Biol Philos (2010) 25:851–901
DOI 10.1007/s10539-009-9168-8

Symposium on J.-L. Dessalles's Why we Talk (OUP, 2007): Precis by J.-L. Dessalles, commentaries by E. Machery, F. Cowie, and J. Alexander, Replies by J.-L. Dessalles

Edouard Machery · Jean-Louis Dessalles · Fiona Cowie · Jason Alexander

Received: 27 October 2008 / Accepted: 23 April 2009 / Published online: 23 June 2009

Abstract This symposium discusses J.-L. Dessalles's account of the evolution of language, which was presented in Why we Talk (OUP 2007).

Keywords Evolution of language · Costly signaling · Evolutionary game theory · Semantics · Pragmatics · Syntax

Précis of *Why We Talk*

Jean-Louis Dessalles

Telecom ParisTech

Language as an isolated niche

Human beings devote hours every day to chatting with conspecifics. The ability to talk relevantly on these occasions has a crucial impact on their ability to establish and maintain appropriate social bonds, and thus on their survival in typical hominin

E. Machery (✉)
University of Pittsburg, Pittsburg, CA, USA
e-mail: machery@pitt.edu

J.-L. Dessalles
Telecom ParisTech, Paris, France

F. Cowie
California Institute of Technology, Pasadena, CA, USA

J. Alexander
London School of Economics and Political Science, London, UK

environments. Why is *homo sapiens* unique in its communicative behavior? In *Why We Talk*, I showed that the most important features of the language faculty make sense, from an evolutionary perspective, if language evolved for individuals to advertise definite qualities, especially the ability to gather original information, that are crucial in the particular political context of our species.

Communication is ubiquitous in Nature. Human language is, however, unique in several respects. Human beings use a huge set of learned signals, typically several thousands of words, to communicate about states of the physical, cognitive and social world. They are apparently the only creatures that systematically communicate about what arouses their curiosity (Tomasello 2006). This behavior shows up in children before 12 months through pointing (Carpenter et al. 1998). Human communication is also unique in that it involves conversational narratives and argumentative discussions, which are two highly specialized and universal behaviors of our species.

Many authors (e.g., Bickerton 1990, p. 156; Pinker and Bloom 1990, p. 712; Pinker 1994, p. 367; Nowak and Komarova 2001; Ritt 2004, p. 2) consider that the contribution of language to biological fitness is 'obvious'. These various qualities ascribed to language in order to explain why natural selection led us to talk share a common property: they are not peculiar to the hominin lineage. The possibility of coordinating actions (Bradshaw 2001, p. 66), of warning for danger (Lieberman 1992, p. 23) or of sharing food sources would be invaluable in all primate species, if this line of reasoning was correct. If information sharing is such a good thing, the inevitable corollary question is: *Why is there only one talking species?*

The problem with all these accounts of language existence is that they are at odds with Darwinian Theory. Contrary to popular descriptions of its mechanisms, natural selection does not favor features merely because they are useful to the species. Natural selection results from differential reproduction *within* the species. Any evolutionary account of language origins must explain why talking individuals did better than non-talking (or less-talking) individuals of their reproductive population. Moreover, the difficult point is not to explain how language benefits listeners, but how it benefits speakers.

Though some authors claim that language evolved as a reciprocal trade of information (Pinker 2003, p. 28; Nowak and Sigmund 2005, p. 1,293), the reality of language (one speaking to many, frequent talkative behavior, no systematic discrimination of audience, futile conversational topics) is inconsistent with the cooperative scenario. Computer simulations and calculus indeed show that cooperation is unstable when, as for language, cheating detection is imperfect and benefits are not substantial.

The mystery deepens once one realizes that language performance is costly. It requires time, energy and risks to get interesting information. The systematic propensity to give it for free to whoever is ready to listen calls for a robust explanation. Merely invoking the fact that the members of our species are cooperative or show prosocial attitudes does not provide such answer.

The main thesis of *Why We Talk* is that language evolved in our lineage because of the specificity of homo's political niche. Casual conversations are the stage on which individuals demonstrate their *relevance*. Their performance is judged according to their ability to bring new and consistent information. This ability is

marginal is most animal species, whereas it is crucial in a species in which members form large coalitions. In the remainder of this précis, I review the main arguments of the book, which all converge on the idea that language is designed for individuals to display their ability to be relevant.

Language as a local optimum

The best image we can get of evolution by natural selection is offered by a technique called *generic algorithms*. It suggests that natural selection is an optimization process. Contrary to popular visions of evolution, natural selection acts rapidly. Thanks to crossover, nature tries various tentative solutions in parallel and rapidly reaches a local optimum. At that point, variants that would be fitter cannot be reached by incremental changes without going through a fitness trench. The species temporarily remains in equilibrium. This is the microevolution phase. Nature is, however, a poor optimizer. Natural selection has no mechanism whatsoever to escape from local optima. What may appear as a poor performance according to engineering standards is a general law in nature: all living species are trapped during unforeseeable duration in local optima. This is the macroevolution phase. Language is no exception: it evolved because of the particular niche in which our lineage entered, and it is locally optimal for its function. Saying that other species are evolving toward language-like communication or would benefit from having language is nonsense. The same holds for precursors of language.

In *Why We Talk*, Bickerton's hypothesis about the putative existence of an intermediary stage in the evolution of language, called *protolanguage*, is taken seriously. The irregular pace of macroevolution makes such intermediary phases likely, if only one is able to show that each stage is locally optimal for its function. This is what I tried to achieve in the case of protolanguage.

The protolanguage hypothesis

Bickerton (1990) defines protolanguage, by comparison with pidgins, as a language devoid of syntax. Proto-sentences were mere juxtapositions of content words, such as "strangers–plain–fire". It is difficult to have a positive look at protolanguage, as we perceive it as a form of language lacking several useful features like tense, embedding, marking, etc. Remember, however, that protolanguage, if it ever existed, must have been optimal only locally.

If protolanguage constitutes a locally optimal phase in our phylogeny, it must include various functional devices and some of them may have survived in us as cognitive modules. One such atavistic module, put forward by Bickerton, is the ability to revert to syntaxless language using one's native language vocabulary, instantaneously adopting a Tarzan-like mode of expression. It would be much harder to drop out part of syntax, only pronouns or determiners, say. But protolanguage would not qualify as a stable evolutionary stage if it were not associated with protosemantics and protopragmatics.

In *Why We Talk*, I make the suggestion that protosemantics consists in the ability to combine perceptual representations evoked through words. This is a non-trivial ability that we may not share with other animals. By hearing a series of words, "strangers", "plain", "fire", we are able to combine the associated perceptions into a single scene, for instance the image of strangers gathered around a fire in the middle of the plain over there. We currently still lack convincing models of this ability, despite the fact that it constitutes an essential component of our ability to construct meaning.

A good strategy to define protopragmatics is to look at components of the current pragmatic behavior of *homo sapiens*. People spend between one quarter and one half of their conversational time telling narratives about immediate or past events. The communication of relevant events could have been the main function of protolanguage. This makes sense, as juxtaposing words and combining concrete meanings is an efficient way of signaling non-immediate events that cannot be shown through mere deictic gestures.

Bickerton's protolanguage hypothesis, augmented this way, accounts for the existence of large learned vocabularies (in language and presumably in protolanguage), as interesting events are infrequent and depend on local conditions. It also explains why we systematically combine evoked meaning into integrated scenes. If protolanguage was a local optimum, one must then explain why the full-blown language faculty that we enjoy now evolved from it.

The transition to language

Language can be contrasted with protolanguage in several crucial respects. The most apparent one is syntax. The two main syntactic devices used in languages are based on marking and position. The main purpose of these devices is to bind predicates to their arguments. In the English sentence "Peter hits Paul", one knows that Peter is the hitter because the proper name is in subject position, whereas in the Latin sentence "Petrus Paulum ferit" the hitting status of Peter is inferred from its nominative case. Both the existence of predicates and the syntactic means to express predicate-argument relations are innovations that come with language and that cannot be granted to protolanguage as long as one wants to keep it as a consistent evolutionary stage.

Cases, gender or class markers introduce distinctions that are mostly conventional but are useful to link entities expressed by words like "Petrus" and "Paulum" in the sentence to predicates expressed by other words like the verb "ferit". The other main syntactic device, phrase structure, uses position to identify argumental relations. This function is achieved thanks to the principle of *semantic linking*. This principle states that syntactically connected phrases must share an argument. In simple structures like "Peter hits Paul", argument sharing is straightforward. To express "Peter hits Paul" for someone who does not know Paul, one may use "Mary hired Paul" and connect both sentences while replacing the mention "Paul" by "the man". English syntax can use movement and pronouns for that purpose: "Peter hits the man that Mary hired". Here, the complement of "hire" migrates to establish a connection with the verb "hits".

The preceding example provides an illustration of the reason why phrase structure is recursive. The main function of recursion is to achieve semantic determination. The predicate expressed through "Mary hired the man" is used to determine the second argument of "hits". In this example, the aggression constitutes the event, whereas Mary's hiring Paul is just a satellite predication introduced for the addressee to be able to determine Paul. Since satellite predicates have arguments that also need to be determined, one gets embedded phrase structures like "Peter hits the man that Jennifer's friend hired".

Where do predicates come from, and what is their purpose? As cognitive representations, predicates cannot be regarded as permanent structures hosted in some kind of mental dictionary, as the existence of such structures leads to inextricable paradoxes (Ghadakpour 2003). Predicates are rather formed in the fly at the interface between language and perceptual representations. One crucial operation of this interface is the ability to perform *thematic segmentation*: perceived or evoked scenes are grossly simplified and only a few topological relations are retained. While words evoke elements in the scene, predicate-argument relations express those topological relations.

Why did our ancestors evolve the capacity to form predicates and the syntactic devices necessary to express them? The answer lies in the observation of language as it is used in our species.

The ethology of language

Language is mainly used during casual conversation. This behavior takes several hours a day, which represent about one-third of our time awake (Mehl and Pennebacker 2003, p. 866). Conversational behavior is, presumably universally, devoted to two principal, sometime intertwined, activities: narratives and discussions. During narratives, individuals signal or report events that most of the time instantiate the four 'Ws': Where, When, Who and What. During discussions, individuals raise problems and then try together to solve them. These two conversational modes obey different laws. In narratives, relevance is governed by emotion and improbability. In discussions, relevance is bound to problems and their tentative solutions. Can we find a convincing scenario that can explain the existence of these two conversational modes?

What is to be explained is, first, why individuals select, among their many experiences, those which arouse emotion and/or surprise and then systematically look for conspecifics to share them (Rimé 2005). Narrative relevance depends on factors like proximity, recency or atypicality, which all have a definite influence on improbability. Why is improbability such a crucial factor in narratives? Second, one must explain why individuals are so prompt to point to problems and to discuss them. A problem is any inconsistency among beliefs and/or desires. Animals are not concerned with inconsistencies. Human beings not only pay attention to them, but feel the urge to make them public through language. These two strange idiosyncratic conducts, experience sharing and problem sharing, find an explanation in the political scenario sketched in the final part of *Why We Talk*.

The political origin of language

Information has value. For instance, acquiring information that can be delivered as news requires time, energy and sometimes involves risks. Not only do human beings give such information for free, but they seem to be competing when doing so. This altruistic behavior is incomprehensible at first sight, as it apparently goes against Darwinian laws. Recent advances in costly signaling theory, based on Zahavi's theory of prestige (Zahavi and Zahavi 1997), offer a way out. We now have models in which showing altruistic behavior, even if it is costly, can be evolutionary stable as long as it provides the performer with opportunities to establish profitable alliances (Dessalles 1999, 2006a; Gintis et al. 2001).

In the model reported in *Why We Talk*, an agent *A* may choose to form an alliance with another agent *B* depending on *B*'s communication performance. By doing so, *A* grants support and status to *B* at its own expense. After alliances have been formed this way, coalitions are ranked according to the 'quality' of the highest status member. The collective benefits of winning coalitions are shared among members of successful coalitions. A short-sighted strategy consists for agents to remain selfish and not to grant status to talkers. Language cannot exist in such a context. However, when the 'quality' of the high status individuals proves crucial to other members of the coalition, and if there is a positive correlation between that quality and communicative performance, it is in the interest of every agent to grant status to the best performers.

This class of models relies on the fact that communicative performance advertises some definite quality and on the fact that profitable alliances are formed based on it (and not on the performer's quality, as it remains inaccessible and must be inferred from performance). The obvious question, in the case of language, is to determine which quality is advertised through conversational performance and how this quality confers an advantage to all members of the alliance.

In *Why We Talk*, I suggest that individuals use language to display their informational competence: it is crucial to show that one was the first to know and that one is able to surprise others. This makes sense in a political species in which individuals form large coalitions. In such a context, physical strength is useless at the collective level, whereas information about the physical and social environment is vital. Language is thus not so much about pooling information, which appears to be a mere side effect. Language is used to demonstrate one's ability to get better information than others. Even futile matters provide an excuse for such demonstration.

One problem remains. Why is human communication honest? If lying were a free option, everyone would lie with the hope of being granted with status for bringing incredible news. At the protolanguage stage, lying is virtually impossible, as listeners are expected to move and check the signaled event with their own eyes. But human beings report about past, uncheckable events. This is where argumentation comes into play.

With the ability to contrast memories with testimonies and to name the difference, using the topological operations of thematic segmentation, individuals can denounce liars and get the social benefits for themselves. In this scenario predication, argumentation and, indirectly, syntax evolved as an anti-liar device (Dessalles 1998; see also Sperber 2000).

The picture we get from human cognitive nature departs from traditional philosophical accounts. Our propensity to share novelty and our logical reasoning abilities turn out to be local adaptations that have no universal character beyond the limits of our species. They emerged because our lineage entered a new political context in which information is more important than traditional assets such as physical strength. This change was probably provoked by the invention of lethal weapons. In such a context, every one has to choose the best informed friends among those who are available.[1] This demand for informed individuals generates a competition in which individuals compete in showing off their ability to know before and better. If the scenario is correct, the evolutionary emergence of human language would be a consequence of dramatic changes in hominin politics.[2]

[1] Recent models (Dessalles 2006a) avoid any explicit reference to status, as it emerges from social preferences. Individuals try to establish social bonds with relevant individuals. This is a good strategy if acquaintance with informed individuals is an asset (e.g., by avoiding being killed by surprise). In this context, advertising one's relevance is a good strategy too.

[2] I recently attributed these changes to the invention of new killing means, making prevention of surprise a condition for survival (Dessalles 2008b). In such a context, individuals who can demonstrate their ability to acquire information better and faster become invaluable friends. Note that this scenario departs from Bingham's (2001) theory, in which the main effect of weapons is to enforce cooperation through retaliation within coalitions.

Do we Talk to be Relevant?

Edouard Machery[3]
University of Pittsburgh, Department of History and Philosophy of Science

In *Why we Talk*, cognitive scientist Jean-Louis Dessalles presents an original, in-depth account of the nature and evolution of human language. Written in a clear and engaging manner, *Why we Talk* is an impressive achievement. Dessalles reviews and contributes to most controversies about human language. He compares human language to other systems of communication found in the animal world, arguing for the originality of the former; he clearly shows that language is a biological trait and that we should study its evolution as we do for other biological traits; he analyzes the nature of grammar; he distinguishes two semantic contributions made by assertions; he proposes several distinct stages in the evolution of language; and, finally, he proposes a new hypothesis about the selective pressures explaining the evolution of our linguistic faculty. In what follows, I will focus exclusively on this new hypothesis: I will argue that it poorly accounts for several important aspects of linguistic communication. Here is how I will proceed. In "Dessalles's Hypothesis about the Evolution of Language", I will review Dessalles's hypothesis about the evolution of language. In "Is Dessalles's Account Supported?", I will empirically evaluate this hypothesis.

Dessalles's Hypothesis about the Evolution of Language

The Puzzle of the Evolution of Language

From an evolutionary point of view, linguistic communication is puzzling. As Dessalles rightly emphasizes, following Grice as well as Sperber and Wilson, for a linguistic exchange to be successful, the speaker has to communicate some relevant information to the listener. Dessalles proposes that the relevance of a piece of information is a function of (at least) two properties: (1) the more probable (given the listener's background knowledge), the less relevant; (2) the more significant for the listener's well-being, the more relevant. Although this characterization of relevance is rather plausible, Dessalles points out that it diverges from both Grice's and Sperber and Wilson's. Be it as it may, because speakers communicate relevant information to others—viz., again, information that others might have judged unlikely given their background knowledge and that might affect their well-being—speakers decrease their relative fitness. A very silly thing to do when natural selection is the name of the game!

Of course, in this respect, linguistic communication is merely another altruistic trait, and the puzzle raised by the evolution of language could be quickly dismissed if one of the theories of the evolution of altruism could be applied to language. Dessalles argues, however, that these theories fail to explain the evolution of

[3] I would like to thank Kim Sterelny for his comments on this article.

language. Hamilton's (1964) kin selection is poorly equipped to explain the evolution of language because people speak with genetically unrelated listeners. Zahavi's (1975) honest-signal theory does not fare better: Linguistic signals are easy to fake, while honest signals often evolve to be hard to fake as a result of an arm race with signals that mimic them.

Trivers's (1971) reciprocal altruism seems at first glance to be well equipped to account for the evolution of language because it would seem to explain why in conversation speakers and listeners take turns. (Similarly, sticklebacks take turns when they examine whether a fish is a predator; Milinski 1987.) However, Dessalles notes that in a reciprocal interaction, the altruistic organism is the one who takes the risk of being cheated. Because reciprocation is often delayed, the organism that benefits from altruism ("the recipient of altruism") might not reciprocate. Altruistic organisms should thus monitor recipients in order to avoid interacting with them in the future if they do not reciprocate. By contrast, in linguistic communication, it is the recipient of the benefit, namely the listener, who seems to be at risk of being cheated. As Dessalles notes, listeners regularly evaluate the informational quality (relevance, truth, justification, etc.) of the pieces of information communicated by speakers.[4] In addition, in contrast to the altruistic organisms in reciprocal interactions, speakers do not check whether the latter reciprocate with relevant pieces of information. Language is thus unlikely to be the evolutionary outcome of reciprocal altruism.

Finally, accounts that view language as the outcome of indirect reciprocity (Alexander 1987; Nowak and Sigmund 2005) rather than direct reciprocity do not fare better, although they have the potential to explain why speakers don't monitor listeners. On this view, speakers do not trade information; rather, they give information to listeners because other speakers will give them other pieces of information on other occasions. As a result, they do not need to monitor whether listeners reciprocate.[5] However, speakers not only fail to monitor listeners, they also engage in wasteful displays. Speakers often strive to provide more interesting (read "more relevant") pieces of information than their interlocutors. Because this amounts to striving to give more than could be indirectly reciprocated, this is evidence that language is not the evolutionary outcome of indirect reciprocity. In addition, indirect reciprocity is typically thought of as a series of pairwise interactions, while linguistic communication is not restricted to pairwise interactions. Rather, a speaker often addresses (and, thus, benefits) many people. And Boyd and Richerson (1988) have shown that when an altruistic trait benefits a large number of individuals, indirect reciprocity is an unlikely explanation of the evolution of altruism.

Everything considered, it thus seems that reciprocity-based accounts are not better equipped than kin selection or honest signal theory to account for the

[4] It is however noteworthy that recipients of altruism are also at risk of being cheated when organisms involved in reciprocal interactions can fake altruism. For instance, among dance flies (*Rhamphomyia sulcata*) males sometimes give fake nuptial gifts (LeBas and Hockham 2005).

[5] One should however note that models of the evolution of altruism by indirect reciprocity typically assume that organisms have a reputation and that when they decide whether to benefit other organisms, altruistic organisms take into consideration the reputation of these organisms.

evolution of language. So the puzzle remains: Linguistic communication is altruistic, but the evolution of language is not explained by the dominant evolutionary accounts of altruism.

The Solution: Showing Off

Dessalles develops an original hypothesis to explain the evolution of language. This hypothesis shares various features with the theories previously discussed, but is distinct from them.

For Dessalles, utterances are signals: Because speakers strive to be relevant, their utterances indicate their capacity to discover relevant pieces of information. In contrast to the accounts of the evolution of language that are inspired by the theory of honest signals, however, these signals are not costly and are thus easy to fake.

But why would speakers care about advertising their capacity to discover relevant pieces of information? Dessalles proposes that some kind of reciprocation explains why they do: Listeners grant status to those speakers who are able to discover relevant pieces of information, and higher status increases people's relative fitness (on this latter point, see Henrich and Gil-White 2001). So, supposing that listeners do grant status, there was a selection pressure for being able to discover relevant pieces of information and for advertising this capacity in speech.

Note an important difference between Dessalles's account of the evolution of language and the reciprocity-based accounts. Speakers are not rewarded for the pieces for information they actually provide in conversation; rather, status rewards their capacity for providing relevant information. By contrast, in direct and indirect reciprocity, it is the actual benefit produced by the agent that is reciprocated by the recipient of altruism or by a third person.

It might seem puzzling that listeners grant status to good speakers because status granting is a zero-sum game: Granting status to someone else means decreasing everybody else's (including one's own) relative status. Dessalles's most original idea is that listeners grant status to good speakers because they thereby signal their desire to form a coalition with them. Given the structure of the social environment of our ancestors, our ancestors' fitness depended on the nature of the coalitions they belonged to. Dessalles proposes that forming coalitions with individuals who were able to gather relevant information was adaptive. Thus, provided that status granting increases the probability of forming a coalition with the individual granted status (a reasonable assumption), status granting might have been selected for and, as a result, inquisitiveness and inquisitiveness advertisement in speech might also have been selected for.

But then, why wouldn't speakers exaggerate the relevance of the pieces of information they provide? As we have seen earlier, linguistic messages are not costly signals, and it would thus be easy to fake the relevance of what one says. In response, Dessalles suggests that listeners have evolved a capacity to evaluate the epistemic value (truth, relevance, justification) of the claims made by speakers. In substance, because it would be costly to grant status to, and to form a coalition with,

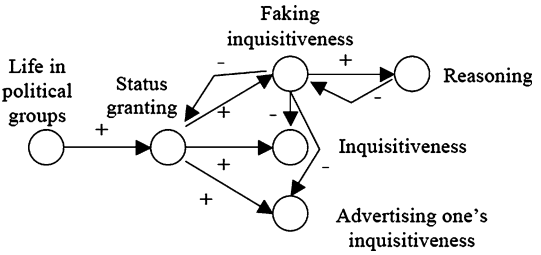


Fig. 1 Dessalles's Showing-Off Hypothesis ("+" positive selective pressure, "−" negative selective pressure)

an individual that is only apparently inquisitive, such a capacity was selected. For Dessalles, this is the proper function of our capacity to reason.[6]

So, why do we speak? We speak to showcase our own inquisitiveness because listeners are disposed to grant status—a fitness-relevant property that we have evolved to desire—to inquisitive individuals in order to indicate to these individuals their desire to form coalitional bonds (Fig. 1).

Is Dessalles's Account Supported?

Dessalles's Adaptationism

In step with evolutionary psychologists, Dessalles follows Williams (1966) in contending that the design of a trait is evidence that this trait is an adaptation for a specific function. That is, Dessalles takes the fact that a trait is so organized as to produce reliably and efficiently a specific outcome that was arguably fitness-conducive in some specifiable past environment to be evidence that this trait is an adaptation that was selected for producing this specific outcome.

In practice, Dessalles relies on what might be called "the adaptationist inference to the best explanation". A hypothesis about the selective pressures acting on the evolution of a trait (and thus about its biological function) is better supported than an alternative hypothesis (be it a competing adaptationist hypothesis, a non-adaptationist hypothesis involving the notion of a byproduct, or a non-evolutionary hypothesis referring, e.g., to learning) if and only if it explains better the properties of the trait to be explained. In marked contrast with Gould and Lewontin (1979), Dessalles contends that when a large number of properties are taken into account, this inferential practice puts strong constraints on the hypotheses one can justifiably hold (for related discussion, see Machery, forthcoming).

In the remainder of this article, I will take this inferential practice for granted, and I will argue that Dessalles's hypothesis about the evolution of language (summarized in "Dessalles's Hypothesis about the Evolution of Language") fails to explain four important features of linguistic communication.

[6] It won't have escaped the reader that according to this hypothesis, linguistic communication is scientific communication writ large. Dessalles notes the analogy.

A Gendered Account

One might first wonder whether Dessalles has inadvertently painted a gendered picture of language use. According to Deborah Tannen (1991), male children, *but not female children*, typically compete to dominate group discussion (by displaying their knowledge and by challenging other speakers). Female children, on the contrary, tend to communicate with friends in small groups or in pairs. It is plausible that the same is true of adult males and females, although to my knowledge relevant evidence is scarce. Now, Dessalles's evolutionary hypothesis assumes that speakers compete to display their inquisitiveness in front of skeptical listeners, a language use that is only characteristic of male speakers if Tannen is right. How could this hypothesis account for the gender differences described by Tannen?

Dessalles could take into account Tannen's work in three different ways. He could first reject Tannen's description of communication among males and females. Alternatively, granting the gender differences noted by Tannen, he could argue that both females and males attempt to showcase their inquisitiveness in communication, but that their display takes gender-specific forms. Dessalles could perhaps speculate that because males and females have long occupied different social roles, different types of inquisitiveness (for instance, an inquisitiveness about different things) have been selected for in males and females. This might explain why males and females display their inquisitiveness differently. Finally, he could argue that language was selected among males and that its presence among females is a by-product of its selection among males. Of these three responses, the second one seems the most plausible, but to make it really plausible, Dessalles would need to flesh it out in much greater detail.

Gullible Listeners

An important feature of linguistic communication is the gullibility of listeners: Listeners tend to believe what they are told. Gullibility has two distinct sources: People lack the motivation to evaluate the epistemic credentials of what they are told, and they lack the reasoning skills to do it. In this section, I focus on the former source of gullibility, leaving the latter for the next section.

People are rarely motivated to evaluate the epistemic credentials of the information they are presented with. The ease with which urban legends spread provides evidence for this lack of motivation. For instance, in 1975, *Newsweek* ran a story about children being hurt and killed by goodies filled with glass, broken needles, and razor blades. In 1985, an ABC poll showed that 60% of parents were worried that their children might be victims of such acts (reported in Heath et al. 2001).

Daniel Gilbert's hypothesis that comprehension and belief are a single process provides a plausible explanation for this lack of motivation (Gilbert 1991).[7] According to him, understanding a proposition is, by default, being committed to its truth, while rejecting a proposition involves some additional effort. If critically

[7] Thanks to Eric Mandelbaum for this reference.

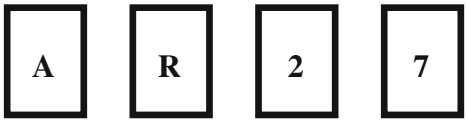
scrutinizing a proposition really is effortful, it is not surprising that in most circumstances, people lack the motivation to evaluate speakers critically.

As we saw, according to Dessalles, listeners' capacity to reason is supposed to prevent speakers from exaggerating the relevance of what they say and from disseminating fraudulent information (see Fig. 1). However, if listeners are truly gullible because they are not motivated to evaluate what is said critically, one wonders what keeps speakers in check. And if speakers are not kept in check, listeners are at risk of granting status to, and affiliating with, frauds—certainly not a fitness-conducive behavior.

Inept Reasoners

Another aspect of linguistic communication is poorly explained by Dessalles's hypothesis: In addition to lacking motivation, people do not seem to be able to properly evaluate the epistemic credentials of what is said to them.

Forty years of research in psychology have painted a bleak picture of human reasoning skills. Consider, for instance, the extensive research on the Wason selection task (see, e.g., Wason 1968; Cheng and Holyoak 1985). In one version of this task, participants are shown the following four cards:



They are then asked to determine whether the conditional "If there is a vowel on one side of a card, then there is an odd number on the other side" is true by selecting the minimal number of cases. Between 80 and 90% of participants incorrectly choose either the card with A or the cards with A and with 7. This type of mistakes has been replicated with many variants of this experiment (but see below for qualifications).

The Wason selection task is particularly relevant for Dessalles's claim that speakers evolved a reasoning capacity to avoid granting status and concomitant favors to frauds, for this task tests whether people know how to falsify conditional claims. This is precisely the kind of capacity that would allow listeners to keep speakers in check and to distinguish frauds from genuinely inquisitive speakers. Furthermore, people's answers in the Wason selection task suggest that they are disposed to look for evidence supporting assertions (rather than evidence falsifying them.) People's answers in this task are not random. Rather, people answer E and 7 because having a card with E on one side and 7 on the opposite side provides confirmatory evidence for the conditional under consideration. Now, being disposed to look for confirmatory evidence is certainly not the kind of reasoning disposition we'd expect from the skeptical listeners hypothesized by Dessalles.

Reasoning failures are naturally not limited to evaluating the truth of conditionals. People also fare poorly when they are asked to reason about various probabilistic matters (Kahneman et al. 1982). They often judge that a conjunction is

more probable than its conjuncts (the conjunction fallacy); they regularly neglect the base rate, when evaluating the probability of a proposition; people's confidence is poorly calibrated, etc.

Reasoning about probabilistic matters is important for distinguishing the credibility of the information we are presented with. To determine whether some information about an event is plausible and should be taken at face value, it seems reasonable to take into consideration the base rate of this type of events.

The systematic failures of human reasoning are poorly explained by Dessalles's evolutionary hypothesis. Again, if listeners grant status and, thereby, favors to individuals who seem inquisitive (viz. who have been able to collect relevant information), they need to be able to distinguish frauds from truly inquisitive minds. But, if their reasoning capacities are poor, how are they to identify frauds?

At this point, there are a few lines of reply available to Dessalles. The common thrust of these replies is that appearances notwithstanding, people are good reasoners. Following some psychologists (e.g., Oaksford and Chater 1994 on the Wason selection task; Hertwig and Gigerenzer 1999 on the conjunction fallacy) and a few philosophers (e.g., Cohen 1981), Dessalles could deny that people actually make reasoning mistakes in the classical experiments on reasoning. For instance, Tversky and Kahneman asked participants to read the following story:

> Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations (1982, 92).

Participants were then asked to rank various "statements by their probabilities", including the following three:

1. Linda is active in the feminist movement
2. Linda is a bank teller
3. Linda is a bank teller and is active in the feminist movement.

(3) was typically judged more probable than (1) and (2). Hertwig and Gigerenzer (1999) have argued that appearances notwithstanding, this answer is not erroneous because people interpret (1) and (2) as implicitly negating the other conjunct. Thus, (2) would be taken to mean that Linda is a bank teller who is not active in the feminist movement. Similar arguments have been developed for the other experiments allegedly showing the frailties of the human mind.

Alternatively, Dessalles could concede that participants reason poorly in these experiments, while contending that people's reasoning fares well in real life (particularly, in real conversational situations) and in experiments that are ecologically more valid. People's mistakes would then be imputed to the ecologically invalid experimental conditions, and not to people's poor reasoning capacities. A few psychologists and cognitive scientists have defended such a line (e.g., Sperber et al. 1995). Particularly, Gigerenzer and colleagues have argued that human probabilistic reasoning is successful when the information is presented as natural frequencies, which is, as it were, the native format of probabilistic information for the human mind (Gigerenzer and Hoffrage 1995).

Finally, Dessalles could reply that these experiments show that reasoning capacities are indeed limited, but that people's limited reasoning abilities are sufficient for distinguishing frauds from genuine inquisitive minds.

The issues touched upon in the previous paragraphs are obviously intricate, and there is more to be said than space allows for here. The short reply is that even if people are better reasoners than the experiments mentioned above suggest, it is dubious that they have the reasoning skills needed to identify anything but the less skillful frauds in conversational settings.

Too Much Chitchat with our Friends and Relatives

The last problem for Dessalles's hypothesis derives from the observation that in a typical conversation, speakers are often neither interested in transmitting information to their interlocutors nor in showcasing their inquisitiveness. Much of our conversation consists indeed in chitchatting.[8] We often talk about the weather, about unremarkable events in our lives, even about things that are common knowledge between interlocutors. It is hard to believe that when we do so, we are motivated by a desire to showcase our inquisitiveness in order to be granted status.

Jakobson (1960) has highlighted the phatic function of some linguistic expressions. Every language has linguistic expressions whose function is to establish and further communication between interlocutors. Expressions like "you see" and "you know what I mean" illustrate these linguistic tools. We also use non-linguistic tools, such as gestures and eye contact, to fulfill this function. Even more important is the fact that much of human linguistic communication *only* happens to fulfill this function. That is, much human conversation only happens to establish contacts between people.

In addition, much of human conversation takes place between affiliates, not between potential associates in coalitional ventures. People mostly talk with their kin, their friends, and their acquaintances. By contrast, Dessalles's account of the evolution of language seems to predict that much of human linguistic communication should take place between, if not complete strangers, at least people who are not already affiliates. After all, for Dessalles, the point of talking is to advertise one's value as a coalitional partner, and the point of listening is to decide whether one is willing to form a coalition with the speaker.

The fact that we typically talk to affiliates is related to the typical triviality of human communication. In a typical conversation, people do not attempt to showcase their inquisitiveness because their interlocutors are not engaged in conversation to evaluate them. Rather, people talk only to signal to each other that they remain affiliates. This is, I believe, the key insight behind Dunbar's (1996) grooming hypothesis about the evolution of language.

The fact that we are so keen to talk to our affiliates and that we so often do not feel compelled to showcase our inquisitiveness is evidence against Dessalles's hypothesis. If Dessalles were correct, people should have little interest in talking

[8] Dessalles is aware of this, but, puzzlingly, he does not seem to view this as a problem for his hypothesis.

with people with whom they have already formed bonds, and they should be motivated to communicate important pieces of information. Furthermore, people's motivation to engage in conversation should be a decreasing function of the existing strength of their affiliation with interlocutors: People should be more motivated to speak with strangers than with acquaintances; they should be more motivated to speak with acquaintances than with friends; and they should be more motivated to speak with friends than with relatives. Noteworthily, in a scientific conference or in a social gathering, speakers are often so motivated: People want to impress with their brilliant conversational skills those people with whom they are *not* connected. It is plain however that much of human conversation is not like this.

Conclusion

So, do we talk to be relevant? We certainly do, at least sometimes. We sometimes do want to impress potential partners in coalitional ventures. Look at conference banquets or social gatherings! But it is dubious that this fact explains the evolution of language. Many important features of human linguistic communication would be utterly mysterious if Dessalles's hypothesis were correct. So, why do we speak? The honest answer is, I don't know.

References

Alexander RD (1987) The biology of moral systems. Aldine de Gruyter, New York

Boyd R, Richerson PJ (1988) The evolution reciprocity in sizable groups. J Theor Biol 132:337–356. doi:10.1016/S0022-5193(88)80219-4

Cheng PW, Holyoak KJ (1985) Pragmatic reasoning schemas. Cognit Psychol 17:391–416. doi:10.1016/0010-0285(85)90014-3

Cohen LJ (1981) Can human irrationality be experimentally demonstrated? Behav Brain Sci 4:317–370

Dunbar RIM (1996) Grooming, gossip and the evolution of language. Faber and Faber, London

Gigerenzer G, Hoffrage U (1995) How to improve Bayesian reasoning without instruction: frequency formats. Psychol Rev 102:684–704. doi:10.1037/0033-295X.102.4.684

Gilbert DT (1991) How mental systems believe. Am Psychol 46:107–119. doi:10.1037/0003-066X.46.2.107

Gould SJ, Lewontin RC (1979) The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. Proc R Soc Lond B Biol Sci 205:581–598

Hamilton WD (1964) The genetical evolution of social behaviour I and II. J Theor Biol 7:1–52. doi:10.1016/0022-5193(64)90038-4

Heath C, Bell C, Sternberg E (2001) Emotional selection in memes: the case of urban legends. J Pers Soc Psychol 81:1028–1041. doi:10.1037/0022-3514.81.6.1028

Henrich J, Gil-White F (2001) The evolution of prestige: freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. Evol Hum Behav 22:165–196. doi:10.1016/S1090-5138(00)00071-4

Hertwig R, Gigerenzer G (1999) The "conjunction fallacy" revisited: how intelligent inferences look like reasoning errors. J Behav Decis Making 12:275–305. doi:10.1002/(SICI)1099-0771(199912)12:4<275::AID-BDM323>3.0.CO;2-M

Jakobson R (1960) Linguistics and poetics. In: Sebeok TA (ed) Style in language, pp 350–377. Wiley, New York

Kahneman D, Slovic P, Terversky A (eds) (1982) Judgment under uncertainty: heuristics and biases. Cambridge University Press, New York

LeBas NR, Hockham LR (2005) An invasion of cheats: the evolution of worthless nuptial gifts. Curr Biol 15:64–67
Machery E (2009) Discovery and confirmation in evolutionary psychology. In: Prinz J (ed) Oxford handbook of philosophy of psychology. Oxford University Press, Oxford (forthcoming)
Milinski M (1987) Tit-for-tat in sticklebacks and the evolution of cooperation. Nature 325:433–437. doi:10.1038/325433a0
Nowak MA, Sigmund K (2005) Evolution of indirect reciprocity. Nature 437:1291–1298. doi:10.1038/nature04131
Oaksford M, Chater N (1994) A rational analysis of the selection task as optimal data selection. Psychol Rev 101:608–631. doi:10.1037/0033-295X.101.4.608
Sperber D, Cara F, Girotto V (1995) Relevance theory explains the selection task. Cognition 57:31–95. doi:10.1016/0010-0277(95)00666-M
Tannen D (1991) You just don't understand: women and men in conversation. William E. Morrow and Company, New York
Trivers RL (1971) The evolution of reciprocal altruism. Q Rev Biol 46:35–57. doi:10.1086/406755
Wason P (1968) Reasoning about a rule. Q J Exp Psychol 20:273–281. doi:10.1080/14640746808400161
Williams GC (1966) Adaptation and natural selection. Princeton University Press, Princeton
Zahavi A (1975) Mate selection: a selection for a handicap. J Theor Biol 53:205–214. doi:10.1016/0022-5193(75)90111-3

Robustness, optimality, and the handicap principle

J. McKenzie Alexander
Department of Philosophy, Logic and Scientific Method,
London School of Economics and Political Science

In 1980, the British gothic rock band Bauhaus released their debut album *In the Flat Field*. Track six, entitled "Small Talk Stinks", complained about the meaninglessness of conversation among the middle class. Although I suspect it wasn't intentional, in that song Peter Murphy identified a curious phenomenon: the human ability to communicate vastly exceeds that of any other species on the planet, and most of the time we seem to waste it. For when we reflect upon the content of our conversations, many of them, ultimately, seem to be about not much of anything.

Surprisingly, the fact that so much of our conversation seems to be about not much of anything is, according to Dessalles (2007), the answer to the question of *why* language evolved:

> If evolution endowed us with language and the cognitive means associated with it, it was not for the purpose of speculating about the world into which we have been brought, of collaborating on the building of bridges or rockets or even devising systems of mathematics. It was so that we could chat. (Dessalles 2007, p. 269)

The last sentence must be taken quite literally: evolution endowed humans with the ability to speak not because of the benefits conferred by exchanging information, or theorizing, or constructing explanations of events, but so that we could *primarily* engage in idle banter (for signalling and social bonding purposes). This is a startling, and counterintuitive, claim.

Of course, saying that something is counterintuitive hardly constitutes an argument against it: many of our intuitions are misleading if not flat-out wrong. (Think of how much effort it takes to stop thinking of the world in Aristotelean terms.) But a counterintuitive claim compels us to take a very close look at the reasons given in support of it. I shan't go through all of the reasons why Dessalles thinks that chatting is the ultimate factor lurking behind the evolution of language, but I will examine three core elements of his argument:

1. His political model of the evolution of language;
2. The claim that evolution selects for locally optimal outcomes, and that language is locally optimal for some adaptive function;
3. The claim that Zahavi's Handicap Principle poses a problem for the evolution of human language, and that the notion of conversational relevance (and the cost of being relevant) provides a solution.

In doing so, I will argue for the following:

1. That the political model of the evolution of language is not robust;
2. That evolution need not select locally optimal outcomes, and that consideration of the evolutionary dynamics of sender–receiver games gives us little reason to think that language need be locally optimal for some adaptive function;
3. That recent work on the evolution of signalling systems challenges the view that honest and reliable signals can only exist if they are costly, and hence Zahavi's Handicap Principle may not pose a problem for the evolution of human language.

The upshot is that we are left uncertain as to what extent Dessalles's account is ultimately supported. I argue that, although it may very well be true that language evolved, in part, because of the benefits brought about by chatting, that it is too hasty at this point to suggest that such benefits are the primary reason language evolved.

The political origins of language

Dessalles suggests that idle banter is a way for people to signal their quality as information detectors. Being good at "small talk" reflects people's ability to report on potential changes in, and salient features of, the surrounding environment. Sterling conversationalists win prestige within their group, thereby increasing their social status. However, in order to avoid the problem of people exaggerating the salience of the situation of which they speak, "[h]earers try to assess accurately the quality of the information presented to them so as to 'reward' it properly through the granting of status" (Dessalles 2007, p. 339). People with a higher status are considered to receive a fitness enhancement as a consequence.

Why does Dessalles call his model of the evolution of language a *political* model? The reason is that we are evolved from social primates, and naturally form coalitions for protection and existence. Which groups we choose to associate with, and whom we choose to let into our group, can be viewed as a kind of political act. Given this, "[s]ince belonging to a coalition is of such vital importance for individuals, what are the criteria on which they choose each other?" (Dessalles 2007, p. 347). We know, through the work of Franz de Waal and others, that chimpanzees pick members to belong to their coalitions based on physical size and strength. This makes sense because chimpanzee coalitions tend to be small so adding a single individual can make the difference between a successful or unsuccessful competition between coalitions. However, *we* probably use a different criterion, since our group sizes tend to be sufficiently large that adding a single person would be unlikely to make a considerable difference. Dessalles proposes that we consider the ability to be relevant as an important criterion for group membership.

Given that we know relatively little about the conditions under which language evolved, it would be nice if Dessalles's model was *robust*, as this would show that the particular assumptions made do not matter much.[9] This notion of robustness is taken from population biology:

[9] Weisberg (2006) provides a nice example of robustness analysis regarding the Volterra Principle.

> we attempt to treat the same problem with several alternative models each with different simplifications but with a common biological assumption. Then, if these models, despite their different assumptions, lead to similar results, we have what we can call a robust theorem that is relatively free of the details of the model. Hence our truth is the intersection of independent lies. (Levins 1984, p. 20)

Consider the following agent-based implementation of Dessalles's political model of language formation, drawn heavily from Dessalles (1999):

- Each agent a_i possesses two traits: $g_i^1 \in [0, 1]$, which measures the propensity to "speak relevantly" about some issue, and $g_i^2 \in [0, 1]$, which measures the propensity of the agent to bestow status upon another person when they speak relevantly[10].
- Each agent a_i has an inherent base ability $q_i \in [0, 1]$ to speak relevantly.
- We begin with a population $P = \{a_1, , a_N\}$. For every round of interactions except the very first, we partition P into a set of coalitions $\mathcal{C}$.
- Each person a_i in the population is paired with k other people at random, with preference given to interacting with members from her own coalition C_i (if a_i and a_j belong to the same coalition, then $C_i = C_j$).[11] Let $\eta_i^t = \{a_{i_1}^t, , a_{i_k}^t\}$ denote the people with whom a_i is paired with at time t. For each member $a_j \in \eta_i^t$, the following takes place:
  1. a_i tries to speak relevantly with a_j. Agent a_i succeeds with probability g_i^1.
  2. If a_i speaks relevantly with a_j, then a_j benefits by $G\ q_i\ g_i^1$ (where G is a global constant) and a_i incurs a cost of $C_1\ q_i\ g_i^1$.
  3. If a_i spoke relevantly, then a_j may bestow status upon a_i. He does so with probability g_j^2.
  4. If a_j rewards a_i with status, then a_i receives a status increase of $R\ g_j^2\ q_i\ g_i^1$ (where R is a global constant set at the beginning of the simulation) and a_j incurs a cost of $C_2\ g_j^2\ q_i\ g_i^1$.
- After all interactions have taken place, a round of "coalition competitions" takes place as described in Dessalles (1999).
- Each agent appearing in a nondegenerate coalition has her status multiplied by the relative aptitude of her coalition (see H7, in Dessalles 1999).
- After all agents in the model have had all of their interactions, we replicate agents using a Moran process.

Define the *fitness* of a_i at the end of generation t to be the sum of all costs, benefits, and status increases received by the agent over the last period. Let the *status* of the agent at the end of generation t simply be the sum of all the status awarded to him

[10] Superscripts denote indexes rather than exponents.

[11] Given the dynamics of coalition formation, it is possible that some coalitions will be degenerate (i.e., containing only one member). When a coalition is degenerate, the people with whom a_i is paired are drawn uniformly from $P \backslash \{a_i\}$. (And it is allowed for a_i to interact with the same person more than once.) If coalition C_i is not degenerate, then *each* of the k interactions for a_i is determined as follows: a_i is paired with someone drawn uniformly from $C_i \setminus \{a_i\}$ with probability 0.6, and otherwise with someone drawn uniformly from $P \setminus \{a_i\}$.

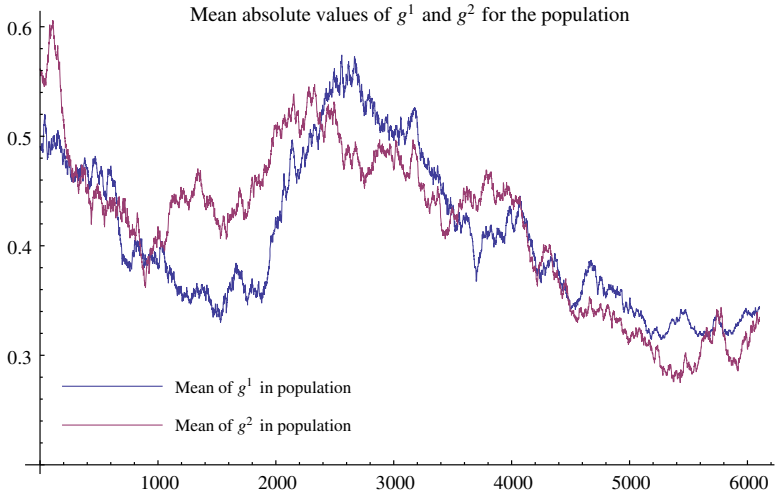


Fig. 1 Time-series plot of the mean values of g^1 and g^2 for the population in the agent-based variant of Dessalles' political model for the origin of language. Population size of 150, (G, R, C_1, C_2) = (2,2,1,1), and three interactions initiated by each agent in each round

by others as a result of his interactions. The status is thus a separate quantity from the fitness of the agent, but the status of the agent contributes to the agent's fitness.

A *Moran process* is often used for modeling evolutionary dynamics in finite, unstructured populations. At time t, each individual a_i is assumed to have a nonnegative fitness f_i, with at least one individual possessing a positive fitness.[12] Fitness are converted into replication probabilities through normalization: the probability that a_i will replicate is simply $\frac{f_i}{\sum_j f_j}$. One individual, say a_i, is selected at random for replication and another individual, say a_j, is selected at random, removed from the population, and replaced by a clone of a_i.[13] A Moran process has two useful properties: first, it keeps the size of the population fixed. Second, it is a useful evolutionary dynamic because one can establish analytic results concerning its long-term convergence behaviour.[14]

Figure 1 illustrates the outcome of one simulation in the agent-based political model of the evolution of language. Notice that, in contrast to the result reported in *Why We Talk* (see Fig. 2) we do not get convergence to a 100% "communication level". What we see, rather, is that the average value of g^1 in the population, representing the probability of people speaking relevantly in an interaction, initially

[12] Because individuals incur a cost when they attempt to speak relevantly, I assume all agents have a baseline fitness of 3. This insures that even if someone chooses to speak relevantly to others, and receives no benefit or status increase, he still has a positive fitness.

[13] Here, I shall assume that a_j is selected using a uniform probability distribution over the entire population.

[14] Pawlowitsch (2007a) models the evolution of a proto-language in a finite population using a Moran process and shows that "efficient proto-languages are the only strategies that are protected by selection." See also the discussion below in "Lewis sender-receiver games as a model of the evolution of language".

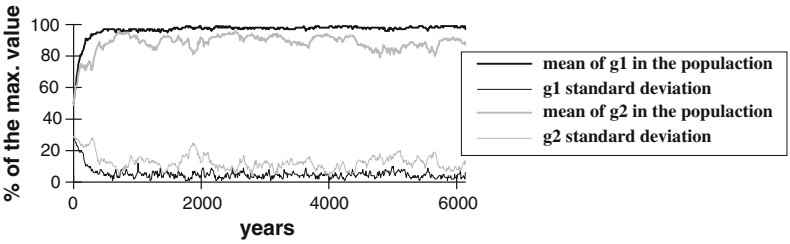


Fig. 2 The emergence of language behaviour (Dessalles 2007)

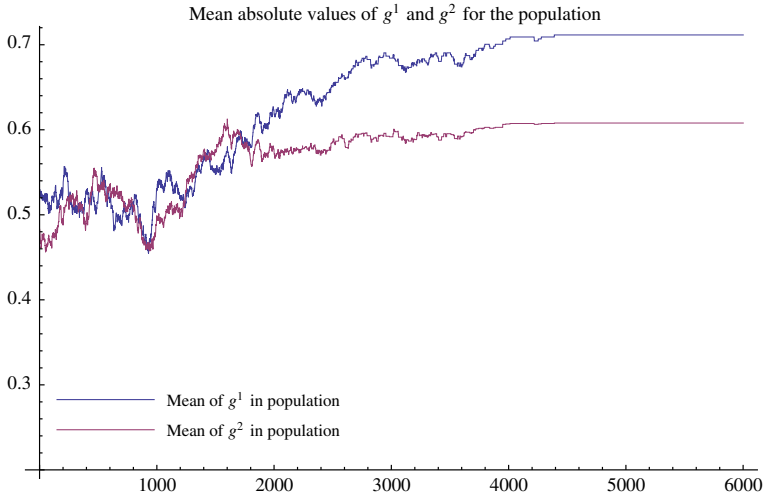


Fig. 3 Time-series plot of the mean values of g^1 and g^2 for the population in the agent-based variant of Dessalles' political model for the origin of language. Population size of 150, (G, R, C_1, C_2) = (1.5,1.75,.5,.6), and three interactions initiated by each agent in each round

declines, then slightly increases, then gradually declines again over the 6,000 generations.

However, if we pick other values for the constants, as in Fig. 3, we find different behaviour. These alternate values may seem more reasonable as they set the cost of both speaking relevantly and bestowing status upon others rather low. In this second simulation, after some initial transient noise is driven out, the population slowly increases the mean values of g^1 and g^2 until it arrives at a point where everyone in the population is identical in type. Note, though, that little significance should be attached to this: because the evolutionary dynamics we are using do not permit the introduction of new types, a Moran process, given enough time, will eventually converge to a state where everyone is identical. For the simulation represented in Fig. 3, this consists of individuals have the following values: $g^1 = 0.71148$, $g^2 = 0.6079$, and $q = 0.852001$.

The result of Fig. 3 appears to replicate the result of Dessalles (2007, p. 350). However, this reproduction is merely due to the random selections made in the Moran process: a second run, initialized with similar initial conditions and identical

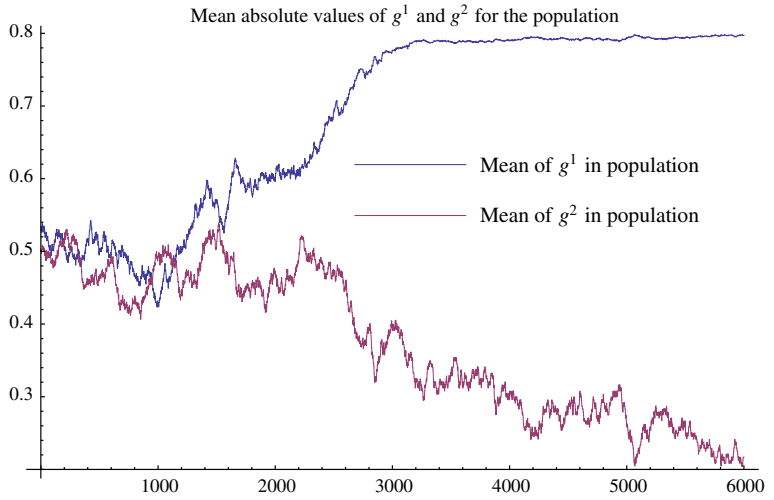


Fig. 4 Time-series plot of the mean values of g^1 and g^2 for the populationin the agent-based variant of Dessalles's political model for the origin oflanguage. Population size of 150, (*G*;R;C1;C2)

values of the key constants, produced the outcome illustrated in Fig. 4. Notice how, in that figure, although the mean value of g^1 does increase to a noticeably high value of 0.8 within 6000 iterations, the mean value of g^2 *declines* to a low point of 0.2. In words: although agents are increasingly inclined to "speak relevantly", not too many people care enough in order to be bothered to award them with an increase in status.

One shortcoming of the agent-based model is that it does not permit the introduction of new strategies (or player types) into the population. What happens if we make that possible? Let us implement a process of "mutation" as follows: if mutations are permitted, each agent a_i has a chance μ of being replaced by an entirely new type of agent. Values of the critical parameters g_i^1, g_i^2 and q_i are selected at random from (0,1).

Figure 5 illustrates how mutations serve to destabilise the apparent reproduction of the result reported by Dessalles (2007). The first 6,000 iterations in that plot coincide with that of Fig. 4 (it is from the same simulation). However, once the population has reached a reasonably "stable" level of nearly 0.8, for the mean value of g^1, and 0.2, for the mean value of g^2, mutations were enabled at a rate of $\mu = 0.00223$. The reason for choosing this particular mutation rate was that it ensured the appearance of approximately one mutant every three iterations[15]

Notice that the presence of even a relatively low rate of mutation serves to overrun the influence of selection: The population mean for both g^1 and g^2 is driven back into the range around 0.5 for both parameters, as shown in the first shaded region. Admittedly, if mutations are disabled again for a period of time, as done between iterations 9,001–12,000, the population mean for g^1 (although not g^2, interestingly) increases again—to a value approaching 0.9. However, re-enabling

[15] The population is of size 150 and $150 \cdot \mu \cdot 3 \approx 1.0035$.

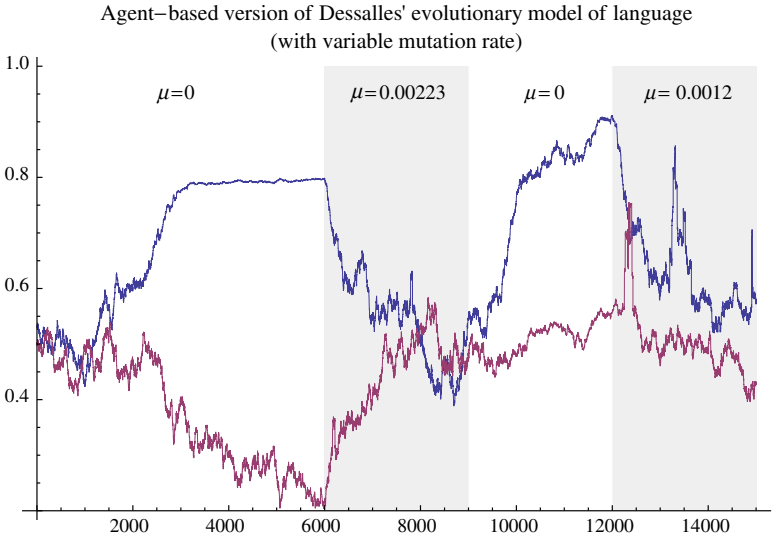


Fig. 5 Time-series plot of the mean values of g^1 and g^2 for the population in the agent-based variant of Dessalles' political model for the origin of language. Population size of 150, (G, R, C_1, C_2) = (1.5,1.75,.5,.6), and three interactions initiated by each agent in each round. Variable mutation rates μ used, with values as specified in the plot

mutations, with a rate *half* of what it was during iterations 6,001–9,000 serves to knock the population out of this state.

This shows that the outcomes of the model reported by Dessalles (2007, p. 350) depend substantially upon the interplay between three features: (a) the particular evolutionary dynamics used, (b) the values of key constants in the model, and (c) the method by which new player types are introduced into the population. Given our ignorance of all three of these regarding the emergence of language during the early period of *homo sapiens*, this dependency of Dessalles's result upon the model should lead us to view his result with caution. Had we found that the same, or at least similar, results were produced from a variety of different evolutionary models, under a range of different conditions, we would have some confidence that we had "found the truth at the intersection of various lies". But the above results suggest that Dessalles's political model for the emergence of language may not be robust. Not only have we not found the truth at an intersection of lies, it is unclear whether we have even found an intersection.

However, even if the model *was* robust, would we be able to draw the inferences from the model which Dessalles suggests we can? I suggest the answer is no. The worry is that the political model of the evolution of language can also be interpreted as a simple model of the evolution of cooperation in a group structured context. Given how little we actually know about the origins of linguistic behavior, the political origins looks more like an interesting Just So story.

Second, the political model leaves many relevant factors unexplored. What happens if people speak relevantly in conversation (hence showing their capacity to

convey information about the environment) in order to achieve membership in a coalition, but then fail to provide information to others? This possibility isn't explored in any real detail, although the general problem of language as a cooperative enterprise is discussed in chapter 16. (Dessalles suggests that Zahavi's "handicap principle" may play a role in solving this problem. One Difficultly, though, is that other work in evolutionary game theory suggests that Zahavi's "handicap principle" is false as a general rule. I return to this point in the section "Zahavi's Handicap Principle and the evolution of language".)

Another problem with the political model is that it fails to explain the "goodness-of-fit" between the world and language. That is, how did language evolve so as to faciliate our making fine-grain distinctions between kinds of things, making true descriptive statements about the world, and issuing commands about what to do and when to do it? This is only a small fraction of what language enables, and any account of how language evolved would need to have an answer to these questions.

One natural framework for tackling this problem is one which Dessalles does not cover in his book: that of Lewis's sender–receiver games. What I will do, briefly, in the remainder of this paper is discuss some results from Lewis signalling games to illustrate how they challenge two core elements which Dessalles invokes: the notion that language is locally optimal and the Handicap principle.

Lewis sender–receiver games as a model of the evolution of language

Consider, as another model of the evolution of language, a two-player sender–receiver game as introduced by Lewis (1969). In such games, Nature chooses a state of the world and reveals this state to the sender, who then sends a signal to the receiver who performs an action. The outcome of the receiver's action generates a payoff for both players, the payoff depending on how well the action performed "fits in" with the state of the world.

The simplest sender–receiver game takes the form of a pure coordination game; when the Receiver matches his action with the state of the world, both he and the Sender obtain payoffs of 1; otherwise, both players receive nothing. A "signalling system", as defined by Lewis, occurs when we have an optimal matching between state and action, so that the payoff for both the sender and receiver is optimal.

Sender–receiver games provide a minimal framework for modeling how meaningless signals can acquire information. It also reveals reasons we should be concerned about assuming that language is locally optimal.

The concept of local optimality plays a prominent role throughout *Why We Talk*. Here are a few places where it is appealed to (italics mine):

> "[L]anguage is not due to a macromutation; it serves an adaptive function for which it is *locally optimal*" (117)

> "Microevolution is rapid because there is open competition among individuals. In equilibrium, this competition is no longer open, as all the *best*

> *available* solutions have been found [...] Microevolutionary competition enables selection to do its work and to create a pressure which pushes evolution in a given direction, that of the next *local optimum*." (124)
>
> "If our species has a predisposition to use a phonological system, then the predisposition must be *locally optimal* for a biologically adaptive function." (160)
>
> Regarding protolanguage: "if protolanguage was one of the characteristic behaviours of a species of hominids, it must be possible to show that it was *locally optimal* [...], that is to say that no minor variation in the competence could have made it any better at fulfilling its biological function." (172) And also: "A conclusion that appears natural is that protolanguage is *locally optimal* for communicating meanings of a certain sort and that word order is chosen so as to facilitate the hearer's construction of meaning." (172)

In these passages, notice how Dessalles shifts in the type of claim he makes regarding the local optimality of language. The first quote, in which it is said that language "serves an adaptive function for which it is locally optimal", is making a straightforward empirical claim. Some of our evolved traits *do*, as a matter of fact, serve adaptive functions for which they are locally optimal, and our linguistic ability might be one of them. However, contrast this with the last quote where he states, "it must be possible to show that [protolanguage] was locally optimal". This isn't an empirical claim, and it is difficult to understand just what Dessalles means. Why *must* it be possible to show that protolanguage was locally optimal?

Is it possible that Dessalles is using "locally optimal" in some special proprietary sense? I suppose so, but it is hard to square that possibility with the comment he makes on page 172 regarding local optimality: "that is to say that no minor variation in the competence could have made it any better at fulfilling its biological function". Normally we say that a trait is locally optimal when it is at a local maximum of the fitness landscape. The explanatory remark that Dessalles provides is perfectly compatible with the ordinary sense of local optimality.

The reason why this is a worry, of course, that it is generally incorrect to assume the outcomes of evolution are locally optimal. While evolution may produce traits, structures, or behaviours which are locally optimal, it need not. There are at least three reasons for this. The first (as Dessalles recognizes in his discussion of Gould and Lewontin's criticism of adaptationism) is that some traits, structures, or behaviours are not selected *for* at all, but are rather evolutionary spandrals. If a spandral is locally optimal, that is a happy accident rather than an explicit product of evolutionary design.

Second, developmental lock-in might preclude the possibility of obtaining locally optimal outcomes. Brute facts about how individuals of a species develop from an embryo to an adult organism may well rule out that species settling upon the locally optimal solution to a particular adaptive problem because it is a developmental impossibility. (If one responds that the concept of "local optimality" takes into

account these kinds of constraints, then the concept of local optimality, becomes tantamount to saying that anything which evolves is locally optimal *by definition*.)

Third, genetic interactions *within* individuals might prevent locally optimal outcomes from being selected for. This last point is important to appreciate because many character traits and behaviours in humans and other species arise through the interaction of multiple genes. Since each of these genes may contribute some part to several nonoverlapping biological functionings, each gene will find itself subject to selection pressure from different sources. The result from the interaction of all of these genes may then not be a locally optimal solution to any particular adaptive problem, but rather a compromise between multiple forces of selection pulling in different directions.

More importantly, though, examination of the dynamics of sender–receiver games reveals instances where the outcome of an evolutionary dynamic may *not* produce a locally optimal outcome. For example, Skyrms (2008) shows that equilibria exist in sender–receiver games which are locally suboptimal, and Pawlowitsch (2007b) proves that, for the replicator dynamics, the population may become trapped in one of these suboptimal equilibria. If the evolutionary outcome of sender–receiver games says something about the evolution of language, even in a very primitive form, we then have reason for doubting Dessalles' claims that protolanguage both *is* and *must be* locally optimal.

Zahavi's Handicap Principle and the evolution of language

Finally, consider Zahavi's Handicap Principle and the role it plays in the evolution of language. Dessalles discusses this in chapter 16 of *Why We Talk*. The problem is that:

> The first effect of speech is that it enables hearers to benefit from this information and the knowledge possessed and conveyed by the speaker. If this behaviour represented mere gratuitous assistance, it should die out rapidly through the workings of natural selection. If it represented self-interested assistance, where is the quid pro quo? (Dessalles 2007, p. 314)

Why should human communication not exist, according to the laws of evolution? An entrenched view in biology is that reliable signals must be costly to send. Yet communication amongst humans is effectively costless, so how could it have evolved?

Dessalles agrees with Zahavi that "the only signals natural selection can favour are the reliable ones"(Dessalles 2007, p. 331)[16] yet denies that it is easy to lie with words. Why? It all has to do with the purported conditions under which language evolved. In his political model of the evolution of language, speakers endeavour to speak relevantly to others, which is not easy. Dessalles points out that "hearers test

[16] However, recall our discussion in "Local optimality and the evolution of language" about sender–receiver games with pooling and partial pooling equilibria. Partial pooling equilibria are not entirely reliable because they conflate states of the world, yet are still capable of being produced by evolutionary dynamics.

the logical consistency of what they are told" (Dessalles 2007, p. 331) in attempts to discover shortcomings. In addition, a hearer can appeal to "trivialization" when a speaker seems to be over-egging the salience of a situation.

Thus Dessalles accepts the basic idea of the Handicap Principle, that signals need to be costly in order to be reliable. Because human communication is effectively costless, he needs to locate the cost of human communication elsewhere than in the manufacturing of the signal. The cost of communicating, then, can be found in the effort required to speak relevantly. As he states:

> According to Zahavi's general idea, communication has to be a costly exercise for speakers, if the benefits of it accrue to them. [...] The cost of behaviours of inquisitiveness and exploration, of whatever intensity, can be understood in part if we see them as a way for individuals to cull information. (Dessalles 2007, p. 331)

A main motivating factor for Dessalles's account of the evolution of language—putting efforts to speak relevantly at the heart of the process—stems from taking the Handicap Principle as a general truth regarding the evolution of signalling systems.

Yet is the Handicap Principle true, in general? Recent work suggests that the story is more intricate and complex than previously thought. In an interesting paper, Hurd (1995) shows how, in a basic signal-response game, signal costs can be reduced to zero without interfering with communication. How can this happen? It has to do with the structure of the game:

> It is the discrete nature of this game that allows us to separate the handicap from the stabilizing cost. The cost-free signalling described here is unlikely to be found in situations where states and signals are continuous. (Hurd 1995, p. 221)

Similar results have been shown to hold for other types of signalling games. For example, Bergstrom and Lachmann (1998) demonstrate that the Sir Philip Sidney game also allows honest, cost-free signals to develop under fairly general conditions. We may not need to work quite so hard to try to resolve the apparent tension between the apparently costless nature of human communication and the handicap principle.

There are other reasons to downplay the centrality of the Handicap Principle in Dessalles' account of the evolution of language. (Bergstrom and Lachmann 1997) show that "despite the benefits associated with honest information transfer, the costs incurred in a stable costly signalling system may leave all participants worse off than they would be in a system with no signalling at all". If Dessalles is committed to the claim that evolution produces locally optimal outcomes, and that human communication is costly, it seems that he would need to demonstrate that honest information transfer, in human communication, is not one of the types of costly signalling systems identified by Bergstrom and Lachmann. If it were, and if evolution produced locally optimal outcomes, evolution might have produced no signalling system at all!

Conclusion

In this paper I have examined three elements of Dessalles's account of the evolution of language: (1) that language evolved as a consequence of the group benefits it conferred, (2) that evolution produces locally optimal outcomes and that language is locally optimal, and (3) that the Handicap Principle presents a challenge for the evolution of human language. I have argued that each of them is to some degree dubitable. Although Dessalles offers a fascinating account for how language might have evolved, it remains a difficult, and largely unsolved, problem.

References

Bergstrom CT, Michael L (1997) Signalling among relatives. I: is costly signalling *too* costly? Phil Trans R Soc Lond B 352:609–617

Bergstrom CT, Michael L (1998) Signaling among relatives. III: talk is cheap. Proc Natl Acad Sci 95:5100–5105

Dessalles J-L (1999) Coalition factor in the evolution of non-kin altruism. Adv Complex Syst 2:143–172

Dessalles J-L (2007) Why we talk: the evolutionary origins of language. Oxford University Press. French edition, *Aux origines du langage*, first published by Hermès Science Publications, Paris, 2000

Gould SJ, Lewontin RC (1979) The spandrals of San Marco and the Panglossian program: a critique of the adaptationist program. Proc R Soc London 205:281–288

Hurd PL (1995) Communication in discrete action-response games. J Theor Biol 174:217–222

Levins R (1984) The strategy of model building in population biology. In: Sober E (ed) Conceptual issues in evolutionary biology. The MIT Press

Lewis DK (1969) Convention: a philosophical study. Harvard University Press

Pawlowitsch C (2007a) Finite populations choose an optimal language. J Theor Biol 249:606–616

Pawlowitsch C (2007b). Why evolution does not always lead to an optimal signaling system. Game Econ Behav 63:203–226

Skyrms B (2008) Evolution of signaling systems with multiple senders and receivers. Phil Trans R Soc Lond B Working paper

Weisberg M (2006) Robustness analysis. Phil Sci

Zahavi A, Zahavi A (1997) The handicap principle. Oxford University Press

By the Waters of Babel: Jean-Louis Dessalles' *Why We Talk*

Fiona Cowie
Caltech

I don't know one damned butterfly from another.
John Berryman

Why We Talk is a complex, ambitious, original, thought-provoking, and sometimes frustrating book. In it, Jean-Louis Dessalles argues that the critical spur to the development of human language—language's true biological function—was political. It wasn't political in any of the senses hitherto floated in the literature, though: language didn't evolve because it fostered group cohesion or cooperation, or facilitated mind-reading or manipulation. Instead, language originally served more or less the same function as ritualized displays of aggression and submission in many social animals: among early *Homo* (maybe erectus, maybe only sapiens—p. 333), one's gifts in the area of gab conferred status (recall Socrates' gripes about the Sophists) and with higher status came, basically, more and better kids, both for the loquacious themselves and for anyone smart enough to ally himself with them.

That oratorical ability correlated with leadership and status, that individuals with such abilities had higher fitness, and that the comparatively tongue-tied did better when led by them are intriguing suggestions. It's prima facie plausible that in small groups, the silver-tongued come out on top, and if there are truisms in evolutionary theory, the ideas that fitness covaries with status, and that individuals (and/or groups) with strong leaders outcompete those that don't, must be among them. Moreover, Dessalles' claims are approachable empirically, along the lines of, say, Dunbar's (1996). Are the leaders of small groups (juries, hunter-gatherer clans, academic committees, small businesses) the good speakers? Do good speakers make the best leaders? Are children of the taciturn fewer or less viable than those of the voluble and/or do groups led by talkers do better? Is it the sheer amount of noise that counts, or is it, as Dessalles maintains, the 'relevance' (see "The evolution of protolanguage") of the noise that's the thing? Coming up with a set of novel, plausible, and potentially empirically productive hypotheses in the area of language evolution is no small achievement, and Dessalles is to be congratulated for it.

He deserves plaudits for sheer guts, too. He is neither a biologist nor a philosopher nor an anthro- or paleo- or socio-anything. Instead, he is an engineer and computer scientist by training. So in taking on language evolution in the real world (as opposed to the artificial worlds inside computer simulations, with which he is more familiar), he risks not just the space between stools that gapes beneath any interdisciplinary effort, but takes his chances with no stool at all! Often, this fresh-eyed approach makes the book better. Dessalles says what he wants to without getting bogged down footnoting footnotes: do we really need to discuss everything everyone's ever said about *p*—again? Other times, though, someone has said something about *p* that's important and relevant, and Dessalles' ignorance of it has unfortunate consequences. There's an amount of wheel-reinvention here, as we'll as

quite a few errors and confusions. The retreads are just annoying, and while many of the mistakes and conflations are harmless enough, some are more serious, as we'll see, and undermine the very strong conclusion that Dessalles wants to draw. However, I'll argue, the book withstands the weakening: even if politicking is *a* function of language, not *the* function, as Dessalles contends, this in itself is well worth knowing. In addition, I'll suggest, Dessalles' emphasis on the conversational uses of language point to other important benefits of language that have not been adequately explored in the literature.

The paradox of language

Why We Talk is an extended attempt to resolve what Dessalles calls the 'paradox' of language. On the one hand, language "seems prima facie disadvantageous for those who use it" (p. 2), making it a puzzle why so burdensome a trait would have been selected for. On the other hand, however, language bears marks of complex adaptive design that make a Darwinian explanation of its origins irresistible.

Dessalles urges that the disadvantages of language go well beyond those generally adumbrated, such as its hogging of metabolically expensive neural tissue and the inconvenience of a low-lying larynx. Because human language is highly structured and uses arbitrary signs, it is both epistemically unreliable (lying is easy and misinterpretation rife—see "Communication costs") and requires substantial learning. It is also inefficient. Not only are some things hard to talk about, there are numerous constraints (anatomical and presumably also cognitive) on its form and use that are unmotivated from a design standpoint. Why would Mother Nature have saddled us with something so clunky? On the other hand, though, when you appreciate how all that complexity dovetails with language's various roles, the opposite intuition prevails. Language is intricately structured and abundantly rule-governed at the levels of phonology, syntax, semantics and pragmatics (morphology gets left out), and each part of this edifice supports crucial linguistic functions. Evolution by natural selection being the only explanation of adaptive complexity, in Dessalles' view, language thus cries out for an adaptationist explanation.

In response to this tension, Dessalles reasons that if language were selected for, then it had to be doing something very well indeed, even if it did other things badly. So, if we can find something language does well—some problem plausibly confronting our ancestors that language was a "locally optimal" (p. 127) solution to—then we can understand how it might have been favored by natural selection, its awkwardness notwithstanding. (Oh, and by the way, we'll have settled the long-running debate in the literature about the biological function of language, too.)

How language works

As a preliminary to discovering what language does well, it's necessary to know what in fact it does. The middle chapters of the book address this issue. Dessalles' discussions of phonology and syntax are pretty standard, although they contain a

number of refreshingly novel digressions, arguments, and lines of evidence. Their upshot is that the phonological system is a way of balancing speed and accuracy of transmission, and provides the raw materials of which words are made, while syntax is a way of putting words together such that more complex meanings can be encoded and reliably extracted. Dessalles' discussion of semantics, by contrast, is highly idiosyncratic and is one of the places in the book where a wider familiarity with the philosophical literature would have been helpful. To the extent I understand his position, it's that (1) language encodes two kinds of semantic information, referential and thematic/temporal; (2) these are represented separately in the minds of language users, reflecting their separate evolutionary trajectories; and (3) these representations are importantly image-like.

Thus, *Mary's about to punch John's nose*! would summon up mental images of Mary, John and noses, together with some (quasi-perceptual) notion of punching (the image of a sweating and bloodied Stallone, perhaps). Such a representation is characteristic of those transmitted by protolanguage, and is good as far as it goes. ("The evolution of protolanguage" discusses why.) However, it doesn't tell you who is the hitter and whose nose the hit, nor when all this was going to happen—information that might well be worth having (though not for the reasons you might think—see "The evolution of language"). So, and this was the step from protolanguage to language proper, further syntactic mechanisms were introduced to encode thematic and temporal information.

Dessalles conceives the representations produced by this system as a type of mental model, spatial in nature, with elements moving around with respect to reference points to indicate thematic relations, and with the space expanding, contracting, or being cut up to represent time. There is little argument for any of this, and Dessalles shows no sensitivity to the well-known difficulties attending imagistic theories of mental representation and the homunculi who manipulate these images in thought. Fortunately, however, the details are mostly irrelevant to his story about language evolution, so we can draw a veil. All that really matters is that both referential and thematic information get encoded, for it is the encoding of referential information that explains the emergence of protolanguage, while that of thematic information explains the advent of language proper.

The evolution of protolanguage

Protolanguage is words concatenated without syntactic constraint. Its emergence is widely assumed to be a rest stop on the road to natural language. On Dessalles' view (though he doesn't put it like this), protolanguage evolved as a more nuanced version of pointing. A protolinguistic utterance like *Mary! John! Nose! Punch!* causes the hearer to token representations of Mary, John, noses, and punching, and functions to direct her attention towards Mary, crouched over a recumbent John, her clenched fist drawn back. Pointing can get you to look *over there*; a protolinguistic utterance narrows your attention still further, telling you more about *what* over there is worth looking at. Protolanguage communicates significant amounts of information about the current state of affairs, particularly when supplemented with context,

and Dessalles accepts that communicating information is its function: "[T]his hypothesis…gives a consistent function to protolanguage" (p. 293).

He stresses, however, that it's not communicating any old information that made protolinguistic behavior attractive to selection. Rather, it was communicating *relevant* information that did the trick. By 'relevant' information, Dessalles means information that is important to the listener in one or both of two ways. Either it's surprising (in the sense that she assigns a low prior probability to that fact), and/or it's productive of a strong affective response (whether positive or negative). It seems clear that getting surprising information is often good, as it enables you to react to unexpected events (*Lion! You! Bite!!!*). But what of affecting information? Why is that good to have? Dessalles doesn't say, but it could be that information that arouses emotional or other affective reactions is beneficial because of the close link between affect and motivation. *Lion! You! Bite!!!* does not just get you to attend to the beast without, it also arouses the fear within. Reason alone may not move us to action, but terror does a pretty fine job.

In sum, then, Dessalles' view is that protolanguage was selected because it conveys relevant information, and acquiring relevant information is good because it alerts you to unexpected events and motivates you to do something about them.

The evolution of language

Dessalles argues that the selective history of language differs from that of protolanguage because the conveying of information is not language's biological function. He does not deny that we do use language to communicate—many linguistic interactions are in the 'informative mode' (281ff.), which as we've just seen was "associated with the protolanguage spoken by the species of hominids which preceded us" (p. 295). Schematically, this mode of present-day conversation proceeds as follows:

1. A offers B a piece of relevant (low probability/high affect) information: *Mary's about to punch John!*
2. Sometimes, B might simply acknowledge the information: *Great!*
3. More often, though, says Dessalles, B will attempt to 'trivialize' A's utterance, implying
    a. that the information is not new to her (*Yes*, *I know*), and/or
    b. that, while perhaps new, it's not very interesting (*She often does that*)

Trivialization, according to Dessalles, serves to protect the hearer from the possibility that the speaker is lying to her; we will discuss this more below ("Communication costs"). For now, it's enough to note that although communication in the informative mode still takes place, and was all you could do with protolanguage, many linguistic interactions nowadays are different. Dessalles holds that the true function of language is to be discerned from consideration of two other 'modes' of language behavior.

Simply accepting or pooh-poohing a speaker's factual assertion, as in the informative mode, is appropriate if the fact concerned is merely improbable or shocking. But when the proffered fact looks impossible, or when it concerns a pragmatic problem for which a solution is required, something more is called for. In these cases, logical reasoning is used to resolve conflicts among representations, as when one has reason to believe both *p* and *not-p*, or when one desires that *q* but has reason to think that *q* is not obtainable. Dessalles argues that when the conflict is between *p* and *not-p*, interlocutors enter the 'logical' mode of talk, in which they collaborate to resolve the apparent impossibility. In this case,

(1) A offers a piece of information that elicits "astonishment" (p. 295) in B: *It's August in Pasadena and it's raining!*
(2) Neither bald acceptance nor dismissal is appropriate for this seemingly impossible claim, so B begins to look for an explanation: *Must be global warming.*
(3) A responds in one of two ways:
    (a) She accepts B's explanation (*You're probably right*); or
    (b) She objects to it. (*No, LA's a desert and that'd make it drier*)
(4) To which objection B responds in one of two ways.
    (a) He defends his explanation, offering further argument for it; or
    (b) He accepts A's objection and offers another explanation.

(3) and (4) are repeated (with A, of course, sometimes occupying B's role as source of explanations and objections) until a mutually acceptable explanation is found.

(5) *The climate of coastal Southern California is highly variable*; *rain in August is unusual, but not out of the question.*

When the conflict is between a desire and beliefs indicating that it can't be satisfied, people enter what Dessalles calls the 'issue-settling' mode, which proceeds as does conversation in the argumentative mode, though with possible plans of action being the currency of exchange, and the denouement being a mutually acceptable one. (*Damn! It's raining and I left my umbrella in the car. We can wait till it stops. No, I have to pick up the kids. Let Steve do it. No, he's out of town. Guess we'll just have to run.*)

In these 'argumentative' modes, facts are being stated, but the passing on of information is not the point of the exchange. Rather, the point is the joint development of explanations and plans. Doing this requires reasoning: one needs not only to be able to see the fact that *p*, but also that if *p* then *q*. Whereas protolanguage does not make reasoning possible, Dessalles suggests, language proper does. For language, unlike protolanguage, conveys thematic relations (via syntax), and reasoning just is the manipulation of mental representations of such relations.

At this point, Dessalles looks like a member of the 'language made us smarter' set (early Bickerton, Deacon). However, he denies that supporting reasoning per se

is the reason language was selected. Instead, he thinks, language was favored because it supported *joint reasoning*, reasoning in the context of conversations, the kind that's required for the collective solution of problems. Language was selected, on Dessalles' view, because it made *arguing* possible. Not *Homo* sapiens, but *Homo* letigiosus.

But what's so great, from our genes' point of view, about arguing? For Desalles, arguing is good because it's the stuff of politics. Life is a "perpetual election campaign" (p. 358), he says, the point of which is to get ourselves or our friends maneuvered into positions of power and influence, thereby upping our genes' chances of making it into future generations. Not *Homo* sapiens *or Homo* letigiosus. Rather, "*Homo* politicus" (p. 355).

Communication costs

Plenty of people think that communication was not the primary driving force behind the evolution of language. But no-one, to my knowledge, has argued like Dessalles that exchanging information via language is positively maladaptive. It imposes a net cost, which the (other) benefits of language need to outweigh.

Conversations in the informative mode appear to benefit hearers at the expense of speakers. They enable hearers to acquire important or 'relevant' information (*Lions bite!*) without having to risk finding it out for themselves. That risk is borne by speakers, who then compound the cost by giving the information away and thereby losing any strategic or other advantage they might have had *qua* sole possessor of it (*Say* '*hello*' *to the nice lion*, *dear*). However, communication is not an unmixed blessing for hearers, either. They run the risk that speakers are lying, for getting information at second hand opens you to manipulation, and checking its veracity costs (at best) time and effort, and (at worst) your life (*Here*, *kitty kitty*…).

Those who argue that conveying information is the function of language assume two things in response to these facts: first, that the benefits of getting information outweigh the costs associated with the possibility of being misled, and secondly, that while a single interaction might be costly to speakers, they benefit from repeated interactions in which the roles are reversed. Dessalles argues (p. 232ff.), however, that an appeal to reciprocal altruism will not fly in the case of language. To be "biologically stable" (p. 324), cooperative systems must resist invasion by cheats. This can be achieved in one of two ways: either the act of signaling must be costly enough to deter cheating, or the benefits of cooperating with the trustworthy must outweigh the costs of detecting the cheats. Animal communication systems reflect these exigencies. For instance, the peculiarities of kinship relations among social insects make honest signaling beneficial to all, and in other species, signaling is often costly, and only important information gets communicated. Human language is different. First, in our case, talk is cheap. Although there are costs associated with obtaining information, and although hearers sometimes get useful information, most of what we communicate is trivial: "the average biological usefulness to a hearer of anything said in conversation should not be overstated" (p. 325). Secondly, whereas in animal systems the sender bears the bulk of the costs,

hearers are the ones who pay in the case of language, for because language is productive and signs are arbitrary, lies are easy to construct and hard to detect. A conversational interaction has the wrong structure to be modeled as an instance of reciprocal altruism.

Dessalles is not here denying that language emergence is to be explained on a cooperative model. Instead, he's arguing that *information is not the currency in which the costs and benefits of language should be reckoned.* His point is that if you think that language affected fitness because it was a way of communicating information, then our language behavior looks very strange. Which is why, he thinks, you should accept his alternative picture. If the real benefits and costs of language use are measured in terms of status won, lost and recognized, then our language behavior emerges as a textbook case of cooperation. Speakers now encounter significant costs: they risk saying something stupid (i.e., irrelevant) and losing face. And there are significant benefits associated with being spoken to: whether or not the speaker speaks relevantly is how you decide whether to ally yourself with her.

One problem with this argument is that it seems to undermine Dessalles' own position on the emergence of protolanguage. If sharing information is a form of cooperation that wouldn't have evolved, then how could sharing information be the biological function of protolanguage, as Dessalles maintains? ("The evolution of protolanguage"). Perhaps the answer is that protolanguage is importantly more like animal communication systems than is natural language. In particular, lying is more difficult when so much of the meaning of an utterance is supplied by context. In the absence of contextual information, *Mary! John! Punch!* is ambiguous, to be sure—but waffling is not lying. Contextual information nails down that sentence's meaning—but also guarantees its veracity. Its absence of syntactic structure, together with the role context (not syntax) plays in fixing meaning makes protolanguage unable to express certain kinds of untruth, particularly those to do with thematic relations. This evens out the costs and benefits of talking between speakers and hearers, Dessalles might say, to the extent that the evolution of this type of information-exchange is no longer blocked.

There are other, more serious problems with Dessalles' argument, however. One lies in his apparent demand that speakers and hearers both receive a net benefit at the end of every communicative episode, and his concern that exchanges of information via language have the wrong cost-benefit structure. What matters to the stability of cooperative behaviors is not whether each interaction benefits each actor, but whether buying into the scheme benefits both in the long run. Similarly, it doesn't matter whether the costs accrue to the individual who performs first. What matters is that interactions are repeated, that parties to the exchange take turns incurring the costs and benefits, and that in the long run, the benefit to each of participating in those kinds of interactions outweighs the cost. Nothing, so far as I can see, in what Dessalles has argued shows that this is not the case when individuals exchange information.

A second problem here is Dessalles' failure to discuss the relevance of group selection to language evolution. Many recent discussions of the evolution of cooperative behaviors suggest that the correct level at which to analyze their

evolution is that of group, rather than individual selection (e.g., Sober and Wilson 1999). Such analysis is missing from *Why we speak*. It's not out of the question that groups that use language to communicate information do better than those that do not, even if communication's effects on individuals in those groups are more variable.

However, we do not need to accept that exchanging information was *not* among the functions of language in order to accept that both causing and informing about status were. There are indeed a number of features of discourse that are ill accounted-for if the exigencies of communication were the only ones shaping language behavior. First, there's the ease of lying, unprecedented in nature. Second, there's the peculiar practice of trivialization in response to a proffered fact—something you do not see much of when a vervet offers an alarm call.[17] Third, there's the fact that much of our language behavior does not involve the exchange of information at all. Dessalles points to the existence of the logical and issue-settling conversational modes, in which the giving and getting of information is subordinated to the task of developing explanations and making plans. In these cases, it's the explanation and the plan that are of value, not the facts informing them per se.

I think that Dessalles is right in identifying argumentation (talk in the logical and issue settling modes) as a locus of evolutionary payoff. However, I think that he mislocates the source of value in these practices. Recall that he rejects the idea that because it enables logical thought, language makes us smarter. I think he's right about this: logical thinking came before language, not with it, in my view. However, he moves straight from the rejection of the 'language makes us smarter' line to his own, and hence, misses the real advantage that the advent of argumentation brought with it. What language enabled was not logical thought, but argumentative *talk*, and argumentative talk is valuable precisely for the reason that Dessalles identifies, but then fails to see the significance of: it facilitates the construction of explanations and plans. Two heads really are better than one, and the only way you can reliably link those heads is via language.

What language does for you, in other words, is that it enables *joint* problem-solving and planning. Exchanging information is fine, but what matters is not what you know, but what you do with what you know. What humans do, to an extent unprecedented in nature, is construct their own niches: they adapt to their environment not over evolutionary time with phenotypical changes wrought by selection on genes, but rather, in organismic time, *by changing their environment to suit themselves.* (We turn on the heater, rather than growing shaggy coats.) Language, in my view, evolved as a tool for niche construction. There are many ways it functions in this connection. First, and this drops straight out of Dessalles' discussion, it permits *co-operative niche construction*. There are limits to what a single human can do by way of environmental redesign: I can turn up the

[17] Vervets can be induced to ignore a particular monkey's alarm call if it's been shown repeatedly to be uncorrelated with the presence of a threat. However, this 'trivializing' response did not generalize to other monkeys, presumably because there was no reason to think they were lying too. Dessalles point is that trivialization occurs whether or not there's reason to think a whopper has been told. I think he's right that this is an important difference between us and other animals.

thermostat, but I could not design or build a furnace. Language, as Dessalles points out, makes possible joint problem-solving and cooperative planning: a bunch of people, working together, could design a furnace, and they (or another bunch) could build it—indeed, this is precisely how a furnace came to be in my basement.

Secondly, language allows an individual to make massive and almost cost-free alterations in her *epistemic niche*. I do not have to spend hours trial-and-erroring or in school to learn how to build a furnace. I can tap 'furnace construction' into the Amazon browser and hit 'one click ordering', and *Furnaces for Dummies* will appear in my mailbox. Such changes in epistemic niche facilitate other niche constructing activities: a quick read, a few more clicks at HomeDepot.com, a couple-three hours, and there's a furnace in my basement.

Finally, and somewhat sinisterly, language also functions as a tool for *Machiavellian niche construction*: it enables us to use other people as tools for intervening on our environments. When I ask my son to turn up thermostat and he complies, I have craftily exploited his youthful energy, rather than my own meager store, to increase my adaptedness. When I read *Furnaces for Dummies* and got supplies delivered from Home Depot, I was using language as a means to exploit other people's sweat and slog in the service of winterizing my home.

In sum, humans' *penchant* for niche construction explains our untoward evolutionary success (and will doubtless explain our coming extinction as well). What Dessalles' discussion makes clearer is how language contributes to that enterprise. Sapient we may be, but explanations and planning are necessary to put knowledge to work: explanations tell you what will happen when you perform various interventions on the world, and plans let you exploit that knowledge. Once you know that cooking makes mammoths more palatable, and that mammoths are made of meat, you can predict the effects of cooking other things, meat and non-meat. Once you know that cooking makes for palatability, and that you need fire for cooking, you can plan to keep the fire going until the hunters return in the afternoon. And so on.

It's unfortunate that Dessalles bypasses all this. He sees the rhetorical aspects of explaining and planning, but misses their primary usefulness: in guiding action. But I don't think that matters. His stressing of language's importance in enabling individuals to collaborate on the kind of thinking that really matters—explaining and planning—is a very important insight. It enabled me to get clearer about the numerous roles played by language in our species' transformation of the world, and I predict that it will turn the conversation about language origins in a new and productive direction.

References

Dessalles J-L (2007) Why we talk: the evolutionary origins of language. Trans J Grieve, Oxford University Press, Oxford

Dunbar RIM (1996) Grooming, gossip and the evolution of language. Faber and Faber, London

Sober E, Sloan Wilson D (1999) Unto others: the evolution and psychology of unselfish behavior. Harvard University Press, Cambridge

Replies

Jean-Louis Dessalles
Telecom ParisTech

Fiona Cowie, Édouard Machery and Jason McKenzie Alexander are raising important issues about what they regard as weak points of my thesis about the evolutionary emergence of the language faculty. Their insightful and well-sustained remarks offer me the opportunity to clarify some important points and even, on a few occasions, to try to reverse the picture and turn some of the debated issues into strong points of the theory.

In what follows, I will first accept the idea that the theory developed in *Why We Talk* indeed relies on a strong version of human cognitive abilities. My claim will be however that human cognition (cognition 'in the wild') is more powerful than what a few popular lab studies have suggested in the past. I will then defend the idea that language is in some precise way a 'local optimum', and that the political model offers a sound possible scenario of why it evolved at all.

Cognition in the lab versus cognition in the wild

In the past decades, clever experiments have shown that human reasoning abilities were nothing like push-button algorithms, contrary to what mathematical idealizations of these abilities would lead us to expect. Half of Logic is not Logic; therefore human 'logical' performance would not result from anything more than a mere set of context-dependent heuristics (Holland et al. 1986; Evans 1989) or would result from an alternative, non-logical, device (Johnson-Laird 1983). Similar claims have been made concerning human probability judgments, which grossly depart from what probability calculus stipulates (Kahneman and Tversky 1982). As Machery correctly observes, if the human mind is unable to make correct reasoning reliably, there is no point in claiming, as I do in *Why We Talk*, that it evolved to detect and signal inconsistencies, as in argumentative discussions, and to detect and signal improbable situations, as in conversational narratives.

Are human beings such poor logical reasoners?

It is always a bit of a surprise to observe tight logical reasoning aiming at proving that… human beings have no logical reasoning powers. If human beings are thus simple that they are unable to process logical implications, as the Wason selection task leads some authors to conclude, there is certainly no point in maintaining a criminal police, in organizing trials, in writing scientific articles or in writing conditional sentences like this one. If, on the contrary, human beings can rely on a genuine logical competence, as I claim, then readers will easily conclude by contraposition that I must explain what is wrong with the Wason selection task.

One thesis of *Why We Talk* is that our logical faculty evolved, in the first place, to detect lies and errors in event reports. To do so, we are equipped with the ability to

detect inconsistencies. A logical inconsistency is a conjunction of propositions that is held to be false, although each of these propositions is independently believed or desired. Individuals are able to detect when an inconsistency occurs, and they are expert in proposing admissible solutions thanks to their ability to perform abduction (Dessalles 2008b). This processing of inconsistencies is a genuine logical competence. Even if its first purpose is to resolve contradictions and not to prove propositions, it can be seen as a form of proof method based on refutation, like resolution or tableaux (which are correct and complete for first-order logic).

We can see now that the Wason selection task "presses the wrong button". It presents subjects with an implication like: "If there is a vowel on one side of a card, then there is an odd number on the other side". Human subjects do not see anything like an inconsistency there, nor the expression of an inconsistency. In the 'concrete' version of the task: "If the mention 'vegetarian' is added to the name of a delegate on one side of a card, then there is a vegetarian menu on the other side", people reach nearly perfect scores (Evans 1989). They instantaneously get the point. The inconsistency they detect reads: it should not be the case that a vegetarian delegate be given non-vegetarian food. And this solves the problem: they choose cards with the vegetarian 'mention' and cards with non-vegetarian food. There is no need to postulate a specific ability to deal with social contract violation (Cosmides 1989). The performance contrast between the 'abstract' (with letters and numbers) and the "concrete" versions of the Wason selection task is explained by the fact that subjects see an inconsistency only in the latter, because they know which terms are incompatible. By contrast, they have no idea that there might be an incompatibility between vowels and even numbers on the two sides of a card.

Machery insists on the fact that in the 'abstract' version of the test, subjects make no attempt to refute the claim "vowel implies odd", and he sees there an incompatibility with the idea that we evolved to behave as skeptical listeners. My answer is that "vowel implies odd" is nothing like a conversational move. In discussions, conversational moves signal inconsistencies or tentative solutions thereof. In narratives, conversational moves signal improbable or emotional states of affairs. Merely claiming, "vowel implies odd" out of the blue does not trigger conversational behavior in humans. Again, one should not wonder that the human mind stalls when the wrong button is pressed.

More generally, there is a problem in extrapolating too much about human competence from lab experiments exclusively. Field studies are indispensable. Measuring the movements of a cheetah in a cage provides poor indication of its normal speed when hunting. Human cognition should also be studied 'in the wild'. This is what I did when I studied spontaneous conversational behavior, before abstracting the models presented in *Why We Talk*.

Human probabilistic expertise

Humans are experts in risk assessment in daily life. Most of us owe their longevity to their ability not to put their safety at risk unnecessarily. Admittedly, we are not equipped with the ability to process statistical figures, but explicit percentages are

not available in nature. However, we are very good at dealing with rare events, and we do it even formally in spontaneous conversation every time we select an event worth to tell or mention a fact that trivializes an event reported by others.

If humans are experts in some form of probabilistic reasoning involved in daily life, one may rightfully wonder why they show consistent 'biases' in probabilistic reasoning. Consider a conversational version of the "Linda" effect mentioned by Machery.

Paul—Do you remember Matthew? The guy was a green activist. He was an active member of the Green Party. Guess what! I saw him yesterday driving a big SUV!
Mary—I saw him too a few days ago. He said it's a hybrid SUV.

Paul's point is straightforward: he signals the improbable contrast between the two successful images offered by Matthew. Mary's point is equally clear: she trivializes Paul's news twice, first by saying that she already knows, and then by qualifying the nature of the SUV.

In this example, extensional probability theory (EPT) based on Kolmogorov's axioms says that Matthew's owning a hybrid SUV is less probable that his owning a SUV. Yet, everyone understands that the purpose of Mary's utterance is not to diminish, but to increase the probability of the event. In this case, EPT fails to predict human probabilistic expertise (HPE).

EPT makes many other predictions that are at odds with HPE. For instance, it sees nothing wrong if the first draw in the new National Lottery happens to be 1–2–3–4–5–6. After all, according to EPT, this draw has the same probability as any other. Human subjects would consider such an event as 'incredible' (Savoie and Ladouceur 1995; Dessalles 2006b) and suspicious. If consecutive series are drawn twice or ten times in a row, EPT again sees nothing wrong, whereas virtually no human being would consider the situation normal and all would require the lottery machine to be changed. Again EPT, while claiming that human behavior results from a representativeness bias (Kahneman and Tversky 1972), is in fact unable to capture an important aspect of HPE. Of course, EPT is the right model to use if one works in a national lottery company or in an insurance company. But EPT is the wrong model to use if the purpose is to understand the biological adaptiveness of human cognition. It is also probably the wrong model to implement in a robot that should perform well in a natural environment.

The claim is not that EPT is too precise to account for a badly laid out HPE. On the contrary. HPE turns out to rely on formal principles that EPT only approximates. Human beings derive probability not from operations on sets, as EPT does, but by assessing *unexpectedness* (Dessalles 2008b). The notion of unexpectedness derives from Kolmogorov's complexity.[18] Individuals assess the unexpectedness of events by contrasting the complexity of their production with the complexity of their description:

[18] The name of Andrei Kolmogorov is involved again, but this is fortuitous.

$$\text{Unexpectedness} = \text{production complexity} - \text{description complexity}.$$

The production complexity of an event is the amount of information (in bits) needed for the world (as one can imagine it) to produce the situation. The description complexity of an event is the size (in bits) of its minimal determination. Unexpectedness can be converted into probability by regarding each bit of the difference as resulting from the flip of a coin (Dessalles 2006b, 2008b). For instance, consecutive lottery draws like 32–33–34–35–36–37 are simple, as their cognitive description is short ("six consecutive numbers starting from 32"). It only requires one number instantiation (here, to 32). Consecutive draws are thus highly unexpected, as the 'world' (in this case the lottery machine) is believed to require six independent instantiations to produce the draw.

Human beings have no direct access to probability, but deduce it from their understanding of the complexity of outcomes.[19] This ability develops early on in ontogeny, as soon as by the age of 12 months (Téglás et al. 2007). The fact that human beings derive probability from unexpectedness also explains the divorce between EPT and HPE in the story about Matthew's driving an SUV. If perceived as typical SUV driver, Matthew is unique in the class of Green activists. This simplicity makes him highly unexpected. More generally, atypicality makes objects simple in their class.[20] The Guinness Book of records presents situations that are simple because they can be easily singled out from the crowd due to some extreme deviation from norm. However, if Matthew turns out to be, not a typical SUV driver, but a hybrid-SUV driver, the conceptual distance to its former stereotype (Green activist) gets smaller. The event will therefore be regarded as less atypical after all, and thus as more probable.

Contrary to Machery's claim, the known discrepancies between HPE and EPT do not say anything about the biological adaptiveness of the human expertise in processing probability. For instance, Machery mentions the faulty human tendency to neglect base rates: in diagnostic reasoning, individuals tend to ignore crucial information given to them verbally about the low probability of hypotheses (Bar-Hillel 1980). This effect is due to the fact that individuals naturally derive probability from unexpectedness, but have difficulty to infer unexpectedness from probability.

Human probabilistic expertise is tuned, not to performing operations among sets of alternatives, but to detecting complexity drops. The former ability would be useless in a natural setting in which the full set of alternatives is never available. Complexity drops, however, are the signature of unknown structure. For instance, repeated complexity drops in a Lottery game may reveal cheating or malfunction. Natural selection discovered the danger-complexity correlation. It endowed us with the ability to detect and signal complexity drops to push forward one's alertness.

[19] See www.unexpectedness.eu.

[20] This effect can be quantified. Unexpectedness varies as k^2 for a Laplace-Gauss distribution, where k is the number of standard deviations.

Gullibility

If human probabilistic and logic reasoning abilities are judged by the set of beliefs they produce, Machery is right to observe that they are far from 'perfect', when judged according to scientific standards. Superstition, religion and urban legends offer many examples of unjustified beliefs. The widespread belief, mentioned by Machery, that children's life is jeopardized by razor blades in candies is a case in point. Note, however, that gullibility concerning extreme danger may be a rational way to remain on the safe side. The maxim sounds like: "believe any claim about dangerous outcomes if you cannot show that it is inconsistent". Individuals, in all cultures, are certainly gullible, but essentially about claims related with such important matters as life, death, illness and the like. However, when one's favorite tool, a pen say, is missing, no one would easily believe that it entered a parallel dimension. To get an empirical assessment of people's gullibility, one has to persuade one's friends of some unlikely fact, such as the fact that a currently famous conductor is unable to read scores. The task may not prove so easy.

Gullibility grows with the authority of who makes the unlikely claim. This phenomenon certainly plays a role in some religious beliefs or in urban legends, thanks to a collective positive feedback. In everyday conversation, however, authoritative assertions may loose their power at once when they are shown to be inconsistent. Our argumentative powers were selected, not to optimize the quality of our beliefs, but to signal inconsistencies on the fly during conversation. The relative overall quality of our beliefs appears to be a side effect of this ability.

The chatting animal

In 1996, Robin Dunbar proposed that language is fulfilling a function similar to the function of grooming in apes: establishing and maintaining social bonds. This was a great insight, and the main thesis of *Why We Talk* is in line with this idea. As it stands, however, Dunbar's analogy is however loosely predictive, as it predicts nothing more than synchronized grunts. Machery is right to remind us of the fact that language fulfils a phatic function. However, this does not either predict the actual form of language as it is massively used in conversation. Even the content of the almost ritual conversations you may have with your neighbor about current weather conditions lie way beyond the predictive powers of phatic coordination.

To get convinced, one only needs to observe the consequences of any slight error in this game. Every conversational move must signal emotion, unexpectedness, inconsistency or restoration of consistency. If you merely utter, "The clouds are white", your neighbor is likely to ask, "Are you ok?". Even when talking about seemingly futile matters such as current weather, one's reputation as a competent conversationalist is at stake.

The existence of futile conversation topics is predicted if language is used to display one's ability to be relevant, as topics are just an excuse for playing the game. Making renewed relevant remarks every morning about weather conditions is certainly a challenge, and is appreciated as such by protagonists.

In virtually all alternative models of the biological function of language, the material usefulness of the information exchanged is crucial. This is especially true in the case of cooperative scenarios, as stable cooperation requires significant benefit to cost ratio (Dessalles 1999). By contrast, if language emerged from the need to push forward one's ability to be relevant, information is a means and not an end. The futility of conversational topics, far from being an argument against the theory, is rather one of its strong points.

Machery, strangely enough, depicts the relevance display theory developed in *Why We Talk* as concerning males only. On closer examination, however, females in our species have an equal need to establish and maintain social networks as males. The same political context applies to both genders, and remaining close to individuals who are able to prevent danger proves as crucial for females as it is for males. Women talk at least as much as men do (Mehl et al. 2007). Relevance displays characterize every of our daily conversations. The oratory typically attached in some ethnographic imagery to a prominent haranguing male is just a marginal exaggeration of it. Such haranguing is absent from the conversational corpus I studied. People gauge their respective relevance in every utterance of every of their casual conversations. This concerns males and females equally.

Slight differences may indeed be found in conversational style (Tannen 1994), but it might be the expected consequence from the fact that females need to secure their friends' reliability even more than men. Contrary to Machery's hypothesis, relevance displays are not only used to establish new connections. Social networks are constantly reshaping. Those who fail to regularly demonstrate their relevance to their current acquaintances are soon forgotten and replaced by others. The point is not only to advertise one's alertness, but also one's readiness to give others the benefit of it. Absent acquaintances are less useful than present ones. This 'grooming' effect of relevance displays is of prime importance to both sexes, even if it might possibly induce slight gender differences.

Is language optimal?

There is no reason to think that the language faculty, as far as it has a non-cultural basis, could be an exception to Darwinian laws. If so, if the language faculty is a direct product of natural selection, then it must be locally optimal. This conclusion is central to the argument in *Why We Talk*: if nothing about language (phonology, morphology, syntax, semantics, narrative relevance, argumentative relevance…) is fortuitous, then all components of the language faculty not only deserve a structural description, but should also be shown to perform a definite function and to be well-designed for it. This fascinating research program collapses if McKenzie Alexander is right in his claim that there are various examples of suboptimal evolutionary stable states.

Two sources of misunderstanding must be cleared up here, one about the notion of *optimality* and the other about the adjective *local*. Darwin and Wallace's great discovery is that nature is a local optimizer. Species improve by accumulating small advantageous variations. Contrary to what Darwin may have thought, this is a relatively rapid process. When all available improvements have been explored, the

species remains in equilibrium for indefinite duration, trapped in a local optimum. The alternation between evolutionary bursts and steady states corresponds to what Eldredge and Gould (1972) called punctuated equilibria. *Locality* means that only improvements that are *within reach* are considered in the Darwinian model. When McKenzie Alexander invokes developmental lock-in to dismiss the idea of optimality, he fails to respect the 'within reach' restriction that defines local optimality. This restriction, according to McKenzie Alexander, is "tantamount to saying that anything which evolves is locally optimal by definition". Certainly not by definition! The fact that all complex products of evolution result from natural selection and that natural selection optimizes locally is a great, certainly not trivial, discovery.

In search for exceptions to the rule, McKenzie Alexander refers to the possibility that language could be a *spandrel*, i.e., a fortuitous side effect of other structures (one may think of general 'intelligence', the ability to produce sounds for mating purposes, and the like). If language were a spandrel, predicting its structure would indeed lie beyond the scope of natural selection. However, as Smith and Szathmáry (1995, pp. 291–302) observe, spandrelization can only reduce complexity. A dead computer may become a paperweight, not the reverse. Since language shows all the earmarks of complex and specific design, language cannot be a mere spandrel and natural selection remains the only available account of its complexity (Pinker and Bloom 1990).

It is crucial to keep in mind that in nature, *all local optima are suboptimal*. Engineers tend to think in terms of global optimality in situations in which they are able, through calculus, to draw an ideal horizon to performance. A good engineer can always think of ways of improving the performance of a living species. She would however be likely to be wrong about what nature optimizes. According to Darwinian principles, differential replication[21] is what is maximized. In the case of animal or human communication, overall efficiency (rate, accuracy, resistance to noise,…) will *not* be optimized if it does not allow both emitter and receiver to leave more offspring. McKenzie Alexander discusses at length situations in which populations are trapped in suboptimal equilibria. In doing so, he mixes considerations about global optimization, which is irrelevant, and evolutionary local optima, which are broadly Nash equilibria.[22] Only the latter matter, and McKenzie Alexander is right to observe that they may be (globally) suboptimal.[23] *They are nevertheless locally optimal for each party* (*sender and receiver*) *independently*, and this is sufficient to draw the conclusions listed in *Why We Talk*. Most criticisms of the so-called 'adaptationist' program, including Gould and Lewontin's (1979), result from similar conflations about what is optimized and about the local aspect of the optimization.

[21] Darwin thought of differential reproduction of individuals. In the modern view, replicators are typically genetic mutations, but more broadly anything that replicates itself and has a causal effect on its own replication. Individual reproductive success is just an intermediary step in that causality.

[22] I do not enter here into distinctions between evolutionary stable strategies, static and dynamic Nash equilibria, and the like, as these distinctions tend to blur in realistic noisy conditions.

[23] Global suboptimality is characteristic of many situations involving cooperation. In the prisoner's dilemma, both parties end up in a state that is less preferable that the cooperative state.

Local optimality is a constraint that any evolutionary model must match. Ignoring it would indeed make the game easier, but vain. When I claim that my reconstruction of protolanguage makes it locally optimal to its function, I implicitly mean that alternative definitions, including Bickerton's (1990), fail the test. In Bickerton's view, protolanguage was used for the same purposes as language now, namely to transmit predicative thoughts. If this were true, the absence of even some rudimentary form of marking would be incomprehensible. In my version, the function of protolanguage is to refer to nearby events. The claim is that juxtaposing content words is an efficient way to fulfill that function (as soon as listeners are able to combine meanings), and that this system cannot be improved by slight modifications.

Modeling the political nature of language

In *Why We Talk*, language is claimed to have evolved as a signaling device. Every conversational move is a way for individuals to signal their ability to be relevant, with the (mostly unconscious) hope to establish and maintain solidarity bonds. McKenzie Alexander challenges the robustness of the claim, as he could not properly reproduce the simulation results mentioned in the book.

It is important that readers clearly understand the logic underlying this class of models. The challenge posed by language is to explain how both speaker and listener can benefit from the communicative act. Here is my solution. Speakers strive to give relevant information. Best performers in this game attract friends, and their social status is automatically increased. This explains the speaker's side. The difficult part is to explain why listeners are sensitive to relevance when choosing their friends. As soon as there is a *positive correlation* between the quality (here relevance) taken as criterion when forming coalitions and the fate of the coalition, the theory predicts a stable communication system. Note that the factual value of what is communicated does not enter the equation.

McKenzie Alexander, without questioning the underlying logic, casts doubts on the robustness of the model, as his implementation of it gives unreliable results. There are however some reasons to believe that the model is truly robust: it is an instantiation of the costly signaling theory, a now established theory which accounts for many cases of animal communication (Gintis et al. 2001); it is mathematically sound (Dessalles 1999) and has given rise to several implementations.[24] If so, why did McKenzie Alexander not reproduce the phenomenon properly? He made a few questionable implementation choices,[25] but as he says, a really robust model should

[24] See for instance www.dessalles.fr/Evolife

[25] One problem is that in McKenzie Alexander's model, genes have systematically two effects: they control both the probability of behavior and its intensity. Such coupling should be avoided. In particular, individual quality has no effect on the probability of being perceived as relevant! Another problem is the choice of a linear selection function. When average fitness is high, the system is unable to provide significant selective advantage to mutants. There is also a problem with the intrinsic limitations of Moran processes, which implement mere imitation games. McKenzie Alexander partially corrected the problem by introducing mutations.

work anyway. My suggestion is that his implementation did not explore the correct region of the parameter space. As explained in (Dessalles 1999), communication only emerges if the coalition factor (CF) is significant. CF controls the influence of the coalition's fate on its members' individual fitness. Most species have no political display, simply because CF is below a definite threshold. When the coalition factor is large, it is crucial for individuals to choose the right friends. Political display emerges as soon as the marginal benefit of making the right choice exceeds affiliation costs. It seems that McKenzie Alexander did not vary the value of CF in his implementation and lets us suspect that it was fixed to 1!

McKenzie Alexander offers no indication of any flaw in the *logic* of the political model. The fact that his implementation does not function as expected is thus a problem for him as much as for me. Such problems with implementations are frequent in modeling studies and are generally easily cleared up.

McKenzie Alexander's mention of costless honest signals is highly relevant to the political model of language. Despite the rhetorical presentation of the argument (Lachmann et al. 2001), there is no contradiction with costly signaling theory: the gist of the theory is that prohibitive costs deter cheaters from lying about their quality, either by preventing them from signaling at an inappropriate level or by making cheating prohibitively costly. The latter option, defended by Lachmann et al. (2001), undoubtedly applies to language. Telling the truth is easy, whereas being proven a liar may have damaging consequences. One should not conclude, however, that conversational performance is always costless. Brilliant conversations presuppose previous acquisition of relevant information by protagonists. Getting original information and knowledge requires time and efforts, and sometimes involves risks. Those who are poorly talented at it or who fail to make the necessary investments will show poorer performance in conversation. This aspect of language is well predicted by standard costly signaling theory.

Is language about information sharing?

Most accounts of language emergence insist on the 'obvious' fact that language is used to share information. Cowie insists on what she regards as the main advantage of language: "Two heads really are better than one". Did language evolve because it increased collective efficiency?

Invoking group selection

It seems natural to many scholars to invoke mechanisms like group selection when it comes to explaining the origin of language, as the current success of our species on Earth seems inseparable from its ability to pool useful information. Cowie refers to the mechanism known as group selection (Sober and Wilson 1998) as an alternative way to explain the emergence of language in our lineage. The conditions for group-selection to operate are, however, quite restrictive and do not apply to our species and to language. In particular, the reproductive success of individuals should be almost totally correlated with the short-term fate of their group, which is generally

not the case in primates, especially for females. Moreover, group-selection effects only exist when there are strong discrepancies between groups regarding the evolving trait (here information sharing). It cannot explain the existence of universal traits, as language in our species.

In my view, the reason why group selection is so attractive to many scholars is because we tend to project human politics onto Darwinian competition. As human beings, we tend to promote values such as competition between coalitions and cooperation within coalition, as such values are positively judged when coalitions form. We forget (1) that coalitions are not groups (the crucial difference is that coalition members actively choose each other); (2) that these promoted values need not coincide with actual behavior; and (3) that Darwinian 'competition' occurs at the genetic level, between allelic mutations, and is distinct from the political competition between coalitions.

I am not denying that the advent of language had a huge impact on the organization of our species. Cowie is right to highlight the fact that information sharing saves individuals the risks associated with experiencing danger by themselves, or the fact that argumentation facilitates the construction of plans. Moreover, thanks to language, the human species has dramatically changed its own environment. However, my account diverges from Cowie's on a crucial point: I doubt that these 'virtues' of language have any causal action on its evolution and its maintaining through natural selection. I can't see how they can be considered anything more than side effects. Admittedly, language contributed to changing our 'niche'. These changes affect many aspects of our behavioral ecology in return, but the loop is not closed since, as far as we know, collective welfare is unable to discriminate in favor of relevant speakers.

Language is *not* a form of cooperation

Machery, following Nowak and Sigmund (2005), evokes the possibility that language could have co-evolved with indirect reciprocity: "I help you and somebody else helps me". Models of indirect reciprocity are complex and unstable: they rely on reputation effects, but slander requires second-order policing, and so on. Moreover, these models do not account for the fact that human individuals are in competition to provide the most interesting information to their conspecifics. Spontaneous utterances (stories or arguments) are nothing like helping. They are willingly given for free, most often insistently. Language is too different from reciprocity to fit in in such theoretical boxes.

Cowie and McKenzie Alexander suggest that the political model developed in *Why We Talk* can be regarded as an instance of direct reciprocity. The only difference with standard cooperation would be that in exchange for information, hearers would return status instead. It is important to understand why this is not how language works.

Since Grice (1975), it is commonplace to see human communicative behavior as cooperative. Speakers are observed to provide every necessary means for their communicative intentions to be understood. Cooperation in the strict sense refers however to an *exchange*. As Cowie reminds us, such exchanges might prove

fruitful for both parties in the long run, though they are obviously not in the instant if listeners are the only ones to benefit from the interaction. In *Why We Talk*, the claim is not only that such information barter does not apply to human spontaneous conversation, but also that the usefulness of information plays no role in the story.

Social status is not something tangible that may be part of any deal. In our species, status emerges from others' will to consider you as a friend. On the other hand, information is most often not substantial either. The information given through protolanguage (*Mary! John! Nose! Punch!*) or through language is just an excuse to demonstrate one's relevance. Its possible usefulness to listeners is fortuitous and is only weakly correlated with relevance. Also during argumentation, making a relevant point demonstrates the speaker's ability to detect some hidden inconsistency or to bring back consistency in previously contradictory beliefs or desires. However, whether or not these changes in consistency are useful to listeners does not matter. The biological outcome of any conversation is not what is learned. It is to know who will become or remain friend with whom.

At some point in the evolution of our lineage, lethal weapons (probably spears) were invented. This invention dramatically changed the politics of our hominin ancestors. As anybody could be killed by anyone if taken by surprise, the paramount quality of ideal friends became the ability to anticipate social danger. Individuals consequently made every effort to signal their qualities in this matter. This led first to pointing, then to protolanguage, and lastly to language when argumentation developed as an anti-liar device. In this scenario, language is a pure signaling device and nothing like a form of cooperation.

Conclusion

This discussion has hopefully proven several things. First, that contrary to what has been implicitly thought in previous decades, there can be progress in the reflection about the evolutionary origins of language. Second, that it is a fascinating and necessary enterprise for anyone who wants to know more about human nature. Third, that new and worthy issues are raised in *Why We Talk*.

Having the last word is embarrassing, as I almost can hear some of the legitimate answers my colleagues are longing to give to my own reactions. I am thankful to Fiona Cowie, Édouard Machery and Jason McKenzie Alexander for having explained some aspects of the theory better than I did and for having given me the opportunity to make a few points hopefully much clearer. Now, I believe that on several crucial issues, we have reached agreement on disagreement. The debate is not over and will be continuing in different forms. Language is probably what made us human. For this reason at least, I hope that the debate about its evolutionary origins will grow among readers as well.

References

Bar-Hillel M (1980) The base-rate fallacy in probability judgments. Acta Psychol (Amst) 44(3):211–233. doi:10.1016/0001-6918(80)90046-3

Bickerton D (1990). Language and species. University of Chicago Press, Chicago

Bingham PM (2001) Human evolution and human history: a complete theory. Evol Anthropol 9(6):248–257. doi:10.1002/1520-6505(2000)9:6<248::AID-EVAN1003>3.0.CO;2-X

Bradshaw JL (1997) Human evolution: a neuropsychological perspective. Psychology Press, Hove, UK

Carpenter M, Nagell K, Tomasello M (1998) Social cognition, joint attention, and communicative competence from 9 to 15 months of age. Monogr Soc Res Child Dev 255(63):1–143

Cosmides L (1989) The logic of social exchange: has natural selection shaped how humans reason? Studies with the Wason selection task. Cognition 31(3):187–276. doi:10.1016/0010-0277(89)90023-1

Dessalles J-L (1998) Altruism, status, and the origin of relevance. In: Hurford JR , Studdert-Kennedy M and Knight C (eds) Approaches to the evolution of language: social and cognitive bases, pp 130–147. Cambridge University Press, Cambridge

Dessalles J-L (1999) Coalition factor in the evolution of non-kin altruism. Adv Complex Syst 2(2):143–172. doi:10.1142/S0219525999000096

Dessalles J-L (2006a) Generalised signalling: a possible solution to the paradox of language. In: Cangelosi A, Smith ADM and Smith K (eds) The evolution of language, pp 75–82. World Scientific, Singapore

Dessalles J-L (2006b) A structural model of intuitive probability. In: Fum D, Del Missier F and Stocco A (eds) Proceedings of the seventh International Conference on Cognitive Modeling, pp 86–91. Edizioni Goliardiche, Trieste, IT

Dessalles J-L (2008a) Coincidences and the encounter problem: a formal account. In: Love BC, McRae K and Sloutsky VM (eds) Proceedings of the 30th Annual Conference of the Cognitive Science Society, pp 2134–2139. Cognitive Science Society, Austin, TX

Dessalles J-L (2008b) La pertinence et ses origines cognitives—Nouvelles théories. Hermes-Science Publ, Paris (in press)

Dunbar RIM (1996) Grooming, gossip, and the evolution of language. Harvard University Press, Cambridge

Eldredge N, Gould SJ (1972). Punctuated equilibria: an alternative to phyletic gradualism. In: Schopf TJM (ed) Models in paleobiology, pp 82–115. Freeman and Cooper, San Francisco

Evans JS (1989) Bias in human reasoning—causes and consequences. Lawrence Erlbaum Associates, ed. 1990

Ghadakpour L (2003) Le système conceptuel, à l'interface entre le langage, le raisonnement et l'espace qualitatif: vers un modèle de représentations éphémères. Thèse de doctorat, Ecole Polytechnique, Paris

Gintis H, Smith EA, Bowles S (2001) Costly signaling and cooperation. J Theor Biol 213:103–119. doi:10.1006/jtbi.2001.2406

Gould SJ, Lewontin RC (1979) The spandrels of San Marco and the Panglossian program: a critique of the adaptationist program. Proc R Soc Lond 205:281–288

Grice HP (1975). Logic and conversation. In: Cole P and Morgan JL (eds) Syntax and semantics, vol. III: speech acts, pp 41–58. Academic Press, New York

Holland JH, Holyoak KJ, Nisbett RE, Thagard P (1986) Induction—processes of inference, learning, and discovery. The MIT Press, Cambridge MA

Johnson-Laird PN (1983) Mental models. Cambridge University Press, London

Kahneman D, Slovic P, Tversky A (1982) Judgements under uncertainty: heuristics and biases. Cambridge University Press, Cambridge, MA

Kahneman D, Tversky A (1972) Subjective probability: a judgement of representativeness. Cognit Psychol 3:430–454. doi:10.1016/0010-0285(72)90016-3

Kern K, Brown K (2001) Using the list of creepy coincidences as an educational opportunity. Hist Teacher 34(4):531–536. doi:10.2307/3054205

Lachmann M, Számadó S, Bergstrom CT (2001) Cost and conflict in animal signals and human language. Proc Natl Acad Sci USA 98(23):13189–13194. doi:10.1073/pnas.231216498

Lieberman P (1992) On the evolution of human language. In: Hawkins JA and Gell-Mann M (eds) The evolution of human languages, pp 21–47. Santa Fe Institute—Proceedings Volume XI—Addison-Wesley

Maynard Smith J, Szathmáry E (1995) The major transitions in evolution. Oxford University Press, Oxford

Mehl MR, Pennebaker JW (2003) The sounds of social life: a psychometric analysis of students' daily social environments and natural conversations. J Pers Soc Psychol 84(4):857–870. doi:10.1037/0022-3514.84.4.857

Mehl MR, Vazire S, Ramírez-Esparza N, Slatcher RB, Pennebaker JW (2007) Are women really more talkative than men? Science 317:82. doi:10.1126/science.1139940

Nowak MA, Komarova NL (2001) Towards an evolutionary theory of language. Trends Cogn Sci 5(7): 288–295. doi:10.1016/S1364-6613(00)01683-1

Nowak MA, Sigmund K (2005) Evolution of indirect reciprocity. Nature 437(27):1291–1298. doi:10.1038/nature04131

Pinker S (1994) The language instinct. Harper Perennial, ed. 1995, New York

Pinker S (2003) Language as an adaptation to the cognitive niche. In: Christiansen MH ans Kirby S (eds) Language evolution, pp 16–37. Oxford University Press, Oxford

Pinker S, Bloom P (1990) Natural language and natural selection. Behav Brain Sci 13(4):707–784

Rimé B (2005) Le partage social des émotions. PUF, Paris

Ritt N (2004) Selfish sounds and linguistic evolution—a Darwinian approach to language change. Cambridge University Press, Cambridge

Savoie D, Ladouceur R (1995) Évaluation et modification de conceptions erronées au sujet des loteries. Can J Behav Sci 27(2):199–213. doi:10.1037/0008-400X.27.2.199

Sober E, Wilson DS (1998) Unto others. the evolution and psychology of unselfish behavior. Harvard University Press, Cambridge, MA

Sperber D (2000) Metarepresentations in an evolutionary perspective. In: Sperber D (ed) Metarepresentations: a multidisciplinary perspective, pp 117–137. Oxford University Press, Oxford

Tannen D (1994) Gender and discourse—featuring a new essay on talk at work. Oxford Unviersity Press, ed. 1996, New York

Téglás E, Girotto V, Gonzalez M, Bonatti L (2007) Intuitions of probabilities shape expectations about the future at 12 months and beyond. Proc Natl Acad Sci USA 19156–19159. doi:10.1073/pnas.0700271104

Tomasello M (2006). Why don't apes point? In: Enfield NJ and Levinson SC (eds) Roots of human sociality: culture, cognition and interaction, pp 506–524. Berg Publishers, Oxford

Williams GC (1966) Adaptation and natural selection: a critique of some current evolutionary thought. Princeton University Press, ed. 1996, Princeton

Zahavi A, Zahavi A (1997). The handicap principle. Oxford University Press, New York