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Pathways and Health Benefits of Biodiversity Perception: An Audio–Visual Collaboration Study

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Supplementary Table 1: Summary of average values for subjective perceptions, audio–visual environmental factors, and objective environmental indicators at each sampling point

Survey point	BP				PR	Visual elements			Actual biodiversity	Soundscape elements		
	PP	IP	BPc	HP	PR	GVI	SVF	BVI	SR	NS	MS	AS
1	2.87	2.29	1.93	2.63	3.00	0.46	0.10	0.14	11.25	0.48	0.39	0.13
2	2.86	2.43	2.26	2.89	3.19	0.58	0.08	0.13	8.25	0.59	0.29	0.12
3	2.84	2.46	2.41	2.96	3.49	0.43	0.13	0.10	7.50	0.55	0.22	0.23
4	2.75	2.39	2.56	2.70	2.96	0.42	0.09	0.11	8.50	0.58	0.29	0.14
5	2.56	2.33	2.21	2.63	2.94	0.44	0.09	0.11	7.75	0.27	0.37	0.36
6	2.76	2.45	2.24	2.81	3.17	0.45	0.10	0.11	5.25	0.38	0.35	0.27

7	2.68	2.44	2.52	2.83	3.23	0.24	0.15	0.10	5.25	0.50	0.19	0.31
8	2.56	2.38	2.13	2.60	2.96	0.35	0.10	0.09	6.50	0.41	0.35	0.24
9	3.11	2.56	2.13	2.99	3.46	0.56	0.08	0.09	9.50	0.27	0.40	0.34
10	3.11	2.69	2.24	3.13	3.58	0.66	0.08	0.11	6.25	0.31	0.29	0.40
11	3.13	2.83	2.61	3.26	3.78	0.50	0.13	0.08	6.50	0.40	0.27	0.33
12	3.03	2.64	2.12	2.85	3.30	0.61	0.09	0.12	8.00	0.30	0.27	0.42
13	3.23	3.36	2.36	3.09	3.66	0.55	0.07	0.08	11.75	0.40	0.44	0.16
14	3.53	3.53	2.71	3.49	3.98	0.66	0.06	0.06	7.00	0.63	0.23	0.14
15	3.56	3.42	2.82	3.65	4.23	0.53	0.12	0.08	7.75	0.61	0.34	0.06
16	3.47	3.29	2.43	3.38	3.81	0.58	0.08	0.07	9.75	0.46	0.35	0.19
17	3.12	2.58	2.19	3.03	3.45	0.57	0.11	0.06	10.00	0.52	0.28	0.19
18	2.84	2.49	2.24	2.70	3.38	0.38	0.16	0.08	7.50	0.42	0.35	0.23
19	3.16	2.81	2.20	2.90	3.39	0.59	0.10	0.04	8.25	0.50	0.21	0.29
20	2.83	2.84	2.70	3.15	3.34	0.53	0.09	0.05	10.25	0.65	0.23	0.12
21	2.58	2.56	2.52	2.89	3.39	0.39	0.09	0.04	6.75	0.34	0.36	0.31
22	2.64	2.58	2.30	2.85	3.23	0.26	0.15	0.08	4.00	0.38	0.20	0.42
23	2.74	2.63	2.50	2.80	3.19	0.53	0.11	0.04	5.50	0.39	0.26	0.35
24	2.84	2.79	2.55	2.98	3.36	0.40	0.12	0.04	7.25	0.40	0.34	0.26
25	3.40	3.18	2.63	3.39	3.94	0.69	0.11	0.03	8.00	0.41	0.34	0.25
26	3.00	2.70	2.38	3.01	3.63	0.48	0.16	0.07	5.50	0.44	0.27	0.29
27	3.33	3.08	2.63	3.14	3.68	0.68	0.09	0.03	6.50	0.26	0.37	0.38
28	3.39	3.23	2.58	3.30	3.66	0.55	0.07	0.02	8.50	0.18	0.36	0.46
29	3.51	3.55	3.01	3.73	4.22	0.70	0.07	0.04	9.25	0.48	0.23	0.29
30	3.25	3.31	2.59	3.33	3.79	0.49	0.12	0.07	6.50	0.52	0.35	0.13
31	3.26	3.29	2.59	3.33	3.78	0.66	0.08	0.03	7.50	0.51	0.36	0.13
32	3.46	3.64	2.89	3.51	3.79	0.59	0.09	0.03	10.25	0.56	0.30	0.14
33	3.02	2.59	2.29	2.80	3.36	0.68	0.06	0.07	11.75	0.62	0.25	0.13
34	2.76	2.52	2.49	2.76	3.17	0.58	0.07	0.12	14.25	0.66	0.16	0.18
35	2.89	2.53	2.38	2.93	3.48	0.53	0.10	0.10	9.50	0.51	0.31	0.19
36	2.90	2.61	2.54	3.11	3.61	0.60	0.09	0.08	9.75	0.54	0.20	0.26
37	2.66	2.52	2.18	2.64	3.20	0.45	0.07	0.07	7.25	0.36	0.33	0.31
38	2.47	2.21	1.80	2.48	2.83	0.54	0.09	0.11	9.75	0.20	0.32	0.48
39	2.49	2.21	1.86	2.54	3.14	0.45	0.10	0.09	6.25	0.48	0.25	0.27
40	2.61	2.51	2.38	2.89	3.34	0.45	0.13	0.09	6.25	0.60	0.17	0.22
41	3.14	2.91	2.51	3.14	3.71	0.72	0.07	0.04	9.00	0.34	0.26	0.40
42	2.93	2.73	2.15	2.88	3.21	0.62	0.07	0.08	11.50	0.32	0.31	0.37
43	3.01	2.76	2.40	3.08	3.60	0.57	0.09	0.09	7.75	0.41	0.24	0.35

44	3.00	2.80	2.38	3.16	3.57	0.64	0.12	0.08	7.50	0.32	0.28	0.40
45	3.21	3.03	2.36	3.31	3.88	0.73	0.09	0.03	10.00	0.43	0.40	0.17
46	2.98	3.12	2.34	3.04	3.49	0.59	0.05	0.11	13.50	0.50	0.30	0.20
47	3.16	3.11	2.67	3.19	3.81	0.58	0.09	0.09	8.75	0.50	0.38	0.12
48	3.38	3.48	2.85	3.59	4.07	0.66	0.10	0.09	9.00	0.46	0.43	0.11
49	2.97	2.81	2.36	2.91	3.42	0.62	0.06	0.04	10.75	0.66	0.17	0.17
50	2.65	2.23	1.73	2.55	3.01	0.47	0.05	0.13	13.00	0.49	0.32	0.19
51	2.54	2.20	1.75	2.45	2.99	0.58	0.07	0.04	11.00	0.59	0.31	0.10
52	2.72	2.45	2.14	2.80	3.26	0.83	0.04	0.07	8.50	0.56	0.29	0.15
53	2.81	2.63	2.13	2.73	3.36	0.67	0.04	0.04	7.00	0.46	0.32	0.22
54	2.07	2.01	1.80	2.19	2.79	0.24	0.06	0.10	8.50	0.26	0.50	0.23
55	2.34	2.23	1.96	2.35	2.99	0.48	0.07	0.07	6.50	0.39	0.35	0.26
56	2.41	2.25	1.89	2.55	3.10	0.57	0.09	0.05	5.75	0.28	0.34	0.38
57	3.08	2.93	2.37	3.18	3.78	0.75	0.03	0.05	8.75	0.35	0.40	0.26
58	2.73	2.56	1.93	2.74	3.30	0.57	0.06	0.10	10.25	0.29	0.38	0.33
59	2.79	2.71	2.23	2.75	3.29	0.60	0.07	0.04	8.25	0.39	0.30	0.31
60	2.74	2.64	2.04	2.78	3.26	0.71	0.02	0.07	6.75	0.33	0.23	0.45
61	3.37	3.54	2.78	3.44	3.96	0.72	0.04	0.06	10.75	0.61	0.25	0.14
62	3.03	3.31	2.38	3.10	3.74	0.61	0.07	0.23	12.00	0.45	0.46	0.09
63	3.04	3.43	2.54	3.15	3.68	0.63	0.06	0.05	9.75	0.59	0.32	0.09
64	3.34	3.60	2.81	3.45	3.89	0.65	0.02	0.04	8.00	0.57	0.27	0.16
Mean	2.95	2.78	2.35	2.98	3.46	0.56	0.09	0.08	8.52	0.45	0.31	0.25
SD	0.32	0.42	0.29	0.33	0.34	0.12	0.03	0.04	2.13	0.12	0.07	0.11

Supplementary Table 2: Questionnaire content, scale of questionnaire, and indicators of Experiment 1

Questionnaire	Question description	Scale
I	NA1: I value natural environments because they are visually pleasing. NA2: I value natural environments because I enjoy the changes in seasons. NA3: I value natural environments because they make me feel better. NA4: I value natural environments because they give me more opportunities to connect with nature. NA5: I value natural environments because they are lively and beautiful. NA6: I find natural environments troublesome because they are a source of harmful wildlife (they are dirty). (R) NA7: I find natural environments burdensome because they are difficult to maintain (e.g., fallen leaves). (R)	5 Likert (strongly disagree—strongly agree)

	NR1: Nature and the environment contribute to my spiritual life. NR2: My connection with nature is an important part of who I am. NR3: I feel a strong connection to all living things on Earth. NR4: My ideal vacation spot is a remote wilderness area. NR5: I always think about how my actions affect the environment. NR6: Wherever I am, I notice wildlife.	5 Likert (strongly disagree—strongly agree)
	1. How would you rate your knowledge level of biodiversity? 2. What do you think is included in the concept of biodiversity? 3. Ecological balance refers to the (?) of biological populations. 4. A habitat is a specific place where organisms live and reproduce. Which of the following is a type of habitat? 5. Which of the following conditions does a habitat primarily provide for organisms to survive? 6. What type of water body is Donghu at Zhejiang A&F University? 7–14. Image selection questions-see attachment)	A, B, C, D (there is one that is correct)
II	PI1: I really like this place and look forward to returning in the future. PI2: This place helps me think more clearly, feel mentally refreshed, and more connected to nature. PI3: Compared to other places, this place has many advantages, reflects my character, and makes me feel proud of it. PI4: This place holds many unforgettable memories, and it feels like a part of me. After leaving, I always miss it.	5 Likert (strongly disagree—strongly agree)
	PI5 (PR): Preference score	5 Likert (strongly disagree—strongly agree)
	BP1 (PP): Plant richness, plant abundance	Anchoring method (< 10, 10–30, 31–50, 51–100, > 100)
	BP2 (IP): Insect richness, insect abundance	Anchoring method (< 4, 4–7, 8–13, 14–20, > 20)
	BP3 (BPc): Bird richness, bird abundance	Anchoring method (< 5, 5–9, 10–19, 20–30, > 30)

	BP5 (HP): Habitat richness	Anchoring method (< 2, 2–4, 5–7, 8–10, > 10)

NOTE

(R) denotes reverse scoring.

Supplementary Table 3: PRS questionnaire of Experiment 2

No.	Question	Dimension
1	I feel a sense of relief in these places.	Being away
2	These places allow me to take a break from my daily routines.	
3	I can temporarily escape the pressures of daily life and study here.	
4	These places help me relax mentally.	
5	Being here helps me reduce unnecessary mental fatigue.	Fascination
6	I find these scenes intrinsically fascinating.	
7	My attention is drawn to many interesting things here.	
8	I want to learn more about these places.	Extent
9	There is much to explore and discover here.	
10	I wish I could spend more time here exploring.	
11	These places are boring. (R)	Fascination
12	These places are charming.	
13	There is nothing much to see here. (R)	
14	There is too much going on in these places. (R)	Extent
15	I find these places confusing. (R)	
16	There are too many distractions here. (R)	Fascination
17	These places feel chaotic. (R)	Extent
18	These places are a good fit for me.	Compatibility
19	I can do what I like to do here.	
20	I feel a sense of belonging here.	
21	I can enjoy myself in these places.	
22	I feel a strong connection with these settings.	

NOTES

1. Items randomly shuffled.

2. (R) denotes reverse scoring.

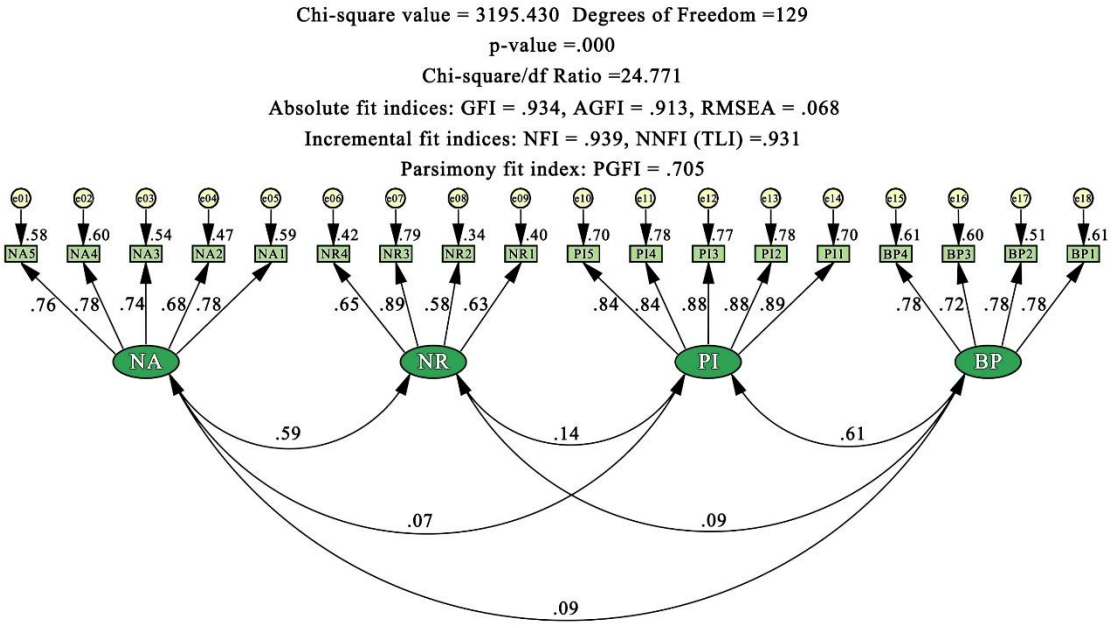
Exploratory and Confirmatory Factor Analysis of Measurement Models

Exploratory factor analysis (EFA) was conducted on the data using IBM SPSS Statistics 27 software, yielding a KMO value of 0.881. Principal component analysis was employed, identifying five principal components. Notably, PR was assigned to PI. The ability test did not align with any dimension. The SEM baseline model was established through EFA.

Through confirmatory factor analysis (CFA) testing of the model, observed variables with path coefficients below 0.6 and SMC below 0.33 were removed. Reverse-scored items for NA were retained, along with NR. The identified capability dimension was subsequently removed. Further construct validity analysis indicated all constructs possessed sound convergent and discriminant validity (average variance extracted [AVE] > 0.5, CR > 0.7).

Supplementary Table 4: Construct validity analysis

Latent variables	α	Composite reliability (CR)	AVE
NA	0.706	0.862	0.556
NR	0.720	0.788	0.488
PI	0.927	0.937	0.747
BP	0.857	0.848	0.582



Supplementary Fig. 1. CFA presentation of Goodness-of-Fit Metric Results.

Supplementary Table 5: SEM fit indices

	Default model	Saturated model	Independence model
NPAR	38	153	115
CMIN	3,053.954	0.000	50,639.698
DF	115	0	136
P	0.000		0.000
CMIN/DF	26.556		372.351
RMR	0.002	0.000	0.020
GFI	0.933	1.000	0.333
AGFI	0.911		0.250
PGFI	0.701		0.296
NFI Delta1	0.940	1.000	0.000
RFI rho1	0.929		0.000
IFI Delta2	0.942	1.000	0.000
TLI rho2	0.931		0.000
CFI	0.942	1.000	0.000

Ethics statements

This study conforms strictly to the Declaration of Helsinki. All experimental procedures were reviewed and approved by the university's Human Subjects Ethics Committee (Approval No. 20240067; Date: 10 May 2024). Prior to participation, all participants received comprehensive research briefings and provided written informed consent. Privacy protection principles were rigorously upheld to ensure the security of personal information and experimental data throughout the study.