Where do you exercise? Exploring the Impact of Different Virtual Environments on Exergame Performance and User Experience: A Preliminary Study

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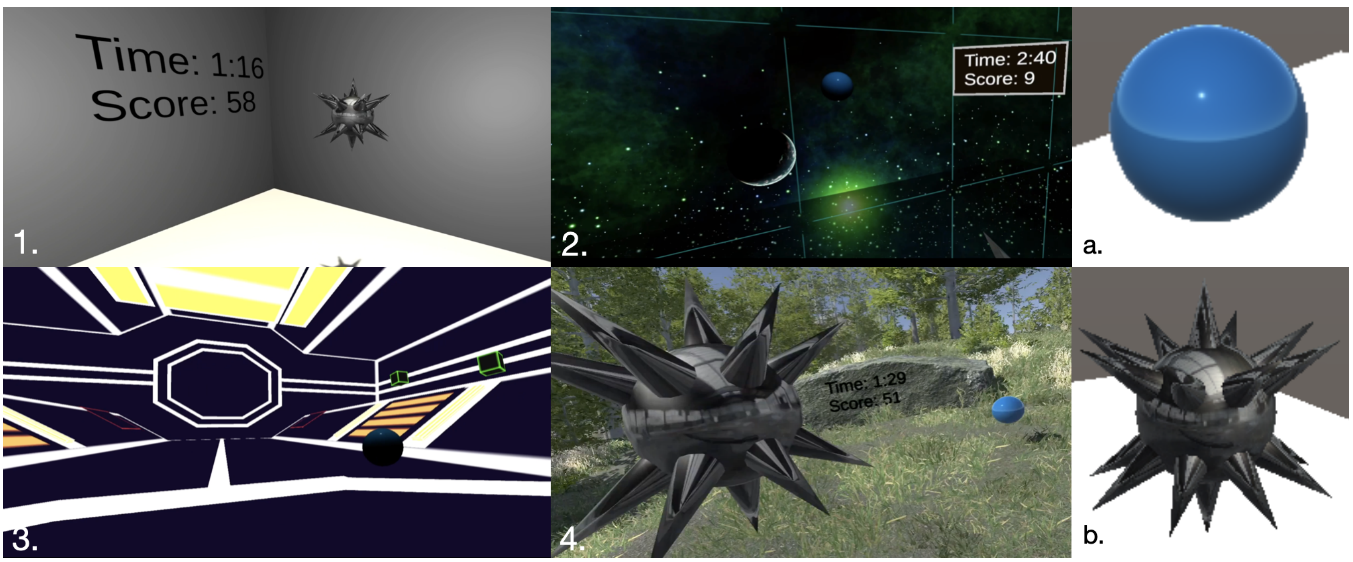

Figure 1: The *(1) white room*, which is an empty white room without sounds except for the game-related hit sounds. The environment next to it shows the *(2) space*, where participants floated without any ground with futuristic sounds and engine humming. The lower left environment, *(3) abstract*, consisted of white lines and colored shapes. This environment was underlined with electronic music. The last environment next to it is *(4) forest*, where participants were positioned in a nice forest with birds singing. On the upper right, (a) the blue hit ball, and on the lower right, the (b) spike ball to dodge is shown.

ABSTRACT

Environments can affect mood, motivation, and productivity. Green spaces, for example, are known to have calming effects on people's moods. In virtual reality (VR), we could take advantage of these effects, as we have full visual control over the environment. In this paper, we explore how such potential effects caused by the environment impact performance and user experience (UX) when playing an exergame. We created four environments differing in their level of detail and visual realism.: *(1) a white room*, *(2) outer space*, *(3) an abstract space*, and *(4) a forest environment.* In a user study (N=26) in which participants played an exergame in all four environments, we found evidence that VEs influence enjoyment and performance. The simulation of green spaces or abstract VEs with enjoyable background sounds has a particularly positive impact. We discuss how environmental features impact performance and UX and present promising avenues for future work investigating specific parts of environmental features.

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CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**;

KEYWORDS

exergame, virtual reality, virtual environments

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1 INTRODUCTION

A person's surroundings can influence their psychological and physiological state, including effects on creativity, productivity, and mental health [8, 12, 21, 28, 34, 37, 48]. A prominent example are green spaces (e.g., nature and forests), which positively influence health, including mental and physical health [13, 18, 26, 33, 49], the immune system [31]and physical activity [22, 32, 43, 45].

In virtual reality (VR), we have full visual and auditory control over the environment, allowing us to change a small dorm room into a whole new world, seamlessly shifting from bad weather to sunshine. However, few empirical investigations explain if and how these changes in different environments influence the user. Research in this area mainly investigated green spaces and non-exercising tasks like work or education [10, 15].

With this work, we present an initial investigation into whether and how different environments influence performance and user experience (UX) in physical exercise tasks. To test this, we implemented an exercise game (exergame) where the player moves and hits balls with their hands while dodging spike balls (see Figure 1). We chose an exergame as a use case: a common application for VR applications. We investigated the influence of four environments that reflect two dimensions (level of detail and realism). The authors' decision-making process for choosing these environments was based on brainstorming and research of currently used environments.

(1) An empty white room with no sounds except game-related sounds (*(1) white room*: low detailed, realistic). (2) An outer space environment, where the user was floating in open space (*(2) space*: detailed, non-realistic). Besides game-related sounds, the environment included an engine humming sound of a spaceship. (3) An abstract environment with colored lines and shapes, underlined with simple electronic music (*(3) abstract*: low detailed, non-realistic). (4) A green space environment, where participants were positioned in an open forest surrounded by trees and listening to singing birds (*(4) forest*: detailed, realistic).

In summary, our research was driven by the following research question: How do the four environments *(1) white room*, *(2) space*, *(3) abstract*, and *(4) forest* affect UX and performance in a VR exergame? To answer this question, we conducted a within-participant study (N= 26), where participants played four versions of an exergame and answered questions about affective state, presence, user experience, and custom questions covering environment characteristics like scariness or calmness, distractions, and perceived exhaustion.

Our results show that different environments in a VR exergame impact enjoyment, perceived competence, and probably even performance itself. Why they occur has to be looked further into, but we can assume that auditory cues and green spaces positively influence performance in fitness-related tasks like our exergame. Lastly, we present a collection of environmental cues that could contribute to the overall experience and should be investigated in future research.

We contribute a preliminary empirical study investigating whether different virtual environments influence performance and UX. Based on our results, we propose more future work that directly examines the individual cues of environments that are decisive for performance boost and pleasant UX.

2 RELATED WORK

Environments can influence psychological and physiological states, ranging from effects on creativity and productivity [8, 12, 28, 29, 37, 48] to influencing mental health [21, 26, 32, 34, 35, 52].

Some influencing triggers can be the color and mood of a room[1, 28, 50, 51], the interior design [23, 27], lightning [29, 53], sounds [4, 5, 30], weather [3, 9, 11, 14, 17, 20] or green spaces which will be discussed in the following section.

2.1 Environment Effects and Green Spaces

Research on the effects of environments has focused a lot on green spaces, such as environments or rooms with many plants and nature. Lots of work found that green spaces in cities can have positive effects on health (mental and physical), well-being (e.g., stress reduction, attentional fatigue), and social factors (e.g., reduction of crime, perception of safety) [6, 19, 21, 38, 47]. Other research provided evidence for environmental effects on productivity [12, 48]. Besides avoiding physical and functional discomfort (e.g., neck pain through bad chair), there are psychological effects. For example, green spaces can contribute to people being more productive in enclosed offices or reporting higher productivity in offices with a view outside. Another study by Choi et al. [12] shows how physical environments affect cognitive load and learning. Here, effects like noise, spatial distance (being close or far away), physical features (like wearing lab coats or not), and emotions (motivational or creative environment) can influence learning performance and cognitive load.

Richardson et al. [41] found that overall physical activity levels were higher and the risk of experiencing mental health issues lower in green neighborhoods. A review by Thompson Coon et al. [46] compared exercising indoors with exercising outdoors in natural environments. Exercising outdoors led to greater enjoyment, "greater feelings of revitalization and positive engagement", decreases in tension, confusion, anger, and depression, and increased energy.

2.2 Environment effects in VR

A meta-analysis by Kaplan et al. [25] did not find lower performance outcomes between simulated (in VR) and non-simulated training. Many studies even found performance improvement for physical tasks after mixed reality training. Workstations between a real and VE did not find effects regarding difficulty, time, and interaction fidelity either [40]. A study by Calogiuri et al. [10] investigated the effects of VR green space/nature on the decision-making process of visiting a place in real life. They explored different virtual walking scenarios in an urban green space. Participants rated afterward to be more likely to visit the location for green exercise. Gao et al. [15] investigated the effects of six different natural spaces (grey, blue, green, and partly opened/closed). All VEs had positive effects on attentional fatigue and negative mood. The partly open green space had the most positive effects, and the closed green space had the worst. A recent study could show that virtual forest bathing improves well-being for adults with disabilities [36]

3 IMPLEMENTATION

To answer our research question, we designed an exergame for the Valve Index, which we called *Hit'n Dodge*. The game consists of two types of objects: simple blue balls (Figure 1 (1)) and spike balls (Figure 1 (3)) that fly toward the player from two areas: The spike ball is randomly targeted at the player's head or hands, while the blue ball takes a random direction and height towards the whole play area. Which type of ball appears is randomly initiated but kept balanced. While the blue balls have to be caught with one of the player's hands (controller), the spike balls have to be dodged. Overall, 106 balls can be caught or dodged in one play-through, which means that 106 points can be gathered by catching and avoiding balls. One play-through took about two minutes.

4 USER STUDY

We conducted a within-participant study with one independent variable *environment* with four levels, resulting in four conditions. We designed the four environments (Figure 1) with varying levels of detail (high/low) and realism (non-realistic/realistic). Based on research about environments we found in VR applications, influenced by green space research, we opted for the two dimensions detail and realism. Realism was interesting to use the variety that is possible with VR [1], while detail was interesting regarding scenes where visually a lot was happening compared to rather boring clean rooms.

We decided to build environments not only visually but with fitting audio since audio takes an important role in environments [16], and no audio would have felt very weird and distracting.

(1) *white:* participants played the Hit'n Dodge game in a completely empty white room (Figure 1 a) (low detail, realistic).
(2) *space:* participants played the Hit'n Dodge game in a space environment with engine and futuristic sounds (Figure 1 c) (high detail, non-realistic).
(3) *abstract:* participants played the Hit'n Dodge game in an abstract environment with colored lines and shapes and futuristic music (Figure 1 d) (low detail, non-realistic).
(4) *forest:* participants played the Hit'n Dodge game in a forest-like environment with forest sounds. Figure 1 b) (high detail, realistic).

4.1 Measures

In addition to a demographics survey (age, gender, fitness, VR experience), we collected scores and employed post-game questions.

Post-Game Questionnaires. After each play-through, participants completed the interest and enjoyment, perceived competence, and tension subscales of the Intrinsic Motivation Inventory (IMI) [42] (7-point scale from 1="not at all true" to 7="very true"). They also completed the self-assessment manikin (SAM) [7] with subscales valence, arousal, and dominance (5-picture scale) and the igroup presence questionnaire IPQ [39] (7-point scale). Finally, we asked 12 custom questions on a 5-point Likert scale (1= disagree to 5= agree) about: enjoyment, performance, satisfaction, whether the participants felt active, motivated, or distracted by the environment if the gameplay was distracting them from the VE, if the environment was perceived scary/frightening or calming, if the environment helped to focus on performance, whether the participants would play again, whether the gameplay was exhausting, and whether they would be interested in exercising in a similar real-world environment.

Pre- and Post-Questions. Before and after playing the game, we asked the participants to rank the four environments according to whether they wanted to be there and whether they wanted to play in them.

4.2 Participants and Procedure

26 participants (10 female, 15 male, 1 "other"; M_{age} = 23.23, SD = 2.19, $range_{age}$= 20-29) participated in our user study. 23 participants were students. 76.92% felt motivated to do sports, 61.54% felt very comfortable using VR, and 57.69% had never used VR at all.

After giving consent, each participant started by ranking the four environments according to whether they would like to be and play there. Then, they were introduced to the *Hit'n Dodge* game and played it four times, each in a different environment. They answered post-game questions after each condition. This process was counterbalanced with a 4x4 Latin square to avoid learning and exhaustion effects. In the end, they were asked again to rank the four environments according to if they liked to be and play there, followed by the demographics questionnaire. The participants finished the study by receiving remuneration.

4.3 Analysis & Results

We first report the findings of our quantitative analysis, with details about significant results and effect size (Friedmans ANOVA (fA), Bonferroni correction for pairwise comparison, Kendall's w for effect size in non-parametric results; Repeated Measures ANOVA (A), Tukey HSD for pairwise comparison, effect size (η^2) for all parametric results).

As we can see in Table 2, we found statistically significant effects for SAM valance between the *(1) white room* to *(3) abstract* and *(4) forest*. IPQ experiences realism is significant between the *(4) forest* and *(1) white room* and *(3) abstract* and IPQ overall presence is significant for post-hoc between *(4) forest* and *(1) white room* (A = 4.026, p= 0.009, η^2 = 0.108). While IMI Enj and IMI perceived competence are significant between *(1) white room* and both *(4) forest* and *(3) abstract*, the overall game score is not significant for the post-hoc test. We did not find significant results for IMI Tension, SAM arousal, SAM dominance, IPQ inv.

For our custom questions, we found strong significance for Enjoyment (fA = 33.6,p = 0.000000240, w = 0.431 (moderate)) between all *(1) white room* to all other conditions. Satisfaction was significant

[1]https://store.steampowered.com/app/1098100/OhShape/

Table 1: We report means (M), standard deviation (SD), Friedmans Anova (fA), or for parametric data One-Way-Anova (A) with p-value and effect size (s=small, m=moderate. For the post-hoc tests, we only report the paired conditions that are significant for measures SAM valance (5-point), IPQ (7-point), and IMI (7-point Likert). Game Performance can reach up to 106 points. Results for further measures can be found in Appendix.

Condition	SAM val		IPQ G1		IPQ real		IMI Enj		IMI PC		Game Score	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
(4) forest	4.35	6.29	3.42	1.03	4.79	1.37	5.69	0.73	5.54	1.026	103.07	3.11
(3) abstract	4.19	7.49	4.04	1.18	4.47	1.43	5.61	0.83	5.54	0.99	102.30	2.58
(2) space	3.92	7.44	4.27	1.37	4.25	1.39	5.35	1.01	5.18	0.91	102.80	2.13
(1) white room	3.54	0.94	4.12	1.90	3.81	1.39	4.86	1.28	4.72	1.21	100.73	3.99
ANOVAs	fA = 16.2		fA = 9.93		A = 4.332		fA = 13.7		A = 3.63		fA = 8.93	
	$p < 0.002$		$p < 0.02$		$p < 0.01$		$p < 0.005$		$p < 0.02$		$p < 0.05$	
effect size	w = 0.208 (s)		w = 0.127 (s)		$\eta^2 = 0.115$ (s)		w = 0.176 (s)		$\eta^2 = 0.098$ (m)		w = 0.115 (s)	
post hoc	white ↔ abstract		abstract ↔ forest		abstract ↔ forest		white ↔ abstract		white ↔ abstract		ns	
	white ↔ forest				white ↔ forest		white ↔ forest		white ↔ forest			

between *(1) white room* and *(4) forest* (fA = 19.0, p = 0.000279, w = 0.243). The *(1) white room* environment was rated significantly scarier (fA = 16.9,p = 0.000724, w = 0.217) than *(4) forest* and *(3) abstract*. *(4) forest*, on the other side, was significantly rated more calming (fA = 37.2,p = 0.0000000414,w = 0.477 (moderate)) than all other conditions. The gameplay was distracting from the environment was significant (fA = 12.3, p = 0.00646, w = 0.158) between *(1) white room* to *(4) forest* and *(2) space*. Gameplay exhausting was only significant between *(1) white room* and *(2) space* (fA = 8.57, p = 0.0355, w = 0.110) Exercising in a real-life environment similar to this environment was significant between *(1) white room* to all other environments (fA = 30.3, p = 0.00000121, w = 0.388 (moderate)). For wanting to play again in the environment, significance was also between *(1) white room* and all other conditions (fA = 27.7, p = 0.00000427, w = 0.355 (moderate))

Feeling more active and being focused on performance was not significant while feeling more active and having more motivation to exercise was non-significant after the post-hoc test.

For *being* in the environment, 42% of the participants kept their first place ranking after the study, while 61% kept their first place ranking for *playing* in the environment. Overall, *(4) forest* was pre-ranked higher for being in the environment than for playing in it and lost ranks after the study, making place for higher abstract ranks (see Figure 3).

4.4 Further Comments by the Participants

Participants liked the *(4) forest* because it was very "calm", "relaxing" (P7, P8, P10, P19, P20, P21, P22), and they liked the "bird sounds"(P17). One participant mentioned that they "felt free" (P5) in the *(4) forest*. Very often they mentioned the motivating sounds from *(3) abstract* (P1, P2, P5, P7, P20, P24). Some participants mentioned that it was very nice that the *(3) abstract* environment "did not try to be real" (P11) or "try to mimic something" (P1). One mentioned that they felt like they were in an action movie (P15). While some felt the direction of the balls was easy to identify (P12) others found the colors were nice but hard to differentiate from the background (P5). For *(2) space*, P3 found the environment "calm and not distracting", and P16 said it was a completely new experience. P23 mentioned that they were distracted through the uncomfortableness of the missing ground because of the feeling of falling, which led to low cybersickness for P5. The white room was described as a "very small" (P5) and a "very monotonous environment" (P23).

5 DISCUSSION

Environment Characteristics. Confirming results from earlier studies on green spaces[6, 19, 21, 22, 38, 47], we found significantly higher calming effects for *(4) forest* as a green space in VR. The *(1) white room* room environment was perceived as significantly scarier, which could be related to being in a closed space [15], but also to a feeling of loneliness and lack of distraction created by the empty room [2]. While the experienced realism was perceived significantly higher in the *(4) forest* than *(3) abstract* and *(1) white room*, it did not influence enjoyment, shown by *(3) abstract*, resulting in low realism but high enjoyment values. Participants even positively emphasized liking that the *(3) abstract* abstained from mimicking something. In general, visual realism or level of detail was not a driving factor for higher performance or UX. We suggest exploring environmental effects with a structured investigation into different dimensions of color moods, lighting, weather, space, shapes, and background sounds.

Environment Preference Ranking. The *(4) forest* environment was ranked highly in the pre-study questionnaire but lost ratings towards the *(3) abstract* environment in the final questionnaire. We assume that participants could not imagine what an abstract room could look like before seeing it in the study condition. Furthermore, the electronic sounds could have influenced them positively, especially for the playing rank. *(2) space* seemed to lose ranking points as well, probably because people expected something more exciting from it. Someone mentioned *(2) space* causing motion sickness, and the floating was a bit scary for some participants.

Enjoyment and Satisfaction. Overall, the questionnaire results showed that the *(4) forest* and *(3) abstract* environments were more enjoyable and satisfactory compared to *(1) white room.* For the custom enjoyment question, the effect size was even moderate, and *(2) space* reached significantly higher values for enjoyment

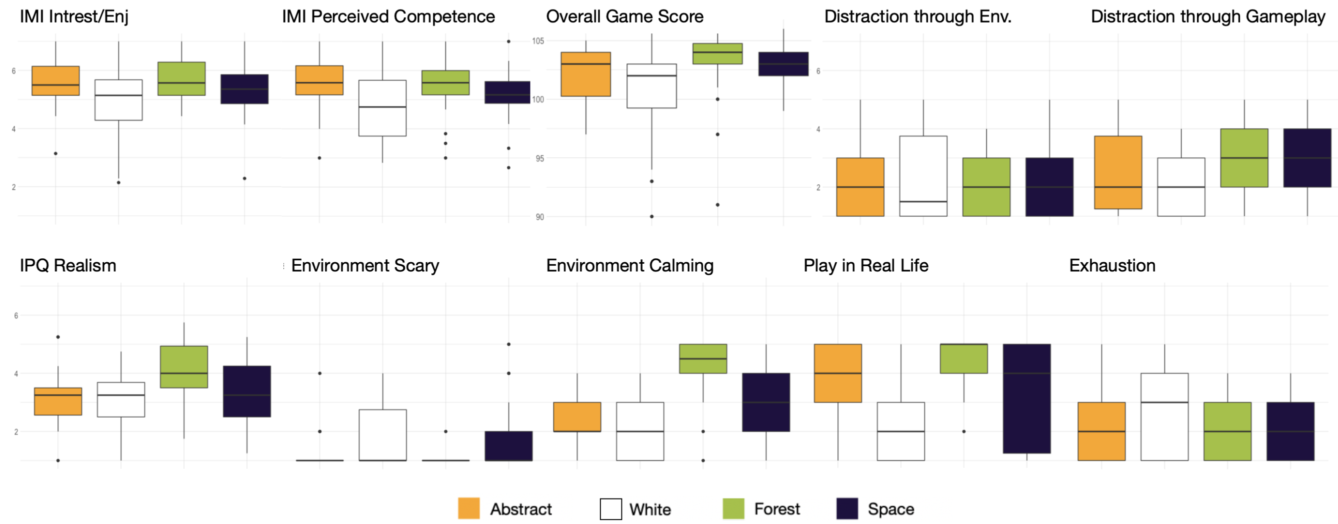

Figure 2: The figure shows boxplots for IMI Interest/Enjoyment, IMI Perceived Competence, Overall Game Score, Distraction through environment, Distraction through gameplay, IPQ Experienced Realism, Environment Scary, Environment Calming, Would play in Real Life in this environment, Perceived Exhaustion

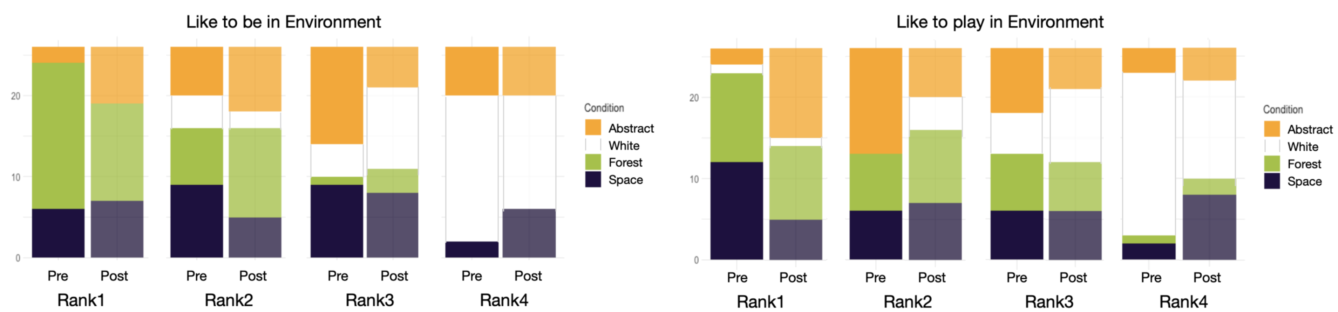

Figure 3: The graphic shows the rankings one best to four worst of the environments for pre and post-study can be seen. On the left, they were asked to be in this environment, on the right they were asked to play the exergame in this environment.

than *(1) white room* as well. Moreover, in *(4) forest*, *(3) abstract*, and *(2) space*, participants were significantly more likely to play the game again in VR and were more likely to play in such kind of environment in real life. For the *(4) forest*, the results agree with the results from [46], where outdoor exercise reached higher enjoyment and satisfaction than indoor exercises. One participant even mentioned the *(4) forest* created a feeling of being free. For *(4) forest* and *(2) space* the environment was at least large or open in space, which could have influenced the positive mood compared to closed spaces, as suggested by Gao et al. [15]. In general, we can state that an empty white environment lowers enjoyment for exergames in VR due to several reasons like distraction, exhaustion, or missing background sounds [24]. From our qualitative comments, we further know that the calming effect, audio (birds or music), and liking of the environment in general could have also influenced enjoyment.

Distraction. The empty *(1) white room* environment overall distracted participants the least compared to the other environments even though there was a high variance between participants. It was probably caused by the feeling of scariness mentioned by some participants. Further, they seemed to be least distracted by the gameplay in *(1) white room*, likely because the empty environment lowered cognitive load. In future work, cognitive load could be measured to see how it influences perceived distraction.

Exhaustion. Perceived exhaustion was overall low but significantly higher for the *(1) white room* than other environments. We assume that through the emptiness of the environment and low enjoyment, participants were not distracted enough by the gameplay, resulting in a higher focus on their own bodies and exhaustion. In future work, the actual exhaustion should be measured to identify whether the effect is only perceptual or also showing in physiological signals, such as heart rate.

Performance. The significantly higher rating of perceived competence in the environments *(4) forest* and *(3) abstract* match the higher (but not post-hoc significant) rankings of the game score for *(4) forest* and *(3) abstract* compared to the *(1) white room.* We assume that the low variance in the game scores is resulting in not significant game scores. However, that *(1) white room* has a lower cognitive load but neither high perceived competence nor high game scores, cognitive load might not be the influencing factor for performance. It could be likely that psychological effects like scariness, calmness, or liking have a higher influence on performance. We argue that effects like increased energy for exercising in outdoor green spaces [46] could be shown through virtual reality outdoor spaces as well. Furthermore, we know from related work that working memory and performance in skill tasks are heightened for having background music compared to complete silence [44], which was the case in the *(1) white room* environment. Nevertheless, we can argue that exergame performance could be positively influenced by engaging, enjoyable, and participants' subjective liking of the environment due to 61% keeping their first choice of environment for playing.

Limitations. Finally, we want to mention that because the game was low-difficulty, the variance in the overall game scores was very low. Furthermore, the exergame had a relatively low level of exhaustion, which makes an assumption towards the exercise part rather weak. Besides perceived exhaustion, actual exhaustion was not measured, e.g., through heart rate, which could be different from perception. However, this was only a preliminary study to see if effects could be found and where they occur.

6 CONCLUSION AND FUTURE WORK

We investigated the effects of different VEs with varying degrees of detail and abstraction on performance and UX in an exergame. Four environments were examined: *(1) white room*, *(2) space*, *(3) abstract*, and *(4) forest*. Based on our findings, we infer that different VEs impact how users experience and perform in VR-based tasks, such as exercising in games. Therefore, we suggest considering which VEs to choose in future research and application of VR exergames and exercises (e.g., green spaces). However, visual realism or level of detail is likely no influencing factor on performance and UX.

Additionally, future studies should explore a larger and more detailed variety of VE aspects (e.g., audio and visual stimuli) separately to gain a more fine-grained understanding of how different environmental elements affect performance and experience. Finally, it would be beneficial to use more demanding or varied tasks in future studies to make stronger assumptions about the effects of VEs on exercise performance.

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A FURTHER STATISTIC RESULTS

Table 2: We report means (M), standard deviation (SD), Friedmans Anova (fA), or for parametric data One-Way-Anova (A) with p-value and effect size (s=small, m=moderate) for all results. For the post-hoc tests, we only report the paired conditions that are significant for measures SAM valance (5-point), IPQ (7-point), and IMI (7-point Likert) and custom (7-point Likert). Game Performance can reach up to 106 points.

	IMI Eng	IMI PC	IMI Ten	SAM val	SAM Aro	SAM Dom
forest	M: 5.69; SD: 0.73	M: 5.54; SD: 1.026	M: 2.40; SD: 0.92	M: 4.35; SD: 6.29	M: 2.69; SD: 1.19	M: 3.62; SD: 1.36
abstract	M: 5.61; SD: 0.83	M: 5.54; SD: 0.99	M: 2.75; SD: 1.07	M: 4.19; SD: 7.49	M: 2.77; SD: 1.14	M: 3.46; SD: 1.14
space	M: 5.35; SD: 1.01	M: 5.18; SD: 0.91	M: 2.92; SD: 1.25	M: 3.92; SD: 7.44	M: 2.81; SD: 1.02	M: 3.27; SD: 1.08
white	M: 4.86; SD: 1.28	M: 4.72; SD: 1.21	M: 3.12; SD: 1.30	M: 3.54; SD: 0.94	M: 3.08; SD: 1.02	M: 3.19; SD: 1.50
ANOVAs	fA = 13.7 p < 0.004	A = 3.63 p < 0.02	A = 1.848 ns	fA = 16.2 p < 0.002	fA = 3.37 ns	fA = 5.19 ns
effect size	w = 0.176	η^2 = 0.098 (mod)		w = 0.208		
post hoc	White - Abstract White - Forest	White - Abstract White - Forest		White - Abstract White - Forest		
	IPQ ges	IPQ sp	IPQ inv	IPQ real		Custom: Distraction
forest	M: 3.42; SD: 1.03	M: 4.95; SD: 0.70	M: 4.79; SD: 1.37	M: 4.79; SD: 1.37		M: 2.23; SD: 1.21
abstract	M: 4.04; SD: 1.18	M: 4.78; SD: 0.90	M: 4.47; SD: 1.43	M: 4.47; SD: 1.43		M: 2.07; SD: 1.23
space	M: 4.27; SD: 1.37	M: 4.69; SD: 0.78	M: 4.25; SD: 1.39	M: 4.25; SD: 1.39		M: 2.30; SD: 1.31
white	M: 4.12; SD: 1.90	M: 4.25; SD: 0.95	M: 3.81; SD: 1.39	M: 3.81; SD: 1.39		M: 2.19; SD: 1.38
ANOVAs	fA = 9.93 p < 0.02	A = 3.288 p < 0.03	A = 2.269 ns	A = 4.332 p < 0.007		fA = 0.582 ns
effect size	w = 0.127	η^2 = 0.059		η^2 = 0.115		
post hoc	Abstract Forest	White - Forest		Abstract - Forest White - Forest		
Custom:	PerformFocus	PlayAgain	PlayDistract	PlayExhausting	Fun	SimilarEnvInRealLife
forest	M: 3.50; SD: 0.86	M: 4.34; SD: 0.74	M: 3.03; SD: 1.21	M: 2.11; SD: 0.95	M: 4.50; SD: 0.90	M: 4.46; SD: 0.85
abstract	M: 3.07; SD: 1.05	M: 4.00; SD: 1.13	M: 2.57; SD: 1.41	M: 2.19; SD: 1.26	M: 4.50; SD: 0.70	M: 3.88; SD: 1.07
space	M: 2.92; SD: 1.05	M: 3.73; SD: 1.25	M: 3.26; SD: 1.34	M: 2.00; SD: 0.93	M: 4.26; SD: 0.91	M: 3.26; SD: 1.66
white	M: 2.88; SD: 1.50	M: 2.30; SD: 1.31	M: 2.00; SD: 1.13	M: 2.76; SD: 1.50	M: 3.69; SD: 1.28	M: 2.19; SD: 1.35
ANOVAs	fA = 5.64 ns	fA = 27.7 p < 0.0001	fA = 12.3 p < 0.007	fA = 8.57 p < 0.04	fA = 17.1 p < 0.0007	fA = 30.3 p < 0.0001
effect size		w = 0.355 (mod)	w = 0.158	w = 0.110	w = 0.219	w = 0.388 (mod)
post hoc		White - Abstract White - Forest White - Space	White - Forest White - Space	White - Space	White - Abstract White - Forest	White - Abstract White - Forest Forest - Space
Custom:	Enjoyment	Satisfaction	MoreActive	ExerMot	Scary	Calm
forest	M: 4.65; SD: 4.85	M: 4.57; SD: 6.43	M: 4.19; SD: 8.00	M: 3.63; SD: 0.97	M: 1.03; SD: 1.96	M: 4.23; SD: 1.03
abstract	M: 4.50; SD: 6.48	M: 4.30; SD: 7.35	M: 4.19; SD: 0.69	M: 3.61; SD: 0.85	M: 1.19; SD: 6.33	M: 2.46; SD: 0.85
space	M: 4.30; SD: 8.37	M: 4.11; SD: 6.52	M: 3.76; SD: 1.03	M: 3.59; SD: 1.01	M: 1.84; SD: 1.37	M: 2.88; SD: 1.27
white	M: 2.92; SD: 1.26	M: 3.46; SD: 1.17	M: 3.69; SD: 1.12	M: 3.00; SD: 1.23	M: 1.92; SD: 1.19	M: 2.11; SD: 0.90
ANOVAs	fA = 33.6 p < 0.0001	fA = 19.0 p < 0.0003	fA = 8.25 p < 0.05	fA = 8.49 p < 0.04	fA = 16.9 p < 0.001	fA = 37.2 p < 0.0001
effect size	w = 0.431 (mod)	w = 0.243	w = 0.106	w = 0.109	w = 0.217	w = 0.477 (mod)
post hoc	White - Abstract White - Forest White - Space	White - Forest	ns	ns	White - Abstract White - Forest	Abstract - Forest White - Forest Space - Forest