

The effect of self-monitoring with the Experience Sampling Method on interoceptive awareness: measurement or intervention tool?

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Abstract

The Experience Sampling Method (ESM) has become increasingly popular among researchers to study human conduct and obtain genuine insight into affective experiences (van Berkel et al., 2017). ESM prompts participants daily to complete numerous surveys for a fixed time period via hand-held devices and specialised software (Eisele et al., 2023; Verhagen et al., 2016). However, recent studies sparked debate over whether ESM is not just a mere measurement tool but also encompasses intervention properties (Eisele et al., 2023). Hence, this study investigates whether daily self-monitoring exerts an effect on interoceptive awareness, the ability to detect and interpret internal signals, compared to individuals who do not self-monitor daily. This study employed an experimental longitudinal design with a 16-day duration, recruiting 57 participants, to assess individual interoceptive awareness. Participants in the control group were asked to complete the pre- and post-assessment, using the Multidimensional Assessment of Interoceptive Awareness (MAIA) Version 2 at the beginning of the study and after the 16 days, whereas the participants in the experiment group participated in ESM with 18 items, three times a day, additionally. Results revealed that the experiment group showed a greater increase in interoceptive awareness between pre- and post-assessment, while the scores of the control group remained stable. Moreover, a weak positive correlation was found between the number of completed ESM-prompts and the changes in interoceptive awareness between assessment points. Four out of five dimensions of the MAIA-2 implemented in the ESM showed a significant increase. However, the interaction effect of time and group did not yield statistical difference. This research demonstrates the potential dual role of ESM and its effective intervention properties, using self-report measures. However, the generalisability of the outcomes is limited due to the small sample size and further research is needed to investigate the effects of moderating variables on interoceptive awareness using ESM.

Keywords: ESM, interoceptive awareness, mere-measurement effect

Introduction

From the moment we wake up, our body is sending us signals, indicating our internal states. These signals are of ranging intensity and may surpass undetected, however, they are deeply linked to our emotional condition, stress level and wellbeing (Nummenma et al., 2018). The prominence of these stimuli can vary greatly. While bodily functions like a heartbeat generally operate without entering conscious awareness, the emotional pain of losing a loved one can be quite overwhelming and not easily be suppressed (Nummenma et al., 2018). In addition to the ranging prominence of stimuli, the ability to detect them also differs on an individual level. The individual degree of accuracy in stimuli detection seems to correlate with psychological pathologies like depression, suggesting that individuals with less accurate detection are more prone to such pathologies (McDonough, 2024). Disruptions in interoceptive awareness might be a common underlying issue in being more susceptible to various condition (Heim et al., 2023). Being able to sense and acknowledge internal bodily cues is of major importance in emotion and body regulation and is referred to as *interoception* (Montoya-Hurtado et al., 2024). Therefore, this capacity is vital for maintaining wellbeing and self-preservation. In the light that over the last decade, there has been a noted rise in the prevalence of mental health issues, there is a need to consider alternative forms of treatment and prevention (Foulkes & Andrews, 2023). These findings show the potential of cultivating awareness for our bodily states as a fundamental cornerstone of maintaining well-being and mental health.

By developing this awareness of internal body sensations, individuals can experience a range of benefits that support both mental and physical health. Fugate et al. (2024) found that fostering an elevated comprehension of the interconnectedness between body and mind and how these components interplay, can gain fundamental insights of themselves alongside psychotherapy. This practice allows individuals to gain an understanding of underlying determinants of personal hurdles and the cultivation of effective adjustment techniques. By developing a heightened awareness for bodily changes (e.g. temperature alterations), emotions can be anticipated faster, aiding individuals in controlling their response based on internal stimuli detection. Moreover, Critchley & Garfinkel (2017) emphasize ubiquitous notions proposing that physiological alterations within the human body generate emotions, and these emotions can be regarded as a reflection of physiological modes. Individuals with high levels of interoceptive awareness are typically linked to possess more effective emotional regulation and verbalisation of affective modes. In addition to these findings, an elevated level of bodily awareness facilitates better self-regulation by reducing impulsive behaviours which in turn

can positively contribute to the prevention of addiction and substance abuse (Miller, 2024). Similarly, the intensity of physical pain tends to be greater for individuals who do not pay attention to their aching sensations compared to those who focus on the pain and accept it (Brani et al., 2013). Since *interoceptive awareness* is a crucial skill in addressing mental health challenges, the development and maintenance are beneficial for everyone interested in alleviating distress and fostering adaptability (Grabbe et al., 2023). Previous research has already investigated populations from around the world to gather new insights into different ethnic groups (Fallata et al., 2023).

The positive outcomes associated with an enhanced awareness of internal body sensations, including improved wellbeing, highlight the profound impact of this skill. However, as research has expanded, so did the terminology and conceptualisation within this research field. In prior research, there is a great variety of different notions and frameworks and prevalent jargon such as *interoception*, *body awareness*, or *interoceptive awareness* is often used synonymously (Gibson, 2019). Therefore, there is no universally accepted definition, underlining the multifaceted nature of the concept (Gibson, 2019). Despite these ambiguities, there are still some revolving commonalities which become evident in the literature. While the term *interoception* refers to the unconscious process of perceiving internal signals, *interoceptive awareness* describes the conscious recognition and understanding of these signals (Scheffers et al., 2024). There are inconsistencies in how *interoceptive awareness* and *interoception* are conceptualised within prevalent research and thus, Garfinkel et al. (2015) provide a conceptual framework of *interoception* with three dimensions. The first dimension of *interoceptive accuracy* refers to the objective measurement of individual levels in precisely perceiving internal bodily signals. Usually, the assessment of heartbeat detection is used to quantify this first dimension of *interoceptive awareness*. The second dimension encompasses *interoceptive sensibility* which involves the subjective perception of individuals regarding their own *interoceptive abilities*. Insights into *interoceptive sensibility* are generated using self-report measures such as questionnaires. These evaluation modalities allow to capture an individual's confidence in their *interoceptive abilities* as well as their perceived attentiveness to internal body signs. However, individual beliefs about this dimension may not always align with the actual performance of an individual. The third and final dimension is called *interoceptive awareness* and is the individual level of certainty of how well one can accurately perceive their internal signals. Subsequently, *interoceptive awareness* is related to both *interoceptive accuracy* and *interoceptive sensibility* and can therefore be regarded as an evaluation of the relationship

between these dimensions, assessing metacognitive insight. However, Poerio et al. (2024) noted apprehensions regarding the assessment of interoceptive accuracy using heartbeat detection and its correlation to the actual construct, as well as the need to implement individual attention to affective modes as an important factor in interoceptive awareness. The heartbeat detection tasks as described by Garfinkel et al. (2015) require controlled (offline) environments with guidance on the task and supervision of measurements. Additionally, in a study exploring the relationship between a mother's ability to perceive and interpret internal bodily sensations and the emotional interactions between her and her infant, the authors emphasised difficulties with heartbeat detection in online intervention modalities, leading to an exclusion of interoceptive accuracy (Suga et al., 2022). Moreover, Mehling et al. (2018) created a self-report questionnaire for assessing interoceptive awareness, accounting for the difficulties associated with the operationalisation of that construct. The authors define interoceptive awareness as “the conscious level of interoception with its multiple dimensions potentially accessible to self-report” (Mehling et al., 2018, p. 2). This conceptualisation aligns with what was earlier referred to as ‘interoceptive sensibility’, focusing on individual internal perception and omitting ‘interoceptive accuracy’ as this dimension lacks correlation to the overall construct of interoceptive awareness (Mehling et al., 2018). Consequently, this thesis adopts the definition of interoceptive awareness by Mehling et al. (2018) due to the online modalities of this study and the adapted conceptualisation. If one wants to research the construct of interoceptive awareness, a suitable measurement tool needs to be carefully selected in accordance with the examination modalities. Ma et al. (2024) suggest the use of momentary assessment techniques as an effective tool for measuring interoceptive awareness.

In the last decades, the application of the *Experience Sampling Method (ESM)*, or *ecological momentary assessment (EMA)*, became more popular among researchers to study human conduct and obtain genuine insight into affective experience (van Berkel et al., 2017). ESM prompts participants daily to complete numerous surveys for a fixed time period via hand-held devices and specialised software (Eisele et al., 2023; Verhagen et al., 2016). The extensive accessibility of smartphones allows to collect enriched data by employing mobile phone sensors and gathering contextual information. These altered modalities enable to measure more unobtrusive and minimise distortions through psychological fallacies (van Berkel et al., 2017). ESM involves measuring within the participants personal surroundings, initiated by notifications on the agreed device. These notifications are usually triggered by either a certain unpredictable time or a specific situation (Beal, D., 2015; Verhagen et al., 2016). By adopting this notification scheme, measurements are more accurate, and target

behaviour can be analysed with a certain immediacy (Verhagen et al., 2016). This form of immediate measurement is especially helpful in assessing emotional states. Since study participants often fail to accurately reproduce emotions, thoughts and feelings of specific situations retrospectively and the recollection of memories is occasionally distorted (Tov & Scollon, 2012). In a study of Chua et al. (2010), the authors state that even if individuals are assured that they vividly recall certain experiences, the veracity of the reproduced information might be false. This notion underlines that memory is susceptible to distortions and the valence of recollected emotions and feelings after their occurrence is questionable. Hence, there is a need to consider the use of alternative data collection methods to collect momentary experiences of individuals accurately, such as the ESM. Recent studies, however, sparked debate over whether ESM is not just a mere measurement tool but also encompasses intervention properties (Eisele et al., 2023).

Expanding on its intervention role, Snippe et al. (2016) found that implementing ESM as an additional measure in interventions facilitates changes in behaviour through elevated awareness of one's individual behavioural patterns. In addition to findings of ESM on behavioural change, evidence by Kauer et al. (2012) showed that the mere use of self-monitoring techniques contributed to an improvement in self-reflection and cognitive awareness which in turn led to a decrease in depression severity. Basic self-monitoring methods are effective in enhancing self-awareness, particularly regarding emotional awareness. Despite the notion that the Experience Sampling Method is a suitable data collection method for capturing moment-to-moment experiences and emotions, the effect of this data collection method on the measured construct remains unexplored (Eisele et al., 2023). There is still a lack of research regarding the dual role of the Experience Sampling Method as a measurement and an intervention tool and its effect on interoceptive awareness. Repetitive and consistent training exercises have been found to be essential for cultivating and improving interoception (Bornemann & Singer, 2017). Hence, there is evidence suggesting that repetitive exposure to questionnaires regarding interoceptive abilities might affect an individual's level of interoceptive awareness through an exercising nature.

This effect is known as the *mere-measurement effect* or *question-behavior effect* and refers to evidence that responding to questions about a specific behaviour can shape how likely a person is to engage in exactly that behaviour. For instance, answering questions regarding alcohol drinking habits can raise consciousness about consumption patterns, leading to a reduction in alcohol usage through responding to the questionnaire (Rodrigues et al., 2015). The mere-measurement effect is however not restricted to behaviours but can expand

on physiological states likewise. Kassam & Mendes (2013) found that the disclosure of affective modes can influence how those modes are experienced. Mere basic assessment can heighten the awareness of cognitive operations and in turn, invoke alterations in brain and bodily responses of affective modes. Similarly, this effect may occur when measuring interoceptive awareness. By focusing on the general population, this research can provide valuable insights into interoceptive awareness that are relevant across various contexts and mental health disorders, providing a comprehensive understanding of this phenomenon.

Therefore, the primary objective of this thesis is to ask:

To what extent does daily monitoring through the Experience Sampling Method contribute to the levels of interoceptive awareness in the general population compared to individuals who do not self-monitor daily?

To answer this research question, the following hypotheses will be tested:

- 1) There is a significant change over time in interoceptive awareness in the experiment group, while no significant change is observed in the control group.
- 2) The interaction effect of time and group results in higher score differences between pre- and post-assessment for the experiment group compared to the control group
- 3) There is a larger increase in scores of the MAIA-2-subdimensions in the post-assessment compared to the pre-assessment for the experiment group.
- 4) The number of completed ESM-questionnaires has a positive correlation with the mean differences in interoceptive awareness between pre- and post-assessment.

Methods

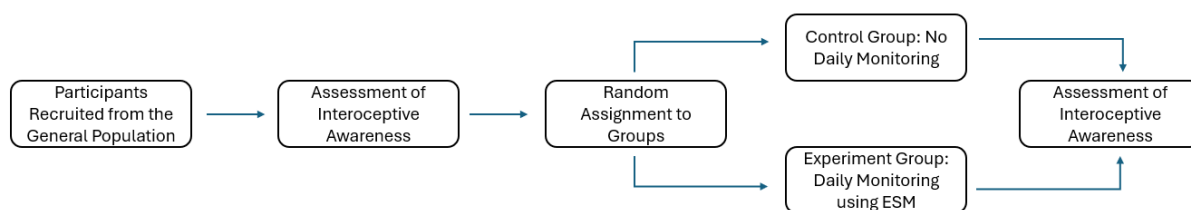
Study Design

This study employed an experimental longitudinal design, using the Experience Sampling Method (ESM) with interoceptive awareness as the dependent variable for quantitative research (see Figure 1). With a study duration of 16 days, data were collected via self-reported questionnaires and momentary assessments at several time points. This data collection followed a structured sequence. First, all participants completed the pre-questionnaire (trait questionnaire), then participants from the experiment group engaged in daily ESM-questionnaires (state questionnaire) throughout 14 days. Finally, at the end of the study, all participants completed the post-questionnaire (trait questionnaire) to assess any

changes compared to the pre-measurement. Employing this design allowed for an examination of measurement effects over time by comparing outcomes of the control group with the experiment group. This research was part of a larger study which has been approved (request nr. 240934) by the BMS Ethics Committee on the 28th of October 2024.

Figure 1

Flowchart of the Study Design



Participants

The target group of this study is depicted by the general population. Inclusion criteria were a minimum age of 18 years, proficiency in the English language, and possession of a smartphone with access to the internet. Due to the potential risks of this study, several exclusion criteria were applied, namely, being under the age of 18 years, a prior diagnosis of any anxiety-related disorder, or ongoing treatment of any mental health disorder. 94 participants were recruited using snowball sampling and convenience sampling, using text messages in different social networks (see Appendix D). Also, the SONA System of the University of Twente was used for the dissemination of the questionnaires, granting 2.5 European Credits (EC) to participating students in both groups, while external participants were ineligible for this form of compensation. The final sample consisted of 57 participants (60.64%), who completed both, the pre- and post-assessment and had high enough data saturation in the ESM questionnaires. Table 1 illustrates the overall composition of the final sample per control group and per experiment group, detailing participants' age, gender, and nationality. 28 participants did not complete the post-questionnaire, resulting in a dropout-rate of 29.79%. The average response rate for the ESM-questionnaires of the final sample after application of the exclusion criteria was determined with 80.04%.

Table 1*Composition of the final sample per group*

Characteristic	Control Group		Experimental Group		Full Sample	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
Gender						
Male	11	32.35	10	43.48	21	36.84
Female	23	67.65	13	56.52	36	63.16
Others	0	0	0	0	0	0
Nationality						
Greek	11	32.35	4	17.39	15	26.32
German	7	20.59	6	26.09	13	22.81
Polish	5	14.71	0	0	5	8.77
Others (incl. double nationality)	11	32.35	13	56.52	24	42.10
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	23.06	7.06	24.44	8.00	23.56	7.37

Materials**Multidimensional Assessment of Interoceptive Awareness (MAIA) Version 2**

The MAIA-2 is a 37-item questionnaire measuring different dimensions of interoceptive awareness on eight subscales using self-report measures with a 6-point Likert scale (0= *never* to 5= *always*), developed by Mehling et al. (2018). MAIA-2 is a revised version of the original questionnaire MAIA. The according dimensions encompassed in the MAIA-2 are *Noticing*, *Not-Distracting*, *Not-Worrying*, *Attention Regulation*, *Emotional Awareness*, *Self-Regulation*, *Body Listening*, and *Trusting*. An illustrative example of an item from the *Noticing*-dimension is “*When I am tense I notice where the tension is located in my body.*”. Within the subscale of *Not-Distracting* five items use reverse scoring and for the dimensions of *Not-Worrying*, three items are reversed. For instance, if the score of item *Q5* “*I ignore physical tension or discomfort until they become more severe.*” is specified with 5 = *always*, this value will be reversed in the scoring procedure to 0, indicating a lower score for awareness (Mehling et al., 2018). Scores of each subscale are determined by the arithmetic mean of its corresponding items, with an elevated score reflecting a greater self-perception of interoceptive awareness (Eggart et al., 2021). Six of the eight dimensions were assessed with a factor loading above .70, which can be regarded as sufficient. The subscales *Noticing* (.64) and *Not Worrying* (.67) have not met the threshold value of .70 but were still integrated into

the final version MAIA-2. Overall, a good internal consistency with a Cronbach's Alpha of .74 has been assigned to the MAIA-2 (Mehling et al., 2018).

Trait Questionnaire (MAIA-2)

The MAIA-2 was included in the trait questionnaire as a pre- and post-measurement for the experimental group and the control group. Other surveys such as the *Perceived Stress Questionnaire* (30 items) and *The Multidimensional Self-Control Scale* (MSCS) (29 items) were added to the trait questionnaire since this research was part of a larger study, however, both questionnaires were irrelevant for this research and will not be mentioned further. In summary, the trait questionnaire consisted of 96 items for the pre-measurement and post-measurement, with an additional three questions regarding the participants demographics (age, gender, nationality), resulting in a total of 99 items for both questionnaires. The post-questionnaire for the experiment group entailed an additional three items in form of qualitative research questions, asking participants to describe their experiences with the experience sampling method and whether their view on the psychological constructs at hand has changed.

State Questionnaire (ESM-Questionnaire)

The total state questionnaire consisted of 18 items in total, including items from the questionnaires mentioned above for this larger study. The state questionnaire relevant for this research consisted of five reformulated MAIA-2 items, along with one interactive task, to test the effect of daily self-monitoring on interoceptive abilities. Only items with a threshold of a .70 factor loading and above on interoceptive awareness were considered (see Appendix A), to ensure high correlation between item and construct as well as good construct validity. Furthermore, items were chosen based on their feasibility for everyday life-situations of the participants, meaning that items entailing indications of different affects were discarded to keep the questions universal to different situations and environments (e.g. at work) and without a certain directive nature. Therefore, the dimensions of *Trusting*, *Body Listening*, *Self-Regulation*, *Attention Regulation*, and *Emotional Awareness* were represented by one item each in the questionnaire. Moreover, the items were reformulated in a retrospective manner, meaning that they always referred to the timeframe since the last notification. For instance, two such items include *Since the last notification, I listened for information from my body about my emotional state.* (Dimension: Body Listening), and *Since the last notification, I used my breathing to reduce any tension in my body.* (Dimension: Self-Regulation). All items were assessed on a 6-point Likert scale (0= *strongly disagree* to 5= *strongly agree*) while the

original Likert-Scale of the MAIA-2 was adapted to fit the phrasing of the modified items. Additionally, the interactive task requires participants to indicate the location of their bodily changes and symptoms on a provided body image template. In combination with item 5, this item asks participants to “*Indicate where you felt such bodily changes. If you did not feel any changes, you can skip this task on the bottom of the page.*”. Therefore, participants received an illustration of a human body with interactive body parts to click on, to indicate their perceived changes in their body in response to their felt emotions. This was the only exception where participants were permitted to skip. Albeit skipping this item, the response rate of the participants was not negatively affected (see Appendix B).

m-Path Application

m-Path is a free platform for conducting momentary assessments of participants and creating interventions, developed by researchers from the KU Leuven (Belgium), and is available as a mobile application and web application (m-Path, 2024). The integration of this app was endorsed by the supervisors of this research and version 2.8.11 was used. m-Path allows researchers to configure personalised notification schedules for participants, who receive these notifications on their own smartphone according to the notification scheme. Participants are prompted to fill-in the questionnaire within a predetermined timeframe multiple times a day. Meanwhile, data of each participant can be monitored by the researchers and study adherence can be supervised using additional data provided by m-Path, such as the response rate or the total amount of notifications sent out (m-Path, 2024). Both, the experiment group and the control group installed the m-Path application. The experiment group used m-Path for taking part in the experience sampling method while the control group participants received a reminder via m-Path to complete the post-questionnaire after 14 days.

Procedure

Participants received instructions and information about this study via the SONA page of this research and within the pre-questionnaire in Qualtrics for non-students. Upon taking part in this study, participants were asked to read the consent form and agree to the modalities (see Appendix C). Afterwards, they were directed to the trait questionnaire, ending on the final page with instructions on how to install the m-Path app and a reminder to activate notifications in their own device settings to receive notifications from m-Path. After installation, participants were asked to enter the user-created nickname into the designated text field on the final page of the pre-questionnaire to assure the correct assignment of both trait questionnaires and state questionnaires to the individual participant. The unique

researcher code, included in the pre-questionnaire, allowed participants to sign-up for this study via their m-Path application. Mail correspondence of the researchers, in case of difficulties, were included in the pre-questionnaire. After completion, participants were systematically assigned to either the control group (even numbers), which only completed the pre- and post-questionnaire, or the experiment group (odd numbers), which additionally engaged in experience sampling over 14 days. The allocation of participants was based on the corresponding order of their participant number (e.g. Participant 1 – experiment group, participant 2 – control group, etc.). For organisational purposes, the ESM-study started on the day after participants completed the pre-questionnaire (sign-up day + 1), so that researchers were able to allocate the participants in time and according to the notification schedule.

On day two, the control group received a notification via m-Path that their next and final questionnaire (post-questionnaire) will be sent out in 14 days, and the experiment group received the first set of ESM items. The control group received another notification after 14 days, being asked to fill in the post-questionnaire. This notification entailed the link to the post-questionnaire on Qualtrics and expired 48 hours after receipt of the notification. 24 hours after this notification, a reminder was automatically sent out to participants who did not finish the questionnaire yet. Participants were instructed to return to the m-Path application and to confirm the completion of the post-questionnaire to notify the researchers.

The experiment group was instructed with the same modalities regarding the post-questionnaire as the control group. Additionally, participants were prompted to answer the state questionnaire three times a day, at 12pm, 4pm, and 8pm. An inter-notification time of four hours was chosen due to the number of 18 ESM-items within each interaction. The state questionnaire and the notification scheme remained fixed throughout the study, with the questionnaire taking approximately three minutes to complete. The time window for completion of each state questionnaire was adjusted to two hours. After one hour, participants received a reminder to complete the questionnaire. If there is no reaction within this timeframe, participants were not able to retrieve the questionnaire, and this questionnaire was reported missing. After completion of the post-questionnaire, participants finished the study and received their course credit when participating via SONA. This research was conducted within a time frame between 07-11-2024 – 06-12-2024.

Data Analysis

The focus of this data analysis was to compare the outcomes of the MAIA-2 within the pre-questionnaires and the post-questionnaires of both, the control group and the experiment

group. In addition, a coding scheme was created to analyse the qualitative research items within the post-questionnaire for the experiment group. Data analysis was conducted using the statistical software IBM SPSS Statistics (version 29.0.2.0 (20)).

Data Preparation

The dataset was cleaned by excluding participant values with a response rate of less than 60% (excluding 9 participants), or if the pre-questionnaire or the post-questionnaire was not completed (excluding 28 participants). In total, 37 participants were excluded from the sample, resulting in 57 participants with complete pre- and post-assessments for analysis. Additional variables 'time' and 'group' were added to the dataset, indicating either the control or experiment group and whether the results were from the pre-assessment or post-assessment.

Demographics of Participants

To analyse the demographic information of the participants, the mean scores and standard deviation of the variable *age* were determined, and maximum and minimum values calculated. Regarding the variables of *nationality* and *gender*, scores were transformed into percentages.

Descriptive Statistics

For the outcomes of the pre-questionnaires and post-questionnaires, specifically for the MAIA-2, a frequency table was developed to compare the mean values and mean differences of both research groups to generate insight into the levels of interoceptive awareness before and after participation in this study. Maximum and minimum values on interoceptive awareness, as well as the average response rates and dropout rates were inspected.

Inferential Statistics

To assess the suitability of parametric tests, the Shapiro-Wilk and Kolmogorov-Smirnov tests were conducted to assess normality of the gathered data. Furthermore, Levene's test of variance was conducted to inspect the homogeneity of variance within the datasets. Additionally, the assumption of linearity was determined by computing a scatterplot of the predicted values and residuals.

For the first hypothesis, a paired t-test was computed to compare the scores of interoceptive awareness between pre- and post-assessment for the control group and

experiment group and to assess whether there is a significant change in interoceptive awareness between measurement points.

Hypothesis two was tested using a linear mixed model with random effects to assess the relationship between the dependent variable of interoceptive awareness (total score) and the interaction of time and group.

For assessing hypothesis three, a paired t-test was conducted on the mean scores of each subdimension of the MAIA-2 for the pre- and post-assessment for the control and experiment group. This analysis was to investigate significant differences in mean scores for each subdimension and to determine whether the experiment group had higher mean differences on each subscale than the control group.

Furthermore, a correlation analysis was conducted for hypothesis four to investigate the relationship between the mean differences of interoceptive awareness between measurements and the number of completed ESM-prompts by applying Pearson's correlation.

For the visualisation of data and corresponding analyses frequency tables were created and a scatterplot for illustrating correlations was computed.

Qualitative Research

Open ended questions were analysed by adopting the model proposed by Braun & Clarke (2006) of thematic analysis for qualitative research. By following the suggested stages of 1) Familiarisation with data, 2) Generation of initial code 3) Searching themes/dimensions, 4) Consolidation and definition of themes/dimensions, and 5) Production of report, a coding scheme was created using Atlas.ti 25 (version 25.0.1.32924). These steps followed an iterative process of reviewing and adapting. Codes were derived from the data, using an inductive approach. Answers of participants assigned to the experiment group were analysed and overarching themes identified.

Results

Assumptions for Using Parametric Tests

To test whether parametric tests can be used for further analyses, relevant assumptions were tested. Normality tests in form of the Kolmogorov-Smirnov and the Shapiro-Wilk tests

were conducted on the mean data of all 37 MAIA-2-items (interoceptive awareness) included in the pre-assessment form and the post-assessment form. The tests were applied to each group and timepoint separately and the results revealed that the data in the control group were normally distributed for the pre-assessment ($D(34) = 0.106, p = .200$), ($W(34) = 0.967, p = .388$) and post-assessment ($D(34) = 0.073, p = .200$), ($W(34) = 0.973, p = .540$). The assumption of normality of data for the experiment group was confirmed for the pre-assessment ($D(23) = 0.105, p = .200$), ($W(23) = 0.947, p = .249$), and post-assessment ($D(23) = 0.167, p = .097$), ($W(23) = 0.956, p = .385$). One outlier was identified ($M = 1.54$), however, due to the sample size the consideration of excluding the outlier was dismissed. No significant deviations from normality were gathered, and therefore the assumptions for parametric tests met.

For an assessment of whether the variances between the control group and the experiment group are equal, Levene's test was computed for both, the pre-assessment scores and the post-assessment scores of interoceptive awareness. The results indicated that the assumption of homogeneous variances was met for the pre-assessment ($F(1,55) = 0.595, p = .444$), indicating that Levene's test is not significant. For the post-assessment, the assumption of homogeneous variances was not met due to the significant results of Levene's test ($F(1,55) = 4.370, p = .041$). A corresponding Levene's Test without the outlier, however, did result in a non-significant p-value for the mean ($p = .055$). Thus, the assumption of homogeneity is within the realm of acceptability.

The assumption of linearity is clearly satisfied through the scatterplot of the predicted values and residuals (see Appendix E), showing a clear lack of pattern through a random distribution around 0.

Descriptive Overview of Interoceptive Awareness

To assess the levels of interoceptive awareness in the control group and the experiment group, the mean scores of the pre- and post-assessments were calculated (see Table 2). The mean scores of interoceptive awareness for the control group were observed to be lower in the post-assessment compared to the results of the pre-assessment whereas the observed mean score of interoceptive awareness seems to be higher in the post-assessment for the experiment group compared to the pre-assessment.

Table 2

Descriptives of the Multidimensional Assessment of Interoceptive Awareness in Experiment Group and Control Group

Group	Scores	<i>n</i>	Min	Max	Mean	<i>SD</i>
Experiment	Pre	23	1.54	3.41	2.77	.45
	Post	23	2.51	3.81	3.04	.35
	Dif	23	.97	.40	.27	.10
Control	Pre	34	1.89	3.76	2.71	.50
	Post	34	1.68	3.60	2.67	.53
	Dif	34	-.21	-.16	-.04	.03

Hypothesis Testing

MAIA-2-score Differences Pre-assessment vs. Post-assessment

To confirm the observation of the increase in mean scores for hypothesis one and assess the time effect for both groups, a paired t-test was conducted since the assumption of normality was met. For the control group, the mean scores of interoceptive awareness between the pre-assessment and the post-assessment revealed no significant effect ($t(33) = 0.71, p = .485$) with a small effect size of Cohen's $d = .12, 95\% CI [-0.22, 0.46]$. For the experiment group, the results revealed a significant effect between the interoceptive awareness scores of the pre-assessment and post-assessment ($t(22) = -3.33, p = .003$). Cohen's d showed a moderate effect size with Cohen's $d = -0.69, 95\% CI [-1.14, -0.23]$. These outcomes show that the mean scores of the MAIA-2-items (interoceptive awareness) in the control group remained relatively stable and reveal no significant difference between assessments whereas a significant and positive difference in interoceptive awareness was observed in the experiment group (see Table 3). Therefore, hypothesis one was accepted.

Table 3

Results of the paired t-test for the differences in means of the control group and experiment group between assessment timepoints

Group	Pre- Assessment (<i>M, SD</i>)	Post- Assessment (<i>M, SD</i>)	Difference (<i>M, SD</i>)	<i>t(df)</i>	Two-tailed p-value	Effect size (Cohens <i>d</i> , 95% CI)
Control Group	<i>M</i> = 2.71 (<i>SD</i> = .50)	<i>M</i> = 2.66 (<i>SD</i> = .53)	<i>M</i> = .052 (<i>SD</i> = .43)	$t(33) = .71$	$p = .485$	$d = .12 [-0.22, 0.46]$

Experiment Group	$M = 2.77$ ($SD = .45$)	$M = 3.04$ ($SD = .35$)	$M = -.27$ ($SD = .38$)	$t(22) = -3.33$	$p = .003$	$d = -.69$ [-1.14, -0.23]
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Interaction Effect of Time and Group on Interoceptive Awareness

To assess hypothesis two of whether there is a difference in the magnitude of change for the levels of interoceptive awareness between both groups and timepoints, a linear mixed model was conducted since the assumptions were met. The model accounted for fixed effects of group, time and the interaction of group and time, as well as for the random effect of time (see Table 4). Among the fixed effects, group and time were not statistically significant predictors ($p \geq .05$) of interoceptive awareness. Consequently, due to the insignificant interaction effect, hypothesis two was rejected.

Table 4

Type three test of fixed effects

Source	Numerator <i>df</i>	Denominator <i>df</i>	<i>F</i>	Significance
Intercept	1	110	19.423	<.001
Group	1	110	.831	.364
Time	1	110	.465	.497
Interaction Time and Group	1	110	3.123	.080

Differences in Dimensions from Pre-assessment to Post-assessment

To address hypothesis three of whether there is a larger increase in scores of the MAIA-2-subdimensions in the post-assessment compared to the pre-assessment for the experiment group, this analysis aimed to evaluate the differences in subdimension scores between the experiment group and control group and both timepoints. Again, the assumptions for normality were met. Therefore, a paired t-test was conducted to reveal the subscale differences between the pre-assessment and post-assessment. Table 5 depicts the mean scores, standard deviation, and scores of each MAIA-2 subdimension for both timepoints for the control group and experiment group. The outcomes suggest that no significant difference was found for either of the subscales for the control group. For the experiment group, however, significant positive differences were revealed for the subdimensions ‘Emotional Awareness’, ‘Self-Regulation’, ‘Body Listening’, and ‘Trusting’. No significant difference was found for the remaining subdimensions for the experiment group. Consequently, the items used for the state questionnaire and the related subdimension have a significant positive change in mean

scores for four out of five applied dimensions. The largest changes in mean scores were observed for the dimensions of ‘Trusting’ (.77) and ‘Self-Regulation’ (.52). Hence, hypothesis three was accepted.

Table

Results of the t-test for each MAIA-2 subdimension for the control group and experiment group

Group	Dimension	Pre-Mean (SD)	Post-Mean (SD =	Mean Difference	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Control Group	Noticing	3.19 (SD = .89)	3.11 (SD = .77)	-0.08	0.555	.583	0.08
	Not Distracting	1.89 (SD = .71)	1.95 (SD = .67)	0.06	-0.588	.560	0.10
	Not Worrying	2.45 (SD = .73)	2.36 (SD = .57)	-0.09	0.739	.465	0.13
	Attention Regulation	2.81 (SD = .67)	2.63 (SD = .80)	-0.18	1.577	.124	0.27
	Emotional Awareness	3.47 (SD = .98)	3.27 (SD = .94)	-0.20	1.598	.120	0.28
	Self - Regulation	2.72 (SD = .86)	2.69 (SD = .98)	-0.03	0.149	.883	0.03
	Body Listening	2.28 (SD = 1.03)	2.38 (SD = .94)	0.10	-0.640	.527	-0.11
	Trusting	2.97 (SD = 1.02)	3.11 (SD = 1.08)	0.14	-0.865	.393	-0.15
	Experiment Group	Noticing	3.42 (SD = .67)	3.62 (SD = .46)	0.19	-1.266	.219
Not Distracting		1.89 (SD = .61)	1.99 (SD = .74)	0.10	-0.904	.376	0.50
Not Worrying		2.50 (SD = .89)	2.41 (SD = .99)	-0.09	0.544	.592	0.77
Attention Regulation		2.86 (SD = .85)	3.09 (SD = .70)	0.23	-1.893	.072	0.58

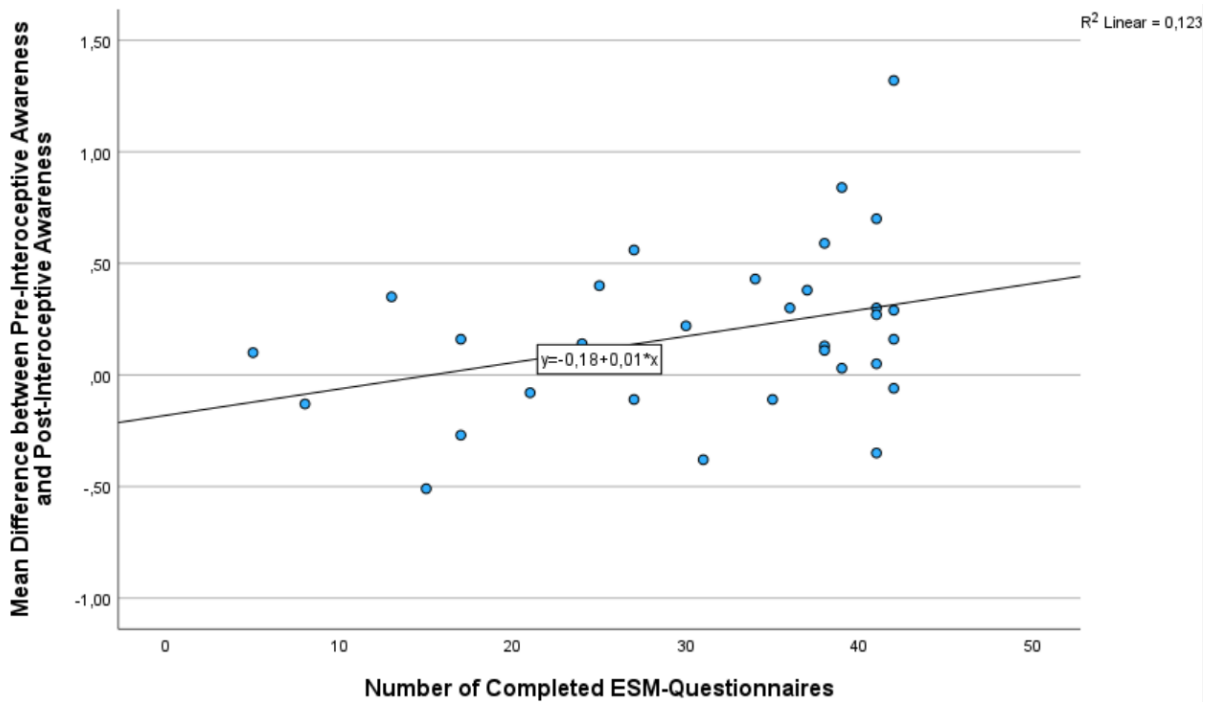
Emotional Awareness	3.58 (SD = .78)	3.97 (SD = .51)	0.39	-2.714	.013	0.69
Self-Regulation	2.55 (SD = .99)	3.07 (SD = .83)	0.52	-3.065	.006	0.80
Body Listening	2.58 (SD = 1.06)	2.97 (SD = .84)	0.39	-2.105	.047	-0.44
Trusting	3.01 (SD = 1.09)	3.78 (SD = .74)	0.77	-4.968	<.001	-1.03

Correlation between Completed ESM-questionnaires and Mean Score Differences

To address hypothesis four and evaluate the relationship between the number of completed ESM-items and the difference between the pre- and post-scores of interoceptive awareness, the experiment group sample was modified by including the participants who were excluded due to a lower response rate (<60%) but still completed the post-assessment ($n = 9$). The mean difference in interoceptive awareness scores for this sample ($n = 32$) was inspected for normality, using the Shapiro-Wilk Test and the Kolmogorov-Smirnov Test. Results revealed that the mean difference shows no deviation from normality, using the Shapiro-Wilk Test ($W(32) = .960, p = .283$), as did the Kolmogorov-Smirnov Test ($D(32) = .098, p = .200$). Therefore, the assumption of normality was met and consequently, Pearson's Correlation applied to assess the relationship. The correlation coefficient ($r(32) = .351, p = .049$) indicates a weak positive correlation between the number of completed questionnaires and the mean score differences in interoceptive awareness for ESM-participant, supporting hypothesis four.

Figure 2

Scatterplot showing the relationship between the mean differences in interoceptive awareness scores in the ESM-sample and the number of completed ESM-surveys



Qualitative Analysis

A total of 23 participants did answer the question implemented in the post-assessment of ‘How did you experience measuring stress, interoceptive awareness and self-control using the ESM (triggers, levels, awareness)? How do you think it affected your view on those constructs?’. Out of those 23 participants, 17 were part of the experiment group, and six were excluded participants of the experiment group due to the exclusion criteria (low response rate), however, their answers were still inspected. The group affiliation was indicated for each response (see Appendix F) and frequencies for each code calculated (see Table 6).

Increase in Awareness

The first theme identified was ‘Increase in Awareness’. This overarching theme refers to text passages of participants describing how they became more attuned to emotional states and bodily sensations. This often involved the expression of a heightened awareness of emotional patterns and physical responses like the feeling of tension or fear, as well as a greater recognition of triggers for such patterns. Codes derived from this theme were ‘Bodily Awareness’ and ‘Emotional Awareness’.

‘Bodily awareness’ captures the recognition of physical sensations such as the feeling of tension in certain body parts or a change in breathing patterns. One participant wrote “I think after answering all these questions for multiple days I feel more aware of my body

sensation and how it affects me” (Experiment Group). Another participant mentioned “Through the daily surveys, I was repeatedly reminded to focus on my sensations, which I found very helpful in various situations” (Experiment Group). Both statements indicate a clear increase in bodily awareness as a result of the ESM-items.

‘Emotional awareness’ encapsulates a contemplation on emotional states and a reflection of how these may differ from situation to situation. This was reflected by a participant mentioning “It made me more aware, especially when filling in the questionnaire, how I (have) felt and how it was in past experiences” (Experiment Group). Additionally, one participant wrote “It made me a bit more comfortable and made me aware of when and why I feel discomfort” (Experiment Group). These statements demonstrate that the ESM-items enabled participants to acquire a deeper understanding of their emotional states and how the context of different situations contributes to emotional experiences.

Challenges

The theme of challenges incorporates the difficulties participants encountered while taking part in the study. These can be of practical or emotional nature and were often connected to logistical difficulties such as time constraints and the demand of increased interoception within the study.

‘Emotional Burden’ alludes to statements indicating distress caused by revisiting strong emotions through the questionnaire items or discomfort related to extensive analyses of feelings and emotional states. This process was reflected by a participant stating that it “made me continuously more aware about me having deadlines & thus kind of stressed me whenever the question was if I postpone things, or if I am worried etc. (Excluded Participant). Another participant shared that it “made me realise how much in a hurry and anxiety I am most of the time during my day, which made me sad” (Excluded Participant).

‘Practical Difficulties’ refers to internal challenges encountered while engaging in the questionnaires, primarily related to a lack of focus or concentration. These deficiencies in concentration and focus were mentioned by a participant “sometimes I was so focused on the tasks I was doing during the day like lectures and studying that the questioners didn't really hit me that deep” (Experiment Group). Another participant explained “I also realised that I can find it hard to focus on sensing my body when I do not feel comfortable” (Experiment Group). Therefore, these statements clearly highlight the internal challenges with maintaining concentration and engagement faced by participants during the study.

Practical Insights

Another recurrent theme is depicted by recurrent passages where participants indicate the use of different techniques such as shifting the attention to breathing or sensing the effect of emotions on their body. These techniques may have been acquired through the study or were part of the participant's inventory.

The code 'Connection between Body and Mind' entails statements about the recognition of the interconnectedness or interplay between emotional states and physical sensations and vice versa. An observation shared by a participant indicated this recognition by stating "Made me more aware of the connection between the way I feel and how it affects my body, the changes in moods that I might experience within a day" (Experiment Group). Additionally, another participant shared the insight "It made me realize how and where I felt tension and that I should pay attention to it, to use breathing to relax a bit more." (Experiment Group).

'New Strategies' entails novel applications of mindfulness techniques to manage emotional affect acquired through the recurring questionnaires. One such strategy was reflected by this statement "I was able to implement some of the content of the question. For instance I caught myself focusing more on sensing rather than thinking" (Experiment Group). One participant also shared that "I think it was a very good experience and I will try to be more mindful about my body and emotional state in the future!" (Experiment Group). Therefore, numerous participants were able to acquire novel insights on how to be more mindful in the future (see Table 6).

Participation Burden

Regarding external obstacles which arose from the design of the study and the degree of involvement, this theme captures aspects hindering participants from full engagement.

'Logistical Difficulties' involve any external challenges connected to the daily routine of the participants and the completion of the daily questionnaires. Several challenges like time constraints or difficulties incorporating the study in their daily routine. Such difficulties were reflected by participants "i didn't participate in every questionnaire, due to work and hobbies (Excluded Participant)" and "there were times when I had to answer it during working or studying when it made me realise how much in a hurry and anxiety I am" (Excluded Participant).

‘Questionnaire Fatigue’ highlights participation burdens caused by the repetitive demand of filling in questionnaires multiple times a day and frustration due to the repetitive nature of the items incorporated. This was clearly reflected in this participant's statement “Also the repetitive nature of the questions sometimes put me off and I didn't really pay as much attention to the questions themselves which made it feel more like a chore.” (Experiment Group). Also, the monotony of the ESM-items was perceived as a limitation for attention towards the receptivity of deviating stimuli “The questions were very similar to one another, so it felt like not all experiences of stress could be identified” (Excluded Participant).

Minimal Impact

This final theme integrates responses from participants who did not state additional benefits or experienced only little effects on their interoceptive awareness.

‘Limited Effects’ entails statements of uncertainty about the effectiveness of the questionnaires and observations of marginal changes. Such an indication was made in this statement “I am not yet sure if this will affect me sustainably” (Experiment Group). This uncertainty was also claimed by this participant “It didn't change my life, but I think it had a positive impact (Experiment Group)”.

‘No Effects’ includes passages where no impact of the study is noted. For instance, one participant mentioned “I cant see effect” (Excluded Participant).

Table 6

Thematic Analysis: Atlas.ti Codes, Frequencies and Participant Count

Theme	Codes	Occurrence	Number of Participants
Increase in Awareness	Bodily Awareness	4	4
	Emotional Awareness	11	11
Challenges	Emotional Burden	3	3
	Practical Difficulties	3	2
Practical Insights	Connection between Body and Mind	7	7
	New Strategies	7	5
Participation Burden	Logistical Difficulties	2	2
	Questionnaire Fatigue	3	3
Minimal Impact	Limited Effects	6	6
	No effect	1	1

Discussion

This study aimed to evaluate whether daily self-monitoring through the Experience Sampling Method impacts the levels of interoceptive awareness compared to individuals who do not practice self-monitoring daily. The main findings of this study suggest that ESM significantly improves the levels of interoceptive awareness and the scores on its subdimensions implemented in the corresponding questionnaire such as 'Emotional Awareness', 'Self-Regulation', 'Body Listening', and 'Trusting'. In comparison, for individuals who did not self-monitor interoceptive awareness, no significant changes in subdimensions were found and the levels of interoceptive awareness remained stable. Furthermore, the weak positive correlation between the number of completed ESM-questionnaires and the mean difference in interoceptive awareness scores highlights the potential of regular engagement with ESM in contributing to an increase in scores. Therefore, ESM might not be a suitable measurement tool for the assessment of baseline levels of interoceptive awareness, highlighting its dual role as a measurement- and intervention tool.

Findings of Kauer et al. (2012) already indicated that mere self-monitoring can contribute to an improvement in self-reflection and cognitive awareness. Similarly, Snippe et al. (2016) found that ESM contributes to an elevated awareness of one's behavioural patterns, fostering changes in behaviour. This effect is known as the question-behaviour effect (Sprott et al., 2006), in this study labelled as the mere-measurement effect. The findings of this study are in line with the indications by both authors as implications of an increase in scores due to the ESM were found, supporting evidence for the mere-measurement effect. An increase in interoceptive awareness scores was found between the pre- and post-assessment for the experiment group that engaged in daily self-monitoring, while the interoceptive awareness scores of the control group remained stable. One explanation for this increase in interoceptive awareness scores may be attributed to the repetitive and consistent engagement in ESM, as this was found to be essential for cultivating interoceptive abilities by Bornemann & Singer (2017). Therefore, participants in the experiment group may have seen an increase in interoceptive awareness scores because the repetitive process of assessing their interoceptive awareness using ESM-questionnaires contributed to a heightened awareness of bodily and emotional cues, reinforcing sustained improvements in interoceptive awareness as seen in the post-assessment scores. Kassam & Mendes (2013) also found evidence that the mere assessment of affective modes can contribute to alterations in related responses. Therefore, the mere process of measuring interoceptive awareness seems to invoke changes in the overall levels. Findings of the qualitative analysis underlined the impact of ESM additionally, as

participants mentioned the application of the questionnaire-items beyond the participation timeframe by incorporating the content into their daily routines. Hence, if baseline levels of interoceptive awareness are the subject of measurements, ESM might not be suitable due to its intervention properties and influence on the measured construct.

Moreover, a significant increase was detected for the experiment group in scores on four of the five dimensions implemented in the ESM-questionnaire: 'Emotional Awareness', 'Self-Regulation', 'Body Listening', and 'Trusting'. Most participants of the experiment were able to increase their personal level within these dimensions. In contrast, no significant changes were observed for the control group on any of the dimensions, suggesting that the changes in the experiment group were facilitated by the daily self-monitoring using ESM. For the fifth dimension of 'Attention Regulation', no significant increase was found, indicating that individual levels within this dimension remained relatively stable. Additionally, the subdimensions of 'Not Distracting', 'Not Worrying', and 'Noticing' which were not part of the ESM-questionnaire also did not yield increases in scores. Hence, only subdimensions entailed in the daily self-monitoring tasks seem to generate an increase in scores. This might be explained with the findings of Kauer et al. (2012) that the mere self-monitoring contributes to improvements in self-reflection and emotional awareness, suggesting that the daily measurement with items of the dimensions 'Emotional Awareness', 'Self-Regulation', 'Body Listening', and 'Trusting' already led to an increase in scores. In addition, fostering a heightened awareness for bodily changes aids in emotion regulation (Fugate et al., 2024). Therefore, the improvements in these dimensions seem to align with this finding, as an increased bodily awareness likely contributed to the enhancements in emotional processing and self-regulation. The largest increase in scores was determined for the dimensions of 'Trusting' and 'Self-Regulation' in the experiment group, proposing that the engagement in ESM has increased the participants confidence in monitoring and controlling their internal cues the most, potentially contributing to improvements on related dimensions such as 'Emotional Awareness'. Several participants of the experiment group stated that they perceived an increase in emotional and bodily awareness and gained more insight into the interplay of the body and mind. The insignificant result of the dimension "Attention Regulation" may be attributed to findings of Posner et al. (2015) who suggest that attention is a multifaceted cognitive process with multiple roles. Therefore, various different methods can be used to enhance specific roles, which can subsequently contribute to the overall effectiveness of attention as well (Posner et al., 2015). Since only one item for the corresponding subscale was implemented in the ESM-questionnaire, this might not have been

sufficient to increase the individual level of attention regulation significantly. The item might not have a larger impact on one of those roles of attention to generate a meaningful impact on the overall level of attention regulation.

Another valuable insight of this study is that the number of completed questionnaires positively correlates with changes in interoceptive awareness scores. Stronger adherence to the study protocol (ESM-prompts) appears to amplify significant improvements, emphasising the role of consistent self-monitoring using ESM in enhancing individual levels of interoceptive awareness. The findings suggest that participants who completed a higher number of questionnaires, tend to show greater improvements in interoceptive awareness between both assessments in comparison to participants with a smaller number of completed questionnaires. This correlation might be explained by novel habit formations. Frequent and consistent interaction with the ESM-prompts may support participants in developing new and lasting habits of noticing and interpreting interoceptive signals. These considerations are in line with findings of Lally et al. (2010) who highlight the role of repetition in habit formation, demonstrating that consistently performing a behaviour in reaction to specific triggers is crucial for the development of new habits. This process was reflected in a participant's answer stating that she was repeatedly reminded to focus on internal cues and the ESM-items kept running through her head which was evaluated as helpful in everyday life. Consequently, this participant was able to internalise the questionnaire items throughout the study and applied them even beyond the realm of this intervention. Hence, the repetitive and consistent nature of the ESM may have fostered the habit of interpreting internal sensations more frequently through the mere measurement, aligning with the findings of Bornemann & Singer (2017) on the importance of repetition and consistency in improving interoceptive abilities, again. These dynamics demonstrate the effect of consistently measuring interoceptive awareness on a daily basis and its impact on the overall interoceptive awareness levels, highlighting further the potential effect of self-monitoring on interoceptive awareness using ESM. The more often an individual's level of interoceptive awareness is measured, the larger the increase in total scores seems to be.

Notably, there was no statistical evidence found that the improvement of the experiment group was significantly different from the changes (or lack thereof) in the control group despite the significant improvement of interoceptive awareness between both assessment time points for the experiment group. While the latter finding would support the potential impact of the ESM, the lack of a significant interaction effect suggests that the magnitude of changes in interoceptive awareness did not differ significantly between both

research groups. However, the control groups interoceptive awareness remained relatively stable, with no significant changes observed, which may have contributed to a weaker interaction effect and the insignificant finding. Additionally, the lower variability in interoceptive awareness scores, the differences in group sizes, and the limited sample size may have contributed to the lack of statistical significance. Research suggests that studies with a lower statistical power are less likely to detect true effects (Button et al., 2013), which may partly explain this finding. Despite the lack of a statistical significance interaction effect, findings of the qualitative analysis reveal that engaging in daily self-monitoring may have still heightened the participants levels of interoceptive awareness. The themes of 'Increase in Awareness' (15 occurrences) and 'Practical Insights' (14 occurrences) showed the highest frequency of codes among the identified themes. In contrast, the theme 'Minimal Impact' (7 occurrences) and its corresponding codes were only mentioned seven times, indicating that the ESM was rarely considered as uninfluential. Consequently, these insights show further support rationale for the missing interaction effect, as the experiment group demonstrated clear improvements in interoceptive awareness while the control groups scores remained stable.

Strengths and Limitations

Within this study, there are certain strengths and limitations that need to be addressed to gain a more elaborate understanding of the findings and outcomes. The limitations may lead to implications for future research.

One of the major strengths of this study is depicted by the investigation of the potential mere-measurement effect of ESM on interoceptive awareness. Previous studies such as Flentje (2020) examined the effect of reactivity related to ESM. However, research on reactivity generated inconsistent outcomes and the effect of ESM on the measured construct remains unexplored (Eisele et al., 2023), underlining the need for further investigation. By focusing on the dual role of ESM (measurement tool vs. intervention tool) and assessing the mere-measurement effect of ESM on interoceptive awareness, this research extends the findings of the related concept of reactivity on ESM. Therefore, this study provides novel insight of the mere-measurement effect of ESM, extending its function as a mere measurement tool. Indications were found that the mere measurement using ESM already contributes positively to an increase in interoceptive awareness scores compared to individuals who did not self-monitor, highlighting its dual role.

Another strength of this study is the participant-friendly and accessible study setup. Participants did not have to undergo procedures for measuring biofeedback to calibrate baseline interoceptive awareness levels, as this is commonly conducted in ESM-studies where interoceptive awareness is measured (Mehling et al., 2018). Therefore, this online format, using m-Path, allowed participants to engage in the study from the location of their choice and at a timepoint of their choice within the 2-hour timeframe per ESM-prompt. These modalities are beneficial for limiting intrusiveness and enhancing study accessibility, as reflected by participants stating that the questionnaires helped them to regain focus which contributed to combating their daily life. This emphasises the unobtrusive integration of ESM in the participant's daily life by acting as a subtle reminder to enhance their awareness. By blending into the participants routine, the questionnaire provided practical value to foster interoceptive abilities which the participants indicated as useful. Furthermore, only a small number of participants reported some inconvenience of the ESM, indicating that the experiment group did not experience the ESM as overly burdensome.

A final strength of this research is the use of the MAIA-2 as a measure of interoceptive awareness in the pre- and post-assessment, as it is a well-validated measurement instrument with good psychometric properties, assessed by Mehling et al. (2018). The MAIA-2 allows to capture interoceptive awareness across a broad range of eight subscales, accounting for reliability and validity in self-report measures. These properties were especially relevant in assessing interoceptive awareness online using the ESM through self-indicated values of the participants since the corresponding items were derived from the MAIA-2. Hence, the assessment of interoceptive awareness and ESM-measurements can be regarded as both, reliable and consistent.

Despite these strong points of this research, there are certain limitations that need to be addressed to contextualise the results. The first limitation of this study lies in the group assignment of participants between control group and experiment group. Participants were assigned alternately based on their participant number, to either the control group or experiment group. While this process is straight forward, it may not have accounted for factors influencing the sample composition. This study's dropout rate of 29.79% can be considered high in comparison with the average dropout rate of 10.58% (SD = 11.57%) reported in a meta-analysis conducted by Wrzus and Neubauer (2022). This elevated dropout rate might be attributed to the time-consuming nature of ESM and the extended study duration of 16 days. Some participants mentioned difficulties in adhering to the completion of ESM questionnaires due to overlaps with working hours or hobbies. These findings suggest that the

participant allocation could be refined to mitigate such challenges. Therefore, greater emphasis should be placed on assigning a larger proportion of participants to the experiment group and elaborate on consideration regarding the threshold of the response rate as an exclusion criterion. Applying such measures may contribute to sufficient data saturation and maintaining enough participants that meet the inclusion criteria.

In addition, the sample size is another limitation of this study. Even though, the recommendation of van Berkel et al. (2017) of 19 participants as a minimum sample size for ESM-studies was generated, this study's primary focus lies on the comparison between pre-assessment and post-assessment. Therefore, additional considerations regarding the sample size for similar methodologies need to be made. For instance, Chen (2016) conducted a study with a similar methodology, based on a sample with 90 participants. Since the final sample of this study consisted of 57 participants, this benchmark was not reached. Due to the smaller sample size, the demographics of the participants were unevenly distributed with a larger number of female participants in the control group and a larger variance in age, as most participants clustered around 23 but a few outliers extended to older ages (e.g. 57). Additionally, the response rate was an influencing factor on the sample size because the threshold of 60% was chosen, excluding participants with complete pre- and post-assessment. However, this is not a fixed threshold for ESM-studies. For instance, van Berkel et al. (2017) determined the average response rate of 69.6% in ESM-studies, based on a literature review of 110 papers, suggesting that participant adherence may vary. Whereas Weermeijer et al. (2023) chose a 55% response rate. Therefore, different response rate thresholds could be tested in the future.

Next to this, there is another limitation due to the potential interference on the measured construct of interoceptive awareness that may arise due to the measurement of multiple psychological constructs in the ESM-questionnaire as part of the larger study. The constructs of stress and self-control were measured with separate items in the ESM-questionnaire, which may influence the measurement of interoceptive awareness. For instance, one participant mentioned that the ESM-questionnaires reminded her to take different perspectives but also made her more aware of upcoming deadlines which contributed to increasing stress levels. This statement highlights the potential interference on the different constructs measured and that these can amplify the emotional cues, leading to a more complicated measurement of each construct independently. Questions such as those, addressing behavioural regulation or deadlines, may divert the participant from accurately

reporting internal sensations and bodily cues. This overlap may confound the results of interoceptive awareness.

Finally, the scope of this study did not allow to include the complete number of dimensions of the MAIA-2 in the ESM-questionnaire, as this also entailed numerous items from two fellow students on their individual psychological constructs. Therefore, only five of the eight dimensions of interoceptive awareness were included. While this approach provides a focused assessment of interoceptive awareness, the integration of all dimensions of the MAIA-2 may capture a more nuanced picture, especially regarding the missing dimensions of 'Not Distracting', 'Not Worrying', and 'Noticing'. The correlation between the number of completed questionnaires on these three dimensions could therefore not be assessed.

Implications for Future Research

Based on these limitations, certain implications emerged. These may aid researchers in further investigations on the effect of ESM on interoceptive awareness. A first implication is to use ESM as a measurement tool with caution. This study's results imply that the assessment of interoceptive awareness using ESM may be less suitable when interested in baseline levels of this skill. Due to the mere-measurement effect of ESM, the outcomes may be impacted by this measurement tool due to its inherent intervention nature. As increases in interoceptive awareness were seen for the self-monitoring group using ESM, this effect may arise in future studies as well, potentially impacting the measurements and confounding the interpretation of baseline levels. Researchers interested in measuring baseline levels of interoceptive awareness should resort to using the MAIA-2 instead of ESM, as the MAIA-2 did not appear to change the levels of interoceptive awareness in the control group. However, when interested in improving individual levels of interoceptive awareness, ESM might be suitable tool.

Beyond these considerations, the finding of a mere-measurement effect of ESM on interoceptive awareness also gives rise to new opportunities for researchers. In interventions targeting interoceptive awareness, researchers could explore the intentional use of ESM as an intervention tool to improve the overall levels of that construct. Further, investigations of the long-term effects of the improvements in interoceptive awareness and corresponding dimensions may deliver insight into the sustainability of the improvements and whether increases are persistent. Moreover, ESM might be suitable as an additional measure in interventions as mentioned by Snippe et al. (2016), to amplify behavioural change and increase the interventions efficiency.

Further, an additional suggestion for future research is to incorporate all dimensions of the MAIA-2 into the ESM-questionnaire to provide a comprehensive assessment of the effect of ESM on interoceptive awareness. This would involve including the dimensions of ‘Not Distracting’, ‘Not Worrying’, and ‘Noticing’. Such an approach could reveal whether these dimensions exhibit similar significant changes with engagement. This would enable a holistic understanding of how all dimensions of interoceptive awareness develop over time through ESM.

A final suggestion is to include a similar qualitative item for the control group such as ‘How did you experience measuring interoceptive awareness using the MAIA-2 (triggers, levels, awareness)? How do you think it affected your view on those constructs?’. Addressing participants of the control group as well by adopting the item of the experiment group would allow for a richer qualitative analysis. Then, a comparison between experiences of the control group with the MAIA-2 items and the experiences of the experiment group could be conducted. Comparing the perception of the measured psychological construct between individuals who monitored themselves daily and those who assessed it only twice (pre-assessment and post-assessment) would potentially reveal how frequent interaction with this construct might influence its perception.

Conclusion

This study demonstrates the significant effect of daily self-monitoring on the levels of interoceptive awareness and its related dimensions while the results for individuals without daily self-monitoring remained stable. Moreover, the amount of completed questionnaires seems to positively correlate with changes in interoceptive awareness between pre-assessment and post-assessment. However, no significant interaction effect between time and group was found, highlighting the need for further research with larger sample sizes to explore potential moderating effects on interoceptive awareness using ESM. The smaller sample size in this study may limit its external validity and the generalisability of the results is constrained. Still, the findings offer a novel perspective on ESM and its potential dual role as a measurement and intervention tool. Based on this study’s findings, researchers should exercise caution when measuring interoceptive awareness using ESM due to its inherent intervention effects and the potential influence on the measured construct. This research can be used as a foundation when investigating the dual role of ESM, but further research is needed to confirm the generalisability of results.

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Appendix

Appendix A

Multidimensional Assessment of Interoceptive Awareness (MAIA) Version 2 (2018) and Factor Loadings per MAIA-2-item per Dimension

**Multidimensional Assessment of Interoceptive Awareness
(MAIA)
Version 2
(2018)**

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Below you will find a list of statements. Please indicate how often each statement applies to you generally in daily life.

	Circle one number on each line					
	Never				Always	
1. When I am tense I notice where the tension is located in my body.	0	1	2	3	4	5
2. I notice when I am uncomfortable in my body.	0	1	2	3	4	5
3. I notice where in my body I am comfortable.	0	1	2	3	4	5
4. I notice changes in my breathing, such as whether it slows down or speeds up.	0	1	2	3	4	5
5. I ignore physical tension or discomfort until they become more severe.	0	1	2	3	4	5
6. I distract myself from sensations of discomfort.	0	1	2	3	4	5
7. When I feel pain or discomfort, I try to power through it.	0	1	2	3	4	5
8. I try to ignore pain	0	1	2	3	4	5
9. I push feelings of discomfort away by focusing on something	0	1	2	3	4	5
10. When I feel unpleasant body sensations, I occupy myself with something else so I don't have to feel them.	0	1	2	3	4	5
11. When I feel physical pain, I become upset.	0	1	2	3	4	5
12. I start to worry that something is wrong if I feel any discomfort.	0	1	2	3	4	5
13. I can notice an unpleasant body sensation without worrying about it.	0	1	2	3	4	5
14. I can stay calm and not worry when I have feelings of discomfort or pain.	0	1	2	3	4	5
15. When I am in discomfort or pain I can't get it out of my mind	0	1	2	3	4	5
16. I can pay attention to my breath without being distracted by things happening around me.	0	1	2	3	4	5
17. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.	0	1	2	3	4	5
18. When I am in conversation with someone, I can pay attention to my posture.	0	1	2	3	4	5

How often does each statement apply to you generally in daily life? Circle one number on each line

	Never					Always				
19. I can return awareness to my body if I am distracted.	0	1	2	3	4	5				
20. I can refocus my attention from thinking to sensing my body.	0	1	2	3	4	5				
21. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.	0	1	2	3	4	5				
22. I am able to consciously focus on my body as a whole.	0	1	2	3	4	5				
23. I notice how my body changes when I am angry.	0	1	2	3	4	5				
24. When something is wrong in my life I can feel it in my body.	0	1	2	3	4	5				
25. I notice that my body feels different after a peaceful experience.	0	1	2	3	4	5				
26. I notice that my breathing becomes free and easy when I feel comfortable.	0	1	2	3	4	5				
27. I notice how my body changes when I feel happy / joyful.	0	1	2	3	4	5				
28. When I feel overwhelmed I can find a calm place inside.	0	1	2	3	4	5				
29. When I bring awareness to my body I feel a sense of calm.	0	1	2	3	4	5				
30. I can use my breath to reduce tension.	0	1	2	3	4	5				
31. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing.	0	1	2	3	4	5				
32. I listen for information from my body about my emotional state.	0	1	2	3	4	5				
33. When I am upset, I take time to explore how my body feels.	0	1	2	3	4	5				
34. I listen to my body to inform me about what to do.	0	1	2	3	4	5				
35. I am at home in my body.	0	1	2	3	4	5				
36. I feel my body is a safe place.	0	1	2	3	4	5				
37. I trust my body sensations.	0	1	2	3	4	5				

	Standardized Loading	SE
Noticing		
1. When I am tense, I notice where the tension is located in my body.	0.599	0.038
2. I notice when I am uncomfortable in my body.	0.640	0.038
3. I notice where in my body I am comfortable.	0.467	0.042
4. I notice changes in my breathing, such as whether it slows down or speeds up.	0.497	0.042
Non-Distracting		
5. I ignore physical tension or discomfort until they become more severe.	0.296	0.044
6. I distract myself from sensations of discomfort.	0.523	0.037
7. When I feel pain or discomfort, I try to power through it.	0.573	0.036
8. I try to ignore pain	0.721	0.029
9. I push feelings of discomfort away by focusing on something	0.734	0.029
10. When I feel unpleasant body sensations, I occupy myself with something else so I don't have to feel them.	0.682	0.030
Not-Worrying		
11. When I feel physical pain, I become upset.	0.547	0.040
12. I start to worry that something is wrong if I feel any discomfort.	0.610	0.040
13. I can notice an unpleasant body sensation without worrying about it.	0.427	0.044
14. I can stay calm and not worry when I have feelings of discomfort or pain.	0.599	0.042
15. When I am in discomfort or pain I can't get it out of my mind	0.521	0.042
Attention Regulation		
16. I can pay attention to my breath without being distracted by things happening around me.	0.513	0.036
17. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.	0.612	0.031
18. When I am in conversation with someone, I can pay attention to my posture.	0.571	0.033
19. I can return awareness to my body if I am distracted.	0.715	0.026
20. I can refocus my attention from thinking to sensing my body.	0.733	0.025
21. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.	0.623	0.031
22. I am able to consciously focus on my body as a whole.	0.681	0.028
Emotional Awareness		
23. I notice how my body changes when I am angry.	0.506	0.036
24. When something is wrong in my life, I can feel it in my body.	0.628	0.031
25. I notice that my body feels different after a peaceful experience.	0.678	0.027
26. I notice that my breathing becomes free and easy, when I feel comfortable.	0.725	0.025
27. I notice how my body changes when I feel happy / joyful.	0.797	0.021
Self-Regulation		
28. When I feel overwhelmed, I can find a calm place inside.	0.595	0.032
29. When I bring awareness to my body, I feel a sense of calm.	0.734	0.025
30. I can use my breath to reduce tension.	0.731	0.025
31. When I am caught up in thoughts, I can calm my mind by focusing on my body/ breathing.	0.804	0.022
Body Listening		
32. I listen for information from my body about my emotional state.	0.826	0.021
33. When I am upset, I take time to explore how my body feels.	0.759	0.024
34. I listen to my body to inform me about what to do.	0.723	0.026
Trusting		
35. I am at home in my body.	0.822	0.020
36. I feel my body is a safe place.	0.889	0.019
37. I trust my body sensations.	0.669	0.028

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Appendix B

State Questionnaire on Interoceptive Awareness

State Questionnaire – Interoceptive Awareness

- 1) At this moment, I feel my body is a safe place. (Trusting)
- 2) Since the last notification, I listened for information from my body about my emotional state. (Body Listening)
- 3) Since the last notification, I used my breathing to reduce any tension in my body. (Self-Regulation)
- 4) Since the last notification, I was able to refocus my attention from thinking to sensing my body. (Attention Regulation)
- 5) Since the last notification, I noticed how my body changed when I felt certain emotions. (Emotional Awareness)
- 6) Indicate where you felt such bodily changes. If you did not feel any changes, you can skip this task on the bottom of the page.

Appendix C

Informed Consent Form

Informed Consent Form

The Experience Sampling Method (ESM): Measurement or Intervention Tool?

Welcome! You are invited to participate in a research study called "The Experience Sampling Method (ESM): Measurement or Intervention Tool". This study is being conducted by Wojciech Walczak, Dimitra Damigou and Jannik Voß from the Faculty of Behavioural, Management and Social Sciences at the University of Twente. The aim of this study is to explore the potential effects of using the Experience Sampling Method (ESM) on stress, self-control and interoceptive awareness. The ESM is a data collection tool, which prompts participants to answer short self-report questions multiple times a day over a set period. We will examine whether the frequent measurement impacts the level of previously mentioned psychological traits over a two-week period.

If you agree to participate in this research project you will be asked to complete a pre-study questionnaire which measures levels of stress, self-control and interoceptive awareness (approx. 30 minutes). Afterwards, you are going to be asked to download a smartphone application called "m-Path". Detailed instructions on how to join this study through the app is going to be provided immediately after finishing the pre-study questionnaire. From that point,

the study will continue in the app in which you may be asked to complete daily surveys (approx. 3 minutes each), three times a day for 14 days. From the moment you receive each notification, you will have 2 hours to answer the survey before it becomes unavailable. At the end of the two-week period, you will be notified through the app to complete a post-study questionnaire, the same as you were asked to complete at the beginning of the study (approx. 30 minutes). From the time you receive this notification, the survey will be available for you to complete for 24 hours.

To participate in this study, you must meet some eligibility criteria. Participation is open to adults 18 years old or older, fluent in English and with access to a mobile device with an internet connection. Furthermore, it is required that participants do not suffer from an anxiety disorder of any kind, and are not currently receiving treatment for any mental disorder. This is because due to the nature of our study, participants may become more aware of their levels of stress, self-control and interoceptive awareness, which some individuals may experience as distressing. On the other hand, participation may offer individuals valuable insight into these areas, potentially increasing self-understanding. Our study has been reviewed and approved by the Ethics Committee HSS (BMS) of the University of Twente.

Data gathered in this study will be treated with the utmost confidentiality. Any information collected that could be traced back to you will be anonymised, so that no individual participant may be identifiable. The data collected in this study will only be used for the purpose of completing our Bachelor's of Psychology thesis assignments. Upon the end of the assignment, they will be securely destroyed. Participation in this study is entirely voluntary. Therefore, you can freely refuse to answer any questions or withdraw from the study at any point, without needing to provide a reason and without any consequences.

Completion of this survey through your mobile phone is possible. However, we recommend completing this survey using a different device, as you will be asked to download and set up an application on your phone, alongside interacting with this survey.

You may sign up for this study until the **20th of November, at the latest**.

Thank you for taking the time to read this information. If you have any questions, feel free to contact the researchers through the contact details below.

Researchers:

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Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl

Appendix D

Recruitment Material: WhatsApp message for sampling

' 🇳🇱 Please Help Us with Our Online Study! 🧠

Hi everyone! We are almost done with our data collection but we still need more participants so we would be eternally grateful if you could take part.

We're conducting a research project for our Bachelor's thesis on how self-monitoring affects stress, self-control and self-awareness, and we need YOUR help! The study is called "The experience sampling method (ESM): measurement or intervention tool?", and participation will award you with 2.5 SONA credits!

✅ Who can join?

- Anyone 18+ with access to a mobile device and internet
- No diagnosis of an anxiety disorder of any kind or ongoing treatment for any mental disorder

Fit those criteria? We are looking for you!

📱 What will you do?

Answer online questionnaires to help us gather valuable data!

We'd be super grateful if you could spare some time to participate. Your contribution could be invaluable in understanding the effects of self-monitoring! 💡

Interested and want to know more?

Click on the link below!

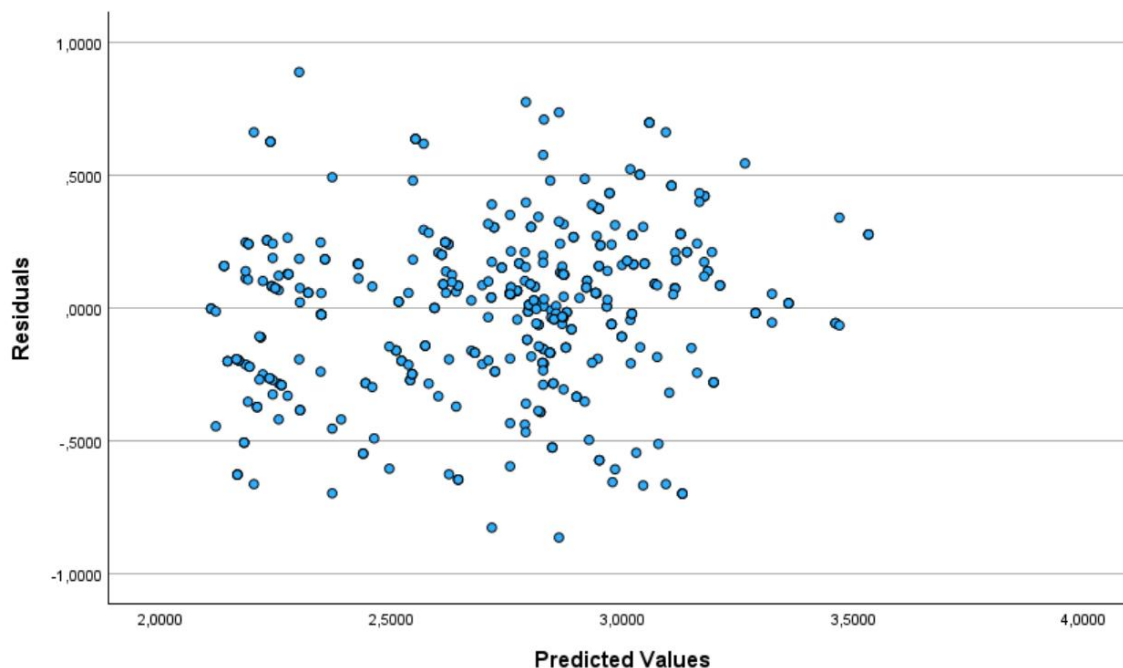
https://utwente.sona-systems.com/default.aspx?p_return_experiment_id=3086

If you are not interested in SONA points anymore, but would still like to help us out, please use the link below or send me a text. We would greatly appreciate any help we could get!

https://utwentebbs.eu.qualtrics.com/jfe/form/SV_9LcB6B5O3vgGuuG

Appendix E

Scatterplot illustrating the linearity of data



Appendix F

Atlas.ti report entailing the codes, grouped by themes, and the corresponding text passages of participants

Project: Bachelor Thesis - Qualitative Analysis

Code Report – Grouped by: Code Groups

All (10) codes

Challenges

2 Codes:

● Emotional Burden

3 Quotations:

1:9 ¶ 30 in ESM: Measurement or Intervention Tool?

I had one panic attack during the 14 day (Experiment Group)

1:10 ¶ 66 in ESM: Measurement or Intervention Tool?

made me realise how much in a hurry and anxiety I am most of the time during my day, which made me sad .(Excluded Participant)

1:11 ¶ 68 in ESM: Measurement or Intervention Tool?

made me continuously more aware about me having deadlines & thus kind of stressed me whenever the question was if I postpone things, or if I am worried etc. (Excluded Participant)

● Practical Difficulties

3 Quotations:

1:12 ¶ 33 in ESM: Measurement or Intervention Tool?

sometimes I was so focused on the tasks I was doing during the day like lectures and studying that the questioners didn't really hit me that deep (Experiment Group)

1:13 ¶ 30 in ESM: Measurement or Intervention Tool?

I also realised that I can find it hard to focus on sensing my body when I do not feel comfortable (Experiment Group)

1:66 ¶ 33 in ESM: Measurement or Intervention Tool?

I didn't really pay as much attention to the questions themselves which made it feel more like a chore

Increase in Awareness

2 Codes:

● Bodily Awareness

4 Quotations:

1:2 ¶ 28 in ESM: Measurement or Intervention Tool?

I think after answering all these questions for multiple days I feel more aware of my body sensation and how it affects me (Experiment Group)

1:4 ¶ 60 in ESM: Measurement or Intervention Tool?

Through the daily surveys, I was repeatedly reminded to focus on my sensations, which I found very helpful in various situations. (Experiment Group)

1:60 ¶ 51 in ESM: Measurement or Intervention Tool?

It made me slightly more aware of my body and breathing (Experiment Group)

1:62 ¶ 66 in ESM: Measurement or Intervention Tool?

It made me realise that I need to pay more attention to my body's reaction (Excluded Participant)

● Emotional Awareness

11 Quotations:

1:7 ¶ 41 in ESM: Measurement or Intervention Tool?

It made me more aware, especially when filling in the questionnaire, how I (have) felt and how it was in past experiences (Experiment Group)

1:29 ¶ 68 in ESM: Measurement or Intervention Tool?

It kind of reminded me to think about situations from another perspective (Excluded Participant)

1:32 ¶ 60 in ESM: Measurement or Intervention Tool?

Over time, the questions "stuck" with me and kept running through my mind in between as well. (Experiment Group)

1:33 ¶ 53 in ESM: Measurement or Intervention Tool?

I definitely noticed changes in my awareness (Experiment Group)

1:37 ¶ 47 in ESM: Measurement or Intervention Tool?

the regular reminder to the topic of awareness and mindfulness has made me more receptive to those aspects, making it more prevalent (Experiment Group)

1:39 ¶ 45 in ESM: Measurement or Intervention Tool?

In the beginning I was only slightly worried how my awareness of this questionnaire would effect my daily awareness of my mental health, but soon after I felt at ease with it (Experiment Group)

1:43 ¶ 32 in ESM: Measurement or Intervention Tool?

it helped to make me be more aware (Experiment Group)

1:45 ¶ 30 in ESM: Measurement or Intervention Tool?

When I feel comfortable (which I do most of the time, there haven't been many occasions where I felt extremely bad) I don't think a lot about sensing my body because usually my body as a whole feels „good“ then. But when I do feel nervous/hungry/sad, I notice changes and that I don't feel entirely good anymore. (Experiment Group)

1:47 ¶ 22 in ESM: Measurement or Intervention Tool?

It made me a bit more comfortable and made me aware of when and why I feel discomfort (Experiment Group)

1:54 ¶ 24 in ESM: Measurement or Intervention Tool?

It was a small boost in my awareness of those things (Experiment Group)

1:58 ¶ 66 in ESM: Measurement or Intervention Tool?

the fact that I had to read the questions and think about the answers in order to be able to answer, made me calmer (Excluded Participant)

Minimal Impact

2 Codes:

- **Limited Effects**

6 Quotations:

1:27 ¶ 74 in ESM: Measurement or Intervention Tool?

Mildly (Excluded Participant)

1:36 ¶ 47 in ESM: Measurement or Intervention Tool?

I am not yet sure if this will affect me sustainably (Experiment Group)

1:38 ¶ 44 in ESM: Measurement or Intervention Tool?

I believe that my awareness of the daily questionnaire had a slight (3.5/10) influence on how I answered the questions (Experiment Group)

1:42 ¶ 35 in ESM: Measurement or Intervention Tool?

It changes my views slightly (Experiment Group)

1:46 ¶ 25 in ESM: Measurement or Intervention Tool?

It didn't change my life, but I think it had a positive impact (Experiment Group)

1:64 ¶ 56 in ESM: Measurement or Intervention Tool?

I felt like I forgot the contents of the survey almost immediately after filling it in. (Experiment Group)

- **No effects**

1 Quotations:

1:56 ¶ 72 in ESM: Measurement or Intervention Tool?

I cant see effect (Excluded Participant)

Participation Burden

2 Codes:

- **Logistical Difficulties**

2 Quotations:

1:20 ¶ 72 in ESM: Measurement or Intervention Tool?

i didn't participate in every questionnaire, due to work and hobbies (Excluded Participant)

1:21 ¶ 66 in ESM: Measurement or Intervention Tool?

there were times when I had to answer it during working or studying when it made me realise how much in a hurry and anxiety I am (Excluded Participant)

● **Questionnaire Fatigue**

3 Quotations:

1:22 ¶ 33 in ESM: Measurement or Intervention Tool?

Also the repetitive nature of the questions sometimes put me off and I didn't really pay as much attention to the questions themselves which made it feel more like a chore. (Experiment Group)

1:23 ¶ 64 in ESM: Measurement or Intervention Tool?

The questions were very similar to one another, so it felt like not all experiences of stress could be identified (Excluded Participant)

1:63 ¶ 56 in ESM: Measurement or Intervention Tool?

I do not think the constant questionnaires helped a lot in getting me to be more aware of my body and concentrate on my body (Experiment Group).

Practical Insights

2 Codes:

● **Connection Body and Mind**

7 Quotations:

1:15 ¶ 42 in ESM: Measurement or Intervention Tool?

It made me realize how and where I felt tension and that I should pay attention to it, to use breathing to relax a bit more. (Experiment Group)

1:16 ¶ 70 in ESM: Measurement or Intervention Tool?

It gave me another perspective on the importance of body awareness and how it relates to self control (Excluded Participant)

1:34 ¶ 54 in ESM: Measurement or Intervention Tool?

This way I noticed kinda what influences me to feel happy and what not (same thing with having motivation to work) (Experiment Group)

1:35 ¶ 49 in ESM: Measurement or Intervention Tool?

It made me a bit more conscious about observing my body and regain relaxation (Experiment Group)

1:40 ¶ 39 in ESM: Measurement or Intervention Tool?

The notifications helped me regain focus on my body and my stress levels. Oftentimes, I didn't notice how I was feeling until filling in the questionnaire, which then helped me to regain focus (for example, if I filled in I was postponing something, it made me realise I should get to work), which was really useful in my everyday life (Experiment Group)

1:44 ¶ 30 in ESM: Measurement or Intervention Tool?

I realised that I personally find it rather hard to focus on my breathing in order to relax myself (Experiment Group)

1:55 ¶ 58 in ESM: Measurement or Intervention Tool?

Made me more aware of the connection between the way I feel and how it affects my body, the changes in moods that I might experience within a day (Experiment Group)

● **New Strategies**

7 Quotations:

1:17 ¶ 30 in ESM: Measurement or Intervention Tool?

I could really use my breathing to calm myself down (Experiment Group)

1:18 ¶ 54 in ESM: Measurement or Intervention Tool?

I was able to implement some of the content of the question. For instance I caught myself focusing more on sensing rather than thinking (Experiment Group)

1:19 ¶ 70 in ESM: Measurement or Intervention Tool?

Some of the notifications were really helpful in the moment especially, when there is a lot going on.(Excluded Participant)

1:28 ¶ 70 in ESM: Measurement or Intervention Tool?

I understood that to self control you do not need to try avoid paying attention to discomfort, but on the other hand be more aware of it without overthinking too much.(Excluded Participant)

1:41 ¶ 39 in ESM: Measurement or Intervention Tool?

I think it was a very good experience and I will try to be more mindful about my body and emotional state in the future! (Experiment Group)

1:57 ¶ 37 in ESM: Measurement or Intervention Tool?

It made me more aware of some techniques to make me feel more at ease (Experiment Group)

1:61 ¶ 54 in ESM: Measurement or Intervention Tool?

It was a good experience to track my moods throughout the day, because I was able to compare them. (Experiment Group)

Appendix G

AI-Statement

Use of AI in Education at the University of Twente

During the preparation of this work the author used Chat GPT for synonym generation and to solve difficulties regarding the statistical coding in SPSS. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the work.