

The naturalist program for neo-Cartesian biolinguistics*

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The conceptual barrier for natural sciences of the mind was first posed as a by-product of Descartes' metaphysical mind-body dualism, but was later eliminated by Newton. However, at the same time, the mystery of free will essentially remains much in the same form as Descartes observed with puzzlement, and the serious naturalistic inquiry into the nature of the mind is presumably only possible when the issues of free will are avoided even in the study of mental aspects of the world. Thus, natural sciences of the mind, if any, would be both methodologically Cartesian and metaphysically anti-Cartesian, in that it respects Descartes' recommendation of avoiding the issues of free will, but it also rejects Descartes' metaphysical mind-body dualism. This paper will argue that biolinguistics under the rubric of the minimalist program is essentially such a neo-Cartesian project. The prospects that it bears for eventual unification with other core sciences are also to be discussed.

1 Introduction

Natural science is arguably one of the noblest achievements in the whole history of humankind. Ever since the "scientific revolution" in the 17th century, when this human-made enterprise came to take its modern shape, there have been a growing number of intriguing discoveries as to the deep nature of the universe that had been otherwise inaccessible to the human common-sense perspective. The progress of scientific inquiry has been made primarily in the domain of the study of what we can (informally) refer to as physical phenomena, subsuming the chemical and atomic structure of matter, motion of objects through space-time, electrical and magnetic forces causing motion at a distance, functions and structures of cells of different organisms, and so on. These achievements are so impressive and appealing that many scientists and philosophers have been inclined to be committed to so-called scientific realism, the belief that the theoretical postulates of successful scientific research reflect the theory-independent reality in the universe, even when the relevant postulates are not themselves observable.

One may naturally wonder whether similar progress is ever possible even into the study of the human mind, what is going on 'inside the head', to which this paper will try to articulate a positive answer with several necessary provisos. Science is a particular human enterprise which can attain a special sort of knowledge of phenomena when the problems can be simplified enough. Descartes first put forward his metaphysical mind-body dualism essentially as a naturalistic hypothesis, which posits that the phenomena of the physical, *res extensa*, are causally closed, and he conjectured that we can pursue a rigorous mechanical understanding of these physical phenomena with appropriate simplifying assumptions. At the same time, he clearly saw the limitation of his mechanical scientific inquiry, most notably in his observation on the uncaused and unbounded creativity of normal language use by ordinary people. He was led to postulate the second substance called *res cogitans* (the mental) as the source of the boundless

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creativity of human linguistic behaviors, and he supposed that in order to investigate this mysterious domain, we have to seek some metaphysical and methodological alternative to the principles and methodology that he proposed to adopt for the science of *res extensa*. This metaphysical dualism was quite congenial to our common-sense understanding of the world, but it was nevertheless effectively dissolved in the post-Newtonian era, as we will see below. Since then, the knowledge of natural science has departed from our common-sense intuitions, and we no longer have any principled understanding of what the 'physical' domain for naturalistic inquiry is.

Newton's dissolution of the Cartesian mind-body dualism effectively eliminated a conceptual barrier for the natural science of the mind (Chomsky 1995a, 2000b), which, in retrospect, set the basis for the 20th century "second cognitive revolution" (Jenkins 2000:2; cf. Chomsky 1994:35), where a body of what are now called "cognitive sciences" emerged. The progress was most notably made in the domain of the study of the *mechanism* (but not *use*) of human language (FL) and of vision (see in particular Marr 1982 for the study of vision). The essential finding in these endeavors was that there are substantive computational mechanisms in the domain of *res cogitans* that are susceptible to naturalistic scientific inquiry. Cognitive scientists are thus metaphysically anti-Cartesian, in that they reject Descartes' metaphysical mind-body dualism as a barrier for such naturalistic inquiry.

However, we should also bear in mind that the mystery of boundless free will essentially remains much in the same form as Descartes once observed with puzzlement. Specifically examining the case of the science of human language, this paper will argue that the serious naturalistic inquiry into the nature of language is possible only when we carefully investigate the mental mechanisms in avoidance of the potentially insurmountable effect of free will, still respecting Descartes' caution on *res cogitans*. This paper will argue that what is nowadays called the *minimalist program for linguistic theory* (Chomsky 1993, 1995b *et seq.*) is essentially such a *neo-Cartesian* project, and will articulate several prospects for the eventual unification of this mental science with the other core natural sciences.

2 Syntax as a natural object

One of the distinct characteristics of human beings is that each individual, apart from serious pathology, can acquire one or more grammars of natural languages from a finite amount of linguistic experience in his/her infancy. Considerations on the poverty of stimulus (Plato's problem) convinced numerous 17th-18th century philosophers and 20th-21st century linguists to propose that the human mind possesses a substantive innate mechanism that constitutes the basis of the acquisition/growth of such linguistic capacity. This biological endowment, the *faculty of language* (FL) as we may call it, is reasonably assumed to be a distinct module of the human mind, with its own internal rules and constraints. A naturalistic scientific study of FL is nowadays called *biolinguistics* (see Jenkins 2000 for overview).

The linguistic capacity that FL enables must include, minimally, a system that recursively and hierarchically manipulate linguistic representations that can be assigned to corresponding sentences. Biolinguists have concluded that this generative system should include, at least as one of its components, *Merge*, a recursively applicable operation that combines a finite number of linguistic forms and creates a larger form composed of them that it can further operate on. Whether the recursive generative

system in question consists of more than just Merge (say, Agree) or can be optimally reduced to this single operation, whether it is distributed over many different subcomponents with their own idiosyncratic rules and constraints (as assumed in, e.g., the so-called (Extended) Standard Theory) or is confined to a single component with cyclic outputs (Uriagereka 1999, Chomsky 2000a, 2008), how many interfaces it has with the neighboring performance systems, and what the exact nature of such interface boundaries is, are all open empirical questions, which biolinguists naturally debate in various ways. However, no matter how these issues are ultimately settled, the biological existence of this very generative capacity in the human mind/brain is beyond any doubt. This generative ability, which makes infinite use of Merge (and possibly other kinds of form-to-form mapping operations) to generate linguistic forms in its humanly unique way, then, is a *bona fide* natural object that we can naturalistically study as such, taking whatever evidence is available. This natural object, presumably distinctively human, is appropriately called *syntax*, or *generative grammar*, and so is the naturalistic theory of it, exploiting systematic ambiguity associated with these terms (Chomsky 1965). Thus, as long as we are studying syntax, we are pursuing a natural science. More than fifty years of investigation have shown, somewhat surprisingly, that this mind-internal natural object can be fruitfully investigated with more or less the same rationale and methodology that have been adopted for naturalistic investigations into any other natural (including physical) phenomena (see Chomsky 1955/1975, 1957, 1965, 1981, 1986, 1995a,b, 2000b, 2007a to name just a very few).

Another obvious fact is that infinite forms that syntax generates mediate between ‘sound’ and ‘meaning’. More specifically, these forms can be used by an individual, appropriately and meaningfully with regard to whatever purposes s/he might use them for, often (but not necessarily) with corresponding ‘externalization’ (association with overt sounds or signs). This everyday observation justifies another foundational assumption of biolinguistics that syntax can somehow interface with some ‘thought’ system responsible for conceptual-intentional utilization of such syntactic forms, which we may call the *Conceptual-Intentional* system (CI), as well as some articulatory-perceptual component responsible for their ‘externalization’, or the *Sensorimotor* system (SM). It is hardly necessary to note that we have only a limited understanding of how and in what form such an interfacing to these syntax-external systems happens, let alone the exact nature of CI or SM (though we have more ‘overt’ evidence for the latter). Still, at the bare minimum, we should be able to conclude, from the above-mentioned everyday linguistic fact, that there *must* exist some such interfaces to CI and SM. The interfaces to these systems are commonly referred to as SEM and PHON, respectively.

Note that in this line of reasoning, we are *passively* postulating the ‘thought’ system (CI) as a rather gross sum of performance mechanisms that syntax can interface with on the ‘meaning’ side, for want of better understanding of how human thought works. In doing so, biolinguists might expect that the inquiry into the nature of FL, when developed, can eventually clarify something about the nature of this interfacing hypothetical construct. But such an expectation is in principle secondary to the scientific study of the forms and workings of syntax, since syntax can generate forms regardless of whether and how ‘meaningful’ they are for human thoughts (cf. *colorless green ideas sleep furiously* and countless other semantically anomalous examples). Whether the theory can eventually meet such expectation will only depend on empirical progress and prospects that the study of syntax will yield in due course. This is the nature of any scientific investigations: there is no *a priori* guarantee that we can construct any

explanatory scientific theory of how syntax works, let alone how the forms it generates can be utilized by the external performance systems.

That said, the fruitful results that more than half a century of biolinguistic investigation has borne constitute a reason for biolinguists to be optimistic, to some extent, about such a prospect. And, of course, we are naturally interested in the nature of SEM. What does SEM look like? How does syntax form SEM from an unorganized array of lexical items? What kinds of instruction does SEM provide for CI? How strongly does SEM configure the ‘thought’ associated with the corresponding sentence? How are recursively generated syntactic forms mapped to SEM? How different are the SEM and PHON of a single syntactic representation? These are, again, all open empirical questions, to which we can seek to find serious answers as our biolinguistic investigation goes, with the same rationale and methodology as are adopted for empirical investigations into any other natural objects (Chomsky 1995a). Then, let us refer to the subdiscipline of biolinguistics that seeks scientific theoretical understanding of SEM as *biosemantics*, following Wolfram Hinzen and Boban Arsenijević’s suggestion (see Hinzen 2008).¹ Biosemantics is as genuine a natural science as syntax already is, given that representations that appear at SEM are just a proper subset of the forms syntax can generate.

3 Approaching the naturalization of semantics

One of the questions that biosemantics faces is:

- (1) How much of the interpretive/semantic properties of a given linguistic form (sentence, noun phrase, etc.) is determined (‘carved out’) by the syntactic generation of its SEM?²

Indeed, (1) has been one of the leading research questions in generative linguistics since Chomsky’s (1955/1975) influential analysis of constructional homonymity, i.e., cases where a certain sequence of phones or signs is analyzed in more than one way by some syntactic representations, resulting in structural ambiguity (see Chomsky 1955/1975, 1957). As Hinzen (2008) correctly points out,

[T]he philosophical and linguistic answer to [(1)] for nearly 700 years has arguably been: by and large, nothing. Ever since the nominalists under Occam’s lead demolished Modistic Universal Grammar in the early 14th century, language was largely regarded as an arbitrary means to express thought: It is deprived of any intrinsic relation to either the structure of the thoughts conveyed or, for that matter, the external world out there, which language can be used to describe. It is a tool for conveying thought, not its cause. If so, language is deprived of the role it was given by the Modists: that of an instrument of knowledge, a format in which systematic knowledge of the world is possible. (Hinzen 2008:349-350)

¹The term ‘biosemantics’ was already invented by Millikan (1987; see also her 1984 and Forbes 1989) to refer to a quite different approach to linguistic semantics. I am here joining Hinzen and Arsenijević in investing a promising alternative conception to this term.

²Hinzen (2008:349) proposes to call this question Uriagereka’s question (Uriagereka 2008; see also Narita 2009c).

However, the advent of generative biolinguistics, or specifically its recognition of human language (FL) as a natural object, has opened up a fresh way to address question (1). Now that we are given the biological existence of syntax and its SEM-interface, it becomes an open question for human biology what aspects of CI-interpretation of a sentence or a phrase are configured by the syntactic derivation of its associated SEM.

Again, numerous facts about constructional homonymity already suggest that the contribution of syntax to CI-interpretation is solid and nontrivial. Moreover, Hale and Keyser (1993, 2002) convincingly argue that the argument structure and θ -theoretic properties of lexical items are largely determined by syntax, a leading idea that has fostered much subsequent research. Further, Borer (2005a,b), in articulating her exo-skeletal approach to the syntax-CI interface, convincingly argues that the CI-interpretations assigned to lexical items are not fully determined by their intrinsic features statically stored in the lexicon but rather strongly configured by the hierarchical structuring of SEM within which they are embedded. Chomsky (2004, 2007a, 2008) also observes that the duality of semantics (thematic structure v.s. discursal structure), one of the pervasive features of CI, correlates rather closely with the bifurcation of external and internal Merge (see also Narita 2009b, in progress).

Building on these results, an even stronger position is argued for by Wolfram Hinzen (2006, 2007, 2008) and Juan Uriagereka (2008). According to their view, syntax is not a tool for expressing independently constructed propositional thoughts. Rather, syntax lies at the heart of the generation of such humanly possible propositional thoughts, and certain empirical properties of thought contents *derive from* the dynamic configuration of SEM by syntax (Uriagereka's 2008 radical co-linearity thesis). For example, the structural coherence and independence of CPs at the mapping of syntax to SEM perhaps play a crucial role in explaining why 'propositions' so prominently arise, to our mind, as units of semantic analysis. Rather than stipulating them as given, we might be able to "deflate" such mysterious entities "into the notion of a CP" (Hinzen 2006:179-180), and we might also envisage more or less the same sort of deflation with respect to other postulated entities of thought, too, such as *events*, seemingly closely tied to *vP*, *referentiality*, to *DP*, and so on. More generally, it is "as if syntax carved the path interpretation must blindly follow." (Uriagereka 1999:275/2002:64, Hinzen 2006:250, Chomsky 2007a:15) The consequence of their claim is that syntax is *the* generative engine that provides the forms of humanly possible linguistically structured thoughts. Effectively, syntax therefore *is* a theory of semantics (see Hinzen 2006, 2007, 2008, Uriagereka 2008; see also Narita 2009c).

Hinzen and Uriagereka's thesis of the strong co-linearity of syntax and semantics is, again, an empirical hypothesis that is to be contested with many other hypotheses on the syntax-semantics interface. Only future empirical inquiry will advise us whether this is an adequate theory of human semantics with empirical support or rather misguided.

I would like to here emphasize one important prospect that the Hinzen-Uriagereka approach holds. As we have noted above, the discrete infinity of human sentences and many other facts amply support the biological existence of syntax, and thus its generation of CI-interpretable representations (SEM). They are, then, *bona fide* natural objects "that we can study as such, even though we see them, somewhat miraculously, systematically condition properties of linguistic meaning that we can empirically attest." (Hinzen 2006:235) Then, so to speak, to the extent that certain properties of linguistic meaning, associated with SEM, are shown to be carved out by syntax along

the lines suggested by Hinzen and Uriagereka, they are ‘naturalized’, or specifically biologized, thanks to the ‘safe’ biological ontology of syntax and SEM that the usual scientific realism naturally assigns to them.

The course of the ‘naturalization’ of semantics, recommended by Hinzen and Uriagereka, can be summarized as follows:

- (2) The biosemantic approach to the naturalization of semantics:
 - a. Assume the ontological reality of syntax as a natural object
 - b. Provide empirical characterizations of syntax and SEM as the biolinguistic study of FL leads to
 - c. Provide sufficient characterizations of interpretive/semantic properties of linguistic meanings determined by the syntactic generation of SEM, to the extent that this move is feasible and empirically reasonable at all

In articulating the research program in (2), Hinzen and Uriagereka are suggesting that we can build on the natural science of syntax as our fixed starting point, and seek to see how much our theory of syntax can tell us about the characteristics of natural language semantics. At least some aspects of natural language semantics have been already known to be carved out by syntax, leaving the question as to exactly *how much* of it is carved out by syntax (question (1)) open to further empirical inquiry.

Chomsky suggests referring to the research program initiated by Wolfram Hinzen and Juan Uriagereka as “a novel approach to what has been called ‘naturalization of meaning’.” (2007a:15; see already Hinzen 2006:235; see also McGilvray 1998, 2002, 2009) Indeed, the problem of naturalization of semantics has a tradition to be contrasted with the biosemantic approach articulated in (2). The concern for naturalization of semantics (“semantic naturalism”) has been discussed in the past, primarily in the philosophical literature (see Dretske 1981, Fodor 1990, 1991, 1994, 2008,³ Loewer and Rey 1991, Boghossian 1991, Loewer 1997, to name just a few). To take a formulation given by Loewer’s (1997) “A guide to naturalizing semantics,” semantic naturalism concerns the question in virtue of what natural language expressions are associated with semantic properties like truth-conditional contents and reference, and seeks to provide some answer to this question in some non-semantic terms. Those philosophers who Loewer (1997) calls “semantic naturalizers” regard it as a serious philosophical problem that semantic properties that they postulate, be they truth-conditions, reference, intentionality, etc., are *prima facie* not conceivable as something that physical entities can possess, and they hope that the ontology of these semantic postulates had better be somehow bottomed out by the ‘safer’ ontology of the “physical,” i.e., materials discernible by our common-sense perspective of the world or better by contemporary physics. Most of the traditional semantic naturalizers accept this position that is usually called “physicalism,” a philosophical doctrine that everything that exists in the world is “physical” in this sense, and conceive their problem of semantic naturalism to be an attempt to reformulate, or in fact reduce, semantical entities they are inclined to postulate to the physical. Thus, for example, Fodor (1994) notes,

[N]aturalizability ... is a general constraint upon the ontology of all the special sciences. It’s a methodological consequence of our conviction—contingent, no doubt, but inductively extremely well confirmed—that ev-

³See also Rønning (2008) for overview of Fodor’s naturalization program. But see also McGilvray (2002) for a serious criticism of the Fodorian representational theory of mind.

everything the sciences talk about is physical. If that is so, then the properties that appear in scientific laws must be ones that it is possible for physical things to have, and there must be an intelligible story to tell about how physical things can have them. (Fodor 1994:5)

Traditional semantic naturalizers share with Fodor the view that special sciences such as linguistic semantics, or cognitive sciences in general, should meet the condition of naturalizability in this sense.

The course of naturalization of semantics these semantic naturalizers envisage can be summarized as follows:

- (3) The traditional approach to the naturalization of semantics:
 - a. Assume what is “semantic” (i.e., entities and relations required by one’s prior conception of linguistic semantics)
 - b. Assume the ontology of the “physical”
 - c. Provide re-characterizations of (a) in terms of either reduction to or supervenience on (b)

If we interpret Fodor and other semantic naturalizers’ position moderately as just expressing a wish to find a way to bridge the gap between (the ontology of) what their linguistic semantic theories posit and what other core natural sciences do, then this wish would be more or less a concern for the problem of unification of these yet divergent disciplines. Under this weak interpretation, biosemanticists would not object to being sympathetic to this wish for eventual unification, except the proviso that the course of naturalization need not take the form of reduction as in (3c) (see Chomsky 1995a, 2000b; we will return to this point later).

However, now that Hinzen and Uriagereka provide an alternative, biolinguistic approach to the naturalization of semantics (2), we may ask to what extent their approach is ‘novel’, compared to the traditional approach to semantic naturalism (3). I will argue that there are several reasons to believe that the Hinzen-Uriagereka approach provides more promising and methodologically sound prospects for the unification problem.

4 Physicalism in the post-Newtonian era

Note that traditional semantic naturalism requires a prior definition of what counts as “physical” as its starting hypothesis (step (b) in (3)). Indeed, for there to be even an issue of naturalization of semantics of the form in (3) in the first place, as traditional semantic naturalizers claim there indeed is, some explicit criteria of “being physical” should be given, so that the physical, so defined, can then serve as the “reduction base” for their course of naturalization as sketched in (3). Providing an adequate definition of the physical is, however, anything but a trivial task, as amply discussed by, e.g., Stoljar (2000, 2001, 2006). And it seems that past semantic naturalizers have not confronted resolving this difficulty.

At the time of Descartes, at least, there was in fact a naturalistic definition of the physical, which was based on *mechanical philosophy*, a metaphysical doctrine dominant in the 17th century. The physical (body, matter, etc.), as conceived of in mechanical philosophy, is defined as any material substance with three-dimensional spatial extension. Such material, and only such material, can move and participate in his contact

mechanics. In Descartes' view, "the extension in length, breadth, and depth which constitutes the space occupied by a body, is exactly the same as that which constitutes the body," (*Principles of Philosophy*, II 10) and consequently, there cannot exist a space separate from body, since all spatial extension simply is body (*ibid*, II 16). In pushing this hypothesis, Descartes was primarily objecting to the then dominant Scholastic and Aristotelian view of the world, in which mystical forces and powers, "occult qualities" of sympathy, antipathy, and so on, affect all sorts of phenomena in the world. As a consequence of his categorical rejection of the relevance of any such "occult" forces to physics, he hypothesized that all phenomena of motion are to be explained strictly in terms of immediate contact of contiguous materials. Motion was defined just as "the transfer of one piece of matter or of one body, from the neighborhood of those bodies immediately contiguous to it and considered at rest, into the neighborhood of others" (*ibid*, II 25) Thus, he hypothesized that the causality of material phenomena is strictly closed, and bodies can be affected only by other bodies through contact. The material world, according to this mechanical view, is essentially conceived of as a machine, simply a far grander version of some automaton.

Mechanical philosophy is firmly grounded in our common-sense understanding of the nature and interactions of objects, presumably genetically determined in large part (Chomsky 2009). It has a number of features that strongly appeal to our intuitive folk physics: persistence of objects through time and space, causality through contact, body being able only to affect body, motion being able to produce nothing but motion, and so on. These corollaries are so intuitively appealing and intelligible to our common-sense understanding of the world that we often forget that this mechanical conception of the physical was effectively demolished by one of Newton's discoveries in the late 17th century. Specifically, Newton's notion of gravity affects objects at a distance, without any medium of body. Thus, his proposal was regarded by the leading scientists of the day as a reintroduction of an "immaterial," "occult" cause that Cartesian contact mechanics had eliminated long before. The mechanical philosophical conception of the material world, where causality among the physical is confined to immediate contact of the physical as a matter of principle, thus turned out to be a wrong scientific hypothesis, and so is our common-sense understanding of the world.

Ever since Newton undermined the Cartesian mechanical philosophy, the concept 'physical', here the object of study in physics, has been subject to constant falsification, modification, extension and refinement, consistently departing from people's common-sense intuitions: Newton's unified analysis of terrestrial and planetary motion in terms of universal gravity lied beyond the bounds of mechanical philosophy, and thus the domain of the physical needed to incorporate such an "occult" force as action at a distance (gravity); the problem of explaining electricity and magnetism in terms coherent to Newtonian mechanics was deemed unsolvable, and effectively overcome by incorporating electromagnetic fields as physical entities; the problem of accommodating chemistry to physics led to the introduction of even more complex hypotheses about the nature of the physical world, e.g., quantum mechanics. In this course, our common-sense beliefs and intuitions were shown to be irrelevant to natural science. Taking the lesson from the history of science into consideration, there is little reason to contend that the scientific conception of 'physical' provided by the latest physics, if any, is complete and absolute by any means. Rather, one may well expect that the eventual unification of any other yet divergent special sciences with physics may, if ever forthcoming, require a rather radical revision of physics and its conception

of the physical.⁴

Given these considerations, one should now be able to swallow the conclusion that there is no rigorous criteria of what counts as physical that can be safely assumed to constitute the reduction base for the traditional approach to the naturalization of semantics (3). On the one hand, if we invest the term 'physical' with our unanalyzed common-sense intuitions on material substance, the relevance of such common-sense beliefs and concepts to scientific inquiry has been shown to be scarce since Newton, so it has little use in linguistic sciences. On the other hand, if we were to incorporate the results of contemporary sciences into the conception of the physical ("scientific physicalism"), then the 'physical' in such a conception would include whatever the best current scientific theories postulate, to which we have no reason not to add principles and entities that the current "best theory" of biolinguistics postulates (SEM, for example). Then, the term 'physical' should be regarded as nothing more than a rhetorical device of clarification, without any substantial import (Chomsky 2009). In either case, there can hardly be any issue of 'naturalization' in the sense envisaged by traditional semantic naturalizers (i.e., reduction to the physical).

5 The Cartesian caution for the problem of free will

Apart from the issue of physicalism discussed in the previous section, one may also take issue with the fact that past semantic naturalizers typically start their investigation by accepting some prior conceptions of semantics, deeply rooted in their philosophical doctrines. Such presupposed semantic theories vary across:

- (4) a. *representational, or referential semantics*, i.e., the contention that linguistic representations in human consciousness 're-present' (or are 'about', or 'refer to') things in the world (Fodor 1987, 1990, 1994, 2008),
- b. *denotational semantics*, i.e., the contention that each linguistic term is assigned as its semantic value a 'denotation', characterized by the extension of the term or some Fregean abstraction (Russell 1905, Frege 1997),
- c. *truth conditional semantics*, i.e., the contention that for each language L, there is a truth theory that can serve as the core of an adequate theory of meaning for L (e.g., Davidson 1967, 1969, Montague 1974, rooted in Alfred Tarski's definition of truth, Tarski 1936/1994, 1983),
- d. *sociological conception of linguistic meaning*, i.e., the contention that meaning of linguistic expressions is primarily determined collectively by the speech community (Lewis 1972, Putnam 1975, Dummett 1986),

and so on. The hypotheses in (4) are *externalistic*, in the sense that the semantic notions envisaged by these hypotheses necessarily speak to various relations between language and mind-external things 'out there' (or maybe some FL-external but still mind-internal re-presentation of these things, for some of them). Indeed, virtually all traditional semantic naturalizers' theories can be characterized by one or another conjunction of these ideas.

I suppose it would not be inaccurate to conjecture that these hypotheses are firmly rooted in an unanalyzed "physicalism" that occupies traditional semantic naturaliz-

⁴This possibility leads one to skepticism about traditional semantic naturalizers' presupposition in (3c) that the course of unification should be expected to take the form of reduction to physics.

ers' concern so persistently. Presumably influenced by the traditional concern for the Cartesian "mind-body problem," once posed by Descartes as a naturalistic research question but later dissolved by Newton (see Chomsky 1995a, 2000b), traditional semantic naturalizers still believe that their investigation should not stay in such 'occult' areas as 'inside the head', and that they must somehow let their linguistic semantics relate to physical things out there or observable behaviors of organisms, so as to take advantage of the 'safer' ontology of the latter. Such "physicalism" always exhibits a strong appeal to our common-sense understanding of the world, but nevertheless not warranted as a natural scientific framework, as we pointed out above.

Once a semantic naturalizer buys any such externalist presuppositions as to the nature of semantics, the problem of naturalization becomes more or less a matter of restatement, in some sort of "physical" terms, of whatever semantic entities s/he is led by these presuppositions to posit. Consequently, s/he is further led to posit non-mental, i.e., externalist, notions like Dretske's conception of information (Dretske 1981, Fodor 1990), causal theory of reference (Kripke 1980), community languages (communalects) (Putnam 1975, Dummett 1986), epistemically optimal conditions (Stampe 1977, Stalnaker 1984), Tarskian T(ruth)-schemata (Tarski 1936/1994, 1983) and so forth to fulfill the naturalization requirement (see Loewer 1997 for overview). Consequently, the course of naturalization that most traditional semantic naturalizers envisage takes the form of reduction, as in (3), repeated here.

- (3) The traditional approach to the naturalization of semantics:
 - a. Assume what is "semantic" (i.e., entities and relations required by one's prior conception of linguistic semantics)
 - b. Assume the ontology of the "physical"
 - c. Provide re-characterizations of (a) in terms of either reduction to or supervenience on (b)

Thus, their reductionist approach arises as a consequence of their adoption of ideological physicalism in step (3b), along with the externalistic assumptions (4) for (3a).

However, now recall that the concept "physical," either a common-sense one or a scientific one, plainly lost its relevance to naturalistic inquiry. Recall further that now we are provided with the biological reality of FL, in particular syntax as its component that assures discrete infinity, for which the concern for naturalization does not arise, insofar as the current best biolinguistic theory requires its existence (it is "physical," according to scientific physicalism). Given these considerations, we should ask to what extent the externalist conceptions of linguistic semantics in (4) are to be justified as naturalistic hypotheses to be incorporated into the linguistic science of FL.

First of all, we should bear in mind that if we decide to treat these relations involving linguistic expressions and mind-external things, then we are going outside of our biology. The resultant theory would not be biological proper anymore, hence not biolinguistic. Of course, one's going outside of human biology does not necessarily entail his going outside of the boundary for serious naturalistic sciences. However, human individuals can talk about virtually all sorts of things recognizable by the human mind. Thus, unless we are given some independent characterization of what in the FL-external world can enter into such externalist relations, the domain of these notions would be unbounded, which in effect makes such an 'E-linguistic' project a 'theory of everything', hence impossible or at best intractable, as pointed out by

McGilvray (1998:237).⁵

It is an everyday truth that human individuals use linguistic expressions appropriately to the context of use, for all sorts of purposes. Language use by ordinary people, even small children, is typically not caused by any external observable stimulus, and often innovative, while still appropriate. This is what has been called the “creative aspect of language use” (see Chomsky 1966/2009 for extensive discussion). The observations of linguistic creativity would include a mundane truth that human individuals can use linguistic expressions to refer to things ‘out there’, to express truths, and so forth. Externalists claim that these facts constitute the empirical foundation of the various externalist hypotheses on linguistic semantics in (4). However, these are just *some*, but far from exhaustive, varieties of creative language use: human individuals can use language to refer to fictitious entities as well as things ‘out there’, to tell false beliefs and intentional lies as well as truths, to ask questions, to order, to make poems, to rhyme, to sing, to pass exams, and so on. Consequently, it would be a *prima facie* additional stipulation, in need of empirical justification, that reference to things out there, or truths in the world, but not any countless other varieties of linguistic behaviors, abstractly constitute foundational postulates in the science of linguistic semantics.

The question is, then, whether the *addition* of any of the hypotheses in (4) will gain substantial empirical support, to the extent that that additional hypothesis would still count as constituting the best linguistic theory. There are reasons to be skeptical about such a prospect.

The observation on the creative aspect of language use goes back to as early as Descartes (Chomsky 1966/2009). At that time, he was pushing his mechanical account of the world to its maximum, but he was aware that his mechanical explanation had certain limitations. Specifically, taking his observation on the creative language use by normal people as a crucial piece of evidence, he concluded that the human mind apparently goes beyond any mechanical account, thus that human individuals cannot be modeled by any sort of automaton. He was thus led to posit *res cogitans* (the mind) as the second substance, counterposed to *res extensa* (body, the physical), only the latter of which he hope to find mechanical understanding. The Cartesian metaphysical mind-body dualism was thus formulated as an naturalistic empirical hypothesis, and his “mind-body problem” was posed as a research question for want of an eventual unification of these two domains of inquiry.

The Cartesian conception of the physical was shown to be untenable by Newton, who reintroduced the “occult” notion of gravity to the causal theory of physical phenomena. Although Newton’s dissolution of mechanical philosophy was then perceived as profound dismay by leading scientists of the day, and even by Newton himself, it had some positive effects, too. Specifically, Newton’s denial of the Cartesian conjecture that the domain susceptible of (mechanical) scientific understanding is confined to *res extensa* in effect undermined the conceptual barrier for the possibility of “natural sciences of the mind.” Indeed, the subsequent “second cognitive revolution” in the 20th century (Jenkins 2000:2; cf. Chomsky 1994:35) brought about a body of

⁵The (un)likelihood of such an ‘E-linguistic science’ is anyway orthogonal to the legitimacy of the science of the biological computational mechanism of human language (biolinguistics, ‘I-linguistics’), since there is no known evidence that the properties of the FL-internal computation, apart from use, are affected by FL-external factors. Thus, that sort of ‘E-linguistic science’, if any, may be supplemented to but suggests no alternative to biolinguistics. See a similar comment by Chomsky on sociolinguistics (Chomsky 1995a:50, Chomsky 2000b:156). See also Lohndal and Narita (in press) for some relevant discussion.

modern 'cognitive sciences', most notably biolinguistics and the study of vision (see in particular Marr 1982 for the latter). Specifically, the essential finding was that there are substantive computational mechanisms in the domain of *res cogitans* that can be susceptible to naturalistic scientific inquiry.

However, we should bear in mind here that the characterization of *res cogitans* (the mental, whose effect is most notably evidenced in the normal use of language) as a domain that does not withstand mechanical scientific analysis was basically kept intact by Newton's dissolution of the mechanical conception of body. To take Chomsky's (2000b:84) words, "Newton eliminated the problem of "the ghost in the machine" by exorcising the machine; the ghost was unaffected." And 'the ghost', i.e., human free will, seemed to remain as mysterious and scientifically unintelligible as before. And probably it will never be overcome by human intelligence with its own genetically imposed limitations, a possibility argued for by McGinn (1991, 1993) among others.

Indeed, this (essentially Cartesian) caution has been respected more or less at face value by a number of cognitive scientists. In the course of establishing natural sciences of the mind, cognitive scientists carefully avoided involving in their computational theories the effects of intentional use by human free will, a residue of *res cogitans*, a yet uncleared 'ghost': thus, for example, cognitive scientists of vision never ask how a particular human individual decides to use the visual system to recognize, say, a book on a table in front of him. And biolinguists have every reason to take the same course, too: thus, no biolinguist succeeded in providing an intelligible computational theory of how a particular human individual uses, say, the SEM of an English expression "this room is hot" to convey a request for a glass of coke or for turning on an air conditioner.

Do we have any strong naturalistic reason to differentiate these apparently theoretically intractable cases from those of the same individual's *referring to* the deictically demonstrated three-dimensional space confined by pieces of wood by the SEM of the noun phrase "this room," or *denoting* the property of being above some contextually salient standard of temperature by the SEM of the lexical item "hot," or his *expressing a truth* (or the condition for it to be true relative to a given world) that this room is hot by the SEM corresponding to that utterance? Stipulating some distinct privileged status, such as "semantic," for these peculiar linguistic behaviors but not for countless others requires strong empirical justification, which is not obviously present at the current stage. We can formally describe such linguistic behaviors for sure, but such alleged formal descriptions may be systematic only because they are based on some particular human projects (such as formal description in terms of denotations or truth-conditions or the like), as pointed out by McGilvray (1998:228-229)

Moreover, we should also bear in mind that once one employs terms like *reference*, *true of*, *denote*, and others as scientific terminology, they become technical innovations, in which case they should be as deprived of common-sense intuitions as *tensors*, *undecidability* or SEM in the technical sense. Hence, we cannot factually test our intuitions against these hypothetical artifacts, which just mean exactly what their inventors tell us they mean (cf. Chomsky 1995a:42, Chomsky 2000b:148). The gap between our raw intuitions about referential properties of linguistic utterances and these stipulated-as-linguistic terminological artifacts is still daunting. And it is not clear that it is any less daunting than the one between our raw intuitions and SEM, either (see also Chomsky 2003).

Given these considerations, if we want to avoid the intractability of boundless free will whose nature may be forever beyond human understanding (McGinn 1991,

1993 among others), it would not be the best naturalistic decision to start an inquiry into natural language semantics by *presupposing* that the linguistic science of meaning must involve relations of linguistic expressions and FL-external things in the world, be they reference, denotations, or truth-conditions. These assumptions are in need of strong empirical justification, even before we should be concerned with ‘naturalizing’ it, whatever that amounts to.

6 The minimalist program as methodological naturalism

In the previous sections, we saw that the traditional approach to the naturalization of semantics (3) is stipulative on two accounts. First, it stipulates that the study of mental phenomena such as linguistic semantics should be grounded by some ontology of the “physical,” even though it does not provide any scientifically informative characterization of the physical that can serve as the reduction base for their purpose. Second, it stipulates some prior externalist conception of linguistic semantics, even though that is not factually supported. These starting assumptions, summarized as (a) and (b) in (3) repeated here, are hence not naturalistically motivated.

- (3) The traditional approach to the naturalization of semantics:
- a. Assume what is “semantic” (i.e., entities and relations required by one’s prior conception of linguistic semantics)
 - b. Assume the ontology of the “physical”
 - c. Provide re-characterizations of (a) in terms of either reduction to or supervenience on (b)

That is, traditional semantic naturalizers adopt “the view that we must abandon scientific rationality when we study humans “above the neck” (metaphorically speaking), becoming mystics in this unique domain, imposing arbitrary stipulations and a priori demands of a sort that would never be contemplated in the sciences, or in other ways departing from normal canons of inquiry,” (Chomsky 2000b:76) namely what Chomsky calls *methodological dualism*.

This vicious doctrine is counterposed to *methodological naturalism*, a naturalistic approach to the mind, adopted by biolinguists and biosemanticists, that “investigates mental aspects of the world as we do any others, seeking to construct intelligible explanatory theories, with the hope of eventual integration with the “core” natural sciences.” (*ibid*, 76). For them, the starting point is the empirically motivated biological existence of FL: they discovered countless facts that demonstrate the poverty of the stimulus (Plato’s problem), and demonstrated that these facts can only be explained by attributing a substantial innate biological mechanism to the human mind/brain. They further discovered that this biological mechanism must be somehow capable of making “infinite use of finite means” that derives the discrete infinity of human linguistic generative capacity (Wilhelm von Humboldt, see Chomsky 1966/2009, McGilvray 2009), which has led contemporary biolinguists to conclude that the biological mechanism in question should be characterized, at the bare minimum, by some sort of ‘recursive function’ R. Further discovery was made as to the pervasive ‘dislocation’ property of the recursive structure-generating system, whose barest characterization is discovered by Chomsky (2004) to be provided by identifying R with *Merge*, whose unboundedness results in the bifurcation of external Merge (structure building) and

internal Merge (Move with the copy theory of movement; see Chomsky 1993, 1995b). Thus, at the present stage of understanding, we put forward Merge and its recursive structure generation as an indispensable principle of the best theory of FL that unifies explanations of these foundational discoveries. As the understanding of linguistic phenomena progresses, further elaboration of the theory of FL is forthcoming, taking whatever evidence is or becomes available. And it is this empirical theory of FL that serves as the ‘first philosophy’ of biolinguists’ methodologically naturalist inquiry into FL.

The methodological decision to build on the empirical fact of some existing scientific knowledge as a fixed starting point of inquiry is rather a common exercise in the history of natural sciences. Indeed, the history of science shows that naturalistic inquiry frequently proceeds without bothering much to find philosophical or metaphysical grounds for their scientific knowledge. Recall, e.g., that Newton famously remarked “I frame no hypotheses” as to his (regretful, to him) inability to find the ultimate ground for the “immaterial” force of gravity in mechanical philosophy. This suggestion was in fact the one that was followed in the post-Newtonian era quite generally, leading to the situation where “[w]e have in our own days so accustomed ourselves to the abstract notion of forces, or rather to a notion hovering in a mystic obscurity between abstraction and concrete comprehension, that we no longer find any difficulty in making one particle of matter act upon another without immediate contact.” (Lange 1890:308) To take another example, the unification of chemistry with fundamental physics was delayed until the 20th century, but even well before that, earlier chemistry seemed to proceed fairly well by letting “chemical affinity be received as a first principle, which [they could not] explain any more than Newton could explain gravitation,” and deferring “accounting for the laws of affinity, till [they] have established such a body of doctrine as he has established concerning the laws of gravitation,” basically the course recommended by the 18th-century British chemist Joseph Black (cited by Schofield 1970:226; see also Chomsky 2003, 2009). Indeed, as Michael Friedman puts the point, “the philosophers of the modern tradition [from Descartes] are not best understood as attempting to stand outside the new science so as to show, from some mysterious point outside of science itself, that our scientific knowledge somehow ‘mirrors’ an independently existing reality. Rather, [they] start from the fact of modern scientific knowledge as a fixed point, as it were. Their problem is not so much to justify this knowledge from some ‘higher’ standpoint as to articulate the new philosophical conceptions that are forced upon us by the new science” (Friedman 1993:48). The fact of scientific knowledge, whether biolinguistic or otherwise, can be regarded as no less than a body of reality in the natural world, and it is not so much in need of philosophical justification from some ‘higher’ standpoint, say of brute ideological physicalism, as it is to be *discovered*, not to be stipulated, in accordance with the naturalist rationale and methodology.

Our science of syntax proceeds where it is to proceed, with little need to await permission by independently stipulated physicalism, whatever that amounts to. And so does biosemantics, among whose research agenda is to address question (1), with an ancillary hope for potential contribution to the biosemantic naturalization of linguistic meaning (2) (both repeated here).

- (1) How much of the interpretive/semantic properties of a given linguistic form (sentence, noun phrase, etc.) is determined (‘carved out’) by the syntactic

generation of its SEM?⁶

- (2) The biosemantic approach to the naturalization of semantics:
 - a. Assume the ontological reality of syntax as a natural object
 - b. Provide empirical characterizations of syntax and SEM as the biolinguistic study of FL leads to
 - c. Provide sufficient characterizations of interpretive/semantic properties of linguistic meanings determined by the syntactic generation of SEM, to the extent that this move is feasible and empirically reasonable at all

No progress is guaranteed *a priori*, let alone any success, and, therefore, “we can do no more than seek ‘best theories’, with no independent standard for evaluation apart from contribution to understanding, and hope for unification but with no advance doctrine about how, or whether, it can be achieved.” (Chomsky 1995a:7, Chomsky 2000b:112) Researchers in these disciplines seek no more than to refine their theory of FL in accordance with whatever empirical data become available.

There is no *a priori* criterion of what counts as data relevant to the biolinguistic inquiry (presupposing anything of this sort would be a methodologically dualist move). We can only reasonably assume that there is still something fundamentally unintelligible in mental aspects of the world that once led the Cartesians to postulate the ‘second substance’ (*res cogitans*) and seek a metaphysical and methodological alternative to mechanical scientific inquiry. This is the mystery of human free will, which most notably surfaces in the normal use of language. The first and foremost difficulty for the science of mental aspects of the world is, then, to discern a body of empirical observations that can be reasonably regarded as a systematic reflection of some deeper principle(s) of a mental mechanism that allows uncaused and unbounded access by, but is still crucially organized distinctly from, free will. This is not a difficulty specific to the scientists of the mind, but probably a more acute one, given that their objects of inquiry are, as it seems, in more ‘direct contact’ with such a ‘ghost’ than, say, gravity or electromagnetism are.

Here again, we should not stipulate *any* mental mechanisms without supporting them by a set of empirical observations that indicate some ‘ghost-proof’ systematicity not to be confused with the effects of far-reaching context-appropriateness and creativity of human free will. To respect this Cartesian caution requires meticulous scrutiny, for free will seems to be able to manufacture, taking various cues from experience, all sorts of artificial rule-systems like science, religion, music, institutional laws, rules of language games and maybe even a certain amount of ‘phonological’ or ‘semantico-morphological’ rules that may pervasively tuck in language production and linguistically structured thoughts. We should be careful not to be confused by these artificial systematicities, or intentionally regularized ‘mental behaviors’.

One of the strongest forms of argument for such a solid mental mechanism is to demonstrate the *poverty of the stimulus* for its emergence in the mind. Human free will is ‘wise’ enough to learn all sorts of regularities and generalizations that are detectable in experience, or sometimes even innovate them building on experience. But if there is some significant gap between any given finite amount of experience and some attained rules and principles in the matured mind, then such an observation on the poverty of the stimulus will serve as a strong piece of evidence for some biologically endowed

⁶Hinzen (2008:349) proposes to call this question Uriagereka’s question (Uriagereka 2008; see also Narita 2009c).

innate knowledge that fills the gap. For example, finite linguistic data by definition contains no evidence for discrete infinity of linguistic generation that is characteristic of any natural language, so human-specific genetic endowment for language should be responsible for the activation of some sort of recursive function R, whose best candidate so far is unbounded Merge. The universal existence of dislocation *qua* copying in any natural language is another crosslinguistic universal that is plainly not attainable by a wisest generalization over any given finite data of a particular I-language, thus it adds further evidence for Merge, which naturally yields internal Merge. The Aristotelian characterization of language as a ‘sound’-‘meaning’ linking system is also a true linguistic universal beyond any doubt, thus there should exist SEM and PHON generable by the Merge-based recursive computational system (syntax) and usable by CI and SM, too. Also, in order to let any sort of Merge-based computation work at all, there must also exist some finite set of ‘atomic elements’ that serve as input to Merge-based recursive structuring, which we can call *lexical items* (LIs). We really don’t know the internal composition of these LIs, but to say the very least, for each LI X, X should be by definition associated with some property that allows it to be subject to Merge, a feature that is called an *edge-feature* (EF).⁷ X may further contain, in addition to the EF, some other intrinsic features that can contribute to interpretation either at SEM and PHON or both, which we can refer to as SEM(X) and PHON(X), respectively, with the proviso that there is no known evidence to exclude the possibility that either SEM(X) or PHON(X) or both may represent an empty set for some particular LI X. So on and so forth. These poverty-of-the-stimulus arguments constitute a body of empirical bases for supposing corresponding mental knowledge, innately endowed even in abstraction of unbounded free will. If we are lucky, some portion of such a body of innate knowledge may be shown to eventually yield human scientific understanding, in which case this naturalistic inquiry will yield a theory of a coherent mental mechanism, characterized by interrelated operations and principles. To the extent that they are shown to be irreducible by some strong poverty-of-the-stimulus argument, we may regard the set of theoretical postulates in such a theory as *virtually empirically necessary*. Note that more or less the same set of postulates are also sometimes referred to as “virtual conceptual necessity” in the biolinguistic literature (see, e.g., Chomsky 1995b:169, 249), but this term might be potentially misleading, given that there is nothing ‘conceptual’ about the empirical justification of them in terms of the poverty of the stimulus.

To respect the Cartesian caution that free will may be beyond human scientific understanding, methodological naturalists should carefully confine themselves to a proper domain of the mind that is distinguished from the interference of free will. Such a domain is to be demonstrated as virtually empirically necessary by means of the poverty-of-the-stimulus argument, not to be stipulated by means of brute common-sense physicalism or ideological semantic externalism. This methodological decision not to stipulate anything beyond virtual empirical necessity is often referred to as the *minimalist program for linguistic theory* (Chomsky 1993, 1995b *et seq.*), but there is nothing specifically linguistic about this research agenda. It is just another name for methodological naturalism that takes seriously the Cartesian caution, which is in fact akin to the 17th century Cartesian mechanical philosophy in nature, in that both of them are in their essence working methodologies to find a proper domain for scientific inquiry.

⁷See Chomsky (2007a, 2008), Fukui (2008, forthcoming), Boeckx (2008b, to appear), Narita (2009a,b,d, in progress) for relevant discussion.

By limiting their domain of inquiry to *res extensa*, the 17th century Cartesians carefully severed their sciences from the fundamental unintelligibility of free will. Minimalist biolinguists succeed this very Cartesian methodology by remaining in the realm of virtually empirically necessary mechanisms of the mind, carefully distinguished from boundless free will. They are thus methodologically quite Cartesian.

At the same time, however, minimalist biolinguists are also metaphysically anti-Cartesian in not confining the domain of their natural sciences to the prison of *res extensa*, taking advantage of Newton's dissolution of Descartes' metaphysical mind-body dualism. The minimalist program for biolinguistics is, then, a *neo-Cartesian* project, as we may call it.

It is rather a regrettable fact that the term 'minimalism' is sometimes wrongly construed as a mystic or even a methodologically dualist doctrine that unwarrantedly disrespects empirical facts and incorporates vague concepts like simplicity and optimality into the theoretical vocabulary without serious empirical justification. But this is plainly a misinterpretation. Minimalists are not mystics but, on the contrary, honest and serious realists: they decide not to presuppose any methodologically dualist doctrine, and *therefore*, just in order to respect the Cartesian caution, they decide to start from the limited set of postulates of valid virtual empirical necessity. In fact, we can equally call the same research project the *naturalist program*, explicitly emphasizing its methodological naturalism.⁸

Due to their methodological Cartesianism, naturalist-minimalists try their best to eliminate recourse to postulates that are not justified with certainty as virtually empirically necessary. In earlier frameworks of biolinguistics, there were a lot of theoretical constructs that were later shown not to count as virtually empirically necessary, such as the varieties of government, the Empty Category Principle, D- and S-structures, the bifurcation of phrase-structure rules and transformations, bar-levels in X-bar theory, indices, and so on. In the course of naturalistic inquiry, these postulates were naturalistically accused of their theoretical redundancies, descriptive inadequacy, and/or inherent stipulations beyond virtual empirical necessity. However, it should also be noted that they were originally argued for by means of some real poverty-of-the-stimulus facts, many of which still pose valid problems that await alternative explanations. The difficulty specific to biolinguistics is again quite naturalistic, which is that we couldn't yet have come up with good theoretical postulates, other than Merge, that crosscut and link the explanations for the remaining poverty-of-the-stimulus facts and are in themselves demonstrated as virtually empirically necessary.

The same minimalist-naturalist scrutiny should apply to the technical apparatuses posited in the domain of linguistic semantics, too, insofar as it is claimed to be part of FL and thus to be a topic for biolinguistics. Take, for example, statements like "'snow' refers to (or re-presents or denotes) snow," or "'John is hungry' is true iff John is hungry." Statements of these types constitute an purported basis for contemporary model-theoretic denotational semantics, be it externalistic or posited as FL-internal postulates. It is presumably true that an English speaker's effortless understanding of these statements owes quite a lot to some FL-internal mechanisms apart from the

⁸It is true that minimalists attempt to seek simplicity and optimality whose conceptions are not yet clarified or defined, but they do so, as any other natural scientists do, not as a matter of presupposed doctrine but as a matter of working methodology that was continuously found to be extremely useful in the entire history of science from Galileo and other 17th century natural philosophers onwards. See also the discussion below.

power of his free will, including the SEMs assigned to these English expressions. The generation by syntax of these SEMs are in turn based on the biologically endowed semantic features (SEMS) of the lexical items (LIs) employed in these SEMs, such as $SEM(John)$, $SEM(hungry)$, $SEM(snow)$, in addition to $SEM(refer)$, $SEM(true)$, and so forth. On one hand, there are indeed nontrivial poverty-of-the-stimulus arguments for the existence of the intrinsic semantic features of these LIs—an English speaker comes to possess knowledge of what these LIs mean, in large part without any conscious effort nor any explicit training. On the other hand, there is presumably no biologically endowed innate knowledge that contributes to the interpretations of *denote*, *represent*, or *iff*, since these words are technical terms, whose references are set *a posteriori* by their innovators. And so are the particular occurrences of terms *refer to* and *true* in these theory-loaded statements. It is quite possible that $SEM(denote)$, $SEM(represent)$, and $SEM(iff)$ each represent an empty set, and the denotations of these terms are supplemented *a posteriori* by free will in service of some particular human-made projects (e.g., formal semantic description). Correspondingly, we are not sure whether there are any facts of naturalistic interest (such as the poverty of the stimulus) for statements of the sort “‘snow’ refers to (or re-presents or denotes) snow,” or “‘John is hungry’ is true iff John is hungry.”

Even less clear are the additional theory-loaded assumptions of semantic types, model-theoretic calculations by Fregean functional application, or strict compositionality distinct from syntax’s contribution. Note in this context that both Pietroski (Pietroski 2005, 2007, 2008, to appear) and Partee (2006) claim that postulation of semantic types is redundant and can be eliminated from semantic theory. Specifically, Pietroski’s *conjunctivist semantics* further claims that the recourse to Fregean functional application can also be eliminated. Simplifying somewhat, he claims that symmetric Merge ($\{X, Y\} = \{Y, X\}$) directly feeds, or maybe even just *is*,⁹ the symmetric ‘and’ operator in CI-interpretations couched in neo-Davidsonian event semantics ($(\exists e:) X(e) \& Y(e) = (\exists e:) Y(e) \& X(e)$). The other side of the same coin is the claim that there is no need to depart from the desirable syntax-semantics co-linearity by assuming that the basic semantic compositional operation correlative of Merge is inherently asymmetric, as most model-theoretic semantic frameworks assume. Consider, e.g., function application, which maps a symmetric Merge-result $\{X, Y\}$ to a value of the function (say the ‘semantic value’ of X , $\llbracket X \rrbracket$) applying to the argument (here the semantic value of Y , $\llbracket Y \rrbracket$), i.e., $\llbracket X \rrbracket(\llbracket Y \rrbracket)$. Note the inevitable asymmetry in semantic composition ($\llbracket X \rrbracket(\llbracket Y \rrbracket) \neq \llbracket Y \rrbracket(\llbracket X \rrbracket)$), which crucially leads them to postulate various *types* of semantic-values (quite often cast in denotational terms) associated with each LI, an undesirable consequence for naturalist-minimalists that conjunctivist semantics neatly avoids. For conjunctivists, the compositional ‘predicate’-‘argument’ asymmetry is to be carved out by some asymmetry-creating syntactic operation (other than the symmetrical Merge), for which various proposals have been put forward: θ -feature checking (Hornstein 2002 and references cited therein), labeling (Irurtzun 2007, Boeckx 2008a, Hornstein 2009), minimal search (Agree) with respect to edge-features (Narita 2009b), and Transfer (Boeckx to appear). (See Pietroski (2005) for various arguments that the conjunctivist semantic theory, which gets rid of function application and semantic types and hence is simpler, does provide equally good (or sometimes even better) accounts of a variety of entailment phenomena. See Pietroski (to appear) for further consequences.)

⁹See below and Narita (2009b, in progress) for relevant discussion.

These comments, however, should not be taken by model-theoretic semanticists as discouragement. There are indeed a number of professional journals and publications for contemporary semantics where a growing number of interesting observations are descriptively presented for a number of particular words and constructions in a variety of natural languages, many of which indeed seem to be valid poverty-of-the-stimulus facts that await naturalistic explanations: discoveries on conservativity of natural language quantifiers, specificity and definiteness effects of various sorts, information-theoretic regularities, patterns and conditions of structural entailment (downward or upward) sanctioning certain dependencies (say negative and positive polarity), and various others. It is just that the commonly employed technologies like semantic types, Fregean function applications, strict compositionality in terms of model-theory and so on are so far not demonstrated by some independent poverty-of-the-stimulus argument as virtually empirically necessary postulates. In short, there are a number of valid empirical observations of semantic interest, but so far few postulates that are demonstrated as virtually empirically necessary that unify and link explanations for these observations, a situation that is quite commonly attested in any naturalistic inquiry.

It might be that the semantic postulates of the model-theoretic kind will be eventually demonstrated as virtually empirically necessary by some crucial poverty-of-the-stimulus facts. Or it might be that the postulates that are already demonstrated as virtually empirically necessary in the study of syntax, say Merge, SEMS of LIs, and SEM, will contribute a lot to the eventual unifications of the yet unrelated explanations of these empirical data, probably with radical modification and refinement of these postulates. This is just one of the many unification problems that biolinguistics faces.

Each naturalist science has its own domain of inquiry, each of which is characterized by the virtual empirical necessary postulates for that domain. As for biolinguistics, the single most important discovery is that Merge is a virtually empirically necessary operation that cross-cut the explanations for some of the crucially relevant poverty-of-the-stimulus facts. Current biolinguistic inquiry tends to take the form of 'Merge-imperialism' which seeks to reduce as many theory-internal postulates to Merge as possible (Chomsky 2007a,b), for the simple reason that so far biolinguists could not have succeeded in pinning down any other theoretical construct as virtually empirically necessary as Merge.

However, it is not true that biolinguists have nothing other than Merge to rely on to investigate their domain of inquiry. In this context, consider Newton's dissolution of the metaphysical mind-body dualism again: as we have seen, Newton's destruction of *res extensa* in effect demolished the conceptual barrier for the possibility of natural sciences of *res cogitans*. What is more, it also effectively emancipated the domain of laws of physics from the prison of *res extensa*. The mind-body dualism declined, and we were explicitly told by Newton's discovery that we have no valid metaphysically closed framework of the physical that partitions off the domain of application of physical laws as a matter of principle. This conclusion troubled the Cartesians a lot, and Newton was then very often accused of his reintroduction of the immaterial occult force to the domain of physics. But, at least for the purpose of pursuing cognitive sciences, we can regard this Newtonian conclusion as rather advantageous. Specifically, there is no longer a well-defined boundary for the coherent physical domain in the post-Newtonian era, and correspondingly, there is no longer any principled reason to exclude the possibility that the set of laws of physics, chemistry, theories of computa-

tion, and all other natural sciences are also applicable to the domain of the mind as well. We can only conjecture, as the Cartesians did, that free will still resists explanations in terms of these physical laws, but the possibility becomes an open empirical question for the discovered mental mechanisms, subtracted from free will. There are indeed quite a few general laws of nature that are discovered and independently justified by physicists and other scientists as virtually empirically necessary in their domain of inquiry. The set of virtually empirically necessary postulates that are not specific to human language is now commonly referred to as the *third factor of language design*¹⁰ (Chomsky 2005). The null hypothesis is that these general laws of nature are also applicable to the mental aspects of the world. This conclusion is even required by a physicalist statement of the sort “everything that exists in the world is physical.” The successful progress of ‘physics-imperialism’ in the 20th century adds another historical plausibility argument for such a null hypothesis. Indeed, the *inapplicability* of such generalized laws of nature to a certain domain, say of language, would be a nontrivial empirical finding that requires explanation.

That said, the nature of the third factor that enters into the theory of FL is admittedly quite ill-understood at this early stage of biolinguistic inquiry. But there are already some proposals. For example, consider the principle of *economy of derivation* proposed by Chomsky (1995b:138-145):¹¹

(5) *Principle of economy of derivation:*

For each pair P of SEM and PHON, syntax chooses the least costly derivation to generate P, where the cost of derivation is determined by some syntax-internal metric, such as the number of derivational steps (Merge, Agree, etc.).

Fukui (1996) points out that this economy principle can be regarded as the linguistic (and hence discrete) version of Hamilton’s Principle of Least Action, a fundamental unifying minimum principle in physics from which numerous laws in various subfields of physics can be deduced, including the laws of mechanics, optics, electricity, and magnetism.¹²

An important corollary of the principle of economy of derivation is that there can be no superfluous derivational step in a given syntactic derivation that does not contribute to some interpretive outcome at CI. Building on this consideration, Narita (2009b, in progress) postulates a strong syntax-semantics co-linearity thesis, which he calls *Derivational Full Interpretation* (DFI):

(6) *Derivational Full Interpretation* (DFI) (Narita 2009b:240,(50)):

Every syntactic operation correlates with interpretation at CI.

Adopting Pietroski’s (Pietroski 2005, 2007, 2008, to appear) conjunctivist semantics reviewed above, Narita claims that Merge of X and Y correlates with, or even maybe just *is*, the ‘&’-conjunction of SEM(X) and SEM(Y) at CI. He further claims that X’s θ -

¹⁰‘Third’ because it is in addition to the first factor (genetic endowment specific to human language) and the second factor (experience) of language design. See Chomsky (2005, 2007a, 2008).

¹¹Some researchers claim that the domain of such economy considerations is localized to well-defined parts of a given derivation, e.g., phases (Chomsky 2000a, 2008). See also Collins (1997), Uriagereka (1999).

¹²One of the familiar examples is the effect of Fermat’s Principle of Least Time in optics, which states that a ray of light in traversing a route from one point to another follows the path that requires least time.

marking Y at CI correlates with minimal search (Agree) of an edge-feature from X to Y in syntax, and that from the assumption that the mode of application of the relevant θ -marking operation is constrained by the principle of economy of derivation, we can deduce the effect of the so-called θ -Criterion, a condition that any argument category must receive one and only one θ -role. He further claims that the observation that any optional application of internal Merge is required to yield some new discursual interpretation (see Reinhart 1997, 2006, Fox 2000, Chomsky 2001 and Kuno 2003) can be seen as another corollary of DFI.

It is significant to observe that the principle of economy of derivation (5), a likely corollary of such a law of nature as Hamilton's Principle of Least Action, leads syntax to adopt a more transparent syntax-semantics mapping, such as DFI (see Uriagereka 2008 for a different approach). The relevant properties of CI-interpretation are thus 'naturalized' by the law of nature, the third factor of language design. This is a significant contribution to the biosemantic approach to the naturalization of semantics ((2) repeated here).

- (2) The biosemantic approach to the naturalization of semantics:
 - a. Assume the ontological reality of syntax as a natural object
 - b. Provide empirical characterizations of syntax and SEM as the biolinguistic study of FL leads to
 - c. Provide sufficient characterizations of interpretive/semantic properties of linguistic meanings determined by the syntactic generation of SEM, to the extent that this move is feasible and empirically reasonable at all

As we have seen, minimalist-naturalists are honest and serious realists who start their inquiry from the limited set of virtually empirically necessary postulates, be it the language-specific Merge-operation or empirically successful postulates borrowed from other naturalistic inquiries (the third factor), taking advantage of the Newtonian dissolution of the metaphysical barrier for such commensurability between 'physical sciences' and 'mental sciences'. To the extent that effects of the physical laws of nature penetrate the domain of FL, this mental mechanism is naturalized/'physicalized', in a way quite different from traditional semantic naturalizers' reductionism couched in ideological physicalism.

To what extent such naturalization is feasible and plausible is an open empirical question, to which we cannot and should not stipulate any *a priori* answer. Again, due to the still daunting intractability of free will, we can only reasonably proceed to address this question by sticking to and refining our set of virtually empirically necessary postulates, taking whatever evidence is or becomes available.

7 Concluding remarks

The possibility of natural sciences of the mind was opened up by the 17th century scientific revolution, where natural science came to take its modern shape. The conceptual barrier for such a naturalistic inquiry was first posed as a by-product of Descartes' mechanical philosophy, but was later eliminated by Newton. However, at the same time, the mystery of free will essentially remains much in the same form as Descartes observed with puzzlement, and the serious naturalistic inquiry into the nature of mind is presumably only possible when the issues of free will are avoided even in the study

of mental aspects of the world. Thus, natural sciences of the mind, if any, would be both methodologically Cartesian and metaphysically anti-Cartesian, in that it respects Descartes' methodological recommendation of avoiding the issues of free will, but it also rejects Descartes' metaphysical mind-body dualism.

This paper argued that biolinguistics under the rubric of the naturalist-minimalist program is essentially such a neo-Cartesian project. It starts from empirical observations, most notably on the poverty of the stimulus, that clearly demonstrate the existence of nontrivial innate knowledge, and it takes as real whatever theoretical postulates are shown to be virtually empirically necessary, without caring much about philosophical justification of them by means of, say, crude ideological physicalism. There is nothing special about this line of approach, or it indeed is just a common practice taken by most of the natural sciences. It is methodological naturalism.

It was pointed out that there is currently no interesting conception of physicalism that can pose a complete and coherent boundary of the physical for which physics can in principle provide explanations. Correspondingly, we have no principled boundary between 'physical sciences' and 'mental sciences'. The situation is then just that there are a number of partially or completely unrelated empirical observations in the physical and mental aspects of the world, each of which potentially indicates the ontological reality of some virtually empirically necessary postulate(s), be it general relativity, electromagnetic fields, the Principle of Least Action, Merge, quanta, prime numbers, LIs, so on so forth. We can do no more than to seek best theories of the given set of empirical observations, making use of whichever of these postulates are found useful, without presupposing any stipulations as to how general each postulate's domain of application can get. Methodologically speaking, then, all the existing sciences are unified under the general rubric of the naturalist program, and the challenge is just to really find true linking hypotheses that crosscut explanations for one or more of these observations, probably with substantial modification and refinement of the postulates that have been thought of as virtually empirically necessary. No progress is guaranteed, let alone any success, but this has been, and always will be, the norm for naturalistic inquiry.

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