**Laboratory**: Laboratoire de Psychologie Cognitive

**Head of the laboratory**: Johannes Ziegler johannes.ziegler@univ-amu.fr

**Team name**: Cognition comparée

**Team leader(s)**: Joel Fagot

**First name and last name of the proposed PhD or Post-Doc supervisor(s)**:

Florence Gaunet (co-supervisor)

Anne-Lise Giraud (co-supervisor). Imera position from Feb to June 2019 (LPC and LPL).

The student will be 100% based in L.P.C./Marseille.

Collaboration with T. Legou/L.P.L. Research conducted in the Labex ILCB framework (Institute of Language, Communication and the Brain).

**Title of the proposed PhD or 2-year Post-doc research project**:

Contour, rhythm or content? What does dogs brain grasp from human speech?

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For the application, PLEASE CONTACT F Gaunet florence.gaunet@univ-amu.fr and AL Giraud annelise.mamessier.giraud@gmail.com

**Summary of the proposed research project**

* **State of the art:** Dogs have so closely coevolved with humans that they are able to make use of short word sequences to execute simple orders (e.g. “Titus, bring the ball”) (Kaminski et al., 2004). The dog speech perception capacity is particularly interesting to explore from a language evolution viewpoint because, while dogs cannot speak (Riede & Fitch, 1999), they show a strong motivation to communicate with us (Gaunet & El Massioui 2014). In humans, understanding connected speech requires segmentation of the acoustic flow. This capital pre-processing step involves slow neural oscillations, which naturally occur in the auditory cortex at a rate close to the average human syllabic rate (4-7Hz) (Giraud and Poeppel 2012). Since the syllabic structure is constrained by the motor system, its contribution to the speech perception is intensely debated (Park et al. 2015).
* **Objectives:** This project proposes to explore the neural bases (including laterality) of dog speech processing to address the contribution of the motor system to speech perception. We expect to determine whether dogs perceive speech on the basis of acoustic cues they can themselves produce, i.e. short “syllable-like” intonated sounds, or whether alternatively, they can be sensitive to cues that they cannot produce at all, phoneme-level cues.
* **Methods:**

*Project 1: acoustic analysis.* We will first record single and polysyllabic animal vocalizations. Polysyllabic vocalizations can be obtained in dogs by mimetism with human speech (Gaunet & Legou In prep; Legou & Gaunet In prep). We will use these recordings to perform a comparative acoustic analysis of dog and man vocalizations. We will compute modulation power spectrum (MPS) as in (Arnal et al. 2015), for both types of signal and will determine the overlap of dog and man modulation acoustic landscape. This analysis will serve to interpret the neural responses and to determine how much of the human communication MPS area is also used by dogs. A preliminary study analyzing dogs’ vocal productions, using internet videos posted by dog owners, is in preparation by Legou and Gaunet.

*Project 2: non-­‐invasive electrophysiology.* We plan to record EEG in 5 dogs (Kis et al. 2014, 2017; Bunford et al. 2017) to explore the ability of auditory cortical rhythms to track syllable boundaries in human speech in: 1/ natural continuous speech of an unknown human intended to the dog, 2/ natural continuous speech of the dog’s owner intended to the dog, 3/ a simple sentence usually understood by the dog pronounced by the dog’s owner with prosody, 4/ the same condition without prosody, 5/ aprosodic single words, 6/ single words with intonation.

The data will be analyzed individually using state of the art methods, involving standard analyses of evoked potentials for single words, and more advanced methods of speech/brain cross-­‐correlations (cross spectral density etc.) and EEG time-­‐frequency analyses for continuous speech, as we recently described (Pefkou et al. 2017). We will also use detrended fluctuation analysis to evaluate long range temporal correlations in dogs EEG at rest and during speech (Borges et al. 2017).

* **Expected results**

We expect to determine whether the dog’s auditory cortical system spontaneously track syllables in speech, how much this tracking depends on the owner’s voice and/or the owner’s prosody, whether word content can be accessed in dogs without prosodic cues, and finally whether their integration capacity fits with long-range autocorrelation properties of their neural activity.

F**easibility over the 3-year period, including project financial support and ethics committee authorizations**: F Gaunet: expert in dog communication; will provide theoretical and practical requirements for dog behaviour experiments. T Legou: expert on instrumentation and signal processing, will provide dedicated technical tools. AL Giraud: expert in the neurobiology of speech processing (incl. EEG) will provide corresponding theoretical and practical support. EEG material and vacations to cover dogs’ training will be partly provided by ALG funding and partly asked to ILCB. Although EEG in dogs is only minimally invasive, Ethics committee approval will be obtained prior to EEG measurements.

* **Expected candidate profile:** Basic knowledge in EEG (e.g. master training or more), interest in animal cognition, good contact with animals, very good French level.