Simulation and mental imagery of complex events: differences and communalities.

Franziska Hartung * [1], Peter Hagoort [2,3], Roel Willems [3,4]

[1] Max Planck Institute for Psycholinguistics (MPI for Psycholinguistics) – Wundtlaan 1 6525 XD Nijmegen The Netherlands, Netherlands
[2] Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour – Netherlands
[3] Max Planck Institute for Psycholinguistics – Netherlands
[4] Donders Institute for Brain, Cognition and Behaviour – Radboud University Nijmegen – P.O. Box 9101 6500 HB Nijmegen The Netherlands, Netherlands

How do our brains construct a narrative when reading fiction? The nature of mental representations, e. g., when comprehending language is a highly debated issue. Despite sometimes being considered controversial, effects of mental simulation are a robust and frequent finding in neuroimaging and behavioral research. Yet, which underlying processes those effects reflect is a matter of dispute. It is often assumed that simulation is a reduced form of mental imagery. However, experimental evidence suggests that imagery and simulation do not necessarily recruit the same brain regions (Willems et al 2009).

It is reasonable to assume that simulation plays a relevant role in language comprehension at the discourse level, where more complex information needs to be integrated in order to construct situation models. Moreover, contextually embedded information is likely to decrease variance between subjects in event representations, e.g. throwing without context can activate very different action representations, while throwing a dart or throwing a tennis ball reduces the probability that subjects activate different types of events. Especially stories seem to be highly appropriate to test simulation in language comprehension, as they promote situation model construction and deep-level processing while warranting adequate similarity across individuals.

In the present study, we used functional MRI to investigate simulation during natural listening to literary stories compared to mental imagery in 1st and 3rd person perspective. First, subjects (N=60) listened to two literary stories without a specific task. Then, they listened to the stories again and were asked to 'imagine being the main character' (1st person imagery) and 'imagine being an uninvolved observer' (3rd person imagery) in two subsequent runs. A baseline condition with unintelligible speech was used to subtract irrelevant activation for all conditions in the data analysis. The order of tasks was counterbalanced across participants. In the analysis, we used an event related design with action and mentalizing events as canonical examples of simulation to compare brain activations in natural comprehension with imagery.

The results show partial overlap of the brain regions activated in simulation and imagery. Listening shows recruitment of additional areas in frontal and temporal regions compared to the two imagery tasks, whereas activation patterns during mental imagery averaged across perspective are to a large degree included in the network active when subjects listen to a story without task. Looking at 1st and 3rd person perspective imagery separately reveals a more differentiated

---

*Speaker

picture: 1st person imagery shares substantial overlap in activation with listening, whereas in 3rd person imagery temporal regions are less pronounced and additional left posterior middle frontal regions are recruited. Comparing the two imagery conditions confirms this finding that 1st person imagery is more associated with temporal regions while 3rd person imagery is more associated with posterior middle frontal regions in story comprehension.

Our results give evidence that simulation in language processing partially overlaps with mental imagery. Simulation during natural story comprehension shows a more global network distribution whereas imagery tasks recruit specific areas. Moreover, participants seem to prefer 1st person perspective when engaging with stories without task requirements.