

The Effect of Tattoos on the Perceived Trustworthiness of Virtual Characters in Virtual Environments

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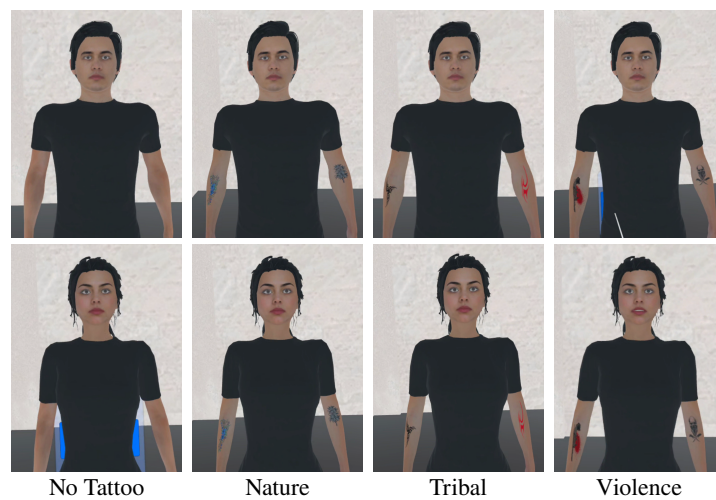


Fig. 1: Virtual characters used in the eight experimental conditions. Each character appears with no tattoo, a nature tattoo, a tribal tattoo, or a violence-related tattoo (columns), for a male (top row) and a female (bottom row) character. Tattoo content was the only manipulated visual feature; all other aspects of appearance were held constant.

Abstract:

Tattoos are a common form of self-expression, but they also act as a social cue: people judge tattooed individuals differently depending on what the tattoo depicts. Virtual characters are now common in social VR, games and training applications, yet it remains unclear whether these biases follow users into immersive environments. We present a first study on how tattoo genre affects the perceived trustworthiness of virtual characters in VR, and whether the character's gender changes this effect. Thirty participants took part in a within-subjects experiment. Standing in front of a locked library door, they were approached by eight virtual characters asking to be let in. The characters differed in gender (female, male) and tattoo condition (no tattoo, nature, tribal, violence) while clothing, posture, animation, height and dialogue were held constant. After each encounter, participants rated

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the character on a seven-point trust scale, and interpersonal distance was recorded as a behavioral measure. Our results show that characters with violence-themed tattoos were trusted the least and those without tattoos the most, with tribal and nature designs in between. Female characters were rated higher than male ones, but this advantage disappeared in the violence condition, where both were rated equally low. Interpersonal distance did not vary across conditions. We conclude that tattoo-related stereotypes reported in real-world studies also apply to virtual characters, at least for explicit judgments. These findings inform designers of social VR, games and procedural character creation, where a single appearance choice can shift how trustworthy a character seems before it says anything.

Keywords: Virtual Reality, Virtual Characters, Tattoos, Perceived Trustworthiness, Social Perception

1 Introduction

Virtual characters are becoming an integral part of social virtual reality (VR), games, and training applications. As interactions with virtual humans become more common, their visual appearance increasingly shapes first impressions and social behavior. Previous research has shown that the visual characteristics of virtual characters can influence perceived traits such as trustworthiness, competence, and social presence [CRN24; WE06]. However, it remains unclear which specific appearance cues carry similar social meanings in immersive virtual environments.

Tattoos represent a particularly relevant appearance cue because they can communicate identity, group affiliation, or personal values. Previous research has demonstrated that tattoo characteristics influence the impressions of real individuals [BTG16; TP17], but it remains unclear whether these effects extend to immersive virtual environments. Unlike static images, virtual characters exhibit movement and social presence, which may alter appearance-based judgments. Furthermore, the influence of tattoo content on the perception of virtual characters has not yet been systematically investigated.

To address the question of whether tattoos on virtual characters influence perceived trustworthiness, we conducted a within-subject virtual reality experiment examining the effects of different tattoo genres on the perceived trustworthiness of virtual characters. Participants interacted with male and female characters displaying tattoos from three genres: Nature, Tribal, and Violence, as well as characters without tattoos. In addition to subjective trust ratings, interpersonal distance was recorded as a behavioral measure to investigate whether character appearance influences participants' spatial behavior.

2 Related Work

In virtual environments, we can often choose the appearance of our avatar. In contrast to the real world, the possibilities are not limited to hairstyles or clothing, but include choices in stylization from very cartoony to very realistic, different genders, ages, body shapes, skin

colors, or even different levels of anthropomorphism, such as embodying robots or aliens [Ou25]. Previous research has shown that the appearance of virtual characters, controlled by a player or computer, affects how they are perceived [ZZM19]. In this work, we investigate how changing the appearance of a virtual character by adding tattoos can influence the trustworthiness attributed to it when interacting in virtual reality.

2.1 Perception of Tattoos

Tattoos are an expression of uniqueness in the appearance domain [TG06] and a means of self-expression [RNP17]. While tattoos are getting a steady growth rate of popularity in the younger generation [PV25], they still carry a stigma and can have negative effects on character assumption [BH17].

Research shows that tattoos affect perceived trustworthiness [BTG16], and this effect can be influenced by gender, which shows a more negative effect on women with tattoos [BH17; SF07], while there is no correlation between having a tattoo and the level of honesty [RW18].

Timming and Perrett [TP17] studied the effects of tattoo categories on the level of perceived trustworthiness of people. They identified and examined five prominent categories of tattoos: violence-themed, nudity-themed, tribal-themed, Christian-themed, and nature-themed. The 221 participants viewed the designs online as 2D pictures of tattoo “flash” art, with hypothetical men and women. The tattoos associated with violent themes were perceived as least trustworthy, followed by nudity-themed tattoos. Tribal-themed tattoos had a neutral effect; the level of trust was higher for Christian-themed tattoos and correlated with participants’ recorded Christian beliefs; and nature-themed tattoos received the highest trust ratings.

Wohlrab et al. showed that tattoos not only affect perceptions of real people but also of virtual characters [Wo09]. Results include that tattooed characters were perceived as more thrilled and adventure-seeking, with perceptions varying significantly between male and female virtual characters.

2.2 Study of Trust

Trust is a foundation for collaboration, and it can be defined as a willingness to accept vulnerability under uncertainty based on positive expectations about the intentions or actions of others [MDS95; Ro25].

Trust has also been shown to be a gendered phenomenon, and studies show that men and women give trust based on different criteria [SS20]. Furthermore, studies suggest that women can receive more trust than men and are expected to be more trustworthy [MB05]. Age also plays a significant role in trust, and some studies suggest older people are more

inclined to trust others [LF13]. These works show the importance of considering gender and age in research about trust.

Perceived trustworthiness can be influenced by many details: For example, the rendering style of a virtual character can affect perceived trustworthiness, with less appealing renderings mostly being judged as less trustworthy [MBB12]. The stylization of an agent can influence perceived trust, with a real agent being rated as more favorably when it comes to ability, benevolence, and integrity than a stylized 3D character [Ga25]. Even incorrect hand motions in a virtual character can lead to a significant decrease in perceived trustworthiness [Ad23]. It has been shown that more attractive individuals are more likely to receive a higher level of perceived trustworthiness [WE06], and that implicit and explicit trust can be influenced by perceived facial attractiveness [Zh15]. Research also suggested that specific visual markers like scars and burn marks can lead to a different level of perceived trust [RB03].

The study of trust has also been explored in virtual environments, and it showed that visual appearance can significantly affect perceived trustworthiness [MES22]. However, it has also been shown that significant visual changes do not always lead to significant changes in trust, for example, the type of stylization of characters [CRN24] or their rendering style [So26]. These mixed results raise the question of whether specific visual markers like tattoos on virtual characters can lead to a more significant change in perceived trustworthiness than completely changing the style of visual representation.

3 Method

To investigate how tattoos influence virtual character trustworthiness, participants evaluated characters that asked for access to a library room in VR. The following sections describe the participants, experimental design, apparatus, procedure, and data analysis.

3.1 Participants

Thirty-two participants were recruited on the university campus by approaching students and university staff. Two participants were excluded from the analysis due to incomplete data. Our final sample consisted of 30 participants, including 17 women, 12 men, and one participant who preferred not to disclose their gender. Participants were between 20 and 55 years old ($M_{\text{age}} = 29.5$, $SD_{\text{age}} = 8.6$). Of the participants, 23.3% reported having a tattoo, and 66.7% reported knowing someone with a tattoo. Participation was voluntary and uncompensated.

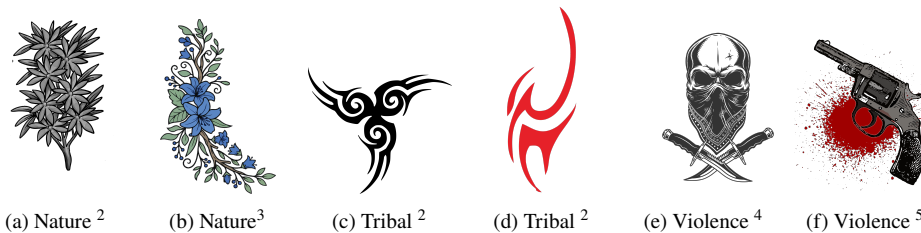
3.2 Experimental Setup and Design

Our study followed a within-subject design. The study employed two independent variables: tattoo genre, operationalized through four levels (No Tattoo, Nature, Tribal, and Violence),

and the virtual character's gender, operationalized through two levels (female and male). Consequently, participants encountered eight virtual characters representing all combinations of tattoo and character gender. The primary dependent variable was the participants' perceived trustworthiness of each virtual character, measured using a seven-point Likert scale. Additionally, we recorded the distance between the character and the participants as a behavioral measure.

The visual stimuli and experimental apparatus were designed as follows. The characters' appearance was manipulated using three of the five genres identified by Timming and Perrett [TP17]: *Nature*, *Tribal* and *Violence*. The *Nudity* and *Christianity* categories were excluded from the study to avoid potential confounding effects associated with religious symbolism and sexual stigma related to nudity.

For each genre, two clearly assignable tattoo designs were selected (see Figure 2), including one colored and one black-and-white design to reduce color-related effects. Both designs were displayed simultaneously on the virtual character's arms to ensure visibility, with adaptations made where necessary for consistency across characters. A control condition (*No Tattoo*) was included in which virtual characters displayed no tattoos.



Two virtual characters, one female and one male, were created using Avaturn from AI-generated reference images. The animations were obtained from Mixamo (Adobe Inc.). Lip synchronization was implemented using the Meta OVR LipSync SDK⁶, while upper facial expressions used scripted animations. The audio was generated using ElevenLabs' text-to-speech model with the voice 'Shay'. To minimize potential confounding factors, all virtual characters had the same height and used identical clothing, facial expressions, body posture, animation, and the same audio using a neutral voice. Only the tattoo appearance and the virtual character's gender varied between conditions.

² Designed by dgim-studio / Freepik.

³ Source: Vecteezy.com

⁴ Source: Pixabay

⁵ Designed by Freepik.

⁶ <https://developers.meta.com/horizon/documentation/unity/audio-ovrlipsync-unity/> (accessed July 22, 2026)

The experiment was implemented in Unity 6 and conducted using Meta Quest 2 head-mounted displays. Participants interacted with the virtual environment using the standard handheld controllers. The virtual environment consisted of a replica of a university building corridor.

3.3 Procedure

The head-mounted display was calibrated individually, and participants received a brief introduction to the VR equipment and controllers before the task.

Participants first completed a demographic questionnaire including age, gender, tattoo ownership, and familiarity with tattooed people. They were then placed in front of a locked library door and encountered eight virtual characters in randomized order, to minimize potential order effects. Each character asked the participant whether they had a key for the library and requested that they unlock the door. The spoken dialogue was identical across all conditions, and only the appearance of the virtual character differed.

Following the interaction, a questionnaire appeared in VR asking participants, "How much do you trust this person?" Participants responded on a seven-point Likert scale ranging from 1 (not trustworthy at all) to 7 (very trustworthy). Additionally, motivated by previous research on proxemics in virtual reality [Zi20], interpersonal distance between the participant and the character was automatically recorded as a behavioral measure after each interaction. Distance was measured as the Euclidean distance between the headset camera's 3D position and the virtual character's world position. Participants were explicitly instructed that they were free to move to inspect the character.

After each rating, the display faded to black and participants were instructed to turn around before the next interaction. Participants completed the experiment individually in virtual reality. The experiment lasted approximately 5 minutes.

3.4 Hypotheses

Based on previous research showing that tattoo genres and gender influence trustworthiness judgments [TP17], the following hypotheses were formulated:

The first hypothesis (H1) states that tattoo category influences perceived trustworthiness ratings, with non-tattooed virtual characters receiving higher trustworthiness rankings than tattooed characters. The second hypothesis (H2) states that tattoo category influences interpersonal distance, with participants maintaining different distances depending on the virtual characters' tattoo category. The third hypothesis (H3) states that the virtual character's gender influences trustworthiness ratings.

3.5 Data Analysis

Descriptive statistics (means and standard deviations) were calculated for perceived trust and distance across all experimental conditions. The effects of tattoo category, virtual character gender, and their interaction were examined using a two-factor repeated-measures ANOVA, applying Greenhouse–Geisser corrections where sphericity was violated.

Shapiro–Wilk tests indicated normal distributions for male character ratings ($p > .05$), whereas female character ratings showed mild departures from normality ($p < .05$) due to baseline ceiling effects. Given the balanced repeated-measures design ($N = 30$) and the robustness of ANOVA to moderate non-normality, the parametric repeated-measures ANOVA was retained as the primary analysis.

Significant effects were further examined using paired comparisons based on participant-level means. Holm-corrected pairwise comparisons were conducted between tattoo categories across and within virtual character genders, and between virtual character genders across and within tattoo conditions. Generalized eta squared (η_G^2) was reported for the ANOVA, and Cohen's d_z was used as the effect size for paired comparisons. The significance level was set at $\alpha = 0.05$. The same analytical procedure was applied separately to perceived trust and distance.

A set of exploratory analyses examined whether participant gender, tattoo ownership, tattoo familiarity, or age moderated these effects. Participant gender, tattoo ownership, and tattoo familiarity were tested using mixed ANOVAs, while age was examined using correlations. Groups smaller than five were excluded, so the participant who did not disclose their gender was dropped only from gender-based analyses. The three-way interaction of participant gender, virtual character gender, and tattoo category was tested using a generalized estimating equations model and a Wald test.

4 Results

Table 1 summarizes the participant-level means for perceived trust. Averaged across virtual character gender, trust was lowest for virtual characters displaying violent tattoos ($M = 4.03$, $SD = 1.72$) and highest for virtual characters with no tattoo ($M = 4.92$, $SD = 1.31$), with the tribal ($M = 4.35$, $SD = 1.30$) and nature ($M = 4.53$, $SD = 1.41$) categories falling in between. Female virtual characters were rated as more trustworthy ($M = 4.84$, $SD = 1.38$) than male virtual characters ($M = 4.08$, $SD = 1.40$).

The two factor repeated measures ANOVA revealed a significant main effect of tattoo category, $F(3, 87) = 5.43$, $p = 0.004$, $\eta_G^2 = 0.039$, Greenhouse-Geisser corrected ($\varepsilon = 0.81$); and virtual characters gender, $F(1, 29) = 10.77$, $p = 0.003$, $\eta_G^2 = 0.055$. More importantly, the tattoo category by virtual character gender interaction was significant, $F(3, 87) = 4.61$, $p = 0.008$, $\eta_G^2 = 0.008$, indicating that the effect of tattoo category on trust depended on the

Tab. 1: Participant-level means and standard deviations for perceived trust by tattoo category and virtual character gender.

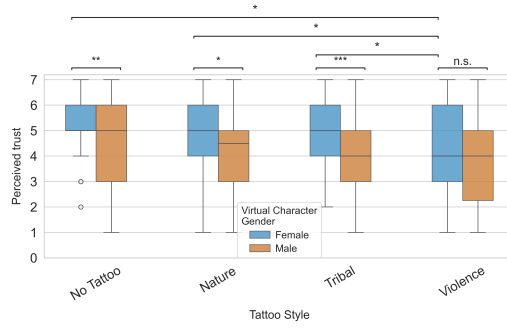
Tattoo category	Female		Male		Overall	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
No Tattoo	5.37	1.33	4.47	1.63	4.92	1.31
Nature	4.90	1.60	4.17	1.58	4.53	1.41
Tribal	4.90	1.47	3.80	1.52	4.35	1.30
Violence	4.20	1.94	3.87	1.81	4.03	1.72
Overall	4.84	1.38	4.08	1.40		

character's gender. Simple-effects analyses showed that, averaged across character's gender, only the difference between the violence and no-tattoo conditions remained significant after Holm correction ($M_{diff} = -0.88$, $t(29) = -3.24$, $p_{Holm} = 0.018$, $d_z = -0.59$). Thus, characters displaying violent tattoos were perceived as less trustworthy than characters without tattoos.

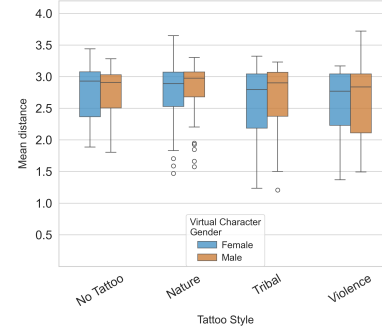
For female characters, the tattoo category had a significant effect, $F(3, 87) = 8.06$, $p < 0.001$, $\eta_G^2 = 0.066$. Violent tattoos received lower trust ratings than tribal, nature, and no-tattoo conditions (all $p_{Holm} < 0.05$), whereas no other pairwise comparisons were significant. For male characters, the omnibus effect of tattoo category was not significant, $F(3, 87) = 2.85$, $p_{GG} = 0.058$, $\eta_G^2 = 0.026$, and none of the pairwise comparisons remained significant after the Holm adjustment. The simple effect of virtual character gender was inspected within each tattoo category. The trust advantage for female virtual characters was absent in the violence condition ($M_{diff} = 0.33$, $t(29) = 1.22$, $p_{Holm} = 0.231$), whereas female characters were trusted more than male characters for tribal ($M_{diff} = 1.10$, $t(29) = 4.10$, $p_{Holm} = 0.001$, $d_z = 0.75$), no tattoo ($M_{diff} = 0.90$, $t(29) = 3.46$, $p_{Holm} = 0.005$, $d_z = 0.63$), and nature conditions ($M_{diff} = 0.73$, $t(29) = 2.71$, $p_{Holm} = 0.023$, $d_z = 0.49$). Thus, the gender difference in perceived trust disappeared specifically for virtual characters displaying violent tattoos, where both genders received similarly low ratings (see Figure 3a).

Exploratory analyses showed that the effects of tattoo category and character gender remained stable across participant gender, tattoo ownership, and age. Participant gender ($p = 0.144$ for the three-way interaction), tattoo ownership ($p = 0.83$), and age ($r = -0.23$, $p = 0.23$) did not affect trust. Familiarity with tattooed people had no main effect ($p = 0.65$), but interacted with virtual character gender ($F(1, 28) = 7.87$, $p = 0.009$): participants without tattoo familiarity trusted female characters more (5.10 vs. 3.50), whereas participants with tattoo familiarity rated male and female characters more similarly (4.71 vs. 4.36).

For the distance measure, means were highly similar across tattoo-design conditions and characters gender (see Figure 3b). The two-factor repeated-measures ANOVA revealed no significant effects of tattoo category, $F(3, 87) = 2.41$, $p = 0.075$, $\eta_G^2 = 0.010$, character gender, $F(1, 29) = 0.51$, $p = 0.480$, $\eta_G^2 < 0.001$, or their interaction, $F(3, 87) = 0.23$, $p = 0.874$, $\eta_G^2 = 0.001$. Therefore, no follow-up comparisons were conducted.



(a) Trust ratings by tattoo category and virtual character gender.



(b) Distance by tattoo category and virtual character gender.

Fig. 3: Comparison of trust ratings and distance across conditions.

5 Discussion and Limitations

This study examined whether tattoo genre and character gender influence the perceived trustworthiness of virtual characters and whether these effects extend to interpersonal distance in VR.

Our findings partly replicate the pattern reported by Timming and Perrett [TP17]. As in their study, violent tattoo designs were trusted the least, whereas the tribal genre occupied an intermediate position. By additionally including an untattooed control condition, we found that characters without tattoos received the highest trust ratings. Overall, the results indicate that trust depends on both the presence of tattoos and their design. We can therefore confirm our hypothesis **H1**.

The low trust associated with violent tattoos supports the idea that certain tattoo motifs act as cues of aggression or threat. Even though all characters shared identical clothing, posture, and dialogue, violent imagery alone reduced perceived trustworthiness. Tribal tattoos produced intermediate ratings, although one participant interpreted a red tribal design as resembling blood, highlighting the difficulty of separating tattoo genre from specific design characteristics.

Female characters were generally perceived as more trustworthy than male characters, supporting hypothesis **H3**, that the virtual character's gender influences perceived trustworthiness. Some previous findings reported stronger negative evaluations of tattooed women, which we could not confirm [BH17; SF07; TP17]. The difference between female and male characters disappeared for violent tattoos because these designs reduced trust in female characters to the level of male characters. Rather than creating a gender bias, violent tattoos eliminated an existing one, suggesting that tattoo meaning and character gender interact in shaping first impressions. Exploratory analyses further indicated that participants familiar

with tattooed individuals rated male and female virtual characters more similarly than participants without such familiarity. Although this finding is consistent with the idea that familiarity reduces stereotypes, it should be interpreted cautiously because it was based on small subgroups.

In contrast to trust ratings, interpersonal distance did not vary across tattoo genres or character genders, failing to support hypothesis **H2**. Participants reported distinct trust levels without translating them into spatial positioning. This dissociation between explicit judgment and spatial behavior may reflect virtual environment constraints, where distance adjustments depend on comfortable movement rather than character perception, or suggest that VR interpersonal distance is governed by scene layout and movement mechanics rather than trust.

Several limitations should be considered. The sample ($N = 30$) was primarily drawn from a university population with few tattooed individuals, limiting generalizability. Furthermore, the brief interactions relied mainly on self-reported first impressions and covered a limited range of tattoo styles. Methodologically, the within-subjects design exposed participants to identical dialogue across eight trials; while controlling for individual baseline differences and counterbalancing trial order, this repetition may have increased task familiarity and introduced demand characteristics. Additionally, while keeping clothing and posture strictly constant ensured high internal validity to isolate tattoos as a single variable, it simplified real-world perception where tattoos interact with broader subcultural aesthetics, potentially drawing heightened visual focus to this single feature. Encountering these repeated visual variations under neutral instructions may have implicitly primed participants toward skin features, slightly constraining ecological validity.

These findings indicate that tattoo-based biases reported in real-world perception studies extend into VR, at least at the level of explicit trust judgments. This has practical relevance for the design of virtual characters in social virtual reality, games, and procedural character creation, where the visual style of a tattoo can shift how trustworthy a virtual character appears.

6 Conclusion and Future Work

This study investigated whether tattoo-related appearance cues influence the perceived trustworthiness of virtual characters in immersive VR. Our findings show that tattoo-related stereotypes observed in real-world perception also extend to virtual characters.

Characters displaying violent tattoos were perceived as less trustworthy than untattooed characters, while virtual character gender moderated this effect. Female characters were generally trusted more than male characters, but this advantage disappeared for violent tattoos. In contrast, tattoo appearance did not influence interpersonal distance, suggesting that explicit trust judgments and behavioral responses may not always align. Future work should

examine whether this results from contextual factors, interaction design, or differences between perceived trust and actual behavior.

These findings highlight practical implications for designing virtual characters in social VR, games, and training applications, where appearance choices can unintentionally shape first impressions and trust. Future studies should use larger and more diverse samples, broader tattoo and virtual character designs, longer interactions, and behavioral trust measures. Additionally, cultural background and realism should be examined to better understand tattoo-related biases in virtual environments.

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