

WHAT WOULD A MORPHEME BE TO A MONKEY? MAPPING THEORETICAL CHALLENGES AND SOURCES OF DISAGREEMENT

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ABSTRACT: In the search for non-human systems homologous to the lexical component of the human faculty of language, part of the literature within primatology and evolutionary linguistics argues that the vocal alarm calling of some non-human primates (*e.g.*, vervet monkeys) is symbolic/referential, a property generally assigned to human language morphemes. It is relevant to note, however, that there is no consensus in primatology as to whether the distribution of these calls truly reveals sound-meaning pairings comparable to those of human languages. This lack of consensus makes the primatology-linguistics interface more heterogeneous than

RESUMO: Na busca por sistemas não-humanos homólogos à competência lexical da faculdade da linguagem humana, parte da literatura em primatologia e linguística evolutiva defende que as vocalizações de alerta de alguns primatas não-humanos (*e.g.*, macacos vervet) são simbólicas/referenciais, uma propriedade geralmente atribuída aos morfemas da linguagem humana. É importante notar, contudo, que não há consenso na primatologia a respeito de se essas vocalizações de fato revelam pareamentos de som e sentido comparáveis àqueles das línguas humanas. Tal falta de consenso faz da relação primatologia-linguística uma

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than what is often depicted in language evolution studies. To assess the extent to which non-human primate vocal behavior contributes to the identification of evolutionary precursors to human language morphemes, we develop a literature review and map the different positions of the on-going debate in primatology. The resulting map indicates at least three productive axes of comparison: (i) methods devised to the identification of sound-meaning pairings, (ii) interdisciplinary bridge theories, and (iii) linguistic characterization of both non-human and human capacities. We argue that our mapping contributes to the theoretical soundness of further hypotheses on the evolution of language.

KEYWORDS: Sound-meaning pairings; primate communication; language evolution.

interface significativamente mais heterogênea em relação ao que é frequentemente apresentado nos estudos em evolução da linguagem. De modo a avaliar a medida em que o comportamento vocal de primatas não-humanos contribui para a identificação de precursores dos morfemas da linguagem humana, desenvolvemos uma revisão de literatura e mapeamos diferentes posições do debate em curso na primatologia. O mapa resultante indica ao menos três eixos produtivos de comparação: (i) métodos desenvolvidos para a identificação de pareamentos entre som e sentido, (ii) teorias de ponte interdisciplinares, e (iii) caracterização linguística de ambas as competências humanas e não-humanas. Defendemos que nosso mapeamento contribui para a plausibilidade de futuras hipóteses sobre a evolução da linguagem.

PALAVRAS - CHAVE : Pareamentos de som e sentido; comunicação primata; evolução da linguagem.

INTRODUCTION

However unique the human faculty of language may be, there is a growing consensus that this competence comprises a complex array of smaller function-specific modules, which in turn may be partially shared with non-human animals (HAUSER *et al.*, 2002). In this respect, the lexical module has been extensively compared with the vocal behavior of non-human primates (for overviews, see HAUSER *et al.*, 2002; SCHLENKER *et al.*, 2016), particularly along the lines of the so-called functional referentiality approach (see NÓBREGA, 2018; WHEELER; FISCHER, 2012). Although this perspective covers a great variety of species, vervet monkey's (*Chlorocebus sp.*) alarm calling is particularly important for this discussion (see Section 2), and its historical and empirical relevance justify our focus on their behavior in this squib.

It is important to notice, nevertheless, that there is some significant disagreement among primatologists as to whether non-human vocal behavior can be viewed as anything like human language morphemes (in the sense of minimal pairings between sound and meaning that build up complex words), since it is argued that they significantly differ in terms of behavior, development and (communicative) function (OWREN; RENDALL, 2001; WHEELER; FISCHER, 2012; FISCHER, 2017; FISCHER; PRICE, 2017). Crucially, we note that this debate makes the primatology-linguistics interface significantly more heterogeneous than what it is often depicted in language evolution studies.

In this squib, we advance towards an assessment of the common ground from which empirically and theoretically sound inferences about the evolution of the faculty of language can be made. In Section 2, we overview the historical development of the debate, from the establishment of the functional referentiality approach to modern critiques against it. In Section 3, we adopt Botha's (2016) Windows Approach as a theoretical device for the conceptualization and the mapping of conflicting positions within this debate. In Section 4, we present our final remarks and point out possible future developments.

1. THE RISE AND FALL OF THE FUNCTIONAL REFERENTIALITY APPROACH

Historically, Struhsaker (1967) is a pioneer study on the naturalistic description of vervet vocal behavior. Out of all 36 registered vocalizations, identified acoustically and functionally, four calls (see Table 1) were evoked by

the presence of a rather specific set of predator species, and, importantly, the observed responses to these calls were also seemingly adapted to responding to these threats. In describing this behavior, Marler (1980 [1977]) argues that it cannot be trivially assigned to general circumstances of the emotional state of the signaler, but rather to definite external entities, which he calls *referents*. Linguistically inspired terms are not a mere aspect of terminology, since these vocalizations are explicitly treated as functioning as “a name for a limited class of external referents” (MARLER, 1980 [1977], p. 222). The author proposes that the specificities underlying vervet call production and perception are signatures of a *symbolic* mode of signaling, in contrast to an *affective* mode.

Chart 1: Classical descriptions of vervet monkeys’ predator-specific calls.

Terminology		Description
Struhsaker	Seyfarth <i>et al.</i>	Marler
<i>(Snake) chatter</i>	<i>Snake alarm call</i>	Evoked by “venomous snake.” Elicits “approach [...] and escort at safe distance.”
<i>Rraup</i>	<i>Eagle alarm call</i>	Evoked by “[i]nitial sighting of eagle.” Elicits “[f]lee from treetops and open areas into thickets.”
<i>Threat-Alarm bark</i>	<i>Leopard alarm call</i>	Evoked by “[i]nitially and after sighting major predator (leopard, lion, serval, eagle).” Elicits “[a]ttention and then flight to appropriate cover.”
<i>Chirp</i>		Evoked “[a]fter initial sighting of major predator (leopard, eagle).” Elicits “[f]lee from thickets and open areas to branches and canopy.”

Source: STRUHSAKER (1967, p. 314–317), MARLER (1980 [1977], p. 223), SEYFARTH *et al.* (1980b, p. 1073).

These specificities were further qualified by a pair of classical studies made by Seyfarth *et al.* (1980a, b). On the one hand, from an observational viewpoint, the authors contribute to the initial observations on vervets (Table 1) by further evidencing that the different anti-predatory responses of the recipients are mutually exclusive, so that it is not the case that the calls elicit generic anti-predator responses, which in turn would be adaptive in response to more than one type of predator. More importantly, on the other hand, calls were tape-recorded and then methodically played back to vervets in their natural environment. The results revealed that vocalizations are perceived categorically, as opposed to continuously (*e.g.*, solely by means of

call length, pitch, amplitude, features that were controlled in the experiment), which in turn would generally be correlated with different states of affectation of the signaler. The specificities of alarm calling were interpreted not merely as such, but rather as evidence that vervet calls are a type of “semantic signaling, probably involving the formation of internal perceptual concepts, or symbols” (SEYFARTH *et al.*, 1980b, p. 1091).

More than a decade later, Marler *et al.* (1992) represents a drawback from stronger commitments to human cognition symbols, at the same time it reinforces the idea that calls can refer to external entities (*viz.*, predators). This seemingly contradictory position is made possible with the introduction of the composite concept of *functional referentiality*. The sub-concept *functional* reflects an epistemological position that referentiality may only be described in terms of its behavioral similarities with human language, since symbolic/referential cognition cannot be accessed directly in non-human primates. For the case of *referentiality* we note that the behavioral description of referentiality takes little of the linguistic literature into consideration, being reserved to philosophical and semiotic discussions on the general problem of meaning². Rather, signals are statistically formalized in terms of their correlations with (i) acoustic characteristics of the signal, (ii) stimulus characteristics, and (iii) motivational state characteristics. Functional referentiality is conceptualized in terms of the little correlation with motivational state variables (*e.g.*, fear) when compared to the correlation with stimulus characteristics variables (*e.g.*, predator class). Similarly, Macedonia and Evans (1993) put forth two sufficient criteria for the identification of functional referentiality, *viz.*, the perception criterion (*i.e.*, referential calls are sufficient to elicit appropriate response in the absence of other environmental cues) and the production criterion (*i.e.*, referential calls are stimulus-specific).

Although some critiques were made to symbolic approaches to alarm calling even before Marler (1980 [1977]), we identify a major movement (roughly, from the 1990s onwards) stressing a variety of aspects that differentiate non-human primate vocal behavior from human language, such as communicative intent, vocal learning, and call learning during ontology. Even though these aspects involve the cognitive capacities underlying the vocal behavior of vervets to some extent, that is not to say that the opponents of the functional referentiality approach do not consider the reservations underlying the idea of *functional* in the complex concept of *functional*

² Although meaning is clearly involved in sound-meaning pairings, the pairing itself is dedicated to an independent branch of linguistic inquiry, namely, morphology. Morphological literature is generally under-represented both by followers and opponents of the functional referentiality approach considered in our literature review.

referentiality. For instance, Owren and Rendall (2001, p. 69) qualify it as a “metaphorical rather than mechanistic or functional approach” that produces false expectations about non-human primate vocalizations (*e.g.*, intentional information transmission). Additionally, Wheeler and Fischer (2012) describe the approach as “a promising paradigm whose time has passed” and propose that context specificity is not a unique property to functional referential signals (*contra* MARLER *et al.*, 1992; MACEDONIA; EVANS, 1993), but rather an emerging adaptation of both senders and receivers engaging in decision-making processes.

The degree of specificity underlying Macedonia and Evans’s (1993) criteria is also subject to counterevidence. Price *et al.* (2015), in a quantitative study on vervet vocal repertoire, uses discriminant functions to test whether acoustic structure is sufficient to determine call type (*viz.*, those on Table 1). Their results defy canonical characterizations of alarm calls, since acoustic characteristics of calls such as *Rraup* overlap with those of calls used in intergroup aggression. This indicates that the anti-predatory behavior may rely on additional contextual features, since the call itself is contextually ambiguous (PRICE *et al.*, 2015, p. 8; *contra* MACEDONIA; EVANS, 1993). From the standpoint of production, Wegdell *et al.* (2019) obtain similar conclusions, as they demonstrate that green monkeys (*Chlorocebus sabaeus*), a species within the same genus of vervets, produce *aerial calls* not only to eagles, but also towards drones.

In sum, our review highlights the main points under consideration for the establishment of the functional referentiality approach and illustrates part of the variety of the arguments that have been used to argue against it. In the next section, we explore how positions of the debate differ from each other.

2. STRUCTURING DISAGREEMENT: A MAP FOR THE ARENA

In section 2, we illustrate the lack of consensus within primatology regarding whether non-human primate vocal behavior is related to, or even informative of, the linguistic competence of humans. Underlying this debate, many different aspects of vervet vocal behavior are involved, from methodological variation regarding the characteristics of observed behavior (*e.g.*, Marler’s, 1980 [1977], specificities *versus* Price *et al.*’s, 2015, discriminant functions) to theoretical characterizations of the primatology-linguistics interface (*e.g.*, Marler *et al.*’s, 1992, functional referentiality versus Owren and Rendall’s, 2001, defective metaphor). Crucially, since such sources of disagreement lie on quite different ontological domains, a crucial step

towards systematizing this debate is to clearly distinguish between epistemological levels.

To take that step, we adopt Botha's (2016) Windows Approach, that, although primarily concerned with evaluating hypotheses on language evolution in a systematic and rigorous fashion, is arguably also productive for conceptualizing and characterizing the different axes of the functional referentiality dispute.

The Windows Approach is formalized in terms of the empirical requirement (*i.e.*, claims must rely on direct evidence) and the soundness requirement (*i.e.*, claims must be sound, according to three conditions) on hypotheses on language evolution. The first soundness condition is groundedness (BOTHÁ, 2016, p. 19–20), which imposes the grounding of hypotheses on evidence that has been sufficiently and uncontroversially described. The warrantedness condition (BOTHÁ, 2016, p. 17–19), in turn, demands theories that license the interface between different ontological domains, making theoretical underpinnings claims/assumptions on one domain (e.g., primatology) adequately translated into the other (e.g., linguistics). The pertinence condition (BOTHÁ, 2016, p. 20–24), finally, stresses that the concepts of the different domains involved must be properly defined in terms of a supporting ontology.

In the following sections, we compare different positions of the debate outlined in Section 2 along with each of these conditions, that, as we demonstrate, provide three productive axes of comparison.

2.1. Groundedness: methods for the identification of sound-meaning pairings

Price *et al.* (2015), in its critique of functional referentiality, is particularly illustrative of the conceptual methods used for the identification of sound-meaning pairings. *Sound* is treated as the acoustic manifestation of behavior, hence being analyzed in terms of acoustic parameters (e.g., call duration, and inter-call interval); and *meaning*, in turn, is understood as the contexts in which sounds were produced (e.g., presence of raptor, leopard, or snake). Crucially, although Price *et al.* (2015, p. 8) argue that vocalizations are contextually ambiguous (against, e.g., MACEDONIA; EVANS, 1993), their methods for the identification of sound and meaning do not differ substantially from Struhsaker's (1977) acoustic and functional features, or Marler's (1980 [1997]) specificities. For that reason, we argue that authors

seem to differ not in how they conceptualize sound-meaning pairings, but rather in whether vervets' pairings are one-to-one correspondences.

In this respect, in describing vocalizations that fail the criteria for functional referentiality (e.g., *Rraup*, see Section 2), Fischer and Price (2017) propose that calls may be described in terms of (i) observed sound structure, (ii) meaning in the sense of eliciting stimuli, but also (iii) the internal states mediating sound and meaning. Fischer and Price (2017, p. 26–27) propose two models for how internal states may account for the pattern of two stimuli (viz., eagle and aggression) relating to one sound (viz., *Rraup*, see Table 1): either (i) stimuli are associated with a single internal state, that in turn is related to pattern generators that output *Rraup* or (ii) each stimulus correspond to a unique internal state, and pattern generators associated with these internal states happen to realize the same vocalization. Although internal states introduce an interesting complexification of sound-(internal states)-meaning pairings (see Section 3.3), it remains unclear how to decide between the proposed models.

Overall, our review has found little disagreement when it comes to the identification of sound-meaning pairings in non-human primate vocalizations. Amongst various positions in the debate, there is an underlying and shared assumption that a pairing is identified by means of its acoustic realization (i.e., the sound) and the circumstances in which it is produced.

2.2. Warrantedness: bridges linking Primatology and Linguistics

As discussed in Section 2, the term *functional* in *functional referentiality* is related to the identification of a gap dividing behavior and competence. This dichotomy evokes a non-trivial philosophical debate (e.g., the opposition of functionalism and materialism) and it affects the literature under consideration in the sense that authors commit to different positions when considering the interface between primatology and linguistics. For our analysis, this is reflected in the existence of two groups of arguments, viz., behavior- and competence-centered.

For the case of behavior, not only do supporters of the functional referentiality approach take the position on the study of behavior (see Section 2), but also its opponents use behavior-centered arguments to dismiss functional referentiality by its own terms. For instance, Price *et al.* (2015) defies Macedonia and Evans' (1993) perception criterion based on similar assumptions on how to frame the sound-meaning pairing behavior (see Section 3.1). Another group of behavior-based arguments against functional

referentially are those who argue that the observed specificities characterizing vervet behavior are comparable not to human language referring expressions (*e.g.*, words), but to other aspects of human linguistic behavior. For instance, Owren and Rendall (2001, p. 64–69), Price *et al.* (2015, p. 8), Fischer and Price (2017, p. 29) and Wheeler and Fischer (2012, p. 201–203) frame vervet alarm calling not in terms of a reference-specific signal (*contra* functional referentiality), but rather as a complex dynamic of how vocalizations are informative (or, to be more precise, indexical) of certain environmental features (*viz.*, the presence of certain heterospecific animals).

For the case of competence, however, there seems to be more consensus due to the significant differences that put vervet vocal behavior and human linguistic competence apart. Some remarkable contrasts are the limited vocal learning in non-human primates and the lack of a sophisticated theory of mind (see NÓBREGA, 2018, p. 118, and the references cited therein). On the other hand, there is some overlap between vervets and humans when it comes to the capacity for auditory learning (OWREN; RENDALL, 2001; WEGDELL *et al.*, 2019) and for perceiving vocalizations categorically, rather than continuously (STRUHSAKER, 1967; SEYFARTH *et al.*, 1980a, b; MARLER, 1980 [1977]; MARLER *et al.*, 1992; MACEDONIA; EVANS, 1993; PRICE *et al.*, 2015).

In sum, our review suggests that arguments come not from a single interface between primatology and linguistics, but rather from at least two major interfaces that reflect deep philosophical debates, *viz.*, the behavior- and the competence-based approaches. Whereas there is a consensus that vervets and humans significantly differ in terms of their cognitive capacities, there is considerable disagreement as to whether vervet alarm calling is comparable to human language use of referential expressions and, if comparable to any human behavior at all, to what behavior should it be compared with.

2.3. Pertinence: conflict on linguistic

When it comes to comparisons with human language faculty and its associated behavior, different assumptions regarding what properties characterize human language can lead to extra-disciplinary (*i.e.*, not strictly primatological) sources of disagreement. Most of the authors considered by our review assume a structuralist notion of linguistic sign. Saussure (2013 [1916]), a central reference to this approach to language, define signs to be the primitive objects for the study of language, and propose that signs link

separate domains, viz., that of the *signifié* (its concept) and that of the *signifiant* (its acoustic image) (SAUSSURE, 2013 [1916], p. 76). Although agreeing in the conception of vocalizations as signs, authors such as Seyfarth *et al.* (1980b) and Fischer and Price (2017) disagree in terms of what type of signs are these vocalizations. On the one hand, Seyfarth *et al.* (1980b, p. 1091) argue that vocalizations are arbitrary and non-iconic, due to their lack of acoustic properties resembling their eliciting referents. If arbitrariness is taken as non-resemblance with the reference for Seyfarth *et al.* (1980b), Fischer and Price (2017) take Peirce's (1958) notion of arbitrariness as socially determined conventionalization to deny its arbitrariness, since sounds are mostly innate and constraint by species-specific determinations.

When it comes to the treatment of vocalizations that are not one-to-one mappings, we propose that solutions come in at least three variants, according to what branches of linguistics they relate to. Although not recognized in such terms, Fischer and Price's (2017) solution of intermediating internal states (see Section 3.1) is at least formally consistent with morphophonological phenomena of human languages. The solution of two internal states for a single sound is consistent with at least syncretism (*e.g.*, in Latin American Spanish, the present tense marking -n realize features of both second- and third-person plural; see EMBICK, 2015, p. 25) and homophony (*e.g.*, in English, *bank* may refer to either a financial institution or the shore of a river). Fischer and Price (2017) give no further detail on the nature of such internal states (*e.g.*, if they are properties of the sensory-motor system), but for the effort in accounting sound-meaning pairings in non-human primate vocalizations focusing on the pairing itself (rather than aspects of meaning), we may call it the morphophonological solution.

The morphophonological analogy contrasts with what we may refer to as semantic solutions. What has been suggested by Seyfarth *et al.* (1980b) on the wide variety of referents to which infant vervets signal vocalizations that are stricter in adult behavior, and by Wegdell *et al.* (2019) on the fact that green monkeys produce *aerial calls* when encountering drones is that semantic representations may be vaguer, representing not specific aerial predators, but rather underspecified aerial threats. This explanation correlates in human languages as well (*e.g.*, *children* underspecifies gender when compared with *boys* and *girls*).

Finally, based on the vocalizations of Campbell monkeys (*Cercopithecus campbelli*), authors such Schlenker *et al.* (2016) and Patel-Grosz *et al.* (2023) propose that, in interaction with underspecified meanings of vocalizations, pragmatic principles (*e.g.*, the principle of informativity, that requires that,

when two underspecified vocalizations ‘fit’ a context, the most context-specific vocalization is produced) model how meaning is enriched in particular contexts. This approach is explicitly inspired by a tradition of studies within linguistics led by Grice (1965), that postulates conversational maxims that regulate meaning extension driven by conversational-specific parameters shared by speakers.

To sum up, our review points to a partial interface between primatology and linguistics, in the sense that, although language is evidently the center of much debate among primatologists, clear and comprehensive characterizations of what one assumes language to be are very rare, being salient only in more recent literature (see SCHLENKER *et al.*, 2016; PATEL-GROSZ *et al.*, 2023). It is not within the purposes of this discussion to provide it either: we restrict ourselves to the suggestion that part of the disagreement between primatologists also come from which linguistic phenomena is considered relevant to the description of vervet vocalizations (*viz.*, minimally which type of sign, and which type of phenomenon: morphophonological, semantic or pragmatic).

3. CONCLUDING REMARKS

Our analysis of the debate within primatology reveals that not only primatological interface is heterogeneous, but so is the linguistic interface. Importantly, most of the primatological literature hereby revised lacks a comprehensive definition of a linguistic ontology, and exactly what linguistic primitives are taken into consideration. Indicative of this situation are cases in which opposing views (*e.g.*, MARLER *et al.*, 1992, *versus* FISCHER; PRICE, 2017) start from similar premises (*viz.*, the saussurean notion of sign) but end up disagreeing with qualifying language (*viz.*, symbolic versus indexical, respectively) without any non-speculative and properly defined consideration of the whole set of possibilities.

A particular case is that of morphology, significantly neglected when compared to the importance that has been dedicated to meaning in the description of sound-meaning pairings. A symptomatic example is that of the criteria put forth by the functional referentiality approach for the identification of sound-meaning pairings (specially the radical interpretation proposed by Macedonia and Evans, 1993): the criteria are so narrow that they are inadequate not only to non-human primate vocal behavior (as suggested by Price *et al.*, 2015), but even human language morphemes fail to behave accordingly (see Section 3.3).

To summarize, we support an interdisciplinary informed framework towards the study of human language evolution (HAUSER *et al.*, 2002; BOTHE, 2016). We demonstrate the relevance of this perspective for the study of potential homology of the lexical component of the faculty of language with non-human primate alarm calling. Our mapping of the functional referentiality debate indicates that different positions seem to agree on the methods for the identification of sound-meaning pairings, but radically differ regarding the prevalence of behavior-/competence-based assumptions, but also regarding the linguistic properties considered to be relevant in the comparison between non-human primates and humans. Hopefully, our mapping contributes to the theoretical soundness of further hypotheses on the evolution of language.

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