Expression of positive emotions differs in illness and recovery in anorexia nervosa

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Highlights

- The facial expression of women recovered from anorexia nervosa (REC) was studied.
- REC smiled more than acutely ill participants in response to a positive film.
- The facial expression of REC was similar to the healthy controls.
- Facial expressivity in REC was not related to depression or anxiety.

Abstract

People with Anorexia Nervosa (AN) display reduced facial expression of emotions. This study investigated the expression of positive affect in response to a film, examining Duchenne and non-Duchenne smiles in 20 women who have recovered from AN (REC), 20 with acute AN and 20 healthy controls (HC). The results indicated that the REC group exhibited Duchenne and non-Duchenne smiles with higher duration and intensity than the AN group, comparable to the HC group. The findings warrant longitudinal studies to confirm that reduced expressivity is linked to acute AN, ameliorating after recovery.

Keywords

Smile, facial expression, eating disorders

Introduction

Anorexia nervosa (AN) has one of the highest chronicity and mortality rates amongst mental disorders (Smink et al., 2012; Steinhausen, 2009). In order to improve treatment outcomes, a better understanding of factors that maintain the pathology is needed (Stice, 2002).

Socioemotional problems have been proposed as maintenance factors for AN (Treasure et al., 2012), and an aspect that seems to be particularly relevant is emotion expression. In a recent meta-analysis, participants with AN showed reduced facial expression of positive and negative emotions compared to healthy controls (HC), with large and medium effect sizes respectively (Davies et al., 2016).

The link between reduced expressivity and the eating disorder (ED) is not clear. Reduced emotion expression has been interpreted as a manifestation of emotion avoidance (Dapelo et al., 2015; Davies et al., 2011), which is a common feature in AN (Lynch et al., 2015; Schmidt and Treasure, 2006; Wildes et al., 2010). However, emotion avoidance could act as a trait or as related to the acute phase of the illness. Comparing acutely ill patients and those who have recovered is an important first step towards disentangling state and trait factors (Davies et al., 2013).

Only one study has explored facial emotion expression in people who recovered from AN (REC) (Davies et al., 2013). The results indicated that, when responding to a positive film clip, a REC group showed higher frequency of positive facial expressions than acutely ill AN, and similar to HC. However, self-reported experience of positive affect showed an intermediate profile between the AN and HC groups. The incongruence

between the facial expression and the subjective experience exhibited by the REC group led the authors to suggest that perhaps REC participants were showing expressions that were more strategic, as opposed to authentic hedonic responses (Davies et al., 2013).

It is possible to infer the authenticity of an expression of positive affect by analysing the smile. Genuine smiles are characterised by the activation of the muscle that contracts the outer corner of the eyebrows producing wrinkles in the corner of the eyes (Darwin, 1872/2003). These are known as "Duchenne smiles" (Duchenne, 1862/1990; Ekman et al., 1990), and have been associated with enjoyment (Ekman et al., 1990), and shown to evoke positive emotions in others, promoting positive social interactions (Harker and Keltner, 2001; Keltner and Bonanno, 1997). In contrast, non-Duchenne smiles can be displayed in a deliberate attempt to convince others that a positive emotion is being felt when it is not (Ekman and Friesen, 1982), or in response to social demands (Hess and Bourgeois, 2010). Even though non-Duchenne smiles have been considered 'false smiles' because they are not linked to authentic feelings of positive affect (Ekman and Friesen, 1982), it has also been proposed that, when displayed in positive situations, they may be appropriate as signals of social politeness (Papa and Bonanno, 2008).

In a previous study, we investigated the expression of Duchenne and non-Duchenne smiles after a positive mood induction in acutely ill AN participants compared to a HC group, finding reduced expression of both Duchenne and non-Duchenne smiles (Dapelo et al., 2015). In this study we aim to explore the expression of Duchenne and non-Duchenne smiles in people who have recovered from AN. Following findings from Davies and colleagues study (2013), it was hypothesised that the REC group will exhibit reduced Duchenne smile facial expressions, which are associated to subjective feelings of

positive affect, but an increased amount of strategic expressions of positive affect (i.e., non-Duchenne smiles), similar to that found in HCs.

Method

This study used a methodology that has been described in detail by Dapelo et al. (2015). Participants were 20 women who had recovered from AN (REC). Inclusion criteria were a past diagnosis of AN according to DSM-5 (APA, 2013) and the absence of ED symptoms for at least one year prior to the assessment. This was evaluated using the Structured Clinical Interview for DSM-IV (SCID) (First et al., 2002). The ED module of the SCID was used to assess past and current ED symptomatology, along with BMI history, and information about the course of the illness and time since remission were collected. Moreover, the Eating Disorders Questionnaire (EDE-Q) (Fairburn and Beglin, 1994) was used to obtain additional information about current symptomatology, and height and weight were measured. In order to meet the study inclusion criteria, participants were required to score below 3 in the EDE-Q and have a BMI $\geq$18.5. The REC group was compared to 20 women with AN and 20 HC, whose data and characteristics have been reported previously (Dapelo et al., 2015).

All participants signed informed consent, then the SCID was conducted, height and weight were measured, they completed an experimental task, and answered questionnaires. Questionnaires included the EDE-Q (Fairburn and Beglin, 1994), Hospital anxiety and depression scale (HADS) (Zigmond and Snaith, 1983), and the positive affect subscale of the Positive and negative affect scale (PANAS) (Watson et al.,

1988). The study was approved by the National Health Research Services Ethics Committee (13/LO/0201).

During the experimental task, a neutral film was presented for 30 seconds. Next, participants completed the positive PANAS questions (pre-film). Then, a 2 minutes clip showing a humorous wedding ceremony was shown (for a description of the clip see Davies et al., 2011). Finally, the positive PANAS questions were repeated (post-film). The participants' facial expressions during the task were recorded and coded using the Facial Action Coding System (Ekman et al., 2002). The facial muscle movements associated with Duchenne and non-Duchenne smiles were identified (i.e., Action Units 6 and 12 for Duchenne smiles, and 12 in the absence of 6 for non-Duchenne smiles) and their duration and intensity was coded. For a detailed explanation of the coding procedures, see Dapelo et al. (2015). Ninety percent of the videos were coded by blind coders (SH and CH), and 10% were coded by the first author (MD), who was not blind to the participant's diagnosis. Twelve percent of the videos were coded twice for reliability purposes. Cohen's Kappas were 0.83 for AU6, and 0.79 for AU12.

Results

Participants' demographics and clinical characteristics are shown in Table 1. On average, the REC participants have been recovered for 6 years and 4 months prior to the assessment (*M*=75.8 months; *SD*=95.3; *Min*=12 months; *Max*=420 months).

---TABLE 1---

To test if the film successfully induced positive affect, a repeated measures ANOVA was used comparing pre-film and post-film PANAS ratings. The results

indicated that there was a significant increase in positive affect after viewing the film ($F(1,53)=24.53$, $p<0.01$). The effect of group ($F(2,53)=0.95$, $p=0.39$) and the Group*Film interaction ($F(2,53)=0.31$, $p=0.73$) were not significant, suggesting a similar increase in reported positive affect in all groups.

To investigate facial expressivity, the duration and intensity of Duchenne and non-Duchenne smiles in all groups were compared. Distributions were not normal, thus Kruskal-Wallis and Mann–Whitney U tests were used. Bonferroni correction was applied, setting statistical significance at $p<0.016$. Effect sizes were calculated using Rosenthal's r (Rosenthal and Rubin, 2003).

The results indicated that the REC group exhibited Duchenne smiles (DS) for longer duration and higher intensity than AN (DS Duration: *Median (Mdn)*$_{REC}$=1.66; $Mdn_{AN}=0.00$; $U=323.00$; $p<0.016$; $r=0.55$; DS Intensity: $Mdn_{REC}=3.00$; $Mdn_{AN}=0.00$; $U=337.00$; $p<0.016$; $r=0.62$), with no statistically significant differences between the REC and HC groups (DS Duration: $Mdn_{REC}=1.66$; $Mdn_{HC}=2.08$; $U=179.00$; $p=0.58$; $r=0.09$; DS Intensity: $Mdn_{REC}=3.00$; $Mdn_{HC}=3.00$; $U=201.00$; $p=1.00$; $r=0.00$).

In the case of non-Duchenne smiles (NDS), REC participants showed an intermediate profile with ratings between AN and HC. REC participants showed NDS for longer duration and higher intensity than AN (NDS Duration: $Mdn_{REC}=2.91$; $Mdn_{AN}=0.83$; $U=291.50$; $p<0.016$; $r=0.39$; NDS Intensity: $Mdn_{REC}=3.00$; $Mdn_{AN}=2.00$; $U=293.00$; $p<0.016$; $r=0.42$), but the differences between REC and HC were not statistically significant (NDS Duration: $Mdn_{REC}=2.91$; $Mdn_{HC}=3.74$; $U=159.59$; $p=0.28$; $r=0.17$; NDS Intensity: $Mdn_{REC}=3.00$; $Mdn_{HC}=3.00$; $U=116.00$; $p=0.02$; $r=0.38$).

Finally, Spearman correlations were carried out within the REC group to test if Duchenne and non-Duchenne smiles were associated to depression or anxiety. The results indicated no significant correlations between duration and intensity of Duchenne and non-Duchenne smiles, and the HADS subscales (p-values ranged between 0.53 and 0.88).

Discussion

This study aimed to investigate facial expressions of positive affect in women who have recovered from AN, examining the Duchenne smile as an expression of authentic positive affect, compared to non-Duchenne smiles. Results were similar for Duchenne and non-Duchenne smiles, indicating that the REC group exhibited both expressions for longer duration and higher intensity than AN, and showed no statistically significant differences to HC. Overall, these results are consistent with previous findings (Davies et al., 2013). However, they do not provide support to the idea that positive expressivity in REC is strategic (Davies et al., 2013).

The study findings, along with previous evidence of similar expressivity for REC and HC (Davies et al., 2013), may suggest that the reduced expression of positive affect shown by people with AN is linked to the acutely ill stage. This would be in line with evidence of other difficulties in emotional processing exhibited by people with AN that have shown to ameliorate with recovery, such as poor emotional theory of mind (Tchanturia et al., 2015; Oldershaw et al., 2011). Longitudinal studies are needed to confirm this hypothesis.

Social isolation is common in people with AN (Robinson et al., 2015; Tchanturia et al., 2013). Moreover, qualitative studies have reported that participants who have

experienced AN think that being able to communicate their emotions and to develop supportive relationships are key aspects of recovery (Rance et al., 2015; Federici and Kaplan, 2008; Jenkins and Ogden, 2012; Kyriacou et al., 2009). Facial expressions of positive emotions, such as the smile, are essential for establishing rapport (Tickle-Degnen, 2006) and are related to cooperative intentions (Schmidt and Cohn, 2001), as well as social rewards (Shore and Heerey, 2011). Thus, targeting the ability to communicate emotions during treatment may help AN patients to reduce emotion avoidance, engage with clinical and peer group, and facilitate recovery (Tchanturia and Baillie, 2015).

Finally, the study found no evidence of association between Duchenne or non-Duchenne smiles and depression or anxiety in the REC group. These results are consistent with findings in acutely ill ED patients (Dapelo et al., 2015), suggesting that reduced expressivity of positive affect is not linked to these comorbidities.

A main limitation of this study is the use of a cross-sectional design, in which it is unknown whether the REC group exhibited reduced positive expressivity during the acute phase of AN. In addition, the small sample size of the study could have had influence on the results, particularly for the intensity of non-Duchenne smiles, in which the differences between the REC and HC group are close to significance ($p=0.02$) and might have reached statistical significance if the study had more power. Future studies using a longitudinal design and a larger sample size are needed to confirm the study findings.

Finally, the current study focused on facial expressions of positive affect, in response to a positive mood elicitation, but it did not explore negative expressions. Given previous evidence of incongruent facial expressivity in REC (Davies et al., 2013), this could be a further line of enquiry in future studies.

In conclusion, the similarities between REC and HC found in this study support the idea that difficulties in facial expression of positive emotion are related to the acutely ill phase of AN and tend to ameliorate after recovery.

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Table 1.

Demographic and clinical characteristics.

	REC (n=20)	AN (n=20)	HC (n=20)	Group statistics	Tukey HSD Post-hoc tests		
	M (SD)	*M (SD)*	*M (SD)*		REC vs. AN	REC vs. HC	AN vs. HC
Age	26.55 (7.63)	28.85 (9.75)	26.40 (7.60)	$F(2,57)=0.54$ $p=0.59$	N/A	N/A	N/A
Current BMI	20.58 (1.75)	15.59 (1.83)	22.47 (2.68)	$F(2,57)=55.86$ **$p<0.01$**	**$p<0.01$** $d=2.86$	$p=0.02$ $d=0.86$	**$p<0.01$** $d=3.00$
Lowest BMI	13.79 (2.07)	13.31 (1.62)	20.66 (2.61)	$F(2,57)=74.60$ **$p<0.01$**	$p=0.77$ $d=0.26$	**$p<0.01$** $d=2.99$	**$p<0.01$** $d=3.47$
Length of Illness (years)	11.40 (9.37)	11.55 (11.26)	N/A	$t(38)=0.05$	$p=0.96$ $d=0.01$	N/A	N/A
EDE-Q	0.98 (0.49)	4.38 (1.04)	0.48 (0.42)	$F(2,57)=179.16$ **$p<0.01$**	**$p<0.01$** $d=4.29$	$p=0.08$ $d=1.12$	**$p<0.01$** $d=4.92$
HADS-A	9.50 (3.56)	13.15 (3.60)	5.95 (1.85)	$F(2,53)=27.40$ **$p<0.01$**	**$p<0.01$** $d=1.15$	**$p<0.01$** $d=1.33$	**$p<0.01$** $d=2.52$
HADS-D	4.31 (2.12)	10.60 (3.15)	3.85 (1.60)	$F(2,53)=48.04$ **$p<0.01$**	**$p<0.01$** $d=2.36$	$p=0.83$ $d=0.26$	**$p<0.01$** $d=2.70$

REC=recovered from anorexia nervosa; AN=anorexia nervosa; HC=healthy control; n=number of participants; M=mean; SD=standard deviation; F=anova test; p=statistical significance; N/A=non-applicable; BMI=body mass index; d=Cohen's d effect size; EDE-Q= Eating disorders examination questionnaire; HADS-A=Hospital anxiety and depression scale, anxiety subscale; HADS-D=Hospital anxiety and depression scale, depression subscale. Bonferroni correction applied, statistical significance at p<0.016. N for HADS-A and HADS-D in the REC group was=16.