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Examining the Proteus effect on misogynistic behavior induced by a sports mascot avatar in virtual reality

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The Proteus effect is a phenomenon found in over 60 studies where people tend to conform behaviorally to their avatars' identity characteristics, especially in virtual reality. This study extends research on the Proteus effect to consider organization-representing avatars and misogynistic behavioral outcomes. Male participants ($N = 141$) in a lab experiment embodied a set of pretested avatars which varied in level of association with a university mascot (i.e., color and body type) in a bespoke virtual reality simulation designed to elicit misogynistic behavior. Namely, participants were directed to place a hand on virtual agents' body parts, including the buttocks (i.e., a transgressive misogynistic act). Time delay in complying with directions to touch the agents' buttocks served as an implicit measure of resistance to this misogynistic behavior. Results suggest that within moderately masculine body-size avatar users, those who embodied a university-color-associated avatar exhibited more misogynistic behaviors (i.e., faster buttocks-touching). Unexpectedly, this effect of avatar color was not apparent within the hypermasculine body-size avatars, and within the university-associated color condition, hypermasculine body-type was associated with less misogynistic behavior. These findings suggest that organization-representing avatars may induce behavioral conformity to implicit attitudes associated with the organization, such as misogyny.

Keywords Avatars, Experiment, Misogyny, Proteus effect

Avatars are usually thought to represent individuals[1], but groups or organizations also utilize digital self-representations akin to avatars, such as mascots or virtual influencers[2]. The present exploratory research examines this notion of organization-representing avatars within the university sports-culture context in order to extend theorization on the Proteus effect, the phenomenon that people tend to conform behaviorally to their avatars' identity characteristics[3]. Building on the logic that mascots represent university sports communities, this study tests if a university's hypermasculine sports mascot used as an avatar induces misogynistic behaviors via the Proteus effect. This research extends theorization on the Proteus effect to include organization-representing avatars in the context of anti-social (i.e., misogynistic) effects.

The Proteus effect

Research on the Proteus effect suggests that when people use avatars, they conform behaviorally to their associations with the avatars' identity characteristics[3]. The Proteus effect has been found in over 60 studies, and recent meta-analyses suggest that the effect size is relatively robust ($r = 0.24$), especially in studies conducted in virtual reality ($r = 0.30$)[4,5]. The Proteus effect has been studied across multiple domains, often with positive connotations for the outcome behaviors examined. For example, perceived avatar height, intelligence, and body shape have been found to influence negotiation prowess, creativity while brainstorming, and exercise activity, respectively[6–8]. Some previous work has explored anti-social behavioral outcomes of the Proteus effect, such as KKK-associated avatars leading to more aggressive intentions[9], sexualized avatars leading to more self-objectification and rape myth acceptance[10,11], and gendered avatars triggering stereotype threat[12,13]. However, no previous research of which we are aware has examined how avatars might induce misogynistic *behavior*, perhaps because of challenges in designing and conducting such a study. The present research addresses this gap, examining the impacts of

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hypermasculine, organization-representing avatars (i.e., mascots) on misogynistic behaviors in a virtual sports environment via the Proteus effect.

Early research on the Proteus effect was inspired by studies of similar phenomena—such as the finding that wearing black (compared to light) jerseys during sports induced more aggressive behavior because of color stereotypes (e.g., black symbolizing aggression)[14]—and offered multiple theoretical explanations of the Proteus effect. Combining these explanations, we infer that the phenomenon occurs because users associate avatar characteristics with their self-perception[7], especially when they experience a sense of embodiment[15] or deindividuation (i.e., less attention on inward, differentiating characteristics) in an avatar[16]. Put another way, avatar use primes avatar-associated characteristics[9], causing users to temporarily incorporate these avatar characteristics into user self-concept, thereby influencing user behavior[4,17,18]. Further, as predicted by the Social Identity model of Deindividuation Effects (SIDE), avatars potentially diminish individuating (i.e., personally relevant, differentiating) information[19], making people more susceptible to the influence of group norms[3,7], though recent findings suggest that social identification can hinder the Proteus effect if those social cues are misaligned with the avatar's identity characteristics[16].

Regardless of the specific mechanism, stereotypes are a central component of the Proteus effect. When avatar appearance is associated with stereotypical schemas, such as masculine avatars with dominance and decisiveness, using such avatars leads to adopting or reinforcing the stereotypes both attitudinally and behaviorally[20,21]. From this perspective, previous Proteus effect findings, including the influence on negotiation style, creativity, and physical activity performance[6–8], can all be seen as the participants adopting latent stereotypical schemas they had in mind based on their perception of the avatars' characteristics. Tall people are stereotypically stronger negotiators. Inventors are seen as more intelligent. Body weight is associated with exercise. Such minor, latent stereotypes linked to avatars can lead to pronounced Proteus effects. However, little research has been conducted on avatars representing organizational or cultural stereotypes.

Mascots as avatars

This research extends the literature to consider organization-representing avatars, such as university mascots, which potentially induce the Proteus effect through associations between the organization (e.g., university) and avatar (e.g., mascot). Research suggests that university students associate themselves more with the university mentally and behaviorally through "BIRGing, or basking in reflected glory after a team victory"[22]. When a university sports team wins, students and other community members tend to feel socially connected to the sports teams and sports culture, expressing this identity connection by displaying iconography (e.g., on clothing, bumper stickers, etc.) associated with the university, such as mascots[23,24]. In other words, mascots are embodiments of university sports culture and are largely visible on university-associated merchandise, so when people display a mascot as a personal identity symbol, they are treating the mascot as a sort of avatar that represents university sports culture. We posit that this interpretation of mascots as avatars of universities can be extended to other types of organizations (e.g., companies, government agencies, brands) that use fictional characters to represent or embody the organization's identity.

Given that avatars can influence users' real-world behaviors and attitudes based on the Proteus effect, the need to understand avatars' social impact becomes increasingly important as avatar-mediated communication becomes more common and interest in the metaverse continues to grow. Gaining more insight into how avatars that represent organizational and cultural stereotypes can influence social behaviors and attitudes is important for societal development in the metaverse era.

Mascots and masculinity

Although university mascots are not necessarily hypermasculine, university sports culture is often associated with hypermasculinity, so hypermasculine mascots likely reinforce this association. This is potentially problematic because hypermasculinity is associated with sexually aggressive attitudes toward women, "macho" culture, and misogyny among college males[25–30]. Misogyny, defined as norms which promote dehumanization and objectification of women[31,32], pervades sports culture and not only discourages women from participating in sports[33] but also creates a hostile environment for female sports fans, which often leads to attacks against them[34,35].

University mascots that are depicted as hypermasculine (e.g., with exaggerated upper body muscle) might be stereotypically associated with misogynistic attitudes. Further, even if a mascot is not hypermasculine but the university sports culture is associated with hypermasculinity, then the university mascot may also be associated with misogyny. In that sense, the more an avatar resembles the impression of a university mascot, the more readily the avatar could be associated with the university sports culture and, in turn, misogynistic attitudes. Therefore, the current study examines two major elements regarding the resemblance of a character, the general body type (e.g., hypermasculine) and the color (e.g., university-associated).

Extrapolating from previous research on the Proteus effect, embodying a university mascot as an avatar should lead the user to exhibit misogynistic behaviors either if the mascot is hypermasculine or the mascot displays the university's colors, assuming the university's sports culture is associated with hypermasculinity. Further, we expect an additive effect of hypermasculinity and the matching color of the mascot avatar on users' misogynistic behaviors. Thus, we propose the following hypotheses to further reflect our reasoning:

Hypothesis 1 Using an avatar with a university mascot's hypermasculine body type, compared to a moderately masculine body type, will lead to more misogynistic behaviors.

Hypothesis 2 Using an avatar with a university mascot's colors, compared to other colors, will lead to more misogynistic behaviors.

Hypothesis 3 There is an interaction effect between avatar color and body type such that the greatest misogyny will result from mascot avatars with a university mascot's colors and hypermasculine body type.

Method

This research took place in two parts: an online pre-test to assess and guide the design of the university mascot avatars for use in an experimental study and then the experimental study designed to test our hypotheses.

Avatar design pretest

Our research team, which included a faculty member, graduate students, and undergraduate students focusing on game design, collaboratively and iteratively designed four avatars. One reflected the body shape of the contemporary Michigan State University (MSU) mascot figure, with broad shoulders and thick arms, which we reasoned would be perceived as highly masculine given that such cues tend to influence masculinity perceptions[36,37]. The other avatar body type, which we expected to be perceived as less masculine, was thinner and less muscular. Our research team drew 2-dimensional images of both body types in two colors, green (MSU's mascot colors) and red (for comparison). See Fig. 1 for the green images (the red images are not shown for trademark policy reasons).

We then recruited 161 participants from the MSU student population to complete an Institutional Review Board (IRB)-approved online survey to assess these avatars. Responses from 157 participants were used for the analysis after removing incomplete responses. Each participant was randomly assigned to rate one of the four avatars (2 body types × 2 colors) on a variety of items, including "This character looks masculine," "This character looks dominant," and "This character reminds me of MSU." Responses on the first two items measuring masculinity were positively correlated ($r = 0.59$), so we used a mean of the two as a composite metric of perceived masculinity. According to an analysis of variance (ANOVA) with avatar body type and color as the independent variables, perceived masculinity was significantly influenced by avatar body types [$F(1, 153) = 5.977$, $p = 0.016$, $\eta_p^2 = 0.038$] but not by color nor the interaction between size and color. However, association with MSU was significantly influenced by color [$F(1, 153) = 5.695$, $p = 0.018$, $\eta_p^2 = 0.036$], not size nor the interaction. In other words, the larger body mascot avatar was perceived as more masculine than the moderately masculine avatars regardless of color, while green mascots were perceived as more associated with the university, regardless of size. Hence, we designed similarly shaped 3-dimensional avatars for use in our lab-based experiment. However, based on qualitative feedback, we chose purple instead of red as the contrasting color for the lab-based experiment in order to avoid associations with any of the university's main rivalries (i.e., blue, yellow, and red).

Lab experiment

Our experiment—approved by and consistent with the guidelines of the IRB at Michigan State University's Human Research Protection Program—was conducted at Michigan State University approximately 2 years after the university had been the subject of widely discussed news reports about misogynistic abusive practices related to university sports. Despite the two-year delay (in part a result of the time required to design and develop this study), the concerns about misogynistic culture at the university were still frequently discussed by the university administration and in community news (e.g., the university president resigned around this time as a result of the exposed abusive practices). The study followed a 2 (avatar color: own university-associated—green—or not-associated—purple) × 2 (avatar body: hypermasculine mascot or moderately masculine mascot) between-subjects design. A third body type (non-athletic) was designed as a control condition but not included in this analysis because its appearance differed too significantly from the main body types of interest in this study.

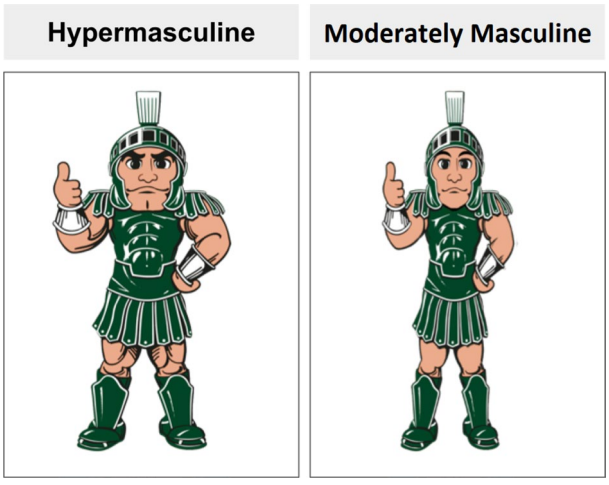

Fig. 1. Avatar designs in the university-associated color (green) used in the pre-test. The non-university associated color (red) avatars are not shown here for trademark reasons. Sparty is a registered trademark of Michigan State University, all rights reserved.

A university research sampling pool was used to recruit anonymous adult men living in the university community area, and a total of 250 people participated in the study. Participants' age ($M = 22.2$; $SD = 6.27$) and race (62% White, 24% Asian, 8% Other, and 6% Black or African American) were consistent with the local area's demographics. Given that this study is designed based on heteronormative assumptions about men being attracted to women and thus engaging in misogynistic behaviors, we asked participants the extent to which they identify as "opposite-sex attracted." Participants who responded with a 1 ("not at all") or 2 ("slightly") or did not respond were not considered in the analyses, leaving participants who responded with 3–5 ("somewhat," "strongly," or "very much) in the study sample, $N = 141$. This metric of participant sexuality was evenly distributed across conditions [$\chi^2(6, N = 250) = 10$, $p = 0.123$].

According to power analysis using the R package pwrss version 0.3.1[38]—with a significance criterion of $\alpha = 0.05$, power = 0.80, and effect size = 0.29[5], the minimum sample size needed to detect a meaningful effect with the desired level of power was 22 (5.5 per group). Thus, the obtained sample size of $N = 141$ was more than adequate to test the study hypotheses.

Procedure

All recruited participants read and signed an informed consent form before completing the study. Upon arrival, participants were given an HTC Vive virtual reality (VR) headset and two hand controllers, which, together with two base stations, precisely tracked participants' head and hand locations and movements in six degrees of freedom. Participants were randomly assigned to avatar conditions and placed inside a model football stadium built in Unity version 2018.3.6f1. Participants then engaged in the task of taking "selfies" with 3D models ("virtual agents") of attractive young women, posing with them in the virtual mirror (Fig. 2). During the entire experience, the participants stood in front of a virtual mirror, which helped make the selfie-taking task more believable while also serving to remind participants of their avatar's identity, thereby reinforcing the experimental manipulation. After a 30-s orientation to the environment, participants completed a brief tutorial in which they were instructed to pose with one hand held in a translucent target box. After practicing on five boxes, a female virtual agent appeared along with the prompt, "Can we take a picture?" above the mirror, followed by a target box on a specific part of a virtual agent's body, either her shoulders, upper back, lower back, or buttocks (see examples in Fig. 2). Before completing the final questionnaire, participants were asked to pose twice with eight different virtual models each (16 total trials). The order of body parts across trials was consistent between participants, with the box placed at the buttocks for trials 4, 6, 8, 9, 11, 13, 15, and 16.

For successful trial completion (indicated by a flash and camera noise), participants were required to hold their hands in the target boxes for five consecutive seconds within a 10-s period. In order to ensure a consistent experience and timing between participants, a limit was placed on the maximum time per trial. Trials in which participants did not place their hands in the target box within 10 s were considered "failed" trials, with no data recorded for that trial. Following failed trials, the virtual environment would automatically advance to the next trial, meaning participants never completed the failed trials. Trials in which participants entered the

Fig. 2. Left top: first-person view of an upper back trial; Right top: an example of the photo-taking task; Left bottom: hypermasculine university-color avatar, Right bottom: moderately masculine university-color avatar.

target box but then removed their hand before the required five seconds had elapsed were considered "flawed" trials. Participants were given an additional five s to return their hands to the target and complete the trial (i.e., by holding their hand in the box for five additional seconds). If they did so, the trial could be completed within 10 s from the start, but it was considered flawed. This approach allowed participants to experience the same general pattern between trials. However, the data from such flawed trials were inherently different from those of successful trials, with no clear way to calculate a comparison between the two. Hence, we chose to remove flawed (in addition to failed) trials from the analysis in order to increase data reliability. Note that the number of failed ($M = 0.606$, $SD = 1.35$) and flawed ($M = 0.568$, $SD = 0.875$) trials per participant was rare compared to completed trials ($M = 14.8$, $SD = 1.72$). Further, according to Fisher's exact test, the number of flawed ($p = 0.476$) and failed trials ($p = 0.523$) was not influenced by condition before the screening, and there were no differences found in observed proportions after screening (failed: $p = 0.898$, flawed: $p = 0.924$). Note also that there were 9 participants who did not succeed in completing any buttocks trial (i.e., all trials were failed or flawed), so they were removed entirely from the analysis, leaving an effective sample size of $n = 132$, which was still adequate according to our power analysis.

Measures

Time-to-touch virtual body parts

The amount of time elapsed was measured for each trial. Time-to-touch buttocks trials were used as an implicit measure of misogynistic behavior, with more time indicating greater buttocks-touching resistance (i.e., less misogynistic behavior). People generally recognize that a man touching a woman's buttocks is socially inappropriate and misogynistic[39]. Given that studies find that people respond to media agents as they respond to other humans[40,41] and that touching a robot's buttocks led to more physiological arousal than other body parts[42], touching a virtual agent's buttocks should also be understood as inappropriate. In other words, the act of virtual-agent buttocks touching can be interpreted as misogynistic and transgressive because it represents a violation of a woman's autonomy[43]. Thus, we reasoned that men influenced to behave misogynistically—through the Proteus effect based on their avatar's appearance—would place their hand on the virtual agent's buttocks more quickly. We constructed a mean time-to-touch metric from all of the eight buttocks-touching trials ($M = 6.47$, $SD = 0.634$, min = 5.05, max = 8.70, skewness = 0.67), which exhibited a sufficiently normal distribution. The reliability across these eight measures was somewhat low (Cronbach's $\alpha = 0.68$), but we considered this acceptable given that the metric is based on behavior with high variability (i.e., hand movement in virtual reality).

Avatar-university association

The perception of the avatar as representing the university was included as a manipulation check. This composite measure was constructed from an average of responses to "The character I controlled reminded me of Michigan State University" and "The character I controlled represents Michigan State University" on 5-point scales of agreement ($r = 0.68$, $p = 0.000$).

A number of additional items were given in the post-survey but not included in the present analysis because this study's primary goal was to focus on behavioral outcomes.

Results

Manipulation check

A manipulation check was conducted to test the assumption that using an avatar with the university's colors and with the university mascot's hypermasculine body type would be perceived as representing the university to a greater extent than an avatar with non-university colors and a moderately masculine body type. Because the homogeneity of variance assumption was not satisfied, a linear model using generalized least squares was performed with avatar color and avatar body type as the independent variables and perception of the avatar as reflecting the university as the dependent variable[44]. The main effect of avatar color was not significant ($b = -0.07$, $t = -0.39$, $p = 0.69$), but the main effect of avatar body type was significant ($b = -0.92$, $t = -3.21$, $p = 0.00$). Additionally, the interaction effect between the two was marginally significant, $\alpha = 0.9$ ($b = 0.62$, $t = 1.75$, $p = 0.08$). A graph of this test (Fig. 3) suggests that avatar-university association was highest in the hypermasculine (mascot-like) body type condition, regardless of avatar color, while in the moderately masculine body type condition, perceived university reflection was higher in the university-color condition. To confirm this interpretation, we conducted two simple effects tests. Within the hypermasculine body type condition, avatar-university reflection did not differ significantly by condition ($p = 0.70$). Within the moderately masculine body type condition, avatar-university reflection was indeed higher in the university-color condition, $t(45.13) = 2.09$, $p < 0.05$. These results suggest that the manipulation was successful as intended.

Main analyses

We then conducted an ANOVA with avatar color and avatar body type as the independent variables and the measure of misogynistic behavior, time-to-touch buttocks trials, as the dependent variable in order to test Hypotheses 1–3. Across color and body type conditions, normality and homogeneity of variance for time-to-touch buttocks were assessed by the Shapiro–Wilk test and Levene's test, but no violations were found. The main effect of mascot body type was not significant, $F(1, 128) = 0.90$, $p = 0.344$, $\eta_p^2 = 0.01$, which is not consistent with H1. The main effect of mascot color was significant, $F(1, 128) = 6.37$, $p = 0.013$, $\eta_p^2 = 0.05$, consistent with H2. Finally, the 2-way interaction between mascot color and mascot body type was also significant, $F(1, 128) = 4.02$, $p = 0.047$, $\eta_p^2 = 0.03$. Results (Fig. 4) suggest that in the moderately masculine mascot condition, using an avatar with university-associated colors led to the lowest buttocks-touching delay—meaning more misogynistic

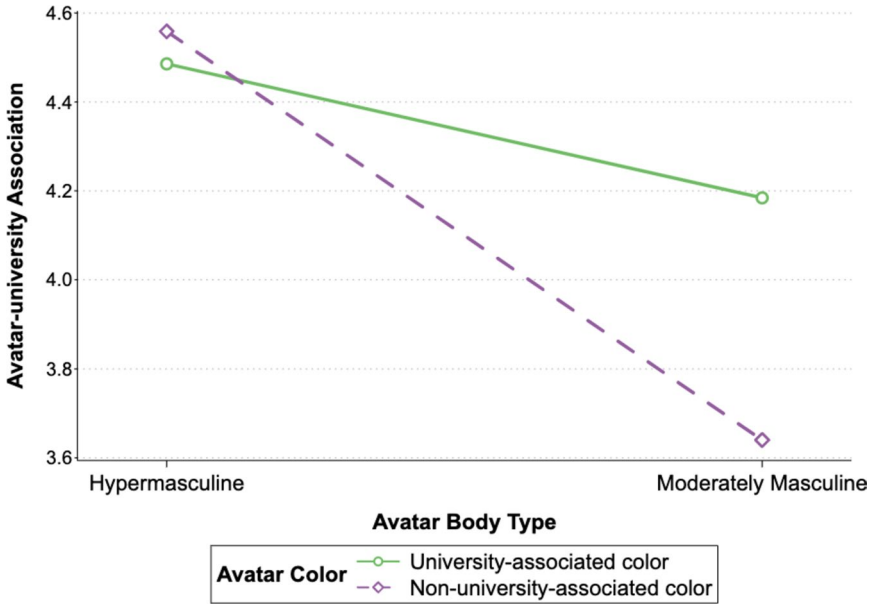

Fig. 3. Manipulation checks for avatar-university association by avatar color and body type.

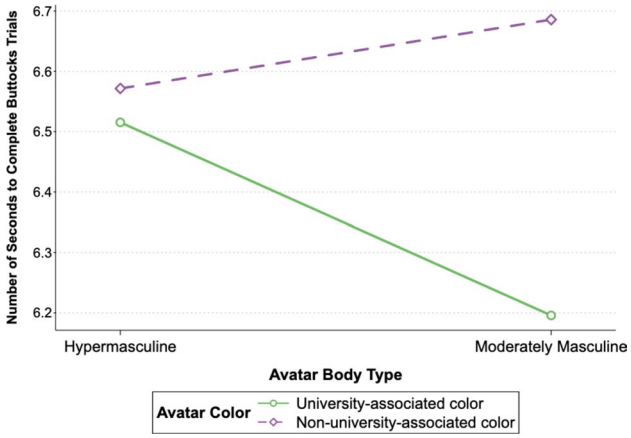

Fig. 4. Impact of avatar color and body type on misogynistic behavior.

behavior (consistent with H2)—but in the hypermasculine body type condition, the avatar color did not appear to make a difference (providing limited support for H2 and no support for H3).

A series of simple effects follow-up tests were then conducted to confirm this interpretation of the data. Within the moderately masculine mascot condition, using an avatar with university-associated colors led to significantly lower buttocks-touching delay—more misogynistic behavior—than non-university-associated colors with a notably large effect size, $F(1, 61) = 11.76$, $p < 0.01$, $\eta_p^2 = 0.16$, which is also consistent with H2 along with the aforementioned main effect. Within the university color-associated condition, hypermasculine body type led to significantly longer buttocks-touching delays—*less* misogynistic behavior—than the average-size mascot, also with a notably large effect size, $F(1, 72) = 7.78$, $p < 0.01$, $\eta_p^2 = 0.10$, contradicting H1. No significant differences were found within the non-university-associated color condition between body types [$F(1, 57) = 0.39$, $p = 0.52$, $\eta_p^2 = 0.01$] or other the hypermasculine-body-type condition between color conditions [$F(1, 67) = 0.12$, $p = 0.73$, $\eta_p^2 = 0.00$]. Together, these results contradict H1, provide partial support for H2 (i.e., in the moderately-masculine condition only), and do not support H3.

Discussion

This exploratory study extends Proteus effect research to consider how organization-representing avatars (i.e., mascots) might induce behaviors that reflect cultural associations with the organization, in this case, misogyny. Participants (opposite-sex attracted men from the community) who used an avatar that was more closely associated with their university (as signaled by color) exhibited more misogynistic behavior, as reflected by lower time delays (i.e., less resistance) in a task requiring them to touch a virtual agent's buttocks with their hand in

the virtual world. However, this difference was driven by an interaction effect, and upon further analysis was found to only be significant when the avatar had a moderately masculine body shape. In other words, no difference was found by the university-color association for participants who used hypermasculine-sized avatars. Within the university-associated color condition, participants who used the hypermasculine body-type avatar exhibited *less* misogynistic behavior (greater resistance to buttocks touching) than those who used the moderately masculine mascot, which contradicted expectations. No differences were found by avatar body type within the non-university-associated color condition. Overall, these findings extend theorization on the Proteus effect, providing evidence that organization-representing avatars can induce behavioral conformity to attitudes associated with the organization, such as misogyny.

The finding that participants who used the university-associated color (compared to non-university-associated color) avatar exhibited more misogynistic behavior—but only for moderately masculine (not hypermasculine) avatars—might suggest that when the body type was less recognizable as the university mascot, the color was the main indication of a connection to university sports culture and implicit misogyny. Hence, controlling this avatar induced more misogynistic behavior via the Proteus effect. It is also possible that "wearing" this university-associated color had a significant impact on their behavior regardless of the avatar. For example, Frank and Gilovich[14] found wearing black jerseys increased participants' aggressive behavior. However, the avatar's clothing and the avatar itself were intrinsically linked in our study. Given the evidence that embodying (i.e., controlling) an avatar leads to stronger Proteus effects than viewing (without controlling) the avatar[4,5,15], we interpret this finding as a reflection of the Proteus effect. Namely, controlling an organization-representing avatar (i.e., mascot) created associations between organization-related schema (i.e., sports culture and misogyny) and self-perception—especially in the moderately masculine condition—inducing conformity with related (i.e., misogynistic) behavior.

The simple effects tests also found that the hypermasculine avatar led to significantly less misogynistic behavior than the moderately masculine avatar within the university-associated color condition. This unexpected finding may have resulted from the hypermasculine avatar being easily recognizable as a specific social other, namely, the university mascot. Instead of priming schema related to sports culture as a whole, this may have primed associations with the specific (fictional) individual mascot. Despite being hypermasculine, this mascot also serves as a family-friendly community member (e.g., posing for pictures with families at public events), so such associations may have counteracted antisocial (e.g., misogynistic) associations with university sports culture. It is also possible that participants attributed their actions to the avatar, a symbol of the university, and acted in accordance with the instructions in order to avoid tarnishing the university's reputation. In other words, we infer that initial expectations regarding associations with the avatar were incorrect—the misogynistic associations of hypermasculinity were less salient than the prosocial associations with the mascot, perhaps because the mascot was highly recognizable in this community. This interpretation would explain why our results did not confirm our hypotheses about avatar body size. Future research in another social context could potentially support the predicted effect of hypermasculine avatar types. Overall, this finding highlights the challenge of predicting user associations with avatar characteristics, contributing to the body of research on limitations in Proteus effect, such as when social cues and individual identity cues are misaligned[16].

Theoretical and practical implications

This study extends Proteus effect research to consider organization-representing avatars and anti-social (misogynistic) behavioral outcomes of the phenomenon. Regarding the former, although the psychological mechanisms of the phenomenon are presumably similar, mascots and virtual influencers[2] that are associated with entire communities or brands can be used by individuals as avatars, thereby influencing user behavior via those associations. This represents a novel paradigm for mediated interaction in virtual reality that may have implications for numerous psychological outcomes (e.g., sense of self and identification, motivation, and well-being).

Regarding this study's context of misogynistic behavior, these findings contribute to a line of research on antisocial or negative Proteus effect outcomes, such as aggression, self-objectification, and stereotype threat[9–13]. Although we may attempt to design avatars—organization-representing or otherwise—to induce more educational engagement, healthier behavior, or greater well-being, avatars may also cause psychological, social, or even physical harm via the Proteus effect. Although we may assume (or hope) that such outcomes are not implemented intentionally within virtual environments, the potential for inadvertent harm via the Proteus effect is quite real. People who use an avatar associated with misogynistic or other anti-social behaviors may act in misogynistic or anti-social ways, even outside of the virtual environment.

The present findings can also be interpreted in the context of the proposed theoretical underpinnings of the Proteus effect. Namely, avatar embodiment[15] facilitates deindividualization[16] and primes avatar-associated characteristics[9] which are incorporated into self-concept[4,17,18], leading to changes in self-perception[3,7] and thus avatar-user behavior. Participants were randomly assigned to control in VR (i.e., embody) an avatar mascot that reflected no personal characteristics (i.e., deindividualizing) and potentially signaled a group norm associated with the organization (i.e., priming) represented by the mascot. The avatar's social identity (i.e., university sports-culture association) potentially became salient to participants' self-concept and self-perception, thereby influencing their behavior in ways that were consistent with perceptions of that identity (e.g., misogynistic acts). Unfortunately, the present study was not designed to test these specific mechanisms of the Proteus, but they remain plausible explanations of the patterns found.

Limitations and future directions

We offer some future directions for Proteus effect research based on this study's limitations, including the study timing and location. The study was conducted shortly after a number of incidents that led to public scrutiny

of misogyny within sports culture at multiple universities. Although these events prompted and reinforced the timeliness of the current study, this research was conducted at a university that changed dramatically in the following years in response to those incidents. The association between the university sports culture and misogyny likely varies depending on publicized news items, events, and cultural initiatives, hindering the potential for replicability in the study as originally designed. Hence, future research on organization-representing avatars should carefully consider what organizational associations are likely to induce the Proteus effect.

Another limitation is the current sample, which was composed only of "opposite-sex attracted" men. Although this decision was purposeful, based on the misogynistic context of the research, future studies should sample from wider populations to increase external validity and better support claims.

The current study only used one mascot that was connected to one specific university. It is possible that the Proteus effect found in this study was specific to this mascot, and thus the phenomenon should be tested at other universities or organizations, with other cues to organizational associations besides color—as well as additional colors beyond those tested here—to enhance external validity.

There was a potential confound in avatar style, with the hypermasculine avatars appearing more cartoonish than the moderately masculine avatars. While we do not believe this difference accounts for the present findings, future research should aim to achieve stylistic consistency across avatars to better isolate Proteus effects.

The present study is limited in its reliance on a single type of implicit measurement of virtual misogynistic behavior. Corroborating this approach with direct measurement of participants' perceived association between organizational culture and misogyny would have strengthened the behavioral metric's validity, but such self-report measures about sensitive topics like misogyny are susceptible to social desirability bias. Another approach could have been to add a survey question asking participants about the extent to which they viewed the buttocks-touching as a transgression. We did not think of this approach at the time, but future research could easily institute this validity check.

Future research could support behavioral measurement validity by including physiological measures or implicit association tests (IAT) of attitudes[45]. Only a few avatar-effects studies have utilized physiological measures [e.g., arousal;[18,46]] or the IAT [e.g., to assess racial bias;[47,48]], while most Proteus effect research has utilized implicit behavioral metrics besides the IAT[4]. Future research could triangulate virtual behavioral effects with physiological or implicit attitudinal measures to bolster internal validity and elucidate psychological mechanisms behind the effects.

Also related to the behavioral metric, we limited the maximum duration of each trial to 10 s, which may have hindered the internal validity of our data by removing the possibility of more extreme data points. Although failed trials and flawed trials were relatively rare, future research should consider avoiding this issue by using naturalistic behavioral metrics that require less experimental constraint.

Another possible critique is that our findings might not have resulted from the Proteus effect, but instead on compliance to the body-touching task in general, not just for the buttocks trials. To address this, we replicated our main analyses, conducting an ANOVA with avatar color and avatar body type as the independent variables and the time-to-touch *non-buttocks* trials as the dependent variable. There were no significant effects found for mascot body type [$F(1, 128) = 0.86$, $p = 0.26$, $\eta_p^2 = 0.01$] color [$F(1, 128) = 0.32$, $p = 0.81$, $\eta_p^2 = 0.00$], or the interaction [$F(1, 128) = 1.12$, $p = 0.09$, $\eta_p^2 = 0.01$]. Hence, this analysis does not contradict our interpretation of these findings as a Proteus effect.

These limitations to measurement validity notwithstanding, the present research illustrates how VR is an ideal platform for observing behaviors that closely mirror real-world dynamics, facilitating analysis of rich, contextually nuanced data that is often challenging to capture through traditional methods[49]. In particular, the study exemplifies an examination of a sensitive topic (i.e., misogynistic behavior) that would be difficult ethically to conduct in a non-virtual environment and less valid if conducted in a less immersive, less naturalistic media environment. Future research should follow this paradigm to ethically measure antisocial effects (Proteus or otherwise) via virtual behavior.

Lastly, the present research was largely exploratory in its approach to examining how a mascot might serve as an avatar and induce the Proteus effect. Future research should continue this line of inquiry on how organization-representing avatars (e.g., mascots, virtual influencers) influence user behaviors in ways that are consistent with stereotypes about organizational culture, for better or in this case, worse. Such research will contribute new theoretical extensions of the Proteus effect as well as practical inferences that are important for technological and societal development, especially as interest in avatar-mediated communication platforms and the metaverse continue to grow.

Data availability

An anonymized, cleaned dataset with all variables analyzed in this study, including the raw time-elapsed data for all 16 agent-touching trials, can be found in this OSF repository: https://osf.io/smf7u/?view_only=01c5b63452fd46b19da7b0176175dcbb. A video example of the study procedure from the participant's perspective in VR can be found here: https://youtu.be/LTDrSx6Y_oQ.

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R.R.: Team leadership, study design, simulation design, writing, data analysis; J.B.: Team leadership, writing, data analysis; G.M.: Study design, simulation design, writing, data analysis; A.D.: Study design, simulation design, writing, data analysis; S.T.: Study design, simulation design, simulation development; D.J.: Writing, data analysis with the revision; T.M.: Writing.

Competing interests

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Additional information

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