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Real is the new sexy: the influence of perceived realness on self-reported arousal to sexual visual stimuli

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ABSTRACT

As state-of-art technology can create artificial images that are indistinguishable from real ones, it is urgent to understand whether believing that a picture is real or not has some import over affective phenomena such as sexual arousal. Thus, in two pre-registered online studies, we tested whether 60 images depicting models in underwear elicited higher self-reported sexual arousal when believed to be ($N = 57$) or presented as ($N = 108$) real photographs as opposed to artificially generated. In both cases, Realness correlated with significantly higher scores on self-reported sexual arousal. Consistently with the literature on downregulation of emotional response to fictional works, our result indicates that sexual images that are perceived to be fake are less arousing than those believed to portray real people.

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Artificially generated images; sexual arousal; fiction

> […] I grant I never saw a goddess go;
> My mistress when she walks treads on the ground.
> And yet, by heaven, I think my love as rare
> As any she belied with false compare
>
> *William Shakespeare, Sonnet 130*

> "titties belonging to a realistic AI generated character" will never be as interesting as "titties belonging to a girl I subscribe to on youtube" no matter how "perfect" or conventionally attractive the AI image is
>
> *Laura Lux (@darthlux), Twitter, Jan 30th, 2023*

1. General introduction

The rapid proliferation and availability of increasingly sophisticated technology for generating photorealistic images is imposing several challenges to contemporary societies. While malicious users are endowed with new tools to spread fake news, journalists are urged to ponder a deontology for using AI-generated images. While computer scientists are devising technological solutions for identifying deepfakes (Shahzad et al., 2022), philosophers are reflecting on the epistemic threats they pose (Fallis, 2021; Harris, 2021). In an op-ed on the *Atlantic*, Daniel Dennett (2023) has expressed particular concerns as regard to artificially generated fake people, i.e. artificial identities that we interact with under the assumption that we are dealing with real people, whose human-like semblance may be leveraged upon to exploit our innate attitude to humanise them, and invoked legal actions to make the creation of "fake people" illegal. But his plea may be doomed to drown amidst an ever-growing multitude of virtual influencers (Sands et al., 2022), dead actors or historical characters "resurrected" via computer-generated imagery (CGI; Lees et al., 2021), and alleged people that are produced, reproduced, or altered with digital means. And while some years ago artificial faces were deemed less trustworthy than their real counterparts (Balas & Pacella,

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2017), recent research suggests that AI-synthesized faces generated by up-to-date technology are already indistinguishable from real ones, and even judged as more trustworthy (Nightingale & Farid, 2022; Tucciarelli et al., 2022, studies 1–2). So much, indeed, that it has been recently suggested that synthetic images could enrich the toolbox of experimental psychology and neuroscience with stimuli that are both ecologically valid and experimentally manipulable (Becker & Laycock, 2023).

An especially widespread and controversial application of AI is to generate sexual pictures and videos. Scholars studying non-consensual dissemination of intimate images and other image-based sexual abuses (Henry et al., 2020) are reporting a particularly worrisome trend. In a survey conducted in 2019, and involving 6109 participants from UK, Australia and New Zealand, aged 16–64, it has been reported that roughly 14% have been victim of some form of deepfake-based abuse such as dissemination of their deepfake intimate contents or the threat to do so (Flynn et al., 2022).

While no author downplays the impact AI-generated images will play on our society, some have proposed that the apocalyptic forecasts ought to be mitigated. A popular argument is that the spread of these technologies will sow distrust in bystanders, hence diminishing their epistemic credentials (e.g. Fallis, 2021; Harris, 2021).

Moreover, an intuition reverberated in literature both high and low, ancient and contemporary, such as the one in Shakespeare's Sonnet 130 and adult content creator Laura Lux's tweet (in epigraph). Namely, the idea that real persons are preferred to made-up persons, no matter how aesthetically pleasing the latter appear to be. In a similar vein, Viola and Voto (2023) have argued that the awareness, or even just the suspicion, that some images are fake rather than genuinely photographically generated, might decrease the arousal they exert on onlookers. Hence, since the allure of non-consensual contents seem to hinge upon their being perceived as real, the shadow of distrust cast by the diffusion of AI-generated images may dampen this threat.

Some empirical data provide evidence that the affective value of some content may be mitigated by a belief in its fictionality. Old studies aimed at assessing the emotional impact of violent TV contents show that the anger-eliciting effect of some clips is downplayed when they are believed to be false (Geen, 1975; Thomas & Tell, 1974). More recently, Mocaiber and collaborators (2010, 2011) showed that instructions indicating that some unpleasant pictures are fictional effectively diminish neurophysiological and electrophysiological activity linked to negative affective states. Sperduti and colleagues (2016) showed that videoclips elicit greater self-reported affective impact when presented as a documentary rather than as fictional, although no significant difference was observed in physiological arousal. They also reported that clips elicit greater arousal when judged to be more relevant for the self, both when presented as true and as fake. In later studies employing emotion-inducing pictures presented as either real or fictional, the same team (Makowski et al., 2019; Sperduti et al., 2017) found that negative stimuli believed to be fake were judged less intense, as well as eliciting a lower physiological activation, and that this affective downregulation was positively predicted by an individual score of belief-updating (as measured by the n-back test). On the other hand, a recent study about (alleged) photojournalistic reports suggests that knowing that something (or someone) is fake rather than real not only affects its emotion-inducing potential, but that the converse also obtains, namely that more intense affective reactions can become an interoceptive cue for judging some content as real (Azevedo et al., 2020).

These findings also resonate with the evidence of several studies on the appreciation of (putatively) AI-made art. In most experimental conditions described in the literature, subjects tend to appreciate more works of art (poems, music, and paintings) when they think they are human-made rather than computer-made (Chamberlain et al., 2018; Chiarella et al., 2022; Di Dio et al., 2023; Kirk et al., 2009; Ragot et al., 2020; Shank et al., 2023; Wu et al. 2020, studies 1 & 3). Interestingly, in many studies this is not due to a manipulation in the stimuli, but rather to the belief that a stimulus is made by a computer rather than by a human artist. This bias against computer-generated art gets mitigated or disappears in some specific conditions, e.g. with stimuli already perceived as intrinsically computer-made such as electronic music (Shank et al., 2023, study 2) or when subjects are exposed to the process of creation enacted by an anthropomorphic robot (Chamberlain et al., 2018, study 2).

What about the response to putatively AI-generated people more specifically? So far, the few studies that explicitly deal with the social perception

of fake persons demonstrated that faces are trusted less when presented as fake (Liefooghe et al., 2023), or even only suspected to be fake (Tucciarelli et al., 2022, study 3). Interestingly, this is independent of the fact that faces are actually AI-generated (as in Tucciarelli et al., 2022) or genuine photos presented as fake (Liefooghe et al., 2023).

However, to the best of our knowledge, no study has investigated how thinking or suspecting that a picture depicts a fake person impacts on sexual arousal. In consideration of the breadth and relevance of this topic, we have run two pre-registered online studies to test the following, simple general hypothesis: (**H**) all things being equal, sexually arousing pictures (people in underwear) judged as real (**Ha**), or presented as real (**Hb**), elicit greater arousal as opposed to similar pictures that are judged to be, or presented as being artificially generated.

2. Study 1

In Study 1, participants were presented with a set of 60 pictures featuring models in underwear or swimsuits. The study involved two counterbalanced tasks aimed at exploring the participants' perception of authenticity and their self-reported arousal level for each image. Following previous literature, we hypothesised that pictures judged as more likely to be real photos (as opposed to artificially generated) wouldalso be rated as more sexually arousing (Ha).

2.1. Methods

2.1.1. Participants

The present study design was preregistered prior to data collection (anonymized pre-registration for peer-review purposes: https://osf.io/m95xh/?view_only = 75fb7b8853d243a08078a827090b1db7). Given that the online context is the most ecological experimental setting for experiencing images of models in lingerie, including potentially manipulated pictures, we implemented an online procedure using Qualtrics.com. This approach provided participants with a more immersive and engaging experience compared to a traditional laboratory setting, arguably reducing Hawthorne-like effects, i.e. distortions due to the presence of the experimenters.

An initial sample of 75 participants was recruited for the purpose of this study. Participants were enlisted using a snowball sampling technique (Parker et al., 2020). The researchers utilised their personal networks and various social media platforms, emails, and private messages to distribute the survey among their acquaintances, then asked them to share it with other people. Additionally, mailing lists accessible to the authors were employed to reach potential participants. Following the data collection process, a total of 18 participants were excluded from the analysis according to the following exclusion criteria: (a) incompletion of the survey (10 participants); (b) failure to provide informed consent to participate (1 participant); (c) participants who opted to view pictures depicting individuals of the same gender as themselves were excluded from the analysis (7 participants). This decision was made to maintain separate categories for males and females during the analysis process, as well as to ensure an appropriately sized sample for each sexual preference category. It is worth noting that all participants were allowed to complete the entire task. After data collection, the data from subjects that chose to view pictures of their own sex and/or indicated an homosexual orientation were excluded, merely because the number of participants within these groups was insufficient to perform any meaningful data analysis. Further research will be needed to test whether the results observed in these studies apply also under different conditions, e.g. in assessing same sex pictures and/or when participants do not self-describe as heterosexual. All the remaining participants ($N = 57$, 27 females [47.4%]; M_{age}: 28.35 $SD = 3.92$) were considered valid subjects. Prior to beginning data collection, informed consent was obtained from all participants. Participants were at first provided with information regarding the study, including its main objectives and purposes. The experimental paradigm lasted about 12 min ($M = 12.55$; $SD = 4.20$) and consisted of a single session designed in a within-subjects fashion. Ethical approval for this research was granted by the Joint Ethics Committee of the Scuola Normale Superiore and the Scuola Superiore Sant'Anna.

2.1.2. Stimuli

In Study 1, a preliminary set of 180 ($F = 90$) pictures were selected. The pictures were high-quality colour photographs sourced from various Internet websites such as Google Images, Creative Commons, Bing, IStock, and Flickr. When necessary, a standard license was obtained through a subscribed account that granted the right to use the photos for any purpose. All other pictures were published under Creative Commons licenses.

All the photographs depicted male or female models wearing lingerie or swimsuits. The selection process adhered to the following criteria: (a) a minimum resolution of 240 PPI was required to ensure high-quality display on screens;(b) the entire face of the model had to be visible; (c) the model's body had to be positioned in a frontal or three-quarter view; (d) the background should be as neutral as possible; (e) the model should adopt a sensual or flirtatious pose without performing any characterising activity; (f) photos should not include recognisable objects, animals, or specific locations. We decided to use only real pictures rather than artificially generated ones, for three reasons: first, in this study we aimed to focus on the effect of beliefs, irrespectively of any possible subliminal perceptual confounds that may exist when watching AI-generated as opposed to real images. Second, we are currently facing a legislative gap concerning the legal status of AI-generated images and who holds their rights, as the novelty of the question and the discrepancy between different states makes it unclear in which cases such images can be used lawfully and ethically, especially when sexuality is involved (Chesney & Citron, 2019). Third, previous literature suggested that AI-generated pictures are already indistinguishable from real ones (Nightingale & Farid, 2022; Tucciarelli et al., 2022, studies 1–2).

Following that, each author independently evaluated the selected pictures using a 5-point Likert scale ranging from "strong reject" to "strong accept." The ratings provided by the authors were based on the aforementioned criteria. As a result, a total of 120 pictures (with 60 featuring models for each gender) that received higher average scores were selected for Study 1.

2.1.3. Procedure

At the beginning of the experiment, participants read the main instructions and answered some basic demographic questions (gender, age, level of education, and provenience). Subsequently, sexual preferences of the participants were investigated by means of two different questions ("I like men"; "I like women") using a 5-point Likert scale (from "not at all" to "very much"). Participants were then informed that they would be presented with sexually arousing photos and were given the option to choose between viewing pictures of male or female models. Participants who picked the opposite gender showed consistent sexual preferences (Males: I like women: $M = 4.83$, $SD = .67$; Females: I like men: $M = 4.60$, $SD = .57$)

Subsequently, the actual experiment began. Participants performed two different preregistered tasks in a counterbalanced order:

1. **Arousal evaluation**: in the arousal task, participants were presented with 60 images in fully random order and were required to indicate the level of perceived arousal for each image. The following instructions were provided: "You will now be presented with a series of 60 images. Among these images, some are authentic photographs, while others have been created using artificial intelligence. Your task is to evaluate how much an image sexually arouses you on a 6-point scale, ranging from 'Not at all' to 'Very much'". The instructions were meant to cue participants to focus on their first-person affective experience rather than on third-person, semantic judgments (cf. Itkes & Kron, 2019).
2. **Realness assessment**: in the other part of the experiment, participants were presented with the same set of 60 images in random order and were asked to assess the perceived authenticity of each image ("You will now be presented with a series of 60 images. Among these images, some are authentic photographs, while others have been generated by artificial intelligence. Your task is to assess, for each image, the degree to which you believe it is real (as opposed to being created by artificial intelligence). Please use a 6-point scale, ranging from 'Definitely Real' to 'Definitely AI' (artificial intelligence)".

Lastly, in order to comprehensively gauge the degree to which our study participants manifested a favourable or unfavourable disposition towards Artificial Intelligence (AI), we administered a set of six items derived from the General Attitudes towards Artificial Intelligence Scale (GAAIS: Schepman & Rodway, 2022). By employing this selection strategy, we aimed to capture a nuanced and comprehensive understanding of individuals' orientations toward AI. In greater detail, we employed the following items: Pos12, Pos17, Pos7, Neg8, Neg15, and Neg10. The selection was made by considering the highest factor loadings (i.e. standardised estimates) of both the positive and negative GAAIS subscales in Study 1 by Schepman and Rodway (2022). The internal reliability was completely satisfactory according to

the common thresholds used in the literature (Cortina, 1993; Dunn et al., 2014): Study 1: $\alpha = .82$; $\omega = .83$; Study 2: $\alpha = .83$; $\omega = .83$.

2.1.4. Statistical notes

The statistical analyses were conducted using IBM SPSS 27.0 (IBM Corp, 2020) and R through Jamovi (The jamovi project, 2022). A significance level of $\alpha = .05$ was employed and *p-values* were reported. In cases where significant effects emerged, the reader will find the unstandardised estimate (β) with its 95% Confidence Intervals and the standard error of the estimate (*SE*). The degrees of freedom were estimated through Kenward-Roger approximation, which "provide good results when applied to generalised linear mixed models" (Luke, 2017, p. 1496).

The effect sizes were reported in terms of R^2 and Cohen's *d*. In greater detail, when a difference between the means was available (i.e. Study 1: Gender; Study 2: Realness and Gender), Cohen's *d* was computed by means of the formula provided by Judd and colleagues (2017, Table 3, line 11). Notably, this formula has the advantage of incorporating the random variance of the model in the denominator. On the other hand, when such a difference was not available, given the continuous nature of both our dependent and independent variables (i.e. Study 1: Realness), Cohen's *d* was assessed starting from the proportion of the variance explained by the predictor (i.e. R^2), as per the following formula (Ruscio, 2008):

$$d = \sqrt{\frac{-4R^2}{R^2 - 1}}$$

Since, to the best of our knowledge, no study has ever investigated similar research questions by operationalising both realness and sexual arousal as continuous variables, a sensitivity power analysis was conducted using the power analysis method for mixed models by Judd and colleagues (2017) to assess the Minimum Detectable Effect Size (MDES). Both Study 1 and Study 2 possessed sufficient statistical power to accurately identify the hypothesised effect as reported in the results sections.

Before proceeding to the modelling phase, the normality of the model-dependent variable (i.e. Arousal) was inspected by means of the Kolmogorov–Smirnov test. The test reached statistical significance (all *p-values* < .001), thus suggesting a significant departure from normality. In greater detail, the Arousal variable was positively skewed (Skewness = .38), especially for female participants (Skewness = .72). For this reason, we opted for a Generalized Linear Mixed Effect Model (Stroup, 2013) that we performed with the GAMLj module (Gallucci, 2022). The Gamma distribution with a log link function was employed because this configuration is frequently utilised as a suitable choice for fitting GLMMs. Notably, it demonstrates efficacy in modelling data with exclusively positive values, characterised by positively-skewed error distributions (Ng & Cribbie, 2017).[1] In each model, the participants' and stimuli's intercepts and slopes have been added as random effects (Judd et al., 2012). In doing so, we accounted for the fact that participants may have varying baseline levels of Arousal (i.e. random intercept) and may also exhibit different patterns or slopes of change in arousal in dependence of the Realness (i.e. random slope).

In other terms, we are able to capture both the between-participant variability in baseline Arousal levels and the within-participant variability in the patterns of Arousal change. This approach helps to account for the correlation and heterogeneity in Arousal measurements within and between participants, allowing for more accurate and reliable estimation of the fixed effects (e.g. effects of independent variables) (Judd et al., 2012) and overall variability in Arousal.

2.2. Results

An initial check of the average Realness score provided by the participants to the pictures was made to ensure that the values were compatible with a credible manipulation. The mean Realness value was 3.50, 95%CI [3.37,3.63] (*Mdn* = 3.45), and it was normally distributed (Kolmogorov-Smirnov test $p = .200$). While not a formal manipulation check, these findings provide reassurance regarding the credibility of the manipulation. A GLMM was run to assess the impact of the Realness estimation on the self-reported level of Arousal. We added the Gender of the participants and the Presentation order (i.e. Realness first or Arousal first) as fixed factors and the GAAIS score as a covariate. Lastly, to control for individual and pictures' variability, the participants and stimuli intercepts and slopes were modelled as random effects.

Both Realness ($\beta = .063$, 95%CI [.031,.094] $df = 56.3$ $SE = .016$, $p < .001$, $R^2 = .029$, $d = .34$) and Gender ($\beta =$

−.269, 95%CI [−.484, −.055] $df = 107.0$ $SE = .109$, $p = .014$, $d = 1.40$) reached statistical significance [Table 2]. Contrarily, the main effects of the GAAIS score ($p = .151$) and Presentation order ($p = .246$), and the Realness × Gender ($p = .706$), the Realness × Presentation order ($p = .708$), and Realness × GAAIS ($p = .371$) interactions failed to show significance.

These results testified that the Realness perception was positively associated with the Arousal level and that this finding does not depend on Presentation order, attitude toward AI, and gender. Secondly, female participants reported significantly lower levels of Arousal ($M = 2.27$; $SE = .18$) than males ($M = 2.98$; $SE = .23$) [Figure 1]. From a merely descriptive point of view, the positive effect of Realness was stronger for females ($\beta = .069$, 95%CI [.023, .114] $SE = .023$, $p = .003$) than for males ($\beta = .056$, 95%CI [.013,.099] $SE = .022$, $p = .010$). A sensitivity analysis was employed to estimate the Minimum Detectable Effect Size (MDES) detectable at power of .80 and $N = 57$. Results indicated that an effect of $d = .11$ was the smallest effect detectable, thus confirming our model suitability to detect the effect of Realness we observed.

2.3. Discussion

In our first study, we observed that the Realness ratings of sexually arousing pictures of models in underwear predict Sexual Arousal, irrespectively of presentation order, attitude toward AI, and gender. These results are consistent with our first hypothesis (**Ha**), according to which self-induced belief that a stimulus is artificially generated results in diminishing its impact on self-reported affective arousal. We also observed higher average scores in male than in female participants. The literature suggests a difference in men's and women's arousal when confronted with sexual stimuli in experimental settings (Chivers et al., 2004; Murnen & Stockton, 1997; Rupp & Wallen, 2008). For instance, it has been claimed that women enjoy more stimuli that allow projection within a situation, hence paying more attention to contextual clues when looking at sexual stimuli, whereas men's consumption relies more on the depicted person abstracted from context (Rupp & Wallen, 2009). This may help explain why our stimuli, which we selected to have as scant a background as possible, were enjoyed less by women than by men.

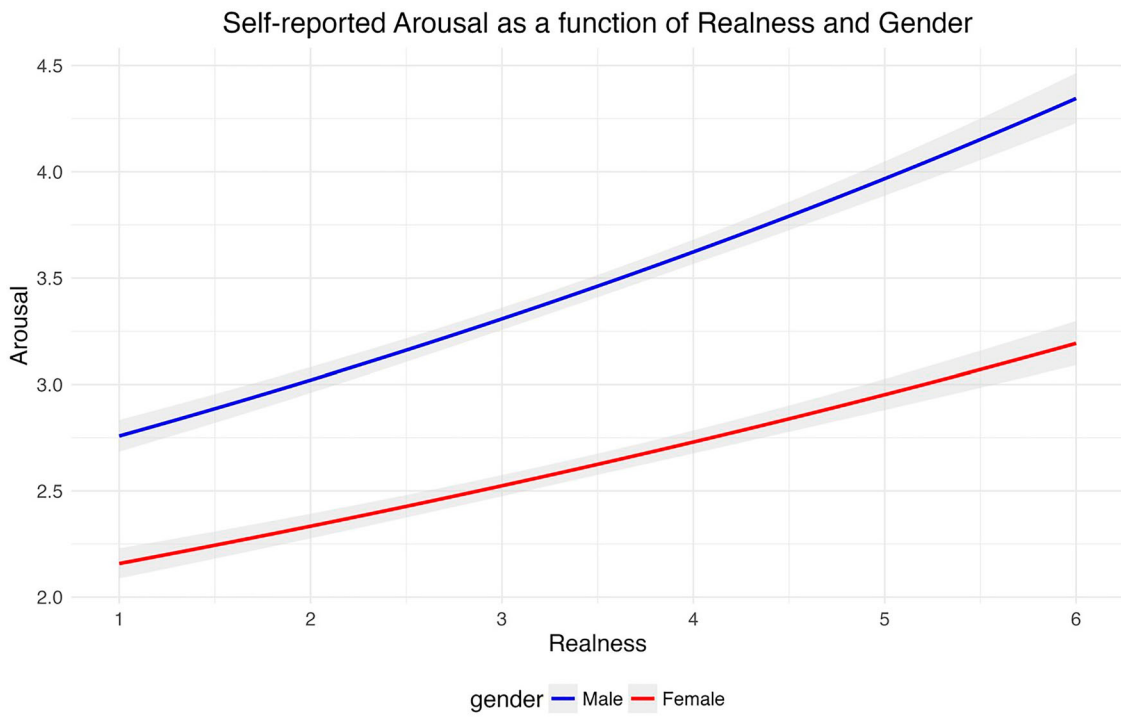

Figure 1. Self-reported Arousal as a function of subjects' Realness estimate and Gender. Note. The confidence region represents the 95% Confidence Intervals.

The fact that the presentation order did not influence the effect of Realness on Arousal (i.e. the impact of Realness on Arousal exhibited consistency regardless of whether Realness was evaluated before or after Arousal assessment) is consistent with three possible underlying mechanisms: (1) Arousal judgment affects Realness judgment, consistently with the results by Azevedo et al. (2020; see also the discussion of Shank et al., 2023, study 1); (2) Realness judgment affects Arousal judgment, as per our hypothesis Ha; or (3) a bidirectional effect. In the light of this experimental methodology and findings, all these three explanations can be considered as equally valid.

Given the high number of stimuli each subject has to rate (60), it is unlikely that these influences are based upon *explicit* memory of each rating. Instead, a most plausible hypothesis is that as soon as a stimulus is presented, either Arousal or Realness judgments (or both) are made automatically and implicitly. Indeed, in our experiment, participants were explicitly informed prior to both tasks (the Arousal assessment and Realness evaluation) that some of the pictures were authentic, while others were generated by artificial intelligence. As a result, participants could have been influenced by such potential variations in authenticity before reporting their perceived levels of arousal. However, while our general hypothesis **H** is mainly consistent with 2, to unravel the direction of the effect we had to rule out that the effects of this study are only due to a monodirectional effect of (implicit) Arousal judgments on Realness judgment (mechanism 1). To do so, we performed another study, in which Realness is manipulated as an independent variable. Namely, instead of asking our participants to infer the realness of the photos, the same stimuli of this study were presented as being real or fake photos; thus leaving less room for an explanation in terms of mechanism 1. In short, the fact that Realness was given a priori precluded any influence of Arousal upon Realness evaluation (cf. Shank et al., 2023).

3. Study 2

To constrain the interpretation regarding the causal direction presented by Study 1 and to test our second hypothesis (**Hb**), i.e. that stimuli presented as real (fake) elicit higher (lower) arousal, in our second study we used the same stimuli of Study 1. Some of them ($N = 30$) were presented as actual photos and others ($N = 30$) as artificially generated, in a counterbalance fashion across participants.

3.1. Methods

3.1.1. Participants

An initial sample of 120 participants was recruited via academic mailing lists. The same exclusion criteria of Study 1 were applied. Thus, we ended up with 108 valid participants (53 females [47.7%]; M_{age}: 31.73 $SD = 6.90$) that fully completed the survey. To prevent multiple entries from the same participants from Study 1, an antiballot box stuffing mechanism was employed.

Before commencing the data collection, all participants provided informed consent to participate and received preliminary information about the study's aim. The whole experimental procedure lasted about 10 min ($M = 9.50$; $SD = 4.30$).

3.1.2. Stimuli

To ensure consistency across studies, we reused stimuli from Study 1. We created two distinct groups of images for each gender, with each group consisting of 30 stimuli. We assured that groups were balanced on Arousal and Realness levels, based on the scores obtained in Study 1.

To do so, first the normality of Realness and Arousal of male photos was checked through the Shapiro–Wilk test. The test indicated that both variables were normally distributed (Realness: $p = .52$; Arousal: $p = .18$). Subsequently, an independent samples T-test assured that the male photos of Group 1 did not differ from those of Group 2 in both Realness ($p = .92$) and Arousal scores ($p = .98$).

As for the female photos, the Shapiro–Wilk test was significant for Arousal ($t = .03$, $p = .04$) and not significant for Realness ($t = .10$, $p = .06$). However, given the low p-values, we opted for a non-parametric Mann–Whitney test. The test failed to reach significance for

Table 1. Descriptive statistics of the stimuli groups.

Depicted Gender	Variable	Group	Mean	SD	p value
Male	Arousal	1	2.51	0.73	.98
		2	2.51	0.73	
	Realism	1	3.47	0.62	.92
		2	3.49	0.73	
Female	Arousal	1	3.27	0.88	.91
		2	3.27	0.90	
	Realism	1	3.51	0.71	.88
		2	3.51	0.73	

both Realness ($Z = 439$, $p = .88$) and Arousal scores ($Z = 442$, $p = .91$; Table 1).

3.1.3. Procedure

At the beginning of the experiment, participants read the main instructions, provided their consent to participate, and expressed their sexual preferences in the same way as in Study 1. Subsequently, participants were presented with two consecutive groups of 30 stimuli each in a counterbalanced order. Each group was preceded by some instructions that presented the stimuli as real photographs or AI-generated images:

1. **Real block**: in the real block, participants were presented with 30 photographs in fully random order and were required to indicate the level of perceived arousal for each photo. The following instructions were provided: "You will now be presented with a series of 30 photos. These photos were taken by professional photographers from 2015 to 2021 and depict adult models from different parts of the world posing in an attractive manner. Our intention is to verify whether these photos can evoke any form of sexual arousal. After each photo, you have to indicate your level of arousal on a scale from 1 (not arousing at all) to 6 (extremely arousing). Please, focus on your personal experience rather than trying to provide an 'objective' rating based on how arousing you believe others might find the photo".
2. **AI-generated block**: in the AI block, 30 allegedly artificially generated images were displayed to the participants in random order. For each image, participants were asked to indicate the perceived level of arousal. The block was presented with the following instructions: "You will now be presented with a series of 30 images of bodies generated by artificial intelligence. These bodies do not belong to real individuals but, thanks to the latest technological advancements, they appear extremely realistic and are indistinguishable from real ones. Our intention is to verify whether these AI-generated images can evoke any form of sexual arousal. For each artificially generated image, please indicate on a scale of 1 (not arousing at all) to 6 (very arousing) how much it excites you. Please focus on your subjective level of arousal rather than attempting to provide an 'objective' score reflecting how arousing you think others may find it".

The block order (Real and AI-generated) was counterbalanced across participants. Similarly, the same group of 30 images (groups) was randomly presented in the real or AI-generated block. Lastly, participants' attitude toward Artificial Intelligence was measured using a subset of six items from the General Attitudes toward Artificial Intelligence Scale (GAAIS: Schepman & Rodway, 2022) as in Study 1.

3.2. Results

Following Study 1 procedures, the normality of the Arousal variable was inspected by means of the Kolmogorov–Smirnov test ($p < .001$). Once again it was found to be positively skewed, especially for females (Skewness = .34; F = .91). All statistical conventions were identical to Study 1.

Coherently, a GLMM was performed on Arousal scores using Realness, Presentation order (i.e. Real first or AI-generated first), GAAIS score, and Gender as fixed effects. Please recall that differently from Study 1, in this study, Realness is codified as a dichotomous and independent variable (i.e. pictures presented as real vs pictures presented as AI-generated). The model reported a significant effect of Realness ($\beta = .087$, 95%CI [.018,.157] $df = 107$ $SE = .035$, $p = .013$, $d = .43$) [Figure 2] and Gender ($\beta = -.443$, 95%CI [−.622, −.265] $df = 213$ $SE = .091$, $p < .001$, $d = 2.17$) and no significant interaction between them ($p = .709$) [Table 2].

Neither the GAAIS score effect ($p = .957$), nor the Presentation order effect was significant ($p = .276$). None of the interactions reached significance: Realness × GAAIS score ($p = .337$) and Realness × Presentation order ($p = .355$). As in Study 1, the Realness of the pictures modulated the reported Arousal by lowering it when evaluating pictures presented as AI-generated. Finally, through a sensitivity analysis, we estimated a MDES of $d = .20$, indicating that our model had the capability to identify smaller effects as compared to the Realness one.

As a further precaution, we devised to re-build the model by including the Arousal score of Study 1 of each photo as a covariate and the interaction term Arousal of Study 1 × Realness. In this way, we aimed at checking whether the effect of Realness was stable at different levels of Arousal inherent to the

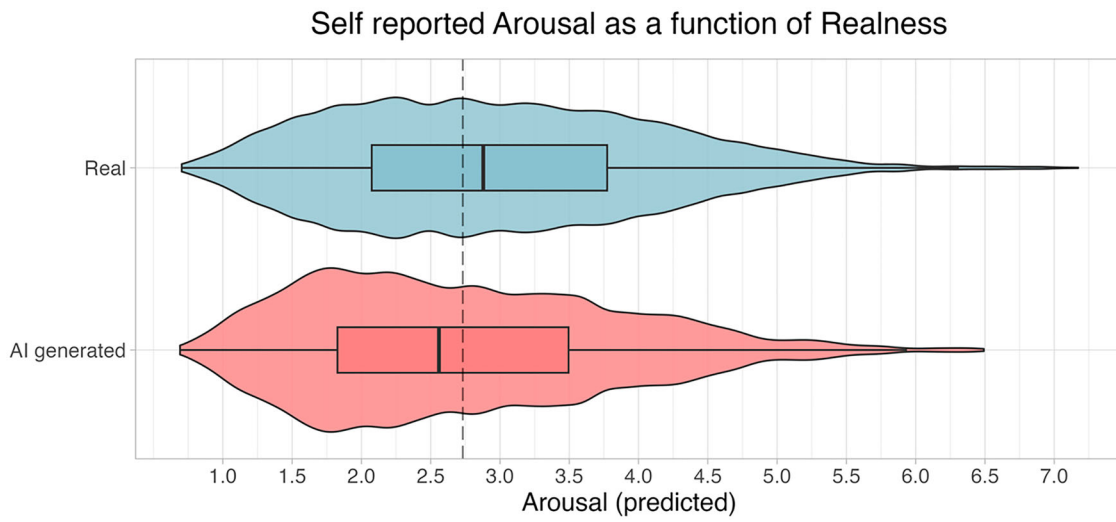

Figure 2. Self-reported Arousal for images presented as real or AI generated. Note. The violin plot visualises the distribution curve, with box-plots indicating interquartile ranges (IQRs) and median values represented by black vertical lines. The vertical dashed line represents the overall median value.

Table 2. Descriptive statistics of the self-reported Arousal as a function of Realness.

					95% Confidence Interval		
	Gender	Realness	Arousal	SE	LL	UL	*p* value (*d*)
Study 1	Male	Mean-1SD	2.69	0.23	2.27	3.20	<.001
		Mean	2.97	0.23	2.56	3.45	(.34)
		Mean + 1SD	3.28	0.27	2.79	3.85	
	Female	Mean-1SD	2.01	0.18	1.68	2.41	
		Mean	2.27	0.18	1.95	2.65	
		Mean + 1SD	2.56	0.22	2.17	3.02	
Study 2	Male	Real	3.09	0.21	2.70	3.54	.013
		AI	3.33	0.23	2.91	3.81	(.43)
	Female	Real	1.96	0.14	1.71	2.25	
		AI	2.17	0.15	1.89	2.48	

Note. The reported *p*-values and Cohen's *d* values represent the main effects of Realness on Arousal

photos, as measured in Study 1. The interaction failed to show any statistical significance ($p = .890$); thus suggesting that the effect of Realness was consistent across all levels of Arousal.

3.3. Discussion

Consistently with our hypothesis **Hb**, and similarly to the results of Study 1, in this study we confirmed that Realness predicts higher arousal ratings: using Realness as an independent variable allowed us to establish that Realness not only is associated with arousal, as already observed in Study 1, but also that it is the perceived realness of sexual pictures itself that make them more arousing. Again, we observed some gender differences, namely that men rated images of female models higher than women ratings of images of male models.

4. General discussion

We conducted two pre-registered studies to test the hypothesis that a picture is more sexually arousing when it is thought to be a photograph of a real person, rather than an artificially generated image. Our findings are consistent with extant literature (Chamberlain et al., 2018; Chiarella et al., 2022; Di Dio et al., 2023; Kirk et al., 2009; Makowski et al., 2019; Mocaiber et al., 2010, 2011; Ragot et al., 2020; Shank et al., 2023; Sperduti et al., 2016, 2017; Wu et al. 2020), as well as with our general hypothesis: we found a significant effect of Realness on elicited

Arousal, both when the rating of realness likelihood was given by subjects (Study 1) and when the Realness was experimentally manipulated by presenting half images as photographs and half as artificially-generated (Study 2). The results of Study 1 are also consistent with the possibility that the Realness-Arousal correlation is due to an effect in the other direction, i.e. Arousal enhancing Realness (cf. Shank et al., 2023, study 1). Indeed, a similar effect has been reported in recent literature (Azevedo et al., 2020). However, while an effect in this direction cannot be excluded, both the results of our Study 2 and the previous literature militate against the possibility that Arousal-to-Realness is the *only* direction of the effect.

We also found that stimuli are deemed less arousing by women than by men. This was by no means unexpected: for instance, Chivers and colleagues (2007) documented data showing that heterosexual men, when exposed to audiovisual stimuli portraying women in sexual and non-sexual activities, exhibited higher self-reported levels of arousal compared to heterosexual women exposed to audiovisual stimuli depicting men. Furthermore, Murnen and Stockton's (1997) meta-analytic review revealed that across 46 studies, there was a small to moderate-sized gender advantage in sexual arousal in response to sexual stimuli in men.

Such a result may also be due to the fact that in women sexual arousal in experimental settings has been proven to rely more on projective strategies than objectification strategies (Rupp & Wallen, 2009), whereas our stimuli were explicitly selected in order to minimise background context, arguably hindering immedesimation.

Recall that all the images employed in our studies are photographs that are declared as authentic online, whereas none of these images were directly generated by the experimenters using AI. Hence, the Realness effect on Arousal is unlikely to be explained by appealing to some low-level perceptual properties. Instead, it is most plausibly due to a modulating effect of beliefs (or suspicions) induced by a simple experimental manipulation, namely informing the subjects beforehand that some images are (Study 2) or can be (Study 1) artificially generated.

It is important to notice that, while the present findings do support the view that images believed to be artificially generated are *less* arousing than photographs that are assumed to portray real people, they *do not* show that the former type of images are *not arousing at all*. Just like people feel empathy for Anna Karenina or Ned Stark despite knowing they are fictional characters, they can also feel aroused by virtual models. Indeed, both the experiences thought to have a real referent and those thought to have a fictional one can scaffold affective reactions via imagination; and more so when the imagined situation is more relevant to the Self (Sperduti et al., 2016). But, other things being equal, elicitors that we take to exist in the real world tend to be more relevant to the Self than those that arguably have no physical body. In the context of the present discussion, that boils down to the idea that real persons are judged to be sexier than their aesthetically indistinguishable counterparts because, at least in principle, it is possible to establish some intimate connection with them. Another non-mutually exclusive explanation is that knowing or thinking that a person is artificially generated might trigger aversive negation due to some feeling of *uncanny* (Mori, 1970; Olivera-La Rosa, 2018).

Since the present paper represents the first attempt at understanding the impact of believing that an image depicts a fake person on sexual arousal, it goes without saying that further studies are in order before any substantial implication could be drawn from the present findings. While in our study we showed sensual pictures of models in underwear, in future studies it would be interesting to see whether the effect replicates also with more markedly sexual stimuli, such as naked bodies and explicit sexual acts. An additional step would be that of enriching contextual information to see whether it modulates self-relevance, as well as facilitating projection – which could also increase women's arousal (Rupp & Wallen, 2009). Another obvious and relevant endeavour would be that of checking whether our results replicate on non-heterosexual samples, and with non-binary body types. Less obviously, future studies may try to follow the footsteps of (Chamberlain and colleagues' 2018, study 2), where showing subjects that some anthropomorphic robots produced art resulted in a mitigation of their lessened appreciation. In the same vein, we wonder whether introducing contextual elements that help "humanizing" AI-generated characters (e.g. providing them with names) could result in a restoration of their affective power.

Moreover, by comparing physiological activity and gaze patterns in pictures believed to be real, believed to be fake, and whose nature is unknown, future

studies could help to better address the complex mechanisms underlying the Realness-Arousal relationship.

To stress why we think that replicating and extending our findings would be paramount, let us briefly indulge in speculating what will follow if the present results are confirmed. First, with the current spread of technology to fabricate images, we might already be in an epistemic situation similar to that of the subjects in Study 1. Namely, we no longer know *a priori* whether some photographic-looking image is an actual photo or a fake. Hence, if Real proves to be sexier than Fake, it is unlikely that a majority of jobs in the sex industry will be lost in favour of digital "fake people", insofar as we develop technologies to reliably signal what contents are fake and what are authentic. Indeed, it is important to emphasise that our results concern *beliefs about authenticity*, not authenticity itself: to the best of our knowledge, all the stimuli we used were photos of real people, yet just perceiving them as fake (either via self-evaluation or due to experimental manipulation) made them less arousing. Leveraging this fact to allay some concerns on the use of AI-generated sexual images, thus, requires making sure that users perceive as real images that are indeed real, while acknowledging as fake those that are artificially generated – a precondition that is currently not realised, according to the literature (Nightingale & Farid, 2022; Tucciarelli et al., 2022). But other than sex workers, this issue can also affect many ordinary people in several contexts. For instance, people engaging in sexting (sending sexy pictures to some digital partner) could soon have the onus of certifying the reality of the pictures they present, just like users in the subreddit for sharing amateur sexy pictures Gonewild have adopted some tactics to verify their identity (van der Nagel, 2020).

But these effects will also extend to the thorny issue of illicit sharing of forged intimate contents: as predicted by Viola and Voto (2023), it may be the case that forged intimate contents will lose some of their intrinsic allure in a context where it would be likely that they are fake. This could result in a mitigation of their spread, but also in some perpetrators attempting to verify that by means of independent verification, possibly exacerbating the risks for privacy.

While their exact implications can only be guessed, artificially generated digital contents are likely here to stay: therefore, understanding our reaction toward (what we take to be) fake persons will be pivotal in the coming years. In any case, given how easy it is for a fake person to have perfect artificially generated bodies, it is kind of reassuring that perceiving an image as depicting our *real* bodies might still make it sexier – despite our imperfections, or maybe just because of them.

Note

1. Two alternative GLMMs were built by employing inverse and identity link functions. We opted for the log link function model after comparing them in terms of their Akaike's and Bayesian Information criteria (i.e. AIC and BIC).

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical approval

All procedures performed were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all participants. The study was approved by the Joint Ethics Committee of the Scuola Normale Superiore and the Scuola Superiore Sant'Anna.

Data availability statement

The data that support the findings of this study may be made available from the corresponding author upon reasonable request.

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