



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 covarying 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. Indi-

viduals 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 in-

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form 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

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

(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, in press-b), 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-enhancing humor. Finally, self-defeating humor is often in the service

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

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 $f = 0.12$, $1-\beta = 0.80$).

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 $r_s = |0.04-0.36|$ (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.

4.2.2. Primary analysis

We analyzed the data using a 2 (Target Strength: Strong vs. Weak) \times 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]), $ICC_{\text{conditional}} = 0.125$.²

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 \times 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 separately³, 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 faces.

² 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, $\chi^2(1) = 10.86$, $p < .001$.

³ 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)

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, in press-b; 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 $2 \times 2 \times 4$ within-subjects design (Cohen's $f = 0.09$, $1 - \beta = 0.80$).

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, in press-b; Sacco et al., 2020). As a result, we presented a unique combination of high-fat/large-muscle, high-fat/small-muscle, 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.

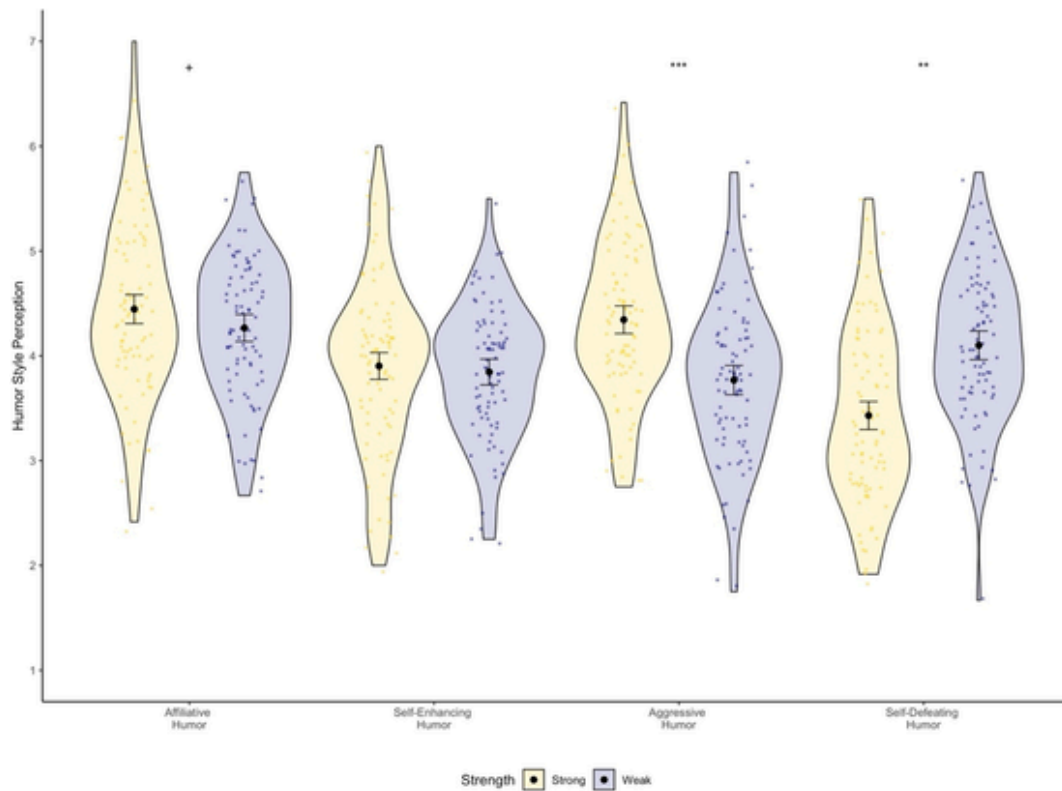


Fig. 2. Results from Study 1. Distributions are shown with violin KDE plots, participants' individual responses to each type of humor and each target's strength level are reflected in the individual points. Mean values are represented by the black dots. Error bars represent 95 % CIs of the means. '+' = $p < .10$, '**' = $p < .05$, '***' = $p < .01$, '****' = $p < .001$.

5.2. Results

5.2.1. Perceived formidability

We conducted a 2 (Target Body Fat: Low vs. High) \times 2 (Target Muscularity: Small vs. Large) repeated ANOVA. A significant Target Body Fat \times 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) \times 2 (Target Muscularity: Small vs. Large) \times 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-Defeating) repeated-measures ANOVA.³ Effects were most superordinately qualified by a Target Body Fat \times Target Muscularity \times 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 \times 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., 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

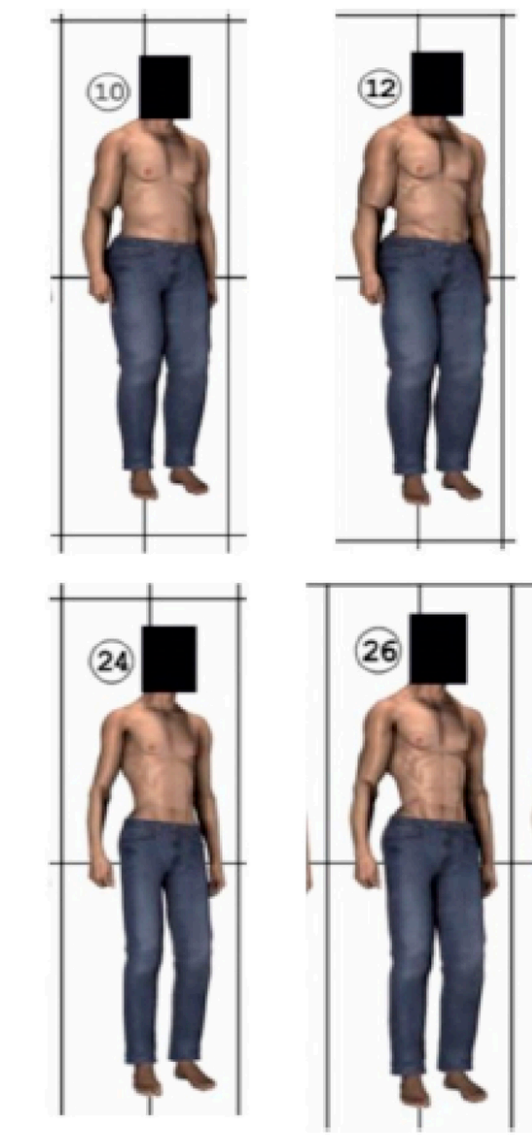


Fig. 3. Target bodies orthogonally manipulated for high (top row) and low body fat with small (left column) and large muscularity from Study 2, with accompanying numbers from the UCLA Body Matrices (Gray & Frederick, 2012).

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

Humor style	α	95 % CI $_{\alpha}$
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)

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 testosterone and the advantages testosterone could afford in intrasexual competition (Caton & Dixon, 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, & Dixon, in press; Caton, Pearson, & Dixon, 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 $f = 0.10$, $1-\beta = 0.80$).

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)

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 study⁴.

6.2.2. Primary analysis

We used a 2 (Target fWHR: High vs. Low) \times 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 ($\sigma^2 = 0.19$, 95 % CI [0.15, 0.25]), and stimuli ($\sigma^2 = 0.08$, 95 % CI [0.04, 0.15]) as well as a random slope of target fWHR for the participant intercept ($\sigma^2 = 0.01$, 95 % CI [0.005, 0.02]), $ICC_{\text{conditional}} = 0.16$.⁵ Effects were qualified by a fWHR \times Humor Style interaction, $F(3, 9146.7) = 42.33$, $p < .001$, $\eta_p^2 = 0.01$ (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 ($ps > .07$).

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 con-

⁴ We report Greenhouse-Geisser corrections to model degrees of freedom for effects with sphericity departures.

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, $\chi^2(1) = 401.43$, $p < .001$.

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]

tact 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; $M_{\text{Age}} = 18.86$, $SD = 1.20$; 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 \times 2 \times 4 within-subjects design (Cohen's $f = 0.07$, $1-\beta = 0.80$).

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) \times 2 (Sternocleidomastoid Size: Small vs. Large) \times 4 (Humor Style: Affiliative vs. Self-Enhancing vs. Aggressive vs. Self-Defeating) repeated-measures ANOVA. Effects were most superordinately qualified by a significant Trapezius Size \times Humor Style interaction, $F(2.35, 607.33) = 3.78$, $p = .01$, $\eta_p^2 = 0.001$ (see Table 10). Simple effects indicated that



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)

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 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. Interper-

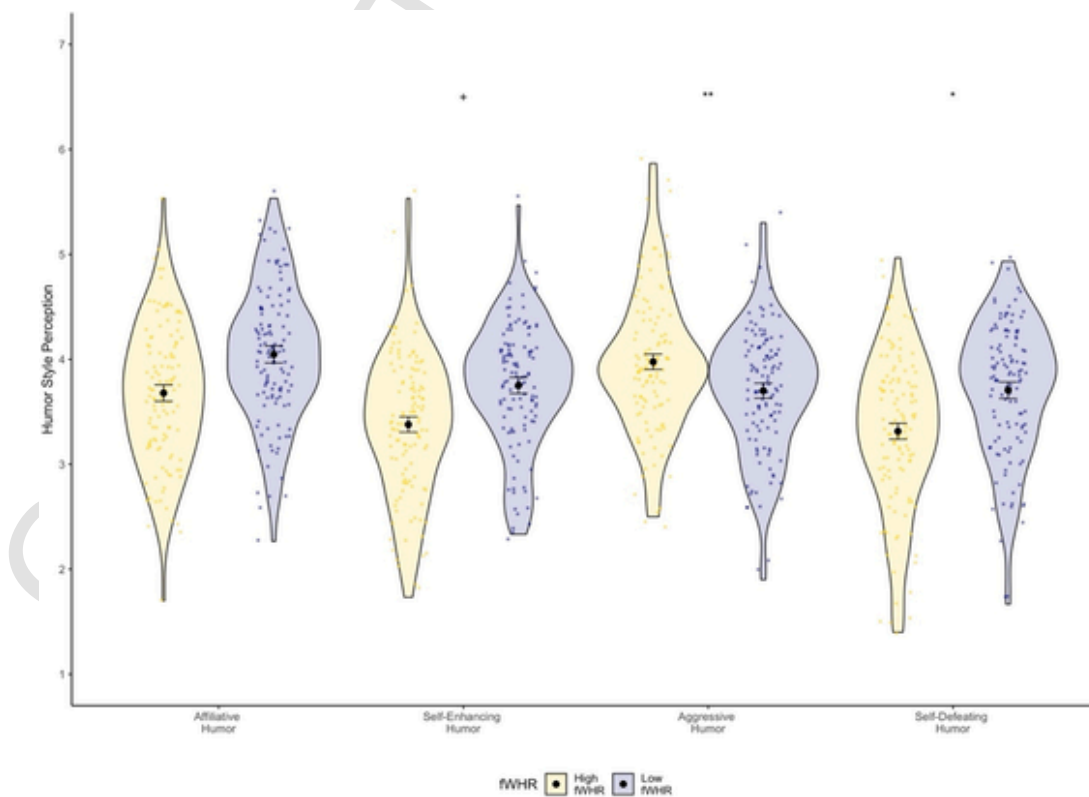


Fig. 5. Results from Study 3. Distributions are shown with violin KDE plots, participants' individual responses to each type of humor and each target's strength level are reflected in the individual points. Mean values are represented by the black dots. Error bars represent 95 % CIs of the means. '+'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

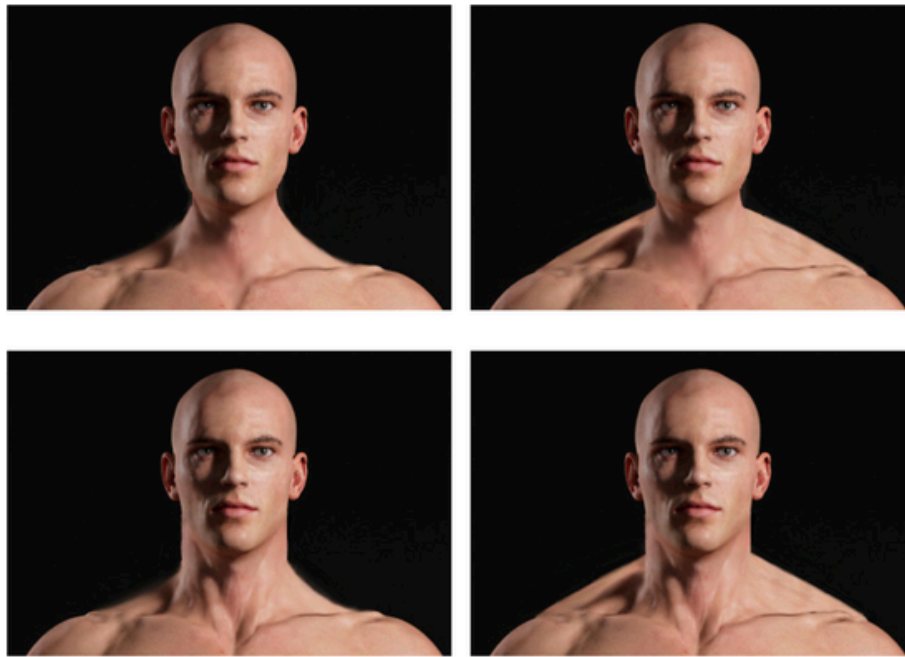


Fig. 6. Targets with small (left column) and large trapezius muscles with small (top row) and large sternocleidomastoids from Study 4 (Caton Lewis, 2022).

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)

sonally, 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, & Dixon, 2022; Deska et al., 2018), which have unique influences on interpersonal preferences based on the goals of an interaction (Brown et al., 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, in press-b; 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 non-formidable 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 (Greengross 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.

Uncited references

Bird et al., 2016
Carrier and Morgan, 2014
Dixon et al., 2017
Greengross et al., 2020
Hodges-Simeon et al., 2016
Lefevre et al., 2012

References

- Aung, T., Rosenfield, K.A., & Puts, D. (2021). *Male voice pitch mediates the relationship between objective and perceived formidability*. *Evolution and Human Behavior*, 42, 121–129.
- Balas, B., & Pacella, J. (2015). *Artificial faces are harder to remember*. *Computers in Human Behavior*, 52, 331–337.
- Balas, B., & Pacella, J. (2017). *Trustworthiness perception is disrupted in artificial faces*. *Computers in Human Behavior*, 77, 240–248.
- Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). *Fitting linear mixed-effects models using lme4*. *Journal of Statistical Software*, 67, 1–48.
- Betz, D.E., & DiDonato, T.E. (2020). *Is it sexy to be sexist? How stereotyped humor affects romantic attraction*. *Personal Relationships*, 27, 732–759.
- Bird, B.M., Jofré, V.S.C., Geniole, S.N., Welker, K.M., Zilioli, S., Maestriperieri, D., ... Carré, J.M. (2016). *Does the facial width-to-height ratio map onto variability in men's testosterone concentrations? Evolution and Human Behavior*, 37, 392–398.
- Bressler, E.R., & Balshine, S. (2006). *The influence of humor on desirability*. *Evolution and Human Behavior*, 27, 29–39.
- Brown, M. (2021). *Goal relevance and desirability of virtuous behavior in satisfying affiliative and pathogen avoidance needs*. *Personality and Individual Differences*, 181, 111025.
- Brown, M., Bauer, B.W., Sacco, D.F., & Capron, D.W. (2021). *Functional inferences of formidability bias perceptions of mental distress*. *Evolutionary Psychological Science*, 7, 401–410.
- Brown, M., Boykin, K., & Sacco, D.F. (2022). *Functional inferences of mating orientations through body fat and sex-typical body features*. *Journal of Social and Personal Relationships*. (in press-b).
- Brown, M., Donahoe, S., & Boykin, K. (2022). *Physical strength as a cue to men's capability as protective parents*. *Evolutionary Psychological Science*, 8, 81–88.
- Brown, M., Sacco, D.F., & Barbaro, N. (2022). *Formidable facial structures influence post-conflict reconciliation judgments*. *Evolutionary Behavioral Sciences*. (in press-a).
- Brown, M., Sacco, D.F., Barbaro, N., & Drea, K.M. (2022). *Contextual factors that heighten interest in coalitional alliances with men possessing formidable facial structures*. *Evolution and Human Behavior*, 43, 275–283.
- Brown, M., Sacco, D.F., & Drea, K.M. (2022). *Ecologically contingent preferences for formidable coalitional allies as a function of conservative ideologies*. *Personality and Individual Differences*, 195, 111699.
- Brown, M., Sacco, D.F., Lolley, K.P., & Block, D. (2017). *Facing the implications: Dangerous world beliefs differentially predict men and women's aversion to facially communicated psychopathy*. *Personality and Individual Differences*, 116, 1–5.
- Cann, A., & Calhoun, L.G. (2001). *Perceived personality associations with differences in sense of humor: Stereotypes of hypothetical others with high or low senses of humor*. *Humor*.
- Cann, A., & Matson, C. (2014). *Sense of humor and social desirability: Understanding how humor styles are perceived*. *Personality and Individual Differences*, 66, 176–180.
- Carrier, D.R., & Morgan, M.H. (2014). *Protective buttressing of the hominin face*. *Biological Reviews*, 90, 330–346.
- Caton, N.R., & Dixon, B. (2022). *Beyond facial width-to-height ratios: Bizygomatic width is highly sexually dimorphic when adjusting for allometry*. *Preprint available at PsyArXiv*.
- Caton, N.R., Hannan, J., & Dixon, B.J. (2022). *Facial width-to-height ratio predicts fighting*

- success: A direct replication and extension of Zilioli et al. (2014). *Aggressive Behavior*. (in press).
- Caton, N.R., & Lewis, D.M. (2022). Human neck morphology is a sexually dimorphic predictor of actual and perceived fighting ability. Preprint available at PsyArxiv.
- Caton, N.R., Pearson, S., & Dixon, B.J. (2022). Is facial structure an honest cue to real-world dominance and fighting ability in men? A pre-registered direct replication of Třebický et al. (2013). *Evolution and Human Behavior*, 43, 314–324.
- Collins, C.L., Fletcher, E.N., Fields, S.K., Kluchurosky, L., Rohrkemper, M.K., Comstock, R.D., & Cantu, R.C. (2014). Neck strength: A protective factor reducing risk for concussion in high school sports. *The Journal of Primary Prevention*, 35, 309–319.
- DeLuca, H.K. (2013). *Aggressive humor: Not always aggressive*. Unpublished Master's Thesis.
- Deska, J.C., & Hugenberg, K. (2018). Targets' facial width-to-height ratio biases pain judgments. *Journal of Experimental Social Psychology*, 74, 56–64.
- Deska, J.C., Lloyd, E.P., & Hugenberg, K. (2018). The face of fear and anger: Facial width-to-height ratio biases recognition of angry and fearful expressions. *Emotion*, 18, 453–464.
- DiDonato, T.E., Bedminster, M.C., & Machel, J.J. (2013). My funny valentine: How humor styles affect romantic interest. *Personal Relationships*, 20, 374–390.
- DiDonato, T.E., & Jakubiak, B.K. (2016). Strategically funny: Romantic motives affect humor style in relationship initiation. *Europe's Journal of Psychology*, 12, 390–405.
- Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of Personality and Social Psychology*, 24, 285–290.
- Dixon, B.J., Lee, A.J., Sherlock, J.M., & Talamas, S.N. (2017). Beneath the beard: Do facial morphometrics influence the strength of judgments of men's beardedness? *Evolution and Human Behavior*, 38, 164–174.
- Durkee, P.K., & Ayers, J.D. (2021). Is facial width-to-height ratio reliably associated with social inferences? *Evolution and Human Behavior*, 42, 583–592.
- Durkee, P.K., Goetz, A.T., & Lukaszewski, A.W. (2018). Formidability assessment mechanisms: Examining their speed and automaticity. *Evolution and Human Behavior*, 39, 170–178.
- Elliott, J., Heron, N., Versteegh, T., Gilchrist, I.A., Webb, M., Archbold, P., ... Peek, K. (2021). Injury reduction programs for reducing the incidence of sport-related head and neck injuries including concussion: A systematic review. *Sports Medicine*, 1–16.
- Faul, F., Erdfelder, E., Lang, A.G., & Buchner, A. (2007). G* power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175–191.
- Fink, B., Klappauf, D., Brewer, G., & Shackelford, T.K. (2014). Female physical characteristics and intra-sexual competition in women. *Personality and Individual Differences*, 58, 138–141.
- Ford, T.E., Lappi, S.K., O'Connor, E.C., & Banos, N.C. (2017). Manipulating humor styles: Engaging in self-enhancing humor reduces state anxiety. *Humor*, 30, 169–191.
- Frederick, D.A., & Haselton, M.G. (2007). Why is muscularity sexy? Tests of the fitness indicator hypothesis. *Personality and Social Psychology Bulletin*, 33, 1167–1183.
- Gallup, A.C., White, D.D., & Gallup, G.G. (2007). Handgrip strength predicts sexual behavior, body morphology, and aggression in male college students. *Evolution and Human Behavior*, 28, 423–429.
- Garza, R., Pazoohi, F., & Byrd-Craven, J. (2022). Women's perceptions of breast size, ptosis, and intermammary distance: Does breast morphology play a role in women's intrasexual competition? *Evolutionary Behavioral Sciences*. (in press).
- Geniole, S.N., Denson, T.F., Dixon, B.J., Carré, J.M., & McCormick, C.M. (2015). Evidence from meta-analyses of the facial width-to-height ratio as an evolved cue of threat. *PLoS One*, 10, e0132726.
- Geniole, S.N., & McCormick, C.M. (2013). Taking control of aggression: Perceptions of aggression suppress the link between perceptions of facial masculinity and attractiveness. *Evolutionary Psychology*, 11, 147470491301100507.
- Gordon, D.S., Madden, J.R., & Lea, S.E. (2014). Both loved and feared: Third party punishers are viewed as formidable and likeable, but these reputational benefits may only be open to dominant individuals. *PLoS One*, 9, e110045.
- Gray, P.B., & Frederick, D.A. (2012). Body image and body type preferences in st. Kitts, Caribbean: A cross-cultural comparison with US samples regarding attitudes towards muscularity, body fat, and breast size. *Evolutionary Psychology*, 10, 631–655.
- Greengross, G., Martin, R.A., & Miller, G. (2012). Personality traits, intelligence, humor styles, and humor production ability of professional stand-up comedians compared to college students. *Psychology of Aesthetics, Creativity, and the Arts*, 6, 74–82.
- Greengross, G., & Miller, G. (2011). Humor ability reveals intelligence, predicts mating success, and is higher in males. *Intelligence*, 39, 188–192.
- Greengross, G., & Miller, G.F. (2008). Dissing oneself versus dissing rivals: Effects of status, personality, and sex on the short-term and long-term attractiveness of self-deprecating and other-deprecating humor. *Evolutionary Psychology*, 6, 393–408.
- Greengross, G., Silvia, P.J., & Nusbaum, E.C. (2020). Sex differences in humor production ability: A meta-analysis. *Journal of Research in Personality*, 84, 103886.
- Hagen, E.H., & Rosenström, T. (2016). Explaining the sex difference in depression with a unified bargaining model of anger and depression. *Evolution, Medicine, and Public Health*, 2016, 117–132.
- Hodges-Simeon, C.R., Hanson Sobraske, K.N., Samore, T., Gurven, M., & Gaulin, S.J. (2016). Facial width-to-height ratio (fWHR) is not associated with adolescent testosterone levels. *PLoS One*, 11, e0153083.
- Holbrook, C., Fessler, D.M., & Navarrete, C.D. (2016). Looming large in others' eyes: Racial stereotypes illuminate dual adaptations for representing threat versus prestige as physical size. *Evolution and Human Behavior*, 37, 67–78.
- Hu, Y., Parde, C.J., Hill, M.Q., Mahmood, N., & O'Toole, A.J. (2018). First impressions of personality traits from body shapes. *Psychological Science*, 29, 1969–1983.
- Kelley, H.H. (1973). The process of causal attribution. *American Psychologist*, 28, 107–128.
- Kerry, N., & Murray, D.R. (2018). Strong personalities: Investigating the relationships between grip strength, self-perceived formidability, and big five personality traits. *Personality and Individual Differences*, 131, 216–221.
- Lassek, W.D., & Gaulin, S.J. (2009). Costs and benefits of fat-free muscle mass in men: Relationship to mating success, dietary requirements, and native immunity. *Evolution and Human Behavior*, 30, 322–328.
- Lasseter, B., Hehman, E., & Neel, R. (2021). The relevance appraisal matrix: Evaluating others' relevance. *Journal of Personality and Social Psychology*, 121, 842–864.
- Lefevre, C.E., Lewis, G.J., Bates, T.C., Dzhelevova, M., Coetzee, V., Deary, I.J., & Perrett, D.I. (2012). No evidence for sexual dimorphism of facial width-to-height ratio in four large adult samples. *Evolution and Human Behavior*, 33, 623–627.
- Lenth, R.V. (2022). emmeans: Estimated marginal means, AKA least-squares means. R package version 1.7.3. <https://CRAN.R-project.org/package=emmeans>.
- Li, N.P., Griskevicius, V., Durante, K.M., Jonason, P.K., Pasisz, D.J., & Aumer, K. (2009). An evolutionary perspective on humor: Sexual selection or interest indication? *Personality and Social Psychology Bulletin*, 35, 923–936.
- Liu, L., Wen, G., & Zheng, L. (2022). Facial width to height ratio and perceived aggression: The disjunction effect of horizontal and vertical components. *Personality and Individual Differences*, 191, 111578.
- Lukaszewski, A.W. (2013). Testing an adaptationist theory of trait covariation: Relative bargaining power as a common calibrator of an interpersonal syndrome. *European Journal of Personality*, 27, 328–345.
- Lukaszewski, A.W., Simmons, Z.L., Anderson, C., & Roney, J.R. (2016). The role of physical formidability in human social status allocation. *Journal of Personality and Social Psychology*, 110, 385–406.
- Ma, D.S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods*, 47, 1122–1135.
- Maner, J.K. (2017). Dominance and prestige: A tale of two hierarchies. *Current Directions in Psychological Science*, 26, 526–531.
- Martin, R.A., Lastuk, J.M., Jeffery, J., Vernon, P.A., & Veselka, L. (2012). Relationships between the dark triad and humor styles: A replication and extension. *Personality and Individual Differences*, 52, 178–182.
- Martin, R.A., Puhlik-Doris, P., Larsen, G., Gray, J., & Weir, K. (2003). Individual differences in uses of humor and their relation to psychological well-being: Development of the humor styles questionnaire. *Journal of Research in Personality*, 37, 48–75.
- McElvane, T.J., Osman, M., & Mareschal, I. (2021). Perceiving threat in others: The role of body morphology. *PLoS one*, 16, e0249782.
- Medlin, M.M., Brown, M., & Sacco, D.F. (2018). That's what she said! Perceived mate value of clean and dirty humor displays. *Personality and Individual Differences*, 135, 192–200.
- Muñoz-Reyes, J.A., Polo, P., Rodríguez-Sickert, C., Pavez, P., Valenzuela, N., & Ramírez-Herrera, O. (2019). Muscularity and strength affect individual variation in self-perception of fighting ability in men. *Frontiers in Psychology*, 10, 18.
- Neuberg, S.L., Kenrick, D.T., & Schaller, M. (2011). Human threat management systems: Self-protection and disease avoidance. *Neuroscience & Biobehavioral Reviews*, 35, 1042–1051.
- Neuberg, S.L., Williams, K.E., Sng, O., Pick, C.M., Neel, R., Krems, J.A., & Pirlott, A.G. (2020). Toward capturing the functional and nuanced nature of social stereotypes: An affordance management approach. *Advances in Experimental Social Psychology*, 62, 245–304.
- Petersen, M.B., & Dawes, C.T. (2017). Assessing causal pathways between physical formidability and aggression in human males. *Personality and Individual Differences*, 113, 161–166.
- Phillips, L.T., Slepian, M.L., & Hughes, B.L. (2018). Perceiving groups: The people perception of diversity and hierarchy. *Journal of Personality and Social Psychology*, 114, 766–785.
- Price, M.E., Sheehy-Skeffington, J., Sidanius, J., & Pound, N. (2017). Is sociopolitical egalitarianism related to bodily and facial formidability in men? *Evolution and Human Behavior*, 38, 626–634.
- Putz, D.A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans. *Evolution and Human Behavior*, 31, 157–175.
- Rodríguez, N.N., & Lukaszewski, A.W. (2020). Functional coordination of personality strategies with physical strength and attractiveness: A multi-sample investigation at the HEXACO facet-level. *Journal of Research in Personality*, 89, 104040.
- Sacco, D.F., & Brown, M. (2018). The face of personality: Adaptive inferences from facial cues are moderated by perceiver personality and motives. *Social and Personality Psychology Compass*, 12, e12410.
- Sacco, D.F., Brown, M., & May, H.D. (2021). Not taking a joke: The influence of target status, sex, and age on reactions to workplace humor. *Psychological Reports*, 124, 1316–1334.
- Sacco, D.F., Holfield, K., Drea, K., Brown, M., & Macchione, A. (2020). Dad and mom Bods? Inferences of parenting ability from bodily cues. *Evolutionary Psychological Science*, 6, 207–214.
- Sell, A., Hone, L.S., & Pound, N. (2012). The importance of physical strength to human males. *Human Nature*, 23, 30–44.
- Sell, A., Tooby, J., & Cosmides, L. (2009). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences*, 106, 15073–15078.
- Smith, M.J.L., Deady, D.K., Moore, F.R., Jones, B.C., Cornwell, R.E., Stirrat, M., ... Perrett, D.I. (2012). Maternal tendencies in women are associated with estrogen levels and facial femininity. *Hormones and Behavior*, 61, 12–16.
- Toscano, H., Schubert, T.W., & Giessner, S.R. (2018). Eye gaze and head posture jointly influence judgments of dominance, physical strength, and anger. *Journal of Nonverbal Behavior*, 42, 285–309.
- Třebický, V., Fialová, J., Kleisner, K., Roberts, S.C., Little, A.C., & Havlíček, J. (2015). Further evidence for links between facial width-to-height ratio and fighting success: commentary on Zilioli et al. (2014). *Aggressive Behavior*, 41, 331–334.
- Treger, S., Sprecher, S., & Erber, R. (2013). Laughing and liking: Exploring the interpersonal effects of humor use in initial social interactions. *European Journal of Social Psychology*, 43, 532–543.
- Trumble, B.C., Cummings, D., von Rueden, C., O'Connor, K.A., Smith, E.A., Gurven,

- M., & Kaplan, H. (2012). *Physical competition increases testosterone among amazonian forager-horticulturalists: A test of the 'challenge hypothesis'*. *Proceedings of the Royal Society B: Biological Sciences*, 279, 2907–2912.
- Tucker, R.P., Wingate, L.R., Slish, M.L., O'Keefe, V.M., Cole, A.B., & Hollingsworth, D.W. (2014). *Rumination, suicidal ideation, and the mediating effect of self-defeating humor*. *Europe's Journal of Psychology*, 10, 492–504.
- Veselka, L., Schermer, J.A., Martin, R.A., & Vernon, P.A. (2010). *Relations between humor styles and the dark triad traits of personality*. *Personality and Individual Differences*, 48, 772–774.
- Whitehouse, A.J., Gilani, S.Z., Shafait, F., Mian, A., Tan, D.W., Maybery, M.T., ... Eastwood, P. (2015). *Prenatal testosterone exposure is related to sexually dimorphic facial morphology in adulthood*. *Proceedings of the Royal Society B: Biological Sciences*, 282, 20151351.
- Zeigler-Hill, V., & Besser, A. (2011). *Humor style mediates the association between pathological narcissism and self-esteem*. *Personality and Individual Differences*, 50, 1196–1201.
- Zeigler-Hill, V., Besser, A., & Jett, S.E. (2013). *Laughing at the looking glass: Does humor style serve as an interpersonal signal?* *Evolutionary Psychology*, 11, 202–226.
- Zilioli, S., Sell, A.N., Stirrat, M., Jagore, J., Vickerman, W., & Watson, N.V. (2015). *Face of a fighter: Bizygomatic width as a cue of formidability*. *Aggressive Behavior*, 41, 322–330.

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