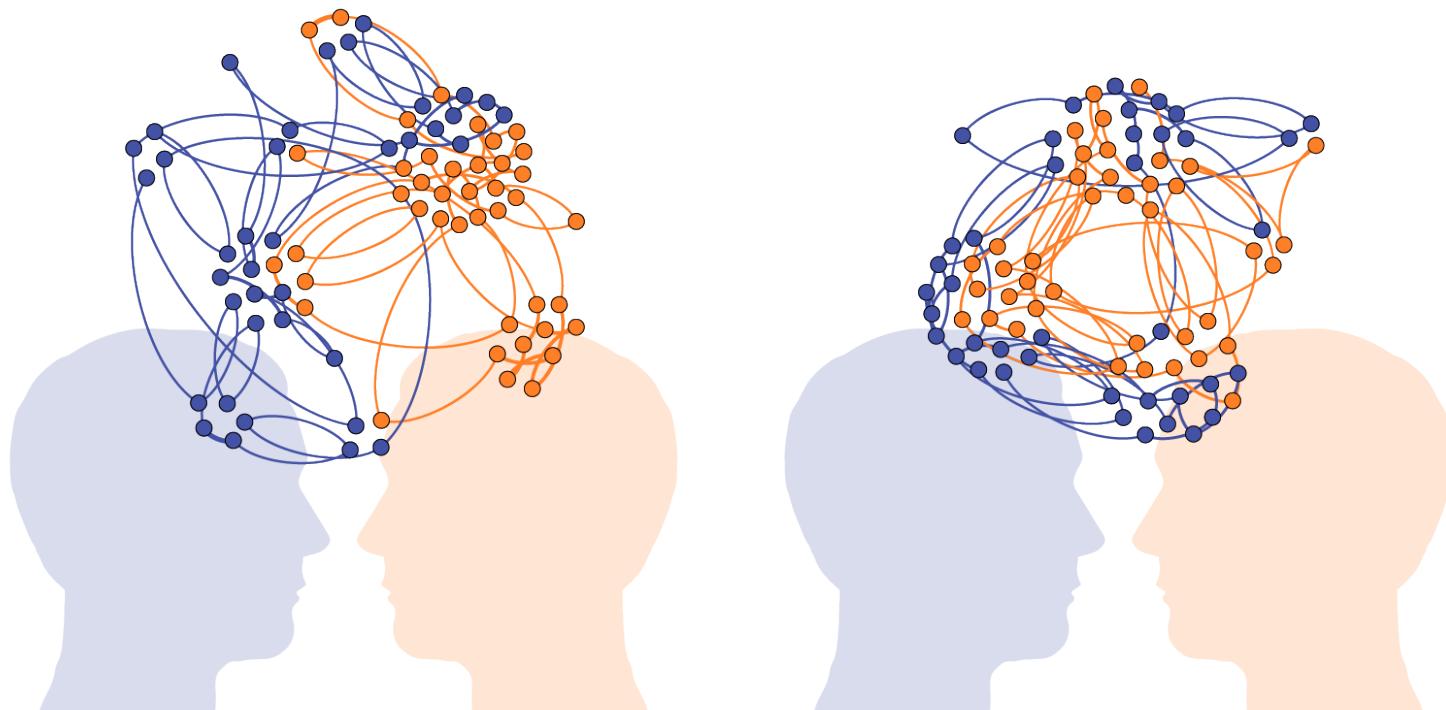




What do we share?



# Shared Conceptual Spaces I



## 1. Theoretical framework

Building a shared conceptual space

## 2. Neural predictions

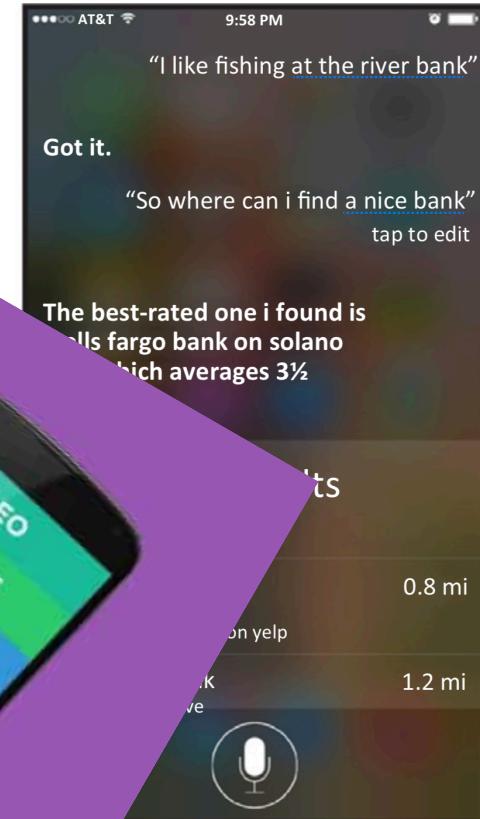
Neural activity supporting shared conceptual spaces

## 3. Neuroscientific evidence

MEG, TMS, and lesion studies

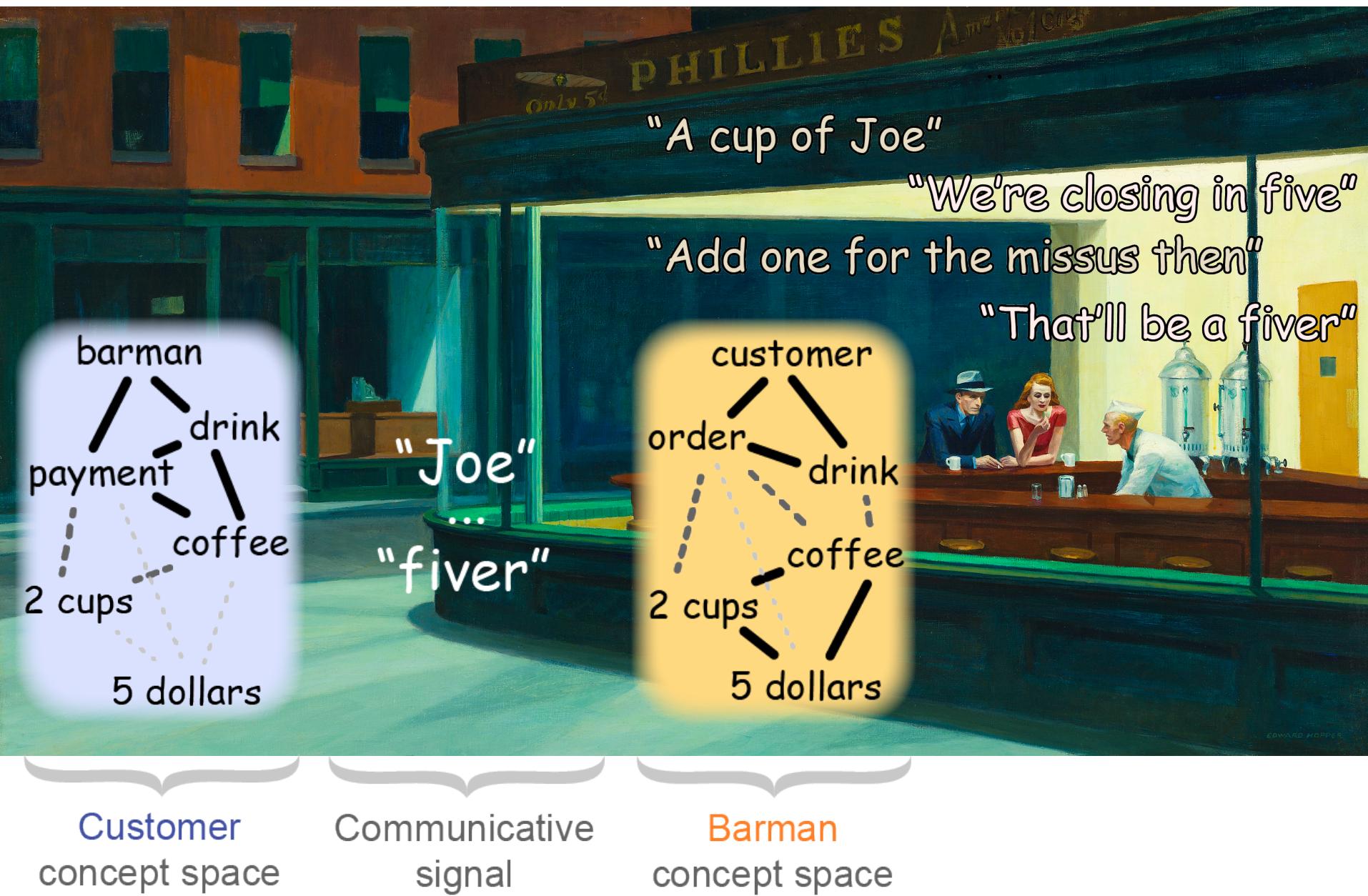


**BBC**  
NEWS  
5 July 2013 Last updated 10:00 BST  
Human  
museum  
Honda's pop  
with gesture rec  
museum guide at the  
museum in Tokyo.  
The machine struggled to differentia  
museum-goers raising their hands to a  
question and raising their hands to take ph  
Associated Press reported.  
It is "working" as a tour guide at the museum for  
the next four weeks as a trial.



# Problem: You determine the context?

# Solution: We build a shared conceptual space?



## 1. Theoretical framework

Building a shared conceptual space

## 2. Neural predictions

Neural activity supporting shared conceptual spaces

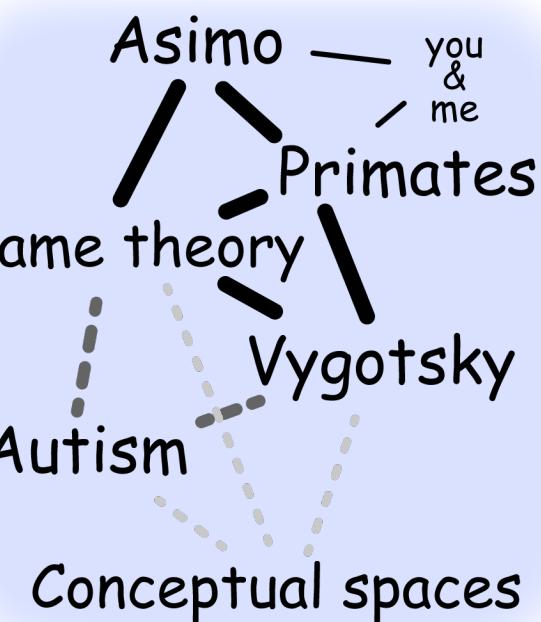
## 3. Neuroscientific evidence

MEG, TMS, and lesion studies



# 4 predictions of neural activity supporting shared conceptual spaces

1. Achieving mutual understanding should evoke neural activity reflecting flexible conceptual processes, in regions known to support conceptual knowledge
2. There should be shared patterns of neural activity during communicative production and comprehension given that these processes relate to the same conversational context
3. The timing of this shared neural pattern should not follow the occurrence of a communication signal given that the conceptual space is defined by the ongoing communicative interaction rather than the signal itself
4. The temporal dynamics of the shared conceptual space should reflect the communicators' adaptation to the shared conceptual space



## 1. Theoretical framework

Building a shared conceptual space

## 2. Neural predictions

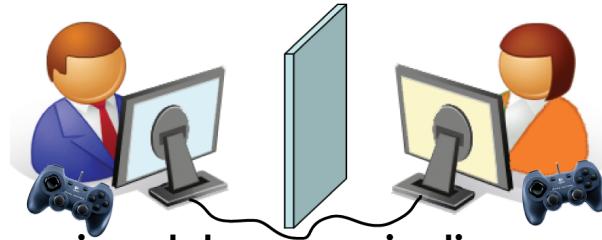
Neural activity supporting shared conceptual spaces

## 3. Neuroscientific evidence

MEG, TMS, and lesion studies



Natural dialogue



Experimental communication

## *What's different?*

Multiple communication channels  
(vocalizations, bodily and facial postures/movements, eye contact)

Access to pre-existing conventions  
(a common language, body emblems, facial expressions)

Spontaneous turn-taking

Single communication channel  
(movements of a geometric shape:  
experimental control over communicative environment)

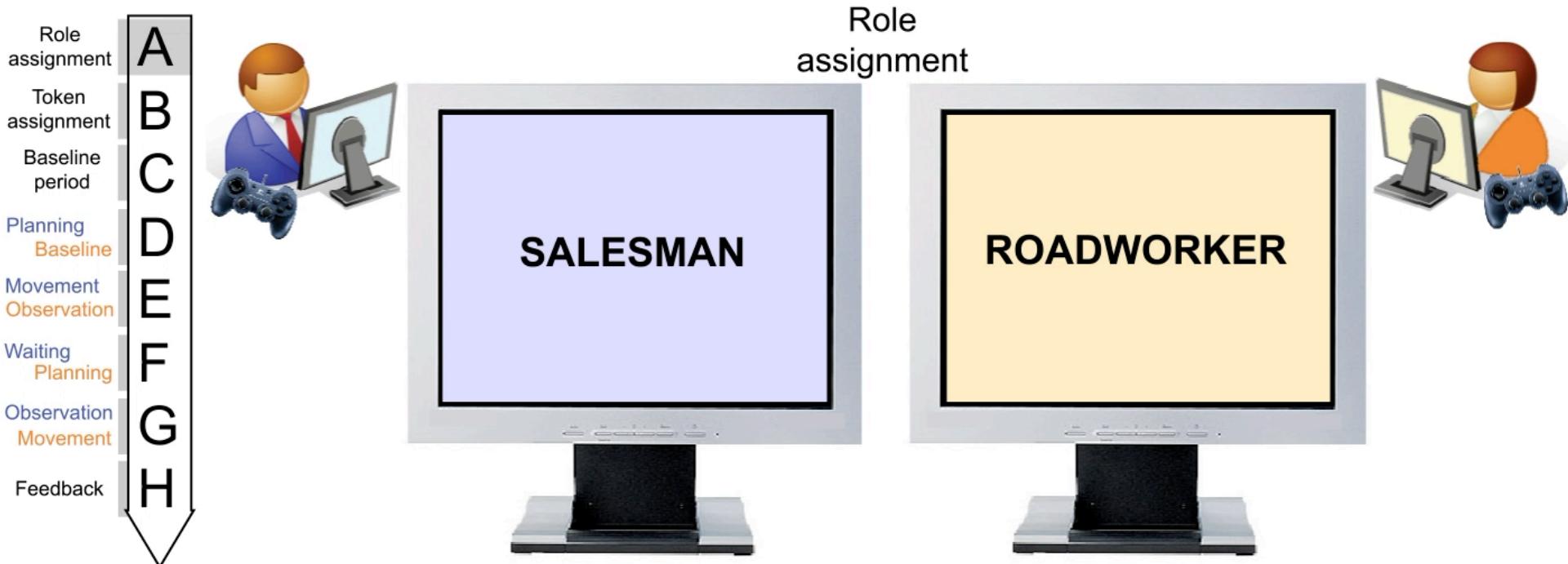
Novel communicative signals  
(lack of pre-existing shared representations:  
experimental control over shared cognitive history)

Experimentally-controlled roles  
(isolation of production and comprehension)

## *What's identical?*

Dynamic communicative context  
(jointly built, updated according to the fleeting idiosyncrasies of an ongoing interaction)

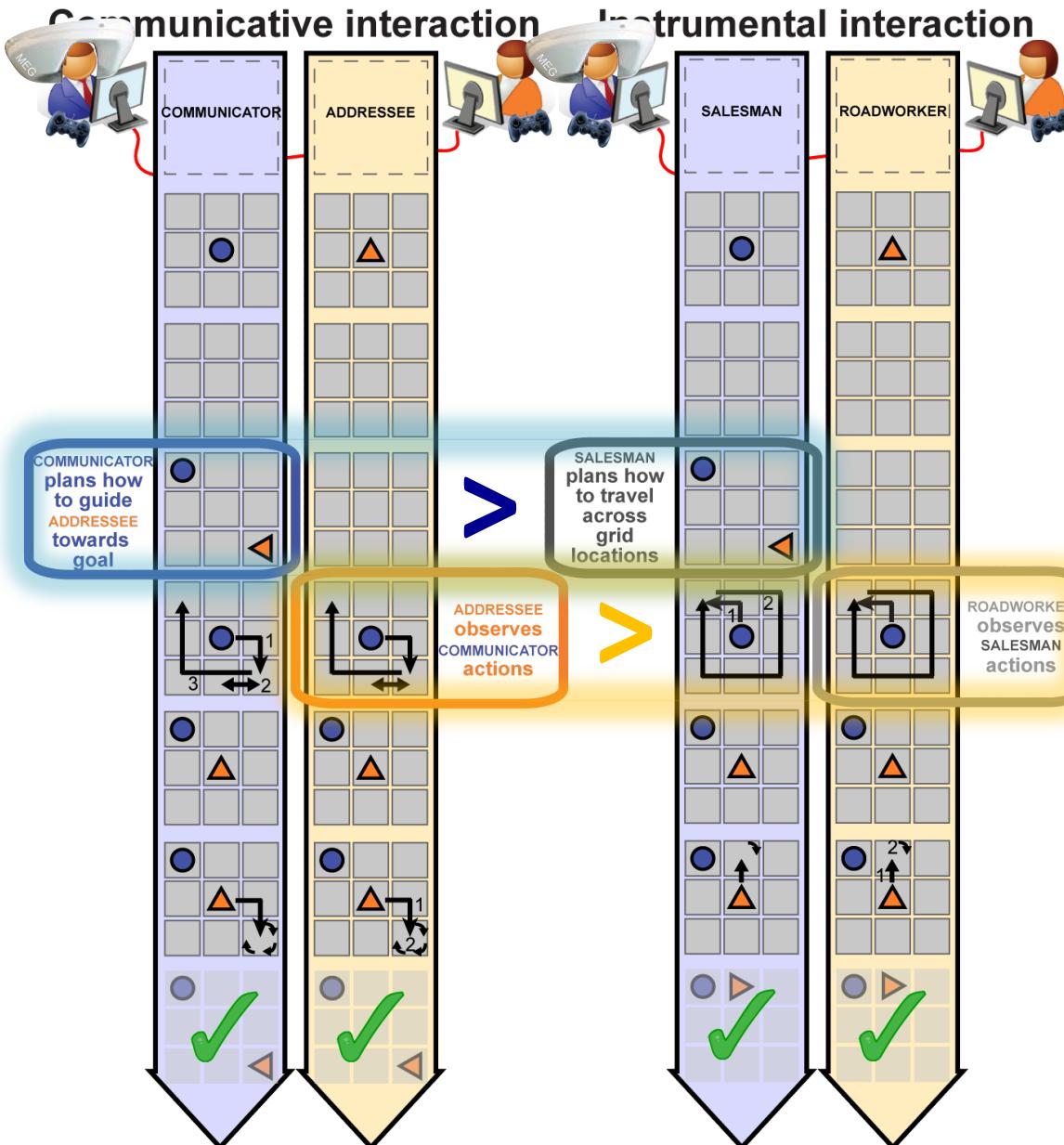
Control interaction task involving the same stimuli, responses, attention and between-subjects dependencies, but no communicative necessities



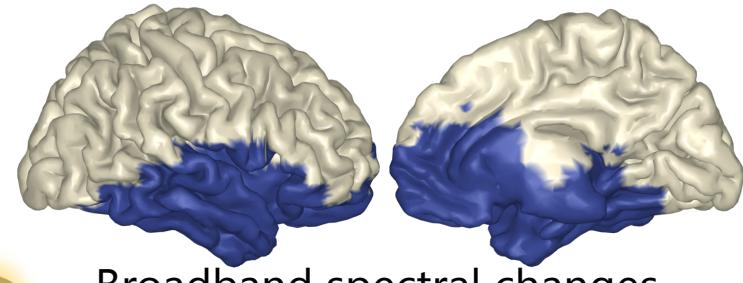


# 4 predictions of neural activity supporting shared conceptual spaces

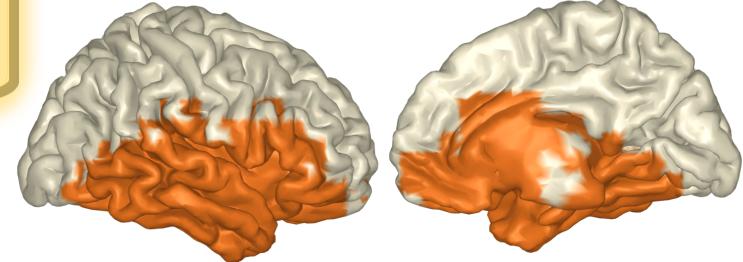
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Production of  
**communicative** actions



Broadband spectral changes



Comprehension of  
**communicative** actions

Neural mechanisms of communicative innovation

Arjen Stolk<sup>a,1</sup>, Lennart Verhagen<sup>a</sup>, Jan-Mathijs Schoffelen<sup>a,b</sup>, Robert Oostenveld<sup>a</sup>, Mark Blokpoel<sup>a</sup>, Peter Hagoort<sup>a,b</sup>, Iris van Rooij<sup>a</sup>, and Ivan Toni<sup>a</sup>



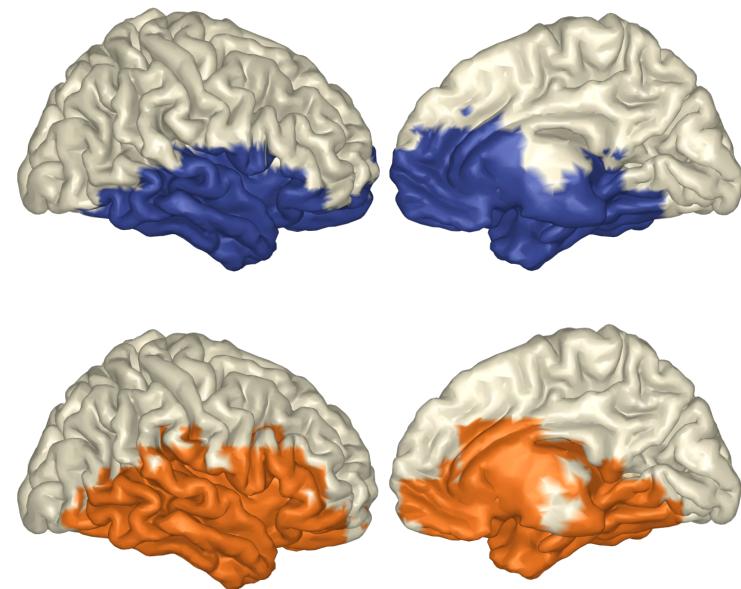
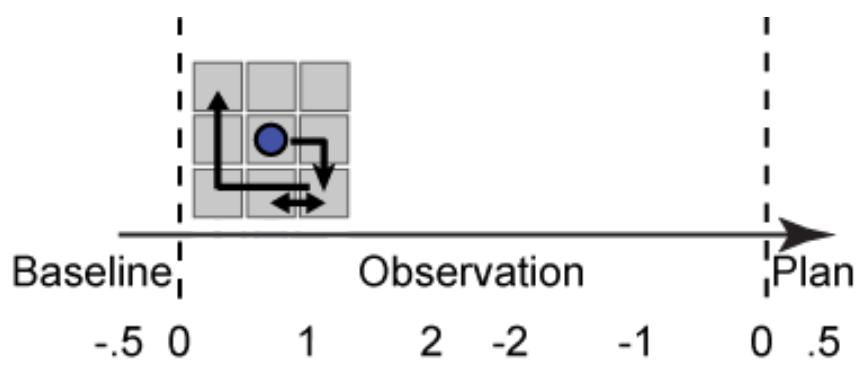
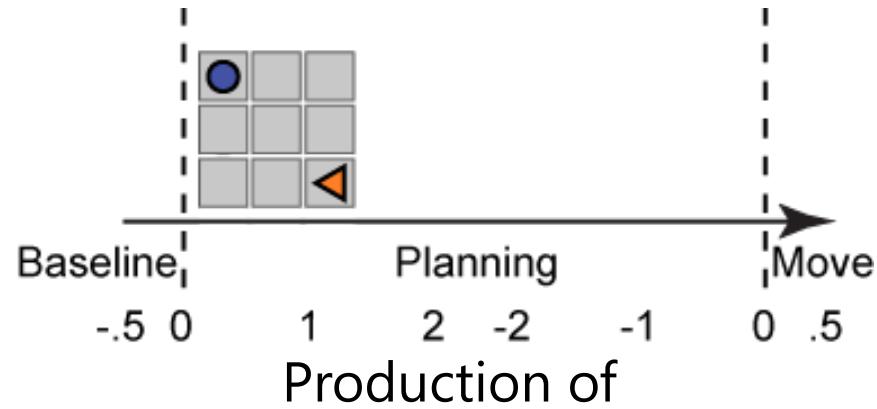
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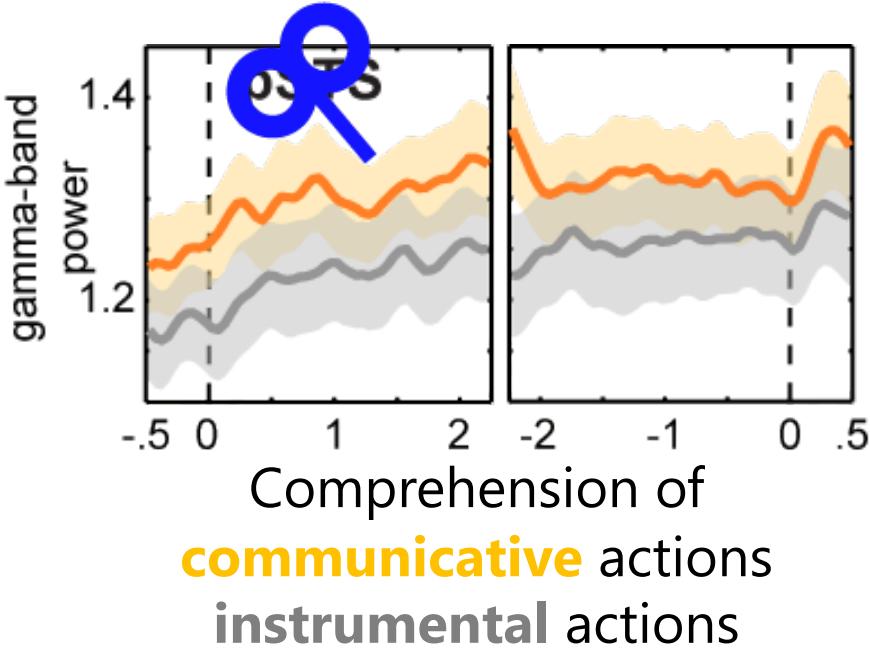
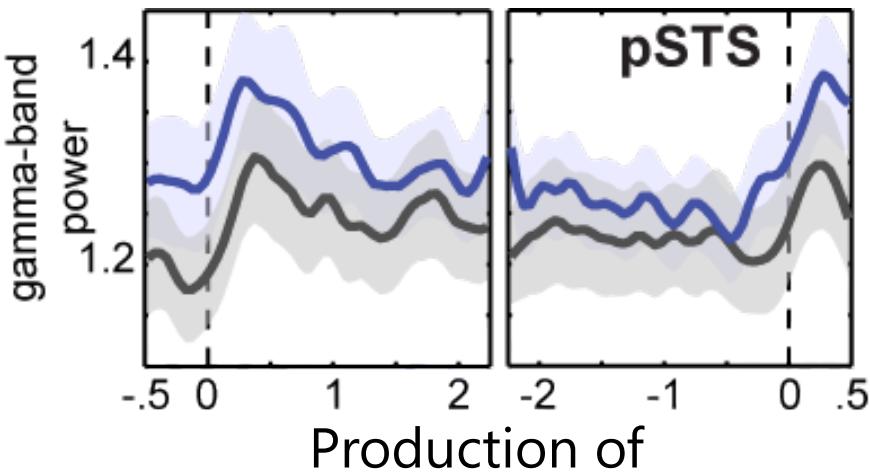
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# 4 predictions of neural activity supporting shared conceptual spaces

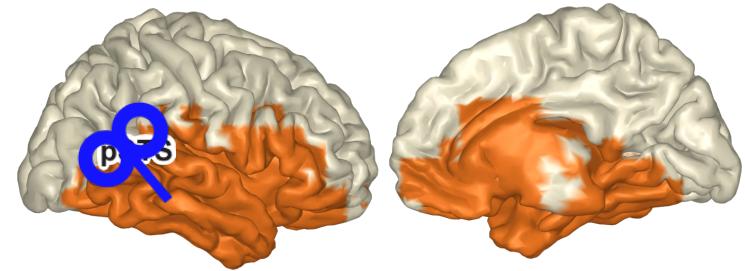
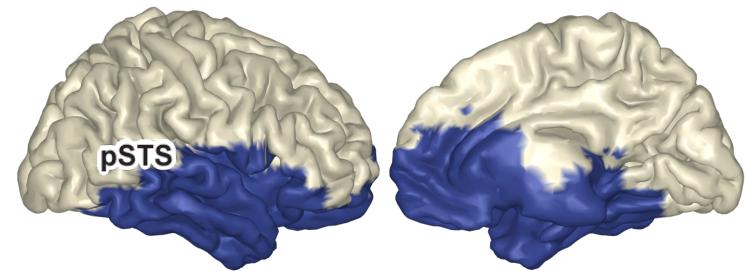
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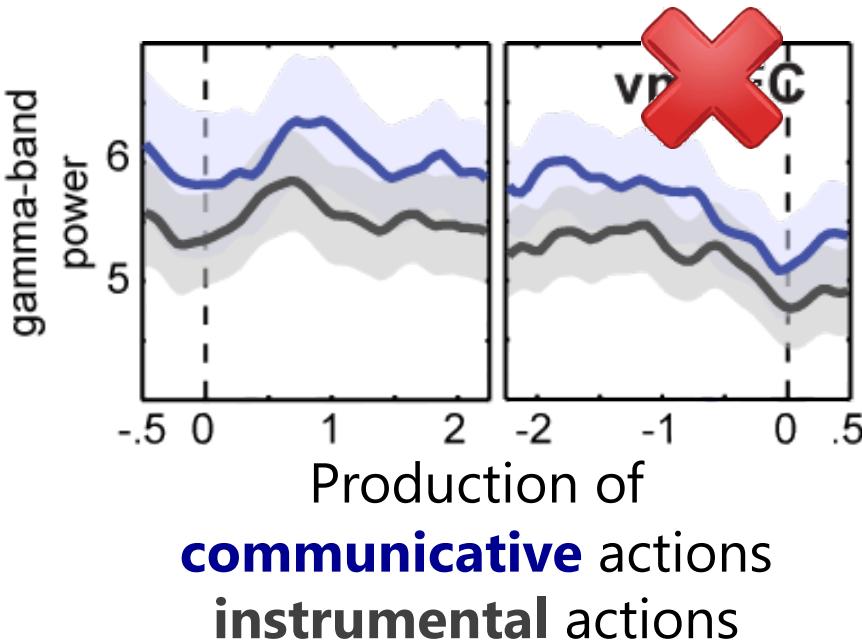


## Understanding communicative actions: A repetitive TMS study

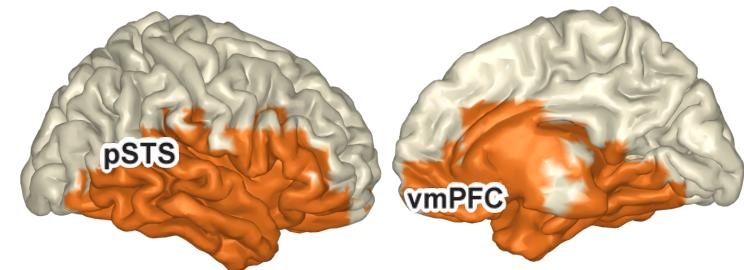
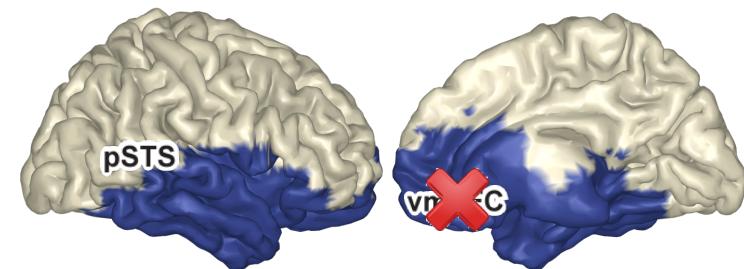
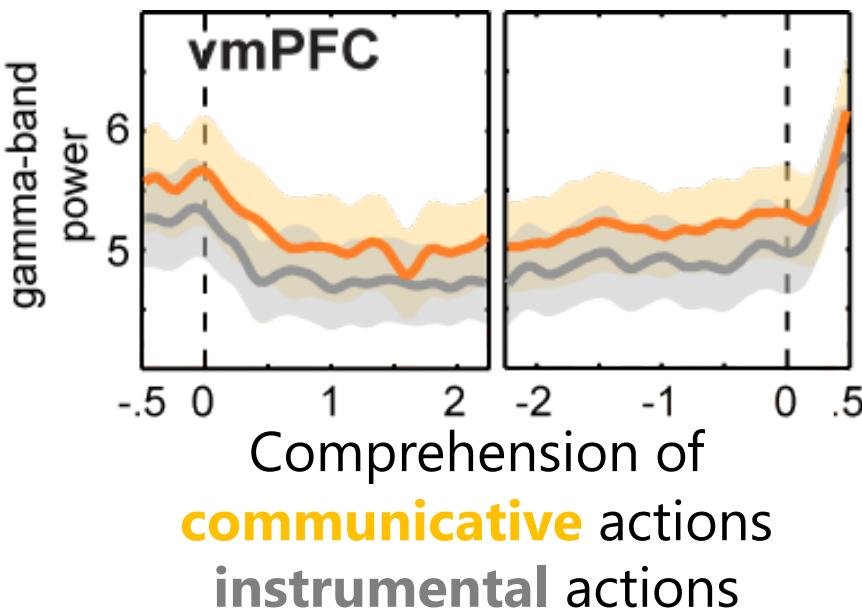
Arjen Stolk <sup>a,\*</sup>, Matthijs L. Noordzij <sup>b</sup>, Inge Volman <sup>a,c</sup>, Lennart Verhagen <sup>a</sup>,  
Sebastiaan Overeem <sup>d</sup>, Gijs van Elswijk <sup>d</sup>, Bas Bloem <sup>d</sup>, Peter Hagoort <sup>a,e</sup> and Ivan Toni <sup>a</sup>



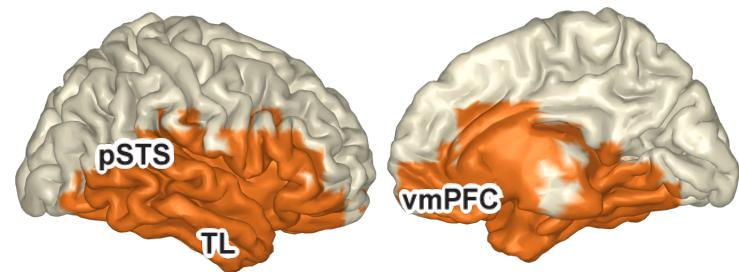
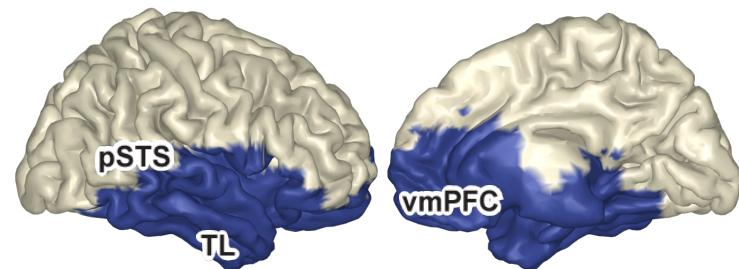
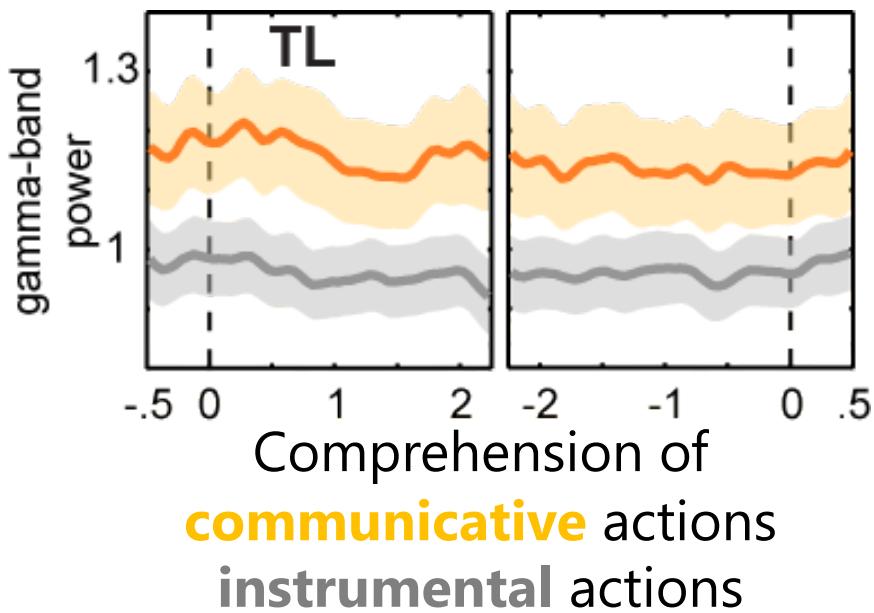
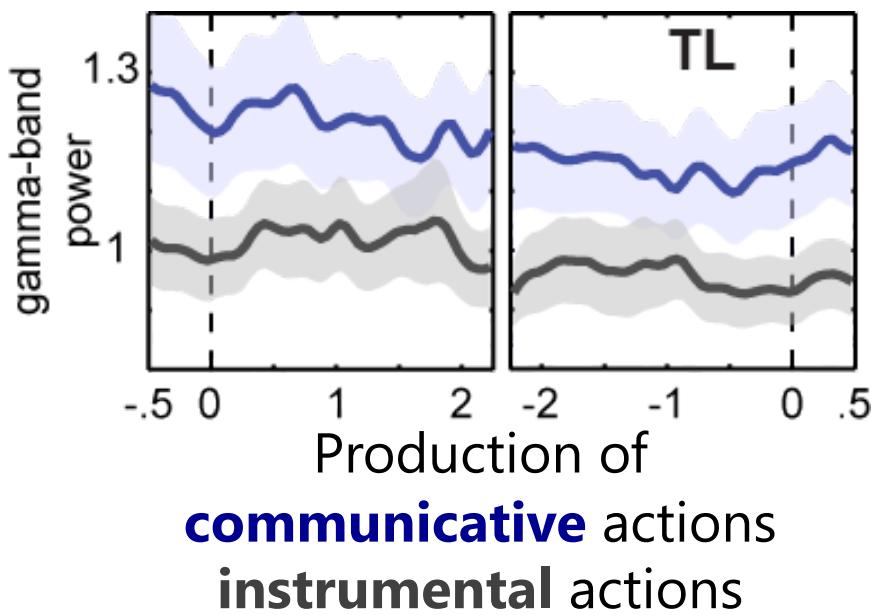
Necessary for  
integrating knowledge  
of the recent  
communicative history



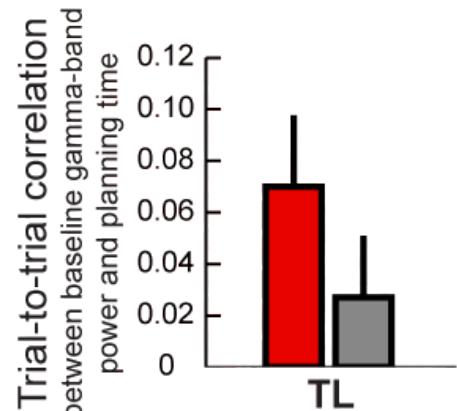
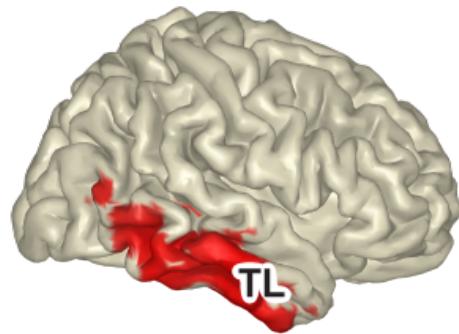
Necessary for tuning decisions with knowledge of a communicative partner



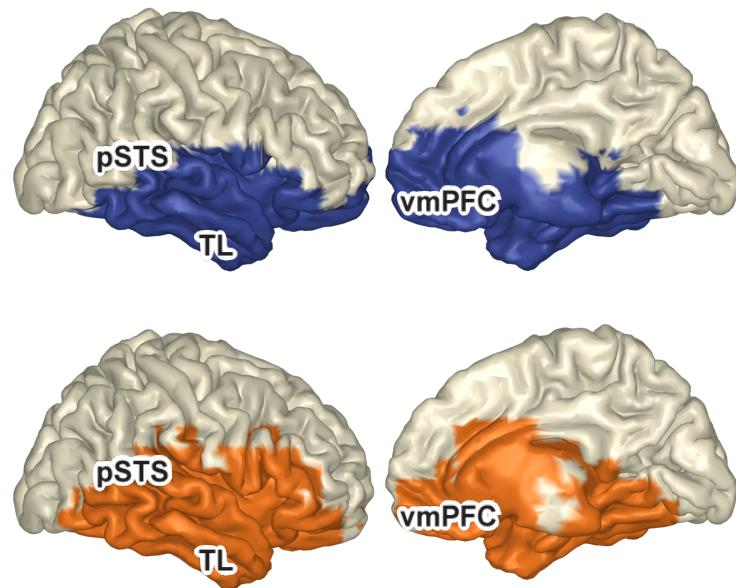
Altered Communicative Decisions following Ventromedial Prefrontal Lesions



*Supports communicative behaviors in a state-dependent manner*



- *Communicative interactions*
- *Instrumental interactions*





# 4 predictions of neural activity supporting shared conceptual spaces

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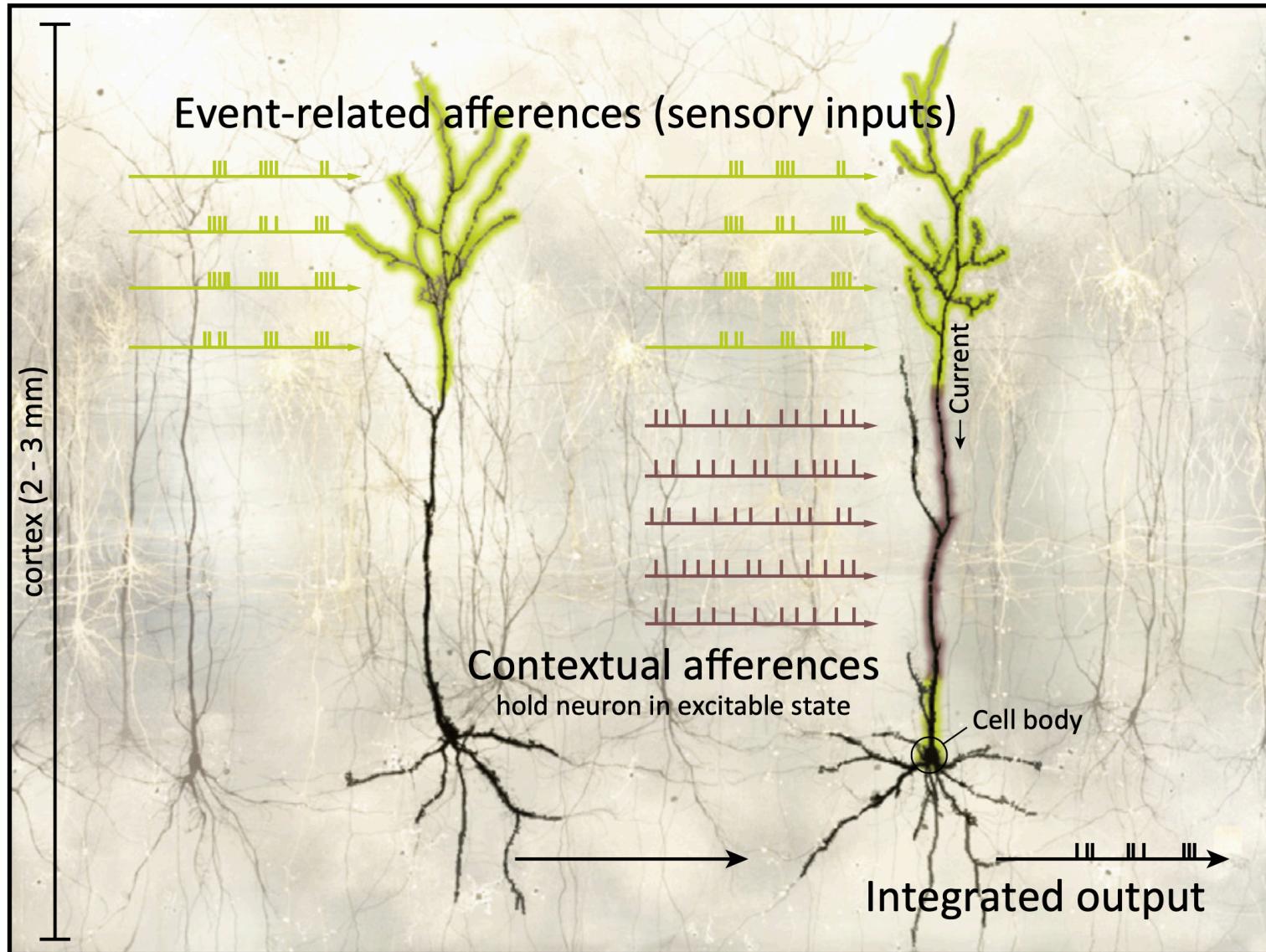
- Communicators and addressees achieve mutual understanding by using the same computational procedures and neuronal substrates  
(implemented in a right-lateralized frontotemporal network)
- Brain regions supporting communication are already upregulated before a communicative utterance is produced or comprehended

- Shared Conceptual Spaces II



# Bonus: A putative neuronal integrative mechanism

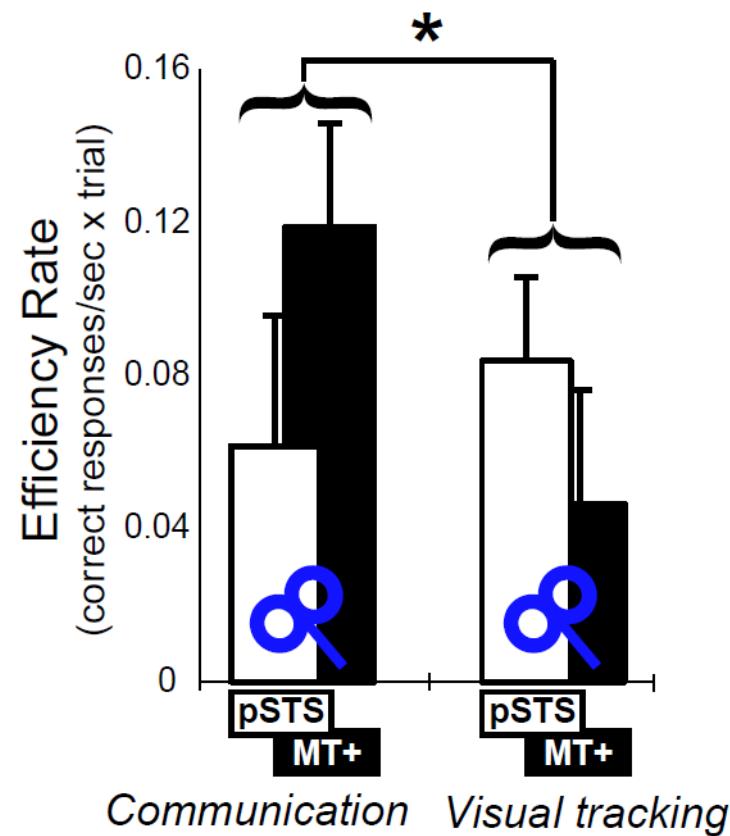
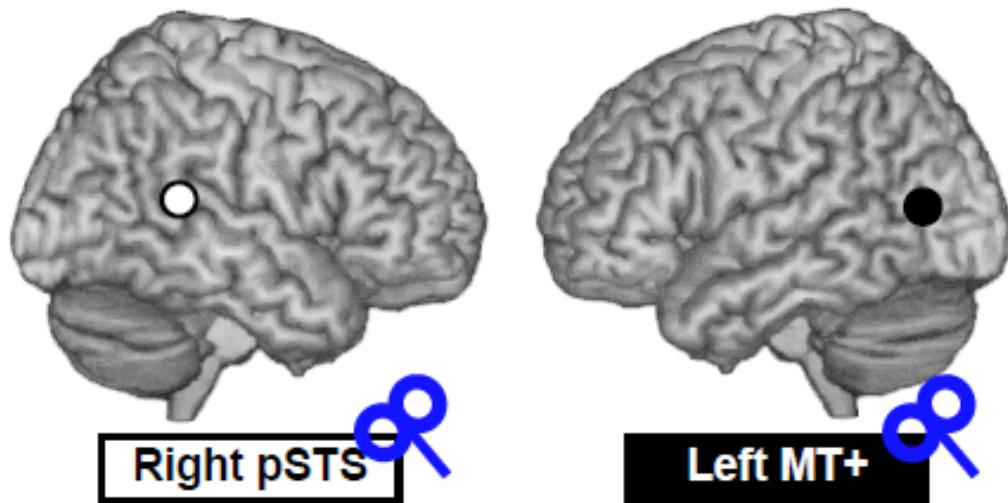
DARTMOUTH



Ongoing contextual inputs can hold neurons near an excitability threshold

# Bonus: Perturbing neural integration

DARTMOUTH



Understanding communicative actions: A repetitive TMS study

Arjen Stolk <sup>a,\*</sup>, Matthijs L. Noordzij <sup>b</sup>, Inge Volman <sup>a,c</sup>, Lennart Verhagen <sup>a</sup>,  
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Right pSTS is necessary to benefit from the recent communicative history