

1 **Exorcising Grice's ghost: an empirical approach to studying**

2 **intentional communication in animals**

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16

17 ABSTRACT

18

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

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38

39 I. Language is considered to be one of the pinnacles of human biological evolution (Fitch 2010). Its  
40 emergence in the *Homo* lineage was presumably enabled by the presence of a set of cognitive abilities  
41 and ecological conditions not shared by other species. One candidate for these abilities is the capacity  
42 to act with, and understand, communicative intentions. The philosopher of language, Paul Grice (1957,  
43 1982), was pivotal in highlighting the importance of such a psychological framework for  
44 communication and many authors working in the ‘Gricean’ tradition have followed him in arguing  
45 that the ability for intentional communication requires a sophisticated, pre-existing, metapsychological  
46 framework in which speaker and hearer (or signaler and receiver) mutually understand one another’s  
47 intentions and beliefs (Sperber & Wilson 1995, Sperber 2000, Tomasello 2008, Scott-Phillips 2015a).

48

49 Within Grice’s influential analysis of speaker meaning there exist three clauses (Strawson 1964, Jacob  
50 1997), the conjunction of which form the basis for Grice’s theory of communication. For a signaler, S,  
51 to mean something via utterance  $x$  requires that: i) S intends that S’s utterance of  $x$  induce a response,  $r$ ,  
52 in receiver, R; ii) S intends that R recognises that S has intention (i), and iii) S intends that R’s  
53 recognition of S’ intention functions at least partly in the motivation for R’s response,  $r$ . On this  
54 account, we not only intend to influence the receiver (through the production of a stimulus) when  
55 communicating, we also want them to recognise that we are acting with such intentions, and respond  
56 on the basis of recognising this. In linguistic pragmatics this communication of intention (surmised by  
57 these three clauses) is often referred to as ostensive or Gricean communication and the reiterated  
58 mutual perspective taking that underlies this process has consequently been highlighted as a defining  
59 feature of human linguistic communication (e.g. Grice 1982, Dennett 1983, Sperber and Wilson 1995,  
60 Sperber 2000, Tomasello 2008, Scott-Phillips 2015a).

61

62

63 Given the proposed centrality of Gricean characterisations of communication (Grice 1957) to human  
64 communicative interaction, questions have been raised as to the uniqueness of these aspects of human  
65 language. The extent to which human and non-human animal communication could involve the same  
66 underlying psychological framework has been debated (Gomez 1994, Tomasello 2008, Scott-Phillips  
67 2015a, b, Moore 2015a). One reason for this is that on standard accounts (Dennett 1983, Sperber  
68 2000), Gricean communication requires that communicators are capable of entertaining very complex  
69 metarepresentations – that is, representations of others’ mental states. Dennett (1983, 1988) played a  
70 critical role in initial attempts to operationalise animals as intentional systems by differentiating  
71 between various orders of the metarepresentational complexity that intentional communication  
72 requires, based on Grice’s analysis (Dennett 1983). Zero-order intentionality attributes no mentality or  
73 intention to the communicative signalling of animals. First-order intentionality requires that the  
74 signaler intends to signal to produce a response in the recipient, but does not require that the recipient  
75 recognise this. Second-order intentionality involves complementing the intention to signal with the  
76 attribution of mental states (by the recipient to the signaler); whilst third- order intentionality requires  
77 that the signaler intend for the recipient to attribute to her the intention to signal. Finally, fourth-order  
78 intentionality requires that signaler and recipient, alike, represent both the signaler’s goal and her  
79 intention that the recipient recognise that goal (Dennett 1983, Sperber and Wilson 1995, Scott-Phillips  
80 2015a,b).

81

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

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

95  
96 This emphasis of mental state attribution is unhelpful for two reasons. Firstly, whilst adult humans are  
97 competent at reiterated mental-state attribution, there is evidence that younger children find high  
98 orders of metarepresentation difficult (Wimmer & Perner 1983, Liddle & Nettle 2006). Some working  
99 in primate cognition have therefore argued that, if standard interpretations of Grice are right, then  
100 Gricean communication would be too difficult for both animals and human children. If this is correct,  
101 then standard interpretations must overstate the cognitive pre-requisites of Gricean communication  
102 (Gomez 1994, Moore 2014, 2015a,b) – and human and animal communication may share a common  
103 psychological framework after all. The less-intellectualised approaches to human communication are  
104 supported by the argument that even in adults, speech production and interpretation seems not to  
105 always require inference computation or belief ascription about speaker intentions (Millikan 1984).  
106 Furthermore, experimental studies under controlled conditions have repeatedly demonstrated that  
107 mind-reading is not deployed automatically during social and communicative situations (Keysar et al.  
108 2003, Apperly et al. 2006) and is even sometimes impeded by the surrounding social environment  
109 (McClung et al. 2013).

110  
111 A second reason for resisting the mental state attribution approach is that it risks obscuring the goals  
112 of comparative psychology and biology. The comparative approach does not aim to show that animals  
113 communicate in a way that fully equates to human communication; instead it aims to elucidate

114 evolutionary precursors of crucial components of human language (Seyfarth et al. 1980, Zuberbühler  
115 2005). The comparative study of semantics, for example, does not hinge on the discovery of symbolic  
116 conventions, displaced in time and space from the referents of communicative behaviour (Tomasello  
117 2008). In that case, to try to evaluate what other animals are doing by human standards is to risk  
118 failing to do justice to their abilities. A more theory-neutral approach to studying intentional  
119 communication would therefore be better.

120

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

139

140 However, there exists some variation in the criteria of intentionality that individual studies apply to  
141 gestural signals and rarely has there been an attempt to apply all criteria to a single signal in a study  
142 species (but see Leavens et al. 2004). Moreover, each individual marker of intentionality in isolation  
143 can be explained through lower-level mechanisms, without needing to invoke intentionality. For  
144 example, sensitivity to the attention state of the receiver could simply be a learned discrimination  
145 where signals are only produced when a receiver's face can be seen; persistence of a signal may have  
146 nothing to do with an intention to communicate with an as yet unresponsive receiver, but simply that  
147 signal production is emotionally driven and only when the goal is met does the underlying emotion  
148 change and terminate signal production (Liebal et al., 2013, Gaunet & Massiou 2014, Savalli et al.  
149 2014). Therefore, it is important, before invoking first order intentionality, to demonstrate convergent  
150 evidence from a number of markers of intentionality for the same signal and species (Liebal et al.  
151 2013, though see Vail et al. 2013). Although multiple cases of converging evidence do not amount to a  
152 proof, the probability of a behaviouristic explanation decreases.

153

154 Whilst gestural studies highlight potential phylogenetic precursors to the intentional communication  
155 of humans and provide crucial comparative data, similar evidence from vocal communication studies  
156 has not been considered as equally convincing. Despite numerous attempts, researchers have failed to  
157 teach enculturated apes to produce spoken language (Yerkes and Yerkes 1929, Hayes 1951). As their  
158 vocalisations are commonly produced in specific contexts, it has been traditionally assumed that  
159 vocalisations are the product of low level emotional processes and are best characterised as  
160 involuntary responses to specific stimuli rather than voluntary, goal-directed signals (Dennett 1983,  
161 Notman & Rendall 2005, Tomasello 2008). Furthermore, invasive procedures have shown that call  
162 initiation in monkeys is mediated by limbic rather than cortical structures in the brain (Jurgens 1992).  
163 On the other hand, some studies suggest that vocal and non-vocal sounds are used intentionally.

164 Leavens, Hopkins and colleagues have shown that great apes use voiced and unvoiced sounds in a  
165 controlled manner that implies flexibility and intentionality (Russell et al. 2005, Hopkins et al 2007,  
166 Hostetter et al. 2007, Hopkins et al. 2011). More recent studies, under natural conditions, have  
167 provided additional support for intentionality in ape vocalisations (Crockford et al. 2012, 2015, Schel  
168 et al. 2013). Moreover, multiple studies have shown vocalisations to be dependent on the surrounding  
169 social audience in a variety of species (Marler et al. 1986, Zuberbühler 2008, Crockford et al. 2012).  
170 These so called “audience effects” are not solely due to simple, arousal mediated, social facilitation  
171 effects (Zajonc 1965), as might be the case when examining the presence or absence of conspecifics  
172 (Tomasello 2008). Instead, they incorporate more subtle social and behavioural variations, e.g.  
173 relationship quality (Slocombe et al. 2010, Mazinni et al. 2013, Schel et al. 2013,) or response of  
174 receivers (Wich and de Vries 2006).

175  
176 Despite this body of data, the existence of intentional vocal communication in animals is still disputed  
177 (Tomasello 2008). Given the central role intentionality plays in human language and the apparent  
178 disparity between the intentional production of gestures and non-intentional vocalisations in non-  
179 human primates, it has been argued that language must have evolved via a gestural, rather than a vocal,  
180 route (Corballis 2002, Tomasello 2008). This theoretical reasoning certainly adds fuel to the fiery  
181 debate surrounding language’s evolutionary emergence. But unfortunately it fails to consider the fact  
182 that the researchers working with gestures and vocalisations, respectively, are operating from different  
183 bases (Slocombe et al. 2011). Animal vocal communication researchers are investigating how the  
184 production of vocalisations may or may not be used to influence the mental states of receivers, often  
185 with negative results (Rendall et al. 2000; but see Crockford et al. 2012, Schel et al. 2013). By contrast,  
186 gestural communication researchers are using an in-place suite of behaviours, derived from child  
187 developmental work, to address how goal-directed and hence intentional (Dennett’s first order  
188 intentionality) gestural production is, predominantly in primates. This means that the research into



189 vocalisations tacitly employs a more demanding criterion for intentionality than the research into  
190 gestures. As a result, comparing intentional production of animal signals at different levels in the two  
191 different modalities commits the mistake of not comparing like with like, and hence renders it difficult  
192 to draw reliable conclusions about differences in intentionality across these modalities.

193

194 To resolve these conceptual and methodological difficulties we propose to ‘level the playing field’  
195 with an updated framework in which the intentional nature of animal communication, irrespective of  
196 modality, can be operationalised and systematically assessed. A single framework approach will  
197 facilitate direct comparative work amongst species and communicative mediums, providing a more  
198 holistic picture of the evolution of human intentional communication.

199

## 200 II. *The new framework*

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

207

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

209

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

211 Goal directed behaviour has been a central focus of comparative psychology research over the last  
212 three decades. At a more rudimentary level the notion of goal-direction involves the role of motor-  
213 processes organising action towards physical targets (Kenward et al. 2009). However, goal-

214 directedness has also been implicated in intentional behaviour, as opposed to automatic or habitual  
215 behaviour (Heyes and Dickinson 1990). Here it is necessary to show that the goal-directed behaviour  
216 is based upon knowledge of the relationship that exists between the action and its consequences (Wit &  
217 Dickinson 2009). Hence within our new framework we shift the cognitive emphasis to demonstrating  
218 that communication is goal-directed.

219  
220 Whilst we appreciate that operationalisation of goal-directedness is not straightforward, it is a far more  
221 tangible and relevant criterion than the demonstration of mental state attribution. Previous studies  
222 probing the intentionality of primate gestures have emphasised the role of persistence and elaboration  
223 in identifying goal-directedness. In line with this, we argue that goal-directedness can be empirically  
224 investigated more generally by merging these criteria with the identification and application of  
225 ‘stopping rules’ (Burkart et al. 2015). When a signaler possesses a goal for its communication, it  
226 would stop upon reaching the goal, but persist and/or elaborate the signal when the goal is not reached  
227 (Leavens et al. 2005). Thus, as with any other behavioural data, regular and reliable observations  
228 fulfilling the criteria (e.g. a goal-dependent cessation of communication, or indeed persistence and  
229 elaboration in the absence of the goal being met) are critical to demonstrating the presence of a goal,  
230 causally linked with the signal. Furthermore, experimental manipulation of goal end states leading to  
231 premature or delayed goal accomplishment is an additional, complementary way, to assess the causal  
232 link between the goal and the communicative signal.

233

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

235 We agree with Leavens et al. (2004) and Moore (2015b) that to show intentionality, behaviour must be  
236 under volitional control and recipient-directed. Criteria generated from studies of intentional  
237 communication in infants (Bates et al. 1979) represent a valuable set of measures to address these  
238 conditions (see table 1). One indicator of voluntary control is selective use of the signal, and in

239 particular, selectively producing or withholding a signal in response to social factors such as audience  
240 composition and behaviour (social use). As we highlighted above, social context could in principle be  
241 part of a complex stimulus to which an automatic, innate signal production mechanism responds. Thus  
242 Hurford (2007, page 232) argues that only if ‘circumstances under which calls are given are too  
243 implausibly complex to be hardwired into the genes’ should we infer these signals are voluntary.  
244 Indicators of the recipient-directed nature of a signal include social use, audience checking and  
245 sensitivity to attentional state (Ristau 1991, Povinelli et al. 2003, Liebal et al. 2004, Leavens et al.  
246 2005, Schel et al. 2013). Every signal type and study species is different. So, whilst it has been  
247 suggested that the more criteria satisfied the greater the confidence that a signal is indeed intentional  
248 (Schel et al. 2013), this may not always be plausible (e.g. certain criteria apply only to the visual  
249 domain). Thus we would argue for a strict *a priori* selection procedure of criteria to ensure fair  
250 comparisons across species and modalities.

251

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

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

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

262

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

264 In a similar way to many primate and non-primate species, chimpanzees (*Pan troglodytes*  
265 *schweinfurthii*) produce vocalisations when faced with dangerous situations (e.g. python or leopard  
266 presence, inter-group interactions). However, due to the rare occurrence of such signals, experimental  
267 manipulations are critical to rigorously assess the mechanisms underlying their production. Schel et al.  
268 (2013) exposed wild chimpanzees in the Budongo Forest, Uganda, to realistic moving snake models  
269 and recorded their vocal behaviour.

270

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

279

280 Secondly, standardised criteria implemented in developmental child intentionality studies must be  
281 applied to the signal to assess its voluntary nature and degree of recipient directedness. Schel et al.  
282 (2013) showed that the production of certain types of alarm calls is influenced by the composition of  
283 the social audience, as the arrival of friends but not non-friends in the area elicited an increase in the  
284 production of these calls. Furthermore, analysis of audience checking behaviour, including gaze  
285 alternation, suggested that signalers monitor and potentially take into account the current behaviour of  
286 receivers when deciding to produce certain alarm calls. Hence chimpanzee alarm calls also appear  
287 recipient directed.

288

289 The third and final criterion requires that receivers of the signal must regularly respond in a way that is  
290 in line with the signaler's presumed intentions. However, such a demonstration does not require that  
291 the receivers understand and represent the intentions of the signaler; and so does not imply any  
292 attribution of a mental state to the signaler by the recipient. Currently the data available from the study  
293 does not sufficiently satisfy this criterion, as Schel et al. (2013) did not directly explore the influence  
294 of alarm calling on the receiver's behaviour. Nevertheless, certain observations do suggest that this  
295 condition may also have been satisfied. When hearing conspecific alarm calls, receivers have been  
296 observed to behave in a similar way as when they encounter predators naturally, including bipedal  
297 scanning behaviour and tree climbing (Slocombe et al. unpublished data, Crockford et al. 2015, see  
298 also Cheney and Seyfarth 1990). These behavioural observations suggest that the goal of the signaler,  
299 in terms of warning group members of a threat, has potentially been met. However, more systematic  
300 comparisons to baseline scanning behaviour indicating that the response was caused by the  
301 communicated content are still required.

302  
303 The above example of alarm calling in chimpanzees is not designed to demonstrate intentional  
304 communication. Instead, it simply serves to illustrate that the proposed framework for assessing  
305 intentional communication in animals is objective and realisable. Moreover, though there have been  
306 previous valuable attempts to operationalise intentionality (Leavens et al. 2005, Liebal et al. 2006,  
307 Vail et al. 2013, Hobaiter and Byrne 2014) these have been predominantly restricted to a single  
308 modality (but see Hopkins et al. 2007), complicating multi-modal comparisons which are vital to  
309 understanding intentional communication holistically. Our approach builds on existing work, but  
310 crucially bridges the current gap that exists between modalities through being applicable to any  
311 reliably and repeatedly observed communication signal.

312  
313 III. CONCLUSION

- 314 1. The voluntary nature of human communication has long been considered a key, potentially  
315 unique, feature of human cognition and language. In light of this, much comparative research  
316 has attempted to unveil analogous or homologous forms of voluntary communication in  
317 animals as a way to better understand what features are really unique to language and from this  
318 how the language faculty may have evolved (Hauser et al. 2002, Fitch 2010). However,  
319 advances in the field have been complicated by the scarcity of convincing evidence of  
320 voluntary production of animal communication in the vocal domain (Wheeler & Fischer 2012,  
321 Rendall and Owren 2013, though see Crockford et al. 2012). This gap in understanding has had  
322 far reaching impacts regarding the predicted evolutionary route via which language may have  
323 evolved, namely whether the origins of language were gestural or vocal.
- 324 2. We propose that the problem does not lie only in insufficient data. Additionally, it is bound up  
325 with a preoccupation with questions about whether voluntary communicative acts in animals  
326 are produced with the same sorts of cognitively complex intentions thought characteristic of  
327 human communication – in particular, the intention to modify the mental states of receivers.  
328 Although mental state attribution and its role in mediating signal production is an important  
329 component of human intentional communication (Dennett 1983, Crockford et al. 2012), we  
330 argue that focusing on this alone detracts from the equally informative examples of behaviour.  
331 Moreover, the assumption that human communication must aim at changing mental states has  
332 been challenged (Moore, 2015a).
- 333 3. How widely distributed first order intentionality is across the animal kingdom is a key question  
334 that must be addressed if we are to i) understand the unique qualities of intentionality in  
335 humans, ii) shed light on the modality and evolutionary route via which language evolved and  
336 iii) understand more generally the adaptive benefit of intentional signalling in non-human  
337 animals.

338 4. Critically, we provide the necessary framework to address first order intentionality, whether  
339 analogous or homologous, across modalities and species giving rise to a unified and unbiased  
340 understanding of the nature of intentional communication in animals.

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490 Table 1: The criteria for intentional communication in animals pertinent to step 2 in the new  
 491 framework. Amended from Schel et al. (2013).  
 492

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.