# SCIENTIFIC REPORT – YEAR 3 (FINAL REPORT)

## "Peace of Mind and Emotion Regulation: Survey-Based, Behavioral, and Neuroscientific Investigations"

Below, I will present the studies that have been carried out as part of this grant work during the duration of this project and point out the current stage of each study (in comparison to the original plan).

The overall aim of this project was to test the theoretical proposition put forward in Sikka et al. (2018) that peace of mind (PoM) relies on adaptive emotion regulation. The objectives of the studies carried out in the framework of this project were to explore how individual differences in PoM are related to (1) explicit habitual (or trait) emotion regulation (Study 1); (2) implicit emotion regulation ability, as indicated by attentional biases to emotional stimuli (Study 2); and (3) electrophysiological correlates of explicit emotion regulation ability (Study 3).

### Study 1a. Peace of Mind and Trait Emotion Regulation

Introduction: The aim of this study was to investigate the relationship between individual differences in PoM and trait emotion regulation, specifically the use of adaptive (i.e., cognitive reappraisal) and less adaptive (i.e., expressive suppression) emotion regulation strategies. We hypothesized that people with higher levels of PoM display (H1) a higher tendency to use adaptive (i.e., cognitive reappraisal) emotion regulation strategies; and (H2) a lower tendency to use less adaptive (i.e., expressive suppression) emotion regulation strategies. Study 1 provided initial support for the hypotheses. The aim of Study 2 was to replicate the results of Study 1 on a different sample of participants.

Methods: In two studies, participants from Finland (Study 1, $N$ = 417, $M_{age}$ = 31.63, $SD_{age}$ = 11.93, 18-67 years; 354 women, 49 men, 14 "other") and the US (Study 2, $N$ = 303, $M_{age}$ = 19.58, $SD_{age}$ = 1.26, 18-26 years; 135 women, 155 men, 7 "other) completed measures of PoM, trait emotion regulation (The Emotion Regulation Questionnaire; Gross & John, 2003), and other aspects of well-being and ill-being.

Results: Results of hierarchical multiple regression analyses showed that, as expected, people with higher (versus lower) levels of PoM reported a greater tendency to use cognitive reappraisal (Study 1: $\beta$ = 0.218, 95% CI [0.133; 0.302], $SE$ = 0.043, $t$ = 5.051, $p$ < .001; Study 2: $\beta$ = 0.232, 95% CI [0.133; 0.331], $SE$ = 0.050, $t$ = 4.617, $p$ < .001) and a lesser tendency to use expressive suppression (Study 1: $\beta$ = -0.174, 95% CI [-0.258; -0.090], $SE$ = 0.043, $t$ = -4.076, $p$ < .001; Study 2: $\beta$ = -0.156, 95% CI [-0.259; -0.055], $SE$ = 0.052, $t$ = -3.018, $p$ = .003). These results provide empirical evidence in support of the proposal that PoM may reflect adaptive emotion regulation (Sikka et al., 2018).

Current Stage of the Study: Manuscript has been published in a peer-reviewed journal (reference below). I also presented the results at a conference (reference below).

Sikka, P., Revonsuo, A., & Gross, J. J. (2023). *Individual differences in peace of mind reflect adaptive emotion regulation*, *215*, 112378.https://doi.org/10.1016/j.paid.2023.112378.

Sikka, P. (2022, April). *Peace of mind and emotion regulation*. Poster presentation at the 9th Society for Affective Science (SAS) Virtual Annual Conference.

**Study 1b: An additional study not part of the original plan. Peace of Mind and Trait Emotion Regulation: A Follow-Up Study**

Introduction: The aim of this study was to conduct a follow-up of Study 1, investigating how PoM is associated with difficulties in regulating emotions as well as with various emotion regulation strategies. Whereas Study 1 focused only on two emotion regulation strategies (cognitive reappraisal and expressive suppression), Study 1b (also consisting of two studies) addressed a wider range of different emotion regulation strategies (acceptance, self-blame, rumination, positive refocusing, planning, positive reappraisal, perspective, catastrophizing, other-blame, engagement-focused strategies, disengagement-focused strategies).

Method: In two studies, English-speaking participants (Study 1: N = 544, $M_{age}$ = 19.59, $SD_{age}$ = 1.47, 323 women, 203 men, 18 "other"; Study 2: N = 568, $M_{age}$ = 19.51, $SD_{age}$ = 1.42, 347 women, 208 men, 13 "other") completed measures of PoM and a variety of different measures assessing difficulties in regulating positive and negative emotions (brief version of the Difficulties in Emotion Regulation Scale, DERS-18; Victor & Klonsky, 2016; Perth Emotion Regulation Competency Inventory, PERCI, Preece, Becerra, Robinson, Dandy, & Allan, 2018) and various emotion regulation strategies (The Cognitive Emotion Regulation Questionnaire, CERQ; Garnefski & Kraaij, 2007; The Emotion Regulation Questionnaire, ERQ; Gross & John, 2003; The Process Model of Emotion Regulation Questionnaire, PMER; Olderbak et al., 2022).

Results: Study 1: With regard to difficulties in regulating emotions, results from hierarchical multiple regression analysis revealed that, when considering demographic variables alone, they accounted for 1.7 % of the variance in PoM scores. However, the inclusion of scales assessing emotion regulation difficulties contributed significantly, explaining an additional 20.1 % of the variance in PoMS5 (model: $F$[6,531] =24.72, $p < .001$). When controlling for difficulties in regulating positive and negative emotions, only difficulties in regulating negative emotions (as assessed by both PERCI and DERS-18) remained significant predictors of PoM. As to emotion regulation strategies, results from hierarchical multiple regression analysis indicated that demographic variables alone accounted for 1.7 % of the variance in PoMS5. Adding ERQ scores explained an additional 15.8 % of the variance in PoMS5 (model: $F$[5,535] =22.7, $p < .001$), while adding all other emotion regulation strategies accounted for an additional 14.6 % of the variance in PoMS5 (model: $F$[14,523] =17.68, $p < .001$). When considering all emotion regulation strategies simultaneously, cognitive reappraisal, positive reappraisal, and self-blame emerged as the strongest predictors of PoM. Study 2: Demographic variables alone accounted for 1.6% of the variance in PoM scores. The inclusion of subscales assessing engagement-focused and disengagement-focused emotion regulation strategies, explained an additional 12.7% of the variance in POMS5 (model: $F$[2,66.908] =43.185, $p < .001$). Engagement-focused strategies were positively associated ($\beta$ = .336, $p < .001$), whereas disengagement-focused

strategies were negatively associated with PoM ($\beta$ = -.124, $p$ < .001), with the strongest predictor still being cognitive reappraisal ($\beta$ = .236, $p$ < .001).Thus, the results of the study corroborate findings of Sikka et al. (2023) and provide further evidence in support of the proposal that PoM reflects adaptive trait emotion regulation.

Current Stage of the Study: Manuscript under review.

**Sikka, P.** (2024, June). *The role of emotion regulation in peace of mind*. Oral presentation at the Broader Bay Area Affective Science Society (B-BAAS) Conference, Berkeley, US.

**Sikka, P.** (2024, March). *The role of emotion regulation in peace of mind*. Poster presentation at the 2024 Society of Affective Science (SAS) Annual Conference, New Orleans, US.

**Study 2. Peace of Mind and Implicit Emotion Regulation**

Introduction: Here, we investigated implicit (or automatic) emotion regulation as a function of individual differences in PoM. According to the process model of emotion regulation, attentional deployment is one family of emotion regulation strategies (Gross, 1998, 2015). Affect-biased (or emotional) attention—selective attention to affectively salient stimuli—reflects attentional deployment and is considered a form of implicit emotion regulation (Todd et al., 2012). It can be measured using well-established emotional attention tasks, such as the attentional dot-probe task (MacLeod et al., 1986). In a preliminary study, we explored attentional biases (AB) to emotional stimuli (happy and angry faces) as a function of individual differences in PoM using the dot-probe task. We found that individuals with higher (as compared to lower) levels of PoM showed an attentional bias towards happy faces (see Sikka et al., 2019, https://osf.io/fwrm5/). The aim of this study was to replicate our preliminary findings.

Methods: The study was a direct replication of our proof-of-concept pilot study conducted with Swedish participants (Sikka et al., 2019). We pre-registered the hypotheses, methods, and analysis plan (https://osf.io/fwrm5/). Healthy participants ($N$ = 113, 100% female, $M_{age}$ = 25.03, $SD_{age}$ = 7.42, 18-53 years) first filled in a shortened version of the WBQ that included scales measuring different aspects of mental well-being, PoM, symptoms of anxiety and depression, and trait emotion regulation. After this, participants took part in a behavioral study: the attentional dot-probe task. Participants were seated in front of a computer screen in an experimental room and were shown emotional and neutral stimuli—faces displaying happy, angry, and neutral expressions. A pair of emotional and neutral stimuli (e.g., happy-neutral faces) was displayed on the screen. One of the stimuli (emotional or neutral face) was followed by a dot probe. The participants' task was to respond, as fast as possible, by stating whether the dot appeared on the left or on the right side of the screen using selected keyboard buttons. After the dot-probe task, participants were shown all the face stimuli and asked to identify the emotion displayed on the faces as well as to rate the intensity and arousal of those stimuli.

Results: Although participants displayed an attentional bias towards happy, as compared to angry faces, and this was stronger in those with higher (than lower) levels of PoM, we did not

observe a significant interaction between the face type (happy, angry) and PoM (high, low), F (1,111) = 0.783, p = .378, $\eta 2$ = .007. Thus, we did not succeed in replicating our earlier pilot study (Sikka et al., 2019).

Current Stage of the Study: Due to null results, we have combined these findings with those of Study 3 in the same manuscript.

Collaborators: Prof. James J. Gross (Professor of Psychology at Stanford University and Director of the Stanford Psychophysiology Laboratory, US). Prof. Antti Revonsuo (Professor of Psychology at the Department of Psychology, University of Turku). Dr. Simone Grassini (Associate Professor at the Department of Psychosocial Science, University of Bergen, Norway). Enyu Lin (PhD student, Department of Psychology, University of Turku).

**Study 3: Peace of Mind and Electrophysiological Correlates of Emotion Regulation**

Introduction: Event-related potentials (ERPs) can be used to investigate the neural basis of emotional processing and emotion regulation. An ERP component – the late positive potential (LPP) – is considered a well-validated electrophysiological index of both emotional processing and emotion regulation (see Hajcak et al., 2010 for review). LPP is a positive-going potential that is maximal at posterior midline areas, occurs approximately 300 ms after stimulus onset and is sustained throughout the stimulus presentation. LPP has been shown to be larger in amplitude for emotionally arousing (vs neutral) stimuli and to be reduced as result of using (implicit and explicit) emotion regulation strategies (e.g., Hajcak et al., 2010). The aim of this study was to investigate how individual differences in PoM are related to emotional reactivity and emotion regulation by studying the modulation of LPP by emotional (as compared to neutral) images.

Methods: Data was collected from 100 healthy Finnish-speaking adults but 85 participants (age = 27.35± 11.87, range = 18 – 70; 86% women, 12.9% men, 1.2% „other“) provided data that could be analyzed. First, participants filled in the PoMS (Lee et al., 20213). After this, they took part in a laboratory emotion regulation task with concurrent EEG measurement. In the task, participants were shown a sequence of emotional (positive, negative) and neutral pictures taken from a validated picture database (e.g., Nencki Affective Pictures System). In one condition (emotional reactivity) participants were asked to simply view the stimuli. In another condition (emotion regulation), they were asked to down-regulate the emotions induced by the pictures using the emotion regulation strategy called cognitive reappraisal. Participants also rated the valence and arousal of each picture. If PoM reflects enhanced emotion regulation capacity, then people with higher (as compared to lower) levels of PoM should display smaller LPP amplitudes in response to negative images during passive viewing, but especially when using adaptive emotion regulation strategies.

Results: Contrary to expectations, PoM was not associated either emotional reactivity ($p > .05$) or emotion regulation ($p > .05$) as measured with both behavioral responses and LPP. However, as in previous studies (see above), PoM was correlated with questionnaire scores measuring adaptive trait emotion regulation, specifically, cognitive reappraisal ($r = .39$, $p < .001$). These

results demonstrate that whereas PoM reflects adaptive trait emotion regulation, it is not associated with emotion regulation ability, as measured with laboratory tasks.

Current Stage of the Study: Data collection has been finished and data has been analyzed. Due to unexpected results (i.e., LPP not showing the usual emotion regulation effects, as demonstrated in previous studies), we spent more time than expected on additional analyses, trying to understand our null results. Therefore, we have not yet managed to finish the manuscript. The manuscript (consisting of findings of Study 2 and 3) will be finalized and submitted to a peer-reviewed journal in Nov-Dec 2024.

Collaborators: Prof. James J. Gross (Professor of Psychology at Stanford University and Director of the Stanford Psychophysiology Laboratory, US). Prof. Antti Revonsuo (Professor of Psychology at the Department of Psychology, University of Turku). Dr. Henry Railo (Department of Psychology, University of Turku). Dr. Simone Grassini (Department of Psychology, Stavanger University, Norway). Enyu Lin (PhD student, Department of Psychology, University of Turku). Nanna Strid (PhD student, Department of Psychology, University of Turku).

**Additional Studies (not part of the original plan but stimulated by the studies of the current research project and/or based on the data collected as part of the above-mentioned studies)**

**Study 4: Peace of Mind and the Emotional Quality of Psychedelic Experiences**

Introduction: In recent years, the potential of psychedelics (e.g., psilocybin, LSD, ayahuasca) for treating various mental health conditions has gained momentum. However, the specific aspects of the psychedelic experience contributing to its therapeutic effect remain unclear. It is proposed that the affective content of the experience may underlie observed benefits. Yet, the relationship between the affective quality of these experiences and improvements in well-being is not well understood. Additionally, while the impact of psychedelics on different facets of well-being has been extensively studied, their effect on PoM has not been explored. In this study, we investigated how the affective content of psychedelic experiences is associated with perceived changes in well-being, especially PoM.

Methods: Participants (psychedelic group: $N = 147$; meditation group: $N = 66$) retrospectively described their most meaningful psychedelic or meditation experience and rated their positive mood during that experience using the positive mood subscale of the Mystical Experience Questionnaire (MEQ30; Griffiths et al., 2006). They also rated perceived changes in PoM. The affective content of their narrative descriptions was analyzed using the Linguistic Inquiry and Word Count (LIWC-22) as well as with RoBETa, a transformer-based machine learning model for natural language processing.

Results: We found no significant relationships between the affective content of the narrative descriptions of experiences and perceived changes in PoM ($p$s > .05). However, positive mood during both the psychedelic and meditation experience predicted increased levels of PoM ($\beta$=.38, $p$ <.001 and $\beta$=.51, $p$ <.01 , respectively). The strongest predictor of PoM was the

feeling of peace and tranquility during the experience ($\beta$=.40, $p$ <.001). These findings suggest that, while positive affect during the psychedelic experience may play a role in enhanced well-being, this may also extend to other meaningful experiences.

Current Stage of the Study: Data collection has been finished and preliminary data analyses have been conducted. In addition to original analyses (using LIWC), we have decided to use RoBERTa, and two human raters (Nanna Strid, Daniel Ogunbamowo) who code the reports. These human codings have been completed. The final data analyses will be conducted and the manuscript submitted to a journal in autumn 2024. We have presented the results at two conferences (references below).

Strid, N., Jylkkä, J., Revonsuo, A., & **Sikka, P.** (2024, June). *Affective quality of psychedelic experiences is associated with perceived changes in peace of mind*. Poster presentation at the 2024 Association for the Scientific Study of Consciousness (ASSC27), Tokyo, Japan.

Strid, N., Jylkkä, J., Revonsuo, A., & **Sikka, P.** (2024, March). *Affective quality of psychedelic experiences is associated with perceived changes in peace of mind*. Poster presentation at the 2024 Society of Affective Science (SAS) Annual Conference, New Orleans, US.

Collaborators: Dr. Jussi Jylkkä (Researcher at the Department of Psychology, Åbo Akademi University, Finland). Prof. Antti Revonsuo (Professor of Psychology at the Department of Psychology, University of Turku). Nanna Strid (PhD student, Department of Psychology, University of Turku). Daniel Ogunbamowo (PhD student, Department of Psychology, Stanford University). Garrett Baber (PhD student, Hamilton Health Lab, University of Kansas, US).

**Study 5: Adaptive Emotion Regulation as a Link Between Psychedelic Experiences and Peace of Mind**

Introduction: Classic serotonergic psychedelics, such as psilocybin, LSD, DMT, or mescaline, have demonstrated a broad spectrum of positive effects on mental health and well-being in both clinical trials (Andersen et al., 2021) and naturalistic settings (Raison et al., 2022). Research suggests that increased psychological flexibility (PF) may underlie the enduring positive effects of psychedelic experiences on mental well-being. However, most research treats PF as a single construct, while it consists of six components. These components, specifically Acceptance and Self-as-Context (viewing oneself as an observer or mental events), reflect adaptive emotion regulation. Moreover, to date, no studies investigating the effects of psychedelics on mental health and well-being have examined PoM, which is considered central to psychedelic experiences (Griffiths et al., 2006). Therefore, the aim of the present study was to explore how features of a psychedelic experience are associated with different components of PF as well as with mental well-being and ill-being, including PoM.

Methods: Out of the total of 2500 participants filling in the pre-screening survey and reporting prior experience of psychedelics, 629 participants were invited to complete the main survey. The main survey comprised demographic questions, background information about past use of

psychedelics, scales assessing psychological flexibility (The Multidimensional Psychological Flexibility Inventory, MPFI -24; Rolffs et al., 2018), different aspects of well-being (The Peace of Mind Scale, PoMS; Lee et al., 2013; The Warwick-Edinburgh Mental Wellbeing Scale, WEMWBS; Tennant et al., 2007) and ill-being (the Patient Health Questionnaire; PHQ-9; Kroenke et al., 2001; Generalized Anxiety Disorder Scale, GAD-7; Spitzer et al., 2006), as well as questions about one psychedelic experience that they considered as the most meaningful or important in their lives. Network and mediation analyses were performed to examine associations between features of the psychedelic experience, components of PF, and well-being/ill-being.

Results: Network analysis showed that psychological insight experienced during the psychedelic experience was associated with the PF component Acceptance, while the PF components Values, Committed Action, and Defusion were associated with well-being and PoM. Mediation analyses showed that PF mediates the effects of psychological insight on well-being, PoM, and ill-being (*p*s < .001). These results show that adaptive emotion regulation, in the form of acceptance, may function as a bridge between psychedelic experiences and other components of PF, and may underlie the beneficial effects of psychedelics on well-being, including PoM.

Current Stage of the Study: Manuscript has been accepted for publication in a peer-reviewed journal.

Krabbe, A., **Sikka, P.,** & Jylkkä, J. (accepted). Acceptance as a possible link between past psychedelic experience and psychological flexibility. *Scientific Reports*.

Collaborators: Dr. Jussi Jylkkä (Researcher at the Department of Psychology, Åbo Akademi University, Finland), Andreas Krabbe (PhD student, Department of Psychology, Åbo Akademi University, Finland).

**Study 6: Peace of Mind, Valuating Low-Arousal Positive Affect, and Mental Health**

Introduction: Studies indicate that PoM is associated with lower levels of depression and anxiety (Lee et al., 2013; Sikka et al., 2018, 2023). However, we do not know how PoM translates to reduced mental health symptoms. One possibility is that it does so via valuing low-arousal positive affect (LAP), which is known to be associated with lower levels of mental health symptoms. To date, the association between PoM and valuing LAP has not been investigated. Here, we explored how individual differences in PoM are associated with valuing LAP, and to what extent valuing LAP mediates the relationship between PoM and mental health symptoms (depression, anxiety).

Methods: 620 participants (376 female, 231 male, 13 other; age 18-31 years old; mean age 19.52 ± 1.41) filled in scales assessing PoM (PoMS; Lee et al., 2013), affect valuation (the Affect Valuation Index; Tsai et al., 2006) and mental ill-being (the Patient Health Questionnaire; PHQ-9; Kroenke et al., 2001; Generalized Anxiety Disorder Scale, GAD-7; Spitzer et al., 2006). Regression and causal mediation analyses were used to analyze the data.

Results: People with higher levels of PoM placed a higher value on LAP ($r = .18$, $p < .001$), exhibited lower discrepancies between actual and ideal LAP ($r = -.36$, $p < .001$). LAP also significantly mediated the relationship between PoM and depression (indirect effect: (-.39) x (.13) = -.05, $p = .002$, ~10.08% explained) as well as anxiety (indirect effect: (-.39) x (.15) = -.06, $p < .001$, ~11.04% explained). These findings suggest that LAP may, in fact, explain how PoM translates to reduced symptoms of depression and anxiety.

Current Stage of the Study: Manuscript is currently in preparation and will be submitted to a journal in September 2024.

Collaborators: Prof. James J. Gross (Professor of Psychology at Stanford University and Director of the Stanford Psychophysiology Laboratory, US). Dr. David A. Preece (Curtin University, Australia). Sherry Hu (MSc student, Stanford University, US).

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