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Nature based guided imagery: an intervention to reduce state craving.

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Abstract

Diese Studie untersuchte die Wirksamkeit von naturbasierten im Vergleich zu stadt-basierten geführten Imaginationen (GI) zur Reduktion von momentanem Craving bei Patient*innen mit Essstörungen. Die Hypothesen besagten, dass momentanes Craving nach der Intervention in beiden Bedingungen signifikant geringer sein würden als vorher (H1) und dass die naturbasierte GI zu einer signifikant stärkeren Reduktion führen würde als die städtische GI (H2). Ein wiederholtes Messdesign wurde verwendet. Zur Messung des momentanen Craving wurde der Food Cravings Questionnaire State (FCQ-S) verwendet (Meule et al., 2012). Zusätzliche Messinstrumente, um potenzielle Kovariaten und Moderatoren zu betrachten waren der Food Cravings Questionnaire Trait (FCQ-T-r) (Meule et al., 2014), die Inclusion of Nature in Self (INS) (Schultz, 2002), der Vividness of Visual Imagery Questionnaire (VVIQ) (Jungmann et al., 2022) und die Mindful Attention and Awareness Scale (MAAS) (Michalak et al., 2008). Die Stichprobe bestand aus 34 Teilnehmer*innen zwischen 18 bis 59 Jahren ($M = 32,47$ Jahre, $SD = 12,08$), die im "sowhat Kompetenzzentrum für Menschen mit Essstörungen" in Wien rekrutiert wurden. Die Ergebnisse bestätigten beide Hypothesen und zeigten, dass GI-Interventionen momentanes Craving signifikant reduzierten, wobei naturbasierte GI-Sitzungen effektiver waren als städtische und dies besonders bei Teilnehmenden mit Bulimia nervosa und Binge-Eating-Störung. Dies stimmt mit der vorhandenen Literatur zur Rolle von GI für das psychische Wohlbefinden (Coughlan et al., 2022; Koivisto & Grassini, 2022; Nguyen & Brymer, 2018) und der Reduktion von Craving (Giacobbi et al., 2018; Hamilton et al., 2013) überein und unterstützt theoretische Ansätze wie die Elaborated Intrusion Theory (Kavanagh et al., 2005; May et al., 2015) und die kognitive Defusion theory (Schumacher et al., 2018, 2019). Die positiven Wahrnehmungen der naturbasierten GI unterstreicht ihr Potenzial als Ergänzung zu bestehenden therapeutischen und präventiven Strategien bei Essstörungen.

Abstract

This study investigated the effectiveness of nature-based versus urban-based guided imagery (GI) in reducing state craving in patients with eating disorders. It was hypothesized that post-intervention state craving levels would be significantly lower than pre-intervention levels across both GI conditions (H1) and that the nature-based GI would lead to a significantly greater reduction than the urban GI (H2). A repeated measures design was used. The Food Cravings Questionnaire State (FCQ-S) was used to as the main measure (Meule et al., 2012). Additional questionnaires to explore potential covariates and moderators were the Food Cravings Questionnaire Trait (FCQ-T-r) (Meule et al., 2014), the Inclusion of Nature in Self (INS) (Schultz, 2002), the Vividness of Visual Imagery Questionnaire (VVIQ) (Jungmann et al., 2022) and the Mindful Attention and Awareness Scale (MAAS) (Michalak et al., 2008). The sample consisted of 34 participants aged 18 to 59 years ($M = 32.47$ years, $SD = 12.08$), who were recruited at “sowhat Kompetenzzentrum für Menschen mit Essstörungen” in Vienna. The results confirmed both hypotheses and showed that GI interventions significantly reduced state craving, with nature-based GI sessions being more effective than urban-based, particularly in participants with bulimia nervosa and binge eating disorder. This is consistent with the existing literature on the role of GI on psychological well-being (Coughlan et al., 2022; Koivisto & Grassini, 2022; Nguyen & Brymer, 2018) and craving reduction (Giacobbi et al., 2018; Hamilton et al., 2013) and supports theories such as the Elaborated Intrusion Theory (Kavanagh et al., 2005; May et al., 2015) and the cognitive defusion theory (Schumacher et al., 2018, 2019). The positive perceptions of nature-based GI emphasize its potential as a complement to existing therapeutic and preventive strategies for eating disorders.

Introduction

Nature and Mental Health

Nature and its effect on biopsychosocial resilience (Frumkin et al., 2017; White et al., 2023) and as a therapeutic factor (Berg et al., 2016; Capaldi et al., 2015; Naor & Mayseless, 2021) has been a growing topic of research in recent years. Connecting with nature is one main factor, suggesting it has potential for wellbeing interventions (Capaldi et al., 2015) and highlighting the importance of identifying other approaches in which research could provide evidence-based public health interventions (Frumkin et al., 2017). White et al. proposed in 2023 the Nature-based Biopsychosocial Resilience Theory (NBRT), suggesting that nature contact contributes to biopsychosocial resilience, helping individuals build and maintain resilience to various stressors.

Besides general well-being and mental health (Berg et al., 2016), therapeutic effectiveness of nature was researched as well. Naor and Mayseless (2021) identified four therapeutic factors enhanced by the natural environment and another qualitative study found enhanced effectiveness in psychotherapy with therapies in an envisioned natural environment (Meuwese et al., 2021). These findings further support the growing body of evidence suggesting that nature can have a positive impact on mental health and well-being.

Mental Imagery and Nature

Recent research has focused on the topic of mindfulness training with nature and mental imagery as a form of nature as an intervention (Koivisto & Grassini, 2022; Lymeus, 2022; Lymeus et al., 2022). Two studies by Lymeus et al. (Lymeus et al., 2019, 2020) demonstrated that a natural meditation setting improves compliance with mindfulness training and supports open monitoring and attention restoration. This

suggests that natural settings can support state mindfulness and restore depleted attention resources.

Coughlan (2022) as well as Koivisto and Grassini (2022) further explored the impact of nature through mindfulness with mental imagery. Their studies revealed that mentalization of nature spaces alone with guided imagery (GI), increased connectedness to nature and could induce positive psychological effects. Moreover, Nguyen and Brymer (2018) found that nature-based GI can be an effective intervention for state anxiety. These findings suggest that imagined nature exposure may be a viable cost-effective and easily accessible alternative to real nature exposure.

Due to the similarity and frequent use of imagination in mindfulness programs like the Mentalizing Imagery Therapy (MIT) (Jain & Fonagy, 2020), the connection between imagination and mindfulness has also been explored. In two studies by Macauly et al. (2022a; 2022b), the authors explored the mediating role of mindfulness and psychological well-being in nature experiences. Macauly et al. (2022a) propose a new framework, in which they theorize self-regulatory mechanisms of mindful engagement to directly influence the positive effects of nature on psychological restoration. Another study by Macauly et al. (2022b) found that despite expectations, the mindful engagement group did not show higher levels of state mindfulness compared to other groups, as well as merely increasing engagement does not guarantee benefits indicating that unguided experiences best restored attention, while mind wandering in nature significantly improved mood. Similarity with mindfulness should therefore be looked at as a potential moderator or mediator of imagination interventions (Coughlan et al., 2022).

Guided Imagery and Craving

The Elaborated Intrusion (EI) Theory (Kavanagh et al., 2005; May et al., 2015) is often used to describe how cravings occur and are elaborated. This theory posits that

cravings occur when the automatic process of initial intrusive thoughts about a desired substance are elaborated through a controlled process, involving representations in mental imagery. The EI Theory has been the focus of various studies exploring craving reduction strategies, often with the use of GI and related techniques (Giacobbi et al., 2018; Hamilton et al., 2013; Missbach et al., 2015; Versland & Rosenberg, 2007; Wilson et al., 2021).

In the context of food cravings and imagery techniques Hamilton et al. (2013) found that while cravings rose during a mind-wandering task, neither GI nor body scanning increased cravings. Similarly, Missbach et al. (2015) and several studies on the effectiveness of cognitive defusion and GI show that it can reduce food cravings and consumption (Schumacher et al., 2018, 2019), and that acceptance- and imagery-based strategies can reduce chocolate cravings (Schumacher et al., 2017; Wilson et al., 2021). Besides craving in food, it could also have an impact on smokers as a study by Versland and Rosenberg (2007) suggests.

In terms of GI and eating disorders, Heiderscheit (2023) and Katterman et al. (2014) highlight different mindfulness meditations as feasible options as interventions for binge eating, emotional eating, weight loss and eating disorder treatment. Several works have also shown the positive effect of general mindfulness on eating disorders (Brewer et al., 2018; Grohmann & Laws, 2021; Sala et al., 2020).

The Present Study

Following the tertiary prevention interventions to build and maintain biopsychosocial resilience through nature contact as suggested by White et al. (2023) this study tried to integrate findings from the nature-based interventions, GI and mindfulness in managing cravings into a GI intervention for craving in patients with eating disorders and cravings. Additionally, the study aimed to provide new insights into GI by evaluating the

effectiveness of GI in a clinical population. The method of GI was used, as it has already been used as an effective intervention to induce positive psychological effects (Koivisto & Grassini, 2022), reduce state anxiety (Nguyen & Brymer, 2018) and reduce food cravings (Giacobbi et al., 2018; Hamilton et al., 2013).

Hypotheses and Research Questions

This study aims to investigate the differential effectiveness of nature-based versus urban-based guided imagery (GI) interventions on state cravings in patients with eating disorders. The primary hypothesis (H1) posited that post-intervention state craving levels would be significantly lower than pre-intervention levels across both GI conditions. The secondary hypothesis (H2) proposed that nature-based GI sessions would result in a significantly greater reduction in state craving compared to urban-based GI sessions. As the main measure the Food Cravings Questionnaire State (FCQ-S) by Meule et al. (2012) was used. To explore these hypotheses further, several covariates and potential moderators/mediators were explored: the Food Cravings Questionnaire Trait (FCQ-T-r) by Meule et al. (2014), the Inclusion of Nature in Self (INS) scale by Schultz (2002), the Vividness of Visual Imagery Questionnaire (VVIQ) by Jungmann et al. (2022), and the Mindful Attention and Awareness Scale (MAAS) by Michalak et al. (2008).

Materials and methods

A repeated measures design was employed, participants were assigned to the nature-based condition during the first session. Following a two-week interval, participants then underwent the other urban-based condition in a second session.

Participants

The sample was drawn from the population of patients above the age of 18 diagnosed with ICD-10 (World Health Organization, 2019) F50 eating disorders at “sowhat

Kompetenzzentrum für Menschen mit Essstörungen" (Competence centre for people with eating disorders) in Vienna. The exclusion criteria comprise of people with ICD-10 (World Health Organization, 2019) F20-F29 schizophrenia, schizotypal, and delusional disorders diagnosis, non-German as mother tongue and those with traumatic experiences in natural or urban environments. A G*Power analysis (version 3.1.9.7) indicated a sample size estimation of approximately 25-36 participants, based on studies on GI and anxiety (Nguyen & Brymer, 2018) and GI and craving (Hamilton et al., 2013), with an estimated effect size of $f = 0.16-0.20$. Data collection took place in four months from the first of March to the first of June 2024.

A total sample of 34 participants (30 female and 4 male) completed the study in its entirety. The mean age of the participants was 32,47 years ($SD = 12,08$), ranging from 18 to 59. Six participants were excluded due to missing data, as they only completed one of the conditions and one participant was excluded due to straightlining.

The most common diagnosis category was binge eating with 17 participants, followed by anorexia nervosa (7), bulimia nervosa (5), other eating disorder (3), and atypical bulimia nervosa and eating disorder non specified with 1 each.

Apparatus and Instruments

For data collection, printed questionnaires were utilized. A self-generated identification code (Audette et al., 2020) for matching the data was obtained first. The study took about 20 minutes per session, with about 10 minutes of surveys, and 10 minutes of intervention. Between the sessions there were an additional 10 minutes of surveys on demographic and covariate data.

Craving

For the main measure of the study, the Food Cravings Questionnaire State (FCQ-S) by Meule et al. (2012) was employed to assess state craving. The Questionnaire is a

validated German version derived from the Food Craving Questionnaires (FCQs)(Cepeda-Benito et al., 2000), which is one of the most frequently used instruments for measuring food cravings (Meule, 2020). It comprises of three categories: triggered by external cues, triggered by negative emotions and triggered by feelings of hunger. The FCQ-S shows a good internal consistency (Cronbach's $\alpha > .90$) and reasonable retest reliability ($r_{tt} = .40$)(Meule et al., 2012). It consists of 15 items which are rated on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree, with no inverted items.

As a potential covariate, the Food Cravings Questionnaire Trait reduced (FCQ-T-r) by Meule et al. (2014) was used. For this measure only the 7 highest loading items ($>.75$) were selected to enhance compliance and to make the study more economical for the participants. The questionnaire has a good internal consistency (Cronbach's $\alpha = 0.94$), shows moderate negative correlation with self-perceived dieting success (Meule et al., 2014) and is rated on a 5-point Likert scale.

Vividness of Imagery

The Vividness of Visual Imagery Questionnaire (VVIQ) adapted and validated in German by Jungmann et al. (2022) consists of 16 items. Participants were asked to visualize a specific scenario and then rate the vividness of their mental image on a 5-point scale. The VVIQ has found to have a good test-retest reliability ($r_{tt} = .68$) and high internal consistency ($\omega = .85$) (Jungmann et al., 2022). The scenarios include imagining a relative or friend, a rising sun, the front of a frequently visited shop, and a country scene involving trees, mountains, and a lake.

Connectedness to Nature

To measure connectedness to nature the study used the Inclusion of Nature in Self (INS) (Schultz, 2002). It is a single graphical question designed to measure an

individual's connection to nature. It consists of two circles representing "Self" and "Nature" with varying degrees of overlap, ranging from no overlap to complete overlap. Participants were asked to choose the image that best represents their relationship with nature. For the validity of the measure correlation between the INS and other nature connectedness scales with values between .57-.60 shows similarity in the construct (Schultz, 2002).

Mindfulness

The Mindful Attention and Awareness Scale (MAAS) by Michalak et al. (2008) is a tool designed to measure the concept of mindfulness, which was first developed by Brown and Ryan in 2003 (Brown & Ryan, 2003) and later validated and translated in German by Michalak et al. (2008). It consists of 15 items and is rated on a scale from 1 = almost always to 6 = almost never. For this study only the 7 highest loading items ($>.65$) were selected and used. The measurement is characterized by three characteristics: intentional, related to the present moment and non judgmental. The MAAS has found to have good internal consistency (Cronbach's $\alpha = 0.83$) and good retest reliability ($r_{tt} = .82$) (Michalak et al., 2008).

Perception Data

After the intervention, participants filled out questions to evaluate their sensory and emotional engagement with the intervention. The questionnaire included items to assess their ability to envision the guided imagery across visual, auditory, olfactory, gustatory, tactile, and emotional sensory modalities. Responses for these items were recorded on a Likert scale ranging from 1 = never to 6 = always.

Additionally, participants were asked to rate their overall ability to perceive the imagination on a 5-point scale and evaluated their subjective experience of the imagination on a 5-point scale, with 1 = negative and 5 = positive.

Guided Imagery Scripts

The outlines of the GI scripts were created based on guidelines for script creation of imaginations (Williams et al., 2013) and adhered to a standardized protocol, aiming for maximum comparability between the conditions. Content-wise, the GI started with a short relaxation instruction, followed by the nature/urban imagination stimulus. For the nature imagination this was: “Eine ruhige, natürliche Umgebung mit viel unberührter Natur” (A calm, natural environment with plenty of untouched nature) and for the urban condition: “Ein lebhaftes, städtisches Zentrum mit vielen Straßen und Gebäuden” (A lively urban center with many streets and buildings). As recommended by the literature the rest of the imagination focused on sensory perception (Coughlan et al., 2022; Green & Lynn, 2008; Vangen et al., 2017), as sensory focus has shown to be effective in GIs to reduce food cravings (Hamilton et al., 2013; May et al., 2010) and long pauses to let the participants process in their own speed (Green & Lynn, 2008; Vangen et al., 2017). The intervention was piloted with students ($n = 4$) in December 2023 and feedback on phrasing was reviewed and incorporated into a finalized version of the script (see Appendix A). The script was approximately 10 minutes long, similar to other studies using GIs to ensure enough time with nature (Coughlan et al., 2022; Hamilton et al., 2013; Nguyen & Brymer, 2018).

Intervention

The intervention design was group-based, with each group undergoing both GI conditions. Initially, all groups undertook the nature-based condition, followed by the urban-based condition two weeks later. This sequential order was not randomized, following recommendations from the institution they were recruited at and considerations specific to the patient population. This decision was made due to the institutional advisement to start with nature-based imagery, as it was deemed less likely to provoke adverse

reactions and more conducive to minimizing initial stressors in consideration of the psychological well-being of participants.

Screening

At the beginning of the biweekly group sessions offered by the institution, the participants were informed about the studies description, aim and inclusion criteria, as well as their possibility to partake in the study after the group session. If they decided to participate, they were handed the informed consent document and after the guided imagery session they were given the other measures such as demographic data and covariates, VVIQ (Jungmann et al., 2022), INS (Schultz, 2002), MAAS (Michalak et al., 2008), and FCQ-T-r (Meule et al., 2014) to fill out at home and bring to the next session.

Guided Imagery Sessions

At the start of each of the GI sessions participants undertook the Food Cravings Questionnaire State (FQC-S) (Meule et al., 2012). After finishing they were instructed to follow the intervention, which was read out using the dedicated script, this was meticulously adhered to, aiming to maintain uniformity in the delivery of the GI. Upon finishing the imagination, the participants again undertook the FQC-S, as well as questions about their perception and content of the imagination.

Statistical Analyses

To analyze the data the Statistical Package for the Social Sciences (SPSS, version 28.0.0.0) was used. Firstly, the quantitative data was checked for missing values. Descriptive statistics for the psychometric scales were computed next. Pearson's correlation coefficient was initially used to assess the relationship between the treatment effects for the conditions and the covariates. Next, the significance of the 3-way

interaction effects to detect moderation effects were looked at to decide if they were to be used as covariates in the subsequent ANOVA analyses.

The statistical assumptions were calculated and evaluated (Bortz & Schuster, 2010; Field, 2017). Following this, a two-way repeated measures ANOVA was employed to determine the main analysis. The interaction effect for time (pre vs. post) and the condition (nature vs. urban) was examined to test the hypotheses for significant differences in the scores pre and post-experiment (H1), and between the nature and urban conditions (H2).

Participants with the ICD 10 diagnoses of bulimia nervosa and binge eating disorder, which are proposed to obtain the most benefit from craving reduction, underwent a sensitivity analysis with another ANOVA.

Lastly, exploratory data analysis was done from the data on participants perception as well as the open-ended question. The qualitative data was clustered by similarity and thematically coded. Initially, an inductive approach was employed to allow themes to emerge naturally from the data itself, subsequently, these themes were compared and aligned with existing thematic categories identified in the work of Nguyen and Brymer (2018).

Results

Descriptive, Covariate and Moderation Statistics

Results of the correlational analysis (Table 1) indicated a significant positive correlation between mindfulness and nature connectedness. Additionally, a significant negative correlation was observed between vividness of imagination and trait craving. The treatment effects for both nature and urban-based guided imagery interventions were positively correlated. Minimal relationships were found between the treatment effects and the other covariates, with correlations ranging from $r = -.22$ to $.09$, suggesting that

the treatment effects were relatively independent of the individual differences in the measured covariates.

The results of the ANOVA to examine the three-way interaction of the previously mentioned covariates revealed no significant interaction for Nature Connectedness ($F(1, 34) = 0.07, p = .79$), Trait Craving ($F(1, 34) = 0.13, p = .71$), Mindfulness ($F(1, 34) = 0.03, p = .86$) and Vividness of Imagination ($F(1, 34) = 0.01, p = .91$), showing no significant moderation effects. Therefore, and in the interests of maximizing power, the variables were not used as covariates in the following ANOVA analyses.

Table 1

Means, Standard Deviations, and Correlation Matrix of Possible Covariates and Treatment Effects

Variable	M	SD	1	2	3	4	5	6
1.Nature connectedness	4.70	1.40	-					
2.Trait craving	4.09	1.52	.02	-				
3.Mindfulness	3.65	0.83	.42*	.02	-			
4.Vividness of imagination	3.56	0.82	.09	-.49*	.06	-		
5.Treatment effect nature	0.58	0.61	.01	.09	-.16	-.22	-	
6.Treatment effect urban	0.24	0.55	.08	.01	-.12	-.18	.52*	-

* Correlation is significant at the 0.05 level (2-tailed).

ANOVA

Before conducting the main analysis one significant outliers was identified upon inspection of boxplots and the participants data was excluded due to straightlining. Consequently, the final sample included 34 participants. The Shapiro–Wilk and Kolmogorov-Smirnov indicated that assumptions of normality were not violated.

The two-way repeated measures ANOVA revealed no statistically significant main effect of the intervention (Nature/Urban) on craving levels, $F(1, 34) = 0.21, p = .65$ suggesting that the type of guided imagery did not independently affect craving levels.

However, there was a significant main effect of time, $F(1, 34) = 22.40$, $p < .001$ indicating a significant reduction in craving scores from pre-intervention to post-intervention regardless of the type of intervention.

The analysis also identified a significant Time x Treatment interaction, $F(1, 34) = 12.09$, $p = .001$. Suggesting that the reduction in craving scores over time differed depending on the type of guided imagery received and implies that nature-based guided imagery resulted in a greater reduction in craving scores compared to urban-based guided imagery.

The effect sizes for Time (partial $\eta^2 = .40$) and the Time x Treatment interaction (partial $\eta^2 = .26$) were both substantial, indicating large effects according to Cohen's (1988) benchmarks. The mean craving score reduction was more pronounced in the nature-based condition compared to the urban condition (Table 2).

To further explore the interaction effect post hoc pairwise comparisons were conducted. The results indicated a significant reduction in craving scores from pre-intervention to post-intervention in the nature-based condition ($M = 0.58$, $SE = 0.10$, $p_{\text{bonf}} < .001$, $d = 0.87$), but not in the urban-based condition ($M = 0.24$, $SE = 0.10$, $p_{\text{bonf}} = .11$, $d = 0.36$). These findings were also visually supported, with downward crossing trends (Figure 1) indicating that nature-based guided imagery resulted in a greater reduction in craving scores compared to urban-based guided imagery, supporting hypothesis 2.

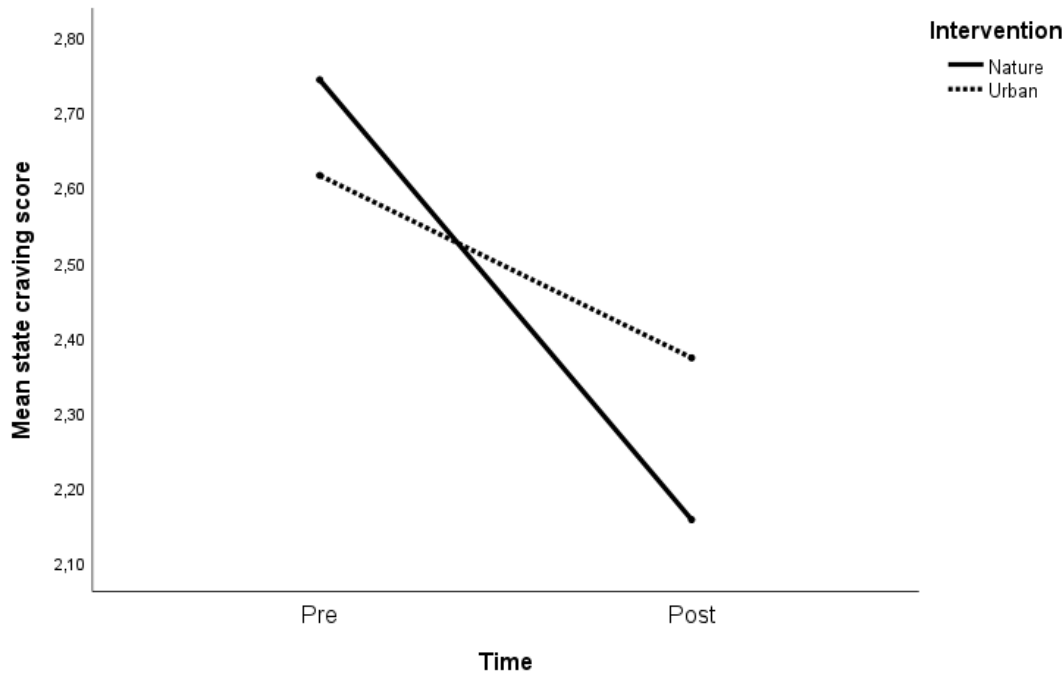
Table 2

Means, Standard Deviations and Confidence Intervals of State Craving for both Conditions

Condition	Pre		Post	
	M(SD)	95%CI	M(SD)	95% CI
Nature (n = 34)	2.74 (0.67)	[2.50, 2.97]	2.16 (0.57)	[1.95, 2.35]
Urban (n = 34)	2.61 (0.71)	[2.36, 2.86]	2.37 (0.73)	[2.11, 2.62]

Figure 1

ANOVA: Changes in State Craving over Time for both Intervention Conditions (N = 34)



Sensitivity Analysis ANOVA

Assumption checks for the combined diagnostic categories of bulimia nervosa and binge eating disorder were conducted. No significant outliers were identified, which led to a sample of 22 participants. Normality assumptions were not violated as assessed by Shapiro-Wilk and Kolmogorov-Smirnov tests.

A two-way repeated measures ANOVA for the combined subgroup revealed similar outcomes with no significant main effect of the Intervention (Nature/Urban), $F(1, 21) = 2.90$, $p = .10$., and a significant main effect of Time, $F(1, 21) = 14.77$, $p < .001$, indicating a reduction in craving scores from pre to post-intervention. The Time x Treatment interaction was significant, $F(1, 21) = 12.40$, $p = .002$, suggesting that in this subgroup the nature-based intervention led to a greater reduction in craving scores than the urban-based intervention for the combined group, visible in Figure B1 (see Appendix B).

Effect sizes for the combined subgroup indicated large effects (Cohen, 1988) of Time (partial $\eta^2 = .41$) and the Time x Treatment interaction (partial $\eta^2 = .37$). The means in craving score for both conditions can be seen in Table 3.

Post hoc comparisons for the combined subgroup showed a significant reduction in craving scores for the nature-based condition from pre to post-intervention, with a larger mean difference of 0.69 (SE = 0.13, $p_{\text{bonf}} < .001$, $d = 1.01$), while the urban-based condition showed a smaller, non significant, reduction (M = 0.267, SE = 0.13, $p_{\text{bonf}} = .39$, $d = 0.39$).

Table 3

Means, Standard Deviations and Confidence Intervals of State Craving in both Conditions for the Combined Diagnostic Categories Binge Eating and Bulimia Nervosa

Condition	Pre		Post	
	M(SD)	95%CI	M(SD)	95% CI
Nature (n = 22)	2.79 (0.70)	[2.48, 3.10]	2.09 (0.48)	[1.88, 2.31]
Urban (n = 22)	2.74 (0.72)	[2.42, 3.06]	2.47 (0.78)	[2.13, 2.82]

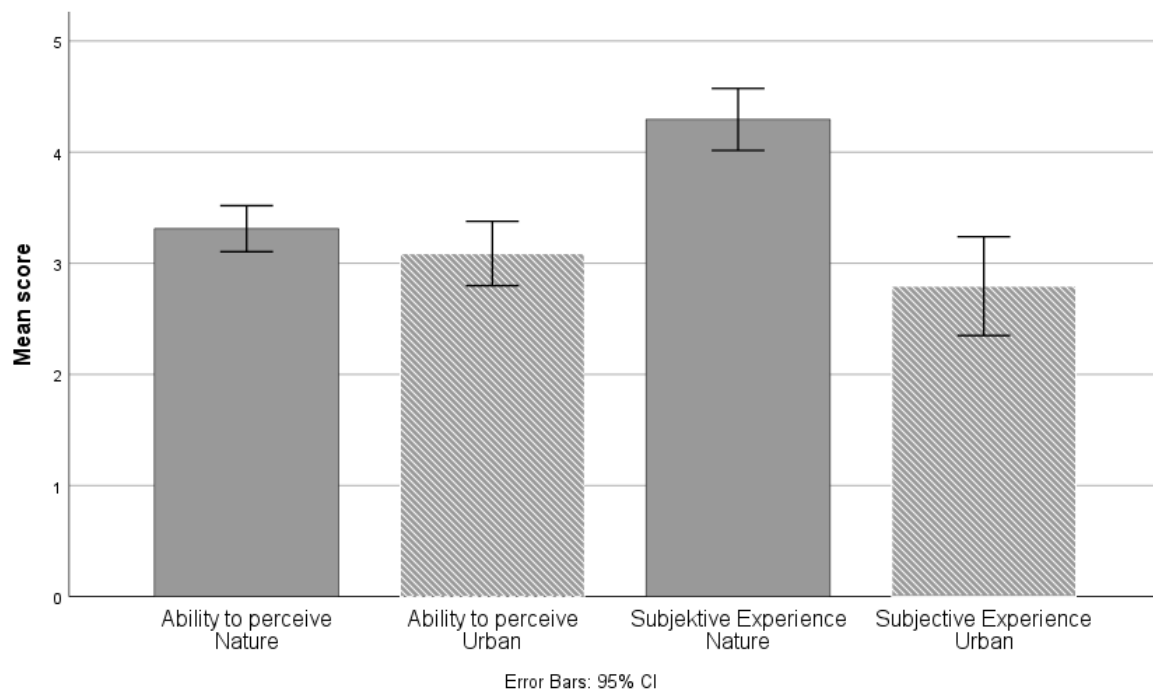
Explorative and Qualitative Analyses

Results of participants abilities to perceive the imaginations and their subjective experiences (Figure 2) show that their ability to perceive nature imagery (M = 3.31, SD = 0.59, Max = 4.43, Min = 2.14, CI = [3.10, 3.51]) was slightly higher than the ability to perceive urban imagery (M = 3.08, SD = 0.82, Max = 4.57, Min = 1.43, CI = [2.79, 3.37]). Their subjective experience of nature imagery was generally positive (M = 4.29, SD = 0.79, Max = 5, Min = 3, CI = [4.02, 4.57]), whereas the urban imagery showed a wider range and a less positive overall perception (M = 2.79, SD = 1.27, Max = 5, Min = 1, CI = [2.35, 3.24]).

Tables B3 and B4 (see Appendix B) present the thematic categories and representative quotes from participants regarding their imagined content in both nature and urban scenarios. In nature imaginations different landscape types were mentioned, these include mountain, water, meadow, forest and urban nature landscapes, as well as combinations of each of those. In urban imaginations their own home, foreign cities/counties and urban social locations were imagined. There was also an overlap in the themes where elements of nature appeared in urban imaginations, for example, participants included elements like trees or well in their urban scenarios, suggesting that despite envisioning an urban environment, to some participants elements of nature still played a role in their imagery.

Figure 2

Comparative Boxplot of Perception and Subjective Experience Post Intervention for both Conditions



Discussion

As for the role of various covariates, the significant positive correlation between mindfulness and nature connectedness suggests individuals with higher mindfulness levels tend to feel more connected to nature. This finding aligns with previous research by (Hanley et al., 2017; Macaulay, et al., 2022) which demonstrated that mindfulness has partial associations with nature connectedness. However, contrary to prior research (Koivisto & Grassini, 2022; Macaulay, 2022) it is notable that our study did not find a similar mediating effect on the intervention effect, indicating that while mindfulness and nature connectedness are related, their influence on craving reduction might differ from their influence on psychological well-being. Furthermore, a significant negative correlation was observed between vividness of imagination and trait craving suggesting that participants with higher vividness of imagination scores tended to have lower trait craving scores. Minimal relationships and no significant moderation effects were found between the treatment effects and the other covariates, with correlations ranging from $r = -.22$ to $.09$. These results are in line with the findings of Nguyen and Brymer (2018), who reported similarly small correlations.

The first hypothesis posited that post-intervention state craving levels would be significantly lower than pre-intervention levels across both GI conditions, which was supported by the study's findings. From a theoretical standpoint, the results of hypothesis 1 can be connected to the Elaborated Intrusion (EI) Theory (Kavanagh et al., 2005; May et al., 2015), which posits that cravings are initially triggered by intrusive thoughts that can be elaborated upon through mental imagery. By engaging in the top-down process of guided imagery, participants may have blocked these intrusive thoughts and therefore reduced craving intensity. Additionally, the cognitive defusion theory supports this mechanism, suggesting that GI can help individuals distance themselves from their cravings, reducing their impact (Missbach et al., 2015; Schumacher et al., 2018, 2019).

Results also supported the second hypothesis, which proposed that nature-based GI sessions would result in a significantly greater reduction in state craving compared to urban-based GI sessions. This finding is consistent with previous studies showing the superior effects of nature exposure over urban settings in reducing anxiety (Nguyen & Brymer, 2018), enhancing nature connectedness (Coughlan et al., 2022) and promoting positive psychological outcomes (Koivisto & Grassini, 2022). Macaulay et al. (2022) provide a theoretical framework that may explain the superior efficacy of nature specifically, proposing that mindfulness practices enhance perceptual sensitivity, decentering, and nonreactivity enabling individuals to derive greater benefits from natural settings. Another possible explanation for the superior effect of nature-based GI is provided by the Stress Reduction Theory (SRT) (Ulrich, 1983), which suggests that nature automatically elicits positive affects in humans, leading to stress reduction and relaxation. This study's results indicate that even the mere imagination of nature can produce positive affects.

The sensitivity analysis further supported both hypotheses, showing similar trends in craving reduction in the binge eating and bulimia nervosa subgroup, with more pronounced changes in craving reduction. This trend was interestingly consistent across other diagnostic categories, even when participants with anorexia nervosa were included, despite their lower baseline levels of craving.

Data on the participants' perceptions show that the nature condition was generally perceived more positively, with no participants rating nature below neutral and generally higher positive scores in the nature condition. This finding supports the decision that was made beforehand to introduce the nature condition first, as there was concern that starting with the urban condition might reduce participation rates. Interestingly, in the qualitative data, natural elements were often mentioned even in urban imaginations, suggesting that nature could be an easier and/or more positive environment to envision.

However, this might also be attributed to a training effect since the nature condition was administered first.

This study is the first to explore the use of nature-based GI as an intervention for state craving in patients with eating disorders. Given that nature-based GI can be practiced independently outside of therapy sessions, it offers a valuable addition to current therapeutic approaches and provides a promising addition to prevention strategies and mindfulness programs.

Limitations and Recommendations for Future Research

One constraint in the present study was the absence of a control group due to the limited number of eligible participants within the required timeframe. Future studies could include a control group, such as one engaging in a mind-wandering task similar to Hamilton et al. (2013), who reported that cravings increased during a mind-wandering, to validate these findings. Additionally, manipulation checks could be included to ensure participants' experiences align with the intended GI exercises.

Another limitation was the potential priming effect from the mindfulness group sessions participants attended before the intervention. This prior exposure to mindfulness practices might have influenced the initial levels of craving and their responses to the GI exercises, potentially affecting the study's outcomes.

This study did not employ randomization in the order of the interventions, following recommendations from the recruiting institution and specific considerations for the patient population. This decision aimed to minimize potential stressors by starting with the less confrontational nature-based imagery, deemed more likely to foster positive engagement and compliance. The perception data supported this approach, which generally received higher positive scores. However, this non-randomized design introduces potential biases and carry-over effects, where participants might have become more

accustomed to the intervention over time, possibly diminishing the urban condition's effect. Future studies should employ a randomized design to evaluate these effects more robustly.

The study also focused on the immediate effects of the GI experience on state craving, leaving the long-term impacts on trait craving unexplored. Furthermore, participants were mainly from Vienna, limiting the generalizability of the findings. Including participants from diverse regions and landscapes could provide insights into the influence of different environmental contexts on GI.

Conclusion

This study demonstrated that guided imagery (GI) interventions significantly reduce state craving levels in individuals with eating disorders, with nature-based GI proving more effective than urban-based sessions, especially for those with bulimia nervosa or binge eating disorder. These results align with existing literature on GI's role in psychological well-being (Coughlan et al., 2022; Koivisto & Grassini, 2022; Nguyen & Brymer, 2018) and craving reduction, (Giacobbi et al., 2018; Hamilton et al., 2013) and theoretical frameworks like the Elaborated Intrusion Theory (Kavanagh et al., 2005; May et al., 2015) and cognitive defusion (Schumacher et al., 2018, 2019). Additionally, participants' positive perceptions of nature-based GI and the practical advantages of this approach highlight its potential as a valuable addition to existing therapeutic and preventive strategies for managing cravings in eating disorder populations. This study adds to the growing evidence of nature's psychological benefits, advocating for its integration into therapeutic practices. While the study provides evidence for the efficacy of nature-based GI in reducing cravings, it also highlights the need for further research to confirm and extend these findings.

Ethic Statement

This study was conducted in accordance with the recommendations of the University of Vienna's research ethics guidelines. The protocol received approval from the ethics committee of the University of Vienna prior to data collection.

Declarations of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix A

Appendix A

Guided Imagery Script

<u>Entspannungsinstruktion</u>		
~1:30 min	Setzen sie sich gemütlich hin und machen Sie es sich bequem... Schließen Sie die Augen... und richten Sie Ihre Aufmerksamkeit auf meine Stimme... Lassen Sie die Gedanken kommen und gehen... Alle Anspannung fällt von Ihnen ab... und tiefe Ruhe durchströmt den ganzen Körper... Die Arme...angefangen von den Schultern... bis vor in die Hände und die Finger ... sind ganz locker ... und gelöst... Die Beine...bis hin zu den Füßen... sind ganz locker...und gelöst... Der Atem ist ruhig... ganz ruhig... tief und gleichmäßig... Nun richten Sie den Blick nach innen... Und stellen sich eine Natur/Stadtlandschaft vor... *Natur Gruppe:* Eine ruhige, natürliche Umgebung mit viel unberührter Natur... *Stadt Gruppe:* Ein lebhaftes, städtisches Zentrum mit vielen Straßen und Gebäuden... Es muss kein Ort sein, den Sie kennen oder besucht haben...	<u>Langsam</u> <u>und ruhig</u>
Gesamt ~1:30 min	Und achten sie darauf was sie Sehen...Riechen... Schmecken... Hören...oder Spüren können...	<u>Lange</u> <u>Pause</u>
<u>Erkundung:</u>		
~8:00 min	Lassen Sie sich dabei Zeit, bis sie die Umgebung vor Augen haben. ... Werfen Sie einen genauen Blick um sich... Sehen Sie sich an diesem Ort um und betrachten Sie die Umgebung... die Farben, die Strukturen... Werden sie sich allem bewusst, was sie sehen können... Wie ist diese Umgebung?...	<u>Langsam</u> <u>und ruhig</u> <u>Lange</u> <u>Pause</u>

Wie sieht der Himmel aus?...

Welche Tageszeit... und Jahreszeit ist es?...

Nehmen Sie wahr, wie sich die Luft anfühlt: Ist sie kühl oder warm? ...

Gibt es einen Luftzug oder ist es windstill? ...

Können Sie etwas riechen?...

Lange
Pause

Nehmen Sie sich einen Moment Zeit, um einen der Gerüche in dieser Umgebung wahrzunehmen...

Was ist das für ein Geruch?...

Gibt es Geräusche, die Sie um sich herum hören können?...

Hören sich diese Geräusche nah oder fern an?...

Wie hört sich das an?...

Wo sind Sie in dieser Umgebung?...

Wie spürt sich das an?...

Wie sieht der Boden aus, auf dem Sie sich befinden?...

Lange
Pause

Während Sie schauen, werden Sie sich bewusst, wie sich die Dinge an diesem Ort anfühlen könnten...

Nehmen Sie sich einen Moment Zeit und beginnen Sie, diesen Ort mit Ihrem Tastsinn zu erforschen...

Wie machen Sie das?...

Konzentrieren Sie sich nun auf eine Sache und betrachten Sie sie aufmerksam aus der Nähe... Wie sieht die Form aus? . . . Die Farbe? . . . Wie groß/ bzw klein?

Wenn Sie mögen, berühren Sie es vorsichtig...

Wie fühlt sich die Beschaffenheit der Oberfläche an?...

Gibt es etwas, was sie tun möchten?...

Welche Gefühle löst das bei Ihnen aus?...

Wo spüren sie das?...

Nun sehen sie die Umgebung nochmal aus einer entfernten Perspektive...

Gibt es etwas, was sie dort noch tun wollen?...

Lange
Pause

Tun sie das, was sie dort tun wollen...

Was macht das mit Ihnen?...

Lange
Pause

Lassen sie sich Zeit und versuchen sie es mit allen Sinnen wahrzunehmen...

Gesamt
~9:30 min

Wie fühlt sich das für sie an?...

Abschluss:

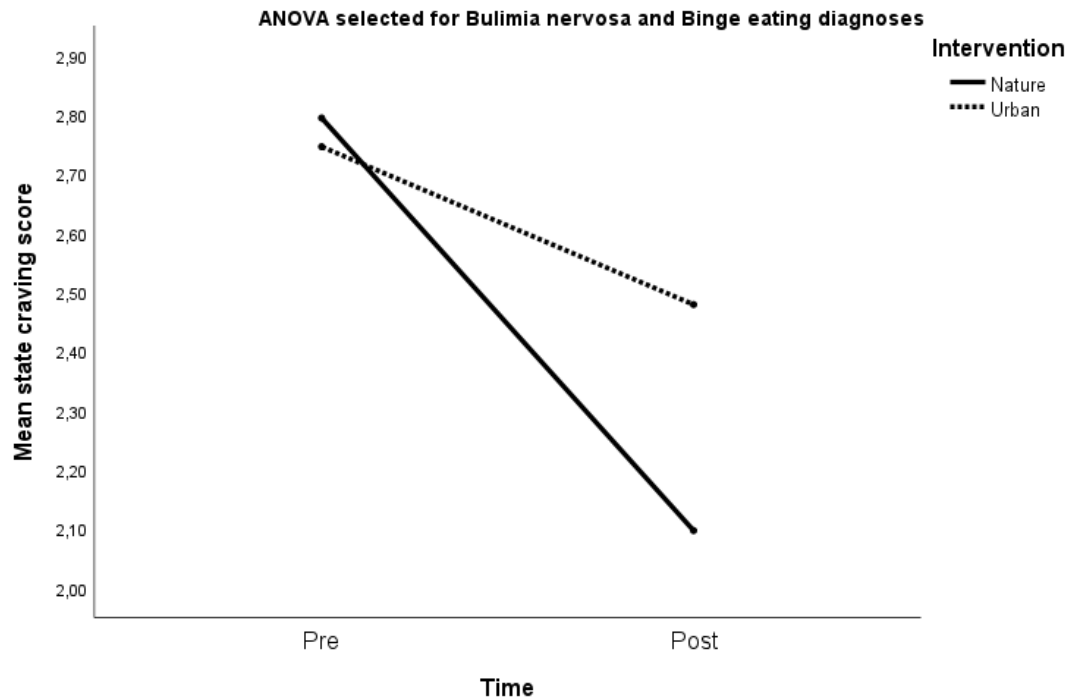
~30 sec	Nun gehen Sie in ihrer Vorstellung noch etwas weiter zurück, betrachten Sie die Umgebung mit etwas mehr Abstand und konzentrieren Sie sich auf das Gefühl das sie jetzt erleben...	<u>Lange Pause</u>
	Verweilen Sie noch einen Moment in dieser Umgebung...	
	Und Lassen Sie die Eindrücke auf sich wirken...	<u>Stimme langsam wieder mehr dynamisch</u>
	Wenn Sie bereit sind ... lassen sie die Bilder langsam wieder verblassen...	
Gesamt ~10:00 min	Öffnen Sie langsam die Augen und kehren Sie in den gegenwärtigen Moment zurück.	

Appendix B**Table B1***Post Hoc Comparisons - Intervention x Time*

		95% CI for Mean Difference			95% CI for Cohen's d					
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p _{bonf}
Nature, Pre	Urban, Pre	0.12	-0.16	0.42	0.10	1.18	0.18	-0.25	0.62	1.00
	Nature, Post	0.58	0.31	0.86	0.10	5.83	0.87	0.37	1.36	< .001
	Urban, Post	0.37	0.01	0.72	0.13	2.85	0.55	-0.01	1.10	0.03
Urban, Pre	Nature, Post	0.45	0.10	0.81	0.13	3.53	0.68	0.11	1.25	0.00
	Urban, Post	0.24	-0.03	0.51	0.10	2.41	0.36	-0.06	0.78	0.11
Nature, Post	Urban, Post	-0.21	-0.51	0.08	0.10	-1.99	-0.32	-0.76	0.12	0.30

Figure B1

ANOVA: Changes in State Craving over Time for both Intervention Conditions for the Combined Diagnostic Categories Binge Eating and Bulimia Nervosa (N = 22)

**Table B2**

Post Hoc Comparisons - Intervention $\times$ Time for the Combined Diagnostic Categories Binge Eating and Bulimia Nervosa

		Mean Difference	95% CI for Mean Difference		SE	t	Cohen's d	95% CI for Cohen's d		p _{bonf}
			Lower	Upper				Lower	Upper	
Nature, Pre	Urban, Pre	0.05	-0.27	0.37	0.11	0.42	0.07	-0.39	0.53	1.00
	Nature, Post	0.69	0.30	1.09	0.13	4.99	1.01	0.30	1.72	< .001
	Urban, Post	0.31	-0.12	0.75	0.15	1.98	0.46	-0.21	1.13	0.32
Urban, Pre	Nature, Post	0.64	0.20	1.09	0.15	4.07	0.94	0.18	1.70	0.00
	Urban, Post	0.26	-0.12	0.66	0.13	1.91	0.38	-0.19	0.97	0.39
Nature, Post	Urban, Post	-0.38	-0.70	-0.05	0.11	-3.31	-0.55	-1.08	-0.03	0.01

Table B3*Qualitative Results put into Themes post Nature Intervention*

Theme	Sub-category	Example quotes
Mountain landscapes	Mountains and Hills	„Alm mit Bauernhaus, Löwenzahn, Frühlingswiese, Berglandschaft, Bewölkter Himmel“; „Italien in den Hügeln und wandern“; „Schafberg, Freunde“;
	Mountain with other landscape	“Berge und ein Gipfelkreuz und einen Fluss“;
Water landscapes	Beach	„Meer und Strand und Kokosnüsse“; „Meer, Felsen, Natur, Sand, Winterluft, viele Pflanzen, Schilf“
	Body of water (river, lake, ocean)	“Klippe am Meer“; „Meer & Wüste, Kitesurfen“; „Meer, Sonne“, „Meer, Delphine, Fische, Wal“;
	Water with other landscapes	“Donauinsel“, “ Teiche, Wald, Wiese“;
Meadows	Meadows	“Eine Blumenwiese auf der ich als Kind oft mit meiner Schwester gespielt habe“; „Sternenhimmel, Picknickdecke, Wiese mit Gänseblümchen“; „Wiese mit Gänseblümchen, Picknickdecke, rosa Himmel, Bäume, Himbeerstrauch“, „Wiese, Blumen“, „Wiesen“
	Meadows with other landscapes	“Einen Blumenwiese und einen Waldrand mit Vögel“; „Große weite Wiese, Berandet mit Wäldern in weiteren Ferne Berge, Frühling, kühler Wind, Hund, Wolken, Sonne“, „Grüne Wiese, Wald, Sommer“, Wechselnd Wiese und so Kornfelder“;
Forrest landscapes	Forrest	“Lichtung im Wald, Walderdbeere“; “Wald, Holz überall“;
	Forrest with other landscapes	„Bach im Wald, hohe Bäume, Sonnenlicht, gelbe Blumen“, „Blumenwiese im Wald“, „Wald, mit Bach“, „Kleiner Bach im Wald“, „Wald-Lichtung-Blumenwiese-Sonniger Morgen-Frühling-viele Blumen-Schmetterlinge-Vögel-Stille“;
Urban Nature	Garden	“Eigener vorgestellter Garten“, “Garten meiner Eltern, Baum“

Table B4*Qualitative Results put into Themes post Urban Intervention*

Theme	Sub-category	Example quotes
Home	Apartment	„Mein eigenes Zimmer“
Foreign city/county		„Barcelona“; „Italien“; „Kleine nordische Stadt, Amsterdam“; „kleine Stadt in Norwegen oder so irgendwas nördliches“; „Salzburg Stadt“
Urban social	Café	„Café sitzen, sonnig, Kaffee trinken“
	City	„bunte Wohnhäuser, Hochhäuser, Busse, Auto, Stadt von Oben“; „ganz kleine Häuser“; „Großstadt“; „Hochhaus, bunte kleinere Häuser, rosa Himmel, Parkbank, Laterne“; „Innenstadt, ruhige Parkbank“; „Sonne, Häuser, Wolken“; „Stadt“; „Stadt, ein Brunnen in der Mitte, viele Menschen“; „Stadtlandschaft, Bauarbeiten, hohe Häuser, viele Menschen, alles sehr grau, angenehme Hitze, kaputte Straßen“; „Wien Innenstadt“
	Shopping center/Shops	„Geschäfte, Bäckerei, Eisladen, Würstelstand“; „Hochhäuser, Geschäfte“ „Markt, Baum“; „Stadt im 18.Jh, Herbstmorgen; Marktplatz“; „viele Geschäfte, Einkaufszentrum, Eis, Sommer“; Einkaufszentrum, mit Bäumen
	Street	„Dunkle Straße mit Bäumen“; „Straßen“; „ruhige Straße, keine Menschen“;
Urban nature	Nature	„Schöne Alee“
	Urban and Nature combined	„Brunnen in Stadt Umgebung“; „Donaukanal“; „Einkaufszentrum, mit Bäumen“; Straße mit Graffiti, Bäume und Büsche“; „Dunkle Straße mit Bäumen“