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

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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 mindreading 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 that 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 that 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 clarify what is meant by attributions of intentional communication in animals and humans.

Key words: communication, language evolution, intentionality, vocalisation, gesture.

CONTENTS

I. INTRODUCTION

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 signaller and receiver) mutually understand one another’s intentions and beliefs (Sperber & Wilson, 1995; Sperber, 2000; Tomasello, 2008; Scott-Phillips, 2015*b*).

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 signaller, S, to mean something *via* utterance *x* requires that: (*i*) S intends that S's utterance of *x* induces 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's intention functions at least partly in the motivation for R's response, *r*. By 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 & Wilson, 1995; Sperber, 2000; Tomasello, 2008; Scott-Phillips, 2015*b*).

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 (Gómez, 1994; Tomasello, 2008; Scott-Phillips, 2015*a*, *b*; Moore, 2015*a*). 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 signaller 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 signaller); whilst third-order intentionality requires that the signaller intend for the recipient to attribute to her the intention to signal. Finally, fourth-order intentionality requires that signaller and recipient, alike, represent both the signaller's goal and her intention that the recipient recognise that goal (Dennett, 1983; Sperber & Wilson, 1995; Scott-Phillips, 2015*a*, *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 (1983) 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 signaller 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, 2015*b*). One major consequence is that it has since become commonplace 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 workers 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 (Gómez, 1994; Moore 2014, 2015*a*, *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 always to require inference computation or belief ascription about speaker intentions (Millikan, 1984). Furthermore, experimental studies under controlled conditions have repeatedly demonstrated that mindreading is not deployed automatically during social and communicative situations (Keysar, Lin & Barr, 2003; Apperly *et al*., 2006) and is even sometimes impeded by the surrounding social environment (McClung, Jentzsch & Reicher, 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, Cheney & Marler, 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 various authors 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, Russell & Hopkins, 2005; Liebal, Pika & Tomasello, 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 the signal if their initial signal fails to reach the apparent goal (Cartmill & 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).

However, some variation exists in the criteria of intentionality that individual studies apply to gestural signals and there have been few attempts to apply all criteria to a single signal in a study species (but see Leavens, Hopkins & Thomas, 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 & Massioui, 2014; Savalli, Ades & Gaunet, 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; although see Vail, Manica & Bshary, 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 & 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 (Jürgens, 1992). On the other hand, some studies suggest that vocal and non-vocal sounds are used intentionally. Great apes use voiced and unvoiced sounds in a controlled manner that implies flexibility and intentionality (Russell *et al.*, 2005; Hopkins, Taglialatela & Leavens, 2007, 2011; Hostetter *et al.*, 2007). More recent studies, under natural conditions, have provided additional support for intentionality in ape vocalisations (Crockford *et al.*, 2012; Crockford, Wittig & Zuberbühler, 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, Dufty & Pickert, 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; Schel *et al.*, 2013; Kalan & Boesch, 2015) or response of receivers (Wich & 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, Waller & Liebal, 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, Cheney & Seyfarth, 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 the signaller and receiver are engaged in mindreading. 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 & Dickinson, 1990). Here it is necessary to show that the goal-directed behaviour is based upon knowledge of the relationship that exits 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, Roelli & Richiger, 2015). When a signaller 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 (2015*b*) 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, p. 232) argues that only if “circumstances under which calls are given are too implausibly complex to be hardwired into the genes” should we infer that 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, Call & Tomasello, 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 signalling 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 signaller or receiver mental-state attribution we only require that the communicative behaviour of the signaller 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 signaller. In order to demonstrate how our conditions can be operationalised, we below interpret data from a recent study on the alarm-calling behaviour of chimpanzees within the new framework and assess its intentionality.

III. 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 assess rigorously 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 signallers exposed to model snakes signal with a goal with a particular content (**I**). To infer the goal of the signaller, Schel *et al.* (2013) investigated the cessation of alarm calling in chimpanzees. Theoretically, if the goal of alarm calling is to warn others, signallers 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 signaller, but instead occurred when receivers were safe (see also Wich & 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 signallers 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 signaller's presumed intentions. However, such a demonstration does not require that the receivers understand and represent the intentions of the signaller; and so does not imply any attribution of a mental state to the signaller by the recipient. Currently the data available from the study do 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 (K.E. Slocombe, A. Schel, S. Townsend, Z. Machanda & K. Züberbuhler, unpublished data; Crockford *et al*., 2015; see also Cheney & Seyfarth, 1990). These behavioural observations suggest that the goal of the signaller, 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, although there have been previous valuable attempts to operationalise intentionality (Leavens *et al*., 2005; Liebal *et al*., 2006; Vail *et al*., 2013; Hobaiter & 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.

IV. CONCLUSIONS

(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 understand better what features are really unique to language and from this how the language faculty may have evolved (Hauser, Chomsky & Fitch, 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 & Owren, 2013; although 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 equally informative examples of behaviour. Moreover, the assumption that human communication must aim at changing mental states has been challenged (Moore, 2015*a*).

(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.

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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: (1) Presence/absence of audience effect: the signal is only produced in the presence of a recipient. (2) Composition of audience: the signal is only produced in the presence of certain recipients (e.g. kin, dominants, friends) (3) Behaviour of audience: signal production is contingent on the behaviour of the recipient
Sensitivity to attentional state of recipient	Visual signals are only produced in the field of view of recipients. If signaller does not have a recipient's visual attention, tactile or auditory signals should be produced. This can also be considered a social use level-3 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 signaller moves itself into the line of view of a recipient (Liebal *et al*., 2004).
Audience checking and gaze alternation	Signaller 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.