



# Sensori-motor grounding of numerical cognition

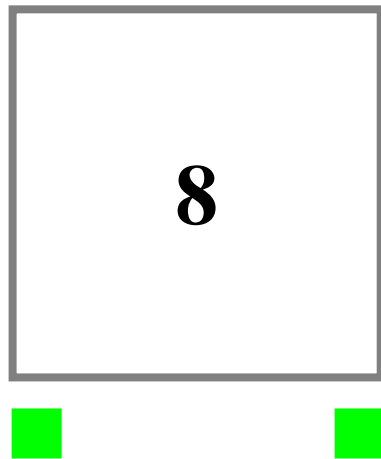
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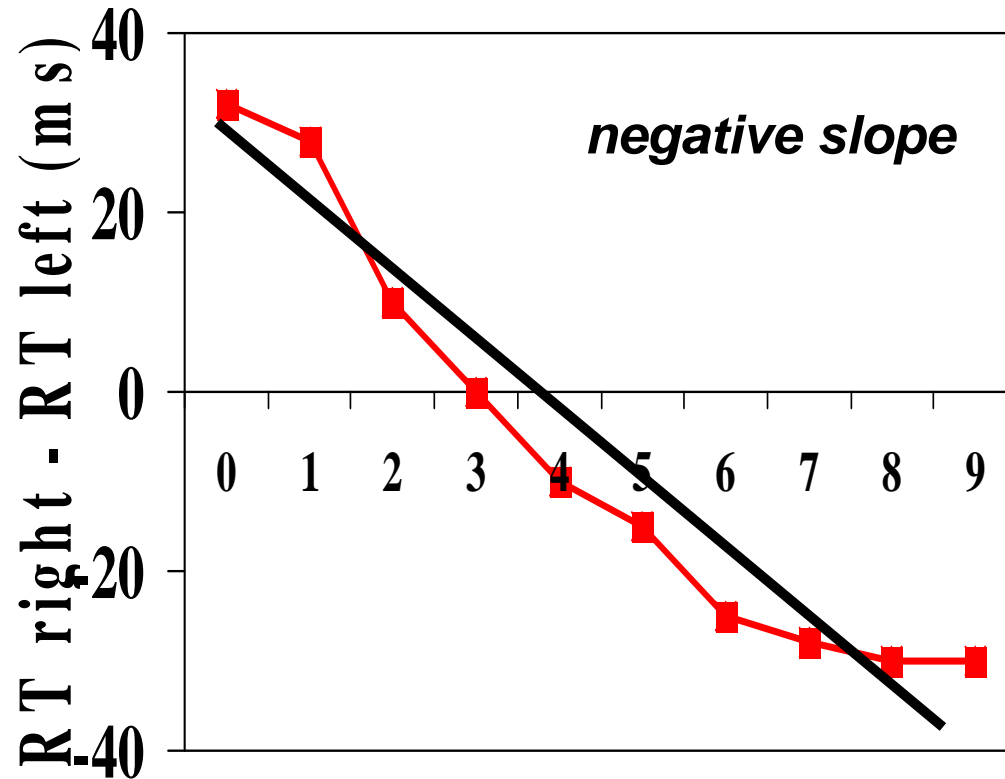
# Mental Arithmetic

- ... is abstract symbol manipulation par excellence
- but: **analog** magnitude representation (size effect, distance effect)
- number representations are
  - **Grounded** – in the physical world
  - **Embodied** – based on our experience
  - **Situated** – task-dependent

# SNARC Effect



odd or even?



Stimulus

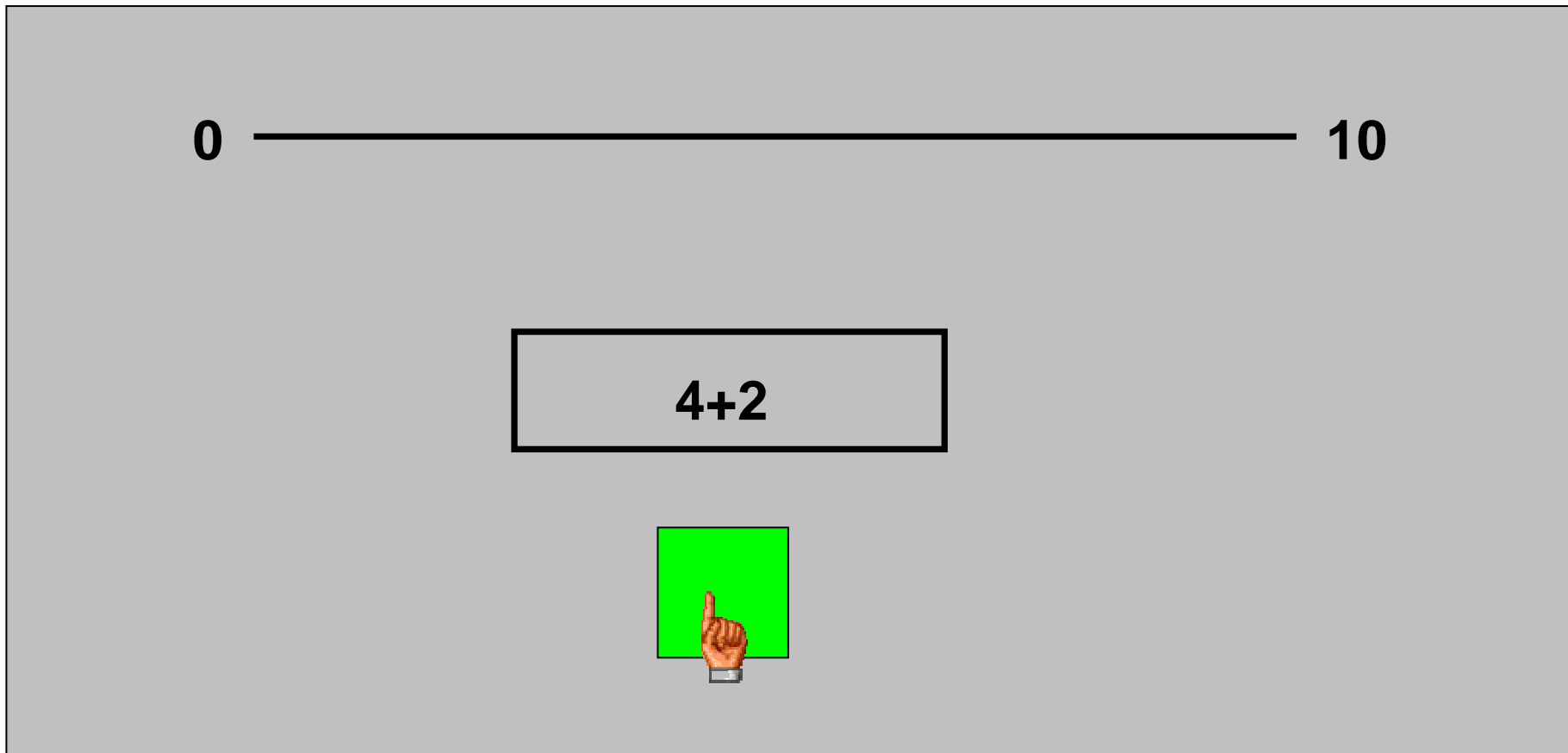
**S**patial-**N**umerical **A**ssociation of **R**esponse **C**odes

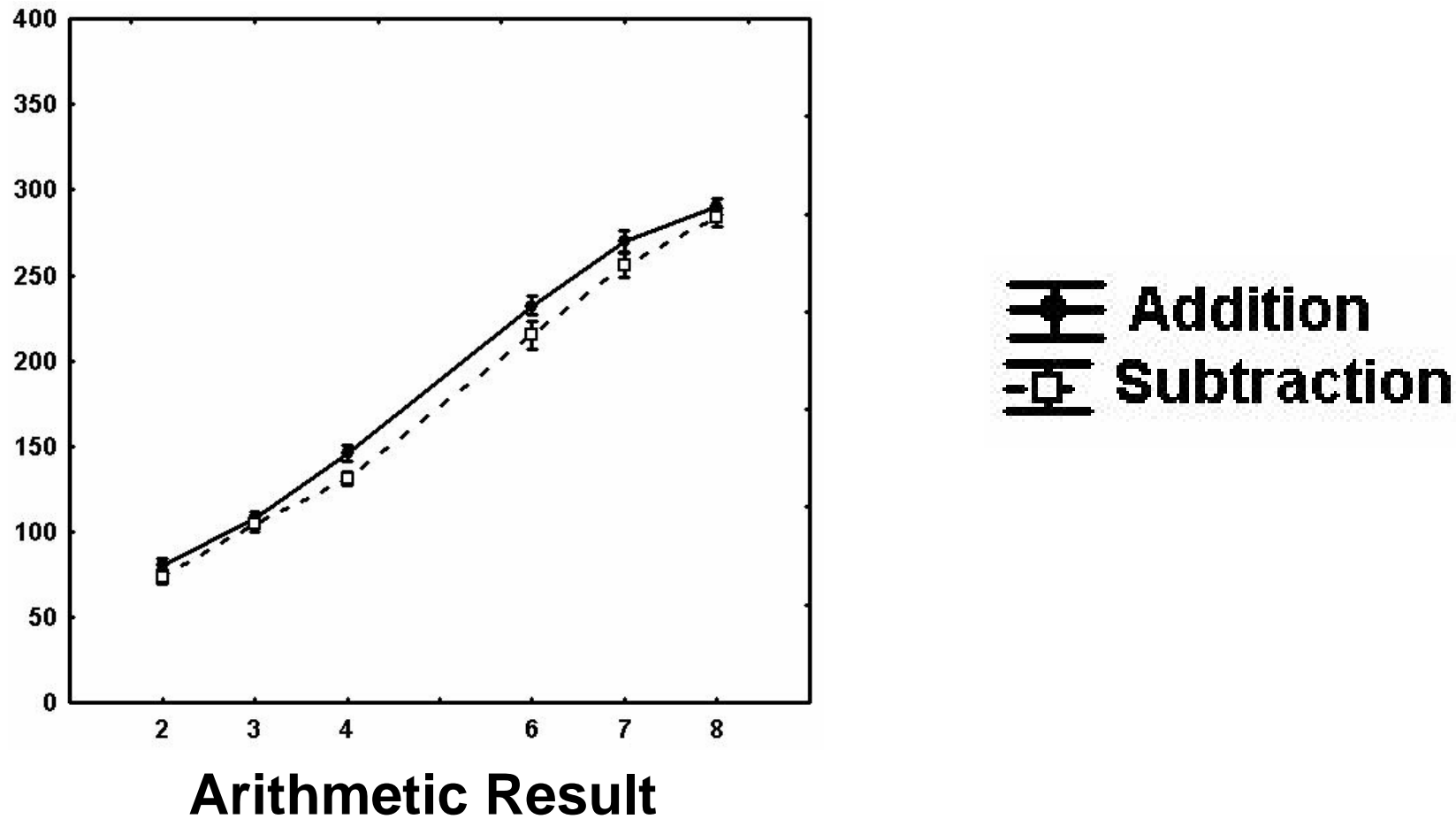
# Number Representations are

- **Grounded**: vertical SNARC – more is up  
(Schwarz & Keus, 2004, P&P)
- **Embodied**: finger counting habit  
modulates adult SNARC (Fischer, 2008, Cortex)
- **Situated**: effects of task/context/WMem
  - Imagery instruction (Bächtold et al., 1998, Neuropsychologia)
  - Reading direction (Fischer et al. 2009, Exp Psy)
  - Digit order in memory (Lindemann et al., 2007, QJEP)

# Effects on Arithmetic

- **Operational Momentum** (Pinhas & Fischer, 2008, Cognition)

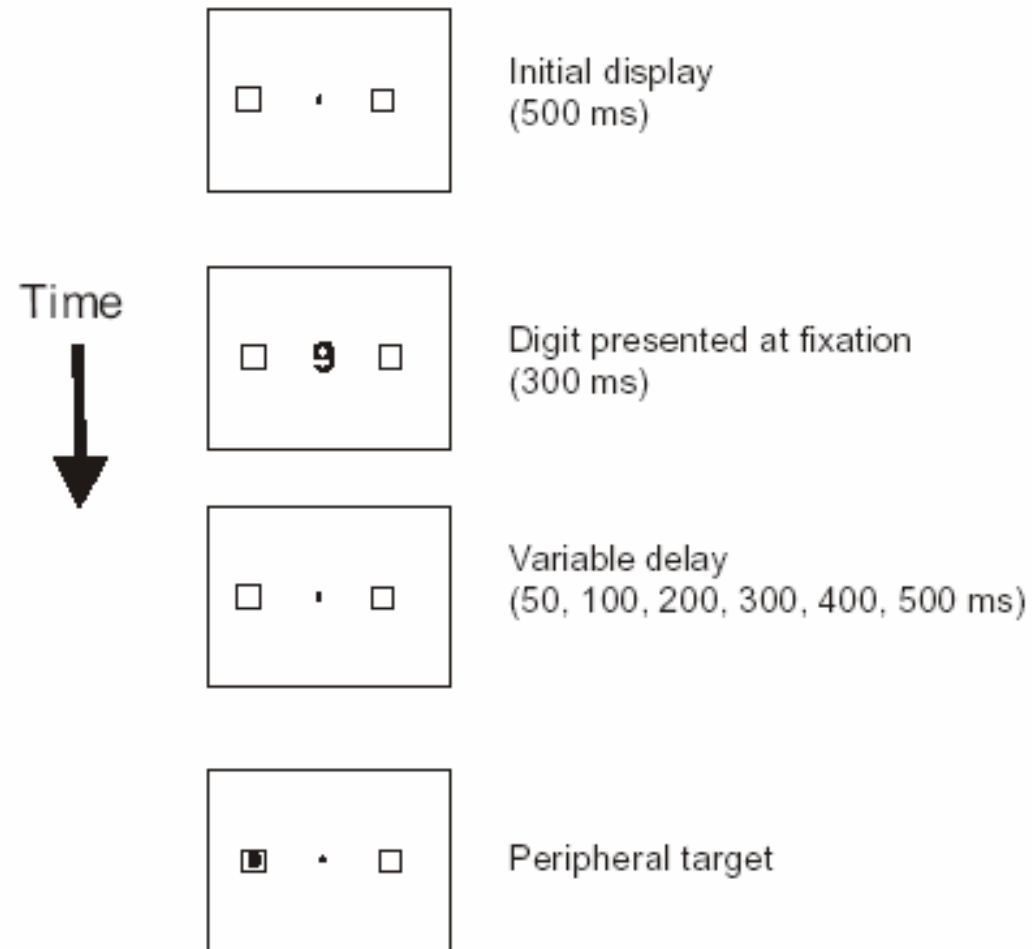




→ chronometric studies to develop  
the embodied cognition framework  
grounding → embodiment → situatedness

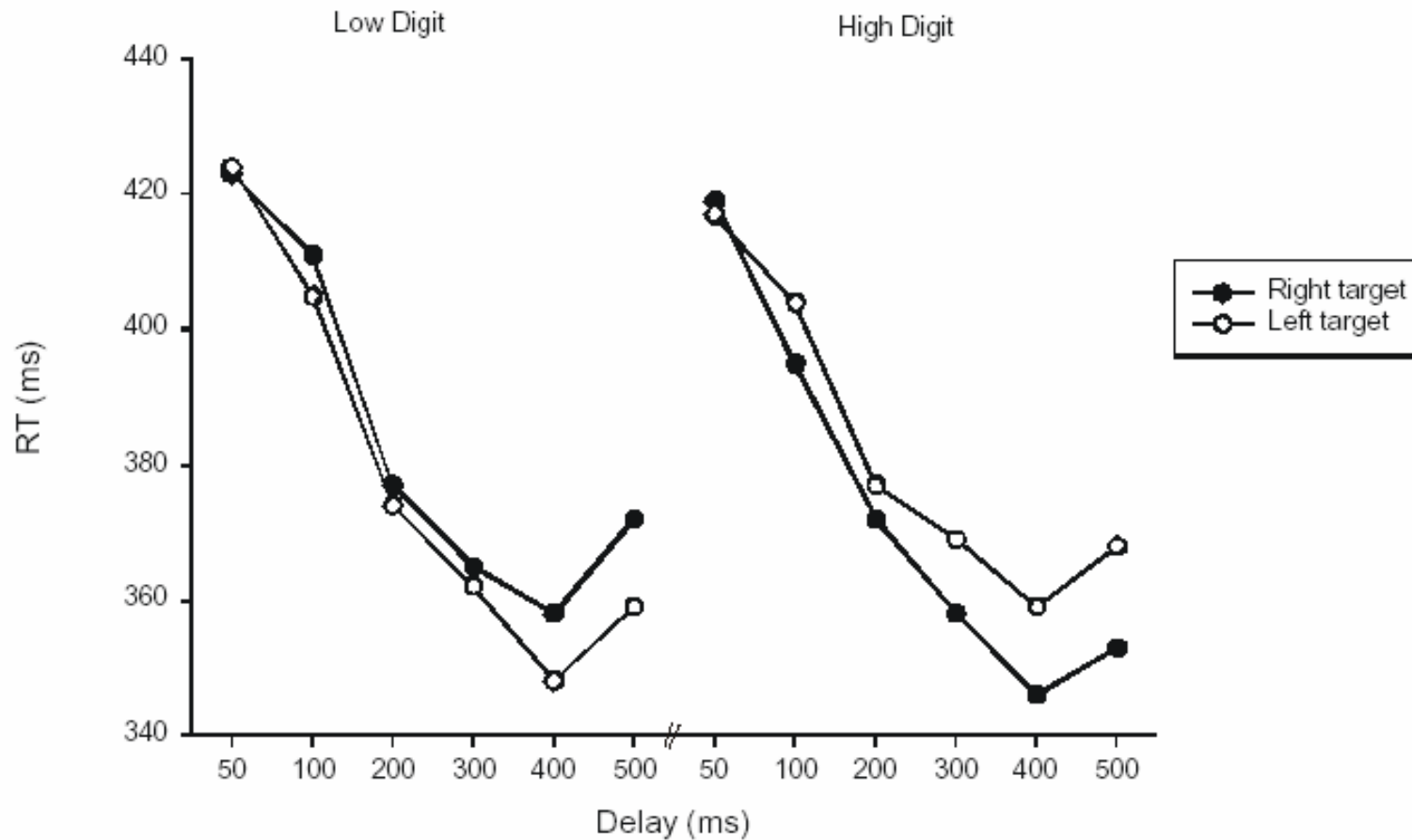
# Attentional Bias from Numbers

A



# Attentional Bias from Numbers

B



Fischer et al., Nature Neuroscience (2003)



# Scanning Directions Matter

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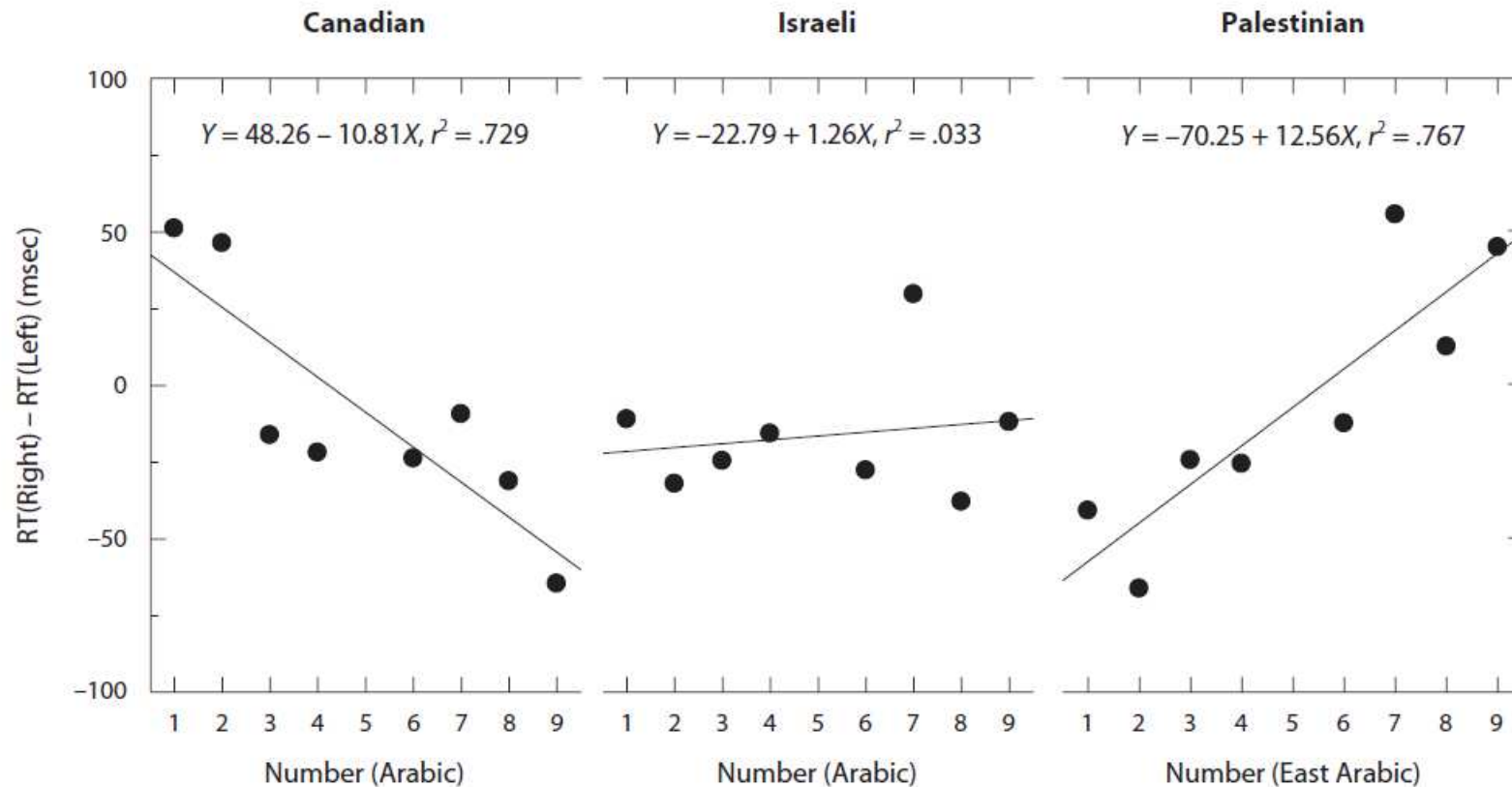


Figure 1. Mean SNARC effect [RT(right) - RT(left) in msec] as a function of digit presented in the parity task with Canadian, Israeli, and Palestinian participants. Direction of reading words and numbers for each group indicated by arrows.

# References

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\*\* (this is the key paper on the EUCOG II web site; contact me for more information)