

# Do Animals Engage in Conceptual Thought?

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## Abstract

This article surveys and evaluates the answers that philosophers and animal researchers have given to two questions. Do animals have thoughts? If so, are their thoughts conceptual? Along the way, special attention is paid to distinguish debates of substance from mere battles over terminology, and to isolate fruitful areas for future research.

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Do animals engage in conceptual thought? Opinions among philosophers diverge, ranging from a resounding “no” (e.g., Davidson 1975) to an emphatic “yes” (e.g., Carruthers 2004), with many qualified answers in between. This paper charts this controversy. At issue is not only our inherent curiosity about the animals that surround us, but also our understanding of our own human uniqueness.

I begin in section 1 by bracketing issues of concepts and considering whether animals have thoughts in any sense. In section 2 I then explain what makes some thoughts conceptual, and consider several arguments that purport to show that animals have conceptual thoughts. Finally, in section 3 I extract some lessons from our discussion that can be applied going forward.

## 1. Do Animals Have Thoughts?

### 1.1. CHARACTERIZING THOUGHT

To a first approximation, thoughts are contentful mental states that mediate between perception and action. Two basic types of thoughts are *beliefs*, whose contents specify how the thinker takes the world to be, and *desires*, whose contents specify how the thinker would like the world to be. Whereas beliefs can be evaluated as accurate or inaccurate, desires can be evaluated as satisfied or unsatisfied. For example, my belief that there is a cat on the mat is accurate just in case there is, in fact, a cat on the mat; and my desire that the cat move to my lap is satisfied just in case the cat does, in fact, move to my lap.

It is essential to thoughts that they be capable of participating in *reasoning*. Thus, when thoughts mediate between perception and action they must do so not just *causally*, but *rationally*, in a way that is explained by their contents. For example, if I believe that the cat is on the mat and that the dog is on the mat, and then conclude that at least two things are on the mat, my conclusion is explicable in terms of the contents of my initial beliefs. Similarly, if I walk to the mat because I desire to pet the cat and believe that the cat is on the mat, my action is explained by the contents of my desire and belief.

This rough characterization of thought skips over many points of controversy, some of which will be introduced below. One point worth flagging right away, however, is that our characterization does not dictate that thoughts be composed of concepts. Obviously, this is partly a terminological choice. One could use the term ‘thought’ such that

thoughts are constitutively conceptual (Burge 2010, 537, n. 3). But our less stringent characterization helpfully allows us to separate the question whether animals have thoughts from the question whether animal thought is conceptual (cf. Glock 2000, 2010).

### 1.2. AN ARGUMENT FOR ANIMAL THOUGHT

Even after the fall of behaviorism as a general theory of human cognition, many animal researchers have continued to operate in a broadly behaviorist paradigm that emphasizes associative learning, such as instrumental conditioning, together with inflexible processes such as imprinting. This paradigm has undeniably succeeded in explaining many aspects of animal behavior without appealing to contentful mental states or reasoning. It is thus natural to question whether there is really any need to appeal to animal thoughts.

Problems for this paradigm arise, however, when we consider certain forms of complex animal behavior that seem to call out for explanations in terms of thoughts. For example, ethologists have observed chimpanzees in the Congo using two different tools to extract termites from their nests: a larger stick that punctures a hole in the mound; and a smaller stick that they collect at a distal location, strip the leaves from, and then deploy as a fishing rod (Sanz, Morgan, and Gulick 2004). Since this behavior exhibits considerable variability among chimpanzee communities (many communities don't deploy the technique at all), it apparently isn't hard wired. And since the behavior seems to involve advanced planning, it doesn't naturally succumb to traditional associative models of learning such as instrumental conditioning either.

The controlled experiments of comparative psychologists paint a similar picture. For example, Clayton and Dickinson (1998) showed that scrub jays, which are disposed to hide food for later retrieval, will flexibly adjust their retrieval strategies according to what they subsequently learn about the decay rates of the different types of food they have hidden, together with the time elapsed since the food was hidden. Clayton, Emery, and Dickinson (2006) argue that this and other remarkable behaviors of the scrub jay are too flexible, and generalize too quickly, to be explained through association. The scrub jay must have *beliefs* about what types of food it has cached together with where and when it cached them.

Other comparative psychologists do not explicitly employ terms such as 'belief' or 'thought', but nevertheless appeal to mental states that satisfy our characterization of these states. For example, Gallistel (1990) presents evidence that mammals, birds, and even insects deploy a variety of contentful mental states that rationally mediate between perception and action, including cognitive maps and magnitude representations of number, time, and rate (cf. Carruthers 2006: 65–83).

Although traditional models of association built on classical and instrumental conditioning are almost surely incapable of explaining the complex forms of animal behavior we have reviewed, one might wonder whether more sophisticated associative models, such as artificial neural networks trained by the powerful backpropagation algorithm, could pick up the slack. While many researchers are skeptical (e.g., Fodor and Pylyshyn 1988; Marcus 2001; Carruthers 2006: 46–50), the issues here are complex, and almost certainly depend on how such models are developed in the future. But whatever the future holds, explanations in terms of neural networks aren't obviously incompatible with explanations in terms of thoughts. Rather, the two types of explanation are naturally viewed as operating at different levels of grain, like physics and chemistry. On this view, even if neural networks eventually tell us how thoughts are implemented in the brain, they won't eliminate thoughts.

The argument we have been considering in favor of animal thought has the following form: animals engage in complex behavior; thoughts participate in good explanations of that behavior; so animals probably have thoughts. This argument and its conclusion have been subject to several lines of attack. In the remainder of this section, I consider three of them.

### I.3. INSTRUMENTALISM

Instrumentalists about animal thought such as Davidson (1975), Dennett (1987), and Jamieson (2009) admit that attributing thoughts to animals yields useful explanations of their behavior, but deny that such explanations are literally true. It is not literally true that scrub jays have beliefs about the food they cache, or that chimpanzees believe that bare branches facilitate termite fishing. Such explanations are to be taken no more seriously than explanations of a thermostat's behavior in terms of its 'desire' to keep the room at 72 degrees Fahrenheit, and its 'belief' that the room has deviated from that temperature.

There is, however, a significant difference in our understanding of animals and thermostats. Whereas appealing to a thermostat's 'thoughts' allows us to explain nothing that we cannot already explain in terms of its circuitry, appealing to an animal's thoughts does afford explanations of its behavior that we cannot provide in other terms. Moreover, if instrumentalists about animal thought are to avoid instrumentalism about science in general, they incur a debt. They must explain why we should be instrumentalists about animal thought, but not (say) electrons or evolution. After all, just as the explanations of physicists and biologists are structured around an appeal to electrons and evolution, the explanations of ethologists and psychologists are structured around an appeal to animal thoughts. So instrumentalists must explain why ethology and psychology should be treated differently from other sciences.

### I.4. INDETERMINACY

One *prima facie* embarrassment for realists about animal thought is the difficulty we face precisely specifying animal thought contents. For example, while an ethologist might say that a chimpanzee is stripping the leaves off a branch because it believes that *bare branches facilitate termite fishing*, it is questionable whether the content of this sentential attribution is a perfect match for the content of the chimpanzee's belief. The contents of our sentences, it might seem, are simply too precise and structured to accurately characterize the mental states chimpanzees actually have. As a result of such worries about the indeterminacy in our attributions of thoughts to animals, many philosophers have questioned whether animals really have thoughts at all (Malcolm 1972–1973; Davidson 1975; Dennett 1987, 1991; Putnam 1992; Jamieson 2009).

There are, however, two reasons to resist this skeptical conclusion. First, while we clearly find it *difficult* to characterize the contents of animal thoughts, it hardly follows that we are doomed to eternal failure. Given sufficient time and effort, animal researchers might meet with greater success (Allen 1992). Second, even if careful observation and experimentation don't allow us to precisely characterize the contents of animal thoughts in human language, it would be rash to conclude that animals don't think. Animal thoughts may simply be too different from sentences of human language, in content and/or format, to be amenable to exact expression therein. Thus, the apparent indeterminacy in our attributions of thoughts to animals gives us little reason to conclude that animals lack thoughts altogether.

### 1.5. REFLECTIVE AND INSTRUMENTAL REASONING

A final reason that some philosophers have been uncomfortable attributing thoughts to animals is that they doubt whether animals genuinely *reason*. Davidson (1975, 1982) and McDowell (1994) develop this line of argument by maintaining that genuine reasoning must include the capacity for *reflection*, which involves the ability to think about one's thoughts (Davidson), or to think about reasons as such (McDowell). Since they also believe that language is necessary for such reflection (cf. Bermúdez 2003, Ch. 8), they deny that animals have thoughts.

Philosophers have objected to both steps in this argument. First, whether reasoning must be reflective is arguably just a terminological issue. We can use the word 'reason' in a stronger sense, such that it requires reflection, or we can use it in a weaker sense, such that it does not. Given that most philosophers who claim that animals think only seem to mean that animals reason non-reflectively, their claim is not obviously threatened by Davidson and McDowell's contention that animals do not reason reflectively. Or at any rate, it isn't threatened unless there is a compelling argument that reflective reasoning is a prerequisite for non-reflective reasoning, a point on which most philosophers have found Davidson and McDowell's discussions to be wanting (Jeffrey 1985; Ward 1988; Glock 2000; Andrews 2002; Carruthers 2004; Camp 2009a; Burge 2010, Ch. 7). Second, the claim that language is necessary for reflection is subject to two empirical challenges: evidence for metacognition in animals (Smith 2009; but cf. Carruthers 2008); and evidence of aphasics with intact mind-reading abilities (Varley 1998).

A weaker yet still substantive constraint requires thinkers to be capable of *instrumental* reasoning. The basic idea is that genuine thought requires a certain amount of distance from the here-and-now. Thinkers must therefore be able to reason about how to realize non-immediate goals, and so a creature that could only 'reason' about what is right in front of it would not really be able to reason at all. While Dummett (1994) concludes that animals must therefore lack thoughts, Bermúdez (2003, Ch. 3) and Camp (2009a) observe that there is ample empirical evidence that chimpanzees, rats, and even birds satisfy this requirement. They draw the line, however, at simple organisms such as honeybees, which do not seem to reason instrumentally. By contrast, Carruthers (2004) argues that instrumental reasoning is only one type of reasoning, and thus that bees should count as genuine thinkers as well. Again, it is not obvious that the debate here is more than terminological. Once we distinguish instrumental reasoning from basic reasoning, we can draw a corresponding distinction between instrumental thought and basic thought, and investigate empirically which animals are capable of each.

## 2. *Is Animal Thought Conceptual?*

Going forward I will assume that at least some animals have at least some kinds of thought. The question I now wish to consider is whether any of those thoughts are *conceptual*.

### 2.1. CHARACTERIZING CONCEPTUAL THOUGHT

'Conceptual thought' is a term of art, and not everyone means the same thing by it. At least one major strand of usage, however, treats thought as *conceptual* when, and only when, it is composed from discrete elements, or concepts, in much the way that a sentence is composed from words. This view of conceptual thought has echoes in Kant and Frege, and is explicitly elaborated in two recent philosophical traditions, one that analyzes conceptual

thought in terms of the exercise of discrete cognitive abilities (Evans 1982; Peacocke 1992), and a second that analyzes conceptual thought in terms of formally individuated sentences in a ‘language of thought’ (Fodor 1975, 1998). For our purposes, the differences between these traditions are less important than their similarities. Both maintain that thoughts are conceptual insofar as they admit of a sentence-like compositional structure.

What sort of compositional structure, exactly, must thoughts have to count as ‘sentence-like’ and thus conceptual? Again, there is no uniform agreement. Some philosophers seem to require solely that thoughts be composed from discrete elements. But most philosophers have something stronger in mind – something that at least includes predicative and logical structure. For example, in the course of spelling out the language of thought hypothesis, Margolis and Laurence write that it posits a ‘language-like syntax’ that ‘incorporates, at the very least, a distinction between predicates and subjects, and that includes logical devices, such as quantifiers and variables’ (Margolis and Laurence 2007: 562). Similarly, Burge takes concepts to be certain constituents in *propositional* structures, whose ‘key element’ is predication (Burge 2003: 525; cf. Evans 1982: 104). Burge also holds that propositional structures have logical form, and thus include conceptual analogs of logical constants such as *not*, *either-or*, *if-then*, and *is identical to* (Burge 2010: 542–5). Obviously, the more strictly we uphold the analogy between the structure of a sentence and the structure of thought, the more difficult it becomes for animals to qualify as conceptual thinkers. It is worth bearing this point in mind as we consider several arguments that purport to show that animal thought is conceptual.

Before we turn to these arguments, however, I want to stress that not all philosophers and psychologists associate the term ‘concept’ with the constituents of sentence-like structures. For example, many comparative psychologists take the capacity to discriminate Xs from non-Xs to suffice for having the concept X (e.g., Herrnstein, Loveland, and Cable 1976; Cook 2002). Others take discrimination as a starting point, but emphasize further conditions for concept possession, such as independence from perception (Allen and Hauser 1991), detecting and learning from discrimination errors (Allen 1999), or extracting classes from perception (Newen and Bartels 2007). There is, of course, nothing wrong with using the term ‘concept’ in these ways. It is just important to realize that they differ from the usage that emphasizes sentence-like compositionality, and that we will be concerned solely with this latter usage as we consider arguments that purport to show that animal thought is conceptual.

## 2.2. THE ARGUMENT FROM PRODUCTIVITY

The first argument I want to consider begins from the premise that thinkers can entertain an infinite number of thoughts. But brains, it is observed, are finite organs. They contain a finite number of neurons, synapses, and even atoms. In order to be stored in brains, thoughts must therefore be structured. They need to be composed from parts that have the capacity to recombine with one another to make infinitely many thoughts, much like words can recombine to make infinitely many sentences (Fodor 1987; Margolis and Laurence 2007).

This argument faces two difficulties. First, while it is plausible that *humans* can think an infinite number of thoughts, it is far from obvious that animals can do so. For example, Carruthers has argued that bees ‘are capable of just a few dozen types of desire, and... just a few thousand types of belief’ (2004: 215). While bees may be a special case (chimpanzees surely have many more beliefs), a proper defense of this argument would need to be supplemented by evidence that animal thought truly is unbounded.

Second, and more fundamentally, language does not provide our only model for generating infinities. An artist is capable of producing an infinite number of drawings. But drawings are not composed from discrete units, let alone units that are structurally analogous to subjects, predicates, and logical constants. Thus, even if some animals truly can think an infinite number of thoughts, it doesn't obviously follow that those thoughts must be conceptual. It is thus doubtful that productivity *per se* should be taken as evidence of conceptual thought.

### 2.3. THE ARGUMENT FROM REIDENTIFICATION

William James articulates a different motivation in favor of animal thought being conceptual.

In this sense, creatures extremely low in the intellectual scale may have conceptions. All that is required is that they should recognize the same experience again. A polyp would be a conceptual thinker if a feeling of 'Hollo! thingumbob again!' ever flitted through its mind. (James 1950: 463)

James' basic idea is that conceptual thought is necessary for reidentification. If a polyp can think *That thingumbob is here* on one occasion, and then *That thingumbob is here again* on another, it must deploy a single concept, *that thingumbob*, in two separate thoughts on two separate occasions. More recently, Bermúdez has developed this idea into an argument that animal thoughts must have a 'subject-predicate' structure (2003: 59). In order to explain how a rat can reidentify a piece of food at different locations, and reidentify a location with or without food present, Bermúdez argues that we must attribute to the rat a thought with the structure of an atomic sentence that is composed from the subject-concept *food* and the predicate-concept *is located at coordinates*  $(x, y)$  (2003: 95–104). (See also Campbell 1986 and Horgan and Tienson 1996.)

But this argument is open to challenge. Many researchers have proposed that animals keep track of items in the environment by affixing mental markers to a cognitive map, which represents by virtue of a structural isomorphism between the geometric properties of the cognitive map and the spatial layout of the environment. While this suggestion may seem to be similar to Bermúdez's proposal, several philosophers have argued that there are important differences between the type of compositionality that is involved in affixing a marker to a map and the type of compositionality that is involved in concatenating a subject and predicate. For example, Rescorla (2009a) argues that neither coordinates nor markers, the two basic components of maps, have the properties typically attributed to predicates by logicians such as Frege or Tarski. Rescorla (2009b) further argues that the cognitive maps roboticists and psychologists appeal to lack logical form, and are in that respect also unlike natural language sentences. Additionally, Heck (2007) and Camp (2007) contend that the geometric structure of maps constrain their contents in ways that do not apply to sentences. Given these apparent differences between maps and sentences, and the possibility that map-like representations could undergird reidentification, it is thus questionable whether reidentification requires conceptual thought.

In fact, one might even question whether anything so complex as a cognitive map is required for reidentification. There is some evidence that bees make use of a form of template matching to reidentify their hives. When a bee leaves its hive, it turns around after flying a few meters away and stares back at the hive before continuing on its journey. On the return trip, when it comes back to within a few meters of the hive, it hovers around until it gets the hive in view from a perspective that is similar to the one



it took in at the start of its outward journey. One theory has it that the bee takes a ‘snapshot’ of the hive on its way out which it stores as a visual image. When it returns, it compares this stored visual image to its on-line perceptual image until they align (Collett and Rees 1997). Even if we interpret conceptual thought weakly, such that it only involves composition from discrete elements, nothing in this theory seems to require the bees’ capacity for reidentification to be driven by conceptual thoughts.

#### 2.4. THE ARGUMENT FROM SYSTEMATICITY

Fodor and his colleagues have maintained that animal thought is ‘systematic’ – i.e., that the thoughts animals can think exhibit sentence-like patterns (Fodor 1987; Fodor and Pylyshyn 1988; Fodor and McLaughlin 1990).

You don’t find organisms that can learn to prefer the green triangle to the red square but can’t learn to prefer the red triangle to the green square. You don’t find organisms that can think the thought that the girl loves John but can’t think the thought that John loves the girl. (Fodor and McLaughlin 1990: 332)

Fodor and his colleagues conclude that animal thoughts must be structured like sentences. For what else could account for the fact that animal thought is universally systematic?

Ned Block has complained that Fodor’s defense of systematicity is ‘uncomfortably anecdotal’ (Block 1995: 411). But a number of philosophers have defended Fodor in greater empirical detail. For example, Carruthers (2004, 2006) and Tetzlaff and Rey (2009) point to systematicities in the foraging behavior of honeybees, such as the fact that bees that can represent that a feeder is a certain distance from the hive can also represent that the hive is a certain distance from the feeder. They argue that such systematicities are rife even in simple organisms.

But even if animal thought is systematic to *some* extent, many philosophers have questioned whether it is *fully* systematic in the way that human thought is. For example, Camp (2009a) argues that although a chimpanzee can plausibly think that an infant is hungry and that an adult male is dominant, it is questionable whether it can think that an infant is dominant. Such an outrageous thought may well be beyond its capacities. Of course, as Carruthers (2004) observes, just because animals *don’t* think certain thoughts doesn’t mean that they *can’t*. It may simply be that animals aren’t interested in certain thoughts (what use would such a thought be to a chimpanzee?), and thus don’t bother to recombine their concepts in certain ways. But as Camp points out, the mere possibility that animals *might* have the capacity to think such thoughts hardly settles the question whether they *do*.

Replying to Camp, Carruthers (2009) distinguishes two types of systematicity, a stronger type that involves full recombining (or something close to full recombining), and a weaker type that involves more limited recombining. Carruthers argues that even weak systematicity, which animals clearly display, is evidence of conceptual thought. He thus concludes that animals as simple as honeybees have conceptual thought.

At this point, it is crucial to remember that the notion of conceptual thought admits of disparate interpretations, depending on just how strongly we take the analogy to sentences. If conceptual thought is merely thought that is composed from some discrete elements or other, then weak systematicity arguably is evidence of conceptuality. But if conceptual thought is supposed to exhibit predicative and/or logical structure, then it is far from obvious that weak systematicity does signal conceptuality. For example, although

cognitive maps arguably lack predicative or logical structure, they are weakly systematic (Rescorla 2009b; Camp 2007).

Further evidence that at least some animal thoughts are *not* strongly systematic derives from so-called *analog magnitude* thoughts, which a wide range of animals use to represent magnitudes such as number, time, distance, and rate. One feature of these thoughts is that they give rise to *Weber's Law*, which entails that the ability to discriminate any two magnitudes is a function of their ratio. As a result, when the ratio of two magnitudes approaches 1, animals can no longer discriminate them. Beck (forthcoming) argues that strong systematicity is thus violated since an animal might be able to think thoughts along the lines of *9 is less than 18* and *10 is less than 20*, but not *9 is less than 10* or *18 is less than 20*. Beck further argues that such violations of systematicity derive from the analog format of the representations underlying animals' magnitude thoughts.

## 2.5. THE ARGUMENT FROM INFERENCE

Many philosophers believe that we human beings must have conceptual thought because we are capable of drawing inferences (Evans 1985: 337; Crane 1992: 146–7; Burge 2010: 542–7). For example, you can draw inferences of the following forms:

Fa	Fa
<u>a = b</u>	<u><math>\forall x(Fx \rightarrow Gx)</math></u>
Fb	Ga

If you believe that Amy is friendly, and then come to believe that Amy = *b*, you can infer that *b* is friendly, no matter what *b* is. And similarly, when you believe that Amy is friendly, and come to believe that everything that is friendly is also G, you can conclude that Amy is G. Given that you are able to draw such inferences for your thousands of beliefs, you must surely have one state that allows you to think of any arbitrary object that it is friendly (for how else could you come to believe that *b* is friendly no matter what *b* is?), and a second, independent state that enables you to think about Amy – i.e., to think of any arbitrary property that Amy satisfies it (for how else could you come to believe that Amy is G no matter what G is?). Thus, your thoughts must be *structured*. They must be composed from multiple, discrete elements in much the way that sentences are.

Given that we defined thoughts as states that participate in reasoning, and argued that animals are capable of at least some forms of reasoning, it may seem to follow that animals must have conceptual thoughts too. But a lot depends on what *kinds* of inferences animals are capable of drawing when they reason. Some transitions over mental states, such as laying down a marker on a cognitive map, or summing two analog magnitude representations, might reasonably be considered inferences, but do not seem to require an appeal to states with predicative or logical structure. By contrast, *logical* inferences, such as those isolated in the previous paragraph, do seem to require an appeal to sentence-like states. Thus, while one's inferential capacities serve as a window into the structure of one's thoughts, only logical inferences are revelatory of conceptual thought.

If we could show that animals are capable of logical inference, we could thereby argue that they have conceptual thought. The extent to which animals *are* capable of logical inference, however, is still hotly contested. Some researchers argue that various types of logical inference are exhibited by animals, including: exclusionary inferences (disjunctive syllogisms) in great apes (Call 2006a,b) and dogs (Erdőhegyi et al. 2007); transitive inferences in



monkeys (McGonigle and Chalmers 1977, 1992), baboons (Seyfarth and Cheney 2002), and sea lions (Schusterman, Kastak, and Kastak 2002); and causal inferences in apes (Call 2006a), monkeys (Hauser and Santos 2006), and rats (Dickinson and Shanks 1995; Blaisdell et al. 2006). But others have reached more skeptical conclusions (e.g., Bermúdez 2003, Ch. 6; Penn and Povinelli 2007; Penn, Holyoak, and Povinelli 2008). The issues here are delicate because behaviors that may at first seem to require logical inference can sometimes instead be explained more modestly. For example, exclusionary reasoning might be explained in terms of Bayesian updating over cognitive maps (Rescorla 2009c) or proto-logical inference (Bermúdez 2003, Ch. 7; 2006); transitive inference might be explained by associative learning (Zentall 2001; DeLillo, Floreano, and Antinucci 2001; Allen 2006) or manipulations over diagrammatic tree-like structures (Camp 2009b); and causal reasoning might be explained through some combination of associative learning and innate biases (Penn and Povinelli 2007) or causal Bayes nets (Blaisdell et al. 2006). Whether the argument from inference can be extended to animals is thus still very much an open question.

### 3. *The Road Ahead*

We began with the question whether animals have conceptual thought. If our inquiry hasn't paved the way to a definitive verdict, it has at least narrowed our search.

We have seen that there exists considerable empirical evidence that animals have thoughts – contentful mental states that causally and rationally mediate between perception and action. The more delicate question is whether those thoughts are conceptual.

One issue to emerge from our discussion is that the notion of conceptual thought is itself imprecise. Because it rests largely on an analogy that likens thoughts to sentences, it admits of disparate interpretations. As we have seen, many philosophers take the analogy to include a commitment to both predication and logical devices, although some others seem to require little more than compositionality. While there is little point arguing about how strongly the analogy 'really' ought to be taken, future research would benefit if researchers were explicit about how they understand the analogy when they make claims about animals having, or not having, conceptual thought. After all, there are real differences in the expressive power of different mediums of representation, so when we attribute mental states to animals we ought to be explicit about exactly what structure is being assumed.

Our discussion has also taught us something about the sorts of considerations that serve as evidence for conceptual thought in animals. Merely asking whether animals' thoughts are productive, or whether animals are capable of reidentification, will not teach us much about the structure of animal thought since productivity and reidentification can occur in the absence of even the weakest forms of conceptual thought. By contrast, considerations based on systematicity and inference are more likely to speak to whether animal thought is conceptual. But these considerations need to be treated with care. It is not sufficient to ask if animal thoughts exhibit *any* systematic patterns, or if animals are capable of *any* types of inference. We need to be explicit about exactly what sorts of systematic patterns and inferences animal thoughts enter into. Only then will we be able to use those patterns and inferences as a window into the structure of animals' thoughts.

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### Short Biography

Jacob Beck is an Assistant Professor of Philosophy at Texas Tech University. He received his PhD in philosophy from Harvard, and his BA from the University of Pennsylvania, where he majored in philosophy and minored in cognitive science. He recently completed an appointment as a James S. McDonnell Postdoctoral Fellow in the Philosophy-Neuroscience-Psychology Program at Washington University in Saint Louis. Beck's research seeks to shed light on the nature of mental representation by bringing philosophical questions and debates into contact with empirical research in the cognitive sciences. Among the topics he is currently investigating are: the nature of concepts and conceptual content; the existence of indeterminacy in our attributions of mental contents; and what separates human cognition from animal cognition. His paper 'The Generality Constraint and the Structure of Thought' is forthcoming from *Mind*.

### Note

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