What is it like to be a jealous dog?

Commentary on **Cook et al.** on *Dog Jealousy*

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Abstract: Jealousy is a good candidate for comparative studies due to its clear adaptive value in protecting social bonds and affective relationships. Dogs are suitable subjects for investigating the evolution of jealousy, thanks to their rather sophisticated socio-cognitive abilities — which in some cases parallel those reported for human infants — and thanks to their long-lasting relationship with humans. The work of Cook and colleagues (2018) addresses the issue of jealousy in dogs through the lens of neuroscience, examining the relationship between the amygdala and jealousy. Their experiment has a number of methodological flaws that prevent distinguishing jealousy from other internal states; it also lacks behavioral indicators that could help in this endeavor. Nevertheless, it is an admirable step towards a multidisciplinary approach to the investigation of non-basic emotions in nonhuman species.

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La jalousie est un mélange d'amour, de haine, d'avarice et de l'orgueil.
(Alphonse Karr, 1839)

The growing body of research aimed at understanding emotions in non-human animals has a double relevance: improving the knowledge of the evolutionary path towards the complex emotional life of humans and gaining insight into animals' affective lives in order to guarantee their welfare and fulfill their needs in their relationships with humans.

There is a general agreement that, because of their fundamental adaptive value, "basic" emotions such as fear and anger can be found in many vertebrate species. In contrast, evidence on the existence of ''non-basic'' or complex emotions such as jealousy, envy and guilt in non-human animals is still limited and provides mixed results (Horowitz, 2009; Steiner & Redish, 2014; de Waal & Preston, 2017; Kujala, 2017). Many researchers still assume that these emotions require elaborate cognitive abilities and emerge relatively late in human development; it is also believed that they imply self and interpersonal awareness, which is generally considered a unique human characteristic.

This perspective is changing, thanks to the contribution of human developmental studies and cross-species comparisons suggesting that some non-basic emotions play a fundamental role in regulating social life in animal species other than human (Draghi-Lorenz et al., 2001). This is the case for jealousy, which is considered a complex social emotion that involves an array of negative basic emotions (e.g., fear, anger, sadness). It arises in specific social contexts (e.g., sibling-parent, sexual, friendship) when one individual believes or perceives that a rival is threatening an affectionate relationship that is a source of material and psychological benefits (Hart, 2010; Dillon, 2013). In humans, this unpleasant emotion is generally accompanied by overt behaviors directed at restoring the relationship with a significant social partner as well as removing the social threat represented by the interloper. Jealousy could have evolved as a strategy for protecting material and affective resources within the parent-offspring relationship and could be the most "basic" among complex social emotions. Indeed, experimental evidence indicates that cognitively immature children exhibit protest behaviors, negative vocalizations and proximity seeking when they lose maternal attention in favour of a potential rival (Hart et al., 2004). Autistic children also show jealous tendencies (Bauminger, 2010), although they exhibit deficiencies in expressions of pity, concern, guilt, and pride (Hobson, 2010). Panksepp (2010) theorized that jealousy does not necessarily arise from cortical processes that mediate social cognition, and Massar and colleagues (2009) showed that it could occur outside conscious awareness.

Studies on jealousy in non-human species are lacking; there are only a couple of behavioural studies on dogs (*Canis familiaris*), with contrasting results: Harris and Prouvost (2014) reported that dogs exhibited a pattern of behavior that appeared indicative of jealousy (e.g., aggressive behavior, pushing/touching the object/owner) when their owner manipulated a stuffed dog, but not other nonsocial objects (i.e., a jack-o-lantern and a book). Conversely, a study by our group (Prato-Previde et al., 2018) found no clear evidence that dogs considered a fake dog as a real social rival and reported no differentiated response in dogs when the owner (i.e., their attachment figure) and an unfamiliar person manipulated the faux dog compared to other nonsocial objects (i.e., a puppet and a book).

These pioneering works do not exclude the possibility that dogs exhibit a primordial form of jealousy, but they highlight the need for additional rigorous research. Hence the work of Cook and colleagues (2018) is really welcome, as it addresses the issue of jealousy in dogs from another perspective: functional brain imaging should help trace the roots of jealousy, by looking at the ancestral regions of the brain.

As already outlined in previous commentaries, however, this study presents a number of methodological limits (the lack of a control group, the choice of the fake dog, the choice of a food-based context rather than a merely affective one) that could be more or less easily corrected in future studies. We agree with other authors that Cook and colleagues overestimate their results in many respects: their dogs were not aggressive, according to the low values of CBARQ, and only 6 out 13 of them showed a positive differential amygdala

activation (i.e., greater activation to the fake dog than to the bucket). Finally, in our opinion, there is too much emphasis on the aggressive component of the jealousy response: jealousy is a blended emotion made up of at least fear, anger, and sadness, apart from aggression; it can be expressed at a behavioral level through attention seeking, proximity, sustained visual attention and even avoidance.

Notwithstanding these limits, the present study represents a starting point for adjusting experimental protocols and producing new ideas to investigate a topic that is challenging because animals cannot give us verbal reports on their subjective experience.

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WORKSHOP 8: *To be announced*
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