CABI Human – Animal Interactions

RESEARCH

Making or breaking the case for a plain face – Is human perception of canine facial expressivity influenced by physical appearance?

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Abstract

Facial communication is important in both human-human interactions and human-dog interactions. Individual factors, such as experience, relationship history, and mood, to name a few, influence the reception of facial signals/expressions. But superficial facial features are also significant in human communication, and likely impact communication between dogs and humans. For example, humans are better at evaluating the frequency and intensity of facial expressions in dogs that have plainer faces, if the dog is familiar to them, which could be related to a preference for non-complexity (human faces are generally much less physically diverse than dog faces). This study explored the effect of the physical complexity of dog and human faces on the perceived expressiveness of neutral-faced, unknown individuals of both species. Results indicate that when looking at static images of unknown dogs and humans, facial complexity has minimal impact on how expressive people perceive them to be. However, dogs are consistently ranked as more expressive than humans, and people who live with dogs tend to rank neutral-face dogs of all facial complexity levels as more expressive compared to the rankings of humans who do not live with dogs – which we hypothesize may be the result of a desire/tendency of dog owners to "read meaning" into dog faces.

Keywords: interspecies communication, dog-human interaction, human-animal interactions, facial expressions, perception, comparative cognition, companion animals, nonverbal communication

Introduction

Naturally occurring, strikingly bold coloration – especially highly contrasted black and white – patterns in mammals are rare, but when present are typically received by other animals as aposematic markings signaling unpalatability, danger, or toxicity (Nekaris *et al*., 2019; Howell *et al*., 2021). However, bold patterns are neither uncommon nor toxic signals in domesticated dogs, who display remarkable species-wide phenotypic diversity as a result of human-directed breeding (Wayne and vonHoldt, 2012). Many breed-associated morphological and superficial characteristics (e.g., bold and unusual coat color(s) and marking patterns) have been artificially selected both for relevance in canine working contexts and according to fanciers' preferences (Schmutz and Berryere, 2007; Lord *et al*., 2016; Friedrich *et al*., 2020).

Still, given the evolutionary significance of physical appearance in social recognition and in communicative signaling (Otte, 1974), it is likely that these artificially selected physical traits also unintentionally convey attributes that may have bearing on dogs' overall life experience and/or potential fitness. Breed biases, for example, have significant implications for animal welfare, legal policy, adaptability and re-homing, and resource allocation, and emerge from human recognition of breed-associated physical features (Turcsán *et al*., 2017; Bir *et al*., 2018; Cain *et al*., 2020; Correia-Caeiro *et al*., 2020; Morrill *et al*., 2022; Riley, 2022). When considering implications for social interactions between humans and dogs, physical features of the face could be particularly relevant, especially because reading heterospecific facial expressions demands compensation for automatic processing (Correia-Caeiro *et al*., 2020).

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Not only do we depend on physical features of the face to aid in visual identification of individuals, but human reliance on information gleaned from facial displays of intent and emotion in our own human-human interactions is well documented (Jack and Schyns, 2015; Redfern and Benton, 2017). Facial expressions serve as a critical tool in assessing mental, emotional, and even physical states of individuals, both strange and familiar, and responding appropriately in social contexts (Buck, 1994; Frith *et al*., 2003; Barrett *et al*., 2019; Tcherkassof and Dupré, 2021). Moreover, not unlike judgments made based on canine breeds as identified by physical characteristics, humans also identify and judge each other based on facial features and expressions (Lander and Butcher, 2015; Li *et al*., 2019). Distinguishing facial features, deformities, marks, and especially perceived "attractiveness" influence perceived personality traits such as trustworthiness, along with how willing individuals are to interact with, help, provide attention to, and cooperate with others, regardless of familiarity (Rennels and Kayl, 2015; Etcoff *et al*., 2011).

Biologically, first impressions from facial cues can affect fitness (Zebrowitz and Montepare, 2008). Indeed, Etcoff *et al*. (2011) suggest that cosmetic manipulations, for example, serve as an extended phenotype of the human face, wherein perception of physical features, marks, and coloring can even influence the reception of facial expressions and signals. In this work, images of human female faces with varying degrees of makeup were displayed for 250 ms or for an unlimited period. In the time-limited condition, cosmetics had significant positive effects on ratings for attractiveness, competence, likeability, and trustworthiness. With longer inspection time, the effect of cosmetics on likeability and trust varied based on specific makeup looks. According to Etcoff *et al*. (2011), these results suggest both automatic and deliberative judgments are affected differently by makeup, or the extended phenotype.

Still, little is known about the impact of facial markings and coloration on humans' immediate, generalized perceptions of unknown but potential heterospecific social partners, such as unfamiliar dogs, in the absence of social context or dynamism. Further, we do not know how this impact compares to our perception of unknown but potential *conspecific* social partners, such as human strangers.

Amici *et al*. (2019) find that humans' ability to recognize canine expressions of emotion is mainly associated with experience with dogs. For adults, the probability of recognizing dogs' emotions increases when people have been raised in a culture that has overall positive attitudes toward dogs. Likewise, Sullivan *et al*. (2022) provide initial evidence that despite having dissimilar facial morphology, familiarity or experience with a non-human animal social target, namely, a dog, can influence accuracy when it comes to categorizing facial displays of emotion. Here, humans better categorized canine facial displays of emotion than those of chimpanzees, a less familiar partner but a close evolutionary relative. While facial morphology is considered, additional physical features are not. And finally, Kujala *et al*. (2017) suggest that humans may indeed perceive human and dog facial expressions similarly, with perceptions likely influenced by humans' psychological factors (Kujala *et al*., 2017).

We previously (Sexton *et al*., 2023) explored how the physical complexity of the face (e.g., color patterns) affected an owner's subjective perception of their dog's behavioral "expressiveness"[1]. Results showed that dog owners tend to more accurately assess their adult canine companion's overall *level of expressivity* – without attempting to categorize the specific expressions – if the dog has a solid-colored face (e.g., few to no spots, patches, ticking, or other such markings). After controlling for the dog's age (and familiarity), owner ratings of their dog's expressiveness significantly agreed with an objective measure of expressiveness (Waller *et al*., 2013) when the dog had a plainer face but not when they had more complex coloring and patterning. The accuracy of ranking unknown individuals, or generalized accuracy at scoring expressivity, was not evaluated.

Building on these results, here we explore how physical complexity in human and dog faces impacts expressivity judgments by unknown individuals. We also evaluate whether or not humans have an inherent preference for plainer faces. Specifically, we ask, in a neutral condition, are dogs with more physically complex facial features perceived by unfamiliar humans as more or less behaviorally expressive than those with solid-colored faces, and do these perceptions follow the same trend when applied to unfamiliar humans?

Methods

ETHICAL CONSIDERATIONS

The experiment was approved by the Harvard University-Area Committee on the Use of Human Subjects under the protocol title: Cognition, motivation, and emotion in domestic dog breeds; Harvard Principal Investigator: Erin Hecht; Protocol #: IRB19-0476 /SITE200061. The George Washington University was approved by the above-named committee as a relying institution; George Washington Principal Investigator Courtney Sexton; Federalwide Assurance: FWA00005945.

SUBJECTS

This study employed an online survey where participants scored digital images. Three hundred twelve (N = 312) respondents were included in the survey. According to self-report, participants included individuals from North America, South America, Europe, Asia, and Australia who identified with various races and genders and ranged in age from 18 to 72. Participants were not required to be dog owners or handlers, nor were they required to be familiar with specific dog breeds. Just over half of the scorers (n = 174, 56%) lived with a dog in their home. One hundred thirty-eight (138) participants lived in an urban environment, 136 in a suburban environment, and 38 in a rural environment (Table 1).

Participants were recruited personally, via social media, and through the Prolific online research service (www.prolific.co) (2023). Participants gave their written informed consent prior to voluntary participation in the study and were informed at that time that they were free to opt-out at any point after beginning the survey. It was also made clear to participants in the description of the study that the purpose of the survey was not to investigate associations or biases related to specific-dog breeds though various dog breeds were included to increase variation in images. Similarly, the survey instructions emphasized that images of humans representing various races were included to span a great segment of human variation.

Criteria for excluding respondents from analyses included: declining to consent, providing responses that indicated lack of attention to survey questions (e.g., "0"s or series of blank responses), and providing contact information and/or question responses that indicated spam/auto-bot responses. After reviewing respondents from an open link survey hosted on Qualtrics, we elected to use the Prolific service to recruit 100 additional participants who were paid an average of US$9.92/h for their participation (101 participated via this service). The surveys on the different platforms were identical. (Survey instructions and full survey available in Supplementary Materials.)

Based on a post-hoc power analysis conducted using G*Power (Version 3.1.9.7) (Faul *et al*., 2007, 2009), this sample size had sufficient power (0.99 at medium effect size ($|\rho|$ = 0.3)).

MATERIALS

The survey included a stimulus set comprising 36 square-cropped color photographs of real dog and human faces (Figs. 1 and 2). (Full set of images available in Supplementary Materials.)

For canine face stimuli, photos were selected using search terms such as "neutral dog face," and "dog face neutral expression" via

Table 1. Participant demographic characteristics.

Characteristic	*n*	%
Residential environment		
Urban	138	44.2
Suburban	136	43.6
Rural	38	12.2
Age group		
18–28	112	35.9
29–39	110	35.3
40–50	53	17
51–61	21	6.7
62–72	16	5.1
Gender identity		
Woman	198	63.5
Man	97	31.1
Non-binary	4	1.3
Gender variant/Non-conforming	3	0.96
Transgender man	1	0.32
Prefer not to answer	9	2.9
Companionship in the home		
Dog(s)/no people	37	11.9
People/no dog(s)	117	37.5
People and Dog(s)	137	43.9
No dog/no other people	21	6.7

Note: N = 312.

the Adobe Stock image database (all images used with permission/rights). Images were "close up" photographs of canine faces, facing forward. To limit variation and reduce potential behavior-associated breed bias, all dog face images selected were from morphologically similar sporting dog breed groups. In order to further standardize the stimuli, backgrounds (if any) were removed, and images were cropped to remove ear/head shape and coat length indicators that might influence perception of mood and/or personality type.

Dog Stimuli: Eighteen (18) images of dog faces were selected to include a balanced set of stimuli with varied facial complexity scores, as ranked according to the scoring system used by Sexton *et al*. (2023). In total, canine face stimuli comprised six "plain-faced" dogs (score 1, min), six moderately marked dogs (score 4–5), and six highly marked dogs (score 9, max). Images included: two dogs with a base solid dark color (score 1); two dogs with a dark base color and mid-level complexity (score 4–5); two dogs with a dark base color and high-level complexity (score 9); two dogs with a base solid medium color (score 1); two dogs with a medium base color and mid-level complexity (score 4–5); two dogs with a medium base color and high-level complexity (score 9); two dogs with a base solid light color (score 1); two dogs with a light base color and mid-level complexity (score 4–5); and two dogs with a light base color and high-level complexity (score 9) (Fig. 1).

Human stimuli: For human face stimuli, six photos of real human faces were selected from the MR2 Face Database (Strohminger *et al*., 2016), three female and three male, which were then manipulated to create a total set of 18 human face photographs, equal to the number of canine face photographs. The MR2 dataset includes images with standardized lighting, clothing, and background conditions, and the photos have been utilized in previous studies concerning face perception (Strohminger *et al*., 2016; Strachan *et al*., 2017; Hester, 2019; Chang *et al*., 2021; Higgins *et al*., 2021). Stimuli from this dataset were selected based on comparable rankings of perceived "attractiveness" and trustworthiness, and normalized for rank of "neutral" mood (all between score 4–4.2 on a 1–7 scale), according to (Strohminger *et al*., 2016).

Stimuli complexity: In order to approximate variations in degrees of facial complexity comparable to the scored facial markings of the canine stimuli, individual human photos were manipulated to articulate different levels of complexity, achieved via makeup on females and facial hair on males. In total, 18 images of humans were included in the set, with three permutations of each of the six selected photos. We used a premium subscription to the Perfect Corp. YouCam Makeup application [Version 6.5.0] to manipulate human face photos.

The final set of human stimuli included three versions of each of the photos selected from the MR2 database as follows: Females – (1) "Plain" = original photo, no makeup or enhancement; (2) "Everyday" = concealer, minimal eyeliner, minimal blush, and lightly toned lip color; (3) "Glam" = concealer, facial contouring and highlighting, significant eyeliner, significant mascara/lash extensions, significant eyeshadow, blush, bold lip color. Males — (1) "Plain" = original photo, no manipulation or enhancement; (2) "Mustached" = added mustache feature; (3). "Full facial hair" = added mustache and "ducktail" style beard. The six "plain" images were considered comparable to a canine face score 1, with low complexity; the "everyday" and "mustached" iterations were considered comparable to a canine face score 4/5, with moderate complexity; and the "glam" and "full facial hair" iterations were considered comparable to a canine face score 9, with high complexity (Fig. 2).

EXPERIMENTAL PROCEDURE

Design: The study consisted of a mixed between/within-subject repeated measures design that included photographs of 3 species and sex of human faces (male humans, female humans, dogs) by three levels of complexity (low, mid, high) as within-subjects variables and canine interaction (limited, some, regular), breed familiarity (not familiar, somewhat familiar, very familiar) and companionship (0–3) as between subject factors. See the description of measures below.

The main dependent measure was participants' subjective perception of potential facial expressiveness (regardless of type of expression or emotional valance), on a scale of 1–10 with 1 being not expressive at all and 10 being extremely expressive.

We did not evaluate sex differences in dogs as the sexes were unknown and irrelevant to the study. While males and females may differ in size and bone structure, there is a lack of discernible sexual dimorphism on dogs' faces (McPherson and Chenoweth, 2012; Wilson *et al*., 2018).

Procedures: Participants accessed the survey via a web link, and could complete the survey on mobile device, tablet, or computer. The survey was hosted using the Qualtrics XM platform, Version (December 2022) of Qualtrics. Participants were presented with study information on the first screen and asked to denote their written consent prior to voluntary completion of the survey by clicking a bubble next to the "I consent" option. If participants clicked the bubble next to the "I do not consent" option, the survey immediately ended.

Instructions for the survey task were presented on the next screen.

Fig. 1. Examples of images used in this study. Photos of dogs selected from the Adobe Stock image database were all sporting breeds with similar facial morphology. The canine stimuli set included dogs with solid faces of different base colors, moderately complex faces, and highly complex faces, as scored according to an original matrix.

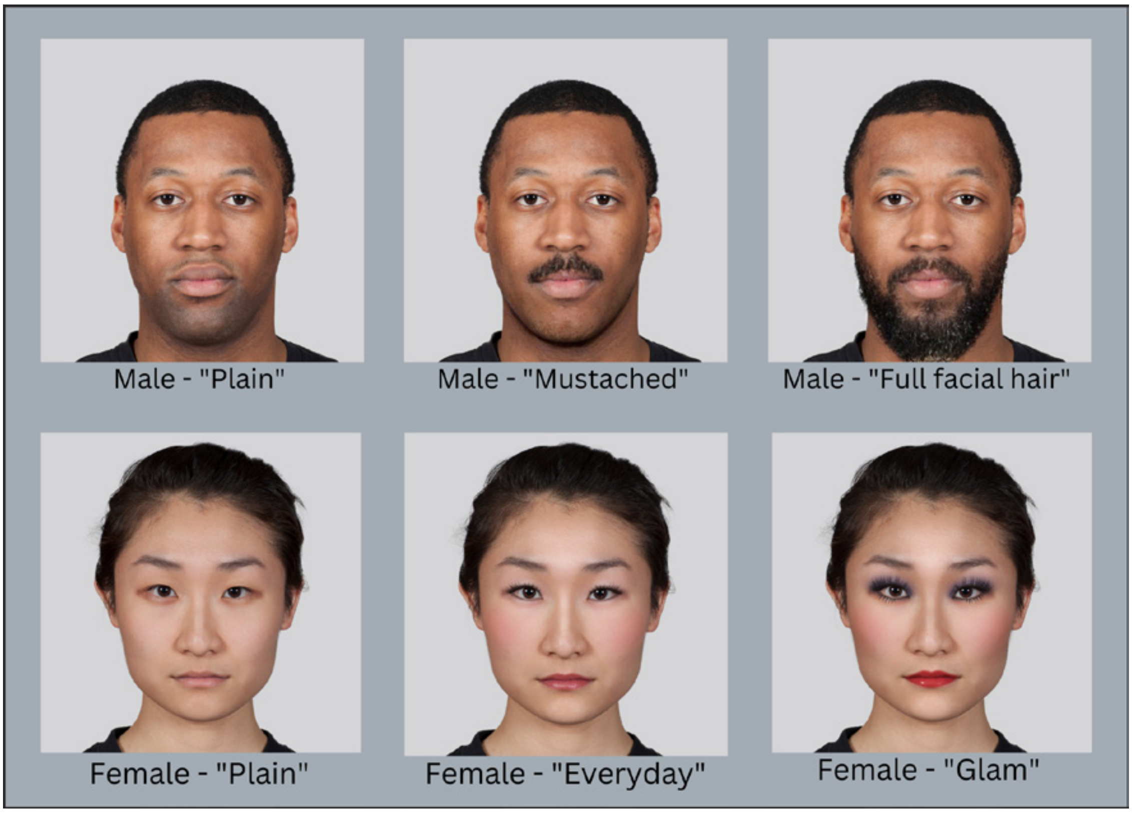

Fig. 2. Examples of images used in this study. Neutral-faced photos of humans were selected from the MR2 database. Each original or "plain" photo was manipulated to have two additional variations in complexity. For female stimuli, this was achieved through adding levels of makeup, and for males, levels of facial hair.

The task is similar to that employed in other studies (Etcoff *et al*., 2011; Bloom and Friedman, 2013; Sullivan *et al*., 2022; Comfort *et al*., 2023). Before the start of the study, all participants completed a practice trial. The image used in the practice was not used in the experimental section. Testing included all 36 images from the full set of canine and human faces, presented in randomized order. Images were presented for 500 ms, after which a likert scale replaced the image on the screen and respondents were asked to rank how expressive they perceived the pictured individual to be (without considering any specific type of expression or related emotional-valance), based on their immediate, "gut" reaction.

Per the survey instructions, participants were instructed the following: "You should look at [each] image and take note of your first impression of how expressive you think the individual's face would be, on a scale of 1 to 10, with 1 being not very expressive, and 10 being highly expressive. Once the image disappears, you should immediately record your response. Please record your first, instinctive response." Participants clicked or pressed the arrow on the screen to advance to the next image.

At the completion of the study, participants were asked a series of questions regarding familiarity with different dog breeds (not familiar at all/slightly familiar/moderately familiar/very familiar/extremely familiar), frequency of encountering and interaction with dogs (never → all the time), and whether or not they shared their home with dogs and/or other people. Voluntary demographic information was also collected (see Supplementary Materials).

The duration of the survey per participant was approximately 6–8 min.

ANALYSES

Statistical analyses were performed using JASP (Version 0.17.1) and Jupyter Notebook for Python (Version 3.7.15).

DEPENDENT MEASURES

Expressivity rank: (Subjective) Participants assigned a score of perceived potential behavioral expressivity (regardless of type/emotional valance) to each image on a scale of 1–10 with 1 being not at all expressive and 10 being extremely expressive.

INDEPENDENT CONDITIONS/VARIABLES

We performed analyses on how perceived expressivity measures varied by the following:

- *Facial complexity*: Images of canine and human faces varied on a complexity scale of 1–9, from low (1), to moderate/medium, to high (9) (Sexton *et al*., 2023).
- *Sex*: (For human stimuli) Sex differences between images of human male and female faces (not relevant to dog stimuli due to lack of sexual dimorphism in canine faces).
- *Canine interaction*: Participant-reported level of interaction with dogs, generally in their day-to-day lives (never, sometimes, about half of the time, frequently, always).
- *Breed familiarity*: Participant-reported level of familiarity with different dog breeds (not familiar at all, slightly familiar, moderately familiar, very familiar, extremely familiar).
- *Companionship*: Participants noted whether they lived with a dog(s) and/or another person(s) in their home. Participants were assigned a number based on companionship type: 0 = no dog/no people, 1 = another person/people in the home but no dog(s), 2 = a dog in the home but no other people, 3 = dog(s) and another person(s) in the home.

Results

All stimuli were ranked within a neutral range (Canine M = 5.19, SD = 1.48; Human M = 4.14, SD = 1.65) on a scale of 1–10.

The 101 participants who were paid via the Prolific platform ranked dogs (M = 4.87, SD = 1.47) and humans (M = 3.82, SD = 1.39) significantly lower than the 211 volunteer participants ranked dogs (M = 5.34, SD = 1.46) and humans (M = 4.3, SD = 1.75), with small effect sizes for both species [All dogs: $t(310)$ = 8613, p = 0.006 (Mann–Whitney); All humans: $t(310)$ = 8897.5, p = 0.018 (Mann–Whitney)]. Both groups ranked dogs higher than humans.

FACIAL COMPLEXITY AND EXPRESSIVITY RANK

To evaluate differences in expressivity rank across all stimuli, we ran a 2-factor repeated measures ANOVA with three levels each that included facial complexity (low, medium, high) and species (dog, human females, human males) and companionship as a between subjects factor. There was a main effect for complexity [F(1.92, 593.28) = 3.86, p = 0.023, η^2 = .012], species [F(1.3, 410.59) = 63.23, p = <0.001, η^2 = 0.17], and companionship [F(3, 308) = 5.92, p = <0.001, η^2 = 0.054].

Post hoc comparisons between complexity levels indicated that medium complexity individuals were ranked marginally higher than low complexity individuals (averaged over the levels of species, i.e., dog, human male, human female) (p_{holm} = 0.017), but see Discussion. Post hoc comparisons between species using a Holm correction indicated that dogs were ranked higher than human males and females, (p_{holm} = <0.001 in both cases). There was no significant difference between human males and females (Fig. 3).

There was also a significant complexity x species interaction [F(3.87, 1191.77) = 3.8, p = 0.005, η^2 = 0.012]. To understand this interaction we explored post-hoc results within-species varying in high versus low complexity and collapsing human male and female faces (all ps > 0.05). Results using a Holm correction showed opposite effects on judgments of dogs versus human facial expressiveness depending on complexity. Whereas low-complexity dog faces were judged to be more expressive than more complex-faced dogs (p = 0.003), the opposite was the case in humans. Low-complexity human faces were judged as *less* expressive than more complex human faces (p = 0.013).

COMPANIONSHIP

Post hoc comparisons between companionship levels using a Holm correction indicated significant differences between respondents who lived with only other people (Companionship = 1) and respondents who lived with only a dog (Companionship = 2) (p_{holm} = 0.003), and Companionship 1 and respondents who lived with both a dog(s) and other person(s) (Companionship = 3) (p_{holm} = 0.016).

Although complexity level differences were statistically significant, there was a mid-low effect size (η^2 = 0.012) (Fig. 3). To further investigate the relationship between companionship and ranking, we ran a single factor repeated measures ANOVA that included species (dog, human females, human males) as a repeated measure and companionship as a between-subjects factor, which again produced a main effect for species [F(1.33, 410.61) = 63.23, p = <0.001, η^2 = 0.17], and a between-subjects effect for companionship [F(3, 308) = 5.92, p = <0.001, η^2 = 0.054]. Companionship level 1 (only other person(s) in home) ranked all stimuli lower than Companionship levels 0, 2, and 3 (p_{holm} = 0.057, 0.003, and 0.016, respectively) (Fig. 4).

EFFECT OF LEVEL OF CANINE INTERACTION

Breed familiarity and canine interaction were highly correlated (r = 0.542, p = <0.001) and so we used canine interaction to investigate the general effect of familiarity with dogs, generally, on expressivity rank of canine stimuli, only. An ANOVA with the expressivity rank of dogs as the dependent variable and dog interaction as the fixed factor was significant [F(2, 309) = 6.37, p = 0.002, η^2 = 0.040], with a mid to small effect. A post hoc comparison between interaction levels indicated a significant difference between people with limited interaction with dogs and those with regular interaction with dogs. People who reported regular interaction with dogs ranked dog stimuli as slightly more expressive than those who reported limited interaction with dogs (p_{holm} = 0.001) (Fig. 5).

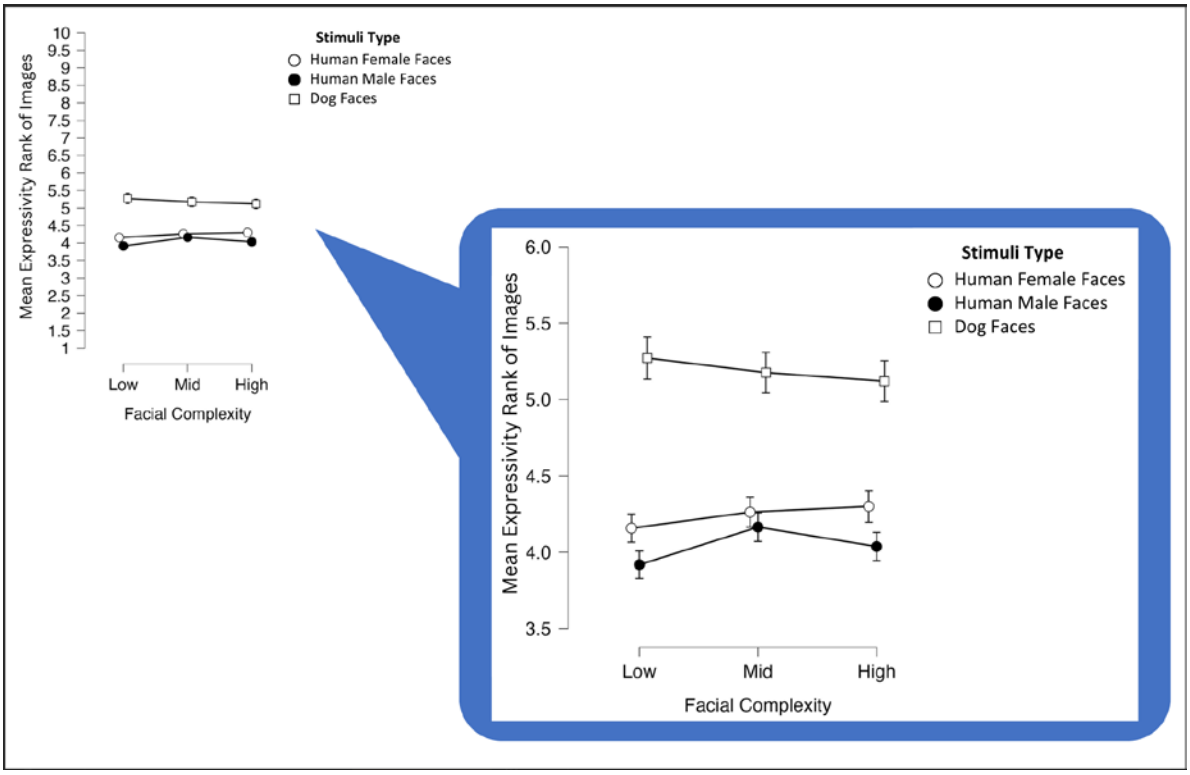

Fig. 3. Expressivity by species by complexity levels. All stimuli were accurately ranked within neutral range on a 0–10 scale (see left). Although the average expressivity rank of dogs was significantly higher compared to humans, facial complexity had the opposite effect on expressivity judgments for dog versus human faces (i.e., Dogs: *less* expressive as facial complexity increased; Humans: *more* expressive as facial complexity increased). In the right-hand iteration of this graph, the y-axis is compressed to include only that neutral range in order to see error.

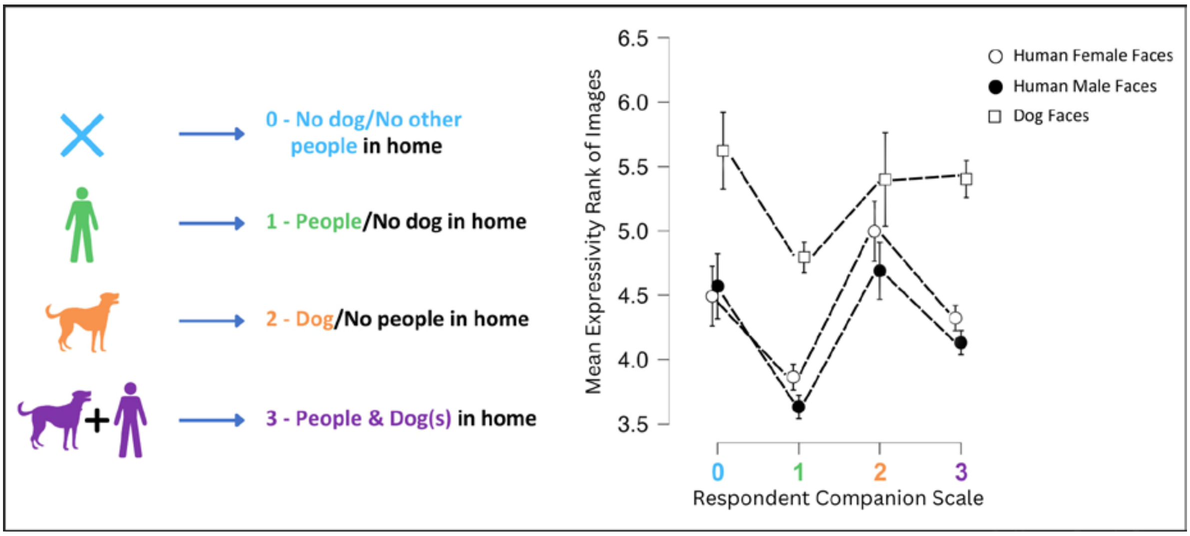

Fig. 4. Companionship with dog(s) and/or other person(s) impacted the way that respondents ranked both human and canine face stimuli. Those who reported living with only a dog tended to rank all stimuli more similarly, regardless of species; whereas those who lived with other person(s) only ranked all stimuli lower than any other companionship level.

Discussion

It is important to clarify that dogs of multiple breeds were included in this study because they are examples of the significant phenotypic variation present in the species, whereas there is some physical variation among humans but not multiple “breeds” (Norton *et al.*, 2019). This study considers humans and dogs analogous only in that despite being different species, they both are potential social partners for people.

We previously showed (Sexton *et al.*, 2023) that owners of adult dogs scored their dog(s)’ expressivity more accurately if their dog had a plainer, or solid-colored face relative to dogs with more complex faces. Dog owners were less likely to either over- or under-estimate their dog(s)’ observed behavioral sum score (OBS) for solid-colored dogs, regardless of expression. Given those observations, this study hypothesized that respondents would rank solid or plain-faced dog stimuli as appropriately neutral, whereas

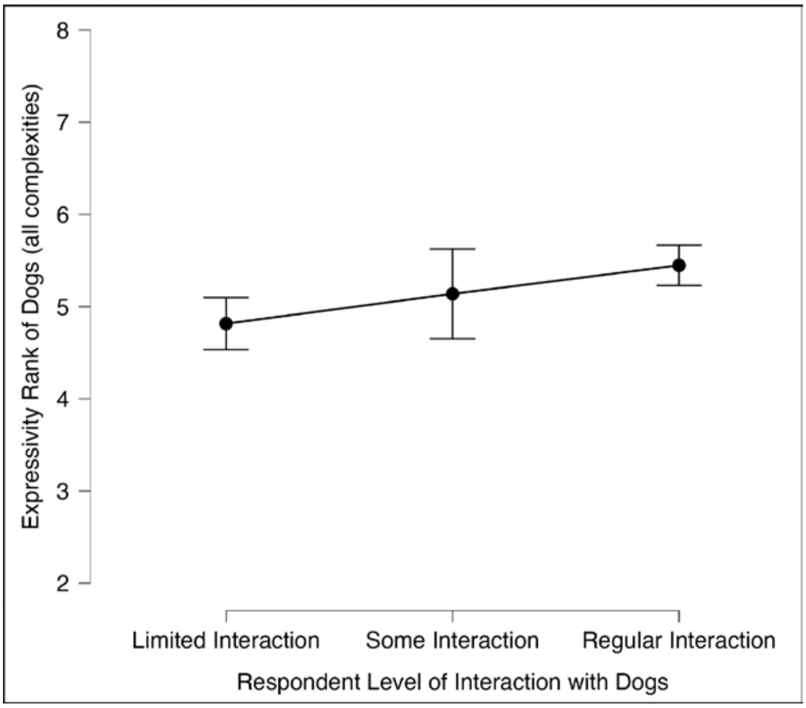

Fig. 5. Respondents who reported regular interaction with dogs ranked dog stimuli higher (more expressive) than those who reported limited interaction with dogs.

canine stimuli with more complex facial markings would be ranked with more deviation from the accurate neutral expressivity score. We likewise hypothesized that people would respond similarly to human stimuli, due to: (1) potential expertise at reading "plain" faces, and (2) the possibility that markings/makeup/facial hair might skew participants' ability to accurately assess expressivity by introducing personality judgments (for humans) and breed biases (for dogs) (Cain *et al*., 2020; Comfort *et al*., 2023).

The results of our study are therefore somewhat counterintuitive – despite a statistically significant correlation, facial marking complexity is unlikely in real-world practice to affect the *accuracy* of people's impressions of how expressive a given individual is, human or canine. The median ranks for all stimuli were accurately neutral (between 4 and 5.5 on a 1–10 scale), regardless of complexity level.

That there were no significant differences in ranking between sexes of human stimuli was especially surprising, given well-established sex differences in the interpretation of neutral faces (Harris *et al*., 2016; Hester, 2019). However, the inverse relationship between complexity and expressivity judgments for dog vs. human faces is of interest. In dogs, plainer faces were ranked higher (more expressive) than those with more complex facial markings. The opposite was true for humans, where the average expressivity ranking increased with facial complexity (facial hair/makeup).

Although the differences in expressivity ranking observed between levels of marking complexity for both species may be trivial as far as accuracy of expression, these small but statistically significant distinctions could potentially have real-world impacts on snap judgments of both people and dogs in social contexts (Said *et al*., 2009; Siegel *et al*., 2018). Further research should address the extent to which this small but significant effect in a controlled experimental paradigm is reflective of perceptual patterns that have a measurable impact in noisy, dynamic, real-world social interactions.

It is also worth noting that there was a significant difference between overall rank of dogs and humans, with a large effect. Dog stimuli, on average, were ranked higher, or perceived as more expressive overall than human stimuli. A possible explanation for this discrepancy is that while MR2 Face Database human face stimuli had previously been verified as "neutral" (Strohminger *et al*., 2016), dog faces were assigned neutral during this study. Neutrality was designated via feature alignment – no open mouth, no closed eyes, eyes and head forward facing, ears not visible/ no ears perked, consistent snout length and head shape – but may have been more open to interpretation. Another possible explanation is an effect of anthropomorphization, wherein humans may tend to overestimate the expressivity of dogs based on enculturated perceptions.

An important distinction between this study and our previous (Sexton *et al*., 2023) is that in the present study, people did not live (were unfamiliar) with the dogs they were assessing. Respondents were assessing unknown individuals, which may indicate that accuracy in ranking expressivity is affected by facial marking complexity only when considering known, familiar individuals.

In fact, experience with dogs does influence how expressive people perceive them to be. Respondents reported their average level of interaction with dogs, which increased with the average rank of perceived expressivity of dog stimuli. Using level of interaction as a proxy for experience/familiarity, we can infer that experience and expressivity rank are related, which would be consistent with previous studies (Kujala *et al*., 2017; Amici *et al*., 2019).

Perhaps the most compelling findings from this study related to the impact of cohabitation with dogs and/or humans (or neither) and rank of both canine and human stimuli (Fig. 4). Recall, respondents who reported sharing a home with a dog or dogs (but not other people) tended to rank all stimuli (humans and dogs) roughly the same (and generally more expressive). On the other hand, those who lived with another person or people (but no dogs) ranked all stimuli (humans and dogs) as less expressive than any other companionship level. And finally, respondents who lived with either no other companions, or both dog(s) and person(s) ranked similarly to one another.

This could be interpreted as an effect of interspecies social partners. Many factors would surely be relevant, such as the nature of the relationship with human cohabitants, and time (duration) spent living together; but, it is possible that regular viewing of facial markings/features of people (such as by living with them) makes humans less attuned to the markings and potential facial expressivity of conspecifics, whether known or stranger. Moreover, at the same time, regular viewing of facial markings and facial expressions of a social partner whose umwelt is entirely unlike our own may cause us to over-attend to these familiar heterospecifics (dogs) with a desire to "read meaning" in their faces, and generalize those experiential interpretations to other, unknown dogs and even people.

FUTURE DIRECTIONS

This study represents the first attempt to evaluate, using static images, how superficial facial markings contribute to human perception of canine expressivity when the animal is unknown and presented devoid of emotional context. Results, especially the effect of living with dogs in a household on expressivity ranking, prompt additional investigation.

A following iteration of this experiment should include cross-analyses of static images of faces of both dogs and humans at multiple levels of facial complexity also portrayed displaying various facial expressions such as those used by Bloom and Friedman (2013) and in studies after Ekman and Oster (1979). This could be especially useful in parsing the inverse relationship between human and dog facial complexity and expressivity ranking seen here.

Future work should also include tests using photographs of different human faces rather than manipulating the same face of several subjects, which would make it more congruent with the dog sample set, and may also shed light on qualitative judgments of personality and communicativeness. More generally, future studies should attempt to use more ecologically valid, complex stimuli – in real life facial movements (e.g., expressions) are fleeting and dynamic, and a single channel in multimodal communication. It could be that the signal-processing effects associated with facial complexity only become significant in such a context.

Other elements that comprise the so-called extended phenotype (such as features like glasses, masks, etc.) should also be considered. Many dogs have patches, "eyeliner", outlines, and other markings around the eyes and mouth; appear to wear eye masks; and/or have contrasting facial pelage, all of which could be compared to humans outfitting their faces with various adornments/accessories.

CONCLUSIONS

In this study, both canine and human images with neutral expressions were selected to assess the effect of physical features *alone* on the perception of expressivity. We found that facial complexity has statistically significant, though minimal, impact on how expressive people perceive unfamiliar dogs or people to be, but that dogs of all complexity levels are ranked higher (more expressive) than humans. In the dog stimuli, dogs with more complex faces were judged as less expressive, while in humans, increased facial complexity aligned with increased expressivity ranking. We additionally found that people who live with dogs tend to rank neutral-face dogs of all facial complexity levels as more expressive than those who do not live with dogs.

HIGHLIGHTS

- Facial physical complexity in unknown dogs and people impacted perceived expressivity between (human-dog) but not within (human-human) species.
- Regardless of facial complexity, unfamiliar neutral dog faces were ranked as more behaviorally expressive than unfamiliar neutral human faces.
- Facial complexity had *opposite* effects on expressivity judgments of dogs versus humans.
- Companionship – living with dogs, people, both or none – affected how expressive human and dog faces were perceived to be.

NOTE

1. A survey of canine demographics and behaviors was included as part of an at-home participation study. The survey included a question about the owner's subjective perception of their dog's expressivity. The owners were asked to rank on a scale of 1–10 their dog(s)' level of non-vocalizing expression, with 1 = does not seem expressive at all and 10 = very expressive.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

The authors confirm that the research meets any required ethical guidelines, including adherence to the legal requirements of the study country.

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AUTHOR CONTRIBUTIONS

CLS carried out conceptualization, investigation, data curation, writing—original draft, visualization, funding acquisition, and project administration; CB and CLS performed methodology; CB carried out validation; CB and CLS carried out data curation; MS managed software; CLS, MS, and FS carried out formal analysis; FS, EEH, and BJB carried out resources; CLS, FS, EEH, and BJB carried out writing—review and editing; EEH and BJB supervised the study. All authors have read and agreed to the published version of the manuscript.

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DATA AVAILABILITY

Data are available as a supplement to this article.

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