Supplementary materials

Three-Level Coding Process

1. Open Coding

Tool: ATLAS.ti 22.0 (ATLAS.ti Scientific Software Development GmbH).

Steps:

Data Preparation:
Transcribed 32 semi-structured interviews (45–60 minutes each) into 80,000 words of text.
Imported transcripts into ATLAS.ti and anonymized participant identifiers (e.g., P01, P02).
Initial Concept Extraction:
Highlighted key phrases reflecting participants' perceptions (e.g., *"I felt completely detached from reality"*).
Generated **280 initial codes** (e.g., "Detachment from Reality," "Visual Realism").
Concept Refinement:
Merged overlapping codes (e.g., "Calmness" and "Inner Peace" → "Calmness").
Removed codes mentioned fewer than twice (e.g., "Fear of Heights").
Finalized **78 non-redundant initial concepts**.

Examples below

Example Raw Statement	Initial Concept	Main Category
"I felt physically and mentally relaxed"	Soothing Effect	VRRE Appeasement
"The environment felt highly realistic"	Visual Realism	VRRE Immersion

2. Axial Coding

Objective: Identify relationships between concepts and group them into higher-order categories.
Method: Thematic clustering based on environmental psychology theories (e.g., ART, SRT).
Steps:

a) **Cluster Analysis**:
Grouped 78 initial concepts into 14 main categories using ATLAS.ti's network view. (e.g., "VRRE Appeasement" includes "Calmness" and "Soothing Effect").

b) **Theoretical Validation:**
Cross-referenced clusters with existing frameworks (e.g., Kaplan's *Attention Restoration Theory*).

Revised categories to resolve contradictions (e.g., merged "Achievement" and "Encouragement" into **"VRRE Support"**).

Outcomes:

Main Category	Initial Concepts Included
VRRE Immersion	Presence, Sensory Immersion, Visual Realism
VRRE Support	Achievement, Encouragement, Optimism

3. Selective Coding

Objective: Synthesize main categories into core theoretical constructs.
Steps:

a) **Core Category Formation**:
Identified **5 core categories** representing overarching themes:

VRRE Appeasement, VRRE Support, VRRE Immersion, VRRE Aesthetic Appeal, VRRE Conceivability.

b) **Theoretical Integration**:

Mapped relationships between core categories (e.g., *"Immersion mediates the effect of Aesthetic Appeal on Stress Reduction"*).

Developed a **theoretical model** (Figure 1 in the main text) using ATLAS.ti's conceptual mapping tool.

Final Framework:

Core Category	Main Categories Included
VRRE Immersion	Presence, Detaching from reality, Visual Realistic
VRRE Conceivableness	Association, Storytelling

Data Saturation Test Methodology

Sample Allocation: Reserved 10% of samples (3 transcripts) for theoretical saturation testing.

Result: No new concepts or categories emerged, confirming saturation.

Full Reliability and Validity Results

1. Reliability Analysis

Overall Cronbach's α: 0.615 (meets threshold > 0.6).

Latent Variable Reliability:

Latent Variable	Cronbach's α
VRRE Appeasement	0.657
VRRE Immersion	0.855

2. Validity Analysis

a) **KMO Value**: 0.685; Bartlett's Test: $p < 0.001$.

b) **Factor Loadings** (partial):

Observed Variable	Standardized Loading
A1 Calmness	0.790
A8 Visual Realism	0.870

Appendix 1

Methods of testing used in the experiments

Schulte Square

12	22	16	21	18
25	11	4	19	13
17	23	20	9	1
24	10	14	2	3
15	6	8	5	7

Click on the number from 1 to 25

Start

Time 00:00.00

Positive and Negative Affection Scale

This scale consists of 20 words describing feelings. Please check the answer that most closely matches your current feelings in each of the following five options:

1. Not at all 2. A little 3. Moderate 4. Strongly 5. Very strongly

PA Items	1	2	3	4	5	NA Items	1	2	3	4	5
Enthusiastic						Scared					
Interested						Afraid					
Determined						Upset					
Excited						Distressed					
Inspired						Jittery					
Alert						Nervous					
Active						Ashamed					
Strong						Guilty					
Proud						Irritable					
Attentive						Hostile					

VRRE Evaluation System

Please rate the virtual reality environment you have just experienced based on your actual situation.

1. Very Weak 2. Weak 3. Moderate 4. Fair 5. Strong 6. Very Strong 7. Excellent

Core categories	Main categories	Score
VRRE appeasement	A1 sense of calm	
	A2 sense of soothing Spirituality	
VRRE supportiveness	A3 sense of optimism	

	A4 sense of accomplishment
	A5 sense of encouragement
VRRE immersion	A6 sense of presence
	A7 sense of detaching from reality
	A8 sense of visually realistic
	A9 sense of spatial existence
VRRE aesthetic appeal	A10 openness of vision
	A11 layer & composition
	A12 depth & proportion
VRRE conceivableness	A13 sense of association
	A14 sense of storytelling

Appendix 2

Participants' descriptive characteristics

Items	Mean±SD or n%						
Environment type	Sum	Forest	Grassland	Tundra	Desert	Water	Space
Sample size	88	18	14	14	14	14	14
Age	22±2	22±2	22±2	22±2	22±2	22±2	21±2
Gender	—	—	—	—	—	—	—
Female	22 (44)	5 (9)	3 (7)	3 (7)	4 (7)	4 (7)	3 (7)
Male	22 (44)	4 (9)	4 (7)	4 (7)	3 (7)	3 (7)	4 (7)
Major	—	—	—	—	—	—	—
Architecture	10 (44)	2 (10)	1 (10)	2 (10)	2 (10)	2 (10)	1 (10)
Urban & Rural Planning	8 (44)	2 (8)	1 (8)	1 (8)	1 (8)	1 (8)	2 (8)
Landscape Architecture	8 (44)	2 (8)	2 (8)	1 (8)	1 (8)	1 (8)	1 (8)
Digital Media and Technology	6 (44)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)
Design	6 (44)	1 (6)	1 (6)	1(6)	1 (6)	1 (6)	1 (6)
Building Thermal Engineering	6 (44)	1 (6)	1 (6)	1(6)	1 (6)	1 (6)	1 (6)

Appendix 3

Personal Information and General Health Questionnaire

This two-part questionnaire is designed to collect basic information and current self-assessment of your health. Any information collected will be used for academic research only, and will be kept strictly confidential, so please feel free to answer the questionnaire.

Part 1

Age:
Major:
Grade:

Part 2
Please check the option that best matches your current feelings in each of the following five categories:
1. Strongly Agree 2. Agree 3. Moderate 4. Disagree 5. Strongly Disagree

Items		Score
Anxiety and depression	Felt constantly under strain	
	Feeling unhappy and depressed	
	Lost sleep over worry	
	Couldn't overcome difficulties	
Social Dysfunction	Feeling reasonably happy	
	Playing a useful part	
	Capable of making decisions	
	Able to face problems	
	Able to enjoy day-to-day activities	
	Able to concentrate	
Loss of Confidence	Losing confidence	
	Thinking of self as worthless	

Appendix 4

The optimal VRRE of specific recovery effect

Table A4-1
The best VRRE for the psychological recovery effect of students in different majors

Major	Overall Recovery	Attention	Affection	Stress
Architecture	Flatland	Broad-leaf Forest	Coniferous Forest	Coniferous Forest
Urban & rural planning	High-altitude Permafrost	High-altitude Permafrost	High-altitude Permafrost/Flatland	Terrestrial Space
Landscape architecture	Extraterrestrial Space	Sandy Desert	Sandy Desert	Extraterrestrial Space
Other majors	Coniferous Forest	Flatland	Flatland	Extraterrestrial Space

Table A4-2
The best VRRE for the psychological recovery effect of students in different grades

Grade	Overall Recovery	Attention	Affection	Stress
Undergraduate	Extraterrestrial Space	High-altitude Permafrost	Highland	Extraterrestrial Space
Postgraduate	Terrestrial Space	Stony Desert	Flatland	Terrestrial Space

Table A4-3
The best VRRE for the psychological recovery effect of students with different health self-assessment status

Self-assessment	Overall Recovery	Attention	Affection	Stress
Health	Terrestrial Space	Stony Desert	Highland	Terrestrial Space
Anxiety and Depression	Extraterrestrial Space	Coastal Water	mixed forest	Extraterrestrial Space
Social dysfunction	Extraterrestrial Space	Extraterrestrial Space	mixed forest	Extraterrestrial Space
Loss of confidence	Coastal Water	Stony Desert	Highland	Coastal Water
Anxiety and Depression & Social dysfunction	Extraterrestrial Space	Extraterrestrial Space	mixed forest	Extraterrestrial Space
Anxiety and Depression & Loss of confidence	Coastal Water	Stony Desert	Highland	Coastal Water

Appendix 5

Test and analysis results of structural equation model data

Table A5-1
Factor Loadings

Latent variables	Observed Variables	Standardized Regression Weights
VRRE appeasement	A1 sense of calm	0.790
	A2 sense of soothing Spirituality	0.628
VRRE supportiveness	A3 sense of optimism	0.819
	A4 sense of accomplishment	0.695
	A5 sense of encouragement	0.732
VRRE conceivableness	A6 sense of association	0.656
	A7 sense of storytelling	0.783
VRRE immersion	A8 sense of presence	0.768
	A9 sense of detaching from reality	0.703
	A10 sense of visually realistic	0.870
	A11 sense of spatial existence	0.777
VRRE aesthetic appeal	A12 openness of vision	0.681
	A13 layer & composition	0.959
	A14 depth & proportion	0.861

Table A5-2
Indices of Fit

χ^2	df	p	CMIN	GFI	RMSEA	CFI	NNFI	SRMR	TLI	IFI
-	-	>0.05	<3	>0.8	<0.08	>0.9	>0.9	<0.1	>0.9	>0.9
119.636	111.000	0.271	1.078	0.843	0.035	0.977	0.968	0.073	0.968	0.979

Table A5c
Model regression coefficient

Factor (Latent variables)	→	Analysis items (Observed Variables)	Coef.	Std. Estimate	Std. Error	Z	P
VRRE appeasement	→	Attention	0.048	0.621	0.017	2.801	0.005***
VRRE supportiveness	→	Attention	-0.014	-0.164	0.014	-0.987	0.324
VRRE conceivableness	→	Attention	0.039	0.497	0.016	2.449	0.014**
VRRE immersion	→	Attention	0.028	0.370	0.011	2.457	0.014**
VRRE aesthetic appeal	→	Attention	0.019	0.340	0.008	2.314	0.021**
VRRE appeasement	→	Affection	0.671	0.201	0.711	0.943	0.346
VRRE supportiveness	→	Affection	1.540	0.431	0.738	2.086	0.037**
VRRE conceivableness	→	Affection	0.341	0.100	0.723	0.471	0.638
VRRE immersion	→	Affection	1.709	0.519	0.616	2.772	0.006***
VRRE aesthetic appeal	→	Affection	0.094	0.039	0.430	0.218	0.827
VRRE appeasement	→	Stress	0.343	0.196	0.345	0.994	0.320
VRRE supportiveness	→	Stress	0.595	0.318	0.354	1.680	0.093*

VRRE conceivableness	→ Stress	0.735	0.410	0.382	1.923	0.054*
VRRE immersion	→ Stress	0.345	0.200	0.294	1.173	0.241
VRRE aesthetic appeal	→ Stress	0.553	0.441	0.211	2.626	0.009***

Note: ***, ** and * represent significance levels of 1%, 5% and 10% respectively