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## Précis of 'An Abductive Theory of Scientific Method'



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This short article is a précis of the author's (2005a) abductive theory of scientific method. This theory of method assembles a complex of specific strategies and methods of relevance to psychology that are employed in the detection of empirical phenomena and the subsequent construction of explanatory theories. A characterization of the nature of phenomena is given, and the process of their detection is briefly described in terms of a multistage model of data analysis. The construction of explanatory theories is shown to involve their generation through abductive, or explanatory, reasoning, their development through analogical modeling, and their fuller appraisal in terms of judgments of the best of competing explanations. The nature and limits of this theory of method are discussed in the light of relevant developments in scientific methodology. © 2008 Wiley Periodicals, Inc. *J Clin Psychol* 64: 1019–1022, 2008.

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In 2005 (Haig, 2005a), I sketched an abductive theory of scientific method (ATOM) relevant to psychology and the behavioral sciences. The theory is broader than both the inductive and hypothetico-deductive accounts of scientific method. The abductive theory of scientific method serves as an organizing framework within which a variety of more specific research methods can be located, combined, and used to give ATOM operational bite.

According to ATOM, scientific research proceeds as follows: guided by evolving research problems comprised of packages of empirical, conceptual, and methodological constraints (Haig, 1987; Nickles, 1981), sets of data are analyzed to detect robust empirical regularities, or phenomena. Once detected, these phenomena are explained by abductively inferring the existence of underlying causal mechanisms. Here, abductive inference involves reasoning from claims about phenomena, understood as presumed effects, to their theoretical explanation in terms of underlying causal mechanisms. Upon positive judgments of the initial plausibility of

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these explanatory theories, attempts are made to elaborate on the nature of the causal mechanisms in question. This is done by constructing plausible models of those mechanisms by analogy with relevant ideas in domains that are well understood. When the theories are well developed, they are assessed against their rivals with respect to their explanatory goodness. This assessment involves making judgments of the best of competing explanations.

The abductive theory of scientific method places great importance on the task of detecting empirical phenomena, and it views the completion of this task as a prerequisite for subsequent theory construction. In understanding this task, phenomena must be distinguished from data (Woodward, 1989). Phenomena are relatively stable, recurrent, general features of the world that researchers seek to explain. The Flynn effect of intergenerational gains in IQ is a prominent example of an empirical phenomenon in psychology. Although phenomena commonly take the form of empirical regularities, it is more useful to characterize phenomena in terms of their role in relation to observation and prediction. Phenomena give scientific explanations their point. They also, on account of their generality and stability, become the appropriate focus of scientific explanation. Data, by contrast, are ephemeral and pliable.

The methodological importance of data lies in the fact that they serve as evidence for the phenomena under investigation. In extracting phenomena from the data, scientists often engage in data exploration and reduction using graphical and statistical methods. Generally speaking, these data analytic methods are of direct help in the detection of phenomena, but not in the explanation of explanatory theories.

To establish that data are reliable evidence for the existence of phenomena, scientists use a variety of strategies. They include controlling for confounding factors (experimentally and statistically), carrying out replications, calibrating instruments, and engaging in data analytic strategies of both statistical and nonstatistical kinds.

A statistically oriented, multistage account of data analysis is outlined to further characterize the phenomena detection phase of ATOM. The model proceeds through the four stages of initial data analysis, exploratory data analysis, close replication, and constructive replication. These four phases are concerned respectively with data quality, pattern suggestion, pattern confirmation, and generalization. The process of phenomena detection is one of enumerative induction in which one learns empirically, on a case-by-case basis, the conditions of applicability of the empirical generalizations that represent the phenomena.

According to ATOM, phenomena serve the important function of prompting the search for their own understanding by constructing relevant explanatory theories. For ATOM, theory construction comprises three methodological phases: theory generation, theory development, and theory appraisal, with the first two phases being temporal in nature; theory appraisal begins with theory generation, continues with theory development, and is undertaken in concerted fashion in the so-called phase of theory appraisal. ATOM characterizes each phase of theory construction as abductive in nature, though the character of abductive inference is different in each case.

Abductive reasoning is a form of inference that takes us from descriptions of data patterns, or phenomena, to one or more plausible explanations of those phenomena (cf. Josephson & Josephson, 1994). A brief characterization of abductive inference can be given as follows: some phenomena are detected that are surprising because they do not follow from any accepted hypothesis or theory. We notice that

the phenomena would follow as a matter of course from the truth of a new hypothesis or theory (in conjunction with accepted auxiliary claims). We conclude that the new hypothesis or theory has initial plausibility and therefore deserves to be seriously entertained and further investigated.

Exploratory factor analysis is discussed as an example of a method in psychology that facilitates the abductive generation of theories about latent factors (Haig, 2005b). With this method theories are generated through a process of existential abduction in which the existence, but not the nature, of the causal mechanism is hypothesized. The claim for the existence of general intelligence is psychology's best known example of a hypothesis about latent factors arrived at by such means.

The abductive theory of scientific method is also a method for theories in the making. It encourages researchers to look upon their theories as developing entities. Because we often do not have knowledge of the nature of the causal mechanisms we abductively probe, such nascent theories stand in clear need of conceptual development. ATOM urges us to construct models of those mechanisms by imagining something analogous to mechanisms whose nature we do know. In this regard, ATOM adopts the strategy of using analogical modeling to help develop explanatory theories (Abrantes, 1999). Because analogical modeling increases the content of explanatory theories, the reasoning it embodies is referred to as *analogical abduction*. With analogical modeling, one builds an analogical model of the unknown subject or causal mechanism based on the known nature and behavior of the source from which the model is drawn (Harré, 1976). The computational model of the mind, based on an analogy with the computer is a clear example of a model that has been developed by using this strategy.

The abductive theory of scientific method takes the systematic evaluation of mature theories to be an abductive undertaking known as *inference to the best explanation*, whereby a theory is accepted when it is judged to provide a better explanation of the evidence than its rivals. ATOM takes inference to the best explanation to be centrally concerned with establishing explanatory coherence (Thagard, 1992). The theory of explanatory coherence maintains that the propositions of a theory hold together because of their explanatory relations. Relations of explanatory coherence are established through the operation of seven principles: symmetry, explanation, analogy, data priority, contradiction, competition, and acceptability. The determination of the explanatory coherence of a theory is made in terms of three criteria: explanatory breadth, simplicity, and analogy. Each criterion is embedded in one or more of the principles. The criterion of explanatory breadth, which is the most important for choosing the best explanation, captures the idea that a theory is more explanatorily coherent than its rivals if it explains a greater range of facts or phenomena. The notion of simplicity deemed most appropriate for theory choice is captured by the idea that preference should be given to theories that make fewer special assumptions. Finally, explanations are judged more coherent if they are supported by analogy to theories that scientists already find credible. Darwin's theory of evolution by natural selection has been shown through use of the theory of explanatory coherence to be a more explanatorily coherent theory than its creationist alternative (Thagard, 1992). The theory of explanatory coherence offers the researcher an integrated account of the criteria deemed important for the appraisal of explanatory theories. The theory of explanatory coherence is implemented through a computer program that enables the researcher to make systematic decisions about the best of competing explanatory theories.

Two important methodological contrasts form part of the deep structure of ATOM: the distinction between generative and consequentialist methodology, and the distinction between reliabilist and coherentist justification (cf. Nickles, 1987). Consequentialist strategies justify knowledge claims by focusing on their consequences. By contrast, generative strategies justify knowledge claims in terms of the processes that produce them. Both generative and consequentialist research strategies are involved in the detection of phenomena, and generative research strategies are involved in the construction of explanatory theories. Exploratory factor analysis is a method of generative justification. The hypothetico-deductive method is a method of consequentialist justification.

The abductive theory of scientific method also makes complementary use of reliabilist and coherentist approaches to the justification of knowledge claims. Reliabilism asserts that a belief is justified to the extent that it is acquired by reliable processes or methods. Reliability judgments furnish the appropriate type of justification for claims about empirical phenomena. By contrast, coherentism maintains that a belief is justified in virtue of its coherence with other accepted beliefs. ATOM adopts the theory of explanatory coherence to provide coherentist justifications for the acceptance of explanatory theories.

The abductive theory of scientific method aspires to be a coherent theory that brings together a number of different research methods and strategies that are normally considered separately. Although ATOM is a broad theory of scientific method, it is not a fully comprehensive account. Rather, it is a singular account of scientific method that is appropriate for the detection of empirical phenomena and the subsequent construction of explanatory theories.

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