Experience and Context Influence the Generation of Hypotheses from Memory

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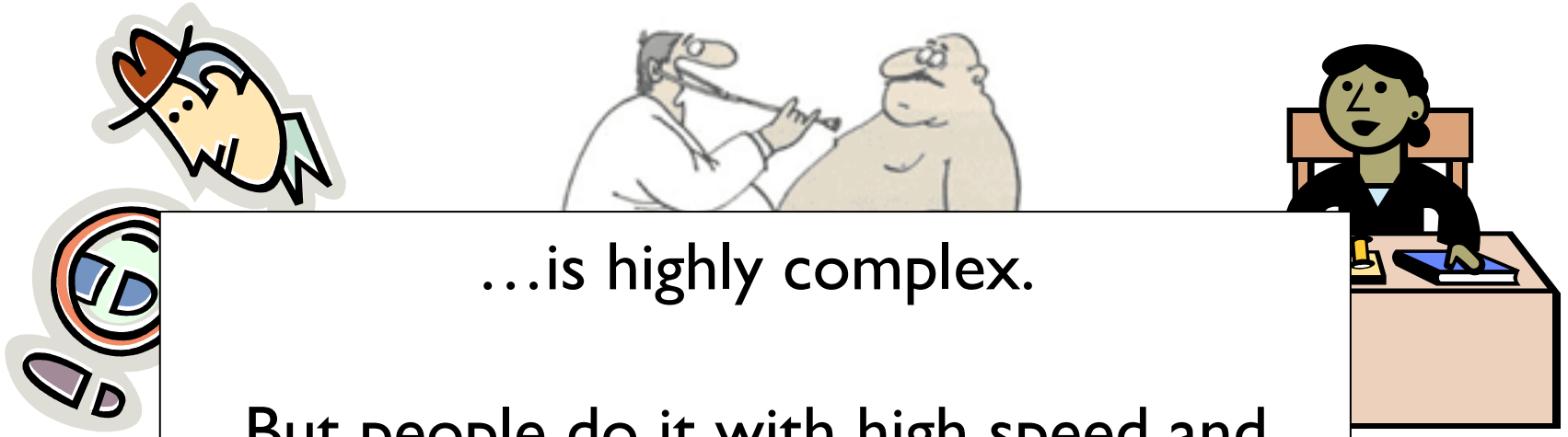
Hypothesis generation…



…is highly complex.

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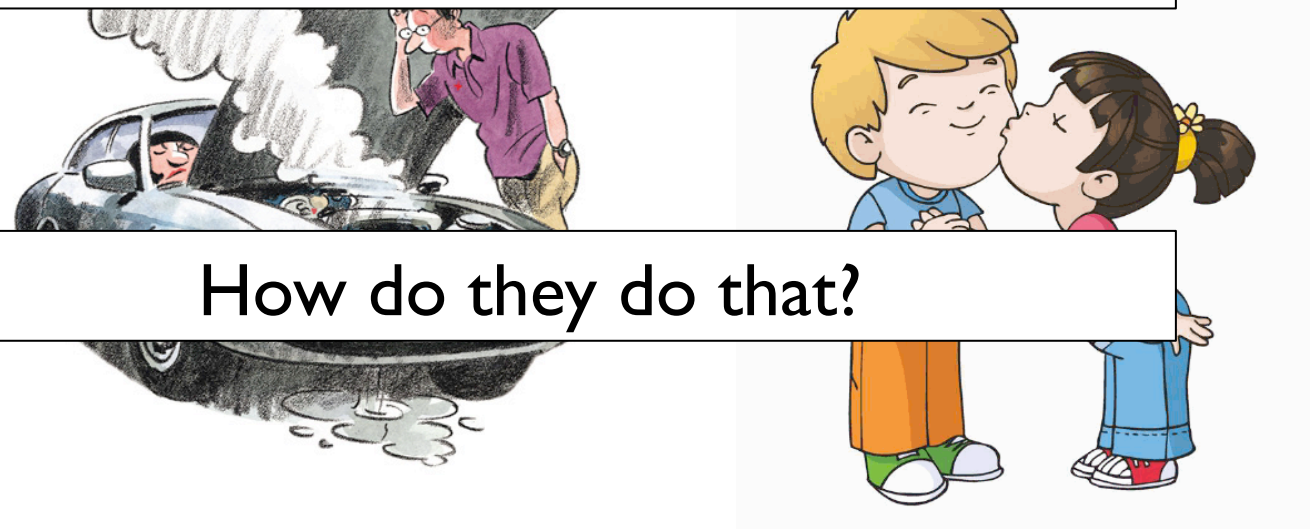


How do they do that?

People generate hypotheses that…

Were successfully used in previous experiences

Are supported by the current context

Possibly related aspects of memory activation:

Base-level activation

Spreading activation

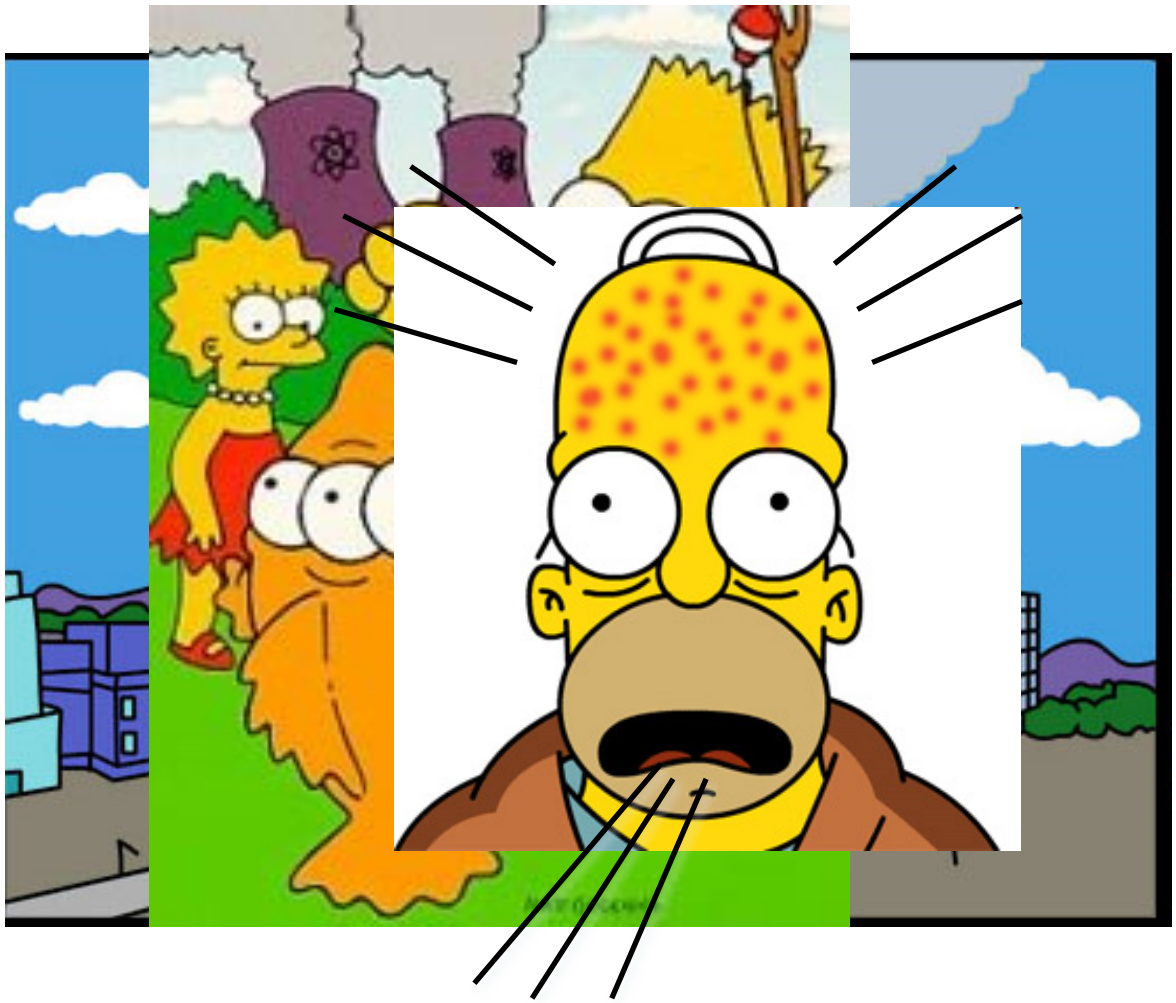
Question:

Can we find evidence for
base-level activation and
spreading activation
on **hypothesis generation**?

Experiment – 3 tasks

Diagnose medical symptoms	Hypothesis generation from memory
React to visual stimuli	Manipulates base-levels of hypotheses in memory
Count (yes, no) a subset of the stimuli	Manipulates spreading activation to hypotheses in memory

Diagnoses - Chemical accident task

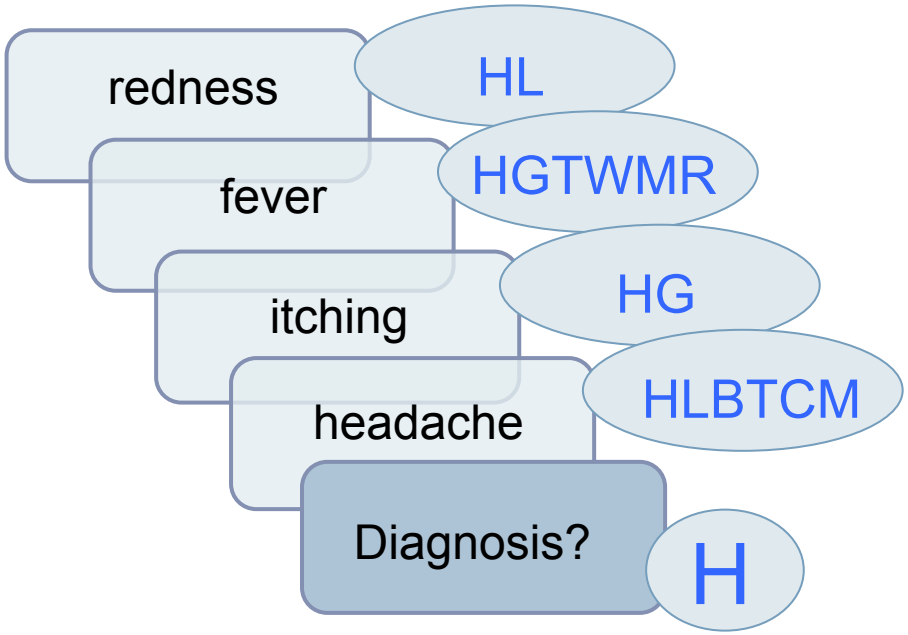


Diagnostic knowledge

→ learned before the experiment

Source	Chemical	Specific symptoms			Unspecific symptoms		
inhaled	B	cough		short breath	headache		dizziness
	T	cough	sneezing		headache	fever	
	W		sneezing	short breath		fever	dizziness
skin contact	L	redness		rash	headache		dizziness
	H	redness	itching		headache	fever	
	G		itching	rash		fever	dizziness
drinking water	C	diarrhea		cramps	headache		dizziness
	M	diarrhea	vomiting		headache	fever	
	R		vomiting	cramps		fever	dizziness

Diagnosis task



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Diagnose medical symptoms	Hypothesis generation from memory
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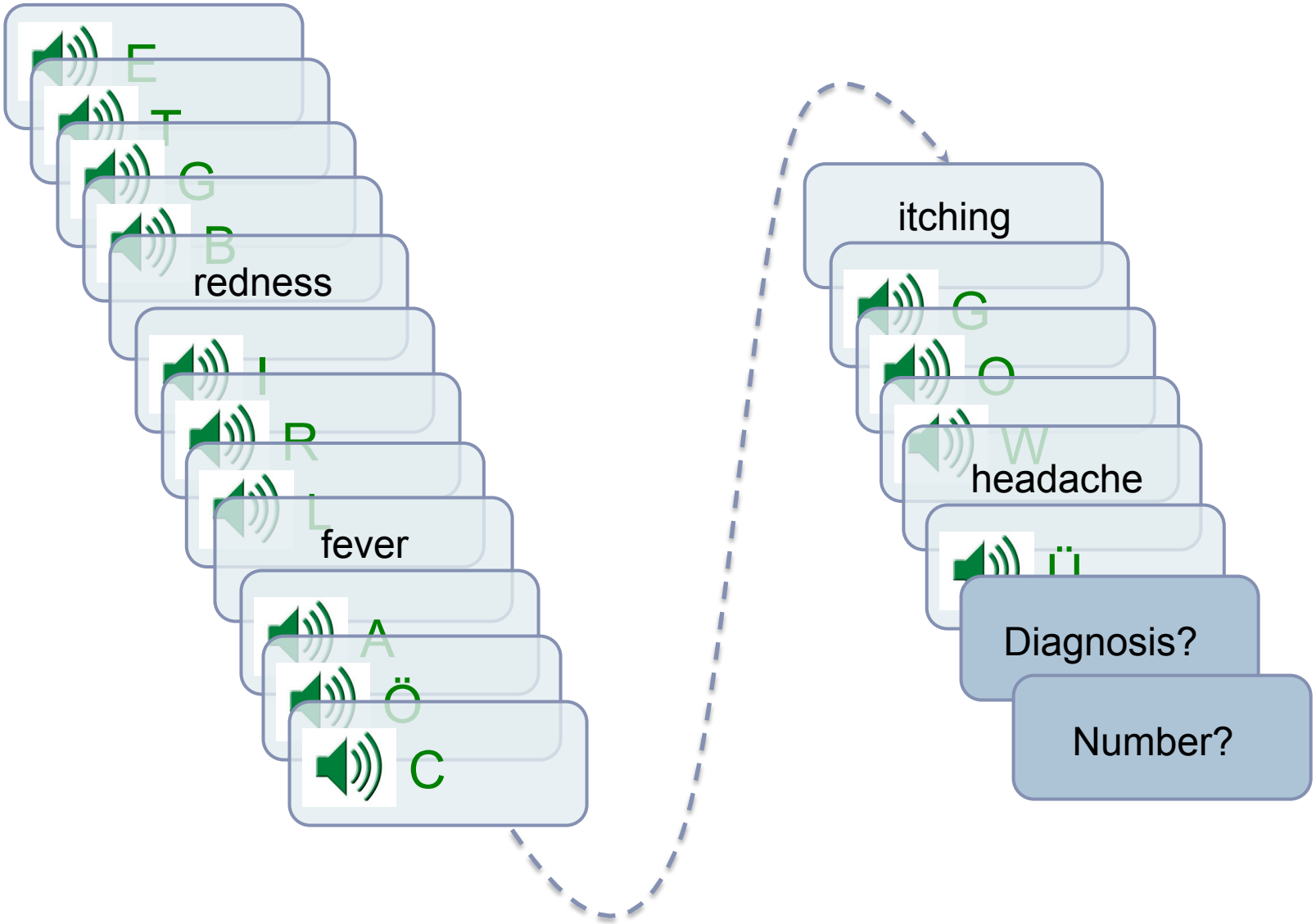
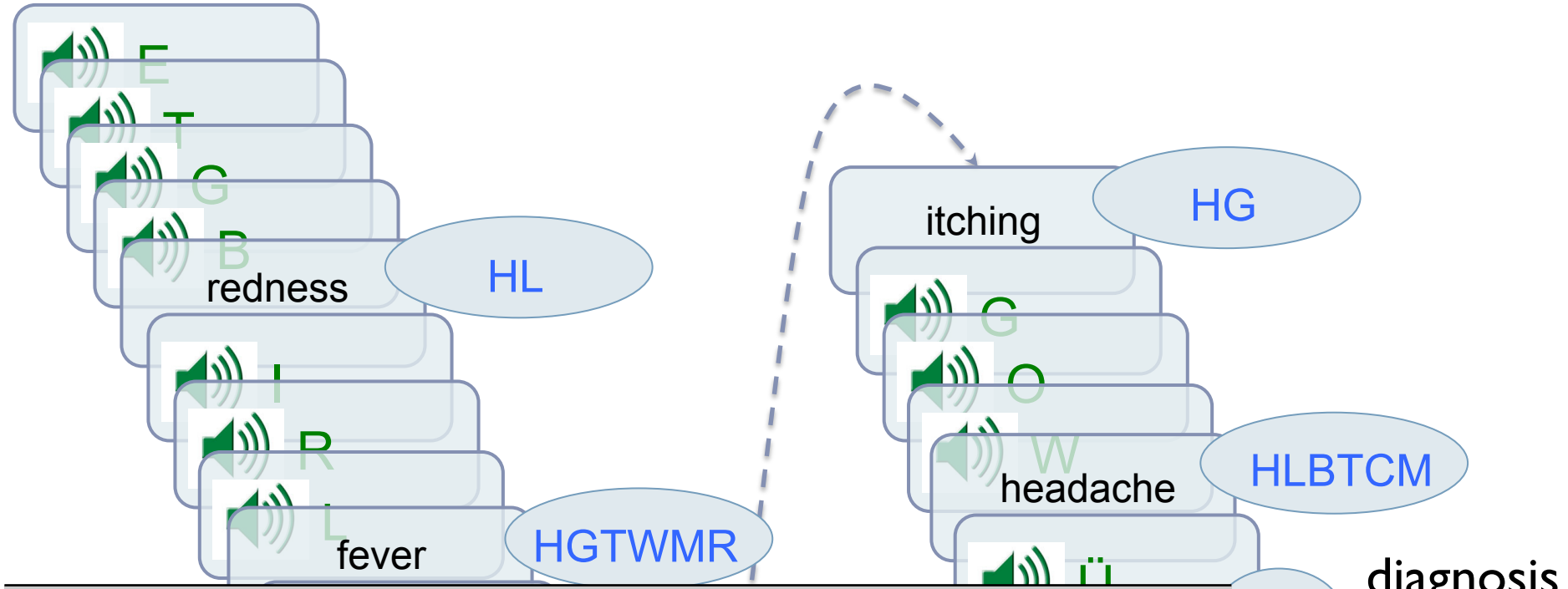
“diagnose & react to letters & count consonants”

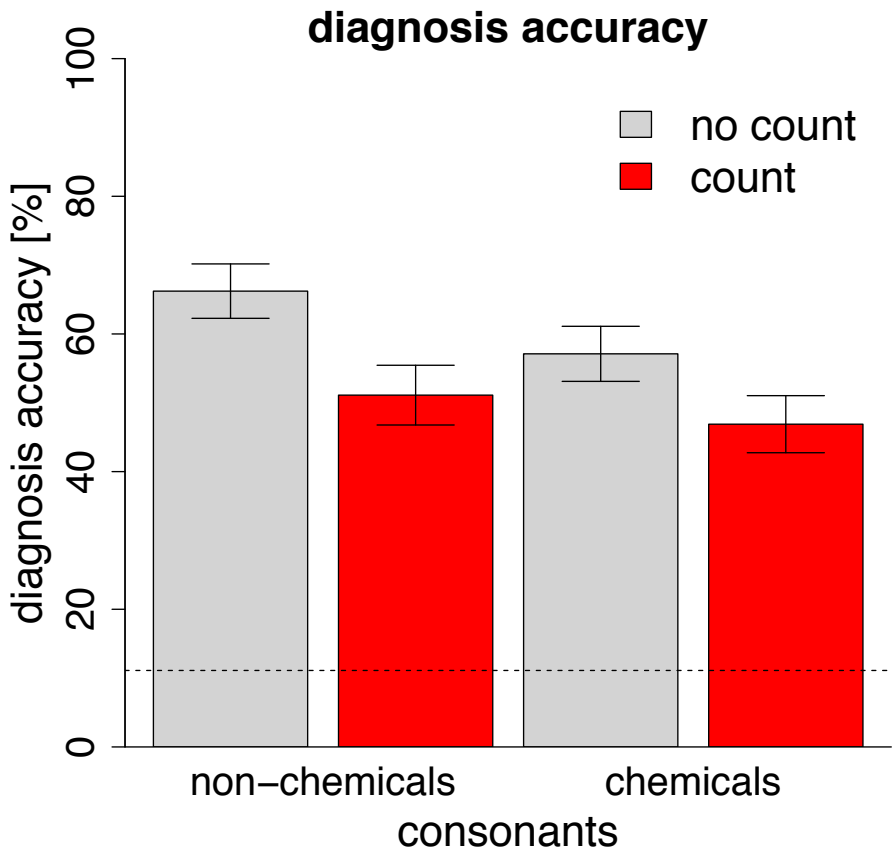


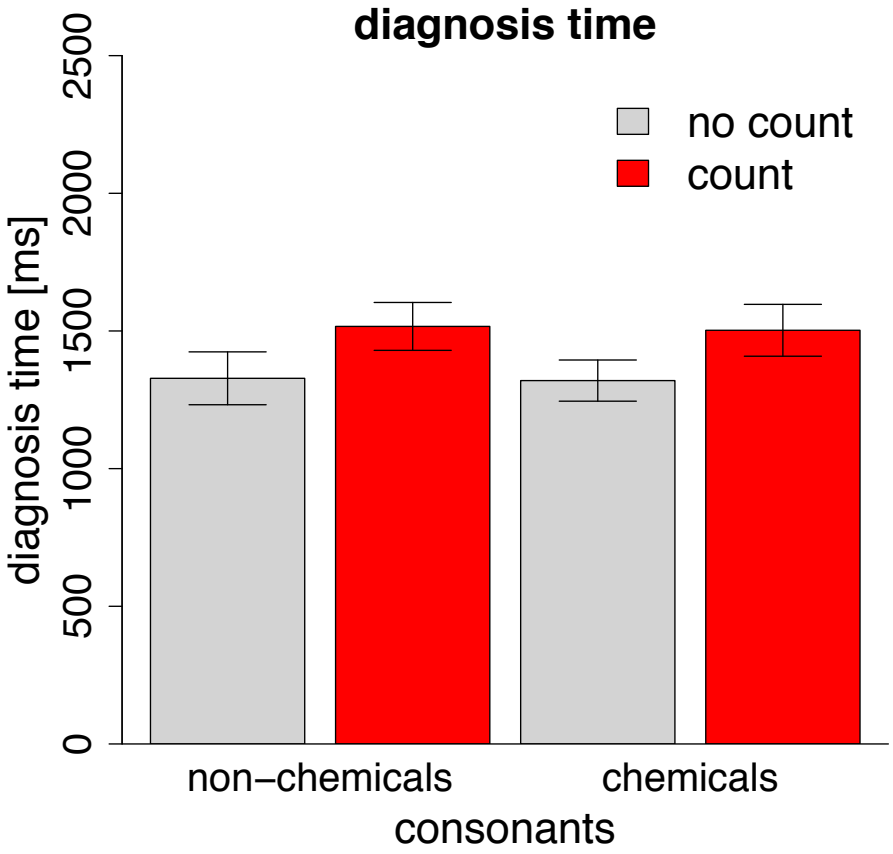
“diagnose & react to letters & count consonants”



		Spreading activation manipulated: No Counting	Spreading activation manipulated: Counting
Base-level manipulated	Neutral consonants	*Baseline performance*	*Disturbed spreading activation*
	Names of chemicals	*Disturbed base-level*	*Both Disturbed*

Results Diagnosis Task



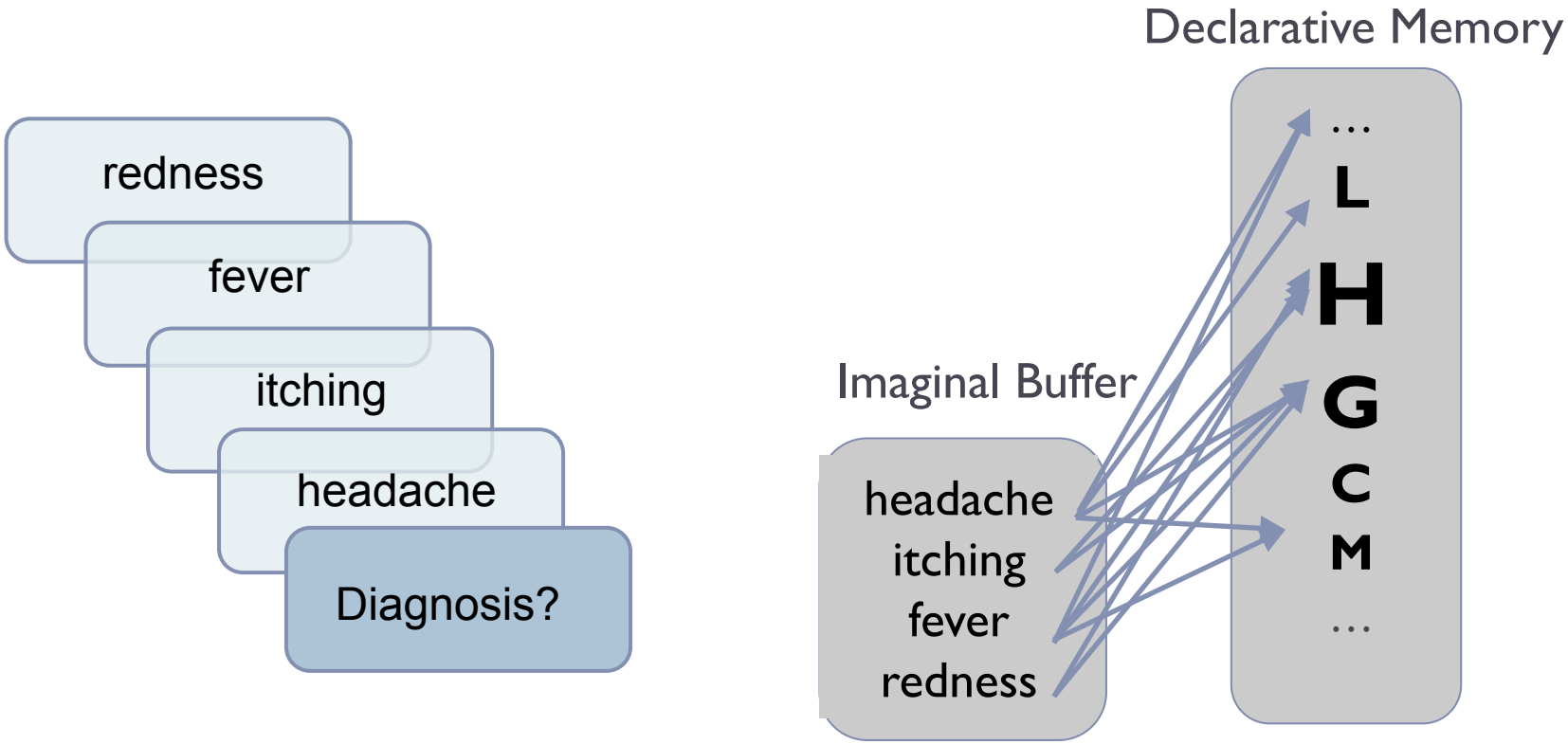


ACT-R model

- Combination of existing models
  - Diagnoses: Spreading Activation Model (Mehlhorn et al., 2011, JEP: LMC)
  - Counting: Count Model (ACT-R tutorial)
  - Task-switching: Problem State Model (Borst et al., 2010, JEP: LMC)

Diagnosis task in the model

→ Retrieve the most active explanation from memory



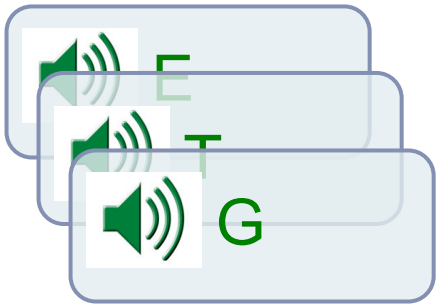
Mehlhorn, K., Taatgen, N.A., Lebiere, C., Krems, J.F. (2011). *JEP: LMC*

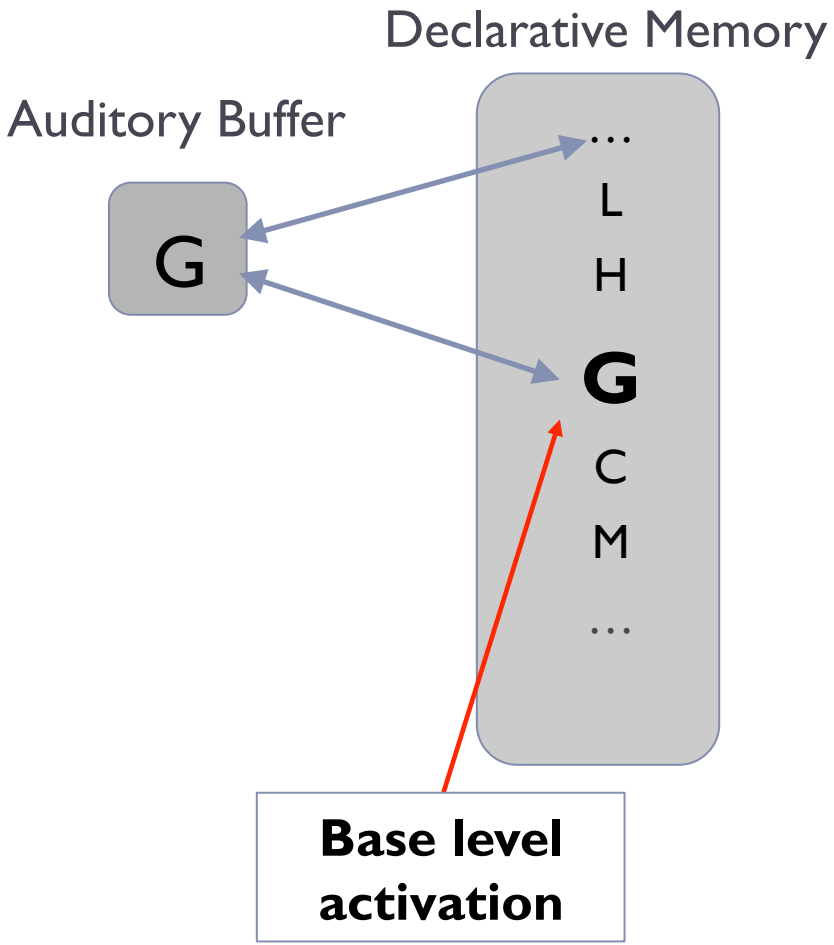
Reaction task in the model

→ Indicate whether heard letter is a consonant or vowel

Reaction task in the model

→ Indicate whether heard letter is a consonant or vowel





Counting task in the model

→ Count consonants

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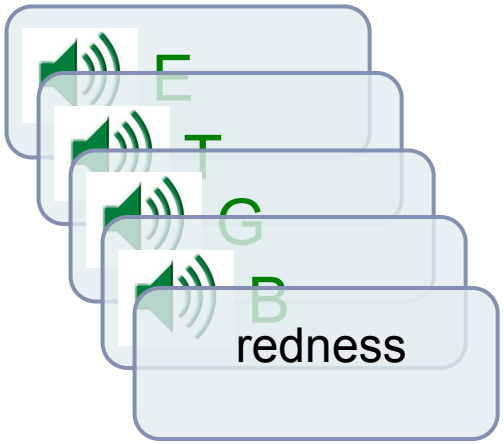


Declarative Memory

Auditory Buffer

B

Imaginal Buffer

redness

…

L

H

G

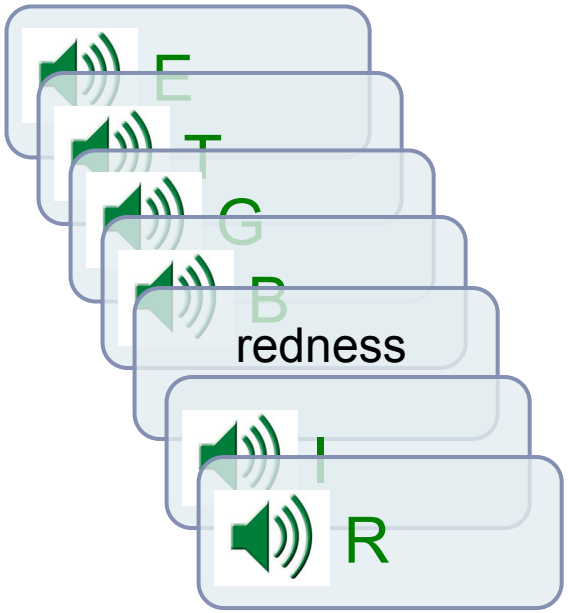
C

M

…

Counting task in the model

→ Count consonants



Auditory Buffer

R

Imaginal Buffer

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Declarative Memory

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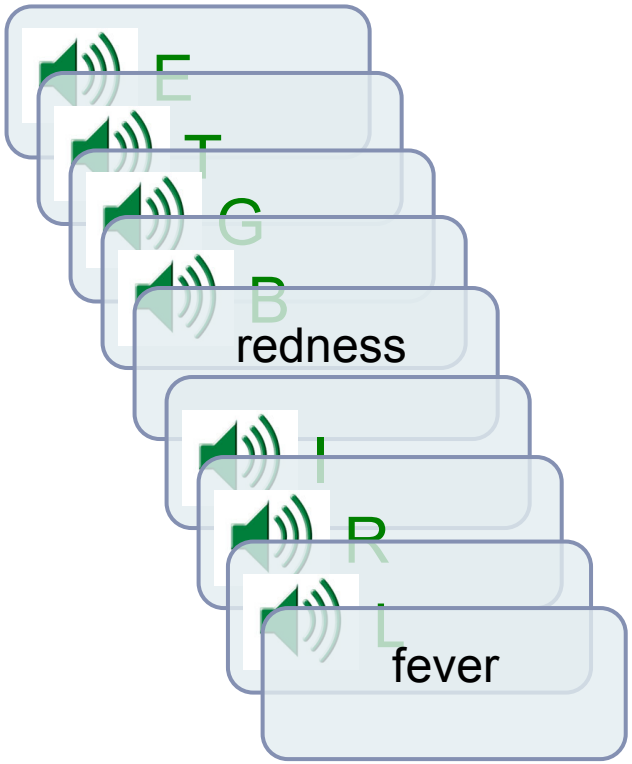
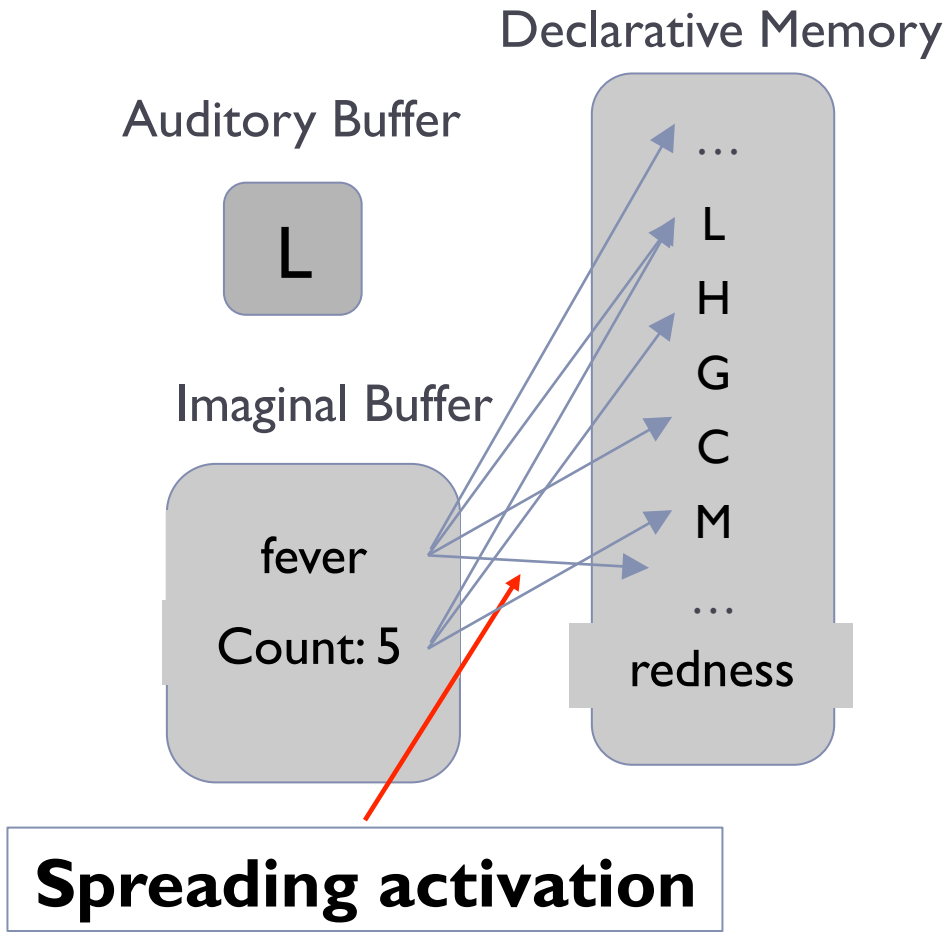
Count: 3

Counting task in the model

→ Count consonants





Counting task in the model

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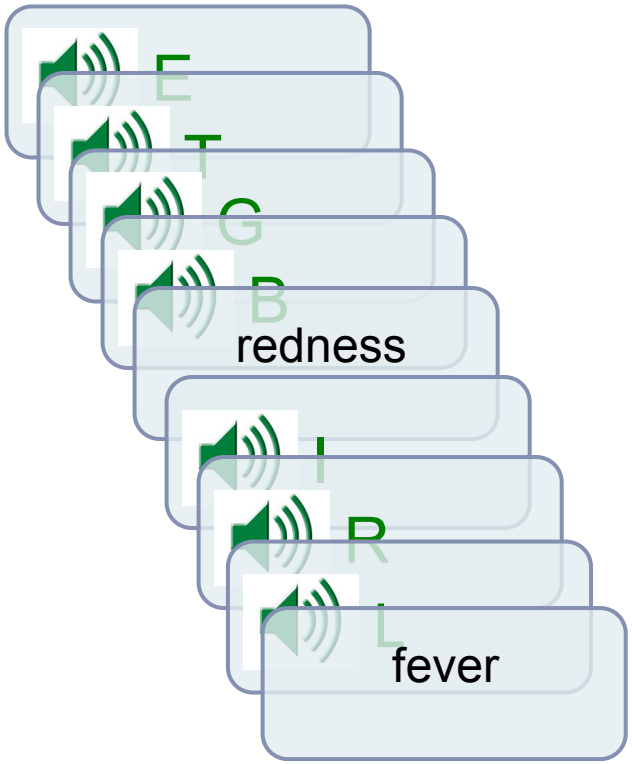
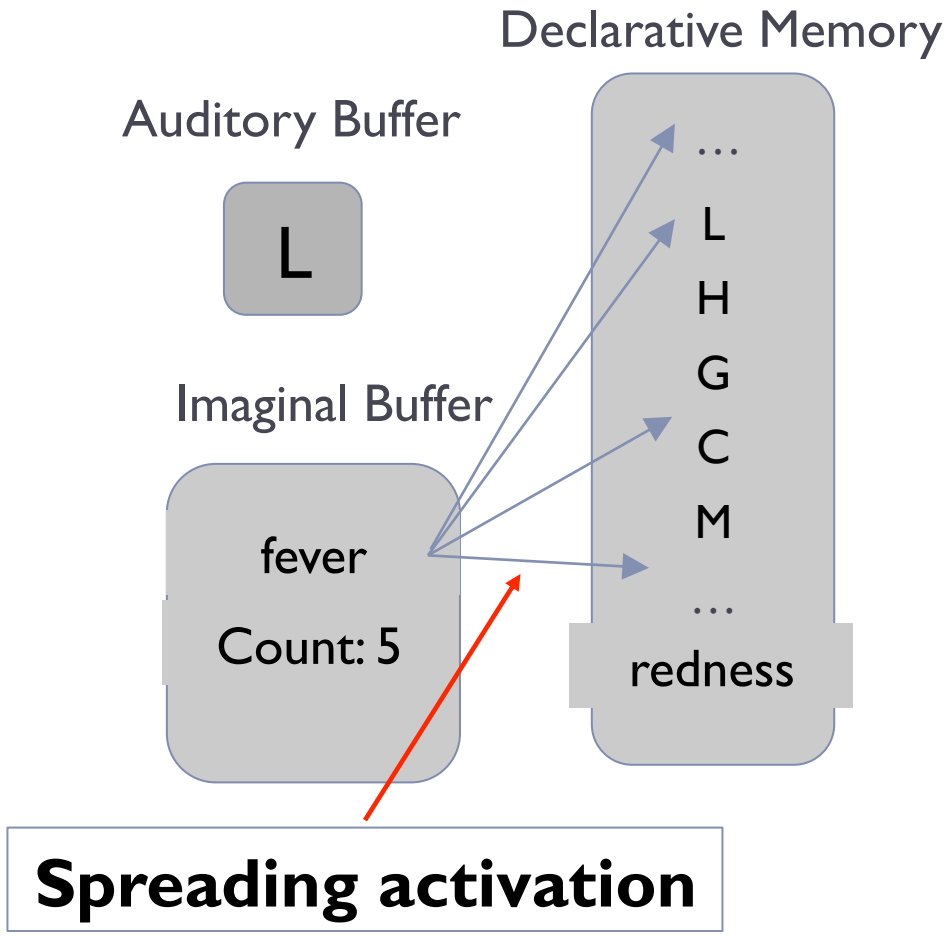
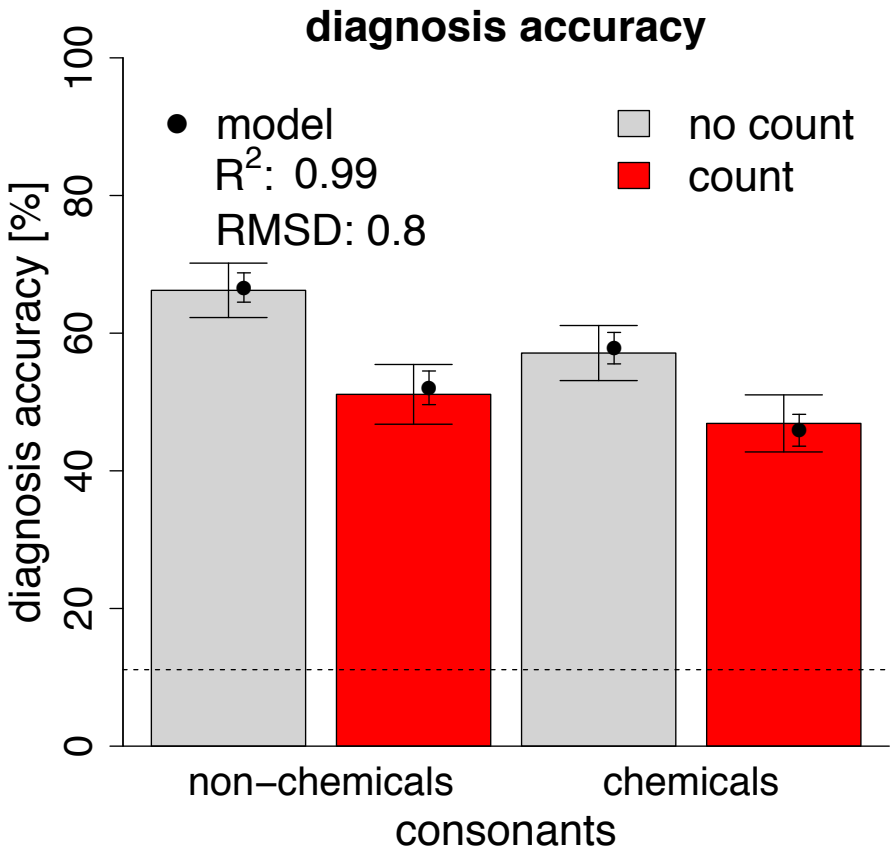
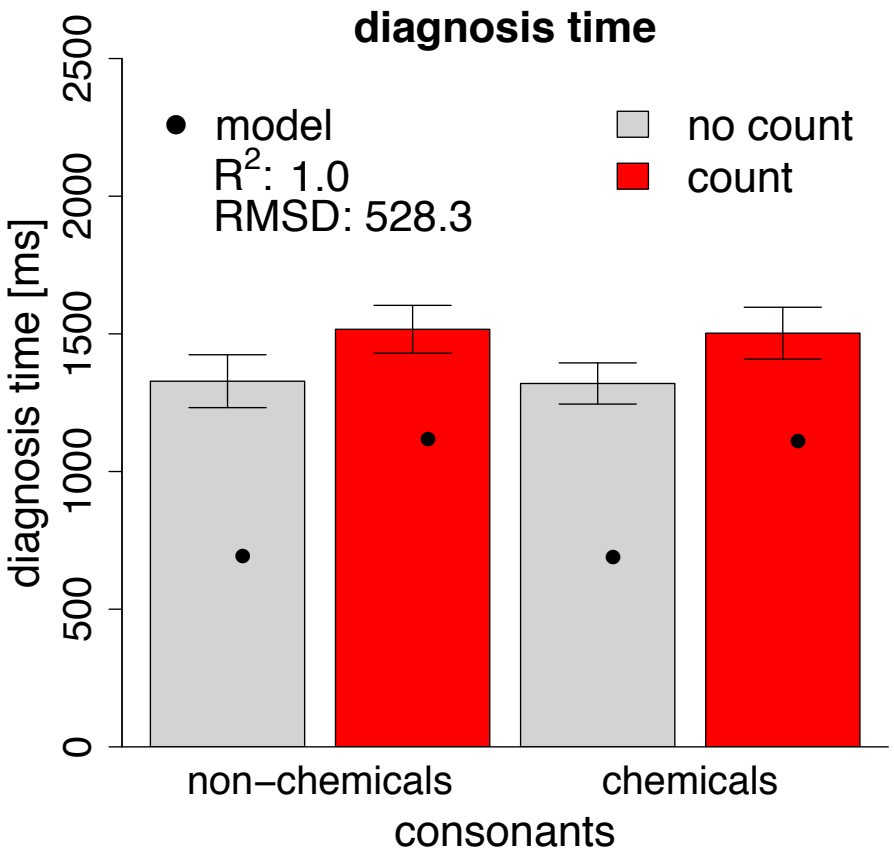




Results Diagnosis Task – Model Fit





Can the correct diagnosis be primed?

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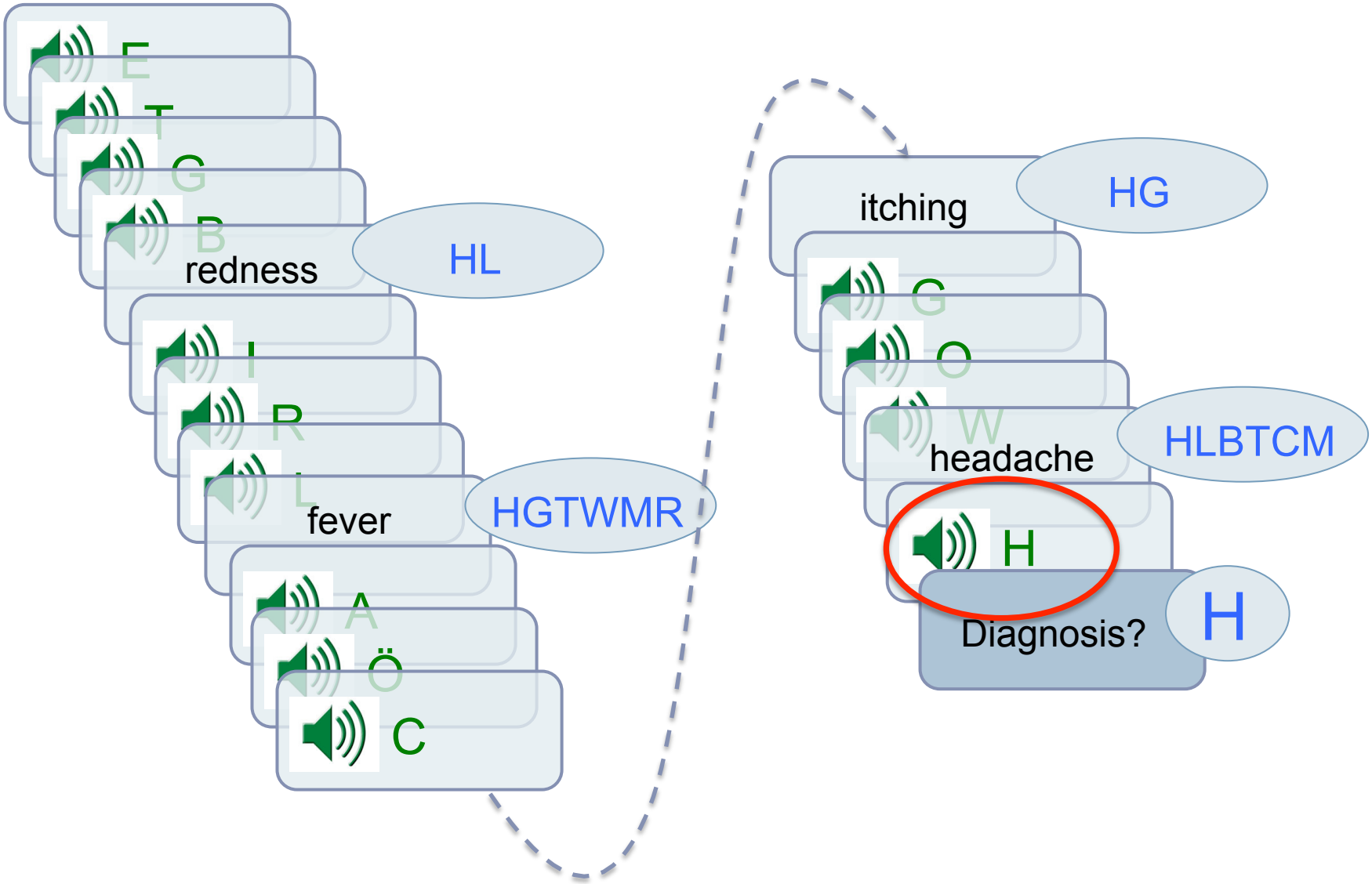
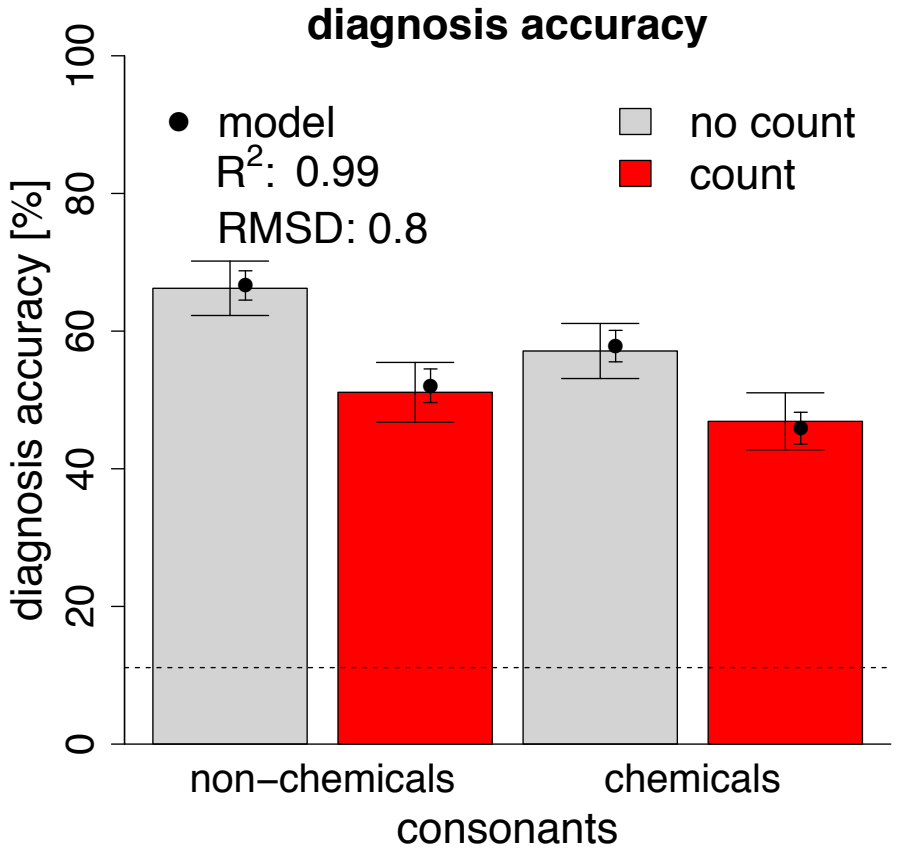


Can the correct diagnosis be primed? - Accuracy



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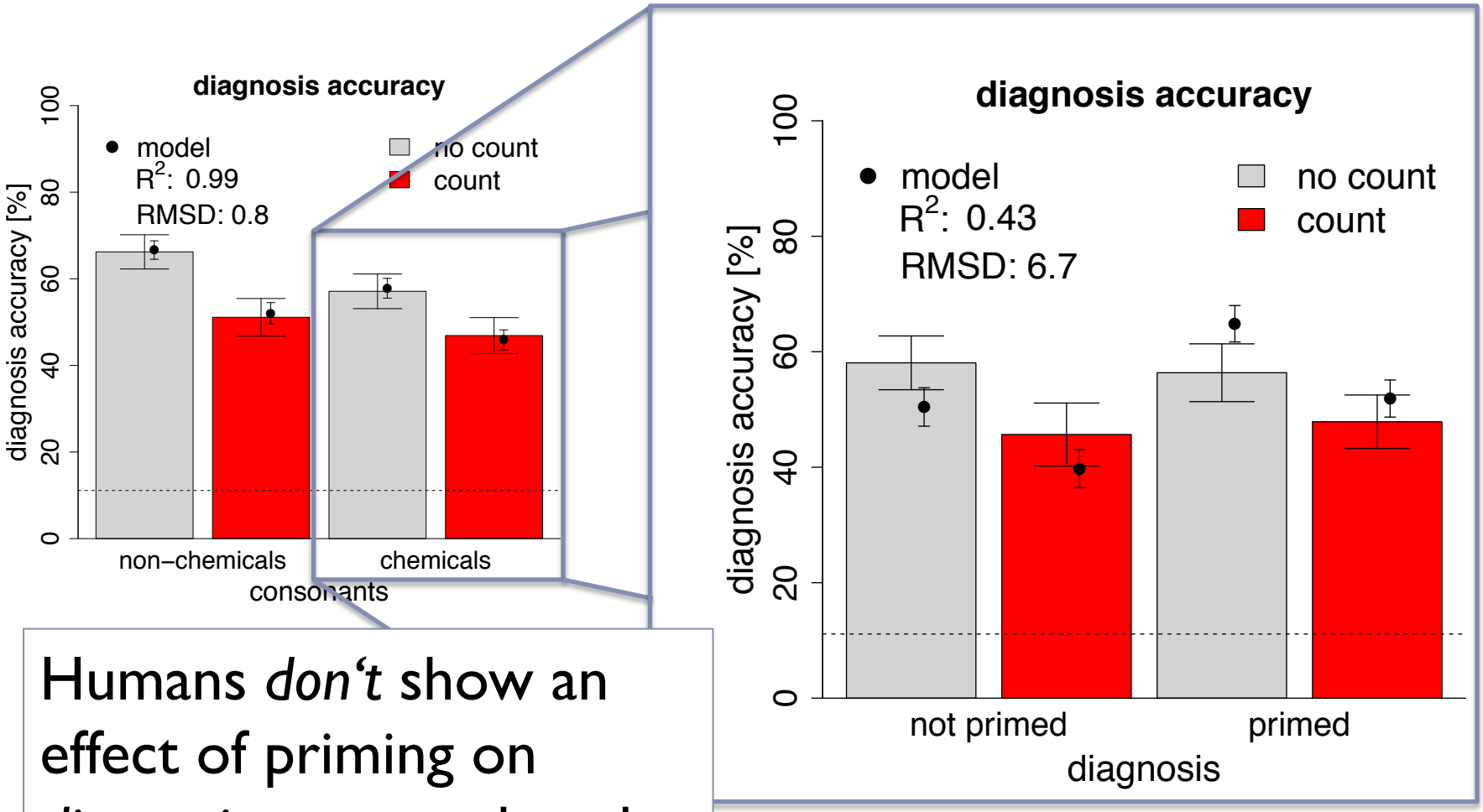
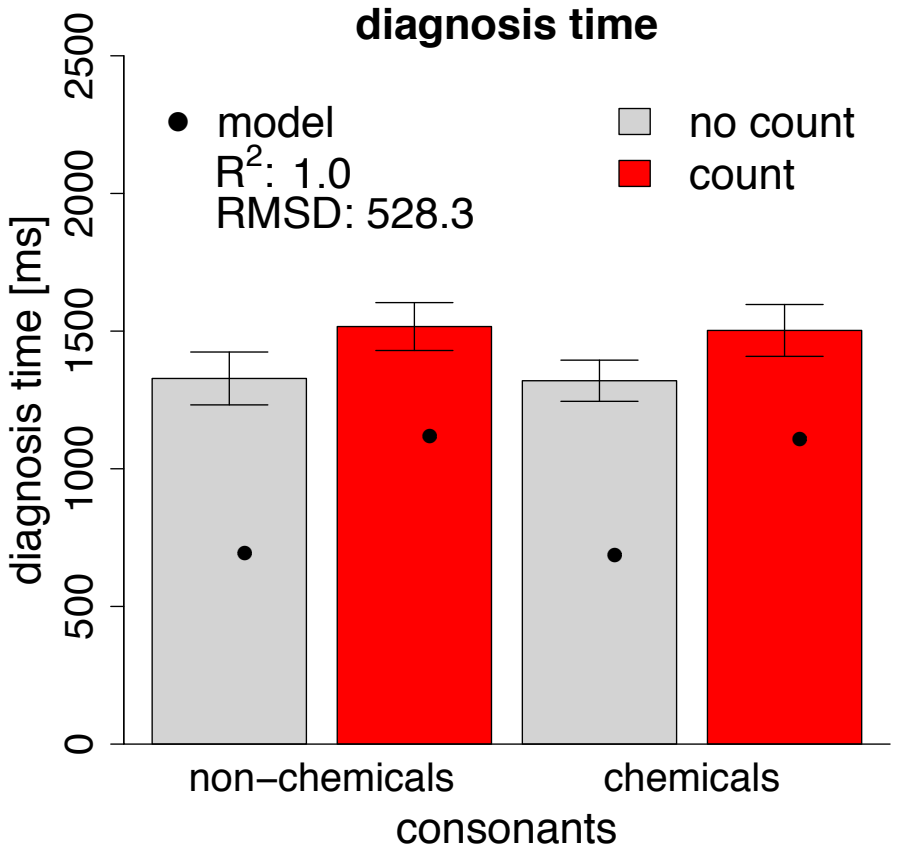
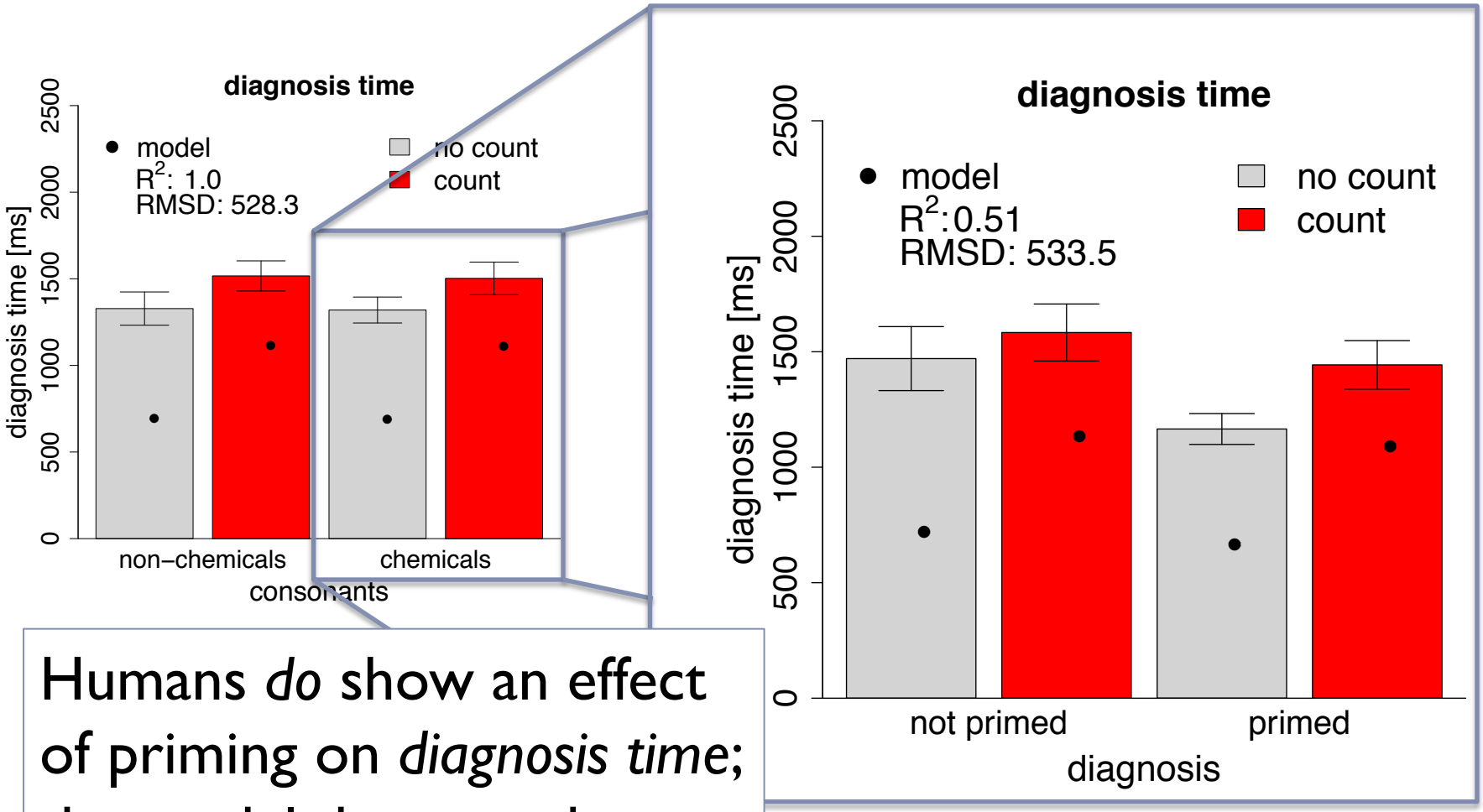


Humans *don't* show an effect of priming on *diagnosis accuracy*, but the model does

Can the correct diagnosis be primed? - Time



Can the correct diagnosis be primed? - Time

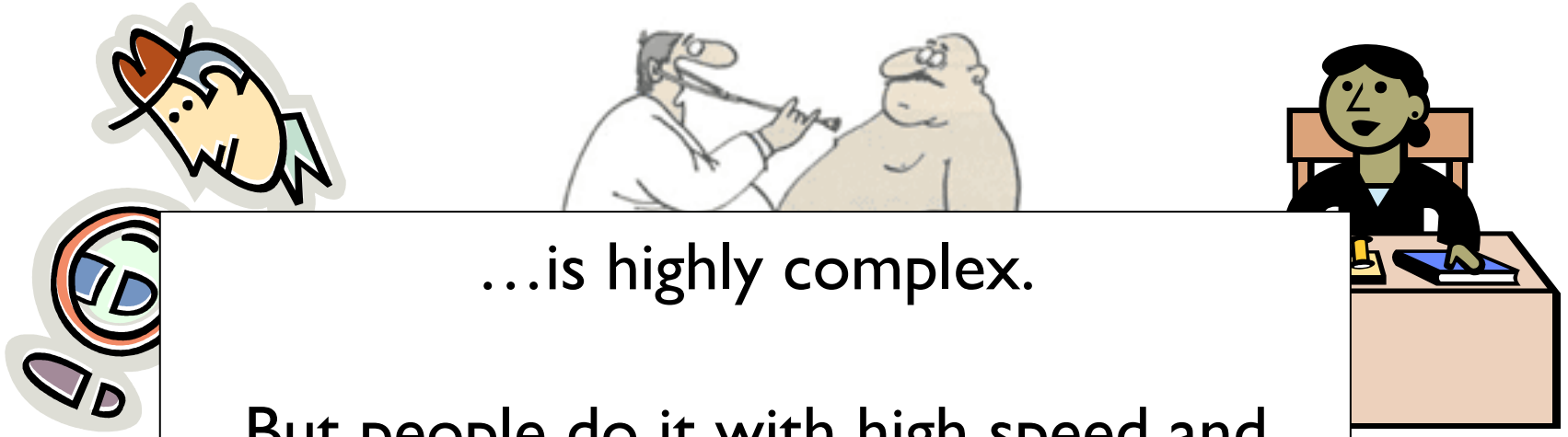


Humans *do* show an effect of priming on *diagnosis time*; the model does too, but less strongly

Summary

- Our experiment shows main effects of both, the reaction task and the count task
- The model suggests that these affects might be due to the two aspects of memory activation proposed by ACT-R
  - However, the model has problems fitting the fine grained effects of priming on diagnosis accuracy

Hypothesis generation…



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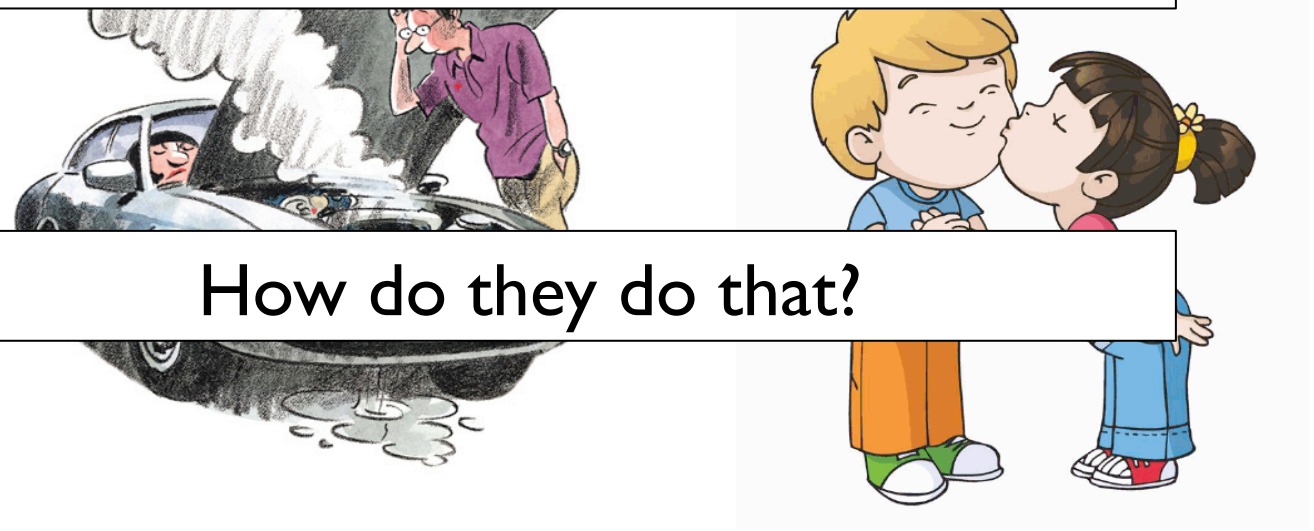
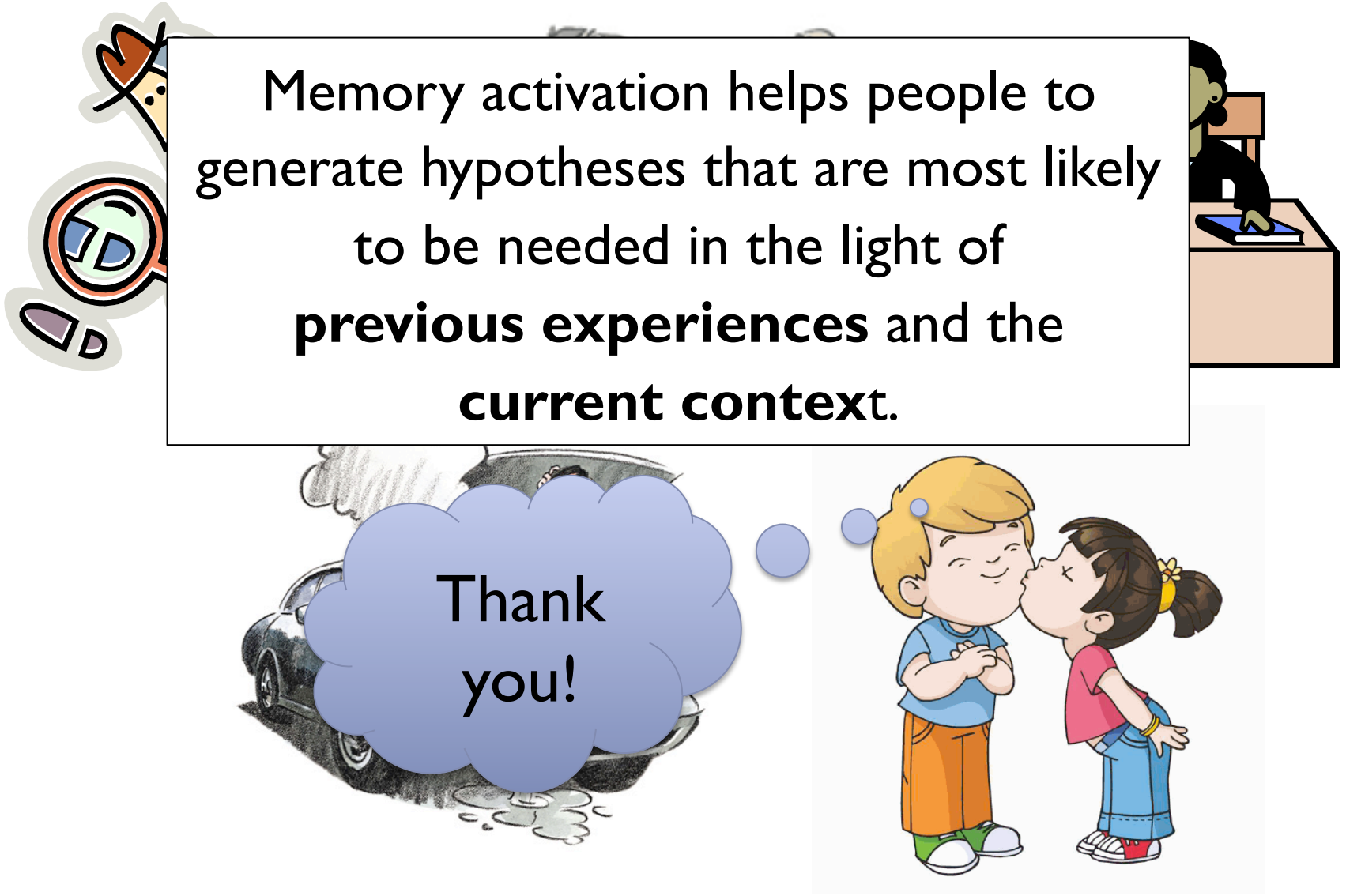


How do they do that?

Conclusion


Memory activation helps people to generate hypotheses that are most likely to be needed in the light of **previous experiences** and the **current context**.
Thank you!