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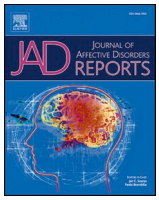

Research Paper

# The interplay of emotion regulation, depressive symptoms, and age under a COVID-19 lockdown: Capturing emotion regulation variability, effort, and success

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ABSTRACT

*Background:* Emotion regulation (ER) plays an important role for mental health. However, there is limited research involving ER variability as a prerequisite for adaptive ER. The present study assessed the relations between two indicators of ER variability (between- and within-strategy), depressive symptoms, perceived ER effort and success, and age.

*Methods:* We implemented a three-week ambulatory assessment study during a nationwide lockdown in Germany during the Covid-19 pandemic (April 2020). The sample comprised 322 participants aged between 15 and 82 years (M = 28.8 years, SD = 14.0, 74.5 % female). Participants reported their daily use of ER strategies in the evening. The data were analysed with stepwise regression analyses.

*Results:* We found significant positive associations between within-strategy variability and depressive symptoms. Perceived ER effort was positively correlated to depressive symptoms, while perceived ER success was negatively associated with depressive symptoms. Between-strategy variability did not show a significant connection to depressive symptoms. Age was negatively associated with within-strategy variability.

*Conclusions:* The findings support that day-to-day ER variability, particularly within-strategy variability, is a significant correlate of depressive symptoms across a wide age range. Our results underscore the importance of considering situational context information when analyzing the adaptiveness of specific ER patterns.

## 1. Introduction

The way we deal with challenging events and demands is strongly connected to our mental health. Given that our environment changes dynamically and constantly, flexibility is needed, allowing us to choose from a range of possible solutions and ways to respond adaptively (Buttelmann and Karbach, 2017). This includes the use of emotion regulation (ER), i.e., the use of strategies to influence own emotions by down-regulating negative affect and up-regulating and maintaining positive affect (Gross, 1998). Thompson (1994) defined ER as the capacity to influence one's own emotional experience in terms of quality, intensity, timing, and dynamics in an intended direction. Mental health issues, such as depression (Berking et al., 2014), generalized anxiety disorder (Mennin et al., 2007), post-traumatic stress disorder (Tull, 2003), social anxiety (Kashdan and Breen, 2008) or eating disorders (Piran and Cormier, 2005), have been linked to difficulties in ER. Difficulties in ER, or emotion dysregulation, refer to dysfunctional patterns of ER. Cole and colleagues (2017) distinguished four types of these dysfunctional patterns of ER that mark different forms of psychopathology, one of which is the persistence of emotions and the ineffectiveness of attempts to regulate them interfering with appropriate goal-directed activity. Individuals' goals may vary from situation to situation, encompassing a broad range of objectives, such as feeling better, engaging appropriately in social interactions, or coping with challenges (Thompson, 2019). Indications of dysfunctional ER are evident when these goals are not met and emotional responding exhibits the characteristics described by above (Cole et al., 2017). Dysfunctional ER plays a particularly important role in triggering and maintaining depression (Beck, 1979).

To comprehend the emergence of ineffective or dysfunctional patterns, research has examined the link between affective psychopathology and the habitual utilization of a wide range of specific ER strategies, having also classified said strategies. A widely used classification is based on their association with psychopathology or direct effects on

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emotion, labelling ER strategies either as adaptive or maladaptive. Past research has investigated different ER strategies, focusing on identifying generally adaptive, healthy strategies on the one hand and generally maladaptive, unhealthy strategies on the other hand. For example, acceptance, or social sharing are considered adaptive ER strategies. Avoidance, suppression, or rumination, on the contrary, are referred to as maladaptive ER strategies (Lincoln et al., 2022). However, this 'fallacy of uniform efficacy' (Bonanno and Burton, 2013) neglected the interplay of person and situation, because the same regulation process can be effective and adaptive in one situation and ineffective in another (Lazarus, 1991, 1993). Cognitive reappraisal, for example, is considered another adaptive ER strategy, but this effectiveness may vary across contexts: Troy and colleagues (2013) found that reappraisal was adaptive when stressors were uncontrollable, but maladaptive when stressors could be controlled. Consistently, lower levels of anxiety and depression have been associated with a balanced profile of alleged adaptive and alleged maladaptive ER strategies. A growing number of studies therefore focusses on the flexible application of ER strategies across situations, rather than on rigid patterns of specific strategies (Cheng et al., 2014).

### 1.1. Flexible ER and depression

Regulatory flexibility encompasses the capacity to discontinue a previous ER strategy and potentially select a new one (Bonanno and Burton, 2013). Research showed that abandoning ineffective ER strategies and shifting to a new ER strategy has also been related to lower levels of depression (Cheng et al., 2014; Kato, 2012). Drawing on this, models of ER flexibility assume that individuals who use ER strategies variably, depending on the context, will be better able to cope with experiencing negative events (Aldao et al., 2015), thus resulting in better psychological adjustment and ultimately lower levels of depression.

Based on the concept of personality traits as 'relatively enduring patterns of thoughts, feelings, and actions' (McCrae and Costa, 2008), Fleeson (2001) defined traits as density distributions of states (i.e., stable interindividual differences in the reactivity to situational cues). We address whether cross-situational ER variability is related to experiencing depressive symptoms, emphasizing the *person* in the situation-strategy fit perspective (Haines et al., 2016). So far, there is little literature that focuses on the direct relation between cross-situational ER variability and depression (Blanke et al., 2020; Wang et al., 2021).

### 1.2. ER flexibility and ER variability

In recent years, the concept of ER flexibility (Bonanno and Burton, 2013) as a specific aspect of psychological flexibility has led researchers to examine how individuals adapt and flexibly regulate emotions across challenging and changing situations. Contemporary ER theories propose that inflexible use of the same supposedly adaptive strategy does not constitute effective ER (e.g., Aldao et al., 2015; Gross, 2015) and does not yield a protective effect against mental health issues. Findings identifying psychological inflexibility as a potential risk factor for various psychological and physiological problems underscore the importance of ER flexibility (Kobylińska and Kusev, 2019). Accordingly, psychological flexibility serves as a protective factor against depression (Kashdan and Rottenberg, 2010), whereas inflexible attributional styles contribute to the development and maintenance of depressive disorders (Cheng et al., 2014; Wang et al., 2021).

According to Aldao and colleagues (2015), ER variability is a necessary precondition for ER flexibility. They define ER variability as variation in the use of one or more ER strategies across situations. ER flexibility exists when ER variability is adapted to the changing demands of a situation so that a pursued goal can be achieved. ER variability is thus a necessary but not sufficient condition for ER flexibility. There are two types of variability: *within-strategy variability* and *between-strategy variability*. While the former is the variation in the intensity of the use of one or more strategies across situations and time, between-strategy variability refers to the selection of strategies at a given point in time (Aldao et al., 2015). To determine intraindividual variability based on intensive longitudinal data, it is necessary to assess the use of ER in the everyday lives of participants via experience sampling methods. Previous research has predominantly focused on the association between ER and (negative) affect (e.g., Bahlinger et al., 2022; Boemo et al., 2022; Daniel et al., 2019). However, recent studies suggest that ER variability may act as a protective factor against depression, given the association between psychological inflexibility and depressive symptoms (e.g., Wang et al., 2021).

We focused on depression because of its high overall prevalence rates – and because the Covid-19 pandemic is a particularly challenging context for depressive symptoms. During difficult, uncontrollable periods such as the Covid-19 outbreak, depression rates can spike, sometimes up to seven times higher (Bueno-Notivol et al., 2021). Challenging times place additional strain on ER, making it important to understand how different facets of ER relate to depressive symptoms, particularly during a lockdown. Given the substantial prevalence of depressive disorders (Shorey et al., 2022), the significant personal and societal impact, and the comorbidities, it is important to examine this relationship.

Therefore, our study investigated the relationship between depressive symptoms and ER variability to improve the understanding of adaptive ER. We consider symptoms of psychopathology as indicators of inadequate adaptive functioning. Within this framework, we acknowledged the potential importance of cross-situational variability in ER strategies, recognizing that it can either mitigate, exacerbate, or result from depression. However, there are heterogeneous findings on the adaptiveness of ER variability. For example, there is evidence for a positive correlation between within-strategy variability and depressive symptoms (Blanke et al., 2020), as well as negative correlations of within-strategy variability of selected ER strategies (distraction and reappraisal) with depression (Wang et al., 2021). The correlates of between-strategy variability appear to be similarly inconsistent, with studies finding either no association or a negative correlation between negative affect and between-strategy variability (Bahlinger et al., 2022; Blanke et al., 2020).

### 1.3. ER effort and ER success

In addition to the variability in the use of ER strategies, perceived effort and success in ER are associated with mental well-being. In general, more effort is reported for negative than for positive experiences (English et al., 2017), and increased use of diverse ER strategies is associated with increased symptoms of psychopathology (Dixon-Gordon et al., 2015). The well-documented association between depression and cognitive impairment persists even after accounting for subclinical depressive symptoms (Halahakoon et al., 2019), contributing to reduced psychosocial functioning. This cognitive impairment may lead to an increase in the perceived effort required for ER, as overall cognitive resources are compromised. Given these considerations, it is worthwhile to examine the relationship between depressive symptoms and perceived ER effort.

Assessing perceived success in using ER strategies may also provide valuable insight into patterns of ER associated with depressive symptoms. Dysfunctional ER, characterized by unmet ER goals, is inherent to depression. Thus, assessing perceived ER success helps to simplify the complex array of personal goals intertwined with ER. This assessment allows us to evaluate the effectiveness of strategy deployment without requiring explicit knowledge or extensive documentation of participants' potentially many and varied emotional goals, whether hedonic or instrumental (Tamir et al., 2008). This nuanced assessment enhances our comprehension of perceived (in)effective ER and its association with psychopathology. For instance, patients diagnosed with bipolar disorder

reported higher ER effort but less ER success (Gruber et al., 2012; Mansella et al., 2007). This potential ER 'effort-success gap' (Gruber et al., 2012), indicative of heightened effort but diminished success in ER, may help elucidate the accompaniment of adaptive ER.

### 1.4. Age differences in ER

Several studies suggest that emotional well-being improves with age (Birditt and Fingerman, 2003; Charles and Carstensen, 2010; Reynolds and Gatz, 2003). Considering the physical and cognitive decline that is associated even with healthy aging, this may be surprising. It is an obvious assumption, that this *emotion paradox in the aging brain* (Mather, 2012) is partly due to more competent ER (Isaacowitz, 2022). There are laboratory-based studies providing indication of better ER with aging such as older adults being more effective at using positive reappraisal (Shiota and Levenson, 2009) or less cognitively costly ER for older adults (Scheibe and Blanchard-Fields, 2009). A naturalistic experience sampling study found that older adults used a wider variety of ER strategies (Puente-Martínez et al., 2021). However, recent reviews yield mixed evidence for age differences in the use of specific ER strategies (Allen and Windsor, 2019) or do not support any robust conclusions (Isaacowitz, 2022). Regarding ER variability, older age is associated with less ER variability within specific ER strategies, such as reappraisal, suppression, situation selection, or distraction. It was concluded that this lower ER variability may be indicative of age-related cognitive decline, whereas its reduction may also indicate appropriate matching of strategies to less variable situational demands (Benson et al., 2019; Eldesouky and English, 2018).

### 1.5. The current study

The main purpose of the current study was to investigate the association between daily ER variability and depressive symptoms, highlighting the significance of ER variability as an important indicator of mental health. For this study, our understanding of adaptiveness is guided by the classification that evaluates adaptiveness based on its association with psychopathology (Lincoln et al., 2022). In other words, we considered ER variability as adaptive, when it was associated with lower levels of psychopathology. We adopted the density-distribution approach proposed by Fleeson (2001) to reliably estimate individual variability in ER, as theoretical frameworks suggest that within-person variability in ER reflects a between-person characteristic (Aldao et al., 2015). We were interested in examining individual differences in this variability. Thus, trait-relevant behavior, represented by the variable ER strategy use, was aggregated across multiple occasions to identify individual differences in day-to-day variation. These aggregations, which are known to be less biased than global retrospective self-reports (Conner and Mehl, 2015, for a review), facilitated our investigation into whether ER variability was associated with age.

We then examined the interplay between depressive symptoms, ER strategy effort, and ER success. Again, we aggregated daily within-person information about ER effort and ER success on the between-person level to see if there was a pattern specific to participants reporting more depressive symptoms. To contribute to research on day-to-day patterns of ER, we conducted a 21-day ambulatory assessment (AA) study during Germany's first nationwide COVID-19 pandemic lockdown. Without a certain end date, the COVID-19 pandemic strongly affected daily life and presented a complex combination of stressors (Chen and Bonanno, 2020), possibly causing an increased need for ER. Given that findings on the adaptiveness of ER variability are heterogeneous (Bahlinger et al., 2022; Blanke et al., 2020; Elkjaer et al., 2022; Wang et al., 2021), we refrained from formulating a directed hypothesis and merely explored in a first step, whether within-strategy and between-strategy variability based on intensive longitudinal data would be significantly correlated with depressive symptoms. Second, we tested whether age is negatively associated with variability in ER strategy use. In line with prior research on age-related differences in ER variability (Benson et al., 2019; Eldesouky and English, 2018), we expected age to be negatively associated with within-strategy and between-strategy variability. Finally, we investigated whether depressive symptoms are associated with higher ER strategy effort and lower ER success. In accordance with the ER effort–success gap observed in individuals with bipolar disorder (Gruber et al., 2012) or psychotic disorders (Strauss et al., 2019), we hypothesized that depressive symptoms are positively associated with perceived ER strategy effort and negatively associated with perceived ER success, especially during a pandemic lockdown, which is characterized by uncertainty and uncontrollability.

## 2. Method

### 2.1. Procedure

We followed the reporting guidelines for AA studies outlined by Trull and Ebner-Priemer (2020). The study started with an online survey including sociodemographic and baseline measures such as depressive symptoms, followed by an AA covering 21 days. We used an interval-contingent sampling scheme with one morning and one evening assessment per day. In order to prevent overburdening the study participants in these difficult times, we chose to minimize the number of daily assessments. The data was collected via Sosci Survey (Leiner, 2018). Participants received the link to the daily assessments via text message, which was valid for a limited time (3 hrs for the morning survey, 6 hrs for the evening survey). Participants received €40 for completing the online questionnaire when achieving at least 50 % compliance with the daily surveys. Participants with a compliance rate of over 80 % received an additional €20. The study was approved by the local ethics committee (application #258_2020) and carried out in accordance with the Declaration of Helsinki. All participants started on the same day in a phase of nationwide lockdown in Germany (13/04/2020 - 03/05/2020). Universities, schools, shops, restaurants, etc. were already closed for the past four weeks. Contact restrictions had been implemented for the preceding three weeks. At the same time, step-wise implementation of obligatory mouth and nose protection was introduced. For more detailed information about the conditions of the lockdown see Lischetzke et al. (2022).

### 2.2. Participants

Participants had to be $\geq$ 15 years old. They had to have access to a laptop, computer, or tablet (for participation in the initial online survey) and to a smartphone (for participation in the daily assessments). All participants provided active written-informed consent. Participant data was included if at least 7 morning and 7 evening surveys (with at least 8 items of the respective daily survey completed) were available after checks for technical problems and careless responding. In order to screen for careless responding, inconsistent responding across reverse-poled (mood) items and response times were analyzed (Meade and Craig, 2012). The final sample comprised 322 participants (74.5 % women) aged between 15 and 82 years (M = 30.7, SD = 14.95), yielding 6084 evening assessments. As only evening surveys included variables relevant to the present research questions, the morning assessments were not analyzed (see Table 1 for an overview of the AA questionnaire). Consequently, we analyzed one measurement point per day and examined the day-to-day variation in the variables of interest. On average, participants provided 18.89 (out of 21 possible) evening assessments (SD = 2.82, Mdn = 20, Min = 7, Max = 21). In the online survey, participants stated their COVID-19-related concerns on a scale ranging from 1 (= 'no concerns at all') to 7 (= 'very high concerns') regarding job loss (M = 2.68, SD = +/- 1.86), financial situation (M = 3.09, SD = +/- 1.88), own health status (M = 3.43, SD = +/- 1.68), and health status of relatives (M = 5.44, SD = +/- 1.50). Additionally, participants stated how many other people lived in their household (17.4 % living alone,

**Table 1**
AA questionnaire used with answer format.

| Variable | Item | Answer format |
|---|---|---|
| ER Strategies | *How did you deal with your feelings today? Please indicate which of the following behaviors you engaged in, regardless of whether the behavior had any effect.* | – |
| Situation selection | *I chose which situation to put myself in.* | *Yes* or *No* |
| Situation modification | *I actively changed something in the situation.* | *Yes* or *No* |
| Distraction | *I did something to distract myself (physically or mentally).* | *Yes* or *No* |
| Reappraisal-change | *I changed the way I was thinking about the situation.* | *Yes* or *No* |
| Reappraisal-perspective | *I took a step back and looked at things from a different perspective.* | *Yes* or *No* |
| Acceptance | *I accepted my emotions as valid and important.* | *Yes* or *No* |
| Rumination | *I thought over and over again about my emotions.* | *Yes* or *No* |
| Social sharing | *I talked with someone about my emotions.* | *Yes* or *No* |
| Ignoring | *I ignored my emotions.* | *Yes* or *No* |
| Suppression | *I was careful not to express my emotions to others.* | *Yes* or *No* |
| ER Effort | *How hard have you tried to influence your feelings today? (to change them or actively maintain them).* | Slider scale: 0 (*not at all*) to 100 (*very much*) |
| ER Success | *How well did you manage to influence your feelings today? (to change them or actively maintain them).* | Slider scale: 0 (*not at all*) to 100 (*very much*) |

35.1 % living with one more person, 47.5 % living with two or more persons). The prevalence of risk factors for severe COVID-19 in our sample was comparable to estimates from a modelling study for Europe (Clark et al., 2020), yet the sample was not representative for different age groups with more younger than older participants. For more detailed information regarding the recruitment, sample characteristics, compliance rates, and data cleaning process, see Lischetzke et al. (2022).

### 2.3. Baseline measures

#### 2.3.1. Depressive symptoms

Depressive symptoms were assessed once using the nine-item self-report depression module of the Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999; German version by Gräfe et al., 2004). Participants rated the frequency of nine depressive symptoms during the past two weeks on a 4-point Likert scale ranging from 0 ('Not at all') to 3 ('Almost every day'). We calculated sum scores across all items as there were no missing items on any of the participants. Total scores of 5, 10, 15, and 20 represent cut points for mild, moderate, moderately severe and severe depression, respectively (Kroenke et al., 2001). Cronbach's alpha for this sample was 0.83.

### 2.4. Daily measures

#### 2.4.1. ER strategies

The use of ER strategies was assessed by ten items adopted from Grommisch and colleagues (2020). Each evening, participants rated their use of ten specific ER strategies during the day. The following eight ER strategies were included to capture all stages of Gross's process model of ER (2015): *situation selection* ('I chose which situation to put myself in'), *situation modification* ('I actively changed something in the situation'), *distraction* ('I did something to distract myself (physically or mentally)'), *reappraisal-change* ('I changed the way I was thinking about the situation'), *reappraisal-perspective* ('I took a step back and looked at things from a different perspective'), *rumination* ('I thought over and over again about my emotions'), *social sharing* ('I talked with someone about my emotions'), and *suppression* ('I was careful not to express my emotions to others'). Additionally, we included *acceptance* ('I accepted my emotions as valid and important') and *ignoring* ('I ignored my emotions') because they have been extensively researched, yet their classification within this model is not straightforward.

For each of the ER strategies, participants were asked to indicate whether they had used a strategy ('Yes'/1) or not ('No'/0) on a dichotomous answer format, regardless of whether the strategy was successful or not. The decision to use a dichotomous variant of answering aimed at disentangling ER strategy use and ER effort. As common instructions employing rating scales (e.g., 'To what extent did you apply the following descriptions since the last survey?') harbors the risk of mixing the notions of ER strategy use and ER effort, we intentionally opted for a dichotomous assessment of ER strategy use, ensuring a clear differentiation between both.

#### 2.4.2. ER strategy variability

In order to determine ER strategy variability, within- und between-strategy variability indicators were calculated using SD (cf. Aldao et al., 2015). In the analysis of binary data, various variation indices have been employed in social science research, SD being one of them (for variables such as male/female, rural/urban, or college educated/not college educated, c.f. Schumm, 2019). We applied the same approach as Blanke and colleagues (2020) and calculated variability indicators at the person level (i.e., across all measurement occasions). Within-strategy variability was derived from SDs of ER strategy usage across multiple measurement occasions, in our case a maximum of 21 measurement occasions. That is, for the mean within-strategy variability, the SDs of all ten strategies were averaged across strategies and measurement occasions for each participant, in line with the principles of the density-distribution approach (Fleeson, 2001).

High within-strategy variability suggests that individuals used more of the respective strategies variably across time. As a measure of between-strategy variability, we first calculated the SDs of the ratings of all ten ER strategies at each measurement point. We then averaged moment level SDs across all 21 measurement points as an estimation of person-level between-strategy variability. Higher values are obtained when prioritizing few strategies strongly, low between-strategy variability is obtained when endorsing multiple strategies to a similar extent. Reliabilities based on Cronbach's alpha were calculated for between-strategy ($\alpha = 0.86$) and within-strategy variability ($\alpha = 0.67$). Although Cronbach's alpha for within-strategy variability was only moderate to acceptable by convention, this possibly reflects that reliability on the within-person level is typically lower than on the between-person level (e.g., Wilhelm and Schoebi, 2007).

#### 2.4.3. ER effort and ER success

In order to measure ER effort and success, we used two items adapted from Gruber et al. (2012). These two questions assessed to what extent participants expended effort ('How hard have you tried to influence your feelings today? (to change them or actively maintain them)') and were successful ('How well did you manage to influence your feelings today? (to change them or actively maintain them)') in regulating their emotions. In contrast to the dichotomous assessment of ER strategy, we opted for a slider scale ranging from 0 ('Not at all') to 100 ('Very much') as the response format for ER effort. This format was used for both ER effort and ER success to ensure consistency in participants' responses.

Following the density-distribution approach (Fleeson, 2001), ER effort as well as ER success were averaged separately across all measurement occasions for each participant to obtain a reliable estimate of interindividual differences in perceived ER effort and ER success.

#### 2.4.4. Statistical analysis

Data analysis was conducted using *R* software (R Core Team, 2021). Within-strategy and between-strategy ER variability was quantified through the calculation of SDs (Aldao et al., 2015; Blanke et al., 2020).

Stepwise multiple regression models were used to determine the relative contribution ($R^2$) of predictors on the respective models by adding the predictors iteratively. Using SDs to calculate ER variability may be confounded with mean levels of ER strategy use. Since higher levels of psychopathology are associated with a higher need for ER regulation (Aldao et al., 2015), we added mean ER strategy endorsement as a variable to our analyses (e.g., Blanke et al., 2020). This allows us to disentangle the effect of ER variability and the effect of mean ER endorsement in our predictions. We controlled for mean ER strategy endorsement along with independent and dependent variable data by averaging the means of all strategy endorsement level across all measurement occasions. The average of dichotomized variables corresponds to the relative frequency of the value 1, indicating the use of a specific strategy by participants in the current study. In our analysis, the terms 'predictor' and 'dependent variable', when used in the context of multiple regression, were employed for analytical purposes only and exclusively in the results section, without implying or inferring causal relations. Effect sizes were expressed as Cohens *f*, with 0.02, 0.15 and 0.35, denoting a small, medium, and large effect size, respectively (Cohen, 1988).

## 3. Results

### 3.1. Preliminary analyses

Descriptive values (M, SD, range) and reliabilities (Cronbach's alpha α) are provided in Table 2. Correlation coefficients are displayed in Table 3. There were no extreme outliers or instances of multicollinearity in the regression analyses. In line with our theoretical framework (Aldao et al., 2015), we used SDs as indicators of variation. However, as there is no optimal method to measure variance for binary variables, we explored an alternative approach by calculating the variation ratio, a measure of statistical dispersion in nominal distributions (Freeman, 1965). Because all main findings were the same, we focus on SDs in this study. To examine the robustness of our results, a post hoc sensitivity analysis was performed using G*Power version 3.1 (Faul et al., 2007). We aimed to detect an increase in $R^2$ with an alpha error probability of 0.05 and a power of 0.90. With the present sample size of 322, increases of $f^2 = 0.045$ can be tested with a power of 0.90, which is sufficient to test the present hypotheses.

### 3.2. Depressive symptoms, within-strategy variability, and age

The first analysis was carried out to determine if depressive symptoms and age are associated with individuals' within-strategy variability in daily ER strategy use. We used stepwise multiple regression analyses to assess the variable's individual contribution to $R^2$ and its effect size (see Table 4). In Step 1, we controlled for mean ER strategy endorsement, preventing within-strategy variability from being confounded with the mean. Multiple regression analysis with the predictors depressive symptoms and age and the dependent variable within-strategy variability showed that a total of 9 % of the variance in the variability of daily ER strategy use can be accounted for by the three predictors, $F(3, 318) = 11.27$, $p < 0.001$,

$f^2 = 0.10$. According to Cohen (1988), this can be interpreted as a small to medium effect size. Looking at the unique individual contributions of the predictors, the results showed that depressive symptoms ($\beta = 0.23$, $t = 3.72$, $p < 0.001$, $f^2 = 0.07$) positively predicted within-strategy variability in daily ER, implying that the more participants reported depressive symptoms, the more they used all considered strategies variably across time and situations. In contrast, age ($\beta = -0.15$, $t = -2.98$, $p < 0.01$, $f^2 = 0.02$) negatively predicted variability in daily ER strategy use, indicating that older participants tended to show less within-strategy variability. The control variable mean ER strategy endorsement ($\beta = 0.01$, $t = 0.25$, $p = 0.79$, $f^2 < 0.01$) did not significantly account for variability in daily ER strategy use.

**Table 2**
Descriptive statistics (N, mean scores, standard deviations and range) and reliabilities (Cronbach's alpha).

| | α | N | M ± SD | Min | Max |
|---|---|---|---|---|---|
| Age (years) | – | 322 | 30.7 ± 14.95 | 15 | 82 |
| 15–20 | | 90 (27.9 %) | | | |
| 21–30 | | 141 (43.8 %) | | | |
| 31–40 | | 28 (8.7 %) | | | |
| 41–50 | | 11 (3.4 %) | | | |
| 51–60 | | 27 (8.4 %) | | | |
| 61–70 | | 20 (6.2 %) | | | |
| > 70 | | 5 (1.6 %) | | | |
| Number of people living in the same household | – | 322 | – | – | – |
| 1 | | 56 (17,4 %) | | | |
| 2 | | 113 (35,1 %) | | | |
| 3 | | 60 (18,6 %) | | | |
| 4 | | 68 (21,1 %) | | | |
| 5 | | 19 (5,9 %) | | | |
| 6 | | 4 (1,2 %) | | | |
| 7 | | 2 (0,6 %) | | | |
| COVID-19-related concerns | – | 322 | | | |
| Potential job loss | | | 2.68 ± 1.86 | 1 | 7 |
| Individual financial situation | | | 3.09 ± 1.88 | 1 | 7 |
| Personal health status | | | 3.43 ± 1.68 | 1 | 7 |
| Health status of relatives | | | 5.44 ± 1.50 | 1 | 7 |
| PHQ-9 | 0.83 | 322 | 7.29 ± 4.81 | 0 | 27 |
| Mean strategy endorsement | 0.95 | 322 | 0.5 ± 0.14 | 0.15 | 0.88 |
| Within-strategy variability | 0.67 | 322 | 0.31 ± 0.09 | 0.06 | 0.49 |
| Between-strategy variability | 0.86 | 322 | 0.48 ± 0.04 | 0.28 | 0.52 |
| ER effort | – | 322 | 34.84 ± 16.31 | 0 | 90.15 |
| ER success | – | 322 | 45.95 ± 17.33 | 2.52 | 97.48 |

### 3.3. Depressive symptoms, between-strategy variability, and age

Next, we examined if depressive symptoms and age are associated with individuals' between-strategy variability in daily ER strategy use, while controlling for mean strategy endorsement (see Table 5). Stepwise multiple regression analysis with the predictors depressive symptoms and age and the dependent variable between-strategy variability showed that a total of 3 % of the variance in the variability of daily ER strategy use can be accounted for by the three predictors, $F(3, 318) = 3.74$, $p = 0.01$, $f^2 = 0.02$. Looking at the unique individual contributions of the predictors, the results showed that age ($\beta = 0.04$, $t = 0.82$, $p = 0.41$, $f^2 < 0.01$) did not significantly account for between-strategy variability in daily ER, neither did depressive symptoms ($\beta = -0.07$, $t = -1.26$, $p = 0.21$, $f^2 < 0.01$). Mean strategy endorsement ($\beta = -0.14$, $t = -2.48$, $p = .01$, $f^2 = 0.02$) negatively predicted between-strategy variability in daily ER, indicating that individuals who endorsed strategies to a lower degree used the strategies more variably across different situations.

**Table 3**
Correlations between age, depression, ER variability, ER effort, and ER success.

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Age | | | | | | |
| 2. PHQ-9 | −0.16** [−0.26, −0.06] | | | | | |
| 3. Mean strategy endorsement | −0.11* [−0.22, −0.00] | 0.21** [0.11, 0.32] | | | | |
| 4. Within-strategy variability | −0.21** [−0.31, −0.10] | 0.27** [0.16, 0.36] | 0.08 [−0.03, 0.19] | | | |
| 5. Between-strategy variability | 0.08 [−0.03, 0.18] | −0.11* [−0.22, −0.00] | −0.16** [−0.27, −0.05] | −0.01 [−0.12, 0.10] | | |
| 6. ER effort | 0.03 [−0.08, 0.14] | 0.20** [0.09, 0.30] | 0.52** [0.44, 0.60] | 0.16** [0.05, 0.26] | 0.01 [−0.10, 0.12] | |
| 7. ER success | 0.15** [0.04, 0.26] | −0.31** [−0.41, −0.21] | 0.21** [0.10, 0.31] | −0.25** [−0.35, −0.14] | 0.10 [−0.01, 0.21] | 0.32** [0.22, 0.42] |

*Note*. Values in square brackets indicate the 95 % confidence interval for each correlation. * $p < 0.05$. ** $p < 0.01$.

**Table 4**
Stepwise multiple regression analysis: Regression analysis of predictors of ER within-strategy variability.

| Parameter | B | SE(B) | ß | t | p | Adj. $R^2$ | Cohens $f^2$ ($\Delta f^2$) |
|---|---|---|---|---|---|---|---|
| Regression analysis of predictors of ER within-strategy variability ($R = 0.30$, $R^2 = 0.10$, Adj. $R^2 = 0.09$, Cohens $f^2 = 0.10$) | | | | | | | |
| Step 1 | | | | | | | |
| (Intercept) | 0.2821 | 0.0184 | 0.0563 | 15.344 | <0.001 | – | – |
| Mean strategy endorsement | 0.0515 | 0.0352 | 0.0572 | 1.462 | 0.15 | 0.0035 | 0.0004 (–) |
| Step 2 | | | | | | | |
| (Intercept) | 0.2638 | 0.0182 | −0.0119 | 14.466 | <0.001 | – | – |
| Mean strategy endorsement | 0.0165 | 0.0010 | 0.0260 | 4.697 | 0.64 | – | – |
| PHQ-9 | 0.0048 | 0.0349 | 0.2582 | 0.471 | <0.001 | 0.0651 | 0.0696 (0.07) |
| Step 3 | | | | | | | |
| (Intercept) | 0.3008 | 0.0219 | 0.0025 | 13.743 | <0.001 | – | – |
| Mean strategy endorsement | 0.0088 | 0.0346 | 0.0139 | 0.254 | 0.79 | – | – |
| PHQ-9 | 0.0042 | 0.0010 | 0.2290 | 4.151 | <0.001 | – | – |
| Age | −0.0010 | 0.0003 | −0.1522 | −2.978 | <0.01 | 0.08756 | 0.0960 (0.02) |

**Table 5**
Stepwise multiple regression analysis: Regression analysis of predictors of ER between-strategy variability.

| Parameter | B | SE(B) | ß | t | p | Adj. $R^2$ | Cohens $f^2$ ($\Delta f^2$) |
|---|---|---|---|---|---|---|---|
| Regression analysis of predictors of ER between-strategy variability ($R = 0.18$, $R^2 = 0.03$, Adj. $R^2 = 0.02$, Cohens $f^2 = 0.02$) | | | | | | | |
| Step 1 | | | | | | | |
| (Intercept) | 0.5004 | 0.0082 | <0.0000 | 61.308 | <0.001 | – | – |
| Mean strategy endorsement | −0.0456 | 0.0156 | −0.1609 | −2.916 | <0.01 | 0.0228 | 0.0233 (–) |
| Step 2 | | | | | | | |
| (Intercept) | 0.5029 | 0.0083 | 0.0037 | 60.286 | <0.001 | – | – |
| Mean strategy endorsement | -0.0407 | 0.0160 | −0.1437 | −2.549 | 0.01 | – | – |
| PHQ-9 | −0.0007 | 0.0005 | −0.0780 | −1.426 | 0.15 | 0.0260 | 0.0267 (0.0034) |
| Step 3 | | | | | | | |
| (Intercept) | 0.4982 | 0.0101 | −0.0004 | 49.124 | <0.001 | – | – |
| Mean strategy endorsement | −0.0398 | 0.0160 | −0.1403 | −2.479 | 0.01 | – | – |
| PHQ-9 | −0.0006 | 0.0005 | −0.0717 | −1.257 | 0.21 | – | – |
| Age | 0.0001 | 0.0002 | 0.0433 | 0.819 | 0.41 | 0.0250 | 0.0256 (−0.001) |

### *3.4. Depressive symptoms, ER effort, and ER success*

The third and fourth analyses were carried out to determine if depressive symptoms are associated with daily ER effort and daily ER success (see Table 6). We conducted two stepwise multiple regression analysis to separately examine the impact of depressive symptoms on ER effort as well as ER success. We also included ER effort as a predictor of ER success in the model, and vice versa.

The first model with the predictors depressive symptoms and ER success and the dependent variable ER effort showed that a total of 20 % of the variance in ER effort was accounted for by the two predictors, $F(2, 319) = 41.02$, $p < 0.001$, $f^2 = 0.23$. According to Cohen (1988), this can be interpreted as a medium to large effect size. Looking at the unique individual contributions of the predictors, the results showed that depressive symptoms ($\beta = 0.33$, $t = 6.32$, $p < 0.001$, $f^2 = 0.04$) as well as ER success ($\beta = 0.43$, $t = 8.14$, $p < 0.001$, $f^2 = 0.19$) positively predicted ER effort. The second model with the predictors depressive symptoms and ER effort and the dependent variable ER success showed that a total of 25 % of the variance in ER success was accounted for by the two predictors, $F(2, 319) = 54.12$, $p < 0.001$, $f^2 = 0.33$. According to Cohen (1988), this can be interpreted as a medium to large effect size. Looking at the unique individual contributions of the predictors, the results

**Table 6**
Stepwise multiple regression analysis: Separately predicting ER effort and ER success with depressive symptoms.

| Parameter | B | SE(B) | ß | t | p | Adj. $R^2$ | Cohens $f^2$ ($\Delta f^2$) |
|---|---|---|---|---|---|---|---|
| Regression analysis of predictors of ER effort ($R = 0.45$, $R^2 = 0.20$, Adj. $R^2 = 0.20$, Cohens $f^2 = 0.23$) | | | | | | | |
| Step 1 | | | | | | | |
| (Intercept) | 29.82 | 1.65 | −0.01 | 18.06 | <0.001 | | |
| PHQ-9 | 0.67 | 0.18 | 0.20 | 3.61 | <0.001 | 0.04 | 0.04 (–) |
| Step 2 | | | | | | | |
| (Intercept) | 7.90 | 3.08 | −0.02 | 2.56 | 0.01 | | |
| PHQ-9 | 1.12 | 0.18 | 0.33 | 6.32 | <0.001 | | |
| ER success | 0.40 | 0.05 | 0.43 | 8.14 | <0.001 | 0.20 | 0.23 (0.19) |
| Regression analysis of predictors of ER success ($R = 0.50$, $R^2 = 0.25$, Adj. $R^2 = 0.25$, Cohens $f^2 = 0.33$) | | | | | | | |
| Step 1 | | | | | | | |
| (Intercept) | 54.39 | 1.70 | 0.01 | 32.00 | <0.001 | | |
| PHQ-9 | −1.12 | 0.19 | −0.31 | −5.90 | <0.001 | 0.10 | 0.11 (–) |
| Step 2 | | | | | | | |
| (Intercept) | 41.65 | 2.20 | 0.02 | 18.92 | <0.001 | | |
| PHQ-9 | −1.41 | 0.18 | −0.39 | −7.96 | <0.001 | | |
| ER effort | 0.43 | 0.05 | 0.40 | 8.14 | <0.001 | 0.25 | .33 (0.22) |

showed that depressive symptoms ($\beta = -0.39$, $t = -7.96$, $p < .001$, $f^2 = 0.11$) as well as ER effort ($\beta = 0.40$, $t = 8.14$, $p < .001$, $f^2 = 0.22$) significantly predicted ER effort. In summary, participants with more depressive symptoms reported higher daily ER effort but less perceived ER success, with effect sizes ranging from small to medium (Cohen, 1988).

## 4. Discussion

In this study, we applied an AA methodology amidst Germany's first nationwide lockdown imposed in response to the COVID-19 pandemic (April 2020) to examine the correlation between depressive symptoms and ER variability. This study further explored the association between ER variability and age. With the use of ER strategies playing a crucial role in mental health, this is an important step towards understanding the correlates of variable and adaptive ER strategy use in daily life. The present study contributes to the literature of adaptive ER by investigating whether ER variability is significantly associated with depressive symptoms. In line with Heiy and Cheavens (2014), we investigated a broad range of ten different ER strategies and we also provided up to 21 prompts, resulting in a stable and robust estimate of individuals' ER variability at the person-level. Additionally, we investigated whether perceived ER effort and perceived ER success were associated with depressive symptoms.

### 4.1. Within-Strategy variability

We found that average within-strategy variability was positively associated with depressive symptoms, indicating that participants with more depressive symptoms reported higher variation in the extent that strategies are used across time and situations. Following the classification of adaptiveness based on the correlation of ER and psychopathology (Lincoln et al., 2022, for an overview), heightened levels of ER variability did not exhibit adaptive characteristics in our study. We focused on uncovering relatively enduring patterns of ER variability related to depressive symptoms with correlational data. As such, participants with higher levels of depressive symptoms, for example more negative affect, might need to employ greater ER variability to attain their personal ER goals. Alternatively, higher ER variability might interfere with the achievement of these personal goals, eventually resulting in heightened depressive symptoms. Cognitive impairment inherent to depression (Culpepper et al., 2017) could also hinder effective ER by causing participants deviating too quickly from ultimately effective strategies, resulting in frequent strategy changes and increased ER variability. This notion is supported by Southward et al.'s (2018) findings of a negative correlation between depression and ER strategy persistence.

Nonetheless, previous findings on within-strategy variability have been heterogeneous (Bahlinger et al., 2022; Blanke et al., 2020; Elkjaer et al., 2022; Wang et al., 2021). Our results are consistent with previous findings suggesting that a certain level of within-strategy variability may be considered potentially adaptive, although too little or too much may also exhibit negative correlations with aspects of mental health. High levels of variability may illustrate particularly pronounced fluctuation and, therefore, instability in ER strategy employment (Blanke et al., 2020; Houben et al., 2015). Accordingly, there may be a sweet spot for the adaptiveness of variability. Too little ER variability implies fixed, inflexible ER whereas too much ER variability may reflect instability and erratic efforts to rather ineffectively regulate one's emotions. Following this notion, previous research suggested that maintaining a specific strategy can be more adaptive than switching to another (Pruessner et al., 2020). A possible decisive factor may be the (un)stable context. A competent estimate of adaptiveness consequently could also be determined based on the joint fluctuation of variable ER strategy use and contextual changes (Aldao et al., 2015), in other words ER flexibility.

We relied on the assumption that context was relatively stable and comparable for all our participants, as they all started on the same day in a phase of a nationwide lockdown and therefore had to cope with the same contact restrictions as well as closed universities, schools, shops, and restaurants. This assumption supported our decision to conduct the assessment of ER strategy usage once a day. We anticipated that during the lockdown, there is reduced variability in participants' contexts compared to usual circumstances, rendering multiple measurements on a single day rather redundant. Therefore, we examine day-to-day ER variation rather than variation within a single day. This methodology is well-established, particularly in fields using evening diaries such as stress research (Iida et al., 2017). Evaluating day-to-day changes across a three-week period could help uncover ER variability that reflects more stable patterns of ER behavior.

Nevertheless, participants differed in their actual circumstances in the lockdown. To gain a basic understanding of the potential variety of life circumstances during the lockdown, participants provided selected information via the online survey. For example, around half of our participants lived either alone or with one more person in the same household, providing less potential for social interactions than bigger households. Additionally, the perceived burden of the pandemic potentially varied between participants, indicated by reports of variance of concerns regarding job loss, financial situation or concerns regarding the health statues of relatives. Still, all participants found themselves in a mainly uncertain situation without much variation from day-to-day, presumably dominating the individual context. Thus, showing high ER variability under these circumstances might not reflect adaptive ER, as context only varied to a limited extent, indicated by the positive

association between within-strategy variability and depressive symptoms.

This must be considered when age-related differences in ER variability are discussed. Our results show that older participants tend to demonstrate less within-strategy variability. Following the assumption of a relatively stable and comparable context for all our participants, and considering that we found a negative association between age and depressive symptoms, the thought of older participants regulating their emotions more effectively comes to mind. Another indication of 'better' emotion regulation in older age is the positive association between age and perceived ER success, implying older participants perceived themselves as more efficiently in regulating their emotions, especially as perceived ER effort does not correlate with age. This result seems to be in line with some findings on ER and aging, implying better ER in older adults (Scheibe and Blanchard-Fields, 2009; Shiota and Levenson, 2009). However, considering recent reviews (Allen and Windsor, 2019; Isaacowitz, 2022), another conclusion seems plausible. Even though we assumed a comparable context for all our participants, we obviously cannot rule out the possibility that the context varied between participants in at least some aspects. Despite the stable societal context under a COVID-19 lockdown, the individual context potentially varied beyond the data we collected and there is evidence for older adults experiencing fewer and less significant stressors (Brose et al., 2015). Therefore, we cannot conclusively make any statement on whether our results imply more effective ER or if this indicative of appropriate matching of strategy use to less variable situational demands (Eldesouky and English, 2018). In accordance with the extended process model of ER (Gross, 2015), potential discrepancies between dynamically changing situational contexts and ER strategy use need to be monitored to reflect adaptive ER. In other words, whether stopping, switching, or maintaining of strategies is adaptive, depends on the situational demands.

### 4.2. Between-Strategy variability

We found no association between average between-strategy variability and depressive symptoms as well as age. This finding seems inconsistent with the theory that prioritizing some strategies instead of simultaneously using all strategies to the same extent could represent an adaptive search for the best strategy, thus having positive associations with measures of mental health (Aldao and Nolen-Hoeksema, 2013). However, this is contrasted by a previous study observing that simultaneously applying several ER strategies was found to be adaptive (Heiy and Cheavens, 2014). Similar to our findings, Bahlinger and colleagues (2022) did not identify significant correlations between between-strategy variability and indicators of adaptiveness, specifically affect. Consistent with previous research, the adaptiveness of between-strategy variability, whether based on association with psychopathology or mood, may be contingent upon the specific combination of strategies used. This could potentially explain the lack of significant associations observed with between-strategy variability in our study. Comparing global indicators of between-strategy variability based on different repertoires of ER strategies, varying in quantity and quality, may be overly simplistic thinking. A promising approach may be the identification of clusters of ER strategies (Lischetzke et al., 2022; McMahon and Naragon-Gainey, 2019). Between-strategy variability in diverse clusters of strategies may differ in adaptiveness.

### 4.3. ER effort and ER success

As expected, individuals reporting more depressive symptoms also reported higher perceived ER effort, but less ER success. Prior research showed similar results regarding participants with bipolar disorder (Gruber et al., 2012; Johnson et al., 2007; Mansella et al., 2007) or psychopathological symptoms in general (Dixon-Gordon et al., 2015). The discrepancy between effort and success might further affect mental health. The experience of putting in more ER effort, but having less ER success at the same time when being exposed to a global stressor like the pandemic can amplify feelings of helplessness (Abramson et al., 1978) in individuals that already tend to have dysfunctional ER, potentially leading to further deterioration of mental health. In line with previous studies, the results provide further information about the subtleties of ER processes which sometimes appear counterintuitive, yet seem to be associated with depressive symptoms. Given that this study used primarily self-report measures, a possible explanation is that participants reporting more depressive symptoms overestimate their ER effort and underestimate their ER success. Dysfunctional negative views (Beck, 1979) and cognitive impairment (Rock et al., 2014) both represent core features of depressive disorders, possibly leading to biased responses when completing the daily questionnaire. This may have been particularly the case in the event of a pandemic, strongly affecting daily life with a complex combination of stressors (Chen and Bonanno, 2020).

### 4.4. Limitations and outlook

The present findings are based upon self-reported assessments. As people do not always pursue conscious regulatory goals (Gyurak et al., 2011) or regulate emotions in an effortful and conscious way, important automated parts of ER are not included in our study. Computing averages across ER strategies could mask the distinct relations that individual strategies have with depressive symptoms, as evidenced by previous research (Aldao and Nolen-Hoeksema, 2012). While our study focused solely on total within-strategy variability, it would be worthwhile for future research to investigate the associations of within-strategy variability for individual strategies. Moreover, we assessed ER strategy use in the evening, resulting in only one daily measurement point for the variables of interest. This design does not allow for any statements about sequential or simultaneous ER implementation during the day. While we effectively captured day-to-day variability, it's important to recognize that delving into daily fluctuations requires a higher frequency of prompts. Future research might assess ER multiple times per day at shorter intervals.

Given the time of data collection of the current study, we also cannot determine if participants regulated emotions any different compared to their daily life before the pandemic. Furthermore, a possible causal relation between ER variability and depressive symptoms cannot be investigated with correlational data. In future studies, employing extended longitudinal designs would be beneficial to investigate whether ER variability precedes the onset of depressive disorders or if the presence of depressive symptoms contributes to reduced variability in regulatory behaviors. Furthermore, the conceptualization employed to define adaptiveness in our study is based on a rather distal association between variable ER and psychopathology. Consequently, our study did not offer a direct explanation of a (potentially bidirectional) underlying mechanism. Plausible scenarios could include moderation through affect or the (non-)attainment of personal goals with regard to ER. Higher ER variability might indicate ineffective deployment of ER strategies (e.g., due to cognitive impairment inherent to affective disorder), thereby making it more difficult to achieve short-term situational goals and ultimately exacerbating symptoms of depression.

It should also be noted that the heterogeneous nature of depression involves different affective, cognitive, and somatic symptoms, each of which may be of different salience to each individual. It is possible that subgroups with different expressions of depressive symptoms may also exhibit or respond differently to ER variability. Neglecting this diversity of symptoms may mask potentially differential associations between clinically distinct symptoms of depression, such as avolition or concentration problems, and ER variability. To address this in future studies, researchers may consider adopting a symptom-level approach (Everaert and Joormann, 2019). Another consideration is that the use of single-item scales to measure core variables within AA designs may have validity limitations. Future studies would benefit from considering the recommendations of Dejonckheere et al. (2022) who suggested two

time-varying test-retest adaptations. Finally, our results are based on a sample over-represented by females aged 20–29, which is especially important regarding the association between ER variability and age. Future investigations should prioritize achieving a more balanced age distribution, ensuring adequate representation of both older and younger age groups. This approach will provide a comprehensive understanding of how ER variability correlates across all life stages, including the elderly and younger cohorts, extending our understanding of ER dynamics across more diverse age ranges.

## 5. Conclusion

The present study provided insights into the association between ER, depressive symptoms, and age during a time of crisis, having followed a large number of participants via repeated assessments of their day-to-day experience. Our findings indicate that ER variability is a significant factor associated with depressive symptoms and thus, an important indicator of mental health. However, variability may not always be adaptive, contrary to the motto *the more, the better*, as illustrated by its positive association with depressive symptoms. We add to the existing body of literature by suggesting that older individuals tend to show less within-strategy variability as well as participants with more depressive symptoms reporting heightened effort but less success in daily ER. In sum, our research contributes to the understanding of variable ER, further pointing towards the necessity of capturing environmental information to conclusively identify the point at which there is possibly *too little* or *too much* ER variability.

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## CRediT authorship contribution statement

**Dorian de la Fuente:** Writing – original draft, Formal analysis, Conceptualization. **Tanja Könen:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Tina In-Albon:** Writing – review & editing, Funding acquisition. **Lea Schemer:** Writing – review & editing, Project administration. **Julia Karbach:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

## Declaration of competing interest

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