

# EXPLORING BOTH INTERNAL AND EXTERNAL FACTORS AND PRAGMATICS OF MONKEY COMMUNICATION

*Ahnaf Mozib Samin*

Language and Communication Technologies  
University of Groningen  
Groningen, Netherlands

`a.m.samin@student.rug.nl`

## ABSTRACT

The evolution of human language has been unknown for decades and thus researchers have started to study primate linguistics with the hope of understanding how human language evolved. Rich data in primatology has made it possible for linguists to apply the theories of contemporary linguistics in explaining monkey communication. However, it is still debatable whether only the environmental factors can determine the monkey calls. In this article, we review recent studies and suggest that both internal and external factors should be considered while doing experiments. We also emphasize studying pragmatic enrichment for both humans and monkeys to understand whether it works in the same way in these two species.

***Index Terms***— Primate vocalization, Monkey calls, Semantics, Internal and external factors, Pragmatic enrichment

## 1. INTRODUCTION

Research on animal vocalization has long been conducted by primatologists to shed light on non-human communication such as vocalizations of bird species, gibbons, whales, apes, monkeys, etc [1, 2, 3, 4]. A recent approach to investigating animal vocalization with the help of formal linguistics has been observed in the last few decades. Special attention has been given to non-human primate vocalizations with the hope of deepening our understanding of the evolution of much complex human language. Thus, a new field of linguistics called evolutionary primate linguistics has started to emerge and appear fruitful to enrich our knowledge of the vocal system of primates over millions of years of evolution.

Schlenker et al. study the vocalizations of three types of monkey species and apply the theories of formal linguistics to explain them [5]. They propose that the main areas of formal linguistics can be observed in monkey calls. First, monkey calls are not combined arbitrarily, rather there are constrained ways to combine them. Thus, these call sequences abide by some rules of syntax. Second, there is a relation between a monkey call and the external context which arouses the call, meaning there is semantics in them. Third, some monkey calls can be divided into prefixes and suffixes which indicates the morphological property of monkey calls. Lastly, monkey calls can be pragmatically enriched by competing words. Pragmatic enrichment is often seen in complex human languages and is considered a marker of improved human cognitive ability.

Although Schlenker et al. emphasize linking a monkey call to an external event and thus consider only the literal meaning of a call influenced by an extrinsic factor as its semantics [5], the emotion-related aspects of monkey calls are ignored. Moreover, it is still doubtful whether monkeys are capable to apply pragmatic enrichment to the same extent humans do. Thus, the following questions arise - can the monkey calls be produced in response to only environmental factors? Or are intrinsic factors such as emotional state solely responsible for producing calls? Can the combination of both internal and external factors play a role in producing the calls in monkeys? Is the pragmatic enrichment defined for human languages exactly the same as proposed by Schlenker et al. for monkeys? In this article, we aim to shed light on the above-mentioned questions after presenting a brief survey of the existing literature. Our analyses might provide new directions for further research.

## 2. BACKGROUND STUDY

A team of researchers including primatologists and linguists gathered data of three monkey species namely Campbells monkeys (*Cercopithecus campbelli*), putty-nosed monkeys (*Cercopithecus nictitans*), and Black-fronted titi monkeys (*Callicebus nigrifrons*) through naturalistic observations and field experiments such as trigger-to-call experiments (e.g. predator presentation) and call-to-behavior experiments (e.g. playback of alert calls) and borrowed the theories from formal linguistics to study their vocalizations [5]. Campbells monkeys living in Tiwai Island, Sierra Leone, and the Ivory coast's Tai forest, putty-nosed monkeys from Africa, and Titi monkeys from South America are studied in this experiment. Campbells monkeys emit four types of calls - *boom*, *krak*, *hok*, and *wok*. *boom* call is given in non-predation situations and it often appears as a pair at the start of a sequence. *hok* call is given in presence of an eagle. In Tai forest, *krak* call is used in the presence of a leopard, however, in Tiwai island where there is no leopard, the same call is used as an unspecific alert. The *hok* and *krak* calls can act as roots by adding the suffix -oo at the end which indicates a weaker form of the corresponding alert. Thus, *hok-oo* indicates non-ground disturbances and *krak-oo* is used for unspecific alerts. To explain the different meanings of the same call *krak* in different places, it has been argued that there is a dialectal variation in monkey calls. However, Schlenker et al. redefined the monkey calls as stated in (2) and applied the informativity principle to explain the *krak* call [5].

According to the Informativity Principle, if a sentence S was uttered and S' is (i) an alternative to S and (ii) strictly more informative than S, then infer that S' is false.

(2) Schlenker et al. [5] hypothesizes that -

- a. *boom boom* refers to non-predation alert.
- b. *hok* denotes non-ground alert.
- c. *krak* indicates unspecific alert.
- d. *R-oo* means weak R-alert.

Since *hok* and *krak-oo* are more informative calls than the unspecific alert *krak*, according to the informativity principle, *krak* competes with *krak-oo* and *hok*. So, whenever *krak* call is used, the meaning of *krak* is also pragmatically enriched to *krak* but not *krak-oo* or *krak* but not *hok*. Ultimately, *krak* is triggered by serious (not *krak-oo*) non-ground (not *hok*) alert in the Tai forest. In Tiwai island, however, since there is no leopard, *krak* call is not pragmatically enriched and takes its literal meaning of unspecific alert.

Putty-nosed monkeys are found to produce *boom* (non-predation alert), *hack* (non-ground movement), *pyow* (general alert), and sequences of *pyow-hack*. The question remains whether *pyow-hack* sequences should be treated as non-compositional idioms. It is found that these sequences are slow and come in many varieties, unlike idioms. If these sequences take the meaning of their compositional parts, they should be used in situations like moving aerial predators or (arboreal) movement of the monkeys. However, in observations and field experiments, it is found to be indicative of group movement. Schlenker et al. propose that the meaning of these sequences are pragmatically enriched by an Urgency Principle which states that within a sequence, the calls that provide information about the location of threat come before calls that do not [5]. Hence, if there were some raptors present, *hack* should be used before. As a result, *pyow-hack* sequences are only used for non-risk-related situations involving movement.

Black-fronted Titi monkeys emit sequences of A-calls and B-calls in a different order. According to Casar et al., [6], the following has been observed:

- a. non-predation alert: sequences of B-calls (B+)
- b. cat on the ground: sequences of B-calls (B+)
- c. cat in the canopy: A call, then sequences of B-calls (AB+)
- d. raptor on the ground: sequences of A-calls and then sequences of B-calls (A+B+)
- e. raptor in the canopy: sequences of A-calls (A+)

Schlenker et al. argued that Titi monkey call sequences are neither non-compositional idioms nor it takes their compositional meaning [5]. They proposed that A-calls are indicative of serious non-ground alerts and B-calls are general alerts. Thus, they hypothesize the Titi monkey calls in the following way:

- a. non-predation alert: since it is not related to predation, B+ calls are emitted.
- b. cat on the ground: significant event but not serious, thus B+ calls are emitted.

- c. cat in the canopy: initially a serious non-ground danger, which becomes weaker after the cat is detected. Thus, AB+ calls are emitted.
- d. raptor on the ground: raptor may attack by flying, thus the serious non-ground alert A+. Afterward, the alert weakens to B+ calls since being on the ground is not a usual hunting position for raptors.

Since Casar et al. argued that aerial predators are the major threats to Titi monkeys [6], S. Commier et al. redefines the A-calls by eliminating the location of the predators [7]. According to them, if the A-calls contain the non-ground part, it is redundancy and thus A-calls refer to only "serious threat". Whenever A-calls are emitted, monkeys can infer that there is a serious threat and they look upwards.

Berthet et al. investigated the acoustic properties of the Titi monkey calls and was able to find some interesting phenomenon [8]. They showed that B-calls given to terrestrial predators ("Bt-calls") are higher pitched than those when the caller is near the ground ("Bg-calls"). Moreover, they also experimented with the B-calls given to aerial predators on the ground by examining the acoustic properties of these calls. They classified 192 Bg-calls and 113 Bt-calls using a linear discriminant analysis on the Mel filterbank and confirmed that Bg-calls and Bt-calls contain different spectral properties. Interestingly, among the 45 aerial B-calls, 28 of them are classified as Bt-calls and the rest of the calls (17 calls) are clear Bg-calls. The fact that a specific phenomenon (presence of aerial predators) can elicit different B-calls is puzzling and thus it has been proposed that the B-calls do not refer to external events. Rather, the B-calls are used to indicate the emotional states of the monkeys. Likewise, A-calls are very high-pitched and used only to indicate serious threats. Based on the previous world knowledge and the frequency of the calls, the listener monkeys can understand the information regarding predator type and location. As a result, unlike Schlenker et al. [5], Berthet et al. propose the following [8]: a. non-predation alert: not a significant event, thus lower-pitched B+ calls b. cat on the ground: significant event but easy to escape from, thus high-pitched B+ calls are emitted. c. cat in the canopy: significant event but easy to escape from when the cat is detected, thus medium arousal with anecdotal peaks of excitement, B+(A) d. raptor on the ground: initially looks like a serious threat but later the caller realizes that it is not serious. Thus, A+B+ calls are emitted.

### 3. BOTH INTERNAL AND EXTERNAL FACTORS DETERMINE MONKEY CALLS

Understanding primate language is crucial to revealing how human language has evolved. As described in the previous section, there have been two contrasting explanations of why Titi monkeys evoke certain calls in response to different situations. While Schlenker et al. argued that external events are responsible for monkey calls and there exists syntax, semantics and morphological properties in these calls [5], Berthet et al. proposed that internal states of the monkeys play a key role in determining which type of B-call to be evoked in which situation [8]. In this paper, we hypothesize that primate vocalizations can be driven by a combination of both internal and external factors although internal factors are not inextricably linked with monkey calls. From the data gathered by Ouattara et al. [9], it indicates a link between an event and the corresponding call which proves the connection between environmental factors and the production of monkey calls. However, in a specific situation, a particular call is not uttered at all times. For example, whenever leopard is seen, *krak* call is used more than 400 times and *krak-oo* in more than 200 times [9]. These statistics show that the degree of arousal of emotional state has an impact on the production of the monkey calls. To further establish the interplay between internal and external factors in monkey communication, more experiments should be designed such as manipulating social contexts. Monkeys can be separated into different numbers (alone, in pair, or a group) to observe the effect of emotional state while presenting predator objects. Moreover, an acoustic analysis should be conducted with the calls of Campbells monkeys and Putty-nosed monkeys to find out the variability in frequency/pitch which is found to be present in the Titi monkeys.

### 4. PRAGMATIC ENRICHMENT IN HUMAN AND MONKEY CALLS

Schlenker et al. proposed that pragmatic enrichment can be seen in primate linguistics [5]. To shed light on whether pragmatic enrichment defined for human language works in the same way as for monkeys, we argue that there is a key difference between pragmatic enrichment seen in human and monkey linguistics. Studies conducted by Crain et al. in 2010 have shown that kids have a different interpretation from adults in the meaning of the disjunction "or" [10]. As kids get older, they learn the pragmatic enriched meaning of this disjunction. Thus, we can argue that the innateness of pragmatic enrichment does not hold for natural human language. However, no studies have confirmed such phenomenon in monkey calls which states that the

pragmatic enriched meaning of "krak" is not learned by younger monkeys. As a result, based on current status of research, we can say that the innateness of pragmatic enrichment cannot be disproved in monkey calls. More research can only confirm whether there is actually a difference in the innateness of pragmatic enrichment seen in humans and monkeys.

## 5. CONCLUSION

Primate vocalization has now been studied to better understand how language has evolved with time. Both primatologists and linguists have devoted themselves to gathering more data and applying new theories to explain primate vocalization. In this article, recent advancements on monkey calls have been presented and contrasting argumentation of these works have been discussed. Based on the current studies, it seems likely that both internal and external factors are responsible for the production of monkey calls. Thus, research on monkey calls might go in the wrong direction if only one factor is emphasized, instead of focusing on both. More experiments can be conducted such as observing monkey calls in different social contexts, measuring physiological changes (e.g. pulse rate, temperature, etc) during calls, doing acoustic analysis of the calls, etc. However, we should also consider that altering the naturalness of the monkeys' environment can have an impact on the results.

Although the linguistic theories applied by Schlenker et al. fit well in explaining why the monkey calls are uttered in specific situations [5], more data needs to be gathered to confirm whether certain calls are pragmatically enriched or not. Young-aged monkeys can be observed more closely to find out whether the innateness of pragmatic enrichment holds for them and then can be compared with human children. Further analysis can enrich our current knowledge of the evolution of language.

## 6. REFERENCES

- [1] Jean Aitchison, *The seeds of speech: Language origin and evolution*, Cambridge University Press, 2000.
- [2] Thomas Geissmann, "Duet-splitting and the evolution of gibbon songs," *Biological Reviews*, vol. 77, no. 1, pp. 57–76, 2002.
- [3] Ryuji Suzuki, John R Buck, and Peter L Tyack, "Information entropy of humpback whale songs," *The Journal of the Acoustical Society of America*, vol. 119, no. 3, pp. 1849–1866, 2006.
- [4] Esther Clarke, Ulrich H Reichard, and Klaus Zuberbühler, "The syntax and meaning of wild gibbon songs," *PloS one*, vol. 1, no. 1, pp. e73, 2006.
- [5] Philippe Schlenker, Emmanuel Chemla, and Klaus Zuberbühler, "What do monkey calls mean?," *Trends in Cognitive Sciences*, vol. 20, no. 12, pp. 894–904, 2016.
- [6] Cristiane Căsar, Klaus Zuberbühler, Robert J Young, and Richard W Byrne, "Titi monkey call sequences vary with predator location and type," *Biology letters*, vol. 9, no. 5, pp. 20130535, 2013.
- [7] Swan Commier and Mélissa Berthet, "Commentary: Titi semantics: Context and meaning in titi monkey call sequences," *Frontiers in Psychology*, vol. 10, pp. 512, 2019.
- [8] Mélissa Berthet, Juan Benjumea, Juliette Millet, Cristiane Căsar, Klaus Zuberbühler, and Ewan Dunbar, "Animal linguistics and the puzzle of titi monkeys alarm sequences," .
- [9] Karim Ouattara, Alban Lemasson, and Klaus Zuberbühler, "Campbell's monkeys use affixation to alter call meaning," *PloS one*, vol. 4, no. 11, pp. e7808, 2009.
- [10] Stephen Crain and Drew Khlentzos, "The logic instinct," *Mind & Language*, vol. 25, no. 1, pp. 30–65, 2010.