Everything You Wanted to Know About the Genetics of Language (and Beyond)

Benítez–Burraco, Antonio. 2009. *Genes y Lenguaje: Aspectos Ontogenéticos, Filogenéticos y Cognitivos* [*Genes and Language: Ontogenetic, Phylogenetic, and Cognitive Issues*]. Barcelona: Editorial Reverté.

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As Cedric Boeckx and Kleanthes Grohmann pointed out in 'The *Biolinguistics* Manifesto', which opened this journal, there are two different senses of the term 'biolinguistics', a weak one and a strong one. Their own words illustrate: "The weak sense of the term refers to 'business as usual' for linguists, so to speak, to the extent that they are seriously engaged in discovering the properties of grammar" (Boeckx & Grohmann 2007: 2). With regard to the second (strong) sense, it "[…] refers to attempts to provide explicit answers to questions that necessarily require the combination of linguistic insights and insights of related disciplines (evolutionary biology, genetics, neurology, psychology, etc.)" (p. 2).

The book reviewed is one of the most important references in the second (strong) sense of 'biolinguistics' which has been published to date. This piece of impeccable scholarship pursues two main aims. Firstly, it provides the reader with an impressive and completely up-to-date overview on the genetic and molecular (and, by extension, biological) foundations of language. In this respect, it suffices to say that whereas the discussion about the genetics of language is usually restricted to the role of the 'famous' *FOXP2* gene, the book refers to (and analyzes) more than 150 genes which recent research has somehow linked to language. Fundamental as this enterprise would be by itself, the book is not confined to it. As a second aim, the aforementioned overview is the input for sophisticated and in-depth discussion about key issues having to do with the biology of language. These include (i) how to manage the relationship between genes and behavior; (ii) what the true significance is of genes, their properties, and their products for understanding human language; (iii) what genes can reveal for topics such as language organization in the brain, language phylogeny (evolution) or language ontogeny (development); (iv) how the relationship between language and cognition should be characterized; and (v) what degree of convergence exists between discoveries coming up from the genetics of language and proposals which theoretical linguistics (especially, the Minimalist Program, henceforth, MP) has brought to the fore. For these reasons, I consider the book by Antonio Benítez–Burraco (henceforth, ABB) to be an essential reference (to put it more precisely, a true hand-book), which everybody interested in the biological

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seat of language should consult.

I began the review by mentioning the two senses the term 'biolinguistics' is endowed with, according to Boeckx & Grohmann. In order to go deeper in discussion on the strong sense of the term, it should be noted that there are in principle two different strategies for such a strong sense to be fulfilled — a multidisciplinary approach and an interdisciplinary approach. Although both strategies are usually conflated, a great difference opposes them. A multidisciplinary approach means that the same problem is studied from several disciplines, but this approach does not necessarily connect achievements gained by each of them. However, with regard to an interdisciplinary approach, quite the opposite applies. Knowledge offered by different disciplines is integrated (i.e. merged), the outcome being a shared body of knowledge. Needless to say, an interdisciplinary approach is much harder to be obtained than a multidisciplinary one. It is perhaps for that reason that, according to Newmeyer (1997), linguists have been traditionally reluctant to seriously consider issues which transcend linguistics itself (for example, clinical, behavioral, cognitive or biological evidence). In that regard, one of the many merits of ABB's book is that it clearly surpasses a multidisciplinary approach (a perspective which does not ensure the property of consilience, or unity of knowledge, as stated by Wilson 1998), to become truly interdisciplinary. ABB is an especially suitable scholar for achieving such a task, given his (really welcome) academic training both in molecular biology and theoretical linguistics.

I will offer a brief outline of the organization of the book and of the main topics the chapters deal with, although this is not an easy task considering the denseness of the book. After a brief introduction (pp. 1–3) where the *raison-d'être* of the book is outlined and its main objectives are advanced, Chapter 1 (pp. 5–33) is devoted to the anatomical and physiological foundations of language. It critically discusses a number of models aiming at explaining the anatomical and functional organization of language. The neurolinguistic discussion is summarized in an appendix which gathers all the brain areas involved in linguistic processing, with an indication of the key references for each of them.

Chapter 2 (pp. 35–53) analyzes the polemic issues of innateness and learning in language ontogeny, and the controversies surrounding them. The author makes the point that, for nativism to be truly justified, the need exists to consider a wider range of evidence than the linguistic one, thus broadening the evidence with which linguists have been mainly concerned. According to ABB, genetic and molecular evidence is suitable for such an objective to be achieved. Nevertheless, what I take to be the main contribution of the chapter is the discussion of what the very notion of 'innate' means, and how it has been reformulated within MP, as opposed to the previous generative tradition. Minimalism has reduced the role of the genetic endowment for language (i.e. the linguistic genotype or 'first factor', following Chomsky 2005) which was supposedly required for language acquisition to take place (cf. Longa & Lorenzo 2008 and Lorenzo & Longa 2009). Accordingly, MP reduces the specifically linguistic (i.e. specifically grammatical) component of the human mind (cf. Lorenzo & Longa 2003), and considers the faculty of language to be the outcome of epigenetic processes rather than the product of purely genetic processes. It is

for those reasons that minimalism redefines the very notion of innateness. As opposed to preceding generative models (paradigmatically GB, that is, Government–and–Binding Theory) and to the Neo-Darwinian framework as well, the notions of genetic trait and innate trait are no longer conflated in MP (cf. Longa 2006). Therefore, minimalism argues for a phenotypic notion of innateness, not a genotypic one (Longa & Lorenzo 2008). The faculty of language would lose its genetic character, but not its congenial or innate nature, in such a way that it would be innate attending to its propensity to arise irrespective of the foundations of its development, those foundations not requiring to be purely genetic (cf. Maclaurin 2002 and Moore 2001: Chap. 13, for a defense of such a view from a strictly biological point of view). ABB's discussion of that issue is well taken and illuminating.

Chapters 3 and 4 develop a wide analysis of the currently known genetic and molecular mechanisms which are responsible for how the neural circuits related to language develop and function. Chapter 3 (pp. 55–81) approaches the molecular bases of development and plasticity of the brain linguistic areas, and how those areas work. The chapter aims at exploring both the structural and functional development, and, furthermore, it seeks to integrate them. As usual in every chapter, an appendix is offered (pp. 80–81) where the different genes referred to so far are summarized: Gene name, chromosome localization, protein function, and main scientific literature.

As of chapter 4, it could well be an independent book by itself on the basis of its length alone (pp. 83–281), and it is undoubtedly one of the most valuable chapters of the book. Had I to highlight one of the chapters, it would be this one. To put it simply, it is impressive. As far as I know, it offers the most extensive overview of the genetic bases of language to date, and it is this overview which makes the chapter so innovative. It begins by presenting the essentials of the different methods and strategies available for cloning genes (comparative, functional, and positional cloning), and then it goes on to characterize the problems which arise when trying to define the linguistic phenotype and its impairments. After those introductory topics, the main goal of the chapter is approached in which the author provides us with both a structural and functional characterization of the currently known genes which are somehow linked to language. For this goal to be achieved, ABB carried out a large and detailed search in many scientific journals, and applied further analysis and synthesis. This has allowed him to collect up to and characterize more than 150 genes which recent research has shown to be related to language. The genes are arranged according to three general categories:

(A) genes involved in exclusively linguistic impairments (although ABB acknowledges the controversy surrounding the specifically linguistic nature of those deficits);

(B) genes involved in general cognitive impairments which also affect language, and

(C) genes involved in cognitive impairments which do not seem to affect language, but are relevant anyway in order to characterize the genetic bases of language.

Although the extensive analysis of the *FOXP2* gene ABB offers should be high-lighted, specific treatment of the remaining genes is worth considering as well. The overall picture offers a comprehensive overview about the regulatory mechanisms which are responsible for how language areas involved in language are organized and function.

Although the appendices are not unusual in the book, I feel obliged to stress a very extensive appendix (pp. 240–281) which ends chapter 4. Its purpose it to collect all the genes discussed in the chapter and their main properties: gene name, chromosome localization, protein function, linguistic impairments associated to the gene mutation, clinical name of the syndrome, and selected scientific literature.

For the reasons specified so far, the chapter is a 'bedside reading' reference about the genes which are somehow related to language ontogeny. As mentioned above, the overall picture spectacularly surpasses the usual conception which conflates the genetics of language with just *FOXP2*.

Chapter 5 (pp. 283–337) is devoted to the other side of the coin, language phylogeny. ABB claims that the range of traditional evidence on language evolution (mainly the vocal tract, symbolic artefacts, and paleoneurological evidence related to brain size and cranial reconstructions) should be broadened with new types of evidence; especially, those that are offered by genetic and molecular analyses. According to ABB, this type of evidence could help us judge more traditional ones, which suffer from an intrinsically ambiguous nature. The goal of the chapter is therefore quite similar to that of chapter 4, but referred to at the phylogenetic level, which is to discuss the evolution of the known genes (related to language) whose expression levels have been modified over the evolutionary course. In a quite similar vein to chapter 4, chapter 5 offers an exhaustive picture of the relevant genes, those genes being arranged according to several categories: (i) genes related to brain size, (ii) brain metabolism, (iii) brain lateralization, and (iv) neural structures (circuits or areas) which have to do with language. The properties of the genes are summarized in a valuable appendix on pp. 332–337.

Finally, chapter 6 is the clearest example of the truly interdisciplinary (not multidisciplinary) nature of the book. Although ABB has chosen to simply name it 'Conclusions', the chapter is really much more than what its title suggests. In fact, the chapter develops a wide discussion (pp. 339–364) about the linguistic significance of the biochemical and genetic evidence analyzed in the preceding chapters. The discussion seeks to unravel the ontogenetic, phylogenetic, and cognitive implications of the genes involved (in several ways) in human language. Many topics of main concern from a theoretical point of view are confronted, and sophisticated attempts are made to offer answers for them. To give some hints of the relevance of the chapter, some of the topics it is concerned with are: (i) how genes really work (far from simplifying assumptions about the direct relationship between genes and phenotypic traits); (ii) an assessment of how the relationship between nature and nurture should be addressed; (iii) a discussion on language evolution; and (iv) how the notion of modularity should be understood in the light of how genes work and are organized. In addition, (v) a proposal is made that the language organ derives from a double developmental program (one being more general and the other one being more specific), and (vi) claims are

made about the non-specific nature of the 'genes of language' (this expression is systematically endowed with quotation marks through the whole book). Let us take into account that this point was already fully advanced by Lenneberg (1967: Chap. 6), when he wrote that it was not necessary to make doubtful claims about 'genes of language'. Finally, (vii) an assessment is made of how the genetic issues considered in the book, and the non-specific nature of the genes themselves, fit in with proposals suggested by MP.

The book ends with an impressive reference section, of more than 80 pages (pp. 365–449) listing more than 2,000 references, showing the immense work put in by the author. A very detailed thematic index is offered as well (pp. 451–478).

Although the book is highly technical (it becomes obvious that such a book could not be jargon-free), ABB's effort to make its reading and use easier should not go unnoticed. Beyond the aforementioned appendices, the book is endowed with 20 tables and no less than 115 figures (the vast majority in color).

I hope that the brief presentation of the main contents of the book will allow to shed light on at least some of its many merits. In addition, it seems necessary to highlight that, although the book focuses on genes, ABB's view is, much to my delight, very far from the primacy of the 'genetic program' metaphor (and, consequently, very far from the primacy of the genes themselves) which has been at the heart of Neo-Darwinian thinking (and which can still be perceived in works such as Carroll 2005 and other practitioners of Evo–Devo). To put it in other words, the author is well aware of the dangers a strictly reductionist perspective has meant for the biological study of organisms (cf. Kaufmann 2000 and Lewontin 2000, among many other references). ABB's own words clearly illustrate: "[…] the genetic approach to the study of language should not be understood from a strictly reductionist perspective, which considers the gene to be the final point of any analysis of language" (p. 364; own translation — VML). As Oyama (2000: 40) puts it, "[…] a gene initiates a sequence of events only if one chooses to begin analysis at that point". For that reason, the author contends that knowledge gained from genetic and molecular analyses should be integrated in an overall picture. As ABB himself acknowledges, his view is not far from 'probabilistic epigenesis' as developed by Gilbert Gottlieb (cf. Gottlieb 2001), an influential scholar close to Oyama's Developmental Systems Theory (cf. Oyama *et al*. 2001a, 2001b). Consequently, according to ABB, genes are not the main biological entities, but they strongly interact with the whole range of developmental resources and levels (cellular, neural, behavioral, environmental, and so on) of which the system is composed. Such a position concerning the role attributed to the genes is in full agreement with theoretical stances which strongly depart from Neo-Darwinian assumptions; in fact, in several passages of the book, ABB suggests that his proposal fits in well with Developmental Systems Theory (cf. p. 363, among others), and with the view sustained by MP as well. Thus, for ABB the genome cannot be conceived of as an encapsulated entity.

Other hints also make it clear that the author departs from the biological establishment (i.e. Neo-Darwinism); for example, this is demonstrated in his conception of heredity. Such a conception goes beyond the usual (Neo-Darwinian) stance, according to which genes are the only biological elements which can be

inherited. ABB recognizes the role of other types of heredity (maternal, epigenetic, social or even behavioral; cf. p. 84), in full agreement with positions which defend that "there is more to heredity than genes" (Blumberg 2005: 148, Jablonka & Lamb 2005: 1), as can be seen in the four dimensions of heredity developed by Jablonka & Lamb (2005) (for a synthetic presentation, see Jablonka 2001), or the even wider notion of 'extended heredity' argued for by Developmental Systems Theory (cf. Griffiths & Gray 2001 and Oyama *et al*. 2001a, 2001b).

Another aspect of the book I fully agree with is the status ABB confers to MP, an ontological one rather than merely methodological. This means that the author does not share the 'consensus view' (cf. Boeckx 2006, Freidin & Vergnaud 2001, and Hornstein *et al*. 2005, among many others) by which minimalism would be no more than an extension, or a mere refinement, of the Principles–and–Parameters model which creates an opening for simplicity, naturalness, and so on (cf. Longa & Lorenzo 2008 for a discussion of the differences between GB and MP). The following words by Hornstein (2009: 178) illustrate: "[…] MP is a continuation of the GB research program […]. MP starts from the assumption that GB is roughly correct." It seems to me that this position is based on a methodological (i.e. weak) minimalism, and it does not jibe with an ontological (i.e. strong) consideration of minimalism. On the contrary, ABB considers MP to be an important (or even radical) break with regard to GB (cf. chapters 3 and 6), and I think that his view is accurate. It should be noted that the biological position adopted by GB was based on the 'consensus view' on organisms and organismal development which Neo-Darwinism brought to the fore (cf. Lorenzo & Longa 2009 for discussion). Robert (2004: 39) characterizes that 'consensus view' according to three main features: (1) genetic informationism (the information required for the development of an organism is contained within its genes), (2) genetic animism (such information consists on a genetic program), and (3) genetic primacy (genes are the vehicles by which the information is inherited, the main promoters of development). The solution GB provided to Plato's Problem was to fully assume that 'consensus view', to assume a genetically encoded state of linguistic knowledge (Universal Grammar) or 'linguistic genotype' (Chomsky 1980, Lightfoot 1982, 2006), which was taken to be a direct expression of the genes. Therefore, the strong geneticist view of GB can be summarized in the notion of a genetic program (Chomsky 1980, Wexler 1999) (cf. Longa 2008 for critical discussion of that notion). However, the strong geneticism (which has been the focal point in every generative model except the minimalist one) has been removed from the agenda, since minimalism advocates the need to reduce the role of the genetic endowment, and argues for the non-specific nature of the principles the language faculty is composed of. The book reviewed clearly favors an ontological minimalism, and, interestingly, ABB shows that the conclusions reached from the analysis developed in the book are consistent (both in phylogeny and ontogeny) with the framework of (ontological) minimalism, as the author himself acknowledges.

To sum up, the book provides us with a delicious cocktail: Biology and theoretical linguistics side by side (i.e. merged in a truly interdisciplinary way). There is no room for doubt: The field of biolinguistics has many reasons to celebrate the publication of ABB's book. I am sure it will become an indispensable

reference for anyone seriously interested in the biolinguistic approach. For this reason, given that the book has been published in Spanish, an English translation would be highly desirable as soon as possible. The lack of such a translation would be an important disservice to the field.

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