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Momentary emotion identification in female adolescents with and without anorexia nervosa

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Abstract

Individuals with anorexia nervosa (AN) often report difficulties in identifying emotions, which have been mostly studied as an alexithymia trait. In a controlled two-day ecological momentary assessment, we studied the influence of time of day and aversive tension on self-reported momentary emotion identification. Analysis on an aggregated level revealed a significant lower mean emotion identification in the AN group. In a mixed model analysis, the AN group showed lower emotion identification than the control group (HC). Both a general and a group effect of time of day were found, indicating that emotion identification improved during the day in HC, whereas a negligible decrease of the emotion identification over time was observed in the AN group. Age was associated positively with emotion identification in general, but no specific effect on a group level was found. No effect of aversive tension was found. Our results indicate that an improvement during the day might be a natural process of emotion identification, which is hindered in AN. Future research should focus on temporal relations between emotion identification and disordered eating behavior to further evaluate the clinical relevance of emotion identification difficulties in AN.

Keywords

Aversive tension; Ecological momentary assessment; Alexithymia; Anorexia nervosa

1. Introduction

Emotion identification is defined as the ability to identify and label a specific self-experienced emotion, and is a key feature to adaptive emotion regulation and interpersonal communication of feelings (Lane and Schwartz, 1987; Subic-Wrana et al., 2014). Most

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Conflicts of interests

All authors declare that they do not have any conflicts of interests.

research on emotion identification in eating disorders has relied on questionnaires regarding alexithymia, a broader personality-based concept characterized by a reduced ability to identify, differentiate and communicate emotions (Nowakowski et al., 2013). Several studies have found higher levels of alexithymia in patients with anorexia nervosa (AN) compared to healthy controls (HC) (Gilboa-Schechtman et al., 2006; Montebanocci et al., 2006; Nowakowski et al., 2013). Additionally, studies have identified deficits in emotional awareness (being attentive to one's emotions in general) and emotional clarity (knowing exactly how one is feeling) among individuals with AN compared to HC (Brockmeyer et al., 2014; Lavender et al., 2015; Oldershaw et al., 2015; Svaldi et al., 2012). However, in some studies the effect of increased levels of alexithymia in patients with AN compared to other psychiatric disorders and HC disappeared when controlling for anxiety and depression (Eizaguirre et al., 2004; Gilboa-Schechtman et al., 2006; Montebanocci et al., 2006; Parling et al., 2010). This might be due to invalid measures since alexithymia has mostly been investigated with the Toronto Alexithymia Scale (TAS) (Bagby et al., 1994), a measure that seems to assess general distress rather than alexithymia (Marchesi et al., 2014).

Because most studies have assessed emotion identification in AN as a trait of alexithymia, it remains unclear whether or not the ability of patients with AN to identify emotions changes at the momentary level. Variations in time of tension and anxiety, which are suspected to correlate with emotion identification on a trait level (Eizaguirre et al., 2004; Gilboa-Schechtman et al., 2006), have been observed in individuals with AN (Lavender et al., 2016). A study on emotion identification in borderline personality disorder (BPD) identified a strong association of current levels of aversive tension and the ability to label specific emotions (Wolff et al., 2007). Aversive tension is defined as a momentary, unpleasant emotional state of high arousal, and adolescents with AN reported higher levels of aversive tension than HC in a recent EMA study (Kolar et al., 2016). However, the association of emotion identification and aversive tension has not been studied in individuals with AN yet.

A modern approach to gather real-time data on inner psychological processes such as emotion identification is ecological momentary assessment (EMA). In EMA, participants fill in an electronic questionnaire over several days on multiple occasions to avoid recognition bias and to display time dependencies (Fahrenberg et al., 2007). In this study, we used an EMA approach to assess for the first time how adolescents with AN compare to HC with respect to their rate of momentary self-reported emotion identification. We hypothesized that adolescents with AN would report lower levels of emotion identification than HC; that emotion identification would vary over time of day; and that aversive tension would influence emotion identification both in general and specifically in adolescents with AN.

2. Methods

2.1. Participants

Twenty adolescents with AN and 20 healthy adolescents participated in this study. All participants were German, female, and aged 12–19 years. With the exception of six participants who were either already university students, in an internship or recently graduated from high school, all other participants attended high school during the EMA. At admission, adolescents in the patient group met full DSM-5 criteria for AN assessed with the

Eating Disorder Examination (Hilbert et al., 2013) and received outpatient treatment at the time of recruiting. Exclusion criteria for adolescents with AN included a medical chart diagnosis of (suspected) borderline personality disorder and a BMI below the 3rd age-adjusted percentile if safety during the study could not be guaranteed. Table 1 provides additional information on the AN group. Control participants were recruited for participation in local youth groups near Mainz, Germany. Mean age of HC was 15.9 years ($SD = 1.55$). Exclusion criteria for HC were a history of psychiatric treatment within the last five years or a clinically relevant symptom load as assessed with the symptom checklist (SCL-90-R) (Franke, 1995) to exclude adolescents currently experiencing a clinical relevant amount of psychological distress. The AN and HC group did not differ regarding age ($t(38) = -0.18$; $p = 0.86$) or education (Fisher's exact test, $p = 0.405$). The study was approved by the ethics committee of the regional medical association and registered at the German register of clinical trials (DRKS00005228). Informed consent was given by each participant as well as their parents.

2.2. Procedure

The current study is part of a larger EMA study examining momentary aversive tension, affective variables, and reports of current activities (e.g. food intake or physical activity) (Kolar et al., 2014). Data regarding intra- and interpersonal effects on aversive tension have been published elsewhere (Kolar et al., 2016). The EMA was conducted using the Android® application Epicollect (Aanensen et al., 2009). Participants used either their own smartphone or a research device and were trained to use the software and to rate the questionnaires. Except for individually arranged night times, participants completed signal-contingent recordings every full hour for two days. Automatic short messages were sent as hourly reminders to complete a recording with an online provider (massenversand.de, GOYYA systems, Dresden, Germany). Delivery of short message was guaranteed by the provider in less than two minutes of request, given that the device had a network connection. However, participants were able to delay their response because of the restriction of smartphone use during school and were advised to respond between classes. Day and time of the response were recorded at each measurement occasion. Of the four item questionnaire, two items regarding emotion identification (“On a scale from 0 – not at all to 9 – very good, how well can you name the emotion that you are feeling right now?”) and aversive tension (“On a scale from 0 – not present to 100 – extremely intense, at this time, how intense is your emotional tension?”) were analyzed in this study. Previous studies on aversive tension and emotion identification reported good validity of this form of measurement (Stiglmayr et al., 2005; Wolff et al., 2007). Prior to participation, all adolescents received a thorough definition of aversive tension and two exemplary situations corresponding to aversive tension levels of 30–50 and 50–70 were given (please refer to supplement one for more detail).

2.3. Data analyses

A linear mixed model (LMM) was used to analyze the association of emotion identification with group (AN versus HC), time of day, momentary aversive tension, and interactions of group with time of day, age, or aversive tension. In line with Bolger and Laurenceau (2013), aversive tension and age were centered by subtraction of the grand mean prior to the

analysis. Time of day was rescaled for a better interpretation of fixed effects such that zero reflected midday and rounded to full integers. Differences between measurement days one and two were not analyzed in detail, as elapsed time was included as a measure of continuous improvement. Random effects of intercept, elapsed time since the first measurement and covariance of time and intercept were estimated. In a preliminary analysis, a spatial power structure of variance was modelled to account for auto-regression between unequally distanced measurements. However, as the auto-regressive parameter was estimated near zero ($V = 2.41e^{-13}$) and fixed and random factor estimates were not affected by exclusion of this parameter, the final model does not report auto-regressive variance to prevent over-specification of the model. The restricted maximum likelihood estimation method was used as this is recommended for smaller sample sizes. Data analysis was conducted with SAS OnDemand for Academics (SAS Institute Inc., Cary, NC, USA, 2013) and SPSS (Version 23.0, IBM Corp., Armonk, NY, USA, 2015).

3. Results

A total of 1030 completed recordings from 40 participants were analyzed in this study. AN and HC groups did not differ regarding the compliance to the EMA schedule as measured by the ratio of completed to planned questionnaires (AN group: $M = 0.79$, $SD = 0.12$; HC group: $M = 0.82$, $SD = 0.17$; $t(38) = 0.72$, $p = 0.476$). Almost half of the sample used a research device during EMA (12 HC and 7 AN participants), but no significant group difference was found regarding their distribution (Fisher's exact test, $p = 0.205$), and neither an effect of using the own device on the compliance was found (own device: $M = 0.80$, $SD = 0.13$; research device: $M = 0.81$, $SD = 0.17$; $t(38) = -0.129$, $p = 0.898$). Responses to the EMA reminder were on average delayed for 20.2 min ($SD = 8.3$) in the AN and 18.0 min ($SD = 6.7$) in the HC group. No significant difference between groups was found on this variable ($t(38) = 0.91$, $p = 0.371$). The groups did not differ regarding their individually arranged start or end times for participation (start time: AN group: $M = 6:54$ a.m., $SD = 51$ min; HC group: $M = 7:07$ a.m., $SD = 51$ min; $t(38) = -0.83$, $p = 0.410$; end time: AN group: $M = 10$ p.m., $SD = 32$ min; HC group: $M = 10:11$ p.m., $SD = 44$ min; $t(34.9) = -0.86$, $p = 0.394$).

Preliminary analysis of emotion identification on a person-wise aggregated level revealed a significant lower mean level of emotion identification in the AN group compared to HC (AN group: $M = 4.10$, $SD = 1.31$; HC group: $M = 5.89$, $SD = 1.79$; $t(38) = -3.60$, $p = 0.001$). Age and emotion identification were not significantly associated across all participants ($r = 0.164$, $p = 0.313$) or in the AN group specifically ($r = -0.220$, $p = 0.351$). However, age was significantly positively correlated with emotion identification in HC ($r = 0.455$, $p = 0.044$). Therefore, age was included in the mixed model analysis as a fixed effect. Fig. 1 shows the simple regression lines of emotion identification over time for the first day of assessment, indicating that intercept and slope differences dependent on time of day between the groups might exist. This indicates that further examination on a momentary level is justified. Further examination of subgroup differences within the AN group did not find significant differences of the emotion identification according to whether participants used prescribed medication (Wilcoxon test: $z = 0.95$, $p = 0.343$) or displayed comorbidity with other Axis-I disorders (Wilcoxon test: $z = 1.40$, $p = 0.162$).

Table 2 shows the parameter estimates of the linear mixed model analysis. We found a significant effect of group on self-reported emotion identification ($\beta = -1.764$, $p < 0.001$), indicating that individuals with AN struggled more than HC with labeling their emotions on a momentary level. Contrary to our hypothesis, aversive tension did not have an effect on emotion identification either across the sample ($\beta = 0.007$, $p = 0.293$) or for the AN group specifically ($\beta = -0.002$, $p = 0.811$). Regarding time of day, we found a positive effect across participant groups ($\beta = 0.059$, $p = 0.002$) and an additive negative effect for individuals with AN ($\beta = -0.061$, $p = 0.023$). In a linear mixed model, for each measurement a linear combination of predictor estimates is assumed. Combining both the general positive effect of time of day across participants with the group-specific effect for AN resulted in a combined effect near zero for each measurement of a participant with AN. In contrast, only the general predictor estimate of time of day added to the overall change of emotion identification in HC, as the group-specific time effect was zero for HC. Thus, from 7 a.m. in the morning to 7p.m. in the evening an increase of 8% in the perceived ability to identify an emotion is observed in HC on average, whereas the AN group remained nearly stable over time with a systematic reduction of only 0.27% of their emotion identification twelve hours later. Fig. 1 illustrates this group and time interaction by plotting the individual and mean regression lines of emotion identification over time. In addition, a significant effect of age was found across all participants ($\beta = 0.429$, $p = 0.016$). The interaction effect of age and group was nearly significance ($\beta = -0.552$, $p = 0.052$). A combination of these effects highlighted in an insignificant decrease of emotion identification for older adolescents with AN. A significant random intercept ($V = 2.103$, $p < 0.001$) and time variance ($V = 0.001$, $p = 0.007$) was found, whereas no significant random effect of intercept-time-covariance ($V = -0.011$, $p = 0.401$) was estimated. The residual variance remained on a significant level ($V = 3.407$, $p < 0.001$).

4. Discussion

To our knowledge, this is the first study that assessed momentary self-reported emotion identification in a natural environment of adolescents with AN compared to HC. LMM analysis revealed a significant difference between adolescents with and without AN regarding their momentary emotion identification rate. This is in line with the literature showing that individuals with AN report higher trait levels of alexithymia and lower trait levels of emotional awareness and clarity compared to HC (Lavender et al., 2015; Nowakowski et al., 2013). In addition, self-reported emotion identification improved over time for HC and declined slightly for adolescents with AN. This might indicate that HC individuals incorporate contextual cues and social feedback that can assist with understanding emotional states more effectively, leading to improved emotion identification during the day. Individuals with AN might struggle to incorporate both internal and external information on their emotional state which could prevent temporal improvement of emotion identification. For example, stating “I feel bad, but I am not sure why” in the morning might improve to “I feel anxious” later that day for HC by attributing an increased heart rate, the math test scheduled for the next day and the comments of peers (e.g., “Are you nervous about the test?”). As time passes, the feedback might aggregate, increasing the confidence of an adolescent in her own current emotional state at the end of a day. This is consistent with

recent neuroscience findings suggesting that individuals with AN have weak central coherence and more set-shifting problems (Reville et al., 2016). Higher age was associated with better emotion identification across all participants. There is evidence that emotion regulation capabilities increase with age (Zimmermann and Iwanski, 2014). Most probably, this is applicable to emotion identification capabilities as well, as they are a specific form of emotion regulation. The natural development of improved emotion identification with increasing age might be interrupted by AN and accompanying maladaptive emotion regulation strategies such as emotional avoidance or rumination. This might explain that age is associated with better emotion identification in the HC group only on an aggregated level. In addition, duration of illness might also explain why older participants with AN did not improve in emotion identification with age (as duration of illness is associated with increased age). However, the effect of age remained small compared to the overall effect of AN on emotion identification in the multi-level model. Although adolescents with AN displayed higher levels of aversive tension on a momentary level (Kolar et al., 2016), aversive tension did not influence the current emotion identification rate. This is in contrast to our hypothesis. Unlike in individuals with BPD, this might indicate that aversive tension and emotion identification are independent pathways to emotion dysregulation in adolescents with AN. A different explanation might be that emotion identification was assessed at a 10 point rating scale, whereas a 100 point scale was used for the assessment of aversive tension. The wider a scale, the more variance can be observed and thus correlated and interpreted. Hence, the missing influence of aversive tension on emotion identification might be due to the scale choice, which could have resulted in more stable emotion identification than aversive tension in this study.

Several limitations of the study have to be addressed. Most notably, the sample size is small compared to other EMA studies on eating disorders (Engel et al., 2016, 2013; Lavender et al., 2016). However, sufficient measurements were recorded to carry out LMM analysis, but the results need to be considered as exploratory. In addition, the short EMA duration of only two days needs to be considered. Although an EMA study on emotion identification in adults with BPD (Wolff et al., 2007) used the same sampling scheme successfully, a longer sampling frame might be recommended in future studies. Conducting an EMA over several days would allow for capturing disordered eating behavior (e.g. bingeing, purging, and restriction) in relation to emotion identification difficulties. Thus, the clinical relevance of the construct and its improvement during the day could be further evaluated. In addition, a future study should also explicitly assess the quality and valence of the momentary emotion to investigate whether the identification is easier for positive versus negative emotions among individuals with AN. Another limitation is that the sample consisted of patients who received treatment, which might resulted in improved emotion identification compared to baseline. Nevertheless, significant group differences were found. In addition, measuring emotion identification in real-life is probably moderated by other momentary (e.g. emotional valence, restrictive eating) and stable variables (e.g. personality traits, depression) that should be addressed in future studies. Another limitation is that due to the naturalistic setting of the study, participants delayed their response on several occasions because of external (e.g. school attendance) and internal causes (e.g. 'too lazy to respond'). Although no significant group differences were found, this might have confounded the data. Further, in

this study we relied on self-report of emotion identification and aversive tension, which could be negatively affected by variables such as poor self-reflection abilities, low self-esteem or a negativity bias, especially in the AN group. Taking advantage of combining questionnaires for trait measurement, more objective behavioral measures of emotional constructs, and EMA for real-life data could be a means to provide further insight in these associations and to validate the momentary measurement of emotion identification additionally.

Our findings provide a first step to clarifying the momentary pattern of self-reported emotion identification. Valid emotion identification is considered a precursor for adaptive emotion regulation (Subic-Wrana et al., 2014). Functional magnetic resonance imagery studies have associated emotion identification with a subsequent decrease in amygdala activity (Lieberman et al., 2007), which indicates that labeling an emotion might be a form of arousal regulation itself. Successful downregulation of emotional arousal enables the individual to engage in goal-oriented behavior and to decrease disordered eating which is considered as a maladaptive short-term emotion regulation (Haynos and Fruzzetti, 2011). Our findings that emotion identification improves over time in the HC group only might be of direct clinical relevance. Encouraging patients to identify and validate their own emotions is already part of several emotion-focused treatments for AN, such as dialectical behavior therapy (Salbach-Andrae et al., 2009). Training patients with AN in their ability to identify emotions by incorporating contextual cues over time might improve their momentary emotion identification within the day and subsequently decrease disordered eating behaviors. This study provided first evidence for a time-dependency of emotion identification, but its relation to disordered eating behaviors remains unclear. Hence, future studies are needed to determine if problems with emotion identification predict eating disordered behavior among individuals with AN on a momentary level, and if these problems can be improved by emotion-focused treatments.

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Fig. 1. Spaghetti plot of the individual regression lines of time of day on emotion identification. Note: regression lines are plotted for day one only. However, regression lines for day two showed a similar pattern.

Table 1

Characteristics of the anorexia nervosa subsample.

	Patients (<i>N</i> = 20)	
	<i>M</i>	<i>SD</i>
Age in years	16.0	1.55
BMI at admission (kg/m ²) ^a	16.5	0.9
Months enrolled in local outpatient treatment	5.75	7.02
	<i>N</i>	%
Previous inpatient treatment	14	70
Restrictive AN-subtype	17	85
Purging AN-subtype	3	15
<i>Comorbidity</i>		
One additional disorder	6	30
Two additional disorders	4	20
None	10	50
<i>Comorbidity by disorder</i>		
Major depression	9	45
Bipolar disorder	1	5
Obsessive-compulsive disorder	2	10
Posttraumatic stress disorder	1	5
Adjustment disorder	1	5
<i>Medication</i>		
Prescription of at least one psychoactive medication	6	30
No medication prescribed	14	70

Note:

^a*N* = 19 as one patient refused weight measurement at initial diagnostic assessment.

Table 2

Linear mixed model parameter estimates of group, time of day, aversive tension and interactions on momentary emotion identification.

Fixed effects	<i>Estimate</i>	<i>SE</i>	<i>t^a</i>	<i>p^b</i>
Intercept	5.801	0.343	16.89	<0.001
Group	– 1.764	0.484	– 3.64	<0.001
Time of Day	0.059	0.018	3.27	0.002
Time of Day × Group	– 0.061	0.026	– 2.38	0.023
Aversive tension	0.007	0.006	1.07	0.293
Aversive tension × Group	– 0.002	0.008	– 0.24	0.811
Age	0.429	0.170	2.53	0.016
Age × Group	– 0.552	0.274	– 2.02	0.052
Random effects				
	<i>Variance</i>	<i>SE</i>	<i>Wald Z</i>	<i>p^b</i>
Intercept	2.103	0.605	3.48	<0.001
Time	0.001	< 0.001	2.45	0.007
Intercept-time covariance	–0.011	0.013	–0.84	0.401
Residual	3.407	0.157	21.71	<0.001

Note: N = 40 persons, 1030 observations. Group was coded 1 = adolescents with anorexia nervosa and 0 = control group. Therefore, interaction effects are additive for the adolescents with anorexia nervosa.

^aDegrees of freedom were based on participants rather than the overall number of observations.

^bAll tests were conducted two-tailed except for variance z-tests as variances are non-negative.