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## Teleology Versus Teleonomy in Animal Behavior



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a future goal or end state causes objects and phenomena in the present. If teleology in its classical sense is inseparable from these assumptions, then it is inappropriate to employ teleological explanations in biology, where backward causation has no place. However, biologists still use teleological language, and one debate is whether the use of such terminology is literal or merely figurative (e.g., Mayr 1992; Neander 1991; Wright 1976).

### History and Background

Aristotle proposed that any object or phenomenon can have four different kinds of explanations: material, formal, efficient, and final (Aristotle, c. 350 BC/1930). In describing these four types of explanations, Aristotle used the Greek term αἴτιον (aition), which has been translated as *causes*, although the meaning is closer to *grounds for* or *reasons* (Chapman 2020). According to Aristotle, it is a combination of these “four causes” that offers a complete understanding of an object or a phenomenon. The “final” cause refers to the end, purpose, or final goal of the object or phenomenon – the final state that it moves toward (*telos*). For example, the *telos* or end of an acorn is to become a fully grown oak tree. That *telos*, the “final end state” or goal, ostensibly *explains* why the acorn came to be and why it is the way it is. Teleological explanations of nature are controversial in science, as they imply some form of backward causation, whereby

### Useful Distinctions

#### Functional Versus Mechanistic Explanations

Both Tinbergen’s “four questions” and Mayr’s distinction between ultimate (or distal) and proximate explanations are useful for understanding teleological explanations in biology (Mayr 1961; Tinbergen 1963). Tinbergen (1968) showed that one can explain a trait by addressing four issues at parallel levels of analysis: (1) survival value (i.e., function), (2) mechanism (i.e., causation), (3) development (i.e., ontogeny), and (4) evolution (i.e., phylogeny). It is the first of Tinbergen’s questions that relates to *telos* or purpose.

Mayr defined ultimate or distal explanations as historical accounts that explain why an organism has a certain trait in terms of differential reproduction in the distant past. While there is debate about what Mayr meant by “ultimate cause,” it can roughly be thought of as representing two of Tinbergen’s questions: function and phylogeny. Mayr’s “proximate cause,” on the other hand,

can be thought of as invoking explanations that are more proximate, as in closer to the present, such as answers to Tinbergen's questions about mechanism and development.

In the study of animal cognition and behavior, identifying the proximate and mechanistic features of a trait is important for understanding the function of the trait and vice versa. Functional hypotheses yield specific predictions about proximate and mechanistic phenomena, and an understanding of the latter can rule out certain functional hypotheses and point researchers toward others (Lewis et al. 2017).

### Teleological Versus Teleonomic Explanations

Functional explanations do not need to be teleological. This is demonstrated by evolutionary biology and the study of animal behavior, because an understanding of the process of natural selection obviates the need for a designer and also explains why traits in nature *appear* as though they were designed with a *telos* in mind even if they were not.

In the classical sense, a teleological explanation invokes an internal striving toward a *telos*, goal, or end state – an explanation that contains a whiff of the supernatural. Accordingly, explanations are truly teleological if the purported goal or function is thought to be a cause of the phenomenon despite coming *after* it in time. By contrast, functional explanations in biology refer to the evolutionary history of a species, namely, the effects of a trait on survival or reproduction in past generations. This history is antecedent to the current form of the trait. Functional explanations in biology are therefore normal instances of the past causing the present and are not teleological in the classical sense.

As Pittendrigh has stated: "It seems unfortunate that the term 'teleology' should be resurrected. ... The biologists' long-standing confusion would be more fully removed if all end-directed systems were described by some other term, like 'teleonomic,' in order to emphasize that the recognition and description of end-directedness does not carry a commitment to Aristotelian teleology as an efficient causal principle" (Pittendrigh 1958, p. 394). Teleonomic

explanations therefore refer to the ends or functions of traits without assuming or implying that these future ends cause the form of traits in the present. Teleonomic explanations *appear* teleological, and may even use the language of teleology, but are figurative and do not involve teleology in the sense of backward causation.

George C. Williams has suggested that the term "teleonomy" be used "to designate the study of adaptation" (1966, p. 258). Williams argued that adaptations should be identified on the basis of the precision, economy, efficiency, reliability, and complexity with which they solve their respective adaptive problems (Williams 1966). These five qualities represent the relevant evidentiary criteria for reverse-engineering the extent to which a trait shows evidence of "special design," that is, the extent to which a trait can be considered an adaptation (Williams 1966). While these five evidentiary criteria could benefit from more concrete operationalizations, reasonable working definitions exist (Al-Shawaf et al. 2020). Comparative studies of animal behavior and morphology can also be useful when assessing whether a trait is an adaptation. For example, if different species faced similar adaptive problems during their evolution, convergent evolution may lead to similar adaptations to similar ecological problems in different species.

The key point about teleology and teleonomy is that adaptations may appear teleological, and researchers may even use teleological language to describe them. Still, the teleological language is a linguistic shorthand for a normal, quotidian causal process (i.e., a history of differential reproduction) in which the past – not the future – caused the present structure and function of the adaptation.

Goal-directed human behaviors provide an interesting special case: humans are capable of consciously representing goals that they strive toward, which may make a certain variant of teleological explanations less obviously objectionable for certain human behaviors. However, the process is still one of normal causation in which the past causes the present: humans' conscious motivations to reach their goal cause behaviors that propel them toward their goals. There is thus no need for backward causation, a

supernatural telos, or anything more exotic than ordinary causation.

## Misunderstandings Related to Teleological Explanations

Humans appear to be predisposed to think about nature using teleological language (e.g., Kelemen et al. 2013). This may impede people's accurate (non-teleological) understanding of biological traits. Unless done carefully, the use of teleological and teleonomic explanations in biology may generate or exacerbate misunderstandings about how natural selection works (Al-Shawaf et al. 2018). These include the following two misunderstandings:

### The Progressive Evolution Misunderstanding

One misunderstanding is that evolution has a goal or direction – this idea is also known as orthogenesis or evolutionary progress. If evolutionary change was geared toward a particular goal or was directional in nature, then it might be teleological. However, the theory that evolutionary change is inherently progressive or directed toward a particular end is mistaken.

### Fitness-Maximizers Misunderstanding

A rigorous evolutionary approach to psychology and behavior should not involve a search for how traits *maximize fitness* in any teleological sense (Symons 1979). The distinction here is between two ways that biologists approach organisms: (1) as fitness-maximizers (an inappropriate approach that Tooby and Cosmides (1992) call fitness teleology) and (2) as adaptation-executors (a non-teleological approach to evolved psychology). “Fitness teleologists” may approach behavior with the following question: “How does this behavior maximize this organism's fitness?” A fitness teleologist who assumes an animal is a fitness-maximizer may have difficulty answering questions like, “Why aren't all men lining up at sperm banks to donate their sperm?” or “How is this obese zoo bear increasing its fitness by eating more sugary confections?” By contrast, an adaptationist will not assume that current behavior

maximizes fitness. Instead, he or she may ask why the bear's evolved neurocognitive mechanisms sometimes cause non-adaptive behaviors. The more useful questions might be: “What is the underlying neurocognitive architecture that leads to this behavior in certain contexts?” and, as Tooby and Cosmides put it, “What are the design features of this architecture— if any—that regulate the relevant behavior in such a way that it would have constituted functional solutions to the adaptive problems that regularly occurred in the species' evolutionary history [even if it is not adaptive in this particular instance]?” (Tooby and Cosmides 1992, p. 55). This way, rather than assuming that every biological trait or behavior contributes to the telos of fitness maximization, scientists can approach behavior by considering how past selection crafted adaptations that may or may not lead to adaptive behavior in the current instance.

## Conclusion

A teleonomic explanation is a metaphorical (and therefore legitimate) cousin of a teleological explanation of nature. Teleonomy is simply the study of evolved functions, which are key to explaining the existence and form of adaptations. Biologists frequently use teleological language such as “birds sing *in order to* attract mates” for the sake of brevity. Still, as indicated by the frequent use of scare quotes and disclaimers, biologists' use of teleological language is figurative and “should not be taken to imply that evolution proceeds by anything other than from mutations arising by chance, with those that impart an advantage being retained by natural selection” (Maddrell 1998, p. 2461).

In sum, natural selection explains the appearance of design without the need for a designer and the appearance of teleology without the need for a supernatural telos. Teleological language (teleonomy) is perfectly acceptable if we remember that it is a linguistic shorthand and do not make the mistake of permitting true teleological (backward) causation into our explanations.

## Cross-References

- ▶ [Adaptation](#)
- ▶ [Convergent Evolution](#)
- ▶ [Nikolaas Tinbergen](#)

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