

Haven't I heard your Voice before?

Same-Different-Categorisation of the Calls of Conspecifics in Pigeons

Paula Gerliz

Paula.Gerliz@ruhr-uni-bochum.de
Ruhr-University Bochum, Department of Biopsychology

Goals

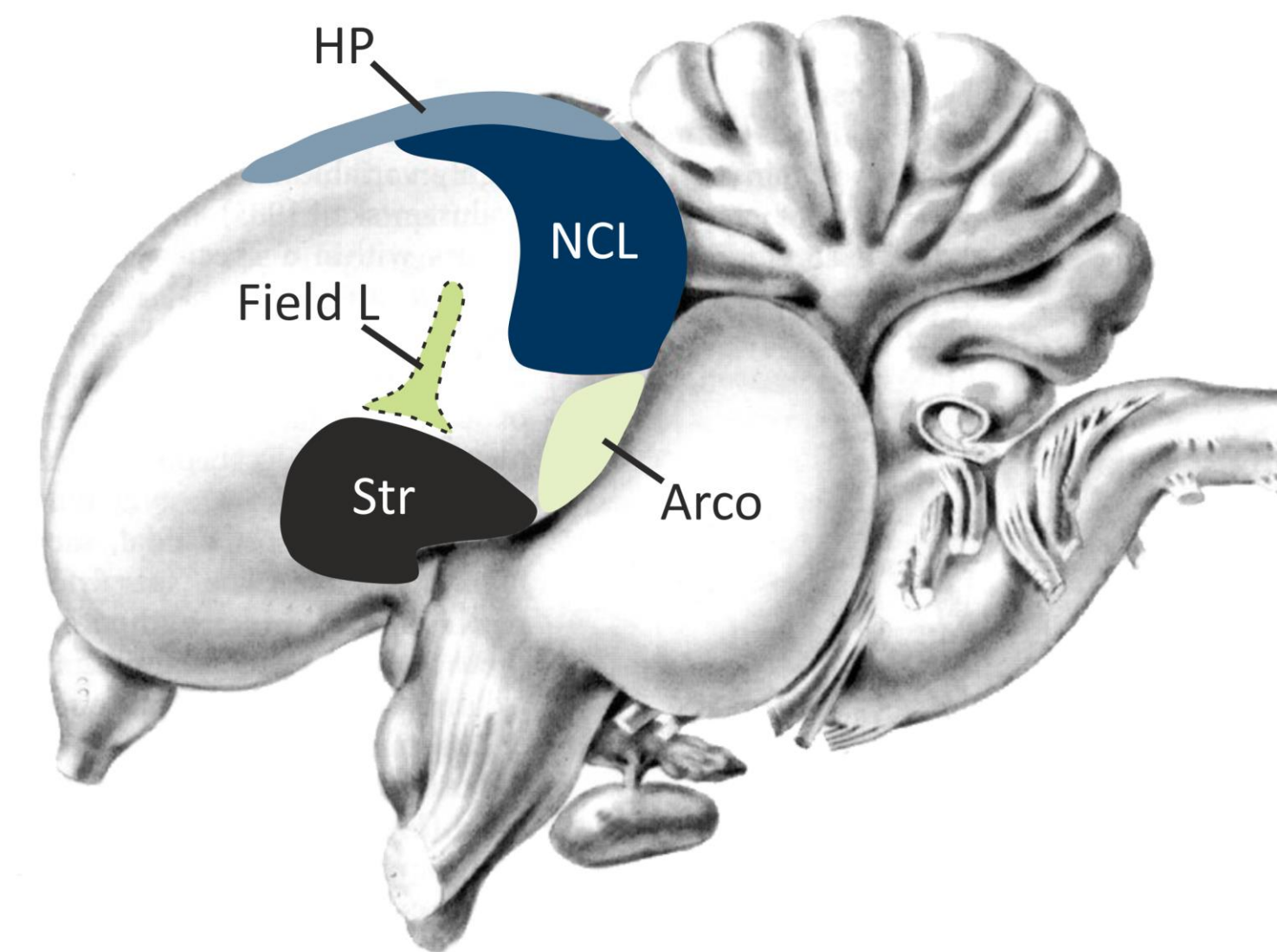
1. Can Pigeons discriminate the quality of social calls of conspecifics?
2. Can Pigeons discriminate the identity of a conspecific by its social call?
3. How does the activation in the pigeon's brain look like when the bird considers conspecific's social calls of different emotional valence?

Theory

- Pigeons have difficulties identifying conspecifics visually (Watanabe & Ito, 1990)
- Pigeons can discriminate sequences up to 12 sounds (natural or man-made; Cook et al., 2016)
- Same/different tasks can be solved by pigeons, however the results in this field are inconsistent (Diaz et al., 2021)
- MRI has not been used often in same-different-categorisation tasks in pigeons so far
- Head fixed pigeons in the MRI can still move their beaks (Behroozi, 2019)
- How could all of this look like in a same-different categorisation using pigeons' social calls?

Expectations

- Activation in the frontal brain, especially in the Nidopallium caudolaterale (NCL) → **Working memory, Decision making** (Atoji & Wild, 2009; Rose et al., 2009))
- Hippocampus (HP) + dopaminergic system (including striatal regions; Str) → **Reward-System** (Atoji & Wild, 2009)
- Trigeminal System, including Arcopallium (Arco), Striatum (Str), principal sensory tigrminal nucleus, nidpallium frontotrigeminale → **Beak movement** (Behroozi, 2019)
- Auditory field L, among other regions → **Auditory processing** (Rose et al., 2009)

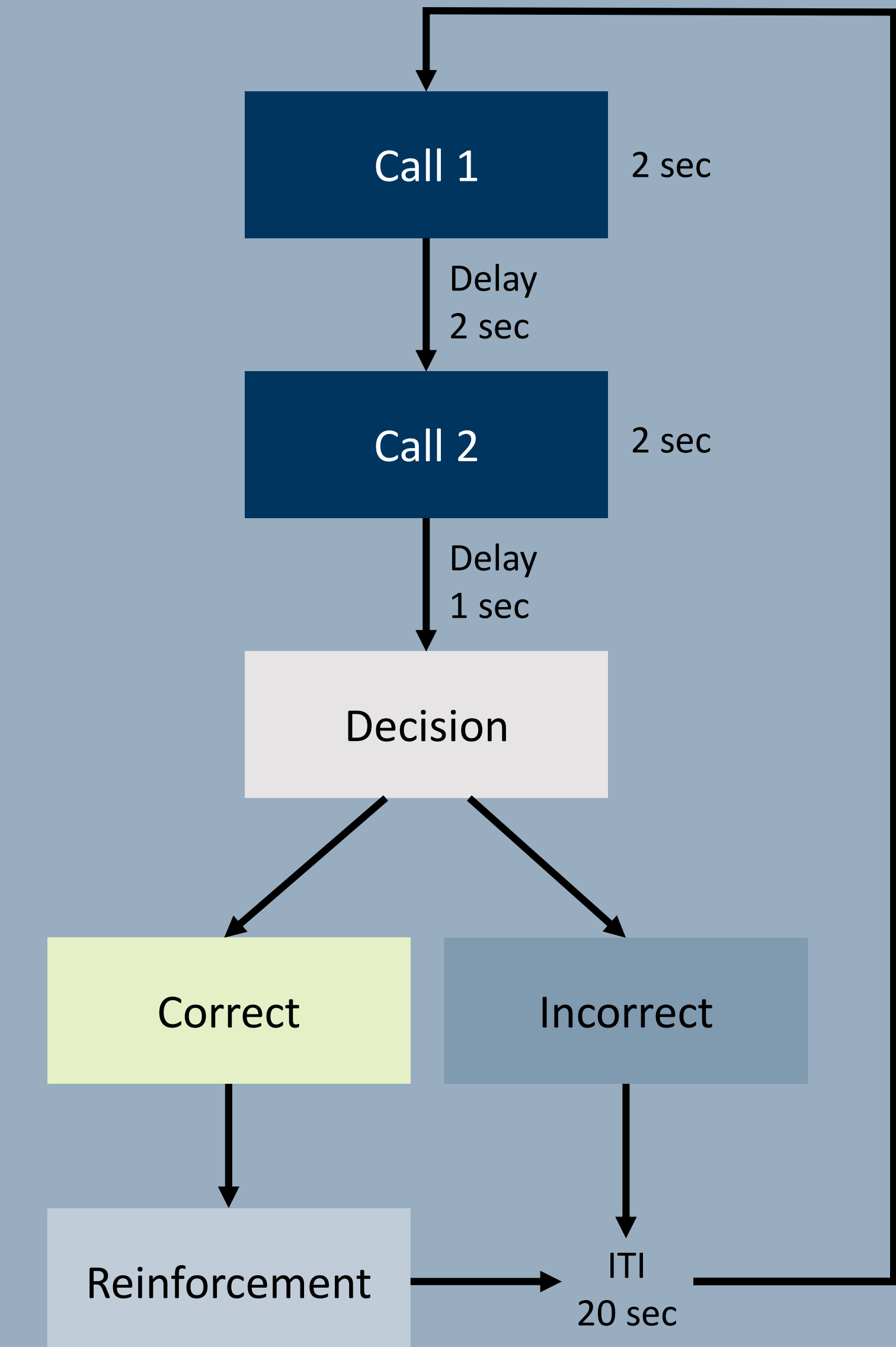


Regions in which activations during the experiments are anticipated. Depiction shows only the biggest regions. Figure is adapted from Kalenscher (2005).
HP Hippocampus, NCL Nidopallium caudolaterale, Arco Arcopallium, Str Striatum

Methods

- Preparations:**
 - Pigeons need to be operated on to allow for head fixation during MRI
 - In order for the conditioning to work, pigeons need to be water deprived
- Quality of stimuli:** courtship, aggression, identical individuals, different individuals
- Conditioning Trial:** The pigeon hears the call of a conspecific; after a short delay, the bird will hear a second call and needs to either open or close its beak (Diagram to the left)
 - The table below shows, how each of the four groups must react to each stimulus combination to be rewarded with a bit of water
 - Occurrence of stimulus combinations are randomised
- Beak movements are tracked with one camera, positioned on one side of the subject's head using **DeepLabCut-Live!** (DLC; Kane et al., 2020)
 - Used to track the pigeon moving its beak during initial conditioning to train a neuronal model
 - Camera runs during scanning; the live-feed is analysed in real time by the DLC-Model
 - Analysis of movement is done to reward the pigeon inside the scanner automatically through a tube with water, when the analysis is combined with MatLab where the script with the design will run
 - The model can also be used to compare whether the way a pigeon mandibulates differs from the stimulus combination it must react to
 - Video will be used to mark the exact times where the pigeon opens the beak

Conditioning Procedure



Combination of Stimuli and Groups

Stimulus compounds		Call 1	Aggression	Courtship	Aggression	Courtship	Aggression	Courtship	Aggression	Courtship
		Call 2	Aggression	Courtship	Courtship	Aggression	Aggression	Courtship	Courtship	Aggression
		Identity	Identical	Identical	Identical	Identical	Different	Different	Different	Different
Group	Follow Quality	Concordant	Correct	Correct	Incorrect	Incorrect	Correct	Correct	Incorrect	Incorrect
		Discordant	Incorrect	Incorrect	Correct	Correct	Incorrect	Incorrect	Correct	Correct
	Follow Identity	Concordant	Correct	Correct	Correct	Correct	Incorrect	Incorrect	Incorrect	Incorrect
		Discordant	Incorrect	Incorrect	Incorrect	Incorrect	Correct	Correct	Correct	Correct

Data Processing using FSL

1. Brain Extraction
2. Distortion Correction (depends on the scanner!)
3. Slice Timing/ Acquisition Correction
4. Motion Correction
5. Spatial Normalisation
6. Spatial smoothing

7. Level-1-Analysis
8. Level-2-Analysis using Double-Gamma HRF
9. Group Analysis

Statistical analysis using Nilearn

- Comparison of the four groups in a general linear model (GLM)



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