

Do Organisms Have Goals and Purpose?

by Amelia Lewis

Introduction

Theories and models of animal behavior are overwhelmingly embedded within neo-Darwinian paradigms and the “Modern Synthesis.” Adaptationist frameworks, where individuals are naturally selected “for: or against,” have given rise to the various iterations of behaviorism, whereby behavioral choices are either “reinforced,” or “punished” through survival or death, or more commonly, through reproductive advantage or disadvantage. Thus, the complex and multifaceted process of learning is treated as nothing more than a training exercise. Nikolaas Tinbergen’s Aristotelian methods, meanwhile, explain animal behavior entirely via adaptationist paradigms, which has biased the last half-century of ethological research toward neo-Darwinian explanations. However, neo-Darwinism fails to acknowledge organismal agency and teleology, or the ability of an organism to interact dynamically with, and to influence, its physical and social environment in a goal directed manner, at the same

time as the environment influences the individual.

Despite this, neo-Darwinism is not the only paradigm from which to interpret evolution and animal behavior. The Extended Evolutionary Synthesis (EES) is a non-creationist alternative to traditional neo-Darwinian thinking, and in this paper, from within the context of the EES, I will discuss how individuals not only respond to and manipulate their environment, but teleologically direct the course of their own evolution. However, they do so whilst embedded within a vast, complex system where each individual pursues its own goals. Thus, it is not only the genome which directs the course of life on Earth, any more than it is any one gene. From the cell, to the individual, to the population, to complex ecosystem function, the gene is a resource. It is not the ruler.

One of the major issues in the biology of animal behavior and welfare is the recognition and acknowledgement of sentience in non-human animals. Some societal and scientific advancements have been made, most recently with

the passing of the Animal Welfare (Sentience) Act 2022 in the UK. However, there is still much progress to be made with respect to recognition of sentience in other species; an undertaking that provokes much debate.

Giacino et al. (2018) succinctly defined consciousness in humans as “the state of awareness of the self and environment.” Meanwhile, animal welfare scientist Marian Stamp-Dawkins grapples with the issue of animal sentience in her book *Why Animals Matter* (Dawkins, 2012). Discussing “The hard question” (is it possible to tell whether non-human animals are conscious?), Dawkins concludes that it is difficult, if not impossible, to study subjective experience in a non-human animal. Dawkins concludes that such intimate knowledge is irrelevant, as humans can meet both the needs and wants of domestic and captive animals to provide for their positive welfare. Whilst Dawkins promotes the economic benefits of providing for good welfare over the recognition of sentience, the neuroscientist Jaak Panksepp proposed his “Theory of Affective Neuroscience,” which attempts to identify and classify animals’ emotional experiences as one of seven “motivational-emotional states” (Panksepp, 2004). These relate goal-directedness (motivation) to the individual’s affective state. Similarly, but more holistically, the ethologist and evolutionary biologist Marck Bekoff fully recognizes: 1) the ability of non-human animals to experience affective states in response to environmental conditions; 2) that non-human animals

also have a degree of cognitive understanding of their environment; and 3) that non-human animals are thus capable of suffering (Bekoff, 2022).

Despite the challenges involved in studying animal sentience, our understanding of sentience has developed considerably since the sixteenth century. During the Renaissance, Cartesian ideas predominated, espousing the concept of mind-body dualism, and the belief that animals do not have a “soul.” However, current biological science not only recognizes that many animal species are sentient, but today, even plants, fungi, and microorganisms are acknowledged to have more complex sensory functioning than originally thought. For example, slime moulds make choices in response to their changing environment, and plants have sensory capabilities in their membrane ion transport systems.¹ These systems allow the organism to respond to stressful environmental conditions, such as high salinity and water deficit, thus maintaining homeostasis.² Further, some bacteria, for example, engage in gradient descent searches when foraging, using chemotaxis and feedback loops to guide their behavior.³

Despite these significant leaps in our understanding of the behavior and cognitive capabilities of other taxa, evolutionary biology and ethology remain reluctant to recognize or accept the essential dimension of teleology or “goal directedness” as an explanatory framework. The “central dogma” of biology and the life sciences remains the same: gene-centric, neo-Darwinian evolution-

ary theories and adaptationist frameworks such as “inclusive fitness,” “selective advantage,” “life-time reproductive success,” and “competitive exclusion” are relied upon to scaffold the fundamental principle of neo-Darwinism and the Modern Synthesis; that being “natural selection.”

In the Modern Synthesis, natural selection is the idea that individual genes are either selected for or against by the environment the organism inhabits, whilst the organism competes with other individuals for resources and the opportunity to reproduce. Those genes encode the physical structures and behaviors of the organism, acting as a blueprint which, via random chance, gives rise to phenotypes which are fitter compared to other, perhaps less fit conspecific phenotypes. This is then presumed to promote the rising prevalence of specific genes (“fit” genes) within the population. Individuals are thus at the mercy of both their genome, and random environmental processes over which they have no control. Ironically, the neo-Darwinist stance, which opposes ideas of “intelligent design,” thus creates its own God; the unseen force of Natural Selection which rolls the dice and decides the fate of individuals and populations alike, based upon whether an individual’s genes confer a survival and reproductive advantage on their star-crossed host. Perhaps this phenomenon is not surprising, given Charles Darwin’s early theological training at Cambridge University.

Due to the over-simplified neo-Darwinist idea of either deleterious or ben-

eficial output from genes and messenger RNA, an individual’s choices and decisions become simple binary processes. In the now ubiquitous learning theory, for example, stimuli are either good or bad, “reinforcing or diminishing,” or “rewarding or punishing.” This reduces living organisms to nothing more than a software program, controlled by the surrounding environment, which guides its activities through a series of logic functions. Thus, biological populations and communities become merely a matrix of simple yet intertwined binary logic pathways specified by a pool of combined genetic codes.

Perhaps the most famous examples of the application of this binary learning phenomenon in animal behavior is B.F Skinner’s mid-twentieth century “radical behaviorism.” Building on the late nineteenth century work by prominent psychologists such as J.B. Watson, Skinner’s behaviorism asserted that behaviors are learned via “reinforcement” that was either negative or positive, and these theories are still prevalent today. The fundamental flaw in Skinner’s work, however, is that Skinner assumes the environment in a laboratory is sufficient to mimic the complex world of the natural environment. Given the assumptions of the Modern Synthesis, it is clear how this flaw arose. Neo-Darwinian theory and the Central Dogma essentially treat the world we and our fellow species inhabit as an enormous “Skinner Box.” Like the Skinner Box, which selects for one specific motor behavior i.e., lever pressing in rats to obtain food, the “environment”

selects one specific gene and reinforces its replication, until its presence dominates the population. Skinner's theory of stimulus-response, positive or negative reinforcement is not, however, representative of the complex environment around us, and eventually, radical behaviorist theory did, to some degree, move on, as mentalistic concepts were included. Behaviorism thus entered a new era; that of "neo-behaviorism."

Following Skinner, radical behaviorism became the foundation for other researchers, notably psychologist Clark L. Hull, to form what is generally recognized today as "neo-behaviorism," which seeks to involve the organism's wider environment in Skinner's stimulus-response paradigm. Both physical environmental conditions, and social conditions are recognized as influencing an individual's behavior. Stimuli no longer are reduced to an isolated chemical, mechanical, visual, or auditory cue, as Skinner studied. Further, an organism's consciousness or awareness of its surroundings is acknowledged, and indeed, Richard Vane-Wright (2023) cites Hull as acknowledging goal-directedness in animal behavior. Nonetheless, whilst the neo-behaviorist movement attempted to introduce complexity into radical behaviorist theory, the model was still based upon "stimulus-response" paradigms and reinforcement processes. Neo-behaviorism thus did not vary from radical behaviorism in any essential way. The only significant difference was that under neo-behaviorist theories, organisms are deemed to have an awareness

of the binary choices open to them, and such choices can be communicated to them by other organisms, and vice-versa (known as "social learning"). Organismal agency is still not fully recognized. The dominant idea that "compelled choice" (for what else is the "stimulus-response" paradigm?) within a very narrow set of deterministic parameters, where choices are either "reinforced" or "punished," remains.

Another framework for studying animal behavior is the ethologist Nico Tinbergen's "Four Questions":⁴

1. What is the function of the behavior?
2. How did the behavior evolve?
3. What is the mechanism of the behavior?
4. What is the ontogeny of the behavior?

In essence, a researcher approaches studying ethological phenomena (behaviors) by answering four questions regarding the proximate and ultimate mechanisms involved in the behavior's occurrence. This framework is still used in neo-Darwinian biology today.

Tinbergen's essentially Aristotelian model, which bears striking parallels to Aristotle's four causes of the existence of any identifiable phenomenon, those being the material cause; efficient cause; formal cause; and final cause, emerged from the evolutionary biologist Julian Huxley's own influential work in animal behavior.

Tinbergen's Four Questions became (and still are today) the universally recognized and accepted standard by which

to study ethology. Even so, Taborsky has pointed out that it is impossible to definitively separate the four factors of causation, survival value, evolution, and ontogeny.⁵ Despite this categorization flaw in the model, the advent of the Four Questions methodology brought clarity and standardization to behavioral research; both key factors to assembling a body of reliable scientific data.

Nonetheless, there is a further problem which has not been recognized by generations of scientific researchers who rely on Tinbergen's framework: the Four Questions assume neo-Darwinian ideas of natural selection and gene-centric evolution to be both axiomatic, and to represent a fundamental law of living systems. However, that is not how the scientific method works. The best that can be achieved by scientists is that, with an arbitrary "confidence interval" of 95 percent, one can exclude those hypotheses which are not supported statistically by the data gathered from experimental or observational studies. This is a fundamental error in an era when even the assumptions of classical physics are being re-thought.

Remarkable developments in computing, artificial intelligence, and bioinformatics have given researchers a previously unthinkable capability to interrogate vast data sets, thus potentially revealing evidence of previously unrecognized phenomena. In behavioral science, how do we therefore reconcile the recognition of animal sentience with the view that organisms and their evolutionary trajectories are under the control

of the genome; that organisms are not agents, but products of a genetic code which (despite the "nature-nurture" debate) is largely seen as controlling phenotype and evolutionary processes? Can the recognition of sentience in non-human animals be reconciled with the embedded belief that random chance at the genome level is deterministic for the individual, rather than recognizing that individuals can, and do, influence both their own cellular physiological processes, and their environment?

Studying Animal Behavior Experimentally

The idea that animals are driven by binary choices which are either rewarding or punishing shapes many of the paradigms used in the study of animal behavior. Innovations such as the STRANGE framework (social background; trappability and self-selection; rearing history; acclimation and habituation; natural changes in responsiveness; genetic makeup; experience) seek to reduce or eliminate those biases and confounding variables in research which arise due to the previous emphasis on homogeneity of sample populations.⁶ Despite this development, however, paradigms remain reductionist in nature, and are based upon the simple binary principles of learning via reinforcement. The "go-no-go" paradigm; the T-maze; radial arm maze; choice tests are all paradigms which are used in laboratory or other captive settings, and all rely on the individual test subject making a

choice based on receiving a reward, no reward, or being exposed to a noxious stimulus. The go-no-go paradigm rewards the correct choice, which means the animal performs a specific behavior when a “go” cue is given, but is trained to refrain from performing the behavior when a “no-go” cue is presented.⁷ Similarly, T-maze and radial maze designs are often used to test memory and spatial awareness. Again, both rely on individuals being rewarded for entering specific target arms of the maze or making spatial orientation choices which have been pre-determined by the researcher.⁸

Studies of affect, meanwhile, rely on highly controlled reductionist paradigms, which bear little, if any, resemblance to the environment in which the individual or its ancestors evolved, for example, “novel object tests,” which are designed to test an individual’s fear responses, or neophilia, or the trait known as “boldness.”⁹ “Startle tests,” meanwhile, where an individual is deliberately startled by, for example, the sudden opening of an umbrella, rely on animals being placed in an unnatural “test arena.” Whilst ethical considerations dictate that the test subjects cannot be forced to enter or engage with these artificial situations, no significant consideration is given to the individual’s free choice.¹⁰ The researcher records the behavioral responses to specific stimuli which have been selected and presented by the researcher. This is a highly artificial setting which seeks to isolate the specific trait under investigation. However, it instead succeeds in creating such an unortho-

dox and unexpected setting, that it is difficult to achieve the goal of isolating the intended stimulus and behavioral response. Indeed, despite some experiments including habituation protocols to acclimatize the subjects to the test environment, one striking feature of these tests is that the individuals are often tested alone, even those of social species. This severely limits normal behavioral responses to stressors, such as seeking social support.

Even more questionable, however, is the often-encountered protocol of eliminating all those animals who do not comply with training protocols from the study. This can happen either during the training, or the experimental phase of the study. Thus, any animal who chooses not to comply with training protocols; those exhibiting significant fear, distress, or aggression; or even, in some cases, those outliers who do not respond to training as predicted, *are not included in the final data set*. They are, in effect, dismissed as not being viable examples of their species.

Even those studies designed to take place outside a laboratory or captive setting, such as some “play back experiments,” rely on the concept of an artificial stimulus (either visual, auditory, or olfactory) which mimics a genuine sign-system being presented to the test subject. Despite carefully constructed ethograms, and the recording of significant amounts of behavioral data, it is the case that the animal being experimented upon is then only observed from within the typical neo-Darwinian framework.

Thus, it will be seen to either approach, or avoid; respond in either a hostile or friendly manner; show fear or boldness. As with the experimental paradigms listed above, those animals who do not engage are simply not included in the study. Moreover, there seems to be little if any consideration given to the contextual meaning of an individual animal's response. For example, Schmidt et al. (2008) use a playback study to elicit the function of the 'broadband trill' which is part of a nightingale's (*Luscinia megarhynchos*) song.¹¹ The authors conclude that the function of the trill is an aggressive signal. However, the recording equipment used to record the real trill was digital; thus, the playback was missing the waveforms of an acoustic signal, and the birds were also able to detect the speaker. Referring to the previously mentioned "novel object" test paradigm; how can these results be separated from the possibility that the birds are simply responding to a "novel object," whether it be the speaker itself, or the recording emanating from it?

What the current paradigms in research are actually achieving, rather than studying animal behavior, is to test and gather large quantities of data on the responses of those animals who will engage in training protocols, thus, biasing the experimental subjects toward those who are compliant and easy to manipulate. It also selects for those animals that are temperamentally suited to study conditions; those individuals who are fit and healthy, and those test subjects who are willing or able to construct some

kind of meaning for the experimental test methodology; otherwise why would they engage with the protocols? And yet, this model of studying compliance, rather than animal behavior, fits the paradigm of the Modern Synthesis, where animals must fall within the mean of a normal curve, or fail, with new advantageous traits quickly forming a new mean (average) group in the population.

Meanwhile, Skinner's radical behaviorism and its derivatives and Tinbergen's reductionist and Aristotelian approach both rely on researchers observing, as detached and (*prima facie*) impartial observers, whilst animals are interpreted as behaving in the same way as a computer software application. The environment, meanwhile, as the software's "user," governs an individual's choices by determining its "fitness."

The Extended Evolutionary Synthesis

It is difficult to see a valid argument by which the described stances can be reconciled with the concept of sentience. In more recent years, however, there has been a growing recognition that neo-Darwinian natural selection cannot account for the evolutionary phenomena we recognize today, including phenotypic traits acquired during the lifetime of an organism which can be inherited by subsequent generations. For example, one recent study by Green and Swaney (2023) investigates the transgenerational effects of environmental enrichments on zebrafish morphology and behavior.¹²

Moreover, Noble (2020) discusses a multitude of assumptions made by the Modern Synthesis, as well as the dubious “Weismann’s Barrier” (which claims that no non-genetic adaptations can be generationally transmitted) a concept which can no longer be supported as contrary evidence accumulates. Noble argues that the Modern Synthesis creates an illusion whereby the simplistic nature of natural selection, and the even more simplistic gene-centric approach of modern Darwinism, promotes a misinterpretation of Darwin’s original works, and, indeed, of most of the latter nineteenth century’s interpretation of living systems.¹³

In response, an alternative evolutionary model has been proposed: the Extended Evolutionary Synthesis (EES). This approach recognizes that individual organisms—be they single or multicellular, plant or animal—evolve via the continuation of transgenerational autocatalytic (self-reinforcing) processes. In the ESS, organisms are recognized as agents, able to engage dynamically with their environment via processes such as niche construction. There is more to evolution, in other words, than simply having inchoate selection pressures imposed upon them. Indeed, Vane-Wright and Corning (2023) make the key point that cellular processes replicate existing material; they do not create novel material. Thus, all cellular life on Earth is descended from the same cells which congregated to form multicellular organisms at the very beginnings of life. The physiological processes of single cells thus form a remarkable thread; a

thread which can be traced back across billions of years, as chemical processes, which have never ceased to continue running, continue to this day in the vast multitude of extant species on Earth.

The implications for the study of biology are profound, yet there is a marked reluctance to acknowledge Extended Evolutionary Synthesis ideas, particularly with regard to organismal teleology and agency. So profound are the difficulties in introducing new paradigms that the ongoing work has not been adopted by mainstream biology, and the Modern Synthesis remains entrenched within both the biological sciences and wider society. Indeed, the debate seems to have become polarized and entrenched, with Pigliucci and Finkelman (2014) highlighting the necessity to include philosophical discourse in the sciences in order for science and, indeed, society, to progress.¹⁴ Despite the *status quo*, however, there are many examples of complex behaviors in animal species which cannot be accounted for simply via neo-Darwinian biology and “learning theory.” Animal migration, and trophobiosis (“farming”) provide two vivid examples of this.

Migration and Navigation

A remarkable feature of many animal taxa, including birds, mammals, fish, reptiles, and invertebrates is their ability to navigate over distances of thousands of miles. Migration happens on a seasonal basis, as animals travel away from a degraded environment to a more productive one, either to forage or to breed.

This comprises a highly complex suite of behaviors, involving not only the environmental and physiological cues to begin to migrate (Tinbergen's "function" and "mechanism," respectively), but also complex cognitive phenomena, such as the long-term memory of migratory routes, and of the location of nesting and/or foraging (destination) sites. Individual animals also possess navigational skills which include using the sun's azimuth as a compass for orientation, as can be observed in bats, monarch butterflies, and turtles.

Other means of navigation include sensing magnetic fields for compass orientation (north-south orientation), as well as local variations of magnetic fields arising from geomagnetic anomalies, as employed by, for example, loggerhead turtles, salmon, and the European robin. Navigation also can depend on complex social interactions, such as migratory geese who fly in flocks, and engage in social group navigation processes. Using "pooled" compass and orientation data, the migrating individuals navigate as a group, employing shared data which is communicated between each group member.

While a genetic basis for some of these phenomena can undoubtedly be identified, it is the emergent properties of the genome and the organism's physiology which confers such complex cognitive ability, resulting in goal directed, teleological behaviors. Moreover, the mode of transgenerational inheritance of behavioral and physiological traits does not have to occur via the germline alone.

In zebrafish, for example, an enriched environment for larvae provided by the parent produced changes in body length and spine curvature that were heritable across two generations.¹⁵ Organisms themselves can alter their environment by the behavioral choices they make during their lifetime, as well as altering their own physiology and genome; alterations which can be passed to their offspring for more than one generation.

Farming and Trophobiosis

Humans began to practice farming about 10,000 years ago, which enabled us to gain a level of control over our habitat that significantly changed our ecology and evolution. However, *Homo sapiens* are not the only species to deliberately cultivate and benefit from other species; a practice known in biological terms as "trophobiosis."

Social insects are a notable example of another taxonomic group where there are species which engage in what can colloquially be termed "farming." Leaf cutter ants (genera *Atta* and *Acromyrex*), for example, use organic leaf matter collected by workers to grow underground "crops" of a nutritious basidiomycete fungus. The fungus is grown in large, purposely excavated chambers, where the crops are tended by worker ants. The Formicidae, however, are not limited to horticultural practices; they also "keep livestock." The phenomenon of ant-aphid mutualism is a well-documented phenomenon, whereby ant colonies use aphids as "ant cows," placing them on plant stems to harvest plant sap, to

produce a sweet secretion (honeydew), which the ants then consume. Ants offer their aphid partners protection from predation, as well as sanitation and protection from disease, whilst the aphids produce nutritious honeydew.

While this symbiotic relationship could *prima-facie* be explained by simple binary reinforcement processes, the ant-aphid relationships are far more complex, with ants actively herding aphids on vegetation and creating “stables” for their charges amongst the root systems of plants. Some ant species (for example, *Crematogaster scutellaris*) have been found to actively and deliberately transport aphids back to the nest during colder months, where the colony offers protection from the elements and in return, have access to a stable and predictable nutrient supply, which is under the control of the ant colony. While ants are not generally accepted as being “sentient,” they do, both as individuals and as a colony, act as goal-directed agents. Indeed, Jackson and Ratnieks (2006) describe the chemically complex pheromone trails left by foraging ants as resulting in a collective group memory.¹⁶ This allows the members of the colony to communicate while foraging, and to guide behavioral foraging decisions in a similar way to the cells of a multicellular organism that work together symbiotically. There is also a striking similarity to the complex group migratory behaviors of some species, which is described previously.

Conclusion

If we are to acknowledge sentience in at least some animal species, while the body of supporting evidence for sentience in other species grows and progresses, then we also need to acknowledge what that means for our understanding of living systems as whole. The two examples discussed in this paper are a minute sample of the multitude of complex behaviors and social interactions observed in the animal kingdom. The list is long: phenomena such as play behavior; tool use; complex communication, for example, human language and birdsong; and complex nest building, such as the elaborate “bowers” constructed by male bowerbirds,¹⁷ cannot convincingly be accounted for by adaptationist, gene-centred neo-Darwinian theory alone, or by basic reinforcement-based models of animal cognition, which neatly fit neo-Darwinian paradigms. These phenomena can only be adequately explained by complex, teleological phenomena; a dynamic interplay of physical and cognitive processes which are under agential control, resulting from complex physiological function and self-reinforcing (autocatalytic) cellular metabolic pathways.

Such processes of “purposeful evolution”¹⁸ can be conceptualized on a more holistic level by invoking ideas and concepts such as “semiotic fitting,” where the choices made by multiple organisms and taxa in a community are shaped by the complex exchange of meaningful signs (semiosis) between them. These

semiotically-mediated agential choices result in holistic system function, without the need for “selection.” Nonetheless, whether viewing processes at a cellular, individual, or community level, teleology and agential choice can no longer be ignored. Instead of asking Tinbergen’s four questions, relying on the dogma that organisms are controlled by a mixture of their genes and a binary feedback system, we instead need to ask: “What will (or did, in its evolutionary history) enable this living system to keep running, at multiple levels of organization?”

Then, I believe, we will start to find the answers which have so far eluded neo-Darwinian biology.

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