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THE STUDY OF INFERENCE IN PHILOSOPHY AND COMPARATIVE PSYCHOLOGY

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SUMMARY: I compare the study of inference in some philosophical and psychological traditions, and I make three general points. First, I suggest that in both human and non-human animals, inference is a means by which subjects aim to achieve an accurate and coherent representation of the world. Second, I contend that philosophical work on rational dispositions and empirical research on reasoning helps to outline an unreflective notion of taking the premises to support the conclusion. Third, I claim that paying attention to the distinction between logic and reasoning is important to fine-tune the standards for the observation of deductive reasoning in empirical research.

KEYWORDS: animal rationality, taking condition, epistemic feelings, logic vs. reasoning, two-cup task

RESUMEN: Comparo el estudio de la inferencia en algunas tradiciones filosóficas y psicológicas a fin de extraer tres conclusiones generales. Primero, sugiero que, tanto en humanos como en animales no humanos, la inferencia es un medio por el cual los sujetos buscan alcanzar una representación precisa y coherente del mundo. Segundo, sostengo que la labor filosófica sobre disposiciones racionales y la investigación empírica sobre el razonamiento contribuyen a delinear una noción no reflexiva de tomar las premisas como respaldo de la conclusión. Tercero, afirmo que atender a la distinción entre lógica y razonamiento es importante para afinar los parámetros de observación del razonamiento deductivo en la investigación empírica.

PALABRAS CLAVE: racionalidad animal, condición de tomar como respaldo (*taking condition*), sentimientos epistémicos, lógica vs. razonamiento, tarea de las dos copas

1. *Introduction*

Inferences are an example of cognitive achievements studied by philosophers and psychologists. While many philosophers work on *normative* theories aiming to specify the conditions under which subjects are rational or justified in performing an inference, psychologists typically are concerned with *descriptive* theories that seek to identify the mechanisms by which subjects perform inferences. Roughly, while normative theories aim to represent how things ought to be, descriptive theories aim to outline how things are. Nevertheless, normative and descriptive investigations are related. On the one

hand, normative theories need to be sensitive to what real subjects can do, lest they risk failing to apply to them. On the other hand, any description of how subjects reason relies on some idealization, which in turn relies on some normative standard—such as, for example, the standard to determine whether two distinct mental processes are tokens of the same type. Thus, normative and descriptive theories had better inform each other.

In this paper, I aim to foster dialogue between the study of inference in the philosophical tradition informed by the characterization of humans as the only rational animals and the study of reasoning in comparative psychology in the wake of Premack's (1995) contrast between associative learning and inference. I begin by clarifying what I take inference to be in general terms, by outlining some differences between its characterizations in the relevant philosophical and psychological traditions, and by illustrating how inference matters to assess the claim that only humans are rational (section 2). After that, I make three general points. The first two concern the potential philosophical gain of engaging with comparative psychology while accounting for the minimal conditions for inference (section 3), and explaining what it takes to appreciate that some premises support a conclusion (section 4). The third point will go in the other direction and suggest that comparative psychology may benefit from engaging with philosophy too. In discussing Engelmann and colleagues' (2023a) recent study on deductive reasoning in chimpanzees, I will suggest that familiarity with the philosophical distinction between logic and reasoning may help comparative psychologists to identify appropriate normative standards for deductive reasoning (section 5).

2. *Characterizations of Inference*

What follows is largely inspired by thinking about the view that humans are the only rational animals. This view, which goes back at least to Aristotle, characterizes rationality as the capacity to respond to reasons or evidence, and describes inference as *personal-level* transitions in thought.¹ That is to say, inference is understood as a transition between consciously entertained premises—or at least premises within conscious reach—to a consciously entertained conclusion. For present purposes, I accept this framing and discuss inference as a

¹Recent defences of the view include Boyle 2018, Korsgaard 2018a, 2018b, and Marcus 2022. For a brief discussion of alternative notions of rationality and why they are not relevant in the present debate see Melis and Monsó 2024 (section 2) and Melis and Blakey 2026 (section 2).

personal-level phenomenon too. This choice does not mean that I think that sub-personal inference is not interesting or irrelevant; it's just that, in this paper, my inquiry is focused on the personal-level—on trying to reconstruct the content of the thoughts of inferring subjects. While it is rarely noted, this approach is in line with the research in comparative psychology that I will touch upon, which also aims to reconstruct what subjects think or represent (rather than what is processed by their cognitive systems).

Simplifying, in comparative psychology, inference is contrasted with associative learning and, following Premack (1995), it is often characterized along two dimensions. The distinction along the *representational* dimension has it that associative learning involves connecting two previously perceived events,² while inference connects a perceived event and an imagined one. The distinction along what we might call the *explanatory* dimension has it that inference, but not associative learning, depends on the search for causes of unexplained events and involves some level of understanding of the observed phenomena. By contrast, associative learning identifies arbitrary regularities between events. (See, e.g., Call 2004, p. 232).

The representational and explanatory characterizations are taken to be individually sufficient for inference, while neither is necessary. Such a disjunctive approach is due to the operational nature of characterizations of inference in comparative psychology. The discipline demands that there be criteria for the empirical identification of inference, and each of the two characterizations outlined provides them. For example, with respect to the representational dimension, associative learning is marked by gradual improvement over time, while success on first trials is a mark of inference. With respect to the explanatory dimension, a sign of inference is subjects' higher rate of success in solving problems when causal understanding is within reach as opposed to situations where relevant regularities—the tracking of which would allow success in the task—are arbitrary.

Simplifying again, in the target philosophical tradition inference is taken to be a transition from a doxastic attitude to another in accordance with a rule or in response to reasons or evidence. Some also insist that inference requires the subject to take the premises to support the conclusion (Boghossian 2014), and sometimes such taking is characterized as involving propositional self-consciousness (e.g., Marcus 2021).

² As in, e.g., the representation of stimuli and responses in classical conditioning.

A clear difference between the two disciplinary characterizations is that, as doxastic attitudes are commonly taken to be composed by concepts, the philosophical notion is more cognitively demanding than the one used in comparative psychology. The former entails conceptual thought; the latter is compatible with non-conceptual (i.e., imagistic or iconic) thought. Since from the outside it is very hard to tell in which format non-human animals (henceforth: animals) reason, the difference noted may invite the claim that genuine inference—a transition between *doxastic* attitudes—is uniquely human. Alternatively, it may appear to warrant the claim that there are two different kinds of inference: one that operates over conceptual contents, and one that operates over non-conceptual ones. And, the story would continue, only humans have the capacities required to engage in the former.³

The presumed difference in kind between human and animal thought is often supplemented by the suggestion that the capacity to respond to reasons or evidence demands that one be able to think of evidence *as evidence*. This is the capacity to identify and assess putative reasons for belief, together with the ability to revise one's views in the light of assessments of reasons (e.g., Boyle 2018; Korsgaard 2018; Marcus 2022; Stovall 2025).

Recently, the claim that the identification and evaluation of evidence is uniquely human has been challenged (e.g., Melis and Monsó 2024; Schleihau et al. 2024). Similarly, it has been argued that the capacity to respond to evidence does not require reflective abilities but is already operative in unreflective subjects—subjects unable to think of evidence as evidence but who nevertheless display sensitivity to it (e.g., Kornblith 2012, pp. 69–70; Melis and Blakey 2026). The foregoing suggestions put pressure on the claim that humans are the only rational animals. Since inference is a special case of forming a belief in response to evidence—i.e., the premises—the study of inference promises to contribute to understanding the nature of rational animals. And, I suggest, engaging with comparative psychology

³ There is very little agreement on how to draw the conceptual/non-conceptual divide, and this is not the place to attempt a characterization of the distinction. What matters for present purposes is that many philosophers who defend human uniqueness with respect to rationality have taken conceptual thought to be available only to humans and to be different in kind from non-conceptual thought (e.g., Dummett 1993a, 1993b, pp. 121–126; Davidson 1975, 1982; Stich 1979; McDowell 1994; Brandom 1994, 2000). The conceptual vs. non-conceptual distinction is thus one of the places where the difference in kind between human and animal minds has been identified. See Laurence and Margolis (2012, 2023) for recent agile overviews of the debate.

is something that philosophers interested in either the nature of inference or the nature of rational animals would be well advised to do.

3. *The Common Core*

We have seen that the outlined characterizations of inference differ with respect to the inferring subject's cognitive abilities. Yet, beyond the surface, the philosophical and comparative characterizations appear to have a common core which, I shall argue in this section, philosophers who think that rationality is the capacity to respond to reasons—and indeed philosophers interested in the relation between human and animal reasoning and in the nature of inference *simpliciter*—should pay attention to.

As per the *representational* characterization in comparative psychology, transitions between doxastic attitudes are often transitions to a new (not-previously perceived or represented) content. Similarly, as per the *explanatory* characterization in comparative psychology, at least in a wide range of cases, inferences between doxastic attitudes involve an appreciation of causal relations which, in turn, embodies a relation of epistemic support.⁴ To appreciate the commonality, it will help to illustrate animal inference with reference to the two-cup task run with great apes by Call (2004).

In Call's task a subject is first shown two empty cups and how they may contain a reward. Then the subject's view of the cups is prevented by positioning a screen in front of them, and the subject sees that a reward is placed behind the screen but cannot see in which cup it goes. Next, the screen is removed and one of the two cups is shown to be empty. Finally, the subject is invited to choose between the two cups. Many apes immediately choose the non-empty cup, without checking either cup first. This experiment, together with the many control conditions to check for possible associative explanations,⁵ shows that apes perform transitions in thought that—

⁴ The interplay between grasp of causal and epistemic relations can be illustrated with an example. When, through experience, one understands that leaving the tea bag in hot water for more than five minutes gives tea a strong taste, one thereby gains a reason to believe a corresponding conditional: <if tea is infused for more than 5 minutes, it tastes strong>. Later, when one realizes that one forgot the tea bag in infusion, the causal understanding informs one's inference from <the tea bag has been in infusion for over 5 minutes> to <the tea has now a strong taste>. In other words, grasp of a causal connection between cause *C* and effect *E* gives one access to an epistemic reason to believe that when *C* happens, *E* happens too.

⁵ I lack the space to discuss the various control conditions, but see, e.g., Call 2006, 2022; Hanus and Call 2008.

from the outside at least—look a lot like disjunctive syllogism: $\langle P$ or Q ; not P ; therefore $Q \rangle$.⁶

Since deductive reasoning is sometimes presumed to be uniquely human (e.g., Bermúdez 2006; Rescorla 2009) and—if Burge (2010) is right—entails conceptual thought, disjunctive syllogism in animals would be remarkable. We'll touch on the debate whether great apes can reason deductively in section 5. For now, let's suppose that the animals who succeed in the task reason *non-deductively*; say, they update visual representations without relying on truth-functional connectives, perhaps along the lines outlined by Bermúdez (2006) or Rescorla (2009).⁷ Even so, at least if we are open to the possibility of unreflective responses to evidence, it is significant that the reasoning in question mirrors deductive reasoning.

In both cases, the inferential transition occurs between mental representations that are evaluable for their truth or accuracy.⁸ In both cases the contents of the premises are accepted in response to perceptual evidence, and the acceptance of the conclusion is based on the premises. This suggests that animals who succeed in the two-cup task, by reasoning deductively or otherwise, form and manage the contents they accept in a way that is very close to the way in which humans form and manage their beliefs—regardless of whether those contents are entertained in conceptual format. I conjecture that, both in the human and animal case, subjects form and revise their representations by inherently aiming at accuracy and coherence, even if they do not think—or cannot think—about the goals of accuracy and coherence.

⁶ With respect to *representation*, the inference just described involves going beyond what is perceived. In inferring P from P Or Q and not- Q one does not perceive P . With respect to *explanation*, to the extent that subjects used non-arbitrary (i.e., causal) cues to solve problems (while they were unable to use arbitrary (i.e., non-causal) ones), their success suggests that they understand (that is, they have accurate and coherent representations of) the relevant phenomena.

⁷ Bermúdez appeals to non-conceptual representation of contrary attributives, while Rescorla suggests that animals may succeed by updating map-like representations through Bayesian mechanisms.

⁸ I am here setting aside the view that animals are not capable of intentional thought at all—a much more radical claim than the denial of conceptual thought in animals (e.g., Sellars 1956 [2003] and Davidson 1975). The view has been discredited because it relies on over-demanding characterizations of what it takes to *have* intentional states, such as grasp of the concepts of truth and belief themselves. See Dretske 2006, Carruthers 2009, and Burge 2014 for more minimal characterizations of what it takes to have intentional states. Sellars (1981) appears to have changed his mind and allow for the ascription of intentional states, including propositional attitudes, to at least some animals.

This last point deserves emphasis. In the picture I have sketched, there is nothing metarepresentational about pursuing the goals of accuracy and coherence. Suppose that when a chimpanzee sees that a reward is being placed behind the screen, she represents the food as being hidden in a specific cup—say, she makes a guess—but then is shown that that very cup is empty. Now, replacing the original representation with one according to which the food is *not* in that cup does not require the capacity to think thoughts like <my previous representation was inaccurate>. It just requires the capacity to respond—*unreflectively*—to simple (positive and negative) evidence.⁹ For what has been said so far, all the chimpanzee's representations remain at the first-order: they all represent the world.

To my mind, the analogy just sketched between human and animal reasoning warrants further scrutiny by researchers interested in understanding the nature of rational animals and the nature of inference. Philosophers who are sympathetic to unreflective responses to evidence will likely acknowledge the significance of engaging with comparative psychology. Philosophers who are suspicious of the notion of unreflective responses to evidence are under pressure to explain away the analogy just sketched. Any rejection of the purported significance of the analogy, however, had better engage with relevant empirical research.¹⁰ We are not cognitively developed humans in a void. We start off as infants and, as we become adults, we remain an integral part of the natural world. So, the question of the relation between our adult epistemic states and those we had as children arises. Similarly, questions arise about the relation of (infant and adult) human epistemic states with corresponding states in animals. To achieve a comprehensive account of such relations, it is important to engage with the empirical research that studies the mental and epistemic states of animals.

I take the foregoing to have illustrated—extremely quickly, no doubt—one way in which the philosophical study of inference stands to gain by engaging with comparative psychology. Doing so enables a full investigation into the nature of rational animals and the relationship between human and animal reasoning. This, in turn, promises to shed light on the nature of inference *simpliciter*. In the next section, I

⁹ For details on what it takes to respond to evidence unreflectively, see Melis and Blakey 2026 (sections 2–3), Melis and Monsó 2024 (section 3), and Melis 2025 (section 4).

¹⁰ It also has to engage with philosophical arguments in defence of unreflective responses to evidence, but that goes without saying. I discuss some of the arguments in Melis 2025.

make a suggestion about how cooperation between philosophical and psychological research may contribute to understanding the nature of inference.

4. *Appreciating the Relation between Premises and Conclusion*

Someone who accepts that unreflective subjects can respond to evidence coming from changing environments, and who is interested in the relation between human and animal reasoning, would be keen to explore an account for the relation between premises and conclusion such that non-human animals—and, indeed, pre-verbal or minimally verbal children—might appreciate it. The topic of subjects' appreciation of the relation between premises and conclusion is often discussed in the philosophical literature in terms of the so-called Taking Condition. Here's Boghossian's original formulation of the condition: "inferring necessarily involves the thinker *taking* his premises to support his conclusion and drawing his conclusion *because* of that fact" (2014, p. 5).

As anticipated by Carroll (1895), one issue with the Taking Condition is the risk of infinite regress. If the taking is cashed out as a judgment or a belief with a content like <the premises support the conclusion>, a premise is thereby added to the original list. But, for the very same reasons that motivated the Taking Condition in the first place, adding a premise would in turn require a judgment or belief to the effect that the extended set of premises supports the conclusion. And so on.

Various attempts to avoid the regress by articulating the Taking Condition in non-doxastic terms have been made. For example, Boghossian (2018) appealed to rational intuitions or intellectual seemings, Peacocke (2026) proposed some *sui generis* attitude, and Boyle (2024, pp. 171–184) invoked a liminal pre-doxastic state—something less than explicit belief and more than a blind causal mechanism or disposition.

Appealing as such para-doxastic construals might be, it is not clear that they have the resources to avoid the infinite regress. For, as Marcus (2021, pp. 105–106) noted, all that is required to generate the regress is the demand that the proposition expressing the connection between premises and conclusion be accepted, even if it does not figure explicitly as an additional premise. As long as the relevant acceptance concerns a (putative) fact, it will involve taking some attitude towards it, be it a *sui generis* one, an intellectual seeming, or some liminal state. But if such attitude is to play the role of vouching

for the good standing of the inference, for the very same reasons that inference needs vouching in the first place, it will require some additional vouching of its own, which will involve a further higher-order attitude in turn. And so on.¹¹

To avoid the regress, it would thus seem that propositional characterizations of the Taking Condition must be abandoned. Alternatively, the Taking Condition itself could be rejected, as suggested by McHugh and Way (2016) and Wright (2014). Yet, denials of the Taking Condition need to be wary of the risk of characterizing inferences as merely something that happens to reasoners rather than as something that reasoners do. It is a phenomenological datum with which we are all acquainted—and which partly explains why we criticize people for the beliefs they form—that inferences, from the first-person, feel like something we do and for which we can take responsibility. The Taking Condition is one attempt to capture this aspect of inference, and it is worth trying a little harder before giving up.¹²

At this stage it may help to remind that the question of what it takes to accept a conclusion on the basis of some premises is a special case of the question of what it takes to form a belief on the basis of one's evidence. To the extent that they express one's rationality, responses to evidence involve some appreciation that the evidence supports taking some specific attitude. And since, as argued elsewhere and recalled above, there can be purely unreflective responses to evidence, there must also be an unreflective notion of taking some premises to support a conclusion. That would be a way of appreciating that the premises support a conclusion without involving any attitudes—doxastic or para-doxastic—towards corresponding propositions.

A two-step strategy may help to account for such *Unreflective Taking Condition*. The strategy would first identify the conditions for such taking to occur from the outside, as it were. Secondly, it would unpack what the taking involves from the subject's own perspective. Let's try to outline each step in turn.

¹¹ Cf. Melis 2025 (p. 326). Note that it does not matter if the relevant attitude is merely potential. The regress is launched by the normative demand that there be some reassurance *that* the premises support the conclusion. Thus, even if the relevant attitude is merely within the subject's reach without being entertained, an analogous regress would kick off at the level of propositional justification.

¹² But, just to limit ourselves to the authors just mentioned, see McHugh and Way 2016 (section 4.4) for scepticism about the Taking Condition's role in accounting for agency, and Wright 2014 (section 3) for an attempt to account for agency without the Taking Condition.

4.1. Rational Dispositions

To identify the conditions under which a subject unreflectively appreciates that some premises support a conclusion, I propose to start from the rational or normative dispositions described by Wedgwood (2006, 2017, chapter 7) and Lord (2018, chapter 5). In Wedgwood's and Lord's pictures, which differ in many important respects,¹³ whether the formation of a new belief is rational does not depend on what the subject could or would believe about the relevant episode of belief-formation. Rather, it depends on features of the episode itself. We can capture the spirit of Lord's and Wedgwood's proposals by describing the relevant dispositions as those that, jointly, serve the purpose of maintaining an accurate and coherent belief-system—or, more broadly, an accurate and coherent representation of the world. As suggested in section 3, the goal of achieving an accurate and coherent representation of the world is inherent to the activity of belief-formation and management; it need *not* be something that the subject herself is in the position to represent.¹⁴ Serving the goal of achieving a set of accurate and coherent representations is what makes the dispositions in question *rational*—responsive to reasons—rather than blindly mechanistic.

In inference, the manifestation of rational dispositions, minimally, requires that it is not an accident that the conclusion is based on the premises. To illustrate, let's paraphrase an example from Lord (2018, p. 132). Suppose that Sam infers that Real Madrid lost from her true belief that Barcelona won. As it happens, this is a good reason to believe the conclusion, given that Real Madrid played Barcelona on that very day. However, Sam is a staunch anti-Real fan and would have reached the same conclusion from virtually any belief. It is thus an accident that Sam accepted the conclusion on the basis of premises that do support the conclusion. To avoid such scenarios, we may consider adding the condition that the inferring subject would not base her belief on the premises, unless the premises actually supported the conclusion. In addition, it would have to be the case that when the subject accepts the conclusion on the basis of her appreciation that the premises *do* support it, should she acquire further reasons to

¹³ For example, Wedgwood is an internalist (of the mentalist variety); Lord is an externalist. Wedgwood thinks that rationality as responsiveness to reasons can be reduced to rationality as coherence; Lord thinks that responsiveness to reasons is a primitive notion.

¹⁴ See also Danón and Kalpokas 2024 for a congenial account which, without mentioning dispositions, is applied directly to animals.

reject one of the premises, she would give up the conclusion as well (assuming that she has no further independent reason to believe it). That is, the inferring subject has to be sensitive to the normative strength of the premises in a broad body of relevant evidence.

One may worry whether such appeal to sensitivity to the normative strength of the premises leaves room for fallacious, or otherwise bad, inferences. We surely want a theory of inference to apply to, say, cases where the subject mistakenly draws a conclusion from premises that, as a matter of fact, *do not* support it. To account for such cases, we can say that in such bad cases one *mistakenly* takes some premises to support a conclusion.¹⁵ In other words, the condition added above had better be weakened to something like “the subject would not base her belief on the premises, unless the premises *reasonably* supported the conclusion.”¹⁶ What good and bad cases have in common is that they all are inherently guided by the goal of maintaining an accurate and coherent belief-system. It’s just that in bad cases, the goal is not being served as well as in the good cases, despite the subject’s efforts.¹⁷

The overarching suggestion is that looking out for the manifestation of rational dispositions may offer the means to identify, from the outside, subjects who make inferences unreflectively. That is, subjects who make inferences without being in the position to think about what they are doing. For example, we may devise ways of checking whether belief-formation exhibits sensitivity to the relation between premises and conclusion by avoiding certain blatantly bad patterns, such as drawing the same conclusion from random sets of premises. Or we might try to check whether one usually complies with well-established principles such as *modus ponens*.

Yet, the appeal to normative dispositions is in need of supplementation if we want to understand what it means for a subject to take some premises to support a conclusion *from her point of view*. To

¹⁵ For present purposes, we can set aside the further question whether fallacious inferences can be justified. What matters is that fallacious inferences can constitute genuine reasoning, as opposed to the reasons-alienated mental gymnastics of cases such as Sam’s above.

¹⁶ Contrast with: “premises actually supported the conclusion.” That is, the notion of reasonable support is *not* a success notion. A set of premises that reasonably support a conclusion is a set of premises that—as far as the subject can in good conscience tell at the time—support the conclusion. But subjects may be mistaken, and it may well be that the premises in fact do not support the conclusion. Sam in the example above would be excluded because he is not in good conscience.

¹⁷ See McHugh and Way 2018 (section 4.4) for an articulated defence of a similar notion of reasoning.

do so, let's consider the following question: how is the manifestation of rational dispositions experienced by the inferring subject in a way that can guide judgment and belief-formation?

4.2. Epistemic Feelings

Empirical research may help to address this question. Recent studies on perceptual judgment, memory retrieval, and reasoning point to the existence of what Proust (2013) calls “epistemic feelings” and Thompson and colleagues (2011) label “feelings of rightness”. Epistemic feelings are affective signals that enable one to monitor one's cognitive activity by tracking characteristics such as fluency and success-rate, thereby providing internal feedback which in turn guides the progress of the relevant activity. They may be described as one's sense of being right or wrong about a cognitive process or state.¹⁸ Shea (2024) suggested that epistemic feelings can be directed at transitions between premises and conclusion. Since feelings are not conceptual, if Shea is right, we may have a way of spelling out the Taking Condition without appealing to any propositional attitude, explicitly or implicitly.

Let's consider an example to illustrate how epistemic feelings may contribute to guide inquiry and decision-making. In a version of “opt-out” paradigms, subjects are trained to discriminate between images that exhibit dense and sparse patterns of pixel density on a screen. When the image shows a dense pattern, subjects get a reward if they pick a D-symbol associated with dense patterns, and they get a penalty—a time out with no possibility to get further rewards—if they choose an S-symbol associated with sparse patterns. When the image shows a sparse pattern, they get a reward for picking the S-symbol and a penalty if they pick the D-symbol. Once subjects master the task and make mistakes only in borderline cases, they are introduced to an O-symbol (for “opt-out”) which enables them to start a new trial without any time-out.¹⁹ Studies with humans and other animals showed that subjects choose the “opt-out” option selectively in borderline cases.²⁰ Epistemic feelings explain how subjects can monitor their own uncertainty to guide choice in borderline

¹⁸ See Shea 2024 (section 3) for a recent discussion of a wide range of relevant studies.

¹⁹ This is a simplified reconstruction of the seminal study by Smith et al. 1997.

²⁰ For general discussion of the significance of the paradigm for the debate on metacognition, and for references to some of the many studies that have implemented it, see Carruthers 2008 and Perner 2012.

cases, without entertaining any second-order propositional states. In clear cases, subjects experience feelings of being right, which track the fluency with which they are disposed to make their choice and, as it were, nudge them to make that choice. By contrast, in borderline cases, subjects experience feelings of uncertainty, which track disfluency in their disposition to choose either the D- or S-option. The feelings associated with the disfluency make subjects hesitant and, as it were, nudge them to pick the “no-penalty no-reward” option.²¹ The point that matters for us is that epistemic feelings contribute to explain why subjects decide—or decide not to—pick the symbol that would give them a reward (or a penalty, if they are wrong).

The suggestion is that something similar may happen in inferences. Considering the premises would trigger the disposition to infer the conclusion together with a feeling about the good standing of the transition. This, in turn, would contribute to explain why one draws, or doesn't draw, the conclusion. Simply put, when the feeling of being right is strong, one proceeds with the inference; when the feeling is weak and gives a sense of uncertainty, the subject hesitates and may refrain from drawing the conclusion.²²

Now, as the mentioned work of Thompson and colleagues illustrates, epistemic feelings are a fallible guide to the good standing of specific transitions, and they seem especially imperfect with respect to the correctness of deductive transitions. This is not an obstacle to the present proposal. I do not mean to suggest that epistemic feelings are infallible or even highly reliable in absolute terms. Rather, the idea is that epistemic feelings provide a general sense about the goodness of inferential transitions, which is largely reliable in simple cases, but may well not be so in less trivial ones. Of course, what counts as simple or complicated is largely subject-dependent. Nevertheless, some conjectures seem plausible. I would suggest that for most subjects who have never taken logic classes, the transition involved in an ordinary case of modus ponens is likely to elicit strong feelings of certainty. And yet, those very same subjects may also associate strong feelings of certainty with corresponding instances of affirming the consequent. Shall we say that in such subjects epistemic feelings are not generally a good guide to the standing of inferential transitions? I don't think so.

²¹ For a more articulated illustration of a strategy along these lines to account for opt-out and uncertainty-monitoring paradigms, see Carruthers and Ritchie 2012 (pp. 84ff).

²² See Shea 2024 (section 4.1) for more extensive general discussion, and Thompson et al. 2011 for empirical studies supporting such a role for epistemic feelings.

First of all, the strong feelings associated with affirming the consequent may be due to the subjects' failure to grasp the difference between the concepts of logical validity and truth.²³ Second, they may be due to the subjects' attempt to reason in non-deductive ways. Shea suggested that subjects who find affirming the consequent compelling may actually be attempting an inference to the best explanation.²⁴ If so, it is not at all clear that subjects are doing anything that is problematic from a normative point of view. And with respect to feelings influenced by a poor grasp of the concept of logical validity, it must be noted that the reliability of feelings can improve with time and practice.²⁵ The discovery of errors provides subjects an opportunity to learn from their mistakes, a process that will involve some intellectual effort and won't rely exclusively on epistemic feelings. It is important to emphasize that the role of epistemic feelings in accounting for the appreciation of the normative relation between premises and conclusion is that of providing subjects with some initial general guidance without discrimination for the difference between deductive and non-deductive inferences. It's not the be-all and end-all of what moves one to reach a conclusion from some premises.

The contribution of epistemic feelings attaching to inferential transitions operates at a non-conceptual level. To illustrate this, let's compare epistemic feelings with intellectual seemings. Appeals to intellectual seemings usually have it that one is justified in drawing a conclusion from some specific premises partly because it seems to one that *that* conclusion follows from *those* premises, that a specific proposition cannot fail to be true, or that some specific inference schema is valid. Intellectual seemings take specific propositions as their content, such as $\langle Q \text{ follows from } P \rangle$, and they are said to arise from *understanding* the propositions or inference-schema in question.²⁶ By

²³ The data gathered by Thompson et al. (2011) suggest that feelings are more in tune with the independent plausibility of a conclusion than with the validity of deductive transition. Interestingly, subjects' rate of success in tracking the validity of some deductive transitions did not improve when subjects were specifically instructed to take their time and consider whether the transitions were logically valid. I take this to suggest that participants—either introductory psychology students or generic members of the University community who were paid a small sum of money to take part in the experiments—did not have a firm grasp of the concept of logical validity. This would not be a surprise to anyone who has taught introductory logic.

²⁴ Shea 2024 (p. 611) gives the following example: "If wood is less dense than water, then wood will float on water; pieces of wood float on water; wood is less dense than water." Cf. also Oaksford and Carter 1994.

²⁵ See, for example, Turner and Thompson 2009.

²⁶ Here are some quotes to illustrate the specificity of intellectual seemings and

contrast, epistemic feelings that attach to inferential transitions lack this specificity and *do not* take specific propositions as their content. They are not, say, feelings *that* modus ponens is valid. They are the same regardless of the specific inference, or form of inference, to which they attach. Epistemic feelings do not distinguish between an instance of modus ponens and an induction, except (possibly) in terms of the strength of the feeling itself. If we really wanted to give feelings a content, it would be a very generic one, something like <this transition is good/bad>. But doing so would be procrustean: subjects needn't be able to articulate such a content: they just experience the feeling, which a theorist may describe in propositional terms as <this transition is good/bad>. Similarly, epistemic feelings do not arise from one's understanding of the schema or propositions involved. Rather, they arise from the dispositions to make a certain transition upon considering the premises. They come before understanding, even if they can influence it and interact with it.²⁷

But the key point for our purposes is that having a feeling that some premises support a conclusion does not require one to be in the position to formulate a thought like <P is a good reason to believe Q> or <P entails Q> to guide the subject's inference. Feelings are not propositional attitudes and do not involve taking an attitude towards any (putative) fact. If the above is along the right lines, epistemic feelings may offer the means to develop an unreflective

their relation with understanding: (i) "Why does the thinker take his MP premises to support his MP conclusion? Because he has the vivid intellectual impression that whenever MP premises are true a MP conclusion must also be true" (Boghossian 2018, p. 62). (ii) "What it is for an intuition experience of yours to have presentational phenomenology with respect to P is for it to both make it intuitively seem to you that P and make it seem to you as if this experience makes you intuitively aware of a truth-maker for P" (Chudnoff 2013, p. 48). (iii) "First, I *understand* the proposition in question [...] Second, given this understanding [...] I am able to see or grasp or apprehend in a seemingly direct and unmediated way that the claim in question cannot fail to be true" (Bonjour 1998, p. 101). (iv) "For you to have an intuition that A is just for it to *seem* to you that A [...] For example, when you first consider one of De Morgan's laws, [...] after a moment's reflection, something happens: it now seems true; you suddenly 'just see' that it is true" (Bealer 1996, p. 613).

²⁷ As we have seen in the previous paragraph, poor understanding may contribute to the generation of misleading feelings. In addition, repeated experience of epistemic feelings may trigger processes of concept-acquisition. One may notice that feelings of high reliability keep attaching to some transitions which in turn have proven to be correct over time, and thereby one may go on to investigate whether those transitions have something in common. In doing so, one may begin to acquire grasp of the concept of epistemic support. Cf. the discussion about the acquisition of the concept of evidence outlined in Melis and Blakey 2026 (section 4).

characterization of the Taking Condition that avoids infinite regress. Of course, much more needs to be said about rational dispositions and the role of epistemic feelings in inference. I hope to have given a sense of how inference can be within the reach of unreflective subjects and meet the Taking Condition without falling prey to infinite regress. Let's now look a bit more closely at some recent research on deductive inference in animals.

5. *Investigating Animal Inferences*

As noted in section 3, the consensus in comparative psychology is that many animals perform inferences. The open questions concern what inferences animals perform and, in particular, whether they make deductive inferences. The question is important for anyone interested in the relation between human and animal reasoning, as addressing it promises to shed light on the relation between deductive and non-deductive inferences, and to clarify which species can engage in either. In this section, I discuss one recent empirical attempt to test for deductive reasoning in animals, and I suggest that comparative psychology may have something to gain by engaging with philosophy too.

5.1. Logic vs. Reasoning

Let's start by recalling the difference between deductive and non-deductive inferences. In deductive inferences the conclusion follows logically from the premises in virtue of a valid argument. Deductive inferences track relations of entailments between propositions such that it is impossible for the premises to be all true and the conclusion false. By contrast, non-deductive inferences do not track entailments, and it is possible for the premises to be true and the conclusion false.

The capacity for deductive reasoning is typically associated with a degree of generality and abstractness that many take to be uniquely human. That's because it is thought that drawing deductive inferences requires appreciating that the same schema would apply for any like-for-like substitution of non-logical terms. Deductive inferences are thus taken to occur purely in virtue of the logical form of the propositions involved and to require grasp of logical concepts, but it is debatable whether animals can grasp concepts whose referents are not readily discernible in the world.²⁸ Inferences done purely

²⁸ Minimally, logical concepts include truth-functional connectives and first-order quantifiers; see MacFarlane (2017) for an overview of the difficulties in drawing the

in virtue of logical form are guided by understanding that the relation between the logical structure of premises and conclusion is that of a valid argument. For example: an inference from <all men are mortal> and <Socrates is a man> to <Socrates is mortal> driven by understanding that it instantiates the following schema: <All *F*s are *G*s; *a* is an *F*; hence, *a* is a *G*>.²⁹ Saying that deductive inferences are done purely in virtue of logical form, in this sense, entails not just some grasp of relevant logical concepts but also the capacity to conceptualize the relation between truth-values of thoughts.³⁰

However, when we look at how people reason in contexts that demand compliance with deductive arguments, it is not clear that they draw inferences purely in virtue of logical form. For example, in the Wason selection task subjects are asked to test the truth of a conditional by turning two of four cards laid on a table. Most people fail to turn the correct cards when the conditional represents abstract relations between numbers and letters, such as <If a card has a vowel on one side, then it has an even number on the other side> (Wason 1968). By contrast, most turn the correct cards when the conditional represents relations with which subjects have some day-to-day familiarity, such as <If a letter is sealed, then it has a 50-lire stamp on it> (Johnson-Laird, Legrenzi and Legrenzi 1972). In short, people seem much better at avoiding the fallacy of affirming the consequent when thinking about scenarios with which they have some direct experience, as opposed to abstract ones. If subjects reasoned purely in virtue of logical form, we should not observe this difference. It appears then that the background context of an inference and the content of the propositions involved are quite important in allowing ordinary folks to appreciate the relation between antecedent and consequent in conditionals. If so, at the psychological level, it is a mistake to reduce deductive inferences to grasp of logical form. But it is a mistake at the normative level too: surely, a subject who has never thought about the difference between affirming the antecedent

logical/non-logical distinction. The question whether animals grasp logical concepts connects with the idea mentioned in section 2 that animals may use pictorial or cartographic systems rather than conceptual ones to represent the world. Since the vehicles of pictorial systems are isomorphic with the content represented, they blur the difference between form and content (Camp 2007) and make it hard to discern logical form. See, e.g., Bermúdez 2006; Rescorla 2009; Aguilera 2016, 2018.

²⁹ See Kornblith 2021 (pp. 53–55) and MacFarlane 2017 for some discussion of the notion of “inference in virtue of logical form”.

³⁰ Cf. Bermúdez 2006 (pp. 128–129). Cf. also Davidson 1982 for the similar idea—rather influential in the philosophical debate on animal thought—that revising one’s beliefs requires grasp of the concept of belief.

and affirming the consequent, has no grasp of the concept of logical validity, and yet makes a non-accidental inference—i.e., manifests the dispositions discussed in subsection 4.1—in accord to *modus ponens*, is justified in believing the conclusion.

To be clear: I am not suggesting that inferences purely in virtue of logical form never occur; just that most of the reasoning in ordinary subjects described as deductive does not proceed purely in virtue of logical form. At this point, it is worth recalling the difference between logic and reasoning. Logic pertains to entailment relations between propositions, which obtain regardless of whether anyone considers them. By contrast, reasoning concerns how subjects go about discovering new truths and managing their representational states. The two are related: when subjects reason well, their reasoning mirrors logical relations, and careful reasoners ought to be sensitive to the constraint on reasoning posed by logic (in essence: avoid logical inconsistency). But they are separate things: while the necessity that binds relations of entailment is inescapable, a subject who performs a deductive inference may well fall short of being certain of the conclusion. This can happen in at least two ways. First, one may perform a deductive inference and yet be less than certain that the premises are true. Second, one can be less than certain that the premises do entail the conclusion.³¹ I suspect that recent research on deductive reasoning in comparative psychology would benefit from paying closer attention to the distinction between logic and reasoning.

In comparative psychology one can find characterizations of the difference between deductive and non-deductive inferences in terms of the degree of confidence with which the conclusion is reached by the inferring subject.³² Roughly, high confidence or certainty is taken as a sign of deductive reasoning, while lower confidence is a sign of non-deductive reasoning. Among the empirical measures of the degree of confidence with which a conclusion is reached are the speed in making up one's mind and the percentage of error. No hesitation and virtual absence of error are taken as signs of deductive reasoning.

Tying certainty and deductive reasoning is appealing, especially when visible signs of deductive inferences are needed. After all, in a

³¹ For discussion of the difference between logic and reasoning see, among others, Harman 1986, 2002; Goldman 1986; Christensen 2004.

³² For example, Call (2022, pp. 185–186), in broad agreement with the characterization proposed by Mody and Carey (2016), distinguishes between “abductive”, “inductive” and “deductive” inferences in relation to weak, moderate and strong degrees of confidence that they elicit in the conclusion.

range of (simple) cases, subjects who perform valid deductive inferences do have a higher degree of confidence in the conclusion than subjects who perform non-deductive inferences. However, if the tie is too tight there is a risk of obscuring that, despite a coincidence between certainty and deductions in favourable situations, the type of inference one performs is orthogonal to the confidence with which the conclusion is reached. One can perform a valid deductive inference and yet be uncertain about the conclusion—think about complicated mathematical proofs. Similarly, one can perform a non-deductive inference and yet be as close to certainty as possible—think about the induction that the sun will rise tomorrow. The point is that, given that uncertainty is consistent with deductive reasoning, evidence of uncertainty in performing a task (e.g., hesitation, or failure to reach 100% success-rate) needn't be evidence of failure to reason deductively. Hence, care is needed when using certainty as a standard for deductive reasoning. Indeed, as noted in the previous section, psychological studies on adult humans suggest that subjective confidence is not significantly correlated with the correctness of one's attempts at deductive reasoning (see also Shynkaruk and Thompson 2006).

5.2. A Recent Study

To illustrate the significance of the point, let us go back to the two-cup task described in section 3. As noted, since the task mirrors the structure of disjunctive syllogism, it provides some initial evidence of deductive reasoning in animals—especially great apes, monkeys, and African grey parrots.³³ However, the evidence is not particularly strong, as high rates of success with little hesitation are compatible with non-deductive reasoning. Susan Carey and colleagues have explored non-deductive explanations in a series of papers (see, especially, Mody and Carey 2016; Leahy and Carey 2020; Leahy et al. 2022; Feiman, Mody and Carey 2022).³⁴ Here's a quote:

While the [two-cup] task can be solved by reasoning by exclusion, deploying both *not* and *or*, it provides better evidence for negation than disjunction. While it is possible that participants represent that the object is in one or the other location, it is also possible that they

³³ For a list of studies that use the two-cup task to investigate inference by exclusion in animals, see table 29.2 of Call and Völter 2017, and the references in Call 2022 (p. 173).

³⁴ I mentioned some non-deductive explanations in the philosophical literature in footnote 7 above. I set these options aside here to focus on comparative psychology, but see Melis and Monsó 2024 (section 6) for some initial discussion.

merely constrain their search space to the two visible containers. After excluding the empty cup, they may check the remaining option because it is the only one left, but *without being certain that the object is there*; indeed, as if they had not already seen that the other location is empty. (Feiman, Mody and Carey 2022, p. 5; my emphasis)

The concern, which recurs in many discussions of the two-cup task, is that subjects may fail to grasp the mutually exclusive relation between the two alternatives, and are therefore unable to deduce, and become certain, that since one cup is empty, the reward is in the other cup.^{35,36}

To try to meet the challenge, more complicated tasks involving three and four cups have been proposed—the idea being that one cannot succeed in the more complicated tasks without grasping the exclusive relation between relevant alternatives. As it happens, results in these more complicated tasks have not been as encouraging as results in the two-cup task. I lack the space to engage in a discussion of the design of these more complicated tasks,³⁷ and I will limit myself to a general methodological point on the perils of neglecting the difference between logic and reasoning. To do so, I will compare the first two experiments run by Engelmann et al. (2023a) in a recent paper on deductive reasoning on chimpanzees.

The first experiment in Engelmann et al. (2023a) was a successful replication of the two-cup task: 14 out of 16 chimpanzees tested picked the right cup well above chance. Overall, chimpanzees chose

³⁵ Here's another example from Leahy and Carey 2020 (p. 71): “Upon seeing the two cups revealed after the hiding event, infants may simulate the prize in one of the cups. If the experimenter then shows that cup to be empty, they simply revise this guess and generate a new one, namely the other cup, which is where they search.” Again, the point is that subjects may not grasp the exclusive relation between two alternatives before one of the cups is shown to be empty and, because of this, are unable to deduce the location of the reward.

³⁶ Other non-deductive explanations have been discussed over the years in comparative psychology. Perhaps the most debated among them was the so-called “avoid the empty cup strategy”, according to which subjects may use a heuristic based on simply avoiding the cup that they have seen to be empty without inferring that the reward is in the alternative cup (originally advanced by Paukner et al. 2006). This explanation has lost appeal in the light of studies showing subjects succeed in variations of the task that do not involve seeing any empty cups, and that require keeping track of the specific reward rather than just the location of the reward (e.g., Call 2006, 2022; Pepperberg et al. 2013; Schmitt and Fischer 2009).

³⁷ The task that is supposed to do the trick really and require grasp of the exclusive relation between the alternatives is the four-cup task. See, e.g., Mody and Carey 2016 (p. 7), Feiman et al. 2022 (p. 5), Engelmann et al. 2023a (pp. 1103–1104).

the correct cup in 95% of trials. The second experiment was a more challenging three-cup task. Subjects were presented with three cups (A, B, C) and two rewards (pieces of apple). The three cups were separated in two groups: a single cup A on one side and a pair of cups B and C on the other side. The two groups were occluded by two separate barriers; first, one reward was hidden behind the barrier that covered cup A, followed by an equivalent reward being hidden behind the screen that covered cups B and C. No cup content was revealed and, once the barriers were lifted, subjects had to choose between cup A, B, or C. The question of interest was “whether chimpanzees [were] above chance in their selection of the option that *must* contain the food (A), relative to one of the options that *could* contain a reward (B or C)” (Engelmann et al. 2023a, p. 1104). Subjects chose the correct cup only 51% of times. In their discussion, the authors of the studies write the following:

The finding that chimpanzees did not appreciate the fact that one cup in the three-cup task must, by logical necessity, contain a reward—as evidenced by their chance level performance (chance was set at 50%)—raises doubts about the possibility that chimpanzees solve the two-cup task by logical thought. (Engelmann et al. 2023a, p. 1112)³⁸

In the light of the compatibility between uncertainty and deductive reasoning, I would be cautious in taking failure to consistently succeed in a complicated task that can be solved with deductive reasoning to be a sign that (i) subjects are unlikely to have reasoned deductively; and (ii) that subjects are unlikely to have reasoned deductively even in a simpler but similar task where their performance was close to ceiling. With respect to (i), subjects may have been uncertain about what the premises were and whether the premise entailed the conclusion. With respect to (ii), imagine that humans’ ability for deductive reasoning—in subjects with no more than a beginner’s acquaintance with formal logic—is tested with university-level natural deductions quizzes. The success rate would not be particularly high. And yet, we would not conclude that in simpler cases where we had ascribed deductive reasoning, subjects probably didn’t reason deductively. Let’s take a closer look at the two tasks in Engelmann et al. (2023a).

³⁸ There is no space to discuss the issue, but the choice of placing chance level at 50% rather than 33% may be queried, as subjects had to choose between three cups.

When we look at the premises that are supposedly involved, the three-cup task looks very similar to the two-cup task. The two premises are no more cognitively demanding than those in the two-cup task, and they are supported to a similar degree by perception. They are:

Premise 1: <Reward is in cup B or reward is in cup C>

Premise 2: <Reward is in cup A>

With these premises on board, subjects are invited to choose—by pulling one of the ropes connected to each cup—between A, B, or C. It is here that things get tricky. Since, for all they know, each of the cups might contain a reward, subjects can't reason by exclusion and eliminate any option like they can do in the two-cup task. Of course, they could remember that cup A contains a reward, and go on to dismiss cup B and C, which only have a 50% chance each to carry a reward. But doing so demands an assessment of the relative probability of finding rewards in each cup, which adds a probabilistic layer of complexity absent in the two-cup task. And it's not obvious that this demand can easily be met. Indeed, there is evidence that apes have difficulties in assessing probabilities around the 33% threshold and that, in some circumstances, they struggle even with the difference between 100% and 50%.³⁹ The three-cup task appears to push subjects out of strict deterministic thinking, as it occurs in deductive reasoning, and this risks making it considerably harder.

Another way to rule out cups B and C may ensue if subjects continued to think of cups B and C as being part of the same group. Subjects who did so may go on to jointly exclude them as the worst option. But note that here “worst” means “each of them is less likely to contain a reward than cup A”, which is again a judgment about relative probabilities. Moreover, continuing to see cups B and C as part of a single package is discouraged by the choice subjects are presented with—a choice between three individual cups rather than between two sets of cups. Nevertheless, some of the chimpanzees may have still managed to reason that way—detailed results of experiment 2 show a few individuals with a success rate of around 75%. But it's not clear that failure to do so suggests incapacity to engage in basic deductive reasoning, as it may be exhibited in solving the simpler two-cup task.

³⁹ See Haun et al. 2011 and Hanus and Call 2014.

One could further note that the schema $\langle A \text{ and } \langle B \text{ or } C \rangle$; therefore $A \rangle$ is deductively valid, and that subjects could use it, without having to make any assessments of probability. This schema is not disjunctive syllogism. In fact, it's a trivial one, as the disjunctive premise is redundant and it reduces to an instance of $\langle A$; therefore $A \rangle$. Presumably, it was not the target of the experiment. Still, it could be argued that using the schema in the circumstances would show understanding that the disjunctive option needs to be set aside because *it does not guarantee* a reward. And that would not be so trivial at the level of reasoning—as opposed to the level of logic. I agree. But if that's how subjects are expected to rule out $\langle B \text{ or } C \rangle$, they're still expected to make an assessment about probabilities of getting the reward. And, again, that brings difficulties that go beyond simple deductive reasoning.

The foregoing invites the following moral. In using certainty as a measure for deductive reasoning, we need to make sure that subjects can easily identify the premises, that they endorse them with a high degree of confidence, and that the train of thought needed to reach a conclusion deductively is transparent enough—within easy beginner's reach, so to say. While the two-cup task does well in these respects, the three-cup task may demand subjects to go through a chain of reasoning opaque to beginners. To suggest an analogy, the three-cup task may be as complicated for great apes as the Monty Hall problem is for adult humans.⁴⁰

Now, because of the possibility of alternative explanations, the two-cup task alone is not sufficient to ascribe deductive reasoning to animals, even when accompanied by very high rates of success. On the one hand, this is not surprising, as we cannot reasonably expect one single experimental design to provide the means to answer a question like “do animals reason deductively?” Given the high degree of complexity involved, it is to be expected that some inference to the best explanation taking into consideration a wide range of studies and philosophical theories of deductive reasoning will be needed. Attempting such an inference to the best explanation exceeds the goals of this article, but readers can find a sketch in

⁴⁰ Here's the Monty Hall problem, as presented by Marilyn vos Savant in *Parade* magazine in 1990: “Suppose you're on a game show, and you're given the choice of three doors. Behind one door is a car, behind the others, goats. You pick a door, say #1, and the host, who knows what's behind the doors, opens another door, say #3, which has a goat. He says to you, ‘Do you want to pick door #2?’ Is it to your advantage to switch your choice of doors?” For discussion of the puzzle, see Kornblith 2021 (pp. 121ff).

Burge 2010 (pp. 59ff).⁴¹ On the other hand, the compatibility of the two-cup task with non-deductive explanations suggests that tasks that rely on relatively complex trains of thought may well have important roles to play. If so, it may be worth paying closer attention to the performance of individuals rather than just to group-performance. Presumably, just like humans, animals exhibit a wide range of cognitive abilities, and it is unlikely that the majority of them can solve relatively difficult puzzles that may still be within the reach of some.

In summary, the overarching point of this section is that familiarity with the philosophical debate on the difference between logic and reasoning may help comparative psychologists to identify the appropriate normative idealization for the task at hand—one in which deductive reasoning does not entail certainty about the conclusion and, especially in relatively demanding tasks, is compatible with non-ceiling performances.

6. *Conclusion*

We have reached the end of this journey into some philosophical and psychological research on inference in humans and animals. I have made three main suggestions. First, in section 3 I have argued that engaging with comparative psychology provides philosophers with some reason to believe that human and animal inference share a common core. In both humans and animals, inference may be one of the means by which subjects aim—without needing to be capable of representing the aim—to achieve an accurate and coherent representation of the world. In future work, developing this suggestion may lead to re-assess whether the difference between conceptual and pictorial thought and between deductive and non-deductive reason-

⁴¹ Someone interested in the project would also be well advised to keep in mind some of the following recent studies. The findings in Engelmann (2021), and the second experiment in Call (2022) seem especially significant for re-assessing the claim that at least some non-human primates appreciate that if the reward is in one cup, it is not in the other, and vice versa (doubts about which provided important motivation to move from the two-cup to the three-cup and even four-cup tasks). In addition, Lambert and Osvath (2018) express validity concerns about the reverse-y-tube task (often mentioned to shed doubt about subjects' capacity to appreciate the exclusive relation between two cups and one reward), and Engelmann (2023b) shows that at least two chimpanzees succeed in the reverse-y-tube task. It will also be worth exploring the suggestion by Baumann et al. (forthcoming) that deliberating about which outcome to bring about—rather than responding to events beyond their control—may facilitate the subject's grasp of the exclusive relation between alternatives.

ing mark differences in kind rather than degree between human and animal reasoning.

Second, in section 4 I have suggested that, with the help of ongoing philosophical work on rational dispositions and empirical research on reasoning, it is possible to outline a thoroughly unreflective notion of taking the premises to support the conclusion. Should this suggestion prove to be resilient in the face of critical scrutiny, it may help to solve long-standing philosophical problems about the very nature of inference, such as Carroll's (1895) notorious regress.

In sections 3 and 4 my overarching concern was to highlight ways in which philosophical research stands to benefit from engaging with empirical research on inference. In section 5, I switched the focus from the philosophical preoccupation with the nature of inference to the empirical study of deductive inference in animals. My third point was that empirical researchers may benefit from thinking about the philosophical distinction between logic and reasoning. Doing so may enable them to fine-tune the empirical standards for deductive reasoning.

The primary goal of this paper was to contribute to building bridges between the empirical and philosophical study of inference in humans and animals. Accordingly, I have drawn a preliminary map of issues that strike me as significant more than I have provided answers. My hope is that philosophers and comparative psychologists might find certain passages that prompt them to dig deeper in some of the issues I have touched upon.⁴²

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