

SNL 2023

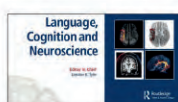
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Program

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discolor brain to create a white matter atlas. We are also mapping the connectivity of two cortical regions involved in social communication in P. discolor, the auditory and frontal cortex, via probabilistic tractography as previous research suggests increased and altered connectivity of such areas in vocal learners. To identify novel vocal-learning related regions in the P. discolor brain, we looked at the expression of a set of genes that show a unique pattern of expression in vocal motor brain regions in humans and songbirds. We hypothesize that these genes could guide us to vocal learning areas of interest in the P. discolor brain. Using immunohistochemistry, immunofluorescence, and in situ hybridization, we mapped the expression of 7 potential marker genes. This neurogenetic mapping revealed that these vocal-motor area marker genes are not dispersed uniformly across the P. discolor cortex, but are enriched and reduced in specific layers and cortical areas, highlighting candidate regions of homology that can be investigated further. Finally, we discuss how this study increased our knowledge of the structure of the P. discolor brain and how this can eventually help us better understand the neurobiology of vocal learning in all mammals, including humans.

Topic Areas: Animal Communication and Comparative/Evolutionary Studies, Speech Motor Control

fMRI evidence for phonetic detail-insensitive word processing in dogs

Poster D83 in Poster Session D, Wednesday, October 25, 4:45 - 6:30 pm CEST, Espace Vieux-Port

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Understanding words requires several processing steps, from the acoustic analysis of a series of sounds to accessing word meaning. While the capacity for certain prelexical processing steps from auditory stimuli, such as speech sound discrimination, is common among animals, evidence for the recognition of sequences of sounds and the understanding of their meaning is scarce in non-humans. Nevertheless, recent reports on dogs' lexical processing capacities suggested that even non-primate mammals may process higher-level information and advances in dog neuroimaging revealed remarkable similarities in how dog and human brains process speech. However, it is debated whether dogs have similar abilities to humans in accessing the phonetic details of words during lexical processing. While a behavioural study has suggested that dogs may attribute a meaning-changing role to a single speech sound in a word, an electroencephalography (EEG) experiment has found no evidence for that. It is also an open question whether the previously identified brain areas involved in lexical processing are sensitive to the phonetic details of words. The aim of the present study was to investigate phonetic sensitivity during lexical processing in the canine brain. Twenty awake, unrestrained dogs were presented with (1) instruction words (WORD), (2) phonetically similar (SIM, differing in only the first vowel) and (3) dissimilar nonsense words (NONW) during the experiment, while the elicited brain activity was measured using functional magnetic resonance imaging (fMRI). The animals were all trained previously to lie motionless in the scanner throughout the test using positive reinforcement. We found that certain auditory cortical brain areas previously found to be involved in the lexical processing of praise words (mid and caudal ectosylvian gyrus) responded stronger to instruction words than to dissimilar nonwords. However, the activity elicited by instruction words and phonetically similar nonwords did not differ in these regions. Furthermore, in a whole-brain analysis comparing the WORD and SIM conditions with the NONW

condition we also revealed a significant cluster outside the auditory cortex, extending to the mid cingulate gyrus, which in humans is associated with cognitive control and decision making during social interactions. These findings suggest the presence of lexical representations in dogs' near-primary and secondary auditory cortex not only for praise but also for instruction words, and reveal that these representations lack phonetic detail, corroborating recent electrophysiological evidence. Finally, the increased activity in an executive region to these instruction-for-action words may reflect that dogs could not only recognize speech sound sequences but also access word meanings.

Topic Areas: Animal Communication and Comparative/Evolutionary Studies, Speech Perception

Neural entrainment in dogs suggests human-analogue specialization in speech sound-category processing

Poster D84 in Poster Session D, Wednesday, October 25, 4:45 - 6:30 pm CEST, Espace Vieux-Port

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Human speech processing appears to depend on assigning different roles to consonants and vowels, with the former sound-category supporting the identification of word boundaries, while vowels provide information on grammar. To date few cross-species comparisons exist, but suggest that humans are uniquely constrained and inflexible in how consonants and vowels are utilized when novel speech input is processed. Dogs which have expanded into the manmade niche since more than 14000 years ago are known to occasionally learn words without explicit training, but it has not been examined if they are uniquely adapted to the perceptual properties of human language, which would include the special roles that consonants and vowels play in providing language with structure. We set out to test how dogs respond to artificial speech while their EEG is measured. Our goal was to observe how the segmentation of continuous sound-streams into words and syllables is affected by assigning different roles (across conditions) to consonants and vowels in providing affordances for structure. Three different speech-streams (one per condition) of 7 minute duration were constructed by concatenating nonsense artificial words, 750 ms long, from three syllables of 250 ms each. In the consonant condition, information about word boundaries was encoded in the consonant patterns, while in the vowel condition word boundaries were defined by vowel patterns. An additional control condition consisted of random syllables which did not form recurrent words. We present data from dogs which attended one condition each, analysing these results in a between-subject design. Using inter-trial coherence (ITC), an established EEG correlate of statistical learning and speech-stream segmentation, we show that in dogs entrainment to the recurrence frequency of syllables (4 Hz) and words (1.3 Hz) is higher when word-identities are defined by consonants as opposed to vowels. In the control condition ITC values were likewise low for 1.3 Hz, but for 4 Hz higher than in the vowel condition. The results suggest that dogs may possess a similar to humans specialization in how sound-categories are utilized when speech is processed. Work with other animals, although sparse, suggests that dogs' perception of speech-like sounds is affected by their proximity to humans. Syllable entrainment was uniquely suppressed during the vowel condition compared to both the consonant and control conditions. Considering that the conditions differed on the level of word

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