

ARE HUMANS THE ONLY RATIONAL ANIMALS?

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While growing empirical evidence suggests a continuity between human and non-human psychology, many philosophers still think that only humans can act and form beliefs rationally. In this paper, we challenge this claim. We first clarify the notion of rationality. We then focus on the rationality of beliefs and argue that, in the relevant sense, humans are not the only rational animals. We do so by first distinguishing between unreflective and reflective responsiveness to epistemic reasons in belief formation and revision. We argue that unreflective responsiveness is clearly within the reach of many animals. We then defend that a key demonstration of reflective responsiveness would be the ability to respond to undermining defeaters. We end by presenting some empirical evidence that suggests that some animal species are capable of processing these defeaters, which would entail that even by the strictest standards, humans are not the only rational animals.

Keywords: rationality, non-human animals, belief revision, responsiveness to reasons, defeaters, epistemology, comparative psychology.

I. INTRODUCTION

In line with the Scholastic slogan ‘man is the rational animal’, many philosophers are committed to the view that rationality sets humans apart from other animals. Historical figures who have subscribed to such view include Aristotle, Thomas Aquinas, Descartes, and Kant. With the advent of naturalism in the 20th century, the contemporary picture is more nuanced, but the view that rationality is an exclusive prerogative of human beings, or that the notion of rationality that applies to humans is inherently different from the one that applies to non-human animals (hereafter ‘animals’) is still dominant in philosophy. Contemporary thinkers who have endorsed the separation of humans and animals in matters of rationality include Sellars (1956), Davidson (1975, 1982), Dummett (1993), Brandom (1994), McDowell (1994), Korsgaard (2009, 2018), Boyle (2018), and many others.

Yet, comparative psychologists and other empirical researchers often show little hesitation in describing animal behaviour as rational

(e.g. Bautista *et al.* 2001; Buttelmann *et al.* 2007; Dawkins 1986; Jensen *et al.* 2007; Kacelnik 2006; O'Madagain *et al.* 2022; Penn and Povinelli 2007; Tomasello 2022). There is thus a tension between the conception of rationality typically endorsed by philosophers and that employed by empirical scientists. We believe that part of this tension can be alleviated by engaging in some conceptual clarification. Offering such clarification is the first goal of this article. In the first part (Section II), we will thus illustrate some notions of rationality and clarify which is the relevant one to engage with the philosophers' contention that humans are the only rational animals. As we will see from this analysis, the notions of rationality operating in philosophy and comparative psychology are markedly different, such that it makes sense for very different views on whether animals are rational to emerge.

We want to argue, however, that even though rationality in the senses most used by empirical scientists 'comes cheap', philosophers are wrong to suggest that animals cannot be rational in the relevant philosophical sense. In the second part (Sections III–V), we will advance some considerations in support of the view that, *in the relevant sense*, humans are *not* the only rational animals. We will do so by, first, spelling out what philosophers understand as a rational belief-formation process (Section III). This will allow us to identify two relevant notions of responsiveness to epistemic reasons: unreflective responsiveness and reflective responsiveness. We will argue that unreflective responsiveness is clearly within the reach of many animals. In Section IV, we will defend that a key demonstration of reflective responsiveness to reasons would be the ability to respond to undermining defeaters. In Section V, we will present some empirical evidence that suggests that some animal species are capable of processing these defeaters, which would entail that even by the strictest standards, humans are not the only rational animals. In the final section before concluding, we will consider two possible objections and how they can be tackled.

II. VARIETIES OF RATIONALITY

To say that a belief, action, choice, or behaviour is rational is to say that it meets some normative standard—that it can be evaluated for its conformity to a norm. All notions of rationality have this much in common. Disagreements begin to emerge when specifying the relevant standard. Let's begin by explaining why some standards of rationality that have been ascribed to animals are *not* the target notion for engaging with the philosophers' claim.

A notion of rationality sometimes ascribed to animals is the one that Kacelnik (2006) calls *economic rationality*. According to economic rationality, patterns of behaviour that maximise some expected utility are rational. Simplifying, behaviour exhibiting the most effective way to fulfil a goal among various

possible alternatives counts as rational. Examples from the animal realm that have been discussed in the literature include the foraging behaviour of species such as starlings. Starlings walk or fly to obtain food in a way that maximises net energy gain: Roughly, they walk when the food is very close, and they fly otherwise (Bautista *et al.* 2001). A similar notion of rationality is employed by Jensen *et al.* (2007) when they claim that chimpanzees are ‘rational maximisers’ in playing an ultimatum game. Within this game, subjects can decide whether to reject a proposed division of rewards if they deem it unfair. Chimpanzees appear not to be sensitive to considerations of fairness in this context and instead behave in a way that is consistent with economic rationality, accepting any reward that is offered to them.

Economic rationality is a purely instrumentalist notion: All that it requires is the acquisition and processing of some information taken as input, and the production of an efficient action or behaviour as output, given a specific goal. With such a broad characterisation, even the policies of institutions or the functioning of a digestive system may be evaluated for their rationality. Economic rationality also risks trivialising the claim that a subject is rational. Since it is a purely instrumentalist notion, it applies to patterns of behaviour regardless of the agent-independent evaluation that they deserve. Economic rationality, for instance, entails that the behaviour of an addict is rational if it maximises the intake of the relevant addictive substance. Economic rationality thus needs to be supplemented by a theory of what utilities deserve to be maximised.

One might think that economic rationality may be constrained by considering as rational only behaviour that maximises expected utility in the service of the goal of enhancing biological fitness. This leads to so-called *biological rationality*, according to which behaviours that are adaptive or conducive to survival are rational (Dawkins 1986; Kacelnik 2006: Section 2.4). This is another notion of rationality often ascribed to animals. It is also a notion that entails economic rationality, so that the foraging behaviour of the starlings and the decisions of the chimpanzees in the ultimatum game would count as biologically rational too. This characterisation does not allow for any perverse behaviour to be in principle rational, but it is still too broad. Under this characterisation, not just all animals but all living beings that have proven to be evolutionarily successful, including plants, would count as rational. A notion that allows that even plants can be rational is not a notion that can be reasonably used to distinguish humans from animals: Under this characterisation, the claim that humans are to be distinguished from other animals because they alone have rational capacities would turn out to be trivially false. Biological rationality is a perfectly respectable notion for some theoretical purposes, but it is not our target notion.

Another conception of rationality that is sometimes ascribed to animals emerges from Dennett’s (1971) intentional stance. Simplifying, Dennett argued

that any behaviour that, at some level, can be helpfully described in terms of beliefs and desires is intentional behaviour, and thus can be assessed for its rationality. In this picture, even thermostats may count as rational agents, for they can be described as having a belief corresponding to the current room temperature and a desire to keep it within certain limits, and they 'act' accordingly. In effect, Dennett offers another instrumentalist characterisation of rationality, which falls prey to the same problems that afflict economic and biological rationality.

What these three notions of rationality have in common is that they can apply to behaviour that, *at the level of individual agency*, can be fully accounted for in non-mentalistic terms. By contrast, when philosophers maintain that only humans' beliefs and actions are apt for assessments of rationality, they typically have in mind the upshots of one's agency. Paradigmatic examples of rationality in this sense are judgements reached after deliberation, as when Sherlock Holmes judges that the butler is guilty after a careful assessment of the available evidence. To engage with the philosophers' claim, we need a notion of rationality that pertains primarily or exclusively to the personal level of one's mental life. Here it is helpful to recall the distinction between the personal, sub-personal, and supra-personal levels of explanation.

Catching a ball is an act that occurs at the *personal* level because, to explain *why* one catches a ball, we need to appeal to the agent's perceptions or beliefs about the location of the ball, and to her desire to catch the ball. By contrast, the various bodily adjustments needed to catch the ball occur at the *sub-personal* level: They can be fully accounted for in physiological or mechanistic terms that make no reference to the subjects' psychological states. All of those movements, *taken together*, are explained by the agent's psychological states. However, each movement, *taken individually*, is not explained by appealing to the psychological notions of desiring to catch the ball and having beliefs about the location of the ball, but rather by the physiological stimulations occurring in muscle tissue, bones, neurons, etc. The same sort of bodily adjustments would occur if, say, the agent wanted to catch something else or just pretended to catch something. Hence, the content of one's specific mental states plays no role in the explanation of any of the bodily movements taken individually. By contrast, to explain why the person is moving in that specific way at that specific time, we need to appeal to the content of one's psychological states.

The same event admits of *supra-personal*-level explanations too. For example, we could say that the person caught the ball because natural selection endowed her with the capacity to move in the required way. In general, anything that happens at the personal level admits of some sub-personal and some supra-personal explanations too, but neither of those would engage with what subjects choose to do from their perspective in those specific times

and circumstances.¹ This is the dimension where one's actions and beliefs are guided by one's mental representations, and it is the one that matters for us. In the following section, we begin to tackle this dimension by outlining the sense of rationality that philosophers consider key in defending human uniqueness with respect to rationality, namely the rationality involved in processes of belief formation and revision.

III. RATIONAL BELIEFS AND UNREFLECTIVE RESPONSIVENESS TO EVIDENCE

Contemporary defences of personal-level rationality in animals have tended to focus on the question of whether animals can *act* for reasons (see e.g. Dretske, 2006; Glock 2019; Hurley 2003, 2006) rather than on the rationality of animal belief. This may have been due in part to a perceived historical difficulty in allowing that animals possess concepts and entertain propositional attitudes like beliefs, without which they wouldn't even qualify as epistemic subjects. Accounting for the rationality of action may thus have been seen as a natural starting point for theories of animal rationality.² Whether or not the rationality of action can be disentangled from the rationality of belief, there is now quite substantial evidence of conceptual thought in animals.³ Thus, the time is ripe for a discussion of the rationality of animal belief.

The obvious candidate to account for the rationality of personal-level belief formation and revision is provided by evidentialist frameworks of epistemic justification (e.g. Conee and Feldman 2004; Williamson 2000). Roughly,

¹ The distinction between proximate and ultimate mechanisms in the empirical literature partly tracks the distinction between personal, sub-personal, and supra-personal explanations. Proximate mechanisms give a causal, mechanistic explanation of behaviour. Ultimate mechanisms give an explanation in terms of its evolutionary role. However, proximate mechanisms encompass causes at the personal and sub-personal level, and these are often not sufficiently distinguished (for instance, in the literature on grief in primates, explanations in terms of hormones are mixed with explanations in terms of emotions or cognition; see e.g. Watson and Matsuzawa 2018).

² See e.g. Hurley (2006: Sections 2 and 3) for some considerations along these lines.

³ See e.g. Bekoff & Jamieson (1991: 19–20), DeGrazia (1996: 154–8), Glock (2019: 651), Carothers (2009), Burge (2010), Newen & Starkaz (2020), Crelier (2022), and Danón (2022). Animal concepts may not correspond to those we use in ascribing thoughts to them, but, with some careful empirical work, the latter may reliably track the former (see Rowlands 2012: ch. 2). Note also that animal concepts needn't be limited to objects and properties they directly perceive, as, for example, Monsó's (2022) work on the concept of death illustrates. We can't discuss theories of concepts here, but we take it that concepts are the building blocks of propositions entertained by epistemic subjects and that they are typically acquired through experience and cognitive development. This is compatible with different views on the nature, structure, and acquisition of concepts. We are committed to denying that the possession of human language is necessary for conceptual thought. We think that this denial is warranted by, among other things, the studies mentioned in this footnote and the consideration that animals engage in truth-functional reasoning, which we will discuss in Section VI.

according to these frameworks, a belief is rational or justified when it is supported by, and based on, the evidence available to the subject—where what counts as evidence and what exact beliefs it supports are determined in a way that is not exhausted by the subject's own perspective. In other words, subjects can be mistaken in identifying the relevant evidence and in assessing what doxastic attitudes it supports.

Relevant episodes of belief formation have been ascribed to animals by some philosophers (e.g. Glock 2018; Kornblith 2021; Rowlands 2012), while others are sceptical (e.g. Brandom 1994; Davidson 1982; Frey 1977; Leahy 1993; McCloskey 1979; Stich 1979), a situation that contrasts with comparative psychology, where the attribution of belief-formation processes to animals is for the most part considered uncontroversial. Though comparative psychologists do not commonly use folk psychological terms like 'beliefs' and 'desires' when describing animal behaviour, most of the work in this discipline starts from the presupposition that animals can form beliefs about their surroundings on the basis of the input provided by their sensory apparatus. Occasionally, this is made explicit. This happens, for instance, in studies that have tested for mental state attribution in animals using other animals as targets. These studies explicitly assume that the target is a minded being with beliefs and desires that the subject has to interpret (e.g. Buttelmann *et al.* 2017; Kaminski *et al.* 2008; Krupenye *et al.* 2016; Ostojić *et al.* 2013). Studies that have tested for metacognition in animals also assume that the animals tested have beliefs that they form on the basis of evidence, and try to determine, for instance, if the animal *knows* that her *beliefs* can be false (e.g. Belger and Bräuer 2018; Bohn *et al.* 2017; Call 2010). In short, the arguments against the attribution of beliefs to animals advanced by the philosophers noted above have not any impact on empirical studies. Otherwise, one would expect comparative psychologists to have carried out studies to directly address the question of whether animals have beliefs, but there are none. Instead, the idea that the animals under study have beliefs and desires that can be manipulated by the experimental conditions is part of the common ground in comparative psychology since the cognitivist revolution (Andrews 2020).

These episodes of belief formation that some philosophers and most comparative psychologists are willing to attribute to animals are, for the most part, taken to be unreflective. This means that the responsiveness to evidence that generates them requires only *sensitivity* to one's evidence (e.g. environmental facts) and *not the scrutiny* of it. To put it differently, they are cases in which the subjects treat their evidence as a reason for belief without representing it as a reason, or without explicitly taking the evidence to support belief in the relatively demanding sense of 'taking' outlined by Boghossian (2014).

Unreflective responsiveness to evidence has a positive and a negative side. One may respond to *positive evidence* supporting belief in P, and later one might encounter *overriding* counterevidence suggesting that one should replace one's

belief in P with a belief in not-P. For example, one might believe that one's phone is on the dining table (say, on the basis of one's memory) and, upon seeing the dining table with no phone on it, replace the original belief with its negation. All that is required to do so is sensitivity to evidence relevant for a specific inquiry (e.g. 'where's my phone?') coming from the environment or one's psychology. It is relatively easy to think of cases where an animal exhibits such sensitivity. For instance, we can imagine a thirsty gazelle who arrives at a waterhole and, after a quick perceptual scan during which no predators are detected, forms a belief like <it is safe to drink here>. If she later detects a suspicious rustle in some nearby bushes, she immediately replaces her belief with <it is not safe to drink here> and runs away.⁴

There is a wide range of empirical studies showing that many animals have a sensitivity to both their own and others' epistemic circumstances (e.g. the evidence they possess and when they need more to answer a specific question). To give some examples, wild chimpanzees have been found to be more likely to give alarm calls in the presence of a snake when group members are not yet aware of it (Crockford *et al.* 2012), scrub-jays adjust their caching strategies to whether or not there was a potential pilferer during the caching event and whether they had visual access to it (Dally *et al.* 2005), pigs can use mirrors to find out the location of hidden food (Broom *et al.* 2009), great apes will double-check the location of food rewards if the stakes are high or if the cost of checking is low (Call 2010), rats will opt-out of a test if it is too difficult based on the available evidence (Foote and Crystal 2007), and rhesus macaques will decline memory tests when they cannot remember the relevant information (Hampton 2001).

We thus take it that there are plenty of reasons to think that animals are capable of *unreflective* responsiveness to evidence. However, the sceptics are unlikely to be convinced of animal rationality by the vindication of unreflective responsiveness to reasons in other species. Therefore, in the following section, we shall begin to address the further question of whether animals may be capable of *reflective* responsiveness to evidence. Reflective responsiveness to reasons is, in effect, the only genuine notion of rationality admitted by strict opponents of animal rationality. For that reason, if we can show that animals have it, we can provide a refutation of the claim that humans are the only

⁴ Any creature who is able to have positive beliefs is also able to entertain negative ones. This is because dropping a belief in response to (sufficiently strong) overriding evidence entails disbelieving P (that is, believing not-P). In other words, whoever is able to form a belief that P must also be able to believe not-P: This simply follows from the equivalence between disbelief and belief-not. Thus, the capacities for believing and disbelieving come together, as disbelieving P aligns with believing not-P. Acknowledging this much entails no commitment to the claim—popular in formal theories of belief-revision such as the AGM model—that disbelief *reduces* to belief-not, so that there would be only one kind of doxastic attitude rather than two. See Sturgeon (2020: ch. 6) for a critical discussion of this claim.

rational animals that even the most sceptical of philosophers would have to accept.

IV. REFLECTIVE RESPONSIVENESS TO EVIDENCE

Some opponents of animal rationality may concede that there is unreflective responsiveness to evidence and that animals may be capable of it, but insist that only humans have the capacity to reflect on their reasons. In line with Korsgaard (2018: 39), we can single out two core features of reflective responsiveness to reasons or evidence:

- (i) the identification of the relevant evidence *as evidence*;
- (ii) the assessment of the evidence in thought.

We commonly exhibit these features through language. Clear examples are replies to questions of the form ‘Why do you believe that P?’. Suppose Bill is asked why he believes that the next railway strike will be revoked, and he answers that he heard on BBC radio that railway workers’ demands have been accepted. In offering this reply, Bill (i) identifies the relevant evidence as evidence (Bill understands that information concerning the status of the workers’ demands is relevant to address the question of the status of the planned strike while, say, the weather forecast is not) and (ii) assesses the relevant evidence (Bill understands the relation of epistemic support between the acceptance of the workers’ demands and the revocation of the strike: The former makes the latter much more likely).

Given this correlation between reflective responsiveness to evidence and the capacity to answer ‘why?’ questions in humans, it is attractive to suppose that the former requires linguistic abilities. Indeed, many philosophers associate reflective responsiveness to reasons with the capacity to articulate reasons linguistically (e.g. Boyle 2016, 2018; Brandom 1994; Davidson 1975, 1982; Dummett 1993; Korsgaard 2009, 2018; McDowell 1994; Marcus 2021, 2022).

The appeal of postulating a tight link between language and reflective responsiveness to reasons is especially evident when we observe that, in the example above, Bill, in effect, relies on his capacity to formulate thoughts of the form <I believe that P because of Q>. Such thoughts are about other thoughts: cases of explicit metacognition or thinking about thinking, as characterised, e.g. by Flavell (1979) and Dunlosky & Metcalfe (2009). Consider now that many believe that language is needed to ascend to the level of thinking about thinking (e.g. Bermúdez 2003; Millikan 2004), and that the empirical evidence for thoughts about other thoughts in non-linguistic subjects is contentious (see e.g. Burge 2018; Carruthers 2008, 2018; Perner 2012; Povinelli 2020). In the light of all this, the view according to which language, explicit metacognition, and reflection come as a package, and that they together make

humans unique with respect to rationality, does have some attraction. It has even been suggested that reflection emerged through evolution to enable linguistic communication for cooperative activities (Mercier and Sperber 2017; Tomasello 2019).

However, a closer look at what's involved in reflective responsiveness to evidence suggests that there might be ways of engaging in it that do not require language. It is at this stage that analytic epistemology makes its contribution through the study of epistemic defeaters. Above, we introduced overriding (aka 'rebutting') defeaters: Evidence suggesting that one should replace one's belief in P with a belief in not-P. In the literature on epistemic defeaters, going back to Pollock (1974), it is common to distinguish overriding defeaters from so-called 'undermining' (aka 'undercutting') ones. In their most basic characterisation, undermining defeaters provide the subject with a reason to give up one's belief in P without thereby providing a reason to believe not-P. Undermining defeaters come in a variety of forms, but we will focus on those that contain evaluative terms, such as those suggesting that a specific source of evidence is unreliable or that a specific piece of evidence may be misleading.

These underminers are especially interesting because of what it takes to respond to them. A proper response to the acquisition of <source X is unreliable> requires the subject to dismiss, or at least look with suspicion at, the next piece of information provided by X. The subject does so by not believing, or attaching a low degree of belief to, what X suggests. In doing so, the subject (i) individuates a piece of information *as a piece of evidence*, and (ii) assesses it as likely to be misleading. These are the two core features of reflective responsiveness to reasons noted above. Responding to at least some undermining defeaters thus requires one to engage in a basic form of reflective thought—the one involved in personal-level epistemic evaluations.⁵ To the extent that this can be done without language and the formulation of thoughts about other thoughts, it is open to subjects without a language and without the capacity for explicit metacognition.

It is important to note that the relevant epistemic evaluations are not like those of the thirsty gazelle scanning the area around a waterhole for the presence of predators. Evaluations like the latter needn't involve the formulation of thoughts referring to evidence or other epistemic features of the situation. Rather, they are guided by a questioning attitude like <is a predator nearby?> and involve direct responses to the evidence relevant to answer the question (e.g. <all is quiet> or <a rustle in the bush>). By contrast, in the case of <source X is unreliable> one responds to evidence that is not directly relevant to answer the question at hand (e.g. <where's the reward?>). Rather, one responds to evidence about the good standing of another piece of evidence,

⁵ See Melis (2014) and Sturgeon (2014) for some initial discussion of the relation between responding to undermining defeaters and higher-order thinking.

namely that which comes from X. <Source X is unreliable> and similar underminers are instances of so-called 'higher-order' evidence. Because of it, responding to them demands explicit epistemic evaluations: the formulation of thoughts about evidence.

It is an empirical question whether animals may be able to respond to undermining defeaters like those described, and thereby engage in basic forms of reflective responsiveness to evidence. In the next section, we discuss some empirical studies that provide preliminary evidence in support of this view.

V. CAN ANIMALS RESPOND TO UNDERMINING DEFEATERS?

An empirical study of animals' capacity to respond to undermining defeaters would look for a behaviour that is best explained by ascribing to the animal a thought like <this source of evidence is unreliable>. This is not an easy task. At first, it might be thought that animals would achieve it by exhibiting sensitivity to the reliability of sources of evidence, by, for example, stopping to follow the indications of a source after having been misled a number of times, while continuing to follow the evidence coming from another source that consistently offered non-misleading information.

However, to the extent that one can stop following the evidence coming from an unreliable source without forming any thoughts about the quality of the evidence or of the source, sensitivity to the reliability of the source remains at the unreflective level. For example, one may just grow tired of repeatedly following indications that tend to lead to disappointment. To do so, it suffices to formulate a thought like <a reward is not here> for each time one has found nothing after following the misleading evidence, together with the frustration generated by the failure to satisfy the desire to find a reward. These are thoughts and attitudes that fall within first-order boundaries: In particular, they express no epistemic evaluations, and yet they are sufficient to guarantee that the animal will lose the motivation to follow the indications coming from that source.

To ascend to the level of conscious evaluation and response to <the source is unreliable>, something is needed in addition to a sensitivity to the reliability of a source. An example would be the refusal to follow indications coming from the unreliable source *the very first time* they reencounter it in a new context, while showing no hesitation in following the indication of the alternative reliable source in an analogous new encounter. Such behaviour would suggest that, based on her previous experience, the subject remembers the source to be unreliable and *expects* the evidence coming from it to be misleading, even in new circumstances. She would have recognised the source as unreliable, as opposed to being merely *habituated* to its unreliability. Of course, this is just a sketch for illustrative purposes, and implementing it in a study would require

much more detail. But the broad idea is that such behaviour would involve the two features of reflective responsiveness to evidence: (i) the identification of a piece of evidence and (ii) its assessment (as misleading).

To the best of our knowledge, no empirical study specifically aimed at assessing whether animals may be able to respond to undermining defeaters has been published so far. Yet, there are studies that, while having other research goals, suggest that animals may be able to individuate and assess evidence in the way required to respond to undermining defeaters.

One such study is Cheney & Seyfarth's (1988) on vervet monkey's semantic competence. Cheney and Seyfarth used hidden speakers to repeatedly play a recording of an individual (A) making a wrr call. Wrr calls are used to signal when another group of monkeys has appeared in the vicinity, and they normally make the recipients look towards the signaller and then scan in the direction in which she is looking. By repeatedly playing back wrr calls from A in the absence of any other group of monkeys, recipients learned that the call was not worthy of much attention and accordingly quickly dismissed it while still giving full attention to wrr calls from other individuals. This could be interpreted as meaning that the recipients had learned (in the unreflective sense) that A was an unreliable informant. What suggests that vervet monkeys may be able to ascend to the level of explicit epistemic evaluations is that chatter calls, which have a similar referent in that they signal aggressive encounters with other groups, were also fairly quickly dismissed if they came from A. That may count as a change of context in the sense outlined above and would suggest that the behaviour is guided by a representation of the source as unreliable. However, we should note that this study does not exhibit the sharp cut-off of altogether refusing to follow the indications coming from the unreliable source the first time in a new context, but rather shows that they pay less attention to the unreliable source in the new context. It is nevertheless suggestive of vervet monkey's capacity to act in ways that are guided by thoughts like <the source is unreliable>.⁶

A study by Takaoka *et al.* (2015) investigated sensitivity to the reliability of sources more directly, in this case in dogs. The study was articulated in two experiments, both including three phases. In the first experiment, dogs were given reliable leads in the first phase (which they followed), unreliable leads in the second phase (which they also tended to follow), and reliable leads again

⁶ A reviewer argues that this account might presuppose a view of animal signals as assertions instead of imperatives, for we are assuming that these alarm calls are something in which the monkeys can have credences. However, we think that this is not obviously so. Even if the monkey's calls ought to be understood as imperatives rather than assertions (<go up a tree!> rather than <leopard coming!>), Cheney and Seyfarth's work shows us that there is some predator-related assertive content that the monkeys attach to these imperatives, given that unreliable calls ended up being dismissed. So, even if the call means <go up a tree!>, there is a description of a state of affairs that putatively justifies it (<leopard coming!>) and to which the monkeys attach some credence.

in the third phase (which they tended not to follow). The invited conclusion is that dogs tended to stop following the leads in the third phase because they had been exposed to the unreliability of the informant in the second phase.

The second experiment differed from the first in that the informant in the third phase was not the same as the informant in the first and second phases. The conjecture to be tested in the second experiment was that, if the reason why the dogs stopped following the leads in phase 3 of the first experiment had been that they assessed the reliability of the informant (and not, say, that they grew tired of the experiment), then they would have followed the leads of the new information in phase 3 of experiment 2. They indeed did so. This, again, is compatible with the suggestion that dogs were guided by thoughts like <that particular informant is unreliable, but not this other one>. Positive results with a similar paradigm were also obtained with great apes (Schmid *et al.* 2017).

Another suggestive group of studies are those that have focused on chimpanzees' grasp of the appearance/reality distinction, such as Krachun *et al.*'s (2016). This study consisted of three separate tests: the Lens Test, the Mirror Test, and the Colour Test. In the Lens Test, the chimpanzees were allowed to choose between a large grape that appeared small and a small grape that appeared large due to the effect of minimising/magnifying lenses. In the Mirror Test, the chimpanzees could choose between two groups of grapes: one whose appearance corresponded to the actual number of grapes and another that was next to a mirror, thus creating the illusion that there were more grapes than in the other group. In the Colour Test, transparent colour filters and baited boxes of different colours were used to determine whether the chimpanzees could discriminate when a box looked to be a different colour than it really was.

The performance of the chimpanzees in the Lens Test was remarkable: Every subject involved passed it. A possible explanation of this is that they had simply learned a reverse-contingency rule like <choose the smaller grape to get the bigger one>. However, this is unlikely because, as the authors note, chimpanzees are notoriously bad at reverse-contingency tests, usually requiring hundreds of trials to learn the relevant rules. Instead, the results are better explained by assuming that the chimpanzees understood that the lens affected their perceptions of grape sizes. The chimpanzees did worse in the Mirror Test, which the authors attribute to the fact that the experiment took longer to set up, which may have disincentivised the chimpanzees' attention. In addition, the chimpanzees may not be as motivated to pick a higher number of grapes as they are to pick a big grape over a small one. Still, some chimpanzees did manage to pass the test, as they did with respect to the Colour Test.

To the extent that the behaviour of the chimpanzees who passed the tests is best explained as being guided by a thought like <the grape *seems* big/small>,

<there *seem* to be *n* grapes>, or <the box *looks* yellow>, these are cases of responsiveness to relevant undermining defeaters. Since grasp of the concept of appearance amounts to a grasp of the difference between ‘is true’ and ‘seems true’, and given that to represent a state of affairs as merely *seeming* true is to make a personal-level epistemic evaluation, to the extent that the study suggests that chimpanzees do have a grasp of the concept of appearance, it also suggests that chimpanzees are capable of basic forms of reflective thinking. In effect, the subject who entertains a thought like <it merely *seems* that P> is a subject who identifies some information as putative evidence for P and judges it to be likely to be misleading.

O'Madagain *et al.* (2022) also used magnifying and minimising lenses, in this case to test great apes' capacity to realise when two pieces of evidence conflict with each other. The apes were offered an initial choice between two boxes that had windows cut on their sides, one of which contained a bigger reward than the other. Once the apes had made their initial preference known, the boxes were rotated to reveal a second window into their contents, which showed information that was either consistent with the apes' initial view or inconsistent due to the effect of a magnifying or minimising lens. The apes were then given the option of peering into the box from above before making a final choice and accessing their chosen reward. The experimenters found that the apes were significantly more likely to seek additional information before making their final choice when the second piece of evidence they had been given conflicted with the first. As the authors conclude, the apes' reluctance to act on conflicting evidence is the upshot of rational belief revision. Apes go beyond the unreflective responses to overriding defeaters, as in the gazelle example, and weigh conflicting evidence of roughly equal strength before taking a settled attitude. While this is something that need not involve the formulation of thoughts about the evidence itself, it exhibits the capacity to respond to overriding defeaters *in cases where they are not so strong to unambiguously mandate belief revision*. This points to a level of cognitive sophistication that goes in the direction of reflective responsiveness to reasons.

A final group of studies that we want to consider concerns great apes' ability to use their own experience with how some distorting factors affect the reliability of a source of evidence (typically, vision) to predict the behaviour of others who have been exposed to those same distorting factors. Kano *et al.* (2019) familiarised great apes with a screen that was either translucent or opaque but that looked the same in either case. They then used an eye-tracking device to see whether the apes who had experienced the screen as opaque would anticipate that the human in a video they were watching would not be able to see through it. Indeed, they found a significant difference in the anticipatory-looking behaviour of the apes who had experienced the screen as opaque and those who had experienced it as translucent, suggesting that these animals are at least sensitive to how environmental obstacles affect the normal working of

a source of evidence. Similarly, Karg *et al.* (2015) used a competitive paradigm to test whether chimpanzees could take into account what an experimenter could and could not see in order to decide where to steal food from. They found that chimpanzees would preferentially steal food from a container with an opaque lid as opposed to one that appeared identical but they had previously experienced as see-through. The chimpanzees seemed to be taking into account that the opaque lid hindered the experimenter's capacity to acquire information by visual means, thus making them less likely to get caught.

This last study is especially significant in relation to reflective responsiveness to evidence, as it is plausible that chimpanzees' decisions about when to act were guided by a thought like <(in these circumstances) competitor can't register my moves>. This is a thought that involves an explicit epistemic evaluation, as it requires one to individuate some potential event (namely the approaching of one's hand towards the container) as evidence for one's competitor to learn that food is being stolen, and to assess when that evidence will not be available to one's competitor. Subjects who can do that are, in effect, instantiating the two core features of reflective responsiveness to evidence: the identification of a piece of evidence as such and its evaluation at the personal level of thought.

VI. OBJECTIONS AND RESPONSES

Our suggestion that animals may be capable of reflective responsiveness to evidence hangs on the assumption that animals are capable of propositional thought. We have made this assumption on the basis of a growing number of empirical and philosophical research on concepts and the practice of ascribing propositional attitudes to animals in comparative psychology (see Section III). However, given its perceived controversial nature, it is worth discussing it more explicitly before concluding.

One clear sign of propositional thought are inferences with truth-functional connectives.⁷ Thus, one way in which the claim that animals engage in propositional thought may be questioned is by raising doubts about animals' grasp of truth-functional connectives. As one reviewer helpfully noted, some studies suggest that many animals and young children below the age of 3 (e.g. Mody and Carey 2016; Leahy and Carey 2020) struggle with disjunctive syllogism, thereby exhibiting shortcomings in their grasp of disjunction or negation. In

⁷ That's because the connectives negation, conditionalisation, and disjunction involve what Burge (2010) calls 'pure predication'. For example, a thought like <the phone is not on the table> successfully refers to a state of affairs in virtue of predicating of something (i.e., the phone) that it lacks a property (i.e., being on the table). This requires a representational mechanism that goes beyond what demonstrative-governed referential mechanisms characteristic of perception allow.

the light of concerns about the grasp of truth-functional connectives, how well founded is the claim that animals can revise beliefs rationally?

To address this concern, it is important to appreciate that truth-functional connectives are not all equal in the cognitive demands they pose on subjects. Specifically, one may grasp the concept of negation without grasping the concept of disjunction. For simplicity, let's focus on exclusive disjunction. Entertaining a thought like <Either P OR Q> requires the subject to represent two incompatible alternatives *simultaneously*, and to see them as open possibilities. This is something that many children struggle with until they reach the age of 3. By contrast, the transition from believing P to believing NOT-P requires one to entertain two incompatible states of affairs, but *not* as two open possibilities; rather, they are entertained sequentially. What is required to entertain incompatible representations of the world sequentially is the capacity to handle multiple mental models in the sense of Perner (1991), or the minimal representation of possibility outlined in Leahy & Carey (2020). These skills are exhibited by children who engage in pretend play—which they do shortly after their first birthday—and they constitute the minimal requirements for children to grasp truth-functional negation and express denials of false states of affairs in the world (Hummer *et al.* 1993). There is very strong evidence that children deny a false state of affairs at about 2 years of age, well before they master disjunctive syllogisms (Austin *et al.* 2014; Feiman *et al.* 2017; Hummer *et al.* 1993; Nordmeyer and Frank 2014). Thus, what seems to explain children's problems with disjunctive syllogism are difficulties in grasping disjunction rather than negation. But grasp of negation, together with grasp of conjunction—which also does not require the representation of two alternative and incompatible open possibilities⁸—is enough to begin to revise beliefs rationally.

Moreover, there is reason to think that at least some animals *do* engage in disjunctive syllogism. To illustrate this, let's briefly rehearse a paradigm used to test reasoning by exclusion in apes. The subject is first shown some food being hidden in one of two places; next, one of the two places is shown to contain no food; finally, the subject is invited to choose between the two places. Many apes immediately choose the non-empty places, without checking either place first (Call 2004). This is *prima facie* evidence that they have reasoned along the lines of <P OR Q; NOT-P; so Q>.

In reply, it may be observed that one familiar difficulty with ascribing deductive inferences on the basis of behaviour is that the relevant reasoning may be mimicked by behaviour that is not underwritten by propositional thought. With respect to behaviour suggestive of disjunctive syllogism, two alternatives

⁸ Bloom *et al.* (1980), French & Nelson (1985), Lust & Mervis (1980), and Morris (2008) show that children productively use the word 'and' around their second birthday, while they do not say the word 'or' until the age of 3.

not involving deductive reasoning have been proposed. On the one hand, the behaviour could result from the representation of contrary attributives such as <absent in container A> and <present in container B>, plus a disposition to anticipate presence in container B on not perceiving the food in container A (Bermúdez 2003). On the other hand, a map-like representational structure with an updating capacity that operates on Bayesian conditional probabilities might be expected to do the job without involving disjunctive syllogism (Rescorla 2009).

Yet, there seems to be an inference to the best explanation supporting disjunctive syllogism in at least some non-human animals, which we can briefly sketch. Apes exhibit the reasoning-by-exclusion behaviour across a wide range of contexts involving different subject matters like location, causation, and object permanence (Call 2006, 2007). Disjunctive syllogism nicely explains such breath of applicability. By contrast, as Burge (2010: 62 ff) noted, the ‘contrary attributives’ explanation has to conjure new pairs of attributives for every topic on which the behaviour shows up, thereby failing to account for the generality of the competence underlying the behaviour. Similarly, the map-like representations plus Bayesian-update proposal appeals to principles specific to locational or causal map-like representations, thereby missing the generality of the pattern of behaviour.

In addition, studies on individual animals, such as Kaminski *et al.* (2004) and Pepperberg *et al.* (2019), support disjunctive syllogism beyond primates. We have no space to discuss them. The point is that there are reasons to think that animals are capable of disjunctive syllogism. And if animals engage in disjunctive syllogism, they are capable of propositional thought. In any case, as already noted, there is no need to grasp disjunction and engage in disjunctive syllogism to be able to revise beliefs rationally: Grasp of negation and conjunction is enough.

Another possible objection, for which we thank an anonymous reviewer, goes in the opposite direction. Once it is acknowledged that animals can entertain questioning attitudes driven by curiosity, why not think that they can also entertain some non-verbal analogues of the ‘why?’ questions that in Section IV we used to illustrate paradigmatic examples of reflective responsiveness to evidence? If so, animals would have a way to ascend to the level of reflective responsiveness to reasons without having to rely on responses to undermining defeaters, and reflective responsiveness to evidence may be even more widespread than we suggest.

We do sympathise with this line of argument, as we don’t mean to suggest that responding to undermining defeaters is the only way to ascend to the level of reflective responses to reasons. We just find it an especially promising research avenue in the light of current empirical evidence. With respect to questioning attitudes, we think that they are central to account for rational belief revision *at the unreflective level*. As Carruthers (2018) explains, questioning

attitudes are *sui generis* first-order propositional attitudes that guide (first-order) inquiries. So, they are central to rational belief-revision simpliciter. However, they are not distinctive of *reflective* belief revision. While curiosity may lead to an investigation about the reasons for one's beliefs or actions, a question that arises out of curiosity is not automatically a request for reasons. First, curiosity is a much wider phenomenon than seeking reasons, as it produces questions that needn't involve an identification and assessment of reasons, such as questions about locations (what is over there?), things (what is that?), events (what is happening?), times (when will the food arrive?), and so on. Secondly, not all 'why?' questions are requests for reasons. A question like 'Why is the food inside a box?' may be satisfactorily addressed by a causal explanation like 'because the biped put it there'.

The 'why?' questions that lead one to reflective reasoning are normative questions. For example: 'Why do you believe that Labour will do well at the next general elections?' or 'Why have you decided to become a vegetarian?' These are requests to articulate one's reasons and, depending on the wider context, to re-assess and defend them. Replying satisfactorily to such questions requires the identification and (re-)evaluation of one's grounds or motives. In some cases, curiosity may originate such question, but addressing them requires engaging in reflective thought, which many think is uniquely human. Our point is that undermining defeaters offer a way to identify and assess epistemic reasons that does not rely on thoughts about other thoughts and is within the reach of animals, without being as ubiquitous as first-order attitudes are.

VII. CONCLUSION

In this paper, we have identified the relevant notion of rationality to engage with many philosophers' claim that humans are the only rational animals: the one that has to do with personal-level responsiveness to reasons. We have distinguished unreflective and reflective notions of responsiveness to reasons and have argued that animals clearly instantiate the former. We have then discussed the possibility that animals may be able to engage in the latter too. We did so by spelling out reflective responsiveness to evidence in terms of having the capacity to (i) individuate and (ii) assess relevant pieces of evidence in personal-level thought. We argued that these capacities may be instantiated by responding to undermining defeaters, and we considered empirical studies that indirectly suggest that some animals may be capable of doing so. We contend that these studies support the view that at least some species engage in reflective responsiveness to reasons. If we are right, human uniqueness with respect to rationality and reflection is a myth, even by the standards of the most demanding of sceptics.

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REFERENCES

- Andrews, K. (2020) *How to Study Animal Minds*. Cambridge: CUP.
- Austin, K., Theakston, A., and Lieven, E. (2014) 'Young Children's Understanding of Denial', *Developmental Psychology*, 50: 2061–70.
- Bautista, L. M., Tinbergen, J., and Kacelnik, A. (2001) 'To Walk or to Fly: How Birds Choose among Foraging Modes', *Proceedings of the National Academy of Sciences of the USA*, 98: 1089–94.
- Bekoff, M. and Jamieson, D. (1991) 'Reflective Ethology, Applied Philosophy, and the Moral Status of Animals', *Perspectives in Ethology*, 9: 1–47.
- Belger, J. and Bräuer, J. (2018) 'Metacognition in Dogs: Do Dogs Know they Could be Wrong?', *Learning & Behavior*, 46/4: 398–413.
- Bermúdez, J. L. (2003) *Thinking Without Words*. Oxford: OUP.
- Bloom, L. et al. (1980) 'Complex Sentences: Acquisition of Syntactic Connectives and the Semantic Relations they Encode', *Journal of Child Language*, 7: 235–61.
- Boghossian, P. (2014) 'What Is Inference?', *Philosophical Studies*, 169: 1–18.
- Bohn, M. et al. (2017) 'Information Seeking about Tool Properties in Great Apes', *Scientific Reports*, 7/1: Article 1.
- Boyle, M. (2016) 'Additive Theories of Rationality: A Critique', *European Journal of Philosophy*, 24: 527–55.
- . (2018) 'A Different Kind of Mind?', in K. Andrews and J. Beck (eds) *The Routledge Handbook of Philosophy of Animal Minds*, 109–18. London, New York: Routledge.
- Brandom, R. (1994) *Making It Explicit: Reasoning, Representing, and Discursive Commitment*. Cambridge, MA: Harvard University Press.
- Broom, D., Sena, H., and Moynihan, K. (2009) 'Pigs Learn What a Mirror Image Represents and Use It to Obtain Information', *Animal Behaviour*, 78/5: 1037–41.
- Burge, T. (2010) 'Steps toward Origins of Propositional Thought', *Disputatio*, 4/29: 39–67.
- . (2018) 'Do Infants and Nonhuman Animals Attribute Mental States?', *Psychological Review*, 125/3: 409–34.
- Buttelmann, D. et al. (2017) 'Great Apes Distinguish True from False Beliefs in an Interactive Helping Task', *PLoS ONE*, 12: e0173793.
- . (2007) 'Enculturated Chimpanzees Imitate Rationally', *Developmental Science*, 10/4: F31–8.
- Call, J. (2004) 'Inferences about the Location of Food in the Great Apes', *Journal of Comparative Psychology*, 118: 232–41.
- . (2006) 'Inferences by Exclusion in the Great Apes: The Effect of Age and Species', *Animal Cognition*, 9: 393–403.
- . (2007) 'Apes Know That Hidden Objects Can Affect the Orientation of Other Objects', *Cognition*, 105: 1–25.
- . (2010) 'Do Apes Know That They Could Be Wrong?', *Animal Cognition*, 13/5: 689–700.

- Carruthers, P. (2008) 'Meta-Cognition in Animals: A Skeptical Look', *Mind and Language*, 23: 58–89.
- . (2009) 'Invertebrate Concepts Confront the Generality Constraint (and Win)', in R. Lurz (ed.) *The Philosophy of Animal Minds*, 89–107. Cambridge: CUP.
- . (2018) 'Basic Questions', *Mind & Language*, 33: 130–47.
- Cheney, D. and Seyfarth, R. (1988) 'Assessment of Meaning and the Detection of Unreliable Signals by Vervet Monkeys', *Animal Behaviour*, 36/2: 477–86.
- Conee, E. and Feldman, R. (2004) *Evidentialism*. Oxford: OUP.
- Crelier, A. (2022) 'Attributing Psychological Predicates to Non-Human Animals: Literalism and Its Limits', *Review of Philosophy and Psychology*.
- Crockford, C. et al. (2012) 'Wild Chimpanzees Inform Ignorant Group Members of Danger', *Current Biology*, 22: 142–6.
- Dally, J., Emery, N., and Clayton, N. (2005) 'Cache Protection Strategies by Western Scrub-Jays, *Aphelocoma Californica*: Implications for Social Cognition', *Animal Behaviour*, 70/6: 1251–63.
- Danón, L. (2022) 'Conceptual Recombination and Stimulus-Independence in Non-Human Animals', *THEORIA*, 37/3: 309–30.
- Davidson, D. (1975) 'Thought and Talk', in S. Guttenplan (ed.) *Mind and Language*, 7–24. Oxford: OUP.
- . (1982) 'Rational Animals', *Dialectica*, 36: 317–27.
- Dawkins, M. S. (1986) *Unraveling Animal Behaviour*. London: Longman.
- DeGrazia, D. (1996) *Taking Animals Seriously*. Cambridge: CUP.
- Dennett, D. (1971) 'Intentional Systems', *Journal of Philosophy*, 68/4: 87–106.
- Dretske, F. (2006) 'Minimal Rationality', in S. Hurley and M. Nudds (eds) *Rational Animals?*, 107–15. Oxford: OUP.
- Dummett, M. (1993) 'Truth and Meaning', in *The Seas of Language*, 147–65. Oxford: OUP.
- Dunlosky, J. and Metcalfe, J. (2009) *Metacognition*. Thousand Oaks: Sage Publications.
- Feiman, R. et al. (2017) 'What Do You Mean, No? Toddlers' Comprehension of Logical "No" and "Not"', *Language Learning and Development*, 13: 430–50.
- Flavell, J. (1979) 'Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry', *American Psychologist*, 34: 906–11.
- French, L. and Nelson, K. (1985) *Young Children's Knowledge of Relational Terms*. Berlin: Springer.
- Foote, A. and Crystal, J. (2007) 'Metacognition in the Rat', *Current Biology*, 17/6: 551–5.
- Frey, R. (1977) 'Interests and Animal Rights', *The Philosophical Quarterly*, 27/108: 254–9.
- Glock, H. J. (2018) 'Animal Rationality and Belief', in K., Andrews and J. Beck (eds) *The Routledge Handbook of Philosophy of Animal Minds*, 89–99. London, New York: Routledge.
- . (2019) 'Agency, Intelligence, and Reasons in Animals', *Philosophy*, 94: 645–71.
- Hampton, R. (2001) 'Rhesus Monkeys Know When they Remember', *Proceedings of the National Academy of Sciences of the USA*, 98/9: 5359–62.
- Hummer, P., Wimmer, H., and Antes, G. (1993) 'On the Origins of Denial Negation', *Journal of Child Language*, 20: 607–18.
- Hurley, S. (2003) 'Animal Action in the Space of Reasons', *Mind & Language*, 18/3: 231–57.
- . (2006) 'Making Sense of Animals', in S. Hurley and M. Nudds (eds) *Rational Animals?*, 139–72. Oxford: OUP.
- Jensen, K., Call, J., and Tomasello, M. (2007) 'Chimpanzees are Rational Maximizers in an Ultimatum Game', *Science*, 318: 107–9.
- Kacelnik, A. (2006) 'Meanings of Rationality', in S. Hurley and M. Nudds (eds) *Rational Animals?*, 87–106. Oxford: OUP.
- Kaminski, J., Call, J., and Fischer, J. (2004) 'Word Learning in a Domestic Dog: Evidence for "Fast Mapping"', *Science*, 304: 1682–3.
- Kaminski, J., Call, J., and Tomasello, M. (2008) 'Chimpanzees Know What Others Know, But Not What They Believe', *Cognition*, 109: 224–34.
- Kano, F. et al. (2019) 'Great Apes Use Self-Experience to Anticipate an Agent's Action in a False-Belief Test', *Proceedings of the National Academy of Sciences of the USA*, 116/42: 20904–9.
- Karg, K. et al. (2015) 'The Goggles Experiment: Can Chimpanzees Use Self-Experience to Infer What a Competitor Can See?', *Animal Behaviour*, 105: 211–21.
- Kornblith, H. (2021) *Scientific Epistemology: An Introduction*. Oxford: OUP.
- Korsgaard, C. (2009) *Self-Constitution: Agency, Identity, and Integrity*. Oxford: OUP.

- . (2018) *Fellow Creatures*. Oxford: OUP.
- Krachun, C. et al. (2016) 'Smoke and Mirrors: Testing the Scope of Chimpanzees' Appearance–Reality Understanding', *Cognition*, 150: 53–67.
- Krupenye, C. et al. (2016) 'Great Apes Anticipate that Other Individuals Will Act According to False Beliefs', *Science*, 354/6308: 110–4.
- Leahy, B. and Carey, S. (2020) 'The Acquisition of Modal Concepts', *Trends in Cognitive Sciences*, 24: 65–78.
- Leahy, M. (1993) *Against Liberation: Putting Animals in Perspective*. London, New York: Routledge.
- Lust, B. and Mervis, C. (1980) 'Development of Coordination in the Natural Speech of Young Children', *Journal of Child Language*, 7: 279–304.
- McCloskey, H. (1979) 'Moral Rights and Animals', *Inquiry*, 22/1–4: 23–54.
- McDowell, J. (1994) *Mind and World*. Cambridge, MA: Harvard University Press.
- Marcus, E. (2021) *Belief, Inference and the Self-Conscious Mind*. Oxford: OUP.
- . (2022) 'Anscombe and the Difference That Rationality Makes', in A. Haddock and R. Wiseman (eds) *The Anscombean Mind*, 23–54. London, New York: Routledge.
- Melis, G. (2014) 'Understanding Undermining Defeat', *Philosophical Studies*, 170: 433–42.
- Mercier, H. and Sperber, D. (2017) *The Enigma of Reason*. Cambridge, MA: Harvard University Press.
- Millikan, R. (2004) *Varieties of Meaning*. Cambridge, MA: MIT Press.
- Mody, S. and Carey, S. (2016) 'The Emergence of Reasoning by the Disjunctive Syllogism in Early Childhood', *Cognition*, 54: 40–8.
- Monsó, S. (2022) 'How to Tell If Animals Can Understand Death', *Erkenn*, 87/1: 117–36.
- Morris, B. (2008) 'Logically Speaking: Evidence for Item-Based Acquisition of the Connectives AND & OR', *Journal of Cognition and Development*, 9: 67–88.
- Newen, A. and Starzak, T. (2020) 'How to Ascribe Beliefs to Animals', *Mind & Language*, 37: 3–21.
- Nordmayer, A. E. and Frank, M. C. (2014) 'The Role of Context in Young Children's Comprehension of Negation', *Journal of Memory and Language*, 77: 25–39.
- O'Madagain, C. et al. (2022) 'Great Apes and Human Children Rationally Monitor Their Decisions', *Proceedings of the Royal Society B*, 289: 2686.
- Ostojić, L. et al. (2013) 'Evidence Suggesting that Desire-State Attribution may Govern Food Sharing in Eurasian Jays', *Proceedings of the National Academy of Sciences of the USA*, 110/10: 4123–8.
- Penn, D. and Povinelli, D. (2007) 'On the Lack of Evidence that Non-Human Animals Possess Anything Remotely Resembling a "Theory of Mind"', *Philosophical Transactions of the Royal Society B*, 362: 731–44.
- Pepperberg, I. et al. (2019) 'Logical Reasoning by a Grey Parrot? A Case Study of the Disjunctive Syllogism', *Behavior*, 156: 409–45.
- Perner, J. (1991) *Understanding the Representational Mind*. Cambridge, MA: MIT Press.
- . (2012) 'MiniMeta: In Search of Minimal Criteria for Metacognition', in M. Beran, J. Brandl, J. Perner and J. Proust (eds) *Foundations of Metacognition*, 94–116. Oxford: OUP.
- Pollock, J. L. (1974) *Knowledge and Justification*. Princeton, NJ: Princeton University Press.
- Povinelli, D. J. (2020) 'Can Comparative Psychology Crack its Toughest Nut?', *AB&C*, 7/4: 589–652.
- Rescorla, M. (2009) 'Chrysippus' Dog as a Case Study in Non-Linguistic Cognition', in R. Lurz (ed.) *The Philosophy of Animal Minds*, 52–71. Oxford: OUP.
- Rowlands, M. (2012) *Can Animals Be Moral?* Oxford: OUP.
- Schmid, B. et al. (2017) 'Great Apes are Sensitive to Prior Reliability of an Informant in a Gaze Following Task', *PLoS ONE*, 12/11: e0187451.
- Sellers, W. (1956) *Empiricism and the Philosophy of Mind*. Cambridge, MA: Harvard University Press.
- Stich, S. (1979) 'Do Animals Have Beliefs?', *Australasian Journal of Philosophy*, 57: 15–28.
- Sturgeon, S. (2014) 'Pollock on Defeasible Reasons', *Philosophical Studies*, 169: 105–18.
- . (2020) *The Rational Mind*. Oxford: OUP.
- Takaoka, A. et al. (2015) 'Do Dogs Follow Behavioral Cues from an Unreliable Human?', *Animal Cognition*, 18/2: 475–83.
- Tomasello, M. (2019) *Becoming Human: A Theory of Ontogeny*. Cambridge, MA: Harvard University Press.
- . (2022) 'What Is It Like to Be a Chimpanzee?', *Synthese*, 200/2: 102.

- Watson, C. and Matsuzawa, T. (2018) 'Behaviour of Nonhuman Primate Mothers toward their Dead Infants: Uncovering Mechanisms', *Philosophical Transactions of the Royal Society B*, 373/1754: 20170261.
- Williamson, T. (2000) *Knowledge and its Limits*. Oxford: OUP.

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