

Diversity in Virtual Humans: Unveiling Biases in Human Characteristics Representation

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Abstract—Recent advancements in Computer Graphics (CG) have significantly enhanced the realism of animations and characters in various media. However, the Uncanny Valley (UV) theory suggests that as Virtual Humans (VHs) become more realistic, they may evoke discomfort. This phenomenon challenges industry professionals and researchers to study human perception, considering diverse characteristics such as gender and skin color. This work investigates human perception and sensations when playing or watching VHs, aiming to answer many questions regarding their visual characteristics. For example, one question examines human perception concerning the relationship between the character’s gender and the participant’s gender. The results showed in-group advantages for participants regarding VHs with binary genders, both in gender attribution and emotion recognition. Additionally, this work explores solutions for deconstructing the gender binary using a genderless Virtual Baby (VB) and an adult VH model. It also discusses the UV effect on VHs with different skin colors, highlighting potential biases in skin color algorithms.

I. INTRODUCTION

Advances in Computer Graphics (CG) have allowed the creation of realistic virtual humans (VHs) [1] in entertainment, often replacing real actors in films and series. Understanding human perception and discomfort related to VHs is crucial to creating realistic experiences [2]. The Uncanny Valley (UV) theory [3] suggests that almost-but-not-quite-human VHs can cause discomfort, linked to human identification [4]. Social Identity Theory [5] explains that individuals favor their in-group over out-groups, affecting perceptions of characteristics such as gender and skin color.

Some questions related to human perception include how the effects of UV are influenced by the gender of VHs or

viewers and whether exposure to CG alters perception, particularly concerning gender diversity and skin color. Tinwell et al. [6] suggested that technological advances increase people’s discernment, implying that UV may never be completely overcome. Gender is a significant factor in VHs perception, with studies showing gender differences in tasks involving facial detection and emotion discrimination [7]–[9]. Despite efforts to increase female VH representation in the media¹², male VHs still dominate³, raising concerns about gender imbalance and its impact on perceptions of comfort and realism [10], [11]. Indeed, people tend to anthropomorphize technologies, attributing human characteristics such as gender to VHs [10], [11], even if they do not have any visual cue. Skin color is another critical factor, with dark colored skin VHs historically being stereotyped in the media⁴. According to Kim et al. [12], techniques for creating skin color often emphasize white skin⁵⁶, leading to questions about whether dark-skinned VHs are perceived as less realistic and more uncomfortable.

This study explores how participants perceive comfort, realism, and emotions in VHs with varying genders and skin colors. It also investigates whether newer CG characters convey more comfort than older ones, whether comfort and realism are perceived differently in male and female VHs, and how skin color affects human perception. Further, the study in-

¹<https://www.playstation.com/en-us/games/the-last-of-us-part-ii-ps4/>

²<https://www.playstation.com/en-us/games/horizon-zero-dawn-ps4/>

³<https://www.statista.com/statistics/871912/character-gender-share-video-games/>

⁴<https://www.pbs.org/independentlens/blog/leveling-up-representation-depictions-of-people-of-color-in-video-games/>

⁵www.youtube.com/watch?v=ROuE8xYLPX8

⁶<https://yaledailynews.com/blog/2022/03/09/yale-professors-confront-racial-bias-in-computer-graphics/>

* Ph.D. Thesis

investigates how genderless VHS are perceived and if participant gender influences this perception. By replicating and extending previous studies, this research aims to understand biases in VH perception to improve VH design and representation. It also explores interaction with VHS, specifically whether gender-based preferences change when interacting with a genderless VH. Finally, it considers if similar preferences emerge when observing a genderless virtual adult, using a perceptual experiment with different naming conditions to analyze these biases. The study contributes to understanding human perception in relation to VHS, aiming to enhance the realism and comfort of virtual experiences.

II. RELATED WORK

This section addresses human perception of VHS with a focus on gender and skin color by reviewing related literature, covering perception concepts, UV theory, and specific examples. Studies have explored how real humans perceive VHS, examining variables like realism, appeal, eeriness, and familiarity. Masahiro Mori's UV theory [3] stated that highly realistic robots can evoke strange feelings. In terms of VHS, Katsyri et al. [4] revisited this hypothesis, suggesting that UV effects occur under specific conditions like inconsistencies in realism. MacDorman and Chattopadhyay [13] explored how reducing visual realism consistency increases UV effects. Banakou et al. [14] found that negative social feedback prevents positive associations with black virtual bodies. Bedder et al. [15] explained implicit bias in white participants using black virtual bodies. Obremski et al. [16] demonstrated reduced racial bias after interacting with VHS. Studies by Zibrek et al. [17], [18] showed that emotional display affects gender classification more than walking movement, and found gender differences in preferred interaction distances with VHS. Durupinar and Kim [19] noted that female VHS are better perceived in conveying emotions. Zhao et al. [20] showed participants better at identifying masculinity and femininity in male and female VHS, respectively. McDonnell et al. [21] showed changes in gender attribution based on VH appearance. Abbruzzese et al. [9] found women better at recognizing emotions expressed by other women.

III. METHODOLOGY

This section analyzes the human perception of VHS/CG characters regarding gender and skin color biases in various media and examines perceptions of binary and nonbinary genders. The first part includes a study comparing perceptions from 2012 and 2020 and creating a diverse dataset of characters. The second part assesses gender bias when people watch or interact with genderless virtual babies and adults.

A. Perception of CG Characters concerning the Advance of Technology

To investigate whether people are more comfortable with newer CG characters than older ones, an experiment was conducted by replicating Flach et al.'s 2012 [22] study using the same questionnaire and images. This study was chosen

due to the diversity of characters in terms of different media, gender, and skin color, facilitating a comparative analysis between perceptions from old and new characters. The original questionnaire included images and videos of characters from games, movies, and the internet, and new characters from 2013-2020 were added to the dataset to observe changes in perception. So, the same ten characters from 2012 were used, and twelve new characters were added. The selection ensured a range of human likenesses and included diverse characters to avoid bias.⁷

1) *Questionnaire and Comfort Chart*: Participants completed a questionnaire via Google Forms without prior knowledge of the study's intent to avoid influencing their responses. The study involved two steps: showing an image of each character followed by a video, with participants answering the same questions after each image/video. The results were used to evaluate participants' perceived comfort and realism. This methodology aims to understand if newer CG characters are perceived more comfortably than older ones, providing insights into changes in human perception of VHS over time. The results for each character were distributed through the Comfort Chart, based on the UV theory, a 2D plot with the X-axis indicating character realism and the Y-axis defining perceived comfort. Based on the answers to the questionnaire, character realism ranges from less to more realistic, while comfort ranges from less to more comfortable, with only positive values used. Figure 1 presents an example of the Comfort Chart.

2) *Results*: The results from the questionnaire were obtained through volunteer participants on social networks and analyzed using statistical methods (refer to the Thesis text for full data and analyses). In terms of realism perception, in one of the results, the very realistic characters in 2020 were perceived as more realistic than their counterparts in 2012. Regarding comfort perception for old characters, it remained consistent between the 2012 and 2020 evaluations (as shown in Figure 1). In addition, participants in 2020 felt more comfortable with new characters than those in 2012 with characters from that era.

B. Perception of CG Characters From a Gender Perspective

This section addresses whether people perceive comfort and realism in female and male CG characters similarly and whether these perceptions change when participants are separated by gender. To explore these questions, perceptual data on comfort and realism from both women and men regarding different female and male characters were used from Section III-A. An equal number of female and male characters were selected from the dataset for analysis, and a Comfort chart was used for character distribution.

1) *Results*: For realism, no significant differences were found in the comparisons between female and male characters, nor between female and male participants. However, in terms

⁷All images and videos of characters from different media of this work were sourced from YouTube, focusing on well-known characters to the general public while including some lesser-known ones.

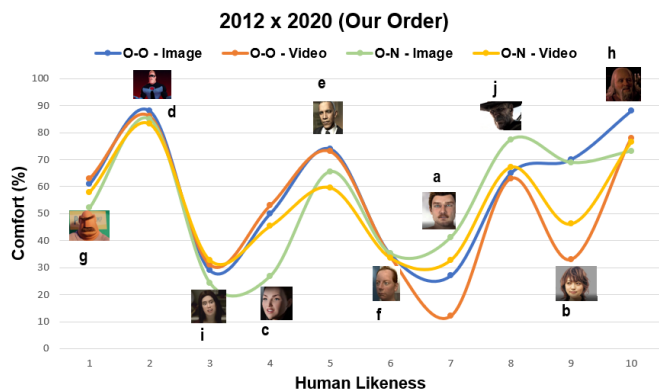


Fig. 1. All the characters used in the work of Flach et al. [22]. The blue and orange lines show the 2012 comfort percentages for each character in images and videos. The green and yellow lines show the same for 2020. Refer to the Thesis text for character letters and additional charts. Note: This image was taken from the paper entitled “Is the perceived comfort with CG characters increasing with their novelty” [23].

of perceived comfort, women felt more comfortable with very realistic female characters than with very realistic male characters. While for men the gender of the characters did not influence their comfort perception.

C. Perception of CG Characters From a Skin Color Perspective

This section investigates perceptions of comfort and realism in CG characters with different skin colors, specifically focusing on dark colored skin characters. The same dataset from Section III-A was used, including perceptual data on CG characters from different media. Only perceptual data for white skinned characters were used from this dataset, while new data were collected for dark colored skin characters. The study focused only on visual attributes without considering narrative context. The same methodology of previous sections was used (stimuli creation, questionnaire process). All demographic data, answers, and analyses are detailed in the Thesis text.

1) *Results:* In terms of realism, dark colored skin characters were perceived as less realistic than white colored skin characters. Regarding comfort, interestingly, dark colored skin characters conveyed more comfort than white colored skin characters. No significant differences were found between different racial groups, though the participants’ racial identification related to white-skinned characters was unknown.

D. Gender Bias in Relation to Observing Virtual Babies

This section explores the perception of genderless VHs to address the following questions: “How do people perceive genderless VHs?”, “Does this perception change based on the participant’s gender?”, and “Do we have a bias in perceiving gender?” To answer these questions, the section replicates and expands Condry and Condry’s experiment [24], where participants watched a video of a baby labeled either as male or female. Their findings indicated a gender bias in emotion perception based on the baby’s labeled gender. The current

study replicate that experiment with a Virtual Baby (VB) and include a third group viewing a gender-unnamed VB. This approach aims to uncover gender biases in VH perception, examining how genderless VHs are perceived and whether observer gender influences these perceptions. The goal is to understand how gender characteristics impact perception and whether designing genderless VHs can mitigate gender stereotypes.

1) *Creation of Stimuli and Questionnaire:* Condry and Condry’s experiment showed participants a video of a real baby reacting to objects. Participants were divided into two groups, one seeing the baby with a female name and the other with a male name. They rated the baby’s emotional reactions to determine if perceived gender influenced emotional perception and gender attribution. In this current work, a 3D model of a VB was used to replicate Condry and Condry’s experiment/methodology in a virtual environment. The VB had animations for crawling, walking, and playing with a ball. Three videos were created showing the VB interacting with a ball, a jack-in-the-box, or a unicorn (shown in Figure 2). The questionnaire was created on the Qualtrics platform and distributed on social networks. Volunteers were divided into three groups: one saw the VB with a female name, another with a male name, and the third with an unnamed VB. They rated the VB’s emotional reactions and answered a question about the VB’s gender. More details on the stimuli, questionnaire, demographic data, and statistical analysis are available in the Thesis text.

2) *Results:* The results mirrored Condry and Condry’s findings. Women perceived the VB with a female name as more emotional than the VB with a male name, while men perceived the VB with a male name and the unnamed VB as more emotional than the VB with a female name. In terms of gender attribution, both women and men attributed gender according to the assigned name, but did not attribute gender when the VB was unnamed.

E. Gender Bias Regarding Interaction with Virtual Babies

This work includes another experiment to measure people’s feelings when interacting with the same VB. Seavey et al. [25] conducted a study similar to Condry and Condry but included interactions between infants and adults. This section aims to assess if participants’ perceptions change when interacting with VBs in 3D environments compared to just watching videos. This study built on the work described in Section III-D by creating a 3D interactive environment. Participants were asked to play with a VB using toys.

1) *Stimuli Creation, Participant Actions and Questions:* In the experiment, participants interacted with a VB using mouse and keyboard in a 3D virtual environment via web browsers. Participants used the same VB, objects, and scenario from Section III-D. They had three possible actions: choosing toys, selecting emojis to represent their feelings, and moving within the 3D environment. The environment was developed using



Fig. 2. Environment and three objects the VB interacts with: (a) the ball; (b) the unicorn; (c) the Jack-in-the-box.

Unity engine⁸, WebGL⁹, and Firebase Realtime Database¹⁰, and hosted on Itch.io¹¹.

2) *Results*: The interactive experiment showed that participants perceived more emotions in the VB compared to those who only watched videos. Unlike the video setup, gender did not influence the interaction with the VB. In terms of gender attribution, participants correctly attributed gender more often when the VB had a male name than when it had no name or a female name. In addition, gender attribution correctness for the female VB was lower in the interactive environment compared to the video environment.

F. Gender Bias in Relation to Observing Adults VHs

In previous sections, we evaluated gender attribution and emotion recognition in relation to VBs. This section addresses whether gender-based preferences also emerge when observing a genderless VH instead of a VB. We focused on textually assigned gender in nonbinary (genderless) adult VHs, alongside male and female adult VHs, during tasks of emotion recognition and gender attribution.

1) *Creation of the Stimuli and Questions*: To minimize binary gender biases, a nonbinary VH model was created with Metahuman Creator¹² by merging male and female features into seven variations. A focus group identified the most nonbinary middle model, and also most male and female models. Figure 3 shows the VH models. Emotion stimuli were created by capturing actors' facial expressions and transferring them to the VHs using the Live Link Face plug-in¹³ in Unreal Engine¹⁴. Participants evaluated happiness and attributed gender to VHs with female, male, or no textual names, divided into three groups for each VH model (nonbinary, female, male). Detailed information on models, participant demographics, statistical analysis, and questionnaires can be found in the Thesis text.

2) *Results*: Results showed that textual gender did not influence happiness perception in nonbinary or binary VHs, contrasting with VB in video setups. Participants recognized

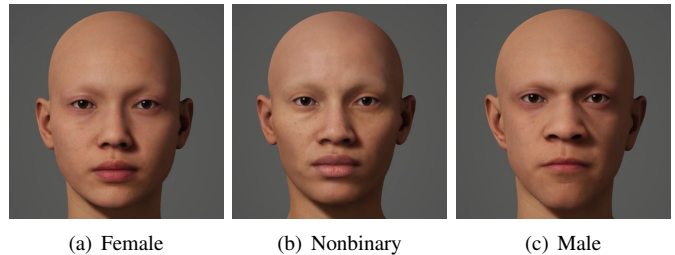


Fig. 3. The binary and nonbinary models: female (a), nonbinary (b), and male (c).

the actress's happiness more in the nonbinary VH, indicating an in-group preference. For binary models, participants recognized the actor's happiness more in the male VH, suggesting a male bias. Overall, happiness was recognized more accurately in nonbinary VHs. Gender attribution was more accurate with nonbinary VHs when textual names were used, suggesting that fewer gender-specific visual cues in nonbinary models helped participants attribute gender.

IV. DISCUSSION

This section aims to briefly discuss the results presented during the thesis development. Concerning VHs of different media, people perceived differences in realism between the 2012 and 2020 characters, suggesting that it is worth investing in very realistic characters if resources allow. Perceived comfort in 2020 was higher than in 2012 for old and new characters, indicating that advances in character modeling improve comfort. However, the 2012 characters' conveyance of comfort has not changed, suggesting that older characters can still convey comfort to viewers. This implies that designers have flexibility in using advanced and less advanced techniques, which benefits those with limited resources. Regarding gender, women felt more comfortable with realistic female characters, suggesting an in-group advantage and potential for increased comfort in realistic games with female characters. The industry should focus on female representation in high-realism products to attract female audiences, as male comfort was less influenced by character gender. In terms of skin color, dark skin colored characters were perceived as more comfortable but less realistic than white characters, potentially due to rendering and illumination techniques favoring white skin [12]. This discrepancy suggests a need for improved

⁸<https://unity.com/>

⁹<https://get.webgl.org/>

¹⁰<https://firebase.google.com/>

¹¹<https://itch.io/>

¹²<https://www.unrealengine.com/en-US/metahuman>

¹³<https://apps.apple.com/br/app/live-link-face/>

¹⁴<https://www.unrealengine.com/>

methods for rendering dark-colored skin for VHs. The study's findings highlight the importance of addressing these biases to enhance equity and representation in CG.

When studying genderless characters, we started with a virtual baby (VB) because it is naturally considered genderless. Most participants perceived a genderless VB baby as male, which aligned with trends in games where male characters are predominantly chosen. Despite the lack of visual gender stereotypes, there were in-group preferences, where women and men perceived emotions in VBs according to their genders. This result aligns with previous research by Condry and Condry [24]. In terms of interactive environments, participants perceived more emotions in interactive VB compared to VB in videos, especially when the VB had a male name. This suggests that different stimuli, like videos and interactive 3D environments, impact user perception. Gender attribution results were similar across both types of stimuli, with a notable bias towards attributing a male gender to unnamed VBs, indicating persistent gender biases even without explicit visual gender cues. For adult VHs, women better recognized happiness in nonbinary VHs animated by an actress, aligning with in-group advantages. Nonbinary VHs had a greater recognition of happiness than binary models, suggesting participants focused more on emotions when gender biases were minimized. Regarding gender attribution, participants had more difficulty attributing gender to female and male VHs than nonbinary VH, particularly when names were assigned. Participants prioritized appearance over name when presented with VHs with distinct masculine or feminine characteristics, resulting in a less accurate gender attribution. Conversely, with nonbinary VHs, participants relied more on the name provided, leading to more accurate responses. This pattern was consistent with the results of the VB experiments, indicating that visual features strongly influence gender attribution. These findings suggest that the use of nonbinary VH models may be a potential solution to combat gender stereotypes, providing valuable information for psychological and CG research.

V. FINAL CONSIDERATIONS

This work proposed a series of experiments to assess how people perceive VHs in contexts involving gender and skin color biases. The studies examined the influence of technological evolution, demographic characteristics, and in- and out-group influences on VH perception. Although there were limitations, such as a lack of participant diversity in skin color and uncontrolled stimuli from different media, the findings were significant for discussions on gender and skin color in society. The research left open hypotheses for future analyses, such as using nonbinary names for genderless VHs and the impact of skin color bias using a continuum of VH models. Future work includes continue investigating VH perception, focusing on creating more inclusive virtual environments using advanced rendering and animation algorithms.

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VI. SCIENTIFIC PRODUCTION

A. Published Research

1 - How Does Computer Animation Affect Our Perception of Emotions in Video Summarization?

Camila Kolling, Victor Araujo, Rodrigo C. Barros, Soraia Raupp Musse

Advances in Visual Computing: 15th **International Symposium of Visual Computing, ISVC 2020**, San Diego, CA, USA, October 5–7, 2020, Proceedings, Part II 15. Springer International Publishing, 2020. p. 374-385. DOI: https://doi.org/10.1007/978-3-030-64559-5_29.

2 - Can we estimate the perceived comfort of virtual human faces using visual cues?

Greice P. Dal Molin, Felipe M. Nomura, Bruna M. Dalmoro, Victor Araujo, Soraia R. Musse

In: 2021 IEEE 15th **International Conference on Semantic Computing, ICSC 2021**. IEEE, 2021. p. 366-369. DOI: [10.1109/ICSC50631.2021.00085](https://doi.org/10.1109/ICSC50631.2021.00085)

3 - Cultural behaviors analysis in video sequences

Rodolfo Migon Favaretto, Victor Araujo, Felipe Vilanova, Angelo Brandelli Costa, Soraia Raupp Musse

Machine Vision and Applications, v. 32, p. 1-24, 2021. DOI: <https://doi.org/10.1007/s00138-021-01225-2>

4 - Is the Perceived Comfort With CG Characters Increasing With Their Novelty?

Victor Araujo, Julia Melgare, Bruna Martini Dalmoro, Soraia Raupp Musse

IEEE Computer Graphics and Applications, v. 42, n. 1, p. 32-46, 2021. DOI: [10.1109/MCG.2021.3090198](https://doi.org/10.1109/MCG.2021.3090198)

5 - Analysis of charisma, comfort and realism in CG characters from a gender perspective

Victor Araujo, Bruna Dalmoro, Soraia Raupp Musse

The Visual Computer, v. 37, n. 9-11, p. 2685-2698, 2021. DOI: <https://doi.org/10.1007/s00371-021-02214-2>

6 - How Much Do We Perceive Geometric Features, Personalities and Emotions in Avatars?

Victor Araujo, Bruna Dalmoro, Rodolfo Favaretto, Felipe Vilanova, Angelo Costa, Soraia Raupp Musse

In: Advances in Computer Graphics: 38th **Computer Graphics International Conference, CGI 2021**, Virtual Event, September 6–10, 2021, Proceedings 38. Springer

International Publishing, 2021. p. 548-567.
DOI: https://doi.org/10.1007/978-3-030-89029-2_42

7 - Perception of Charisma, Comfort, Micro and Macro Expressions in Computer Graphics Characters

Lucas Andreotti, Morgana Luiza Weber, Tiago Luz da Silva, Victor Araujo, Soraia Raupp Musse

In: 2021 20th **Brazilian Symposium on Computer Games and Digital Entertainment, SBGames 2021**. IEEE, 2021. p. 107-116.

DOI: 10.1109/SBGames54170.2021.00022

8 - Perception of Personality Traits in Crowds of Virtual Humans

Lucas Nardino; Diogo Schaffer, Felipe Elsner, Enzo Krzmienski, Victor Araujo, Gabriel Fonseca Silva, Vinícius Jurinic Cassol, Rodolfo Migon Favaretto, Soraia Raupp Musse

In: 2021 20th **Brazilian Symposium on Computer Games and Digital Entertainment, SBGames 2021**. IEEE, 2021. p. 107-116.

DOI: 10.1109/SBGames54170.2021.00023

9 - GrandGamesBR: Perceptual Analysis of Computer Graphics Characters in Digital Entertainment

Soraia Raupp Musse, Greice P. Dal Molin, Bruna M. Dalmoro, Victor Araujo

In: 2021 20th **Brazilian Symposium on Computer Games and Digital Entertainment, SBGames 2021 - GrandGamesBR Forum**. IEEE, 2021. p. 107-116.

DOI: https://doi.org/10.5753/sbgames_estendido.2021.19753

10 - Perception of Computer Graphics Characters in Groups with Skin Color Diversity

Victor Araujo, Diogo Hartmann Muller Schaffer, Angelo Costa, Soraia Raupp Musse

In: 2021 20th **Brazilian Symposium on Computer Games and Digital Entertainment, SBGames 2021 - Jogos Diversos Forum**. IEEE, 2021. p. 107-116.

DOI: https://doi.org/10.5753/sbgames_estendido.2021.19763

11 - Estimating Perceived Comfort in Virtual Humans based on Spatial and Spectral Entropy

Greice P. Dal Molin, Victor Araujo, Soraia Raupp Musse.

In: **VISGRAPP (4: VISAPP)**. 2022. p. 436-443.

DOI: 10.5220/0010831300003124

12 - How do we perceive Characters? An Analysis of Human Perception in Still Images, Animations and VR Scenarios

Victor Araujo, Bruna M. Dalmoro, Rafael Geiss, Márcio S. Pinho, Soraia Raupp Musse.

In: Proceedings of **Brazilian Symposium on Games and Digital Entertainment, SBGames 2022**, Brasil. 2022.

DOI: https://doi.org/10.5753/sbgames_estendido.2022.225436

13 - Towards Virtual Humans without Gender Stereotyped Visual Features

Victor Araujo, Diogo Schaffer, Angelo Brandelli Costa, Soraia Raupp Musse

In: **SIGGRAPH Asia 2022 Technical Communications**. 2022. p. 1-4.

DOI: <https://doi.org/10.1145/3550340.3564232>

14 - Mitigating bias in facial analysis systems by incorporating label diversity

Camila Kolling, Victor Araujo, Adriano Veloso, Soraia Raupp Musse

Computers & Graphics, v. 116, p. 173-184, 2023.

DOI: <https://doi.org/10.1016/j.cag.2023.08.021>

15 - Perceptual Analysis of Computer Graphics Characters in Digital Entertainment

Soraia Raupp Musse, Greice Pinho Dal Molin, Victor Araujo, Diogo Hartmann Muller Schaffer, Angelo Costa Brandelli

In: Forum on Grand Research Challenges in Games and Entertainment. Cham: **Springer Nature** Switzerland, 2020. p. 207-232.

DOI: <https://doi.org/10.1007/978-3-031-27639-2>

Book Chapter

16 - Evaluating the Uncanny Valley Effect in Dark Colored Skin Virtual Humans

Victor Araujo, Angelo Brandelli Costa, Soraia Raupp Musse

In: 2023 36th **SIBGRAPI Conference on Graphics, Patterns and Images. SIBGRAPI 2023**. IEEE, 2023.

DOI: <https://doi.org/10.1109/SIBGRAPI59091.2023.10347145>

17 - Revisiting Micro and Macro Expressions in Computer Graphics Characters

Rubens Montanha, Giovana Raupp, Vitória Gonzalez, Yanny Partichelli, André Bins, Marcos Ferreira, Victor Araujo and Soraia Musse

In: 2023 22th **Brazilian Symposium on Computer Games and Digital Entertainment. SBGames 2023**.

DOI: <https://doi.org/10.1145/3631085.3631228>

B. Ongoing Publications

1 - Examining the Attribution of Gender and the Perception of Emotions in Virtual Humans

Victor Araujo, Júlia Melgare, Diogo Schaffer, Natália Pizzol, Viviane Souza, Angelo Brandelli Costa, Soraia Raupp Musse

ACM Transactions on Applied Perception 2024

Submitted. - Review Process

2 - Evaluating the Gender Label in Virtual Babies Using a 3D Interactive Environment

Victor Araujo, Catherine Pelachaud, Angelo Brandelli Costa, Soraia Raupp Musse

IEEE COMPUTER GRAPHICS AND APPLICATIONS 2024

Submitted - Review Process - Major Revisions

3 - Perception of Micro and Macro Facial Expressions by Driven Animations in Realistic Virtual Humans

Rubens Montanha, Giovana Raupp, Ana Schmitt, **Victor Araujo**, Soraia Raupp Musse

Entertainment Computing 2024

Submitted - Review Process - Minor Revisions

4 - Surveying the Evolution and Challenges in Virtual Human Applications

Paulo Knob, Rubens Montanha, **Victor Araujo**, Greice Pinho, Gabriel Fonseca Silva, Vitor Peres, Soraia Raupp Musse

Computers & Graphics 2024

Submitted. - Review Process - Major Revisions

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