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Emotion Regulation in Obsessive-Compulsive Disorder: An Ecological Momentary Assessment Study

Claudia Bischof [1]
Nicola Hohensee [1]
Christoph-Dornier Foundation Münster
University of Münster

Fanny Alexandra Dietel
University of Osnabrück

Philipp Doebler
Nadja Klein
TU Dortmund University

Ulrike Buhlmann
University of Münster

Emotion dysregulation is a central process implicated in the genesis and maintenance of obsessive-compulsive disorder (OCD). However, past research on OCD has examined emotion regulation with a trait-level approach, thereby neglecting important situational and temporal dynamics. The present study is the first one to examine moment-to-moment emotion regulation in individuals with OCD. A 6-day ecological momentary assessment was used to assess affect, emotion regulation strategies, perceived effectiveness of emotion regulation strategies, and acceptance of emotional experiences in $n = 72$ individuals with OCD and $n = 54$ psychologically healthy controls. As expected, individuals with OCD reported more negative and less positive affect. Group differences in positive (but not negative) affect did remain significant when controlling for baseline depression. Furthermore, the OCD group reported to use a higher momentary number of avoidance-oriented regulation strategies and less perceived effectiveness of emotion regulation, even when controlling for current symptoms and negative affect or baseline depression scores. Further, irrespective of group, more momentary negative affect amplified use of avoidance-oriented strategies and diminished perceived effectiveness and emotional acceptance. Contrary to expectations, these effects were not more pronounced in the OCD group. Possible explanations for unexpected findings and implications for future research, particularly regarding more holistic emotion regulation treatments, are discussed.

Keywords: OCD; emotion regulation; ecological momentary assessment; multilevel model

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Address correspondence to Dr. Ulrike Buhlmann, Fliednerstraße 21, 48149 Münster, Germany. e-mail: ulrike.buhlmann@uni-muenster.de.
[1] Joint first authors.

OBSESSIVE-COMPULSIVE DISORDER (OCD) is characterized by obsessions (e.g., fear of contamination by HIV or doubts about having turned off the stove)

and compulsions (e.g., ritualized hand washing or repetitively checking the stove) with either one or both symptom groups being present. As obsessions cause anxiety or distress, individuals try to suppress, ignore, or neutralize these thoughts by engaging in compulsions (American Psychiatric Association, 2013). Compulsions may alleviate negative emotions in the short term, but in the long term, they serve to maintain OCD symptoms as they prevent disconfirmation of underlying maladaptive core beliefs (Salkovskis et al., 1995). Thus, dysfunctional emotion regulation (ER) can be considered as a core feature in the maintenance of obsessive-compulsive (OC) symptoms. Generally, ER is a pervasive phenomenon in daily life, and includes all cognitive-behavioral acts that influence our emotional experiences in order to meet environmental demands (Gross, 1998). Individuals use different ER strategies to modulate the intensity and the type of their emotional experiences as well as the situations eliciting their emotions (Gross, 1998). Regarding OCD, disorder-specific dysfunctional regulatory behavior (e.g., repetitively checking the stove) is typically targeted in exposure and response prevention (ERP) treatment, which, however, has a considerable attrition rate of around 19% (Ong et al., 2016). Hence, improving our understanding of ER dysfunction might aid in developing more tailored, ER-oriented treatment approaches for OCD in the future (See et al., 2022).

Overall, prior research indicates that ER strategies are diverse and often used simultaneously (Ford et al., 2019). Given this complexity, it appears plausible to group strategies and investigate their joint effect on emotional outcomes (Ford et al., 2019; Southward & Cheavens, 2020). In the past, two commonly identified groups of ER strategies were engagement-oriented and avoidance-oriented strategies (Daros et al., 2020; McMahon & Naragon-Gainey, 2019): Engagement-oriented strategies, like cognitive reappraisal, involve active engagement and shift of attention towards an emotional experience or situation (e.g., trying to think differently about a situation). Conversely, avoidance-oriented strategies, like emotional suppression, focus on the inhibition and shift of attention away from emotional experiences or situations (e.g., trying to ignore emotion-related thoughts).

Considering transdiagnostic associations with psychopathology, avoidance-oriented (vs. engagement-oriented) strategies were often described as putatively maladaptive, because their habitual use was associated with a wide range of different psychopathologies (e.g., Aldao et al., 2010). However, prior ecological momentary assessment (EMA) studies that gauged ER strategies within a higher time density and situational variability remained inconclusive. While some studies found a positive association with worse mood or internalizing symptoms (McMahon & Naragon-Gainey, 2019; Short et al., 2018; Southward & Cheavens, 2020), others showed beneficial effects for avoidance-oriented strategies on affect as well, thereby pointing, on the one hand, towards a potential negative reinforcement of avoidance-oriented strategies as a maintaining factor (Brans et al., 2013; Daniel et al., 2019). On the other hand, findings might also support the notion that ER strategies can vary in their effect across situations, depending on the context and individual differences (Aldao & Nolen-Hoeksema, 2012).

To further disentangle these contextual influences, previous studies stressed the importance of including additional variables, like the perceived regulatory effectiveness of different ER strategies or the momentary intensity of negative affect (e.g., De France et al., 2022; Dixon-Gordon et al., 2015). Regarding emotional context, past research showed that more intense negative emotions often coincide with an interpretation of the emotional state as undesirable and lead to a more avoidance-oriented management of these emotions (Dixon-Gordon et al., 2015; Sheppes et al., 2011). In addition, other lines of research suggested to focus more on ER flexibility and the repertoire of strategies used in a certain situation. Past research emphasized beneficial emotional outcomes when an individual flexibly used a large number of putatively adaptive ER strategies (i.e., polyregulation theory, Ford et al., 2019; Southward & Cheavens, 2020). Inversely, the use of many putatively maladaptive ER strategies had more detrimental effects on situational emotional well-being (Southward & Cheavens, 2020). In sum, these findings point towards a complex interplay between negative affect, use of ER strategies, and psychopathology.

In previous research conducted in clinical, student, and community samples, higher levels of OC symptoms were consistently related to more pronounced negative affect, less positive affect, and a reduced acceptance of emotional responses (Heller et al., 2021; Moore & Howell, 2017; Yap et al., 2018; See et al., 2022). Relatedly, OC symptoms were associated with heightened use of avoidance-oriented strategies and a reduced use of engagement-oriented strategies in individuals with OCD as well as a community sample (e.g., Fergus & Bardeen, 2014; Moritz et al., 2018). This coincided with difficulties in goal-directed

behavior (e.g., focusing on something other than obsessions or compulsions) as well as general difficulties in accessing ER strategies (e.g., See et al., 2022; Yap et al., 2018). In addition, higher ER dysfunction, measured by the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), was cross-sectionally associated with higher severity of OCD and DERS scores were higher in individuals with OCD compared to a matched nonclinical control group (See et al., 2022; Yap et al., 2018; Yazici & Yazici, 2019). Importantly, Berman et al. (2020) provide laboratory evidence for the link between certain obsessions, affect, and emotion dysregulation: They showed that students who completed an induction of taboo (vs. contamination) thoughts, reported an increase in (self-conscious) negative affect and higher DERS-state scores.

Altogether, studies using mostly retrospective trait questionnaires demonstrated that individuals with OCD seem to present ER deficits not only in disorder-provoking situations, but also throughout their daily lives (Yap et al., 2018). Nevertheless, these mainly retrospective data are limited in their informative value. Past research showed that associations of trait-measures are not necessarily directly transferable to state-measures, e.g., illustrated by conflicting results regarding the association between avoidance-oriented ER strategies and affect (Aldao et al., 2010; Daniel et al., 2019). In addition to the well-documented reliability issues attributed to retrospective recall biases (e.g., MacLaren Kelly et al., 2019), both ER and affect also vary across situations and time (Park & Naragon-Gainey, 2019; Trull et al., 2015). Moreover, it remains difficult to clearly distinguish the reasons for dysfunction (i.e., situation-specific, symptom-specific, or general dysfunction) through retrospective self-reports alone. The little evidence that comes from experimental studies (e.g., Berman et al., 2020) is derived from an analogue sample reporting regulatory difficulties in a lab setting. Therefore, the external validity of these findings is restricted as well.

In this respect, EMA is an emerging approach to explore variable, contextual data, reduce retrospective bias, and increase external validity (Trull & Ebner-Priemer, 2020). Hence, the current study uses EMA to replicate findings regarding emotion dysregulation in OCD, derived from retrospective self-report measures, by examining moment-to-moment ER difficulties in daily life in individuals with OCD and psychologically healthy controls (HC). Importantly, because of the EMA design, we are able to take fluctuating contextual variables into account (i.e., momentary negative affect).

Building upon the aforementioned evidence, we hypothesized the following:

GROUP COMPARISONS (HYPOTHESIS 1)

Individuals with OCD (vs. HC) would report more negative and less positive affect. Further, individuals with OCD would report more avoidance-oriented ER strategies, less engagement-oriented ER strategies, and less perceived effectiveness of ER than individuals in the HC group. When asked for reasons why participants currently do not try to change their emotions, individuals with OCD (vs. HC) would name acceptance of emotions less often and negative expectations and competence deficits more often.

ASSOCIATIONS BETWEEN NEGATIVE AFFECT AND OTHER EMOTION REGULATION VARIABLES (HYPOTHESIS 2)

On assessment points where individuals report higher (vs. lower) levels of negative affect, participants would report a higher-than-usual number of avoidance-oriented and a lower-than-usual number of engagement-oriented ER strategies, lower-than-usual subjective effectiveness of ER as well as less frequent reporting of acceptance and more frequent reporting of negative expectations and competence deficits as reasons for nonregulation. We expect these associations to be more pronounced in the OCD vs. the HC group.

Method

The study design, hypotheses, and analysis plan were preregistered on Open Science Framework (registration ID OSF.IO/XQV2J) in August 2021. While recruitment had already started earlier, all data analyses occurred after preregistration. Further data analyses planned with the current dataset are also preregistered (registration IDs OSF.IO/3V4X7; OSF.IO/9B8HK; OSF.IO/UC4VF). The study was approved by the ethics committee of the Department of Psychology and Sport Science at the University of Münster, Germany.

PARTICIPANTS

Figure 1 shows a flowchart describing the study process and participant flow: Participants were recruited via paid and unpaid postings on social media, German OCD-related online forums, self-help groups, cooperation with general and OCD-specific outpatient clinics throughout Germany, and public advertisements. Recruitment started in January 2021, and data collection was conducted between February 2021 and April 2022. Informed consent was obtained from all participants. Upon volunteering to participate, participants self-

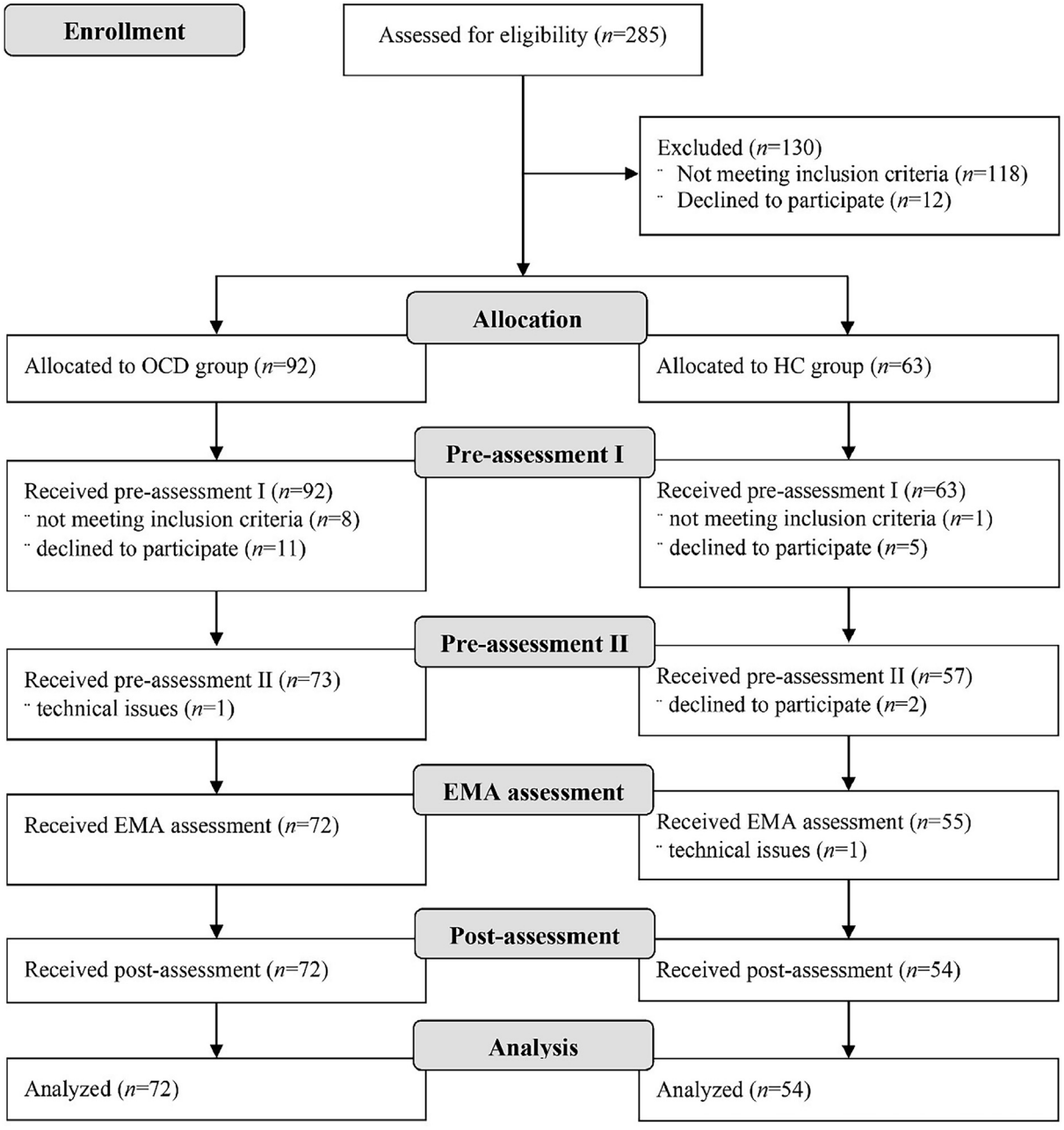

FIGURE 1 *Flow chart. Note.* OCD = obsessive compulsive disorder; HC = psychologically healthy controls; EMA = ecological momentary assessment.

identified as either having OCD or being psychologically healthy, and group fit was later confirmed during a telephone screening. Screening identified $N = 155$ eligible participants ($n = 92$ participants with OCD and $n = 63$ individuals in the HC group) who took part in an initial diagnostic session. The main inclusion criterion for the OCD group was a current primary diagnosis of OCD according to DSM-5 (American Psychiatric Association, 2013). Participants were excluded from the study if they were currently or had formerly been diagnosed with a psychotic disorder, bipolar disorder, or borderline personality disorder; were currently or in the last 5 years diagnosed with substance dependence or substance abuse, had a change in psychotropic medication in the 8 weeks before or during the study; were currently suicidal; were under 18 years or over 65 years of age; or possessed insufficient German language skills. To qualify for the HC group, participants could not have been currently or formerly diagnosed with any mental illness, could not have cur-

rently or formerly received psychotherapeutic treatment, and could not have currently or formerly used psychotropic medication.

All participants completed up to six EMA assessments per day for 6 days. Overall, 21.7% of the OCD group and 14.3% of the individuals in the HC group dropped out prematurely or were excluded during the study, resulting in a final sample size of $n = 72$ participants in the OCD group and $n = 54$ participants in the HC group. Most frequent dropout reason in both groups was not showing up for the pre-assessment after successfully passing a telephone screening. In the OCD group, some participants had to be excluded during pre-assessment, because their answers in the DIPS interview diverged from answers during the telephone screening so that inclusion criteria were no longer met.

POWER ANALYSIS

The sample size was estimated based on a power analysis addressing the main research questions using simulations with the R package "simr" (version 1.0.7; Green & MacLeod, 2016). The analysis was conducted assuming a medium effect size of ER differences between a clinical OCD and matched control sample (e.g., Yap et al., 2018). We aimed for a power of at least 80% and set our alpha level at .05. Using a medium effect size of Cohen's $d = .30$ resulted in a total suggested sample size of $N = 100$ (i.e., $n = 50$ individuals per group). Due to further analyses beyond those conducted in this study focusing on within-group analyses, we enlarged the OCD sample to $n = 70$ before beginning recruitment. This resulted in an increased a priori power of 90.40%.

MATERIALS

Pre-Assessment

At pre-assessment, clinical interviews and various self-report questionnaires were used to ensure the fulfillment of the inclusion criteria and to assess relevant sample characteristics. Here, only measures relevant to the present research questions will be described. Other self-report questionnaires assessing affect, emotional clarity, ER, distress intolerance, and anxiety sensitivity will be reported elsewhere.

Diagnostic Interview for Mental Disorders (DIPS; Margraf et al., 2021*).* The DIPS is a structured interview for mental disorders based on DSM-5 criteria. The interview was used at pre-assessment to ensure a primary diagnosis of OCD (based on symptom severity) in the OCD group, to identify comorbid mental disorders in the OCD group, and to exclude participants with any mental illnesses from the control group. Inter-rater reliability was calculated based on 20% of double-rated ratings for the OCD section, which were randomly selected. Cohen's κ showed perfect agreement between the two raters, $\kappa = 1$. The two interviewers were the shared first authors of the present paper, who had both undergone advanced training as cognitive behavioral psychotherapists.

Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Goodman et al., 1989; Hand & Büttner-Westphal, 1991*).* The Y-BOCS is a widely used 12-item, semistructured interview that assesses symptom severity of obsessions and compulsions. Again, inter-rater reliability was calculated based on 20% of all ratings for the Y-BOCS total score. An intra-class correlation coefficient of .99 indicated excellent agreement between the two raters.

Brown Assessment of Beliefs Scale (BABS; Buhlmann, 2014; Eisen et al., 1998*).* The BABS is a six-item, semistructured interview that assesses insight into OCD-related beliefs. Based on 20% of all ratings for the BABS total score, the intra-class correlation coefficient of .97 indicated excellent inter-rater reliability.

Difficulties in Emotion Regulation Scale (DERS; Ehring et al., 2013; Gratz & Roemer, 2004*).* The DERS is a 36-item, self-report questionnaire that identifies problems in understanding and accepting emotions, engaging in goal-directed behavior, and accessing effective ER strategies. The internal consistency for the DERS total score in the current sample was very high ($\alpha = .96$).

Emotion Regulation Questionnaire (ERQ; Abler & Kessler, 2009; Gross & John, 2003*).* The ERQ is a 10-item, self-report questionnaire that assesses preferences for two commonly used ER strategies: suppression and reappraisal. The internal consistency in the current sample was good, with $\alpha = .90$ for the reappraisal subscore and $\alpha = .79$ for the suppression subscore.

Depression Anxiety Stress Scales (DASS-21; Lovibond & Lovibond, 1995; Nilges & Essau, 2015*).* The DASS-21 is a 21-item, self-report questionnaire that assesses the severity of depression, anxiety, and stress symptoms on three subscales. Internal consistency in the current sample was high, with $\alpha = .92$ for the depression subscore, $\alpha = .87$ for the anxiety subscore, and $\alpha = .91$ for the stress subscore.

EMA Assessment

Figure 2 illustrates the process and structure of the EMA assessment. Original wording of all EMA items in German (and a post-hoc English translation) as well as a detailed descriptive analysis of

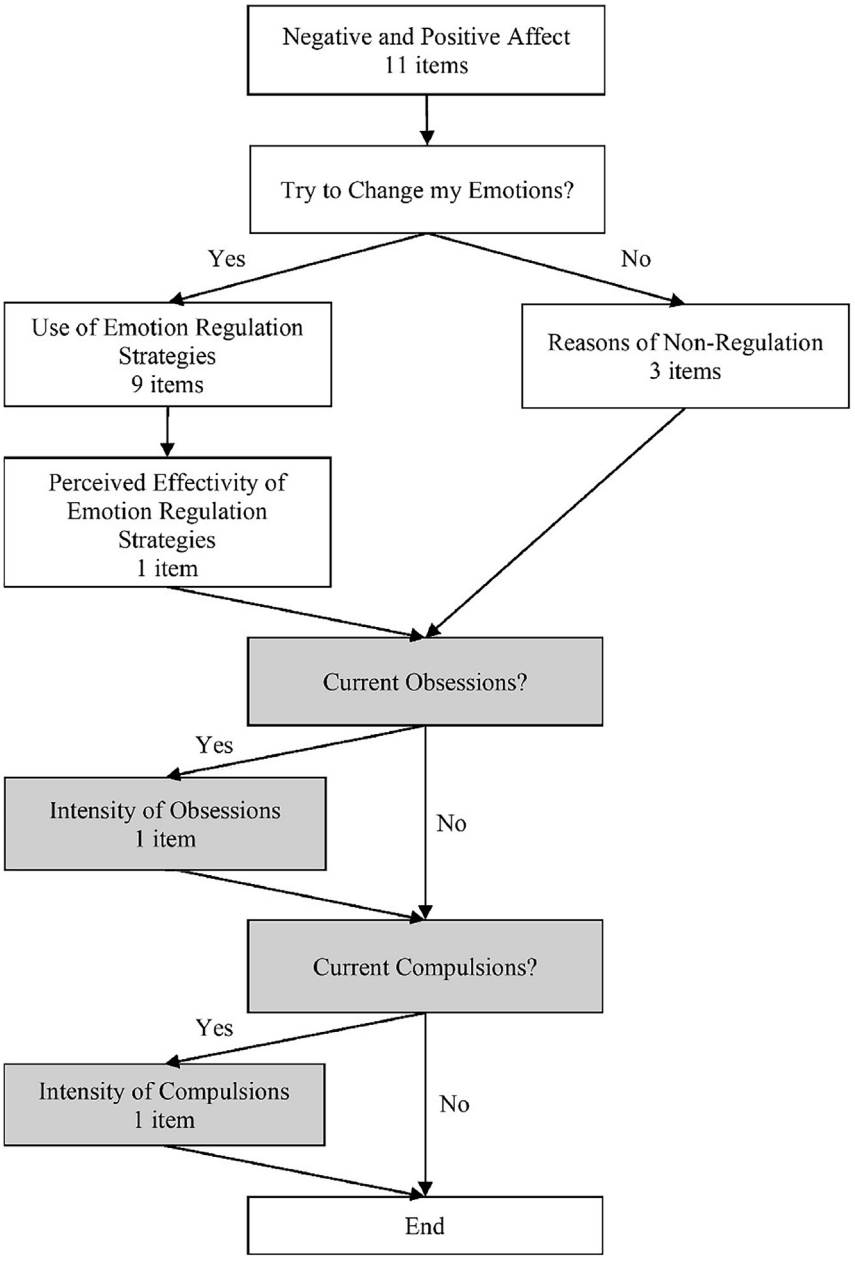

FIGURE 2 *Flow chart EMA procedure. Note.* The section marked in grey refers to the OCD group only.

the EMA items can be found in the online supplement A.

Momentary affect. Momentary negative and positive affect was measured via 11 items (i.e., "*active,*" "*in a good mood,*" "*calm,*" "*relaxed,*" "*angry,*" "*anxious,*" "*lonely,*" "*sad,*" "*ashamed,*" "*guilty,*" "*disgusted*") rated on a 5-point Likert scale. Affect items were based on the Emotion Sense Application (e.g., Lathia et al., 2017), augmented by the compulsion-specific emotions disgust and guilt. The item "disgusted" was added after assessment of the first 10 participants due to feedback that this disorder-specific emotion was missing.[2] Momentary negative and positive affect, respectively, were operationalized as the mean of the corresponding items. The intraclass correlation coefficient (ICC) derived from a null model was .66 for negative affect and .56 for positive affect, which indicated that 66% of variance in negative affect and 56% of variance in positive

[2] Analyses were conducted with and without the first ten participants missing the affect item "disgusted." Except for one statistical model (see Table 2, panel A), this did not change the significance of our findings. The results reported herein include these ten participants.

affect is accounted for by variations *between* individuals. Due to between-group heteroscedasticity, we computed individual ICCs based on the ratio of the between-person variance (across the two groups) and the total variance. The total variance was derived from the sum of the between-person variance and the person-specific residual variances using multilevel Gaussian location-scale models (see data analysis for further details). The range of ICCs was .53 to .85 for negative affect and .53 to .69 for positive affect.

Reasons for non-regulation. At each time-point, participants were asked to choose whether or not they tried to change their emotions. If not, they could choose from three different reasons for non-regulation: acceptance of emotions, perceived competence deficit, or negative expectation of possible change of emotions. Multiple selections were possible. Reasons were based on DERS subscales (Gratz & Roemer, 2004). Variables were dummy-coded for later analyses (e.g., acceptance: 0 = "*no*" and 1 = "*yes*").

Emotion regulation strategies. If participants indicated that they tried to change their emotions, they could choose between nine ER strategies given a dichotomous response format (based on Daros et al., 2020; Park & Naragon-Gainey, 2019): emotional suppression, distraction, expressive suppression, rumination, behavioral avoidance, problem solving, cognitive reappraisal, introspection, and seeking advice. The momentary use of avoidance-oriented or engagement-oriented ER strategies was operationalized as the sum of the chosen strategies from that group (Daniel et al., 2019; Daros et al., 2020; Ford et al., 2019). The ICC was .47 for avoidance-oriented ER strategies and .39 for engagement-oriented strategies. Considering between-group heteroscedasticity, the range of individual ICCs was .42 to .85 for avoidance-oriented ER strategies and .36 to .67 for engagement-oriented ER strategies.

Momentary subjective effectiveness of emotion regulation. The effectiveness of the applied strategies was measured via one item rating the change in current emotions as a result of the ER attempts on a scale from 0 ("*much worse*") to 100 ("*much better*"), based on previous work by Daniel et al. (2019). The ICC was .32 for ER effectiveness. Considering between-group heteroscedasticity, the range of individual ICCs was .30 to .41.

Momentary OC symptoms. Only participants in the OCD group were asked whether they currently experienced obsessions or compulsions. If yes, they were asked to specify the intensity of these symptoms on a 5-point Likert scale from "*mild*" to "*extreme*." The ICC was .37 for averaged momentary OC symptoms. Considering between-group heteroscedasticity, the range of individual ICCs was .34 to .47.

STUDY PROCEDURE

All data were collected online via video appointments with the RED connect software (RED Medical Systems GmbH, Version 4.3.0), self-report questionnaires via EFS Survey (Tivian XI GmbH, Version 21.2) and smartphone application-based ecological momentary assessment using MovisensXS (Movisens GmbH, Version 1.5).

After two screenings, the first online and the second telephone based, individuals participated in an initial video appointment during which the DIPS was conducted. Upon meeting the inclusion criteria, participants progressed to the assessment period: During a second video session, participants completed a self-report questionnaire that assessed demographic information, followed by the DERS, ERQ, and DASS-21 to identify ER difficulties and psychopathology. For the OCD group, the Y-BOCS and the BABS were administered afterwards. Subsequently, the EMA smartphone application was installed on the participant's smartphone. During a detailed briefing, all items were explained to the participants. The use of the smartphone application started on the Friday after the two video appointments and was completed on Wednesday of the following week (i.e., across 6 days, with six prompts administered per day). The alarms were randomly distributed between 9:00 a.m. and 9:00 p.m., and all questions referred to the participant's current emotional experiences right before each alarm. Participants could delay the alarm by 5 or 10 minutes and had a total time window of 15 minutes to respond to each questionnaire. It was also possible to refuse alarms or to pause the smartphone application for a fixed time (e.g., 1 hour) or as long as required to attend important appointments. Participants were paid up to €80 (€10 per hour) for their participation (i.e., completing the pre- and post-assessment, attending the video appointments, and using the smartphone application), with a further €20 paid if at least 80% of the EMA questionnaires were completed (based on the rationale described in Schulte et al., 2021). Payment was arranged by wire transfer.

DATA ANALYSIS

Data were analyzed using the software R (R Core Team, 2023). Group comparisons for sample description were calculated using Chi-square tests and one-way ANOVAs.

In the course of data preparation, sporadically missing data in self-report questionnaires administered at pre-assessment (i.e., 0.38% of single items in DERS, ERQ, and DASS-21) were addressed by individual mean imputation. We used multilevel regression models to test our hypotheses while accounting for the hierarchical structure of the EMA data (i.e., measurements, Level 1, were nested within participants, Level 2). Due to between-group heteroscedasticity, we used a multilevel Gaussian location scale model as implemented in the function "gaulss()" from the R package "mgcv" (version 1.8-33; Wood, 2017). In this way, it is possible to model the scale parameter of the response as a function of the predictors (here, group membership, gender, age, and an interaction term between gender and age). The result are individual specific residual variances that have the potential to decrease the risk of overly conservative or liberal inference due to heteroscedasticity. Embedded in a (penalized) likelihood framework, standard errors are readily available, and we used them to compute 95% confidence intervals for all quantities of interest.

To investigate Hypothesis 1, we estimated multilevel models with random intercepts in which momentary (1) negative and (2) positive affect, use of (3) avoidance-oriented and (4) engagement-oriented strategies, (5) subjective effectiveness as well as (6) non-regulatory reasons (binomial distribution with 1 = acceptance and 0 = competence deficit and negative expectations cumulated in other reasons) were predicted from a single Level 2 predictor: group membership (i.e., OCD vs. HC). To account for possible influences of momentary OC symptoms on affect, the same multilevel models were computed with time points reporting current OC symptoms omitted. As a deviation from our pre-registered data analysis plan, we did not run separate binomial multilevel models for the rate of acceptance and the rate of other non-regulatory reasons: After the exclusion of inconclusive trials, the two dependent variables were exactly inverse (one could be calculated precisely from the other) and thus, fitting these models did not add any value.

To investigate Hypothesis 2, we used multilevel models with random intercepts and random slopes regressing the use of (1) avoidance-oriented and (2) engagement-oriented strategies, (3) subjective effectiveness, as well as (4) reasons for nonregulation on person-mean centered momentary negative affect. We added group membership as potential moderator of the association between negative affect and selected strategies, ER success, and reasons for non-regulation.

Variants of all models were also fitted by additionally including grand-mean centered score of the DASS-21 depression subscale (only in models addressing Hypothesis 1 because models for Hypothesis 2 already included negative affect as predictor), day of assessment, age, gender, and interaction effect between day of assessment and group, as well as an interaction effect between age and gender to check whether any of the relationships change when we control for these variables. We also conducted graphical analyses to better understand significant fixed interaction effects. Multilevel models involving reasons for non-regulation were combined and not computed separately, thus deviating from the pre-registration.

Data and analysis code are available under the registration ID osf.io/7auvm.

Results

DESCRIPTIVE ANALYSIS

For sociodemographic and clinical characteristics, see Table 1. In sum, groups did not differ in age, gender, or years of education. Individuals with OCD reported significantly higher DASS-Depression subscores, DERS total scores, and ERQ-Suppression subscores as well as lower scores in the reappraisal subscale of the ERQ. In the OCD group, the mean DASS-Depression subscore of 7.36 indicated a moderate level of depressive symptoms (adapted from Lovibond & Lovibond, 1995). Overall, participants showed a compliance rate of 89.7%, indicated by an average of 32.3 (SD = 4.23) questionnaires submitted in total. Groups did not differ significantly in their compliance rates (OCD: M = 31.65 (4.58); HC: M = 33.06 (3.60), p = .07). Overall, 4,064 observations were included in our analyses for models with negative and positive affect as outcome variables (OCD: 2279, HC: 1785). OC symptoms were reported in 935 time points (observations per person: M = 12.99, SD = 7.06). Because use of avoidance-oriented ER strategies and engagement-oriented ER strategies as well as perceived ER effectiveness were only measured, when participants indicated that they tried to change their emotions (which was the case in around 25% of the collected data points as can be seen in supplement A), these models included 920 out of 4,062 emotion regulation observations (2 observations only included affect reports). Individuals in the OCD group contributed 651 observations (observations per person: M = 9.57, SD = 6.80), individuals in the control group contributed 269 observations (M = 6.26, SD = 4.01). Inversely, in

Table 1
Sociodemographic and Clinical Characteristics

	OCD ($n = 72$)	HC ($n = 54$)	*p-value*
Age (*M* (*SD*), Range)	29.17 (8.04), 19 - 55	27.76 (4.59), 20 - 45	.25
Gender (female)	$n = 57$ (79.17%)	$n = 43$ (79.63%)	>.99
Years of education (*M* (*SD*))	17.56 (3.58)	18.75 (3.83)	.08
Nationality (%)	$n = 71$ German (98.61%) $n = 1$ Bulgarian (1.39%)	$n = 54$ German (100.00%)	>.99
Current comorbidity (yes)	$n = 46$ (63.89%)		
No. of comorbidities (*M* (*SD*))	2.0 (1.16)		
OCD-related disorder (%)	$n = 4$ (8.70%)		
Anxiety disorder (%)	$n = 38$ (82.61%)		
PTSD (%)	$n = 6$ (13.04%)		
Psychosomatic disorder (%)	$n = 5$ (10.87%)		
Depressive disorder (%)	$n = 15$ (32.61%)		
Sexual dysfunction (%)	$n = 3$ (6.52%)		
Eating disorder (%)	$n = 2$ (4.35%)		
Sleeping disorder (%)	$n = 2$ (4.35%)		
ADHD (%)	$n = 1$ (2.17%)		
Current psychotherapy (yes)	$n = 33$ (45.83%)		
Current medication (yes)	$n = 26$ (36.11%)		
DASS-Depression (*M* (*SD*))	7.36 (5.03)	1.52 (2.17)	<.001
DERS (*M* (*SD*))	97.57 (25.49)	59.48 (13.81)	<.001
ERQ-Reappraisal (*M* (*SD*))	3.92 (1.25)	5.20 (0.97)	<.001
ERQ-Suppression (*M* (*SD*))	3.73 (1.29)	3.15 (1.18)	.01
Y-BOCS (*M* (*SD*))	22.21 (5.56)		
BABS (*M* (*SD*))	8.51 (3.22)		

Note. OCD = obsessive-compulsive disorder; HC = psychologically healthy controls; PTSD = posttraumatic stress disorder; ADHD = attention deficit hyperactivity disorder; DASS = Depression Anxiety Stress Scales; DERS = Difficulties in Emotion Regulation Scale; ERQ = Emotion Regulation Questionnaire; Y-BOCS = Yale-Brown Obsessive-Compulsive Scale; BABS = Brown Assessment of Beliefs Scale.

3,142 out of 4,064 observations participants indicated that they did not try to change their emotions and therefore, provided reasons for nonregulation. EMA time points with ambiguous data (e.g., acceptance and competence deficit at the same time, negation of all three reasons for nonregulation) were excluded from our analysis to ensure clearly interpretable results and interactions. This procedure resulted in a further reduction from 3,142 to 2,474 observations for our statistical model predicting acceptance of emotions (OCD: 1211 observations, $M = 17.81$, $SD = 7.35$, HC: 1263 observations, $M = 24.29$, $SD = 8.52$)[3]. There were no significant group differences regarding the quantity of inconclusive data points ($p > .05$).

[3] All statistical analyses were repeated when including EMA time points where individuals indicated acceptance and competence deficit at the same time. Result patterns did not change, which is why we will only report results from models excluding ambiguous data.

MULTILEVEL ANALYSIS

For seven out of eight multilevel models, at least one of the included predictors for the sigma coefficient was significant. These findings indicate that group membership, age, and gender may partially explain our between-group heteroscedasticity (see the online supplement B for detailed results).

Group Comparisons (Hypothesis 1)

For simplicity, fixed and random effects estimates for all models are included in Table 2, panel A. The main effect of group was significant for all multilevel models except for engagement-oriented strategies, indicating that the OCD (vs. HC) group showed significantly less positive and more negative affect. Additionally, participants with OCD reported significantly more avoidance-oriented strategies as well as less subjective effectiveness of ER. Further, participants with OCD less often reported acceptance as a reason for nonregulation and more often reported other reasons (i.e., negative expectations and competence deficit). There was no group difference in use of engagement-oriented strategies. The results for

Table 2
Estimates for Multilevel Models

A. Estimates addressing group comparisons (Hypothesis 1)

	Fixed effect	*z-value*	*p-value*	.95 CI	Random effect (*SD*)
Negative affect					
Intercept	0.169	2.687	0.007		0.460
Group	0.498	5.968	<.001	0.335, 0.662	
Positive affect					
Intercept	2.711	37.062	<.001		0.527
Group	−0.913	−9.427	<.001	−1.103, −0.723	
Engagement-oriented ER[1]					
Intercept	1.969	14.542	<.001		0.769
Group	−0.234	−1.378	0.168	−0.566, 0.099	
Avoidance-oriented ER					
Intercept	1.768	11.606	<.001		0.874
Group	0.898	4.698	<.001	0.523, 1.272	
Effectiveness					
Intercept	64.050	45.074	<.001		7.526
Group	−10.840	−6.040	<.001	−14.357, −7.322	
Non-regulatory reasons[2]					
Intercept	4.977	4.226	<.001		7.300
Group	−2.947	−1.966	0.049	−5.886, −0.009	

B. Estimates addressing associations between negative affect and other ER variables (Hypothesis 2)

	Fixed effect	*z-value*	*p-value*	.95 CI	Random effect (*SD*)
Avoidance-oriented ER					
Intercept	1.647	10.740	<.001		0.857
Negative Affect	0.718	3.297	<.001	0.291, 1.144	0.459
Group	0.937	4.903	<.001	0.563, 1.312	
Negative Affect:Group	−0.299	−1.225	0.221	−0.777, 0.179	
Engagement-oriented ER					
Intercept	2.005	14.478	<.001		0.769
Negative Affect	−0.191	−0.914	0.361	−0.602, 0.219	0.508
Group	−0.263	−1.522	0.128	−0.602, 0.076	
Negative Affect:Group	0.210	0.884	0.377	−0.255, 0.674	
Effectiveness					
Intercept	65.689	45.453	<.001		7.348
Negative Affect	−8.738	−3.424	<.001	−13.741, −3.736	5.833
Group	−10.951	−6.055	<.001	−14.496, −7.406	
Negative Affect:Group	1.091	0.371	0.710	−4.666, 6.848	
Non-regulatory reasons[2]					
Intercept	6.250	2.177	0.030		18.306
Negative Affect	−8.638	−4.764	<.001	−12.192, −5.085	4.665
Group	−3.946	−1.070	0.285	−11.174, 3.281	
Negative Affect:Group	5.239	2.596	0.009	1.284, 9.193	

Note. ER = emotion regulation; the reported models include time points with OCD symptoms and are not controlled for time of assessment, age, gender, and interaction effect between time of assessment and group as well as age and gender. [1] When excluding the first ten participants without the affect item "disgusted" and including all control variables, the main effect for group was significant in this model, [2] 1 = acceptance and 0 = other reasons.

positive affect, avoidance-oriented strategies, and subjective effectiveness remained significant when omitting time points with reported OC symptoms and when including grand-mean centered score of the DASS-21 depression subscale, time of assessment, age, gender, the interaction between time

of assessment and group, and the interaction between age and gender as covariates.[4]

Associations Between Negative Affect and Other Emotion Regulation Variables (Hypothesis 2)

Detailed results including fixed and random effect estimates are displayed in Table 2, panel B. The main effect of group remained significant for avoidance-oriented ER strategies and ER effectiveness as outcome variables. The main effect of negative affect was significant for all of our multilevel models except for the effect on engagement-oriented strategies, indicating that on time points where individuals reported higher-than-usual negative affect, they used a higher number of avoidance-oriented strategies and perceived their ER effectiveness as lower. In addition, when reporting higher-than-usual negative affect, individuals were less likely to report acceptance as a reason for non-regulation and more likely to report negative expectations and competence deficits. Significant interaction effects between group and negative affect were only found regarding reasons for non-regulation. Graphical analyses suggested that the negative association with acceptance (and other non-regulatory reasons) was more pronounced in the OCD (vs. HC) group for momentary negative below and around the individual mean. High negative affect (above the individual mean) was reversely associated with lower acceptance in the HC group (see the online supplement C for an interaction plot). All presented results remained significant when omitting time points with reported OC symptoms and when including time of assessment, age, gender, the interaction between time of assessment and group, and the interaction between age and gender as covariates.

Discussion

The aim of the present study was to assess OCD-related ER deficits and their association with momentary negative affect using an EMA design. Extending prior work on self-reported ER and OCD symptoms, this approach allowed us to examine differences in daily life ER between a clinical OCD and a HC group while reducing retrospective bias and accounting for contextual variables such as negative affect.

Regarding Hypothesis 1, our multilevel analyses confirmed group differences across all variables assessed except engagement-oriented strategies, supporting findings from previous studies using retrospective trait questionnaires (e.g., Moritz et al., 2018; Yap et al., 2018). As expected, individuals with OCD (vs. individuals in the HC group) reported more negative and less positive momentary affect, chose avoidance-oriented ER strategies more frequently, perceived their ER as less effective, and reported less acceptance of their emotional experiences. Contrary to previous results, individuals with OCD did not use less engagement-oriented strategies. As descriptive analyses indicated, the nonsignificant findings might be explainable by a generally smaller effect size for engagement-oriented strategies than expected (see Cohen's *d* in supplement A). As these results partially contradict Moritz et al. (2018), who emphasized the lack of adaptive strategies in OCD patients as an effect which distinguished them even from other clinical control groups, replicative EMA studies with larger OCD samples are needed before we draw substantive conclusions from these findings. In addition, group differences in negative affect and acceptance of emotions did not remain significant when omitting time points with OC symptoms and controlling for baseline depression scores, age, gender, and day of assessment, indicating a more unstable effect. These findings show that differences in negative affect might be better explainable by comorbid depressive symptoms (Moore & Howell, 2017), while group differences in positive affect seem to be more OCD-specific. Regarding emotional acceptance, future studies using dimensional (instead of dichotomous) EMA items may provide insight into more fine-grained group differences.

However, particularly the fact that individuals with OCD perceived their ER as less effective may impact their daily regulatory behavior and symptomatology. Supporting this presumption, recent studies have indicated that the association between ER strategies and psychopathology is partially moderated by perceived effectiveness (e.g., De France et al., 2022), suggesting the influence of perceived regulatory success on symptom reduction. Similarly, Daniel et al. (2019) reported an association between perceived effectiveness and psychopathology but found no association between more objective measures of regulation effectiveness and symptom severity. Additionally, recent evidence indicates that higher intensity of affect also reduces perceived effectiveness of ER

[4] Additionally, we ran post-hoc analyses for all group comparisons when including comorbidity either as bivariate variable (i.e., comorbidity yes/no) or the number of comorbidities as continuous variable, which did not change any result patterns. Another post-hoc analysis with engagement-oriented ER strategies as outcome measure was conducted where we compared individuals in the HC group either with individuals with OCD currently enrolled in psychotherapy or currently not enrolled in psychotherapy. Results showed that non-significant group differences in engagement-oriented ER strategies were not explainable by treatment status.

strategies, which is consistent with our results; this may also support the hypothesis that individuals with OCD are more likely to be less confident of their own ER competence while dealing with more negative affect (Wylie et al., 2022). Future studies should investigate the underlying mechanisms of these findings and implications for long-term outcomes in OCD.

To the best of our knowledge, this study was the first to examine OC symptoms using a discriminative EMA approach. Interestingly, group differences in positive affect, use of avoidance-oriented strategies, and ER effectiveness presented in Hypothesis 1 remained significant even when omitting reported OC symptoms from our analyses. These findings support structural—rather than symptom-dependent—ER deficits in individuals with OCD, which is consistent with previous results regarding emotion dysregulation as a transdiagnostic element of psychopathology (Aldao et al., 2010; Yap et al., 2018). To further elaborate on the question of whether the observed ER group differences are transdiagnostic or OCD-specific, future studies with clinical control groups (e.g., major depression) are beneficial.

Regarding Hypothesis 2, momentary negative affect exerted a significant effect on ER. As presumed, more intense momentary negative affect was associated with diminished perceived ER effectiveness and acceptance of emotional experiences and heightened use of avoidance-oriented ER strategies across groups. Given generally heightened negative affect in the OCD group (see Hypothesis 1), higher momentary negative affect may be one of several factors driving the strong group differences in ER we observed. These results stress the importance of including negative affect, at least as control variable, in future ER studies. However, importantly, group differences for ER effectiveness and avoidance-oriented ER strategies remained significant even when accounting for momentary OC symptoms and negative affect. Thus, individuals in the OCD group seemed to present more ER difficulties than the control group above and beyond generally heightened negative affect (Heller et al., 2021; Moore & Howell, 2017). In addition, past research suggested that associations between negative affect and ER difficulties might differ between different types of obsessions (e.g., taboo vs. contamination; Berman et al., 2020). To increase our understanding for differential ER processes within this heterogeneous disorder, future OCD studies should assess the momentary content of obsessions as well.

In contrast to other ER components, we did not find a significant effect of momentary negative affect on engagement-oriented ER strategies. These findings partially contradict previous studies observing less use of engagement-oriented ER strategies when experimentally manipulating the intensity of negative affect (e.g., Sheppes et al., 2011). However, our divergent results for avoidance-oriented and engagement-oriented ER strategies still point towards more emotional disengagement in response to high negative affect instead of a generally higher need for regulation across different groups of ER strategies (Brans et al., 2013; Dixon-Gordon et al., 2015). One explanation for the contrasts to other EMA studies showing that the frequency of engagement-oriented strategies does increase in the presence of heightened negative affect as well (Brans et al., 2013; Dixon-Gordon et al., 2015), could be that we used the total number of engagement-oriented strategies instead of endorsement of single ER strategies rated on Likert-scales as predictors. As in our analyses pertaining to Hypothesis 1, another explanation for these surprising findings may be the insufficient statistical power for the detection of small effect sizes. Thus, before further interpretation of these findings, replications of these results with systematic variations in study design and in a larger sample are needed.

Surprisingly, interaction effects between negative affect and group were mostly insignificant and the only significant interaction effect on reasons for non-regulation of emotions was not in line with our hypothesis. For momentary negative affect below and around the individual mean, the negative association with acceptance (and other non-regulation reasons) was more pronounced in the OCD group (vs. the HC group). High negative affect (above the individual mean) was associated with lower acceptance in the HC (vs. OCD) group, indicating that a relatively more negative attitude towards negative emotions is only more pronounced in individuals with OCD in situations with below-average and average distress. However, these findings should be interpreted with caution due to the small sample size underlying parts of this specific model: Only n=16 individuals in the control group reported other reasons for non-regulation (i.e., competence deficit or negative expectations). In an exploratory analysis, we found significantly higher trait distress and lower trait ER competence in this small subgroup (i.e., significant deviations in scores on the DASS-21, DERS, and ERQ). Hence, group differences in the association between acceptance and above-average

negative affect may be driven by a small subgroup of HC displaying higher-than-typical distress scores and, thus, is not representative of the whole group. In addition, very large random effects (see Table 2, panel B) indicate large individual differences in the association between acceptance and negative affect and lead to higher statistical uncertainty. In this regard, further research with larger sample sizes is needed to better understand factors driving individual differences and replicate findings before a solid interpretation of the results is feasible. For correct uncertainty quantification, the current analysis profited from models for person-specific residual variance, and we assume results of many other EMA data analyses could be robustified by the use of generalized (additive) models for location and shape.

LIMITATIONS

This study has several limitations. First, because EMA inherently involves observations at various time intervals, and because we only collected time-based data (not event-based data) starting at 9:00 a.m., we may have missed the occurrence of relevant OC symptoms for some participants, especially OC symptoms in the early morning (e.g., when leaving the house and checking windows and lights). However, the restricted time frame from 9:00 a.m. to 9:00 p.m. was specifically chosen to decrease the participant's experienced burden during data collection. Second, individuals in the HC (vs. OCD) group reported significantly less frequent ER. This may be due to an actual lower need for regulation, which would be consistent with generally more positive and less negative affect in this group, but this could also be driven by motivational factors, for example, decreasing the time load caused by study participation. Third, for practical reasons, it was necessary to limit the choices of ER strategies, which artificially restricted the response behavior of our participants and may have made it challenging to respond precisely in some instances. Fourth, although intrusive thoughts with similar content to clinical obsessions are a common phenomenon in the general population (Rachman & de Silva, 1978), we did not record subclinical intrusions in the control group; however, individuals in the OCD group were specifically instructed to report only those obsessive thoughts that were classified as clinically relevant in the interview before the EMA assessment. Potential reactivity to the EMA assessment could be largely eliminated by including time of assessment as a covariate in our statistical analyses. Fifth, the generalizability of our findings is somewhat limited: We excluded individuals with certain mental disorders (e.g., borderline personality disorder or addiction), we did not explicitly assess participant's race or sexual orientation, and both groups were comparatively young with a maximum age of 55 (OCD) or 45 (HC) years. Thus, future studies assessing this missing demographic information and using more diverse samples are warranted.

CONCLUSION

The present study was the first of its kind to investigate emotion dysregulation in OCD with an EMA design. We could replicate extensive trait-level group differences in affect and ER behavior between individuals with OCD and HC on the momentary level. Importantly, most group differences remained significant after controlling for current OC symptoms and negative affect or depression. In addition, we shed light on associations between momentary negative affect and other ER components. We plan to conduct more systematic investigation on ER dynamics and their contribution to OCD psychopathology in the future. Results regarding associations between momentary use of (avoidance-oriented vs. engagement-oriented) ER strategies and subsequent OC symptoms will be reported elsewhere.

Clinically, our results might indicate that the treatment of OCD should incorporate a more holistic approach of ER next to targeting disorder-specific situational emotions (e.g., fear of a supposedly contaminated door handle) via ERP. Especially our findings on very robust group differences in positive affect and subjective ER effectiveness may support the potential of broader up-regulation of positive affect (e.g., Quoidbach et al., 2015) in contrast to ERP focusing strongly on the reduction of avoidance-oriented strategies in OCD-specific situations. In support of this idea, transdiagnostic programs addressing ER, such as the *Unified Protocol for Transdiagnostic Treatment of Emotional Disorders,* have already shown promising results (e.g., Barlow et al., 2017). Furthermore, it might be beneficial to provide training in general ER abilities and, consequently, increase perceived ER effectiveness, which, in turn, can influence choice of adaptive ER strategies (De France et al., 2022).

Supplementary data to this article can be found online at https://doi.org/10.1016/j.beth.2024.01.011.

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