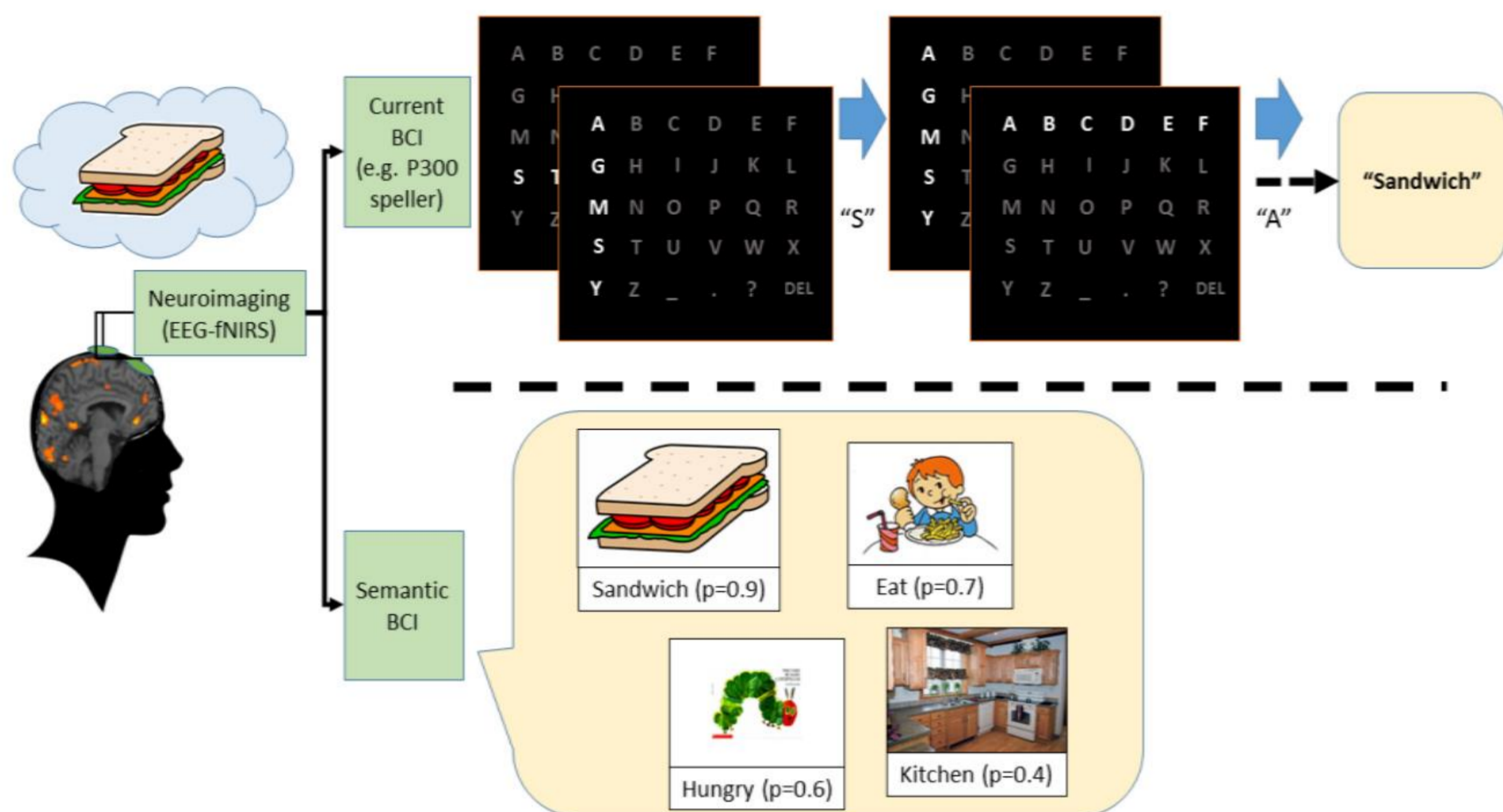


Towards intuitive brain-computer interfaces for communicating concepts

Milan Rybar, Ian Daly, Riccardo Poli

Semantic BCIs

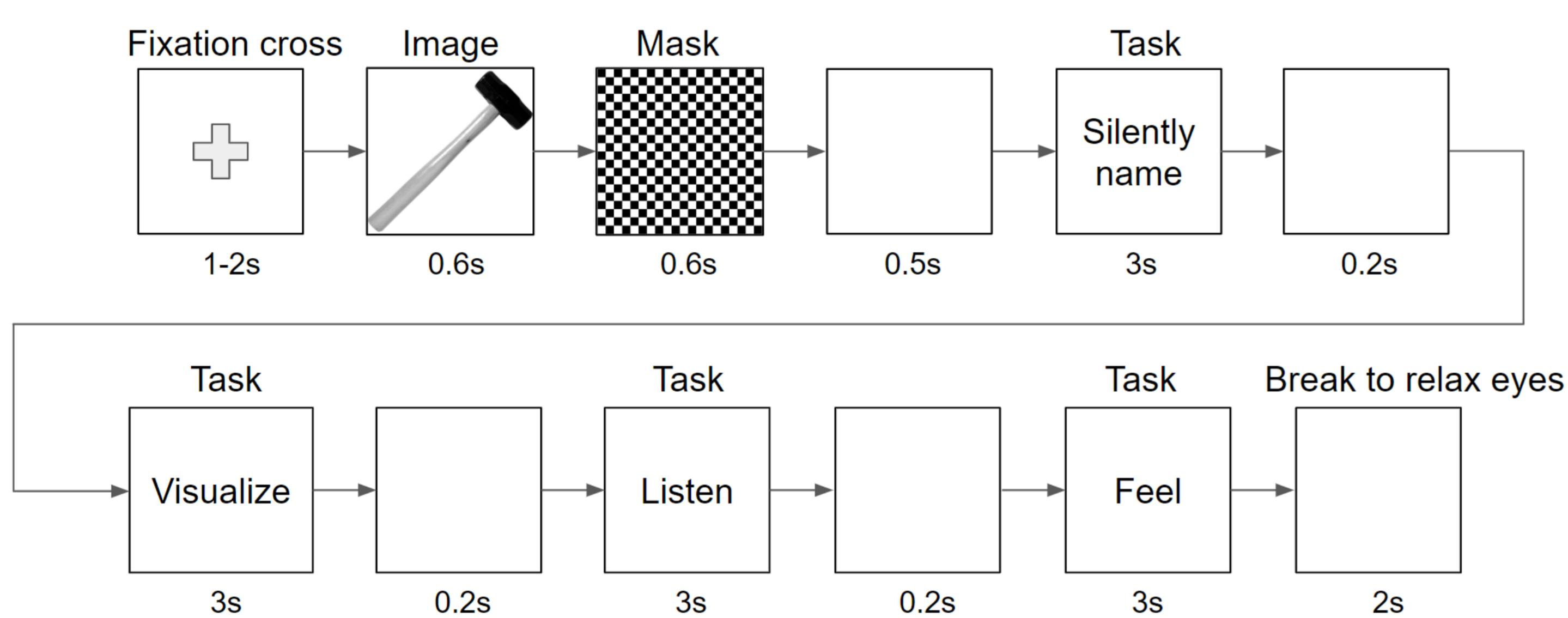
- Brain-computer interfaces (BCIs) provide an alternative pathway between a human brain and external devices.
- BCIs based on identifying activity in the brain related to semantic concepts have the potential to be highly intuitive and allow greater levels of accuracy and communications speed in comparison with current BCIs.



- We present our ongoing study to discriminate between animals and tools using the simultaneous recording of electroencephalography (EEG) and functional near-infrared spectroscopy (fNIRS).
- Most tasks from prior semantic neuroimaging research are not usable for BCIs.

Experimental design

- Images of animals (18) and tools (18)
- 90 trials per category (each item is shown 5x)
- Participants: English native speakers, right-handed, 18+



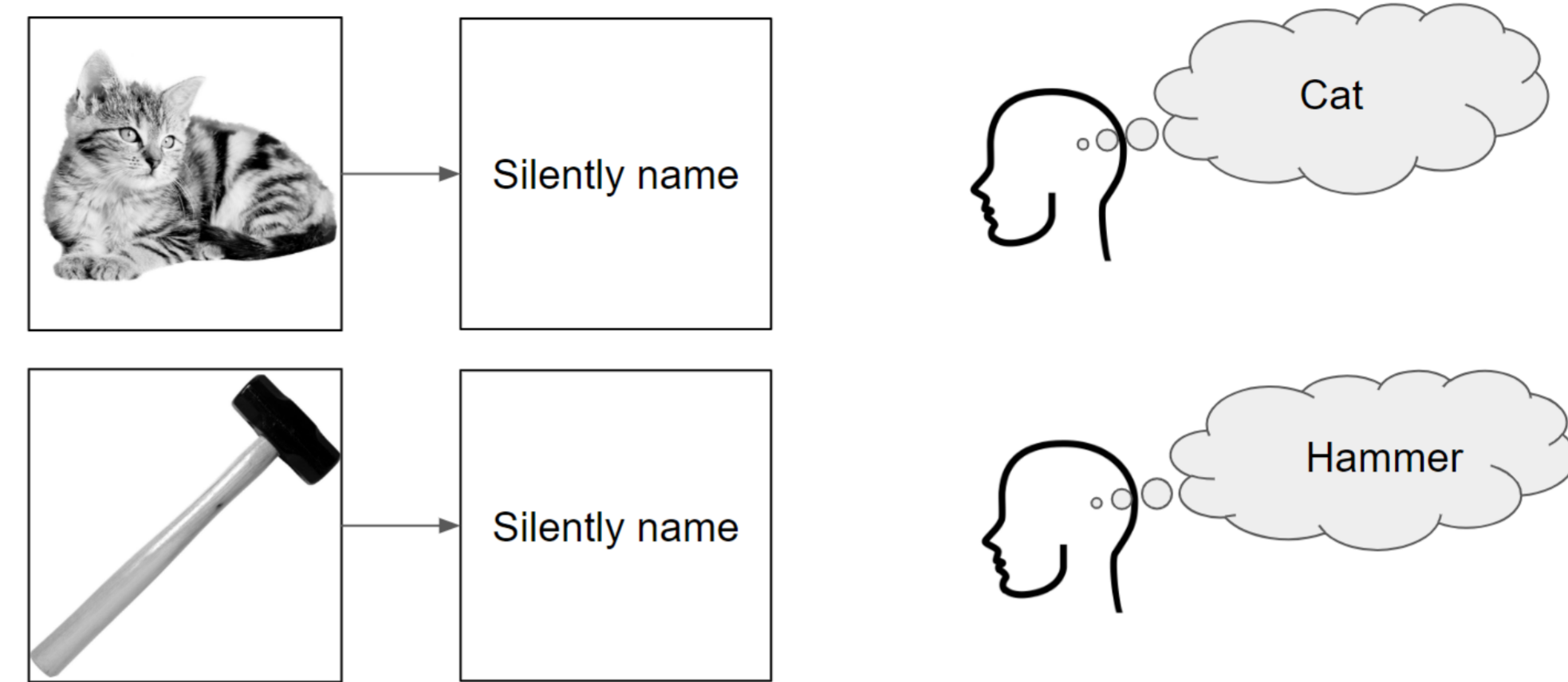
Research questions

- Can we classify semantic concepts using our tasks?
- Which sensory-based task achieve highest accuracy?
- Would a multi-sensory task induce more differentiable neural activity?
- Can the combination of fNIRS and EEG improve accuracy?

Tasks

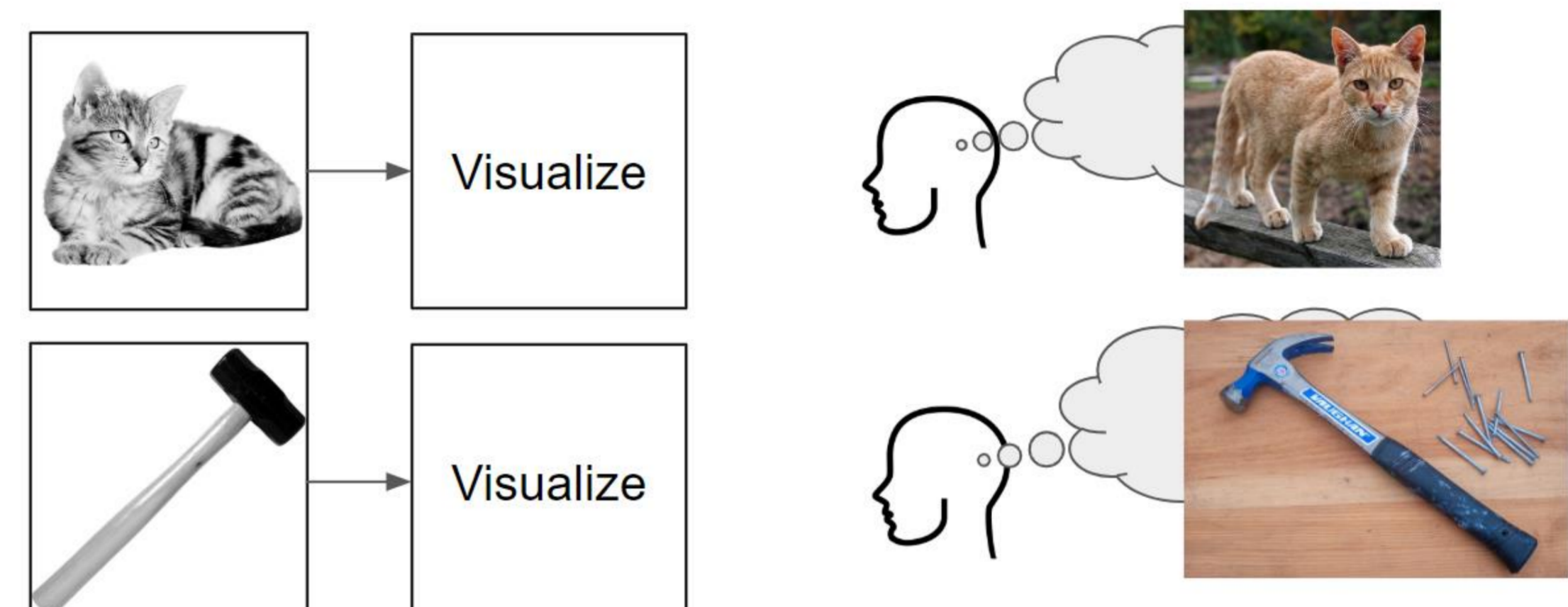
Silent naming task

- Name the presented object in your mother tongue



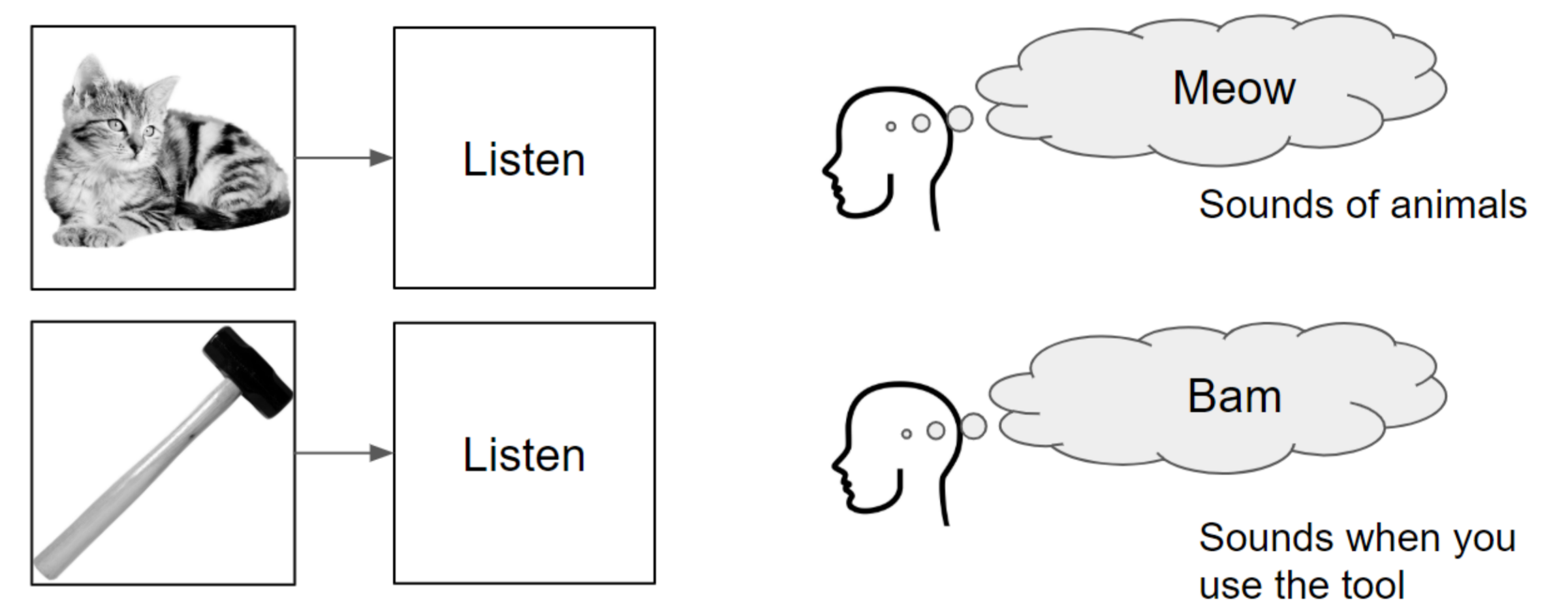
Visual imagery task

- Visualize the presented object in your mind
- Try not to visualize the particular image but rather what you visualize under the presented concept



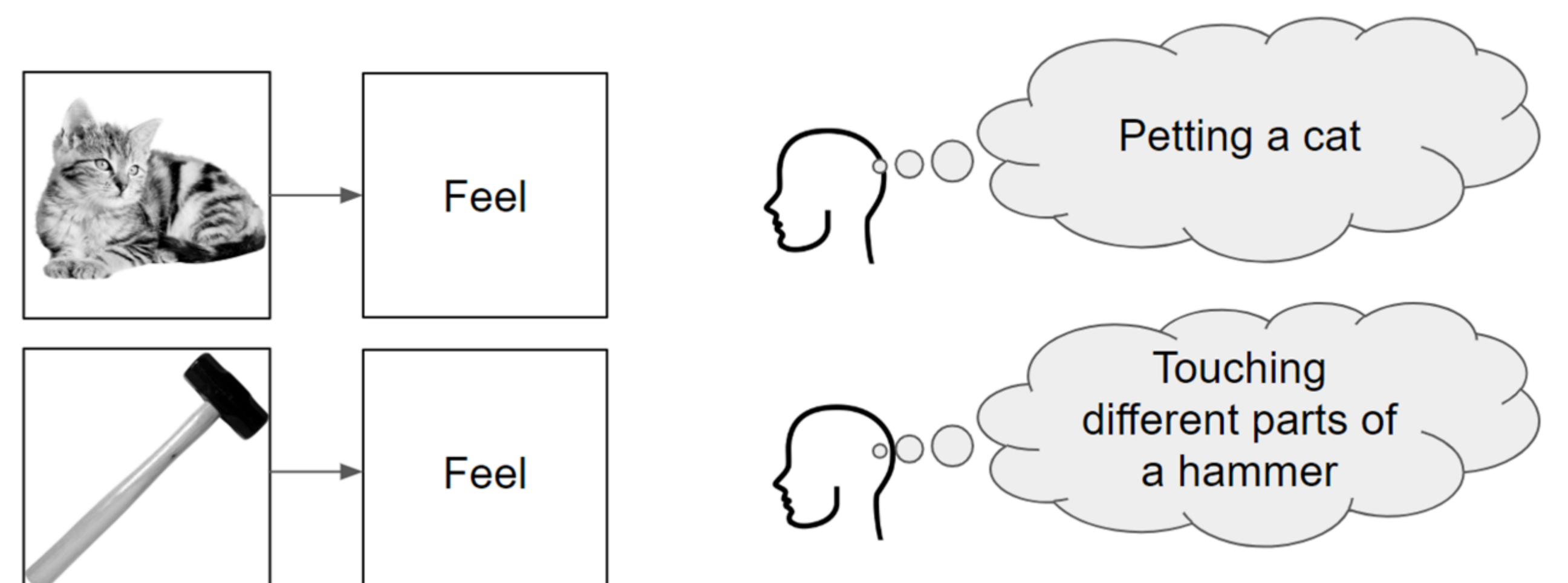
Auditory imagery task

- Imagine sounds made by the presented object
- What do you hear when you interact with the object?



Tactile imagery task

- Imagine feel of the presented object
- What do you feel when you touch the object?

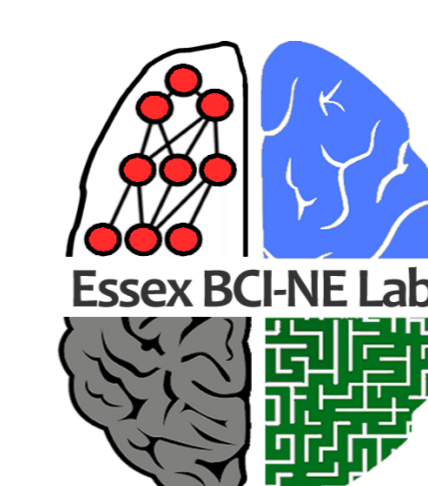


Can you imagine it for all items?

- Animals: bear, cat, cock, cow, crab, crow, dog, donkey, duck, elephant, frog, lion, monkey, owl, pig, sheep, snake, tiger
- Tools: axe, bottle-opener, broom, chain saw, computer mouse, hammer, hand saw, kettle, computer, keyboard, knife, microwave, pen, phone, scissors, shovel, toothbrush, Hoover, corkscrew

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