CORTICAL PROCESSING OF EMOTIONAL VALENCE AND INTENSITY IN HUMAN AND ANIMAL VOCALIZATIONS

Attila Andics[1,2], Márta Gácsi[1], Tamás Faragó[1], Anna Kis[1,3], Ádám Miklósi[1]

[1]MTA-ELTE Comparative Ethology Research Group, Hungarian Academy of Sciences - Eötvös Loránd University, Budapest, Hungary
[2]MR Research Center, Semmelweis University, Budapest, Hungary
[3]Comparative Behavioural Research Group, Institute of Cognitive Neuroscience and Psychology, Hungarian Academy of Sciences, Budapest, Hungary

attila.andics@gmail.com

INTRODUCTION

Emotional voice processing involves superior temporal sulcus (STS), inferior frontal cortex (IFC) and amygdala bilaterally [1,2], but their role is unclear.

Are emotional valence and intensity[3] coded separately in voice regions?

Are human and nonhuman (dog) vocal emotions processed similarly?

Are there hemispheric asymmetries for emotional voice processing?

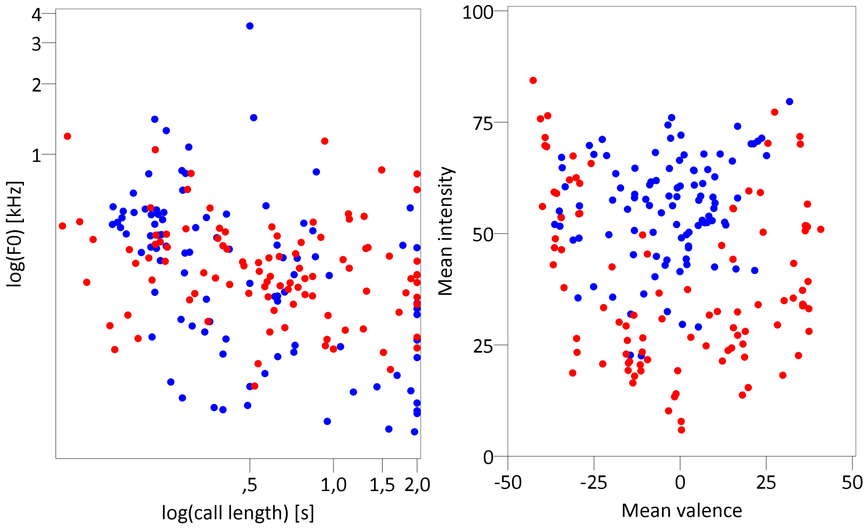
Right-hemisphere hypothesis: emotional processing is right-lateralized.
Valence hypothesis: POS and NEG emotions are left- and right-lateralized, respectively.[4]

METHODS

Participants. 22 human listeners (11 female; 12 dog owners)

Stimuli. 96 human vocalizations (nonlinguistic, emotional)
96 dog vocalizations (various contexts, emotional)
96 nonvocal sounds (familiar environmental)

Human and dog stimuli rated for perceived emotional valence and intensity



Design. 8-s-long blocks of 4 stimuli (all < 2 s) with similar perceived emotional valence
24 blocks per condition (human, dog, nonvocal and silence)
3 runs of 6 mins (35 volumes each), passive listening
Philips Achieva 3T, TR=10 s (2 s acquisition + 8 s silent gap)

Analysis. Standard preprocessing in SPM8
Group-level whole-volume random effects analyses
Parametric modulation analyses to test valence and intensity effects
ROI-based analyses for hemispheric asymmetry tests
Regions: spheres with a 10 mm radius around local maxima of human vs nonvocal
For amygdala: anatomical definition (wfupickatlas)

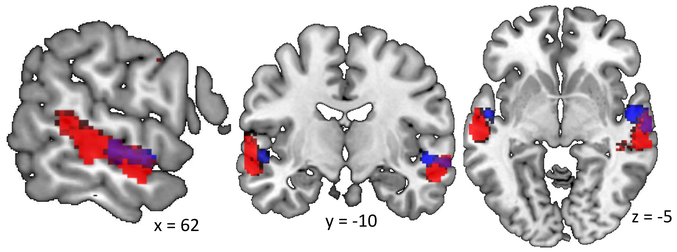
RESULTS

1. Perceived **emotional valence** of both human and dog vocalizations covaries with activity in bilateral STS (i.e., POS > NEG). p < .001 (uncorr)

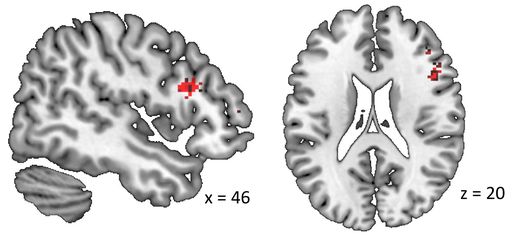
Valence effect, cluster peaks

Human	L STS	[-64 -14 -6]
	R STS	[64 -12 -12]
Dog	L STS	[-52 -18 2]
	R STS	[52 -6 -6]

FWE cluster corrected p < .05



2. Perceived **emotional intensity** of human but not of dog vocalizations covaries with right IFC activity (peak at [46, 16, 20]. p < .001 (uncorr)



3. **Hemispheric asymmetries** in the covariation of valence and regional activity

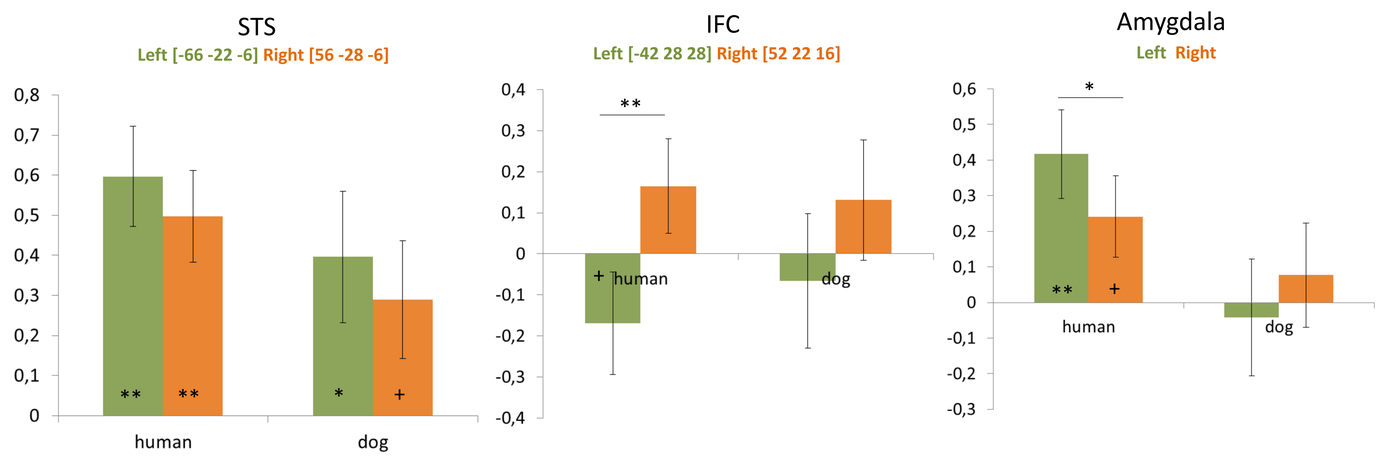
Covariation with valence (beta)

One-sample t-test per region (on bars)

Paired t-tests within region, between hemispheres (above bars)

**: p < .01, *: p < .05, +: p < .1

Error bars: S.E. of mean



CONCLUSIONS

- Emotional valence and intensity modulate distinct stages of the voice processing hierarchy
- The same neural network is used to process human and dog vocal emotional valence
- Valence-based lateralization effects differ across regions. More positive human vocalizations correspond to…
  …no lateralization in the STS …a rightward bias in the IFC … a stronger leftward bias in the amygdala

REFERENCES
[1]Fecteau et al. (2007) Amygdala responses to nonlinguistic emotional vocalization. Neuroimage 36:480–487
[2]Ethofer et al. (2012) Emotional voice areas: anatomic location, functional properties, and structural connections revealed by combined fMRI/DTI. Cereb Cortex. 22:191–200
[3]Russell et al. (1980). A circumplex model of affect. J Pers Soc Psychol 39:1161–1178
[4]Killgore & Yurgelun-Todd (2007) The right-hemisphere and valence hypotheses could they both be right (and sometimes left)? Soc Cogn Affect Neurosci. 2:240–250