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## Dogs aren't jealous – they are just asking for accurate information

Commentary on [Cook et al.](#) on *Dog Jealousy*

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**Abstract:** Awake fMRI offers us a unique opportunity to view and understand how dogs see the world and use the information in it. Given the limitations of behavioral assays and the small sample sizes inherent in these studies, labeling of patterns of canine behaviors using pop psychology terms may actually interfere with our understanding of canine brains and obscure for us a more parsimonious but exciting interpretation of canine behavior. We should use this window into how dogs think wisely.

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The target article by Cook et al. (2018) adds to the growing compendium of information about regional brain activity for a group of pet dogs taught to cooperate with and participate in imaging using awake fMRI. This body of work (Berns et al., 2012, 2013, 2017; Cook et al., 2014, 2016 a-c) has suggested that dogs perform similarly to humans with respect to stimulus-dependent activity in the amygdala and caudate nuclei. These findings are not unexpected given the convergent patterns of evolution of candidate genes associated with neurotransmitter function shared by dogs and humans (Saetre et al., 2004; Li et al., 2013).

Because of the detailed methodology used to validate this type of imaging, and the conditions under which measurements are made, there is no doubt that there is variation in regional signals and scan parameters within this small population of trained dogs (here, 13 dogs are studied). The interpretation of the attendant variation in behavior is, unfortunately, not assessed with a similarly rigorous methodology. This is no fault of the authors but is instead a reflection of the state of the field of assessment in veterinary behavior and behavioral medicine — and it warrants discussion.

**Phenotyping behavior.** The behavioral assay used here is the C-BARQ, a questionnaire that asks owners to rate their dogs' behaviors in a variety of situations. There are two concerns here. The first is that the C-BARQ is invariably represented as a validated tool. However, the study that is

always cited as having validated it (Hsu and Serpell, 2003) used two sets of clinical populations for which published, detailed, semi-quantitative, questionnaires (Overall, 1997) were used in conjunction with clinical behavioral evaluations. As such, the version of C-BARQ published as part of this study represented a dramatic change in content from its earlier version (Serpell and Hsu, 2001). So what may have occurred during this process is that the questionnaires used to assess the patients were actually validated for a clinical population. This matters because clinical populations are not opportunistic samples, as is the case for most studies published using C-BARQ.

Clinical populations have greatly diminished population variation compared with the range of dogs without behavioral concerns and are comprised of dogs whose owners already believe that their dog needs specialist help. As such, the owners are not evaluating the dogs wholly by themselves but are providing semi-quantitative, objective information, targeted by the clinicians, which correlates with known patterns of behavioral associations within behavioral diagnoses (Overall, 2001, 2005). As part of the process of making such diagnoses, owners' answers to questionnaires are themselves assessed for accuracy to ensure that what the clinician intended by a word or phrase is understood and evaluated within that content. Such etymological care is necessary because words used to talk about behaviors are all in the popular domain and unprotected by scientific terminology. It is for this reason that behavioral medicine specialists use such questionnaires in the context of an in-person behavioral evaluation of the patient, targeted video and, sometimes, provocative tests. Only in this multi-tiered information context can diagnostic criteria be consistently and accurately applied. As part of the process, questionnaire information may change or be considered not relevant, as objective and quantitative information from the behavioral evaluation emerges. When more subjective, owner-completed questionnaires are used, there are no such standards or tests for accuracy. Simply, the population for which the C-BARQ claims validation differs and is held to a different standard with respect to validity.

The second concern is the accuracy of owner-based descriptions and assessments. The extent to which owners are willing to report behavioral traits that they think are perceived as unfavourable depends on the confidentiality of the survey (Segurson et al., 2005). Subjects may not all be dealt with equitably. There are also data showing that owners may recognize or understand only the easiest to detect signs of any fear- or anxiety-related condition and so underestimate the presence of the condition if their dogs show different signs (Mariti et al., 2012). The extent to which owners recognize anything other than overtly happy behaviour depends on their professional training with dog behaviour, their personal experience with dogs, and which body part(s) they are observing (Wan et al., 2012). Even after being given training to recognize behavioural signs of concern or aggression in dogs, when quizzed using specific risk photo scenarios, owners consistently under-estimate risk to children, and err in the interpretation of canine behaviors (Arhant et al., 2016). When asked to view the scenarios as reflections of their own dogs, owners further discount behavioural signs.

Even in studies where clients have received information defining specific behavioural patterns, some behavioral signs used by researchers are simply less apparent than others if constant monitoring of the dog does not occur. If dogs are not exposed to certain provocative stimuli, or not observed to react in any given context, false negatives can be reported, a sequela that can be minimized by behavioural testing and rigorous, objective quantitative or semi-quantitative questionnaires (Overall et al., 2006; Tiira and Lohi, 2014; Overall et al., 2016; Bellamy

et al., 2018). Furthermore, dogs may change with age, exposure, and level and type of provocative stimulus, all of which may have affected how the owner evaluated the dog the day any survey was completed.

I go into this depth with respect to concerns about the use of a questionnaire as a solitary behavioural measure because behaviour is more complex than this, and the assessment of scores as a measure of “dog-dog” or “dog-human” aggression may be optimistic. Barking and growling are not isomorphic with “aggression.” “Aggression” can be normal or pathological, and determining this involves more than vocal signals. Barking, growling, et cetera can be viewed as provocative signals designed to gain information about potential interactions. As such they may tell us more about awareness, vigilance and tendencies to react, regardless of outcome. This sounds like a minor distinction, but labelling a dog “aggressive” or an interaction as “aggression” is not a trivial matter.

**How do dogs inform others that they are aroused?** Given the distribution of scores reported by Cook et al. (2018), the dogs with the greatest extremes in average amygdala activation had the lowest behavioral scores. Only 6/13 dogs had a score of greater than 1, but less than 2, suggesting – at most – a mild behavioural response. Finally, in the best-case scenario, the C-BARQ scores accounted for only 22% – one fifth – of the variance in a small population.

So, are we actually studying an “aggressive” response, or any kind of aggression, let alone “dog-dog aggression” or “human resource guarding”? Here again, the pop culture labelling appears to have gotten ahead of the science — something the authors acknowledge in their discussion.

The data for increased differential arousal are actually quite compelling. Consider that dogs are not all the same with respect to their arousal levels (e.g., the level to which they will react) or reactivity profile (e.g., the number of situations over which they react and number of behaviors they use as part of their reaction) (Overall, 2013). Some dogs will need more information than others to form a response in an uncertain circumstance. Rather than postulate covert arousal, the authors may wish to consider the role played by signals involved in putative “aggressive” responses. The point of signalling behaviour is to make clear something that was previously unknown or hidden (Smith, 1981). When the signal is not clear or understood, the receiver (here, the dogs in the scanner) may send reciprocal signals back to the original sender (the fake dog) and may further act to seek information and clarity (Smith, 1981). Under such circumstances, dogs who are more easily aroused or more reactive may exhibit provocative behaviors or experience provocative arousal in the absence of more overt behaviors, especially if the arousal is mild and they have been taught to behave in a specific manner within the given context (e.g., the scanner). This profile is consistent with the Cook et al. results.

As the authors clearly note, none of these dogs was overtly aggressive, none of them had given the owners cause to complain of any aggression, and all had been readily trained as part of a group to cooperate with all aspects of the imaging process for these awake fMRIs, a scenario that would probably have provoked dogs who had a propensity to react with aggression for any reason. Furthermore – and this is important – the authors “found significant habituation of the amygdala response across experimental sessions — but only in the aggressive dogs: the ones who had amygdala activation in the first place. Notably, this activation was maximal in the first run but effectively nonexistent in the second and third runs. Whether the decrease in amygdala response

is due to habituation or desensitization is difficult to determine, but a decreased physiological response following repeated exposure is consistent with the classical definition of habituation” (page 9, Cook et al., 2018). This pattern of behavior is again consistent with provoking, obtaining and using information about whether one should react. Clearly, these dogs gained sufficient data across exposures to provide them with the information that further arousal was not warranted.

**Fabulous fakes are still ... fake.** Although the fake dog had been “flavored” with canine odorants, dogs quickly read and integrate many more subtle signals over a variety of signaling modalities to gain information. Dogs can distinguish between odorants from various body regions and can discriminate scent pictures (Kalmus, 1955); they respond with incredibly different amplitudes and directions of tail wags depending on the social stimulus (Quaranta et al., 2007), and they are able to signal attention to human facial signaling with one set of muscles controlling their brow region (Kaminski et al., 2017). Exposure would be sufficient to tell test subjects that these signaling domains lacked congruence and that this “dog” was not a dog.

The problem with using models to represent a real, but potentially risky experience is at the core of evaluations to test whether dogs will react adversely to food being taken, or to a child. Data collected both in shelter environments (where food is taken with a fake plastic hand on a stick) and home environments (where humans interact with dogs and food) have shown that the test with the fake hand produces large numbers of false positives for a “problem” that people who adopt the dogs do not perceive as a concern and that generally does not require further intervention in a home environment (Mohan-Gibbons, 2012; Marder et al., 2013).

A similar concern has been raised for the use of dolls to test aggression toward children. In a test situation, a doll or a fake dog elicited more social behaviors than did an ambiguous object, but it lacked sufficient validity to use in a predictive assessment for any dogs tested when the groups (control, aggressive to dogs, aggressive to children) were compared (Barnard et al., 2012). Significant associations were found for barks, growls and snaps, signals used to elicit further information about whether frank aggression is warranted.

These studies tell us is that dogs recognize models as “other”, i.e., not a real hand, not a real dog, not a real child. The Cook et al. data support this contention.

**The importance of labels.** Behavior is dynamic. It’s the visceral representation of the integration of all the body’s organ system responses to the immediate environment, within the boundary conditions set by underlying genetic constraints and previous learning at the molecular level. This means that behavior is difficult to define and measure in ways that are unambiguous. When such concerns are raised, we should be mindful of attribution and should understand that how we label something may affect how we think about it — in which case, we should be careful, indeed. The biggest risk is that we will think by that the application of a label, that we understand something ... and we do not (Feymann, 1973).

We know that dogs recognize resource inequity, and having something or not having something (Range et al., 2009), so need we label this as anything else? Jealousy is a concept in human psychology that varies in how it is defined, and it is difficult to test. By using psychometric testing to evaluate dependency, self-esteem, insecurity and trust, Rydell and Bringle (2007) found that jealousy grouped into reactive and suspicious morphs, where insecurity and suspicious jealousy co-occurred, but dependency did not. The pattern was reversed for reactive jealousy.

Reactive jealousy was more often associated with external events, whereas suspicious jealousy was under endogenous control and associated with anxiety. The definitional and evaluative criteria used in this and related studies are not met here, so a borrowed characterization of “jealousy” is premature.

Dogs may not be “guarding” their humans as a “social resource” through any use of aggressive signals when their humans interact with another dog; they may be asking for clarification of the behavioral patterns, using signals that occur in agonistic events but that need not by themselves entail true hostility or “aggression.” It’s far more likely that such events are an essential part of defining, establishing, solidifying and maintaining social relationships for a species that have a co-evolutionary history with humans but that differ in the repertoire of verbal and non-verbal signals.

The role of opposable thumbs (which dogs lack) is essential to understanding differences in how dogs signal. When dogs ask questions of and gain information from other dogs in active interactions, tactile exchanges are frequent and complex, often involving mouthing (Normal et al., 2015; Cordoni et al., 2016), an activity that humans both misunderstand and actively discourage in interactions with dogs. Detailed evaluation of dogs approaching known vs. unknown dogs in a controlled test situation reveals a discrepancy in behavioral patterns (Mariti et al., 2017). The incidence and frequency of various behaviors differ depending on whether the interaction was close or at a distance, whether the recipient of the signals was known or unknown, and what signal preceded the response. The most common response to any aggressive signal from an unknown dog was to freeze — again, a finding consistent with the Cook et al. data.

There are other explanations for this study’s outcomes that do not involve evoking aggression or guarding behavior. The handler, who was instructed to look at the dog in the scanner only when feeding that dog, either put food into a hidden pouch attached to the fake dog’s mouth or placed it into a bucket. Kaminski et al. (2017) have demonstrated that in such circumstances — the absence of attentiveness from humans — dogs view food as a non-social but arousing signal. Yet the handler knew whether they were putting food in the bucket or into the fake dog’s pouch and so could have exhibited subtle intention cues that animals with experience with humans learn and use to shape responses (Proops et al., 2010, 2013), again providing information that may have caused differential attention across the study dogs. Both outcomes pertain to the Cook et al. data.

We should also consider that pet dogs witness food of all types being put in various containers as part of daily life. At a minimum, this activity signals to them that the food is unavailable to them. Here, the fake dog could not exhibit any behavior, including appetitive behavior. Such a contextually discordant situation would logically provoke information-seeking behavior in dogs who were monitoring the reactions of others more; this may be what has been described here. One would then hypothesize that with exposure and no further interaction on the part of the fake dog, these dogs would attenuate their response once they received no input from either the fake dog or the handler because there was no value of salience to them in future interaction. This is exactly what happened here in an outcome consistent with the Cook et al. results.

So there are potentially many things going on here; there is need to invoke “jealous” behavior and “human resource guarding.”

**Scary outcomes: Will dogs die?** My final concern is about things that scare me. The possibility that this study will be used to justify assertions that dogs exhibit “jealous” behavior and “human resource guarding” is worrisome.

As someone who does research as well as sees patients as a specialist in veterinary behavioural medicine, I see the damage that such labels can do and how virulent simplified concepts from papers with sexy titles can be for my patients. The dog-owning public still has not recovered from the popular myth that they must “dominate” their dogs, despite a large number of publications showing that normal dogs don’t spend their days challenging people or other dogs for status. There are compelling data showing that the misapplication of such concepts has resulted in abusive and damaging treatment to pet dogs (reviewed in Ziv, 2017), and that the risk of euthanasia is higher for dogs for whom such techniques were recommended by “behaviourists” who were not veterinary specialists (Siracusa et al., 2017).

As Cook et al. note, there is always a concern about anthropomorphism. However, the concern quickly rises to the level of anthropocentrism when dealing with sexy labels — especially if they fit with extant bias. When this happens, everything that the dog is, is lost in translation.

Anthropomorphism may demean the inherent nature of “self” for other species, but it can make humans more compassionate. Anthropocentrism prohibits us from realizing the extent to which another species lives within its own context. As result, we are far more interested in how dogs and other species may resemble us than we are in understanding how they perceive and act on various behaviors and emotions while they live in a world where they must accommodate human mistakes in translation.

The cost of such mistakes is high. My fear is that when the popular press grabs hold of the concepts of “jealousy” and “resource guarding of humans,” without any understanding of whether such concepts are ones that dogs would choose and use themselves, owners will view canine comments as a signs of “jealousy” and will punish normal dogs; or they will blithely dismiss pathological dogs as merely “jealous” or “resource guarding their human,” and so fail to seek timely, humane treatment that will make their and their dog’s lives better and safer.

These fears are not unfounded. “Resource guarding” has become the training community’s default catchphrase for many behaviors involving dog-dog and dog-human interactions, stunningly demonstrating how by using a label, we obscure what we could know. It now takes a 10-to-15-minute disquisition during consultations to disentangle this phrase from what the dog is actually doing that concerns the clients. This is not progress.

**Dogs tell us what they value.** Aggression and the signals that go with it can be a normal behavior in dogs. Some dogs do not like some dogs. Some dogs don’t like or trust some people. These can be normal behaviors about which dogs should be allowed to signal honestly. In the absence of labels that obscure our ability to understand what such behaviors mean to the dog, we can learn their value from the dog’s perspective.

And it is here that the excitement in the Cook et al. study is found. What is fascinating in this study and should not be lost in any of my complaints about labels, process, and sexy taglines, is what this differential response tells us about how dogs get and use information. Dogs ask questions and work for accurate information.

The types of imaging studies pursued by Berns and colleagues, especially when coupled with the imaging studies of behavioral pathologies (Peremans et al., 2003, 2005, 2006; Vermeire

et al., 2011, 2012) and interventional studies that show how dogs with specific suites of behaviors respond to psychopharmacological interventions (Overall, 1994, 2001; King et al., 2000; Simpson et al., 2007; Korpivaara et al., 2017; Taylor et al., 2017), can be our window into dogs in translation, as translated by native speakers. For this to happen, we need to let the dogs speak without anthropomorphism or anthropocentrism — and we need to listen without labels.

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**The Other Minds  
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**Overview.** Since Descartes, philosophers know there is no way to know for sure what — or whether — others feel (not even if they tell you). Science, however, is not about certainty but about probability and evidence. The 7.5 billion individual members of the human species can tell us what they are feeling. But there are 9 million other species on the planet (20 quintillion individuals), from elephants to jellyfish, with which humans share biological and cognitive ancestry, but not one other species can speak: Which of them can feel — and what do they feel? Their human spokespersons — the comparative psychologists, ethologists, evolutionists, and cognitive neurobiologists who are the world's leading experts in "mind-reading" other species — will provide a sweeping panorama of what it feels like to be an elephant, ape, whale, cow, pig, dog, chicken, bat, fish, lizard, lobster, snail: This growing body of facts about nonhuman sentience has profound implications not only for our understanding of human cognition, but for our treatment of other sentient species.

**Gregory Berns:** [Decoding the Dog's Mind with Awake Neuroimaging](#)

**Gordon Burghardt:** [Probing the Umwelt of Reptiles](#)

**Jon Sakata:** [Audience Effects on Communication Signals](#)

**PANEL 1: Reptiles, Birds and Mammals**

**WORKSHOP 1: Kristin Andrews:** [The "Other" Problems: Mind, Behavior, and Agency](#)

**Sarah Brosnan:** [How Do Primates Feel About Their Social Partners?](#)

**Alexander Ophir:** [The Cognitive Ecology of Monogamy](#)

**Michael Hendricks:** [Integrating Action and Perception in a Small Nervous System](#)

**PANEL 2: Primates, Voles and Worms**

**WORKSHOP 2: Jonathan Birch:** [Animal Sentience and the Precautionary Principle](#)

**Malcolm MacIver:** [How Sentience Changed After Fish Invaded Land 385 Million Years Ago](#)

**Sarah Woolley:** [Neural Mechanisms of Preference in Female Songbird](#)

**Simon Reader:** [Animal Social Learning: Implications for Understanding Others](#)

**PANEL 3: Sea to Land to Air**

**WORKSHOP 3: Steven M. Wise:** [Nonhuman Personhood](#)

**Tomoko Ohyama:** [Action Selection in a Small Brain \(Drosophila Maggot\)](#)

**Mike Ryan:** ["Crazy Love": Nonlinearity and Irrationality in Mate Choice](#)

**Louis Lefebvre:** [Animal Innovation: From Ecology to Neurotransmitters](#)

**PANEL 4: Maggots, Frogs and Birds: Flexibility Evolving**

**SPECIAL EVENT: Mario Cyr:** [Polar Bears](#)

**Colin Chapman:** [Why Do We Want to Think People Are Different?](#)

**Vladimir Pradosudov:** [Chickadee Spatial Cognition](#)

**Jonathan Balcombe:** [The Sentient World of Fishes](#)

**PANEL 5: Similarities and Differences**

**WORKSHOP 5 (part 1): Gary Comstock:** [A Cow's Concept of Her Future](#)

**WORKSHOP 5 (part 2): Jean-Jacques Kona-Boun:** [Physical and Mental Risks to Cattle and Horses in Rodeos](#)

**Joshua Plotnik:** [Thoughtful Trunks: Application of Elephant Cognition for Elephant Conservation](#)

**Lori Marino:** [Who Are Dolphins?](#)

**Larry Young:** [The Neurobiology of Social Bonding, Empathy and Social Loss in Monogamous Voles](#)

**Panel 6: Mammals All, Great and Small**

**WORKSHOP 6: Lori Marino:** [The Inconvenient Truth About Thinking Chickens](#)

**Andrew Adamatzky:** [Slime Mould: Cognition Through Computation](#)

**Frantisek Baluska & Stefano Mancuso:** [What a Plant Knows and Perceives](#)

**Arthur Reber:** [A Novel Theory of the Origin of Mind: Conversations With a Caterpillar and a Bacterium](#)

**PANEL 7: Microbes, Molds and Plants**

**WORKSHOP 7: Suzanne Held & Michael Mendl:** [Pig Cognition and Why It Matters](#)

**James Simmons:** [What Is It Like To Be A Bat?](#)

**Debbie Kelly:** [Spatial Cognition in Food-Storing](#)

**Steve Phelps:** [Social Cognition Across Species](#)

**PANEL 8: Social Space**

**WORKSHOP 8:** [To be announced](#)

**Lars Chittka:** [The Mind of the Bee](#)

**Reuven Dukas:** [Insect Emotions: Mechanisms and Evolutionary Biology](#)

**Adam Shriver:** [Do Human Lesion Studies Tell Us the Cortex is Required for Pain Experiences?](#)

**PANEL 9: The Invertebrate Mind**

**WORKSHOP 9: Delcianna Winders:** [Nonhuman Animals in Sport and Entertainment](#)

**Carel ten Cate:** [Avian Capacity for Categorization and Abstraction](#)

**Jennifer Mather:** [Do Squid Have a Sense of Self?](#)

**Steve Chang:** [Neurobiology of Monkeys Thinking About Other Monkeys](#)

**PANEL 10: Others in Mind**

**WORKSHOP 10:** [The Legal Status of Sentient Nonhuman Species](#)