Interpreting nature

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Abstract

We assume that knowledge arises through an interpretation of phenomena and ask what type of process is involved. To this end, on the basis of a theory of cognition and a Peircean theory of signs, we introduce a process model of interpretation and show the existence of a relation of our model with Platonic solids and the golden section. The model's relation with syllogistic, hence the possibility of a relation between phenomena and reasoning, implies that knowledge can be inevitable.
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Keywords: Interpretation; Process model; Peirce; Sign aspects

1. Introduction

It is our assumption that knowledge arises through an interpretation of phenomena and we ask what *type* of process is involved. To this end, we introduce a process model of interpretation on the basis of a theory of cognition and a Peircean theory of signs. What makes Peircean theory particularly interesting for cognitive modeling is its potential for a systematic definition of *types* of distinctions that can be made, hence also known, by means of signs. Through applying our model to wave phenomena and analyzing the arising process from a geometrical perspective we reveal the existence of a relation between our model and Platonic solids. The model's relation with syllogistic suggests the possibility of a link between phenomena and reasoning. How is our model of interpretation related to meaningful processing? As the recipe of a cake to the cake itself. By following the instructions, the result *may* be taste-ful. Tasting the ingredients and the cake itself is beyond the model's possibilities, however.

2. A process model of interpretation

An oft-cited experiment by Yarbus (1967) reveals a fundamental property of cognition: only if there is a change there can be interpretation. An ingenious mechanism enabling interpretation even if the input is not changing is known as the saccadic movement of the eyes. As a change assumes the existence of an interaction and an interpretation is a reaction on a change, which is an event, we conclude that interpretation must be an event representation of an interaction, mediated by a change.

An example of an interaction is one between an input light ray and photoreceptors of the retina, an example of a representation of a change is the signal by on and off center ganglion cells, an example of an event is a motor action, explaining the signal of those cells and so the input interaction. Interaction, change and event can be shown to characterize higher level cognitive activity such as language processing and reasoning as well. In reasoning, an example

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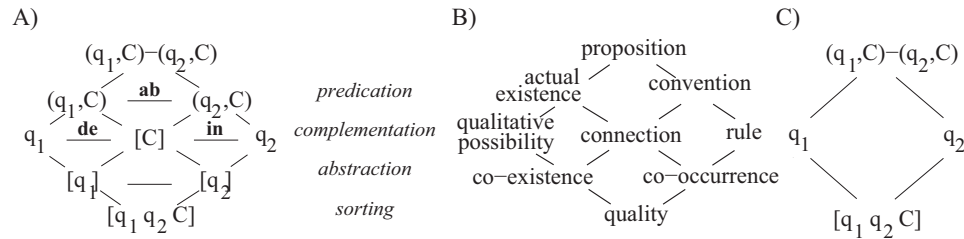 *E-mail address:* janos@cs.ru.nl (J.J. Sarbo).

Fig. 1. Process model. (A) Interpretation moments and (B) corresponding Peircean sign aspects in mundane terms. Events, displayed by a horizontal edge, can be labelled by a type of reasoning (de/in/ab-ductive). In this and later diagrams, a "," symbol designates synonymous interpretation, e.g., of q_1 and C, in (q_1,C). Synonymous interpretation refers to a common perspective; a perspective to a subset of qualities. For example, pencil and choke can be synonymously interpreted as 'a tool for erasable writing', on the basis of a subset of qualities shared by them. It is by virtue of *this* perspective that the two symbols can be considered to be identical. Square brackets are used to indicate that an entity is not yet interpreted as a sign; no bracketing or the usual bracket symbols indicate that some interpretation is already available. (C) Matching mode processing.

of an interaction is one between a (next) premise and the interpreting system (e.g., a human agent), an example of a representation of a change is a relation between this premise and a previous one, e.g., a common term, an example of an event is an expression of a conclusion. In language processing, an example of an interaction is one between a (next) word and the interpreting system, an example of a representation of a change is a combinatory potential between this word and an input expression obtained so far, an example of an event is a representation of a new input expression satisfying the above combinatory potential, e.g., a phrase or a sentence.

Qualities which are in interaction must be in principle independent. In our model we assume that an interaction is between an interpreting system occurring in some *state*, and an independent stimulus or *effect*. The qualities of this state (q_1) and effect (q_2), completed with contextual information about similar interactions in the past (C), define the input for information processing ([q_1 q_2 C]). The goal of interpretation is to find out why this effect is occurring to this state. This requires that the input qualities are sorted (*sorting*; [q_1], [q_2], [C]), represented independently from one another (*abstraction*; q_1, q_2), completed with background information (*complementation*; (q_1,C), (q_2,C)), and merged in a final relation (*predication*; (q_1,C)-(q_2,C)). See Fig. 1A.

The running example of this section is the phenomenon of being bitten by an insect. By assuming that the input state involves the qualities of your skin, the effect those of the perceived act of biting, and the context your knowledge about normal skins and biting by insects, including bees, *sorting* obtains the input state and effect, as constituents ([q_1]), and their co-occurrence as an event ([q_2]), *abstraction* results in a representation of the two types of qualities irrespective of one another (q_1, q_2), *complementation* in an expression of your normal skin as the subject ((q_1,C)) and biting by a bee as the predicate ((q_2,C)) of the interaction, and *predication* results in a representation of the input as a relation between this subject and predicate ((q_1,C)-(q_2,C)). A reaction, which is beyond the model's horizon, can be a motor action, e.g., you hit on the location of the biting.

We suggest that the above type of process is involved in (meaningful) interpretation. In order to justify our conjecture we build on a theory of interpretation, which we found in Peirce's theory of categories and signs (Collected papers by Charles Sanders Peirce, 1931). Briefly, Peirce's categories are modes of organization or relation (Taborsky, 2004); his concept of a sign is concerned with the conditions of signification. According to Peirce, interpretation is involved in all (sign) phenomena, hence in *nature*.[1]

Following Peirce's categorical scheme, signs can be analyzed into *sign aspects*, defining a hierarchy (Bense, 1976). See Fig. 1B. The relation between signs and sign aspects can be illustrated with the phenomenon of apparent motion perception, as a metaphor. Although each snapshot of a film can be meaningful in itself, the interpretation of a single snapshot is restricted to its import (cf. sign aspect) in the perception of a series of snapshots as motion (cf. sign).

The relation between our model and the hierarchy of sign aspects enables the interpretation moments, in Fig. 1A, to be characterized from a semiotic stance. Accordingly, [q_1 q_2 C] involves the sign aspect *quality*, [q_1] the one of *co-existence* (cf. constituency), and [q_2] the sign aspect *co-occurrence* (cf. simultaneity). Each interpretation moment is a representation of the input qualities. An important difference between state and effect is that a state may occur in itself, but an effect always implies the existence of a state. Conform to this difference, [q_1] represents the input co-existence by the state and the effect as a state, [q_2] represents the input co-occurrence by the effect and the state as a quality,[2] involved by the effect. The context, [C], can be assigned the sign aspect *connection*. Conform to the single type of a reference enabled by the context (cf. a pointer), information by complementary states, effects and relations between them is represented in a synonymous fashion. The abstract state, q_1, involves the sign aspect *qualitative possibility*, e.g., the potential of your skin to be qualified as normal; the effect, q_2, the sign

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[1] Peirce is against the Cartesian dualism into mind *and* matter, but sees matter as mind *(2)* **6** 24.
[2] The term quality may refer to a single quality, and a collection of qualities, ambiguously.