PART 5

Communication

27

PRAGMATIC INTERPRETATION AND SIGNALER-RECEIVER ASYMMETRIES IN ANIMAL COMMUNICATION

Dorit Bar-On and Richard Moore

Gricean communication and the evolution of language

Prominent theorists of language evolution have converged on the idea that pragmatic phenomena are of fundamental importance to the emergence of language (Tomasello 1999, 2008; Sperber and Wilson 2002; Scott-Phillips 2014, 2015). In particular, some of these authors have argued that it is the emergence of capacities for 'Gricean' or 'ostensive–inferential' communication that is the seed of human language. At the heart of these arguments is a conception of human linguistic communication that goes back to Paul Grice (Grice 1957). Grice's central idea was that human communication is made possible by hearers' interpretive comprehension of speakers' communicative intentions. What he called 'speaker meaning' is a matter of a speaker producing an utterance with the intention of (a) producing an effect on the psychological states of some receiver, and with the further intention of (b) producing that effect in part by means of the receiver's recognition of that intention. The speaker (or gesturer) *intentionally* and *overtly* (or '*ostensively*') produces an utterance with the intention of soliciting some response from her interlocutor (typically by aiming to produce some belief in her, or to solicit some action). The hearer infers the speaker's communicative goal through recognizing the speaker's intention to communicate, and infers the content of this intention on the basis of what the speaker said. The speaker's intention is fulfilled just when the receiver recognizes her intention (and when this recognition plays some part in producing the intended effect). Call this the *Classical Gricean* picture of communication.

On the Gricean view, communicative intentions can play a foundational role in understanding the nature of language because they are *independent* of language. Grice took speaker meaning to be conceptually prior to linguistic meaning (Grice 1967[1987]) and envisaged an explanation of the standard meanings of words and sentences in terms of community-wide, conventionalized speaker meanings. This suggests a '*pragmatics-first*' approach to the evolution of language, since it explains the emergence of conventional *semantic* properties of linguistic items (such as words and sentences) from acts of producing utterances with communicative intentions.

The Classical Gricean picture requires more than that sender and receiver possess concepts and draw inferences (conscious or unconscious) that deploy those concepts. It requires that both senders and receivers have a 'Theory of Mind' (hereafter ToM); that is, a capacity to ascribe

beliefs and other psychological states to others (see the chapters in Part 4: Mindreading). Insofar as Gricean communication presupposes such social cognition, a Gricean approach to understanding the evolution of language introduces a clear explanatory task: to account for the phylogenetic emergence of these capacities in our hominin ancestors. As Origgi and Sperber put it, it implies that

> language as we know it developed as an adaptation in a species already involved in inferential communication, and therefore already capable of some serious degree of mindreading . . . the existence of mindreading in our ancestors was a precondition for the emergence and evolution of language.
>
> (2000: 20)[1]

This approach is controversial, since explaining the emergence of such social cognition – including a capacity for propositional and even recursive thoughts – *prior* to the emergence of propositional-compositional language would seem no less difficult than explaining the evolution of language itself. Incorporating the Classical Gricean view into an account of language evolution thus means trading the 'language Rubicon' for a 'psychological Rubicon' (see Bar-On 2013, and Chapter 28 in this volume).

Gricean communication and signaler-receiver asymmetries

The Classical Gricean view supposes that Gricean communicators must be capable not only of intentionally producing and responding to signals, but also of acting with and attributing *communicative intentions*. The production of utterances with communicative intentions and their comprehension is cognitively demanding, because according to the Classical Gricean view (Sperber 2000; Scott-Phillips 2014, 2015), they require entertaining fourth-order metarepresentations of mental states – something that has yet to be identified even in ten-year-old children (Liddle and Nettle 2006; see also 2016c). Despite this evidence, researchers have often taken it for granted that the abilities required for Gricean communication are present in young children but not in nonhuman animals (e.g., Sperber 2000; Tomasello 2008; Corballis 2011; Scott-Phillips 2014, 2015). Even assuming that nonhuman animals have *first-order* thoughts (i.e. thoughts about the world, including others' behavior), can attribute simple mental states to others (including intentions, if not beliefs; Call and Tomasello 2008), and possess concepts with which they can draw inferences (consciously or unconsciously), Tomasello, Scott-Phillips and others doubt that they have higher-order thoughts about others' mental states. Consequently, Tomasello, Call, and Hare conclude that "in contrast to human children, chimpanzees may not understand . . . such things as . . . communicative intentions" (Tomasello et al. 2003: 156).

Even apart from animals' comparative lack of ToM capacities, there seems to be a difficulty in regarding animal vocalizations, specifically, as a source of insight into human communication. It has long been assumed that primate vocalizations, especially, are involuntary emotional responses to salient stimuli (e.g., Tomasello 2008). If this assumption is correct, then primate calls are not a species of intentional behavior. For this reason, many researchers (most recently Wheeler and Fischer 2012) have argued that we should focus on the *comprehension* and not the *production* of primate calls to tell us what we want to know about language evolution.[2]

Some of those who adopt the Gricean approach to language evolution have argued that the receiver's side of the sender-receiver relationship raises no problems peculiar to human communication, since nonhuman receivers can make context-sensitive inferences about the significance

of (even unintentionally produced) con- and extra-specific signals. This, it is claimed, reveals a fundamental *asymmetry* between animal senders and receivers. According to Fitch (2010), the real explanatory challenge for language evolution research is to explain the emergence of *senders* who act with Gricean communicative intentions. The problem of the receivers' contribution was solved long ago; so we can assume that, at least on the receivers' side, the psychological Rubicon had already been crossed (though one may wonder how).[3]

Findings from primate vocal communication appear to support the signaler-receiver asymmetry claim. Wheeler and Fischer (2012) review evidence suggesting that nonhuman primates lack the voluntary control over their vocalisations that humans have. In their words,

> the same neurobiological circuits that are responsible for innate vocalizations, including laughter and reactions to pain in humans, exist in both nonhuman primate and human nonverbal vocal production systems; the more derived parts responsible and necessary for voluntary control of vocalizations seem to be limited to humans, or at least have not been identified in other primates.
>
> (2012: 197)

Thus, as Seyfarth and Cheney observe, when primates learn about the world from hearing another's screams, they "acquire information from signalers who do not, in the human sense, intend to provide it" (2003: 168).

Unlike (at least some) human utterances, calls produced by primates also appear not to be produced with sophisticated other-directed goals in mind. For example, Seyfarth and Cheney have shown that vervet monkeys produce calls that dramatically affect the *behavior* of their audience, but without seeming to take into account the psychological states of their audience (Seyfarth and Cheney 2003). In producing, e.g. 'contact barks', baboon callers also seem to show little awareness of their listeners' states (of mind or otherwise) (Cheney et al. 1996). Thus, on the part of signalers, there seem to be only affective *reactions* to a perceived situation, albeit ones that may exhibit sensitivity to the presence of a suitable audience.[4]

Whereas animal vocal production therefore appears unsophisticated, animal receivers show an impressive capacity for making contextual inferences to extract information from others' signals. Thus, Seyfarth cites experiments (Bergman et al. 2003) that show that baboon listeners who witness a sequence such as 'A threat-grunts to B and B screams' must be attributing to A a disposition to act toward B in a very specific way. Seyfarth thinks this supports the view that, *as listeners*, "baboons (and probably many other animals) deduce information about events and scenes in the world from the vocalizations that other animals make" even in the absence of intentional production (personal communication). Tomasello, too, finds a "stark contrast" between the "flexible comprehension" exhibited by call receivers and the inflexibility exhibited by call producers (2008: 16f.), and he cites as the reason for the lack of flexibility the fact that nonhuman vocalizations "are mostly very tightly tied to emotions" (2008: 17). So there seems to be an asymmetry between inflexible signalers and sophisticated receivers in at least some animal vocal communication systems.

With this asymmetry in mind, Wheeler and Fischer conclude that "any continuities or parallels that exist between the communication systems of humans and our extant primate relatives reside not in the ability of signal producers to transmit symbolically encoded information, but in the flexible, learned responses of receivers" (2012: 199). Accordingly, they recommend that "a more productive framework" for primate communication research should be "pragmatics, the field of linguistics that examine the role of context in shaping the meaning of linguistic utterances" (2012: 203).

Combining the asymmetry claim with a Gricean conception of the task for a theory of the evolution of language, Fitch draws the following conclusion:

> [A]nimal communication, before language, largely involved signalers who generate signals either automatically (e.g. innate calls) or selfishly ("manipulations"), and thus obeyed no Gricean maxims. *Listeners, on the other hand, have been processing these signals inferentially, fulfilling their half of the Gricean equation, for the entire history of communication systems*. . . . The component of this Gricean model that demands special evolutionary explanation is . . . the speaker's contribution to this cooperative endeavor. *'Going Gricean,' then, required a fundamental change in the rules of animal communication on the part of signalers*, and this step is a logical necessity before language could get off the ground.
>
> (2010: 135, emphases added; see also §4.11)

This shifts the target of language evolution research. Followers of Grice take the primary task of language evolution research to be to provide an account of the social and ecological selection pressures that led to the emergence of subjects' capacities to *both* act with *and* understand communicative intentions (Sperber and Wilson 1995; Origgi and Sperber 2000; Tomasello 2008; Scott-Phillips 2014). On their view, animal communication systems differ from human languages precisely in being fully captured by the (non-Gricean) 'code model', on which *neither* animal signalers nor animal receivers exhibit Gricean mindreading capacities. Thus, they would have to deny that there is a signaler–receiver asymmetry that is relevant to the emergence of Gricean communication. By contrast, Fitch claims that animal receivers have long been 'fulfilling their half of the Gricean equation' (quoted above). If Fitch's view is right, then our nonhuman ancestors already had the cognitive abilities needed for *Gricean* interpretation, so that all that would require explanation is the phylogenetic emergence of *speakers* who were motivated to produce utterances with Gricean intentions. (See also Hurford 2007: 332 and *passim*.)

So, despite agreement about the need for a pragmatics-first approach to language evolution, there are now two different agendas on the table. On the first, an account of language evolution must explain the phylogenic emergence of subjects who can act with and attribute communicative intentions. On the second, language evolution research need explain only the emergence of *speakers* who can put already-existing cognitive capacities to use in the *production* of communicative acts.

The apparent disagreement stems, at least in part, from the presence of two different conceptions of pragmatics. The signaler–receiver asymmetry described above is relevant to the explanation of the evolution of language on one but not the other. If theorists of language evolution are to embrace a pragmatics-first approach, then they must be clear on this distinction before they can settle on the right agenda for a theory of language evolution.

Signaler-receiver asymmetries and pragmatics

On the approach advocated by Tomasello, Scott-Phillips, Sperber and Wilson, and others, it is not enough that animal receivers extract rich information from signals. What needs to be established is that, when interpreting signals, receivers make inferences *about signalers' communicative intentions*. But from the fact that receivers extract rich information from the signals they receive (*even if* they do so inferentially), it does not follow that their doing so depends on their employment of (even a rudimentary) ToM. Many creatures extract rich information about their physical environment without attributing mental states to anyone.

The ability to make context-sensitive inferences about the significance of calls is one that Grice himself would contrast with the ability to understand communicative intentions. His notion of speaker meaning is introduced in contrast with what he labeled *natural meaning*. The latter is the sort of significance we assign to various natural signs, as when we say, e.g., "Those dark clouds mean rain". In contrast to utterances that possess speaker (or 'nonnatural') meaning, natural signs possess natural meaning independently of anyone's intending to communicate anything by them. An astute observer can learn to recognize natural meaning by learning the causal correlations between the sign and what it signifies. Thus, the hearer of an animal call can learn that it correlates with the presence of some specific danger, whether or not it was produced intentionally, and thereby derive the call's natural meaning without attributing communicative intentions.

Returning to Fitch's formulation of the speaker–hearer asymmetry, if animal signals are issued unintentionally, then it would seem odd to credit receivers with a *Gricean* interpretation of them. For this would suggest that hearers regularly attribute communicative intentions where none exist. If animal *signalers* do not 'fulfill *their* half of the Gricean equation', then at best we could credit animal receivers with regularly – but *falsely – attributing* communicative intentions. If signalers never act with Gricean intentions, such attributions would at best be idle. Moreover, on the face of it, 'receivers' and 'signalers' designate different *roles*, not distinct subcategories of creatures with different psychological profiles. The receiver of an alarm call on one occasion is a producer on another. So whatever psychological capacities animals are thought to possess as receivers, they are unlikely to disappear when the same animals become signalers. Either *both* signalers and receivers should be credited with a capacity for ostensive-inferential communication, or *neither*.

Perhaps when Fitch claims that animal receivers 'fulfill their half of the Gricean equation', he has in mind something cognitively less demanding than the ability to attribute communicative intentions. Perhaps his idea is simply that animal receivers are astute interpreters of the *natural* significance of *unintentionally produced* signals. He does write that there is "strong evidence that sophisticated inference is common among primates" (2010: 189). However, while Fitch argues that monkeys, prairie dogs, suricates, ground squirrels, many birds, and even chickens all produce calls that are "inferentially interpreted" by receivers despite the absence of any "intentional encoding" (2010: 191), this would not support the conclusion that these species are Gricean interpreters.

But if animal receivers are not *Gricean* interpreters, then Fitch's 'pragmatics-first' approach is different from the one advocated by Origgi and Sperber, Tomasello, and others. The form of the pragmatics-first approach that focuses primarily on contextual inference would then be only indirectly relevant to their theories of language evolution. Moreover, once it's acknowledged that animal receivers neither act with *nor* attribute communicative intentions, then whatever asymmetry there is between vocal signalers and receivers, it is not relevant to a Gricean understanding of what is required to explain the emergence of language.

Signaler-receiver asymmetry and pragmatic interpretation: diagnosis

There are at least two different sorts of cognitive prerequisites for genuinely Gricean communication. First, there are *rational mindreading* (that is, ToM) capacities: the capacity to issue utterances with other-directed informative-communicative intentions, and the capacity for attributing them to others. In addition, at least on the hearer's side, *inferential* capacities are also needed to figure out the *specific content* of the message the speaker is trying to convey. When drawing a sharp distinction between animal and human communication, and when speculating

on the Rubicon that must have been crossed to explain the advent of language, post-Gricean thinkers focus on the first set of (mindreading) capacities. By contrast, Fitch, Hurford, Wheeler and Fischer, and others (including Scarantino and Clay 2015), who are looking to find evidence for precursors of language in the behaviors of existing animals, focus on the second set of (inferential) capacities. Assuming 'inference' is understood in a suitably relaxed fashion, it is uncontroversial that inferential capacities exist in the animal kingdom. However, this observation does little to support the conclusion that animal receivers are *Gricean* interpreters. But then the puzzle for language evolution is as much to explain the emergence of Gricean interpreters as it is to explain how signalers have become Gricean producers.

If this diagnosis is correct, it reveals that, when Fitch talks about animal receivers as engaging in pragmatic interpretation and 'fulfilling their half of the Gricean equation', he must have in mind something much weaker than is required by the Classical Gricean view. For contextual interpretation need not presuppose the attribution of communicative intentions, and so it is not part of any Gricean equation.

Fitch's Gricean reading of the asymmetries likely turns on a conflation of two different sorts of pragmatic phenomena, which have been described independently by Carnap (1942) and Grice (1957). Carnap introduced the term 'pragmatics' to cover the study of those aspects of meaning that are dependent on contextual (or 'situational') factors. On this reading, pragmatic phenomena include the various ways in which the same sentence (type) might be interpreted differently in different contexts. (So, for example, "It's raining" might be used to convey a different proposition on different occasions.) Pragmatics in the Carnapian sense can also cover the ways in which an animal alarm call (understood as a type) might have different significance in different circumstances. Consider, for example, the finding by Palombit et al. (1997) that male baboons are more likely to respond to calls produced by females with whom they have mated than other females – particularly where those females have dependent offspring and are in the presence of a potentially infanticidal male. Wheeler and Fischer's treatment of such differential responses as pragmatic phenomena is in keeping with the Carnapian notion.

Although Grice's work on pragmatics encompassed the ways in which the interpretation of words and sentences can vary with their use (and thus context), he was primarily interested in a deeper phenomenon than the context-sensitivity of interpretation – namely the dependence of linguistic meaning on a special kind of (communicative, audience-directed) intentions. He offered an analysis designed to capture the structure of those intentions, which must be understood by hearers if they are to comprehend the speaker's intended meaning. In addition to an analysis of the nature of speaker meaning, Grice (1975) introduced a set of heuristics – 'Conversational Maxims' – to which hearers can appeal in trying to make sense of speakers' communicative intentions (referred to by Fitch 2010: 135, quoted above).

On the Gricean view, to engage in pragmatic interpretation just is to attribute communicative intentions. Therefore, on the Carnapian *but not* the Gricean version of pragmatics, there can be phenomena of pragmatic interpretation even in the absence of intentional communication. To recap:

> Carnapian pragmatics is the study of the variation (and derivation) of the significance of sentence (or signal) types with the context of production.
> Gricean pragmatics is the study of the production of utterances with communicative intentions and their mindreading interpretation by interlocutors.

These different notions of pragmatics have made their way into the literature on animal communication without being properly distinguished. Moreover, they yield different accounts of

what is involved in a pragmatics-first approach to language evolution. If we treat Fitch, Wheeler and Fischer, and Cheney and Seyfarth as making claims about Carnapian pragmatic phenomena, then it is clear that what they have in mind is not the attribution of communicative intentions, but simply hearers' ability to make discriminations about the significance of various bits of environmental information – including information derived from unintentionally produced alarm calls. This is not the sense of pragmatics to which Tomasello and others are appealing when giving an account of the Gricean foundations of language evolution.

Conflating these two different senses of pragmatics threatens to be pernicious. For example, when observing that primate receivers of calls can derive different messages from the same calls in different situations – and thus engage in *Carnaptian* interpretation – one can mistakenly conclude that understanding such interpretation can help account for the phylogenetic emergence of abilities needed for Gricean communication. While there may be some overlap in the abilities deployed in Carnapian contextual interpretation and Gricean mindreading interpretation, the former are not sufficient for the latter. Since Gricean but not Carnapian interpretation requires possession of sophisticated ToM, there could be (and likely are) creatures capable of Carnapian contextual interpretation alone.

At times, the slide between the two senses of 'pragmatics' is made explicitly. For example, Scott-Phillips (2014, 2015) argues that there is a fundamental, qualitative difference between animal communication, which can be fully understood on the 'code model', and human communication, which is essentially 'ostensive-inferential' (Scott-Phillips (2014, 2015). On the neo-Gricean view that he defends, it is the absence of the ability for ostensive-inferential communication that explains why non-human great apes did not develop language. Pragmatic phenomena on *this* approach are understood in the Gricean way. Yet, Scott-Phillips reverts to the Carnapian conception when defining pragmatics as "the branch of linguistics that studies meaning and language use in context" (2015: glossary; see also Scott-Phillips 2010). His use of the term 'pragmatics' is thus not univocal.[5] The same equivocation seems to be present in work by Fitch (2010), Hurford (2007), and sometimes even Tomasello (2008: 14–15).

Concluding remarks

There *are* interesting asymmetries between signalers and receivers in animal communication – including these described by Fischer and Wheeler (2012) and others. Even within Gricean dyads, there are marked differences in 'cognitive load' between speakers and hearers (Moore 2013). For example, Gricean communication requires that hearers infer speakers' communicative goals – but not that the speakers infer their own goals. However, this suggests that Gricean communication is cognitively more demanding on *hearers*, reversing the asymmetry claims considered earlier.

Our goal here has not been to argue against the assumptions that motivated the original asymmetry claims. For example, the possibility that some primate calls are not produced voluntarily is at least partly independent of questions about the phylogenetic emergence of Gricean communication. Some empirical evidence suggests that great apes' call production may involve more voluntary control than has been assumed (Slocombe and Zuberbühler, 2007; Slocombe et al. 2010; Crockford et al. 2012). However, while voluntary control over production is necessary for acting with Gricean intentions, it is not sufficient. So this empirical evidence does not show that these calls are produced with Gricean intentions.

We hope to have shown that the pragmatic asymmetries highlighted by Fitch (2010) and Wheeler and Fischer (2012) are, at least on Gricean approaches, only indirectly relevant to the study of language evolution. Failure to recognize this is likely to undermine our interpretation

of comparative data, since an equivocal use of the label 'pragmatics' risks masking deep differences between the two conceptions of the task of language evolution research. For example, on the Carnapian conception of pragmatics, existing forms of animal communication may seem to be more continuous with language than on the traditional Gricean conception. That is why Tomasello, Scott-Phillips, and others have argued that animal communication does *not* illuminate the origins of language, and that language evolution required the emergence in phylogeny of a completely new form of communication that presupposed the capacity to act with and understand communicative intentions.

Our view is that language evolution research would now be best served by asking what could constitute genuine precursors to Gricean communication, and by looking for evidence of such precursors in animal communication. One way to pursue this line of research (favored by Bar-On 2013, and Chapter 28 in this volume) would be to consider what forms of language (or proto-language) might have emerged in phylogeny via the operation of *non*-Gricean mechanisms, and prior to the emergence of a capacity to produce and comprehend utterances with communicative intentions. Recognizing forms of animal communication, like *expressive communication*, that resemble Gricean communication in certain (but not all) respects; and identifying non-Gricean mechanisms (such as ontogenetic ritualization, voluntary control, and imitation), may then provide valuable insights into the emergence of human communication in phylogeny.

An alternative approach (Moore 2016a, 2016b, 2016c) argues that classical interpretations overstate the socio-cognitive abilities that Gricean communication requires, and that once we reconsider the demands of Gricean communication, it is appropriate to conclude that great apes are *already* Gricean communicators. On this approach, other instances of Gricean communicators in the animal kingdom may not be rare – rendering the study of animal communication directly relevant to understanding the evolution of language after all.

These different approaches to studying precursors or early forms of Gricean communication may well be complementary rather than incompatible. Indeed, there may be several different paths to progress in language evolution research. All approaches could benefit from a more fine-grained characterization of the various asymmetries that exist in animal communication systems, as well as from a more nuanced account of what is entailed by a pragmatics-first approach to language evolution.[6]

Notes

1 Additionally, Tomasello (2008) argues that Gricean communication is a cooperative, reciprocal endeavor, and that consequently it could emerge only "within the context of collaborative activities" (2008: 7). Moore (Forthcoming a) argues against this claim.
2 Other authors (most notably Tomasello – e.g., 2008) take evidence of the lack of intentional vocal production in great apes to be a reason for looking to their gestural communication to find precursors of language, since great apes' gestures are uncontroversially under voluntary control. Proponents of the assymetry view typically work in the field of primate vocal communication.
3 See Bar-On (Chapter 28 in this volume) for relevant discussion.
4 Some recent evidence undermines aspects of this asymmetry claim. For example, see Crockford et al. (2012) for evidence that chimpanzee vocalizations are both produced voluntarily and sensitive to the others' knowledge states.
5 In a short paper written after the completion of this chapter, Scott-Phillips (2017) introduces a distinction between 'weak' and 'strong' pragmatics that roughly corresponds to the one we draw above between Carnapian and Gricean pragmatics.
6 Parts of this chapter derive from a talk presented by Bar-On in Leipzig and Edinburgh in the summer of 2012. Final versions of the material were presented at the Humboldt-Universität zu Berlin and at the Rethinking Animal Minds And Meanings workshop at the Wissenschaftskolleg zu Berlin in the spring of 2016. We thank the audiences for helpful discussions.

Further reading

Cheney and Seyfarth's (2008) *Baboon Metaphysics: The Evolution of a Social Mind* and Tomasello's (2008) *Origins of Human Communication* are classic books on primate cognition and communication. Tomasello's book, especially, develops an important account of language evolution; as does Fitch's *The Evolution of Language* (2010). For the authors' views on the role of communicative intentions in language evolution, see Bar-On (2013, Chapter 28 in this volume) and Moore (2016, Forthcoming b).

References

Bar-On, D. (1995) "Reconstructing 'meaning': Grice and the naturalization of semantics," *Pacific Philosophical Quarterly* **7**6: 83–116.

——— (2013) "Origins of meaning: Must we 'go Gricean'?" *Mind & Language* 28(3): 342–375.

——— (2018) Gricean intentions, expressive communication, and origins of meaning. In Kristin Andrews and Jacob Beck (eds.) *Routledge Companion to the Philosophy of Animal Minds*. London and New York: Routledge.

Bergman, T., Beehner, J., Cheney, D., and Seyfarth, R. (2003) "Hierarchical classification by rank and kinship in baboons," *Science* 302: 1234–1236.

Call, J., and Tomasello, M. (2008) "Does the chimpanzee have a theory of mind? 30 years later," *Trends in Cognitive Sciences* 12/5: 187–192.

Carnap, R. (1942) *Introduction to Semantics*, Cambridge, MA: Harvard University Press.

Cheney, D., &and Seyfarth, R. (2008) *Baboon Metaphysics: The Evolution of a Social Mind*, Chicago: Chicago University Press.

Cheney, D., Seyfarth, R., and Palombit, R. (1996) "The function and mechanisms underlying baboon contact barks," *Animal Behaviour* 52: 507–518.

Corballis, M. (2011) *The Recursive Mind: The Origins of Human Language, Thought, and Civilization*, Princeton, NJ: Princeton University Press.

Crockford, C., Wittig, R. M., Mundry, R., and Zuberbühler, K. (2012) "Wild chimpanzees inform ignorant group members of danger," *Current Biology* 22(2): 142–146.

Fitch, T. (2010) *The Evolution of Language*, Cambridge: Cambridge University Press.

Grice, P. (1957) "Meaning," in P. Grice (1989) *Studies in the Way of Words*. London: Harvard University Press.

——— (1967/1987) "Utterer's meaning and speaker's intentions," in P. Grice (1989) *Studies in the Way of Words*. London: Harvard University Press.

——— (1975) "Logic and conversation," in P. Grice (1989) *Studies in the Way of Words*. London: Harvard University Press.

Hurford, J. (2007) *The Origins of Meaning: Language in the Light of Evolution*, Oxford: Oxford University Press.

Liddle, B., and Nettle, D. (2006) "Higher-order theory of mind and social competence in school-age children," *Journal of Cultural and Evolutionary Psychology* 4(3–4): 231–244.

Moore, R. (2013) "Evidence and interpretation in great ape gestural communication," *Humana.Mente* 24(1): 27–51.

——— (2016a) "Meaning and ostension in great ape gestural communication," *Animal Cognition* 19(1): 223–231.

——— (2016b) "Gricean communication, joint action, and the evolution of cooperation," *Topoi*, 1–13. doi: 10.1007/s11245-016-9372-5.

——— (2016c) "Gricean communication and cognitive development," *Philosophical Quarterly*, pqw049. doi: 10.1093/pq/pqw049.

Origgi, G., and Sperber, D. (2000) "Evolution, communication, and the proper function of language," in P. Carruthers and A. Chamberlain (eds.) *Evolution and the Human Mind: Modularity, Language, and Meta-Cognition*. Cambridge: Cambridge University Press, pp. 140–169.

Palombit, R., Seyfarth, R., and Cheney, D. (1997). "The adaptive value of 'friendships' to female baboons: Experimental and observational evidence," *Animal Behaviour* 54: 599–614.

Scarantino, A., and Clay, Z. (2015) "Contextually variable signals can be functionally referential," *Animal Behaviour 100*: e1–e8.

Scott-Phillips, T. (2010) "Animal communication: Insights from linguistic pragmatics," *Animal Behaviour* 79(1): e1–e4.

——— (2014) *Speaking Our Minds*, London: Palgrave Macmillan.

——— (2015) "Nonhuman primate communication, pragmatics, and the origins of language," *Current Anthropology* 56(1): 56–80.

——— (2017) "Pragmatics and the aims of language evolution," *Psychonomic Bulletin and Review* 24(1): 186–189.

Seyfarth, R., and Cheney, D. (2003) "Signalers and receivers in animal communication," *Annual Review of Psychology* 54: 145–173.

Slocombe, K., Kaller, T., Turman, L., Townsend, S., Papworth, S., and Zuberbuehler, K. (2010) "Production of food-associated calls in wild male chimpanzees is dependent on the composition of the audience," *Behavioral Ecology and Sociobiology* 64(12): 1959–1966.

Slocombe, K., and Zuberbühler, K. (2007) "Chimpanzees modify recruitment screams as a function of audience composition," *Proceedings of the National Academy of Sciences of the United States of America* 104: 17228–17233.

Sperber, D. (2000) "Metarepresentations in an evolutionary perspective," in Sperber (ed.) *Metarepresentations: A Multidisciplinary Perspective*. Oxford: Oxford University Press.

Sperber, D., and Wilson, D. (1986/1995) *Relevance: Communication and Cognition*, 2nd edition, Oxford: Basil Blackwell.

Sperber, D., and Wilson, D. (2002) "Pragmatics, modularity, and mind-reading," *Mind and Language* 17(1–2): 3–23.

Tomasello, M. (1999) *The Cultural Origins of Human Cognition*, Cambridge, MA: Harvard University Press.

Tomasello, M. (2008) *Origins of Human Communication*, Cambridge, MA: MIT Press.

Tomasello, M., Call, J., and Hare, B. (2003) "Chimpanzees understand psychological states–the question is which ones and to what extent," *Trends in Cognitive Science* 7(4): 153–156.

Wheeler, B., and Fischer, J. (2012) "Functionally referential signals: A promising paradigm whose time has passed," *Current Anthropology* 21: 195–205.