Affective Representations between Association and Cognition

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Abstract

Research on animal cognition is currently struggling with two main problems. Firstly, mainstream views on reasoning in philosophy of mind and epistemology are unable to explain a growing body of empirical results in animal cognition research. The second problem concerns the interpretation of the same empirical results within comparative psychology, namely, whether they are best explained by appeal to ('lower') associative or ('higher') cognitive mechanisms, where neither side is providing convincing explanations. This problem is amplified by a crisis of the dichotomy itself between the 'associative' and the 'cognitive'. In response to these two problems, I develop an affect-based construal of cognition, which broadens the conception of cognition to also include affective processes. I introduce the concept of affective representations that exhibit both 'associative' and 'cognitive' characteristics. This concept allows for new kinds of explanations of comparative research results, and indicates a future direction to explore human and nonhuman cognition.

Keywords: animal cognition; association; cognition; affects; mental representation; affective representation

1. Introduction

This paper explores the role of affective experiences in cognition from a comparative and developmental perspective. I aim to provide an alternative to the mainstream understanding of cognition and reasoning, which I'll argue is unjustifiably narrow, anthropocentric, and overly intellectualized.

Historically, reasoning has been mostly discussed in the context of adult human thought, and was considered a uniquely human capability (Andrews & Monsó, 2021). Philosophers of mind have traditionally denied that non-human animals are capable of inferential reasoning. Variations of arguments from Descartes (1637), Stich (1979), Davidson (1982), etc. that significantly influenced the discussion on animal thought, take the lack of language in non-human animals as one of the main reasons for their incapability of thought and reasoning. In contemporary philosophy of mind and cognitive science, reasoning is most commonly construed as closely related to or even dependent on having a public human language (Bermudez, 2003; Broome, 2013; Boghossian, 2014, 2018; Quilty-Dunn & Mandelbaum, 2017; Valaris, 2014, 2017). At closer inspection, this linguistic requirement for reasoning seems to be motivated by certain assumptions about the kinds of representations and the kinds of processes necessarily involved in reasoning (Munroe, 2021). It is often assumed that reasoning requires implementation of thoughts with representations that are amodal, internally structured and systematically interconnected, and it is widely held that only one sort of structure can suffice: the discursive, or language-like structure of representations, with a subject-predicate form. Supposedly, without the help of language, the contents of thoughts couldn't be organized or mentally manipulated in a way that allows for flexibility of thought required for making inferences (Broome, 2013; also see Camp, 2018).

This anthropocentric and highly intellectualized conception of reasoning results in an a priori exclusion of non-human animals and prelinguistic children from the class of agents capable of reasoning. However, this view has been recently challenged by comparative and developmental psychology: prelinguistic children as well as many species of animals such as non-human primates, crows, pigeons, rats, etc., exhibit behaviors seemingly fueled by different kinds of reasoning such as logical (Cesana-Arlotti et al., 2018; Feiman et al., 2022; Call, 2004, 2006; Erdőhegyi et al., 2007; Marsh & MacDonald, 2012), causal (Blaisdell et al., 2006; Völter & Call, 2017; Schloegl & Fischer, 2017), and transitive reasoning (Moon & Zeigler, 1979; Vasconcelos, 2008; Lazareva, 2012; Gazes & Lazareva, 2021). These findings put pressure on the mainstream anthropocentric and intellectualized view of reasoning.

In light of these recent studies, I set out to explore an alternative account of reasoning that challenges the mainstream approach. The main goal is to construct a conceptual framework for explaining reasoning in non-linguistic agents such as infants and non-human animals, but also in adult humans as a mode of reasoning that exists alongside linguistically implemented reasoning.

I will argue that the account I propose here helps resolve two important problems of philosophy of mind and cognitive science that arise when the existing theories and practices are faced with the results of animal research. I call the just presented tension between the traditional view and the empirical results 'the first problem of animal reasoning'. This is importantly connected to the second problem, which I will now turn to.

Current debates on the nature of animal cognition are predominantly focused on the question whether many observed intelligent animal behaviors are best explained as a

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product of 'mere' association or some form of cognitive reasoning (Buckner, 2011). The 'Standard Practice' of comparative psychologists is guided by the idea that, when explaining observed animal behaviors, unless we have clear evidence of a more complex underlying psychological process, we should assume that a simpler learning process can account for the behavior. The Standard Practice thus involves a default preference for simpler associative explanations, while a cognitive explanation of the empirical results is acceptable only if we can show that the behavior couldn't be explained by an associative underlying mechanism (Buckner, 2011, 2017). The default preference for the associative explanations is justified by the fact that associative mechanisms are considered ubiquitous among non-human animals, for example, basic forms of conditioning have been found even in species such as *Aplysia* and *Drosophila melanogaster* (Quinn et al., 1974; Walters et al., 1981; Buckner, 2011, 2017), while the same cannot be said for cognitive mechanisms.

Another central assumption of the Standard Practice is that associative and cognitive explanations of behavior are mutually exclusive alternatives. The research agenda that resulted from these assumptions consisted in designing experimental tasks that could be solved only by the use of a cognitive strategy and that cannot be solved by any associative strategy. This has further led to an increasing extension of the associative models that aim to explain complex or flexible behaviors of animals: cognitivists devise a behavioral test that seemingly cannot be passed with the principles of the associative learning theory, and then associationists devise a modest extension of prior associative theory (creating increasingly complex models), so that it allows their models to pass the cognitivists' benchmark (Buckner, 2011, 2017; Dacey, 2017). This 'back and forth' practice has been continuing for several decades, and has resulted in the creation of the 'new generation' of associative models, which, while more successful than their simpler predecessors, possess features that put their 'merely associative' character in question (for examples see Frank et al., 2003; Van Elzakker et al, 2003; Frank et al., 2005). Many of these models involve sophisticated between-stimulus interactions, higher-order stimulus relations, preprocessing of stimuli, and even complex architectural ideas (Buckner, 2017). They also seem capable of producing the degree of flexibility characteristic of cognitive mechanisms. By usual criteria for the distinction between associative and cognitive mechanisms, these new models seem difficult to be neatly classified as either cognitive or associative (Buckner, 2017; Penn & Povinelli, 2007). This has led many authors to criticize and question both the Standard Practice and the cognitive vs. associative dichotomy itself. The practice has already been criticized for being oversimplified, relying on conceptual confusions, and leading to unproductive discussions (e.g., Allen, 2006; Papineau & Heyes, 2006; Buckner, 2011, 2017; Dacey, 2016, 2017). A possibility has also been suggested that the new associative models may actually implement cognitive capacities, rather than being a deflationary alternative to cognitive explanations. This suggestion means that, at a certain level of complexity and/or flexibility, cognitive capacities are implemented or emerge from associative ones, and cognitive processes may be simultaneously and correctly described by associative models at a lower level of analysis (Buckner, 2011, 2017). If one was to accept this possibility, a question remains as to how exactly this implementation works, and how association and cognition can be connected, given that they are conceived in substantially different terms, the former as involving nodes (stimuli) and links (associative connections), the latter as operating through rules and discursive representations (Dacey, 2016). This somewhat mirrors the problem of applying traditionally conceived language-like reasoning processes to non-linguistic animals, which are widely assumed to be capable only of associative mechanisms. I call this crisis of the cognitive vs. associative dichotomy and the question of their relationship 'the second problem of animal reasoning'. The dichotomy is also undermined implicitly by explanations of complex social abilities of primates that also don't fall neatly into either associative or cognitive group of explanations (Tomasello, 2003, 2008), and explicitly by emphasizing that both associative and cognitive kinds of processes can be of varying degrees of complexity – the feature that was supposed to be mark the difference (Tomasello, 2014).By developing an affect-based account of reasoning that postulates 'affective representations' (AR), I aim to address these two problems of animal reasoning. In the following, I will put forward a description of ARs in a way that shows in what way they can a) resolve the tension between associative and cognitive processes (addressing Problem 2), and b) function as representations suitable for making inferences without a linguistic capability or discursive representations (addressing Problem 1). In the first step, I reject the assumption of a clear-cut dichotomy between automated, affectively-laden associative basis of learning, and rule-based reasoning over structured representations. I argue that there is instead a largely unexplored continuous space or spectrum between them that comprises different degrees of complexity and flexibility. I introduce affective representations as a common concept suitable for both associative and cognitive/discursive kinds of explanations, such that can integrate the advantages of both kinds of explanations.

After presenting support for this view in the next section, I will apply ARs to explain the phenomenon of 'emotional bookkeeping', which refers to the observed ability of primates for long-term tracking of the exchange of benefits with other individuals in their social groups in the context of reciprocal altruism (Schino & Aureli, 2009). I argue that the concept of ARs can provide a unifying explanation to these and similar case studies.

2. Affective Representations between Association and Cognition

2.1 Affects and Associations

The role of feelings of satisfaction and discomfort in associative learning has been well known and uncontroversial in behavioral research (Pavlov 1906; Thorndike 1911; Skinner 1953). Rescorla and Wagner (1972) formalized this by showing that valence significantly impacts the strength of learned associations in classical conditioning. Damasio (1994) further demonstrated that affect, through learned associations with bodily states (somatic markers) influences human decision-making. Finally, Panksepp (1998, 2011) provided neurobiological evidence that core emotional systems are fundamentally associative, designed to link stimuli, bodily states, and behaviors.

The processes based on affectively laden associations are commonly understood as automated and instinctive, without the agents mentally evaluating and weighing options before responding (Walsh & Lovett, 2014). Recent neuroscientific studies provide evidence of the common neural substrate of associative and affective processing, indicating a fundamental relationship between them (Barrett & Bar, 2009; Shenhav et al., 2012). Both the contextual associative information and affective valence are found to be rapidly computed and used for the generation of corresponding (contextual or evaluative) predictions.

Based on this, I construe ARs as both shaped by associations and crucial to shaping associations.

2.2 Affects and Cognitive Representation

Here I will argue that affective experiences can be considered as structured representations by providing a semantic and structural analysis, which reveals their potential for compositionality and shows in which way they enable flexible assessments of the environment.

2.2.1 Semantic Analysis: Affects as Representational

Affective representations are not recognized in the literature on mental representations, nor are they discussed in animal cognition research. On the other hand, in the philosophical literature aimed at defining emotions and affects, it is uncontroversial that most affective states are experiences that involve an intentional object (they are object-directed) and an appraisal or evaluation of that object, often cast in representational terms (e.g., Roberts, 2003; Carruthers, 2017; Tappolet, 2023; Deona & Teroni, 2022). The experience of affective states consists in experiencing the intentional object in evaluative terms: they are specific ways of being (dis)pleased with the object. Or, in other words, affect is a reaction to an object that is apprehended in some evaluative guise (Roberts, 2003). Affects in general are characterized by valence – positive vs. negative. They qualify their intentional objects in a particular way – as good vs. bad, or as attractive vs. aversive, or in more complex emotional terms. This involves assessments of environmental or bodily events, and their relevance either to previously formed goals, or to the underlying values stored subcortically as dispositional properties of reward-systems in the basal ganglia. And they can also involve reappraisals of the same intentional objects (De Sousa 1987; Roberts 2001; Döring 2007; Gunther, 2004; Deonna & Teroni, 2015; Carruthers, 2017; Gross, 2015; Scarantino & de Sousa, 2022). For example, sadness is considered as being crucially connected to the evaluation or a representation of its object as a loss, fear as connected to the evaluation of the object as threatening (Deonna & Teroni, 2012). The metaphor 'wearing rose-colored glasses' hints at how affective states towards someone or something makes us evaluate the intentional object differently than if there was no affective state, or if there was a different affective state involved. One reason in support of thinking of affective states as representational is that they are generally outward focused, in the sense that the focus of the subject of the affective state is targeted on the intentional object.[2] For example, if someone is afraid of a bear, it is the threatening aspect of the bear that makes the frightened person have a negative evaluation of it, it is the bear that seems threatening (Carruthers, 2017).

Another argument in favor of an evaluative understanding of affective states is the recognized crucial role they play in human practical reasoning and decision making (Carruthers, 2017; Damasio, 1994; Gilbert & Wilson, 2005, 2007; Buckner, 2010; Seligman et al., 2013). When choosing between different options, for example, we respond to the options affectively, with positive or negative valence directed at the alternatives. The options are evaluated as good or bad, or better or worse, which provides intrinsic motivation to pursue or avoid them (Carruthers, 2017).

The representational and evaluative nature of affects aligns with the insights from grounded cognition (Barsalou, 1999, 2010, 2017). In particular, my account is supported by the recognition that modal perceptual representations can perform the roles typically thought to be exclusive to amodal representations. While Barsalou incorporates introspection and affective states into his perceptual symbol theory, he does not elaborate on the precise mechanisms by which affective states operate as perceptual symbols. The account presented here aims to address that gap by demonstrating how the affective aspect of experience can also serve as a representational symbol.

2.2.2 Syntactic Analysis: Affects as Structured

In virtue of having intentional objects to which evaluative properties are assigned, affective experiences lend themselves to an analysis in terms of structure. Here I argue that affective experiences are structured in the sense that they are complex states that involve distinct components – the object and the properties – that jointly constitute the content of a particular affective representation. I will argue that the structure of affective representations allows them to be a viable alternative to language-like propositions and that they can be constituents of inferential transitions.

An important structural feature of representations considered necessary for inferential transitions is having discursive, or subject-predicate form. The *subject* is something that the representation is 'about'. The *predicate* functions to qualify the subject in a particular way. This is taken as a paradigmatic type of structure for discursive representations, and as such they are suitable for participating in inferences. Episodes of affective experience, on the other hand, most often involve qualifying or appraising their intentional object as 'being in a particular way'. As already noted, affects in general are characterized by a positive or negative valence, in the sense that they qualify their intentional objects, for example, as attractive or aversive, etc. Affects are also characterized by having a degree – they are felt at a particular degree of strength. They can thus qualify their objects as more or less attractive, or more or less aversive. Valence and degree importantly determine the evaluative character of affects, since it is through them that the subjects experiencing affects qualify the intentional objects.

Another important feature of representational systems that can sustain inferences is *compositionality*. Representations need to be able to systematically assign the same property to different objects, or different properties to the same object. Due to their structure that can involve different evaluations and have different entities as objects, affects have the kind of structure that permits assigning the same property to different objects ('A is good', 'B is good'), or assigning different properties to the same object ('A is good', 'A is bad'). Their structure also permits higher-order evaluations such as 'I feel bad about the fact that I feel good about A'. Affects thus satisfy the condition of compositionality in the traditional sense because their overall meaning (e.g., 'A is good') is a direct function of meanings of their constituents: the specific intentional object of the affective state ('A') and the particular affective evaluation of the object ('being good'). This structure allows for systematic recombinability of objects and evaluations, which is regarded as necessary for flexible reasoning. Admittedly, affects may not rise to have an elaborate structure as linguistic expressions, and may not allow the degree of flexibility as language-like representations can, but the particular structure revealed here should suffice for sustaining at least some kinds of inferences as well as allowing some degree of flexibility.

3. Emotional Bookkeeping: Explanatory Value of Affective Representations

As an illustration of the account, and also to show its explanatory benefit, I will apply the previously developed concept of affective representations to a case study on what is called 'reciprocal altruism' in primates. Reciprocal altruism refers to the behaviors (such as grooming, sharing food, providing support in conflicts with other individuals) in which the actor incurs immediate costs (while the recipient gains immediate benefits) and receives delayed benefits that depend on the future behavior of the recipient, or in another interpretation, regardless of later consequences (Schino & Aureli, 2009). This study focuses on grooming behavior, but also on the exchange of grooming for other 'favors'. Two important aspects define reciprocal altruism. First, the *time lag* between costs and benefits, which eliminates the possible explanation through an expectation of an immediate return of the benefits. Second, the *uncertain* relation between the costs and the benefits, in the sense that the benefits are not an inevitable consequence of the actor's behavior. The analyzed studies show evidence of a stronger correlation between favors given and received from the same partner over a period of several months, than over short-term periods such as a single day. Evidence was also found for long-term stability of social preferences: primates show consistent long-term preference for which partners from their social group they were willing to give favors to. These preferences correlate with the partners that were reciprocating favors over longer periods of time, and not necessarily in the short-term. Additionally, short-term effects (of the favors received) were unable to reverse the preexisting long-term social preferences.

In this meta-study, the authors looked for an understanding of the proximate mechanisms underlying such altruistic behavior, and for an explanation how the animals involved negotiate or exploit the uncertainty and time lag between costs and benefits. They arrived at the conclusion that the results are best explained by a system they termed 'emotional bookkeeping', which refers to an emotionally based mechanism that allows to keep track of benefits exchanged over extended time periods. In other words, primates did not seem motivated by the expected immediate benefits or reciprocation, but rather by the 'good track-record' based on longer periods.

Coming back to affective representations, this emotional bookkeeping fits with the way the ARs are characterized above. While the ARs were formed associatively through received favors in the past, the time lag between favors received and given, as well as the long-term stability in partner choice for giving favors (to those individuals who reciprocated most in long-term time frames) eliminate the purely associative explanation. The behavior patterns fit better with the stability of affective representations that do not depend upon immediately previously received favors, i.e., they are not easily updated on a case-by-case basis. The fact that the emotional bookkeeping involves partner-specific memory fits with the capacity of ARs for compositionality: there is a specific affective representation tied to each potential grooming partner.

The structure of ARs – involving an intentional object and an affective evaluation of it – directly supports the partner-specific nature of emotional bookkeeping. Primates are forming specific affective evaluations for each potential grooming partner in the social group based on past interactions. Compositionality of ARs (in the sense of systematic recombinability of partners and evaluations) allows for flexible assessments for each individual. This makes it possible to have distinct affective track records for multiple individuals in the social group, which forms the

basis for decision-making about who to groom and who to avoid.

By explaining emotional bookkeeping through ARs, we see how these representations can participate as constituents in inferential processes, without requiring language-like amodal representations. Reasoning can be based instead on stored affective evaluations of specific individuals based on extensive previous interactions in the past.

4. Potential additional support for postulating ARs

Some additional support for this view comes from recent neuroscientific and cognitive science research which suggests a novel conception of the affective system as a flexible learning system, capable of tracking relations in the environment and of guiding behaviors in a way that is strikingly similar to how rational procedures for decision making are commonly understood in philosophy (Railton, 2014; Quartz, 2007; Schwarz & Clore, 1983, 2007; Carver & Scheier, 1990; Pessoa, 2008; Zahn et al., 2009). There is, in addition, an anatomical and functional connection between what we consider rational reasoning and the affective states, as reasoning processes are found to depend on the specific brain systems, some of which also process affective states (Damasio, 1994). Emotions support reasoning processes in more than one way: by influencing attention, perception, and memory, e.g., by reducing the range of alternatives to consider, raising salience of particularly good or bad options and reducing cognitive load. Furthermore, the brain regions active in affective processing are found to be active already in the object recognition stage (Barrett & Bar, 2009). This is taken to support the view that affective responses support object recognition via affective valence associated with the object, based on the affective impact of the object in the past. Finally, the neuroanatomical and neuroimaging literature doesn't seem to support the long-held assumption of cognition and affect as separate processes with separate brain areas. Instead, affect is instantiated by a widely distributed, functional network in the brain that includes both the regions that have been considered cognitive and those considered affective (Duncan & Barrett, 2007).

I take the ubiquitous presence of affective processing from the early stages or perception, shared anatomy and functionality with cognitive processing, as well as flexibility and adaptability of the affective system similar to rational processes, all support the role of ARs in rational reasoning and decision-making.

5. Conclusion

In response to the two problems of animals cognition, I have identified a cluster of processes, namely, those involving the postulated affective representations, which have certain key features in common with two supposedly mutually exclusive processes: associative and cognitive ones. The associative/cognitive dichotomy has already received criticisms based on the considerations presented in the Introduction, and I believe postulating reasoning based on ARs further undermines the mutual exclusivity assumption. My proposal should also serve to help us conceive of a higher-level explanation of (some of) the reasoning processes that do not require a capability for language. Reasoning performed over ARs is meant as one way (there may be many others) to describe inferential reasoning, and it is therefore meant to broaden the definition of what reasoning is and can be. In this paper, I have justified postulating ARs by three kinds of support. First, by providing a representational and structural analysis of affective experiences that reveals their similarity to both associative and cognitive processes, and their suitability to participate in inferences. Second, by indicating their explanatory value when the concept of ARs is applied to an empirical case study with primates. Third, by indicating a possible neuroscientific support, which is still undeveloped in this stage of the project (but will hopefully be further developed soon).

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