Behavioural Processes 117 (2015) 82–91

Contents lists available at ScienceDirect

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc

Evolution cannot explain how minds work

Johan J. Bolhuis[a,b,*]

[a] Cognitive Neurobiology and Helmholtz Institute, Departments of Psychology and Biology, Utrecht University, Utrecht, The Netherlands
[b] Department of Zoology and Sidney Sussex College, University of Cambridge, UK

ARTICLE INFO

Article history:
Available online 16 June 2015

Keywords:
Evolution
Cognition
Learning
Memory
Birdsong
Songbirds
Birdsong learning
Speech
Language

ABSTRACT

Following Jerry Hogan, I argue that questions of function and evolution, and questions of mechanism should be seen as logically distinct. Evolution is concerned with a historical reconstruction of traits, while the actual underlying mechanisms are the domain of cognitive neuroscience and psychology. Functional and evolutionary considerations may be used to generate hypotheses regarding the underlying mechanisms. But these hypotheses may be false and should always be tested empirically. Many researchers still hold that common descent implies cognitive closeness. Studies on birds suggest that evolutionary convergence may be the rule rather than the exception in animal cognition. Neurocognitive differences between classes of individuals are often thought to be the result of adaptive specialisation. In the case of learning and memory, however, empirical results are more consistent with a 'general process' interpretation, without qualitative differences between different taxa. Evolutionary psychology (EP) argues that the mind of modern humans was formed as a result of selection pressures in the Stone Age. The empirical data are often overinterpreted, and EP is mostly based upon an outdated view of evolutionary biology. In human speech and language, both neurogenetic homology and evolutionary convergence are involved regarding speech, but human language has a unique combinatorial complexity.

This article is part of a Special Issue entitled: In Honor of Jerry Hogan.

Contents

* Correspondence to: Cognitive Neurobiology and Helmholtz Institute, Departments of Psychology and Biology, Utrecht University, Padualaan 8, 3584CH Utrecht, The Netherlands.
E-mail address: j.j.bolhuis@uu.nl

http://dx.doi.org/10.1016/j.beproc.2015.06.008
0376-6357/

1. Introduction: two evolutionary fallacies

Among many other things, Jerry Hogan has taught us that cause and function are logically distinct categories (Hogan, 1988, 1994, 2009). Some might argue that the cause/function distinction is a trivial one, and that 'Teleology [. . .] can be said to have ceased to be a source of confusion in its cruder forms, in which function was given as a proximate cause [. . .]', as Tinbergen (1963), (p. 413) put it. I beg to differ, and I would maintain that Hogan's arguments for a distinction of cause and function in the study of behavioural processes are not only very sensible, but that this distinction is crucial for a proper understanding of animal behaviour in all its facets. Failure to distinguish between these two categories has led to considerable confusion in the brain and behavioural sciences. In fact, I would argue that there are complete disciplines – cognitive ecology, neuroecology and evolutionary psychology – that are based on an erroneous confounding of cause and function.

Evolutionary and/or functional analysis might be brought to bear on behaviour or cognition in two different ways. First, functional or evolutionary considerations could be used to explain the mechanisms underlying a particular trait. This approach is fraught with difficulties. As Hogan (1988, 1994) has argued, questions of evolution or function are fundamentally different from those relating to mechanism, so evolution can never 'explain' mechanisms (Bolhuis and Wynne, 2009). This is because evolution by natural selection is not a causal factor of either cognitive or neural mechanisms (Bolhuis and Wynne, 2009; Bolhuis et al., 2014). Natural selection can be seen as one causal factor for the historical *process* of evolutionary change – but, as Bolhuis et al. (2014) argued, that is merely stating the essence of the theory of evolution. It is the case that evolutionary considerations – in particular, reconstructing the evolutionary history of relevant traits – might provide clues or hypotheses as to mechanisms, even though such hypotheses have frequently been shown to be false or misleading (Bolhuis and Wynne, 2009; see also below). A good example of such an evolutionary clue is provided by analyses of the possible evolution of language, as discussed in Section 4, below.

The second, more traditional way of applying evolutionary analysis to behaviour or cognition is to attempt to reconstruct its evolutionary history. In my view, this is essentially what an evolutionary analysis of behaviour should be about. However, here too, we are confronted with major explanatory obstacles. For a start, the evolution of a particular trait may have proceeded in different ways, such as via common descent, convergence or exaptation, and it is not easy to establish which of these possibilities (or a combination of them) is relevant (Bolhuis, 2005; Bolhuis and Wynne, 2009; Bolhuis et al., 2014). One of the cornerstones of evolutionary analysis is the comparative method, which generally relies on features that are shared by virtue of common descent. Alternatively, in convergent evolution similar traits, such as birds' wings and bats' wings, arise independently to 'solve' functionally analogous problems. As we shall see in Section 2, below, vocal imitation learning is an example of a trait that has had convergent evolution. It is present in humans and songbirds, *inter alia*, but not in our closest relatives, the great apes. Bolhuis et al. (2014) have argued that a likely reconstruction of the evolution of the faculty of language is consistent with a contemporary view of language's syntactic structure.

The study of brain, behaviour and cognition has been plagued by two major misinterpretations of the theory of evolution. First, emphasis on common descent has led to what, I would call an 'ancient' view of evolution, involving the idea of a 'scala naturae' (Hodos and Campbell, 1969). Second, there is often a confounding of evolutionary (and functional) considerations on the one hand, and considerations of mechanism on the other. I will discuss these two problems in turn.

2. An ancient view of evolution

2.1. Scala naturae thinking leads to anthropomorphism

In a classic paper, Hodos and Campbell (1969) discuss the originally Aristotelian concept of the 'scala naturae', a hierarchy of complexitity within the animal kingdom, with man at the top. The concept was widely adopted in medieval times as a way of classifying Creation, with, in this case, angels at the top, followed by man and the 'higher mammals' and so on, until we reach the bottom of the hierarchy, with worms and sponges. In a different form, this kind of hierarchical thinking is still prevalent in contemporary behavioural biology, where, attempts are made to neatly arrange the cognitive capacities of animals along a continuous phylogenetic scale. Darwin himself suggested as much when he wrote: "[. . .] there is a much wider interval in mental power between one of the lowest fishes, [. . .] and one of the higher apes, than between an ape and man." (Darwin, 1871).

In this approach, the emphasis is clearly on common descent, where closely related species will have similar cognitive abilities. I will discuss a number of examples to suggest that this is often not the case. In addition, this approach often leads to anthropomorphism, where human cognitive or emotional traits are attributed to non-human animals, particularly to our closest relatives. A prominent example of this can be found in the work of Frans de Waal and colleagues, as discussed below (de Waal, 1997, 1999, 2009; Wynne, 2004a,b, 2007; Bolhuis and Wynne, 2009).

2.2. Scant consolation

In his study of the behaviour of the chimpanzee colony in Arnhem zoo, Frans de Waal noticed that the animals often behaved in a particular way after agonistic interactions (e.g. de Waal and van Roosmalen, 1979; cf. Aureli and de Waal, 2000). When two chimpanzees had been involved in an agonistic interaction, often a third individual would arrive and perform certain behaviours towards one of the two participants in the fight. The third party could, for instance, put its arm around the participant, or otherwise touch it. De Waal and collaborators called this third-party affiliative behaviour 'consolation', arguing that it is similar to the behaviour of humans in a similar situation (de Waal, 1997, 1999). This would seem to be the kind of anthropomorphism that Tinbergen (1951) suggested would 'kill our urge for continued research' (p. 4).

Subsequent research by Sonja Koski on the same chimpanzee colony proved Tinbergen's point (Koski and Sterck, 2007). Koski reported similar behaviour patterns to the ones that de Waal had observed decades before her. However, she reached quite different conclusions, which prompted her to use the term 'triadic post-conflict affiliation' to characterise the chimps' behaviour. Koski confirmed that the behaviour that de Waal had termed 'consolation' was performed roughly equally towards the 'victor' and the 'loser' of an agonistic interaction. In addition, 'consolation' behaviour did not reduce stress (measured behaviourally) in the 'consoled' animals, and it was also directed to participants without increased levels of post-conflict stress (Koski and Sterck, 2007). The authors conclude that "[..] it seems that consolation does not 'console'" (p. 140), and that it may be that this third-party behaviour is performed to reduce the likelihood of future aggression from either of the two participants (Koski and Sterck, 2007). They suggest that the term 'consolation' be replaced by 'triadic postconflict affiliation'. These results suggest that a characterisation of behaviour in anthropomorphic terms should be avoided, as it can indeed prevent further research (Tinbergen, 1951; Wynne, 2004a,b; 2007). The work by Koski and Sterck (2007) suggests that the chimps' behaviour is not so much an indication of human-like 'empathy' (de Waal, 2009), but more likely the result of more 'selfish' motives (cf. Bolhuis, 2009).