What is Abductive Inference?

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Abductive reasoning: constitutes according to Peirce the "first stage" of scientific inquiries (CP 6.469) and of any interpretive processes. "Abduction" is the process of adopting an explanatory hypothesis (CP 5.145) and covers two operations: the selection and the formation of plausible hypotheses. As process of finding premisses, it is the basis of interpretive reconstruction of causes and intentions, as well as of inventive construction of theories.

Since the "mind is a sign developing according to the laws of inference" (CP 5.313), "Semiosis", the infinite process of interpretation of sign, is structured as argumentation. Thinking and reasoning is based on abductive, deductive and inductive inferences, aiming at establishing beliefs, habits, rules and codes.

In his early writing "Deduction, Induction and Hypothesis" (1878), Peirce describes the three modes of inference as different syllogistic forms. In his "Lectures on Pragmatism" (1903) Abduction, Deduction and Induction become interacting aspects with different epistemological functions. Deduction determines the necessary consequences, relying on logical provable coherence between premisses and conclusion. Induction is aiming at empirical provable coherence between the premisses and experience, in order to derive a probable generalization. Yet, induction only classifies the data (CP 3.516), while abductive reasoning furnishes the reasoner with a problematic theory explaining the causal relation among the facts. From the abductive suggestion, which syntheses a multitude of predicates, "deduction can draw a prediction which can be tested by induction" (CP 5.171).

Motivated by the observation of a surprising fact or an anomaly that disappoints an expectation, abductive reasoning is a strategy of solving problems and discovering relevant premisses. It is "inference to the best explanation". Abductive reasoning has the logical form of an inverse *modus ponens* and is "reasoning backwards" from consequent to antecedent. Therefore Peirce calls it also "Retroductive reasoning" (CP 1.74). From a logical point of view, reasoning backwards is no valid form of inference. It is conjectural, or presumptive thinking, aiming at matching pragmatic standards of plausibility, guided by the reasoner´s "guessing instinct" (CP 7.46). However, Peirce claims that Abduction is logical inference, because it can be represented in a "a perfect definite logical form" (CP 5.188): "The surprising fact, C, is observed; But if A were true, C would be a matter of course, Hence, there is reason to suspect that A is true" (CP 5.189).

With his concept of abductive reasoning as a "logic of discovery" Peirce tries to reformulate the Kantian question, how synthetical reasoning is possible at all. The notion of abductive inference becomes a fundamental issue in the "pragmatistic" concept of the evolution of knowledge. In his "Lectures on Pragmatism" Peirce states that the question of pragmatism "is nothing else than the question of the logic of abduction" (CP 5.196). Since it is the "only kind of reasoning which supplies new ideas, the only kind which is, in this sense, synthetic" (CP 2.777), it must be by abductive reasoning that we have the capacity "to learn anything or to understand phenomena at all" (CP 5.171). Even perceptual judgements are to be regarded as "extreme cases" of abductive inferences (CP 5.181). As an "act of insight" that "comes to us like a flash" (CP 5.181), Abduction is also related with creative and aesthetic aspects, such as contemplation, daydream, and play of thought, which Peirce calls "Musement" (CP 6.458).

The question of the status of abductive reasoning as major aspect of a "logic of discovery" is a controversial issue in philosophy of science and epistemology. Hanson (1965: 45) differentiates between two aspects in the rational procedure of hypothesis selection, namely firstly, reasons for accepting an hypothesis, and secondly reasons for entertaining a hypothesis in the first place. While the first point highlightens the problem of logical coherence the second stresses the pragmatic relevance.

In Popper's concept of "Logic of Science", growth of knowledge is due to a procedure of "trial and error". On the one hand, the ability to solve problems, is "a creative ability to produce new guesses, and more new guesses" (Popper 1979: 261). The task of a logic of science, on the other hand, is the critical discussion of the methods and the logical criteria of hypothesis falsification and elimination. The Peircean account of abductive inference, denies the possibility to draw a sharp borderline between "context of discovery" and "context of justification".

Peirce describes the evolution of knowledge in analogy to the Darwinian model of evolution. The "selection" of hypotheses is performed by an partly inborn, partly learned "guessing instinct", which has developed as a part of the universe and is grown during evolution under the influence of its laws. Therefore, Peirce states that abduction is "nothing but guessing" (CP 7.219). In order to make "fair guesses", abductive inference links the reasoner´s "guessing instinct" with the rational "principle of economy", which is the "leading consideration" in Abduction (CP 5.600). The "Economy of Research" aims at maximal plausibility of the hypothesis and at the maximal efficiency of the process of hypothesis formation and hypothesis testing. Therefore, "the simpler Hypothesis in the sense of the more facile and natural, the one that instinct suggests, that must be preferred" (CP 6.477).

Besides epistemology, the model of abductive inference has an increasing impact on Linguistics, Hermeneutics and Artificial Intelligence. Chomsky uses the Peircean notion of guessing instinct and abductive inference, in order to explain language acquisition as an process of limiting the class of admissible hypotheses that are submitted to "corrective action" (See Chomsky 1968).

Bonfantini and Proni suggest to interpret the abductive "guessing instinct" not only as a "natural insight", a *lumen naturale*, but also as a *lumen culturale*, an insight in our cultural background (See Bonfantini & Proni 1983: 134). Thus, as Eco points out, the abductive "logic of interpretation" could also become a model for hermeneutic processes (See Eco 1990: 59).

Recently the concept of abductive reasoning as reasoning to the best explanation is introduced and discussed in the field of Artificial Intelligence and expert systems (See van der Lubbe 1993). Expert systems aim at imitating the reasoning process and the human faculty to deal with uncertain information in a very efficient way. The question, however, is, how abductive inference as a pragmatic strategy of reasoning can be implemented in expert systems and whether artificial intelligence as a computational automatism can make creative

guesses.

References

Bonfantini, Massimo & Proni, Giampaolo, "To guess or not to guess". In: Eco & Sebeok (eds.) The Sign of the Three. Dupin, Holmes, Peirce. Indiana University Press, 1983, pp. 119-134.

Chomsky, Noam, Language and Mind. Harcourt, Brace and World, 1968.

Hanson, Norwood Russel, "Notes Toward a Logic of Discovery". In: Perspectives on Peirce. Critical Essays on Charles Sanders Peirce. (Ed.) Richard J. Bernstein. New Haven and London, 1965, pp. 43-65.

Eco, Umberto, The Limits of Interpretation. Indiana University Press, 1990.

Lubbe, Jan C.A. van der, "Human-like Reasoning under Uncertainty in Expert Systems". In: Signs, Search and Communication. Semiotic Aspects of Artificial Intelligence. (Eds.) René J. Jorna, Barend van Heusden, Roland Posner. Berlin, New York: de Gruyter, 1993, pp. 113-133.

Peirce, Charles Sanders, Collected Papers. (CP). Band I-VI. (Hrsg.) Charles Hartshorne und Paul Weiß. Harvard University Press 1931-1935. Band VII, VIII. (Hrsg.) Arthur W. Burks. 1958.

Popper, Karl R., Objective Knowledge. An Evolutionary Approach. Oxford, 1979.