Unit 4 Life and Function

3. Teleology and Function

"Haldane [in the `30s] can be found remarking, 'Teleology is like a mistress to a biologist: he cannot live without her but he's unwilling to be seen with her in public.' Today the mistress has become a lawfully wedded wife. Biologists no longer feel obligated to apologize for their use of teleological language; they flaunt it. The only concession which they make to its disreputable past is to rename it 'teleonomy'." David Hull (1982)

Aristotle: For the sake of what?

- "Democritus, however, neglecting the final cause, reduces to necessity all the operations of nature. Now they are necessary, it is true, but yet they are *for* a final cause and *for the sake of* what is best in each case. Thus nothing prevents the teeth from being formed and being shed in this way; but it is not on account of these causes but on account of the end; these are causes in the sense of being the moving and efficient instruments and the material. …to say that necessity is the cause is much as if we should think that the water has been drawn off from a dropsical patient on account of the lancet alone, not on account of health, for the sake of which the lancet made the incision." Aristotle, *Generation of Animals* V.8, 789a8-b15

The Spookiness of Teleology

- For Aristotle, natural phenomena were teleological
  - Events happened ***to*** achieve ends
    - These results explain the events even through they come after the events
  - "Nature adapts the organ to the function, and not the function to the organ" (*De partib. animal.*, IV, xii, 694b; 13)
- How is this supposed to work? How do ends bring about means?

Clicker Question

What is it about talk of purposes according to Buller that makes it problematic in modern biology?

A. Our inability to understand how having ends might produce effects
B. The fact that it seems to involve backwards causation: purposes generating what achieves them
C. Only humans have goals or ends, nature does not
D. Ends are too subjective to be considered in the context of a scientific inquiry

Teleology—Hard to Kill

- The scientific revolution seemed to remove purpose from the world
  - Events happened solely because of prior causes
  - Quest for mechanisms in biology
    - Mechanisms explained their effects in terms of preceding, efficient causes
- But teleological talk lives on in the language of functions in biology
  - The heart's function is to pump the blood
  - The kidney's function is to filter and remove waste
  - The function of the ribosome is to synthesize proteins
- A teleological perspective is especially prominent in the willingness to say that something is malfunctioning—to malfunction is to fail to perform a function

Human Purposive Action

- The idea of acting for goals is something we are familiar within in the case of ourselves
  - We think of ourselves as setting goals and then selecting actions to achieve them
- In our case, there is also a ready way to account (at least in outline) for how this is accomplished
  - We represent (e.g., in language) the goal we seek to accomplish, and then that representation can play a role in determining our action
- But this account cannot readily be extended to biology generally unless we also posit an intelligent agent planning all purposive biological activities

Naturalizing Teleology

- If teleology (talk of functions) is to be legitimate in science, it should be grounded in natural phenomena
  - This requires showing under what conditions a natural system has purposes or goals
- Cybernetics offered a proposal for naturalizing teleology
  - it occurs whenever a system is regulated by negative feedback
    - enables system to pursue a target
  - but who set the target?
    - humans in the case of technology
    - but what in the case of natural systems?
- Three naturalizing strategies:
  - Causal role theories
  - Etiological theories
  - Biological organization/autonomy theories

Discussion Question

What do you think accounts for the fact that the function of your heart is to pump blood

A. Simply that it does so
B. That is what it was selected to do
C. That it serves other physiological activities that ultimately keep me alive
D. It has no function. Biology is best rid of all function talk

Causal Role Accounts of Functions

- Cummins claims that the statement
  - "The heartbeat in vertebrates has the function of circulating the blood through the organism."

  is appealed to in **explaining** circulation (the function)
  - That is, we start with circulation, and identify something as having that function in the context of explaining it
  - And we may **explain the advantage** of the heartbeat by identifying the activity it facilitates
    - This is different than explaining the existence of the heartbeat

Dispositions and the Analytic Strategy

- Functions and dispositions: “to attribute a function to something is, in part, to attribute a disposition to it. If the function of x in s to Φ, then x has a disposition to Φ in s”
- Dispositions require explanation:
  - “if x has [disposition] d, then x is subject to a regularity in behavior special to things having d, and such a fact needs to be explained.”
- The appropriate explanatory strategy: Analytic strategy:
  - Analyze “d of a into a number of other dispositions d_1 . . . d_n, had by a or components of a such that programmed manifestation of the d_i results in or amounts to a manifestation of d”

Analytic Strategy in Biology

- “The biologically significant capacities of an entire organism are explained by analyzing the organism into a number of ‘systems’—the circulatory system, the digestive system, the nervous system, etc.,—each of which has its characteristic capacities. These capacities are in turn analyzed into capacities of component organs and structures. Ideally, this strategy is pressed until pure physiology takes over, i.e., until the analyzing capacities are amenable to the subsumption strategy.”
- This should seem familiar: mechanism in biology exemplifies this approach
  - Parts perform functions that explain what the whole does

Discussion Question

Does a gene that has been identified as resulting in schizophrenia have the function of producing schizophrenia?

A. Yes, if that is what the gene in question causes, then that is its function
B. Yes, assuming that is the only thing the gene causes
C. Yes, but only if it can be shown that schizophrenia has or once benefitted people
D. No, schizophrenia is a malfunction and it makes no sense to attribute a function to the gene that causes it

Criticisms of Causal Role Theories

- Many things have effects that do not seem to be their functions
  - The structure of your nose enables it to support glasses
    - But is supporting glasses the function of the nose?
- Causal role theories make the notion of function redundant to effect within a mechanism
- Causal role accounts fail to capture the normative aspect of function
  - A function is something that **should** be performed
  - Something malfunctions if it fails to perform its function

Teleology and Darwin

- Recall Darwin's high regard for Paley
  - Biological organisms are complex systems that are highly adaptive (functional) in their environments
- Darwin offered an explanation for traits that had seemed to require design—they are the products of natural selection
  - Does natural selection remove the last vestige of teleology from science? or
  - Does natural selection license teleological discourse in biology?
    - The function of a trait is that effect of it on which natural selection operated by causing ancestors with the trait to reproduce more successfully

Larry Wright: Functions as Explanatory

- "Merely saying of something, X, that it has a certain function, is to offer an important kind of explanation of X."
  - To ask "what is the function of X?" is comparable to asking "Why do C's have X's (or do X)?"
- The sought for explanation specifies how X came to be —it came to be because of what it does
- But remember the challenge: the function is realized only after X
  - How could what comes later explain what came earlier?

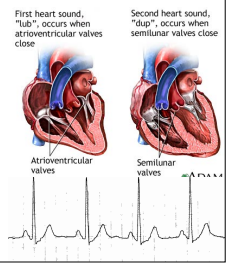
Natural Selection as an Explanation

- If an organ has been naturally differentially selected-for by virtue of something it does, we can say that the reason the organ is present in a current organism is that it was present in an ancestor and that ancestor was selected because that organ did that thing
  - animals have kidneys because they eliminated metabolic wastes from the bloodstream of ancestors;
  - porcupines have quills because they protected their ancestors from predatory enemies;
  - plants have chlorophyll because chlorophyll enabled their ancestors to perform photosynthesis;
  - the heart beats because in ancestors such beating pumped blood, enabling their ancestors to live

- Since it accounts for the function of X in terms of what caused it, this is known as the aetiological account of function
  - **The function of X is Z means**
    - **(a) X is there because it does (did) Z**
    - **(b) Z is a consequence (or result) of X's being there**

Wright's Distinction Between a Trait's Function and Other Effects

"Very likely the central distinction of this analysis is that between the *function* of something and other things it does which are *not* its function (or one of its functions). . . . The function of the heart is pumping blood, not producing a thumping noise or making wiggly lines on electrocardiograms, which are also things, it does. This is sometimes put as the distinction between a function, and something done merely 'by accident'." (Wright, p. 141)



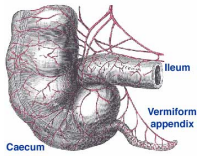
Discussion Question

What implications does Gould and Lowontin's critique of adapationism have for the aetiological account of function?

A. None. They were concerned with adaptation, not function
B. It could severely limit what count as functions. If something isn't an adaptation, then it doesn't have a function on the etiological account
C. It shows that it is difficult to assign function on the aetiological account since it is difficult to show that something is an adaptation
D. It shows that the aetiological account has too narrowly characterized functions by requiring that functions be the product of natural selection

Challenges for the Aetiological Account

- Cave fish have remnants of an eye
  - What is its function?
    - It was originally selected for sight
    - Is that still its function?
- What is the function of the human appendix?
  - Darwin: used by other primates to digest leaves
  - Is that its function in us?
- Must we know the evolutionary history of a trait in order to know its function?



Causal Role versus Aetiology

- The causal-role strategy: explain how something is able to perform a function
  - Treat functions as dispositions of things
  - Decompose the disposition into sub-dispositions
    - Objections:
      - Treats any effect as a function
      - Fails to provide any normative standard for functions
- The aetiological strategy: explain the function of traits in terms of how they were selected
  - Treat traits as adaptations
  - Function explained aetiologically
    - Objections
      - Only looks to the past, not the present
      - Denies functions to anything that is not an adaptation

Teleology from the Autonomy Tradition

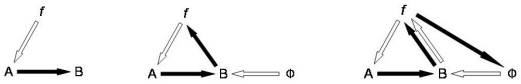
- Mossio and Bich: “Our central claim is straightforward: the organisation of biological systems is inherently teleological, which means that its own activity is, in a fundamental sense, first and foremost oriented toward an end.”
- Self-determination: through their actions, biological systems make, repair, and maintain themselves
  - the function of the action is its role in making, repairing, or maintaining the organism itself
    - hence, the goal is intrinsic, not imposed from without (as it is on accounts that appeal to natural selection)

Closure and Teleology

- "biological organisation can be adequately understood as a causal regime in which a set of structures, acting as constraints on the underlying, far from thermodynamic equilibrium, flow of energy and matter, realise a mutual dependence among them, which we label 'closure'. Because of closure, the constitutive constraints maintain each other, such that the whole organisation can be said to collectively self-constrain, and therefore to self-determine: accordingly, we contend that closure provides a naturalised grounding for teleology."

Robert Rosen and Repair

- All organized systems require repair
  - Why?
    - Don't forget the second law!
- Almost no human made artifacts can repair themselves
- Rosen's account of metabolism-repair or (M,R)-systems
  - Closed to efficient causation
    - black arrows—material causation—open
    - white arrows—efficient causation—closed



Closure of Efficient Causation

- Closure is achieved if each efficient cause is itself the product of an efficient cause within the system
  - "Within closure, in particular, teleology coincides with the inversion of efficient causation: if x is the efficient cause of y, then y is the final cause of x. The reason is that, because of closure, what x does (y) contributes to the very existence of x. Final causation, therefore, finds its justification in the very organisational principles of the system, without reference to an external designer or user."
- Mossio and Bich take this one step further—closure of constraints on flows of free energy
  - each constraint in a system is produced by another constraint constraining flows of free energy

Alternative Naturalized Circular Accounts

- Both the aetiological (natural selection) account and the organizational account are cyclic accounts
  - On the aetiological account, those traits counts as function that are the product of their predecessors success in natural selection
  - On the organizational account, an organism's traits figure in its own cyclic process of self-maintenance
    - "living systems are teleologically organised entities whose components produce and maintain each others as well as the whole."