

A PHILOSOPHY FOR THE SCIENCE OF ANIMAL CONSCIOUSNESS

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ROUTLEDGE


2

THE EXPLANANDUM

Animal Consciousness and Phenomenological Complexity

2.1 Introduction

This monograph aims to make progress in our search for the place of mind in nature by considering the evolutionary origins and distribution of consciousness across the tree of life, including the question of what the subjective experiences of other animals are *like*. The goal of this chapter is to make progress on the problem of consciousness by forcing it through the theoretical bottleneck of evolutionary theory and to explicate my notion of “phenomenological complexity”. Once again, let us begin with an important insight by Griffin:

Subjective qualities and mental experiences have remained largely untouched by the Darwinian revolution, primarily for lack of effective methods for detecting them reliably in other species, let alone analyzing them by scientific methods. But, in our present state of ignorance, we certainly cannot exclude the possibility that mental experiences, like other attributes of animals and men, exhibit continuity of variation and are not typologically discrete, all-or-nothing qualities totally restricted to a single species.

Donald R. Griffin (1981, p. 125)

If consciousness is an evolved biological phenomenon, we ought to expect both *gradations* and *varieties* of it across the tree of life – just as for any other biological phenomenon. A recognition of this phenomenological complexity will enable us to progress in our understanding of the subjective experience of other animals and narrow the explanatory gap by breaking the features of consciousness down into a number of different dimensions. This reshaping of the mind will not only enable us to resist the urge to think of consciousness as an all-or-nothing capacity that an evolutionary account is demanded to explain in one swift strike but also to acknowledge that we have already developed a wide range of experimental paradigms to investigate the minds of other animals.

2.1.1 Chapter Outline

This chapter is structured as follows. In [Section 2.2](#) “How to Naturalize Phenomenological Complexity?”, I argue that phenomenological complexity must be at the heart of an evolutionary and comparative approach to consciousness. [Sections 2.3–2.6](#) discuss the proposed

multidimensional framework for animal consciousness provided by Birch et al. (2020), as well as a variety of experimental paradigms that can be used to investigate the subjectivity of other animals. This will enable us to operationalize phenomenological complexity by distinguishing five different dimensions of consciousness that can, at least in principle, all be measured in their own right. Finally, Section 2.7 “Conclusion, Objections, and Further Directions” summarizes the discussion and addresses some further difficulties in studying phenomenological complexity.

2.2 How to Naturalize Phenomenological Complexity?

In the previous chapter, I argued that a naturalization of consciousness should not rely on conceptual analysis, but instead follow Churchland’s advice to bootstrap from paradigmatic cases to develop a science of consciousness. An obvious problem with this approach, however, has been the tendency to mistake the apparent features of human consciousness as insights into the necessity of all conscious experience. It is an instance of what Dennett (1991) once called the *philosopher’s syndrome*: “mistaking a failure of imagination for an insight into necessity” (p. 401).

This problem is of course not unique to consciousness. As Figdor (2018) notes, “untutored imagination in general doesn’t have a very good track record in terms of understanding the natural world” (p. 10). My endorsement here of an evolutionary bottom-up approach should importantly not be confused with the idea that we cannot or should not use humans as the starting point of our investigation *at all*. An insight by Lyon (2006) is important here: “Explanatory targets and starting points are not always – and perhaps not even usually – identical” (p. 52). Unfortunately, modern consciousness science has done little to distinguish human consciousness from consciousness as a natural phenomenon, suffering – as I noted in the previous chapter – from the very same problem Watson pointed out in 1913, that a focus on human consciousness would force “us into a situation similar to that which existed in biology in Darwin’s time” (p. 124). However, in the face of this problem, one does not have to adopt the behaviourist response of banning consciousness entirely from science.

To study the role of consciousness in nature isn’t to anthropomorphize non-human animals; it is to naturalize the mind by freeing it from the confines of the human model of consciousness (see also Figdor, 2018). Once we reject a human-centric model of subjective experience for all of consciousness, the problem of anthropomorphism will fade alongside with it. Our interest lies in what the subjective experiences of animals feel like for them, not what it would be like for us to be in an animal body. Human consciousness is a very important data point and part of what is to be explained, but it ought not to be the be-all and end-all of a Darwinian science of animal consciousness.

Evolutionary thinking is sometimes narrowly thought of as the mere construction of hypotheses about the origins and function of traits, but it is importantly also meant to be about their diversity and the wealth of alternative life-history strategies we find in nature. An evolutionary approach to subjective experience is one that recognizes both gradations and varieties of subjective experience across the tree of life, both within and across species, and studies them in a comparative manner. Consciousness, like all complex biological traits, comes in varieties and degrees, so we are bound to be misled if we use human consciousness as a *model for all subjective experience* (see also Figdor, 2018). Diversity in subjective experience across taxa is likely to be much higher than the diversity of subjective experience within a single species such as humans.

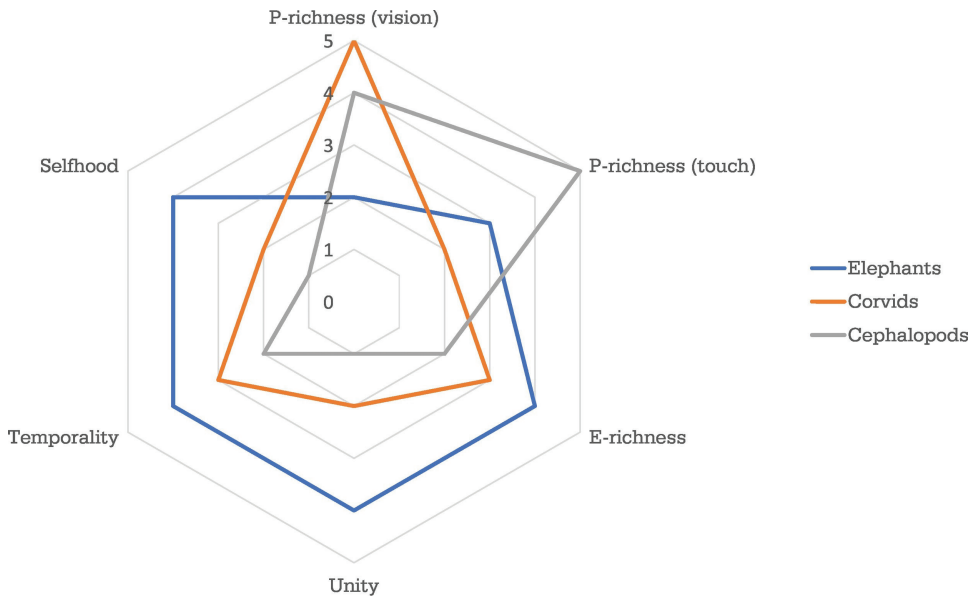
Yet, it may seem like an incredibly difficult task to study the variations and gradations of consciousness even if we limit ourselves to humans. Among humans, there are striking differences in our sensory modalities, our emotional lives, the experienced flow of time, the ability to engage in mental time travel, how unified our experiences are, and of course pathological

variations of consciousness. Note, however, that care must be taken not to characterize all variations as pathological – as “lesser versions of consciousness” – since, as with any other biological trait, we should expect some variation to be the norm without thereby making it maladaptive.

Furthermore, what counts as a pathological variation of human consciousness may not be so for an animal, e.g. what would count as colour blindness in humans would not do so in a species such as the European mole (*Talpa europaea*) that evolved a less rich visual experience. Neither do we think that humans must be pathological because our distance vision is worse than that of a Peregrine falcon (*Falco peregrinus*). These examples illustrate that each species has their own biological norms and that we are in need for a teleonomic perspective that addresses the role consciousness plays for organisms in their normal lives, which was precisely what motivated Donald Griffin to call for a cognitive ethology. Understanding consciousness in all of its diversity requires a comparative study of phenomenological complexity.

However, some may maintain that such an investigation would be impossible in non-human animals, due to their inability to verbally communicate their subjective experiences. Luckily, for purposes of this book, it is precisely this challenge that has motivated Birch in a recent joint paper with two scientists at the University of Cambridge – the behavioural ecologist Alexandra Schnell and Professor of Comparative Cognition Nicola Clayton – to offer perhaps the first attempt at assessing phenomenological complexity across the animal kingdom by creating hypothetical “consciousness profiles” for other animals (see Figure 2.1).

In their article “Dimensions of Animal Consciousness”, Birch et al. (2020) distinguish between what they consider to be the five most important dimensions of variation in consciousness between



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FIGURE 2.1 Birch et al.’s hypothetical consciousness profiles [reproduced from Birch et al. (2020, Figure 1, p. 791) CC BY]

“These hypothetical profiles highlight six important dimensions of variation, with p-richness represented separately for vision and touch. These are not finished, evidence-based profiles: they are conjectures based on current evidence. A key goal for animal consciousness research should be to produce a much richer evidence base for the construction of consciousness profiles and more precise ways of measuring the dimensions. Abbreviations: p-richness, perceptual richness; e-richness, evaluative richness” (Birch et al., 2020, p. 791).

species: *p-richness* (perceptual richness or rather sensory richness), *e-richness* (evaluative richness), *selfhood* (self-consciousness and an awareness of other selves), *temporality* (integration of subjective experiences across time), and *unity* (integration of subjective experiences at a specific time) (p. 790). In Table 2.1, I have borrowed their list of experimental paradigms for their proposed five dimensions, on which I will elaborate in this chapter since (i) their discussion of the dimensions is quite brief, (ii) the dimensions are important for making my case that phenomenological complexity is operationalizable, and (iii) the distinctions between the five dimensions will help us in the next chapter to reverse-engineer the evolution of consciousness and narrow the explanatory gap by re-conceptualizing consciousness as a complex multidimensional phenomenon that can gradually evolve, rather than an all-or-nothing property that would appear to resist evolutionary explanation.

2.3 The Experience of a Self

The first dimension of consciousness I will discuss here is a notion that has remained strikingly popular both in research and among the public – the idea that consciousness is self-awareness. Birch et al. (2020) call this dimension *selfhood* by which they try to capture both an “awareness of oneself as distinct from the world outside” and an “awareness of oneself as the persisting subject of a stream of experiences, distinct from other such subjects” (p. 797). Looking at different forms of selfhood in some detail will be helpful to emphasize how even within a single dimension there can be further varieties and gradations that might require further divisions.

2.3.1 Theory of Mind

We begin with what is possibly the most complex form of selfhood – the awareness of other subjects with their own distinctive subjective experience – which appears extraordinarily hard to test in animals. Yet, Birch et al. (2020) are right to point to research on the so-called theory of mind as an important line of evidence for this capacity. This “theory” or rather mindreading ability is meant to capture the capacity of mental state attribution to oneself and others (Baron-Cohen, 1997).

The prevailing paradigm for research on mindreading has largely relied on *false-belief tasks* which test whether an animal can attribute false beliefs to others (Dennett, 1987; Nichols & Stich, 2003; Saxe & Kanwisher, 2003). We know that humans have this ability, and much research has focused on the development of associated mental faculties during infancy (Dörrenberg et al., 2018; Wellman, 2014). Furthermore, the same tests have been done in those with mental disorders that appear to have mindreading deficits, such as autism (Baron-Cohen, 2000). This focus both on development and on pathological varieties is a good starting point for understanding the role of this capacity in nature.

Unfortunately, evidence for mindreading in the animal kingdom is still sparse and seen as controversial, though there is some indication that something like a theory of mind is found in other non-human primates – especially the great apes (Call & Tomasello, 2008; Krupenye & Call, 2019; Premack & Woodruff, 1978). The partial success in false-belief tasks may be indicative that many animals have a more rudimentary capacity to use their own experience to extrapolate to that of others, which Birch et al. (2020) refer to as *experience projection* (see Table 2.1).

2.3.2 Self-Awareness

When it comes to self-awareness, performance of appropriate behaviour in response to their own self-reflection in a mirror has been seen as one of the hallmark “proofs” of animal consciousness. So it is hardly surprising that Birch et al. (2020) suggest the most sophisticated current form of

TABLE 2.1 Birch et al.'s suggested experimental paradigms for the five dimensions

<i>Dimension</i>	<i>Experimental paradigm</i>	<i>Question being investigated</i>	<i>References</i>
P-richness	Induced blindsight	Can blindsight-like phenomena be induced in the animal through lesions to specific brain regions? If so, what information typically reaches those regions? (Drawback: highly invasive).	Cowey (2010)
	Discrimination learning	Can the animal learn to respond differently to very slight differences between stimuli (and how small can the differences be)?	Pearce et al. (2008)
	Reversal learning	When stimulus contingencies are reversed, can the animal rapidly learn that they have been reversed? This is potentially linked to consciousness in humans.	Bublitz et al. (2017); Travers et al. (2018)
	Trace conditioning	Can the animal still learn stimulus contingencies when the stimuli are separated by a temporal gap? This is potentially linked to consciousness in humans.	Clark et al. (2002); Allen (2017)
E-richness	Motivational trade-off	Does the animal weigh different needs against each other in a “common currency” to make flexible decisions?	Balasko and Cabanac (1998a, 1998b); Appel and Elwood (2009); Elwood and Appel (2009)
	Outcome devaluation and revaluation	If the value to the animal of a reward is manifestly changed, will the animal change its behaviour quickly?	Balleine and Dickinson (1998)
	Cognitive bias	Does the animal respond differently to novel stimuli depending on its affective state?	Crump et al. (2018)
Unity	Emotional contagion	Is the animal susceptible to “catching” the emotions of other individuals?	Osvath and Sima (2014)
	Interocular transfer	If the animal is conditioned to respond to a stimulus presented in one visual hemifield, can the same response be elicited by presenting it to the other hemifield?	Ortega et al. (2008)
	Meta-control	If the two visual hemifields are presented with conflicting information, can the animal resolve the conflict?	Adam and Güntürkün (2009)
	Crossmodal integration	Can the animal integrate information from different sense modalities (e.g. vision and hearing?)	Narins et al. (2005)
	Visuo-spatial bias	Does the animal exhibit visuo-spatial biases in behaviour (e.g. a preference for using a particular eye to guide a particular task?)	Schnell et al. (2016); Rogers et al. (2013)

(Continued)

TABLE 2.1 Birch et al.'s suggested experimental paradigms for the five dimensions (*Continued*)

<i>Dimension</i>	<i>Experimental paradigm</i>	<i>Question being investigated</i>	<i>References</i>
	Multitasking	When given two tasks simultaneously (e.g. foraging and watching for predators), does the animal divide the labour between the two hemispheres?	Rogers et al. (2013)
Temporality (timescales <1 s)	Electroencephalograph studies of sleep	Does the animal exhibit unihemispheric or bihemispheric sleep?	Mascetti (2016)
	Apparent motion	Can the animal respond differently to moving and static images? Can it make inferences from video images to real moving objects and vice versa?	Lea and Dittrich (2000)
Temporality (timescales >1 s)	Episodic-like memory	Can the animal simultaneously remember “what”, “where”, and “when” about a specific past event?	Clayton and Dickinson (1998)
	Source memory	Can the animal remember information about how a memory was acquired (e.g. by vision or by smell)?	Billard et al. (2020)
	Memory integration Future planning	Can the animal update old memories with new information? Can the animal flexibly and spontaneously plan for a future event, and for future desires, without relying on reinforcement learning?	Clayton et al. (2001) Cheke and Clayton (2012)
Selfhood	Mirror-mark	Does the animal recognize a mark seen in a mirror as a mark on its own body?	Anderson and Gallup (2015); Morrison and Reiss (2018); Plotnik et al. (2006); Prior et al. (2008); Kohda et al. (2019)
	Body awareness	Can the animal recognize the position of its own body as a potential obstacle to success in a task?	Dale and Plotnik (2017)
	Experience projection	Can the animal predict how others are likely to behave in a scenario on the basis of a specific past experience it had in the same scenario?	Emery and Clayton (2001); Kano et al. (2019)

Source: Reproduced from Birch et al. (2020, Table 1, p. 798) CC BY.

“A list of established experimental paradigms with the potential to provide insight into p-richness, e-richness, unity, temporality, and selfhood. There is continuing debate regarding the implications of these paradigms for questions about conscious experience. Inferences to properties of conscious states will be stronger when based on a battery of convergent experimental results from different paradigms [...]” (Birch et al., 2020, p. 798).

this test – the *mirror-mark test* – as the key to studying this capacity (see Table 2.1). Here, an animal is tested in regard to whether it “is able to recognise a mark seen in a mirror as a mark on its own body” (Birch et al., 2020, p. 797), i.e. whether they are able to make a mental connection between the “self in the mirror” and their own body as a self in the world.

Most human infants by around two years old are able to pass the test by touching the mark as guided by their reflection in the mirror, though there is some inconsistency in the results due to varying operationalized definitions (Archer, 1992; Bard et al., 2006). But this should be expected in a gradualist picture; already in healthy human development we recognize that this capacity doesn’t just pop into existence, so we shouldn’t be surprised if this side of experience is reported to vary across the animal kingdom. Birch et al. (2020) even highlight a recent study by Kohda et al. (2019) on the cleaner wrasse (*Labroides dimidiatus*) to suggest that “grade of self-consciousness required to pass the mirror-mark test is possessed by a wide range of animals” (p. 797).

What Kohda et al. (2019) demonstrated was that the cleaner wrasse not only behaved atypically in front of the mirror, or ceased social behaviour towards the reflection, but also attempted to remove a coloured mark through scraping behaviour, which they did not do when the mark was translucent or in the absence of a mirror. This suggests a higher level of self-awareness than is typically assumed in fish. Naturally, there has been much controversy surrounding their experiment and the mirror-test paradigm at large (Gallup Jr & Anderson, 2020; Vonk, 2019) which relates to the parallel controversy over the “correct” meaning of self-awareness (see Gallagher, 2011 for a number of different definitions).¹

Much of the controversy here results from a mistaken binary conception of self-consciousness (which is partially encouraged by the very idea of the mirror *test* that can be passed or failed, as introduced by Gallup, 1970). Self-consciousness, like other mental phenomena, does not just suddenly pop into existence like a light being switched on, but gradually emerges in incremental steps towards greater cognitive and phenomenological complexity (de Waal, 2019; de Waal & Ferrari, 2010; Godfrey-Smith, 2020c). As Frans de Waal (2019) describes it, we still “live with a [‘]Big Bang[’] theory, according to which this trait appeared out of the blue in just a handful of species, whereas the vast majority lacks it” (p. 1).

Borrowing de Waal’s mirror self-recognition (MSR) diagram to distinguish the two views, it is obvious that what he calls the “traditional binary model” (**A** in Figure 2.2) fails to recognize gradations of self-awareness. Here, self-awareness is only attributed to the great apes, elephants, dolphins, and magpies, who are known for their high intelligence and problem-solving ability, whereas *all* others are lumped together into a single category considered to lack self-consciousness. This gross simplification of the empirical data results in much information being lost. In contrast, a gradualist view of self-consciousness recognizes a wide variety of self-recognition abilities across taxa (**B** in Figure 2.2).

All hominids appear, de Waal (2019) points out, to “spontaneously explore and play with their reflection and care about their appearance” (p. 5). Furthermore, we can recognize a broad range of intermediate levels of response, where we could place African grey parrots (*Psittacus erithacus*) and monkeys (*Macaca tonkeana* and *M. fascicularis*) that have been shown to use a mirror as a tool to their advantage in order to discover objects outside of their visual field (Anderson, 1986; Pepperberg et al., 1995). Even with this decades-old paradigm, we are already able to recognize a diversity of more and less sophisticated forms of self-awareness:

Reactions to mirrors range from permanent confusion about one’s reflection to a certain level of understanding of how mirrors operate (e.g., using them as tools) and only brief or no confusion between one’s reflection and a stranger.

Frans de Waal (2019, p. 5)

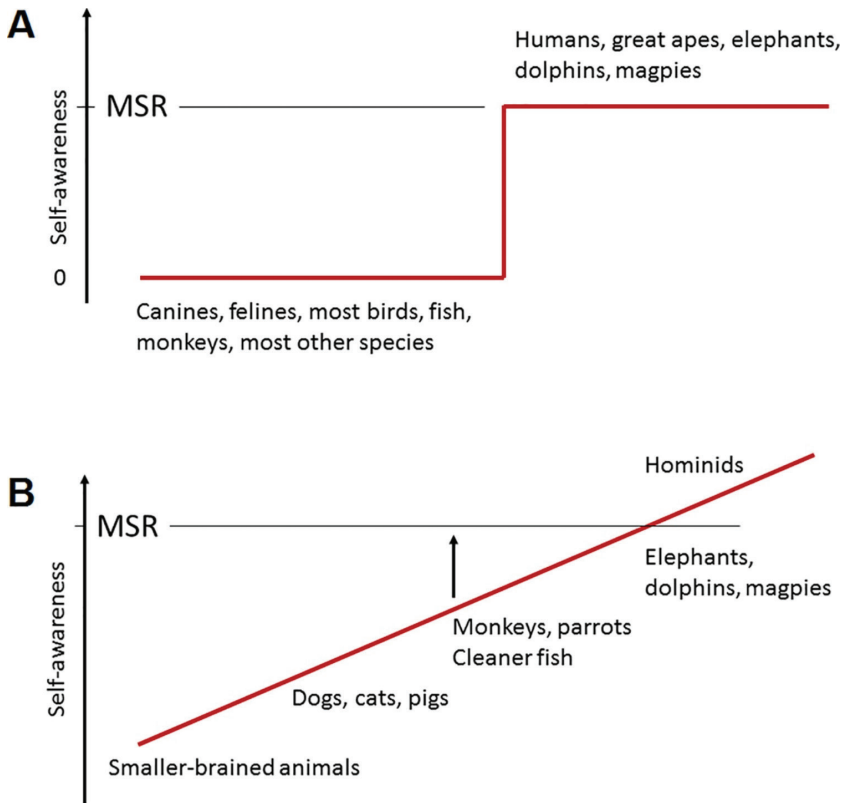


FIGURE 2.2 A binary (**A**) versus a gradualist (**B**) view on the evolution of self-awareness [reproduced from de Waal (2019, Figure 3, p. 5) CC BY]

Moreover, de Waal (2019) urges us to recognize that multiple sensory modalities are involved in such findings, since marks often involve a physical object, e.g. a sticker, rather than just a discolouration and are thus visually much more noticeable and abnormal, in addition to plausibly causing pain and discomfort, or at least some somatosensory experience.² This is precisely why de Waal included an arrow in his depiction of the gradualist view of self-awareness (**B** in Figure 2.2), since training and multimodal stimulation are able to raise an animal towards displaying a higher level of self-awareness. A visual mark may simply not be interesting to many animals whose lifestyle naturally leads to discolourations.

For cleaner wrasse, however, visual marks are likely to be ecologically salient; the species frequently engages in cooperative social behaviour with larger host fishes, having evolved and become adapted to detecting and freeing these host fishes from parasites and dead skin. This then makes it less surprising that they are able to pass the visual mirror-mark test. Such a social lifestyle, as de Waal (2019) notes, involves complex “economic decision-making” (p. 2). Hence, within the context of my framework, an increase in phenomenological complexity in the face of this pathological complexity should not at all be surprising.

These varieties and gradations of self-awareness elegantly illustrate the importance of locating empirical findings in tests about consciousness within an evolutionary context. As de Waal (2019) puts it: “Only with a richer theory of the self and a larger test battery will we be able to determine all of the various levels of self-awareness, including where exactly fish fit in” (p. 7). To assume that a single experiment – or for that matter a set of experiments – could

simply be applied across the tree of life without any consideration for the species' ecological lives and evolutionary history is as absurd as using the mirror-mark test on a pig or hippopotamus (Allen, 2004, p. 598). It is here that the pathological complexity thesis will offer us a useful framework for accommodating the criticism commonly raised by cognitive ethologists that the animal's ecological life-history context is being ignored within comparative psychology.

2.3.3 A Minimal Sense of a Bodily Self

Lastly, the most minimal form of self-consciousness Birch et al. (2020) plausibly suggest involves “registering a difference between self and other: registering some experiences as representing internal bodily events and other experiences as representing events in an external world” (p. 797). We may want to call it a bodily self. Such a capacity they suggest (similarly to de Waal) is plausibly found in all complex animals that need to be able to distinguish their own sources of bodily feedback from external ones. In addition, we may want to include features such as an awareness of oneself in space and perhaps an awareness of one's bodily state that in richer forms eventually give rise to self-awareness. Birch et al. (2020) mention *body awareness* experiments, such as those by Dale and Plotnik (2017) on elephants that try to test whether an animal is able to recognize its own body as an obstacle in a task (see Table 2.1).

Yet, determining how to distinguish conscious self-recognition from unconscious self-recognition would require a better theoretical understanding of the function of consciousness, which makes it hard to have agreement on what kinds of tests would vindicate a minimal feeling of bodily self – a problem that is admittedly shared with all the minimal forms of the five dimensions. Since we are interested in the origins of consciousness, the next chapter will look again at this minimal form of selfhood and its possible connection to consciousness, but we shall now turn to the dimensions of unity.

2.4 The Unity of Experience

Birch et al. (2020) understand unity as the integration of experience *at a point in time*. By this, they mean the experience of a single self or subject as opposed to multiple selves. The terminology is not perfect, however, since they use the label *temporality* for the unification of experience across time. Here, I will simply discuss them as two dimensions of unity: one I shall call synchronic and the other diachronic.

2.4.1 Synchronic Unity

We know from our own experience that healthy human adults have a highly unified experience. Smell, taste, vision, general bodily feelings – whatever it is we're experiencing appears to be experienced synchronously. Other animals, however, may not have such a unified experience.

As Birch et al. (2020) point out, the curious case of split-brain patients already suggests that the unity of consciousness may not be a necessary feature of subjective experience (see also Godfrey-Smith, 2021a). In the twentieth century, some people suffering from severe forms of epilepsy had their *corpus callosum* (the connecting pathway between the two brain hemispheres) cut as an experimental treatment (Schechter, 2018). Those who had it “wholly or partially severed”, however, occasionally displayed strikingly “disunified behaviour when different stimuli

are presented to the two halves of the visual field” (Birch et al., 2020, p. 793). Indeed, such split-brain patients appear to have two distinct streams of experience:

If these subjects are asked to verbally describe what they see, they will report what is visible on the right-hand side of their visual field. This is because language is predominantly controlled by the brain’s left hemisphere, which only has access to visual information from the right-hand side. Yet, when asked to draw with the left hand what they see, they will draw what is visible on the left-hand side of the visual field. This is because the left hand is predominantly controlled by the right hemisphere, which only has access to visual information from the left-hand side.

Birch et al. (2020, p. 793)

Researching decision-making in split-brain patients can help us to understand how a healthy brain achieves what Birch et al. (2020) call *meta-control* when faced with conflicting sensory information from the hemispheres (see Table 2.1), which may hold clues regarding the role of unity. In animals with highly lateralized brain hemispheres, however, disunified experience will not necessarily be dysfunctional, so the study of this capacity in animals whose brains resemble those of split-brain patients may reveal the adaptive benefits of synchronic disunity.

As Birch et al. (2020) point out, for animals that simultaneously engage in multiple complex tasks, i.e. what they call *multitasking* (see Table 2.1), there might be a division of labour between hemispheres. A useful experimental paradigm Birch et al. (2020) mention that could probe such division of labour are *visuo-spatial bias tests* (see Table 2.1) that check whether there are preferences for using a particular sensory organ to deal with a task. Relatedly, Birch et al. (2020) suggest that *crossmodal integration* (see Table 2.1) could help to assess whether information is being integrated differently depending on the sensory modality (e.g. touch vs pain). After all, unity may not be an all-or-nothing affair.

What I consider to be the most important paradigm that Birch et al. (2020) discuss for this dimension is the study of *interocular transfer* (see Table 2.1). Here, an animal is trained “to perform a task in response to a stimulus presented to one eye”, after which we test “whether the task can still be performed when the stimulus is presented to the other eye” (Birch et al. 2020, p. 793). If an animal fails to do so, this could be suggestive of disunified experience, where the different brain hemispheres contain in some sense distinct “selves”.

Finally, another compelling paradigm mentioned by Birch et al. (2020) for studying the unity of conscious experience is *electroencephalograph studies of sleep* (see Table 2.1). By studying the electrical activity of brains during sleep, we can determine whether one of the hemispheres is sleeping while the other is in a wakeful mode, i.e. whether they have bihemispheric or uni-hemispheric sleep. As Birch et al. (2020) rightly note, this evidence would be suggestive of “more than one stream of consciousness” (p. 794). We will return to this and other experimental paradigms in the next chapters to discuss the connection between synchronic integration and consciousness. Let us now consider the dimension of temporal unity.

2.4.2 Diachronic Unity

Birch et al. (2020) call the integration of experience across time *temporality* and illustrate it using the example of subjectively experiencing “the leaves of a tree blowing in the wind”, which we do not experience as a mere “series of static snapshots” (p. 794). Beyond this integration of experience across short timescales, however, Birch et al. (2020) also note that humans are able to engage in *mental time travel*, i.e. the ability “to recall past experiences and simulate future

experiences” (p. 794). In their table of established experimental paradigms, Birch et al. divide those paradigms testing timescales of under one second against those that integrate over a longer time span (Table 2.1). Naturally, the second category is a much more expansive one and appears to be related to memory, whereas the first is about the way we experience time. Let us thus divide them into mental time travel and the experience of time.

2.4.2.1 *Mental Time Travel*

Most animals are assumed to lack the ability for mental time travel – indeed, they might well be described as “living in the moment”. So it is hardly surprising that the study of mental time travel in animals is a controversial subject and Birch et al. (2020) suspect that the ability would require “substantial cognitive sophistication” (p. 794). However, as they point out, we have already accumulated a wealth of data suggesting that corvids have this capacity, which I will discuss in Chapter 5.

There are plenty of tests for the backwards-looking aspect of conscious mental time travel or as it is typically called “episodic memory”. Birch et al. (2020) mention a paradigm that Clayton herself was involved in developing, i.e. testing for *episodic-like memory* (see Table 2.1), which is meant to assess whether animals are able to retrieve memory about the so-called three Ws: “what”, “when”, and “where” of past events. However, the suffix “-like” was added precisely because success in such tasks does not necessarily imply conscious recall.

Birch et al. (2020) recommend that tests of *source memory* (see Table 2.1) may help us to demarcate information that can be retrieved consciously, by investigating whether the animal can recall the sensory modality through which the information was acquired, rather than just the content. For this, the suggestion by Birch et al. (2020) to study *memory integration* (see Table 2.1) is also helpful since the ability to update old memories in light of new experiences could be suggestive of conscious mental time travel.

Lastly, in regard to mental time travel directed towards the future, Birch et al. (2020) suggest research on *future planning* as flexible future-directed behaviour that goes beyond mere reinforcement learning (see Table 2.1). If we can find such planning, Birch et al. (2020) are certainly right to consider it as a “promising nonverbal indicator of conscious temporal integration” (p. 796).

2.4.2.2 *The Experience of Time*

Could some animals perceive the world in a more fragmented way than humans? This question may seem impossible to answer. Yet, Birch et al. (2020) suggest that we could draw on research on the so-called colour-phi illusion, “in which two spatially separated, differently coloured dots flashed in sequence are perceived as a single moving dot that changes colour half-way across the gap”, to understand how the brain integrates them to construct “a coherent account of how the stimulus is changing” (p. 794). This research supports the idea that integration of sensory stimuli plays an important functional role in humans. In some animals, however, things might look different.

Birch et al. (2020) urge us to take seriously the possibility of conducting colour-phi tests in non-human animals, even in the absence of a verbal report, by suggesting that we could train animals to “respond differently to perceptions of continuous and discrete stimuli and to stimuli that change colour half-way and stimuli that do not” (p. 794). If they were then to be presented with a colour-phi test, we could change the interval between both stimuli in order to test whether – just like in the human case – there is a threshold at which animals move between an experience of the phenomena as two discrete or one continuous stimulus. Similarly, we could

draw on what Birch et al. (2020) call the *apparent motion* paradigm (see Table 2.1) to assess how animals react to videos with higher and lower frame rates.

An experimental test that they surprisingly do not mention – despite already having been investigated extensively in animals and likely constituting the best evidence for assessing the experience of time in other animals – is the *critical flicker fusion frequency* paradigm, which tries to find the lowest frequency of a flickering light at which the light is perceived as continuous rather than as independent stimuli (D’Eath, 1998; Healy et al., 2013; Potier et al., 2020).³ A broad comparative study of this capacity may reveal the evolutionary benefits and drawbacks of a more fragmented way of experiencing the world, the possibility of which I will discuss in the next chapter, but we shall now turn to the dimension most readily associated with consciousness research.

2.5 Sensory Experience

The perhaps most diverse dimension of phenomenological complexity is sensory experience. Birch et al. (2020) describe the dimension of sensory experience as *perceptual richness* (or p-richness). I prefer the term sensory richness because it is less evocative of a primacy of the modality of vision, which has unfortunately so far dominated much of consciousness science. Following Birch et al. (2020), we can understand different degrees of richness in terms of how fine-grained the conscious (sensory) discriminations of an animal are.

This doesn’t mean, however, that all sensory modalities can be put on a single scale. Unlike with the other dimensions, Birch et al. (2020) maintain that there are as many sub-dimensions of the sensory side of consciousness as there are different sensory modalities, such as vision, smell, and touch. Furthermore, there are sensory modalities that some animals have but humans lack (Keeley, 2002). So it is perhaps unsurprising that Birch et al. (2020) deny the possibility of an overall measure for how different sensory modalities could be integrated into an overall measure: “Any measure of p-richness is specific to a sense modality, so we should not refer to a species’ overall level of p-richness. A species might have richer perceptual experiences than another in one modality, but less rich experiences in a different modality” (p. 790). This is nicely illustrated in Figure 2.1 which distinguishes the hypothetical consciousness profiles of elephants, corvids, and cephalopods by splitting p-richness into vision and touch. To their credit, Birch et al. also accept that perceptual consciousness can vary within a sense modality, which (though they don’t state this explicitly) could then lead to a sentience profile for a particular perceptual dimension of an animal.

Visual experience, Birch et al. (2020) note, could be divided into “bandwidth (the amount of visual content experienced at any given time), acuity (the number of just-noticeable differences to which the animal is sensitive), and categorisation power (the animal’s capacity to sort perceptual properties into high-level categories)” (pp. 790–791). But their reply to the worry that this would make an overall evaluation difficult is not particularly satisfying, since they merely maintain that an animal can be considered to have a richer visual experience if it outperforms another in two but loses in one. But surely this would also depend on the case: consider a species that is mildly worse in two categories but outperforms another species in the third by a large margin. Nevertheless, Birch et al. accept that further empirical investigation may require us to move to an even more fine-grained profile or – as I would put it – a realization that there is greater phenomenological complexity in nature than we may have anticipated.

The most basic paradigm that Birch et al. (2020) mention for measuring p-richness is *discrimination learning* (see Table 2.1), which tests whether animals are able to respond to ever more fine-grained differences between different stimuli. The cognitive capacity to distinguish stimuli alone, however, may not provide us with evidence that they are also consciously experienced. To

address this problem, Birch et al. (2020) suggest relying on blindsight research that has received much discussion in the consciousness literature, since those suffering from this pathological condition “report blindness in part of their visual field, but they are able to use visual information about objects in that region to guide action” (p. 791).⁴

Birch et al. (2020) argue that we could use experimentally *induced blindsight* (see Table 2.1), which has been commonly used to target the primary visual cortex (V1) of monkeys, who appear to behave strikingly similarly to humans with blindsight in *forced-choice tasks* when this part of their brain is damaged. These findings, Birch et al. (2020) argue, could be compelling evidence for sensory consciousness in animals: “if a stimulus is processed in a brain region such that damage to that region results in blindsight, then a healthy, blindsight-free animal of the species in question probably perceives that stimulus consciously” (p. 792). On pains of evolutionary continuity, this method appears quite promising. Indeed, Birch et al. suggest that we could extend this strategy “to non-mammals, based on identifying homologues or analogues of V1 in those animals” (p. 792).

Yet, they are right to admit that experimentally induced blindsight is highly invasive, difficult, and understandably considered ethically problematic despite its scientific potential. However, not all neuroscientific methods of inducing blindsight must be invasive, as recent studies on *transcranial magnetic stimulation* of the visual cortex have shown (Christensen et al., 2008; Jolij & Lamme, 2005; Ro et al., 2004). While Birch et al. surprisingly do not mention this method, it may provide an excellent way to temporarily induce blindsight-like states by using magnetic impulses to disrupt the local brain regions responsible for visual experience in other animals (see Railo & Hurme, 2021 for a critical review).

Another alternative method that Birch et al. propose for making progress on assessing the sensory worlds of animals is to focus on identifying special tasks that have been linked to conscious experience in humans and apply corresponding tasks to animals. One of their proposed paradigms for this is *reversal learning* where the valence of the reward associated with two different stimuli is switched and a measure taken of the time until an animal learns the new connection, which appears to have links to conscious perception in humans (see Table 2.1).

The experimental paradigm that Birch et al. highlight for a cognitive test of sensory consciousness is *trace conditioning*, where a conditioned stimulus and an unconditioned stimulus are presented with a short delay between them to check whether the connection can be applied over these timescales as opposed to merely instantaneously (see Table 2.1). As they point out, in trace conditioning tests on humans, subjects appear to only produce a conditioned response if they have been consciously aware of the initial unconditioned stimulus (e.g. a sound), which suggests that this form of learning is indicative of consciousness and could be applied in non-human animals. Since tests involving learning are also related to evaluation, let us now turn to the last of the five dimensions.

2.6 Evaluative Experience

As I identify the origins and function of consciousness within hedonic valence, it is unsurprising that the dimension of evaluative richness (e-richness) plays a special role in this book and will hence receive extra attention here. While philosophers have given relatively little attention to this dimension, several well-known scientists continue to defend the intuition of Romanes that an understanding of the evaluative mechanisms of the brain would bring us closer to understanding consciousness and suffer less from the challenge coming from the hard problem. Most prominently, the father of affective neuroscience (the neuroscience of emotions) Jaak Panksepp (1998, 2005, 2010, 2011) argued that emotions plausibly constitute the most basic and ancient kind of consciousness – a view that will also be defended in the following chapters.

For Birch et al. (2020), this evaluative dimension of consciousness is meant to capture the subjective experience of emotions and moods – which are often described as so-called affects (Browning, 2020b; Panksepp, 2005). They suggest that “valence” would be a great concept for understanding varieties in animal experience, since it is always involved in affective (emotional) decision-making, irrespective of speculations about whether the animal exhibits complex human-like emotions. I am less convinced of this statement since the terms “valence” and “affective decision-making” are used in an ambiguous way in the literature in both conscious and unconscious senses of evaluation. What they appear to have in mind are rather hedonic decision-making and hedonic valence:

Some conscious emotions, such as pain, fear, grief, and anxiety, feel bad. These are affective experiences with negative valence. Others, such as pleasure, joy, comfort, and love, feel good. These are affective experiences with positive valence. All affective responses have positive or negative valence.

Birch et al. (2020, p. 792)

Importantly, my emphasis on adding the prefix “hedonic” is not a mere side note. Research in animal welfare science and the affective sciences (the sciences of emotion) has notoriously suffered from ambiguity in the use of terms such as “fear”, “valence”, “emotion”, and “welfare”, where these are sometimes used as descriptions of nonconscious neurological, behavioural, or physiological processes and at other times used to refer to subjective experiences. Prominently, this ambiguity has recently been criticized by Dawkins (2017a, 2017b, 2021) in animal welfare science and by LeDoux (2017a, 2017b, 2019, 2022) in affective neuroscience, both of whom think that this confusion has harmed the progress of their sciences and urge caution when talking about consciousness in non-human animals.

Dawkins (2017a) has described this ambiguous use of language as “flirting with consciousness”, i.e. researchers use terms that in their everyday use carry implications of subjective experience, but when pressed in a scientific context tend to back off and state that they are not necessarily implying consciousness. Because of this, LeDoux and Dawkins believe that both the public and scientists have come to overestimate how much we really understand about conscious emotions, especially in other animals. Notably, LeDoux (2022) himself admits that he has been guilty of this way of speaking in his earlier pioneering work on how the brain achieves Pavlovian fear conditioning in rats, which has led to him routinely being introduced as the discoverer of “how conscious feelings of fear arise from the amygdala” (p. 4). LeDoux suspects that the origins of this ambiguous language lie in the behaviourists’ usage of folk mental state terms (e.g. “fear” conditioning) for what they saw as purely behavioural learning processes, not conscious emotions. But because the behaviourists failed to communicate their definition to the public, and more and more anti-behaviourists, such as Panksepp (2005, 2011), were interested in actually studying fear in its folk sense as a conscious experience, LeDoux (2022) asserts that we have returned to the “semantic ‘wild west’ of the late nineteenth century” when “animal psychology tried to use intelligent and emotional behaviour as marks of consciousness” (p. 8). As a solution, LeDoux (2022) has proposed to use terms such as “fear” exclusively for the subjective experience it refers to, rather than its “behavioural and physiological correlates” (p. 4). What he once called “fear circuits”, he thus now calls “survival circuits” (LeDoux, 2022).

At a first glance, the use of mental-state neutral language for what goes on in animals may appear sensible. However, in doing so, LeDoux ends up artificially widening the explanatory gap between the mechanisms of the brain and the “mysterious” subjective feelings of the mind. Admittedly, LeDoux and Dawkins are right to warn that it is very difficult to establish links

between brain mechanisms and subjective experience and that, because the brain does a lot unconsciously, we are in need of an explanation as to why a particular brain process is conscious rather than nonconscious. However, many, if not most, animal consciousness researchers are well aware that most information processing in the brain is done unconsciously and that we have to disassociate conscious from unconscious processes. The fact that researchers such as Panksepp made *hypotheses* identifying subjective experiences with particular brain processes should not at all be seen as a “Gotcha!” moment revealing the naiveté of the field. The science of consciousness has made progress thus far precisely by challenging proposed hypotheses for the functions of consciousness and by showing that many proposed functions can also be performed unconsciously.

This “speculation” is simply how science progresses, not a deep conceptual and methodological error. In a biological materialist picture of consciousness, subjective experience is constituted by particular mechanisms and processes of the nervous system. It is not “produced” by it – such thinking would lead us straight back to dualism. But the insistence that “flirting” with consciousness must be a bad thing and that we should not use any mental state terms for physical processes inevitably brings with it older dualist ways of thinking. Similarly, the assertion by LeDoux (2019) that the problem of other minds is merely “a hypothetical philosophical argument, not a scientifically based one”, and only applies to non-human animals as they have very different brains from our own, likewise evokes strangely dualist thinking about the separation of philosophy and science and the difference between us and other animals.

LeDoux (2019) is, of course, entirely correct in stating that “if the unique aspects of our brain and our cognition are key to our kind of consciousness, then our kind of consciousness should not simply be assumed in other animals on the basis of the other minds problem” (p. 318). But his implication that the work of contemporary animal consciousness researchers is no different from nineteenth century speculations that simply anthropomorphized other animals and attributed human-like conscious experiences to them based on some behavioural similarities is an unfair straw-manning and misrepresentation of contemporary animal minds research:

When the claims match common sense and lore, they feel correct, and when they are repeated authoritatively in scientific or lay communities, they come to be assumed as indisputable facts. [...] The widespread assumption that innate defensive behaviours are a fool-proof reflection of conscious feelings of fear is a case in point.

Joseph LeDoux (2022, p. 8)

These assertions are greatly overstated. While members of the public might anthropomorphize their own pets, few would accept innate defensive behaviours in insects, gastropods, and worms as foolproof evidence for consciousness. Even for more complex evaluations and survival behaviour, few animal consciousness researchers would accept these as foolproof indicators of conscious feelings. Indeed, there is hardly a scientific field that is kept under higher scrutiny for its hypotheses about its target phenomenon. Yet, LeDoux (2019) simply asserts that animal consciousness researchers fail to live up to the standards of human consciousness research, since their “experiments are not designed to ascertain whether a particular behaviour is consciously or non-consciously controlled. Instead, they involve amassing more and more support for the intuition that consciousness was involved” (p. 319). Worse, he accuses animal consciousness researchers of (i) not knowing the methods for distinguishing conscious from unconscious processes, (ii) not caring about them because they would support nonconscious explanations, and (iii) endorsing animal consciousness for moral rather than scientific reasons (LeDoux, 2019, p. 320). I suspect that many contemporary animal consciousness researchers would take great offence at these accusations.

As this chapter hoped to illustrate, animal consciousness researchers care a great deal about disassociating conscious mental processes from unconscious ones, possessing a rich diversity of empirical approaches that put them in a very different position from the speculations of Darwin, Romanes, and others. Although future research will inevitably improve on the methods I am discussing here, they are not just the non-verbal guesswork LeDoux tries to make them out to be. That the origins of animal consciousness research have involved plenty of speculation should be seen as no more problematic than the speculations we find at the origins of any new scientific field of research, so long as they are empirically grounded and provide us with eventual tests with which to examine hypotheses.

Nevertheless, one might readily see the recent book by LeDoux (2019) as an inverse project of the one I am engaged in here. Whereas I argue that consciousness arose very early in the history of animal life in order to deal with the fundamental trade-off problem of life (i.e. pathological complexity), LeDoux spends a large part of his recent book on the deep history of survival behaviours, from single-cell organisms to us, to highlight that we cannot simply infer consciousness from the presence of such behaviour and that consciousness should therefore be seen as a much more recent invention. While the survival circuits and survival behaviours of animals have become more complex over evolutionary time, he thinks that this is no reason to attribute sentience to them, since they are mere “manifestations of an ancient survival function – the ability to detect danger and respond to it” (p. 1). Here, LeDoux (2019) simply commits the same mistake as the biopsychists who use the evaluative behaviour of single-cell organisms to argue that all life is sentient. As [Chapter 4](#) will make clear, both fail to think in evolutionary terms and recognize important gradations and major transitions through which consciousness could have gradually evolved. The presence of evaluation in nonconscious organisms cannot be used as a “proof” that *all forms* of evaluation must be nonconscious. The goal of the pathological complexity thesis is simply to defend one such hypothesis about a special kind of teleonomic complexity that made a hedonically felt form of evaluation worth having and led to a major transition in the evaluative agency. While LeDoux and Dawkins may think that any such hypothesis for animals could also be explained through nonconscious means, I will argue in [Chapter 4](#) that hedonically felt valence is the best explanation of how animals came to deal with just this kind of complexity and thus how consciousness gradually evolved.

But before I do so, let us first look at some of the empirical methods that have been developed for assessing “valence” and “affective states” in other animals. This is important, whether or not they are consciously experienced, since it is only by developing a greater understanding of the evaluative capacities of animals that we will be able to make sense of the evolution and function of sentience. As Birch et al. (2020) nicely put it: “Finding out how positive and negative valence are produced in an animal, and how these processes vary across taxa, should be a central goal of animal consciousness research” (p. 792).

A particularly useful paradigm Birch et al. (2020) mention to investigate the role of affects is work on *cognitive bias* in animals, i.e. whether an animal reacts differently to new stimuli based on which affective state they are in (see [Table 2.1](#)). Relatedly, their proposal to study *outcome devaluation and revaluation* (see [Table 2.1](#)) investigates whether and how quickly an animal will change its behaviour when the rewards associated with a behaviour are changed, which is also related to the reversal learning discussed in the sensory dimension. Finding evidence for these capacities could be suggestive of evaluative experience.

Furthermore, they also list *emotional contagion*, i.e. the “transmission” of affective states across individuals, as a promising paradigm for evaluative richness (see [Table 2.1](#)). Among highly social species that require synchronous behaviour, it may even be possible to find richer evidence for this capacity than is found in humans, but this paradigm has unfortunately been understudied.

Naturally, here we find a close connection to other minds research discussed in the dimension of self-consciousness.

The most significant experimental paradigm for evaluative experience, however, that Birch et al. (2020) introduce is that of *motivational trade-offs* (see Table 2.1). It is the study of how animals weigh multiple needs and opportunities against each other. Unfortunately, there has been very little comparative work on this capacity, but Birch et al. (2020) declare this paradigm a “priority for future work” (p. 793). Indeed, the importance of trade-offs is one of the core motivations for the pathological complexity thesis and will be looked at in detail in Chapter 4, but I shall lay some of the groundwork here.

Importantly, Birch et al. (2020) argue that valence provides an evaluative *common currency* for just these kinds of trade-offs in affective decision-making (p. 792). This is a different usage of the term “common currency” from the way I have used it in Chapter 1, but they are conceptually very similar. Unlike fitness, which provides a common currency for the trade-offs of pathological complexity that organisms face in their life histories, this usage of a common currency refers to a common currency that helps organisms to evaluate trade-offs arising from their different needs/goals. There are thus two domains where common currency arguments are frequently made, one in evolutionary biology, where fitness provides an *ultimate* common currency for optimal design, and the other in the behavioural and cognitive sciences, where people talk of a *mechanistic* common currency for optimal decision-making. Perhaps unsurprisingly, many authors in the behavioural, cognitive, and affective sciences have argued that complex animals have, or perhaps even must have, a *proximate* common currency linked to fitness in which the values of different actions are ranked (Cabanac, 1992; McCleery, 1977; McFarland & Sibly, 1975; McNamara & Houston, 1986; Shizgal & Conover, 1996).

Again, however, we should point out that this mechanistic claim is defended in both conscious and nonconscious versions and Spurrett (2014) has offered an elegant paper criticizing the common conflation of these common currency claims both in science and in philosophy. Indeed, the idea that hedonic valence constitutes a felt common currency of decision-making is an old one that has long been defended by philosophers in the tradition of psychological hedonism and utilitarianism, such as Bentham (1879). Here, it is also important to distinguish between the usage of pleasure as a particular kind of mental state with positive valence (as done in the above quote of Birch et al.) from pleasure as positive valence itself. Utilitarianism has often been attacked for narrowing all of the human experience down into pleasure and pain, but Bentham was using them in the deliberately broad sense of hedonic valence common to all affective experience: the pleasures and pains of experience. This is the sense in which Chapter 4 will explicate the evolution of Benthamite creatures.

Furthermore, the idea that all affective states in humans and non-human animals can be mapped onto a two-dimensional space of valence and arousal is a widely shared view with a long tradition in the study of emotion, in both psychology and animal welfare science (Burgdorf & Panksepp, 2006; Mendl et al., 2010; Plutchik, 1962, 1980; Russell, 2003; Russell & Barrett, 1999; Russell & Fehr, 1987). Rather than thinking of emotions in terms of “typological” theories that treat them as discrete entities, such as in the work of Panksepp (2005), this tradition of “dimensionalist” approaches treats the dimensions of valence and arousal as the real phenomena in nature, with emotions being mere theoretical constructs aimed to target particular points in these dimensional spaces.⁵ Today, these ideas are especially important in Lisa Feldman Barrett’s (2017) “constructivist” theory of emotions, which had a major impact on affective psychology, in both humans and non-humans. Naturally, my approach bears greater resemblance to the tradition of the dimensionalists, rather than the typologists, since we could similarly think of conscious feelings as locations in a multidimensional space of phenomenological complexity.

2.7 Conclusion, Objections, and Further Directions

My goal in this chapter was to argue that any biological theory of consciousness must make sense of the full diversity and complexity of consciousness in nature, and this includes the subjective experience of non-human animals. For this purpose, I have introduced my notion of “phenomenological complexity” as something that should be at the very heart of our theorizing about consciousness.

Against those who might be sceptical of the very viability of such a comparative project across the animal tree of life, I have reviewed and expanded the recent call by Birch et al. (2020) to develop a multidimensional framework for the study of animal consciousness, in order to show that phenomenological complexity can be operationalized and in principle be measured by distinguishing five dimensions of consciousness. We have finally developed a battery of tests to probe the experiences of other animals, rather than merely ask where to draw a line in the tree of life. This can be seen as great progress, even in the face of much uncertainty.

Cognitive ethologists such as Griffin were treated with much hostility, but they were right to call out the mistake in identifying a current lack of methods with the impossibility of developing them. Due to the lack of effective methods for probing the subjective experiences of non-human animals, Darwinian theorizing about the function, presence, and origin of mind has long been viewed with much suspicion. But as the present chapter has hopefully illustrated, we have reached a significant stage for a phase transition in which we can use the developed range of experimental paradigms for assessing the minds of other animals as a useful intermediate step for the removal of humans from the centre of reference.

Nevertheless, a multidimensional framework poses new challenges, such as how many dimensions we should distinguish. An objection to the advancement of this project could certainly challenge the five dimensions discussed here. Notably, Birch et al. recognize that their dimensions, such as diachronic experience and self-consciousness, may be correlated – especially once we reach the more sophisticated levels of each – but maintain that they are conceptually distinct. Both the worry and their response are misplaced, however. There is no need to have sharp dividing lines between these dimensions, as long as they offer a superior model to those offered in the past. To assert that their division constitutes genuine conceptual distinctions is beside the point. The conceptual playing field can be carved up in any number of ways, and we should be careful to not mistake such intuitively attractive distinctions for necessary insights into the nature of minds.

The mere conceivability of the possibility of animals with a “richly temporally integrated stream of experiences without any awareness of itself as the subject of those experiences” and others with “temporally fragmented ‘staccato’ experiences while being aware of itself as the subject of those fragment” (Birch et al., 2020, pp. 798–799) is by itself no more interesting than the assertions by Chalmers and colleagues that we could conceive of zombies that are exactly like us but lack anything it’s like to be them.⁶ What is needed is an evolutionary approach that asks what the adaptive value of these varying degrees and varieties of consciousness could be in order to assess their plausibility.

The five dimensions should thus primarily be seen as a useful way of overcoming current one-dimensional thinking. This is why I have not set out to fundamentally challenge their proposal. There is nothing to gain from trying to determine the right dimensions *now*. This must be an outcome of future comparative inquiries into the nature of mind and I expect that a greater appreciation for the phenomenological complexity in nature will force us to give up on the idea that such profiles are anything more than useful models to highlight the diversity of minds. There is no such thing as *the* “appropriate grain of analysis” (Birch et al., 2020, p. 797).

Different purposes, such as which species we are comparing, will lend themselves to alternative ways of carving up the differences among them and it is these comparisons that should really matter for a cognitive ethology.

Lastly, it is precisely because of this that my review of the five dimensions began with self-hood, since this dimension most elegantly demonstrates the need for and promise of a strongly gradual and multidimensional approach to the dimensions of animal consciousness. Notably, de Waal (2019) asks us to consider the possibility that “self-awareness develops like an onion, building layer upon layer, rather than appearing all at once” (p. 6). Some may object that such a complex nested view of a scientific phenomenon would make research much more difficult, but if consciousness is a varied and complex phenomenon in nature, we will simply have to learn to change our experimental paradigms accordingly.

Indeed, in the next chapter, I will take de Waal’s metaphor of an onion to heart and argue that evaluative experience is the most promising candidate for the origins of consciousness, by shedding the other dimensions aside one by one, in a reverse order from which I argue they plausibly emerged as something like “outer layers” of sentience. This reverse-engineering approach will allow us to significantly reduce the explanatory gap by asking for the most minimal form of consciousness.

Notes

- 1 Recently, further compelling evidence for mirror self-recognition in the cleaner wrasse has been presented in a follow-up study by Kohda et al. (2022), but it has not yet received critical responses.
- 2 Another sensory modality worth considering is olfaction. Cazzolla Gatti et al. (2021), for instance, have recently used a sniff test with wolves to demonstrate that they can engage in self-recognition based on smell.
- 3 Schukraft (2020) offers a critical discussion of whether critical flicker fusion frequency tracks the subjective experience of time.
- 4 See Danckert et al. (2021) for a useful recent review.
- 5 I thank Paul Griffiths for this point.
- 6 See Kirk (2021) for an excellent overview of this debate.

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