

## Signs and Offline Brain Systems in Language Evolution

**Bouchard, Denis.** 2013. *The Nature and Origin of Language*. Oxford: Oxford University Press.

by Gonzalo Castillo

Denis Bouchard's book is a refreshingly new take on the old problem of detailing the processes by which humans became linguistic creatures, a puzzle that researchers of varying disciplines have been attempting to solve since long before the inception of modern biolinguistics. It is perhaps not surprising that the book, divided into four parts, starts with several chapters that call to our attention the apparent failure to provide a definite answer to this question. Bouchard argues that, for a start, language cannot be explained scientifically if linguistics receives a treatment or a status that is different from the other sciences, a mistake that he finds evidenced by the scarcity of principled explanations in the literature.

A principled explanation is one that considers the object of study as dependent on logically prior elements from which it arises. Since language can be considered as a system that links percepts and concepts, or representations of sound and meaning, the principled elements of language should be those studied by the sciences of meaning and perception. Explaining the evolution of language, in sum, is determining how the systems that produced concepts and percepts changed in the brains of our ancestors so that their products could be linked and become *signs*. The existence of signs is, therefore, "the only special property of language" (p. 97).

Parts II and III of the book, introducing Bouchard's own Sign Theory of Language (STL), invite us to consider the evolutionary implications of assuming that language is just a system of signs. But first, what is a sign? According to Saussure (1916), a sign can be defined as a relation between a representation of a sound pattern (a *signifier*, e.g. /dɔg/), and a representation of a chunk of cognition (a *signified*, e.g. the concept of dog). Two special properties of signs are crucial to understanding their nature: abstraction and arbitrariness. Signs are abstract because they are detached from any brain-external stimuli or immediacy. Signs are arbitrary relations because there is nothing in any of the properties of their parts that justifies their linking.

Perhaps controversially, Bouchard argues that abstraction was the change in the conceptual system of our ancestors which ended up granting humans their unique cognitive suite. Not only language, but also complex imitative abilities, theory of mind, episodic memory, and object permanence could be traced back to



the emergence of *Offline Brain Systems* (OBS) in the brain of our ancestors. Since these systems did not appear from nothing, but were a new functionality that occurred in preexisting mirror systems, perhaps the term is a bit misleading. It should not be taken, however, as anything else than the claim that some parts of the brain started to represent things in the absence of external stimuli, while inhibiting any motor actions that would follow from actual perception. This change is linked by the author to an increase in the number of neurons in the human cortex, which, added to a tendency towards a more globular shape of the cranium, led to an increase in connectivity and internal activity (pp. 115–119).

Of course, signs would not be possible without OBS. Abstraction is the key difference that separates human concepts from animal categories or percepts. By taking a percept (for instance, a sound pattern like /dɔg/) and abstracting it from the immediate environment, we are able to entertain a signifier. Since signifiers have the same psychological nature as signifieds (both are conceptual), linking them to create a sign becomes an easy step. Bouchard thinks that the relation that exists between signifier and signified is one of reciprocal predication. It should be noted that the author follows Hurford (2007) in considering predication as a trait with evolutionary ancient roots, present in the perceptual systems of complex animals. This pre-existing property is then employed to fulfill the role of sign formation in a similar way to how a specific color pattern is attributed to a leopard.

The second property of signs, arbitrariness, arises as a side effect of the completely different perceptual origins of signifiers and signifieds. Arbitrariness has important structural implications for language. Since the link between signifier and signified is generally unmotivated, the range of possible signs, in theory, is unbounded, and the links between their parts can change rapidly both across time and individuals. This would lead to a chaotic, random system, if it were not for the fact that language is a biological function that arises under the physical and cognitive constraints of the human mind. In chapter 6, Bouchard introduces the notion of *epigenetic self-organizing constraints*, borrowed from biology (Jacob 1982, Erwin 2003), to account for the language-external properties of both parts of the sign.

Regarding external constraints on signifiers, we find that vocalizations and gestures are naturally perceived as discrete segments, and that the phonemic repertoire is organized towards a balance between ease of articulation and ease of perception. As a consequence of this balance, the phonemic repertoire tends to cluster into a small set of percepts that maximizes contrast between its elements. Given that the set of phonemes ends up being very small, and that the set of possible meanings is much larger, phonemes are not enough to match all of the latter, so they start to combine with each other (together with other biologically common vocal resources like stress, length, and intonation), building words. This process is made possible by OBS, which can reinterpret a chain of distinctive phonemes as a discrete unit, granting it the status of a new sign. Similar to phonemes, words are limited in complexity by their frequency of use (cf. Zipf 1949/1965) and, of course, human memory. This proposal that I just summarized is also a justification for the existence of signifiers. We could perfectly well imagine an internal language that lacks the phonological component but is still able to

discretely combine signifieds. However, Bouchard argues that this hypothetical language would “lack the triggering elements for combinatorial processes to emerge” (p. 160).

Signifieds are also affected by language-external constraints. The author, again following Hurford (2007), points at perception being organized around objects and properties, a distinction manifested in language by the subject-predicate and head-dependent relations. Similar to what happened in the case of signifiers, although OBS can take any perceptual episode and encode it as a signified, the meanings that usually cluster into signs are those that are activated more frequently and within a broader array of contexts. Since our perception is based on categories, it is expected that the words of a language can be employed to refer to sortals, abstract qualities, etc., and not exclusively to specific perceptual events.

At the end of Part III (pp. 169–179), the author introduces an original view of syntax that is also based on the sign. More specifically, syntax is defined as a small set of signs (*C-signs*) that are in charge of relating words to produce complex meanings. The signifier of a C-sign can be either part of a paradigm that is stored in memory (such as in case marking), or a syntagmatic relation of elements (such as the subject–verb–object relation). Its signified, on the other hand, is based on the most distinctive feature of perception: property attribution (predication). The relation between signifier and signified, being arbitrary, produces cross-linguistic variation depending on the way languages randomly match specific predicative relations with oral or gestural resources such as juxtaposition of elements, intonation, stress, length, or morphological markers.

Since both C-signs and unit signs are based on the same pre-existing properties of the sensorimotor and conceptual interfaces, Bouchard argues against the existence of a long proto-language stage, defending that all that is needed to have syntax is a brain equipped with OBS and subject to external self-organizing constraints (ch. 7). Thus, the origin of C-signs is the result of predication being a ubiquitous aspect of perception, which ends up creating a pressure to match it with the gestural or oral percepts available to a language. Since storing words is costly in terms of memory, and perception is organized around an object–property dichotomy (Hurford 2007), it is not plausible that a language will develop a lexicon that treats each attribution of properties with a different root, so compositional processes come into play. Syntax, therefore, does not emerge *for* communication or the organization of thought (although it might as well produce such benefits), but as a regularizing side effect of the chaotic system that is triggered by OBS.

The final part of the book (Part IV) can be described as an open letter specifically addressed to linguists. These chapters analyze some formal, UG-based models of linguistic phenomena under the cognitive umbrella of Bouchard’s STL, and so they are more technical and less interesting from a multidisciplinary perspective. I will only highlight that the author, faithful to the idea of looking for principled explanations, rejects many milestones of generative theory (Principles and Parameters, *wh*-movement, *c*-command), extending his notion of C-signs to specific cases that would require a very detailed elaboration, far beyond the scope of this review.

So far, I have provided a summary for what I consider the main ideas discussed in the book. Although the picture of language that they present is coherent and promising, they will only triumph after some questions are some day answered, so I would like to finish this review by introducing a few of them. The first thing I would like to talk about is abstraction being the clear-cut line that separates humans from other animals. There is no doubt that humans excel at offline thought processes, but it is, in my view, too early to claim that these are a unique result of the evolutionary path followed by hominins. In fact, it is currently possible to find evidence suggesting that many species have to a certain extent some of the functions attributed to OBS. For instance, Osvath & Osvath (2008) show that great apes can select tools that will only be useful in the future in a not currently perceived location, indicating that immediate needs do not play a role in their behavior. Other experiments on animal episodic memory such as Clayton & Dickinson (1998) and Hoffman *et al.* (2009) show a capacity to integrate and remember information on *what*, *where*, and *when* in scrub jays and rhesus monkeys respectively.

This indicates that offline thought processes may not be human-specific, something that the STL would have to take into account to explain why language is. If the solution is that abstraction turns out to be language-enabling when it becomes frequent enough, then we would still need to consider why less-refined abstract thought processes cannot confer a less-refined linguistic stage, provided that abstraction was indeed all that is needed to acquire signs. In other words, if abstraction is gradual, we should ask ourselves either why within this gradation a critical point that facilitated the sudden acquisition of signs could have appeared, or if the acquisition of signs could have also been a gradual process. If the latter was the case, sign systems would not only have evolved by means of self-organizing constraints, but also in parallel with the evolution of OBS.

Whatever the answer turns out to be, my view is that the emergence of abstraction is simply not enough to explain the human-specific usage of signs, and that a means to reliably control abstractive processes, such as an improvement in executive control (Baddeley 1996, 2002), is also an important requirement, and perhaps the key to those who would like to claim that language is a relatively recent and sudden cognitive revolution. The investigation on OBS could benefit from the copious amount of research that has been conducted so far on Working Memory, since both are reaching similar conclusions about the nature of humans' cognitive uniqueness (e.g., Coolidge & Wynn 2005).

Additionally, a distinction should be made between the cognitive properties that are brought about by OBS, and those that are just an indirect result of them, being caused by the existence of signs. The most relevant example for the latter is cross-modularity, where representations produced by different modules can be joined together under the same word or sentence, generating what appear to be new conceptual capacities. In a series of experiments by Hermer & Spelke (1994, 1996) and Hermer-Vasquez *et al.* (1999), it was shown that masking the linguistic abilities of adult humans by making them repeat what they are listening to can impair their orientation skills to the level of rats and prelinguistic infants, since they are unable to use expressions such as *to the right of X* in their thoughts. Similarly, numerical words seem to be a combination of a system for

subitizing individuals and a system for representing large, inexact numerosities (Dehaene 1997).

Since these capacities do not seem to be part of our prelinguistic stock, it is not completely accurate to claim that language is a mere reflection of a shared conceptual interface plus abstraction, and that integration only pertains to the origin of OBS. On the contrary, it seems that the sign awakens new integrative processes, affecting thought in a unique way that still needs to be investigated as an enterprise on its own. To do so, we do not need to abandon the search for principled explanations. On the contrary, we should follow Bouchard's suggestion by looking for a possible relation between the sensorimotor aspects of signs and the enhancement of cognition. As a suggestion, we can claim that the arbitrary relation that exists between the signifier and signified allows that multiple signifieds can be associated with the same signifier, thus strengthening the connections between different, unrelated systems.

All in all, Bouchard's Sign Theory of Language has the advantage of building a bridge from other disciplines to the usually isolationist realm of linguistics. Unlike other multidisciplinary attempts, this one makes a conscious effort to prevent as much as possible an almost inevitable simplification or vagueness, providing testable hypotheses and original perspectives for the solution of old problems. A quote on the back cover of the book by Christopher Petkov says: "Denis Bouchard's theory may be exactly what is needed to take linguistics and neuroscience in exciting new directions." Whether one of these directions will effectively take us to a full explanation of language evolution, we cannot yet foresee, but one thing we can depend on is that the advancement of science rarely sticks to the same road for long.

## References

- Baddeley, Alan D. 1996. Exploring the central executive. *The Quarterly Journal of Experimental Psychology: Section A* 49, 5–28.
- Baddeley, Alan D. 2002. Fractionating the central executive. In Donald T. Stuss & Robert T. Knight (eds.), *Principles of Frontal Lobe Function*. New York: Oxford University Press, 246–260.
- Clayton, Nicola S. & Anthony Dickinson. 1998. Episodic-like memory during cache recovery by scrub jays. *Nature* 395, 272–274.
- Coolidge, Frederick L. & Thomas Wynn. 2005. Working memory, its executive functions, and the emergence of modern thinking. *Cambridge Archaeological Journal* 15, 5–26.
- Dehaene, Stanislas. 1997. *The Number Sense: How the Mind Creates Mathematics*. Oxford: Oxford University Press.
- Erwin, Douglas. 2003. The Goldilocks hypothesis. *Science* 302, 1682–1683.
- Hermer, Linda & Elizabeth S. Spelke. 1994. A geometric process for spatial representation in young children. *Nature* 370, 57–59.
- Hermer, Linda & Elizabeth S. Spelke. 1996. Modularity and development: The case of spatial reorientation. *Cognition* 61, 195–232.

- Hermer-Vasquez, Linda, Elizabeth S. Spelke & Alla S. Katsnelson. 1999. Sources of exibility in human cognition: Dual-task studies of space and language. *Cognitive Psychology* 39, 3–36.
- Hoffman, Megan L., Michael J. Beran & David A. Washburn. 2009. Memory for “what”, “where”, and “when” information in rhesus monkeys (*Macaca mulatta*). *Journal of Experimental Psychology: Animal Behavior Processes* 35, 143–152.
- Hurford, James R. 2007. *The Origins of Meaning: Language in the Light of Evolution*. Oxford: Oxford University Press.
- Jacob, François. 1982. *The Possible and the Actual*. New York: Pantheon.
- Osvath, Mathias & Helena Osvath. 2008. Chimpanzee (*Pan troglodytes*) and orangutan (*Pongo abelii*) forethought: Self-control and pre-experience in the face of future tool use. *Animal Cognition* 11, 661–674.
- Saussure, Ferdinand de. 1916. *Cours de Linguistique Générale*. Critical edition prepared by Tullio de Mauro. Paris: Payot.
- Zipf, George K. 1949/1965. *Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology*. New York: Hafner.

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