The Mechanics of Testing a Theory: Implications for Intelligent Design

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INTRODUCTION

In my article, *Evolutionary Biology versus Intelligent Design: Resolving the Issue*[2], I briefly outlined the nature of hypotheses and theories. Hypotheses are explanatory constructs, suggesting past causal conditions that might account for effects observed in the present, while theories are established or generally accepted explanatory concepts, or set of concepts, that we apply to our sense perceptions to give us understanding of what we do or might perceive. An important aspect stressed in that article is that hypotheses refer to specific events in the past and effects in the present, whereas theories are spatially and temporally unconstrained. Theories are intended to apply to the past, present, and future; on this planet, in this galaxy, and beyond.

Given the differences between hypotheses and theories, the protocols for critically assessing their veracity by way of the procedure of testing also show distinct differences. The most obvious is that the testing of theories has the quality of an experiment, where one must be in a situation to witness the causal conditions stipulated by the theory, as well as subsequently observing the effect(s) from those conditions. As will be discussed next, it is this experimental character that imposes distinct limitations on what theories can be critically evaluated in the realm of science, providing the criterion for demarcating the theories comprising evolutionary biology from any theory of 'intelligent design' (ID). The principle implication to be identified is that any ID theory is immune to testing. A related implication is that a hypothesis derived from an ID theory, especially pertaining to organisms, also exhibits this quality of immunity. As the goal in any field of science is the ever-increasing acquisition of causal understanding, ID cannot be subjected to the critical testing that is consistent with that goal.

[2] Available from this web site.

THE STRUCTURE OF THEORY TESTS

I noted earlier that the testing of a theory requires that one be in a position to know and/or observe the causal conditions under which a particular theory is claimed to provide understanding. The act of testing determines whether or not the causal relations stated in a theory manifest themselves.

The basic format of any theory, as a general statement of cause and effect relations, has the following form:

[1] Theory α: When causal conditions of type x occur, effects of type y will occur.

Developing a test of theory α would involve the derivation of specific predicted effects that should follow from the stated causal conditions. The basic format of a potential test of theory α would then have the form:

[2] Potential test of theory α: If the causal conditions of type x_1 are encountered, then an effect of type y_1 should then be observed.

The actual test of theory α would then have the form of an experiment, be it under laboratory or natural conditions, during which causal conditions of type x_1 are produced, and effects subsequently observed. If effects are as one predicted, then the effects provide confirming evidence for the theory, giving one reason to conclude that the theory has, at least for the moment, some worth as a tool for acquiring understanding. Such a test would have the form:

[3] Actual test$_a$ of theory α (instance of confirmation): A causal condition of type x_1 was created in the lab at time t_0, and an effect of type y_1 was observed at t_1.

∴ Theory α is currently accepted as a construct for providing causal understanding.

Alternatively, if the effects that follow from the known causal conditions of type x_1 are not those predicted by the theory, then this is potential evidence disconfirming the theory:

[4] Actual test$_b$ of theory α (instance of disconfirmation): A causal condition of type x_1 was created in the lab at time t_0, and an effect of type y_2 was observed at t_1.

∴ Theory α does not appear to provide relevant causal understanding, potentially leaving consideration of other theories, or revision of theory α.

In other words, the cause and effect relations claimed by the theory do not appear to hold. The theory might either be in jeopardy and in need of being replaced, or it might simply require revision to some extent.

IMPLICATIONS FOR INTELLIGENT DESIGN THEORIES

Given the mechanics required for testing theories, what are the implications for critically evaluating any ID theory? The most serious impediment to testing an ID theory is the simple realization that it would never be possible to empirically witness the actions of an intelligent agent as part of the conditions required in the act of testing, such that one could ascertain if the causal relations stated in the theory actually manifest themselves. If an intelligent agent cannot be discerned, then any ID theory is immediately immune to being tested, contrary to the test conditions stipulated in **[3]** and **[4]**. As a consequence, there could be no observed effects that could serve as confirming evidence for an ID theory. By the same token, it would not be possible to claim any ID theory to be disconfirmed by any observed effects. As an intelligent agent cannot be witnessed during some set of test conditions, that agent could not be ruled out as having some part to play in the conditions that are witnessed. Recall once again that theories assert cause and effect relations, e.g., **[1]**. The goal of testing is to evaluate the veracity of the claim of such relations. This requires that causal agents, conditions, and/or events be available to observation. If such agents, conditions, and events cannot even be introduced into the realm of testing a given theory, then it is not at all possible to subject that theory to testing.

Let's look at an actual example of the difficulty of testing an ID theory. In his book, *Darwin's Black Box*, Behe (1996, Free Press, New York) introduced the notion of 'irreducible complexity.' Irreducible complexity is the view that some biological structures are too complex to have been developed naturally through the processes of random mutations and natural selection. Additionally, there is the contention that since such complex structures cannot function if critical components are missing, then natural selection could not have operated on 'intermediate' stages leading to fully functional structures. Thus, we are compelled to consider that these features are not the products of evolution, but an intelligent, purposeful designer.

The example of such intelligent design offered by Behe (1996) is the bacterial flagellum. Members of some bacteria species have hair-like projections, called flagella (‘flagellum’ is the singular) extending from their cell membrane (Fig. 1A). The number of flagella varies from one to many, depending on the species. Each flagellum is composed of about 20 different protein parts, and is powered by a rotary mechanism that provides the cell with motility (Fig. 1B). Given the remarkable complexity of the ‘engine’ that drives these flagella, Behe (1996) argued that the origin of such an intricate array of proteins could only have occurred by the action of a designer.

Now, what Behe (1996) proposed was a *hypothesis* to account for the occurrence of bacterial flagella. What he relied upon to infer that hypothesis was a *theory* of intelligent design. Regardless of the elegance or appeal of the *hypothesis*, what we first need to be concerned with is the matter of how to test the *theory* that was used. If the theory is

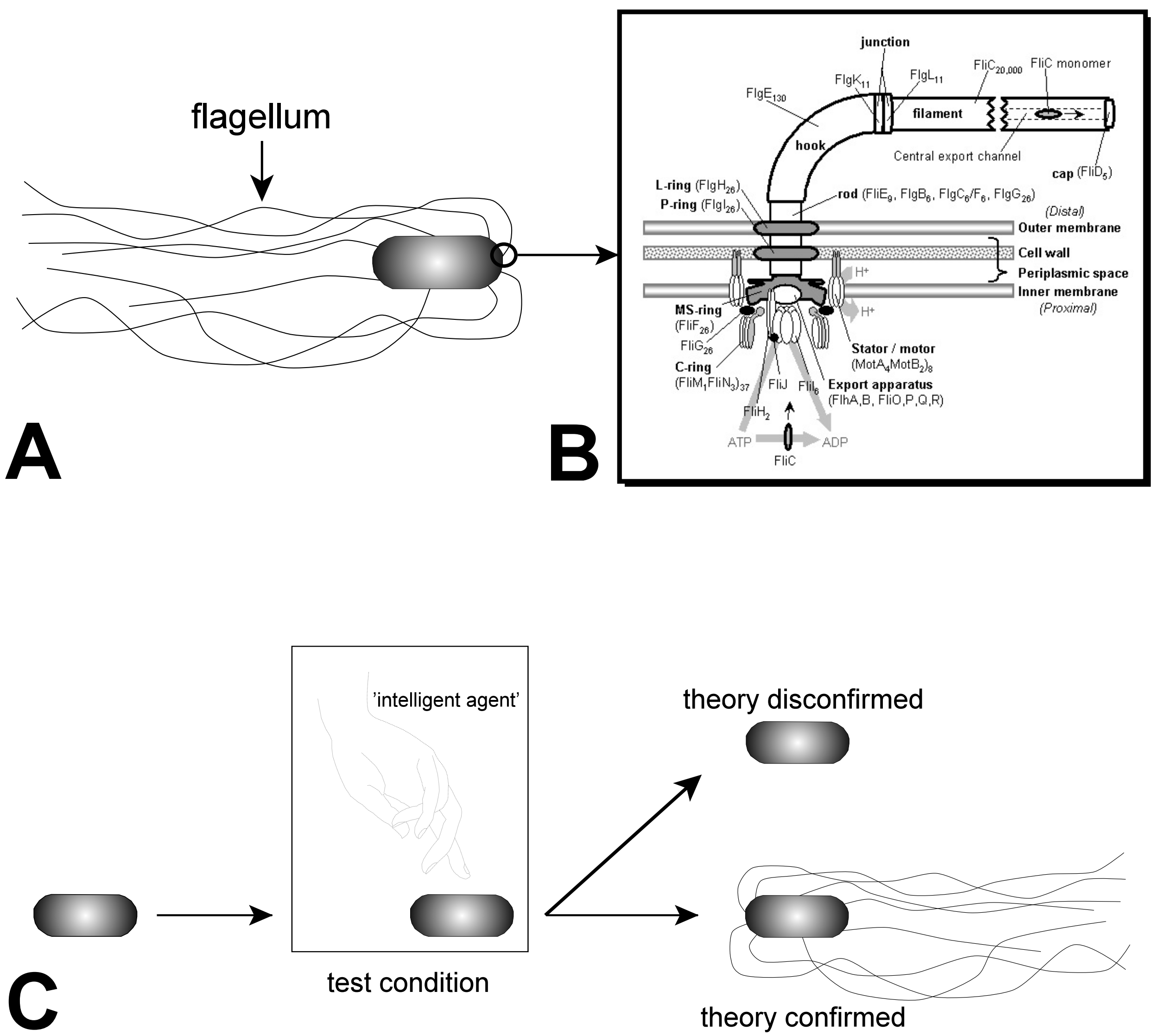

Figure 1. **A.** A bacterial cell with flagella. **B.** Schematic diagram of a flagellum in cross section (adapted from http://www.talkdesign.org/faqs/flagellum.html). **C.** An example of testing an intelligent design theory.

not open to being tested, then the hypothesis, which is quite imaginative, really provides no scientific understanding.

Recall that to test any theory, we must establish an experimental regime wherein we have an opportunity to witness the causal conditions required of the theory, as well as observing ensuing effects that can confirm or disconfirm the theory. We can use the subject of bacterial flagella as a useful example of what would be involved in actually testing intelligent design. The basic experimental setup for testing the intelligent design theory would have the form shown in Figure 1C. Given a culture of bacteria that lack flagella, we would have to witness a test condition wherein some specified intelligent agent is introduced to act upon the culture. Subsequently, if no members of the culture exhibit flagella, we could conclude that the intelligent agent was not able to induce that structure, thereby disconfirming our theory. Alternatively, if flagella did appear, then our theory of intelligent design has been confirmed.

Notice that this example illustrates the components of testing presented earlier in **[1]** through **[4]**. An important difference, however, is that we did not provide any of the specifics regarding the causal relationships that would be necessary to actually engage in legitimate testing. But, in any example regarding intelligent design, such specifics are actually unimportant for the fact that we would never be able to witness the 'test conditions' illustrated in Figure 1C. It is this inability to observe the interactions between an intelligent agent and organisms that precludes any intelligent design theory from being seriously considered in the realm of science.

The requirements for properly testing intelligent design shown in Figure 1C differ substantially from what Behe (2000)[3] has claimed to be a test regarding flagella. Behe states,

In fact, my argument for intelligent design is open to direct experimental rebuttal. Here is a thought experiment that makes the point clear. In Darwin's Black Box (Behe 1996) I claimed that the bacterial flagellum was irreducibly complex and so required deliberate intelligent design. The flip side of this claim is that the flagellum can't be produced by natural selection acting on random mutation, or any other unintelligent process. To falsify such a claim, a scientist could go into the laboratory, place a bacterial species lacking a flagellum under some selective pressure (for mobility, say), grow it for ten thousand generations, and see if a flagellum--or any equally complex system--was produced. If that happened, my claims would be neatly disproven.

Behe's claim that intelligent design would be 'disproven' is not correct for the simple fact that no legitimate test of the intelligent design theory has been provided in his example. Once again, what we have to acknowledge is that in order to test intelligent design theory, the required test conditions must be such that the causal interaction between an intelligent agent and organism must be available to observation as indicated in **[2]** through **[4]**. Behe's suggestion of an experiment involving active selection for mobility is quite irrelevant to testing an intelligent design theory since the causal conditions involve the experimenter, not the intelligent agent to which the theory refers.

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[3]Available at: http://www.arn.org/docs/behe/mb_philosophicalobjectionsresponse.htm

Implications for Intelligent Design Hypotheses

The problems we just identified with the testing of any ID theory also present implications for the testing of ID-based explanatory hypotheses. A hypothesis is the product of one applying some theory, or set of theories, to observed effects. On a daily basis, we encounter effects to which we apply any variety of previously accepted theories. Assuming some theory to accurately portray cause and effect relations, one is compelled to apply that theory to present effects in the hopes of giving themselves some degree of understanding of why those effects are the case. From an explanatory perspective, the relations between a theory, hypothesis, and observed effects have the follow form:

[5] (i) effects *x*, *y*, *z* are observed,

(ii) apply theory α (e.g. **[1]**),

(iii) conclude hypothesis *H*, i.e., causal events *o*, *p*, *q* occurred in the past.

Hypothesis *H* provides an accounting of effects *x*, *y*, *z* because these effects are to be expected, given the assumption that theory α is an accurate representation of cause and effect relations.

In order to test *H*, one must seek effects that are related as closely as possible to the causal events stipulated in *H*. In other words, we should strive to find effects that have the lowest probability of being observed if the events stated in *H* did not occur. The formal structure of such a test would then have the form:

[6] (iv) Given theory α, and,

(v) hypothesis *H*, then,

(vi) in addition to observed effects *x*, *y*, *z*,

(vii) conclude test consequences *a*, *b*, *c*.

Given that the inferences of explanatory hypotheses are intended to provide us with at least initial understanding of observed effects, we would want to utilize theories that themselves have been previously subjected to testing, per **[2]** through **[4]**. The importance of such theory testing in the context of subsequently testing hypotheses is that we have a clear understanding of the cause and effect relations we have attempted to apply to presently observed effects. Such empirically based understanding is critical to being able to stipulate possible tests of hypotheses (cf. **[6]**).

But, if one utilizes a theory that is immune to critical evaluation to infer some hypothesis, then this immunity from testing will extend to the hypothesis as well. Once again, as the theory serves to stipulate the occurrence of specific causal conditions in the hypothesis (cf. **[5]**), the potential tests of the hypothesis must be in the form of effects that are directly related as closely as possible to those causal conditions (cf. **[6]**).

Unfortunately, if it is not possible to witness the causal conditions involving an intelligent agent as part of the test conditions for a theory, as indicated in **[2]** through **[4]**, then by extension it is also not possible to state what effects one should predict as possible test evidence for a hypothesis derived from such a theory (cf. **[6]**). At the other extreme, this inability to provide viable predictions means that no observed effects can be claimed as disconfirming evidence for an ID hypothesis. All effects can be explained away by an ID theory.

The example presented in Figure 1C can be used to illustrate the problem just described. Let's say we have observed bacteria with flagella, for which we infer, as indicated in **[5]**, the hypothesis that these structures originated as a result of an intelligent agent in the past. Testing this hypothesis would require seeking evidence that directly links that agent to the origin of flagella. But, as was discussed in the previous section, an intelligent design theory cannot be tested because there are no test conditions that can be produced wherein a causal agent can be experienced. The consequence for testing the hypothesis that observed flagella were caused by an intelligent agent is that we would not be able to predict any test consequences that could potentially test the hypothesis. With no past empirical experience documenting interactions between an intelligent designer and organisms, there can be no consequences to be expected from such interactions that can serve as test evidence for either supporting or refuting the current hypothesis.

SUMMARY

A theory or hypothesis that invokes an intelligent, supernatural cause will be entirely immune from critical evaluation. The problem with such immunity is that there can be no tangible growth of knowledge by the process of critical evaluation as has become the hallmark of all fields of science.

About the author. *J. Kirk Fitzhugh has been Curator of Polychaetes at the Natural History Museum of Los Angeles County since 1990. He received his B.S. in marine biology from Texas A&M University at Galveston, M.S. in biology from Texas A&M University, and Ph.D. in biology from George Washington University. While his research has focused mainly on the systematics of polychaete worms around the world, Dr. Fitzhugh's research interests extended to the philosophical foundations of evolutionary biology about 10 years ago.*