



Townsend, S., Koski, S., Byrne, R., Slocombe, K., Bickel, B., Boeckle, M., Braga Goncalves, I., Burkart, J., Flower, T., Gaunet, F., Glock, H. J., Gruber, T., Jansen, D. AWAM., Liebal, K., Linke, A., Miklosi, A., Moore, R., van Schaik, C., Stoll, S., ... Manser, M. (2017). Exorcising Grice's ghost: an empirical approach to studying intentional communication in animals. *Biological Reviews*, 92(3), 1427-1433. <https://doi.org/10.1111/brv.12289>

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# **Exorcising Grice's ghost: an empirical approach to studying intentional communication in animals**

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**Keywords:** communication, language evolution, intentionality, vocalisation, gesture

## ABSTRACT

Language's intentional nature has been highlighted as a crucial feature distinguishing it from other communication systems. Specifically, language is often thought to depend on highly structured intentional action and mutual mind-reading by a communicator and recipient. Whilst similar abilities in animals can shed light on the evolution of intentionality, they remain challenging to detect unambiguously. We revisit animal intentional communication and suggest progress in identifying analogous capacities has been complicated by (i) the assumption that intentional (that is, voluntary) production of communicative acts requires mental-state attribution, and (ii) variation in approaches investigating communication across sensory modalities. To move forward, we argue a framework fusing research across modalities and species is required. We structure intentional communication into a series of requirements, each of which can be operationalised, investigated empirically, and must be met for purposive, intentionally communicative acts to be demonstrated. Our unified approach helps elucidate the distribution of animal intentional communication and subsequently serves to better clarify what is meant by attributions of intentional communication in animals and humans.

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I. Language is considered to be one of the pinnacles of human biological evolution (Fitch 2010). Its emergence in the *Homo* lineage was presumably enabled by the presence of a set of cognitive abilities and ecological conditions not shared by other species. One candidate for these abilities is the capacity to act with, and understand, communicative intentions. The philosopher of language, Paul Grice (1957, 1982), was pivotal in highlighting the importance of such a psychological framework for communication and many authors working in the ‘Gricean’ tradition have followed him in arguing that the ability for intentional communication requires a sophisticated, pre-existing, metapsychological framework in which speaker and hearer (or signaler and receiver) mutually understand one another’s intentions and beliefs (Sperber & Wilson 1995, Sperber 2000, Tomasello 2008, Scott-Phillips 2015a).

Within Grice’s influential analysis of speaker meaning there exist three clauses (Strawson 1964, Jacob 1997), the conjunction of which form the basis for Grice’s theory of communication. For a signaler, S, to mean something via utterance  $x$  requires that: i) S intends that S’s utterance of  $x$  induce a response,  $r$ , in receiver, R; ii) S intends that R recognises that S has intention (i), and iii) S intends that R’s recognition of S’ intention functions at least partly in the motivation for R’s response,  $r$ . On this account, we not only intend to influence the receiver (through the production of a stimulus) when communicating, we also want them to recognise that we are acting with such intentions, and respond on the basis of recognising this. In linguistic pragmatics this communication of intention (surmised by these three clauses) is often referred to as ostensive or Gricean communication and the reiterated mutual perspective taking that underlies this process has consequently been highlighted as a defining feature of human linguistic communication (e.g. Grice 1982, Dennett 1983, Sperber and Wilson 1995, Sperber 2000, Tomasello 2008, Scott-Phillips 2015a).

Given the proposed centrality of Gricean characterisations of communication (Grice 1957) to human communicative interaction, questions have been raised as to the uniqueness of these aspects of human language. The extent to which human and non-human animal communication could involve the same underlying psychological framework has been debated (Gomez 1994, Tomasello 2008, Scott-Phillips 2015a, b, Moore 2015a). One reason for this is that on standard accounts (Dennett 1983, Sperber 2000), Gricean communication requires that communicators are capable of entertaining very complex metarepresentations – that is, representations of others’ mental states. Dennett (1983, 1988) played a critical role in initial attempts to operationalise animals as intentional systems by differentiating between various orders of the metarepresentational complexity that intentional communication requires, based on Grice’s analysis (Dennett 1983). Zero-order intentionality attributes no mentality or intention to the communicative signalling of animals. First-order intentionality requires that the signaler intends to signal to produce a response in the recipient, but does not require that the recipient recognise this. Second-order intentionality involves complementing the intention to signal with the attribution of mental states (by the recipient to the signaler); whilst third- order intentionality requires that the signaler intend for the recipient to attribute to her the intention to signal. Finally, fourth-order intentionality requires that signaler and recipient, alike, represent both the signaler’s goal and her intention that the recipient recognise that goal (Dennett 1983, Sperber and Wilson 1995, Scott-Phillips 2015a,b).

Although this operationalisation would appear to serve as a useful guide to identifying what type of intentionality an animal communicative system displays, it has also generated problems related to what the levels of intentionality represent. As Dennett has noted, both first and higher orders of intentionality require that an act of signalling is produced voluntarily and in a goal-directed way. However, second order intentionality (and beyond) likely employs cognitive mechanisms of a qualitatively different kind - since it requires that both signaler and recipient engage in some form of

mental state attribution. For this reason, second order intentionality has received most interest because it has been generally considered as more “human” or, as Grice highlighted, as more indicative of “true” linguistic communication (Grice 1957) and hence a step further along the continuum towards human language (Scott-Phillips 2015a). One major consequence is that it has since become common-place to assume that in order to demonstrate convincing evidence that animal vocal production is intentional and thus relevant to human language, at the very least, an attribution of mental states during vocal communication is required.

This emphasis of mental state attribution is unhelpful for two reasons. Firstly, whilst adult humans are competent at reiterated mental-state attribution, there is evidence that younger children find high orders of metarepresentation difficult (Wimmer & Perner 1983, Liddle & Nettle 2006). Some working in primate cognition have therefore argued that, if standard interpretations of Grice are right, then Gricean communication would be too difficult for both animals and human children. If this is correct, then standard interpretations must overstate the cognitive pre-requisites of Gricean communication (Gomez 1994, Moore 2014, 2015a,b) – and human and animal communication may share a common psychological framework after all. The less-intellectualised approaches to human communication are supported by the argument that even in adults, speech production and interpretation seems not to always require inference computation or belief ascription about speaker intentions (Millikan 1984). Furthermore, experimental studies under controlled conditions have repeatedly demonstrated that mind-reading is not deployed automatically during social and communicative situations (Keysar et al. 2003, Apperly et al. 2006) and is even sometimes impeded by the surrounding social environment (McClung et al. 2013).

A second reason for resisting the mental state attribution approach is that it risks obscuring the goals of comparative psychology and biology. The comparative approach does not aim to show that animals communicate in a way that fully equates to human communication; instead it aims to elucidate

evolutionary precursors of crucial components of human language (Seyfarth et al. 1980, Zuberbühler 2005). The comparative study of semantics, for example, does not hinge on the discovery of symbolic conventions, displaced in time and space from the referents of communicative behaviour (Tomasello 2008). In that case, to try to evaluate what other animals are doing by human standards is to risk failing to do justice to their abilities. A more theory-neutral approach to studying intentional communication would therefore be better.

In line with this idea, over the last ten years Byrne, Hopkins, Leavens, Tomasello, and colleagues have taken a less theory-laden approach to intentionality. This approach sidesteps the requirement that intentional communication involves understanding the minds of others and does not assume that intentional use of communicative signals involves the sorts of ‘ostensive-inferential’ communication that thinkers in the Gricean tradition have argued characterises human communication. Through borrowing behavioural markers implemented by developmental psychologists to distinguish between reflexive and more intentional gestural communication in children (Bates et al. 1979), progress has been made in identifying traits that are precursors to distinctively human intentional communication systems (Leavens et al. 2005, Liebal et al. 2006). In a similar way to humans, non-human primates, primarily great apes, also communicate with each other by gesturing. Observations of the production of gestures suggest that they fulfil a number of the criteria specified for intentionality in communicative signals (table 1). Individuals have, for example, been observed to take into account the attention state of the receiver, only gesturing when selected receivers are appropriately attentive (Leavens et al. 2005), and to elaborate or change signal if their initial signal fails to reach the apparent goal (Cartmill and Byrne 2007). By avoiding the question of mental state attribution, and by focusing on behavioural markers of flexible and goal-directed communication, an array of studies have demonstrated first order intentionality in the communication of our closest living relatives (Call & Tomasello 2007, Pika & Liebal 2012, Byrne 2016).

Table 1: The criteria for intentional communication in animals pertinent to step 2 in the new framework. Amended from Schel et al. (2013).

Criterion	Explanation
Social use	The signal is directed at a recipient. This can be assessed at various levels: <ol style="list-style-type: none"> <li>1. Presence/absence audience effect: the signal is only produced in the presence of a recipient.</li> <li>2. Composition of audience: the signal is only produced in the presence of certain recipients (e.g., kin, dominants, friends)</li> <li>3. Behaviour of audience: signal production is contingent on the behaviour of the recipient</li> </ol>
Sensitivity to attentional state of recipient	Visual signals are only produced in the field of view of recipients. If signaler does not have a recipient's visual attention, tactile or auditory signals should be produced. This can also be considered a level (3) of audience effect.
Manipulation of attentional state of recipient	Before a visual signal is produced, attention-getting behaviours are directed towards a recipient who is not visually attending to the signaler or the signaler moves itself into the line of view of a recipient (Liebal et al. 2004).
Audience checking and gaze alternation	Signaler monitors the audience and visually orients towards the recipient before producing a signal. If a third entity is involved, gaze alternation may occur between recipients and this entity.

However, there exists some variation in the criteria of intentionality that individual studies apply to gestural signals and rarely has there been an attempt to apply all criteria to a single signal in a study species (but see Leavens et al. 2004). Moreover, each individual marker of intentionality in isolation can be explained through lower-level mechanisms, without needing to invoke intentionality. For example, sensitivity to the attention state of the receiver could simply be a learned discrimination where signals are only produced when a receiver's face can be seen; persistence of a signal may have nothing to do with an intention to communicate with an as yet unresponsive receiver, but simply that signal production is emotionally driven and only when the goal is met does the underlying emotion change and terminate signal production (Liebal et al., 2013, Gaunet & Massiou 2014, Savalli et al.



2014). Therefore, it is important, before invoking first order intentionality, to demonstrate convergent evidence from a number of markers of intentionality for the same signal and species (Liebal et al. 2013, though see Vail et al. 2013). Although multiple cases of converging evidence do not amount to a proof, the probability of a behaviouristic explanation decreases.

Whilst gestural studies highlight potential phylogenetic precursors to the intentional communication of humans and provide crucial comparative data, similar evidence from vocal communication studies has not been considered as equally convincing. Despite numerous attempts, researchers have failed to teach enculturated apes to produce spoken language (Yerkes and Yerkes 1929, Hayes 1951). As their vocalisations are commonly produced in specific contexts, it has been traditionally assumed that vocalisations are the product of low level emotional processes and are best characterised as involuntary responses to specific stimuli rather than voluntary, goal-directed signals (Dennett 1983, Notman & Rendall 2005, Tomasello 2008). Furthermore, invasive procedures have shown that call initiation in monkeys is mediated by limbic rather than cortical structures in the brain (Jurgens 1992). On the other hand, some studies suggest that vocal and non-vocal sounds are used intentionally. Leavens, Hopkins and colleagues have shown that great apes use voiced and unvoiced sounds in a controlled manner that implies flexibility and intentionality (Russell et al. 2005, Hopkins et al 2007, Hostetter et al. 2007, Hopkins et al. 2011). More recent studies, under natural conditions, have provided additional support for intentionality in ape vocalisations (Crockford et al. 2012, 2015, Schel et al. 2013). Moreover, multiple studies have shown vocalisations to be dependent on the surrounding social audience in a variety of species (Marler et al. 1986, Zuberbühler 2008, Crockford et al. 2012). These so called “audience effects” are not solely due to simple, arousal mediated, social facilitation effects (Zajonc 1965), as might be the case when examining the presence or absence of conspecifics (Tomasello 2008). Instead, they incorporate more subtle social and behavioural variations, e.g.

relationship quality (Slocombe et al. 2010, Mazinni et al. 2013, Schel et al. 2013,) or response of receivers (Wich and de Vries 2006).

Despite this body of data, the existence of intentional vocal communication in animals is still disputed (Tomasello 2008). Given the central role intentionality plays in human language and the apparent disparity between the intentional production of gestures and non-intentional vocalisations in non-human primates, it has been argued that language must have evolved via a gestural, rather than a vocal, route (Corballis 2002, Tomasello 2008). This theoretical reasoning certainly adds fuel to the fiery debate surrounding language's evolutionary emergence. But unfortunately it fails to consider the fact that the researchers working with gestures and vocalisations, respectively, are operating from different bases (Slocombe et al. 2011). Animal vocal communication researchers are investigating how the production of vocalisations may or may not be used to influence the mental states of receivers, often with negative results (Rendall et al. 2000; but see Crockford et al. 2012, Schel et al. 2013). By contrast, gestural communication researchers are using an in-place suite of behaviours, derived from child developmental work, to address how goal-directed and hence intentional (Dennett's first order intentionality) gestural production is, predominantly in primates. This means that the research into vocalisations tacitly employs a more demanding criterion for intentionality than the research into gestures. As a result, comparing intentional production of animal signals at different levels in the two different modalities commits the mistake of not comparing like with like, and hence renders it difficult to draw reliable conclusions about differences in intentionality across these modalities.

To resolve these conceptual and methodological difficulties we propose to 'level the playing field' with an updated framework in which the intentional nature of animal communication, irrespective of modality, can be operationalised and systematically assessed. A single framework approach will

facilitate direct comparative work amongst species and communicative mediums, providing a more holistic picture of the evolution of human intentional communication.

## II. *The new framework*

The framework that we propose consists of three distinct criteria, each of which needs to be met by a signal type before intentionality is ascribed to it. We do not abandon consideration of cognitive components to intentionality, but instead argue that questions about whether or not vocal communication is produced voluntarily and in a goal-directed way can be answered independently of questions about whether signaler and receiver are engaged in mind-reading. Therefore, we return to goal-directedness and its role in intentional behaviour as the first criterion requiring satisfaction.

Animal **S** intentionally communicates **I** to receiver **R** if the following three propositions all hold:

### 1) *S acts with a goal with the content I*

Goal directed behaviour has been a central focus of comparative psychology research over the last three decades. At a more rudimentary level the notion of goal-direction involves the role of motor-processes organising action towards physical targets (Kenward et al. 2009). However, goal-directedness has also been implicated in intentional behaviour, as opposed to automatic or habitual behaviour (Heyes and Dickinson 1990). Here it is necessary to show that the goal-directed behaviour is based upon knowledge of the relationship that exists between the action and its consequences (Wit & Dickinson 2009). Hence within our new framework we shift the cognitive emphasis to demonstrating that communication is goal-directed.

Whilst we appreciate that operationalisation of goal-directedness is not straightforward, it is a far more tangible and relevant criterion than the demonstration of mental state attribution. Previous studies

probing the intentionality of primate gestures have emphasised the role of persistence and elaboration in identifying goal-directedness. In line with this, we argue that goal-directedness can be empirically investigated more generally by merging these criteria with the identification and application of ‘stopping rules’ (Burkart et al. 2015). When a signaler possesses a goal for its communication, it would stop upon reaching the goal, but persist and/or elaborate the signal when the goal is not reached (Leavens et al. 2005). Thus, as with any other behavioural data, regular and reliable observations fulfilling the criteria (e.g. a goal-dependent cessation of communication, or indeed persistence and elaboration in the absence of the goal being met) are critical to demonstrating the presence of a goal, causally linked with the signal. Furthermore, experimental manipulation of goal end states leading to premature or delayed goal accomplishment is an additional, complementary way, to assess the causal link between the goal and the communicative signal.

## 2) *S produces voluntary, recipient directed signals as a means to reach the represented goal*

We agree with Leavens et al. (2004) and Moore (2015b) that to show intentionality, behaviour must be under volitional control and recipient-directed. Criteria generated from studies of intentional communication in infants (Bates et al. 1979) represent a valuable set of measures to address these conditions (see table 1). One indicator of voluntary control is selective use of the signal, and in particular, selectively producing or withholding a signal in response to social factors such as audience composition and behaviour (social use). As we highlighted above, social context could in principle be part of a complex stimulus to which an automatic, innate signal production mechanism responds. Thus Hurford (2007, page 232) argues that only if ‘circumstances under which calls are given are too implausibly complex to be hardwired into the genes’ should we infer these signals are voluntary. Indicators of the recipient-directed nature of a signal include social use, audience checking and sensitivity to attentional state (Ristau 1991, Povinelli et al. 2003, Liebal et al. 2004, Leavens et al. 2005, Schel et al. 2013). Every signal type and study species is different. So, whilst it has been

suggested that the more criteria satisfied the greater the confidence that a signal is indeed intentional (Schel et al. 2013), this may not always be plausible (e.g. certain criteria apply only to the visual domain). Thus we would argue for a strict *a priori* selection procedure of criteria to ensure fair comparisons across species and modalities.

### 3) *S's signaling behaviour changes the behaviour of R in ways conducive to realising I*

As the last condition for intentionality, we focus on the behaviour of the receiver with respect to the signal produced. Given our shift of focus away from signaler or receiver mental state attribution we only require that the communicative behaviour of the signaler elicits a change in the behaviour of the receiver. To rule out the pitfall of simply treating any behavioural change in the receiver as sufficient for intentionality, we strengthen our condition by specifying that the change in the receiver's behaviour must be repeatable, consistent and in line with the apparent intentions of the signaler.

In order to demonstrate how our conditions can be operationalised, we shall now interpret data from a recent study on the alarm calling behaviour of chimpanzees within the new framework and assess its intentionality.

#### **An example of intentionality in vocal communication assessed with the proposed criteria**

In a similar way to many primate and non-primate species, chimpanzees (*Pan troglodytes schweinfurthii*) produce vocalisations when faced with dangerous situations (e.g. python or leopard presence, inter-group interactions). However, due to the rare occurrence of such signals, experimental manipulations are critical to rigorously assess the mechanisms underlying their production. Schel et al. (2013) exposed wild chimpanzees in the Budongo Forest, Uganda, to realistic moving snake models and recorded their vocal behaviour.

In line with our framework, it is first critical to show that signalers exposed to model snakes signal with a goal with a particular content (**I**). To infer the goal of the signaler, Schel et al. (2013) investigated the cessation of alarm calling in chimpanzees. Theoretically, if the goal of alarm calling is to warn others, signalers should persist until all potential receivers are safe. By implementing an objective behavioural criterion of “safety” Schel et al. (2013) demonstrate that signal cessation was not affected by the safety of the signaler, but instead when *receivers* were safe (see also Wich and de Vries 2006). When alarm calling stopped, receivers were significantly more likely to be safe than during the rest of the experimental trial.

Secondly, standardised criteria implemented in developmental child intentionality studies must be applied to the signal to assess its voluntary nature and degree of recipient directedness. Schel et al. (2013) showed that the production of certain types of alarm calls is influenced by the composition of the social audience, as the arrival of friends but not non-friends in the area elicited an increase in the production of these calls. Furthermore, analysis of audience checking behaviour, including gaze alternation, suggested that signalers monitor and potentially take into account the current behaviour of receivers when deciding to produce certain alarm calls. Hence chimpanzee alarm calls also appear recipient directed.

The third and final criterion requires that receivers of the signal must regularly respond in a way that is in line with the signaler’s presumed intentions. However, such a demonstration does not require that the receivers understand and represent the intentions of the signaler; and so does not imply any attribution of a mental state to the signaler by the recipient. Currently the data available from the study does not sufficiently satisfy this criterion, as Schel et al. (2013) did not directly explore the influence of alarm calling on the receiver’s behaviour. Nevertheless, certain observations do suggest that this condition may also have been satisfied. When hearing conspecific alarm calls, receivers have been

observed to behave in a similar way as when they encounter predators naturally, including bipedal scanning behaviour and tree climbing (Slocombe et al. unpublished data, Crockford et al. 2015, see also Cheney and Seyfarth 1990). These behavioural observations suggest that the goal of the signaler, in terms of warning group members of a threat, has potentially been met. However, more systematic comparisons to baseline scanning behaviour indicating that the response was caused by the communicated content are still required.

The above example of alarm calling in chimpanzees is not designed to demonstrate intentional communication. Instead, it simply serves to illustrate that the proposed framework for assessing intentional communication in animals is objective and realisable. Moreover, though there have been previous valuable attempts to operationalise intentionality (Leavens et al. 2005, Liebal et al. 2006, Vail et al. 2013, Hobaiter and Byrne 2014) these have been predominantly restricted to a single modality (but see Hopkins et al. 2007), complicating multi-modal comparisons which are vital to understanding intentional communication holistically. Our approach builds on existing work, but crucially bridges the current gap that exists between modalities through being applicable to any reliably and repeatedly observed communication signal.

### III. CONCLUSION

1. The voluntary nature of human communication has long been considered a key, potentially unique, feature of human cognition and language. In light of this, much comparative research has attempted to unveil analogous or homologous forms of voluntary communication in animals as a way to better understand what features are really unique to language and from this how the language faculty may have evolved (Hauser et al. 2002, Fitch 2010). However, advances in the field have been complicated by the scarcity of convincing evidence of voluntary production of animal communication in the vocal domain (Wheeler & Fischer 2012,

Rendall and Owren 2013, though see Crockford et al. 2012). This gap in understanding has had far reaching impacts regarding the predicted evolutionary route via which language may have evolved, namely whether the origins of language were gestural or vocal.

2. We propose that the problem does not lie only in insufficient data. Additionally, it is bound up with a preoccupation with questions about whether voluntary communicative acts in animals are produced with the same sorts of cognitively complex intentions thought characteristic of human communication – in particular, the intention to modify the mental states of receivers. Although mental state attribution and its role in mediating signal production is an important component of human intentional communication (Dennett 1983, Crockford et al. 2012), we argue that focusing on this alone detracts from the equally informative examples of behaviour. Moreover, the assumption that human communication must aim at changing mental states has been challenged (Moore, 2015a).
3. How widely distributed first order intentionality is across the animal kingdom is a key question that must be addressed if we are to i) understand the unique qualities of intentionality in humans, ii) shed light on the modality and evolutionary route via which language evolved and iii) understand more generally the adaptive benefit of intentional signalling in non-human animals.
4. Critically, we provide the necessary framework to address first order intentionality, whether analogous or homologous, across modalities and species giving rise to a unified and unbiased understanding of the nature of intentional communication in animals.



## **Acknowledgments**

This paper was seeded in a workshop “Deciphering the origins of intentional communication in animals: an integrative approach” at University of Zurich. SWT, SEK, and IBG thank University of Zurich’s Graduate Campus Grant for funding the workshop. We thank the anonymous reviewer for constructive and helpful comments.

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