

***On guessing and reasoning: a reply to Paul Bourguine's
“Models of abduction”***

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The hope that there is sufficient affinity between the reasoner's mind and nature's to render guessing not altogether hopeless.

— Peirce

Introduction

Charles Peirce ends the above tentative definition of the grounds for abduction by stating that “the effort should therefore be to make each hypothesis, which is practically no more than a question, as near an even bet as possible” (CP 1.121). The reason why I am quoting this passage of the *Collected Papers* is that I assume it can justify why should I (with no solid background in symbolic logic or mathematics) dare coming up with a debate on Paul Bourguine’s article “Models of abduction.”

Taking the following rendition of an abductive inference as a guide:

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)

I therefore decided to consider Paul’s article as a “surprising fact,” and to try my best in devising relevant questions about it. I believe should thank my deductive capacities for enabling me to extract hopefully clear and reliable consequences from those questions, but I will only be able to evaluate the pertinence of my efforts after a moment of induction I expect to share with you, dear reader.

What kind of process is abduction?

Abduction is clearly a controversial issue among Peirce scholarship (cf. Anderson 1986, Turrissi 1990, Santaella 1997). Much of this controversy is due to the fact that Peirce alternately described abduction in terms of a logical procedure (CP 4.541, 5.171, 5.181, 5.192, 5.196, 7.202) and in terms of “guessing” (CP 1.121, 2.755, 5.589, 6.526, 7.219, 7.220). While some maintain this is exactly what he meant, setting grounds for a kind of “logical form for instinct” (Santaella 1997: 7), others (see Anderson 1986: 155-156, Turrissi 1990: 467-477) claim that this dual nature of abduction is unsustainable. According to many, however, abduction must be seriously regarded as a kind of inference that “admits of logical analysis—that is, it should exhibit some logical form” (Anderson 1986: 153). At this point, scholars diverge between devising a logical treatment that preserves the originative and ampliative character of abduction implicit in the “guessing” approach, or simply dismissing those features as something that precludes a solid logical approach.

Within this context, Bourguine’s proposal of axiomatic and geometrical models for abduction is applaudable both for its originality and its pertinence towards the dialogue between cognitive science and semiotics. My main concern, however, is whether Bourguine’s proposal truly preserves the originative and ampliative features that, as I will claim, characterize Peirce’s abductive inference.

The concept of abduction

As Bourguine properly mentions in his introduction, there is a certain agreement among Peirce scholarship to divide Peirce’s approach to types of reasoning in two main periods: the syllogistic, pre-1900 approach; and the inferential, post-1900 approach. It is important to note, however, that, as suggested by authors like Anderson (1986), Turrissi (1990), and Santaella (1997), the development of Peirce’s theory of types of reasoning during this period is more than a simple change from a depiction of abduction, deduction, and induction in terms of Barbara syllogisms to a description of those processes from a methodological point of view.

An important accomplishment of this development was a sharper distinction between the three kinds of reasoning: while in the pre-1900 papers there is a clear distinction between what Peirce calls “deductive” and “ampliative” reasoning (the later encompassing both induction and abduction, cf. CP 2.709), after 1900 we will find that abduction differs from induction for being “the only kind of argument which starts a new idea” (CP 2.96, 1902), and in this sense the only kind of originary reasoning. This means that, by dismissing the ampliative character of abduction, we may end up confounding it with deduction; while by dismissing its originary feature we may mix it up with induction.

I am afraid this is exactly what happens in Bourguine’s conclusion, when he aligns deduction and abduction as “synchronic” processes and affirms that changes in a system of belief are only possible through induction. It seems clear to me that what he takes for a “moment of induction” in this excerpt should be better described as a moment of *perception*. Once that, according to Peirce,

Reasoning does not beg in until a judgment has been formed; Reasoning, therefore, begins with premises which are adopted as representing percepts, or generalizations of such percepts.(CP 2.773)

Abduction, consistency, and perception

Still on perception, in one of his Lectures on Pragmatism Peirce affirms that:

abductive inference shades into perceptual judgment without any sharp line of demarcation between them; or, in other words, our first premises, the perceptual judgments, are to be regarded as an extreme case of abductive inferences, from which they differ in being absolutely beyond criticism. (CP 5.181)

Bourguine’s first axiom for abductive reasoning states that “nothing can be abduced from a contradiction”, and



is formalized as “A1-Consistency: $(\perp |< a)$ ”. Once abduction has its roots on perception, and once we cannot dismiss or deny a perceptual judgment, I would agree that, as the logical form of axiom A1 proposes, abduction is *always* based on something that, from the point of view of the “abducer”, has the value of “truth”.

I am not sure, however, about the implications of Bourguine’s claim that this “is the dual of the well-known property of deduction : everything can be deduced from a contradiction”. As I understand, this property could be described as ‘from $(\beta \wedge \neg \beta)$ it is possible to deduce everything’, or, conversely, that ‘from $(\beta \wedge \neg \beta)$ it is not possible to deduce anything’. If $(\beta \wedge \neg \beta)$ can be interpreted as a contradiction between something (β) that is expected and something else $(\neg \beta)$ that is given, instead, by perception, $(\beta \wedge \neg \beta) |< a$ seems to be a perfect example of a ‘surprising fact’ that would not only permit, but also *require* abduction. Clearly, I do not believe that this abduction could be just “anything” (as it is the case of trivialization in classical deduction), but rather some kind of procedure that would allow this contradiction to be solved.

Abduction and belief revision

Trying to keep up with the belief revision terminology Bourguine is adopting, I would describe this “new or surprising fact” as something that is not recognizable as a part of a system of belief, or that contradicts one or more elements of this system. This new or surprising fact is imposed by perception, as a Perceptual Judgment, over which the system has no control (cf. 4.541, 5.181). This moment of disruption is followed by abduction, or the generation of a new hypothesis, which consists in the suggestion of an element or structure that needs to be added to the system in the hope of reestablishing some kind of coherence.

In a sense, this is very close to the definition of *revision* found in the belief revision literature suggested by Bourguine (Alchourrón et al. 1985, Katsuno & Mendelzon 1991). I am afraid, however, that Peirce’s account of abduction would fail to satisfy the requirement of generating hypothesis that would not only add to or modify, but also *guarantee* the subsequent consistence of the system.

This warrant is far beyond what Peirce envisioned as abduction. According to him, “abduction, ... is merely preparatory. It is the first step of scientific reasoning, as induction is the concluding step” (CP 7.218). Whether the hypothesis suggested will in fact reestablish coherence or not, is not a matter of abduction anymore, but of deduction and induction. “Abduction merely suggests that something *may be*” (CP 5.171). The consequences of this hypothesis are then to be traced by deduction (transforming this *may be* in a provisional *must be*), and experimented by Induction (which will finally show us if this *must be* built up by Deduction *actually is* operative) (cf. CP 5.171, 7.220).

It seems to me that Bourguine’s account, by restricting abduction to the formulation of hypothesis that belong to a pre-ordered set (pre-ordered according to preference relations), reduces abduction to selection, rendering abduction a species of induction, or, worse, a species of deduction. This reduction to selection is also found in the work of scholars who interpret abduction as “inference to the best explanation” (Fetzer 1998, Josephson & Josephson 1996). Gudwin (1998) correctly criticizes this view, claiming that it overlaps generation, evaluation and selection, but unfortunately misses the point by choosing to connect *generation* of hypothesis with induction, while abduction is relegated to “verification and selection.”

Modeling abduction

All the models considered by Bourguine belong to the category of experts (a physician), or would-be experts (a novice chess player learning, by mimetism, from a master chess player), from who we would not expect, in fact, “creative” (new, original, surprising, unforeseen) strategies for problem solving.

The novice chess player is highly constrained by the rules of the game, and the best she can do —according to Bourguine’s account— is to construct an accurate evaluation of every possible situation within the chess-playing space. Once this construction is accomplished, Bourguine says, “choosing the next move becomes strongly abductive: take the move in $G(X)$ [the directly accessible situations from the current situation] which has the best evaluation”.

I will claim that this “choosing” is not at all “abductive” in the Peircean sense, but rather *inductive*. It consists in the application of a well-known successful procedure suggested by a highly *deductive* structure (the built-up accurate evaluation of every possible situation), that could, at best, lead to an even more accurate evaluation of the procedure, and do not call for the *generation of new hypothesis*.

Moreover, abduction, in the Peircean sense, involves an element of *surprise* that seems to be absent in the selection of a chess move based on this huge data-base of accurate descriptions for every possible move. If the chess player already knows *every* possible situation that may happen, how could she be surprised? This seems to be, in fact, the rationale behind the implementation of chess programs, like Deep Blue. As we know, artificial chess masters turned out to be possible exactly by applying implementation strategies that avoid any kind of surprise.

As for the physician, I believe it is fair to say that anyone, *as a patient*, prefers to believe that doctors know exactly what they are doing, and will *not* be surprised even by our most strange symptoms, *neither* will come up with a *tentative* and *fallible* hypothesis about our health care. Even if we *know* that this is *not always* the case, we prefer to believe that, as in the example given by Bourguine, thanks to their vast knowledge of possible symptoms and diseases, they will always be able to come up with the correct diagnosis or send us to another expert.

It is also quite fair to expect that, if we are to come up with artificial doctors, they should proceed exactly this way, always giving us a correct diagnosis based on well-known procedures and evaluations or sending us to another physician, and *never* coming up with “creative” diagnosis or prescriptions. In the real world, however, physicians do come up with new and tentative hypothesis —diagnosing new diseases, devising new and hopefully better procedures—, and this is the only way, according to Peirce and his theory of abduction, to add *new* knowledge to any domain.

Peirce’s theory of abduction, understood within the frame of his pragmatism and synechism, implies that *there will always be something new and surprising to know about any domain*, and coming up with a *new*

hypothesis on how to make sense of this new and surprising fact is not only the first step in self-controlled reasoning, but also the source of every new concept or idea. We should therefore assume that, if coming up with a total understanding of every possible situation in a certain domain is ever possible, there may be no need for abduction.

According to Peirce, the ultimate goal of abduction is “through subjection to the test of experiment, to lead to the avoidance of all surprise and to the establishment of a habit of positive expectation that shall not be disappointed” (CP 5.197). But, once the capacity to *change* habits is inseparable from Peirce’s conception of mind (on the implication of Peirce’s concepts of habit and habit change see Farias 1998), abduction can only be understood as a “living” process as long as its ultimate goal is never achieved.

My feeling is that, unless we are dealing with cognitive models that involve creativity or real world adaptability, there may be no ultimate test of the adequacy of a theory of abduction, at least in Peirce’s terms. This seems to be the case of the models analyzed by Bourguine, as well as of impressive models of creativity based on mimetism like David Cope’s EMI (Hofstadter 1999). Once EMI deals explicitly with the problem of creating music in the style of a specific musician, no matter how sophisticated and non-trivial this process might be, the range of possible knowledge about the domain is clearly restricted, leaving little if any space for surprise.

So... do we really need abduction, after all? According to Kapitan (1997: 489), Peirce offered at least three kinds of justifications of abduction: the *Evolutionary Justification* (the mind developed a natural tendency to think according to nature); the *Success Justification* (abductions proved to be beneficial for survival, hence recommended); and the *Desperation Justification* (abduction may be the only hope of attaining a rational explanation).

Less restricted domains of cognition imply the necessity of dealing with contradictory or unexpected information from perception, and the modeling of such processes may have the need to appeal, at least, to the *Desperation Justification*. This seems to be the case of Garry McGraw’s Examiner, a model of letter recognition for which the author devised what he called “Role clamping and guessing” strategies (McGraw 1995: 189-191) for “unparsable” letters. As long as there exists the need of devising strategies for dealing with unforeseen information, there may be a place for a theory of abduction.

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