

# Human Interactivity & Language Lab

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2020/2021

# Lab members, students & collaborators



# Manifesto

**Cognition** is system's adaptation to environment.

**Communication** regulates interaction creating functional (distributed) systems.

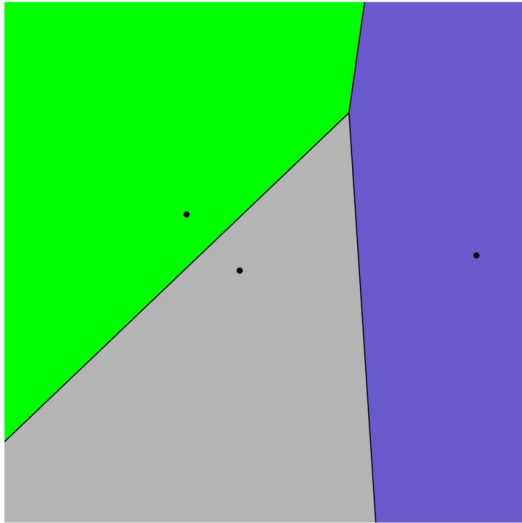
We study **physical, situated, embodied** and **value-laden** interactions of people with each other and with the world.

# Current projects

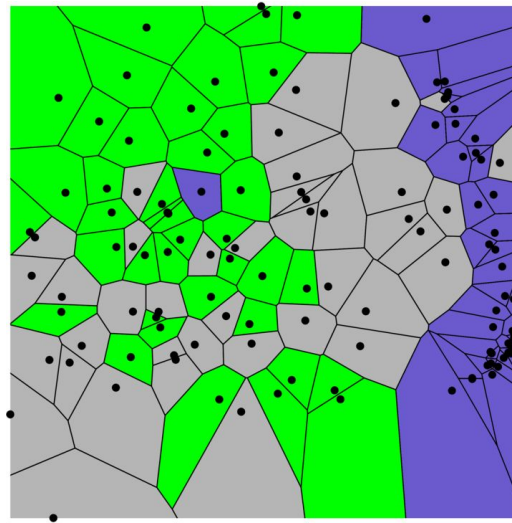
- Ecological models of categorization
- Early semantic development
- Parent-child coordination & social cognition
- Uhura: enriching communication of larynx amputees
- Symbol “un-grounding” models
- **NEW:** Communication in times of COVID-19

# Projects and datasets

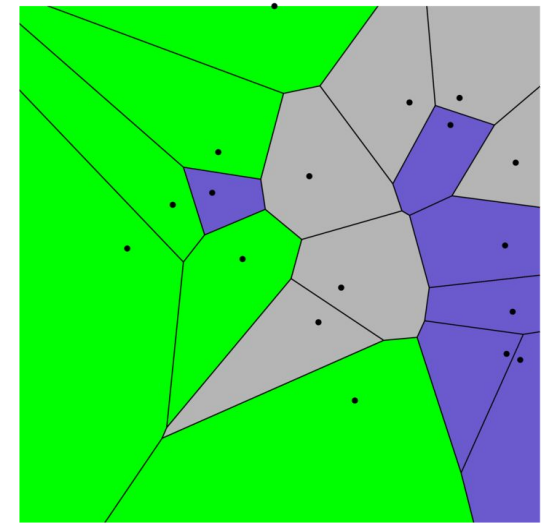
# Ecological models of categorization



Prototype model



Exemplar model

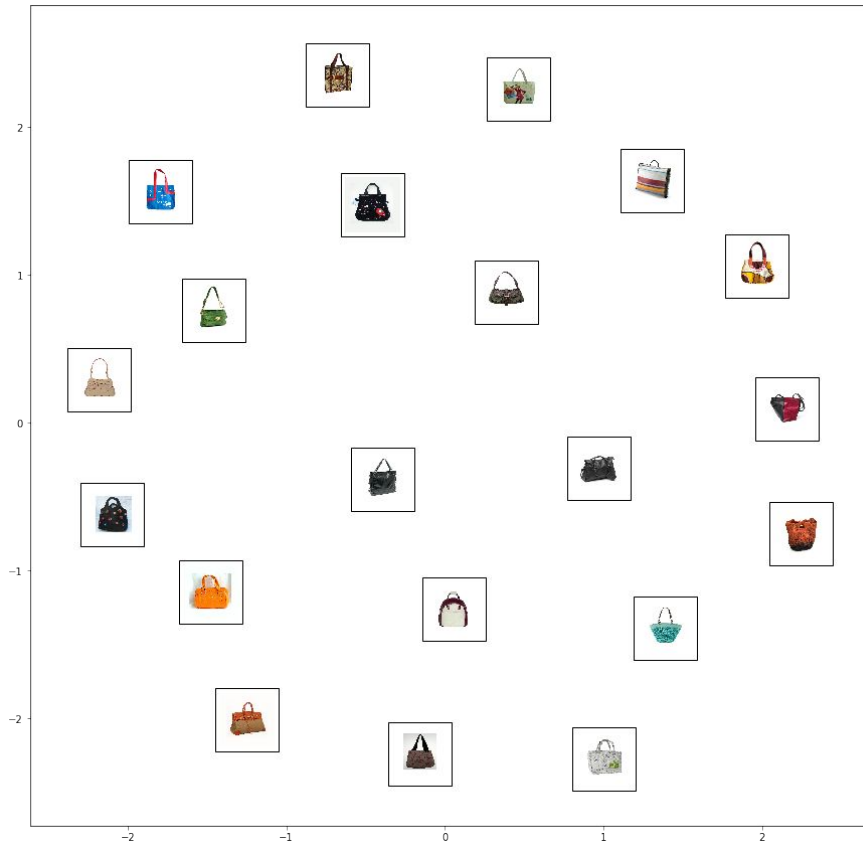


Adaptive model

Which objects from category are taken as reference?

- Typical?
- Surprising?
- Evenly spaced?

# Ecological models of categorization



## Data:

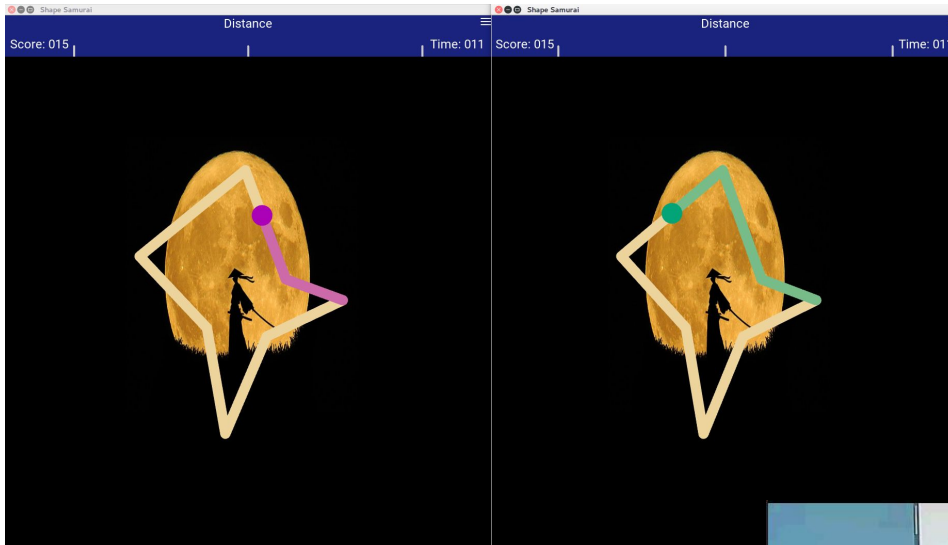
Perceptual similarity spaces of realistic objects (clothes, accessories, etc.).

## Questions:

- Contextual complexity of categories?
- Experience shaping categories?
- Task-dependent categories?
- Individual preferences?

# Parent-child coordination & social cognition

Collaboration with Arkadiusz Białek and Marta Białecką-Pikul (Jagiellonian University)



**Shape Samurai:** coordination game played on tablets

- Players trace particular shapes.
- They have to trace their shapes simultaneously.
- Shapes may be identical or different.

**Labyrinth:** coordinative puzzle made from ecological materials

- Natural play of child and parent.
- Rich interaction context.
- How movement coordination and social coordination are related?

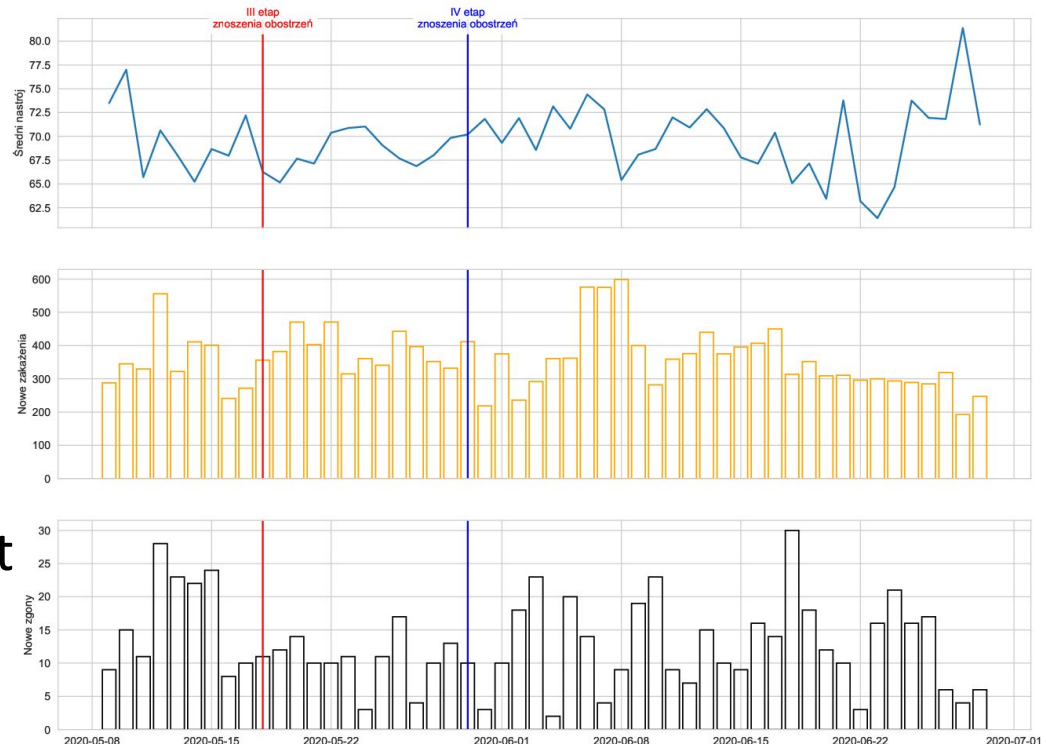


# Communication in the times of COVID-19

- During spring lockdown human interactions were greatly altered.
- Most of the communication occurred over electronic media.
- How the communication changes? How these changes affect us?

Rhythms of the Day -- mood, daily routines and communication routines.

Rhythms of Communication -- structure of verbal and non-verbal communication (text and audio-video).



# The Uhura Project

The aim of the project is to study interactions of larynx amputees in order to find a way to enrich the rehabilitation process and to better understand their communication.



We also investigate how wearable technologies and artificial intelligence could be used in a way that not replace, but support and augment natural human intelligence.



# Uhura Research: field studies

We are about to finish our ethnographic research. Case study of 9 laryngectomees consists of observation, individual in-depth interviews and shadowing sessions.



The results of this research changed our perspective from studying the voice loss only to studying the whole interaction and reminded us of the importance of the body as well.

# Uhura Research: interaction tests

We work on a process that will provide patients with the more aware and data-driven way of choosing their method(s) of communication to enrich the speech rehabilitation with its multimodal, personalized and context-dependent aspects.

- 1) choose of situations which quality are the most important predictors of one's overall quality of life,
- 2) observation and recording in natural environment,
- 3) measurement: laryngectomee and interlocutor(s) satisfaction,
- 4) participatory design recommendations.

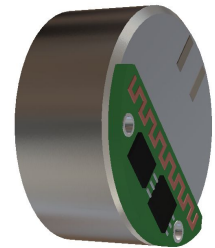
We are **looking for 1-2 students** interested in experimental psychology and/or user experience research.

# Uhura Technologies: wearable audio interface

We're going to start a project of our own system, convenient for laryngectomees, consisting of a microphone, a speaker, an amplifier and (optionally) a tiny earbud for listeners.



We are **looking for 1-2 students** with technical or engineering background and/or interested in user experience design of physical interfaces.



# Early semantic development

- NCN-DFG Beethoven 1 (with Katharina Rolfing and Iris Nomikou, Paderborn, Portsmouth).
- Two video corpuses (parent-infant interactions: diaper changing, peekaboo).
- Qualitative & quantitative analyses (behavioral coding, movement analyses, dynamical time series).
- Goal: language emergence in interaction, as coordination tool.



Contact

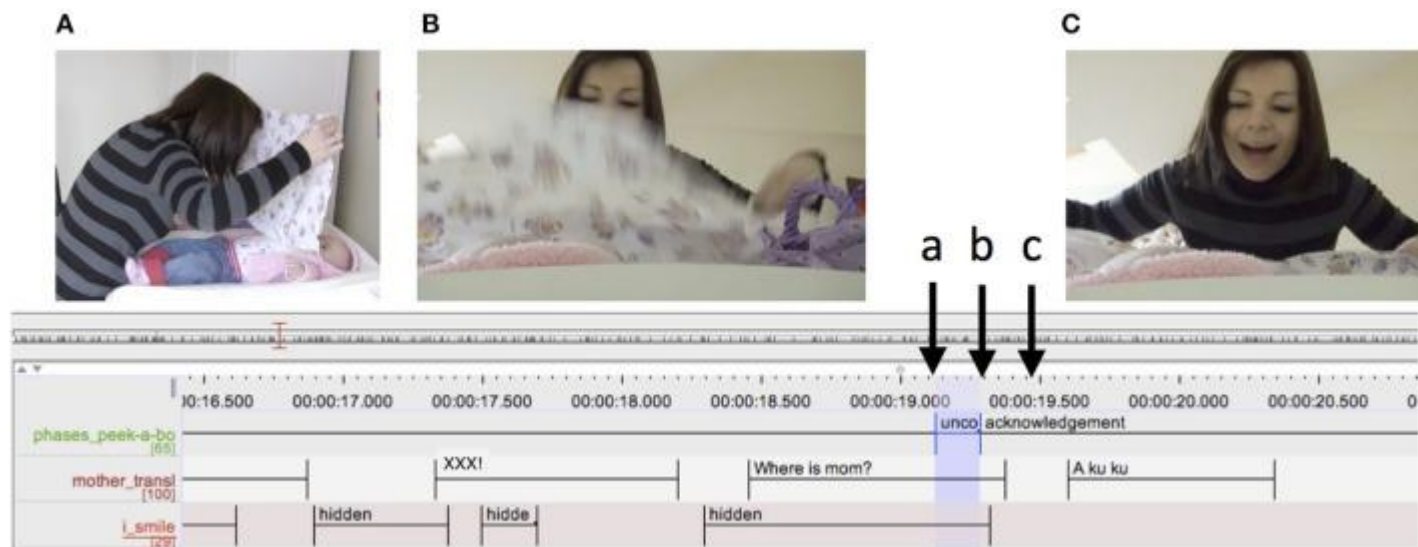


Disappearance

Appearance - Contact

# Early semantic development (continuation)

- Early dialogicity development.
- Is mother talking to infant “in dialogue” or “in monologue”?
- **NEW:** Gender differences in talking to infants (collaboration with prof. Anne Fausto-Sterling).
- Transcription of mother’s speech & infant’s vocalizations (current research labs K1 & K2) --> CLARIN\_pl



# Symbol “un-grounding” models

- Symbol grounding problem: how abstract symbols get their meaning? (Harnad, 1990)
- Symbol un-grounding problem: how physical signals being a part of real-time interactions can ever become abstract?

Classic C.S. Peirce’s semiotic framework:

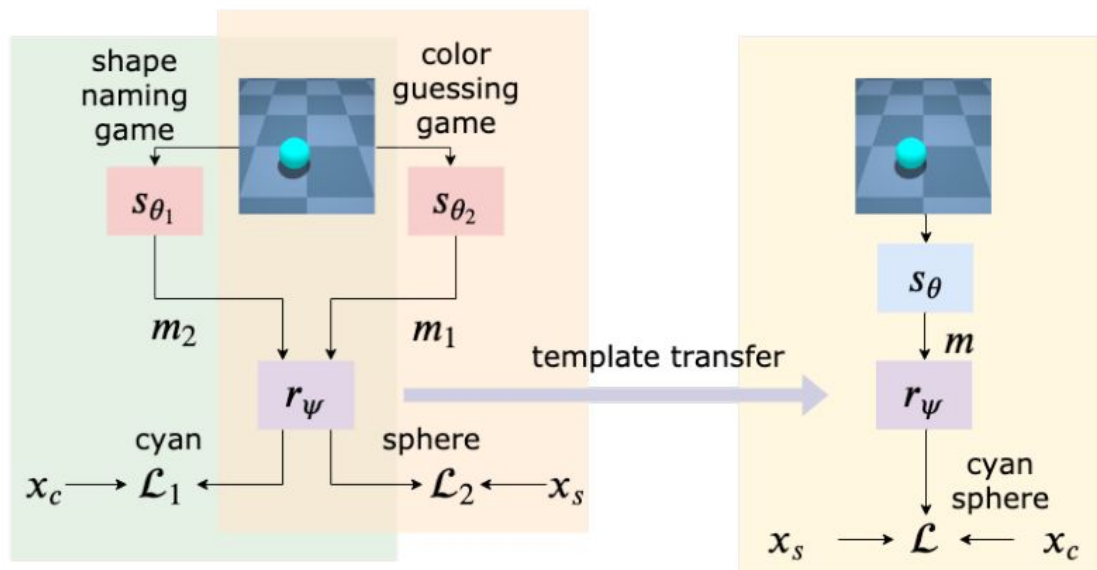
- Icons – meaning based on similarity
- Indices – meaning based on co-occurrence
- Symbols – meaning based on...?



Modern language development theory by T. Deacon.

# Symbol “un-grounding” models

- We are building computational models illustrating symbol emergence.
- Mostly interested in social dynamics of coordinated joint-action (using agent-based models).

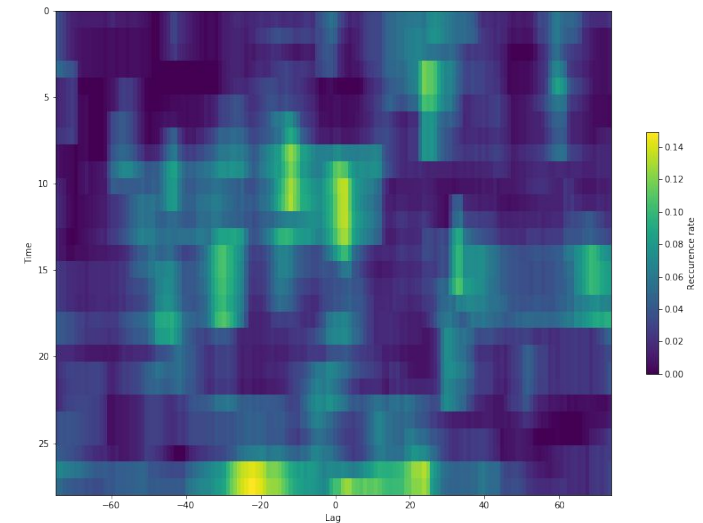
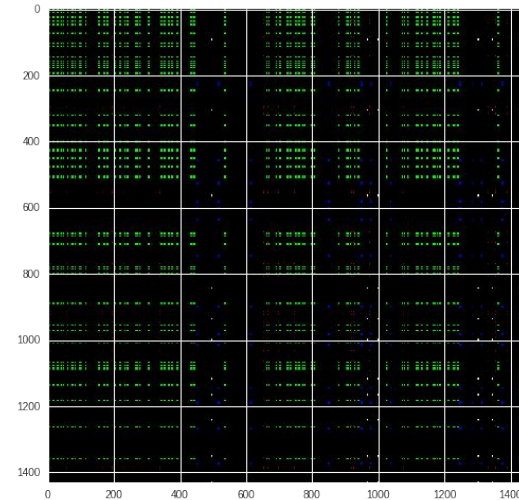


**Developmentally motivated emergence of compositional communication via template transfer.** Tomasz Korbak, Julian Zubek, Łukasz Kuciński, Piotr Miłoś, Joanna Rączaszek-Leonardi.

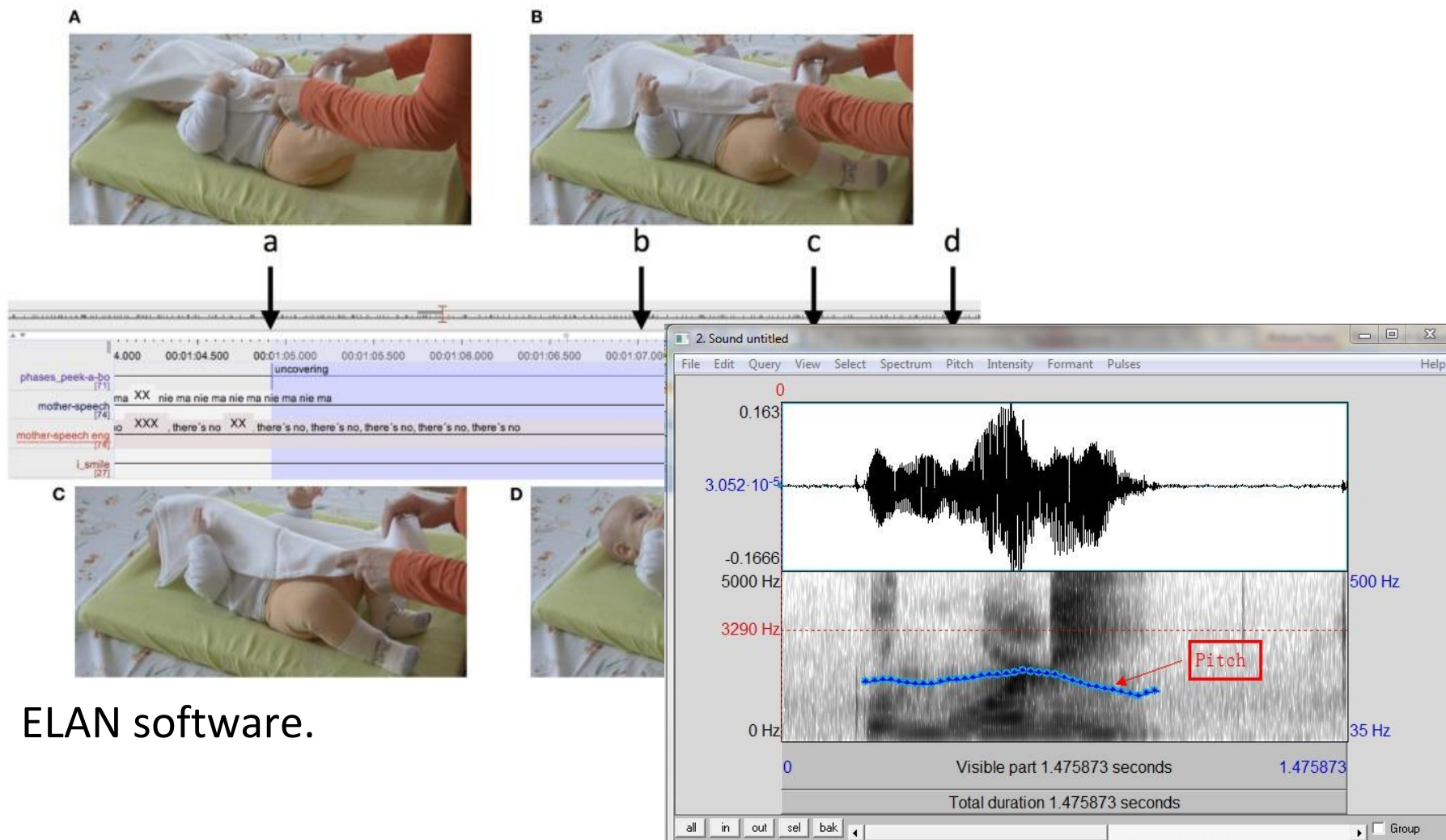
Tools, techniques, opportunities

# Diverse datasets and tools

- Intensive measurement of real-time interactive systems.
- Data: video recordings, interaction transcripts, material artifacts (notes), task performance, reaction times etc.
- Tools: software for behavioral coding (ELAN, Praat), movement analysis (frame-difference methods, motion tracking).
- Analytical techniques: qualitative, quantitative statistics (single and multilevel linear models), non-linear predictive modelling (machine learning), dynamical time series analysis (RQA, cRQA).



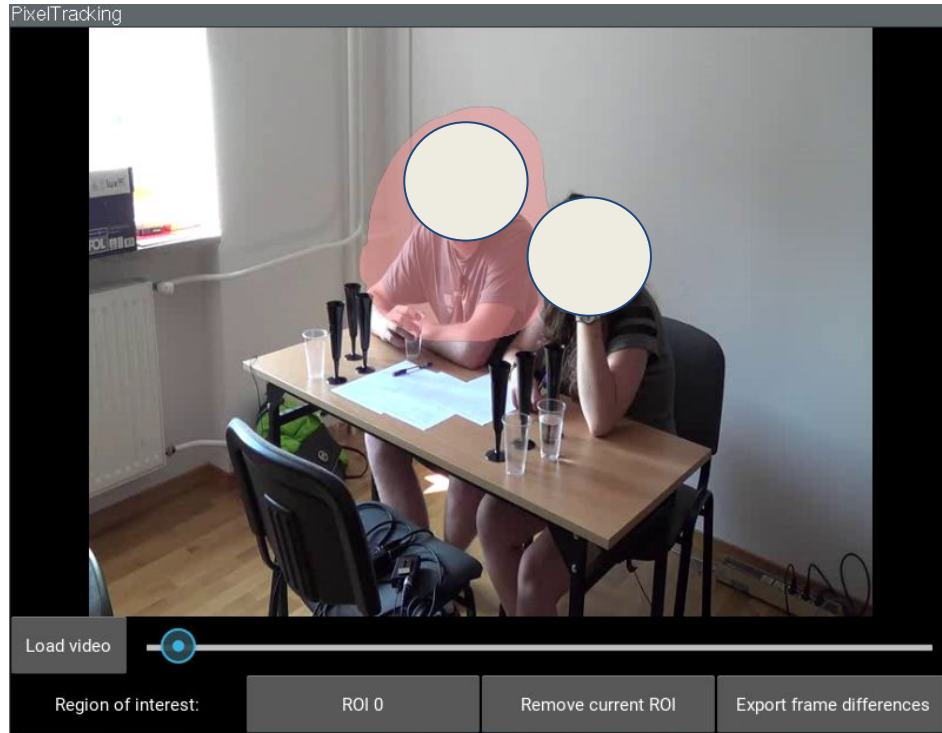
# Video and audio coding



ELAN software.

Praat software.

# Frame-difference movement quantification



Time series suitable for cRQA analysis.

Custom PixelTracking software:

[https://github.com/zubekj/pixel\\_tracking](https://github.com/zubekj/pixel_tracking)

# Agent-based models

- Reimplementing and studying existing models from symbol emergence perspective.
- Designing new models from scratch.

## Techniques:

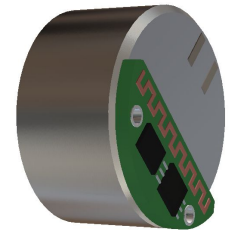
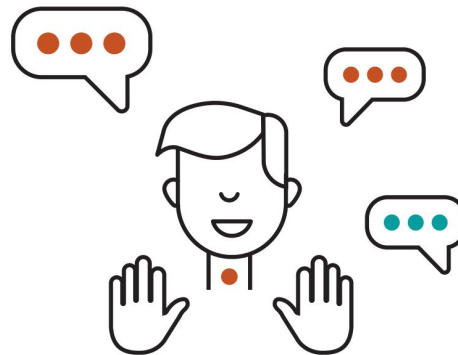
- Deep reinforcement learning.
- Genetic programming.

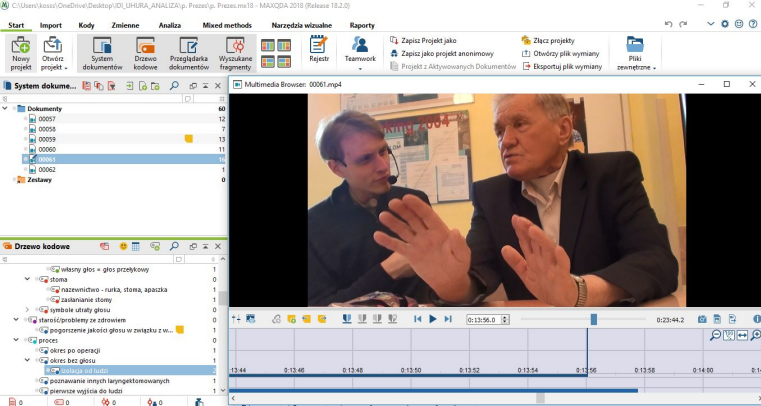


Possibility to embed models in e-puck 2 robots.

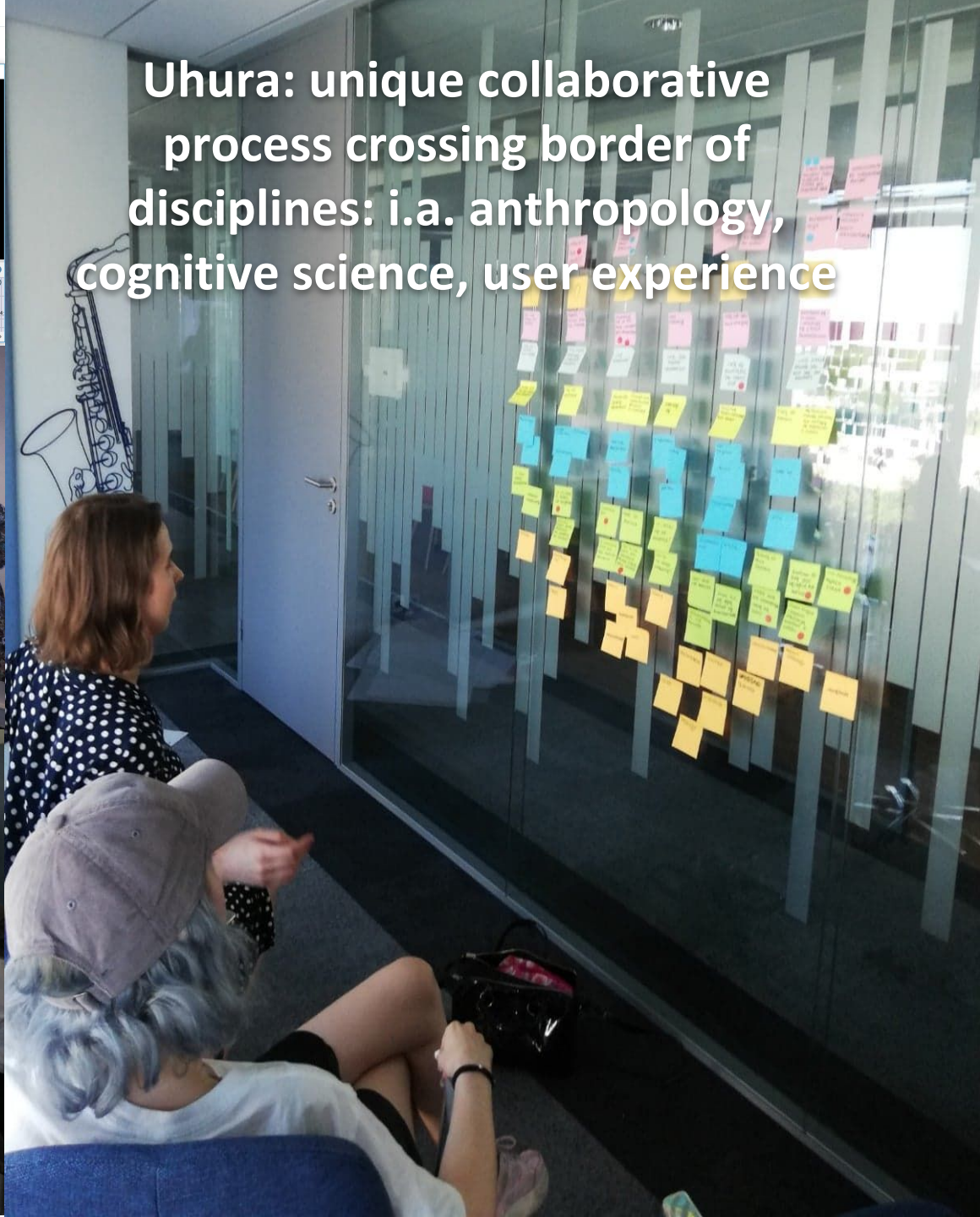
# Uhura: user experience design

The opportunity to design 3D models and build functional prototypes according to participatory design methodology






Uhura: unique collaborative process crossing border of disciplines: i.a. anthropology, cognitive science, user experience



# NEW: Watch out for the opportunities for collaboration within the Twinning Project

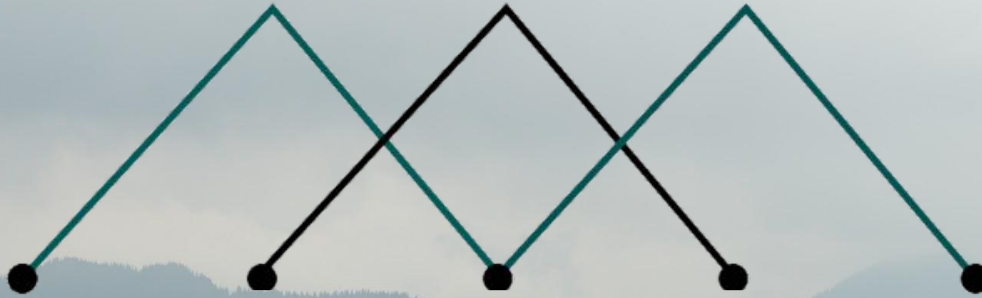
**New EU grant with HILL as coordinator!**



**TRAINCREASE – From Social Interaction to Abstract Concepts and Words: Towards Human-centered Technology Development** is aimed at strengthening the interdisciplinary field of research on the emergence, understanding and use of abstract concepts and words in human, and in human-machine interaction through the collaboration between the University of Warsaw, the University of Manchester, Sapienza University of Rome and Aarhus University.

Feb-March 2021: Calls for “Microtwinning” projects in collaboration with the 3 research institutions

HILL



# Bibliography, 1/2

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# Bibliography, HILL+K2 students papers

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2. Zieliński, Szamburski, Machnac. 2019. Post-laryngectomy interaction restoration system. *Companion Proceedings of 24th International Conference on Intelligent User Interfaces*. ACM.
3. Zieliński, Szamburski, Biernacka, Rączaszek-Leonardi. 2019. Field study as a method to assess effectiveness of post-laryngectomy communication assistive interfaces. *Companion Proceedings of 24th Int'l Conference on Intelligent User Interfaces*, ACM.
4. Korbak, T., Zubek, J., Kuciński, Ł., Miłoś, P., Rączaszek-Leonardi, J. „Developmentally motivated emergence of compositional communication via template transfer”, *NeurIPS 2019, 3rd Workshop on Emergent Communication*, Neural Information Processing Systems Foundation, 8-14.12.2019, Vancouver, Kanada
5. Główna, Niklewski, Wiszowata, Korbak, Rączaszek-Leonardi, Zubek (2020). The Emergence of Action-grounded Compositional Communication. Poster at Cognitive Science Society Conference.

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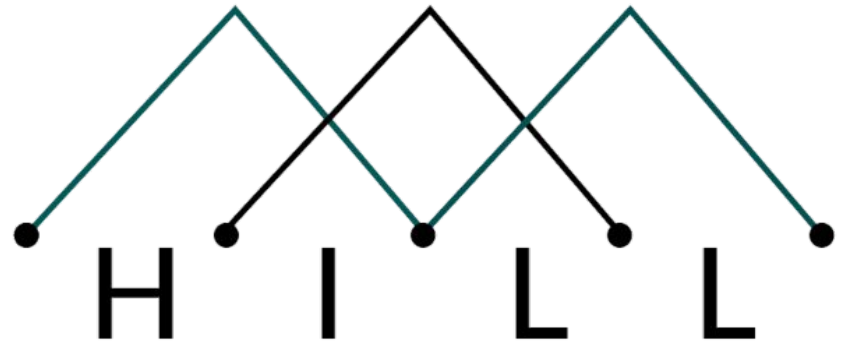
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