The Association between Number Magnitude and Space is dependent on notation

Evidence from a perceptual orientation task

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The Association between Number Magnitude and Space

- In most cultures, responses to relatively larger numbers are faster for the right hand, those to smaller numbers for the left hand, even when number magnitude is irrelevant to the task.

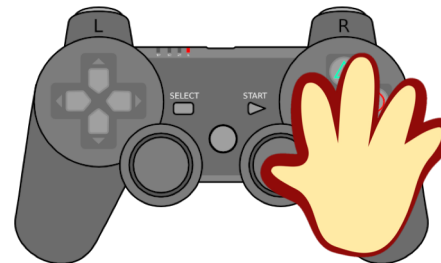- the Spatial-Numerical Association of Response Codes effect (the SNARC effect)

Dehaene et al., 1993

Classic paradigm:
the parity judgement task

Welcome to our experiment!

In this experiment, you will see some Arabic numbers.

press the left key if the present number is odd.

press the right key if the present number is even.

7

4

(NUMBERS FROM 0-9)

Background

Dehaene et al., 1993
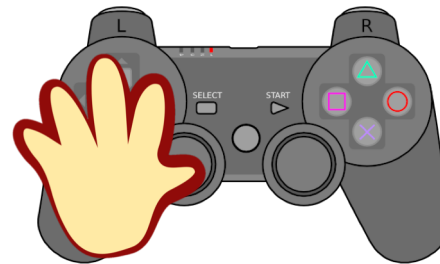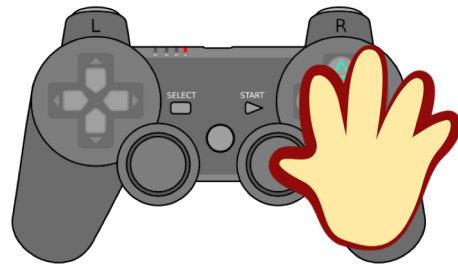
Classic paradigm:
the parity judgement task

In the next section, the rules change

press the left key if the present number is even.
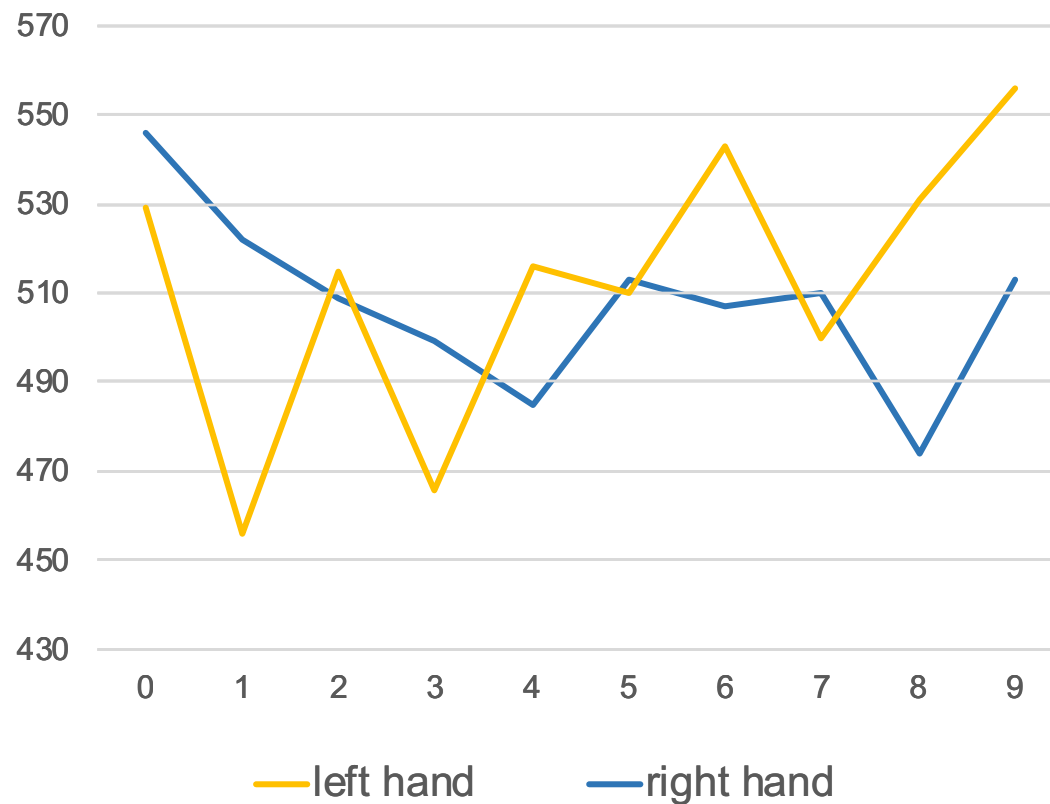
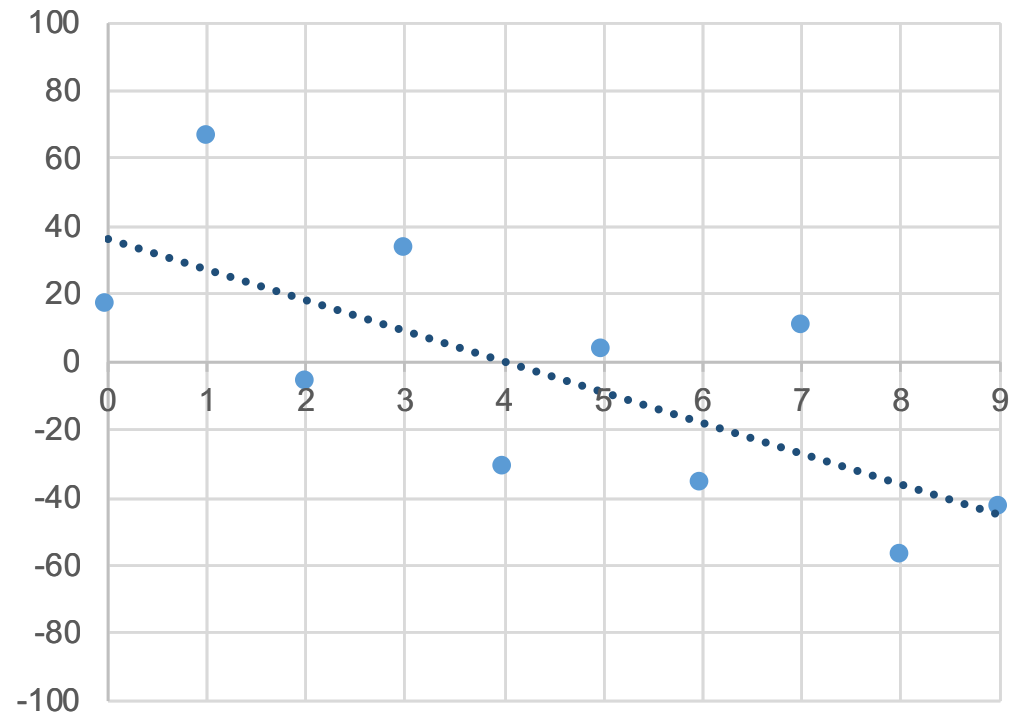press the right key if the present number is odd.

7

4

(NUMBERS FROM 0-9)

Background

Dehaene et al., 1993

Classic paradigm:
the parity judgement task

Mean Reaction Time

Background

Yu et al., in submitted

Classic paradigm:
the parity judgement task

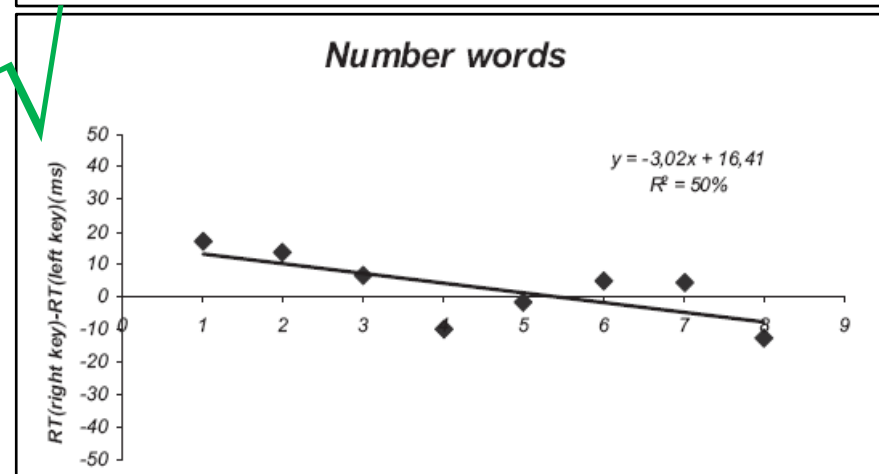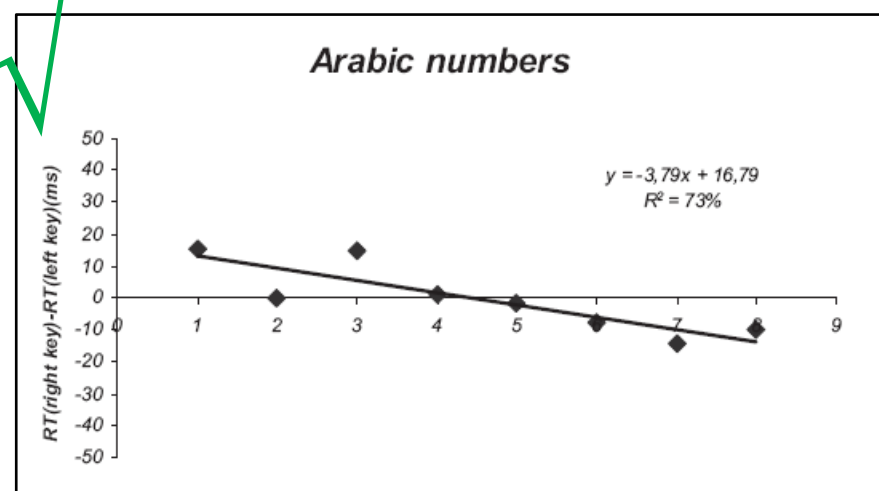**RT(right hand) minus RT(left hand)**

Background

Does the SNARC Effect Depend on the Notations ?

Background

Does the SNARC Effect Depend on the Notations ?

- In the parity judgement task

Arabic Number	Number Words
0	null
1	eins
2	zwei
3	drei
4	vier
5	fünf
6	sechs
7	sieben
8	acht
9	neun

Arabic numbers

$y = -3,79x + 16,79$
$R^2 = 73\%$

RT(right key)-RT(left key)(ms)

Number words

$y = -3,02x + 16,41$
$R^2 = 50\%$

RT(right key)-RT(left key)(ms)

Background

Does the SNARC Effect Depend on the Notations ?

- Why familiar and unfamiliar notations can process the same SNARC effect ?

- Does this notation-independent SNARC effect phenomenon really stable? We need to use another paradigm to prove it !
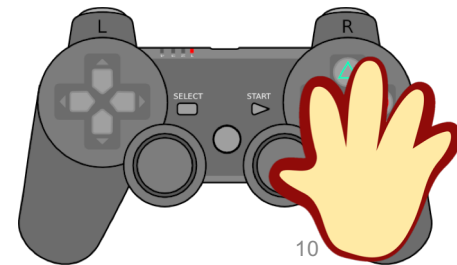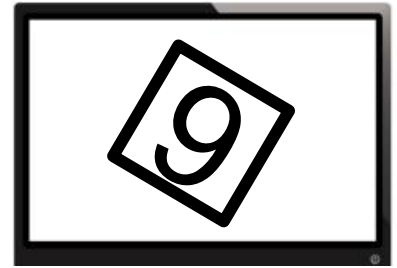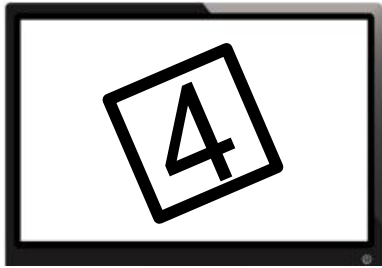
Background

New paradigm:
the perceptual orientation task

Welcome to our experiment!

In this experiment, your will see some frames .
Each one contains a number.
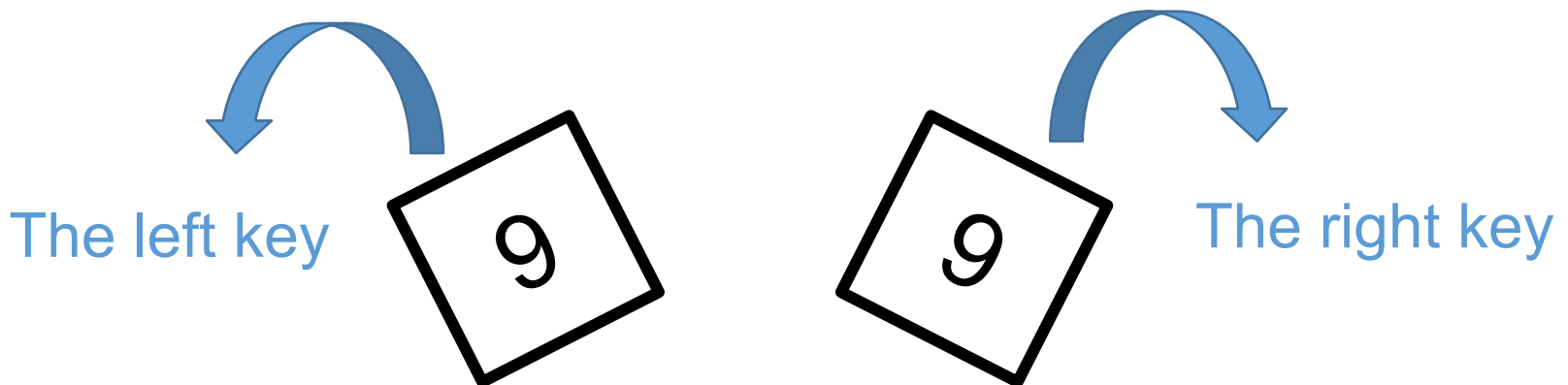press the left key if the frame is left-rotated.
press the right key if the frame is right-rotated.

New Paradigm

New paradigm:
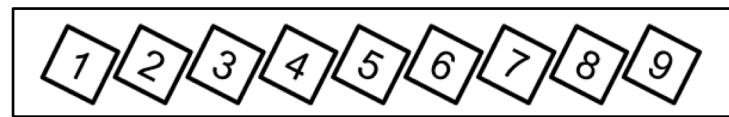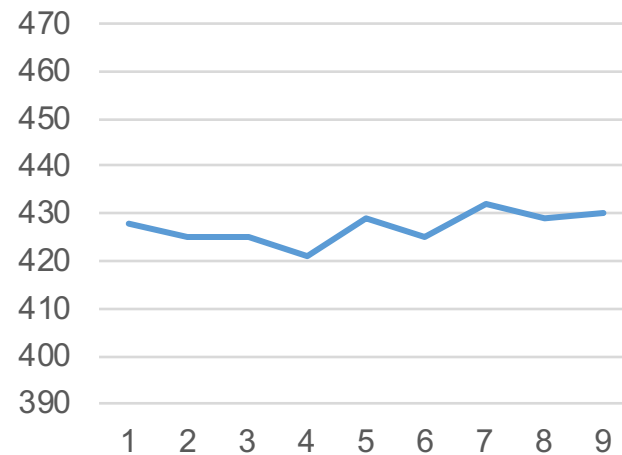# the perceptual orientation task

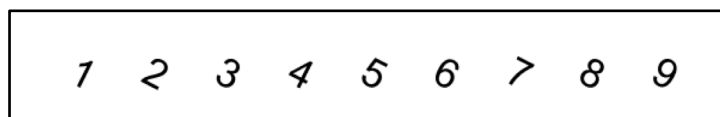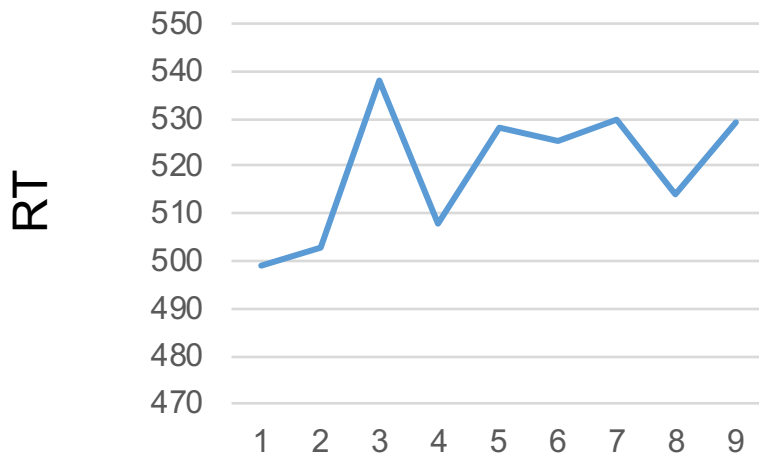## Advantage 1: simpler and easier

· Never need to change the responding rule

· the task demand has nothing to do with numbers.

The left key   9   9   The right key

New paradigm:
the perceptual orientation task

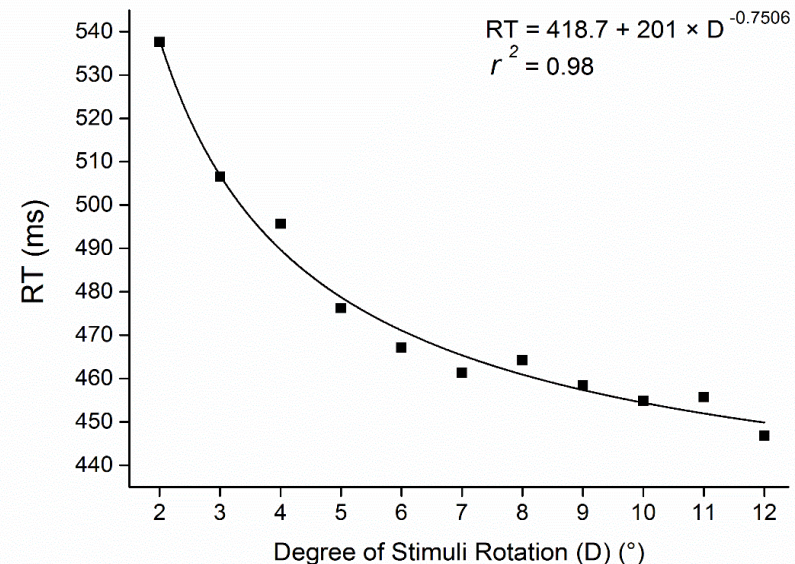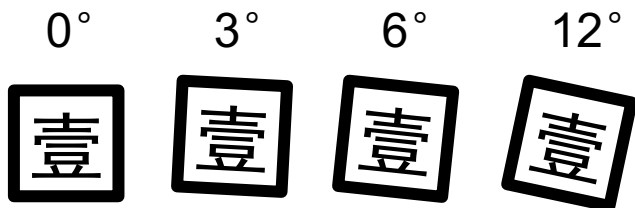## Advantage 2: control between different numbers

• Add the frame to control different physical features of numbers

New paradigm:
the perceptual orientation task

Advantage 3: control between different notations

- Using an adaptive program to equate the RTs of different notations (Ex. If the reaction times are longer for Chinese numbers than for Arabic numbers, the program would enlarge the degree of rotation for Chinese stimuli to make it easier.)

0°　　3°　　6°　　12°

$$RT = 418.7 + 201 \times D^{-0.7506}$$
$$r^2 = 0.98$$

RT (ms)

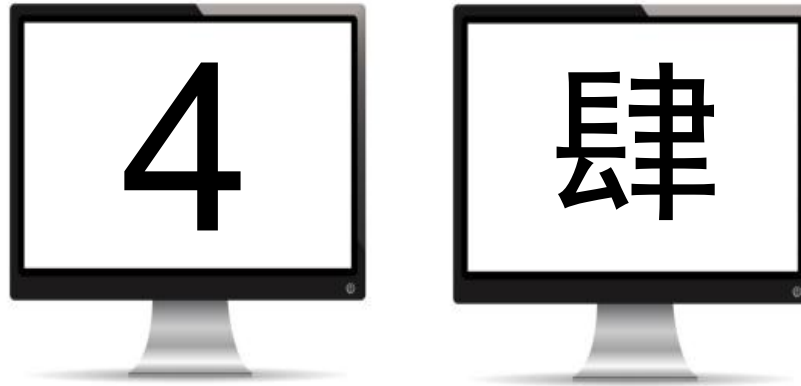Degree of Stimuli Rotation (D) (°)

New paradigm

Research hypotheses

- The SNARC effect would occur for both Arabic (familiar) and Chinese(unfamiliar) numbers in the parity task.

- Under the control of confounding variables, the SNARC effect would only occur for Arabic numbers but be absent for Chinese numbers

New paradigm

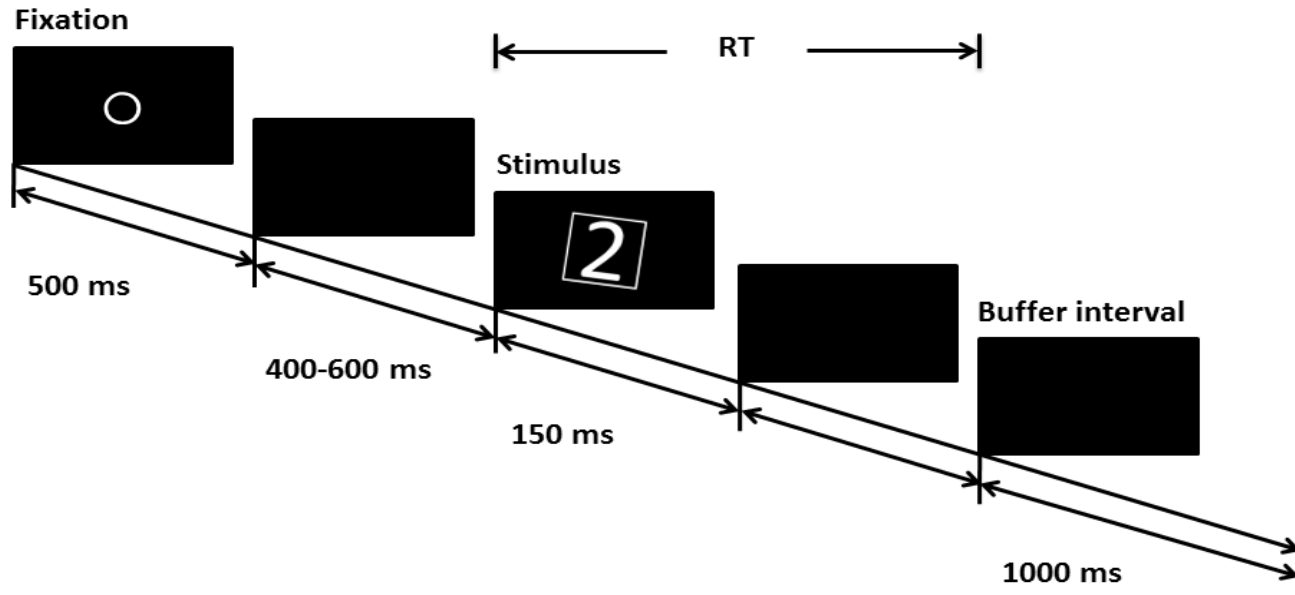# Participants & Procedures

The classic parity judgement task

Method

Participants & Procedures

The Main Experiment

Arabic	1	2	3	4	5	6	7	8	9
Chinese	壹	贰	叁	肆	伍	陆	柒	捌	玖

Method

Results

Arabic

$$dRT = -9.05 \times M + 36.40$$

Chinese

$$dRT = -7.71 \times M + 25.38$$

Sig

$t(17) = -4.30, p < .01$

Sig

$t(30) = -4.89, p < .05$

Results   *(One-sample t-test on the slope of dRT)*

17
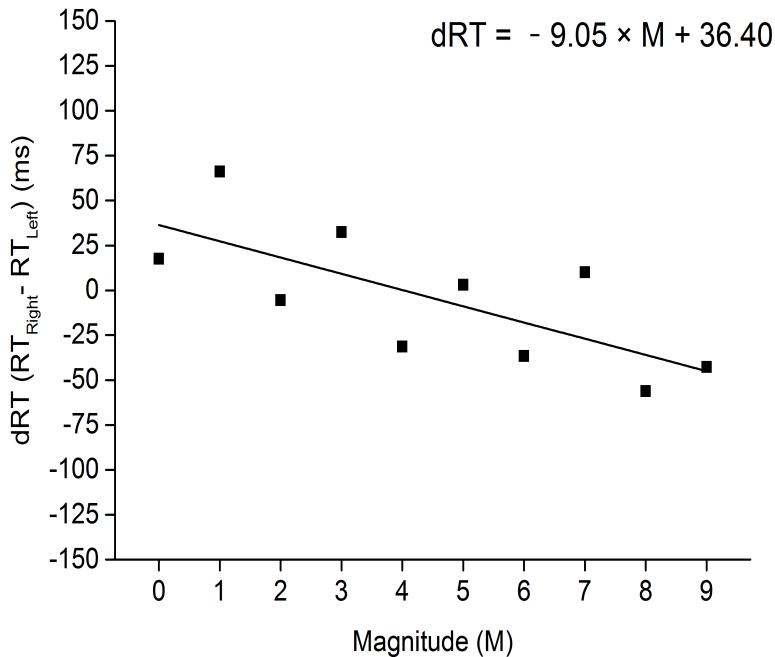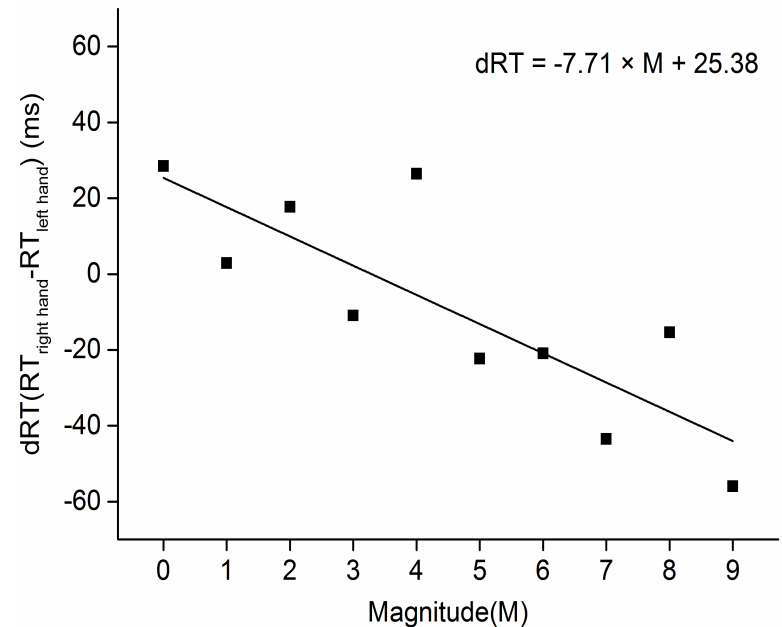
Results

The perceptual orientation task

Arabic — A

$dRT = -2.25 \times M - 1.68$

Sig

$t(21) = -2.41, p < .05$

Chinese — B

$dRT = .75 \times M - 16.68$

Non-Sig

$t(21) = .84, p = .408$

Results   *(One-sample t-test on the slope of dRT)*
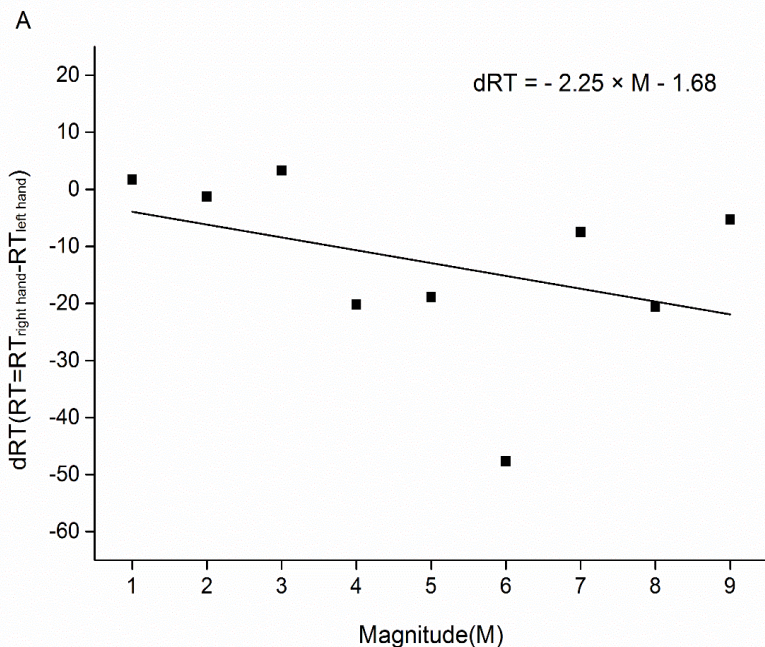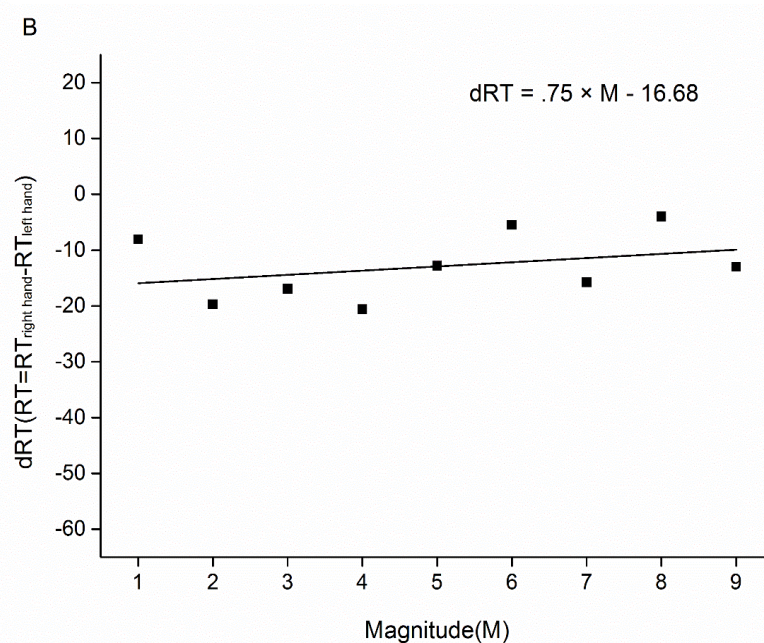
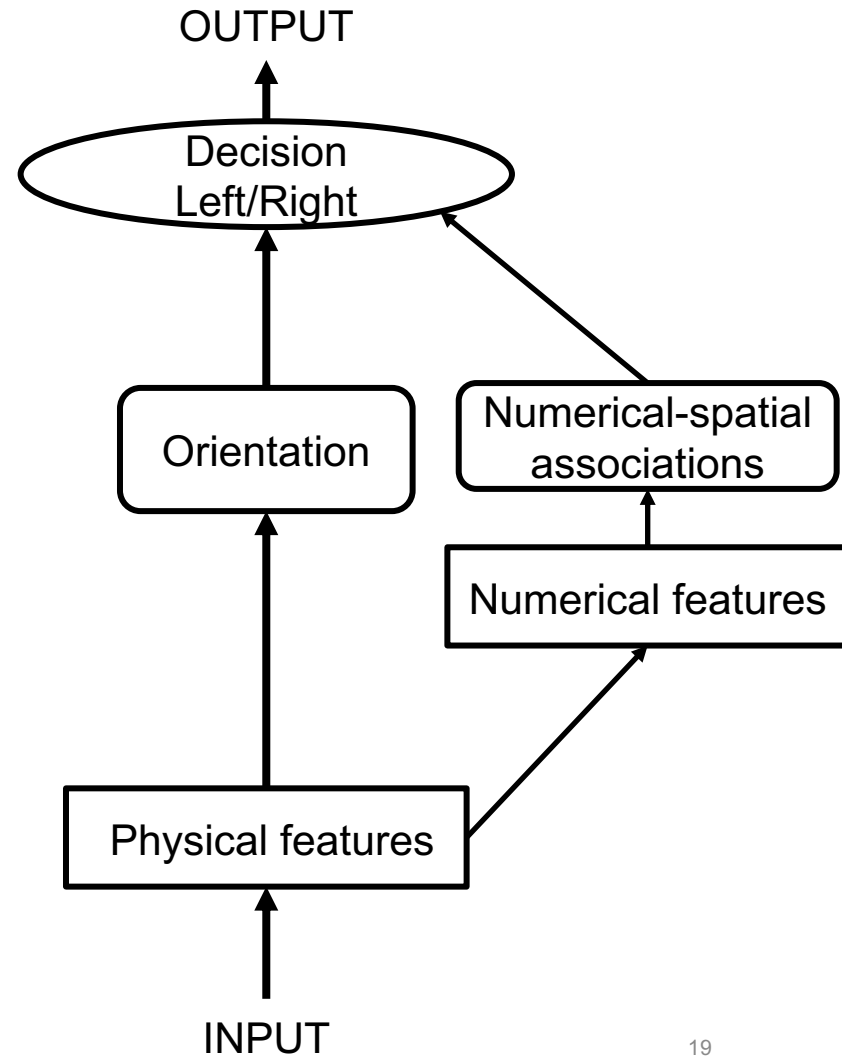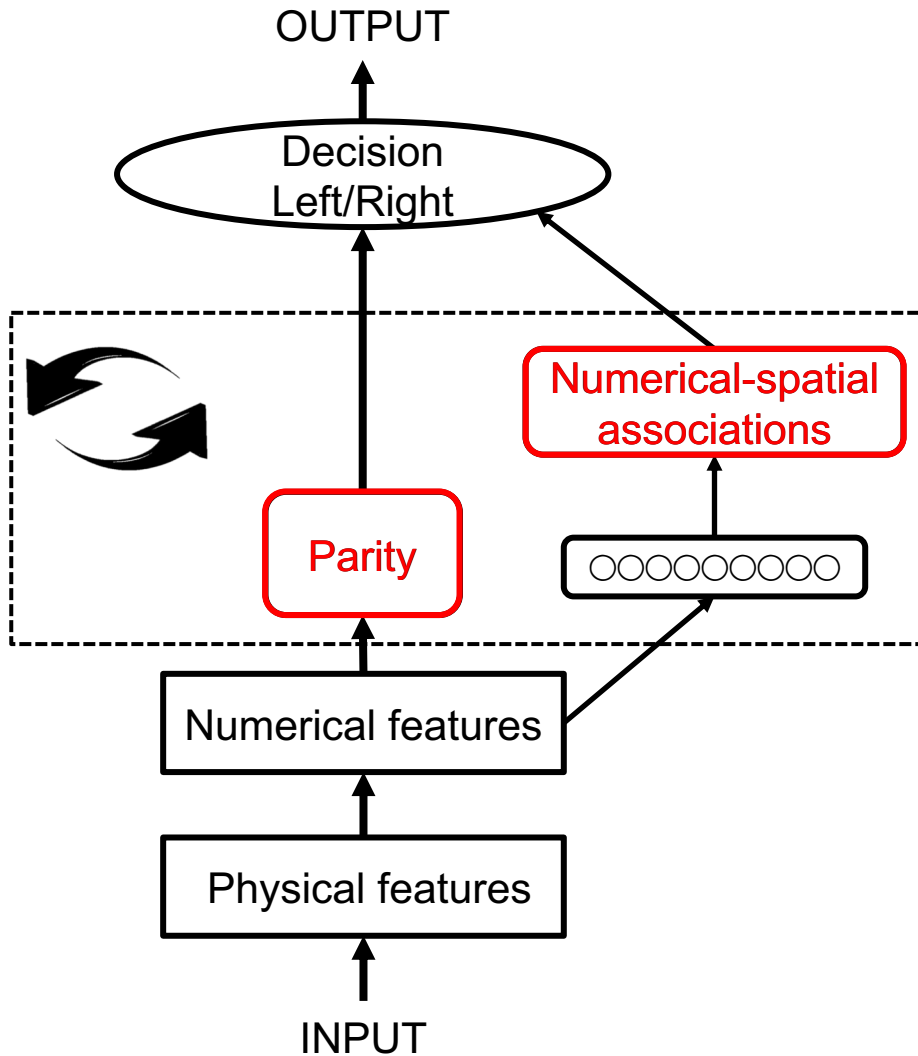# The parity task vs. the new perceptual task
Which represents the automatic process?

Discussions

THANK YOU FOR LISTENING

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