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ABSTRACT

Movement based games, also known as exergames, provide a great opportunity for encouraging physical activity among players. These games, however, have not accounted for users possessing physical disabilities in the existing design guidelines. Using semi-structured interviews which utilized Interpretative Phenomenological Analysis and an online survey, the guidelines previously established by Mueller and Isbister were refined, and expanded to account for disabled people, based on their various preferences discussed through the study.
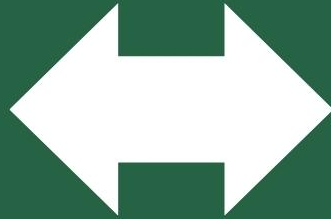
METHODOLOGY

THIS RESEARCH PAPER RELIED ON **TWO** DATA COLLECTION METHODS

INTERVIEW

A semi-structured interview involving 6 participants aged 19 to 61 was conducted over two stages.

STAGE 1

Firstly, demographic information and individual backgrounds were used to gather perspectives and previous experiences with physical activity, and experience with movement-based games, and games in general.

STAGE 2

The second stage of the interview involved introducing game concepts through a website, using a poster and associated demonstration video containing a wizard of oz prototype and demonstrator to support it. To ensure that participants understood the concepts, follow-up questions were then asked regarding their opinions on each concept.

METHOD OF ANALYSIS

IPA (interpretative phenomenological analysis- *"a qualitative approach that aims to provide detailed examinations of personal lived experience before moving on to more general claims"*

The method of analysis chosen by the researchers, IPA prioritized the unique personal experiences to create *"rich and detailed descriptions of each participant".*

Interviews were first transcribed and read several times by the research lead

Important points were recorded on each transcription

Themes were then identified after systematically exploring the data

Online Survey

An online survey was used(N=21), which provided basic information on the study, then collected preferences on gaming and information on physical activity. To collect this information, 1 to 5 Likert scales with one being designated as high were used. Following this, game concepts were presented, and reports on their perspective of it were gathered. Lastly, the respondents were asked to compare the different game concepts to each other, giving reasons for their preferences.

Data analysis

This data was then analyzed using inductive thematic analysis. The main researcher first studied the data, coded it and then identified themes from the coded data. The themes were then reviewed and defined by another researcher before eventually being defined by all authors. The quantitative was processed using SPSS (Statistical program for quantitative data analysis) as seen on the next page

SPSS analysis

"Respondents. Twenty-one people responded to the questionnaire (12 female, 8 male, 1 non-binary; age range 18-64; all from Western societies including Europe, North America and Australia). Sixteen respondents were active wheelchair users (predominantly manual active chairs), and length of use ranged from less than six months to more than ten years, varying between continuous and occasional use. Participants reported medium to high perceived levels of PA (M=1.95, SD=0.84), with a strong emphasis on PA participation for health benefits (M=1.85, SD=1.08). Interestingly, not everyone enjoyed PA (M=2.47, SD=1.17). Participants reported a wide array of activities they take part in, such as basketball, archery, boxing, swimming and hand cycling. Engagement with games was relatively high (M=1.9, SD=0.97), with the majority of participants playing between 7-12 hours per week. Engagement with movement based or exertion games was lower (M=2.9, SD=1.37). Example of movement-based games participants had previously played include Beat Saber [14], Pokémon Go [44], and games on the Nintendo Wii and Switch consoles. Overall, participants reported a high interest in exploring movement-based games to support PA (M=1.28, SD=0.45). "

RESULTS

The key findings of this study are separated into

THREE MAIN ELEMENTS.

1 First Thing

The recipients noted the importance of a meaningful individual adaptation, which would allow them to for example replace specific movements that are difficult with others. This allows players to each receive an adequate amount of challenge, ensuring that the game is not too trivial for more capable players, and not too difficult for others.

Secondly, the respondents view on social play was not entirely positive, as some people had physical activity experiences that were stigmatizing in nature, whereas others love the idea of social aspects in games. Therefore, careful considerations and decisions must be made when implementing social aspects into these games.

Finally, movement-based games need to be engaging first and physically challenging second, meaning that the game being enjoyable should be the priority, and the physical aspect secondary

Discussion

This paper should assist developers of exergames in creating accessibility friendly experiences for players. It can also spark further research into developing exergames for users impacted by other types of physical disabilities not explored in the paper, and lead to refinement of the guidelines mentioned in the paper.

Limitations

The paper, however, must be viewed with its limitations in mind. A limitation of this paper was the lack of fully developed exergames for the participants to use and try out. Some other notable limitations were the demonstration videos relying on a person without a physical disability and the lack of research into non-wheelchair users.
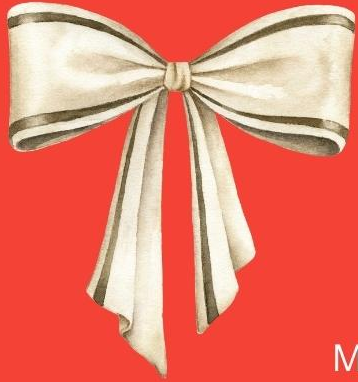
Conclusion

Movement Based Games provide avenues for physical activity, and with the findings of this paper should be better extended to disabled players. The existing recommendations require adjusting to achieve this goal, with the refined guidelines creating a good starting point for designing game features and mechanics with the nuance required for accommodating physically disabled players, of various body types into mainstream movement-based games.

That's it ☺

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MEET THE AUTHORS

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Systems Session: Mental Health and Emotion

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ABSTRACT

Virtual Reality (VR) allows users to represent themselves through avatars, thus influencing their body perception. While the sensation of controlling a virtual body is well-studied, the impact of VR on body awareness is less understood.

In this study, 40 participants performing moving meditation tasks in both VR and reality, findings showed VR negatively impacted body awareness, influenced by the sense of embodiment through avatars. The presence of a mirror also worsened body awareness. These results highlight the importance of assessing body awareness in VR designs aimed at mental health, as realistic scenarios can distract from users' internal bodily signals.

WHAT HAPPENS TO OUR BODILY EXPERIENCE WHEN WE SUDDENLY HAVE TO ACT AND INTERACT THROUGH A
DIGITAL REPLICA INSTEAD OF OUR WELL-KNOWN AND FAMILIAR BODY?

KEY TERMS

EMBODIMENT
The experience of simultaneously being and having a body

BODY AWARENESS
The ability to recognize subtle internal body signals

RESEARCH QUESTIONS

IN AN ENVIRONMENT AS SIMILAR TO REALITY AS POSSIBLE, WITH AN AVATAR MOVING AS CONGRUENT TO PHYSICAL MOVEMENT AS POSSIBLE

- How does VR impact on body awareness?
- Does a mirror increase the sense of embodiment and affect body awareness?
- To what extent is the sense of embodiment towards the visible body fundamental for experiencing body awareness in VR?
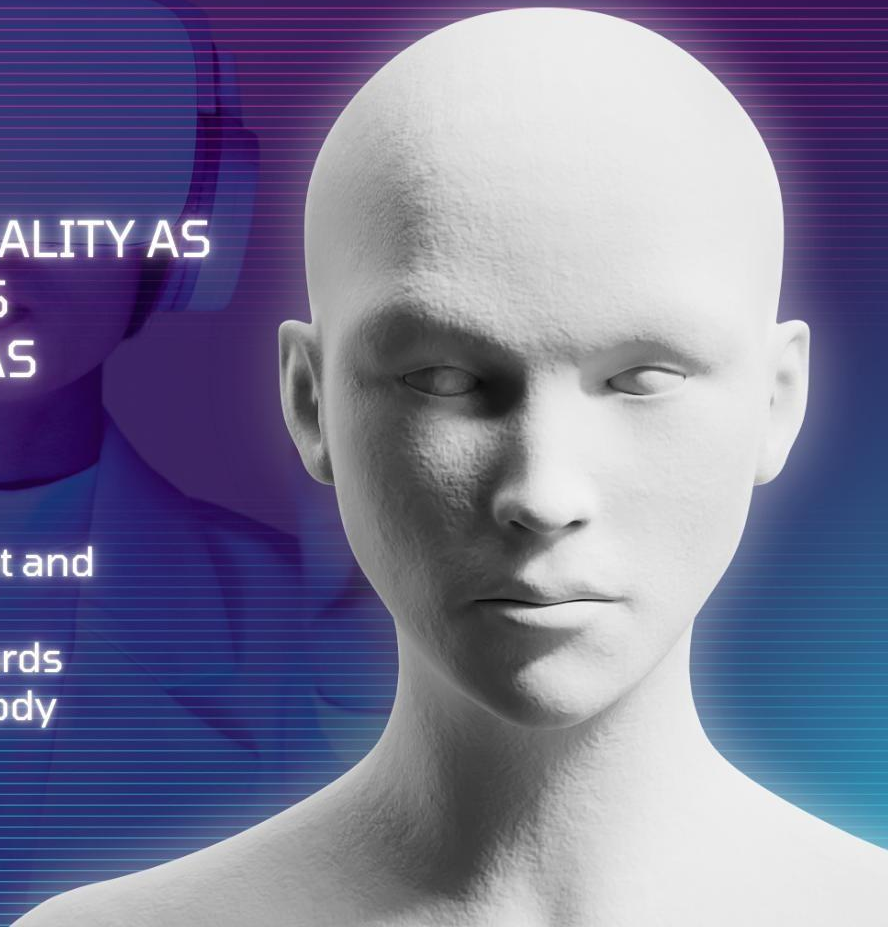
HOW'D THEY CONDUCT THEIR RESEARCH?

- **Study Design:** A 2x2 mixed experimental design was used, with two independent variables: virtuality (reality vs. VR) and perspective (with or without a mirror). Participants experienced both reality and VR conditions in a counterbalanced order, with perspective varying between participants.

- **The dependent variables** included self-reported body awareness and interoceptive accuracy (IAC), with the Sense of Embodiment (SoE) as a potential mediator. Control variables, such as body awareness, body consciousness, simulator sickness, and avatar uncanniness, were also considered.

- **Experimental Setup**: The experiment took place in a controlled laboratory setting. The real and virtual environments were designed to match closely. Privacy screens were used to minimize experimenter influence during tasks, ensuring that participants had minimal visual contact with the experimenter.

HOW'D THEY CONDUCT THEIR RESEARCH? (CONT)

Apparatus: The VR setup included an HTC Vive Pro headset, Valve Index Controllers, and Vive Trackers, managed via SteamVR and Unity software. Motion-to-photon latency was measured at 64.79ms. The real and virtual environments were spatially aligned for consistency. Heart rate monitoring was done using the Empatica E4 smartwatch.

PROCEDURE:

Procedure

- Information, Consent, Pseudonym
- Body Measurements
- Body Scan
- Demograpic, MAIA, OBCS, SSQ 🖥
- IAC Task 🖥
- 🧍 Mirror ⟨Between-Subjects⟩ No Mirror ⏳ ♻
- UVI 🖥
- Debriefing, Compensation

Reality ⟨Within-Subjects⟩ VR

- Fitting
- Eye Test
- Calibration
- Body Aw. Movement Tasks
- In-Experience Questions
- Mirror Exposure Task
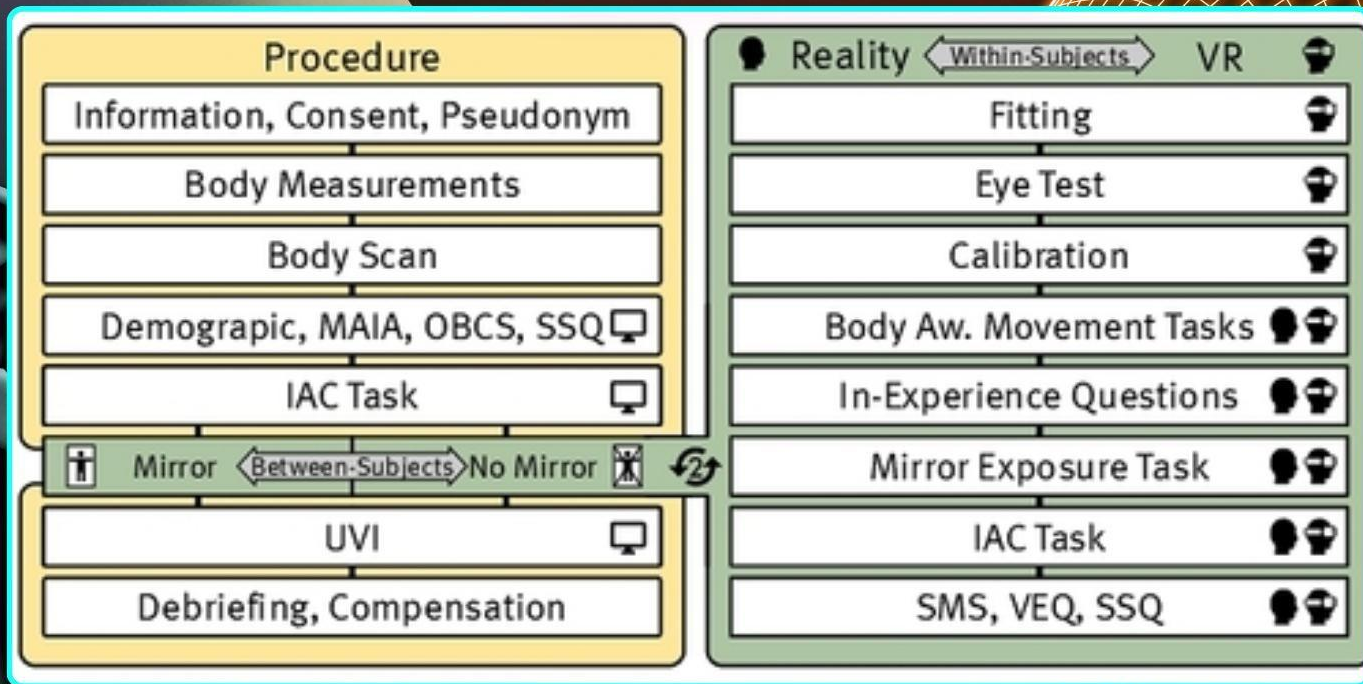- IAC Task
- SMS, VEQ, SSQ

Figure 1: A participant in front of a mirror: the virtual replicas (left) were designed to match the real setting (right).

DATA COLLECTION

- Sense of Embodiment (SoE): Assessed using the Virtual Embodiment Questionnaire (VEQ), which measures body ownership, agency, and change, both during and after the experience.

- Self-Reported Body Awareness: Collected through adapted items from the State Mindfulness Scale (SMS), focusing on noticing external and internal cues, body listening, attention regulation, and visual attention.

- Interoceptive Accuracy (IAC): Measured via a heartbeat-counting task, comparing participants' perceived heartbeats with their actual heart rate.

- Control Variables: Included everyday body awareness (Multidimensional Assessment of Interoceptive Awareness - MAIA), body consciousness (Objectified Body Consciousness Scale - OBCS), simulator sickness (Simulator Sickness Questionnaire - SSQ), and avatar uncanniness (Uncanny Valley Index - UVI).

Table 1: In-experience items for SoE, body awareness, and avatar uncanniness.

Variable	Item	Original scale
Sense of Embodiment		
Body Ownership (BO)	It felt like the virtual body was my body.	VEQ [52]
Agency (AG)	The virtual body's movements felt like they were my movements.	VEQ [52]
Change CH	I felt like the form or appearance of my own body had changed.	VEQ [52]
Body Awareness		
Noticing external (NE)	I noticed various sensations caused by my surroundings (e. g. heat, coolness, the wind on my face)	SMS [62]
Noticing internal (NI)	I clearly physically felt what was going on in my body	SMS [62]
Body listening (BL)	I listened to what my body was telling me.	SMS–PA [9]
Attention regulation (AR)	It was easy for me to pay attention to my body.	—
Visual attention (VA)	I focused more on how my body looked than how it felt.	OBCS [47]
Avatar Uncanniness		
Satisfaction	I was satisfied with my body.	—
Discomfort	I felt uncomfortable in my body.	—

LIMITATIONS

1. The results are limited to virtual experiences where the virtual environment and body closely resembles reality.
2. The design is limited due to the mirror exposure performed at the end to highlight the difference between virtual reality and real life.
3. Due to the small sample size, effects that would've been more apparent with a larger group could've been missed
4. The choice of tasks, focused on increasing body awareness, limits applicability to other contexts.

RESULTS
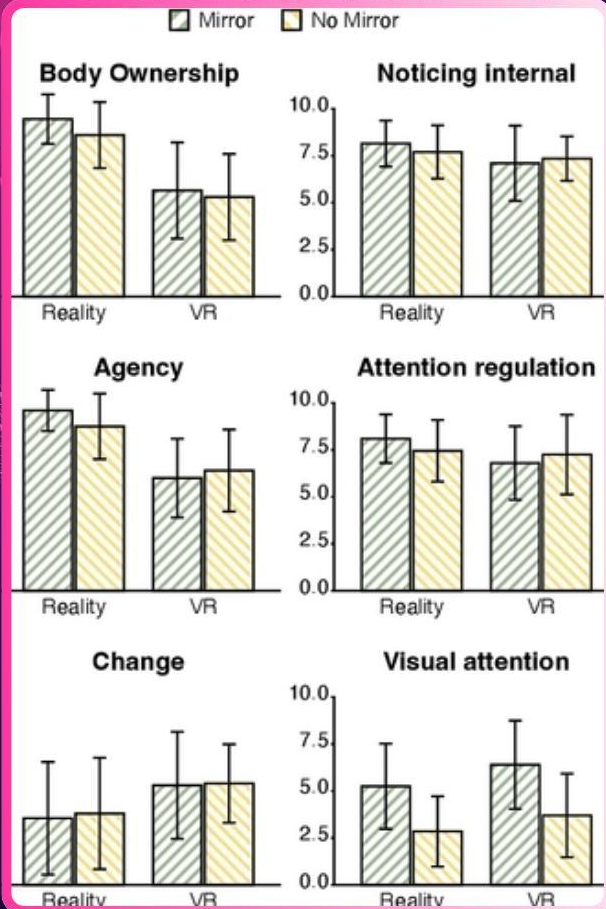
BODY OWNERSHIP: NO SIGNIFICANT INDIRECT EFFECTS WERE FOUND BETWEEN VIRTUALITY AND BODY AWARENESS REGARDING INTERNAL NOTICING, ATTENTION REGULATION, OR VISUAL ATTENTION.

AGENCY: AGENCY PARTIALLY MEDIATED VIRTUALITY'S EFFECT ON ATTENTION REGULATION, WITH HIGHER AGENCY LINKED TO BETTER ATTENTION REGULATION. NO SIGNIFICANT MEDIATION WAS FOUND FOR INTERNAL NOTICING OR VISUAL ATTENTION.

CHANGE: SIGNIFICANT INDIRECT EFFECTS WERE OBSERVED BETWEEN VIRTUALITY AND BODY AWARENESS VIA THE FEELING OF CHANGE:

NOTICING INTERNAL: VIRTUALITY INCREASED THE FEELING OF CHANGE, ENHANCING INTERNAL NOTICING.
 VISUAL ATTENTION: VIRTUALITY IMPROVED VISUAL ATTENTION, MEDIATED BY THE FEELING OF CHANGE.

Table 3: Descriptive results of all variables compared between conditions

		Mirror	No mirror	Mirror	No mirror
	Range	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Sense of Embodiment (SoE)					
VEQ BO	[1 − 7]	4.82 (1.85)	4.65 (1.55)	6.26 (1.27)	5.95 (1.41)
VEQ Agency	[1 − 7]	5.76 (0.85)	5.66 (0.99)	6.61 (0.92)	6.36 (0.88)
VEQ Change	[1 − 7]	2.84 (1.70)	3.34 (1.48)	2.25 (1.28)	2.67 (1.72)
In-exp. BO	[1 − 10]	5.65 (2.56)	5.3 (2.30)	9.45 (1.32)	8.60 (1.76)
In-exp. Agency	[1 − 10]	6.00 (2.10)	6.4 (2.19)	9.60 (1.10)	8.75 (1.74)
In-exp. Change	[1 − 10]	5.30 (2.85)	5.4 (2.09)	3.55 (3.00)	3.80 (2.97)
Body Awareness					
SMS Body	[1 − 75]	3.67 (0.64)	3.60 (0.68)	3.82 (0.57)	3.67 (0.62)
Noticing External	[1 − 10]	4.55 (2.50)	4.00 (2.20)	4.65 (2.23)	4.85 (2.37)
Noticing Internal	[1 − 10]	7.10 (2.00)	7.35 (1.18)	8.15 (1.23)	7.70 (1.42)
Body Listening	[1 − 10]	6.70 (1.75)	6.90 (1.55)	7.15 (1.18)	7.20 (1.54)
Attention Regulation	[1 − 10]	6.80 (1.96)	7.25 (2.12)	8.10 (1.29)	7.45 (1.64)
Seeing vs. Feeling	[1 − 10]	6.40 (2.35)	3.70 (2.23)	5.25 (2.27)	2.85 (1.87)

# IMPLICATIONS OF VIRTUAL REALITY ON BODY AWARENESS

The study reveals that using photorealistic virtual bodies in VR temporarily impairs body awareness, with participants relying more on visual cues than internal bodily signals. This effect contrasts with previous research showing positive impacts of body ownership on body awareness. Personalized avatars did not improve body awareness and, in fact, reduced it, suggesting that high realism alone does not enhance internal signal processing.
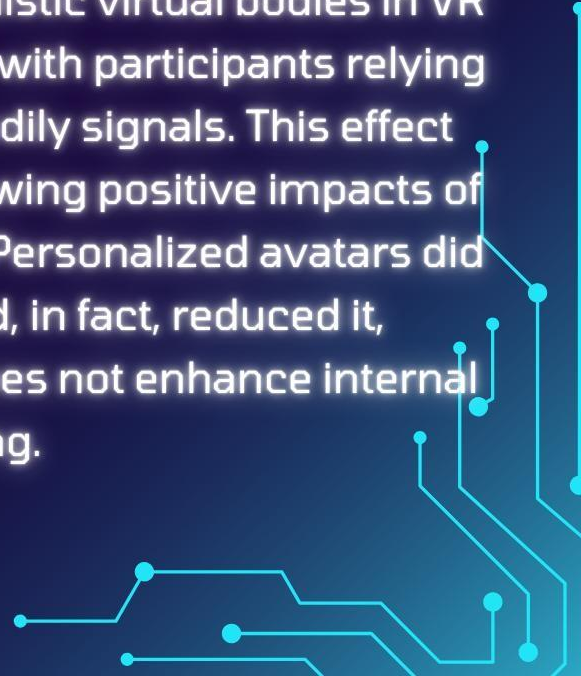
IMPLICATIONS OF VIRTUAL REALITY ON SOE MEDIATION:

The Sense of Embodiment (SoE) was found to mediate the effects of VR on body awareness. Perceived agency in VR was linked to better attention regulation, while perceived changes in the virtual body led to decreased awareness of internal signals and increased reliance on visual information. This supports the idea that external and internal stimuli compete in VR settings, with external visual signals often overshadowing internal sensations.
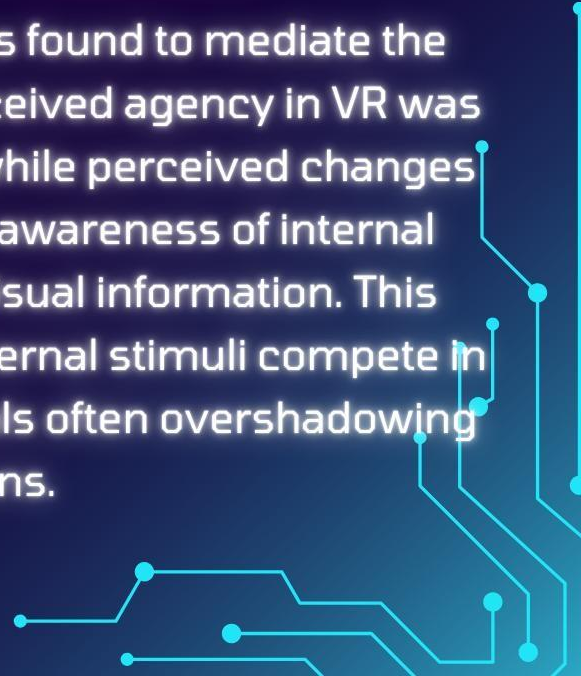
These findings indicate that while VR and avatar personalization can affect body awareness, the impact is complex and mediated by SoE. Designers should be cautious with mirror usage and avatar realism, focusing on maintaining user attention to internal bodily signals to optimize VR experiences for mental and physical well-being.

CONCLUSION

Virtual reality (VR) can replace our body's visual information with a virtual self-representation. In this study, it was found that embodying a personalized virtual body affects body awareness and the sense of embodiment.

Participants reported a lower sense of embodiment with their virtual body compared to their real body, and they were less aware of internal body signals while using a virtual body.

Interestingly, using a virtual mirror did not enhance embodiment, leading users to focus more on appearance rather than internal signals. The sense of embodiment, particularly the feeling of physical change during the experience, mediates VR's effects on body awareness. Future research should explore the impact of less personalized virtual bodies and different tasks unrelated to body movement or awareness.

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STYLETTE: STYLING THE WEB WITH NATURAL LANGUAGE

CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS 2022

ABOUT THE AUTHORS

Tae Soo Kim, DaeEun Choi, and Yoonseo Choi are PhD students at KAIST, researching AI and human-computer interaction under the guidance of Juho Kim, an associate professor and director of KIXLAB. Their work focuses on enhancing user interaction with AI, developing AI tools for creative processes, and improving human-AI interaction systems. Juho Kim is renowned in the HCI field and has received several awards. Their paper, published in 2022, was presented at the CHI Conference on Human Factors in Computing Systems and received an Honourable Mention Award for its impact and significance.

ABSTRACT

End-users often want to style and customize websites but lack the expertise to translate their high-level styling goals into specific code edits using in-browser developer tools. To address this, we introduce Stylette, a browser extension that allows users to modify website styles by expressing their goals in natural language. Stylette leverages a large language model to interpret user goals and draws from a dataset of 1.7 million web components to generate a palette of CSS properties and values. Users can then apply these suggestions to achieve their desired styles. In a comparative study with 40 participants, Stylette reduced the learning curve and enabled users to perform styling changes 35% faster than traditional developer tools. By offering multiple alternatives for a single goal, Stylette also helped users learn CSS through experimentation. This approach can be extended beyond CSS to assist novices in quickly understanding complex software or programming languages.

THE MAIN OBJECTIVE

The paper aims to simplify web styling by allowing users to customize websites using natural language commands instead of complex code. This makes web design more accessible to those without extensive web development or CSS knowledge. The system, named Stylette, uses a large language model to interpret user commands and generate styling suggestions from a dataset of 1.7 million web components. Research shows that users performed styling changes 35% faster with Stylette compared to traditional tools, reducing the learning curve for web design. The paper highlights how natural language processing can bridge the gap between user intentions and code implementation, making web design more user-friendly.

KEY TERMS

Web Design

Natural Language Interface

End-User Programming; Machine Learning

RESEARCH FOCUS

- WHETHER STYLETTE WAS EFFECTIVE IN DEVELOPING A USER FRIENDLY INTERFACE?

- WHETHER WEB STYLING WAS SIMPLIFIED?

RESEARCH METHODS

The research methods used are:

Formative study which is where 8 participants who did not have any background in web development. They had to request styling changes using natural language. The goal of this was to understand how people with no knowledge in this area navigate styling changes and learn of their challenges and patterns.

An evaluation was also done where 40 participants were used to compare the performance between Stylette and Chrome Dev Tools.

The method of system implementation was used where the Chrome extension was developed that utilises Natural Language Processing and Computer Vision which interprets user requests.

The design goals were where users were provided with multiple styling alternatives to choose from. This ensures that the system could handle vague requests well.

RESULTS

The Natural Language for styling changes allows for accessibility to those who are not familiar using developer tools or CSS. This allows a larger range of users to participate in the design process.
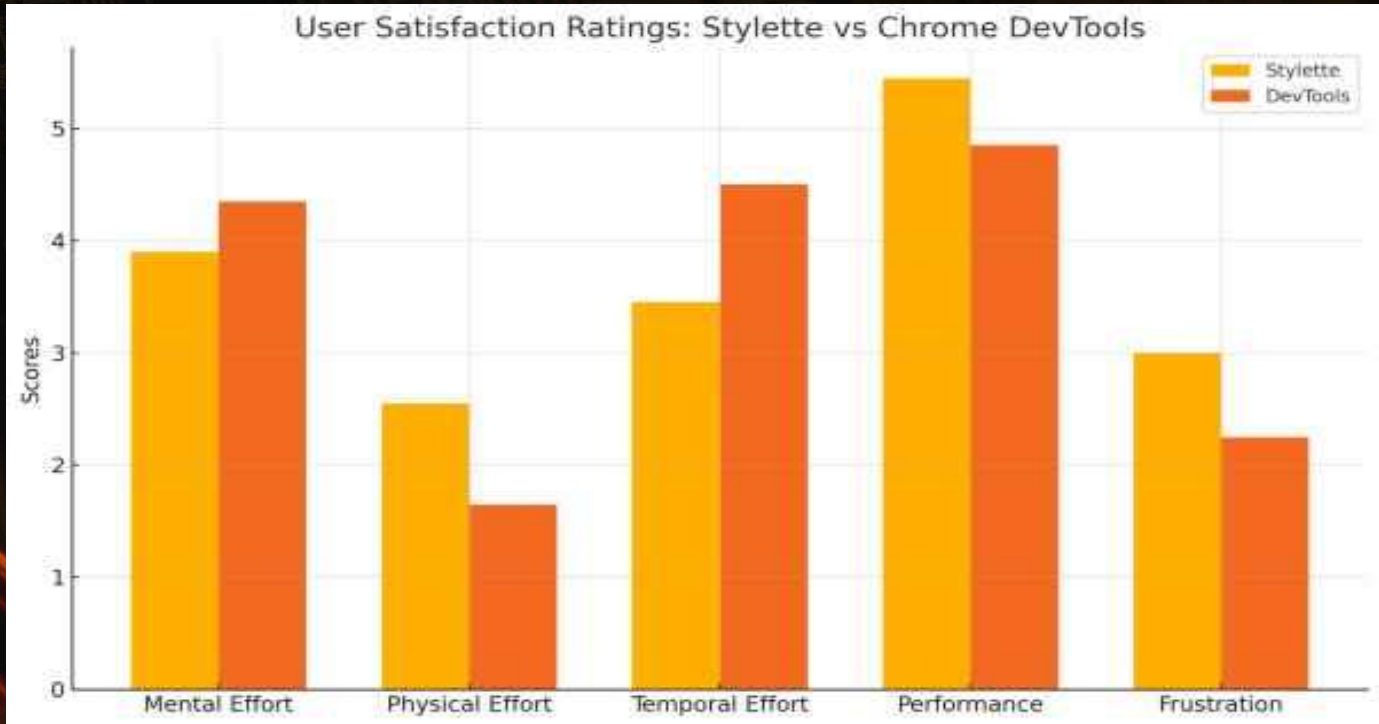
There was also an improved user satisfaction where the scores state that the users find the natural language interface easier and far more enjoyable to use which leads to more efficient workflows in web design.
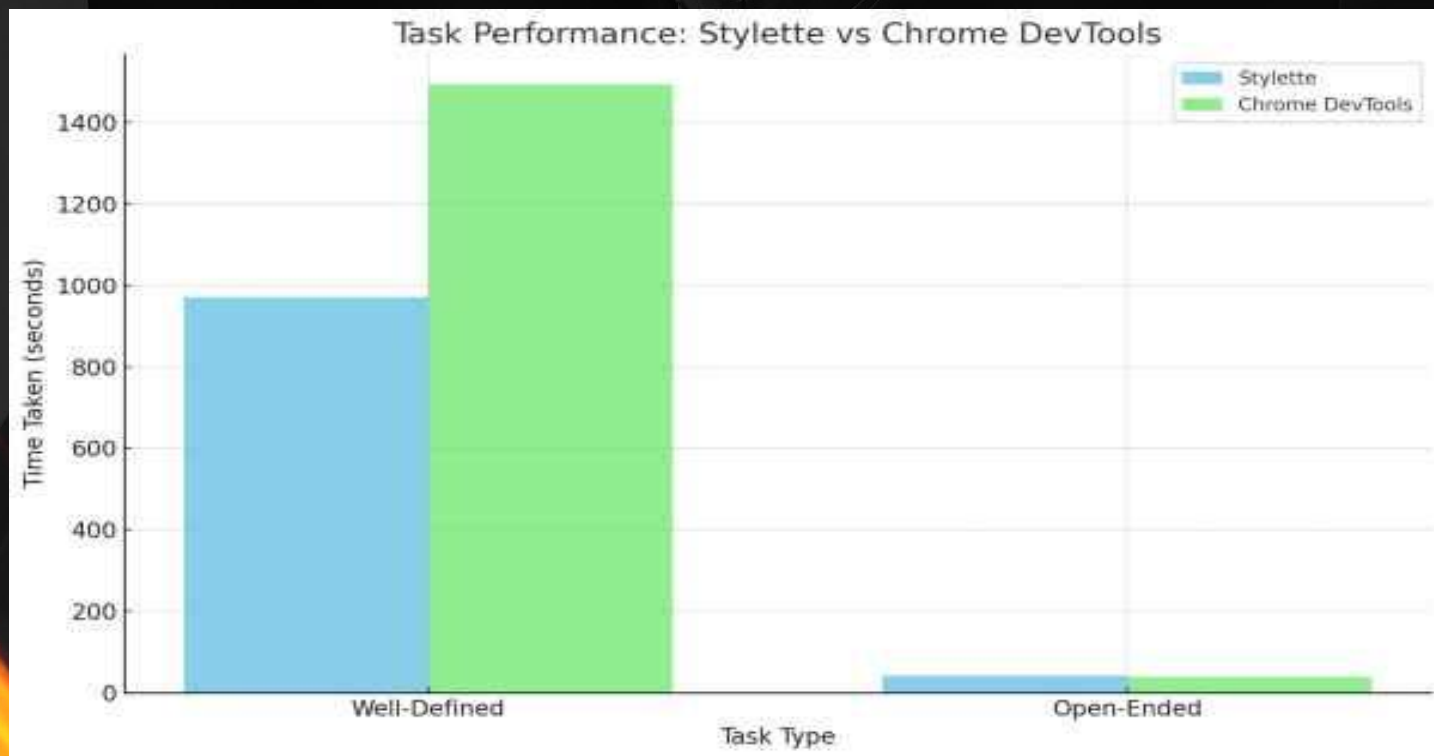
RESULTS CON'T

Stylette provides a better performance when it comes to open ended tasks which shows that it supports a more creative and flexible design process. There is a wider range of styling options which promotes more innovative web designs.

Based on its Iterative Design, it provides multiple alternatives and supports iteration on changes which aligns great with iterative design principles in human-computer interactions. This enhances the quality of the final design by allowing users to refine the choices they made.
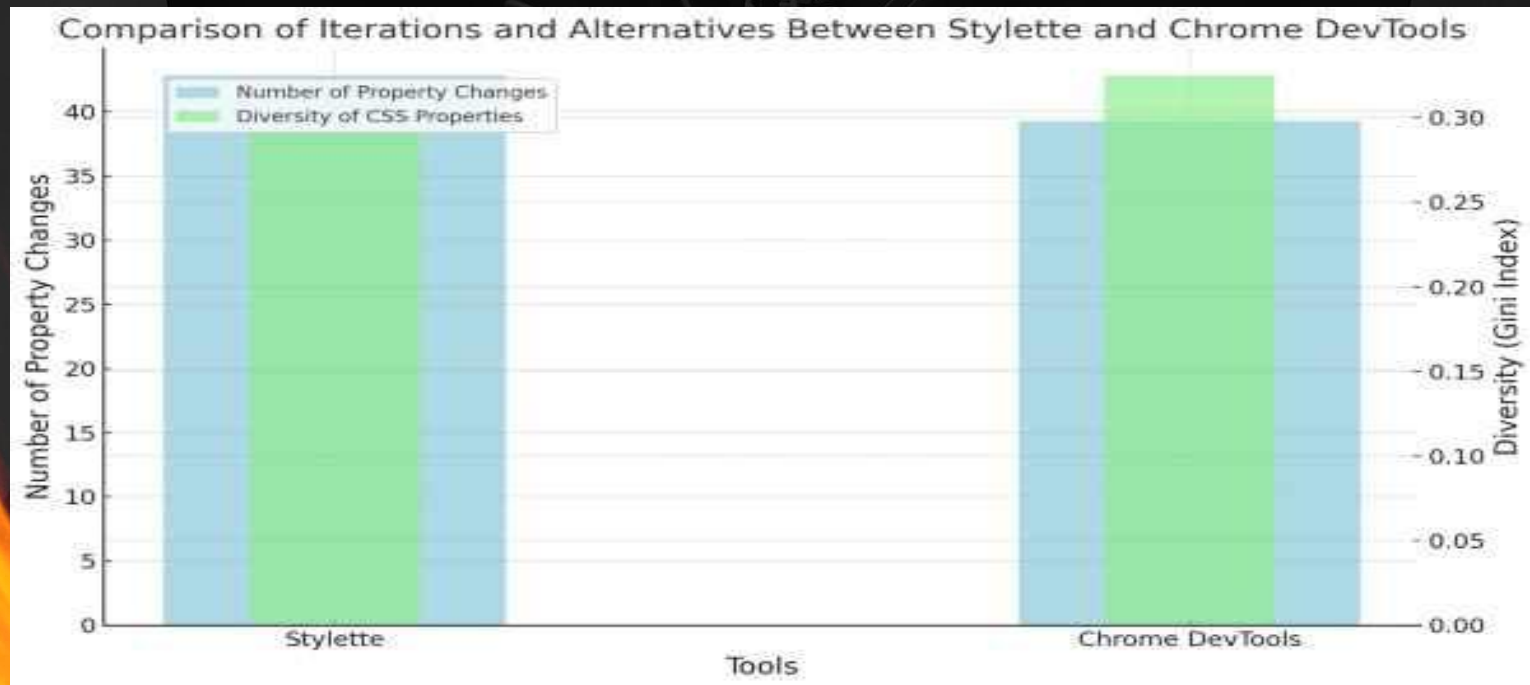
USER SATISFACTION RATINGS

User Satisfaction Ratings: Stylette vs Chrome DevTools

TASK PERFORMANCE GRAPH

Task Performance: Stylette vs Chrome DevTools

COMPARISON GRAPH

Comparison of Iterations and Alternatives Between Stylette and Chrome DevTools

DISCUSSION

Enhanced Accessibility: By allowing users to make styling changes using natural language, Stylette lowers the barrier to entry for web design. This democratises web development, making it accessible to a broader audience, including those without technical expertise.

Improved User Experience: The higher satisfaction scores reported by users indicate that natural language interfaces can make complex tasks more intuitive and enjoyable. This aligns with HCI principles of creating user-friendly and efficient interfaces.

Support for Creativity: Stylette's ability to handle open-ended tasks better than traditional tools suggests that natural language interfaces can foster creativity. Users can explore a wider range of design options, leading to more innovative outcomes.

LIMITATIONS

While Stylette excels with simple and moderately complex styling requests, its effectiveness diminishes with highly complex or specific changes, indicating a need for future improvements.

Despite the general accessibility of natural language interfaces, users may face a learning curve in phrasing their requests, suggesting the tool could benefit from more guidance or examples.

The study's limited participant diversity highlights the need for a larger, more varied sample to better assess the tool's effectiveness across different user groups. Additionally, the accuracy of natural language processing and computer vision technologies can vary, leading to potential misinterpretations, underscoring the necessity for ongoing enhancements to improve reliability.

CONCLUSION

The paper "Stylette: Styling the Web with Natural Language" introduces a browser extension that allows users to modify website styles using natural language commands. By leveraging a large language model and a dataset of 1.7 million web components, Stylette translates user requests into CSS property suggestions, making it easier for users without coding knowledge to customise web pages. The system was found to help users perform styling changes 35% faster than traditional developer tools, and it encourages experimentation and learning through a palette of suggested alternatives.

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