

[Lost emotional self](#)

# Emotional skills in adolescents and young adults suffering from anorexia nervosa – an integrative approach

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## Summary

**BACKGROUND:** Although emotional difficulties are amongst the core deficits of individuals with anorexia nervosa, little is known about the specific emotional functioning. Therefore, this study used an integrative approach to examine the emotional skills of adolescents and young adults suffering from compared with healthy controls.

**METHODS:** We compared the emotional skills of 32 females, aged between 14 and 35, with acute anorexia nervosa with 45 female healthy controls. In particular, we examined alexithymia (awareness and identification of their own emotions) using the TAS-20, the capacity for identifying basic emotions expressed dynamically using a computerised morphing task, the capacity for identifying complex emotions using the Reading the Mind in the Eyes task, and nine different strategies of cognitive emotion regulation using the CERQ.

**RESULTS:** Participants with anorexia nervosa displayed higher levels of alexithymia. Both groups were able to recognise basic and complex emotions in others; however, participants with anorexia nervosa displayed higher sensitivity in identifying anger, disgust, sadness and surprise in others. Moreover, participants with anorexia nervosa reported use of specific emotion regulation strategies in comparison with healthy controls (“acceptance” and “rumination” more so than the emotion regulation strategies of “positive refocusing”, “catastrophising”, and “blaming others”).

**CONCLUSION:** Our findings document a distinct pattern of emotional functioning of individuals with anorexia nervosa compared with (difficulties in ability to recognise their own emotions, hypersensitivity to certain emotions in others and use of certain cognitive emotion regulation strategies) even if no general deficits could be identified. These results highlight the importance of considering the specific dimensions of the emotional (dys)functioning of anorexia nervosa in multimodal treatment approaches.

## Background

Anorexia nervosa is a mental disorder with a typical onset in adolescence [1]. Recent findings highlight the important role of emotion dysregulation in this complex developmental disorder [2]. The literature suggests that individuals with anorexia nervosa display deficits in emotion processing across a variety of processes, such as experience, expression, identification or regulation [3]. Therefore, emotional difficulties may play a key role in the emergence and maintenance of the disorder [3–6].

This is especially a matter of interest as a coherent theoretical model on the understanding of the development and maintenance of this disease and, in turn, an effective treatment are still lacking [7]. Adolescence and young adulthood is a sensitive period for the development of emotional skills given that the demand for these skills across a variety of emotional and social situations may be greater than at other developmental stages [8]. However, the literature on emotional skills in adolescents and young adults suffering from anorexia nervosa, especially from an integrative perspective including a variety of emotional processes (in one individual, apprehending the intra-individual variability) is scarce.

Alexithymia (deficits in the awareness and identification of their own emotional states) has been observed in the majority of adolescents (60%; [9]) and adult females (63–77%; [10, 11]) suffering from anorexia nervosa, as shown by systematic reviews [12–14] and meta-analyses [14]. In previous studies, alexithymia has been examined by self-report questionnaires, in particular the Toronto Alexithymia Scale (TAS) [13–15]. The most

consistent findings were found for the subscales Difficulties Identifying Feelings and Difficulties Describing Feeling of the TAS, and less for the subscale External Oriented Thinking [14].

Inconsistent results were observed regarding the identification, in others, of basic emotions (happiness, anger, sadness, fear, disgust and surprise). Indeed, in adolescents with anorexia nervosa, two studies indicated higher accuracy amongst respondents in identifying particular emotions, namely happiness [16] and fear [17], as well as higher sensitivity to all emotions [16]. In contrast, in another study, female adolescents with eating disorders were less accurate in a free-labelling and forced-choice emotion recognition task (happiness, anger, sadness, fear, disgust, surprise, contempt [9]) than were their counterparts without anorexia nervosa. In adult females with anorexia nervosa, one study observed lower performances when they were asked to identify all basic emotions [18], whereas other studies did not observe any differences (e.g., [19, 20–23]), and, finally, several studies reported lower accuracy in identifying sadness (e.g., [24–26]), disgust (e.g., [26, 27]) or fear (e.g., [25]), indicating specific deficits. Beyond emotion identification on static material, few studies have examined this emotional skill in a more naturalistic context by using dynamic morphing materials. For instance, a study using body movements (the point light walkers task) observed that adults with acute anorexia nervosa evidenced deficits in distinguishing between basic emotions (happiness, sadness, fear, anger and neutral) compared with individuals after recovery from anorexia nervosa and healthy controls [28]. Another study also using the point light walkers task [29] reported that participants with anorexia nervosa had a poorer performance in recognising sadness that was expressed through bodily movement than did healthy controls, with a lower performance for adolescents with anorexia nervosa compared with adults with anorexia nervosa and healthy controls. By contrast, a study using video-clips of sincere, false and sarcastic dialogue showed no significant difference between adult females with anorexia nervosa and healthy controls in identifying the six basic emotions [30].

Likewise, studies examining the identification of complex emotions (e.g., the Reading the Mind in the Eyes task) revealed contrasting results. Indeed, some studies [31–33] in adolescents with anorexia nervosa reported no significant differences compared with controls, whereas studies in adults with anorexia nervosa [34–40] have revealed a lower performance or no difference in the identification of complex emotion [39, 41].

Beyond emotion identification, emotion regulation refers to all processes aimed at reducing, maintaining or increasing an emotional response [42] and it is an important concept to describe the emotional skills of an individual. Previous studies have suggested that adolescents with anorexia nervosa, compared with healthy controls, use more maladaptive than adaptive (i.e., appropriate expression and regulation of an emotion in a certain situation) emotion regulation strategies [33, 43–45]. Likewise, a systematic review and meta-analysis suggested that female adults with anorexia nervosa use more maladaptive emotion regulation strategies and less adaptive emotion regulation strategies than healthy controls [15], indicating that dysregulated emotion may play a central role in anorexia nervosa. More specifically, the concept of emotion regulation includes a wide range of biological, social (e.g., social support), behavioural, conscious (cognitive) and unconscious (e.g., memory distortions, denial and projection) processes [46]. Despite the importance of all the different emotion regulation processes, it has been suggested that the different domains should be clearly distinguished to provide a better understanding [47]. To the best of our knowledge, no previous study has examined the cognitive conscious emotion regulation strategies (i.e., mental strategies individuals use to cope with emotional arousing information [46]) in individuals suffering from anorexia nervosa. However, strong relationships were found between cognitive conscious emotion regulation strategies and psychopathological symptoms such as anxiety and depression as well as between these strategies and psychological well-being [46, 48].

### The current study

The current study thus used an integrative approach to examine specific emotional skills, namely, the identification of their own emotions (alexithymia), basic and complex emotions in others, as well as ER, in adolescents and young adults with anorexia nervosa compared with controls, during a crucial period of development. To our knowledge, measuring this wide range of emotional skills within the same individuals has not been undertaken thus far. In line with previous literature, we expected to find higher levels of alexithymia in individuals with anorexia nervosa. As results regarding the identification of emotions in others are inconsistent, we expected with this study to contribute new evidence to the existing literature on whether there are differences between individuals with anorexia nervosa and healthy controls or not. Moreover, we also expected to add new information by using a dynamic morphing test, which not only examines the ac-

curacy of identification of emotion in others but also in terms of sensitivity. In addition, we examined the cognitive conscious emotion regulation strategies in individuals with anorexia nervosa, which has not been undertaken so far. Nevertheless, we expected that, in line with the previous literature on emotion regulation strategies, the individuals with anorexia nervosa would show more maladaptive cognitive emotion regulation strategies. A better understanding of these aspects of emotional functioning in individuals with anorexia nervosa would facilitate the understanding of the emergence and maintenance of the disease with the ultimate goal to develop more efficient treatment by targeting specific components of emotional skills.

## Methods

### Participants

Seventy-seven adolescent and young adult women (32 with anorexia nervosa and 45 healthy controls) participated in this study. The age range for inclusion in each group was 14 to 35 years, and their mean age did not differ significantly (table 1). Participants with anorexia nervosa were recruited during their hospitalisation in a specialised unit for eating disorders in Western Switzerland. The participants of the control group were recruited through local advertising at the University of Lausanne, using the snowball method to gain access to a wide range of participants (e.g., family and friends of students).

Diagnoses were based on clinical assessment by experienced clinicians, according to the ICD-10 criteria of anorexia nervosa (F50.0; World Health Organization, 2008) and excluded other predominant psychiatric disorders (e.g., psychotic disorder, autism spectrum disorder, major depression). Moreover, both groups completed the Eating Attitudes Test [49, 50]. Exclusion criteria for healthy controls included a body mass index (BMI) below 18 or above 30 kg/m<sup>2</sup> (n = 6) and a Beck Depression Inventory II (BDI-II; [51, 52]) above the cut off score (cut off score 20, n = 7). Subjects with anorexia nervosa and the healthy controls did not differ

in their age, but they did differ regarding several clinical characteristics (table 1).

### Ethics approval and consent to participate

The study was approved by the institutional review board and by the local ethics committee (407/14). Written informed consent was obtained from all participants after a comprehensive explanation of the experimental procedures. The participants received no remuneration.

### Measures

The Toronto Alexithymia Scale (TAS-20; [53–55]) is a self-report questionnaire with three factors assessing difficulties in identifying feelings and distinguishing between feelings and the bodily sensations of emotional arousal (DIF), difficulties describing feelings to other people (DDF) and externally oriented thinking (EOT). In our sample, Cronbach's alphas were 0.88, 0.86, and 0.65 for DIF, DDF, and EOT, respectively, the latter subscale having slightly lower than acceptable internal consistency.

To assess the identification of basic emotions, we used a dynamic morphing test, namely, the Multimorph test (for further information see [56, 57]). This task consists of a set of 36 trials (6 faces: 3 women and 3 men; 6 basic emotions for each face), presented in a random order. The stimuli are based on the empirically validated and reliable photographs of facial affect by Ekman and Friesen [58]. Each trial transmutes gradually from a neutral expression into one of the six prototypical emotions (sadness, happiness, surprise, anger, disgust, fear), according to 40 2.5% incremental stages. Each picture was presented for 500 ms followed immediately by the next morphed stimulus in the sequence. Each trial lasted for 20 seconds. The participants were asked to observe the changes in facial expression and signal the emotion expressed whenever they thought they had identified it, by clicking with the mouse on one of the six corresponding boxes (located below the stimulus). They could change their initial response at any moment and as often as necessary by clicking

**Table 1:** Comparison of participants' characteristics.

	Patients (n = 32)		Controls (n = 45)		t-test	df	p-value
	Mean	SD	Mean	SD			
Age (years)	20.75	6.58	22.71	3.43	1.53	43.22	0.13
aBMI (Kg/m <sup>2</sup> )	16.00	1.38	22.01	2.47	13.49	69.91	<0.001
EAT-26	37.62	14.64	9.53	5.47	10.33	37.49	<0.001

aBMI = age-adjusted body mass index; df = degrees of freedom; EAT-26 = Eating Attitudes Test; SD = standard deviation.

again on one of the response buttons. The participants were informed that they would not be notified of the quality (correct or incorrect) of their response, and that the face would continue to change even after their response. At the end of each trial (40th stage), they had to point out their final choice. We measured the success rate (i.e., correct identification) for each emotion, as well as the number of stages required for the accurate identification of each emotion (sensitivity). Higher scores of accuracy indicate better accuracy, whereas lower scores of sensitivity indicate a higher sensitivity. In our sample, Guttman's maximum split-half reliability was acceptable for most of the emotions,  $\lambda_4 = 1$ , for happiness,  $\lambda_4 = 0.63$  for surprise,  $\lambda_4 = 0.80$  for anger,  $\lambda_4 = 0.61$ , for disgust and  $\lambda_4 = 0.63$  for fear. Only sadness was below the acceptable levels,  $\lambda_4 = 0.42$ .

In the Reading the Mind in the Eyes task (RME; [59]), participants are presented with a series of 36 pairs of eyes. Around each pair of eyes, four words describing an emotional state are presented. The participant has to choose the word that best describes the emotional state of the individual. The outcome variable used is the number of correct answers. A higher score indicates better identification of complex emotions (e.g., concerned, interested or relaxed). In our sample, Guttman's maximum split-half reliability was good,  $\lambda_4 = 0.85$ .

The Cognitive Emotional Regulation Questionnaire (CERQ; 46, 60) is a 36-item self-report questionnaire, which evaluates the cognitive conscious strategies of emotion regulation. Items are rated on a five-point Likert scale from 1 (*almost never*) to 5 (*almost always*). Nine conceptually separate emotion regulation strategies, which could be grouped into adaptive and maladaptive strategies, are measured. The adaptive strategies are acceptance, positive refocusing, refocus on planning, positive reappraisal and putting into perspective. The maladaptive strategies are self-blame, rumination, catastrophising and blaming others. Higher scores indicate more frequent use of the emotion regulation strategy. Cronbach's alpha reliabilities of the nine subscales ranged from 0.65 to 0.89 in our sample, with the rumination ( $\alpha = 0.65$ ) and acceptance ( $\alpha = 0.69$ ) subscales

slightly below the levels that are generally considered as acceptable.

### Data analysis

To compare the two groups (anorexia nervosa vs healthy controls) on their emotional processes, we used repeated measures 2 (groups: anorexia nervosa vs healthy controls)  $\times$  n (subscales of the tests) mixed analyses of variance (ANOVAs) followed by post-hoc t-tests for the TAS-20, the Multimorph and the CERQ, and Student's t-tests for the RME. Whenever sphericity was violated, we reported the Greenhouse-Geisser epsilon estimate to correct the degrees of freedom of the F distribution. Generalised eta squared was used as a measure of effect size for the mixed ANOVAs and Hedge's g for the t-tests. To control the family-wise error rate for the whole dataset, we also calculated adjusted p-values using the Holm method. All data analyses were conducted using R, version 3.5.2 [61].

We ran post hoc Monte Carlo power analyses for repeated-measures mixed ANOVAs with 10,000 simulations. These analyses concluded that there is sufficient power (>80%) to detect the effects we observed in most of our analyses ( $\text{power}_{\text{TAS-20}} = 97.7\%$ ;  $\text{power}_{\text{CERQ}} = 100\%$ ;  $\text{power}_{\text{Multimorph Sensitivity}} = 85.1\%$ ). The only exception was the Multimorph Accuracy result ( $\text{power}_{\text{Multimorph Accuracy}} = 34.4\%$ ). For this analysis, we would have needed 71 participants in each group to reach a power of 80% and to detect the small effect we observed ( $\eta^2 = 0.18$ ).

### Results

Compared with controls, participants in the anorexia nervosa group showed greater difficulties in describing, identifying and expressing their own emotional states. Table 2 shows that the mixed ANOVA on the TAS-20 showed a significant interaction effect between the group and the three subscales of the TAS-20 (i.e., DIF, DDF, and EOT),  $F(2, 150) = 11.57$ ,  $p < 0.001$ ,  $\eta^2 = 0.06$ . Post-hoc t-tests showed that participants with anorexia nervosa had significantly higher scores on each subscale of the TAS-20 (all p-values < 0.001) (table 3).

**Table 2:** Results of the 2 (group: patients vs controls)  $\times$  3 (subscales: DDF, DIF, EOT) mixed ANOVA for the TAS-20.

Predictor	$df_{Num}$	$df_{Den}$	$\epsilon$	$F$	p-value	$\eta^2$
Group	1.00	75.00		66.62	0.000	0.36
Subscale	1.97	147.75	0.99	53.25	0.000	0.21
Group $\times$ subscale	1.97	147.75	0.99	11.57	0.000	0.06

DIF = difficulties identifying feelings; DDF = difficulties describing feelings; EOT = externally oriented thinking;  $df_{Num}$  indicates degrees of freedom numerator;  $df_{Den}$  indicates degrees of freedom denominator;  $\epsilon$  indicates Greenhouse-Geisser multiplier for degrees of freedom, p-values and degrees of freedom in the table incorporate this correction.

Individuals with anorexia nervosa did not show deficits in identifying basic emotions in others. Regarding the accuracy scores of the Multimorph, Mauchly's test for sphericity differed between the groups,  $W = 0.487$ ,  $p < 0.001$ . After correction of the departure from sphericity, we found a main effect for the type of emotion,  $F(4.13, 309.44) = 28.72$ ,  $p < 0.001$ ,  $\eta^2 = 0.18$ , but no interaction between type of emotion and group (table 4). Regarding their sensitivity to identifying these emotions, participants in the anorexia nervosa group had lower sensitivity scores for anger, disgust, sadness and surprise than the controls, indicating that the anorexia nervosa participants needed fewer indices to detect these emotions. Sphericity was violated in the

analyses that concerned the sensitivity scores of the Multimorph,  $W = 0.055$ ,  $p < 0.001$  (table 5). After correction of the departure from sphericity, we found an interaction between group and sensitivity scores,  $F(2.46, 184.70) = 3.55$ ,  $p = 0.022$ ,  $\eta^2 = 0.03$ . Post-hoc tests controlling for multiple comparisons showed that sensitivity scores for anger, disgust, sadness and surprise were lower for the participants with anorexia nervosa than in the control group, all  $t$ -values  $> 3.19$ , all  $p$ -values  $< 0.001$  (table 3). The RME (identification of complex emotions) did not show any statistically significant difference between groups in accuracy, after adjustment for multiple comparisons,  $t(74) = 2.53$ ,  $p = 0.175$ .

**Table 3:** Comparison of outcome scores depending on group (patients vs controls).

	Patients (n = 32)		Controls (n = 45)		t-test	df	p-value	Adjusted p-value	g
	Mean	SD	Mean	SD					
RME	27.53	3.48	25.70	2.80	2.53	74	0.013	0.175	0.58
TAS									
DDF sum scores (mean scores)	<b>19.31 (3.86)</b>	<b>4.25 (0.85)</b>	<b>12.49 (2.50)</b>	<b>4.83 (0.97)</b>	<b>6.42</b>	<b>75</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.47</b>
DIF sum scores (mean scores)	<b>25.91 (3.70)</b>	<b>5.99 (0.86)</b>	<b>15.73 (2.25)</b>	<b>5.53 (0.79)</b>	<b>7.68</b>	<b>75</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.76</b>
EOT sum scores (mean scores)	<b>20.03 (2.50)</b>	<b>4.15 (0.52)</b>	<b>15.07 (1.88)</b>	<b>4.15 (0.52)</b>	<b>5.18</b>	<b>75</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.19</b>
CERQ									
Accept	<b>13.22</b>	<b>3.02</b>	<b>6.75</b>	<b>2.72</b>	<b>9.76</b>	<b>74</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>2.25</b>
Pos. Ref.	<b>8.56</b>	<b>3.29</b>	<b>11.80</b>	<b>2.59</b>	<b>4.83</b>	<b>75</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.10</b>
Refoc. Plan.	13.88	4.21	14.27	2.79	0.46	49.97	0.648	1.000	0.11
Pos. Reapp.	11.66	4.36	13.40	2.87	1.98	49.74	0.053	0.588	0.45
Perspect.	12.88	3.95	12.20	3.40	0.80	75	0.424	1.000	0.18
Self-Blame	14.34	3.42	13.64	4.04	0.80	75	0.428	1.000	0.18
Rumin.	<b>13.58</b>	<b>3.64</b>	<b>6.44</b>	<b>2.07</b>	<b>9.87</b>	<b>43.43</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>2.28</b>
Catastroph.	<b>8.71</b>	<b>3.56</b>	<b>14.98</b>	<b>2.99</b>	<b>8.31</b>	<b>74</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.92</b>
Blame Oth.	<b>6.56</b>	<b>2.47</b>	<b>14.84</b>	<b>3.44</b>	<b>11.64</b>	<b>75</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>2.67</b>
Multimorph Accuracy									
Anger	0.68	0.22	0.79	0.20	2.30	75	0.024	0.293	0.53
Disgust	0.73	0.16	0.72	0.19	0.18	75	0.858	1.000	0.04
Sadness	0.82	0.17	0.82	0.21	0.10	75	0.918	1.000	0.02
Fear	0.83	0.17	0.83	0.21	0.02	75	0.984	1.000	0
Surprise	0.87	0.15	0.87	0.19	0.08	75	0.938	1.000	0.02
Happiness	0.99	0.03	0.97	0.15	1.21	48.50	0.233	1.000	0.28
Multimorph Sensitivity									
Anger	<b>0.77</b>	<b>0.12</b>	<b>0.95</b>	<b>0.21</b>	<b>4.82</b>	<b>69.61</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.12</b>
Disgust	<b>0.80</b>	<b>0.13</b>	<b>0.98</b>	<b>0.15</b>	<b>5.48</b>	<b>74</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>1.26</b>
Sadness	<b>0.76</b>	<b>0.11</b>	<b>1.00</b>	<b>0.00</b>	<b>12.22</b>	<b>31</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>2.81</b>
Fear	0.79	0.11	0.80	0.10	0.50	75	0.620	1.000	0.11
Surprise	<b>0.69</b>	<b>0.16</b>	<b>0.89</b>	<b>0.32</b>	<b>3.52</b>	<b>66.42</b>	<b>&lt;0.001</b>	<b>0.011</b>	<b>0.81</b>
Happiness	0.56	0.16	0.66	0.48	1.31	55.60	0.194	1.000	0.30

Holm method was used for calculating adjusted p-values. All analyses were also replicated using ANCOVAs, including age as a covariate, and showed similar results. **Bold** = significant differences after p-value adjustment. DIF = difficulties identifying feelings; DDF = difficulties describing feelings; EOT = externally oriented thinking; RME = reading the mind in the eyes test; SD = standard deviation; df = degrees of freedom; Accept. = acceptance; Pos. Ref. = positive refocusing; Refoc. Plan. = refocus on planning; Pos. Reapp. = positive reappraisal; Persp. = putting into perspective; Rumin. = rumination; Catastroph. = catastrophising; Blame Oth. = blaming others.



**Table 4:** Results of the 2 (group: patients vs controls) × 6 (emotions: sadness, happiness, surprise, anger, disgust, fear) mixed ANOVA for the Multimorph Accuracy.

Predictor	$df_{Num}$	$df_{Den}$	$\epsilon$	$F$	p-value	$\eta_G^2$
Group	1.00	75.00		0.16	0.688	0.00
Emotion	4.13	309.44	0.83	28.72	0.000	0.18
Group × emotion	4.13	309.44	0.83	2.08	0.082	0.02

$df_{Num}$  indicates degrees of freedom numerator;  $df_{Den}$  indicates degrees of freedom denominator;  $\epsilon$  indicates Greenhouse-Geisser multiplier for degrees of freedom, p-values and degrees of freedom in the table incorporate this correction.

In terms of emotion regulation skills, participants with anorexia nervosa tended to use strategies of acceptance and rumination more often than controls (p-values <0.001). However, they tended to use positive refocusing, catastrophising and blame of others less often than healthy controls (p-values <0.001). For the CERQ, using Mauchly's test for sphericity of the mixed ANOVA, we detected an interaction between group and subscales of the CERQ,  $W = 0.185$ ,  $p < 0.001$ . The Greenhouse-Geisser corrected ANOVA showed an interaction between group and subscales,  $F(5.31, 398.92) = 57.17$ ,  $p < 0.001$ ,  $\eta_G^2 = 0.36$ . Post-hoc tests adjusted for multiple comparisons indicated that participants with anorexia nervosa had higher scores than controls on acceptance and rumination and significantly lower scores on positive refocusing, catastrophising, and blame of others, all t-values >4.82, all p-values <0.001.

## Discussion

The main purpose of this study was to specify the emotional functioning of adolescents and young adults suffering from acute anorexia nervosa, compared with healthy controls within an integrative approach. Our findings showed a specific pattern of emotional (dys) functioning in individuals with anorexia nervosa, characterised by lower identification of their own emotions (alexithymia), identical accuracy in identifying basic and complex emotions in others coupled with higher sensitivity for some basic emotions, as well as a specific use of cognitive emotion regulation strategies. More specifically, we observed that adolescents and young adults with anorexia nervosa displayed difficulties in describing, recognising and expressing their own emotional states, defined as alexithymia, which is in line with previous literature [14]. Moreover, individuals with anorexia nervosa did not show significant deficits in recognising basic (i.e., Multimorph) or complex (i.e., RME) emotions in others, which stressed that individuals with anorexia nervosa did not demonstrate deficits in identifying emotions in others. These results

are in line with previous studies [16, 17, 31–33, 39, 41], but conflicting results were also reported in the literature [18–20, 24–30]. Our results also suggested that individuals with anorexia nervosa present a higher sensitivity in identifying anger, disgust, sadness and surprise, indicating that they needed fewer facial cues to detect emotions, which is in line with a previous study [16], but our findings extend this result to young adults.

Taking into account all of the above-mentioned results, we observed that adolescents and young adults with anorexia nervosa showed greater difficulties in recognising their own emotions (alexithymia) than in recognising the emotions of others. They were also more sensitive in recognising some basic emotions in others. These results could be in line with a recent study using eye tracking [62]. This study revealed that young adults with anorexia nervosa did not differ from healthy controls in the recognition of emotions in others, but “hyperscan” (i.e., increased scan path lengths with fixations of shorter duration) stimuli and process images of their own face differently. Indeed, during the processing of their own face, they avoid visually attending to salient features. This discrepancy in the recognition of own emotion vs emotion in others and self-perception vs facial emotion perception of others might be linked to the “lost emotional self” in individuals with anorexia nervosa, which is described as difficulties in navigating the world without an emotional conductor to guide one, and being persistently and increasingly reliant upon and sensitive to the gaze and feedback of others [5]. Individuals with anorexia nervosa dedicate a lot of energy to the identification and satisfaction of the needs of others, while neglecting their own needs [5].

Regarding the emotion regulation skills, individuals with anorexia nervosa more heavily used the adaptive strategy of “acceptance” (accepting the experience and resigning yourself to what has happened), as well as the maladaptive strategy of “rumination” (constant thinking about the feelings and thoughts associated with the negative event). In contrast, they used less the adaptive emotion regulation strategies of “positive refocusing”

**Table 5:** Results of the 2 (group: patients vs controls) × 6 (emotions: sadness, happiness, surprise, anger, disgust, fear) mixed ANOVA for the Multimorph Sensitivity.

Predictor	$df_{Num}$	$df_{Den}$	$\epsilon$	$F$	p-value	$\eta^2_G$
Group	1.00	75.00		23.93	0.000	0.11
Emotion	2.46	184.70	0.49	25.76	0.000	0.03
Group x emotion	2.46	184.70	0.49	3.56	0.022	0.03

$df_{Num}$  indicates degrees of freedom numerator;  $df_{Den}$  indicates degrees of freedom denominator;  $\epsilon$  indicates Greenhouse-Geisser multiplier for degrees of freedom, p-values and degrees of freedom in the table incorporate this correction.

(thinking about joyful and pleasant issues instead of thinking about the actual event), and the maladaptive strategies of “catastrophising” (thoughts that explicitly emphasise the terror of an experience) and of “blaming of others” (thoughts of putting the blame of what you have experienced on others). Thus, our results stress a distinct pattern of cognitive conscious emotion regulation strategies in individuals with anorexia nervosa compared with healthy controls, but not general deficits, which is in line with the results of a functional magnetic resonance imaging (fMRI) study suggesting that individuals with anorexia nervosa present no general deficit in the voluntary regulation of negative emotions [63]. Nevertheless, these results are not aligned with previous studies suggesting that individuals with anorexia nervosa use fewer adaptive emotion regulation strategies and more maladaptive strategies [15, 33, 43–45]. This difference may be explained by the use of different assessment tools. Our study is the first to use the CERQ to examine a population suffering from anorexia nervosa. Contrary to the other emotion regulation questionnaires that were used in previous studies (e.g., Difficulties in Emotion Regulation Scale – DERS, Fragebogen zur Erhebung der Emotionsregulation bei Kindern und Jugendlichen – FEEL-KJ), the CERQ assessed only cognitive conscious strategies [46]. Thus, our results indicate that individuals with anorexia nervosa have no general deficits in terms of cognitive conscious emotion regulation strategies. However, their difficulties in the processing of emotions may lie in the interplay of the different aspects of emotion regulation, including behavioural, social and cognitive conscious and unconscious processes, as well as in the interplay between the different emotional skills (e.g., experience, expression, identification and regulation). The difficulties of individuals with anorexia nervosa to clarify and to understand their emotional experiences (alexithymia) are described as important risk factors for the development of the condition [5]. The discrepancy in the recognition of their own emotions vs emotions in others, or even, as our results suggest, the hypersensitivity to emotions in others, may as well constitute important

risk factors. We might hypothesise that these factors make them experience emotions as overwhelming and confusing, which, combined with their difficulties to clarify their subjective feelings, makes them more reactive to emotions. This vulnerability, coupled with the use of maladaptive strategies (despite the fact that they have no general deficits in terms of cognitive conscious emotion regulation strategies), might lead to more negative emotional experience. In the long term, this mechanism could conduct to the control and avoidance of emotional experience. This persistent emotional avoidance cycle has been described as an important maintenance factor of anorexia nervosa [5]. In consequence, one could as well hypothesise that, to avoid emotional experiences, they prevent themselves from learning from these experiences and, consequently, they compromise their development. Particularly, alongside the chronicity of the illness, these difficulties in the processing of emotions may increase through the developmental challenges related to different stages of life (e.g., adolescence, early adulthood, midlife, late adulthood). This highlights the importance of intervening early during adolescence as the social brain network (the amygdala, ventral striatum, prefrontal cortex, subcortical and cortical circuits) undergoes extensive and enduring development throughout adolescence before stabilising in the mid-twenties (e.g., [8 64–67]). Considering cognitive conscious emotion regulation strategies, besides the recognition of one’s own emotions and the sensitivity to emotion in others, could be an important aspect of treatment and relapse prevention. This could in the long term interrupt the emotional avoidance cycle. Further research is needed to investigate this hypothesis. Particular interest should be taken in the examination methods of emotion recognition in others (accuracy and sensitivity; dynamic morphing tests). Besides, we cannot conclude for sure whether the observed difficulties in emotion processing in participants with anorexia nervosa are related to clinical presentation in the acute phase of illness (i.e., state) or are trait variables (i.e., linked to the illness per se). Literature shows a tendency that the

emotional functioning of adolescents with anorexia nervosa differs from adults with anorexia nervosa (i.e., better abilities in the recognition of emotions in others). This is in line with the hypothesis of a persistent emotional avoidance cycle and the concept of “the lost emotional self” in individuals with anorexia nervosa. Future research is needed to examine the specific pattern of emotional (dys)functioning in individuals with anorexia nervosa from a longitudinal, developmental and integrative perspective, including acute and remitted states of illness and illness duration.

### **Clinical implications**

Emotional difficulties play a central role in the emergence and maintenance of anorexia nervosa [2]. Efficient emotional experience refers to a balance between the identification, the expression and the regulation of emotion in order to optimise situational outcomes [68]. Despite their difficulties in identifying and regulating their own emotions (alexithymia), individuals with anorexia nervosa have the capacity to identify emotion in others; they even seem hypersensitive to emotion in others. Besides, they show no general deficits in the cognitive conscious regulation of emotions. This emphasises the importance of considering the various dimensions of emotional (dys)functioning in multimodal treatment approaches. In particular, treatment and relapse prevention should increase the awareness of own emotions and the use of adaptive cognitive emotion regulation strategies, as well as take into consideration the sensitivity to emotion in others. Nevertheless, despite significant advances in the understanding of the development and maintenance of this disease, a coherent theoretical model and, in turn, effective treatment are still lacking [7]. In future studies, integrating the specific emotional dysregulation of individuals with anorexia nervosa into a testable theoretical framework such as the functional model of emotion avoidance [69] may lead to an improvement in treatment outcomes.

### **Limitations and strengths**

The number of participants is rather small and includes only female individuals, which limits the generalisability of the current study. In addition, we did not check the groups for their socioeconomic status (SES). However, current research on heterogeneous populations using health questionnaires have revealed that eating disorders equally affect all people, independently of the [70]. Besides, although we assessed depressive symptoms in the healthy controls (using the BDI-II), we did not apply a systematic assessment of psychopathology. Although we did not collect data on

psychotropic medication, the effect of psychotropic medication on individuals with anorexia nervosa and on their emotional functioning (and in particular on the capacity for facial emotion identification) are inconsistent [18, 27]. This should be investigated in future studies. Our study is cross-sectional; longitudinal studies are needed to better understand the causal role of emotion dysregulation in the emergence and maintenance of anorexia nervosa. Because of the study design and small sample size, we cannot make statements on developmental aspects of the emotional skills.

Despite these limitations, our study has some merits. One is the focus on an integrative approach during the crucial period of adolescence and young adulthood by taking into account multiple emotional skills in a single sample. As far as we know, this has not been undertaken up to now. Besides, we examined the identification of emotion in others in terms of accuracy and sensitivity by using a dynamic morphing test. The examination of the cognitive conscious emotion regulation strategies through the use of the CERQ has never been undertaken before. Finally, we found some important effects with instruments whose reliability were lower than that of other instruments (CERQ Acceptance and Rumination subscales, Multimorph Sadness subscale). Some estimation methods would have allowed us to correct the estimation of the effect size in the population by taking into account the unreliability of the instrument (e.g., [71]). Such a correction would have increased the effect size estimate in the population. It is therefore likely that the true population effects are much greater than those we observed. However, knowing that the way to make such adjustments is still controversial [72], we prefer to remain cautious in our interpretation of these results and suggest instead that our study be replicated with instruments that are more reliable.

### **Conclusions**

Adolescents and young adults with anorexia nervosa, in contrast to their difficulties regarding their own emotional states (alexithymia), are hypersensitive to emotions in others. Although participants did not present general deficits in cognitive conscious emotion regulation strategies, the difficulties in the processing of emotions may lie in the interplay of the different aspects of emotion regulation (e.g., behavioural, social, cognitive conscious and unconscious processes), as well as in the interplay between the different emotional skills (e.g., experience, expression, identification and regulation). This could lead in the long term to a persistent emotional avoidance cycle, which has been



described as an important maintenance factor of anorexia nervosa [5]. This highlights the importance of intervening early during adolescence and the need to develop testable theoretical frameworks that take into account the dimension of emotion (dys)functioning.



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#### Availability of data materials

The dataset collected and analysed during the current study is not publicly available as this could compromise participant privacy. The corresponding author can be contacted and can upon motivated request share part of the dataset.

#### Author contributions

LH, SU, GM, KJP, CJ made a substantial contribution to developing the study design. LH, SG, DSM supervised the data collection. The plan of statistical analyses was a collaborative effort between all authors. CJ

wrote the first draft of the manuscript. LH supervised the whole process together with SU, GM and KJP, and all authors made substantial contributions to the final paper. All listed authors are accountable for all aspects of the work, including issues related to accuracy and integrity. All authors read and approved the final version of the manuscript.

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#### Competing interests

The authors declare that they have no competing interests.

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