

MEANING AND ABDUCTION AS PROCESS-STRUCTURE: A DIAGRAM OF REASONING

Inna Semetsky, PhD

ABSTRACT: This paper is informed by Charles Sanders Peirce's philosophy as *semiotics* or the doctrine of signs. The paper's purpose is to explore Peirce's category of abduction as not being limited to the inference to the best explanation. In the context of the logic of discovery, abduction is posited as a necessary although not sufficient condition for the production of meanings. The structure of a genuine sign is triadic and represents a synthesis between precognitive ideas and conceptual representations. The novel model of reasoning is offered, based on the mathematical formalism borrowed from Gauss' interpretation of the complex number. It is suggested that this model in a form of a diagram not only represents a semiotic process-structure but also overcomes the long-standing paradox of new knowledge. For Peirce, it is a diagram as a visual representation that may yield solutions to the otherwise unsolvable logical problems. What appears to us as a paradox is the very presence of abductive, or hypothetical, inference, as Peircean generic category of Firstness within the Thirdness of the total thought-process. Firstness (feeling), Secondness (action), and Thirdness (reason) together constitute a dynamic structure of experience.

KEYWORDS: abduction; experience; complex plane; logic; paradox of new knowledge; Peirce; reasoning.

INTRODUCTION

This paper draws from Charles Sanders Peirce's philosophy as *semiotics* having its origins in the doctrine of signs. The word "structure" in the title asserts the primacy of relations over elements. Structure is a systemic property; the system's elements being generated out of the relations that connect them to each other. The pair "process-structure" emphasizes the structure's dynamical character in agreement with process (vs. substance) metaphysics within which, however, a specifically triadic structure of a genuine sign is of prime importance. The dynamics inherent in this complementary relation purports to drive home the idea of the development, growth, and synthesis implying a "sense of learning" (Peirce CP 1.377) involved in the process, as well as being used in its mathematical sense (see below). The inferential process under discussion derives from Peirce's semiotics as the theory of signs that are broadly understood as both linguistic and extra-linguistic, such as images, icons or diagrams. Intentional content is an in-

stance of structure. This paper will demonstrate that for the structure to be functional—or to have meaning, in a pragmatic sense—it must include the Peircean “Firstness” as the logical category of abduction.

In the current philosophy of science discourse, abduction is usually taken in one sense only, as an inference to the best explanation; as such abduction remains the fundamental problem of contemporary epistemology (Hintikka 1998; Magnani 2001). This paper will posit abduction as open to interpretation in both logical and psychological terms. In brief, abduction is a type of inference aiming at the creation of new meanings, rather than plainly representing the old ones. First, I will introduce three basic ontological categories of Firstness, Secondness, and Thirdness, which Peirce considered to be the “conceptions of complexity” (Peirce CP 1. 526). The cardinal nature of these categories assures that Thirdness must include Firstness in itself. This means that abduction is an inferential mode representing the necessary condition without which it would be impossible for the mind to reason to its full capacity, intelligently. To illustrate this point I will offer a formal model of reasoning that incorporates Peircean categories.

The mathematical formalism is borrowed from Gauss who left us an ingenious interpretation of a complex number (Fig. 2). I will however expand on Gauss by suggesting that the modes of inference may be represented as vectors on a complex plane (Fig. 3). Because of the model’s triadic character, in its totality it represents a relation between preconceptual ideas and conceptual cognitive representations; together they constitute a dynamic production of meanings for experience. In this respect, abductive inference may acquire naturalistic interpretation: it cannot end (paraphrasing Hilary Putnam) just at the skin. Triadic process leads to establishing some stable structures in repeated experiences as the formation of habits. In fact, Thirdness as a category inscribed in the evolutionary, both developmental and learning, process is described by Peirce in terms of “the tendency to take habits” (Peirce CP 6.7).

I will conclude this paper by asserting that my model offers a solution to the paradox of new knowledge that appears to haunt us since Plato first articulated it in his *Meno* dialogue. While strictly speaking the paradox *per se* cannot be overcome, the very existence of what common sense considers a paradox is an ineliminable feature of triadic logic as semiotics: what seems to be a paradox is in fact the presence of abductive inference, as Peircean generic category of Firstness, within the Thirdness of the total cognitive process. As such, it is inherent in the semiotic thinking and is a precondition for the meaning production in the dynamics of learning and forming beliefs. Furthermore, abduction not only leads to experience and belief but it is itself informed by experience even if the informational input enters the process below the conscious level.

PEIRCE’S TRIADIC SEMIOTICS

The triadic nature of relations between signs leads to Peirce’s classifying signs in terms of basic relational categories of Firstness, Secondness and Thirdness: “First is the conception of being or existing independent of anything else. Second is the conception of

being relative to, the conception of reaction with, something else. Third is the conception of mediation, whereby first and second are brought into relation.... In psychology Feeling is First, Sense of reaction Second, General conception Third, or mediation. ... Chance is First, Law is Second, the tendency to take habits is Third. Mind is First, Matter is Second, Evolution is Third" (Peirce CP 6. 7). Firstness is quality, possibility, freedom. Secondness, as a relation of the First to the Second, is of opposites, physical reality, rigid deterministic laws, direct cause and effect physics-wise, or action and reaction, psychology-wise. Thirdness represents synthesis, communication, memory, or any mediation in general.

A sign can be anything that in some respect stands for something else, its object, and in such a relation so as to generate another sign called by Peirce an *interpretant*. For Peirce, the concepts literally take part in the reality of what is conceived, implying holism and a sense of auto-referentiality between the inner and outer realities. As a result of multiple interrelations, signs move from one to another and grow. Sheriff (1994, p. 35), elaborating on the notion of specifically Peircean sign, presents the process of how the *interpretant* of the sign in a triadic sign-object-interpretant relation becomes a *sign* in a subsequent triadic relation, and so forth, by means of the following graph (Fig. 1):

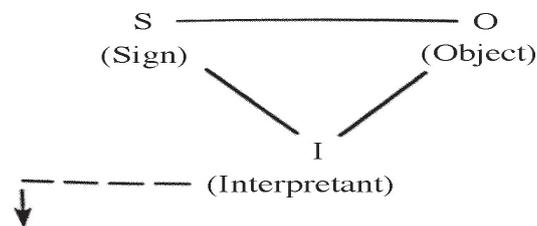


Fig. 1. A triadic relation

Every sign is subject to interpretation by the series of subsequent thought-signs, and the whole triad enveloping the "the relation-of-the-sign-to-its-object becomes the object of the new sign" (Sheriff 1994, p. 37). For Peirce, logic is a science of the necessary laws of thought. Logic is not a pure invention of logicians but is a *ratio* that always already exists in human praxis. Because thought always takes place by virtue of the action of signs, Peirce equated logic with semiotics therefore "treating not merely of truth, but also of the general conditions of signs being signs" (Peirce CP 1. 444); this general condition being a triadic, mediated, relation.

A perceptual judgment, for Peirce, is a rather involuntary operation of the mind based on quali-signification as a qualitative immediacy of experience. In psychological terms, such judgment would be based on insight, intuition or imagination, all the psychological categories traditionally left outside the boundaries of formal logic. Peirce's philosophy, as such, blends logic and psychology and allows for the pre-sensory and

preconscious, not limited to perceptual sense data, apprehension of reality upon which, despite it being necessarily vague, people are prepared to act. This level of perception constitutes the category of Firstness, that is, a precognitive category that Peirce called a quali-signification. Still, abduction is a mode of inference; therefore it has to have a logical form, such as: a surprising fact is observed; but if our hypothesis of this fact were true, then this fact would be a matter of course; therefore there is reason to suspect that our hypothesis is true. The immediate Firstness—a sort of premodern natural attraction—was, together with the Thirdness of mediation, left out as insignificant by the “pure reason” of modernity and substituted by the dualistic sin-signification and instrumental rationality based on conventional logic of *excluded* middle.

The presence of the Peircean *interpretant* as per Fig. 1, however, amounts to the logic of the *included* middle due to which the bare *facts* of experience become enriched with *meanings*. The category of meaning is absent in the conventional dyadic logic as the logic of identity that excludes an interpretant but proceeds directly from premise to conclusion without any symbolic mediation. Even when “the surprising fact ... is observed” (Peirce CP 5.185), the problematic situation includes something not fully present to the senses and beyond immediate comprehension, otherwise the fact would not have been surprising. The fact is perplexing, that is, it involves doubt, tension and conflict, because of the mind’s encounter with the world of objects as Seconds in the physical world of our actions and the often-times “reaction against my will” (Peirce CP 8. 144) due to the very intervention of brute facts as signs to be interpreted. Peirce described signs in categories represented by cardinal, and not simply ordinal, numbers like sequential first, second or third. By definition, Secondness contains one and two, so there is Firstness in Secondness, and there are three in the Thirdness so that Thirdness must always already contain the Firstness in itself.

An inquiring mind must make a first step toward apprehending the experience by means of abduction, or a peculiar logic of discovery. Despite being initially pre-conscious and necessarily vague, the abductive inference, according to Peirce, belongs to objective logic understood broadly as the “laws of thought, ... thought always taking place by means of signs” (Peirce CP 1.144). All thought is inferential, and the basic semiotic relation must be inferential, or illative. The formal, albeit vague, rule of abduction enables mind to reason from the premise to the conclusion; such an inference being described by the following statement: if A is B, and C can be signified by B, then maybe A is a sign of C. The interpretation is triggered by the Firstness of abduction, which is tending towards the perceptual judgment and is a hypothesis-bearing statement that asserts its conclusion only conjecturally; yet, according to Peirce (CP 5. 189); there is a reason to believe that the resulting judgment, under the circumstances, is true.

Peirce (CP 5. 184) was adamant that there exists no sharp line of demarcation between abduction and perceptual judgment: one shades into the other along the inferential process. The continuity thesis, advanced by Peirce, points to the fact that the level at which a perceptual judgment is being formed is pre-conscious: “because it is sub-conscious... [it] does not have to make separate acts of inference but performs its acts

in one continuous process” (Peirce 1998, p. 227). The given premise must entail some empirical consequences; the explication of the initial perception is achieved by analogical reasoning which unfolds into inferences to the would-be consequences of abductive conclusions eventually leading “to a result indefinitely approximating to the truth in the long run” (Peirce CP 2.781), asymptotically integrating into the synthetic inference in the process.

The epistemic process is viewed as a step away from the Cartesian theatre and one’s privileged access to propositions that mirror reality: Peirce transforms the notion of a static proposition that represents reality into the dynamics of interpreting reality and living it out experientially. Semiosis, as the action of signs, comprises relations between the object and the mind by virtue of a sign such that a sign is both affected by the object and is affecting the mind thereby producing an effect, as the sign’s interpretant, that creates the meaning for this particular sign. All signs have a tendency “to affect certain others which stand to them in a peculiar relation of affectability” (Peirce CP 6. 104).

The object of the relation does not have to have a solely physical existence: it may be a preceding sign, a thought, or even a dream. The abductive guess as a matter of the First borders on intuition, an intuitive knowledge traditionally being a synonym for immediate, or direct, knowledge. For Peirce, however, there is no direct or immediate knowledge: all cognition is signs-mediated. Perception turns inwards and directs itself towards the objects of conception by means of the Firstness of insight or intuition that constitutes some as yet pre-conceptual implicit content. The very etymology of the word confirms this: to *in-tuit* means to learn from within even though “the parish of percepts [is] ...out in the open” (Peirce CP 8. 144), in the experiential world. Peirce sometimes used abduction as interchangeable with retroduction, the term that appears to have emphasized the backward movement necessary for the intuitive learning from within albeit performing an abductive leap forward to the unknown; he gave a name *musement* to such abductive-like process.

Affirming the continuity of consciousness, Peirce stressed its temporal character. The inferential process of interpretation is a series of thought-signs, and the meaning of each thought becomes understood in each subsequent thought, creating a process of unlimited semiosis. No thought is ever instantaneous because it needs an inferential stretch for its own interpretation. Yet the immediacy of Firstness is always presented in an instant and, as Firstness, it is had by the mind prior to the Thirdness of mediation, making inference seem to border on association and guessing as if by-passing reason. Peirce stated that cognition exists only “in the relation of my states of mind at different instants.... In short, the Immediate (and therefore in itself unsusceptible of mediation—the Unanalyzable, the Inexplicable, the Unintellectual) runs in a continuous stream through our lives; it is the sum total of consciousness, whose mediation, which is the continuity of it, is brought about by a real effective force behind consciousness” (Peirce 1955, pp. 236-237), the apparent materiality of this force enabling the recursive process of re-presentation upon presentation.

Signs reiterate; they become signs of signs, or representations. As Peirce stated, “the

mode of being of a representamen [that is, a sign-vehicle, psychical or physical alike, which is semiotically connected with the ground, the object and the interpretant] is such that it is capable of repetition" (CP 5. 138, brackets mine) leading to the creation of definite patterns as habits. But because every meaning may become a precursor to a new interpretant, such repetition is never a strict reproduction of the same. Peirce distinguished between the immediate and the real objects, and one's intuition never proceeds from *tabula rasa* but is based on some previous, and as though given interpretation, which is that what constitutes the immediate object of the sign. The immediate object may or may not represent the real one, however the latter does not have to be unknowable: "over against all cognition, there is an unknown but knowable reality" (Peirce CP 5. 257), which needs a series of interpretants to ultimately manifest in our understanding. Reality itself, for Peirce, is a quasi-utterer of signs understood as potentially interpretable phenomena; a human utterer is in fact an intermediary that the greater reality speaks through. The chain of interpretants constitutes a semiotic or communicative process, and the semiotic communication by means of signs is taken broadly and not limited to linguistic signs or speech acts.

Because "consistency belongs to every sign ... the man-sign acquires information and comes to mean more than he did before" (Peirce 1955: 249): we as "man-signs" can learn from our experiences because of the growth in meanings therefore contributing to our own evolution. The value of knowledge is in its practical import, that is, the way we, as "man-signs" will act, think, and feel thus discovering the dimension of meaning in our very experience that exceeds our factual knowledge. The meaning and essence of every conception depends, in a pragmatic sense, on the way the latter is being used: it "lies in the application that is to be made of it" (Peirce CP 5. 532): Peirce's pragmatic maxim presupposes the discovery of meanings notwithstanding their being *in futuro* as possible effects. What serves as the criterion for meaning is the production of real practical effects: "Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then our conception of these effects is the whole of our conception of the object" (Peirce CP 5. 402).

Everything is a sign: the whole universe, for Peirce, is perfused with signs; yet "nothing is a sign unless it is interpreted as a sign" (Peirce CP 2. 308) by means of triadic relations leading to each successive sign becoming an interpretant for the preceding one. What seems to be a paradoxical statement is derived from the nature of the pragmatic method itself. Abduction does seem to function instantaneously not because there is no temporal interval of inference, but because the mind remains unaware (at the level of consciousness) of when it begins or ends. Yes, this abductive implicit "content" (a contradiction in terms within conventional logic) is amenable to a clear insight, therefore potentially becoming conscious. The total dynamics of sign-process still presupposes its ties to consciousness thereby (and in agreement with Searle 1994; cf. Kihlstrom 1993) fulfilling the condition of genuine intentionality or "aboutness".

The abductive suggestion "comes to us as a flash. It is an act of *insight*" (Peirce CP 5. 181) which is fallible but still has a mysterious power "of guessing right" (Peirce CP

6. 530) even while being pre-conscious and not rationally controllable. At the psychological level, this unconscious inference functioning abductively as insight borders on intuition. Intuition presents the content, which is indeed *about* something, although this *something* constitutes knowledge that at the level of Firstness is as yet tacit and implicit, as if as yet *nothing*. With a stroke of genius, Peirce appears to quote Shakespeare referring to the ontological possibilities for abduction as “airy nothings to which the mind of a poet, pure mathematician, or another might give local habitation and a name within that mind” (Peirce CP 6. 455).

Intuition, never mind a province of poets or inventive mathematicians, still means cognition even if determined by the object *outside* one’s personal (Cartesian) *Cogito*. It is such by virtue of it being a part of reason as the Firstness of Thirdness. To reiterate, the cardinality of Peircean categories ensures that Thirdness always already includes Firstness in itself. Peirce considered consciousness to be a vague term but asserted its significance emphasizing that “if it is to mean Thought it is more without us than within. It is we that are in it, rather than it in any of us” (CP 8. 256). For Peirce, consciousness is not reduced to a rational thought but comprises quasi-immediate feelings, which are not by themselves capable of representation but need to be integrated into Thirdness that functions as “a synonym for representation” (Peirce CP 5. 105). While staying in the mode of Firstness, however, it (consciousness) simply presents itself to us.

Describing the structure of perceptual abduction, Peirce noted: “the first premise is not actually thought, though it is in the mind habitually. This, of itself would not make the inference unconscious. But it is so because it is not recognized as an inference; the conclusion is accepted without our knowing how” (Peirce CP 8. 64-65). The result of abductive inference is the guess proffered or the hypothesis drawn. If reasoning from premises to conclusion is considered to be either deductive, or inductive, or fallacious, then an abductive guess understood as an inference to the best explanation, that expresses merely some likelihood in reasoning, would seem to represent a fallacious kind, indeed. In the Peircean logic, however, abduction suggests that something *might* possibly be the case (Peirce CP 5. 171).

For Peirce, what is real cannot be in any way reduced to the actual, in fact “the will-be’s, the actually-is’s and the have-been’s are not the sum of the real. They only cover actuality. There are besides would be’s and can be’s that are real” (Peirce CP 8. 216), such *would-be-ness* constituting the realm of the virtual, however still semiotically *real*, world. The semiotically real world includes possibilities “articulated” by means of abduction. At the ontological level, Firstness as a mode of being is possibility, Secondness—actuality, that is, our physical existence, and Thirdness—potentiality. But—and importantly—because thoughts as the signs in the category of Thirdness must include Firstness as qualities and Secondness as facts, the ontological and experiential levels interpenetrate: the *potentia* of Thirdness is what connects the possible with the actual.

By the same token, although Peirce assessed meanings as “altogether virtual ... [because located] not in what is actually thought, but in what this thought may be connected with in representation by subsequent thoughts” (Peirce CP 5. 289), as if in *futuro*,

they are still maximally real due to their ability to produce real effects in terms of consequences, or “practical bearings” (Peirce CP 5. 402) in accord with Peirce’s pragmatic maxim. The realm of the virtual constitutes “Reality which by some means contrives to determine the Sign to its Representation” (Peirce CP 4. 536), and it is because of the dynamic structure of the sign-process as semiosis that the meaning assumes the form of a relatively stable pattern—or habit—which can be generated, sustained and modified in experience. Since semiosis is always a relational process comprising three categories, it effectively eliminates the dichotomy between subject and object and enriches the notion of interpretation “as more a matter of relation between signs than between signs and [substantial] things” (Merrell 1995, p. 45; brackets mine).

The mind itself is part of nature by virtue of the Thirdness of the evolutionary process, the continuity of which as Peirce’s *synechism* is irreducible to materialism or idealism alike. The relation between the mind and the natural world defies Cartesian dualism but is thoroughly semiotic: because matter is effete mind (cf. Santaella 2001), mind as Firstness has to be entrenched in habits as Thirdness so as to congeal, according to Peirce, into matter as Secondness. Peirce refused to “conceive of the psychical and the physical aspect of matter as two aspects absolutely distinct” (Peirce CP 6. 268). Peircean holism implies the coordination between the two different aspects of one total semiotic process (cf. Rescher 1996). Matter is mind, whose habits however became so fixed and rigid that there is no way for the “mind” in question either to take a new habit or break an old one. Habit-taking as an evolutionary learning process—the cardinal Thirdness—exists only providing it includes the Firstness in itself, in a form of chance, feeling, creativity, novelty or freedom as a necessary condition of its own dynamics.

Importantly, the role of interpretant is efficacious only if the content of mental representation “can make a difference to either the internal states or [external] behavior... in ways that depend on the content” (Von Eckardt 1996, p. 281) of this very representation¹. The obvious problem of the infinite regress in the supposedly endless chain of interpretants can be avoided precisely because of the possibility taking new habits that Peirce expresses in terms of “modification of a person’s tendencies toward action” (Peirce CP 5. 476). New meanings are capable of abruptly interrupting the semiotic regress therefore effectuating the modification of habits. For Peirce, the meaning of anything lies in the “habits it involves” (Peirce CP 5. 4). The final interpretant of a certain mental representation would be a physical change at the *metalevel* of action in our very experience, which thereby halts the supposedly infinite regress.

The triadic model of inference enables one to become consciously aware of one’s own habits that subsist below the level of consciousness even if the first stimulus borders on subliminal perception that reaches us via abduction: it is semiosis as the action of signs that can make the unconscious conscious. The continuity of inference, even

1. See Chapter 8 in Von Eckardt (1996) for the detailed analysis of Peirce’s views with regard to contemporary cognitive science. See also Fetzer (1991) who proposed a semiotic theory of mind as early as 1988. Fetzer asserts that “the most striking feature of Peirce’s theory of signs is that it suggests a corresponding theory of mind, according to which *minds* are sign-using (or “semiotic”) systems” (1991, p. 65).

if only in a probabilistic sense, defies the idea of some unknowable thing-in-itself, the latter being only hypothetical like any other First and can be ultimately known as a sign, a genuine Third, after being “present to me” (Peirce CP 5. 289). It is the dynamic Thirdness that governs Secondness causing the formation of beliefs and concepts: it determines the objects of knowledge because it is Thirdness in its interpretive capacity of performing a mediating function that creates or “brings information... [it] determines the idea and gives it body” (Peirce CP 1. 537) in the physical world for “man is nature’s interpreter” (Peirce CP 7. 54).

According to Peirce’s logic (or grammar), the triadic relation is what establishes *speculum*, that is, the eventual correspondence between the signs and their objects, the latter also signs if and when interpreted (see Fig. 1). The self-referential closure of a genuine sign seemingly establishes identity—but with a difference—such as the difference existing, as posited by Peirce, between a sign’s immediate and real objects. It is the Thirdness of interpretation that completes the auto-referential relation therefore creating the meaning for a sign’s object. The interpretant represents the paradoxical “future memory” (Peirce CP 7. 591) hinted to by an initial abductive guess. It not only can create “in the mind of a person an equivalent sign [but] ...a more developed sign” (Peirce CP 2. 228) because of a new meaning as a conceptual (conscious) content: signs grow, develop and become other signs. Any object of experience contains potentialities as virtual meanings, which are not yet actualised or explicit. Due to the infinite stream of interpretants, a total number of possible meanings can never be exhausted, and a thought that has passed from doubt to belief is a sign of signs, or representation. The dyadic relation alone would not lead to the creation of meanings: a sign, “in order to fulfil its office, to actualise its potency, must be compelled by its object” (Peirce CP 5.554) therefore it strives to abductively leap from the unconscious (as First) into being integrated into consciousness (as Third).

The unconscious ideas constitute a psychological ground for habits: Peirce’s “general idea ...is already determinative of acts in the future to an extent to which it is not now conscious” (CP 6. 156). He used the terms *ampliative* and *explicative* to differentiate between the modes of reasoning that aim not only at plainly increasing the background knowledge but, by contrast, at making hidden or implicit knowledge explicit, at making manifest what is as yet latent and “located” at the level of pre-conceptual unconscious “contents”. The new concepts are never completely determined: they are born from the qualitative Firsts of intuition and insight and always contain a subtle feeling, which is present as the Firstness of abduction in the Thirdness of reason. In the absence of Thirdness this fleeting feeling is simply “first, present, immediate, fresh, new, initiative, original, spontaneous, free ... Only, remember that every description of it must be false to it” (Peirce CP 1. 357). This apparent “falseness” or vagueness is due to abductive precognitive reasoning that constitutes “sensations so faint” (Peirce and Jastrow 1884, quoted in Hacking 1990, p. 205) so as to seemingly bypass the level of cognitive awareness.

Still, the practical bearings of some possible precognitive reasoning are not to be ignored. Peirce emphasized the feeling-tone of abduction saying that every abductive

inference involves a particular emotion: “the various sounds made by the instruments in the orchestra strike upon the ear, and the result is a peculiar musical emotion... This emotion is essentially the same thing as a hypothetic [that is, abductive] inference” (Peirce CP 2. 643; brackets mine)². It is quite difficult to account for rational conclusions based on such vague sensations, emotions, faint first impressions, or subtle affects. In a characteristic language, Peirce and Jastrow commented that the “insight of females as well as certain ‘telepathic’ phenomena may be explained in this way. Such faint sensations ought to be fully studied by the psychologist and assiduously cultivated by every man” (in Hacking 1999, p. 206).

A DIAGRAM OF REASONING

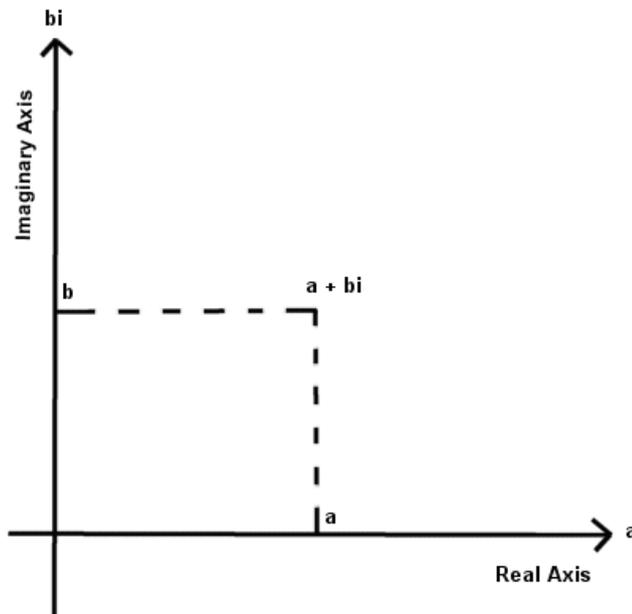
Let us move closer to studying abduction never mind it bordering on a faint and fleeting emotion. Peirce asserted that all logical relations, and accordingly the process of semiosis, could be studied by means of being displayed in the form of existential graphs, or iconic representations; such diagrammatic reasoning may yield solutions to the otherwise unsolvable logical problems. A diagram is an icon in Peircean categorization, and because icons are described in term of structural properties common with their referents, the diagrammatic reasoning is especially advantageous in semiotics represented by the logic of relations, as well as bringing out experimental and exploratory character of reasoning (Greaves 2002).

Unlike the sentential dyadic reasoning, an abstract diagram is open to the Thirdness of interpretation thereby creating meaning, which is implicit in its very structure. Peirce emphasized the role of diagrammatic reasoning saying that “passing from one diagram to the other, the [reasoner]... will be supposed to see something... that is of a general nature” (Peirce CP 5.148), hence contributing to making one’s ideas clear. The purpose of such a diagrammatic mode of expression was to depict the dynamical character of thought-process.

In this section I suggest a model of abductive inference based on Peirce’s triadic structure of the sign. The spatial representation of the structure is a grid, although non-Cartesian: the two coordinate axes are located on a Gauss (or Argand) plane and marked with imaginary, on a vertical axis, and real on a horizontal axis, numbers respectively.

An imaginary number i is defined as the square root of minus one. Descartes had a rather derogatory attitude towards imaginaries: it was he who first coined the name. There was no place for them in Newton’s mechanistic philosophy either: he considered them plainly impossible. Leibniz recognized their intermediary character and positioned them at the ontological level between being and not being. The true metaphysics of imaginary number was elusive even for Gauss, who however agreed that their geometrical or diagrammatic representation establishes their meaning.

2. Cf. Oatley and Johnson-Laird (1987) who proposed a cognitive theory of emotions as abductions.



Imaginary and real numbers together form a plane, on which a point represents a complex number $a+bi$. The point therefore stands for the pair, a of the real numbers and b of the imaginary numbers (Fig. 2).

Fig. 2. The Complex Plane

Abduction's place would be on the vertical axis: because it is an act of insight, an intuitive leap, a jump in imagination, an imaginary number i , I suggest, serves as the appropriate symbol to signify the Firstness of abduction especially considering its indeterminate and elusive character. The level of Secondness is marked along the horizontal axis by means of real numbers, in the actuality of our physical world of action that also includes our linguistic behaviour. The analytical representation of direction is also possible, by means of a vector: the two vectors along the horizontal and vertical axes "add up", geometrically, to a resultant vector r on a complex plane represented by an arrow from the origin to the point $a+bi$ (Fig. 3).

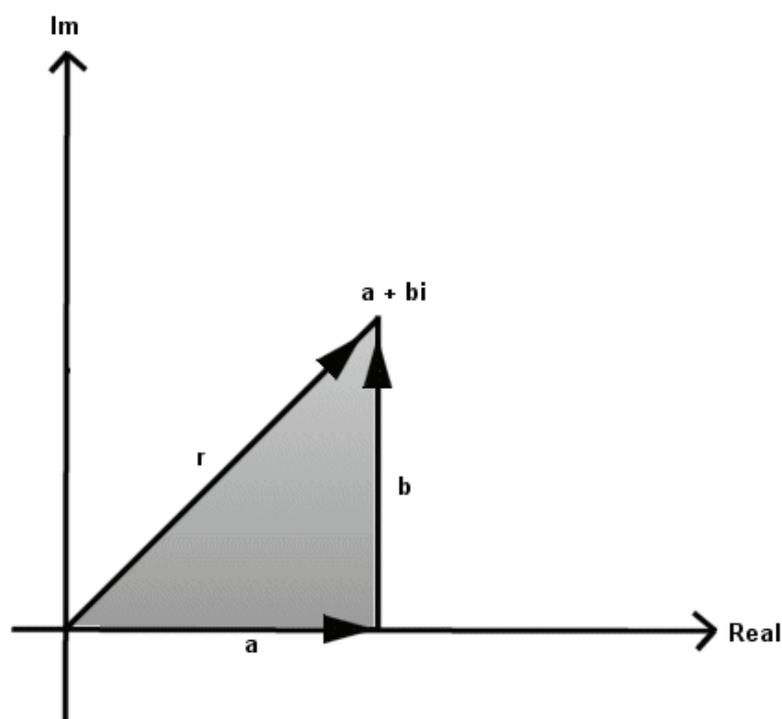


Fig. 3. The resultant vector

So in this model, the formal deductive reasoning is complemented by imagination, insight or intuition, such logic being represented by means of complex numbers as the ordered pair on a complex plane. A vector, by definition, has both magnitude and direction, that is, it can be described in principle both by a mathematical quantity and a physical property. A vectorial diagram, therefore, represents the dynamics—or process—inherent in abstract structure: it is an organizational pattern or a process-structure reflecting Peirce's process ontology.

The resultant vector may be considered to represent evolution in meaning as different from the strictly *a priori* knowledge, because abduction contributes to explicating and amplifying that what was yet tacit and implicit. But also—and this is crucial—by virtue of itself enabling a transition from the level of real numbers onto the succeeding level of numbers on the complex plane, it therefore contributes to the *complication* of knowledge, to a new—more complex—meaning. In Peirce's evolutionary philosophy (cf. Hausman 1997) the semiotic categories of Firstness, Secondness and Thirdness are presented as the “conceptions of complexity” (Peirce CP 1. 526). Sure enough, the addition vector as a *whole* is greater than the arithmetical sum of its parts, making the mind as a whole greater than its Cartesian *cogito*.

Without the Firstness of abduction, all knowledge would remain pretty sequential,

because signs would stay at the level of Secondness, perhaps growing in magnitude solely because of arithmetical progression along the horizontal axis but not being able to change their direction. Yes, some prior knowledge would be amplified, but the genuine emergence of novelty is precluded because the tacit and preconscious, implicit and pre-conceptual knowledge would lack any possibility of explication so as to enable the new knowledge, represented now as a vector on a complex plane, and with a definite direction, determined by both horizontal and vertical evolutions and pointed to by the end of the arrow, to enter cognition.

It is the Thirdness as a diagonal transversal line that enables the coming into being of new meanings, for us, as the newly created concepts. If we imagine positioning ourselves in the midst of this resultant line, there are two perspectives that may emerge. Peirce articulated the similar idea in the anti-dualist terms: “Viewing a thing from the outside, considering its relations of action and reaction with other things, it appears as matter. Viewing it from the inside, looking at its immediate character as feeling, it appears as consciousness” (Peirce CP 6. 268). Respectively, we may view the resultant vector as embodying two dimensions simultaneously, external *and* internal, therefore representing the dynamics inscribed in the indiscernible succession of mental states³. The complex number $a+bi$ pointed to by the arrow of the vector represents a single synchronic slice of the total diachronic evolution, or a quasi-determinate content constituted by both internal and external features. In this respect, the diagram on Fig. 3 addresses knowledge representation of the mind in its active *interaction* with the world, thereby moving us a step closer to solving one of the fundamental problems in the philosophy of mind, namely: what is the relation between the mind and the world (or intentionality-with-a-t; see Guttenplan 1994).

We remember that, for Peirce, the object to which a sign refers may not have a solely physical existence but may very well be a thought, a dream or a totally imaginary entity; ditto for the interpretant whose being in *futuro*, as a non-manifest goal, “will suffice” (Peirce CP 2. 92). The abduction as a quasi-instantaneous action is informed (the Latin *informare* literally means giving material form) by the instance of the real, here-and-now experience, and the magnitude along the vertical axis of imaginary numbers would inadvertently affect the direction the diagonal resultant vector would have taken. A novel hypothesis might literally as we can see in the Figures 2 and 3, bring a new direction into the line of reasoning, and the semiotic categories of Firstness and Thirdness, the two categories outside the formal logic, functioning only on the margins the latter, are capable of constructing the new level of knowledge brought into being at the different level of complexity. Abduction (or intuition, or imagination, or insight, in mentalistic terms) creates a magnitude along the vertical axis, the logical *depth*, that is, an intuitive leap towards the different level of order in the complex knowledge-system⁴.

3. Seager (1999) suggests an analogous approach for addressing the internalist-externalist debate in the philosophy of mind.

4. The term “logical depth” has been elaborated in Hoffmeyer (1993). The information theory defines a message’s logical depth as the expression of its meaning, its worth or value. Hoffmeyer labels such logical

Peirce's semiotics reflects novelty that alone provides "*uberty* or richness of thought" (Deely 2001, p. 627) contained in the Firstness that carries the level of reality over and above the customary mechanistic Secondness usually considered as constituting "the whole truth about existence" (Deely 2001, p. 627). For Peirce, signs always move from one to another; they grow and engender other signs because the triadic logic leads to signs always becoming something more and something else exemplifying the notion of learning from experience as a necessary condition for the evolution of signs.

Peirce's *genuine* doubt is not a personal doubt of the Cartesian subject but has an external, indeed beyond the skin, origin by virtue of a surprising, anomalous or perplexing instance: it is an objective uncertainty constituted by implicit tension or difference between the present experience, or the current level of knowledge, and the whole of the organism-environment system⁵. The diagrammatic representation expressed in the Figures 2 and 3 is conceptualised on the premise of what Peirce called "a portraiture of Thought" (Peirce CP 4. 11). As such, it conforms to the semiotic categories of representation, relationality and mediation and appears to be capable, albeit in a static format, of "rendering literally visible before one's very eyes the operation of thinking *in actu*" (Peirce CP 4. 571), or demonstrating the very dynamics of the inferential process⁶.

The field of the complex numbers is undifferentiated and would appear to be, in Peirce words, "what the world was to Adam on the day he opened his eyes to it, before he had drawn any distinctions, or had become conscious of his own experience" (Peirce CP 1.302). The complex plane as a whole contains what Peirce would have called *an admixture* or, in other words, the weighted sum (cf. Penrose 1997; Seager 1999) of real and imaginary components, *a* and *bi*. Peircean holism anticipated a peculiar parts-as-always-parts-of-the-whole system's organization, which conceptualises all causal relations as if flowing in two directions at once, bottom-up and top-down, thereby creating a seemingly strange feedback loop.

The triangle as per Fig. 3 thereby represents an auto-referential process-structure feeding back on itself (that would have supported the connectionist challenge to the classical internalist approach; see note 6), which demands an admixture of mind-dependent and mind-independent relations that, due to the triadic nature of the sign, are ultimately supposed to solve the problem of intelligibility and understanding. The field Adam has awakened to is Williams James' famous *blooming, buzzing confusion*, indeed the weighted sum of "dream and reality, possibility and actuality" (Deely 2001, p. 645), of both mind-

depth "a semiotic freedom" (1993, p. 66). In Peircean terms, freedom is manifest in the Firstness, the logic of creative abduction.

5. Deely (2001) expresses the same idea in the following way: "Modern philosophy began with the universal doubt whereby Descartes had made being a function of his thinking. Pragmaticism [Peircean pragmatism] begins rather from a belief in the reality of what is more than thought, and proceeds by continually putting to test the contrast between thought and what is more than thought, between merely objective being and objective being which reveals also something of the physical universe" (Deely 2001, p. 627; brackets mine).

6. In the philosophy of mind, Smolensky (1988, 1991) suggests the connectionist network model in which the real medium of cognition is an "intuitive processor"; mental representations are expressed by vectors, and mental processes are described by differential equations.

dependent and mind-independent relations that comprise human experience.

To think means to differentiate and the degrees of differentiation can be expressed diagrammatically via spatial projection enabling, by means of the laws of projective geometry, also the reduction of dimensions of this initially undifferentiated field constituted by complex numbers. Our sense-perception presents us solely with top-down projections of real signs “residing” in the complex world: the horizontal axis is only one, visible, aspect of the intelligible Ideas as shadow-projections on the walls of Platonic Cave. Yet the construction of meanings does take place by virtue of sign-mediation via a series of *interpretants* (Fig. 1); and it is the complex plane (Figs. 2 and 3) that serves as the locus for the creation of meanings enacted by projection—or, rather, re-injection—which is constituted by a re-directed, bottom-up, abductive or intuitive, leap. In other words, it is the semiotic exchange between the human mind and the natural world that enables the sign’s potential relation to itself as a condition for its ultimate intelligibility. Signs are Janus-like, relational, entities; they “reside” in-between the realms that, in the absence of semiosis, would have remained the rigid binary opposites of Cartesian *res extensa* and *res cogitans*; yet signs partake on both.

CONCLUSION: CAN WE RESOLVE THE PARADOX OF NEW KNOWLEDGE?

Let us recall Plato’s *Meno* dialogue and the famous *ens primum cognitum* later formulated by Aquinas, or the problem of being as first known. Meno is puzzled by what Socrates means when he provocatively says that there cannot be any new knowledge and that what is called learning is pretty much a process of recollection. Plato states the famous paradox in the following way:

Men. And how will you inquire, Socrates, into that which you know not? What will you put forth as the subject of inquiry? And if you find what you want, how will you ever know that this is what you did not know?

Soc. I know, Meno, what you mean; but just see what a tiresome dispute you are introducing. You argue that a man can not inquire either about that which he knows, or about that which he does not know; for he knows, and therefore has no need to inquire about that—nor about that which he does not know; for he does not know that about which he is to inquire.⁷

Are we facing an absurdity because either one knows *a priori* what is it that s/he is looking for, or one does not know what s/he is looking for and therefore cannot have prior expectations of finding anything? According to Plato, the theory of recollection demands that we always already possess all the knowledge unconsciously and simply recognize the given truths. Recognize? Not exactly, even if the slave boy in the *Meno* dialogue indeed has some kind of “tacit precognition” (Magnani 2001, p. 13). If any new knowledge is incompatible with prior learning—the latter is fact being a precondition

7. *The Essential Plato* (1999). Introduction by Alain De Botton. Translated by Benjamin Jowett. Book-of-the-Month Club, Inc., p. 442.

for the understanding of what is new—then it appears that there is no foundation on which to build such a new knowledge. An encounter with the experiential world breaks in.

It is our life, our experience from which we continuously learn due to the function of signs that creates such a dynamic and always evolving, unorthodox, “foundation” in our very existence. According to Peirce, the new knowledge is conceptualised because of the logic of discovery exemplified in the Firstness of abduction. For the cognitive function so as to fulfil its purpose it must have a triadic structure as a necessary condition of this very fulfilment. Specifically, for the cognitive function of us, biological beings, to function properly in the physical world means to comprise all three Peircean categories, that is, to reason (Thirdness) *intelligently* as *both* analytically (Secondness) *and* also insightfully or intuitively (Firstness). This is logic as an ethics of thinking (see Deely 2001, p. 622) which for Peirce is inseparable from human action, that is, an ethics of doing.

The sign, if reduced to Secondness only, is what Peirce would call de-generate—but only as genuine or triadic, the sign would amount to the Thirdness of “synthetic consciousness, ...sense of learning” (Peirce CP 1.377). Abduction is a necessary condition for production of meanings, as without the Firstness of insight or abduction no triadic structure, as an auto-referential loop, would have been formed. Albeit being a necessary condition for the production of meanings and yielding new information, abduction by itself is insufficient and cannot be the sole means to new knowledge: all three forms of inference are necessary.

If abduction was the only reason behind the total cognitive process, no new knowledge or any conceptual change would have occurred because a leap of imagination, a First fleeting feeling, or a glimpse of intuition—if such indeed were to take place—would return back to the point of its own departure without becoming a *sign* of immediate Firstness and without having been able to become conscious via mediation or interpretation as the Thirdness of Firstness. It would not make any difference to the representational content because, to repeat, nothing would appear as “present to me” (Peirce CP 5. 289) in the first place. So it would not seem as if there is anything for us to interpret and, respectively, to make a difference in the world of action, to create novel meanings. The triadic indecomposable structure is a precondition for representations. The abductive guess initiating the mediation of the present experience brings in novel meanings and, rather than simply eliciting our adaptation to the environment, affects and transforms the total organism-in-the-environment situation as a whole.

The Firstness of abduction is as yet a pre-conscious presentation; nevertheless it functions, as Peirce used to say, as a real force behind consciousness. As a powerful and quite possibly real material force because of its vectorial quality, it reaches the representation in consciousness at the level of Secondness, along the horizontal axis of real numbers (Fig. 3). It will surely have a different magnitude: using a trivial example, pain is directly had, but may be interpreted as a toothache or as an effect of being burned and hence judged to be a specific meaningful singular experience. The diagonal resultant vector casts its own shadow on the horizontal axis emerging as though from nowhere

because its end-point $a+bi$ exists at the level of complexity exceeding the realm of real numbers.

The effect of abduction is enabled by the “inward [or] *potential* actions...which somehow influence the formation of habits” (Peirce CP 6. 286) precisely because these actions were initiated due to the structural loop, and the circularity of Thirdness provides conditions for the flight of abductive inference because of the subtle meaningfulness implicit in the experience. This inward direction creates an internal dimension, the logical depth of meaning, as a necessary outcome within the process of semiosis. We never have a total *tabula rasa*, and the natural world is not limited to its solely mechanical aspect—just like human conscious experience is irreducible to unmediated action and reaction solely. Thirdness enters the process as mediation and learning, it takes time and self-reflection; it enables response to meanings rather than to direct physical stimuli, and meaning, in pragmatism, is “that form in which the proposition becomes applicable to human conduct” (Peirce CP 5. 425), to our very actions and experiences.

Nature is broader than its solely physical, Newtonian, aspect and includes its own virtual dimension, which is however never beyond experience. The creation of meanings for and within human experience is possible because of it being not separate from, but continuous with, the natural world. Peirce’s holistic logic as triadic semiotics that includes abduction as part-of-the-whole is necessary for interpreting, evaluating and understanding such an experience. In semiotic terms human experience itself is a relational category: it is also a sign that necessarily mediates between the mind and the world. Structured by sign-relations, human experience then is to be understood as the expression of a deeper semiotic process. Because every sign conveys a general nature of thought, and the Thirdness is ultimately a mode of being of intelligence or reason, the generality does come about from a quasi-mind comprising what Peirce called a repository of ideas or significant forms that apparently subsist in the “virtual reality” of Platonic realm.

If there were no abductive inference, then no new knowledge would ever come into being because there would not be any pre-conceptual Firstness, therefore no Thirdness either: the cardinality of Thirdness by definition must include Firstness in itself. And because Thirdness does govern Secondness by bringing information, it sure enough determines an idea and “gives it body” (Peirce CP 1. 537), that is, it *embodies* immaterial ideas in the physical, material, world therefore contributing to the objects of knowledge, as seconds, appearing to consciousness. Otherwise no concepts, beliefs, or the full-bodied *doxa* would have been formed. To Peirce, all the regularities in *both* the nature *and* the mind are regarded as products of growth, evolution and learning from experience, so that the mind expands because of the new meanings being communicated. The Thirdness is ultimately a mode of being of intelligence or reason. In this respect a semiotic triangle in Fig.3 also closes the Platonic gap between the realms of the sensible and the intelligible.

Firstness, by definition, does not refer to anything else. We remember Peirce having said that abduction bypasses our awareness and the mind remains unaware of when

and where abduction begins and ends. Something “fresh and new” (Peirce CP 1. 357) has to be perceived—but not only seen, heard, or touched as tangible Secondness. It will have to be also felt or intuited, as Firstness, in order to make a difference so as to create its integration into reflective, auto-referential reasoning; to construct an integral, holistic, thought. Without Firstness, Secondness *per se* is impossible, as both are cardinal categories—but this Peircean, semiotic, finesse is being generally ignored. So is Thirdness that by virtue of itself governing Secondness contributes to learning and creates the necessary mediation of immediacy. Therefore it completes the triadic structure, which properly provides the signs with their meanings.

The semiotic triangle simply must close on itself because a complete integral thought demands the elaboration of an initial abductive guess to its logical conclusions with respect to the original surprising fact. As John Dewey, himself a Peirce’s student, was saying, “an integral act of thought requires that the person making the suggestion (the guess) be responsible also for reasoning out its bearings upon the problem in hand” (Dewey 1991, p. 98), in the world of action. The triangle in Fig. 3 is such an *integral*, a closed *area* on the plane informed by some original surprising fact having initiated this guess in the first place by virtue of itself being an “immediate element of experience, generalized to its utmost” (Peirce CP 7. 365) even if non-conscious and barely perceived. Because the growth of reason consists “in embodiment, that is, in manifestation” (Peirce CP 1. 615), in this informative or semiotic process the sensible world becomes intelligible while in the meantime affording sensibility to the intelligible world theorised yet by Plato.

University of Newcastle Australia
inna.semetsky@newcastle.edu.au

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