Abstract ID: 536

Abstract category: C1. Philosophy of the Formal Sciences (incl. Logic, Mathematics, Statistics, Computer Science)

Presentation type(s): Contributed symposia

**Tracking the Diagrammatic Turn in Recent Philosophy of Notation**

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**TRACKING THE DIAGRAMMATIC TURN IN RECENT PHILOSOPHY OF NOTATION:** Symbols represent by codes like conventions, whereas icons represent by similarity (Couturat 1901; Dascal 1978; Gensini 1991; Serfati 2001). Until recently, much of the literature in philosophy of notation tended to follow Leibniz in assuming that we always or most often think in symbols. However, current debates have increasingly been driven by the recognition that any system of representation depends, to some extent, on iconicity, such that the purported line of demarcation is rather a continuum (Stjernfelt 2014). This slow but resolute turn toward iconic signs has begun to change how we see logic. With different emphases, linguists (Simone 1995; Van Langendonck 2007), logicians (Burch 1991; Shin 1994, 2002; Hammer 1995; Allein & Barwise 1996; Pietarinen 2006, 2010, 2011, 2012), historians of mathematics (Nets 2004; Mancosu, Jorgensen & Pedersen 2005; Giaquinto 2007), semioticians (Stjernfelt 2007, 2014; Bordron 2011; Dondero & Fontanille 2012), philosophers of mind (Champagne 2014) and cognitive scientists (Glasgow, Nara Y. Anan & Chandrasekaran 1995; Hoffmann 2010a, 2010b, 2011; Magnani 2011; Nakatsu 2010) have all recognized that a better understanding of reasoning by icons, specifically diagrams, is crucial to understanding problem-solving, inference-drawing, and hypothesis-making.

Arguably, no one has explored the potential of iconic notations more systematically than C. S. Peirce. It is commonly believed that the birth of new formal logic(s) by Frege (1884), Russell (1903) and Couturat (1904) rendered Kant’s appeal to intuition redundant (cf. Kneale & Kneale 1962, VII-VIII; Coffa 1991; Carson & Huber 2006). However, an alternate line of development is clearly discernable in the work of Peirce. For Peirce, the notion of intuition is by no means redundant, being instead the faculty which allows necessary reasoning to yield informative truths (Peirce 1931-1958; Peirce 2010; cf. Hintikka 1980; Hookway 1985; Ketner 1985; Shin 1997; Pietarinen 2006; Stjernfelt 2007; Bellucci 2012). The diagram, in this Peircean paradigm, transforms intuition into a visual commodity amenable to careful public scrutiny. Indeed, one of the most striking features of Peirce’s diagrammatic notation is its depiction of inferences as transformations. Inference rules, being answerable to the self-same nature of images, are motivated in a way that makes them less rule-like. For example, enclosures, a common device used by Peirce, place distinct limits on what counts as included/inside, excluded/outside, or both. One can attempt to transgress these limits, but the iconic sign-vehicles at hand simply repel erroneous interpretations. While Venn exploited this to prove categorical syllogisms, Peirce shows how to generalize the method, thereby giving a novel justification for the normative force of logic. Peirce’s unpublished technical work in logic has thus far influenced debates mainly through the intermediary of specialists (Shin 2002; Sowa 2011), but the upcoming publication of Peirce’s full Existential Graphs (Logic of the Future, edited by A.-V. Pietarinen) promises to augment this rate of influence, by making available a 1000-page buffet of diagrammatic and iconic logical systems. Participants to this symposium are thus invited to reflect on how Peirce-inspired diagrammatic approaches to notation can positively reshape issues pertaining to logic, cognition, and reason-giving practices generally.

**PAPER 1 (of 4) - PHILOSOPHY OF NOTATION IN LOGIC OF THE FUTURE:** Peirce’s graphical systems of logic, especially his method of Existential Graphs, still harbour a number of mysteries, including, in the first place, their invention, development and the precise form and meaning. Peirce’s 5000-odd pages of writings on Existential Graphs have, until now, largely remained unpublished. Roberts (1973) stands as the lone unfailing guide to Peirce’s numerous logical systems and to his diagrammatic thought. And even when something relevant has been published, the presentation of Peirce’s arguments that crucially depend on getting the diagrammatic notations exactly right were either cut short by altogether omitting those sequences that deal with the graphs, or else those presentations managed to distort Peirce’s original intentions in overlooking the subtle logical, notational, typographical, chromatic and other design features involved in them. But it is precisely such features that we find him attenuating to when he was scribing the graphs and when he was designing what at first sight might look like new logical symbols and meaning by conventions of interpretation, although in reality they he meant these notations to serve, at least predominantly, the role of logical icons and meaning by resemblance. Peirce’s reason for his insistence on such delicate notational features of icons was not only to maximize visual accuracy, readability, cognitive economy or pedagogical virtue of the resulting systems. The deeper reason was to develop new methods for logical analysis that would be superior to other methods.
Notation indeed contributes to analyticity. In this talk, I present some selected examples from the book that are representative of these deeper aims and what at the same time concern some decisive issues that have to do with getting the diagrammatic notations exactly right whenever reproducing, interpreting and improving upon Peirce’s philosophical and logical thought.

PAPER 2 (of 4) - CONVENTION AND RESEMBLANCE IN DIAGRAMMATIC PROOFS: Since he stated that diagrams should be “as iconic as possible,” it seems fair to assume that Peirce favoured resemblance as a notational mode which is more effective, in some sense, than convention. However, his own logical diagrams frequently rely on features which are predominately symbolic. On the other hand, Euler diagrams could reasonably be said to be “as iconic as possible,” but their iconicity is a double-edged sword – as well as providing the expressive appeal of “well-matchedness,” the iconic nature of Euler diagrams can be implicated in problems of overspecificity and clutter. Existential graphs are capable of providing a more compact representation, relative to Euler diagrams, and do so by exploiting symbolic features. Furthermore, when the meaning of symbolic features is internalised by a user, their position on the spectrum from symbol to icon becomes less clear. The syntactic feature of a closed curve corresponds to its meaning in an Euler diagram (where it denotes a set) but not to its meaning in the β-system of existential graphs (where it denotes negation). However, it may be that a curve can acquire a resemblance to the concept of negation for experienced readers. Arguing for the benefit of using symbols when reasoning with visual logics may seem to overlook the distinctively graphical potential of diagrams. However, it would be too hasty to presume that the benefit of using diagrams for reasoning stems only from their differences from sentential logics. In this work, we explore the interdependence of the iconic and symbolic modes in the acts of making and reading diagrammatic proofs. We do this by examining the balance of convention and resemblance in individual inference rules and in entire proofs made using Euler-based and Peircean notations. We will also put this comparison in context by describing ongoing work to develop criteria for “readability” in automatically generated diagrammatic proofs.

PAPER 3 (of 4) - TOWARDS A METHODEUTIC OF NECESSARY REASONING: In 1902 Peirce announced his “first real discovery” in the philosophy of mathematical reasoning: the distinction between corollarial and theorematic deductions (Hintikka 1980). But what steps did Peirce take to arrive to such a distinction? Is this a critical or methodeutical distinction? As his works on formal logic proceeded, the notion of logical analysis became more and more central. Logical analysis is the first step of deduction; demonstration, either theorematic or corollarial, becomes the second. What distinguishes theorematic from corollarial reasoning is the presence in the former of a theoric step which is retroductive. Now, since it is retroductive, it is no wonder that it is in need of a methodeutic. That is why in his later years Peirce imagines an inventory of theoric steps in the history of mathematics. This inventory was part of what Peirce called a “methodeutic of necessary reasoning” (CP 4.613, 1908). But the methodeutic of necessary reasoning is not limited to the study and classification of theoric steps. Another fundamental part of the methodeutic of deductive logic is the study and invention of logical notations, which will also benefit from an historical survey of the “useful systems of logical representation” (MS 283). Here we have a fundamental distinction: deduction is not only a sign formaliter (the premise is a sign of the conclusion), but also a sign materialiter (as expressed in external signs). This contrast is captured by the distinction between operative and optimal iconicity (Stjernfelt 2014). The two parallel historical inventories of the “facts of deduction” belong respectively to two different senses of iconicity of formal thought: the inventory of theoric steps belongs to the operative iconicity (deduction as sign formaliter); the inventory of logical notations belongs to the optimal iconicity (deduction as sign materialiter). Both belong to the methodeutic of necessary reasoning.

PAPER 4 (of 4) - THE ORIGIN OF THE NOTION OF ICONICITY: “Iconicity” has become a widespread term in many areas of research during the recent decades, from logic to art history to computer interface studies. It may therefore be of interest to trace the origin of the term. It is widely believed that the term iconicity originates with Charles Morris’ interpretation of C. S. Peirce’s icon-index-symbol trichotomy, leading Morris to address degrees of iconicity. This popular gloss, however, is not correct. The origins of iconicity as a robust concept arose from Peirce’s discussion of the optimal way of diagramming mathematical and, especially, logical structure. Moreover, already in Peirce, the notion addressed degrees of iconicity as a measure stick of the appropriateness of a representation. I thus propose to investigate the origin of such iconicity in Peirce in both its “operational” and “optimal” variants in order to show how the arguments for degrees of iconicity apply to the latter variant.