem et al., 2016). This is a brief, 8-item version of the well-established and commonly used Eating Disorder Examination-Questionnaire (EDE-Q; Hilbert, Tuschen-Caffier, Karwautz, Niederhofer, & Munsch, 2007) which keeps the structure of the four subscales "restraint eating," "eating concern," "weight concern," and "shape concern." Previous research demonstrated excellent internal consistency (α = .93) and a strong correlation with the long form of the EDE-Q (r = .97; Hilbert & Tuschen-Caffier, 2016; Kliem et al., 2016). In the current study, the instruction and response format was adapted to cover the past 1 to 3 days in order to allow for the assessment of short-term changes.

2.3.3 | Body mass index

Body weight and height were objectively assessed by clinic staff, on a regular basis during inpatient treatment. BMI was calculated using bodyweight in kilogram divided by height in meter squared (kg/m^2). BMI data from the closest weighing before and after the training session were taken as a potential further indicator for changes in AN symptom severity.

2.4 | Intervention

2.4.1 | Training of ERA

TERA consisted of a single session of computerized, audiovisual training (approx. 35 min) which included an instruction part and a practice-with-feedback part, both teaching participants to recognize and differentiate among 14 different emotions (Schlegel et al., 2017). The instruction part consisted of brief written descriptions and short video clips in which an experimenter explained the meaning of and nonverbal cues related to each emotion (e.g., "sadness typically occurs after the loss of a person, place, or thing and describes a state of unhappiness and misery with low physical arousal," "sadness can be recognized by a slow and low voice, lip corners pulled down, inner eyebrows lifted, frowning, slouched posture, arms hanging, little body movement"). Each explanation was followed by two example video clips (1–3 s) from the GEMEP to illustrate these cues (Bänziger et al., 2012). As described above for the GERT, each clip conveyed facial, gestural, postural, and auditory emotional cues. Participants could replay the example clips up to three times and reread the description of the nonverbal cues while watching. In the practice-with-feedback part, 42 additional GEMEP video clips were presented. After each clip, participants had to decide which of the 14 emotions was expressed by the actor, and received immediate written feedback about whether their answer was correct. Correct responses were followed by the next clip. In case of an incorrect answer, the video was replayed and the participant chose a second answer. If the second answer was still wrong, the correct emotion was displayed on the screen and the participant proceeded to the next clip.

2.4.2 | Cloud training control condition

In the sham training (Schlegel et al., 2017), participants learned to categorize 14 different cloud types. In accordance with TERA, the characteristic features (e.g., altitude, opaqueness, shape) of each cloud type such as Cirrus or Nimbostratus were described by an experimenter in a short video clip and a written description followed by two pictures of each type. The practice-with-feedback-part included 42 pictures of clouds that had to be categorized by the participants. Instructions and feedback were given according to the same structure as in the real training. That is, participants were informed whether their answer was correct and, in case of a wrong answer, were given a second chance to respond. If the second answer was still wrong, the correct cloud type was revealed.

2.5 | Procedure

All participants attended three appointments at intervals of 1 to 3 days. Participants who met the eligibility criteria were invited to the pre-assessment (45 min) to measure ERA (GERT) and self-reported eating disorder symptoms (EDE-Q8). As stated above, BMI was assessed on a regular basis during inpatient treatment, and BMI data from the weighing sessions closest to the study assessments were taken from patient records. Thereafter, participants were randomly assigned to one of the two groups. Randomization was performed in a 1:1 ratio without stratification, using a specific online tool (www.randomizer.org). The training session (approx. 35 min) took place 1 to 3 days after the first assessment. One to 3 days later, ERA, self-reported eating disorders symptoms, and BMI were reassessed (45 min).

2.6 | Statistics

All statistical analyses were carried out using SPSS 25. Statistical tests were performed two-tailed with the statistical significance value set to $p < .05$. Changes in outcomes were assessed by means of 2×2 mixed ANOVAs with group (TERA vs. control) as between-subjects factor and time (before vs. after training) as within-subjects factor. Means and *SD*s at pre-assessment were tested for group differences using *t* tests for independent samples. At post-assessment, the BMI data of one participant of the control group was lost, reducing the sample size to $n = 19$ in the control group for analyses concerning patients' BMI.

In exploratory analyses, changes concerning the recognition of the 14 specific emotions covered by the GERT were assessed using separate 2×2 (group × time) mixed ANOVAs. Furthermore, moderator analyses (using PROCESS v3.4; Hayes, 2017) were performed to examine whether BMI, age, duration of illness, or time between pre-assessment and post-assessment influenced the effects on ERA and eating disorder symptoms.

3 | RESULTS

3.1 | Sample characteristics at pre-assessment

The two groups did not differ in any variable at pre-assessment (Table 1), indicating that randomization was successful. In addition, groups neither differed regarding the length of time between pre-assessment and post-assessment ($M_{TERA} = 3.65$ days, $SD_{TERA} = 1.10$, $M_{Control} = 4.50$, $SD_{Control} = 2.71$, $t(38) = -1.30$, $p = .20$) nor regarding the use of psychotropic medication (TERA: 45%, control group: 40%, $\chi^2(1) = 0.10$; $p = .75$).

3.2 | Effects of TERA on emotion recognition

3.2.1 | GERT total score

There was no significant main effect of group, $F(1, 38) = 1.83$, $p = .19$, but a significant main effect of time, $F(1, 38) = 72.19$, $p < .001$ (Table 2). In support of our hypothesis, this main effect of time was qualified by a significant group × time interaction effect, $F(1, 38) = 16.70$, $p < .001$, indicating that the magnitude of change differed between groups. This significant interaction effect was followed up by separate paired samples *t*-tests for each of the groups. Both groups showed a significant increase in GERT scores from pre-assessment to post-assessment, $t_{TERA}(19) = 8.07$, $p_{TERA} < .001$, $t_{Control}(19) = 3.52$, $p_{Control} = .002$, with a large effect size ($d_{TERA} = 1.81$) in the TERA group and a medium effect size ($d_{Control} = 0.78$) in the control group.

3.2.2 | GERT single emotion categories

We found significant group × time interaction effects for GERT scores for the following emotions: disgust, pleasure, anger, joy, despair,

TABLE 1 Sample characteristics at pre-assessment

	TERA group ($n = 20$)	Control group ($n = 20$)	Test statistic
Age (years)	23.35 (8.54)	21.05 (5.40)	$t(38) = 1.02$, $p = .32$
Education (years)	12.78 (3.05)	11.50 (2.08)	$t(38) = 1.55$, $p = .13$
Illness duration (years)	4.29 (4.03)	4.45 (4.59)	$t(38) = -0.12$, $p = .91$
AN restricting subtype (%)	55.0	70.0	$\chi^2(1) = 0.99$, $p = .32$
BMI (kg/m^2)	15.79 (2.21)	16.02 (2.03)	$t(38) = -0.34$, $p = .74$
EDE-Q8	3.31 (1.67)	3.40 (1.80)	$t(38) = -0.16$, $p = .87$
GERT-total	0.68 (0.10)	0.69 (0.06)	$t(38) = -0.63$, $p = .53$

Note: Data are means and *SD*s or percent.
Abbreviations: AN, anorexia nervosa; BMI, body mass index; EDE-Q8, eating disorders examination questionnaire-8; GERT, Geneva emotion recognition test; TERA, training of emotion recognition abilities.

TABLE 2 Descriptive statistics and group comparisons on outcome measures

	Pre-assessment				Post-assessment					
	TERA group (n = 20)		Control group (n = 20)		TERA group (n = 20)		Control group (n = 20)		Test statistic	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Group × time	*p*
BMI (kg/m^2)	15.79	2.21	16.02	2.03	16.05	2.33	16.16	2.02	$F(1,37) = 0.17$	.68
EDE-Q8	3.31	1.67	3.40	1.80	2.61	1.65	3.33	1.90	$F(1,38) = 7.17$	.01
GERT										
Total	0.68	0.10	0.69	0.06	0.82	0.09	0.74	0.06	$F(1,38) = 16.70$	<.001
Anxiety	1.33	0.38	1.22	0.41	1.96	0.74	1.53	0.37	$F(1,38) = 2.15$	.05
Disgust	1.78	0.75	1.84	0.59	2.66	0.53	2.22	0.67	$F(1,38) = 4.57$	.04
Pleasure	1.85	0.40	1.91	0.48	2.62	0.56	2.18	0.64	$F(1,38) = 8.68$	.005
Anger	1.77	0.55	1.90	0.49	2.54	0.64	2.08	0.48	$F(1,38) = 7.07$	.01
Irritation	1.33	0.44	1.36	0.46	1.57	0.51	1.44	0.48	$F(1,38) = 0.84$	.36
Fear	1.93	0.57	1.91	0.47	2.34	0.64	2.23	0.54	$F(1,38) = 0.18$	.67
Sadness	1.79	0.63	1.66	0.72	2.08	0.80	1.86	0.58	$F(1,38) = 0.11$	.74
Joy	1.44	0.57	1.57	0.45	2.16	0.47	1.70	0.32	$F(1,38) = 10.33$	.003
Despair	1.34	0.58	1.32	0.39	1.93	0.80	1.33	0.46	$F(1,38) = 7.18$	.01
Pride	1.52	0.63	1.50	0.36	2.12	0.54	1.81	0.56	$F(1,38) = 2.10$	.16
Surprise	0.97	0.40	1.18	0.42	1.34	0.64	1.09	0.53	$F(1,38) = 9.60$	.004
Amusement	2.09	0.48	2.05	0.52	2.41	0.49	2.23	0.62	$F(1,38) = 0.46$	.50
Relief	1.93	0.57	2.09	0.54	2.71	0.58	2.28	0.74	$F(1,38) = 7.68$	.009
Interest	1.32	0.54	1.41	0.63	1.54	0.40	1.39	0.45	$F(1,38) = 1.52$	.23

Note: At post-assessment the BMI data of one participant of the control group was lost, reducing the sample size of the control group to n = 19.
Abbreviations: BMI, body mass index; EDE-Q8, eating disorders examination questionnaire; GERT, Geneva emotion recognition test; TERA, training of emotion recognition abilities.

surprise, and relief (Table 2), indicating that the magnitude of change in the ability to recognize these emotions differed between groups. Separate paired samples *t*-tests for each of the groups revealed that both groups significantly improved in their ability to recognize disgust and pleasure (all $p \leq .03$). However, only patients in the TERA group showed improvements regarding their ability to recognize anger, joy, despair, surprise, and relief, all $p \leq .02$.

3.3 | Effects of TERA on eating disorder symptoms

3.3.1 | Eating disorder examination questionnaire-8

We observed no significant main effect of group, $F(1, 38) = 0.55$, $p = .46$, but a significant main effect of time on EDE-Q8 scores, $F(1, 38) = 10.98$, $p = .002$, indicating that both groups showed lower EDE-Q8 scores after the training. In support of our hypothesis, this main effect of time was qualified by a significant group × time interaction effect, $F(1, 38) = 7.17$, $p = .01$, indicating that the magnitude of change differed between groups. This interaction effect was followed up by separate paired samples *t*-tests for each of the groups. Whereas patients in the TERA group showed a significant reduction in EDE-Q8 scores, $t(19) = 3.58$, $p = .002$, $d = 0.80$, patients in the control group did not, $t(19) = 0.58$, $p = .57$, $d = 0.13$.

3.3.2 | Body mass index

There was no significant main effect of group, $F(1, 37) = 0.03$, $p = .86$, but a significant main effect of time, $F(1, 37) = 41.15$, $p < .001$, indicating that both groups gained a significant amount of weight. However, we found no significant group × time interaction, $F(1, 37) = 0.17$, $p = .68$, indicating that the magnitude of change in BMI was comparable in both groups.

3.4 | Moderator analyses

Exploratory moderator analyses revealed no moderating effects of BMI, age, duration of illness, or time between pre-assessment and post-assessment on the relationship between group assignment and GERT scores or EDE-Q8 scores at post-assessment, all $p > .07$, when controlling for pre-assessment scores in these variables.

4 | DISCUSSION

The primary aim of the present experimental proof-of-concept study was to examine whether ERA can be improved by a brief computerized training in patients with AN. The secondary aim of the study was to isolate ERA as a potential key process in AN in order to investigate

its unique influence on AN symptoms. Inpatients with AN received a single-session training of either ERA (TERA) or a sham training. All patients showed improvements in ERA, reductions in self-reported eating disorder symptoms and increases in BMI after the training. Importantly, however, patients who received TERA showed greater improvements in ERA and self-reported eating disorder symptoms than patients who received sham training. This suggests that ERA can be effectively trained in patients with AN, and that difficulties in ERA may contribute to the maintenance of AN. Taken together, these preliminary findings suggest that specific, computerized trainings of ERA hold promise as an additional component in AN treatment.

4.1 | Effects of TERA on ERA

Previous research found that ERA can be improved in clinical samples, such as schizophrenia (Russell, Chu, & Phillips, 2006; Russell, Green, Simpson, & Coltheart, 2008), body dysmorphic disorder (Buhlmann, Gleiß, Rupf, Zschenderlein, & Kathmann, 2011), and children with autism spectrum disorder (Berggren et al., 2018; Golan et al., 2010). This is the first study to investigate whether ERA can be trained in patients with AN. As expected, patients who received TERA showed greater improvements in overall ERA and, beyond that and in contrast to patients in the control group, also specifically improved in the recognition of certain emotions (i.e., anger, joy, despair, surprise, and relief). Hence, this is first evidence that this specific training is not only effective to improve ERA in healthy adults (Schlegel et al., 2017) but also in a clinical sample. Moreover, it seems as it is similarly effective in patients with AN as in healthy individuals, given the exact same amount of improvement in GERT scores (12%) in this study and in a previous study in healthy individuals (Schlegel et al., 2017). The effects of TERA were not moderated by age, duration of illness, or BMI at baseline, indicating that TERA works equally well for a relatively broad range of patients with AN.

The fact that all patients, irrespective of group affiliation, increased their ERA can be explained by familiarity and practice effects as the GERT was used twice, at pre-assessment and post-assessment. This is in line with previous research (Bänziger, Grandjean, & Scherer, 2009 Bänziger et al., 2012; Schlegel et al., 2017) indicating that repeated presentation even without feedback can increase performance due to increasing familiarity with the task, with the emotion categories, and with the associated nonverbal expressions. Although the magnitude of improvement in the control group (d = 0.78) may appear surprising, it is actually not that large if one considers that it reflects only 5% more correct responses (as compared to 12% in the TERA group), which is in line with a previous study in healthy volunteers in which a significant improvement of 6% was observed, in absence of any intervention and with a pre-post time interval of 4 weeks (Schlegel et al., 2017). Also, all patients knew that the study investigated a training of emotion recognition. Possibly, this knowledge has spurred participants to perform well in the tasks, leading to enhanced ERA in all patients.

Future research regarding the enhanced recognition of specific emotions might be fruitful as some emotions may play a more crucial role in AN, for example, disgust sensitivity (Aharoni & Hertz, 2012), anger (Harrison, Genders, Davies, Treasure, & Tchanturia, 2011; Waller et al., 2003), or anxiety (Lloyd, Haase, Foster, & Verplanken, 2019).

4.2 | Effects of TERA on eating disorder symptoms

If emotions of others are not decoded precisely, dysfunctional social interactions might be triggered, leading to uncertainty, aversive feelings of guilt, shame and anxiety, and thus intensify AN behavior to regulate just these. Misinterpretation of another person's negative feelings might result in interpersonal distress, whereas mistaking another person's positive feelings might entail missing out on positive interpersonal experiences. Thus, the second focus of the study was to explore whether TERA leads to short-term changes in AN symptoms, which would provide proof-of-concept support for the importance of ERA in the maintenance of AN (Field et al., 2019; Jansen, 2016). Groups did not differ in terms of weight gain, which is not surprising given the short period of time examined in this study and given that all participants received inpatient treatment with highly structured meal plans. However, participants who received TERA showed greater short-term improvements in self-reported eating disorder symptoms. Given that this was a single-session training and that the assessment period was rather short, this effect is quite astonishing. If one tentatively assumes that this effect was not just due to demand effects, it suggests that ERA is indeed a maintenance factor in AN. In the following, we purposely go beyond our data in order to present some specific hypotheses about processes that may have been initiated by TERA and that should be further tested in future studies. There might have been several ways in which enhanced ERA contributed to short-term reductions in AN symptoms. During inpatient treatment, study participants frequently engage in social interactions with many other patients, therapists, and their caregivers. If patients realize through enhanced ERA that others do not hold as many negative feelings toward them as previously suspected, this might lead to reduced negative emotions and thus to a reduced drive to use restrictive eating to regulate aversive emotions. In addition, enhanced ERA might also enable patients to recognize actual negative feeling in others more precisely, giving them the opportunity to respond more adequately to these situations and to other people's needs. This in turn might contribute to faster resolutions of social conflicts and reduced interpersonal distress. Consequently, the drive to use restrictive eating as maladaptive emotion regulation might also be reduced. Beyond that, patients who recognize (through enhanced ERA) that others have in fact positive feelings about them might experience social interactions as more rewarding, which may again decrease the need to utilize AN behavior to control aversive emotions. However, given the limitations of this study (see below), the results have to be interpreted with caution and replication of the results including further measures are needed before such conclusions can be drawn with greater certainty.

Existing treatment programs for AN, such as MANTRA (Schmidt, Wade, & Treasure, 2014), focal psychodynamic psychotherapy, and enhanced cognitive behavioral therapy (CBT-E; Zipfel et al., 2014), already include aspects of socioemotional functioning. However, these approaches do not specifically address the ability to infer emotions from nonverbal cues and do not involve specific training on that. Recent models of AN underscore the importance of social cognition deficits including impaired emotion recognition in AN (Harrison et al., 2010; Harrison, Tchanturia, Naumann, & Treasure, 2012). Such deficits are considered to be both a precursor and maintenance factor for AN (Harrison et al., 2010; Kothari et al., 2015; Oldershaw et al., 2010), and to be further corrupted by self-starvation and weight loss through blunting of emotional processing (Brockmeyer et al., 2012, 2013, 2019; Kaye et al., 2003). Implementing specific trainings of ERA such as TERA as an add-on to existing treatment programs could be a promising avenue to improve treatment outcome in AN (if the findings of the present study can be replicated).

4.3 | Limitations

The present study has some limitations. The sample in the current study was limited to relatively severe inpatients with a long average illness duration. This limits the generalization of the results to a wider spectrum of patients with AN. Thus, replication of the study in larger, more heterogeneous samples, including outpatients is required. Blinding of participants was not possible. Consequently, confounding effects of social desirability and demand effects cannot be ruled out (Adair, 1984). However, this does not apply to the GERT which is a performance-based test (similar to cognitive intelligence tests) and not a self-report measure (Schlegel et al., 2014). An increased motivation to perform better (e.g., due to social desirability) in such a test is unlikely to result in better scores because it does not increase participants' actual ability to detect the correct answers (Hall, Blanch et al., 2009).

In addition, only short-term effects on AN symptoms were assessed in this proof-of-concept study. Future studies should involve follow-up assessments. For instance, Schlegel et al. (2017) found that TERA effects persisted over 4 weeks in healthy participants. Eating disorder symptoms were only measured via an adapted version of the EDE-Q8 (Kliem et al., 2016) and the patients' BMI. Future studies may also involve further measures such as a laboratory meal in which caloric intake is measured.

The video clips used in the GERT partially overlapped with those used in the TERA (Schlegel et al., 2014). Moreover, as we used only the GERT (Schlegel et al., 2014) to assess ERA, it is uncertain to what extent patients are able to transfer improved ERA to daily social life in a real-world context. Future studies may therefore additionally use further stimuli, a different performance test, self-report measures, or behavior observation (including analyses of actual social interactions in which affect, conflict resolution, and related constructs are coded) to test for transfer effects. However, Schlegel et al. (2017) found transfer effects of TERA to different ERA tests (Nowicki, 2006; Scherer & Scherer, 2011) and social interactions (Schlegel & Hall, 2019), indicating that TERA improves real-life ERA in healthy participants. The simultaneous training of multiple nonverbal channels (face, voice, body) in the TERA might facilitate its transferability to real-life situations.

The stimuli and the variety of emotions that are presented contribute to the GERT's ecological validity and thus represent a clear strength of the study. In addition, by following the same structure and time span like the real treatment, the cloud control training constituted an aligned comparator. Further strengths include the randomized controlled study design as well as the study's power due to the adequate sample size.

5 | CONCLUSIONS

The present study provides preliminary evidence that TERA is a brief and effective single-session training of ERA that can improve ERA in patients with AN. In addition, the findings suggest that ERA plays a causal role in the maintenance of AN. Depending on the replication of the findings of this study, TERA might represent a useful add-on module to existing treatment programs for AN. Further studies using a broader range of ERA assessments and a longer follow-up interval in larger, more diverse samples are required.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data analyzed in the current study are available from the corresponding author upon reasonable request.

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REFERENCES

Adair, J. G. (1984). The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology*, *69*(2), 334–345.

Aharoni, R., & Hertz, M. M. (2012). Disgust sensitivity and anorexia nervosa. *European Eating Disorders Review*, *20*(2), 106–110.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. Arlington, VA: American Psychiatric Association.

Arcelus, J., Mitchell, A. J., Wales, J., & Nielsen, S. (2011). Mortality rates in patients with anorexia nervosa and other eating disorders: A meta-analysis of 36 studies. *JAMA Psychiatry*, *68*(7), 724–731. https://doi.org/10.1001/archgenpsychiatry.2011.74

Bänziger, T., Grandjean, D., & Scherer, K. R. (2009). Emotion recognition from expressions in face, voice, and body: The multimodal emotion recognition test (MERT). *Emotion (Washington, D.C.)*, *9*(5), 691–704. https://doi.org/10.1037/a0017088

Bänziger, T., Mortillaro, M., & Scherer, K. R. (2012). Introducing the Geneva multimodal expression corpus for experimental research on emotion perception. *Emotion*, *12*(5), 1161–1179.

Berggren, S., Fletcher-Watson, S., Milenkovic, N., Marschik, P. B., Bölte, S., & Jonsson, U. (2018). Emotion recognition training in autism spectrum disorder: A systematic review of challenges related to generalizability. *Developmental Neurorehabilitation*, *21*(3), 141–154. https://doi.org/10.1080/17518423.2017.1305004

Bora, E., & Köse, S. (2016). Meta-analysis of theory of mind in anorexia nervosa and bulimia nervosa: A specific impairment of cognitive perspective taking in anorexia nervosa? *International Journal of Eating Disorders*, *49*(8), 739–740.

Brockmeyer, T., Friederich, H.-C., & Schmidt, U. (2018). Advances in the treatment of anorexia nervosa: A review of established and emerging interventions. *Psychological Medicine*, *48*(8), 1228–1256.

Brockmeyer, T., Holtforth, M., Bents, H., Herzog, W., & Friederich, H.-C. (2013). Lower body weight is associated with less negative emotions in sad autobiographical memories of patients with anorexia nervosa. *Psychiatry Research*, *210*(2), 548–552.

Brockmeyer, T., Holtforth, M., Bents, H., Kämmerer, A., Herzog, W., & Friederich, H.-C. (2012). Starvation and emotion regulation in anorexia nervosa. *Comprehensive Psychiatry*, *53*(5), 496–501.

Brockmeyer, T., Pellegrino, J., Maier, C., Münch, H. M., Harmer, C. J., Walther, S., … Friederich, H.-C. (2019). Blunted emotion-modulated startle reflex in anorexia nervosa. *International Journal of Eating Disorders*, *52*(3), 270–277.

Brockmeyer, T., Pellegrino, J., Munch, H., Herzog, W., Dziobek, I., & Friederich, H.-C. (2016). Social cognition in anorexia nervosa: Specific difficulties in decoding emotional but not nonemotional mental states. *The International Journal of Eating Disorders*, *49*(9), 883–890. https://doi.org/10.1002/eat.22574

Buhlmann, U., Gleiß, M. J. L., Rupf, L., Zschenderlein, K., & Kathmann, N. (2011). Modifying emotion recognition deficits in body dysmorphic disorder: An experimental investigation. *Depression and Anxiety*, *28* (10), 924–931.

Cagar-Nazai, H. P., Corfield, F., Cardi, V., Ambwani, S., Leppanen, J., Olabintan, O., … Treasure, J. (2014). A systematic review and meta-analysis of "Systems for Social Processes" in eating disorders. *Neuroscience and Biobehavioral Reviews*, *42*, 55–92. https://doi.org/10.1016/j.neubiorev.2013.12.002

Calugi, S., Dalle Grave, R., Sartirana, M., & Fairburn, C. G. (2015). Time to restore body weight in adults and adolescents receiving cognitive behaviour therapy for anorexia nervosa. *Journal of Eating Disorders*, *3* (1), 21.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

Costabile, T., Capretti, V., Abate, F., Liguori, A., Paciello, F., Pane, C., … Saccà, F. (2018). Emotion recognition and psychological comorbidity in Friedreich's ataxia. *The Cerebellum*, *17*(3), 336–345. https://doi.org/10.1007/s12311-018-0918-5

Craig, M., Waine, J., Wilson, S., & Waller, G. (2019). Optimizing treatment outcomes in adolescents with eating disorders: The potential role of cognitive behavioral therapy. *The International Journal of Eating Disorders*, *52*(5), 538–542. https://doi.org/10.1002/eat.23067

Davies, H., Fox, J., Naumann, U., Treasure, J., Schmidt, U., & Tchanturia, K. (2012). Cognitive remediation and emotion skills training for anorexia nervosa: An observational study using neuropsychological outcomes. *European Eating Disorders Review*, *20*(3), 211–217.

Dinkler, L., Rydberg Dobrescu, S., Råstam, M., Gillberg, I. C., Gillberg, C., Wentz, E., & Hadjikhani, N. (2019). Visual scanning during emotion recognition in long-term recovered anorexia nervosa: An eye-tracking study. *The International Journal of Eating Disorders*, *52*(6), 691–700. https://doi.org/10.1002/eat.23066

Eddy, K. T., Tabri, N., Thomas, J. J., Murray, H. B., Keshaviah, A., Hastings, E., … Keel, P. K. (2017). Recovery from anorexia nervosa and bulimia nervosa at 22-year follow-up. *The Journal of Clinical Psychiatry*, *78*(2), 184–189.

Field, M., Christiansen, P., Hardman, C., Haynes, A., Jones, A., Robinson, E., & Reid, A. (2019). Translation of laboratory research into behavioral interventions for obesity and problem drinking: The experimental medicine approach. https://doi.org/10.31234/osf.io/scre4.

Golan, O., Ashwin, E., Granader, Y., McClintock, S., Day, K., Leggett, V., & Baron-Cohen, S. (2010). Enhancing emotion recognition in children with autism spectrum conditions: An intervention using animated vehicles with real emotional faces. *Journal of Autism and Developmental Disorders*, *40*(3), 269–279.

Hall, J. A., Blanch, D. C., Horgan, T. G., Murphy, N. A., Rosip, J. C., & Schmid-Mast, M. (2009). Motivation and interpersonal sensitivity: Does it matter how hard you try? *Motivation and Emotion*, *33*(3), 291–302. https://doi.org/10.1007/s11031-009-9128-2

Hall, J. A., Andrzejewski, S. A., & Yopchick, J. E. (2009). Psychosocial correlates of interpersonal sensitivity: A meta-analysis. *Journal of Nonverbal Behavior*, *33*(3), 149–180.

Halmi, K. A., Agras, W. S., Crow, S., Mitchell, J., Wilson, G. T., Bryson, S. W., & Kraemer, H. C. (2005). Predictors of treatment acceptance and completion in anorexia nervosa: Implications for future study designs. *Archives of General Psychiatry*, *62*(7), 776–781.

Harrison, A., Sullivan, S., Tchanturia, K., & Treasure, J. (2010). Emotional functioning in eating disorders: Attentional bias, emotion recognition and emotion regulation. *Psychological Medicine*, *40*(11), 1887–1897. https://doi.org/10.1017/S0033291710000036

Harrison, A., Tchanturia, K., Naumann, U., & Treasure, J. (2012). Social emotional functioning and cognitive styles in eating disorders. *British Journal of Clinical Psychology*, *51*, 261–279. https://doi.org/10.1111/j.2044-8260.2011.02026.x

Harrison, A., Genders, R., Davies, H., Treasure, J., & Tchanturia, K. (2011). Experimental measurement of the regulation of anger and aggression in women with anorexia nervosa. *Clinical Psychology & Psychotherapy*, *18*(6), 445–452. https://doi.org/10.1002/cpp.726

Harrison, A., Tchanturia, K., & Treasure, J. (2010). Attentional bias, emotion recognition, and emotion regulation in anorexia: State or trait? *Biological Psychiatry*, *68*(8), 755–761. https://doi.org/10.1016/j.biopsych.2010.04.037

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Publications.

Hilbert, A., & Tuschen-Caffier, B. (2016). Eating disorder examination-questionnaire: dgvt-Verlag.

Hilbert, A., Tuschen-Caffier, B., Karwautz, A., Niederhofer, H., & Munsch, S. (2007). Eating disorder examination questionnaire: Evaluation of the German translation [in German]. *Diagnostica*, *53*, 144–154.

Himmerich, H., Hotopf, M., Shetty, H., Schmidt, U., Treasure, J., Hayes, R. D., … Chang, C.-K. (2019). Psychiatric comorbidity as a risk factor for mortality in people with anorexia nervosa. *European Archives of Psychiatry and Clinical Neuroscience*, *269*(3), 351–359. https://doi.org/10.1007/s00406-018-0937-8

Iacoboni, M. (2009). Imitation, empathy, and mirror neurons. *Annual Review of Psychology*, *60*, 653–670. https://doi.org/10.1146/annurev.psych.60.110707.163604

Jansen, A. (2016). Eating disorders need more experimental psychopathology. *Behaviour Research and Therapy*, *86*, 2–10. https://doi.org/10.1016/j.brat.2016.08.004

Kanakam, N., Krug, I., Raoult, C., Collier, D., & Treasure, J. (2013). Social and emotional processing as a behavioural endophenotype in eating disorders: A pilot investigation in twins. *European Eating Disorders Review*, *21*(4), 294–307.

Kaye, W. H., Barbarich, N. C., Putnam, K., Gendall, K. A., Fernstrom, J., Fernstrom, M., … Kishore, A. (2003). Anxiolytic effects of acute tryptophan depletion in anorexia nervosa. *International Journal of Eating Disorders*, *33*(3), 257–267.

Khalsa, S. S., Portnoff, L. C., McCurdy-McKinnon, D., & Feusner, J. D. (2017). What happens after treatment? A systematic review of relapse,

remission, and recovery in anorexia nervosa. *Journal of Eating Disorders*, *5*(1), 20.

Kim, Y.-R., Eom, J.-S., Yang, J.-W., Kang, J., & Treasure, J. (2015). The impact of oxytocin on food intake and emotion recognition in patients with eating disorders: A double blind single dose within-subject cross-over design. *PLoS One*, *10*(9), e0137514. https://doi.org/10.1371/journal.pone.0137514

Kliem, S., Mößle, T., Zenger, M., Strauß, B., Brähler, E., & Hilbert, A. (2016). The eating disorder examination-questionnaire 8: A brief measure of eating disorder psychopathology (EDE-Q8). *International Journal of Eating Disorders*, *49*(6), 613–616. https://doi.org/10.1002/eat.22487

Kothari, R., Barona, M., Treasure, J., & Micali, N. (2015). Social cognition in children at familial high-risk of developing an eating disorder. *Frontiers in Behavioral Neuroscience*, *9*, 208. https://doi.org/10.3389/fnbeh.2015.00208

Kucharska-Pietura, K., Nikolaou, V., Masiak, M., & Treasure, J. (2004). The recognition of emotion in the faces and voice of anorexia nervosa. *International Journal of Eating Disorders*, *35*(1), 42–47. https://doi.org/10.1002/eat.10219

Lloyd, E. C., Haase, A. M., Foster, C. E., & Verplanken, B. (2019). A systematic review of studies probing longitudinal associations between anxiety and anorexia nervosa. *Psychiatry Research*, *276*, 175–185. https://doi.org/10.1016/j.psychres.2019.05.010

Nalbant, K., Kalaycı, B. M., Akdemir, D., Akgül, S., & Kanbur, N. (2019). Emotion regulation, emotion recognition, and empathy in adolescents with anorexia nervosa. *Eating and Weight Disorders*, *24*(5), 825–834. https://doi.org/10.1007/s40519-019-00768-8

Nowicki, S. (2006). *A manual and reference list for the diagnostic analysis of nonverbal accuracy (DANVA2)*. Atlanta, GA: Emory University.

Oldershaw, A., Hambrook, D. [D.], Stahl, D., Tchanturia, K., Treasure, J., & Schmidt, U. (2011). The socio-emotional processing stream in anorexia nervosa. *Neuroscience and Biobehavioral Reviews*, *35*(3), 970–988. https://doi.org/10.1016/j.neubiorev.2010.11.001

Oldershaw, A., Hambrook, D., Tchanturia, K., Treasure, J., & Schmidt, U. (2010). Emotional theory of mind and emotional awareness in recovered anorexia nervosa patients. *Psychosomatic Medicine*, *72*(1), 73–79. https://doi.org/10.1097/PSY.0b013e3181c6c7ca

Pennesi, J.-L., & Wade, T. D. (2016). A systematic review of the existing models of disordered eating: Do they inform the development of effective interventions? *Clinical Psychology Review*, *43*, 175–192.

Preston, S. D., & de Waal, F. B. (2002). Empathy: Its ultimate and proximate bases. *Behavioral and Brain Sciences*, *25*(1), 1–20. https://doi.org/10.1017/S0140525X02000018

Reas, D. L., & Rø, Ø. (2018). Less symptomatic, but equally impaired: Clinical impairment in restricting versus binge-eating/purging subtype of anorexia nervosa. *Eating Behaviors*, *28*, 32–37. https://doi.org/10.1016/j.eatbeh.2017.12.004

Renwick, B., Musiat, P., Lose, A., DeJong, H., Broadbent, H., Kenyon, M., … Schmidt, U. (2015). Neuro- and social-cognitive clustering highlights distinct profiles in adults with anorexia nervosa. *The International Journal of Eating Disorders*, *48*(1), 26–34. https://doi.org/10.1002/eat.22366

Russell, T. A., Schmidt, U., Doherty, L., Young, V., & Tchanturia, K. (2009). Aspects of social cognition in anorexia nervosa: Affective and cognitive theory of mind. *Psychiatry Research*, *168*(3), 181–185. https://doi.org/10.1016/j.psychres.2008.10.028

Russell, T. A., Chu, E., & Phillips, M. L. (2006). A pilot study to investigate the effectiveness of emotion recognition remediation in schizophrenia using the micro-expression training tool. *British Journal of Clinical Psychology*, *45*(4), 579–583. https://doi.org/10.1348/014466505X90866

Russell, T. A., Green, M. J., Simpson, I., & Coltheart, M. (2008). Remediation of facial emotion perception in schizophrenia: Concomitant changes in visual attention. *Schizophrenia Research*, *103*(1), 248–256. https://doi.org/10.1016/j.schres.2008.04.033

Scherer, K. R., & Scherer, U. (2011). Assessing the ability to recognize facial and vocal expressions of emotion: Construction and validation of the emotion recognition index. *Journal of Nonverbal Behavior*, *35*(4), 305–326.

Schlegel, K., & Hall, J. A. (2019). The effects of emotion recognition training on interpersonal effectiveness. https://doi.org/10.31234/osf.io/8x2dj.

Schlegel, K., Vicaria, I. M., Isaacowitz, D. M., & Hall, J. A. (2017). Effectiveness of a short audiovisual emotion recognition training program in adults. *Motivation and Emotion*, *41*(5), 646–660. https://doi.org/10.1007/s11031-017-9631-9

Schlegel, K., Boone, R. T., & Hall, J. A. (2017). Individual differences in interpersonal accuracy: A multi-level meta-analysis to assess whether judging other people is one skill or many. *Journal of Nonverbal Behavior*, *41*(2), 103–137.

Schlegel, K., Fontaine, J. R. J., & Scherer, K. R. (2019). The nomological network of emotion recognition ability: Evidence from the Geneva Emotion Recognition Test. *European Journal of Psychological Assessment*, *35*(3), 352–363.

Schlegel, K., Grandjean, D., & Scherer, K. R. (2013). Constructs of social and emotional effectiveness: Different labels, same content? *Journal of Research in Personality*, *47*(4), 249–253.

Schlegel, K., Grandjean, D., & Scherer, K. R. (2014). Introducing the Geneva emotion recognition test: An example of Rasch-based test development. *Psychological Assessment*, *26*(2), 666–672.

Schmidt, U., Wade, T. D., & Treasure, J. (2014). The Maudsley model of anorexia nervosa treatment for adults (MANTRA): Development, key features, and preliminary evidence. *Journal of Cognitive Psychotherapy*, *28*(1), 48–71.

Steinhausen, H.-C., Grigoroiu-Serbanescu, M., Boyadjieva, S., Neumärker, K.-J., & Winkler Metzke, C. (2008). Course and predictors of rehospitalization in adolescent anorexia nervosa in a multisite study. *International Journal of Eating Disorders*, *41*(1), 29–36.

Treasure, J., Corfield, F., & Cardi, V. (2012). A three-phase model of the social emotional functioning in eating disorders. *European Eating Disorders Review*, *20*(6), 431–438. https://doi.org/10.1002/erv.2181

Waller, G., Babbs, M., Milligan, R., Meyer, C., Ohanian, V., & Leung, N. (2003). Anger and core beliefs in the eating disorders. *International Journal of Eating Disorders*, *34*(1), 118–124.

World Health Organization (1992). *The ICD-10 classification of mental and behavioral disorders: Clinical descriptions and diagnostic guidelines*. Retrieved from http://www.who.int/classifications/icd/en/bluebook.pdf

Wyssen, A., Lao, J., Rodger, H., Humbel, N., Lennertz, J., Schuck, K., … Munsch, S. (2019). Facial emotion recognition abilities in women experiencing eating disorders. *Psychosomatic Medicine*, *81*(2), 155–164.

Zipfel, S., Lowe, B., Reas, D. L., Deter, H. C., & Herzog, W. (2000). Long-term prognosis in anorexia nervosa: Lessons from a 21-year follow-up study. *Lancet (London, England)*, *355*(9205), 721–722. https://doi.org/10.1016/S0140-6736(99)05363-5

Zipfel, S., Wild, B., Groß, G., Friederich, H.-C., Teufel, M., Schellberg, D., … Herpertz, S. (2014). Focal psychodynamic therapy, cognitive behaviour therapy, and optimised treatment as usual in outpatients with anorexia nervosa (ANTOP study): Randomised controlled trial. *Lancet (London, England)*, *383*(9912), 127–137.

Zucker, N. L., Losh, M., Bulik, C. M., LaBar, K. S., Piven, J., & Pelphrey, K. A. (2007). Anorexia nervosa and autism spectrum disorders: Guided investigation of social cognitive endophenotypes. *Psychological Bulletin*, *133*(6), 976–1006. https://doi.org/10.1037/0033-2909.133.6.976

How to cite this article: Preis MA, Schlegel K, Stoll L, et al. Improving emotion recognition in anorexia nervosa: An experimental proof-of-concept study. *Int J Eat Disord*. 2020; 53:945–953. https://doi.org/10.1002/eat.23276