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# Validation of Guided Imagery Interventions with Basic Mindfulness Elements for Neurological Early Rehabilitation Patients

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**Abstract:** Acquired brain injury leads to numerous affective symptoms, and coping with these changes can be a burdensome process. Therefore, we aimed to validate a guided imagery intervention with basic mindfulness elements (GIME) for patients in early neurological rehabilitation (ENR). Patients ( $N = 30$ ) could choose among four different scenarios and were presented with the intervention up to six times. Statistical analyses revealed a highly significant improvement in mood, arousal, and pain with large effect sizes. The above-mentioned improvements were found continuously for repeated applications. We found our GIME to be a useful, feasible, and easy tool to implement in everyday clinical life within the ENR.

**Keywords:** early neurological rehabilitation, relaxation, guided imagery, mindfulness, acquired brain injury

## Validierung einer geführten Imagination mit grundlegenden Achtsamkeitselementen für neurologische Frührehabilitationspatientinnen und -patienten

**Zusammenfassung:** Erworbene Hirnschädigung führt zu einer Vielzahl affektiver Symptome und der Umgang mit diesen Veränderungen ist ein belastender Prozess. Deshalb strebten wir an, eine geführte Imagination mit grundlegenden Achtsamkeitselementen (GIGA) für Patient\_innen der neurologischen Frührehabilitation (NFR) zu validieren. Die Patient\_innen ( $N = 30$ ) konnten zwischen vier verschiedenen Szenerien wählen und nahmen bis zu sechs Mal an der Intervention teil. Statistische Analysen zeigten hochsignifikante Verbesserungen der Stimmung, inneren Unruhe und Schmerzen mit großen Effektstärken. Die genannten Verbesserungen konnten bei mehrfacher Anwendung durchgehend beobachtet werden. Die GIGA stellt ein hilfreiches, effektives und einfach anzuwendendes Instrument im Alltag einer NFR dar.

**Schlüsselwörter:** Neurologische Frührehabilitation, Entspannung, geführte Visualisierung, Achtsamkeit, erworbene Hirnschädigung

## Introduction

Acquired brain injury (ABI) is a frequent cause of hospitalization and leads to a wide variety of cognitive, emotional, and physical symptoms and syndromes (Goldman et al., 2022). There is a high risk of developing depressive symptoms (Kreutzer et al., 2001), mood disorders in general, anxiety, or posttraumatic stress disorder (PTSD; Williams & Evans, 2003) following ABI. Also, previous treatment at an intensive-care unit (ICU) can severely impact long-term

cognitive and affective outcomes (Carr, 2007; Davydow et al., 2013).

## Relaxation and Mindfulness-Based Interventions in Neurology

Mind-body interventions for neurological and (mostly cardiological) ICU patients have already proven effective for improving mood, anxiety, and stress (e.g., Hampson,

2020; Kizilkan et al., 2024; Sauder et al., 2021a; Zhang et al., 2024).

Case and colleagues (2018) showed that patients with relapsing-remitting multiple sclerosis (MS) improved significantly regarding depression and fatigue when undergoing 10 hours of a healing-light-guided imagery exercise. A 4-week home-based program for MS, where patients listened to a 20-minute guided imagery (GI) audio file, also showed significant improvements in mood and fatigue (Beitollahi et al., 2022).

A mindful attitude may lead to an enhanced tolerance of different affective states (Burschka et al., 2014; Sauder et al., 2021a, 2021b). Bishop et al. (2004, p. 232) described mindfulness using a two-component model including the self-regulation of attention and a curious, open, and accepting orientation toward the present moment. Mindfulness interventions also proved helpful for coping with neurological diseases. There is evidence for improvements in various domains such as fatigue, sleep quality (Zhang et al., 2024), spasticity, and quality of life (Wathugala et al., 2019). Furthermore, the potential benefits of guided imagery on attention control, which is another promising factor of these interventions, are especially relevant regarding a cohort with cognitive deficits (Zemla et al., 2023).

Generally, both types of interventions show a substantial overlap. Luberto et al. (2020) provide a comprehensive overview of similarities and differences between relaxation and mindfulness interventions. Both types of interventions can elicit a relaxation response and are efficient means to treat health problems such as stress, anxiety, pain, and mood disorders. Nevertheless, there are some differences between the two approaches. For example, mindfulness interventions involve accepting the present moment and being aware of bodily sensations and surroundings without judging them, while relaxation interventions guide patients to deliberately deepen their breath or to generate imagined scenarios that are not rooted in actual surroundings. Also, the authors state that relaxation exercises always involve mindful awareness. A study by Kharlas and Frewen (2016) showed that participants with higher trait mindfulness reported increased imagery vividness, further implicating an overlap between the two types of interventions.

## Adjustment to the Needs of Early Neurological Rehabilitation Patients

However, most studies use group interventions, rather long sessions, and/or implement physical activity such as tai chi or yoga (Burschka et al., 2014; Kraemer et al., 2022; Love et al., 2019). Early neurological rehabilitation (ENR) provides initial intensive therapeutic support for patients with severe impairment concerning activities of daily living. Pa-

tients within ENR display different levels of consciousness ranging from comatose to functionally interactive as well as various cognitive and affective symptoms (Heindorf & Keller, 2009). Therefore, the patients' attention span, cognitive capacity, and physical ability are quite limited in most cases, and interventions suited for ENR must be adapted to the needs and abilities of the patient cohort.

Studies within ENR are scarce, and, as mentioned above, existing programs are mostly conceptualized as group interventions and require patients to be awake and attentive for up to 90 minutes. However, a randomized controlled trial by Fincham et al. (2023) found mindfulness meditations to be equally beneficial for well-being, whether it was 30 or 10 minutes of (daily) practice. Therefore, we created our own shorter, easy-to-apply guided imagery intervention using basic mindfulness elements (GIME; Springer et al., 2025). In the previous feasibility study, we reported the first preliminary outcomes. We implemented the GIME within the ICU ward of our ENR, found a state-specific decrease in systolic blood pressure and a highly significant improvement in arousal with large effect sizes following GIME stimulation, and compared this to a control audio stimulation (Springer et al., 2025).

## The Current Study

Building on the very promising findings of our previous study (Springer et al., 2025), we decided to extend our research question by applying our GIME to a more extensive sample of ENR patients, thereby validating our therapeutic approach in a larger and more heterogeneous sample. Since our previous study found effects predominantly among functionally interactive patients (Springer et al., 2025), we wanted to take a closer look at this cohort, which is commonly encountered in ENR. Every patient hospitalized at the ENR had a critical illness to overcome, and most of them had been transferred from ICUs or stroke units.

The current study further examined whether the application of the GIME would be associated with beneficial alterations in self-reported mood, pain, and inner unrest during treatment sessions (pre/post GIME state alterations). We hypothesized that mood would improve significantly, and that pain and inner unrest would decrease significantly, during sessions after listening to our GIMES, based on our previous findings (Springer et al., 2025).

We also examined whether multiple applications might lead to mid-term changes in mood, pain, or inner unrest across several treatment sessions in an exploratory analysis. The latter analysis, addressing putative trait-like alterations, was exploratory, as we anticipated that the clinical setting would limit the overall number and frequency of treatment sessions. Nevertheless, to this end, we explored the potentially beneficial alterations in self-report "pre"-values across sessions.

## Methods

### Participants

The current study was approved by the Ethics Committee of the University of Bamberg, Germany. Participants were continuously recruited during routine clinical care at the ward for early neurological rehabilitation at the Department of Neurology, Klinikum Bayreuth GmbH, Medical Campus Upper Franconia, Germany. Caregivers gave consent per procura, but patients were asked and informed beforehand. Similar to our previous study, we applied the following inclusion and exclusion criteria here: Patients with brain lesions that were in any form suspected to have led to impairment in hearing or processing of speech were excluded due to the auditory presentation. The regions considered for speech processing were Brodmann area 22 and 42 for passive lexical-semantic processing as well as the gyrus temporalis superior for phonological listening (Friederici, 2012). Also, we excluded patients with brain lesions in regions that would have led to cortical deafness (bilateral lesions of the auditory cortices, subcortical parts of the auditory pathway) or auditory agnosia (bitemporal lesions, gyri temporales transversi) (Engelien, 2012). During the screening process, we reviewed magnetic resonance imaging (MRI) or cranial computer tomography (CCT) scans for each individual patient to ensure that none of these regions were affected. Furthermore, patients had to understand and use the presented self-report scales. For patients who we were not sure could use the scales appropriately, we did a try-out and excluded them after one appointment if our clinical expertise showed that there were difficulties. They were then also not included in the analyses.

In total  $N=30$  patients ( $M(\text{age})=67.53$ ,  $SD=8.73$ , Min; Max=51; 86) participated and were included in the analysis. Table 1 lists the clinical and demographic characteristics. All in all, with the specific characteristics of patients within the ENR, our sample consisted of patients with various underlying syndromes and symptoms. Cognitive ability was also very heterogeneous, which is reflected in Montreal Cognitive Assessment (MoCA) values ranging from 10 to 29. Table 2 presents further descriptive characteristics of the applied scales. Over a timespan of 4 months, we screened and/or approached a total of 123 patients respectively their caregivers. See Appendix A for a flowchart describing patient recruitment and reasons for noninclusion.

Regarding the intervention, patients could choose between a male or a female voice and between four different scenes (meadow, forest, lake, or beach). Over the course of up to 4 weeks, patients were presented with their chosen GIME audio file up to six times, depending on length of stay or dropout. Overall, we implemented 125 treatment sessions. The sample size dropped from appointment to

appointment due to the special setting with discharge to the next rehabilitation facility or the need for various medical interventions. However, on average patients participated in four sessions ( $M(\text{appointments})=4.167$ ).

### Design and Setting

The current study presents a prospective within-subject longitudinal design with consecutive recruitment of patients during routine clinical practice at the Early Rehabilitation Unit of the Department of Neurology.

### Audio Files

In addition to the single GIME we used in our first study (Springer et al., 2025), we created three further scenarios to offer participants in order to meet broader preferences of relaxing places. We were able to offer participants a choice of either a male or a female voice, whichever they preferred. Patients then needed to stick to their chosen voice, but were able to choose a different scenery for each of the up to six appointments. The scenes we created were as follows:

**Table 1.** Clinical and demographic characteristics of the sample

|            |                              | Frequency | Percent |
|------------|------------------------------|-----------|---------|
| Sex        | Female                       | 14        | 46.7    |
|            | Male                         | 16        | 53.3    |
| Education  | 9 years                      | 19        | 63.3    |
|            | 10 years                     | 6         | 20      |
|            | 12 to 13 years               | 5         | 16.7    |
| Handedness | Right                        | 28        | 93.3    |
|            | Left                         | 2         | 6.7     |
| Diagnosis  | Infarction, bleeding         | 11        | 36.7    |
|            | CIP/CIM                      | 2         | 6.7     |
|            | MS                           | 1         | 3.3     |
|            | Post CPR                     | 1         | 3.3     |
|            | Encephalopathy, encephalitis | 4         | 13.3    |
|            | Tumor                        | 1         | 3.3     |
|            | TBI                          | 1         | 3.3     |
|            | Mixed etiology               | 9         | 30      |

Notes. Abbreviations: CIP = critical illness polyneuropathy; CIM = critical illness myopathy; CPR = cardiopulmonary resuscitation; MS = multiple sclerosis; TBI = traumatic brain injury.

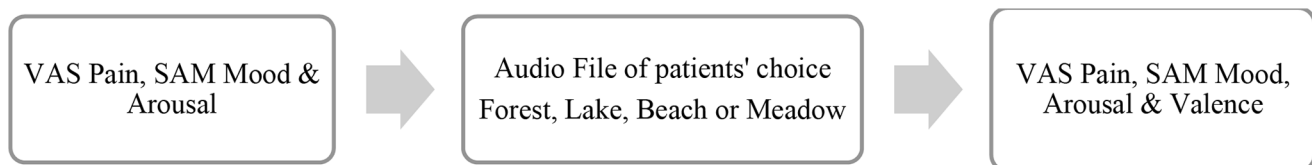
**Table 2.** Descriptive statistics of applied scales

|         | Appointment |      | N  | Mean (SD)   | Min; max |
|---------|-------------|------|----|-------------|----------|
| Mood    | 1           | Pre  | 30 | 5.2 (1.9)   | 1;8      |
|         |             | Post | 30 | 7.07 (1.6)  | 3;9      |
|         | 2           | Pre  | 27 | 5.78 (1.65) | 3;9      |
|         |             | Post | 27 | 7.07 (1.54) | 3;9      |
|         | 3           | Pre  | 24 | 5.87 (1.94) | 2;9      |
|         |             | Post | 24 | 7.12 (1.42) | 5;9      |
|         | 4           | Pre  | 19 | 5.95 (1.47) | 2;8      |
|         |             | Post | 19 | 7.11 (1.33) | 4;9      |
|         | 5           | Pre  | 14 | 5.57 (2.03) | 2;9      |
|         |             | Post | 14 | 7.21 (1.25) | 5;9      |
|         | 6           | Pre  | 11 | 5.73 (2.37) | 2;9      |
|         |             | Post | 11 | 7.09 (1.45) | 5;9      |
| Arousal | 1           | Pre  | 30 | 4.5 (2.01)  | 1;9      |
|         |             | Post | 30 | 3.1 (1.73)  | 1;6      |
|         | 2           | Pre  | 27 | 4.52 (1.83) | 1;8      |
|         |             | Post | 27 | 3.11 (1.42) | 1;6      |
|         | 3           | Pre  | 24 | 4.29 (1.76) | 1;7      |
|         |             | Post | 24 | 2.75 (1.33) | 1;7      |
|         | 4           | Pre  | 19 | 4.05 (1.72) | 1;7      |
|         |             | Post | 19 | 3.0 (1.7)   | 1;7      |
|         | 5           | Pre  | 14 | 4.29 (1.68) | 1;7      |
|         |             | Post | 14 | 3.21 (1.37) | 1;6      |
|         | 6           | Pre  | 11 | 4.82 (2.09) | 2;7      |
|         |             | Post | 11 | 3.18 (1.83) | 1;6      |
| Pain    | 1           | Pre  | 30 | 1.73 (2.38) | 0;8      |
|         |             | Post | 30 | 1.13 (1.81) | 0;5      |
|         | 2           | Pre  | 27 | 1.33 (2.5)  | 0;8      |
|         |             | Post | 27 | 0.96 (2.03) | 0;8      |
|         | 3           | Pre  | 24 | 2.04 (2.58) | 0;7      |
|         |             | Post | 24 | 1.42 (2.02) | 0;6      |
|         | 4           | Pre  | 19 | 1.0 (1.86)  | 0;6      |
|         |             | Post | 19 | 0.68 (1.25) | 0;4      |
|         | 5           | Pre  | 14 | 1.43 (2.5)  | 0;7      |
|         |             | Post | 14 | 0.79 (1.37) | 0;4      |
|         | 6           | Pre  | 11 | 1.64 (2.29) | 0;7      |
|         |             | Post | 11 | 1.09 (1.45) | 0;4      |

**Table 2.** Descriptive statistics of applied scales (continued)

|                 | Appointment | N  | Mean (SD)    | Min; max |
|-----------------|-------------|----|--------------|----------|
| Valence         | 1           | 30 | 7.97 (1.22)  | 5;9      |
|                 | 2           | 27 | 7.67 (1.3)   | 5;9      |
|                 | 3           | 24 | 7.71 (1.16)  | 5;9      |
|                 | 4           | 19 | 7.16 (1.46)  | 5;9      |
|                 | 5           | 14 | 7.64 (1.6)   | 5;9      |
|                 | 6           | 11 | 7.27 (1.9)   | 3;9      |
| MoCA raw scores |             | 27 | 19.93 (5.04) | 10; 29   |

Notes. A screening with the MoCA could be conducted only for patients who were able to properly respond to the screening items. Mood, arousal, and valence were assessed using self-assessment manikins with a scale from 1 to 9; pain was assessed using a visual analog scale from 0 to 10. Abbreviation: MoCA = Montreal Cognitive Assessment.



**Figure 1.** Procedure: Patients could choose which of the four guided imagery interventions to listen to for each appointment. Abbreviations: VAS = visual analog scale; SAM = self-assessment manikin.

1. *Forest*: A walk in the forest, including a short break at a small stream.
2. *Meadow*: A walk through a springlike meadow, including a short break sitting down.
3. *Lake*: A walk to a wintry lake, including forming a snowball.
4. *Beach*: A walk on a sunny beach, including going into the water.

All GIME audio files included birds chirping, forest and lake included burbling of water when approaching the stream or lake, meadow included bees buzzing lightly. Furthermore, they all included detailed descriptions of the surroundings as well as frequently employed mindfulness elements, reminding patients to focus on their breathing or directing their attention to specific scents or visual or haptic impressions. All of the audio files were reasonably matched in length (about 10 minutes) and word count. The introduction, the outro, and the recurring mindfulness elements were exactly the same for all audio files. For examples of mindfulness prompts, see Appendix B. The audio files were presented using noise-canceling headphones (Sony WH-1000XM4).

## Scales

Before and after the patients listened to the audio files, we asked them to rate their current level of pain on a visual

analog scale (VAS) from 0 to 10. Furthermore, we asked them to rate their current mood and level of arousal using self-assessment manikins (SAM; Bradley & Lang, 1994) on a scale from 1 to 9. After they had listened to the audio files, we included a SAM, asking patients to rate the valence of the audio files, also on a scale of 1 (*not pleasant*) to 9 (*very pleasant*). We decided to use those scales again because they are easy to understand, quite self-explanatory, and do not require a lot of time to answer, especially for our patient cohort with cognitive impairment of varying severity. Please refer to Figure 1 for an overview of the whole procedure and to Appendix C for pictures of the scales used.

## Data Analysis

We conducted the statistical analyses using SPSS (Version 31). For the self-report measures, we conducted multi-factorial repeated measures ANOVAs with the factors Time (pre- and postlistening) and Appointment (1 to 6). In consideration of dropouts attributable to the setting of early neurological rehabilitation, e.g., due to discharges or various required medical interventions, we decided to run three separate analyses. We implemented analyses for appointment 1, appointments 1 to 4, and appointments 1 to 6. We chose these particular timepoints and intervals because we wanted to examine initial alterations within the

full sample size of  $N=30$ , but also for the average number of appointments ( $M(\text{appointments})=4.167$ ). Finally, we wanted to investigate alterations for patients who participated in all sessions. Additionally, we conducted posthoc  $t$ -tests for every pre-post pair for appointments 1, 4, and 6 as well. Reported  $p$ -values for the  $t$ -tests were adjusted using the Bonferroni-Holm method for multiple testing, similar to our previous study (Springer et al., 2025).

## Results

### Descriptive Statistics

The valence of the different GIMEs was rated very positive on a 9-point Likert scale with  $M$  (beach)=7.95,  $M$  (forest)=7.99,  $M$  (lake)=7.25, and  $M$  (meadow)=7.5, with no significant mean differences between the valences (all  $p>.05$ ). For an overview of which setting was chosen for which appointment, see Appendix D.

### Self-Report Measures

#### Mood

For appointment 1, we found a highly significant main effect for Time in  $N=30$  patients with  $F(1,29)=20.01$ ,  $p<.001$  and  $\eta_p^2=.408$ , reflecting a state-specific positively-valenced mood alteration. The ANOVA across four appointments ( $N=19$ ) also showed a highly significant main effect of Time, with  $F(1,18)=43.20$ ,  $p<.001$  and  $\eta_p^2=.706$ , indicating a consistent state-specific alteration of mood across sessions. For six appointments ( $N=11$ ), we observed the

same highly significant main effect on mood, with  $F(1,10)=38.02$ ,  $p<.001$ , and  $\eta_p^2=.792$ . Please refer to Figure 2 for a comprehensive overview.

Posthoc  $t$ -tests showed highly significant differences for preappointment 1 vs. postappointment 1 ( $p=.003$ ), preappointment 4 vs. postappointment 4 ( $p=.004$ ), and preappointment 6 vs. postappointment 6 ( $p=.005$ ), also indicating a state-specific positively-valenced mood alteration (Table 2, Table 3).

#### Arousal

Similarly, at appointment 1 ( $N=30$ ), there was a highly significant main effect for Time on arousal,  $F(1,29)=23.30$ ,  $p<.001$  and  $\eta_p^2=.445$ , reflecting a state-specific decrease in arousal following the GIME treatment session. Across appointments 1–4 ( $N=19$ ), there also was a highly significant main effect for Time, with  $N=19$ ,  $F(1,18)=40.52$ ,  $p<.001$  and  $\eta_p^2=.692$ , indicative of a consistent decrease in arousal across sessions. Across appointments 1–6 ( $N=11$ ), there also was a highly significant main effect of Time, with  $F(1,10)=35.13$ ,  $p<.001$ , and  $\eta_p^2=.778$ , see Figure 3.

Posthoc  $t$ -tests showed highly significant differences for preappointment one vs. postappointment one ( $p=.003$ ), preappointment four vs. postappointment four ( $p=.002$ ), and preappointment six vs. postappointment six ( $p=.001$ ), further indicating a decrease in arousal (Table 2, Table 3).

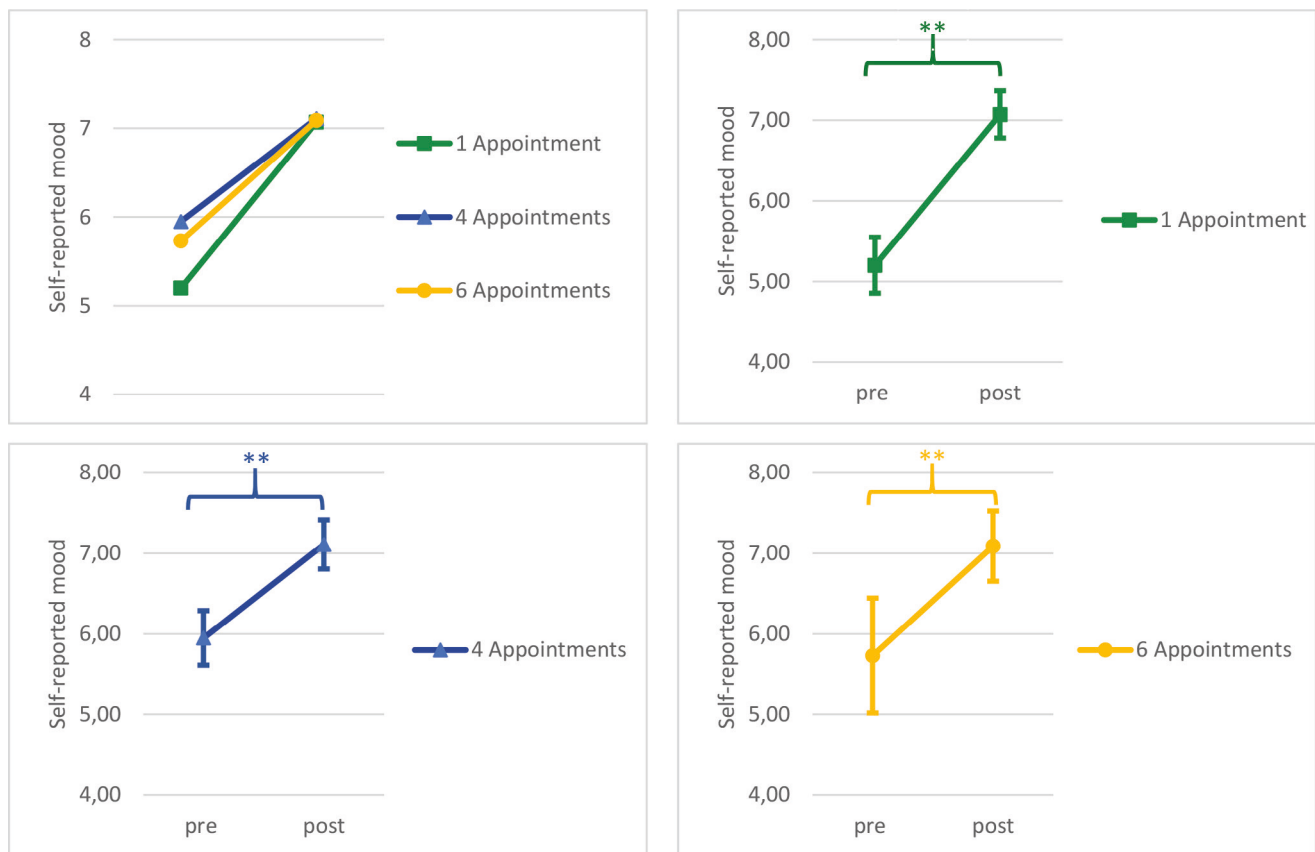
#### Pain

For pain, the analysis showed a significant main effect of Time for appointment 1 in  $N=30$  patients, with  $F(1,29)=7.99$ ,  $p=.008$ , and  $\eta_p^2=.216$ . When we took four of the six appointments into account, we found a significant main effect for Time as well, with  $F(1,18)=11.13$ ,  $p=.004$ , and  $\eta_p^2=.382$  ( $N=19$ ). For all of the six appointments

**Table 3.** Pre-post comparison for self-report measures

|         |                       | T      | df | M      | SD    | p (one-sided) |
|---------|-----------------------|--------|----|--------|-------|---------------|
| Mood    | Pre-postappointment 1 | -4.474 | 29 | -1.867 | 2.285 | .003**        |
|         | Pre-postappointment 4 | -3.364 | 18 | -1.158 | 1.5   | .004**        |
|         | Pre-postappointment 6 | -3.155 | 10 | -1.364 | 1.433 | .005**        |
| Pain    | Pre-postappointment 1 | 2.827  | 29 | 0.6    | 1.163 | .012*         |
|         | Pre-postappointment 4 | 2.051  | 18 | 0.316  | 0.671 | .056          |
|         | Pre-postappointment 6 | 1.491  | 10 | 0.545  | 1.214 | .083          |
| Arousal | Pre-postappointment 1 | 4.826  | 29 | 1.4    | 1.589 | .003**        |
|         | Pre-postappointment 4 | 3.618  | 18 | 1.053  | 1.268 | .002**        |
|         | Pre-postappointment 6 | 5.285  | 10 | 1.636  | 1.027 | .001**        |

Notes. All reported  $p$ -values are adjusted using the Bonferroni-Holm-Method for multiple testing and were conducted using pre- and postvalues of the same appointment. \* $p<.05$ ; \*\* $p<.01$ .



**Figure 2.** State-specific alterations in mood following GIME: Subjective mood was measured using self-assessment manikins on a scale from 1 to 9. \* $p < .05$ , \*\* $p < .01$ . Reported mean values are pre- and postvalues of the depicted appointment. Abbreviation: GIME = guided imagery intervention with basic mindfulness elements.

( $N=11$ ), the analysis showed  $F(1,10)=15.10$ ,  $p=.003$  and  $\eta_p^2=.602$ . For a graphic illustration, refer to Figure 4.

Posthoc  $t$ -tests only showed significant differences for preappointment 1 vs. postappointment 1, with  $p=.012$ , indicating a decrease in reported pain values.  $t$ -tests for preappointment 4 vs. postappointment 4 ( $p=.056$ ) and preappointment 6 vs. postappointment 6 ( $p=.083$ ) were not significant.

For a comprehensive overview of the conducted  $t$ -tests for all pre/post comparisons of mood, arousal, and pain, see Table 3.

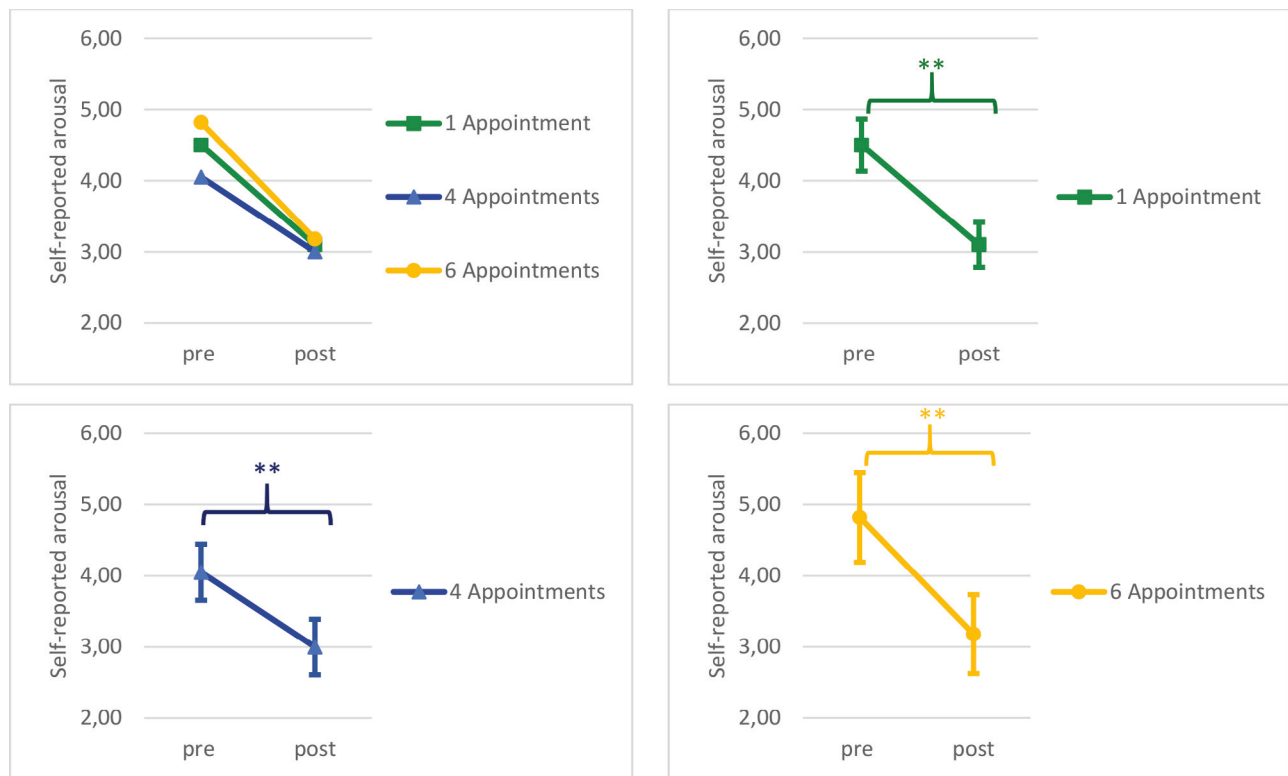
There was no significant interaction effect between Time and Appointment and no main effect of Appointment for any of the self-report scales (all  $p$ -values  $> .05$ ).

## Discussion

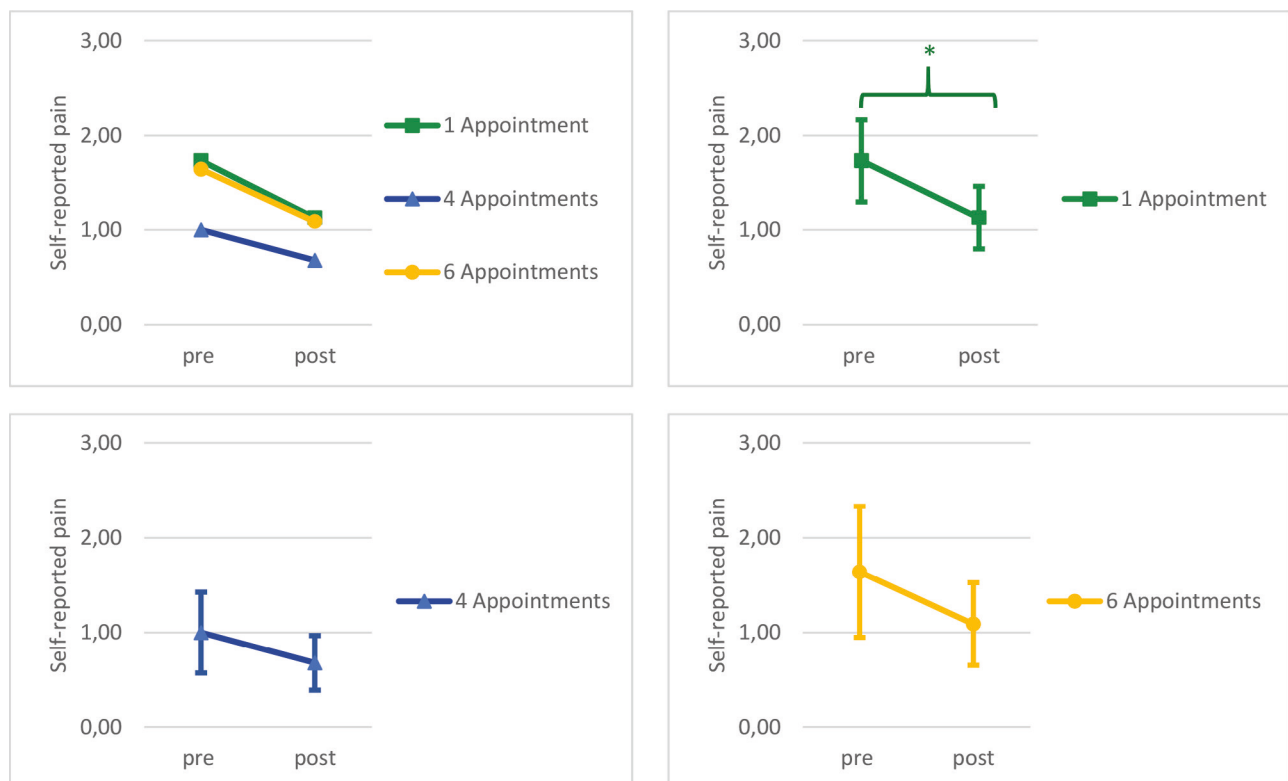
The current study found that multiple applications of our GIME in ENR patients led to highly significant, state-specific, and beneficial alterations, including an improvement in mood and a decrease in arousal. Also, there was a signif-

icant decrease in pain. These beneficial short-term alterations, reflected by large statistical effects, were consistently observable across up to six consecutive appointments and were already evident after a single session. It is noteworthy that these beneficial short-term alterations associated with the exposure to our GIME did not wear off after repeated applications.

Our exploratory analyses did not reveal trait-like alterations, such as a decrease in arousal or pain or an improvement in mood for baseline measures across sessions. However, the short-term, state-specific effect on these three subjective parameters was consistent. Six interventions may not be sufficient to establish mid- to long-term effects. For example, Watanabe et al. (2005) found positive effects on mood, general stress, and general health for participants who practiced home-based guided imagery interventions for up to 20 months, with better effects correlating with longer history of practice. Kral et al. (2018) found no differences in amygdala activity following negative stimuli for healthy participants with up to 10,000 hours of meditation experience or for healthy adults following an 8-week mindfulness-based stress reduction (MBSR) intervention. The eight-week MBSR course, however, did lead



**Figure 3.** State-specific alterations in arousal following GIME: Subjective arousal was measured using self-assessment manikins, on a scale from 1 to 9. Reported mean values are pre- and postvalues of the depicted appointment. \* $p < .05$ , \*\* $p < .01$ . Abbreviation: GIME = guided imagery intervention with basic mindfulness elements.



**Figure 4.** State-specific alterations in pain following GIME: Subjective pain was measured using a visual analogue scale, on a scale from 0 to 10. Reported mean values are pre- and postvalues of the depicted appointment. \* $p < .05$ , \*\* $p < .01$ . Abbreviation: GIME = guided imagery intervention with basic mindfulness elements.

to an increased connectivity between the amygdala and the ventromedial prefrontal cortex compared to control. If we take the above-mentioned studies as well as our own findings into account, we cannot conclude that there were any learning effects from session to session, as the prevalences between sessions did not differ. In sum, based on the results obtained in the included sample with heterogeneous cognitive impairment ( $M$  (MoCA raw)=19.93;  $SD=5.04$ ), it stands to reason that mid- to long-term effects occur only after much longer practice – if ever – for patients with lesions in insular or prefrontal regions (Sevinc et al., 2018).

Our current results allowed us to reproduce our previous findings of beneficial state-specific alterations associated with our GIME (Springer et al., 2025) and establish their consistency by replicating them even across multiple measurement timepoints. In accord with our previous findings, the feasibility of our GIME may also be regarded as very high. A single GIME intervention could be easily administered within a time slot of 30 minutes, i.e., a common interval in routine ENR therapy. Moreover, in the context of clinical routine, there is no need for an extensive application of scales before and after listening.

The impression of the certified clinical neuropsychologists and neuropsychological staff involved in the implementation of the current study was that there was a high acceptance of the GIME within the respective patient cohort. The same applied to caregivers, since they considered the GIME to be an obvious therapeutic approach and provided consent for participation if they were the patients' legal caregivers. Also, as the valence of the applied audio files was rated to be very high: Overall, participants perceived the intervention as very positive and helpful. Compatible with this, we found consistent and homogeneous positive state-specific changes in mood, pain, and arousal according to our hypotheses.

Some patients reported that the GIME reactivated memories of their previous holidays or their favorite route through the nearby forest. Still, applying the intervention led to an increased demand for therapeutic talks in a minority of patients. For one patient, it led to a resurfacing of a traumatic childhood memory when their parent left them alone in the forest. This was the only case of a more severe need for therapeutic support and was resolved within a psychological therapy unit. Hence, we strongly recommend always supervising the application with personnel who are psychologically trained. From an integrative neuropsychological perspective, one may speculate that such occurrences might be related to the relaxation and the mindfulness instructions leading to refined interoception of physiological and introspection of emotional states. Research has indicated that relaxation-induced anxiety can occur due to hypervigilance or perceived loss of control

(Lazarus & Mayne, 1990). Such occurrences should not be regarded as reflecting potential contraindications per se, but rather as an opportunity for patients to get in touch with their feelings, which they sometimes may not have sufficient access to after acquired brain injury.

Due to the possible therapeutic intervention, one could argue that therapists might just stick to reading the intervention to the patients themselves to better react to the seldomly experienced need for adjustment or breaks. However, within the common setting of two- to three-bed patient rooms, providing patients with noise-cancelling headphones has proven to be very beneficial. For both studies, we observed a high frequency of interruptions consisting of doctors, nurses, therapists, or relatives entering the room, despite a big red stop sign on the door or other patients needing care at the same moment. Coordination of appointments within a three-bed room is not always easy, and sometimes therapy sessions have to take place simultaneously for two patients. Therefore, using current technology provides a feasible way to improve patients' well-being within the busy schedules of patient rooms with multiple beds. Furthermore, using audio recordings made it possible to include voice and sounds (e.g., birds chirping) to make the intervention even more immersive for the patients. Of course, choosing the application modality is always up to the therapist. There are benefits and disadvantages for both audio files and individually reading to a patient.

## Limitations

This study did not include a control condition. However, in our previous study (Springer et al., 2025), we examined state effects of the GIME relative to a control condition, which included everyday hospital noises. The GIME had the same beneficial state effects as observed in the current work and further yielded beneficial physiological alterations (e.g., decreased blood pressure). In contrast, there was no change in mood, arousal, and pain in the control condition. Exposure to the control condition even yielded a trend of a negative influence on blood pressure. Consequently, even though the current design did not allow the inference of a direct effect of our intervention, results from our previous study do provide strong support for a potential state effect on various parameters. In light of the clinical setting and critical illnesses involved in the current study, we also found it ethical to expose as many patients as possible to a potentially helpful audio file.

There was likely a selection bias since patients who initially had a slightly more positive attitude toward the intervention were probably more likely to participate in the first place. Furthermore, only very few participants dropped out of the study because they did not appreciate the inter-

vention. However, some of the 11 patients who completed the six appointments even wanted to keep on listening to the GIME after the study was completed. One patient started to listen to relaxation techniques on their own phone because of the benefits they perceived from listening to our GIME.

## Relevance for Practice

Our study shows that, within the very stressful and aversive setting of ENR, our GIME is a useful, feasible, and easy-to-apply instrument in daily clinical practice to provide patients with a moment of inner tranquillity, improved mood, and less pain. The GIME provides a positive influence on patients' well-being even for multiple applications. It is suited for a large variety of cognitive abilities (and impairments) and can also be administered to patients in need of a ventilator. With the additional scenes, patients have a choice of which safe place they want to visit in that precise moment. Because of the large effect sizes and no apparent contraindications or adverse effects, we strongly advise implementing such interventions within clinical routine for ENR – especially since research has shown that in-hospital stress can lead to long-term cognitive impairment (Davydow et al., 2013).

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## Conflicts of Interests

The authors have no conflicts of interest to report.

## Publication Ethics

The current study was approved by the Ethics Committee of the University of Bamberg, Germany. The caregivers gave informed consent per procura; patients were informed and asked personally before talking to their caregiver.

## Authorship

RS proposed the research question and design for this study. TP and RS were responsible for data acquisition, statistical analyses, data interpretation as well as for drafting and reviewing the manuscript. SH and PK contributed to the conception, design, interpretation, draft, and revision. RW contributed to the draft. SK and RA contributed to the conception. PO contributed to the revision. JR contributed to the draft and revision. All authors approved the submitted version.

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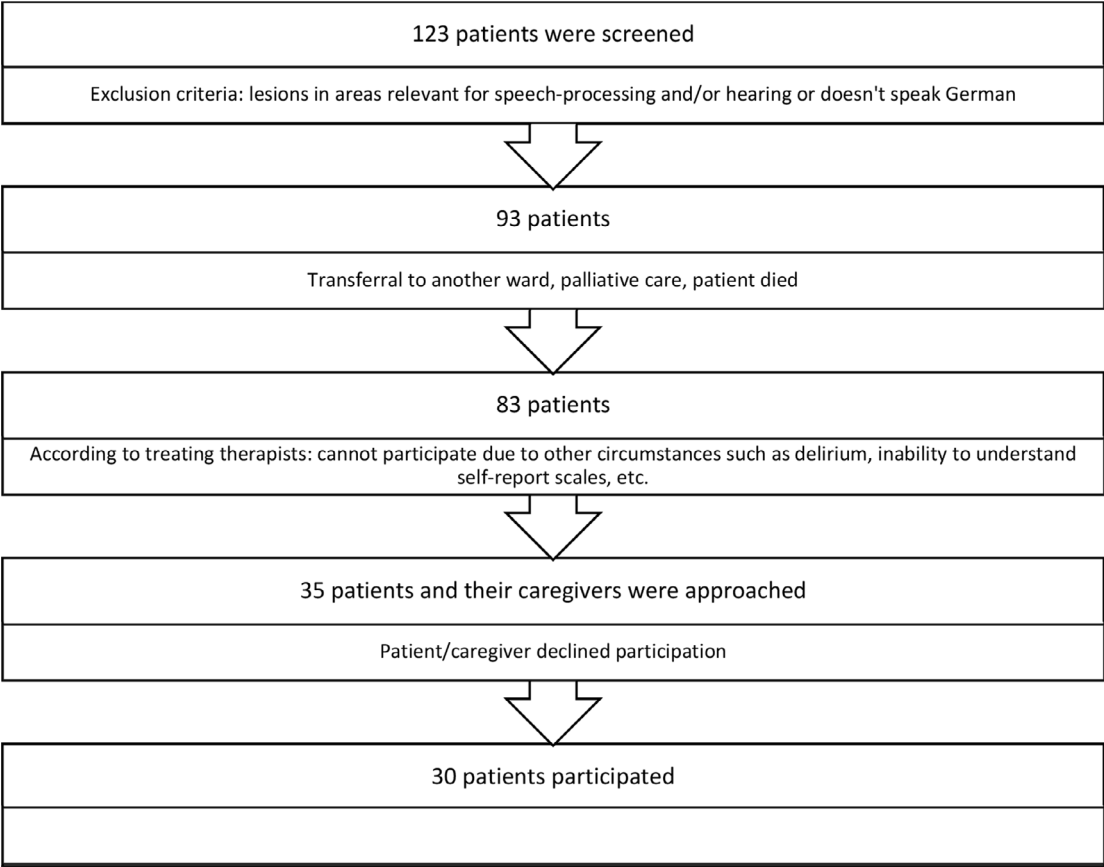
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## Appendix A



**Figure A1.** Flow Chart Survival

## Appendix B

### Examples of Mindfulness Prompts

Original: Wenn in dir während der Übung Gedanken oder Gefühle aufkommen, versuche sie sanft wahrzunehmen, und versuche, sie auf eine vorbeiziehende Wolke zu setzen und einfach wegziehen zu lassen. Versuche immer wieder zur Übung zurückzukehren. Alle Gedanken und Gefühle, die aufkommen, dürfen sein, versuche sie, ohne sie zu bewerten, einfach vorbeiziehen zu lassen.

Translation: If thoughts or feelings arise during the exercise, gently observe them, try to place them on a passing cloud, and simply let them drift away. Keep trying to return to the exercise. Allow all thoughts and feelings that arise to be present; try to let them pass by without judgment.

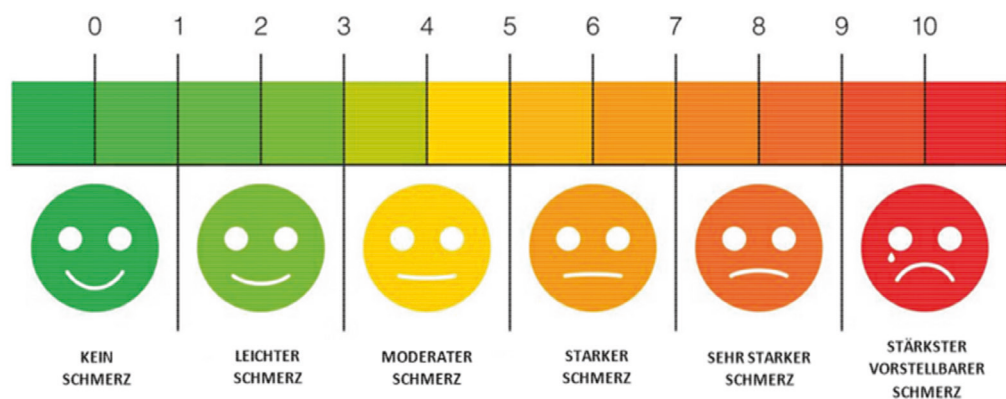
Original: Du atmest tief ein und nimmst ganz bewusst wahr, wie die kalte, klare Luft in deine Lunge strömt.

Translation: You take a deep breath and consciously perceive how the cold, clear air flows into your lungs.

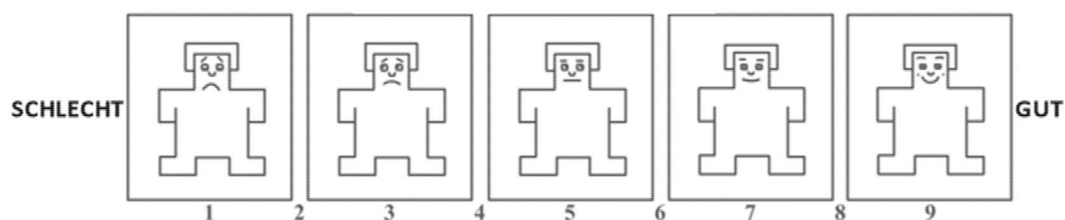
Original: Du gehst tiefer ins Wasser und nimmst ganz bewusst wahr, wie das Wasser deine Beine umspült. Du nimmst die sanften Wellen wahr und gehst weiter, bis deine Knie schließlich im Wasser sind.

Translation: You wade deeper into the water and consciously notice how it washes over your legs. You feel the gentle waves and continue until your knees are finally submerged.

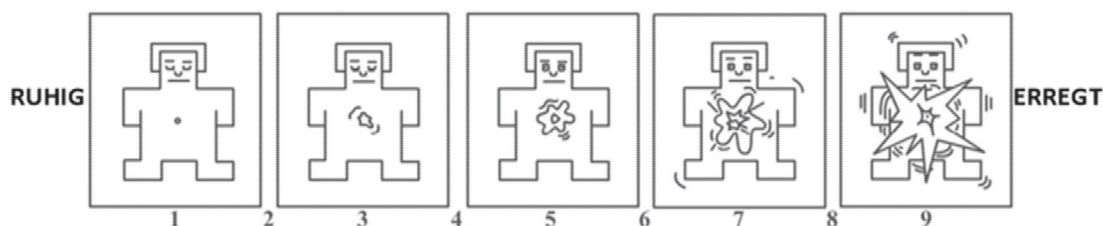
## Appendix C



### STIMMUNG



### ERREGUNG



### VALENZ

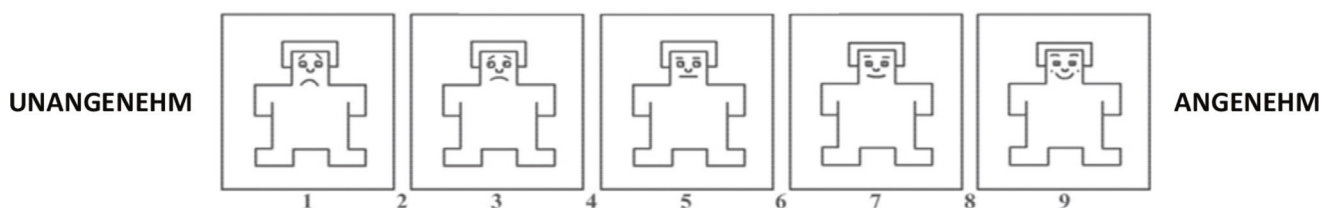
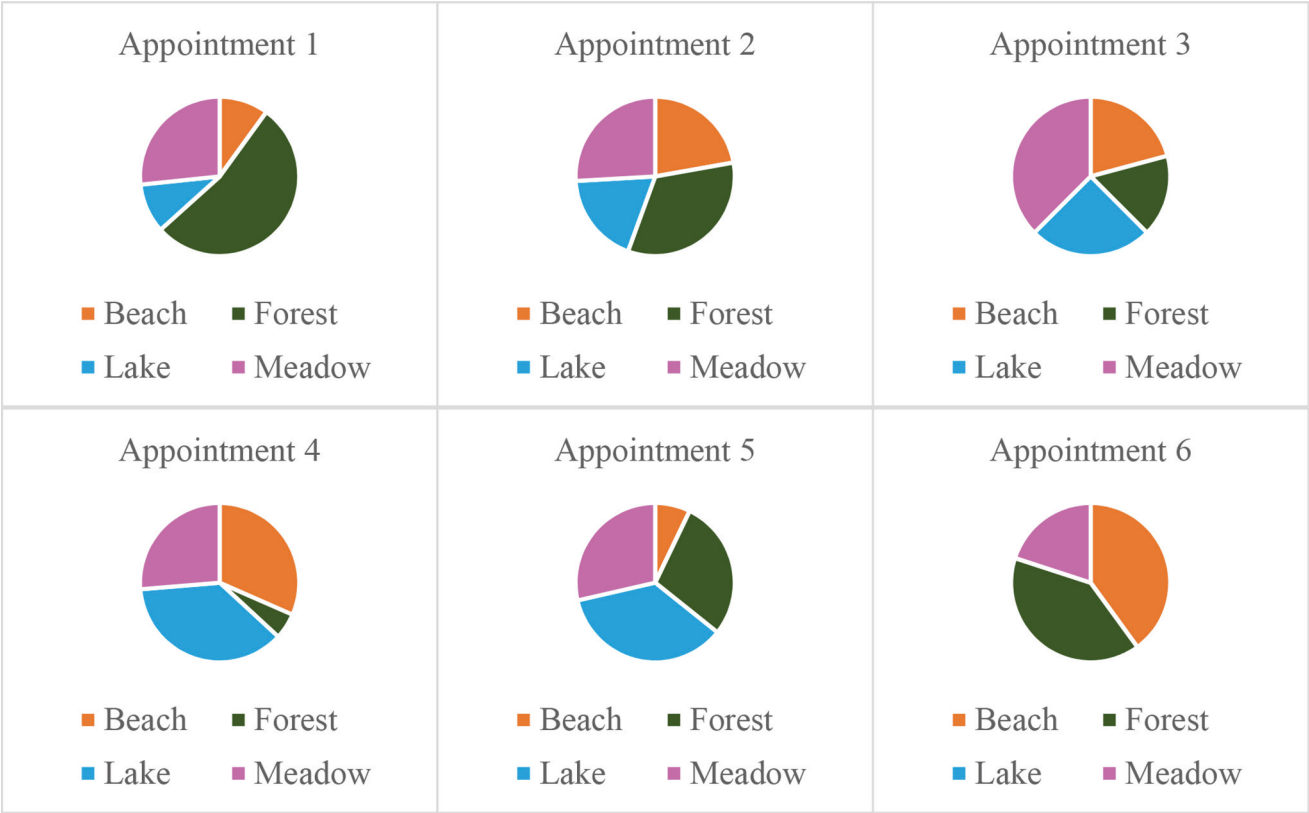


Figure C1. Self-Report Scales

Appendix D



**Figure D1.** Distribution of Settings to Appointments. *Note.* Appointment 1 –  $N = 30$ ,  $N(\text{beach}) = 3$ ,  $N(\text{forest}) = 16$ ,  $N(\text{lake}) = 3$ ,  $N(\text{meadow}) = 8$ ; Appointment 2 –  $N = 27$ ,  $N(\text{beach}) = 6$ ,  $N(\text{forest}) = 9$ ,  $N(\text{lake}) = 5$ ,  $N(\text{meadow}) = 7$ ; Appointment 3 –  $N = 24$ ,  $N(\text{beach}) = 5$ ,  $N(\text{forest}) = 4$ ,  $N(\text{lake}) = 6$ ,  $N(\text{meadow}) = 9$ ; Appointment 4 –  $N = 19$ ,  $N(\text{beach}) = 6$ ,  $N(\text{forest}) = 1$ ,  $N(\text{lake}) = 7$ ,  $N(\text{meadow}) = 5$ ; Appointment 5 –  $N = 14$ ,  $N(\text{beach}) = 1$ ,  $N(\text{forest}) = 4$ ,  $N(\text{lake}) = 5$ ,  $N(\text{meadow}) = 4$ ; Appointment 6 –  $N =$ ,  $N(\text{beach}) = 4$ ,  $N(\text{forest}) = 4$ ,  $N(\text{lake}) = 0$ ,  $N(\text{meadow}) = 3$ .