

**OVERVIEW ARTICLE**

# Language design and communicative competence: The minimalist perspective

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In the Minimalist Program, the place of linguistic communication in language evolution and design is clear: It is assumed to be secondary to internalisation. I will defend this position against its critics, and maintain that natural selection played a more crucial role in selecting features of externalization and communication than in developing the computational system of language, following some core insights of Minimalism. The lack of communicative advantages to many core syntactic processes supports the Minimalist view of language use. Alongside the computational system, human language exhibits ostensive-inferential communication via open-ended combinatorial productivity, and I will explore how this system is compatible with – and does not preclude – a Minimalist model of the language system.

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“For in spite of language, in spite of intelligence and intuition and sympathy, one can never really communicate anything to anybody.” – Aldous Huxley (1931)

## 1 Introduction

With the possible exception of the centuries-old debate about the developmental basis of language (roughly, nativism vs. empiricism), the question of whether language is primarily an instrument of thought or communication may well be the oldest controversy in the study of language. I will here critique a number of positions in this ancient dispute, ultimately defending the view generally attributed to modern generative linguistics. Specifically, it is a major claim of contemporary Minimalist linguistics (founded by Chomsky 1995) that the core features of language (discrete infinity and recursion) are not found in other known communication systems, and as such it is implausible to claim that language evolved for communication. The major topics of critique will here be centred on the following three proposals, which will be discussed sequentially:

1. There are no communicative advantages to many core linguistic processes (e.g. successive-cyclic movement).
2. “Communication” is not a natural class and so any putative human communication system cannot have been subject to the laws of evolution.
3. Core aspects of language are difficult to derive through the logic of natural selection.

Carruthers (2002: 657–658) writes that a general consensus in cognitive science aligns with “the (purely) communicative conception of language”. In contrast, the generative tradition maintains a computational conception of language, seeing it as a tool of thought (e.g. Hinzen 2006; Chomsky 2013).

## 2 Proposal 1: Use of language

Natural language exhibits a range of features which pose difficulties for evolutionary accounts which hold that it primarily evolved to serve a communicative function. The property of discrete infinity, for example, has a wide range of cognitive functions (Hauser & Watumull 2017), making it appear more plausible that it was selected for aiding recursive forms of cognition, or mathematics, or morality. Language differs from animal systems of communication in that it is not stimulus-driven, nor does it have a specialised function like alarm calls or seduction songs.

Core features of syntax under the Minimalist model, such as recursive embedding and dislocation (i.e. phrasal “movement” from one syntactic position in a sentence to another), in fact hinder communication (Pietroski & Crain 2005). There appear to be no communicative advantages to successive-cyclic movement, the conservativity of quantifiers, and numerous other core properties of the syntax-semantics interface (Keenan & Stavi 1986; Boeckx 2003; Piattelli-Palmarini 2008).

The language faculty is itself underspecified, being able to be realised morpho-phonologically and syntactically in a variety of ways, lacking a stable state of the kind needed to maximise communicative efficiency. In addition – and perhaps most importantly – investigating the role of language in communication tells us nothing about the design of the language system itself; the major goal in contemporary Minimalism (Chomsky 2001).

There are also a range of unacceptable outputs of syntax that are nevertheless comprehensible. To pick one example, consider double object constructions (Barss & Lasnik 1986; Larson 1988; Jackendoff 1990a).

- (1)
  - a. \*I showed himself John
  - b. I showed John himself.
- (2)
  - a. \*Which lion<sub>i</sub> did you show its<sub>i</sub> trainer?
  - b. Who<sub>i</sub> did you show his<sub>i</sub> reflection in the mirror?
- (3)
  - a. \*I gave anyone nothing.
  - b. I gave no one anything.

Anaphor, *wh*-movement and weak crossovers, negative polarity items and a range of other constructions permit double object asymmetries whereby a slight syntactic reorganisation results in degraded acceptability. If the connection between syntax and externalisation was close such that syntax was selected for based on its communicative potential, one would expect breakdowns in syntax to have severe communicative impacts. In addition, if the language faculty was geared towards communication, one would expect a much more idiosyncratic variation in acceptability levels in grammaticality judgements; a prediction not borne out (Sprouse & Almeida 2017). As Hinzen (2006: 131) notes, “the strange intricacy of syntactic rules makes communication harder, by keeping us from assigning meanings to expressions that it would otherwise make perfect sense to assign to them, and that may even effortlessly be assigned”.

Consider another case of co-reference. If language were optimised for communication, then syntax and interpretation would presumably opt to be implemented over linear distance, rather than some more abstract unit of hierarchical structure. As Asoulin (2016) and Reinhart (1983) discuss, it was originally believed that the way to capture

the distinction between (4a) and (4b) a linear relationship of precede-and-command was computed, through which the pronoun cannot both precede (linearly) and (c-)command its antecedent (since ‘her’ in (4b) precedes but does not c-command ‘Jane’ it was thought that this explained the contrast).

- (4) a. \*She<sub>i</sub> denied that Jane<sub>i</sub> met the minister.  
 b. The man who travelled with her<sub>i</sub> denied that Jane<sub>i</sub> met the minister.

Reinhart (1983: 36ff.) points to notable exceptions to this arbitrary rule:

- (5) a. \*In John’s picture of Mary<sub>i</sub>, she<sub>i</sub> found a scratch.  
 b. In John’s picture of Mary<sub>i</sub>, she<sub>i</sub> looks sick.  
 (6) a. \*She<sub>i</sub> found a scratch in John’s picture of Mary<sub>i</sub>.  
 b. \*She<sub>i</sub> looks sick in John’s picture of Mary<sub>i</sub>.

The alternative explanation that Reinhart and other syntacticians have provided is that co-referential relations are established not via linear relationships, but via the structural properties of the phrases. Through this analysis, coreferential readings are permitted only when anaphors are bound by another nominal (subjects can bind objects, but objects cannot bind subjects). This is one of many examples in which linear distance is ignored – to the detriment of communicative efficiency – in favour of structural distance. In addition, even the normal functioning of the parser (part of the sensorimotor system) operates without much concern for communicative efficiency, leading to a range of structural ambiguities and garden path sentences (see Phillips & Lewis 2013).

Similarly, the normal functioning of syntax leads to situations which reduce communicative flexibility and efficiency. Consider the structure in (7).

- (7) You persuaded John to buy a car.

Both the individual and the object being purchased can be questioned, but questioning the more deeply embedded object forces the speaker to produce some form of more complex circumlocution ([ ] = originally merged position of *wh*-expression).

- (8) a. \*[What] did you persuade who to buy [ ]?  
 b. [Who] did you persuade [ ] to buy what?

Both structures in (8) involve the same lexical items and same interpretation, yet because (8a) involves the more computationally costly process of moving the more deeply embedded (and hence more difficult to search for) element, it is deviant (see Chomsky 1995 for discussion). If language were fundamentally geared towards concerns of communication, it would licence both structures in (8), yet it prioritises the demands of syntactic computation.

Even a cursory review of the Minimalist literature reveals that the structure and design of language is assumed to be optimised for cognition, not externalisation, and this is consequently where the bulk of research has been focused; namely, into rules governing morphophonology, morphosyntax, agreement, labeling, transfer, phases, the feature types manipulated by syntax, and economy principles like Last Resort (Adger 2019). The general trend is to focus on the *formal* structure of language, rather than its range of potential *functions*. Minimalism and “internalism” (which, in philosophy of biology, stresses the importance of structural complexity over external shaping effects; McGhee 1998; Amundson 2006) is also the standard position in physics: the solar system has no “function”, but it does have an internal structure, dictated by natural law. Minimalist assumptions about

syntactic workspace architecture, the searching of features, and the categorial labeling of lexical roots (e.g.  $\langle n, R \rangle$ ) are not tied to any models of communication.

None of this is to deny that language is *used* in the service of communication; rather, it is to deny that its design features are primarily geared towards communication. As Fodor and Pylyshyn (2015) explore, thoughts and sentences share identical structural organisation (see also Pietroski 2018). As Jackendoff (1990b: 27) claimed shortly before evolutionary linguistics became a major topic of concern, “syntax presumably evolved as a means to express conceptual structure, so it is natural to expect that some of the structural properties of concepts would be mirrored in the organization of syntax”.

This is not to discount the gradual impact of communicative factors on syntactic *output* (as opposed to the generative system itself). Consider, for instance, how Kayne (1994) initially provided a UG-based parametric account for why rightward movement is generally restricted cross-linguistically, only for Ackema and Neeleman (2002) to account for this through invoking increased parsing difficulties. These parsing effects *may* dovetail into communicative functionality, although establishing this connection with any degree of empirical strength is difficult (see also Gazdar 1981).

Moreover, it is not strictly the case that Minimalists have a precise conception of communication *per se*; rather, they have a conception of the language faculty’s *relation* to communication. A core Minimalist assumption is that communicative factors had no impact on the evolution and format of the generative system in terms of its computational procedures (e.g. Search, Merge, Label...) and representations (e.g. syntactic and semantic features; Adger & Svenonius 2011).

Lastly, turning to semantics, in a recent review Gibson et al. (2019: 389) argue that “languages must offer communicative efficiency under information processing and learning constraints”. While the process of communication itself may be in many respects efficient (drawing on linguistic and non-linguistic processes), this is distinct from claiming that the language system itself is geared towards communicative efficiency. The claim that externalisation has been shaped by pressures of communicative efficiency, and is strongly influenced by natural selection, is not incompatible with the Minimalist perspective. One of the arguments that Gibson et al. (2019: 393) provide is that context “resolves all communicatively relevant ambiguity”. Not only is “all” much too strong, but this is also an argument about everyday language use, and not about the design of the language system. Overall, Gibson et al.’s (2019) main thesis is that efficiency shapes externalisation – an interesting thesis but one which is crucially not incompatible with Minimalism (contrary to the way the topic is framed by the authors).

When claims are made about ambiguity being beneficial for communicative efficiency, the domain of inquiry is typically restricted to a small range of ambiguities, like simple forms of polysemy or basic forms of syntactic ambiguity (as in Gibson et al. 2019 and their focus on why SVO syntax might be more communicatively efficient than SOV syntax), ignoring more complex polysemy (e.g. copredication; Collins 2017) and syntactic phenomena (e.g. islands; Asoulin 2019). Copredication, for instance, provides a flexible means of relating distinct concepts, as when a “lunch” is conceived as “tasty” but also “delayed”; a novel form of perspective-generation but not optimal for clear referential communication. In cases of homonymy or polysemy a lack of concern for communicative efficacy and efficiency is also found, whereby a discrete word like “bank” can refer to a riverbank (‘John sat by the bank’), a financial institution (‘The bank was sued’), a building in which the financial institution is located (‘The bank is across the street’), its employees (‘The bank went on strike’), and so forth. Syntactic islands also provide perfectly cognizable thoughts, as has long been known (Boeckx 2012; Sprouse et al. 2012), but ones which cannot be articulated, suggesting that the interface between syntax and interpretation is prioritised over the interface the between syntax and externalisation.

### 3 Proposal 2: Insights from ethology

“Communication” is not a natural class, and so any putative human communication system cannot have been subject to the laws of evolution, and is rather a collection of distinct processes like intention, reference, imitation, and so on. The term “communication” will always need considerable unpacking, no matter what theoretical context it appears in. As Chomsky (2018: 34) notes, “probably 99% of our use of language” involves “talking to ourselves, something that we do constantly, night and day, and can only be prevented by a dedicated act of will”. Chomsky notes that while internal speech is ‘conscious’ in its phonology (e.g. echoic memory, phonological loop), everything else about it is unconscious (syntax and semantics). Chomsky provides no direct empirical support for this “99%” claim, although it is difficult to think of ways to conduct a controlled investigation of language use once one considers the range of cognitive functions narrow syntax might be contributing to (Hauser & Watumull 2017). Dor (2017: 44) even argues that the evolution of language aided our ability to lie possibly more than it aided our ability to communicate: “We evolved *for* lying, and *because* of lying, just as much as we evolved for and because of honest communication”. He adds: “Language would be much simpler had it evolved just for honest communication, and we would be much less imaginative, suspicious and inquisitive, and emotionally-controlled. We would probably have very little symbolic culture, no myths, no propaganda, and we would also probably insult each other much more often” (Dor 2017: 57).

How to discuss this issue within a broader ethological context? Consider how the human conceptual system is uniquely rich, with 3-year-olds reaching 300 words, the very limit that adult non-humans have acquired after intensive training (Anderson 2004). Numerous monkey species produce call combinations which convey complex meanings distinct from the atomic calls, but do this in a highly constrained and non-cyclic fashion (Zuberbühler 2012). Monkey alarm calls in particular appear to be homologous to spontaneous human emotional vocalisations, given their common neural organisation (Owren et al. 2010; 2011). Bottlenose dolphins demonstrate “a capability for reasoning about higher order relations through the spontaneous combination or concatenation of previously generalized concepts” (Herman et al. 2008: 139). A syntactic labeling operation (Shim 2018), attributing to hierarchically organised phrases a particular syntactic/combinatorial identity, appears to be absent from all of these computations. The communication systems of nonhuman primates (prosimians, monkeys and apes) appear to have a fully specified semantics related to basic, non-complex concepts, but their means of manipulating these representations appears relatively meagre. While a basic syntax with compositional semantics has been argued for in the discrete vocal system of a social passerine, the pied babbler (*Turdoides bicolor*) (Engesser et al. 2016), it is far from clear that this finding taps into computational capacity rather than some other cognitive system like associative memory (e.g. see the critique in Bolhuis et al. 2018).

Though clearly lacking in cyclicity, the evolution of rhythm can be explored through examining the drumming behaviour of Fongoli chimpanzees. These apes crack a baobab fruit (*Strydnos spp*) in a particular rhythm, and as Meguerditchian et al. (2017) review the sequences appear to be composed of repetitive power beats, or sequences of 1 power beat + 1 soft beat (i.e. a loud beat and a quieter beat), or 1 power beat + 2 soft beats. Interestingly, this appears to map onto the basic syntax of monkey calls (Murphy 2016), such that individual calls can be isolated (e.g. ‘krak’) or delivered with a smaller morphological element (e.g. ‘krak-oo’), similar to 1 power beat + 1 soft beat structures, and sometimes with two “main” calls followed by a single morphological element. A more complex rhythmic pattern is not found amongst these chimpanzees (see also Berwick 2011).

While animal communication systems may not be discrete and compositional, animal conceptual systems certainly are. Nonhumans can grasp colour, material, location and number concepts and map these onto novel situations and objects (Shettleworth 2009). They can also recombine learned concepts productively through using reasoning by exclusion (Aust et al. 2008) or transitive inference (Paz-y-Miño et al. 2004) to infer concepts they have no perceptual basis for. Likewise, while baboon calls and their associated meanings may be simple, baboon cognition is far from rudimentary, exhibiting hierarchical social structures, semantic combinatorics and a rich pragmatics system (Fitch 2017). Koko, a western lowland gorilla, allegedly exhibited the ability to master over 1000 gestural signs, even combining discrete signs to refer a new object which corresponded to the intersection of the meaning of two signs, referring to a ring as a ‘finger bracelet’ (Patterson & Linden 1981). Nevertheless, this was only after massive training efforts, not needed for human infants, and the data has never been analysed by a third party. Terrace (2019) reviews a range of related cases of attempted non-human linguistic training, and suggests that Chomsky (and other generativists) were right in their claim that non-humans cannot acquire language, but for a different reason to the one given (i.e. their limited syntax): Non-human primates cannot even learn words, let alone syntax. Likewise, Jiang et al. (2018) documented the predictive mental abilities of rhesus macaques, triggering a context-free grammar via operant conditioning tasks, but their trainings ran over 1000 trials of task sessions. In addition, no ape communication researchers have so far shown that nonhuman species can use a hierarchical reassembly process to imitate such gestural or vocal forms, suggesting that the gestural signs used by apes are implemented simply through more basic forms of imitation. Primate calls also typically exhibit an “audience effect”, being used in the presence of conspecifics, whereas human language is often externalised in the absence of any audience (e.g. soliloquies, brief comments about events, singing). Meanwhile, human syntax is deployed in a range of novel ways which aids planning, interpretation and memory – and when it is used to communicate, it is sometimes done to manipulate and influence the mindset of others to one’s own advantage (see Rebol 2015). What appears most unique about language, then, is not its communicative potential, but its combinatorial and interpretive scope.

What of other, closely connected linguistic notions? Terrace, reviewing decades of ape communication studies, claims that there is “[n]o evidence that apes used any of the symbols they learned to *refer* to objects or events, or that those symbols had any function other than to request food or drink” (2005: 101). What ethologists define as the “eagle call” may not, in fact, refer to eagles: Animal communication “units aren’t designed to refer, they’re designed to get other animals to do things” (Bickerton 2009: 12). Bees and ants also display the capacity for signal displacement (e.g. the waggle dance of bees), but these signals are thoroughly hardwired and genetically determined, whereas humans can achieve signal displacement simply through conventional learning (Aboitiz 2017: 18–22) and for a multitude of functions. Informally speaking, it has been well established by ethologists that animals do not have names for things, but what has not been recognised by many language scientists is that neither do humans: Internalist studies in philosophy of language show that lexical items are highly intricate and conceptually independent of the entities posited by physical theory (Chomsky 2000; 2018; Hinzen 2006; 2007), and act as instructions to construct highly specific concepts (Pietroski 2018). Contrary to externalists like Putnam (1975) and Burge (1979), *water* does not directly amount to H<sub>2</sub>O partly because “[e]ntities in a domain of the mind do not symbolize other elements in that domain: they *are* the elements” (Bouchard 2013: 44). Indeed, “the belief in the existence of *definitions* is really utopian” (Hornstein 1984: 132). For Pietroski (2018) in particular,

linguistic meaning is not formulated in terms of entities, truth-values, functions or type hierarchies, but in terms of concepts picked out by lexical items. This distances linguistically-manipulated concepts even further from communicative endeavours.

#### **4 Proposal 3: Communication and evolution**

This penultimate section will branch out to broader evolutionary concerns, exploring Proposal 3 that natural language syntax cannot be explained through natural selection, whereas communicative competence readily can. As such, it pursues this topic in the spirit of Lightfoot's (1991) observation that the syntactic principle of "[s]ubjacency has many virtues, but [...] it could not have increased the chances of having fruitful sex".

There are reasons to believe that sensorimotor processes shared across a variety of vertebrates could underlie language-universal acoustic patterns in humans, supporting the Minimalist assumption that while certain components of externalisation may exhibit species-specific patterns, externalisation itself should not be a candidate for a species-specific property of language. Particular focus should be placed on terrestrial vertebrates, or tetrapods (nonavian reptiles, mammals, birds, amphibians), with whom we share a substantial proportion of our hearing and vocal production machinery. As Fitch (2018: 263) summarises: "50 years of comparative speech research reveals a broadly shared set of perceptual mechanisms that, although potentially evolved for conspecific voice perception in amniotes, are in no sense unique to human speech". Fitch adds that certain "phenomena such as categorical perception may represent domain-general processing mechanisms, whereas others such as vocal tract normalization may be specific to vocal sounds" (2018: 263). We appear to share with other primates a number of mechanisms for vocal articulation, and so the origins of verbal communication can be traced to ancestral primates, with many of these structures possibly being shaped by natural selection.

There seems nothing directly comparable to natural language syntax in the rest of the animal kingdom, posing a problem for the comparative language sciences. For all the work of comparative ethologists and linguists, there may be "not much to compare" (Bolhuis et al. 2014). There are, though, certain capacities that interface with language which we likely share with a range of species. Our human-specific powers of imitation most probably contribute to an explanation for why our vocabularies are relatively wide, for instance. Imitation contributes to the development of the sounds of language, which are used to manipulate various syntactic and logico-semantic relations, although imitation alone cannot explain the nature of the syntax-semantics interface. Newborn infants only 42 minutes old have the ability to replicate adult gestures on mouth-opening, tongue-protrusion and lip-protrusion (Meltzoff & Moore 1997). While this form of neonatal imitation is also found in chimpanzees (Myowa-Yamakoshi et al. 2004) and macaques (Ferrari et al. 2006), this pre-adaptive form develops into a considerably more elaborate format in human children.

Recent work has begun to explore this issue. Hobaiter and Byrne (2017) systematised aspects of ape gestures (e.g. rhythmic repetition, contact with recipient, movement) and showed that, taking into account all of these gestural features readily used by apes, there is a potential repertoire of over 1000 gestures given all possible combinations. Yet, in reality apes only use just over a tenth of all possible gestures, pointing not to physical (motor) limitations, but to the absence of mental combinatorial flexibility, of the kind that human language readily delivers. Only in human language do we see such an impressively large store of units to manipulate on the fly (under standard Minimalism, these are lexical roots and syntactic/semantic features deployed in, amongst other things, labeling; Bauke & Blümel 2017), and while categories such as "noun" and "adjective" may not be innate

(since these differ cross-linguistically), the capacity to categorise in such a way is likely human-specific. Even in the case of complex feeding skills exhibited by gorillas, it is not at all clear that their powers of imitation are sufficient for learning, since the young appear to look not at the complex motor actions when they are learning, but rather at the food itself (Corp & Byrne 2002), which suggests that other learning strategies (e.g. trial and error) besides imitation might be responsible (or at least contribute to) their knowledge (see also Zentall 2006). Arbib (2012: 191) summarises related research, although these topics remain controversial: “Monkeys have little or no capacity for imitation beyond observational priming and macaques had their common ancestor with humans some 25 million years ago. Apes have an ability for imitation by behavior parsing and had their last common ancestor with humans some 5 to 7 million years ago”.

Along with imitation, there are a host of physiological traits which appear to aid various linguistic processes. For instance, Kalashnikova et al. (2017) show that infant-directed speech (IDS) exhibits acoustically exaggerated vowels which are not the result of adjustments to tongue or lip movements, but rather result from a shortened vocal tract (relative to other great apes) thanks to a raised larynx. This supposedly occurs because adults unconsciously try and appear smaller and less threatening to infants. Kalashnikova et al. (2017) speculate: “This adjustment in IDS may be a vestige of early mother-infant interactions, which had as its primary purpose the transmission of non-aggressiveness and/or a primitive manifestation of prelinguistic vocal social convergence of the mother to her infant”. When human language emerged, a secondary purpose for IDS did too; “facilitating language acquisition via the serendipitously exaggerated vowels”.

With respect to the evolution of this categorisation capacity, in terms of its implementation it may have evolved from an expanded procedural memory system involved in statistical-sequential analysis (Wijnen 2013). But what of its implementation within a given “language game”, in the Wittgensteinian sense? Steels (1995) presented the “naming game” as a possible insight into how agreed upon and popular words first emerged. In this game, a population of agents are tasked with coming up with names for other agents. When a group of agents have no name for a given nameless agent, one of them is either forced to randomly generate a word, or choose a name from its existing mental store of names (with the probability being proportional to the previous success of the name being used in the community). If the agents then agree on this classification, then the success of the given name is increased through positive feedback. This process helps contribute to the formation of lexicons without any central control, even if it says nothing about the origins of lexical atoms themselves (i.e. their neural and genetic basis). As such, a process of natural selection together with artificial human selection is applied to the communicative power associated with the organisation of the lexicon – but this does not seem to be applied to the computational atoms themselves.

For these and a range of other reasons, natural and sexual selection likely played a more crucial role in selecting features of externalization than in developing the computational system of language (see also Hinzen 2006). For instance, manufacturing and tool use may have had selective advantage insofar as communicative burdens were relieved from the hands and transferred to the face (but see Cataldo et al. 2018, who show that linguistic instruction does not help human subjects as much as nonverbal gesture, so it is not clear if any selective advantage was conferred; see also Murphy 2018b for further discussion of this issue). Communication is plainly not an ability unique to humans, and is something even bacteria seem to do (via quorum sensing; Williams et al. 2007). Symbiotic relationships can result in cross-species communication, such as when the honeyguide bird leads honey badgers to bee nests via a specific sound, at which point the badger breaks the nest and both species are able to benefit from the nutrition. Elephants communicate through



infrasounds that the human ear cannot pick up, while electric fish communicate through generating specific currents that only they can produce and sense. Human language seems unique, as we will see, in that it exhibits *ostensive-inferential* communication via open-ended combinatorial productivity.

As Hinzen (2017: 306) notes, “it is in my view timely now to concede that, with language, and apparently inherently and exceptionlessly, goes a form a communication that is as sapiens-specific as language is”. Non-human forms of communication seem able to be classified as adhering to what is often referred to as the “code model” (Blackburn 2007); that is, their communication systems involve simple, one-to-one mappings between signs and meanings. There is little decoding required, and everything appears largely unambiguous (Rendall et al. 2009). Current work in the field indicates that primate vocalisations are largely innate and tied to emotional states. Nonhuman primates also do not seem capable of understanding or expressing communicative intent, suggesting a poverty in their ability for mental state attribution. But as Fischer and Price (2017: 22) argue, nonhuman primates are nevertheless proficient at integrating multiple information sources, rendering their communicative apparatus “relatively powerful, despite the lack of higher-order intentionality”. In humans, the ability to exercise voluntary control over speech production depends on neural connections between the primary motor cortex and the nucleus ambiguus, controlling laryngeal motor neurons. Speech production also involves the basal ganglia and cerebellum, while the left anterior insula appears crucial for speech articulation (Wise et al. 1999). In both humans and nonhuman primates, the ventrolateral prefrontal cortex and ventrolateral premotor region, along with the mid-cingulate cortex, coordinate to implement cognitive control over vocalisations – regions which are cytoarchitectonically comparable across humans and nonhuman primates (Kee Loh et al. 2017). In humans, the mid-cingulate cortex and ventrolateral prefrontal and premotor regions are not simply involved in cognitive control over emotion-related vocalisations, but also over acquired vocalisations. The reasons for this may be due to the emergence in humans of a laryngeal representation in the human orofacial motor area, which likely presented humans with a finer degree of motor control over oro-laryngeal motions (Simonyan 2014). As a result, the mid-cingulate cortex would be able to implement fine oro-laryngeal adjustments, something which might explain the ability of humans to flexibly modify vocal behaviour based on contextual cues. Moving beyond these anatomical regions, rostral lateral frontal regions such as Brodmann areas 45 and 10 could be involved in higher-order monitoring of speech action choices (Petrides 2005), and the particular morphology assumed by these regions of the human brain compared to our closest relatives can likely explain in some fashion how these higher cognitive functions are implemented.

These ideas are also supported by much recent work reviewed in Fitch (2017), which suggests that it is specifically motor control of the larynx which is human-specific, with the motor neurons for this lying in the nucleus ambiguus within the medulla. Along with the syntactic combinatorial capacities of language (on the syntax-semantics side), human speech (on the sensorimotor side) is also a species-defining trait. I am not aware of any work into the linguistic function or neural dynamics of the nucleus ambiguus of the medulla, but the interactions between the conceptual temporal and parietal systems and these areas during speech would presumably be a prerequisite for a global theory of speech. Kumar et al. (2016) also discovered robust connectivity in the human brain between laryngeal motor cortex and somatosensory and inferior parietal regions; connectivity which was considerably stronger than in the macaque brain and thus may form part of the explanation for human speech control.

But granting these species-specific components of externalisation, the Minimalist can still respond that they are separable from the computational-representational component which is ultimately used for the purposes of speech control. In other words: Acknowledging the intricacies of speech control does not force the Minimalist to concede that *language* therefore evolved for speech.

## 5 Why is Gamora?: Searching for minimalism/communication compatibility

“That for which we find words is something already dead in our hearts. There is always a kind of contempt in the act of speaking.” – Friedrich Nietzsche (1889)

Since we have seen that Minimalists object to all “(purely)” (Carruthers 2002) communicative models of language, the next question to ask is what exactly would a model of communication that is compatible with Minimalist assumptions look like? This final section will briefly contend that certain strands of Relevance Theory exploring ostensive-inferential communication are compatible with Minimalist computations and cognitive architecture.

There are a number of cases in which human behaviour can be analysed as adhering to the code model, mentioned above, as in smiling (Scruton 2015), frowning and involuntary laughter (all of which encode a simple form of information), with the latter appearing to be an evolutionary homologue to great ape laughter (Bryant & Aktipis 2014). However, language presents a more complex puzzle. Human communication seems to be more complex than the code model, with a substantial amount of contemporary research agreeing that ostensive-inferential communication is a more accurate characterisation. The act of production is termed “ostension”, and the act of comprehension “inference”. In general, with human language, the semantic meaning of an utterance typically fails to correspond precisely to what the speaker intends to communicate; think of ambiguities in nominal and eventive reference, or stilted/restarted speech, whereby the listener either needs to make substantial inferences or delay inferences. This involves the expression and perception of information and communicative intentions, and it is directly grounded in contemporary Relevance Theory (Sperber & Wilson 1995). For instance, a customer in a restaurant executes a pen writing gesture (providing evidence; ostension) and the waiter fetches the bill (interpreting evidence; inference). This aspect of language could have plausibly evolved from natural selection, which above all else produces organisms which act in goal-directed ways (Gardner 2009), with a major feature of ostensive-inferential communication being the ability to alter and manipulate mental states (see also Moore 2016 for evidence that some great ape gestures satisfy criteria for ostensive communication). Supporting this claim, Scott-Phillips (2010) develops a game-theoretic model of the evolution of communication and uses it to derive some basic qualities that evolutionarily stable communication systems will necessarily satisfy. Out of the communicative models Scott-Phillips tests against this model (another being neo-Gricean accounts), these qualities are found to precisely map onto the core principles of Relevance Theory, providing biological support for the claim that natural selection drove ostensive-inferential communication.

In contrast, certain other aspects of language are more difficult to square with the logic of natural selection, as mentioned above. As Brandon and Hornstein (1986: 170) discussed in relation to language, “one must recognize that not every organic feature is an evolutionary adaptation”. Scott-Phillips (2015a; b) claims language-specific recursion came about because it was needed (that is, because of selectional pressures). Yet, this is not a theory, only a teleological stipulation. There currently exists no evidence that language-specific recursion would have adapted as a response to selectional pressures in a continuous evolutionary process (Hauser et al. 2014). Scott-Phillips’s (2015a: 47) central

thesis is that “once ostensive-inferential communication exists, it is used to create the various communicative conventions (semantic, syntactic, phonological, etc.) that we call language”. How the maxims of Relevance Theory could help give birth to phonological representations or long-distance dependencies or the Empty Category Principle is not pursued concretely. Scott-Phillips does not assume that ostensive-inferential communication is the most central aspect of language evolution, nor does he assume that the novelty of language lies in its ability to provide “new ways to transfer information” (Scott-Phillips 2015a: 153). Rather, the emergence of an entirely different linguistic feature allowed humans to combine the operations of two separate cognitive systems often used for communication (producing signals and making inferences), generating new behaviours and forms of communication. This linguistic feature boils down to the capacity to combine elementary representations into hierarchically structured units (Pietroski 2018; Shim 2018; Adger 2019), as Minimalism maintains.

Along with the capacity for ostensive-inferential communication comes a need for intersubjectivity. This emerges from an infant’s relation with its mother. Humans are unique among primates in that they cradle their infants, most likely because human infants are uniquely vulnerable, with their parents having little body hair to cling to. The volume of the human infant brain is approximately 25 per cent of the adult brain (Stuart & Stevenson 1950), whereas the figure is closer to 45 per cent in chimpanzee infants. The human skeletal system is also more vulnerable and is more generally quite poorly developed. A significant effect of this cradling is that infants are in close proximity to their mother’s eyes and facial expressions, sharing gazes and emotional expressions (see Konner 2010 for a comprehensive review). The close temporal correlation between the infant’s behaviour and the mother’s behaviour is termed dyadic by developmental psychologists, with triadic relations emerging at around 6 months with the addition of objects of mutual interest, facilitating joint attention (a phylogenetically younger capacity). All of these factors lay the basis for human-specific levels of attentional and communicative competence; shared with other primates, but well-refined, and also directed by selective pressures (Gong & Shuai 2012). Without joint attention it may be more difficult for a child to learn the name of a given object, since *bear* might refer to any feature of an object, any process associated with it, any location the object is placed on, and so forth (Wilkes-Gibbs & Clark 1992). Yet, while joint attention certainly plays its part, other research by Medina et al. (2011) suggests that during word learning comprehenders implement a learning procedure in which only a single meaning is hypothesized and retained across learning instances, unless disconfirmed. Medina et al.’s (2011) results suggest that neither alternative hypothesized meanings nor details of past learning situations were retained, suggesting that while joint attention can certainly direct aspects of learning, learners nevertheless appear to use a one-trial “fast-mapping” procedure, even under conditions of referential uncertainty (Markman 1990; Aravind et al. 2018). In addition, as Reboul (2015) discusses, mind-reading relies on metarepresentations generated by a recursive syntax (e.g. ‘Walt believes that Jesse believes that *p*’), and so it is reasonable to assume that this crucial aspect of human communication (relying as it does on intersubjectivity) was derived from syntax, rather than the other way around. This satisfies a core assumption of Minimalist syntactic architecture, whereby communication is in fact a tertiary component of language, being a sub-part of externalisation, which is in turn secondary to the primary role of syntactic combinatorics, with syntax being a simple recursive generator which maps objects to a workspace – MERGE (Chomsky et al. 2018) – lacking non-nomological constraints, i.e. not having any principled constraints based in logical necessity. This radically departs from the more popular assumption that the basic function of language

is to communicate information from speaker to hearer (e.g. the *Performance-Grammar Correspondence Hypothesis*; Hawkins 2009). Instead, as Jacob (1982: 59) summarised, “the role of language as a communication system between individuals [may have come] about only secondarily”. Mobbs (2015) also reviews how our success in acts of communication significantly varies as a function of personality, education, and other related contingencies: “If it were communicatively-oriented, this would make the [faculty of language] somewhat anomalous among core domains of cognition, such as vision, memory, motor control, etc., in which the overwhelmingly better part of competence is taken to develop irrespective of anything but major deficiencies in input or other abilities”.

Along with attentional advances, the capacity for mutual trust would also have required certain modifications. Hrdy (2009) argues in a seminal study that a human infant would have needed to share affect not only with its parents but with other caretakers in the community too, given the expanded size of human tribes relative to those of other great apes. Infants which were competent at this generalised affect-sharing would obtain more direct language-relevant data from their caretakers and so would presumably obtain a selectional advantage, not just in the sense that their language faculties would be properly developed, but also in that their mutual trust for their fellow group members would be enhanced. In terms of the evolutionary timeline, Studdert-Kennedy and Terrace (2017: 122) note that it is hard to imagine joint attention emerging without the pre-existing foundation of intersubjectivity. It is also possible that the emergence of an extensive vocabulary was aided by the pre-existing foundation of joint attention; while the dates may be currently hard to pin down, the chain of evolutionary events at least seems somewhat clearer. Nevertheless, it is doubtful that joint attention is a fundamental component of vocabulary acquisition given cases of successful vocabulary formation in the absence of joint attention occurring (Cossu & Marshall 1990). There is consequently no need to claim with Corballis (2017: 571), during a discussion of theory of mind and communicative competence, that “it is difficult to believe they surfaced in a single step late in the evolution of our species”, since we can assume that such capacities were mostly already in place. Again, this is in line with a core Minimalist assumption of saltationism (see Murphy 2018b for a more detailed timeline which is largely, but not wholly, in accord with the Minimalist framework).

While Scott-Phillips (2015a: 46) maintains that “nothing that looks even remotely like language can emerge prior to the evolution of ostensive-inferential communication”, what happened under the Minimalist account was that the ability to generate phrase structure emerged. As well as linking syntax to phonology and externalisation, syntax was also linked to interpretation/semantics. The syntax-semantics interface may have made way for other interfaces relying on conceptual systems; for our purposes, the very specific interface between ostension (production) and inference (comprehension), which parallels the externalisation-syntax interface. The apparently human-specific ostensive-inferential interface in turn may have helped the phrase structure-generating procedure reach into broader conceptual territory through communication with conspecifics, generating an ever-expanding list of representational combinations (possibly through reciprocal causation; Lewontin 1983; Walsh 2015). This model of paired, interfacing systems is well within the scope of Minimalist assumptions, and also seems psychologically plausible; Carston (2000) proposes along these lines that “the point of contact between the language faculty and [Relevance Theory] pragmatics is either the output of the parser or of some further performance system interfacing between parser and pragmatics”. Neither of these systems – hierarchical syntax and communicative competence – need to be considered a causal influence on the design and function of the other, and language does not need to be seen as “for communication” any more than ostensive-inferential communication needs to be seen as “for successive-cyclic movement”.

The readiness with which ostensive-inferential communication can be executed via open-ended combinatorial processes is deeply compatible with the Minimalist framework for language more generally (Sperber & Wilson 2015; Mazzarella & Domaneschi 2018). Indeed, Carston (2000) notes that both Minimalist syntax and Relevance Theory seek to explore core competences associated with interpretive properties of language (even if Relevance Theory also encompasses non-linguistic forms of communication and interpretation), they both embrace some form of competence-performance distinction, and they both explore matters of computational economy (processing effort for Relevance Theory, combinatorial and search processes for Minimalism). Ultimately, a substantial number of generative concepts carry over from Minimalism to Relevance Theory. Considering, for instance, the *Second (Communicative) Principle of Relevance* (“Every utterance conveys a presumption of its own (optimal) relevance”), one is immediately struck by the role that computational factors such as *least effort* play, as they also do in Minimalist framings of phrase structure building. Bringing our discussion full circle, in an attempt to develop a model of pragmatics compatible with generative grammar, Kasher (1991: 135) concludes that “pragmatic competence, as such, is independent of communication”; it is a process geared towards interpretation and the performance of particular, appropriate actions.

Lastly, it is worth briefly noting that additional barriers are also faced by those wishing to develop a communicative model of language. For instance, it is difficult to explore the neurobiological basis of communication because this notion, in connection to human language, has not been sufficiently decomposed into its computational primitives. On the other hand, syntactic, semantic and phonological computations have been decomposed to a sufficiently generic level, permitting a range of brain-language linking hypotheses (e.g. Murphy 2016; 2018a; Murphy & Benítez-Burraco 2017; Grimaldi 2018). This *internalist* focus on the mental faculty of language (Berwick 2017) is in stark contrast to the *externalist* focus on the output of language, such as speech and communication. Fisher (2016) and Fisher and Vernes (2015), along with many others, have explored in some detail the genetics of *speech* and *communication*, but it is unclear whether this relates to language evolution if language is understood in the computational/representational terms of Minimalism. Distinguishing speech from language (and from communication) is an essential first step in exploring the biological basis of higher cognition.

## 6 Conclusion

The currently available evidence grants support to the Minimalist conception of language as being primarily a system contributing to higher cognition than it does to the communicative view of language use and evolution. Overall, it not only undermines the complexity of human language to hold that its primary evolutionary function is communication; given the complexity of nonhuman cognition reviewed here, focusing on the communication systems of animals – as opposed to their conceptual capacities – also undermines them.

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The author has no competing interests to declare.

## References

- Aboitiz, Francisco. 2017. *A brain for speech: A view from evolutionary neuroanatomy*. London: Palgrave Macmillan. DOI: <https://doi.org/10.1057/978-1-137-54060-7>
- Ackema, Peter & Ad Neeleman. 2002. Effects of short term storage in processing rightward movement. In Sieb Noteboom, Fred Weerman & Frank Wijnen (eds.), *Storage and computation in the language faculty*, 219–256. Dordrecht: Kluwer. DOI: [https://doi.org/10.1007/978-94-010-0355-1\\_8](https://doi.org/10.1007/978-94-010-0355-1_8)
- Adger, David. 2019. *Syntax unlimited: The science behind our most creative power*. Oxford: Oxford University Press.
- Adger, David & Peter Svenonius. 2011. Features in minimalist syntax. In Cedric Boeckx (ed.), *The handbook of linguistic minimalism*, 27–51. Oxford: Blackwell. DOI: <https://doi.org/10.1093/oxfordhb/9780199549368.013.0002>
- Amundson, Ronald. 2006. EvoDevo as cognitive psychology. *Biological Theory* 1(1). 10–11. DOI: <https://doi.org/10.1162/biot.2006.1.1.10>
- Anderson, Stephen R. 2004. *Doctor Dolittle's delusion: Animals and the uniqueness of language*. London: Yale University Press.
- Aravind, Athulya, Jill de Villiers, Amy Pace, Hannah Valentine, Roberta Golinkoff, Kathy Hirsh-Pasek, Aquiles Iglesias & Mary Sweig Wilson. 2018. Fast mapping word meanings across trials: Young children forget all but their first guess. *Cognition* 177. 177–188. DOI: <https://doi.org/10.1016/j.cognition.2018.04.008>
- Arbib, Michael A. 2012. *How the brain got language: The mirror system hypothesis*. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/acprof:osobl/9780199896684.001.0001>
- Asoulin, Eran. 2016. Language as an instrument of thought. *Glossa: A Journal of General Linguistics* 1(1). 46. 1–23. DOI: <https://doi.org/10.5334/gjgl.34>
- Asoulin, Eran. 2019. Why should syntactic islands exist? *lingbuzz/004556*.
- Aust, Ulrike, Friederike Range, Michael Steurer & Ludwig Huber. 2008. Inferential reasoning by exclusion in pigeons, dogs, and humans. *Animal Cognition* 11(4). 587–597. DOI: <https://doi.org/10.1007/s10071-008-0149-0>
- Barss, Andrew & Howard Lasnik. 1986. A note on anaphora and double objects. *Linguistic Inquiry* 17. 347–354.
- Bauke, Leah & Andreas Blümel (eds.). 2017. *Labels and roots*. Studies in generative grammar vol. 128. Berlin: Walter de Gruyter. DOI: <https://doi.org/10.1515/9781501502118>
- Berwick, Robert C. 2011. All you need is merge. In Anna Maria Di Sciullo & Cedric Boeckx (eds.), *The biolinguistic enterprise: New perspectives on the evolution and nature of the human language faculty*, 461–491. Oxford: Oxford University Press.
- Berwick, Robert C. 2017. A feeling for the phenotype. In James McGilvray (ed.), *The Cambridge companion to Chomsky*, 87–109. 2nd ed.; Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/9781316716694.005>
- Bickerton, Derek. 2009. *Adam's tongue*. New York: Hill and Wang.
- Blackburn, Perry. 2007. *The code model of language: A powerful metaphor in linguistic metatheory*. SIL International.
- Boeckx, Cedric. 2003. *Islands and chains: Resumption as stranding*. Amsterdam: John Benjamins. DOI: <https://doi.org/10.1075/la.63>
- Boeckx, Cedric. 2012. *Syntactic islands*. Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9781139022415>
- Bolhuis, Johan J., Gabriel J. L. Beckers, Marinus A. C. Huybregts, Robert C. Berwick & Martin B. H. Everaert. 2018. Meaningful syntactic structure in songbird vocalizations? *PLoS Biology* 16(6). e2005157. DOI: <https://doi.org/10.1371/journal.pbio.2005157>

- Bolhuis, Johan J., Ian Tattersall, Noam Chomsky & Robert C. Berwick. 2014. How could language have evolved? *PLoS ONE* 12. e1001934. DOI: <https://doi.org/10.1371/journal.pbio.1001934>
- Bouchard, Denis. 2013. *The nature and origin of language*. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/acprof:oso/9780199681624.001.0001>
- Brandon, Robert N. & Norbert Hornstein. 1986. From icons to symbols: Some speculations on the origins of language. *Biology and Philosophy* 1(2). 169–189. DOI: <https://doi.org/10.1007/BF00142900>
- Bryant, Gregory A. & C. Athena Aktipis. 2014. The animal nature of spontaneous human laughter. *Evolution and Human Behavior* 35(4). 327–335. DOI: <https://doi.org/10.1016/j.evolhumbehav.2014.03.003>
- Burge, Tyler. 1979. Individualism and the mental. *Midwest Studies in Philosophy* 4. 73–121. DOI: <https://doi.org/10.1111/j.1475-4975.1979.tb00374.x>
- Carruthers, Peter. 2002. The cognitive functions of language. *Behavioral and Brain Sciences* 25. 657–726. DOI: <https://doi.org/10.1017/S0140525X02000122>
- Carston, Robyn. 2000. The relationship between generative grammar and (relevance-theoretic) pragmatics. *Language & Communication* 20(1). 87–103. DOI: [https://doi.org/10.1016/S0271-5309\(99\)00020-8](https://doi.org/10.1016/S0271-5309(99)00020-8)
- Cataldo, Dana Michelle, Andrea Bambreg Migliano & Lucio Vinicius. 2018. Speech, stone tool-making and the evolution of language. *PLoS ONE* 13. e0191071. DOI: <https://doi.org/10.1371/journal.pone.0191071>
- Chomsky, Noam. 1995. *The minimalist program*. Cambridge, MA: MIT Press.
- Chomsky, Noam. 2000. *New horizons in the study of language and mind*. Cambridge, MA: MIT Press. DOI: <https://doi.org/10.1017/CBO9780511811937>
- Chomsky, Noam. 2001. Beyond explanatory adequacy. *MIT Occasional Papers in Linguistics* 20. 1–28.
- Chomsky, Noam. 2013. What kind of creatures are we? Lecture 1: What is language? *The Journal of Philosophy* 90(12). 645–700. DOI: <https://doi.org/10.5840/jphil2013110121>
- Chomsky, Noam. 2018. Mentality beyond consciousness. In Gregg Caruso (ed.), *Ted Honderich on consciousness, determinism, and humanity*, 33–46. London: Palgrave Macmillan. DOI: [https://doi.org/10.1007/978-3-319-66754-6\\_2](https://doi.org/10.1007/978-3-319-66754-6_2)
- Chomsky, Noam, Ángel J. Gallego & Dennis Ott. 2018. Generative grammar and the faculty of language: Insights, questions, and challenges. In Ángel J. Gallego & Dennis Ott (eds.), *Generative syntax: Questions, crossroads, and challenges*. Special issue of *Catalan Journal of Linguistics*.
- Collins, John. 2017. The copredication argument. *Inquiry* 60(7). 675–702. DOI: <https://doi.org/10.1080/0020174X.2017.1321500>
- Corballis, Michael. 2017. Leaps of faith: A reply to Everaert *et al.* *Trends in Cognitive Sciences* 21(8). 571–572. DOI: <https://doi.org/10.1016/j.tics.2017.05.006>
- Corp, Nadia & Richard W. Byrne. 2002. Ontogeny of manual skill in wild chimpanzees: Evidence from feeding on the fruit of Saba Florida. *Behavior* 139. 137–168. DOI: <https://doi.org/10.1163/15685390252902328>
- Cossu, Giuseppe & John C. Marshall. 1990. Are cognitive skills a prerequisite for learning to read and write? *Cognitive Neuropsychology* 7(1). 21–40. DOI: <https://doi.org/10.1080/02643299008253433>
- Dor, Daniel. 2017. The role of the lie in the evolution of human language. *Language Sciences* 63. 44–59. DOI: <https://doi.org/10.1016/j.langsci.2017.01.001>
- Engesser, Sabrina, Amanda R. Ridley & Simon W. Townsend. 2016. Meaningful call combinations and compositional processing in the southern pied babbler. *PNAS* 113(21). 5976–5981. DOI: <https://doi.org/10.1073/pnas.1600970113>

- Ferrari, Pier F., Elisabetta Visalberghi, Annika Paukner, Leonardo Fogassi, Angela Ruggiero & Stephen J. Suomi. 2006. Neonatal imitation in rhesus macaques. *PLoS Biology* 4(9). e302. DOI: <https://doi.org/10.1371/journal.pbio.0040302>
- Fischer, Julia & Tabitha Price. 2017. Meaning, intention, and inference in primate vocal communication. *Neuroscience and Biobehavioral Reviews* 82. 22–31. DOI: <https://doi.org/10.1016/j.neubiorev.2016.10.014>
- Fisher, Simon E. 2016. A molecular genetic perspective on speech and language. In Gregory Hickok & Steven Small (eds.), *Neurobiology of language*, 13–24. Amsterdam: Elsevier. DOI: <https://doi.org/10.1016/B978-0-12-407794-2.00002-X>
- Fisher, Simon E. & Sonja C. Vernes. 2015. Genetics and the language sciences. *Annual Review of Linguistics* 1. 289–310. DOI: <https://doi.org/10.1146/annurev-linguist-030514-125024>
- Fitch, W. Tecumseh. 2018. The biology and evolution of speech: A comparative analysis. *Annual Review of Linguistics* 4. 255–279. DOI: <https://doi.org/10.1146/annurev-linguistics-011817-045748>
- Fodor, Jerry A. & Zenon W. Pylyshyn. 2015. *Minds without meaning: An essay on the content of concepts*. Cambridge, MA: MIT Press. DOI: <https://doi.org/10.7551/mitpress/9780262027908.001.0001>
- Gardner, Andy. 2009. Adaptation as organism design. *Biology Letters* 5(6). 861–864. DOI: <https://doi.org/10.1098/rsbl.2009.0674>
- Gazdar, Gerald. 1981. Unbounded dependencies and coordinate structure. *Linguistic Inquiry* 12(2). 155–184.
- Gibson, Edward, Richard Futrell, Steven P. Piantadosi, Isabelle Dautriche, Kyle Mahowald, Leon Bergen & Roger Levy. 2019. How efficiency shapes human language. *Trends in Cognitive Sciences* 23(5). 389–407. DOI: <https://doi.org/10.1016/j.tics.2019.02.003>
- Gong, Tao & Lan Shuai. 2012. Modelling the coevolution of joint attention and language. *Proceedings of the Royal Society B* 279(1747). 4643–4651. DOI: <https://doi.org/10.1098/rspb.2012.1431>
- Grimaldi, Mirko. 2018. The phonetics-phonology relationship in the neurobiology of language. In Roberto Petrosino, Pietro Cerrone & Harry van der Hulst (eds.), *From sounds to structures: Beyond the veil of Maya*, 65–103. Berlin: De Gruyter. DOI: <https://doi.org/10.1515/9781501506734-003>
- Hauser, Marc D., Charles C. Yang, Robert C. Berwick, Ian Tattersall, Michael J. Ryan, Jeffrey Watumull, Noam Chomsky & Richard C. Lewontin. 2014. The mystery of language evolution. *Frontiers in Psychology* 5. 401. DOI: <https://doi.org/10.3389/fpsyg.2014.00401>
- Hauser, Marc D. & Jeffrey Watumull. 2017. The universal generative faculty: The source of our expressive power in language, mathematics, morality, and music. *Journal of Neurolinguistics* 43(B). 78–94. DOI: <https://doi.org/10.1016/j.jneuroling.2016.10.005>
- Hawkins, John A. 2009. Language universals and the performance-grammar correspondence hypothesis. In Morten H. Christiansen, Christopher Collins & Shimon Edelman (eds.), *Language universals*, 54–78. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/acprof:oso/9780195305432.003.0004>
- Herman, Louis M., Robert K. Uyeyama & Adam A. Pack. 2008. Bottlenose dolphins understand relationships between concepts. *Behavioral and Brain Sciences* 31(2). 139–140. DOI: <https://doi.org/10.1017/S0140525X08003658>
- Hinzen, Wolfram. 2006. *Mind design and minimal syntax*. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/acprof:oso/9780199289257.001.0001>



- Hinzen, Wolfram. 2007. *An essay on names and truth*. Oxford: Oxford University Press.
- Hinzen, Wolfram. 2017. What language is. *Theoretical Linguistics* 43(3–4). 297–317. DOI: <https://doi.org/10.1515/tl-2017-0020>
- Hobaiter, Catherine & Richard W. Byrne. 2017. What is a gesture? A meaning-based approach to defining gestural repertoires. *Neuroscience and Biobehavioral Reviews* 82. 3–12. DOI: <https://doi.org/10.1016/j.neubiorev.2017.03.008>
- Hornstein, Norbert. 1984. *Logic as grammar: An approach to meaning in natural language*. Cambridge, MA: MIT Press.
- Hrdy, Sarah Blaffer. 2009. *Mothers and others: The evolutionary origins of mutual understanding*. Cambridge, MA: Belknap Press of Harvard University Press.
- Huxley, Aldous. 1931. Sermons in cats. *Music at night and other essays*. New York: Doubleday, Doran & Co.
- Jackendoff, Ray. 1990a. On Larson's treatment of the double object construction. *Linguistic Inquiry* 21. 427–456.
- Jackendoff, Ray. 1990b. *Semantic structures*. Cambridge, MA: MIT Press.
- Jiang, Xinjian, Tenghai Long, Weicong Cao, Junry Li, Stanislas Dehaene & Liping Wang. 2018. Production of supra-regular spatial sequences by macaque monkeys. *Current Biology* 28. 1851–1859. DOI: <https://doi.org/10.1016/j.cub.2018.04.047>
- Kalashnikova, Maria, Christopher Carignan & Denis Burnham. 2017. The origins of babytalk: smiling, teaching or social convergence? *Royal Society Open Science* 4. 170306. DOI: <https://doi.org/10.1098/rsos.170306>
- Kasher, Asa. 1991. Pragmatics and Chomsky's research program. In Asa Kasher (ed.), *The Chomskyan turn*, 122–149. Oxford: Blackwell.
- Kayne, Richard S. 1994. *The antisymmetry of syntax*. Cambridge, MA: MIT Press.
- Kee Loh, Kep, Michael Petrides, William D. Hopkins, Emmanuel Procyk & Céline Amiez. 2017. Cognitive control of vocalizations in the primate ventrolateral-dorsomedial frontal (VLF-DMF) brain network. *Neuroscience and Biobehavioral Reviews* 82. 32–44. DOI: <https://doi.org/10.1016/j.neubiorev.2016.12.001>
- Keenan, Edward L. & Jonathan Stavi. 1986. A semantic characterization of natural language determiners. *Linguistics and Philosophy* 9(3). 253–326. DOI: <https://doi.org/10.1007/BF00630273>
- Konner, Melvin. 2010. *The evolution of childhood: Relationships, emotion, mind*. London: The Belknap Press of Harvard University Press.
- Kumar, Veena, Paula L. Croxson & Kristina Simonyan. 2016. Structural organization of the laryngeal motor cortical network and its implication for evolution of speech production. *Journal of Neuroscience* 36. 4170–4181. DOI: <https://doi.org/10.1523/JNEUROSCI.3914-15.2016>
- Larson, Richard K. 1988. On the double object construction. *Linguistic Inquiry* 19(3). 335–391.
- Lewontin, Richard C. 1983. Gene, organism, and environment. In D. S. Bendall (ed.), *Evolution from molecules to men*, 273–285. Cambridge: Cambridge University Press.
- Lightfoot, David. 1991. Subjacency and sex. *Language & Communication* 11. 67–69. DOI: [https://doi.org/10.1016/0271-5309\(91\)90020-V](https://doi.org/10.1016/0271-5309(91)90020-V)
- Markman, Ellen E. 1990. Constraints children place on word meanings. *Cognitive Science* 14(1). 57–77. DOI: [https://doi.org/10.1016/0364-0213\(90\)90026-S](https://doi.org/10.1016/0364-0213(90)90026-S)
- Mazzarella, Diana & Filippo Domaneschi. 2018. Presuppositional effects and ostensive-inferential communication. *Journal of Pragmatics* 138. 17–29. DOI: <https://doi.org/10.1016/j.pragma.2018.09.012>

- McGhee, George. 1998. *Theoretical morphology*. New York: Columbia University Press.
- Medina, Tamara Nicol, Jesse Snedeker, John C. Trueswell & Lila R. Gleitman. 2011. How words can and cannot be learned by observation. *PNAS* 108(22). 9014–9019. DOI: <https://doi.org/10.1073/pnas.1105040108>
- Meguerditchian, Adrien, Adelyne Vuillemin & Jill D. Pruett. 2017. Identifying the ape beat in the wild: Rhythmic individual signatures from the sounds of manual fruit cracking in Fongoli chimpanzees. Ms. Aix-Marseille Université. DOI: <https://doi.org/10.12775/3991-1.072>
- Meltzoff, Andrew N. & M. Keith Moore. 1997. Explaining facial imitation: a theoretical model. *Early Development and Parenting* 6. 179–192. DOI: [https://doi.org/10.1002/\(SICI\)1099-0917\(199709/12\)6:3/4<179::AID-EDP157>3.3.CO;2-I](https://doi.org/10.1002/(SICI)1099-0917(199709/12)6:3/4<179::AID-EDP157>3.3.CO;2-I)
- Mobbs, Iain Jerome. 2015. *Minimalism and the design of the language faculty*. Cambridge: University of Cambridge dissertation.
- Moore, Richard. 2016. Meaning and ostension in great ape gestural communication. *Animal Cognition* 19(1). 223–231. DOI: <https://doi.org/10.1007/s10071-015-0905-x>
- Murphy, Elliot. 2016. Evolutionary monkey oscillomics: Generating linking hypotheses from preserved brain rhythms. *Theoretical Linguistics* 42(1–2). 117–137. DOI: <https://doi.org/10.1515/tl-2016-0005>
- Murphy, Elliot. 2018a. Interfaces (travelling oscillations) + recursion (delta-theta code) = language. In Eva Maria Luef & Manuela M. Marin (eds.), *The talking species: Perspectives on the evolutionary, neuronal and cultural foundations of language*, 251–269. Graz: Unipress Graz Verlag.
- Murphy, Elliot. 2018b. No country for Oldowan men: self-domestication and cranial globularity as factors in language evolution. *UCL Working Papers in Linguistics* 30. 35–56.
- Murphy, Elliot & Antonio Benítez-Burraco. 2017. Language deficits in schizophrenia and autism as related oscillatory connectomopathies: An evolutionary account. *Neuroscience & Biobehavioral Reviews* 83. 742–764. DOI: <https://doi.org/10.1016/j.neubiorev.2016.07.029>
- Myowa-Yamakoshi, Masako, Masaki Tomonaga, Masayuki Tanaka & Tetsuro Matsuzawa. 2004. Imitation in neonatal chimpanzees (*Pan troglodytes*). *Developmental Science* 7(4). 437–442. DOI: <https://doi.org/10.1111/j.1467-7687.2004.00364.x>
- Nietzsche, Friedrich. 1998/1889. *Twilight of the idols*. Duncan Large (trans.). Oxford: Oxford University Press.
- Owren, Michael J., Drew Rendall & Michael Joseph Ryan. 2010. Redefining animal signaling: Influence versus information in communication. *Biology & Philosophy* 25. 755–780. DOI: <https://doi.org/10.1007/s10539-010-9224-4>
- Owren, Michael J., R. Toby Amoss & Drew Rendall. 2011. Two organizing principles of vocal production: Implications for nonhuman and human primates. *American Journal of Primatology* 73(6). 530–544. DOI: <https://doi.org/10.1002/ajp.20913>
- Patterson, Francine G. & Eugene Linden. 1981. *The education of Koko*. New York: Holt, Rinehart and Winston.
- Paz-y-Miño, Guillermo, Alan B. Bond, Alan C. Kamil & Russell P. Balda. 2004. Pinyon jays use transitive inference to predict social dominance. *Nature* 430. 778–781. DOI: <https://doi.org/10.1038/nature02723>
- Petrides, Michael. 2005. Lateral prefrontal cortex: Architectonic and functional organization. *Philosophical Transactions of the Royal Society B* 360. 781–795. DOI: <https://doi.org/10.1098/rstb.2005.1631>
- Phillips, Colin & Shevaun Lewis. 2013. Derivational order in syntax: Evidence and architectural consequences. *Studies in Linguistics* 6. 11–47.

- Piattelli-Palmarini, Massimo. 2008. Events and conservativity: Clues towards language evolution. In Maria Christina Amoretti & Nicla Vassallo (eds.), *Knowledge, language, and interpretation: On the philosophy of Donald Davidson*, 81–105. Frankfurt: Ontos Verlag/Transaction Books.
- Pietroski, Paul. 2018. *Conjoining meanings: Semantics without truth values*. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/oso/9780198812722.001.0001>
- Pietroski, Paul & Stephen Crain. 2005. Innate ideas. In James McGilvray (ed.), *The Cambridge companion to Chomsky*. Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/CCOL0521780136.009>
- Putnam, Hilary. 1975. The meaning of 'meaning'. *Minnesota Studies in the Philosophy of Science* 7. 131–193.
- Reboul, Anne C. 2015. Why language really is not a communication system: A cognitive view of language evolution. *Frontiers in Psychology* 6. 1434. DOI: <https://doi.org/10.3389/fpsyg.2015.01434>
- Reinhart, Tanya. 1983. *Anaphora and semantic interpretation*. Beckenham: Croom Helm.
- Rendall, Drew, Michael J. Owren & Michael J. Ryan. 2009. What do animal signals mean? *Animal Behaviour* 78. 233–240. DOI: <https://doi.org/10.1016/j.anbehav.2009.06.007>
- Scott-Phillips, Thomas C. 2010. The evolution of relevance. *Cognitive Science* 34. 583–601. DOI: <https://doi.org/10.1111/j.1551-6709.2010.01095.x>
- Scott-Phillips, Thomas C. 2015a. *Speaking our minds: Why human communication is different, and how language evolved to make it special*. New York: Palgrave Macmillan.
- Scott-Phillips, Thomas C. 2015b. Nonhuman primate communication, pragmatics, and the origins of language. *Current Anthropology* 56(1). 56–80. DOI: <https://doi.org/10.1086/679674>
- Scruton, Roger. 2015. Smiles from reason flow. Lecture delivered at the Alpine Fellowship, Venice.
- Shettleworth, Sara J. 2009. *Cognition, evolution, and behavior*. Oxford: Oxford University Press.
- Shim, Jae-Young. 2018.  $\langle \varphi, \varphi \rangle$ -less labeling. *Language Research* 54(1). 23–39. DOI: <https://doi.org/10.30961/lr.2018.54.1.23>
- Simonyan, Kristina. 2014. The laryngeal motor cortex: Its organization and connectivity. *Current Opinion in Neurobiology* 28. 15–21. DOI: <https://doi.org/10.1016/j.conb.2014.05.006>
- Sperber, Dan & Deirdre Wilson. 1995. *Relevance: Communication and cognition*. Oxford: Blackwell.
- Sperber, Dan & Deirdre Wilson. 2015. Beyond speaker's meaning. *Croatian Journal of Philosophy* XV(44). 117–149.
- Sprouse, Jon & Diogo Almeida. 2017. Setting the empirical record straight: Acceptability judgments appear to be reliable, robust, and replicable. *Behavioral and Brain Sciences* 40. e311. DOI: <https://doi.org/10.1017/S0140525X17000590>
- Sprouse, Jon, Wagers, Matthew W. & Colin Phillips. 2012. A test of the relation between working-memory capacity and syntactic island effects. *Language* 88(1). 82–123. DOI: <https://doi.org/10.1353/lan.2012.0004>
- Steels, Luc. 1995. A self-organizing spatial vocabulary. *Artificial Life* 2. 319–332. DOI: <https://doi.org/10.1162/artl.1995.2.319>
- Stuart, Harold C. & Stuart S. Stevenson. 1950. Physical growth and development. In Waldo Emerson Nelson (ed.), *Mitchell-Nelson textbook of paediatrics*. 5th edn; Philadelphia, PA: W.B. Saunders.

- Studdert-Kennedy, Michael & Herbert Terrace. 2017. In the beginning: a review of Robert C. Berwick and Noam Chomsky's *Why only us*. *Journal of Language Evolution* 2(2). 114–125.
- Terrace, Herbert S. 2005. Metacognition and the evolution of language. In Herbert S. Terrace & Janet Metcalfe (eds.), *The missing link in cognition: Origins of self-reflective consciousness*, 84–115. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/acprof:oso/9780195161564.003.0003>
- Terrace, Herbert S. 2019. *Why chimpanzees can't learn language and only humans can*. New York: Columbia University Press. DOI: <https://doi.org/10.7312/terr17110>
- Walsh, Denis M. 2015. *Organisms, agency, and evolution*. Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9781316402719>
- Wijnen, Frank. 2013. Acquisition of linguistic categories: Cross-domain convergences. In Johan J. Bolhuis & Martin Everaert. (eds.), *Birdsong, speech, and language: Exploring the evolution of mind and Brain*, 157–177. Cambridge, MA: MIT Press.
- Wilkes-Gibbs, Deanna & Herbert H. Clark. 1992. Coordinating beliefs in conversation. *Journal of Memory & Language* 31. 183–194. DOI: [https://doi.org/10.1016/0749-596X\(92\)90010-U](https://doi.org/10.1016/0749-596X(92)90010-U)
- Wise, Richard J. S., Joshua Greene, Christian Büchel & Scott, Sophie K. 1999. Brain regions involved in articulation. *Lancet* 353. 1057–1061. DOI: [https://doi.org/10.1016/S0140-6736\(98\)07491-1](https://doi.org/10.1016/S0140-6736(98)07491-1)
- Zentall, Thomas R. 2006. Imitation: Definitions, evidence, and mechanisms. *Animal Cognition* 9(4). 335–353. DOI: <https://doi.org/10.1007/s10071-006-0039-2>
- Zuberbühler, Klaus. 2012. Cooperative breeding and the evolution of vocal flexibility. In Maggie Tallerman & Kathleen R. Gibson (eds.), *The Oxford handbook of language evolution*, 71–81. Oxford: Oxford University Press. DOI: <https://doi.org/10.1093/oxfordhb/9780199541119.013.0005>

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