Language, Logic, and the Brain

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ABSTRACT

Although linguistics may treat languages as a syntactic and/or semantic entity that regulates both language production and comprehension, this article perceives that language is a physical and a biological phenomenon. The biological view of languages presents a new metaphor on an evolutionary time-scale the human brain and human language have co-evolved. Therefore, the brain is the instrument with a repository of syntactic and semantic constraints. The logical vocabulary of natural languages has been understood by many as a purified abstraction in formal sciences, where the internal transactions of reasonings are constrained by the logical laws of thought. Although no vocabulary can be entirely independent of semantic understanding, logical vocabulary has fixed minimal semantic content independent of context. Therefore, logic is centered in linguistic evolution by observing that all connective vocabulary descends from lexical vocabulary based on spatial relationship of sentences. Far from having fixed minimal semantic content, logical vocabulary is semantically rich and context-dependent. Many cases of mutations in logical vocabulary and their semantic changes have been observed as similar to that of biological mutations. These changes proliferate to yield a wide diversity in the evolved uses of natural language connectives.

Keywords: biological mechanism; brain; cognitive informatics; connectives; evolution; linguistics; logic; syntax; semantics; interaction

INTRODUCTION AND BACKGROUND

George Boole (1815-1864) called his seminal study The Laws of Thought. Boole took the title seriously as a description of the relationship between logic and thought. Cognitive scientists should not. Why not? is the subject of this address.

Boole’s ambitions for the treatise are clear enough, and are repeated several times in the course of his introduction. This is the opening sentence:

The design of the following treatise is to investigate the fundamental laws of those operations of the mind by which reasoning is performed, to give expression to them in the symbolic language of a Calculus, and upon this foundation to establish the science of Logic, and construct its method. (Boole, p. 1)
The difficulty is in getting at those fundamental laws. Boole presents his solution to the problem, which is to get at them through an examination of the language of reason, as a tactic of convenience. A fastidious reader might wish that Boole had spent fewer words on a more perspicuous justification of the method.

*It will not be necessary to enter into the discussion of ... whether language is ... an essential instrument of reasoning ... . It is the business of Science to investigate laws; ... whether we regard signs as the representatives of things and of their relations, or as the representatives of the conceptions and operations of the human intellect, in studying the laws of signs, we are in effect studying the manifested laws of reasoning ... . For though in investigating the laws of signs a posteriori, the immediate subject of examination is Language, with the laws which govern its use; while in making the internal processes of thought the direct object of inquiry, we appeal in a more immediate way to our personal consciousness, it will be found that in both cases the results obtained are formally equivalent. Nor could we easily conceive, that the unnumbered tongues and dialects of the earth should have preserved through a long succession of ages so much that is common and universal, were we not assured of the existence of some deep foundation of their agreement in the laws of the mind itself.* (pp. 24-25)

Boole’s contemporary, Augustus De Morgan (1806-1871), had he understood what we now understand of such things, would have been forced to judge Boole in this matter as he judged the philosophers of his day, who, he said, “speak with the majesty of ignorance.” It is merely an article of faith that we could have access to something called thought independently of our use of language, though we could empirically investigate some human capacities by experiments that required no explanation as to protocol.

**FOLK SEMANTICS**

The notion that universal semantic features of language reveal themselves at the level of connective vocabulary is more likely an artefact of our practices of translation. One still reads in introductory logic tests, that English has one word for *or*, whereas Latin had two. Latin has at least half a dozen words (including *vel, aut, sive, seu*, and enclitic *ve*) that we can translate as *or*, and so does English. They include *unless, alternatively, but, and otherwise*. One might ask whether each of these is usefully thought of as the representative of a conception or operation of the human intellect. Boole, like many more recent authors, in the course of expounding oversimple theories about natural language connectives, himself quite unselfconsciously uses the very connectives he is speaking of in ways that his theory does not comprehend. (In the Boole passage cited, notice the *whether ... or* construction.) In every case that I know of, the judgement about the connectives of natural languages arises, not from a study of natural languages, but from a fascination with or a devotion to a formal technology. Psycholinguistic studies are not free of this taint. In one such study, the dogma that the satisfaction-conditions of non-exclusive disjunction and those of exclusive disjunction exhaust the uses of English *or* premises, a test administered to young children; nevertheless the explanation of the experimental protocol offered to the young subjects is framed with a use of *or* that is not admitted by the experiment. Unremarkably, the four-year-olds had sufficient command of that use of the word, that they were able to understand the test. Unremarkably, none of the adult academics noticed.

Here is an example: suppose that a waiter says to you “You can have tea or you can have coffee.” Is his pronouncement an exclusive or inclusive disjunction? Audiences generally divide on this subject into two camps: a majority who think the former, and a minority who think the latter. But although there is a division on the question when they are explicitly asked, when asked immediately thereafter whether in such a situation they would infer that they could have
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