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Naturalizing logic

Errors of reasoning vindicated: Logic reapproaches cognitive science

Lorenzo Magnani

Department of Humanities, Philosophy Section and Computational Philosophy Laboratory, University of Pavia, Pavia, Italy

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ABSTRACT

A complete revision of mainstream logic is an urgent task to be achieved. This revision will be able to bring logic into a creative rapprochement with cognitive science. This can be achieved by trying to do for logic what over forty years ago Quine and others attempted for epistemology. It is necessary to propose a "naturalization" of the logic of human inference. This paper deals with an examination of how the naturalization process might go, together with some indication of what might be achieved by it. To assist the reader in understanding the naturalization of logic I will take advantage of my own research on the concept of abduction, which vindicates the positive cognitive value of the fallacy of the affirming the consequent thanks to the so-called EC-model (Eco-Cognitive model), and of the recent book *Errors of Reasoning: Naturalizing the Logic of Inference* (2013) [86], by John Woods. While this paper certainly aims at promoting the research program on the naturalization of logic, it also further advocates the placement of abduction in the research programmes of logic, and stresses to what extent our contemporary philosophical and logical tradition is indebted towards Charles Sanders Peirce, a thinker often praised for his productivity but whose quality and importance are too often overlooked.

> Of the three Universes of Experience familiar to us all, the first comprises all mere Ideas, those airy nothings to which the mind of poet, pure mathematician, or another might give local habitation and a name within that mind. Their very airy-nothingness, the fact that their Being consists in mere capability of getting thought, not in anybody's Actually thinking them, saves their Reality.
>
> Charles Sanders Peirce, *A Neglected Argument for the Reality of God*, 1908.

1. Errors of reasoning: Logic reapproaches cognitive science

In this paper I will deal with an examination of how the naturalization process might go, together with some indication of what might be achieved by it. To help the reader in understanding the naturalization of logic I will take advantage of my own research on the concept of abduction and of the recent book *Errors*

E-mail address: lmagnani@unipv.it.

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of Reasoning: Naturalizing the Logic of Inference (2013) [86], by John Woods, which I think constitutes a major event in logic and philosophy, especially if seen in their relationships with cognitive science. Even if there is quite natural tendency among orthodoxies in the realm of logic not to pay much attention to work done outside their sphere of interest, or to dismiss it out hand when it calls them into question, one would expect the book's very subtitle to catch the attention of many of the journal's readers, even if not belonging to the cognitive science area of research. It would be attention well-rewarded by what the subtitle promises. The naturalization of logic is a notable departure from how logic is usually conceived.

It has to be said that the idea of naturalizing logic does not really or completely originate with John Woods. In the modern era alone, it was actively proposed by Dewey [19, vol. 12, p. 27] and sympathetically entertained by Toulmin [81, p. 257], and Finocchiaro [21, pp. 6–7]. Pointing out additional specific recent relevant and effective published work on the collective effort to naturalize logic, arisen over time in cognitive science or AI, I have to cite the new Kowalski's book *Computational Logic and Human Thinking* [43], where the 17 chapters each consider a different type of reasoning, also taking advantage of considerations related to the need of the extension of logic. Starting with deductive reasoning on horn clauses, Kowalski considers abduction, induction, planning, nonmonotonicity, decision making, temporal and meta-reasoning and many other forms of reasoning, showing how logical studies related to computer science and AI can be extended to encompass and explain them all. Further, the recent synoptic book *Human Reasoning and Cognitive Science* [77] certainly adds new insight on the naturalization of logic: both a psychologist and a logician richly show the choice of logical formalisms for representing actual reasoning. There are two interlocking questions: what are the right formalisms to represent how people reason, and what forms do the reasoners themselves bring to the world in order to reason about it? This is an excellent book in cognitive science that logicians can learn some new logic from.

Many other results of the current literature directly or indirectly related to the naturalization of logic need be quoted, such as recent AI oriented research on counterfactual reasoning [15,56,64,68]; moral reasoning [37,67,74,75]; mutual debugging and argumenting [65,66]; objecting [62,63]; preferring [61]; forgetting [3]; updating [2,4,38]; intention recognition and decision making [31,33]. Also, interesting studies related to the evolutionary game theory concerning emergent population norms and emergent cooperative behavior morals represent a new promising area for the naturalization of the logic of agents embedded in populations and groups, and certainly points out central issues which help to go beyond the expressive rigidity of the mainstream received logical tradition [3,30,32,34–36].

In *Errors of Reasoning* Woods adds new important considerations. He holds a naturalized logic to an adequacy condition of "empirical sensitivity". This is achieved in three ways. One requires that the logicians familiarize themselves with the data that cognitive science seeks to account for: "At a minimum, the decision to naturalize the logic of reasoning is a decision to take into account well established lawlike results of the cognitive science" [86, p. 62]. A second requires an informed acquaintance with the findings of the best-confirmed of those theories. The third requires a logic's empirical disconformities with the data and findings of the partner sciences be accounted for, under pain of having to give them up.[1] In this perspective we should conclude that "It is not in the general case preferable – indeed it is not smart and not even possible – to upgrade our cognitive targets in ways that favor truth-preservation or experimental/statistical confirmation as general cognitive strategies" [86, p. 198].

A special importance is possessed by this third condition, which leads to view with suspicion (and lots of telling argument) the most prominent justification for hanging on to an empirically false theory. According to that view, it is not the aim of such theories to be descriptively adequate; the goal is to establish rules

[1] Indeed the author maintains it is necessary to construct an "empirically sensitive logic": a logic considered as an "empirically sensitive and epistemologically responsive account of the reasoning practices of beings like us" [86, p. 386].