**Comparison of Two Ecological Momentary Intervention Modules for Treatment of
Depression on Momentary Positive and Negative Affect**

Daan A. Ornée^{a,b}, Albertine J. Oldehinkel^a, Jojanneke A. Bastiaansen^{a,b,1}

^aUniversity of Groningen, University Medical Center Groningen, Department of Psychiatry,
Interdisciplinary Center Psychopathology and Emotion Regulation, Groningen, The
Netherlands

^bFriesland Mental Health Care Services, Department of Education and Research, Leeuwarden,
The Netherlands

Declarations of interest: none

---

¹ Corresponding author: Jojanneke Bastiaansen, University of Groningen, University Medical
Center Groningen, Department of Psychiatry, UMCG, Hanzeplein 1, 9700 RB Groningen,
The Netherlands. E-mail: j.bastiaansen@umcg.nl, Tel: 0031503611169, Fax: 0031503619722

Abstract

Background: Ecological Momentary Interventions (EMI), comprising repeated self-assessments in daily life, have shown promise as intervention strategy for depression. Whether the content of such assessments influences affect has hardly received attention. The ZELF-i study consists of two EMA intervention (EMI) modules, enabling us to compare the impact of EMI content on the course of momentary affect during the intervention. **Methods:** ZELF-i is an add-on to depression treatment comprising intensive self-monitoring (5x/day, 28 days) and weekly personalized feedback. Patients with depressive complaints ($N = 110$; $M_{\text{age}} = 32.9$, $SD = 12.2$; 44.5% male) were randomly assigned to one of two treatment modules focusing on activities and positive affect (“Do”) or on thoughts and negative affect (“Think”). **Results:** Linear mixed models showed no significant ($p > .18$) differences between the two modules on both positive and negative affect over time. Across modules positive affect showed an initial decreasing trend, leveling off towards the end of the intervention period. Negative affect did not change significantly over time ($p > .06$). **Limitations:** Both modules assessed positive and negative affect, enabling a direct comparison but potentially decreasing the impact of their differential focus. **Conclusions:** In our sample, the focus of the EMI did not impact momentary affect beyond any general effect of systematic self-monitoring. This means that a focus on negative affect instead of more general self-monitoring may not lead to added adverse effects on mood, which is an often voiced concern when using EMA in both research and clinical practice.

Keywords: Depression, Ecological Momentary Assessment, Affect, Measurement Reactivity, Emotions, Pragmatic Clinical Trial

Comparison of Two Ecological Momentary Intervention Modules for Treatment of Depression on Momentary Positive and Negative Affect

Introduction

Depression is characterized by at least one of two main symptoms: depressed mood and loss of interest or pleasure (American Psychiatric Association, 2013). Both symptoms illustrate the important role of the affective system in depression (Gross & Jazaieri, 2014; Hofmann, Sawyer, Fang, & Asnaani, 2012). Not surprisingly, a large body of research has investigated the role of positive and negative affect (PA and NA) in depression and how interventions change experienced affect (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Dunn, 2012; Sin & Lyubomirsky, 2009).

In the past two decades, researchers have increasingly used Ecological Momentary Assessment (EMA, also referred to as Experience Sampling Methodology or ESM) to study how affect fluctuates in daily life in people with depression (for reviews see: aan het Rot, Hogenelst, & Schoevers, 2012; Myin-Germeys et al., 2018). EMA is a structured self-monitoring data collection technique, which allows repeated, real-time measuring of thoughts, feelings and behaviors during the day (Csikszentmihalyi & Larson, 2014; Shiffman, Stone, & Hufford, 2008). A typical design consists of up to ten short questionnaires a day for several days or weeks. EMA provides rich and detailed data leading to new insights in psychopathology, and has been suggested as a tool for treatment as well (Myin-Germeys, Klippel, Steinhart, & Reininghaus, 2016; van Os et al., 2017).

Currently, only two randomized controlled trials (RCTs) that used EMA as an intervention strategy for depressive symptoms (EMI) also investigated concurrent changes in affect (for a review see: Colombo et al., 2019). These interventions combined repeated self-monitoring for several weeks with person-tailored feedback. In the first RCT by Kramer et al. (2014), 102 depressed adults received either six weeks of EMA with weekly PA-focused feedback sessions, six weeks of EMA without feedback, or treatment as usual (TAU). Although depressive symptoms reduced in the EMA-plus-feedback group, no significant differences in affect were found during the intervention period (Hartmann et al., 2015). In the second RCT by van Roekel et al. (2017), 69 young adults with elevated anhedonia scores received an EMI for two months. After the first month the participants were randomized into one of three groups 1) EMA, 2) EMA and lifestyle advice, or 3) EMA, lifestyle advice and a

tandem skydive. Contrary to the results from the first RCT, the intervention groups showed higher PA compared to controls, while no group differences were found for depression.

The most obvious source of these mixed effects is the difference in study population. A second likely source is that the content of the EMA questionnaires and feedback differed between the RCTs. The first RCT measured affect using four positive and six negative items, whereas the second RCT used ten positive and eight negative items, potentially placing more focus on PA than NA. The first RCT additionally measured daily life activities, persons present, physical activity and events, whereas the second additionally measured stress, time alone, social interaction, time outside, worrying, snacks and physical discomfort. Since these questions were asked multiple times a day for a prolonged period of time they could have further created differences in focus between the two interventions. A third possible source of the mixed findings are the different measurement schedules. The EMA in the first RCT consisted of ten measurements a day for three consecutive days each week, at semi-random intervals, compared to three times each day at fixed intervals in the second RCT. The potential influence of number of measurements is illustrated by Conner and Reid (2012), who found that a positive effect of measuring happiness once a day dissipated with increasing numbers of measurements per day in individuals with depressive symptoms. Together, these differences in population, content and methods make direct comparisons of these interventions impossible. To understand the role of content on affect, we need to look at EMI's with identical methods and study populations, where only the content differs.

The recent ZELF-i RCT (Bastiaansen et al., 2018) was set up to investigate the effects of EMI content on depression and momentary affect. Participants who were randomized into one of the two intervention modules engaged in similar procedures, but with a different focus of the questionnaires and the feedback. Both groups engaged in 28 days of EMA (five times per day) and received weekly descriptive feedback reports, next to or preceding the start of TAU. The first part of each EMA questionnaire measured momentary affect and was identical between groups, whereas the second part and the weekly feedback reports had a different focus. One module focused on activities and PA ("Do-module"), whereas the other focused on thoughts and NA ("Think-module"). This design allowed us to directly compare the effects of a stronger focus on activities and PA versus thoughts and NA.

The focus on activities and PA in the Do-module incorporates some of the core aspects of behavioral activation (Cuijpers, van Straten, & Warmerdam, 2007; Dimidjian, Barrera, Martell, Muñoz, & Lewinsohn, 2011; Kanter et al., 2010). Classical behavioral activation therapy aims to counter the passivity and NA symptoms in depression by teaching patients to

avoid behaviors that decrease mood and engage in behaviors that improve mood (Hopko, Lejuez, Ruggiero, & Eifert, 2003). One prominent tool to achieve these goals is for patients to monitor activities and rate the experienced pleasure, which is incorporated in the Do-module. Furthermore, both the broaden and build theory (Fredrickson, 2004) and evidence from positive psychology interventions (Sin & Lyubomirsky, 2009) suggest that repeated focus on what goes well can result in a positive spiral of activities and PA. The feedback reports in the Do-module sustain this focus by showing the experienced PA, but not NA, in relation to the reported activities.

In the Think-module, participants monitor their thoughts and feelings and receive feedback on how these thoughts were associated with minor daily events and experienced NA. This could enable them to identify and target maladaptive thinking patterns, an key component of cognitive therapy (Beck, 2005; Cuijpers, Cristea, Karyotaki, Reijnders, & Huibers, 2016). The feedback reports in the Think-module support this process by showing the experienced NA, but not PA, in relation to thoughts and daily events.

Despite the potential of both modules to positively influence affect, repeated self-monitoring could also have negative effects. Both modules might lead to an increase in self-focused attention, which has been associated with NA (Mor & Winquist, 2002). Furthermore, the focus on activities and PA in the Do-module could lead to a realization of all that does not go well, and consequently decrease PA. In the Think-module, focusing on thought patterns could invite rumination, which has repeatedly been associated with NA (Thomsen, 2006). Although it is conceivable that a difference in focus will lead to different effects on momentary affect, the conflicting ideas and theories in the literature preclude clear hypotheses regarding the direction of effects. We will therefore test two-sidedly whether there is a differential effect of module type (Do vs. Think) on momentary PA or NA. Given that all participants received TAU next to the intervention, we further hypothesize that, on average, both groups will show an increase in PA and decrease in NA.

Methods

Participants

For this study we included the 110 participants who were randomized into the treatment arms of the ZELF-i RCT (ZELF-i, Dutch Trial Register, NTR5707, <http://www.trialregister.nl>). The total sample consisted of 161 patients who were assigned to treatment for unipolar depression in one of five study locations. Exclusion criteria were: required crisis intervention, presence of psychotic or manic symptoms and incapability of

following research procedures due to inadequate Dutch language proficiency or significant auditory or visual impairments. All participants provided written informed consent before enrolment.

Procedure

During clinical intake patients were informed about the study and screened for eligibility. Interested eligible patients were subsequently contacted by a researcher for an on-site study intake during which randomization was performed and the EMA program tested, explained and trained once. Randomization was stratified based on current psychotherapy and use of antidepressant medication. A full description of the design, procedures and primary outcomes of the ZELF-i trial are published elsewhere (Bastiaansen et al., 2018). The ZELF-i study was approved by the Medical Ethical Committee of the University Medical Center Groningen (no. 2015/530).

Experience Sampling Intervention

Both Zelf-i modules consisted of 28 consecutive days of EMA in which participants filled out brief questionnaires on their smartphones five times a day. The measurements were set at fixed moments during waking hours with an interval of 3 hours, programmed individually to optimally fit the participants daily routine (e.g., during breaks at work, see Figure 1a for an example). Each measurement comprised a momentary part, a module-specific retrospective part (past three hours) and a module-specific prospective (next three hours) part (see Figure 1b). In both modules momentary well-being (“How do you feel right now”), momentary affect (PA/NA, see ‘measures’) and momentary physical state (i.e., hunger, tiredness, physical discomfort and impact of drugs/alcohol) were measured first (for the full item list see Bastiaansen et al., 2018). Participants in the Do-module then retrospectively recorded experienced pleasure, motivation, physical activity, busyness and time spent at home, in pleasant social contexts and outdoors. Participants additionally recorded which activities they performed. A list of common activity categories was provided, with the option of adding an extra activity using a text box. For each performed activity, participants selected the best fitting category. Next, participants prospectively recorded anticipatory pleasure and motivation.

Participants in the Think-module retrospectively recorded the amount of focus on feelings and amount of brooding. Participants then recorded which negative events had taken place. A list of possible negative event categories was provided, with the option of adding an extra event using a text box. For each event participants selected the best fitting category. Next, participants indicated how unpleasant the events were taken together and whether they

experienced negative thoughts about themselves or their situation. This procedure was repeated for positive events and positive thoughts. Lastly, participants prospectively recorded worrying.

Figure 1. (a) Example EMA measurement schedule over three days, with fixed three-hour intervals. Starting times were set individually to best fit participant's schedules. (b) Single measurement flow chart for both intervention modules showing the identical momentary questions and diverging retrospective and prospective questions

Personalized feedback reports were generated and emailed to the participant after each week of EMA with each successive report containing richer information. The Do-module reports comprised various graphs showing PA patterns and associations between PA and activities, whereas graphs in the Think-module focused on NA over time and associations with thinking patterns (example feedback reports in Dutch are available online:

<https://osf.io/hn2ze/>)

Measures

Momentary affect: For momentary affect, participants scored emotional adjectives on visual analogue scales ranging from “not at all” (0) to “very much” (100). The adjectives used were balanced on both the valence dimension (i.e., positive and negative) and arousal

dimension (high/low) of emotional experience (Watson & Tellegen, 1985). PA was measured with the adjectives cheerful (e.g. “I feel cheerful”), relaxed, satisfied, energetic, enthusiastic and calm. NA was measured with the adjectives irritated, down, indifferent, anxious, listless and stressed. The order of the items was fixed. Similar to other studies in the field (Hartmann et al., 2015) a PA and NA scale score were calculated by averaging the positive and negative adjectives, respectively, resulting in a score between 0 (not at all) and 100 (very much) per person per measurement. Multilevel reliability analyses following Nezlek (2017) showed moderate reliability for the PA items ($\alpha = 0.78$) and fair reliability for the NA items ($\alpha = 0.58$). For each participant the first five measurements (1 day) were excluded to reduce the effect of a potential initial elevation bias (Shrout et al., 2018), resulting in a maximum of (27 * 5) 135 measurements. Furthermore, all measurements that were not completed within a half-hour window were discarded.

Analyses

To reduce experimenter bias, all analyses and data handling procedures were preregistered before any analyses were performed (<https://osf.io/4e52q/>). Blinded analyses were not possible due to the researchers’ knowledge of the unequal number of dropouts between the groups. All analyses were otherwise performed as preregistered.

For both PA and NA, we applied an identical multilevel model to accommodate the nested structure of the data, with measurements (level 1) nested within individuals (level 2). We used R (R Core Team 2019) and the lme4 (Bates, Mächler, Bolker, & Walker, 2015) and lmerTest (Kuznetsova, Brockhoff, & Christensen, 2017) packages to perform a linear mixed model (LMM) analysis of the relationships between group and momentary affect over time (R analysis code is available online: <https://osf.io/bg7pr/>). The model (Figure S1) included group and time as fixed effects. To test our hypothesis on differential effects over time the interaction term group * time was included. Quadratic effects were added based on improved model fit (Table S1). The model included random intercept and slopes effectively allowing participants to vary in their experienced affect at the start (T0) and in trajectories of affect change over time. The model was fitted using restricted maximum likelihood estimation and correlated random slopes and intercepts. As indication of the random effects the variance of both intercept and slope are reported.

Results

Descriptives

Baseline characteristics of the two groups are shown in Table 1. The groups were very

similar with respect to gender, age, educational level and depression level at intake. In total, 110 participants completed 10,173 valid measurements, with an average of 92.5 measurements per participant. After controlling for dropouts (Do: 7, Think: 13), by-group boxplots of the percentage of completed measurements showed a similar spread for participants in the Do-module (median % complete = 80.4, IQR = 66.9 – 89.5) and Think-module (median % complete = 80.4, IQR = 65.7 – 90.0; Figures S2 & S3). The percentage of completed measurements at each time point showed a small decrease over time (Figure S4). After removing the first five measurements (one day) of each participant, we analyzed the data of 107 participants, who completed 9,713 measurements in total (3 participants dropped out of the study on the first day).

Table 1.

Baseline characteristics of the two treatment groups

Group	<i>N (males)</i>	Mean Age [†] (SD)	Mean Depression [‡] T0 (SD)	Education [§]		
				Low	Middle	High
Do	55 (27)	32.2 (11.6)	35.7 (11.4)	15	27	13
Think	55 (22)	33.6 (12.8)	35.9 (10.5)	10	32	13

Note. Numbers represent count (N) or mean $\pm$ standard deviation (SD). [†]Age in years at study intake. [‡]Depression was measured during intake with the 30-item self-report Inventory of Depressive Symptomatology (IDS-SR; Rush, Gullion, Basco, Jarrett, & Trivedi, 1996). Each symptom item was scored on a scale from 0 to 3, with higher scores indicating greater symptom severity. [§]Low = no, primary, lower secondary or vocational education; Middle = intermediate vocational and intermediate to higher secondary education; High = higher vocational education and university.

Momentary Affect

All mixed model assumptions were satisfied (Figures S5 to S8 and Table S2). The results of the LMM analyses for PA and NA are presented in Table 2 and Table 3, respectively (see tables S3 and S4 for results under maximum likelihood). The fixed effects show the results for the typical participant and are represented by the four regression lines in Figure 2. Contrary to our primary hypothesis, no significant ($p > .19$) differences were found between the two modules on the development of PA and NA over time. Overall, PA showed an initially decreasing trend, which leveled off towards the end of the intervention period. NA

did not change significantly over time.

The random effects, representing the differences between participants across groups, indicated a large variance in both PA and NA starting levels (S^2 PA intercept = 145; S^2 NA intercept = 212) and changes over time (S^2 PA slope = 0.38; S^2 NA slope = .47). This heterogeneity is illustrated by the large spread of the individual predicted regression lines in Figure 3. The intraclass correlation (ICC) indicating the proportion of variance accounted for by participants (level 2) was .51 for PA and .63 for NA. This effectively means that more than half of the residual variance is explained by between-person differences.

The effect size f^2 was .14 for both PA and NA, indicating that the full models explain 14% of the variance in momentary affect relative to the remaining unexplained variance, which is a small to medium effect according to Lorah (2018).

Table 2.

Linear mixed model estimates for positive affect ($N = 107$)

Fixed effects (intercept, slopes)	Estimate (SE)	t (105,9602)	p	CI95	
				Lower bound	Upper bound
Intercept (level at T0)	41.5 (1.7)	24.4	< .001	38.2	44.8
Time	-0.50 (0.12)	-4.2	< .001	-0.73	-0.27
Time ²	0.016 (0.003)	5.0	< .001	0.010	0.022
Group	-1.31 (2.43)	-0.5	.59	-6.06	3.44
Group x Time	0.015 (0.173)	< 0.1	.93	-0.32	0.35
Group x Time ²	-0.001 (0.005)	-0.3	.78	-0.01	0.01

Note. Do-module was used as reference group for between-group effects. Time was set in days, with five measurements each day. Measurements on the first day were excluded, removing three participants who dropped out on the first day. Linear mixed model was fitted with restricted maximum likelihood estimation. To ensure unbiased reporting, results under maximum likelihood estimation can be found in table S3.

Table 3. Linear mixed model estimates for negative affect ($N = 107$)

Fixed effects (intercept, slopes)	Estimate (SE)	t (105,9602)	p	CI95	
				Lower bound	Upper bound
Intercept (level at T0)	31.7 (2.0)	15.6	< .001	27.7	35.7
Time	0.18 (0.12)	1.48	.14	-0.06	0.42
Time ²	-0.005 (0.003)	-1.86	.06	-0.011	< 0.001
Group	2.15 (2.89)	0.7	.46	-3.51	7.81
Group x Time	0.17 (0.18)	0.95	.34	-0.18	0.52
Group x Time ²	-0.006 (0.004)	-1.32	.19	-0.014	0.003

Note. Do-module was used as reference group for between-group effects. Time was set to days, with five measurements each day. Measurements on the first day were excluded, removing three participants who dropped out on the first day. Linear mixed model was fitted with restricted maximum likelihood estimation. To ensure unbiased reporting, results under maximum likelihood estimation can be found in table S4.

Figure 2. (a) Group-mean positive affect at each measurement point with model-fitted regression line for Do- and Think-module. Five measurements represent 1 day, with the measurements on the first day removed. (b) Group-mean negative affect at each measurement point with model-fitted regression line for Do- and Think-module. Five measurements represent 1 day, with the measurements on the first day removed.

Figure 3. (a) Individual predicted lines for positive affect within each group. The bold lines show the group-level regression line for both groups. Five measurements represent 1 day, with the measurements on the first day removed. (b) Individual predicted lines for negative affect within each group. The bold lines show the group-level regression line for both groups. Five measurements represent 1 day, with the measurements on the first day removed.

Sensitivity analyses

To investigate the influence of the first five measurements and dropouts, both PA and NA models were re-run twice; once with the first five measurements included and once with the dropouts removed. No large differences were found with the original models, for details see tables S5 to S8. No exploratory analyses on the effect of the feedback reports on momentary affect were possible because there were no substantive subgroups of participants that did not read the feedback reports (Supplementary materials: Feedback reports).

Discussion

In this study we compared the effects of two EMA intervention modules on momentary affect in 110 individuals with depression. The modules employed similar methods but differed in the content of the EMA questionnaires and the weekly feedback reports; the Do-module focused on activities and PA, whereas the Think-module focused on thoughts and NA. The results do not support a differential effect on momentary affect between the modules over time. Furthermore and contrary to our hypothesis of an average increase in PA and decrease in NA, PA showed an initial decline which leveled off towards the end of the intervention period and NA showed no significant change at all over the course of the intervention.

The lack of a differential effect over time could mean that EMA content does not matter. It is possible that completing EMA questionnaires leads to a generic introspective

process regardless of the specific questionnaire contents. Another possibility is that the content does matter, but that both the Do- and Think-module lead to similar outcomes on affect. This would correspond to the findings in the literature that both cognitive therapy and behavioral activation are effective in decreasing depressive symptoms, although the working mechanisms differ (Cuijpers et al., 2013; Sturme, 2009). Regardless of the underlying mechanism, in practice both possibilities mean that the specific content of the EMI does not influence momentary affect. This point is also supported by Addington et al. (2019), who found similar changes in positive and negative emotion for both an intervention group and an emotion reporting control group. One implication of this conclusion would be that EMI's with different contents are more comparable than we anticipated, and that the diverging results from the previous RCTs using EMI's likely stem from other factors than the content of the questionnaires and feedback reports. Another implication would be that there is no content specific measurement reactivity in terms of affect level (see Widdershoven et al., 2019 for EMA reactive effects on emotion differentiation). This means that a focus on NA instead of more general self-monitoring may not lead to added adverse effects on mood, which is an often voiced concern when using EMA in both research and clinical practice. This is surprising given evidence from meta-analyses that focusing on negative self-aspects is associated with higher NA than focusing on positive self-aspects (Mor & Winquist, 2002) and that positive psychological interventions enhance well-being and decrease depression (Sin & Lyubomirsky, 2009).

Because all participants started treatment during or shortly after the EMI, we expected a general increase in PA and decrease in NA. Instead, NA did not change over the course of the intervention and PA did not improve, even showing a small initial drop. A possible explanation for the decrease in PA is the measurement frequency. A study by Conner & Reid (2012) showed that people with depressive symptoms showed decreased happiness over time when they reported momentary happiness six times per day, while this effect was reversed for participants who reported only once a day. Hartmann et al. (2015) also found no positive effect of an EMI for depression on PA, with ten measurements a day. Conversely van Roekel et al. (2017) found an increase in PA using three measurements a day and Addington et al. (2019) found increased positive emotions and decreased negative emotions using one measurement a day. Together with our findings, this suggests that the measurement frequency might play a crucial role in the effects of EMI's on momentary affect.

Limitations

Although the conclusion that EMI content does not matter seems justified, we cannot exclude that our null finding is due to aspects of our study design. The focus of the intervention modules differed but there was overlap in the first part of each EMA questionnaire; both the Do- and Think-module measured PA and NA. Less overlap between the modules might have led to a larger and therefore more detectable effect of content on affect. That said, it was precisely this overlap in the first half of the questionnaires that enabled us to compare the modules on momentary affect. In order to compare EMI's with larger content differences one would have to find other suitable measures to assess the influence on affect. Another characteristic of our study design was that our participants started TAU during or shortly after the intervention. Patient expectations, placebo effects and varying wait-list periods are among the many processes other than a differential effect of the EMI that could have influenced momentary affect (Posternak & Miller, 2001; Rutherford, Mori, Sneed, Pimontel, & Roose, 2012). Our design provided the benefit of testing the intervention directly in a clinical setting, but the heterogeneity of this setting may have masked possible subtle effects of the intervention content. Closely related is the argument that, given the large between-person heterogeneity of affect trajectories in our sample, which module works best may well be different for each participant. Theoretically, it is possible that exactly because content matters, but differently for each person, we did not find differential effects across groups.

Conclusion

To our knowledge, this is the first study that directly compares the effects of EMA intervention content on momentary affect. Our results show that focusing on NA and thoughts or PA and activities in self-monitoring does not lead to differential effects on momentary affect. This suggests that the effects of EMI's can be compared even when content differs and that focusing on thoughts and NA does not necessarily lead to adverse effects compared to focusing on PA and activities. Future research should also investigate the effects of number of measurements in EMI's, as they might have a mediating role.

References

- aan het Rot, M., Hogenelst, K., & Schoevers, R. A. (2012). Mood disorders in everyday life: A systematic review of experience sampling and ecological momentary assessment studies. *Clinical Psychology Review, 32*(6), 510–523. <https://doi.org/10.1016/j.cpr.2012.05.007>
- Addington, E. L., Cheung, E. O., Bassett, S. M., Kwok, I., Schuette, S. A., Shiu, E., ... Moskowitz, J. T. (2019). The MARIGOLD study: Feasibility and enhancement of an online intervention to improve emotion regulation in people with elevated depressive symptoms. *Journal of Affective Disorders, 257*, 352–364. <https://doi.org/10.1016/j.jad.2019.07.049>
- Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*(2), 217–237. <https://doi.org/10.1016/j.cpr.2009.11.004>
- Bastiaansen, J. A., Meurs, M., Stelwagen, R., Wunderink, L., Schoevers, R. A., Wichers, M., & Oldehinkel, A. J. (2018). Self-monitoring and personalized feedback based on the experiencing sampling method as a tool to boost depression treatment: A protocol of a pragmatic randomized controlled trial (ZELF-i). *BMC Psychiatry, 18*(1), 276. <https://doi.org/10.1186/s12888-018-1847-z>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). *Fitting Linear Mixed-Effects Models Using lme4* | Bates | *Journal of Statistical Software*. <https://doi.org/10.18637/jss.v067.i01>
- Beck, A. T. (2005). The Current State of Cognitive Therapy: A 40-Year Retrospective. *Archives of General Psychiatry, 62*(9), 953–959. <https://doi.org/10.1001/archpsyc.62.9.953>
- Colombo, D., Fernández-Álvarez, J., Patané, A., Semonella, M., Kwiatkowska, M., García-Palacios, A., ... Botella, C. (2019). Current State and Future Directions of Technology-Based Ecological Momentary Assessment and Intervention for Major Depressive Disorder: A Systematic Review. *Journal of Clinical Medicine, 8*(4), 465. <https://doi.org/10.3390/jcm8040465>
- Conner, T. S., & Reid, K. A. (2012). Effects of Intensive Mobile Happiness Reporting in Daily Life. *Social Psychological and Personality Science, 3*(3), 315–323. <https://doi.org/10.1177/1948550611419677>

- Csikszentmihalyi, M., & Larson, R. (2014). Validity and Reliability of the Experience-Sampling Method. In *Flow and the Foundations of Positive Psychology* (pp. 35–54).
https://doi.org/10.1007/978-94-017-9088-8_3
- Cuijpers, P., Berking, M., Andersson, G., Quigley, L., Kleiboer, A., & Dobson, K. S. (2013). A Meta-Analysis of Cognitive-Behavioural Therapy for Adult Depression, Alone and in Comparison with other Treatments. *The Canadian Journal of Psychiatry*, 58(7), 376–385. <https://doi.org/10.1177/070674371305800702>
- Cuijpers, P., Cristea, I. A., Karyotaki, E., Reijnders, M., & Huibers, M. J. H. (2016). How effective are cognitive behavior therapies for major depression and anxiety disorders? A meta-analytic update of the evidence. *World Psychiatry*, 15(3), 245–258. <https://doi.org/10.1002/wps.20346>
- Cuijpers, P., van Straten, A., & Warmerdam, L. (2007). Behavioral activation treatments of depression: A meta-analysis. *Clinical Psychology Review*, 27(3), 318–326. <https://doi.org/10.1016/j.cpr.2006.11.001>
- Dimidjian, S., Barrera, M., Martell, C., Muñoz, R. F., & Lewinsohn, P. M. (2011). The Origins and Current Status of Behavioral Activation Treatments for Depression. *Annual Review of Clinical Psychology*, 7(1), 1–38. <https://doi.org/10.1146/annurev-clinpsy-032210-104535>
- Dunn, B. D. (2012). Helping Depressed Clients Reconnect to Positive Emotion Experience: Current Insights and Future Directions. *Clinical Psychology & Psychotherapy*, 19(4), 326–340. <https://doi.org/10.1002/cpp.1799>
- Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 359(1449), 1367–1378. <https://doi.org/10.1098/rstb.2004.1512>
- Gross, J. J., & Jazaieri, H. (2014). Emotion, Emotion Regulation, and Psychopathology: An Affective Science Perspective. *Clinical Psychological Science*, 2(4), 387–401. <https://doi.org/10.1177/2167702614536164>
- Hartmann, J. A., Wichers, M., Menne-Lothmann, C., Kramer, I., Viechtbauer, W., Peeters, F., ... Simons, C. J. P. (2015). Experience Sampling-Based Personalized Feedback and Positive Affect: A Randomized Controlled Trial in Depressed Patients. *PLOS ONE*, 10(6), e0128095. <https://doi.org/10.1371/journal.pone.0128095>

- Hofmann, S. G., Sawyer, A. T., Fang, A., & Asnaani, A. (2012). EMOTION DYSREGULATION MODEL OF MOOD AND ANXIETY DISORDERS: Review: Emotion Dysregulation Model of Mood and Anxiety Disorders. *Depression and Anxiety, 29*(5), 409–416.
<https://doi.org/10.1002/da.21888>
- Hopko, D. R., Lejuez, C. W., Ruggiero, K. J., & Eifert, G. H. (2003). Contemporary behavioral activation treatments for depression: Procedures, principles, and progress. *Clinical Psychology Review, 23*(5), 699–717. [https://doi.org/10.1016/S0272-7358\(03\)00070-9](https://doi.org/10.1016/S0272-7358(03)00070-9)
- Kanter, J. W., Manos, R. C., Bowe, W. M., Baruch, D. E., Busch, A. M., & Rusch, L. C. (2010). What is behavioral activation?: A review of the empirical literature. *Clinical Psychology Review, 30*(6), 608–620. <https://doi.org/10.1016/j.cpr.2010.04.001>
- Kramer, I., Simons, C. J. P., Hartmann, J. A., Menne-Lothmann, C., Viechtbauer, W., Peeters, F., ... Wichers, M. (2014). A therapeutic application of the experience sampling method in the treatment of depression: A randomized controlled trial. *World Psychiatry, 13*(1), 68–77. <https://doi.org/10.1002/wps.20090>
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software, 82*(1), 1–26.
<https://doi.org/10.18637/jss.v082.i13>
- Lorah, J. (2018). Effect size measures for multilevel models: Definition, interpretation, and TIMSS example. *Large-Scale Assessments in Education, 6*(1).
<https://doi.org/10.1186/s40536-018-0061-2>
- Mor, N., & Winquist, J. (2002). Self-focused attention and negative affect: A meta-analysis. *Psychological Bulletin, 128*(4), 638–662. <https://doi.org/10.1037//0033-2909.128.4.638>
- Myin-Germeys, I., Kasanova, Z., Vaessen, T., Vachon, H., Kirtley, O., Viechtbauer, W., & Reininghaus, U. (2018). Experience sampling methodology in mental health research: New insights and technical developments. *World Psychiatry, 17*(2), 123–132.
<https://doi.org/10.1002/wps.20513>
- Myin-Germeys, I., Klippel, A., Steinhart, H., & Reininghaus, U. (2016). Ecological momentary interventions in psychiatry. *Current Opinion in Psychiatry, 29*(4), 258.
<https://doi.org/10.1097/YCO.0000000000000255>

- Nezlek, J. B. (2017). A practical guide to understanding reliability in studies of within-person variability. *Journal of Research in Personality, 69*, 149–155.
<https://doi.org/10.1016/j.jrp.2016.06.020>
- Posternak, M. A., & Miller, I. (2001). Untreated short-term course of major depression: A meta-analysis of outcomes from studies using wait-list control groups. *Journal of Affective Disorders, 66*(2), 139–146. [https://doi.org/10.1016/S0165-0327\(00\)00304-9](https://doi.org/10.1016/S0165-0327(00)00304-9)
- Rush, A. J., Gullion, C. M., Basco, M. R., Jarrett, R. B., & Trivedi, M. H. (1996). The Inventory of Depressive Symptomatology (IDS): Psychometric properties. *Psychological Medicine, 26*(3), 477–486. <https://doi.org/10.1017/S0033291700035558>
- Rutherford, B. R., Mori, S., Sneed, J. R., Pimontel, M. A., & Roose, S. P. (2012). Contribution of spontaneous improvement to placebo response in depression: A meta-analytic review. *Journal of Psychiatric Research, 46*(6), 697–702.
<https://doi.org/10.1016/j.jpsychires.2012.02.008>
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological Momentary Assessment. *Annual Review of Clinical Psychology, 4*(1), 1–32.
<https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>
- Shrout, P. E., Stadler, G., Lane, S. P., McClure, M. J., Jackson, G. L., Clavél, F. D., ... Bolger, N. (2018). Initial elevation bias in subjective reports. *Proceedings of the National Academy of Sciences of the United States of America, 115*(1), E15–E23.
<https://doi.org/10.1073/pnas.1712277115>
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology, 65*(5), 467–487. <https://doi.org/10.1002/jclp.20593>
- Sturmey, P. (2009). Behavioral Activation Is an Evidence-Based Treatment for Depression. *Behavior Modification, 33*(6), 818–829. <https://doi.org/10.1177/0145445509350094>
- Thomsen, D. K. (2006). The association between rumination and negative affect: A review. *Cognition and Emotion, 20*(8), 1216–1235.
<https://doi.org/10.1080/02699930500473533>
- van Os, J., Verhagen, S., Marsman, A., Peeters, F., Bak, M., Marcelis, M., ... Delespaul, P. (2017). The experience sampling method as an mHealth tool to support self-monitoring, self-insight, and personalized health care in clinical practice. *Depression and Anxiety, 34*(6), 481–493. <https://doi.org/10.1002/da.22647>

- 499 Van Roekel, E., Vrijen, C., Heininga, V. E., Masselink, M., Bos, E. H., & Oldehinkel, A. J. (2017).
500 An Exploratory Randomized Controlled Trial of Personalized Lifestyle Advice and
501 Tandem Skydives as a Means to Reduce Anhedonia. *Behavior Therapy*, 48(1), 76–96.
502 <https://doi.org/10.1016/j.beth.2016.09.009>
- 503 Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological*
504 *Bulletin*, 98(2), 219–235. <https://doi.org/10.1037/0033-2909.98.2.219>
- 505 Widdershoven, R. L. A., Wichers, M., Kuppens, P., Hartmann, J. A., Menne-Lothmann, C.,
506 Simons, C. J. P., & Bastiaansen, J. A. (2019). Effect of self-monitoring through
507 experience sampling on emotion differentiation in depression. *Journal of Affective*
508 *Disorders*, 244, 71–77. <https://doi.org/10.1016/j.jad.2018.10.092>
- 509
- 510