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Moral inferences from androgynous faces are beyond categorical uncertainty: Evidence of a positive bias towards androgynous targets

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Abstract

Postulating a negative bias towards social ambiguity, we conducted cross-cultural online research to assess whether categorical discrepancies in the perception of androgynous faces were associated with the uncanny feeling and inferences of different morality. Across four studies, we found that androgynous faces were harder to classify into a binary sex category than sex-typical faces, but this difficulty did not influence social judgements of androgynous targets in a negative fashion. In Study 1 (Spanish-speaking sample, $N = 76$), we found that androgynous faces were rated as more trustworthy, less creepy, and less morally different than sex-typical faces. Study 2 replicated most of the findings from Study 1 in an Italian sample ($N = 45$). Positive bias towards androgyny was not replicated with a different set of stimuli featuring faces of diverse ethnic backgrounds (Study 3, Spanish-speaking sample, $N = 140$). However, results revealed a main effect of ethnicity in participants' responses. When controlling for the effect of morphing procedures in stimuli selection, an overall positive bias towards androgynous targets arose, especially when compared to masculine targets (Study 4, Spanish-speaking sample, $N = 85$). These findings suggest that, at least in certain conditions, a positive social bias towards androgynous faces may emerge that does not depend on categorical uncertainty and facial attractiveness.

KEYWORDS
androgyny, creepiness, morality, social perception, trustworthiness

1 | INTRODUCTION

The study of the cognitive basis of prejudice can contribute to a more comprehensive study and reduction of stigmatizing behaviours. Recently, Olivera-La Rosa, Chica-Franco & Ingram (2023a) suggested that the uncanny valley hypothesis (Mori et al., 1970/2005) constitutes an insightful framework to account for the negative bias towards physically androgynous individuals.

According to this hypothesis, human-like stimuli that closely resemble 'real' humans but still bear a slightly artificial quality can elicit a negative emotional response in an observer. Various hypotheses have been proposed to elucidate the psychological mechanisms underlying the uncanny response (Kätsyri et al., 2015; Wang et al., 2015). One of the most pertinent is the categorical uncertainty hypothesis, which posits that ambiguity in categorizing extremely realistic artificial characters can trigger uneasy feelings in an observer (Burleigh et al., 2013;

Wang & Rochat, 2017). A proclivity towards categorical thinking is consistent with the broader goal of cognitive economy: cognitive processes are oriented to use minimal mental effort to process the most useful information (Allport, 1954; Kahneman, 2011). The categorical uncertainty hypothesis is consistent with the hedonic fluency model: information that is easily processed is often accompanied by a positive affective response, which can impact preference evaluations in a congruent manner; (Reber & Schwarz, 2006; Winkielman et al., 2003).

Some studies showed that stimuli that defy easy categorization (beyond the natural–artificial distinction) can generate a negative affective response (Ferrey et al., 2015; Yamada et al., 2013). Notably, the uncanny response is not confined solely to artificial entities: it has been associated with clowns, people deemed unattractive, or even 'Botox victims' (Olivera-La Rosa, Villacampa, Corradi, & Ingram 2023b; Pollick, 2010; Smith, 2014). Human entities appraised as unnatural and/or emotionally unpredictable may trigger the uncanny feeling, which may function as a heuristic mechanism of moral inferences ('if it is physically disturbing, it is morally disturbing'; Olivera-La Rosa, 2018). For instance, uncanny faces were rated as less socially desirable and more morally different than aesthetically neutral faces (Olivera-La Rosa et al., 2023b).

Do androgynous faces follow a similar pattern? Androgyny can introduce challenges in sexual categorization because it represents an ambiguous state between the sexual categories of man and woman. Indeed, despite the rising prominence of political movements and support groups advocating for sex and gender diversity, state-of-the-art research suggests that sex perception from an early age is still categorical and binary (Campanella et al., 2001; Freeman et al., 2010; Martin & Slepian, 2021; Quinn et al., 2002). Some evidence suggests that gender is a critical attribute of perceiving humanness and that removing gender from human targets causes dehumanization (Martin & Mason, 2022). Therefore, difficulty in categorizing androgynous faces into a binary category may signal 'unnaturalness' and social unpredictability. The integration of these assessments with the negative emotional response stemming from processing disfluency can potentially trigger the uncanny feeling and the associated deductions of social exclusion (Olivera-La Rosa et al., 2023a). Built on these insights, in this research, we assess whether categorical uncertainty in the perception of androgynous faces is related to appraisals of uncanniness and perception of moral traits.

1.1 | First impressions from faces: The primacy of moral inferences in person perception

Traditionally, research on how people form first impressions of unfamiliar targets has focused on warmth (i.e., a social dimension that revolves around connection and community) and competence (i.e., a cognitive dimension that revolves around agency and goal pursuit) as the two fundamental dimensions driving person perception (Fiske et al., 2007; Martin & Slepian, 2021). However, some studies suggest that two-dimensional models of impression formation do not fully capture the importance of moral information in overall impressions of social targets. Goodwin and colleagues (2014) showed that, despite warmth and morality being 'social' dimensions, both dimensions diverge (e.g., a person can be charming but of dubious moral character). Further, 'pure' moral traits (e.g., honesty) were shown to be the strongest predictors of impressions, suggesting that perceptions of moral character may be the most important source of social information in impression formation (Goodwin, 2015). The primacy of moral character in person perception may reflect both social-functionalist (e.g., assessing intentions) and symbolic considerations related to what it means to be human (Goodwin, 2015; Olivera-La Rosa, 2018; Strohminger & Nichols, 2014).

Indeed, inferring moral information from unfamiliar targets is a ubiquitous practice and often results from evaluations based on whatever information is available. For instance, moral behaviours (Uhlmann et al., 2015), affective reactions (Olivera-La Rosa et al., 2021; Kastendieck et al., 2021) and uncanny faces (Olivera-La Rosa et al., 2023b) have been revealed as sources of moral inferences. The latest finding is consistent with decades of research on face perception, showing that people spontaneously draw several first impressions from faces, a process that can be characterized as mainly automatic (Bar et al., 2006; Engell et al., 2007). Some authors claim that initial social perception should be understood as a dynamic negotiation between bottom-up visual features inherent to a target (e.g., facial traits) and social cognitive factors that perceivers bring to the perceptual process (e.g., stereotypes and attitudes; Freeman & Ambady, 2011; Freeman et al., 2020). This model suggests that, in those cases when facial information is particularly ambiguous (e.g., androgynous facial features), social-conceptual knowledge may influence representational competition one way or another (e.g., man or woman). For instance, perceiving a face as real (instead of artificial) can impact perceived trustworthiness (Tucciarelli et al., 2022), which seems consistent with the influence of the uncanny feeling in social judgements (Olivera-La Rosa, 2018). From an evolutionary standpoint, a quick and accurate evaluation of another's intentions can assist people to engage in the proper behavioural response (e.g., approach vs. avoid) (Atkinson & Adolphs, 2005). Negative biases towards ambiguous social interactions have been explained as social perception mechanisms prioritizing caution to reduce false-positive errors at the cost of increasing false-negative errors (Schaller & Park, 2011).

Trustworthiness is a moral trait that has been of special interest in previous face perception research, playing a crucial role in automatic first impressions of unfamiliar faces (Oosterhof & Todorov, 2008; Todorov et al., 2009). Indeed, social traits critical to survival, such as trustworthiness, are more likely to be automatically inferred from faces (Engell et al., 2007). Judgements of trustworthiness approximate the global evaluation of faces (Oosterhof & Todorov, 2008), which is consistent with the primacy of moral information in impression formation (Goodwin, 2015). For instance, unfamiliar faces elicit judgements of trustworthiness or untrustworthiness in as little as 33–100 ms (Todorov et al., 2009; Willis & Todorov, 2006). Untrustworthy faces elicited increased amygdala activity (Said et al., 2010), which is related to basic affective evaluations (e.g., fear). Perception of trustworthiness can be influenced by face typicality, with locally typical faces being judged as more trustworthy than faces typical of other places (Sofer

et al., 2015, 2017). Based on this research, it can be argued other types of atypical faces (e.g., androgynous faces) may be more likely to be perceived as untrustworthy.

Some evidence showed that facial attractiveness impressions precede and influence the perception of trustworthiness (Gutiérrez-Garcia et al., 2019). Indeed, facial attractiveness positively influences social judgements in a plethora of fields (Langlois et al., 2000); however, unattractive faces often provoke sounder effects on social judgements than attractive faces. This negative bias has been explained as due to unattractive faces being perceived as more ambiguous and, as a consequence, harder to categorize (Griffin & Langlois, 2006). Appraisals of unpredictability and ambiguous social threats are associated with the creepiness response (i.e., an unpleasant and confusing psychological reaction), which is mainly triggered by facial cues (McAndrew & Koehnke, 2016; Watt et al., 2017). According to these authors, ambiguity in social information derived from the face is involved in this negative response. Altogether, these findings suggest that face evaluation may be related to heuristic mechanisms for inferring moral information (e.g., harmful intentions) (Olivera-La Rosa, 2018; Oosterhof & Todorov, 2008).

1.1.1 | Social perception of androgyny

Androgynous individuals possess similar levels of feminine and masculine traits (Kark, 2020); that is, they exhibit aesthetic and/or behavioural characteristics of an ambiguous nature. It is worth mentioning that the current research focuses on the perception of androgynous faces (i.e., physical androgyny via morphing of sex-typical female and male faces) and not on the sexuality of androgynous individuals (for a similar approach; see Atwood & Axt, 2021).

Previous research suggests the existence of a negative social bias towards androgyny. Stern and Rule (2018) demonstrated that negative attitudes towards physically androgynous transgender individuals can be attributed to participants' difficulty in determining their sex. The authors concluded that the struggle in sorting androgynous-looking faces into a binary category represents a metacognitive variable capable of influencing negative social judgements towards them (see also Owen et al., 2016). This finding is consistent with research by Lick and colleagues, showing that metacognitive processes underlying categorization influence social judgements and interpersonal prejudice (Lick & Johnson, 2013; Lick et al., 2015). For instance, gender-atypical faces were associated with bisexual categorizations and were rated more negatively, partially by disfluent processing in the early stages of social perception (Lick et al., 2015). Such a negative bias against androgynous people has also been shown by implicit procedures (Atwood & Axt, 2021; Axt et al., 2021).

2 | THE PRESENT RESEARCH

Although these findings are certainly insightful, the impact of categorical difficulty in moral inferences (besides attitudes) of androgynous faces requires further research. Our research aims to fill this gap by assessing the moral perception of androgynous targets from the standpoint of the uncanny valley framework, which connects metacognitive processes underlying categorization with moral inferences (Olivera-La Rosa, 2018). We believe that the centrality of moral information in person perception justifies the dependent variables chosen in this research. For instance, the perception of moral character may be more informative of moral judgements than that of the permissibility of acts (Uhlmann et al., 2015). Moreover, previous studies on negative biases towards androgynous faces were largely based on United States citizens (Atwood & Axt, 2021; Axt et al., 2021; Stern & Rule, 2018), which restricts the generality of these findings. Therefore, we assessed whether categorical difficulty in the perception of androgynous faces is related to judgements of untrustworthiness, appraisals of creepiness (uncanniness) and judgements of a different moral stance (i.e., 'the target person does not share my moral values') in two samples that were underrepresented in previous research: Spanish-speaking and Italian samples. Based on these findings, we predicted that

- H_1: Androgynous faces should be rated as creepier, more untrustworthy, and more morally different than sex-typical faces.
- H_2: A negative bias towards androgynous faces could be caused by the fact that the participants would have a harder time resolving androgynous faces' biological sex, thus leading to an increase in the reaction times (RTs).

We tested these hypotheses in four online experiments conducted with Spanish-speaking and Italian participants. In Study 1, we assessed the role of categorization difficulty in moral perception of androgynous targets in a Spanish-speaking population. Study 2 was conducted to extend the generalizability of Study 1 results by applying the same experimental design in a different cultural context (Italian sample). Further, Study 2 explores whether potential differences in stimulus familiarity resulting from the particularities of the experimental procedure play a role in the obtained results. Study 3 incorporated a different set of face stimuli (previously used by Atwood & Axt, 2021) varying in ethnicity to assess the role of stimuli selection in the results of Studies 1 and 2. Finally, Study 4 used morphed faces both for androgynous and sex-typical faces to control the potential influence of features of the face stimuli (e.g., realness/attractiveness related to morphing procedures) in our findings.

3 | STUDY 1

3.1 | Introduction

The main aim of this online study was to investigate whether categorization difficulty played an important role in influencing social judgements of androgynous targets in a Spanish-speaking sample. We adopted three social judgement variables – trustworthiness, creepiness and shared moral values – to assess the social perception

of androgyny. Please note that the concept of 'uncanniness' has encountered translation challenges. The initial term, *Bukimi No Tani*, was initially translated as 'strangeness' (Mori, 1970/2005) and subsequently substituted with expressions like 'creepiness' or 'eeriness' (Wang et al., 2015).

3.2 | Methods

3.2.1 | Participants

We recruited 116 participants via internal email and social networking. Most participants were from Colombia (73.7%), Peru (21.1%), or Spain (2.6%). Before the experiment, all participants affirmed their consent to participate in the study and provided written consent in accordance with ethical procedures approved by the Bioethics Committee of Universidad Católica Luis Amigó, Medellín, Colombia. They then indicated their age, biological sex, sexual preferences, and country of residence.

3.2.2 | Exclusion criteria

Two different criteria were adopted to clean the data before the analyses. First, we excluded the participants who did not complete the whole experiment ($N = 35$). Second, we applied the Mahalanobis' criterion for identifying multivariate outliers (Masnan et al., 2015) to exclude the participants whose response times for masculine, feminine and androgynous faces exhibited a considerable distance from the centroid ($N = 5$).

After such exclusions, the final sample was 76 participants (49 females, $M_{age} = 33.12$, $SD = 13.42$). The task was completed in a median time of 17.28 min.

3.2.3 | Face evaluation task and stimuli creation

We assessed the relationship between categorization difficulty and social perception of sex-typical versus androgynous faces using a modified version of the face evaluation task. Following Stern and Rule's (2018) experimental design, the task consisted of two parts. First, participants categorized target faces in a random order as either male or female faces by pressing the A and L keys, respectively. Consistent with previous research (Owen et al., 2016; Stern & Rule, 2018), response latency was included as a measure for ease (or difficulty) of the categorization difficulty of the target.

Concerning the stimuli, we selected 15 faces (five androgynous, five feminine, and five masculine faces) after two pilot studies directed to control for sex typicality and attractiveness (see Supporting Information). Androgynous faces were created by morphing male and female faces (i.e., 50% Female–50% Male faces) from DeBruine and Jones (2017). Masculine and feminine faces were selected from the same database.

3.2.4 | Social judgements

We measured social judgements towards androgynous faces through three independent scales. Thus, participants then viewed the same target faces again and rated each face on the dimensions of trustworthiness, creepiness/uncanniness and morality. We randomized the order of the faces for this task, along with the order of presentation of the three social judgement scales.

We measured trust by asking participants to indicate the perceived trustworthiness of the target on a 7-point scale ranging from 'not at all trustworthy' to 'completely trustworthy'. The question was framed as follows: 'Based on your intuition, how trustworthy does this person seem to you?'. Higher ratings correspond to higher trustworthiness judgements. Participants rated the perceived creepiness by indicating how creepy they perceived the target person to be on a 7-point scale from 'not creepy at all' to 'extremely creepy'. We used 7-point Likert scales to measure trustworthiness and creepiness because we aimed at building a catchy task that was feasible in a relatively short amount of time. All the studies are <18 min and this can be considered satisfactory; especially considering the works on the scarce reliability of long (>20 min) online studies (Revilla & Höhne, 2020; Revilla & Ochoa, 2017). Moreover, trustworthiness and creepiness were measured by using a 7-point scale in previous online research on face perception (Olivera La Rosa et al., 2020; Olivera-La Rosa et al., 2021). Participants responded to the shared moral values scale (Szczurek et al., 2012), by indicating how much they felt the target face shared their moral values ('I feel the target individual shares most of the same moral values as me'), using a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The shared moral values scale was used as a 6-point scale as in previous research (Olivera-La Rosa et al., 2021; Szczurek et al., 2012).

3.3 | Results

3.3.1 | Statistical notes

In all the analyses, a mixed approach was adopted. Jamovi (The Jamovi project, 2022) was used as the analytic software. In greater detail, the Generalized Linear Mixed-effect Models (GLMMs; Stroup, 2013; Faraway, 2006) were run on GAMLj (Gallucci, 2019). This procedure has already been proven to be effective and satisfactory in analysing reaction times data in psychological studies for several reasons: firstly, GLMMs do not average across individual responses; secondly, they can handle data that do not meet the normality assumption. Lastly, such a procedure allows differences between individuals to be measured appropriately, especially with skewed data (Lo & Andrews, 2015).

TABLE 1 Descriptive statistics of all studies.

		Faces' appearance						
		Androgynous		Feminine		Masculine		
	EXP	*M*	*SE*	*M*	*SE*	*M*	*SE*	*d*
RT	EXP1	2.40	0.21	1.60	0.12	1.43	0.12	0.62
	EXP2	1.75	0.19	1.24	0.12	0.98	0.09	0.70
	EXP3	3.07	0.19	1.87	0.14	1.87	0.15	0.48
	EXP4	2.34	0.19	1.55	0.11	1.23	0.08	0.42
Trustworthiness	EXP1	3.83	0.32	3.20	0.23	2.94	0.22	0.16
	EXP2	4.24	0.35	3.59	0.27	2.82	0.23	0.29
	EXP3	3.35	0.18	3.00	0.20	3.15	0.20	0.07
	EXP4	3.38	0.25	3.42	0.22	2.83	0.19	0.13
Creepiness	EXP1	1.96	0.14	2.61	0.20	2.87	0.23	0.28
	EXP2	1.73	0.15	2.43	0.23	2.74	0.28	0.42
	EXP3	2.26	0.13	2.20	0.16	2.29	0.16	0.02
	EXP4	2.55	0.18	2.93	0.20	3.25	0.23	0.16
Shared Moral Values	EXP1	3.01	0.24	2.41	0.19	2.37	0.18	0.21
	EXP2	3.20	0.26	2.88	0.23	2.61	0.19	0.16
	EXP3	3.00	0.16	2.74	0.18	2.84	0.18	0.07
	EXP4	3.03	0.19	2.87	0.18	2.52	0.17	0.12

To control for the participants' and stimuli' variability, within the GLMMs, the participants and stimuli were modelled as random intercepts (Judd et al., 2012). Moreover, the effect of the face's appearance (i.e., masculine, feminine, or androgynous) was modelled as a random slope within each participant; thus implying that the effect of the face's appearance could differ from participant to participant. Therefore, the following formula was used:

DV (Trustworthiness, Creepiness or Shared Moral values) = Faces' appearance + Participant sex + (1 | Stimulus) + (1 + Faces' appearance | Participant)

In all models, gamma distribution was used with an inverse link function, except for the response times model, where we used a gamma distribution with a log link function (for a rationale about distributions and link functions; see Ng & Cribbie, 2017; Yousefi et al., 2015). Moreover, we excluded the sex of the participants from the RT models as we did not expect any difference between male and female participants in RTs.

Generalized Logistic Mixed Models with the same formula were used with the sex chosen by the participants for each face as the model-dependent variable. This was done to assess the probability of androgynous faces being categorized as females.

In all models, we estimated the parameters of masculine and feminine faces contrasting them with the androgynous faces. The significance of the only missing comparison (i.e., masculine vs. feminine) was investigated through a planned pairwise contrast. In the results of the GLMMs, the reader will find the description of the main effects in terms of χ^2, degrees of freedom (*df*), *p*-value and effect size in terms of Cohen's *d*.[1]

For each estimate, a description is provided of the estimated coefficient (β), standard error (*SE*), level of statistical significance (*p*-value), and 95% bias-corrected bootstrap confidence interval (95% CI). All the descriptive statistics can be found in Table 1.

Furthermore, to enhance the reader's comprehension of the findings, we have included a Bayesian perspective on the results in the Supporting Information. Specifically, we present the Bayes Factors (BF_{10}) derived from Bayesian paired samples *t*-tests with all pairwise comparisons. For all tests conducted, we employed JASP (JASP Team, 2023) with weakly informative Cauchy priors (location parameter was centred to $\mu = 0$ and the scale parameter was set to $\sigma = 0.70$). This Bayesian approach offers an alternative lens through which to interpret the data, providing additional insights into the strength of evidence in support of the alternative hypothesis (H_1) relative to the null hypothesis (H_0).

3.3.2 | Response times and face evaluation

The model showed that the RTs were significantly affected by the manipulated face's appearance ($\chi^2 = 27.8$, $df = 2$, $p < .001$, $d = 0.62$). Considering the androgynous faces as the reference category, the

[1] Cohen's *d* was derived from the proportion of the variance explained by the predictor (i.e., R^2) as per the following formula (Ruscio, 2008; Marini et al., 2024): $d = \sqrt{\frac{-4R}{(R^2-1)}}$

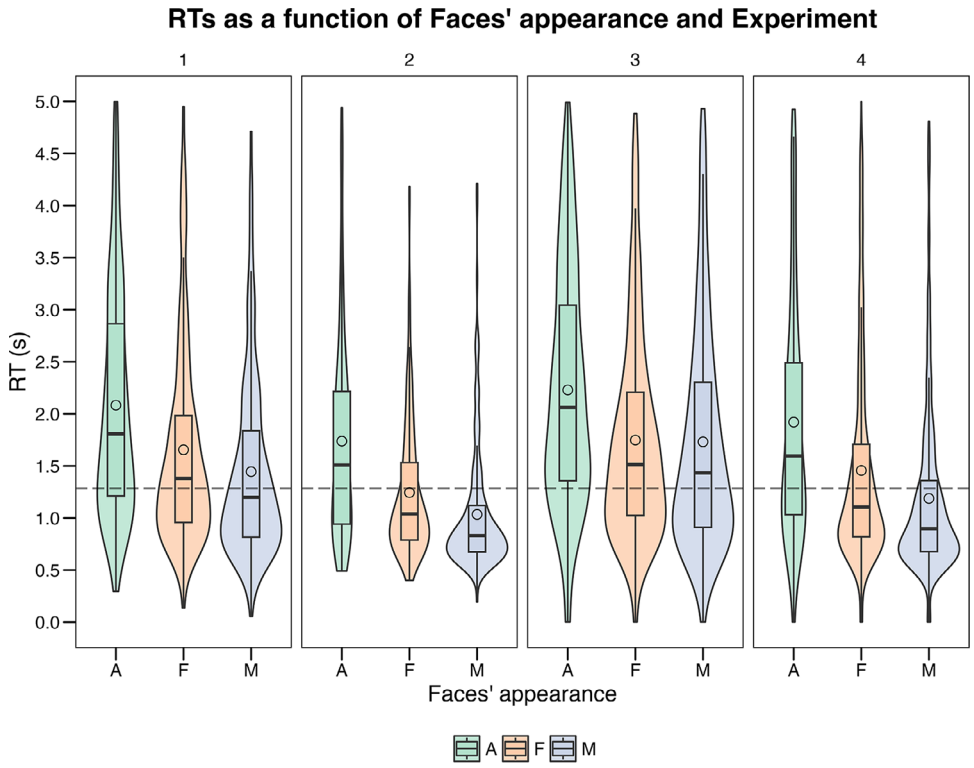

FIGURE 1 Response times as a function of faces' appearance and experiment (violin plot). The form of the violin indicates the distribution curve. The boxplots within each violin represent interquartile ranges (IQRs). Black vertical lines within the boxplots indicate median values. Black circles within the boxplots indicate mean values. The dashed line indicates the median. In the computation of the median, Study 3 was excluded.

model indicated that both the masculine ($\beta = -.50$, 95% CI [−0.64, −0.36], $SE = 0.07$, $p < .001$) and feminine ($\beta = -.39$, 95% CI [−0.53, 0.25], $SE = 0.07$, $p < .001$) faces fostered a significant decrease in RTs, thus showing greater difficulty in categorizing androgynous faces. No difference was found between the RTs of feminine and masculine faces ($p = .140$) (Figure 1). The probability that an androgynous face was characterized as female was 60.8%, 95% CI [47.6, 72.5].[2]

3.3.3 | Social judgements

Trustworthiness had a significant effect ($\chi^2 = 8.8$, $df = 2$, $p = .012$, $d = 0.16$). The androgynous faces were perceived as more trustworthy than feminine ($\beta = .05$, 95% CI [0.002, 0.10], $SE = 0.02$, $p = .043$) and masculine faces ($\beta = .08$, 95% CI [0.02, 0.13], $SE = 0.02$, $p = .004$). A planned pairwise contrast of the estimated marginal means revealed that the difference between feminine and masculine faces was not significant ($p = .319$) (Figure 2).

The creepiness GLMM led to very similar results ($\chi^2 = 19.6$, $df = 2$, $p < .001$, $d = 0.28$), but in the opposite direction. Namely, the androgynous faces were rated as significantly less creepy than masculine ($\beta = -.17$, 95% CI [−0.25, −0.09], $SE = 0.04$, $p < .001$) and feminine faces ($\beta = -.12$, 95% CI [−0.19, −0.06], $SE = 0.03$, $p < .001$). The same pairwise contrast found no difference between masculine and feminine faces ($p = .177$). Female participants reported higher levels of creepiness overall as opposed to male participants ($\beta = .08$, 95% CI [0.001, 0.17], $SE = 0.04$, $p = .046$) (Figure 2).

The shared moral values model reached significance ($\chi^2 = 12.0$, $df = 2$, $p = .002$, $d = 0.21$). The androgynous faces had higher ratings in Shared Moral Values (SMV) than masculine ($\beta = .09$, 95% CI [0.03, 0.14], $SE = 0.03$, $p = .003$) and feminine faces ($\beta = .08$, 95% CI [0.02, 0.14], $SE = 0.03$, $p = .005$). Feminine and masculine faces did not differ ($p = .784$) (Figure 3).

3.4 | Discussion

Our findings indicate that categorizing androgynous faces into a binary sex category is more challenging compared to sex-typical faces. However, this difficulty does not result in unfavourable social judgements towards androgynous targets. Contrary to our expectations, androgynous faces were perceived as less creepy, more trustworthy, and less morally different than sex-typical faces, suggesting a positive social bias towards androgynous faces independent of processing disfluency. Interestingly, our results diverge from prior research on the social perception of androgynous faces (Atwood & Axt, 2021; Axt et al., 2021) and the perception of facial ambiguity (Griffin & Langlois, 2006; Olivera-La Rosa et al., 2023), and also, inconsistent with the hedonic

[2] A Bayesian model comparison approach was taken to make sure that the effect of the manipulated faces' appearance was not merely due to the sex chosen by the participants. In other words, to make sure that the effects found were not merely due to a gender bias. The results of the comparison of the predictors are in theSupporting Information.

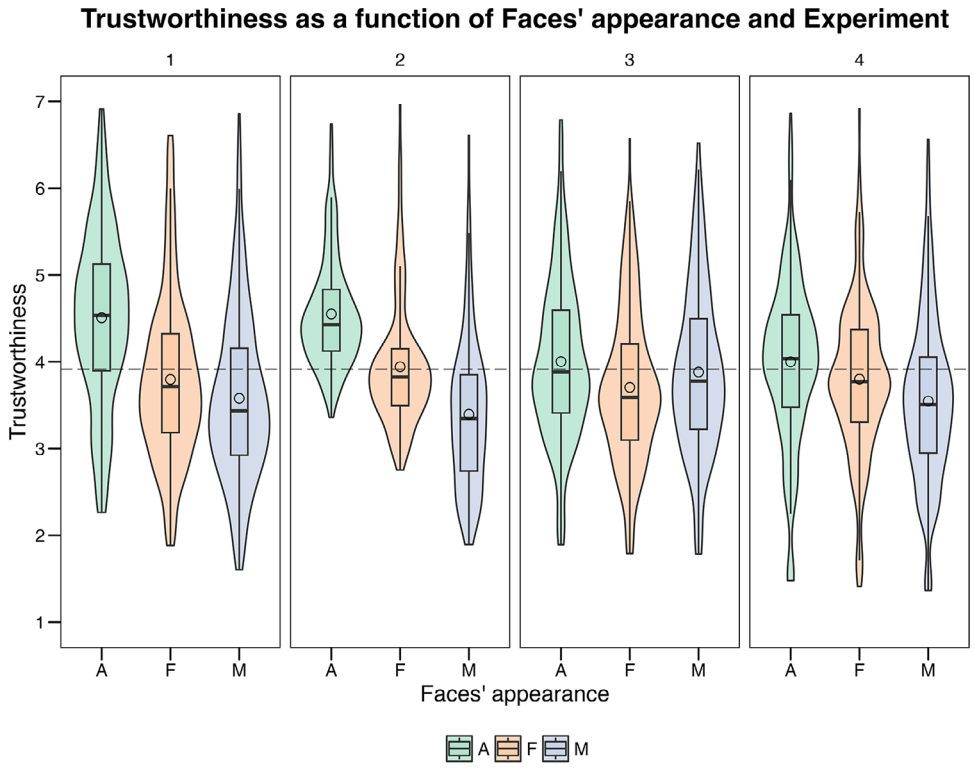

FIGURE 2 Trustworthiness as a function of faces' appearance and experiment (violin plot). The form of the violin indicates the distribution curve of the predicted values. The boxplots within each violin represent IQRs. Black horizontal lines within the boxplots indicate median values. Black circles within the boxplots indicate mean values. The black dashed line indicates the grand mean. In the computation of the grand mean, Study 3 was excluded.

fluency model (Reber & Schwarz, 2006; Winkielman et al., 2003), may reflect another side of social perception of androgynous targets that occurs under certain specific circumstances. Therefore, we have initiated a second study to validate and expand upon our current findings.

4 | STUDY 2

4.1 | Introduction

Negative biases towards androgynous faces were found in samples that were mainly composed of United States citizens (Atwood & Axt, 2021; Axt et al., 2021; Stern & Rule, 2018), which opens the possibility that the divergence of those findings with Study 1 results reflects cultural differences in social perception. Therefore, Study 2 tested a different sample (Italian participants) to ensure that any observed results generalize beyond the sample used in the first study (Spanish-speaking participants). In addition, the fact that participants took longer to categorize androgynous faces than sex-typical faces implies that they were exposed to androgynous faces for a longer period of time before the social judgement task. As a result, it cannot be ruled out that androgynous faces have become more 'familiar' than sex-typical faces and are rated more positively (see Stern & Rule, 2018). Therefore, by controlling the order of the experimental tasks (face evaluation task vs. social judgements), Study 2 explores whether our results were explained by the particularities of the experimental procedure.

4.2 | Methods

All relevant methodological variables were held constant with Study 1, except for one critical modification. We balanced the appearance of the face evaluation task between subjects: some participants completed the face evaluation task before the social judgement scales (i.e., after the individual differences section), while others completed it after the social judgement scales (i.e., at the end of the experiment).

4.2.1 | Participants

Initially, we recruited 55 participants. Subsequently, we executed some exclusions with the same criteria as Study 1. The valid sample was 45 participants (26 females, M_{age} = 30.80 years, SD = 7.72). All participants were Italian. The task was completed in a median time of 12.21 min. As in Study 1, all participants confirmed that they agreed to undergo the study and provided written consent in accordance with ethical procedures approved by the Bioethics Committee of Universidad Católica Luis Amigó, Medellín, Colombia, before the experiment. Demographic information was collected as in Study 1.

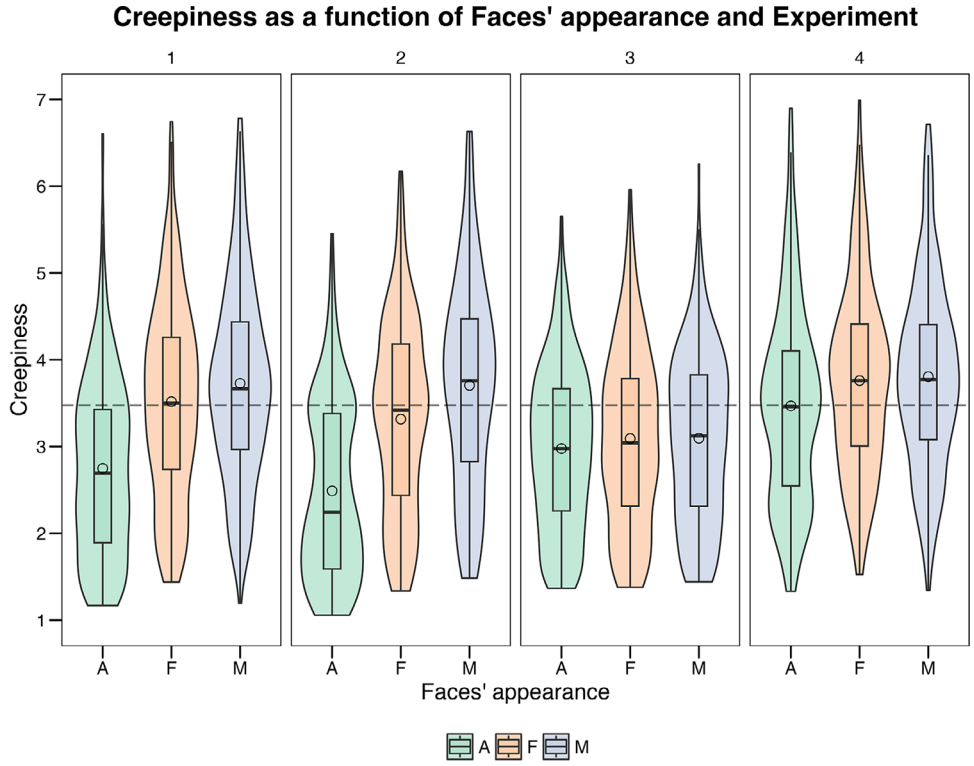

FIGURE 3 Creepiness as a function of faces' appearance and experiment (violin plot). The form of the violin indicates the distribution curve of the predicted values. The boxplots within each violin represent IQRs. Black horizontal lines within the boxplots indicate median values. Black circles within the boxplots indicate mean values. The black dashed line indicates the grand mean. In the computation of the grand mean, Study 3 was excluded.

4.3 | Results

4.3.1 | Response times and face evaluation

A GLMM identical to that of Study 1 was run. The androgynous faces increased the RTs both with respect to the masculine ($\beta = .54$ 95% CI [0.42, 0.68] $SE = 0.06$ $p < .001$) and feminine faces ($\beta = .31$, 95% CI [0.17, 0.44], $SE = 0.06$, $p < .001$) (Figure 1). Feminine faces required more time than masculine to be categorized ($p < .001$). The main effect of the faces' appearance was significant ($\chi^2 = 31.6$, $df = 2$, $p < .001$, $d = 0.70$).

The probability that an androgynous face was characterized as female was 77.0%, 95% CI [62.9, 86.9].

4.3.2 | Social judgements

The same GLMMs were run, and the presentation order was added to the model to take into account its potential impact. The results were very similar to those of Study 1.

The trustworthiness omnibus effect reached significance ($\chi^2 = 11.7$, $df = 2$, $p = .003$, $d = .29$); proving that androgynous faces were rated as more trustworthy than masculine ($\beta = .11$, 95% CI [0.04, 0.17], $SE = 0.03$, $p < .001$) and feminine faces, although this result just approached significance ($\beta = .04$, 95% CI [−0.004, 0.09], $SE = 0.02$, $p = .077$). The result of the pairwise comparison indicated that the difference between masculine and feminine faces was also significant ($p = .028$), with feminine faces being perceived as more trustworthy than masculine ones (Figure 2).

The effect of the faces' appearance on creepiness was significant ($\chi^2 = 20.8$, $df = 2$, $p < .001$, $d = 0.42$). The androgynous faces were perceived as less creepy than both masculine ($\beta = -.20$, 95% CI [−0.28, −0.11], $SE = 0.04$, $p < .001$) and feminine ($\beta = -.15$, 95% CI [−0.23, −0.07], $SE = 0.04$, $p < .001$) faces. The difference between masculine and feminine faces was not significant ($p = .205$). Comparably with Study 1, female participants' creepiness scores were higher as opposed to those of male participants ($\beta = .12$, 95% CI [0.001, 0.25], $SE = 0.06$, $p = .047$) (Figure 3).

As for the shared moral values, the effect of the faces' appearance failed to reach significance ($\chi^2 = 3.2$, $df = 2$, $p = .197$, $d = 0.16$) (Figure 4).

In all models, no effect of presentation order was found ($ps > .29$) and the presentation order did not interact with the faces' appearance ($ps > .42$). Furthermore, we inspected Akaike and Bayesian information criteria (i.e., AIC and BIC) values of the same models with and without the presentation order. In all cases, the model without the presentation order fits better with the data (i.e., lower values of AIC and BIC). For this reason, although we always manipulated presentation order, we will not include it in the models of Studies 3 and 4.

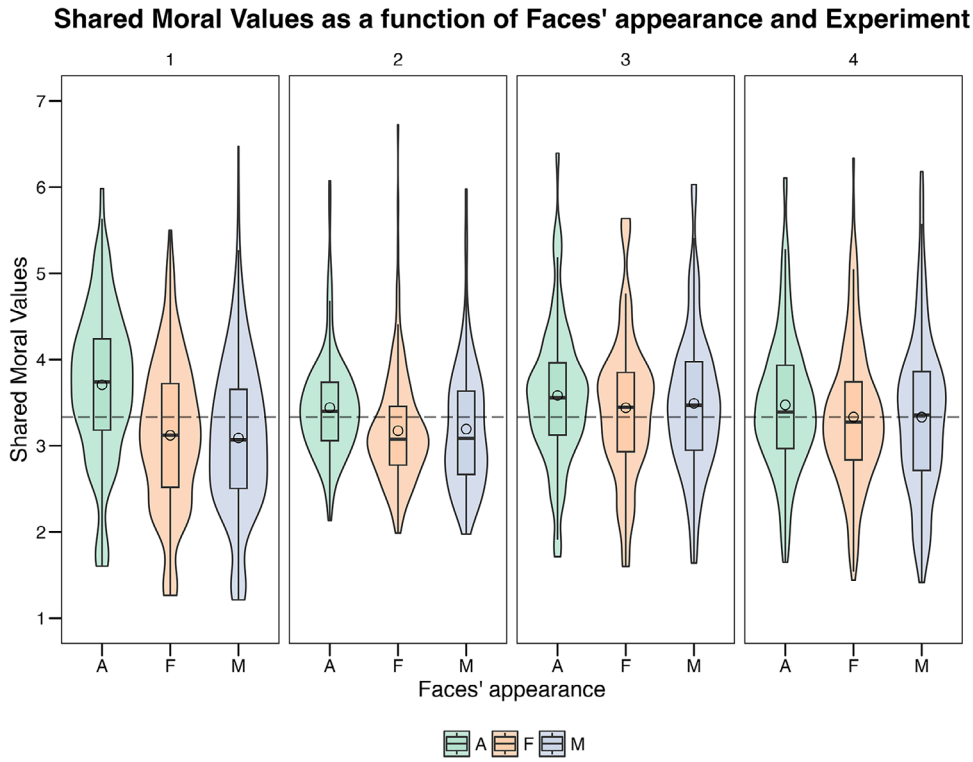

FIGURE 4 Shared moral values as a function of faces' appearance and experiment (violin plot). The form of the violin indicates the distribution curve of the predicted values. The boxplots within each violin represent IQRs. Black horizontal lines within the boxplots indicate median values. Black circles within the boxplots indicate mean values. The black dashed line indicates the grand mean. In the computation of the grand mean, Study 3 was excluded.

4.4 | Discussion

The results of Study 2 replicated most of the findings from Study 1 in an Italian sample. Relative to sex-typical faces, androgynous faces were rated higher in trustworthiness and lower in creepiness. As in Study 1, these findings were insensitive to androgynous faces causing greater categorical uncertainty (and presumably, greater cognitive effort) than sex-typical faces. Moreover, the fact that we found no effect of task order on social judgements suggests that these findings cannot be explained away as an artefact of stimulus familiarity. In summary, the findings from Study 2 align with the presence of a favourable social bias towards androgynous faces, a trend not confined to the specific sample employed in Study 1 (Spanish-speaking participants).

5 | STUDY 3

5.1 | Introduction

Since results from Studies 1 and 2 go against the reviewed literature, we decided to conduct a third study to assess whether our results generalize beyond the particular set of androgynous faces used in those studies. With this aim, Study 3 is directed to explore the replicability of our findings with a set of faces that have been shown to trigger negative bias towards androgyny. Specifically, by using a set of face stimuli that consistently revealed more positive associations towards sex-typical than androgynous faces (Atwood & Axt, 2021), we expected to determine the potential impact of stimuli selection on our findings.

5.2 | Methods

The procedure was identical to that used in Study 2, except that faces were obtained from Atwood and Axt (2021, Study 1b). Therefore, we used eight faces (four masculine/feminine, four androgynous) matched on ethnicity and attractiveness. Sex-typical faces were obtained from the Chicago Face Database (Ma et al., 2015), and androgynous faces were created by morphing one of the male/female headshots with another headshot of an individual of the same ethnicity and 'other' biological sex. All images were cropped in an oval shape to include only the front of the face (see the Supporting Information). As in Study 2, we balanced the appearance of the face evaluation task between participants.

5.2.1 | Participants

Two hundred participants were recruited. However, after the exclusions (the same criteria of Studies 1 and 2 were followed), the valid

sample was 140 participants (65 females, one decided not to declare; M_{age} = 31.03 years, SD = 29.13). Most participants were from Colombia (51.1%), followed by Peru (43.3%). The remaining participants were from Spain (2.1%), the USA, Italy, Belarus, and Argentina (0.8% each). The median completion time was 16.31 min.

5.3 | Results

5.3.1 | Response times and face evaluation

The same GLMM of the previous studies was employed. As predicted, the androgynous faces increased the RTs with respect to the masculine (β = .45, 95% CI [0.27, 0.62], SE = 0.09, p < .001) and feminine faces (β = .46, 95% CI [0.28, 0.64], SE = 0.09, p < .001). No difference was found between masculine and feminine faces (p = .889) (Figure 1). The main effect of the faces' appearance was significant (χ^2 = 58.1, df = 2, p < .001, d = 0.48).

The probability that an androgynous face was characterized as female was 51.8%, 95% CI [37.9, 65.5].

5.3.2 | Social judgements

Initially, we found no effect on the faces' appearance in any of the models of Study 3 (p-values: trustworthiness = .262, creepiness = .892, SMV = .310) (Figures 2–4). At this point, as this study differed from Studies 1 and 2 by incorporating stimuli featuring faces of diverse ethnic backgrounds, we wondered whether ethnicity could have played a role in the evaluations. Therefore, we built three analogous GLMMs, but we substituted the faces' appearance with the faces' ethnicity.

In the trustworthiness model, the effect of ethnicity was significant (χ^2 = 37.5, df = 3, p < .001, d = .23). Compared to White faces, Asians were perceived as less trustworthy (β = −.02, 95% CI [−0.04, −0.01], SE = 0.02, p = .007), whereas Afro-Americans as more trustworthy (β = .02, 95% CI [0.01, 0.04], SE = 0.02, p = .003). No difference was found between White and Latinx ethnicity (β = .01, 95% CI [−0.01, 0.03], SE = 0.01, p = .090).

The effect of ethnicity was significant also in the creepiness model (χ^2 = 14.7, df = 3, p = .002, d = .27), where the Afro-American faces were perceived as significantly less creepy than White (β = −.03, 95% CI [−0.07, −0.01], SE = 0.02, p = .049), Asian (β = −.06, 95% CI [−0.10, −0.02], SE = 0.02, p < .001), and Latinx faces (β = −.06, 95% CI [−0.09, −0.02], SE = 0.02, p = .001).

Similar results were obtained in the SMV model (χ^2 = 45.9 df = 3, p < .001, d = .26). Afro-American faces reported higher values of SMV compared to White (β = .02, 95% CI [0.01, 0.04], SE = 0.01, p < .001), Asian (β = .04, 95% CI [0.03, 0.06], SE = 0.01, p < .001), and Latinx faces (β = .03, 95% CI [0.01, 0.04], SE = 0.01, p < .001).

A graphical representation of these results can be found in the Supporting Information.

5.4 | Discussion

Consistent with Studies 1 and 2, androgynous faces caused greater categorical uncertainty than sex-typical faces. However, contrary to those studies, we found no effect of perceived androgyny on judgements of trustworthiness, creepiness, and shared moral values. At first glance, results from Study 3 suggest that positive bias towards androgynous targets is susceptible to stimuli selection. Therefore, the theoretical implications of this bias should be taken with caution. Interestingly, the analysis of the role of ethnicity in social judgements showed a main effect of ethnicity in participants' responses, suggesting that the discrepancy between Study 3 and Studies 1 and 2 results is likely to be explained as a result of an ethnic bias. Indeed, differently from Studies 1 and 2, Study 3 faces (androgynous and sex-typical) were from four different ethnic groups: Asian, Afro-American, Latino, and Caucasian. Study 3 was designed to assess the generalizability of the obtained effects with a set of faces that were previously shown to trigger negative bias in implicit research (Atwood & Axt, 2021, Study 1b). Therefore, using face stimuli from different ethnic groups was a consequence of this decision, not a theoretical and/or methodological goal of our research. In this vein, even if a positive bias towards androgynous faces was not replicated with this particular set of stimuli, it is worth mentioning that we did not find evidence of a negative bias towards androgynous faces (as in Atwood & Axt, 2021). As a result, we designed a new study directed to assess whether methodological decisions regarding the creation of androgynous faces play a role in our previous findings. Crucially, we controlled for the same variables as in Studies 1 and 2 (e.g., ethnicity).

6 | STUDY 4

6.1 | Introduction

Lastly, as an additional control, we conducted another study using morphed faces for both androgynous and sex-typical faces. We implemented this specific procedure as a precautionary measure, driven by our awareness of the potential influence of the morphing process on facial features beyond the specific aspect of attractiveness that was initially considered. Recognizing that the morphing procedure can introduce subtle changes in facial characteristics, we aimed to mitigate any unintended alterations that could have occurred during this process. For instance, some evidence showed that artificial faces were rated as more real than 'real' faces (i.e., faces of existing people; Tucciarelli et al., 2022). Interestingly, the authors found that participants evidenced greater social conformity (trustworthiness) to faces perceived as real (even if those faces were actually artificial). In contrast, Marini and colleagues (2024) discovered that the perceived or declared realness of certain images depicting human figures positively correlated with self-reported sexual arousal, demonstrating a favourable bias towards images perceived as (or declared to be) real. These findings suggest that social perception of artificial faces may be rather

complex, in the sense that different features of the face stimuli set (e.g., perceived realness) may impact first impressions.

6.2 | Methods

The procedure was identical to that used in Studies 1 and 2. We used 15 morphed faces (five masculine, five, feminine and five androgynous) whose original versions were taken from DeBruine and Jones (2017). The sex-typical faces were morphed within each biological sex by averaging their attractiveness, that is, the most attractive face was morphed with the least attractive (see the Supporting Information). The androgynous faces were those of Studies 1 and 2.

6.2.1 | Participants

Eighty-five valid participants were recruited (30 females; $M_{age} = 23.20$ years, $SD = 4.79$). Most participants were from Peru (55%), followed by Colombia (27.5%). The remaining participants were from Italy (13.8%), Germany, Niger, and the USA (1.3% each). The median completion time was 16.85 min.

6.3 | Results

6.3.1 | Response times and face evaluation

The same GLMM of Studies 1 and 2 was employed. As predicted, the androgynous faces increased the RTs with respect to the masculine ($\beta = .62$ 95% CI [0.52, 0.71] $SE = 0.05$ $p < .001$) and feminine faces ($\beta = .41$ 95% CI [0.31, 0.50] $SE = 0.05$ $p < .001$). The RT to categorize feminine faces was higher than masculine' ($p < .001$). The main effect of faces' appearance was significant ($\chi^2 = 58.1$, $df = 2$, $p < .001$, $d = 0.42$). The probability that an androgynous face was characterized as female was 61.2%, 95% CI [52.6, 69.2].

6.3.2 | Social judgements

The effect of the faces' appearance on trustworthiness was significant ($\chi^2 = 9.1$, $df = 2$, $p = .010$, $d = .13$). The androgynous faces were perceived as more trustworthy than masculine faces ($\beta = .06$, 95% CI [0.01, 0.10], $SE = 0.02$, $p = .009$). However, they were rated as trustworthy as the feminine faces ($\beta = -.01$, 95% CI [−0.04, 0.03], $SE = 0.02$, $p = .938$). Feminine faces were perceived as more trustworthy than masculine faces ($p = .005$) (Figure 2).

As for the creepiness effect ($\chi^2 = 11.2$, $df = 2$, $p = .004$, $d = 0.16$), the androgynous faces were rated as less creepy than both feminine ($\beta = -.05$, 95% CI [−0.10, −0.01], $SE = 0.02$, $p = .022$) and masculine faces ($\beta = -.08$, 95% CI [−0.14, −0.03], $SE = 0.02$, $p < .001$). the difference between masculine and feminine faces was not significant ($p = .156$) (Figure 3).

The effect of shared moral values reached statistical significance ($\chi^2 = 6.7$, $df = 2$, $p = .034$, $d = 0.12$). In greater detail, and similarly to the results about trustworthiness, the SMV scores assigned to the androgynous faces were indistinguishable from those assigned to feminine faces ($\beta = .02$, 95% CI [−0.02, 0.06], $SE = 0.02$, $p = .354$), but higher than masculine faces ($\beta = .07$, 95% CI [0.01, 0.12], $SE = 0.02$, $p = .010$). Feminine faces' ratings were significantly higher than those of masculine faces ($p = .045$) (Figure 4).

6.4 | Discussion

Overall, the results from Study 4 seem to be more nuanced than those of Studies 1 and 2. Despite being more difficult to categorize, androgynous faces were perceived more positively than masculine faces. As for the differences between androgynous and feminine faces, they were only significant for the creepiness variable. Consistent with our previous results, androgynous faces were rated as less creepy than sex-typical faces. However, the effect of androgynous faces on trustworthiness judgements was only partially replicated, that is, androgynous faces were perceived as more trustworthy than masculine, but not feminine faces. The shared moral values scores mirrored this effect, indicating that social perception of androgyny can be sensitive to the particularities of the experimental task (Owen et al., 2016). At first glance, it may be argued that the morphing procedure being employed for only androgynous faces increased the attractiveness of the faces in Study 1–3, owing to their proximity to the average face (Rhodes et al., 2002; but see, Sofer et al., 2015). However, this explanation is unlikely for two main reasons. First, the results from Pilot 2 showed that morphed androgynous faces were not rated as more attractive than 'real' sex-typical faces. Second, if our previous results can largely be explained as an effect of morphing on attractiveness, it is unclear why in Study 4 we replicated the positive effect of androgynous faces in creepiness. Further, the morphing-attractiveness explanation seems difficult to conciliate with androgynous faces being perceived as more trustworthy and less morally different (i.e., more likely to share participant's moral values) than masculine faces. However, it cannot be ruled out that other features related to morphing procedures (e.g., realness; Tucciarelli et al., 2022) may play a role in Study 4's results. We return to this discussion in greater depth in the next section.

7 | GENERAL DISCUSSION

We tested whether categorical discrepancies in perception of androgynous faces were associated with a negative social bias towards androgynous faces in four online experiments conducted with Spanish-speaking and Italian participants. Overall, we found consistent evidence showing that the fact that androgynous faces were harder to classify into a binary category compared to sex-typical faces does not cause negative bias towards androgynous targets. Instead, under certain circumstances, a positive bias towards androgynous faces emerged. Our results indeed reveal a significant association between

androgyny and categorical difficulty. However, contrary to our predictions in H_1 and H_2, this relationship did not exert an negative impact on social judgements. Although androgynous faces were consistently more challenging to classify than sex-typical faces and, presumably, caused more cognitive effort due to processing disfluency (Stern & Rule, 2018), this meta-cognitive variable did not cause a negative impact on social judgements of androgyny. Interestingly, the tendency for androgynous faces to receive more positive judgements in most conditions (though there was an exception in Study 3) despite their increased categorical difficulty raises intriguing questions that warrant further investigation. On the one hand, some lines of research suggest that categorical difficulty can be an implicit marker of negative social judgements. As previously mentioned, research on the uncanny valley showed that human-like stimuli that are difficult to categorize could trigger uncanny feelings in an observer (Burleigh et al., 2013; Wang & Rochat, 2017). This hypothesis found its roots in the proposal of Ernst Jentsch (1906/1997), who claims that things we are unable to categorize generate discomfort due to their strangeness or unfamiliarity. Consistent with this view, research on face perception showed that appraisals of ambiguity and unpredictability derived from the face are involved in negative judgements (Doyle et al., 2022; Griffin & Langlois, 2006; Olivera-La Rosa, 2018; Watt et al., 2017).

On the other hand, some studies have questioned the association between ambiguity and the experience of negative affect. Cheetham and colleagues (2014) found that ambiguous faces did not result in reports of greater strangeness. In fact, greater difficulty in perceptual discrimination correlated with more positive affect. Norton and colleagues (2007, 2013) demonstrated that, in specific situations, ambiguity can lead to increased likability. Interestingly, familiarity, under certain circumstances, can breed contempt in social interactions. This positive bias towards uncertainty may be operative in face perception. For instance, some research showed that occlusion of facial features increases facial attractiveness (Hies & Lewis, 2022; Sadr & Krowicki, 2019). In this vein, faces in incomplete photographs were judged more attractive than in complete photographs, suggesting that people tend to have optimistic inferences about others' personalities under information shortage (Orghian & Hidalgo, 2020). According to Norton and colleagues (2007), initial impressions are overly optimistic because of erroneous perceptions of similarity to ambiguous targets. Since people often perceive themselves more positively in different social dimensions than the average person (Sedikides & Gregg, 2008), it is possible that, due to their ambiguous nature, androgynous faces serve as blank canvases onto which individuals project their own, often more positively perceived qualities. However, this hypothesis is highly speculative and warrants further study.

Despite political and social interest in sex and gender diversity, it is somewhat surprising that the research on the social perception of androgynous appearance is still limited. Jackson (1983) found that androgynous and feminine persons were perceived as more likable than masculine persons. Their results suggest a halo effect: more likable persons were also rated as having more desirable social traits. That being said, more recent evidence suggests that there is a negative bias towards androgynous people (Atwood & Axt, 2021; Axt et al., 2021), which may be explained as a result of categorical uncertainty (Olivera-La Rosa et al., 2023a; Stern et al., 2018) and may be sensitive to particularities of the experimental task. Owen and colleagues (2016) found that androgynous targets were disfluent and perceived as less attractive only when they were classified by gender and not necessarily when participants focused on other categorical dimensions. Further, the fact that Stern and Rule (2018) used naturalistic stimuli of self-identifying transgender persons must be taken into account when evaluating these results in the context of our research. Our results are consistent with these studies in two major aspects: androgynous faces are more difficult to categorize into a binary category (Studies 1–4) and are judged differently than sex-typical faces under certain conditions (Studies 1,2,4, but see Study 3). On the other hand, our results contradict the existence of a negative bias towards androgynous faces nor an impact of processing fluency (Stern & Rule, 2018) or categorical availability (Owen et al., 2016) on the social perception of androgynous targets. Hence, our findings suggest that being more difficult to categorize is not sufficient for negative bias: whether there is a negative or positive bias towards androgynous targets may depend on certain conditions, which requires further research.

Indeed, we found evidence of a positive bias towards androgynous faces across different experimental conditions (i.e., Studies 1, 2, and 4), which appear to be more robust (i.e., less sensitive to morphing procedures) when comparing androgynous versus masculine faces. One possible explanation for these findings is that participants inferred that *physically* androgynous targets were also *psychologically* androgynous. The term psychological androgyny is used to describe individuals who possess similar (high) levels of stereotypically female and male psychological attributes (Kark, 2020). Some evidence showed that psychologically androgynous people were liked better than people who mainly possessed sex-typed psychological attributes (Major et al., 1981). Hence, it may be that, when making more general evaluations (e.g., attitudes) of androgynous targets, participants rely on 'holistic' strategies based on available affective feelings (e.g., negative affect resulting from categorical difficulty; Olivera-La Rosa et al., 2023; Stern & Rule, 2018). Conversely, when asked for specific social judgements (e.g., trustworthiness), they may try to 'look inside' into the target personality, inferring psychological androgyny and giving them positive evaluations. Since we did not control for the perception of psychological androgyny, further research is needed to disambiguate this issue.

Another possibility is that participants associated androgynous targets with the LGBTQ+ community, which leaves open the possibility that their responses were driven by social desirability. Socially desirable responses towards marginalized targets are associated with a tendency to more positive ratings in an effort to compensate for potential negative bias (Mendes & Koslov, 2013), which may explain why in different conditions participants attributed higher social standards (e.g., less creepiness) to androgynous targets as opposed to sex-typical ones. Furthermore, people may have explicitly rated androgynous targets as more socially desirable but implicitly still perceived them in a negative way. For instance, results from Study 3 (conducted with stimuli from different ethnic groups) suggest that racial bias may play a

role in social judgement scores, which would explain why the results of this particular study substantially differ from Studies 1, 2 and 4. Interestingly, the same set of facial stimuli proved to trigger negative bias in an implicit task (Atwood & Axt, 2021). Future studies could assess the influence of ethnicity in implicit and explicit social judgements of androgynous targets to test this prediction.

Lastly, in Studies 1–3, we employed the morphing process to create androgynous faces but not for the sex-typical ones. As mentioned before, some evidence suggests that morphing may increase attractiveness (Tucciarelli et al., 2022; especially in those cases wherein it generates a 'typical' face) as morphed faces could be perceived as more 'average' (Rhodes et al., 2002). However, theoretical reasons and the data obtained suggest that it is unlikely that this explanation applies to our results. In fact, one might as well assume the opposite effect to be true; namely, a morphed face (i.e., an artificially created face) is perceived as less attractive than a real face (the uncanny valley hypothesis; Mori, 1970/2005). Worth mentioning here, Perrett et al. (1998) demonstrated that the averaged (i.e., morphed) shape of female faces is less preferred when compared to a feminized version of the same face, showing that averageness is not necessarily good. Moreover, prior studies suggested that sex typicality (especially the femininity of women, but also the masculinity of men) relates to perceptions of attractiveness for both heterosexual and homosexual individuals (Rieger et al., 2011). Indeed, face typicality was shown to impact perceived trustworthiness but not attractiveness (Sofer et al., 2015).

Even if we assume that averageness is universally attractive, this concept primarily applies when morphing two faces within the same biological sex. However, it does not hold as true when morphing between male and female faces. A morphed male–female face is unlikely to be perceived as prototypical because it results in an individual quite distinct from the two starting populations. Importantly, our data do not support the idea that the morphing process significantly increased the attractiveness of androgynous faces, as demonstrated in our pilot and Study 4.

However, although we are not currently aware of any other morphing-dependent mechanisms that could be responsible for the positive bias towards androgynous faces, this possibility remains open. Paradoxically, previous research showed that artificial faces can be perceived as more real than the faces of real people and that perceptions of realness influence perceived trustworthiness (Tucciarelli et al., 2022). Results from Study 4 showed that morphing had some impact on perceived trustworthiness and judgements of shared moral values (but not in perceived creepiness). This suggests that morphing may influence the perception of certain social cues (beyond attractiveness) that are involved in the perception of trustworthiness and moral character, but not in perceptions of creepiness. Indeed, the fact that in Study 4 androgynous faces were rated as more trustworthy than masculine (but not feminine) faces, may indicate that the influence of morphing on social perception was sensitive to the face's appearance.

Another possibility is that morphing increases sex typicality, that is, increases the perception of masculinity in male faces and femininity in female faces. Previous research showed that perceptions of femininity are associated with the social dimension of warmth/communality (which revolves around other-focus, social orientation and desire for connection; Martin & Slepian, 2021), which may positively impact social judgements of female faces. Conversely, increasing perceptions of masculinity in male faces may boost perceptions of dominance (i.e., 'the ability of an individual to exert power over others'; Todorov et al., 2008). Some evidence suggests that a more masculine facial appearance can activate 'criminal stereotypes', increasing the likelihood of being judged guilty of a crime (Ward et al., 2012). However, since we did not control for perceived masculinity and perceived femininity of the morphed set of sex-typical faces, this explanation needs to be empirically tested. Worth mentioning here, we conducted additional analyses to assess if our results were shaped by gender bias (i.e., faces judged as female faces were rated more positively than faces judged as male ones). We found that the manipulated faces' appearance (and not the sex chosen by the participants) was always the best predictor of social judgements (see the Supporting Information). Indeed, a general positive bias towards feminine faces (relative to masculine faces) seems difficult to reconcile with the results of the creepiness judgements. It may be argued that creepiness is more an 'aesthetic' than a 'moral' response, but previous research showed that creepiness is related to judgements of social ambiguity and perception of a potential threat (men are, therefore, creepier than women; Watt et al., 2017). Further studies will need to resort to more ecological pictures to replicate our results. Moreover, future research may benefit from using a two-dimensional assessment of sex-typicality. Finally, future studies should apply a cross-cultural approach to extend the generalizability of existing research on the social perception of androgyny, for instance, by including relevant social dimensions such as competence, dominance, warmth and/or averageness.

We believe that understanding how moral inferences of androgynous faces work is necessary to deal with some relevant daily implications (e.g., job interviews, election outcomes or legal decisions). Just as finding the right solution for any problem largely depends on a thorough understanding - which may not always be pleasant – further research should be conducted to achieve a more comprehensive understanding of which factors determine the occurrence and direction of the effect of androgynous facial traits in social judgements and moral inferences. For instance, future studies should investigate the extent to which such a positive bias towards the androgynous faces might depend on the participants' assumptions about the faces' gender identities. As shown in this research, previous findings on negative bias can benefit from different theoretical (e.g., the uncanny valley framework) and methodological (e.g., cross-cultural online research) approaches to obtain a more 'fine-grained' understanding of the specific conditions in which these cognitive mechanisms operate.

8 | CONCLUSION

In contrast to previous research and H_1 and H_2, our results revealed a lack of negative bias against androgynous faces. Instead, under

certain conditions, we observed a positive social bias towards androgynous targets. Our findings, consistent across four studies with cross-cultural samples, demonstrate that androgynous faces posed challenges in binary sex categorization, yet this difficulty (i.e., processing disfluency) did not affect social judgements. These results reveal a unique aspect of androgyny perception. Future studies should extend and replicate these findings, which will help to reach a deeper understanding of the cognitive basis of attitudes towards androgyny.

AUTHOR CONTRIBUTIONS

A.O. conceived the research and wrote the main manuscript text except for the analytic sections. A.A. built the experimental procedures, conducted the statistical analyses, wrote the analytic sections, and prepared the figures. Both authors reviewed the paper and contributed equally to this work.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

FUNDING INFORMATION

No funding was received for conducting this study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study may be made available from AA upon reasonable request and under a confidentiality agreement.

ETHICS STATEMENT

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. The study was approved by the Bioethics Committee of the Universidad Católica Luis Amigó - Medellín, Colombia (No. 65256/2022).

TRANSPARENCY STATEMENT

All results are reported honestly, the studies were conducted ethically, and the submitted work is original. All data, variables and codes are available at request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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