Covariation between formidability inferences and perceptions of men's preferred humor styles☆

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ABSTRACT

Individuals infer men's formidability through various facial and bodily features. Such inferences covary with perceptions of men's personalities and motivational states, potentially informing subsequent affiliative decisions. Within these inferences could be an implicit understanding of men's preferred humor styles. Across four studies, this research considered perceptions of men's proclivity to employ four humor styles through different formidability cues: upper body strength (Study 1), muscularity (Study 2), facial width-to-height ratio (Study 3), and neck musculature (Study 4). A relatively consistent perception emerged of formidable men as more likely to use aggressive humor. Conversely, an absence of formidability cues elicited perceptions of increased likelihood to use self-defeating humor. We interpret results from an evolutionary perspective for how individuals can identify behavioral strategies through morphological features.

To reap the benefits of group living, individuals have historically relied upon affiliating with group members with benevolent intentions. A sense of humor is one trait that could indicate the degree to which another would such intentions, given its proposed evolutionary function in facilitating closeness, even at minimal acquaintance (e.g., Li et al., 2009; Treger et al., 2013). Because of this ability to foster closeness, selection would have favored those capable of detecting a sense of humor in others and thus able to navigate social groups with greater success. Nonetheless, humor's social benefit appears limited to when the humor conveys actual benevolence to the perceiver. Benign humor could implicate a conspecific as being a safe interaction partner (Cann & Matson, 2014; Zeigler-Hill et al., 2013). Conversely, injurious humor could connote exploitative intentions (e.g., bullying), motivating aversion from perceivers (e.g., Martin et al., 2012; Sacco et al., 2021; Veselka et al., 2010).

Identifying another's benevolent or exploitative intentions could be based upon humor style. A signaled humor style could represent a co-varying behavioral repertoire diagnostic of social intentions. Inferences of humor styles are possible through behavioral cues and useful in informing affiliative decisions (Betz & DiDonato, 2020). However, more direct and rapid cues to behavioral intent and humor style may be possible through identifying evolutionarily relevant physical features. Individuals would thus need to use additional static cues to infer intentions *before* relying on behavioral cues. Selection would have favored those capable of inferring humor styles through physical features from which a perceiver could develop functional heuristics of a social target's preferred behavioral repertoire (Neuberg et al., 2020). Trait inferences relevant for affiliative opportunities occur quickly through facial and bodily channels (e.g., Hu et al., 2018; Sacco & Brown, 2018). Inferences may include assessments of men's formidability through these morphological channels (e.g., Brown, Sacco, & Barbaro, in press-a; Durkee et al., 2018; Sell et al., 2009), which can be used to identify aggressive intent (Petersen & Dawes, 2017). This could inform perceptions of men's humor styles based on a heuristic association between a physical feature and a behavioral pattern. This research sought to identify which components of formidability inferences inform perceptions of men's humor styles.

1. Social affordances of humor styles

Individuals may use implicit theories regarding humor to infer another's intentions and ability to satisfy a perceiver's social needs. Implicit

theories are the beliefs that certain traits correspond with each other, allowing a perceiver to infer another's social affordances and inform affiliative decisions (Kelley, 1973). For example, physically attractive people are perceived as competent and trustworthy (Dion et al., 1972). Germane to the conversation, humorous individuals are regarded as socially desirable and mentally healthy (Cann & Calhoun, 2001). Humorous men are also rated as highly attractive mates and report more lifetime sexual partners (Bressler & Balshine, 2006; Greengross & Miller, 2011).

The purpose of humor varies with the information to be conveyed to the perceiver. Individual differences in humor styles inform perceptions of intentions. Research has identified four distinct styles that exist for intrapersonal and interpersonal targets with benign and injurious intentions (Martin et al., 2003). Interpersonal styles in this model are affiliative humor (benign), which serve to enhance social bonds through lighthearted joking. Conversely, aggressive humor styles (injurious) serve to harm others to bolster the self. Affiliative humor is typical among extraverts, whereas aggressive humor by disagreeable and hostile individuals (Greengross et al., 2012; Vernon et al., 2008). Additionally, the intrapersonal styles are self-enhancing humor (benign), which bolsters the self in stressful situations, and self-defeating humor (injurious), defined by self-derogation. Self-enhancing humor is associated with higher self-esteem and self-defeating humor with lower self-esteem (Zeigler-Hill & Besser, 2011). Table 1 provides a graphic representation of these styles.

Recent findings highlight several social affordances for each humor style. These affordances would inform the perceiver for how social targets facilitate the perceiver's social goals. Benign humor users are desirable peers and romantic partners (Cann & Matson, 2014; Zeigler-Hill et al., 2013). Affiliative humor connotes warmth and competence, inferences that foster desirability in long-term relationships (DiDonato et al., 2013). Conversely, aggressive humor is undesirable for romantic partners (Greengross & Miller, 2008), though acceptable among close friends (DeLuca, 2013). The perceived association between physical appearance and behavior suggests that it could be further possible to infer humor styles through appearance.

2. Formidability inferences

The frequency of physical conflict throughout human history necessitated the evolution of perceptual systems able to estimate the hostility and fighting ability of social targets from which a perceiver could identify potential interpersonal threats (Neuberg et al., 2011). One way in which individuals identify threats is through features connoting formidability. Such inferences occur automatically toward men to ensure perceivers can quickly determine whether to approach or avoid an individual (Durkee et al., 2018). Formidability is multimodal, manifesting through several static and dynamic channels. Dynamic channels include deepening the voice (Aung et al., 2021) and tilting back the head (Toscano et al., 2018). However, these cues may only create the appearance of threat without connoting *actual* prowess. Static cues, such as facial and bodily features, may provide more reliable cues, given the historic difficulty in altering them (Sell et al., 2009). The selection pressures that arose from frequent physical conflict that favored formidable men led to physical size asymmetries in men and women, resulting in formidability as central to many inferences of men's coalitional value (Puts, 2010; Sell et al., 2012).

Strong men are recruited for intragroup rule enforcement and

intergroup representation. Features diagnostic of formidability are often the basis of choosing men for tasks requiring strength and protection (Brown et al., 2017; Brown, Sacco, Barbaro, & Drea, 2022; Brown, Sacco, & Drea, 2022; Lukaszewski et al., 2016). Despite awareness of the potential benefits of strong allies, formidability presents costs that requires individuals to determine whether the benefits outweigh the costs of formidable men in group living (Gordon et al., 2014). Formidable men's aggressive social bargaining could leave group members vulnerable to aggression (Price et al., 2017; Sell et al., 2012). They are indeed perceived as hostile parents (Brown, Donahoe, & Boykin, 2022; Sacco et al., 2020), non-monogamous (Brown, Boykin, & Sacco, 2022), and dominant (Frederick & Haselton, 2007).

Awareness of such costs and benefits could foster perceptions of preferred humor styles. Inferences of affiliative and aggressive intentions are prevalent from these cues (Holbrook et al., 2016; Sell et al., 2009), which could lead perceivers to estimate the manner in which men derive humor. Additionally, formidable men are aware of their physical advantages in conflict (Lukaszewski, 2013). This awareness could lead them to perceive themselves as not needing to ingratiate through self-deprecation typical of low-status men (Greengross et al., 2012).

3. Current research

This research investigated how formidability informs functional perceptions of men's humor styles. We considered physical features through which individuals perceive men's formidability: upper body strength (Study 1); muscularity and adiposity (Study 2); facial width-to-height ratio (Study 3); and components of neck musculature (Study 4). We report all manipulations and measures. Power statements reported herein were based on statistical sensitivity analyses conducted in G*Power using appropriate dimensions for each experimental design (Faul et al., 2007).[1] No data were excluded across all studies.

4. Study 1

Study 1 was an initial investigation of how formidability informs perceptions of humor styles. We considered the most reliable cue of men's formidability, upper body strength (Sell et al., 2009). This signal value may inform perceivers about men's interpersonal styles to inform affiliative decisions. For example, strong men are more gregarious (Lukaszewski & Roney, 2011), which could lead to perceptions of them as desirable for high-status group roles (Holbrook et al., 2016; Lukaszewski et al., 2016). Nonetheless, despite the salient benefits of physical strength, strong men may impose several interpersonal costs to group living. One cost may be a result of strong men's heightened interpersonal aggression (Gallup et al., 2007), as their advantage in physical conflict could lead perceivers to view themselves as vulnerable to exploitation and shape perceptions of strong men as harmful (Sell et al., 2012). Given this cost-benefit analysis, we predicted that strong men would be perceived as more affiliative and aggressive with their humor. However, the competing signal values of strength as both a coalitional ally and threat led us to remain agnostic to which effect would be larger.

With self-enhancing humor, we considered previous research indicating that increased formidability in men is associated with reduced mental distress (Hagen & Rosenström, 2016; Kerry & Murray, 2021). This reduced distress could be due to strong men's advantages in physical conflict that would increase their likelihood of incurring less harm. Men without these advantages could be perceive themselves as more prone to exploitation and harm and thus live with greater dispositional vigilance toward threats (see Kerry & Murray, 2018). Given the role of self-enhancing humor in reducing anxiety (Ford et al., 2017), we predicted that weak men would be perceived as more likely to use self-

Table 1
Humor styles along target dimensions (rows) and intentions (columns), as defined by Martin et al. (2003).

	Benign	Injurious
Interpersonal	Affiliative	Aggressive
Intrapersonal	Self-enhancing	Self-defeating

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[1] Data, syntax, measures (with subscale intercorrelations), and all stimulus materials for each study is available online at: https://osf.io/m72w3.

enhancing humor. Finally, self-defeating humor is often in the service of ingratiation wherein the individual vies for the approval of group members through self-deprecation. Such displays are viewed as more common among low-status individuals, which would correspond with the general disinterest in allocating leadership positions to weak men (Greengross & Miller, 2008; Lukaszewski et al., 2016). This led us to predict that weak men would be perceived as more likely to use self-defeating humor.

4.1. Method

4.1.1. Participants

We recruited 85 undergraduates from a private university in the Northeastern U.S. for course credit (65 women, 20 men; $M_{Age} = 20.16$, $SD = 3.64$; 43.5 % White, 28.2 % Latin, 15.3 % Black, 8.2 % Asian, 4.7 % Other). Our sample had sufficient power to detect small effects for a 2 × 4 within-subjects design (Cohen's $f = 0.12$, 1-β = 0.80).

4.1.2. Materials and procedure

Participants evaluated eight unique targets varying in physical strength. Four targets were of physically strong men and four were physically weak men. The strength of these targets was ascertained in the initial norming data through a composite measure of targets' upper body strength derived from their chest press and handgrip (Lukaszewski et al., 2016). Targets categorized as strong were stronger than those categorized as weak, which was also accurately inferred by perceivers in the norming data (see Fig. 1 for sample bodies).

Targets were standardized by all wearing white tank tops and presented in waist-up photographs with neutral expressions. The latter standardization was critical to reduce the likelihood of facial features influencing perceptions. Participants viewed targets in random order and indicated how strong each target appeared with a single-item manipulation check (1 = *Not at All Strong*; 7 = *Very Strong*).

4.1.2.1. Perceived humor style.
We tasked participants with assessing the perceived likelihood of each target using all four humor styles. Assessments occurred using a short-form other-report version of the Humor Styles Questionnaire (HSQ) previously developed to assess social perceptions of others (Zeigler-Hill et al., 2013). We modified these items for the purpose of this study using subjunctive language for hypothetical social targets.

Items were derived from the original self-report HSQ, which provided evidence for four humor styles. In this original research, these styles were only modestly correlated with each other with $rs = |0.04$–$0.36|$ (Martin et al., 2003). Across these four studies, an overall pattern of modest correlations emerged between subscales with heterogeneity in effect sizes that indicate a degree of empirical distinctiveness between humor styles in this research. Participants indicated the extent to which a target would use each humor style via three items (1 = *Totally Disagree*; 7 = *Totally Agree*). Table 2 provides example items and reliabilities for each subscale.

4.2. Results

4.2.1. Perceived formidability

Paired-samples *t*-tests indicated strong targets were perceived as stronger than weak targets, $t(84) = 22.23$, $p < .001$, $d = 2.72$. Table 3 provides relevant statistics for Study 1 outcomes[2].

4.2.2. Primary analysis

We analyzed the data using a 2 (Target Strength: Strong vs. Weak) × 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-

Defeating) linear mixed effects model (LMM) using the 'lme4' package (Bates et al., 2015) in the R programming language (R Core Team, 2021). This model included a random intercept for participants ($\sigma^2 = 0.16$, 95 % CI [0.11, 0.24]) with a random slope of target strength included in the participant intercept ($\sigma^2 = 0.04$, 95 % CI [0.02, 0.07]), $ICC_{conditional} = 0.125$.[3]

We computed an analysis of variance (ANOVA) on the resultant model to determine significant effects and interactions for the model's fixed factors. We report interactive effects exclusively in these studies for factorial models (i.e., beyond basic comparisons). This analytic decision was based in the relative inefficiency of main effects in explaining basic effects when interactive effects supersede them. Main effects are reported in online supplemental materials.

Effects were qualified by a Target Strength × Humor Style interaction, $F(1, 2544) = 34.29$, $p < .001$, $\eta_p^2 = 0.04$. Fig. 2 displays these data. We conducted simple effects tests on the effect of Target Strength for each Humor Style separately[4], using the 'emmeans' package (Lenth, 2022) to conduct pairwise comparisons. Strong targets appeared marginally more likely to use affiliative humor than weak targets, $F(1, 219.2) = 3.84$, $p = .051$, $\eta_p^2 = 0.02$. Strong targets additionally appeared significantly more likely to use aggressive humor than weak targets, $F(1, 84) = 37.95$, $p < .001$, $\eta_p^2 = 0.31$. Weak targets appeared more likely to use self-defeating humor than strong targets, $F(1, 84) = 36.84$, $p < .001$, $\eta_p^2 = 0.30$. No difference emerged in perceptions of strong and weak targets to use self-enhancing humor ($p = .50$).

4.3. Discussion

Strong men were perceived as significantly more aggressive in their humor and marginally more affiliative. These perceptions could represent the perceivers' understanding of the interpersonal costs *and* benefits of formidable men in group living. Although an implicit understanding of strong men's gregariousness appears to exist in humor displays (Lukaszewski & Roney, 2011; Rodriguez & Lukaszewski, 2020), perceivers could have recognized strong men's potential for aggression due to their advantage in conflict (Sell et al., 2012). The substantially larger effect for aggressive humor than affiliative humor could reflect greater salience of the interpersonal costs of formidability over the benefits. This salience of costs corresponds with inferences of aggressive intent interfering with inferences of desirability (Geniole & McCormick, 2013).

Strong men elicited perceptions of being less likely to use self-defeating humor. This perception could be rooted in recognizing strong men to be high-status, rendering the need to self-deprecate unnecessary (Greengross & Miller, 2008). These findings provided initial evidence for how bodily cues to formidability inform perceptions of men's preferred humor styles. However, this study did not address whether specific components of bodily formidability connote certain humor styles. Additionally, the stimuli in this study presented both a face and a body that may not isolate specific signal values of bodily cues as effectively as presenting faces and body separately. Study 2 sought to determine which components of men's bodies would be specifically indicative of their preferred humor styles with stimuli that had occluded

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[2] We report Greenhouse-Geisser corrections to model degrees of freedom for effects with sphericity departures.

[3] We fit several models in addition to the one reported in the main text, including models with random intercepts and stimuli and multiple random slopes. These models were built starting with the minimal random effects structure (only a random intercept for participants) and proceeding to the maximal (random intercepts for participants and stimuli). Prior to obtaining the results from any models, we compared model fit via model AIC, reporting the model that indicated the most optimal fit to the data. Of these, the model reported here provided the best fit to the data from Study 1 when compared to models without fit or convergence issues, $\chi^2(1) = 10.86$, $p < .001$.

[4] Each model fit a random intercept of participant and a random slope of target strength. The models for affiliative and self-enhancing resulted in singular fits for the random effects, though are reported here for the sake of consistency across models used in Study 1.

Fig. 1. Examples of strong (left) and weak targets based on their bodies from Study 1 (Lukaszewski et al., 2016).

Table 2
Example items for the modified HSQ with subscale reliabilities for Study 1.

Humor style	Example	α	95 % CI$_\alpha$
Affiliative	This person looks like he would joke around with other people.	0.91	[0.88, 0.94]
Aggressive	If someone makes a mistake, this person would tease them about it.	0.86	[0.81, 0.91]
Self-enhancing	If this person is feeling depressed, it looks like he could usually cheer himself up with humor.	0.81	[0.74, 0.88]
Self-defeating	It looks like this person lets people laugh at him or make fun at his expense more than he should.	0.86	[0.81, 0.91]

Table 3
Means (and standard deviations) of perceived strength and exhibition of humor styles from strong and weak targets in Study 1.

	Strength	Affiliative	Self-enhancing	Aggressive	Self-defeating
Strong	5.01 (0.80)	4.45 (1.29)	3.90 (1.19)	4.34 (1.24)	3.43 (1.25)
Weak	3.01 (0.66)	4.27 (1.21)	3.85 (1.15)	3.77 (0.131)	4.10 (1.28)

faces.

5. Study 2

Study 2 employed standardized male bodies that systematically varied in two dimensions implicated in formidability. We considered men's muscularity and body fat (i.e., a bodily feature wherein increased levels are ostensibly related to reduced formidability) to identify the components of formidability most associated with perceptions of humor styles. Muscular men have considerable physical prowess in combat, with perceivers employing muscularity as a heuristic for men's fighting ability (Muñoz-Reyes et al., 2019). These inferences could be amplified among muscular men with low levels of body fat. Knowledge of reduced aggression among men with higher adiposity could foster a complementary heuristic of body fat as non-threatening to a perceiver's physical safety (e.g., Lassek & Gaulin, 2009; Trumble et al., 2012). Men exhibiting high levels of body fat are indeed perceived as friendly and non-aggressive (Brown, Boykin, & Sacco, 2022; Frederick & Haselton, 2007; Sacco et al., 2020).

These various signal values led us to predict that high levels of muscularity would elicit perceptions of men as more aggressive and less affiliative with their humor, especially in concert with low levels of body fat. Conversely, we predicted high levels of body fat would connote greater interest in affiliative humor and disinterest in aggressive humor. Additionally, we again predicted targets high in muscularity to be perceived as less self-enhancing and self-defeating compared to low-muscularity targets given the potentially inferred physical advantages and high status of muscularity.

When considering the typically reduced proclivity toward aggression from men with greater adiposity (both actual and perceived, Sacco et al., 2020; Trumble et al., 2012), we predicted there to be interactive effects between body fat and muscularity. Specifically, we predicted that muscular men would be perceived as less likely to use aggressive humor when they have higher levels of body fat but more likely to use affiliative humor in that instance. Our final predictions were that higher adiposity would foster perceptions of particularly greater likelihood of employing self-defeating and self-enhancing humor among low-muscularity targets due to perceptions of additional physical advantages in conflict.

5.1. Method

5.1.1. Participants

We recruited 101 undergraduates for course credit from a public university in Southeastern U.S. (56 women, 45 men; M_{Age} = 18.82, SD = 0.90; 85.1 % White, 7.9 % Latin, 4 % Black, 1 % Asian, 2 % Other). We had adequate power to detect small effects for a 2 × 2 × 4 within-subjects design (Cohen's f = 0.09, 1-β = 0.80).

5.1.2. Materials and procedure

Procedures mirrored Study 1. Participants evaluated four computer-generated male targets selected from the UCLA Body Matrices. Targets had occluded faces that varied in orthogonally manipulated body dimensions, resulting in unique combinations of high/low body fat and small/large muscles (Gray & Frederick, 2012). Unlike Study 1, targets' category memberships in Studies 2–4 are based on relative differences in size with each other. Nonetheless, given the typically categorical nature of perceiving physical features based on group membership (Phillips et al., 2018), we continue to report high and low levels of given features to reflect humans' typical classification of relative size differences in features into discrete categories for these studies.

The specific target bodies selected varied in these dimensions and were chosen based on their deviation from a previously identified central image in the matrix that ostensibly represented an average-build man. The targets used in this study were two units away from this center body for both dimensions, which amplified the differences in these target categories without appearing too exaggerated (Brown, Boykin, & Sacco, 2022; Sacco et al., 2020). As a result, we presented a unique combination of high-fat/large-muscle, high-fat/small-muscle,
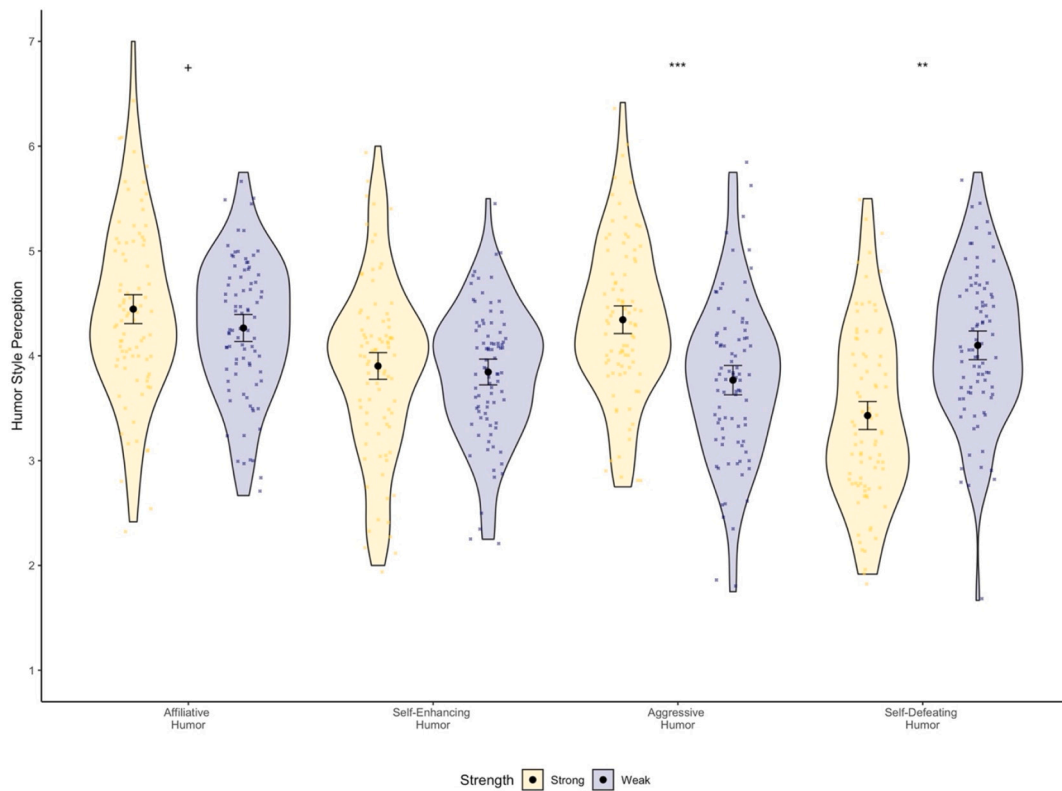
Fig. 2. Results from Study 1. Distributions are shown with violin KDE plots, participants' individual responses to each type of humor and each target's strength level are reflected in the individual points. Mean values are represented by the black dots. Error bars represent 95 % CIs of the means. '+' = $p < .10$, '*' = $p < .05$, '***' = $p < .01$, '****' = $p < .001$.

low-fat/large-muscle, and low-fat/small-muscle (see Fig. 3). Participants evaluated targets on a single 7-point item assessing perceived strength (1 = *Not at All Strong*; 7 = *Very Strong*) and the HSQ from Study 1. Table 4 provides relevant reliability analyses.

5.2. Results

5.2.1. Perceived formidability
We conducted a 2 (Target Body Fat: Low vs. High) × 2 (Target Muscularity: Small vs. Large) repeated ANOVA. A significant Target Body Fat × Target Muscularity interaction emerged, $F(1, 97) = 16.22$, $p < .001$, $\eta_p^2 = 0.14$. Large-muscle targets at high levels of fat were perceived as stronger than small-muscle targets at high levels of fat, $F(1, 100) = 73.54$, $p < .001$, $\eta_p^2 = 0.42$. Large-muscle targets at low levels of fat were additionally perceived as stronger than small-muscle targets at low levels of fat; this difference occurred at a larger magnitude, $F(1, 97) = 147.20$, $p < .001$, $\eta_p^2 = 0.60$. Table 5 provides relevant statistics.

5.2.2. Primary analysis
As participants responded only to a single target in each condition in this within-subjects design, we conducted a 2 (Target Body Fat: Low vs. High) × 2 (Target Muscularity: Small vs. Large) × 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-Defeating) repeated-measures ANOVA.[4] Effects were most superordinately qualified by a Target Body Fat × Target Muscularity × Humor Style interaction, $F(2.56, 253.29) = 4.41$, $p = .008$, $\eta_p^2 = 0.04$. Table 6 provides relevant statistics.

We conducted simple interactive tests exploring the effects of Target Muscularity and Body Fat for each Humor Style separately. These analyses revealed no simple interactive effects for perceptions of affiliative, self-enhancing, or aggressive humor ($ps > .10$). This prompted no further consideration of these humor styles in this analysis. For self-

defeating humor, a simple Body Fat × Muscularity interaction emerged, $F(1, 99) = 10.17$, $p = .002$, $\eta_p^2 = 0.09$. Among the small-muscle targets, the low-body fat target was seen as more likely to use self-defeating humor ($M = 4.08$, $SD = 1.18$) than the high-body fat target ($M = 3.77$, $SD = 1.23$), $t(99) = 2.06$, $p = .04$, $d = 0.21$. For large-muscle targets, no difference emerged in perceptions of high-body fat target ($M = 3.56$, $SD = 1.43$) and low-body fat target in use of self-defeating humor ($M = 3.24$, $SD = 1.15$), $t(100) = 1.72$, $p = .09$, $d = 0.17$.

5.3. Discussion

Contrary to hypotheses, participants did not perceive the interpersonal components of humor as readily through these bodily cues. These null findings could reflect an awareness of the inferred, and competing, signal values of muscularity and adiposity (Sacco et al., 2020). That is, perceivers could be aware of both the potential costs and benefits. Whereas muscularity could foster perceptions of affiliative intent, the signal value of aggression could have interfered with recognizing muscular men as being more benevolent (Geniole & McCormick, 2013). The lack of effects as a function of body fat for affiliative humor could reflect similar awareness, given that body fat is heuristically associated with friendliness. Alternatively, the signal value of upper body strength from Study 1 may have provided a distinct cue of social value for interpersonal contexts that could be more difficult to detect in computer-generated images for certain personality traits.

We found continued evidence in this study for low levels of formidability being associated with the use of self-defeating humor, albeit in an unpredicted capacity. Among targets with low levels of muscularity (i.e., lack of formidability), low levels of fat connoted greater interest in self-defeating humor. This signal value could reflect a specific connotation of a body as appearing emaciated. Men with less body mass overall could be seen as particularly non-threatening (McElvaney et al.,
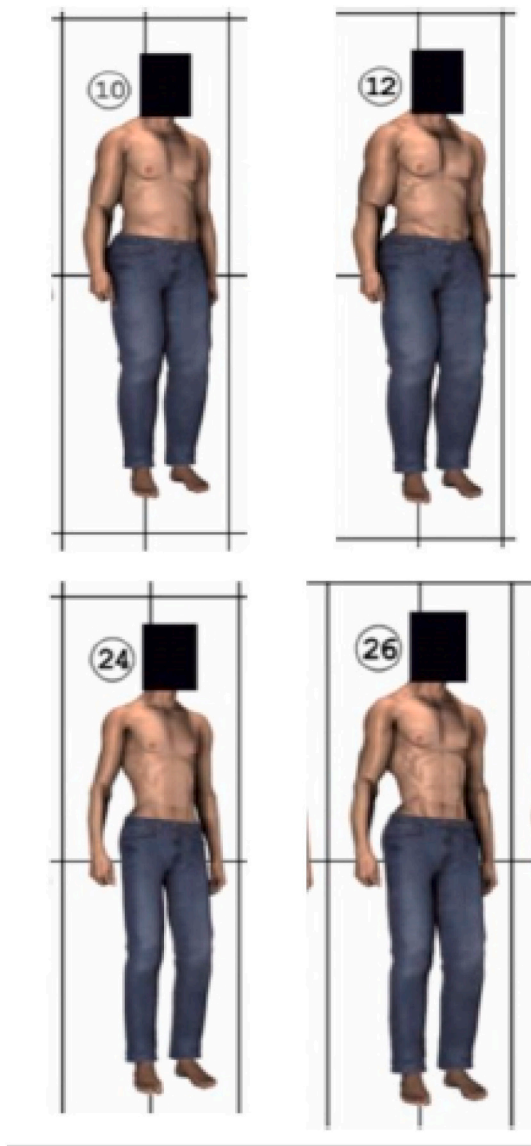
Fig. 3. Target bodies orthogonally manipulated for high (top row) and low body fat with small (left column) and large muscularity from Study 2, with accompanying numbers from the UCLA Body Matrices (Gray & Frederick, 2012).

Table 4
Reliability analyses for humor style subscales in Study 2.

Humor style	α	95 % CI_α
Affiliative	0.91	[0.88, 0.94]
Self-enhancing	0.86	[0.81, 0.91]
Aggressive	0.81	[0.74, 0.88]
Self-defeating	0.86	[0.81, 0.91]

Table 5
Perceived strength of small- and large-muscle targets as a function of high and low fat as means (with standard deviations) in Study 2.

	High fat	Low fat
Small muscles	4.60 (1.11)	3.27 (1.32)
Large muscles	5.58 (1.23)	5.03 (1.24)

Table 6
Means (and standard deviations) for perceived humor style use among targets as a function of body fat and muscularity in Study 2.

		Affiliative	Self-enhancing	Aggressive	Self-defeating
High-fat	Large muscle	4.26 (1.22)	3.73 (1.19)	3.85 (1.26)	3.56 (1.43)
	Small muscle	4.35 (1.16)	3.97 (1.11)	3.84 (1.05)	3.77 (1.23)
Low-fat	Large muscle	4.03 (1.11)	3.88 (1.05)	4.00 (1.02)	3.24 (1.15)
	Small muscle	4.55 (1.22)	4.31 (1.03)	3.76 (1.04)	4.08 (1.18)

2021). The lack of body mass for this particular target could have connoted a lack of overall social capital to a perceiver, thus fostering a perception of an interest in using self-defeating humor for its ingratiation function. Studies 1 and 2 provided a relatively consistent pattern of results indicating that formidability inferences inform perceptions of self-defeating humor. This suggests that a component to these inferences is tied to emotional states. Study 3 focused on a cue to formidability that additionally provides a concomitant signal of a target's emotional state by considering facial width-to-height ratio.

6. Study 3

The primacy of face-to-face contact in human evolutionary history has facilitated several adaptations for individuals to use facial features as the basis of social judgments. Within this suite of potential inferences is an understanding of men's formidability, which is often rooted in the presence of masculinized facial features. Masculinized facial features are themselves a veridical cue to men's upper body strength, as physically strong men exhibit greater facial masculinity (Price et al., 2017).

Part of these masculinity inferences is an understanding of facial width-to-height ratio (fWHR), a ratio of bizygomatic width relative to upper face height. Though not entirely sexually dimorphic (e.g., Kramer, 2017), this ratio is a configuration of several masculinized facial features that exhibit a degree of sexual selection based on facial skeletal structures that were protective in combat (Carrier & Morgan, 2015). Men have wider and longer lower faces (Hodges-Simeon et al., 2021). The crux of this dimorphism appears rooted in an overall wider face in men due to testosteronization and the advantages testosterone could afford in intrasexual competition (Caton & Dixson, 2022; Whitehouse et al., 2015). Among men with wider faces, the signal value of their masculinization appears amplified by their upper face height (Durkee & Ayers, 2021; Liu et al., 2022). In fact, men with a higher fWHR are more aggressive (Geniole et al., 2015). Additional findings indicate that men exhibiting such formidable structures have more favorable win-loss records in mixed martial arts, especially in grappling domains (Caton, Hannan, & Dixson, in press; Caton, Pearson, & Dixson, 2022; Třebický et al., 2015; Zilioli et al., 2015).

Formidability inferences through fWHR could also inform perceptions of men's humor style. Our first prediction was that high-fWHR men would be perceived as more likely to use aggressive humor, given an implicit understanding of high-fWHR men as more aggressive (Geniole et al., 2015). Unlike upper body strength, which is associated with sociability (Lukaszewski & Roney, 2011), the signal value of aggression through fWHR led us to predict that high-fWHR men would be perceived as less likely to use affiliative humor. Additionally, we predicted that high-fWHR would be perceived as less likely to use self-defeating humor due to their advantage in conflict that could afford them social status. Finally, the perception of high-fWHR men as less prone to mental distress led us to predict that high-fWHR men would be perceived as less likely to use self-enhancing humor (Brown et al., 2021).

6.1. Method

6.1.1. Participants

We recruited 119 undergraduates for course credit from a public university in Southeastern U.S. (85 women, 34 men; M_{Age} = 19.42, SD = 2.92; 83.2 % White, 7.6 % Latin 2.5 % Black, 0.8 % Asian, 5.9 % Other). We had adequate power to detect small effects for a 2 × 4 within-subjects design (Cohen's f = 0.10, 1-β = 0.80).

6.1.2. Materials and procedure

Participants evaluated 20 individuals in random order using the HSQ from the previous studies (see Table 7 for reliability analyses). Targets were normed color images of White male faces from the Chicago Faces Database (Ma et al., 2015). Targets varied in fWHR and were chosen in previous research for possessing the 10 highest and 10 lowest fWHRs (Deska & Hugenberg, 2018). This resulted in differences between stimuli in fWHR (d = 6.32), affording us the opportunity to consider faces in categories of *high- fWHR* and *low-fWHR* similarly to how humans categorize faces (see Fig. 4). Faces were neutrally expressive and did not differ in attractiveness (d = −0.05). We used the same perceived strength item from the previous studies with one item perceived aggressiveness (1 = *Not at All Aggressive*; 7 = *Very Aggressive*).

6.2. Results

6.2.1. Perceived formidability

We conducted tests of perceived aggressiveness and strength for high-fWHR, versus low-fWHR, targets using linear mixed effects models. These analyses revealed that high-fWHR targets were perceived as more aggressive than low-fWHR targets (b = 0.66, p < .001, d = 0.45) and also perceived as stronger than low-fWHR targets (b = 0.69, p < .001, d = 0.54). Table 8 provides relevant statistics for this study.

6.2.2. Primary analysis

We used a 2 (Target fWHR: High vs. Low) × 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-Defeating) linear mixed effects model (LMM) to analyze the data from Study 3. We fit the model with random intercepts for participants (σ^2 = 0.19, 95 % CI [0.15, 0.25]), and stimuli (σ^2 = 0.08, 95 % CI [0.04, 0.15]) as well as a random slope of target fWHR for the participant intercept (σ^2 = 0.01, 95 % CI [0.005, 0.02]), $ICC_{conditional}$ = 0.16.[5] Effects were qualified by a fWHR × Humor Style interaction, F(3, 9146.7) = 42.33, p < .001, η_p^2 = 0.01 (see Fig. 5).

We decomposed the interaction by conducting simple effects tests, predicting humor perceptions from target fWHR for each type of humor style using linear mixed models. High-fWHR targets were perceived as more likely to use aggressive humor than low-fWHR targets, b = 0.14, SE = 0.04, t(21.27) = 3.36, p = .003, d = 0.73. Low-fWHR targets were seen as more likely to use self-defeating humor than high-fWHR targets, b = 0.20, SE = 0.07, t(18.99) = 2.61, p = .02, d = 0.60. We found no effect of fWHR on affiliative or self-enhancing humor (ps > .07).

Table 7
Reliability analyses for humor style subscales in Study 3.

Humor style	α	95 % CI$_\alpha$
Affiliative	0.95	[0.94, 0.97]
Self-enhancing	0.93	[0.91, 0.95]
Aggressive	0.91	[0.89, 0.94]
Self-defeating	0.95	[0.93, 0.96]

[5] We fit several models to determine the best fit. The model reported in the main text provided the best fit relative to models with simpler random effects while also not showing any convergence or fit issues, χ^2(1) = 401.43, p < .001.

6.3. Discussion

High-fWHR targets were perceived as more aggressive with their humor, an inference potentially rooted in the threat connoted in general aggressiveness that formidable facial features elicit (Durkee & Ayers, 2021). Low-fWHR targets were additionally perceived as likely to use self-defeating humor. This perception could reflect inferences of low-fWHR men as exhibiting fewer physical advantages in combat and thus an increased willingness to degrade oneself for ingratiation. The lack of effects for affiliative and self-enhancing humor could potentially reflect the signal value of fWHR in these domains being less apparent. Despite reliably connoting formidability, fWHR ultimately remains an imperfect modality for trait inferences. The primacy of face-to-face contact could suggest additional formidability cues near the face may provide similar bases for humor style perceptions. Study 4 considered neck musculature, an intermediary feature between facial and bodily cues to formidability.

7. Study 4

Rates of physical violence throughout human history would have led selection to favor those capable of absorbing strikes during hand-to-hand combat to increase their chance of survival. A relatively recent development in formidability research has begun to consider bodily features that could ensure this survival in the form of neck musculature. Specifically, men's trapezius muscles and sternocleidomastoid (i.e., neck width) appear to serve these protective roles by stabilizing the head to reduce the risk of injury during combat (Collins et al., 2014; Elliott et al., 2021). In fact, this neck musculature has recently been implicated as predictive of men's actual success in combat, both through resistance to knockout blows and greater striking power (Caton & Lewis, 2022).

For those exhibiting these features, aggressive humor may be less costly due to the stabilization their necks would afford. Men with larger neck musculature should be perceived as more likely to use aggressive humor. Conversely, and in-line with predictions in previous studies, this advantage led us to predict that larger neck musculature would connote less interest in using affiliative, self-enhancing, and self-defeating humor. With previous research indicating much of the signal value being based in the trapezius (Caton & Lewis, 2022), we predicted that these inferences would be more rooted in the trapezius than in the sternocleidomastoid.

7.1. Method

7.1.1. Participants

We recruited 289 undergraduates for course credit from a public university in Southeastern U.S. (176 women, 110 men, 3 identifying as neither; M_{Age} = 18.86, SD = 1.20; 80.3 % White, 8.3 % Latin, 4.8 % Black, 2.8 % Asian, 3.1 % Other). We had adequate power to detect small effects for a 2 × 2 × 4 within-subjects design (Cohen's f = 0.07, 1-β = 0.80).

7.1.2. Materials and procedure

Participants evaluated four computer-generated images of men (Caton & Lewis, 2022). These images were designed to have systematically large or small trapezius muscles and sternocleidomastoids (SCM), resulting in four trials that represent a unique combination of both dimensions (see Fig. 6). Targets appeared in random order, with participants responding to the HSQ (see Table 9 for reliabilities).

7.2. Results

We conducted a 2 (Trapezius Size: Small vs. Large) × 2 (Sternocleidomastoid Size: Small vs. Large) × 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-Defeating) repeated-measures ANOVA. Effects were most superordinately qualified by a significant

Fig. 4. Examples of high-fWHR (left) and low-fWHR targets from Study 3.

Table 8
Means (and standard deviations) of perceived strength, aggression, and exhibition of humor styles from high- and low-fWHR targets in Study 3.

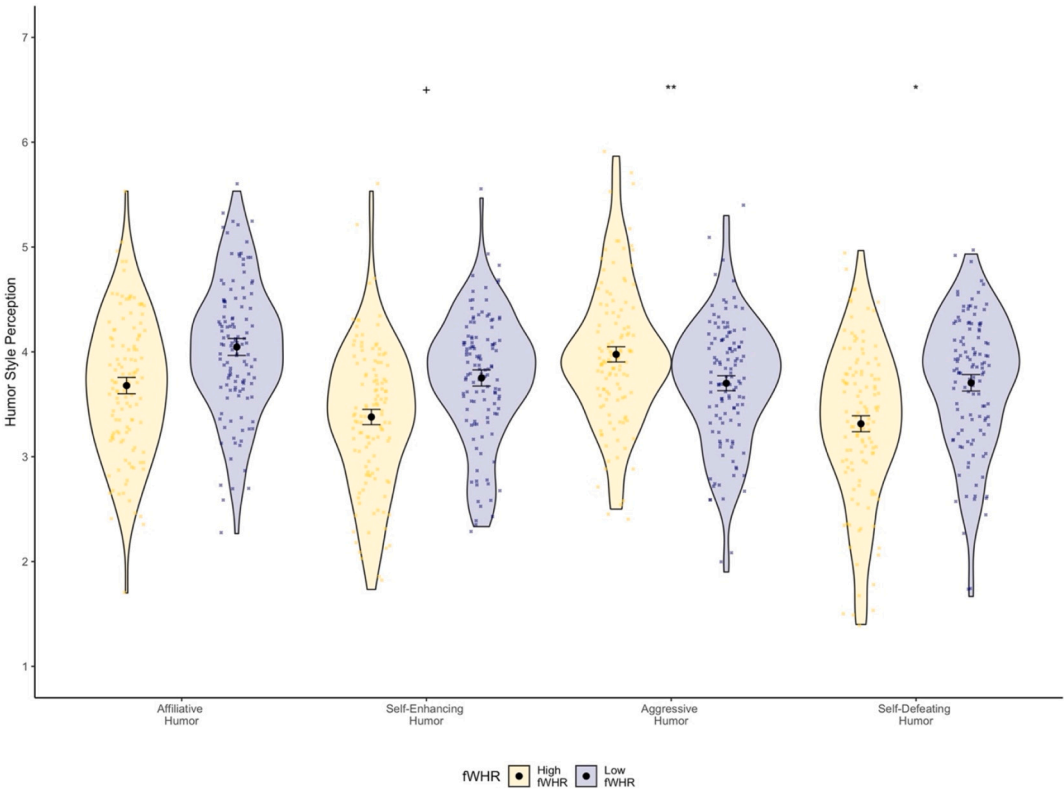|	Strength	Aggression	Affiliative	Self-enhancing	Aggressive	Self-defeating
High-fWHR	4.49 (1.47)	4.69 (1.61)	3.68 (1.36)	3.38 (1.28)	3.98 (1.27)	3.31 (1.33)
Low-fWHR	3.10 (1.42)	3.37 (1.68)	4.05 (1.41)	3.75 (1.34)	3.70 (1.25)	3.70 (1.37)

Fig. 5. Results from Study 3. Distributions are shown with violin KDE plots, participants' individual responses to each type of humor and each target's strength level are reflected in the individual points. Mean values are represented by the black dots. Error bars represent 95 % CIs of the means. '+' = $p < .10$, '*' = $p < .05$, '**' = $p < .01$, '***' = $p < .001$.

Trapezius Size × Humor Style interaction, $F(2.35, 607.33) = 3.78$, $p = .01$, $\eta_p^2 = 0.001$ (see Table 10). Simple effects indicated that large-trapezius targets were perceived as more likely to employ aggressive humor ($M = 3.98$, $SD = 1.26$) than small-trapezius targets ($M = 3.86$, $SD = 1.16$), $t(258) = 2.32$, $p = .02$, $d = 0.14$. No differences emerged for the other humor styles ($ps > .22$). No other interactive effects emerged ($ps > .06$).

7.3. Discussion

Findings provide converging support to previous studies implicating formidability cues as diagnostic of aggressive humor. Unlike previous studies, these inferences centered on aggressive humor, potentially reflecting the specificity of the signal value for neck musculature. Neck musculature may be less encumbered by stereotypes present in other features that led to inferences beyond aggressive humor. The fact that large trapezius muscles were the basis of this perception aligns with work demonstrating the importance of the trapezius muscles in these

Fig. 6. Targets with small (left column) and large trapezius muscles with small (top row) and large sternocleidomastoids from Study 4 (Caton & Lewis, 2022).

Table 9
Reliability analyses for humor style subscales in Study 4.

Humor style	α	95 % CI$_\alpha$
Affiliative	0.95	[0.94, 0.96]
Self-enhancing	0.91	[0.89, 0.93]
Aggressive	0.85	[0.82, 0.88]
Self-defeating	0.90	[0.88, 0.92]

Table 10
Means (and standard deviations) for perceived humor style use among targets as a function of trapezius size (trap) and sternocleidomastoid size (SCM) in Study 4.

		Affiliative	Self-enhancing	Aggressive	Self-defeating
Large trap	Large SCM	3.50 (1.34)	3.29 (1.16)	3.93 (1.26)	3.02 (1.28)
	Small SCM	3.57 (1.29)	3.35 (1.25)	4.02 (1.28)	3.09 (1.34)
Small trap	Large SCM	3.51 (1.29)	3.34 (1.22)	3.93 (1.22)	3.02 (1.28)
	Small SCM	3.63 (1.32)	3.38 (1.22)	3.83 (1.20)	3.20 (1.34)

inferences, possibly because of the greater perceptual salience larger trapezius muscles may have over the sternocleidomastoid (Caton & Lewis, 2022).

8. General discussion

These studies provide relatively consistent evidence for how formidability informs perceptions of men's preferred humor style. Interpersonally, the most consistent finding was aggressive humor being inferred through putative cues to formidability. This inference could reflect an understanding of formidable men's greater hostility, given their physical advantages in conflict, that could correspond with greater willingness to employ aggressive behavioral strategies which would include humor (Gallup et al., 2007; Sell et al., 2012; Vernon et al., 2008). Perceptions of aggressive humor use could be part of a threat detection system to identify antagonistic group members likely to bully or tease a perceiver.

Upper body strength and fWHR exhibited different signal values for affiliative humor. Strong men were perceived as marginally more affiliative with their humor, whereas fWHR appeared uninformative for affiliative humor. These conflicting findings suggest that formidability inferences are based on various physical features with their own separate signal values from which perceivers can recognize specific physical capabilities and intentions from a social target. The structures implicated in fWHR appear to have competing signal values of fighting ability and anger (Caton, Pearson, & Dixson, 2022; Deska et al., 2018), which have unique influences on interpersonal preferences based on the goals of an interaction (Brown, Sacco, Barbaro, & Drea, 2022). These competing signal values could interfere with perceptions of affiliative intent. Physically strong men are conversely more gregarious (Lukaszewski & Roney, 2011; Rodriguez & Lukaszewski, 2020). As such, trait inferences of strength could translate to expectations of their humor as relatively more ingratiating. The affiliative benefits of strength may be alternatively more salient compared to fWHR. Strong men are more attractive and held in higher esteem within groups, creating a potential halo effect (Holbrook et al., 2016; Lukaszewski et al., 2016).

Formidability provided additional cues to the purpose of intrapersonal humor. Namely, targets who appeared relatively non-formidable were largely perceived as more likely to use self-defeating humor. Men with a greater disadvantage in physical conflict are more prone to mood and anxiety disorders (Hagen & Rosenström, 2016), a vulnerability that could leave them susceptible to exploitation. Being the "butt of the joke" from their presumably low status could foster expectations of less formidable men to use this humor for ingratiating purposes (Greengross & Miller, 2008). Similar effects emerged for low-fWHR men, though this effect could reflect inferences of formidable men as being less prone to psychological disorders associated with self-defeating humor (Brown et al., 2021; Tucker et al., 2014).

It should be noted that images of actual people appeared more informative in shaping inferences of humor styles compared to computer-generated images. This difference may reflect the fact that computer-generated images' artificial signal value may not reflect actual physical prowess to the same degree as actual images, an effect that parallels previous work indicating that the signal value of various morphological features is reduced in artificial faces (e.g., Balas & Pacella, 2015, 2017). Indeed, the actual images were appropriately

normed for these studies, though such a difference in signal value may suggest other components of formidability are driving effects more readily. Future research would benefit from specifically identifying which components of formidability are indeed driving these effects.

8.1. Limitations and future directions

Within this consistency of findings are several limitations that warrant future research. Most notably, this research relies on an understanding of stereotypes without addressing the veracity of these stereotypes. Future research could assess self-reported humor styles while taking measures of participants' actual formidability through measures of upper body strength or face morphology (e.g., Lukaszewski & Roney, 2011; Price et al., 2017). Additional assessments of self-perceived formidability could determine whether formidable men's employment of a given humor style is mediated by perceptions of their physical prowess (e.g., Kerry & Murray, 2018; Sell et al., 2009). Upon identifying these associations, a subsequent study could determine whether humor style is accurately perceived through formidability cues (e.g., Aung et al., 2021; Lukaszewski et al., 2016; Zilioli et al., 2015).

A function of these judgments could be to determine goal (in)congruity with a social target to motivate approach or avoidance. Future research would benefit in determining how inferred humor styles may serve as a mechanism for subsequent affiliative decisions with formidable men. Additional studies could consider the interactive effects of a target's humor style and formidability. The potential benefit of strong men could be more salient in the presence of affiliative humor cues, which could exceed the inferred costs (Brown, 2021; Lassetter et al., 2021). Formidable men using aggressive humor could conversely be perceived as costly, undermining any affiliative benefit. High-status men's self-deprecation augments their desirability (Greengross & Miller, 2008), which could be rooted in perceptions of prestige orientation (Maner, 2017). Conversely, formidability and concomitant displays of self-enhancing humor may be perceived as overly dominant and thus threatening.

Moving beyond affiliative domains, future research could address mating contexts and men's proclivity toward humor to connote sexual receptivity. Short-term mating motives heighten men's interest in employing aggressive humor (DiDonato & Jakubiak, 2016), wherein such strategies are more tolerated (DiDonato et al., 2013). Given formidable men's proclivity toward short-term mating and accompanying perceptions of this interest (Brown, Boykin, & Sacco, 2022; Gallup et al., 2007), it would seem likely for formidable men to be perceived as likely to use aggressive humor in mating strategies. Sexual receptivity may further generalize to dirty humor, a strategy desirable to women interested in short-term mating (Medlin et al., 2018).

Future research would additionally benefit from extending beyond perceptions of discrete categories of social stimuli to identify a potential continuum in the espousals of humor styles. This is most apparent when considering the lack of "average" levels of physical features in targets to serve as a midpoint. It remains less clear whether the proclivity toward aggressive humor among relatively formidable men is rooted in perceptions of such men as excessively aggressive or if the relatively nonformidable men are less aggressive than men of average formidability. Previous research indicates that many inferences about men's bodily features frequently operate quadratically (e.g., attractiveness; Gray & Frederick, 2012; Frederick & Haselton, 2007), with other work suggesting that considerable noise can exist between relatively high and low categories (Durkee & Ayers, 2021). Additional work could address a wider range of stimuli to determine potential trajectories of effects.

This research considered only men's bodies. This decision is rooted in the perceptual acuity toward formidability exhibited toward male features (Lukaszewski et al., 2016; Sell et al., 2009). Humor production is also more critical in men's social value, suggesting greater covariation between male features and humor (Silvia et al., 2021). Nonetheless, humor styles could be inferred through women's features that were

selected. For example, facial femininity is both highly attractive and reliably diagnostic of women's warmth (Smith et al., 2012), a disposition that could foster perceptions of feminine women as more affiliative. Conversely, feminine features may duly connote a proclivity to aggressive humor to other women, given perceptions of women possessing attractive features (e.g., large breasts, low waist-to-hip ratio) as intrasexually threatening (Fink et al., 2014; Garza et al., in press).

9. Conclusion

The value of humor in human sociality presents a challenge among individuals to identify group members whose sense of humor may satisfy their relational needs. These findings indicate inferences of such capabilities are possible through physical features. Specifically, the multifaceted signal of formidability provides perceivers the opportunity to identify myriad costs and benefits of a humor style to inform affiliative decisions.

CRediT authorship contribution statement

Mitch Brown conceptualized and programmed the four studies presented in this manuscript. He provided the primary draft.

Ryan E. Tracy provided statistical analyses and critical commentary on how to report results.

Kaitlyn Boykin provided substantial commentary on this manuscript and was involved in critical theory-building.

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