What makes Lassie smart? Human Perceptions of Canine Intelligence

Miriam A. Ross (miriam_ross@brown.edu), Bertram F. Malle (bertram_malle@brown.edu),
Daphna Buchsbaum (daphna_buchsbaum@brown.edu)
Department of Cognitive, Linguistic and Psychological Sciences, Brown University

Abstract

What makes Lassie a smart dog? People have strong intuitions about dogs' intelligence, yet the content and organization of these intuitions remain unknown. Two studies examined the structure of laypeople's concepts of dog intelligence, creating a conceptual map of what people represent as a "smart" or "dumb" dog. Study 1 elicited open-ended ideas about dog intelligence. We turned consistent themes into items in a 50-item survey. Study 2 asked participants to picture either a smart or dumb dog and rate that dog on the items derived from Study 1. Participants strongly agreed in their ratings of smart and dumb dogs, and we discovered a coherent dimensional structure underlying people's intuitions. They represent smart dogs as socially skilled with a good temperament, and dumb dogs as bad at physical reasoning and avoiding threats. These representations align well with findings from canine research and with dog trainers' practical knowledge.

Keywords: Animal cognition; Dog intelligence; Survey development; Lay concepts

Introduction

From making friends to getting a job, people's judgments of each other's intelligence influence many parts of their lives. Just as judgments of human intelligence influence people's behavior, so do assumptions about dog intelligence guide the selection of working dogs (Bray et al., 2021a), contribute to breed stereotypes (Gunter et al., 2016), and influence emotional relationships with companion dogs (Howell et al., 2013). People's assumptions about dog intelligence shape their interactions with their canine companions. One study found that pit bulls waited longer for adoption, partly because of people's prejudice that pit bulls were less intelligent than other breeds (Gunter et al., 2016). Another study found that owner's reported impressions of dog intelligence influenced people's fondness for dogs and willingness to form emotional bonds (Riddoch et al., 2022). Our study focuses on unraveling people's concept of dog intelligence.

When people assess another person's intelligence, in addition to evaluating their behavior, they also rely on factors such as facial attractiveness (Zebrowitz et al., 2002), perceived classiness (Sternberg, 2004), and cultural context (Gergaud et al., 2016). Similarly, people infer the intelligence of other animals from behaviors (Maust-Mohl et al., 2012), strength of emotional bonds (Howell et al., 2013), and from their perceived similarity to humans (Eddy et al., 1993). Dog and cat owners tend to rank common pet species as more cognitively skilled than do non pet owners (Maust-Mohl et al., 2012), and dog owners in particular rank the cognitive abilities of dogs more highly than do non dog owners (Howell et al., 2013). Moreover, most people surveyed (all of whom were in the US) viewed animals commonly adopted as pets in Western culture as more intelligent than those used for food or other domestic purposes (Maust-Mohl et al., 2012).

Dogs have become an especially popular species for cognitive research, given their notable ability to comprehend human social cues (e.g., Bräuer et al., 2006; Pelgrim et al., 2021), form close emotional bonds with humans (Payne et al., 2015), and serve in diverse roles in human society (Cobb et al., 2015). However, this research is influenced by researchers' implicit assumptions about the kinds of behaviors that indicate dog intelligence, and these assumptions also guide laypeople's selection of pets and working dogs, and the tendency to form a bond between dog guardians and their pets.

Researchers have explored dogs' cognitive abilities across social and non-social domains, where they excel in interpreting human gestures, socially informed decision-making, and emotional recognition (e.g., Cook et al., 2014; Albuquerque et al., 2016). Findings of strong performance on social tasks (MacLean et al., 2017), and comparatively weaker performance on physical tasks (Lea & Osthaus, 2018) has led some researchers to theorize that dogs as a species are comparatively strong in social cognition and weaker in physical reasoning abilities (Bräuer et al., 2006). We aim to discover whether these research findings and their underlying assumptions about dimensions of dog cognitive abilities correspond to people's intuitive concepts of dog intelligence.

More directly, the Perceptions of Dog Intelligence and Cognitive Skills (PoDIaCs) survey probed people's perceptions of several cognitive capacities such as problem solving and recognizing human emotions (Howell et al., 2013). Specifically, they asked participants to rate the skill of dogs in general (not their own dog) across eight cognitive domains, such as 'learned problem-solving abilities,' and 'general intelligence compared to humans.' Guardians rated dogs as smarter and more cognitively skilled if they had a closer emotional bond with their dogs or claimed substantial knowledge of dogs (Howell et al., 2013).

In two studies, we explored people's conceptual maps of dog intelligence. Are there domains of cognition (e.g., emotional awareness, problem solving) that lead people to perceive a dog as more or less smart? One possibility is that people share conceptions of what constitutes dog intelligence, and that these conceptions are structured around a few core traits. Another possibility is that people's perceptions of dog intelligence are idiosyncratic, with little systematic structure.

In Study 1, we gathered participants' examples of behaviors that make a dog appear smart or dumb. Via a bottom-up approach, we identified frequently mentioned behaviors that were reliably identified by independent coders. In Study 2,

In L. K. Samuelson, S. L. Frank, M. Toneva, A. Mackey, & E. Hazeltine (Eds.), *Proceedings of the 46th Annual Conference of the Cognitive Science Society.*

we collated the behaviors from Study 1 into a 50-item survey. We asked participants to think of a dog they considered either very "smart" or "dumb" and to rate that dog on the 50 items.

We hypothesized that people's assessments of what makes a dog smart or dumb would (1) show considerable inter-judge agreement and (2) cluster together in a small number of dimensions. Our studies thus did not presuppose which dog behaviors constitute dog intelligence but directly investigated people's perceptions of what makes dogs smart or dumb.

Study 1

In a study on people's folk concept of intentionality, Malle and Knobe's (1997) demonstrated that researchers can elicit the shared content of a lay concept by asking people to describe that concept in detail. Our first study took a similar approach, asking people to think of smart and dumb dogs and then describe the behaviors and qualities such a dog has.

Participants

We recruited 49 adults (age mean (M) = 23.99, 7 women, 1 man, 1 transgender woman; many participants opted out of identifying their gender) without compensation through online forums and word of mouth. After first passing a bot check, (no participants were excluded) participants were presented with a survey designed in Qualtrics, which had a median completion time of 15.2 minutes.

Procedure

The survey was introduced as follows: "We are interested in how people think about dog intelligence, and what makes dogs smart. We will ask several open-ended questions. Please respond with anything that comes to mind, and feel free to give longer answers." All participants answered all the questions displayed in Table 1. Participants provided fewer answers to questions about dumb dogs than smart dogs, which we will return to. Participants received no further instructions beyond the questions in Table 1 and typed their answers into an empty box. Participants also answered questions about their demographics and level of experience with dogs. 33 of 49 participants responded to the first question, and 34 to the second. Of the participants who responded, 19 participants did not own a dog, 2 replied Other, and 12 currently had dogs.

Table 1: Free response Dog Intelligence Questions, Study 1.

1. Think of dogs in general. When you say that a dog is smart, what does this mean?
2. Thinking of dogs in general, give some examples of when a dog's behavior seems smart.
3. Now think of a dog you actually know. Give a couple examples of that dog acting smart.
4. Now think of a dog you actually know. Give a couple examples of that dog acting dumb.
5. Thinking of dogs in general, what kind of behaviors do smart dogs show? Give a couple of examples.
6. Thinking of dogs in general, what kind of behaviors do generally dumb dogs show? Give a couple of examples.
7. What can people do to make their dog smarter?
8. Under what conditions can a dog become smarter?

In addition, 21 participants had owned a dog in the past or grown up in a family with a dog; 12 participants had not, and 1 replied Other.

Content Analysis

Table 2: An example of 1 of 36 codebook entries (row 1), their definitions (row 2) and example responses (rows 3-4).

Category Name	Commands
Definition	Understanding, following, and remembering commands, learning or knowing large numbers of commands, knowing complex commands.
Ex. Quote 1	"They are fast at learning commands and the recognize multiple verbal commands."
Ex. Quote 2	"A dog's behavior seems smart when it's able to pick up and follow commands."

The first author reviewed all responses and developed a codebook corresponding to behaviors and personality traits mentioned by three or more participants. The author applied this initial codebook to classify all responses and calculate their frequencies. Behaviors that could not be categorized were labeled "Other." This left 23 coding categories for smart dogs and 13 for dumb dogs. In group discussion, the authors agreed on definitions for these categories and established a revised codebook (see Table 2) based on the group discussion, and defined each of the 36 categories with examples directly quoted from participants.

We found that these lower-level categories, corresponding to specific behaviors or traits, naturally lent themselves to two steps of aggregation. At the first step, related behaviors were brought under a common term, such as the label manipulative to encompass the lower-level categories of manipulative, deception, and circumventing rules. In this way, we created six mid-level labels to describe smart dog behavior and four mid-level labels to describe dumb dog behavior. A final level of aggregation combined these mid-level labels into overarching capabilities: for smart dogs, they were Social Reasoning, Learning, and Physical Reasoning; for dumb dogs, they were Doesn't Learn, Bad Physical Reasoning, Lacks Threat Detection.

To validate the behavior categories and establish coder reliability, the first author trained a research assistant to classify all responses into the 36 lowest-level categories for two questions. To measure reliability values between the RA and first author's coding, we calculated Gwet AC1 values for each coding category (kappa was not suitable because several categories had very low frequencies; Gwet, 2008). AC1 values ranged from 0.99 to 0.67 across all categories. Thus, our coding approach reliably identified 36 lower-level features of dog intelligence, which can be organized into meaningful higher-level groupings. We now report results and interpretations of both lower-level features and higher-level groupings.

A first finding of the lower-level features of dog intelligence was that people's conception of smart dogs required 23 distinct behavior and trait categories, while their conception of dumb dogs required 13 categories. As noted earlier, participants also provided more answers about smart dogs than dumb dogs. These findings suggest a potential differentiation in people's conception of smart and dumb dogs. However, we should first acknowledge the possibility of survey fatigue affecting our participants' responses, since they were asked about dumb dogs later on in the survey, which could also account for the sparser and less differentiated answers about dumb dogs.

Another possibility could be that, in the minds of participants, some of the behaviors for smart dogs involved subtle distinctions (e.g., understand people & understand human emotion, or defend owner & get help), whereas those for dumb dogs were more starkly differentiated (e.g., doesn't learn, repeats mistakes). An alternative explanation is that smart behaviors are more exceptional accomplishments, thus easily retrievable from memory, whereas dumb behaviors encompass variants of failures to accomplish a goal, none of which is particularly memorable. However, it remains unclear why people's memory did not show the greater salience and tight organization of negative information that has been amply documented in the literature (Malle & Horowitz, 1995; Baumeister et al., 2001). Determining whether this finding of greater differentiation of smart behaviors is robust, and exploring what might explain it, may be a promising area for future work.

A second finding of the lower-level features was that people judged dog intelligence across numerous contexts. Examples of dogs seeming smart included building strong relationships with other dogs or animals, demonstrating navigation skills, displaying a strong memory, and comforting their favorite humans when they are sad. Notably, lay intuitions highlighted a dimension absent from formal research: people included clumsiness among the indicators of lower intelligence in dogs.

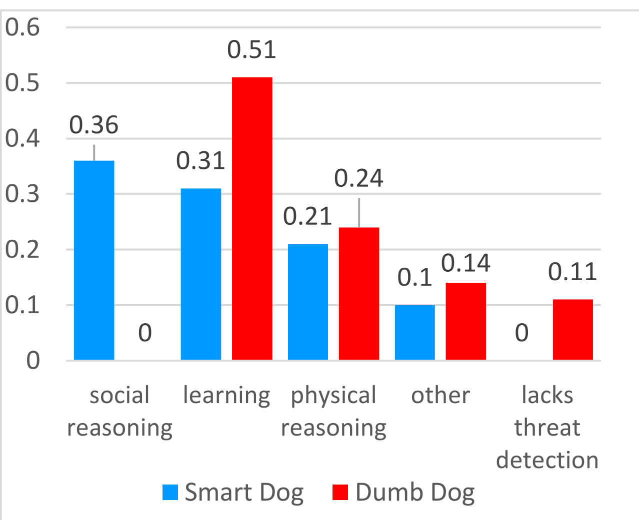

Figure 1. Response proportions for one prompt about a smart dog (Q2 from Table 1) and one about a dumb dog (Q6). Results shown for the highest level of feature aggregation.
c

We aggregated the lower-level features of smart dogs into the more abstract categories of Social Reasoning, Learning, and Physical reasoning; and the lower-level features of dumb dogs into the categories of Doesn't Learn, Bad Physical Reasoning, and Lacks Threat Detection. Comparing the frequencies of these categories across questions about smart and dumb dogs (Figure 2), we see that people conceptualized Learning and Physical Reasoning as bipolar dimensions applicable to both kinds of dogs: Dumb dogs struggle in these domains, whereas smart dogs excel. However, two higher-level categories (and their associated features) were unique to each group. Participants thought of smart dogs, but not dumb dogs, in terms of Social Reasoning; and they thought of dumb dogs, but not smart dogs, in terms of Threat Detection.

Our results suggest that people's conceptions of dog intelligence are distributed over a large number of distinguishable features but also seem to cluster around a definable set of higher-level categories. To provide further evidence for this interpretation, we conducted Study 2.

Study 2

We used the 36 lower-level categories (behaviors and personality traits) that emerged from our bottom-up approach in Study 1 to select and design intuitive items for a dog intelligence survey in Study 2. We asked participants to judge a smart or dumb dog along numerous features represented by the items. In an effort to minimize potential to bias directionality of participant responses that might come from the wording of Study 1 responses. we rephrased all questions to begin with a bidirectional framing such as 'how often/well does this dog [perform behavior]? A first goal was to establish that people show high agreement on these judgments. A second goal was to demonstrate that the items jointly differentiate smart from dumb dogs. A third goal was to examine whether these judgments form abstract dimensions that reflect higher-level categories of dog intelligence similar to the ones we had derived from the lower-level features in Study 1.

Participants

We recruited 103 online participants, 77 from Prolific and 26 via word of mouth and online forums. Prolific participants, fluent in English and residing in Canada or the US, were compensated $1.92. The remaining volunteers received no financial compensation. After excluding participants who failed a bot check, N = 1, we presented a survey designed in Qualtrics, with median completion time of 6.3 minutes. Our age mean was (M) = 33, and of the participants who provided gender identity we had a gender distribution of 64 women, 34 men, 1 trans men, 2 non binary participants.

Procedure

Participants were randomly assigned to either the "smart dog" or "dumb dog" condition. We asked them to: "[...picture a dog, and answer several questions about their behavior…Think of a real dog that you know, who is generally very smart. If you can't think of a specific smart dog, please imagine what that dog would be like..."]. In the "dumb dog" condition, participants were told to [“Think of a dog that you know that is generally NOT very smart”]. Next, they rated 50 items on a 0-100 rating scale.

Our Survey 2 questions were derived directly from the level of items from Survey 1. We ensured that items were represented from all higher level categories, and that distinct lower frequency behaviors still entered the survey. Our selection also accounted for content uniqueness along with frequency. Specifically, we included questions about how empathetic and observant a dog was, based on unique answers from our “Other” category. We also included three questions from a similar survey by Howell et al. (2013), to provide concrete scenarios as a contrast to our less contextualized items. The included questions explored a dog's potential to problem-solve in specific scenarios by watching or interacting with an appropriate human. Finally, we included five control questions which checked for rating bias (ensuring that participants didn’t give universal ratings for smart dogs on every item). Participants were also asked about their experience with dogs. 102 of 103 participants responded to the first question, all 103 to the following questions. Of participants who responded to the question “Have you spent lots of time around dogs growing up or recently?” 12 replied No, 23 said Some, and 67 said Yes. 63 participants did not own dogs; 40 did. 81 participants had owned a dog in the past or grown up with a dog, while 22 participants had not.

Results

To quantify how much people’s lay judgments of dog intelligence converged, we conducted an inter-judge reliability analysis. We computed the correlation of any one judge’s ratings with the remaining group’s mean ratings, r(j*G), the transpose of the classic corrected item-total correlation in scale reliability analysis. Importantly, by correlating judges with the group as a whole, we capture how well any given judge stands for the community judgment and how well the group mean represents each individual judge.

For the smart condition, the average judge-to-group correlation was 0.65 (range -0.12 to 0.88), with only two participants displaying negative correlations, and three participants with correlations of 0.04 or below (with the next smallest value being 0.44). For the dumb condition, the average correlation was 0.54 (range -0.31 to 0.79), with three participants displaying negative values and two displaying values of 0.05 or below (with the next smallest value being 0.38). Altogether, eight participants seem to be outliers based on their negative or very low correlation with the group. Without these participants, the smart condition average correlation is 0.70, and the dumb condition average is 0.61. Outliers were included in analyses, but analyses without the outliers did not substantively change results.

These high correlations show that our participants agree on which item set are predictive of whether a dog is smart or dumb. We next explored distributions for each item split by condition (smart vs. dumb). On the 45 items designed to capture dog intelligence, participants gave strongly differing ratings when thinking of a dumb versus a smart dog (for the 45 items, Cohen’s d ranges 0.31 to 2.54). The control questions did not differentiate between the groups, with Cohen’s d ranges of 0.01 to 80.21, indicating that people were not simply showing a valence effect (e.g., smart dogs are always successful)

We performed a discriminant function analysis to examine whether groups of items could jointly predict whether a participant had been instructed to evaluate a smart or dumb dog. We obtained a Wilks' Lambda value of 0.193, indicating that the discriminant function, formulated as a linear combination of the feature variables, accounts for 80.7% of the between-groups (smart vs. dumb) variance. Table 3 displays items with the highest loadings (correlations) on the discriminant function that separates participants who were picturing a

Table 3: Correlations between items and the discriminant function, from the structure matrix. On display, three items with largest values for Smart and Dumb dogs.

Behavior Label	Coefficients	Condition
Struggle find treats	-0.356	Dumb Dogs
Act clumsy	-0.447	
Repeat mistakes	-0.539	
How quick to learn	0.564	Smart Dogs
How understanding	0.519	
Well follow commands	0.505	

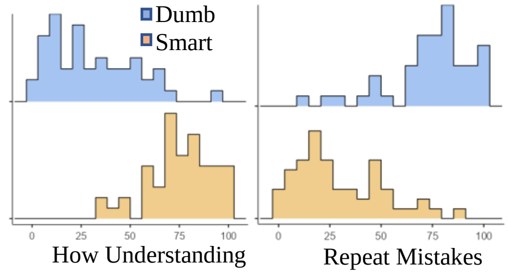

Figure 2: Distribution of participant responses across two questions. A clear differentiation between smart and dumb conditions is visible. Left, “How understanding is this dog?” Right, “How often does this dog repeat mistakes?”

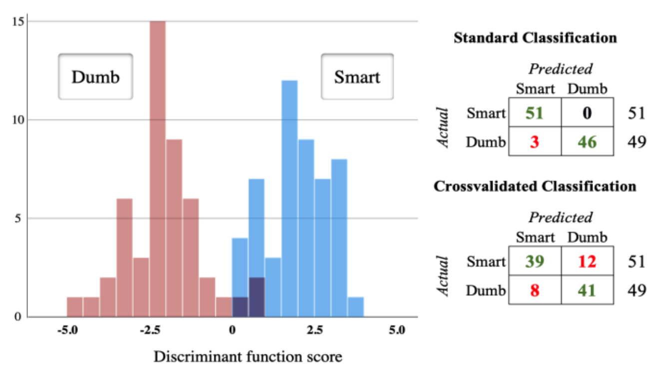

Figure 3: Left: counts of participants classified as “describing dumb dog” or “describing smart dog” on the basis of the discriminant function of all 45 meaningful items. Right: classification results for the discriminant function.

smart or a dumb dog. For example, if a participant rated a dog highly on clumsiness and chasing traffic, we can be confident that they were picturing a dumb dog.

In Figure 3, we can observe this differentiation between participants in the two conditions. The minimal overlap between the participant groups demonstrates that only three participants were incorrectly classified. The major separation between dumb and smart distributions indicates that the discriminant function was robustly able to distinguish whether a participant's responses were about a smart or dumb dog. All in all, 97.0% of the original grouped cases and 80.0% of cross-validated grouped cases were correctly classified. Our final goal was to examine whether people's judgments on individual items hung together systematically so as to reflect higher-level categories of dog intelligence, similar to the ones we had discovered in Study 1. We conducted a Principal Component Analysis (PCA) on the 45 relevant items, excluding control items. Parallel analysis justified a three-component model, which explained 57.8% of the variance. In order of strength, we labeled these components Physical Reasoning, Social Ability, and Temperament. Subsequent refinement led to a final 21-item list, chosen based on loadings ≥ 0.5, minimal cross-loadings, and elimination of redundant behaviors. Figure 4 shows this 21-item PCA, which retained the original three-dimensional model (60.2% explained variance) and featured at least five high-loading items for each of the three dimensions.

Principal Component Analysis			
Legend			
	Trouble with Physical Reasoning	Social Reasoning	Temperament
Component Loadings	1	2	3
physically_stuck	0.843		
crash_intostuff	0.833		
act_clumsy	0.804		
run_to_cars	0.78		
dangerous_situations	0.744		
aware_surroundings	-0.738	0.401	
how_quick_learn	-0.662	0.547	
struggle_find_treats	0.661		
how_many_names		0.813	
learn_notraining		0.715	
understand_others	-0.331	0.714	
help_emergency		0.638	-0.333
adapt_new_situations	-0.323	0.623	-0.318
howoften_communicate		0.617	0.37
comfort_others		0.548	
howoften_deceive		0.526	
calm_meet_new		0.394	-0.691
bark_big_dogs			0.667
bark_attention			0.667
over_excited			0.663
howoften_distracted	0.405		0.612

Figure 4: Principal component loadings from a varimax rotation, parallel analysis. Numbered columns represent individual components. We only displayed loadings ≥ 0.3, to investigate only strong loadings and clarify emerging trends.

Discussion

Our aim in Study 2 was to transform candidate features of dog intelligence we had found in Study 1 into a set of items that formed a rating scale. Participants who evaluated smart and dumb dogs on these items agreed strongly in their judgments. As a set, these behaviors differentiated between people who evaluated a smart dog vs. a dumb dog. Most important, we found an organized structure in people's judgments of these specific features of dog intelligence, which reduced the larger item set to three major components: Physical Reasoning, Social Reasoning, and Temperament.

In our Principal Component Analyses across the entire dataset, we noticed different valences of items across components. Traits mentioned in Physical Reasoning often had negative valence, while Social Ability traits predominantly had positive valence and Temperament traits are equally split. Physical Reasoning traits were generally things dogs were bad at: being clumsy, crashing into objects. By contrast, Social Ability traits were usually example of things dogs were skilled at, such as navigation. The emotional valence of items in our Study 2 PCA supports our discovery that laypeople's perceptions align with canine research: specifically, that smart dogs succeed socially while dumb dogs are physically challenged. In this data, this emerges by smart social behaviors exhibiting a positive valence, and dumb social behaviors exhibiting a negative valence. For instance, six of the eight items in Physical Reasoning have negative connotations. Our three strongest items were getting physically stuck, crashing into things, and acting clumsy. By contrast, seven of eight factors for Social Reasoning had positive connotations. The three strongest items were the number of words or toy names a dog knew, skill at learning without training, and how well they understood humans.

We conducted two further exploratory Principal Component Analyses to investigate the smart and dumb conditions separately. Though the sample sizes were small, the results point to directions for future research. By itself, the smart dog condition yielded four components, whereas the dumb condition yielded three components, which is the same number of components as the analysis for the entire dataset. One hypothesis to explore in the future is that participants' conception of smart dogs may be more complex (with more distinguishing dimensions) than that of dumb dogs. The results could also reflect the fact that Study 2 encompassed more items that participants in Study 1 had associated with smart dogs. However, this larger number of smart behaviors discovered in Study 1 may itself reflect those participants' subtler and more nuanced representation of what a smart dog is like.

General Discussion

In this work, we aimed to discover the contents of laypeople's intuitions about dog intelligence and its possible parsimonious conceptual structure. Studies 1 and 2 demonstrated that laypeople have a consistent conceptual structure in which several behaviors and traits of dog intelligence cluster together in a small set of dimensions. Study 1 successfully elicited people's concepts of dog intelligence, represented by several dozen of behaviors and traits. In Study 2, we translated Study 1's themes into rated questions and identified Social Ability, Physical Reasoning, and Temperament as the three primary dimensions that organize people's evaluations of dogs as dumb or smart. Combining insights from both studies, we discovered people associate smart dogs with social skills and good temperament, and dumb dogs with poor physical reasoning and threat avoidance. Regarding physical reasoning, participants appeared to have bimodal impressions: smart dogs were exceptionally good while dumb dogs were exceptionally bad.

These findings align with dog trainers' emphasis on temperament's importance, and with prior research showing dogs' social skills and challenges in physical reasoning. The dimensions we discovered in Study 2 are similar but not identical to the behavioral categories we discovered in Study 1. In Study 2, we had expected to find social reasoning, physical reasoning, learning, and lack of threat detection to be major dimensions in our Principal Component Analysis, since this would be consistent with the behavioral categories from our freeform answers in Study 1. Our first PCA with 45 items revealed that items describing learning collapsed into our dimensions of physical reasoning and social ability, and items describing a lack of threat detection collapsed into our dimensions of physical reasoning and temperament. This trend was preserved in our 21 item PCA.

Experiments 1 and 2 highlight the alignment between laypeople's intuitions, the theories of canine science, and the practical knowledge of dog trainers. This alignment suggests that in several ways, laypeople's fundamental assumptions about dog intelligence track traits relevant to dog research and training. Studying laypeople's conceptual maps not only defines an idea, but investigates the accuracy of the assumptions shaping it, which have real-world impacts. This is essential because while people hold intuitions, these ideas might not always consistently align to clearly defined items.

Our finding that laypeople viewed temperament as a predictive dimension of dog intelligence will significantly influence our future explorations into people's perceptions. This discovery emphasizes the need to base our approach on uncovering and defining laypeople's intuitions. Without this approach, surveys created solely by us or based on pre-existing work may have overlooked temperament. The importance of temperament in shaping our perceptions of dog intelligence is intriguing because temperament does not necessarily tie into actual cognitive abilities. Although temperament is not actually reflective of intelligence, it might impact perceptions of intelligence. This trend parallels work in the human literature, which finds personality attributes like temperament to be an important part of how we judge others' intelligence (Borkenau & Liebler, 1993).

Research has indicated that, like dog temperament's indirect relation to dog intelligence, studies on our perceptions of human intelligence reveal the influence of unrelated subliminal factors, such as appearance and body language (Zebrowitz et al., 2002; Gergaud, 2016). Similarly, in our Study 1 free-response questions, we noticed that people's intuitions were affected by whether they perceived a dog's appearance as smart or dumb. However, in Study 2 we did not pose any questions about dog appearance, leaving open the question of its relationship to perceived intelligence.

Our study fills a niche in that it examines, perhaps for the first time, what laypeople think about dog intelligence. Previous studies focused on questions about dog intelligence, driven by researchers' assumptions about which dog behaviors were significant. In other fields, researcher have successfully identified lay concepts of various psychological phenomena, such as free will (Monroe & Malle 2009; Monroe & Malle 2014) or intentionality (Malle & Knobe, 1997). We took a similar approach and identified a working model of what people's lay concept of dog intelligence is composed of. The selected 21 items from Study 2 can now be used as a measurement instrument to explore people's attitudes and perceptions of their own dogs' intelligence or of different breeds' intelligence. Further down the line, we can use this instrument to explore if the connection between people's perceptions and their dog's actual performance across several cognitive tasks is accurate.

From our two studies, we have developed survey questions that can capture people's assumptions of dog intelligence. We plan to use these questions in future work exploring dog guardians' perceptions of their own pet's intelligence. This work also contributes to the broader understanding of how people conceptualize dog intelligence, select working dogs, and provides insight into how we understand our pets. Our findings illuminate how we make social judgements about nonhuman animals – especially animals with which we share a strong emotional connection.

Acknowledgments

We would like to thank David Sobel and Madeline Pelgrim for their helpful comments, and Anwyn Gatesy-Davis and Brooke Jordan for their help with survey administration. We would also like to thank our research assistants Claire Washington, Isabella Yoo, and Justin Lee for their help in this process. We are grateful to our participants for their responses.

References

Albuquerque, N., Guo, K., Wilkinson, A., Savalli, C., Otta, E., & Mills, D. (2016). Dogs recognize dog and human emotions. *Biology Letters*, *12*(1), 20150883. https://doi.org/10.1098/rsbl.2015.0883

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is Stronger than Good. *Review of General Psychology*, *5*(4), 323–370. https://doi.org/10.1037/1089-2680.5.4.323

Borkenau, P., & Liebler, A. (1993). Convergence of stranger ratings of personality and intelligence with self-ratings, partner ratings, and measured intelligence. *Journal of Personality and Social Psychology*, *65*(3), 546–553. https://doi.org/10.1037/0022-3514.65.3.546
Bräuer, J., Kaminski, J., Riedel, J., Call, J., & Tomasello, M. (2006). Making inferences about the location of hidden food: Social dog, causal ape. *Journal of Comparative Psychology*, *120*(1), 38–47. https://doi.org/10.1037/0735-7036.120.1.38
Bray, E. E., Otto, C. M., Udell, M. A. R., Hall, N. J., Johnston, A. M., & MacLean, E. L. (2021). Enhancing the Selection and Performance of Working Dogs. *Frontiers in Veterinary Science*, *8*. https://www.frontiersin.org/articles/10.3389/fvets.2021.644431
Cobb, M., Branson, N., McGreevy, P., Lill, A., & Bennett, P. (2015). The advent of canine performance science: Offering a sustainable future for working dogs. *Behavioural Processes*, *110*, 96–104. https://doi.org/10.1016/j.beproc.2014.10.012
Cook, A., Arter, J., & Jacobs, L. F. (2014). My owner, right or wrong: The effect of familiarity on the domestic dog's behavior in a food-choice task. *Animal Cognition*, *17*(2), 461–470. https://doi.org/10.1007/s10071-013-0677-0
Eddy, T. J., Gallup Jr., G. G., & Povinelli, D. J. (1993). Attribution of Cognitive States to Animals: Anthropomorphism in Comparative Perspective. *Journal of Social Issues*, *49*(1), 87–101. https://doi.org/10.1111/j.1540-4560.1993.tb00910.x
Gergaud, O., Ginsburgh, V. A., & Livat, F. (2016). *Looking Good and Looking Smart* (SSRN Scholarly Paper 2801871). https://papers.ssrn.com/abstract=2801871
Gunter, L. M., Barber, R. T., & Wynne, C. D. L. (2016). What's in a Name? Effect of Breed Perceptions & Labeling on Attractiveness, Adoptions & Length of Stay for Pit-Bull-Type Dogs. *PLOS ONE*, *11*(3), e0146857. https://doi.org/10.1371/journal.pone.0146857
Gwet, K. L. (2008). Computing inter-rater reliability and its variance in the presence of high agreement. *British Journal of Mathematical and Statistical Psychology*, *61*(1), 29–48. https://doi.org/10.1348/000711006X126600
Howell, T. J., Toukhsati, S., Conduit, R., & Bennett, P. (2013). The Perceptions of Dog Intelligence and Cognitive Skills (PoDIaCS) Survey. *Journal of Veterinary Behavior*, *8*(6), 418–424. https://doi.org/10.1016/j.jveb.2013.05.005
Lea, S. E. G., & Osthaus, B. (2018). In what sense are dogs special? Canine cognition in comparative context. *Learning & Behavior*, *46*(4), 335–363. https://doi.org/10.3758/s13420-018-0349-7
MacLean, E. L., Herrmann, E., Suchindran, S., & Hare, B. (2017). Individual differences in cooperative communicative skills are more similar between dogs and humans than chimpanzees. *Animal Behaviour*, *126*, 41–51. https://doi.org/10.1016/j.anbehav.2017.01.005
Malle, B. F., & Horowitz, L. M. (1995). The puzzle of negative self-views: An exploration using the schema concept. *Journal of Personality and Social Psychology*, *68*(3), 470–484. https://doi.org/10.1037/0022-3514.68.3.470
Malle, B. F., & Knobe, J. (1997). The Folk Concept of Intentionality. *Journal of Experimental Social Psychology*, *33*(2), 101–121. https://doi.org/10.1006/jesp.1996.1314
Maust-Mohl, M., Fraser, J., & Morrison, R. (2012). Wild Minds: What People Think about Animal Thinking. *Anthrozoös*, *25*(2), 133–147. https://doi.org/10.2752/175303712X13316289505224
Mele, A. R. (2015). *Surrounding Free Will: Philosophy, Psychology, Neuroscience*. Oxford University Press.
Monroe, A. E., & Malle, B. F. (2010). From Uncaused Will to Conscious Choice: The Need to Study, Not Speculate About People's Folk Concept of Free Will. *Review of Philosophy and Psychology*, *1*(2), 211–224. https://doi.org/10.1007/s13164-009-0010-7
Payne, E., Bennett, P. C., & McGreevy, P. D. (2015). Current perspectives on attachment and bonding in the dog–human dyad. *Psychology Research and Behavior Management*, *8*, 71–79. https://doi.org/10.2147/PRBM.S74972
Pelgrim, M. H., Espinosa, J., Tecwyn, E. C., Marton, S. M., Johnston, A., & Buchsbaum, D. (2021). What's the point? Domestic dogs' sensitivity to the accuracy of human informants. *Animal Cognition*, *24*(2), 281–297. https://doi.org/10.1007/s10071-021-01493-5
Riddoch, K. A., Hawkins, R. D., & Cross, E. S. (2022). Exploring behaviours perceived as important for human—Dog bonding and their translation to a robotic platform. *PLOS ONE*, *17*(9), e0274353. https://doi.org/10.1371/journal.pone.0274353
Sternberg, R. J. (2004). Culture and Intelligence. *American Psychologist*, *59*(5), 325–338. https://doi.org/10.1037/0003-066X.59.5.325
Zebrowitz, L. A., Hall, J. A., Murphy, N. A., & Rhodes, G. (2002). Looking Smart and Looking Good: Facial Cues to Intelligence and their Origins. *Personality and Social Psychology Bulletin*, *28*(2), 238–249. https://doi.org/10.1177/0146167202282009