

Summary talk Kim:

I focus in my part of the presentation on the semantic language network of the human brain, and particularly on semantic retrieval processes in language production.

Despite many open questions in the neuroscience of language, we know that hemispheric specialization (lateralization) is especially relevant in the fronto-parietal network for higher thought and language in the human brain. This newest part of the cortex (heteromodal association cortex) has developed with language. We argue that by this individual “specialization” of information processing that is achieved in language and thought processes, there is an infinite level of individuality in the human brain (“mind”), enabling us to generate new concepts. Here, we see the basis of free will as free thought process.

During overt speech production, specific (semantic) retrieval processes are required to assess concepts in “verbal/semantic memory”. Using functional brain imaging (fMRI), we aimed to assess the neural correlates of causal, semantic and phonological retrieval during continuous single word production. MRI is useful to investigate such task-related effects (i.e. semantic retrieval, compared to non-semantic, i.e. phonological, stimulus-driven response to the same cue word).

During word production, semantic retrieval evokes neural activity in left lateralized frontal (Broca) and posterior (Angular gyrus/parietal lobe) cortex regions (“the semantic network”). This retrieval process is most of the time automatic and non-explicit (i.e. “embodied” concepts are evoked when we speak). However, humans necessarily also have a concept of causality at an abstract (cognitive) level of representation (concept processing). Every relation that has itself a meaning (so, every relation that is also a “concept”, and not only an association) can be described using the words if-then. Which neural processes underlie causal aspects of retrieval during language is widely unknown. We found distinct neural activity for causal word retrieval compared to free semantic association in the left middle frontal gyrus while fewer words were generated per time. This supports the hypothesis, that metacognitive processes for the retrieval of meaningfully (causally) related concepts require more energy due to higher explicitness when we think/reflect.