Dancing Numbers
Exploring Dancers' Space-Numbers Assosiations

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BACKGROUND THEORIES

THE STUDY

CURRENT DISCUSSION

BACKGROUND THEORIES
THE SNARC EFFECT

What is the SNARC ?

Embodied Numerosity

The spatial-numerical association response codes (SNARC effect, Dehaene et al., 1993) describes the association between numerical magnitude and external space.

Embodied numerosity: Implicit hand-based representations influence symbolic number processing across cultures

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- **small numbers** are associated with left space, **larger numbers** with right space
  (Gevers et al., 2006; Restle, 1970)
- **parity judgment task** (Wood et al., 2008)

Sensori-motor spatial training of number magnitude representation

Ursula Fischer · Korbinian Moeller · Martina Bientzle · Ulrike Cress · Hans-Christoph Nuerk

What is the SNARC ? · **A Theory of Magnitude (ATOM)**

The spatial-numerical association response codes (SNARC effect, Dehaene et al., 1993) describes the association between numerical magnitude and external space.

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- **parity judgment task** (Wood et al., 2008)

A theory of magnitude: common cortical metrics of time, space and quantity

Vincent Walsh

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Review

The parietal cortex and the representation of time, space, number and other magnitudes

Domenica Bueti[1] and Vincent Walsh[2,*]

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BACKGROUND THEORIES
DANCE EXPERTISE

Dance is an artistic discipline based on the movement of the whole body in space.

Ballet Dance Training

- Counting (from 1 to 8)
- Performing sequences from the right and from the left

(Jola et al., 2011; Minvielle-Moncla et al., 2008; Poon and Rodgers, 1997)

Effect of **dance expertise**: the perception of the temporal and spatial stimuli (Henley, 2015; Jola et al., 2011; Magnani et al., 2014)

THE STUDY
GOAL AND HYPOTHESIS

Goal

- To investigate whether the **sensory-motor training** modulate the **numerical representation**

- To explore how **different dance styles** can influence the numerical representation

Hypothesis

- A minor SNARC effect in **expert dancers** (Hoffmann et al., 2014, Jola et al., 2011)

vs. Sensory-motor training (Ficher et al., 2016)

- **Similar SNARC** effects in non-dancers and dancers not exposed to number counting
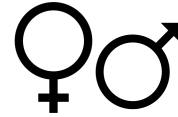
vs. ATOM (Walsh, 2003)

90 participants
aged between 18 and 35

Females

Right-handed

Normal vision or
corrected-to-normal

No history of **neuropsychological disorder** or **drug abuse**

Monetary compensation:
€ 10/15

30 non-dancers
control group

- no experience in dance or dance-like activity

30 ballet dancers
experimental group

- 10 year of experience x 7 h of weekly training
- professional dancers, teachers, choreographers

(Calvo-Merino, 2004; Cross et al., 2006; Jola et al., 2011; Orlandi, 2017)

30 hip hop freestyle dancers
control group + sensory-motor training

- 10 year of experience x 7 h of weekly training
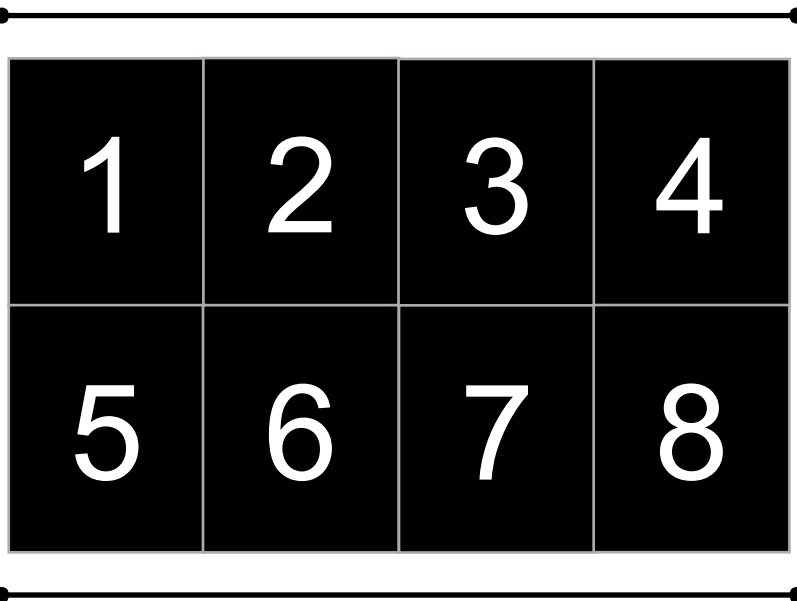- professional dancers, teachers, choreographers

METHODS : STIMULI (3/4)

2 counterbalanced tasks: **parity judgment** task (PJT) and **simon** task (ST)
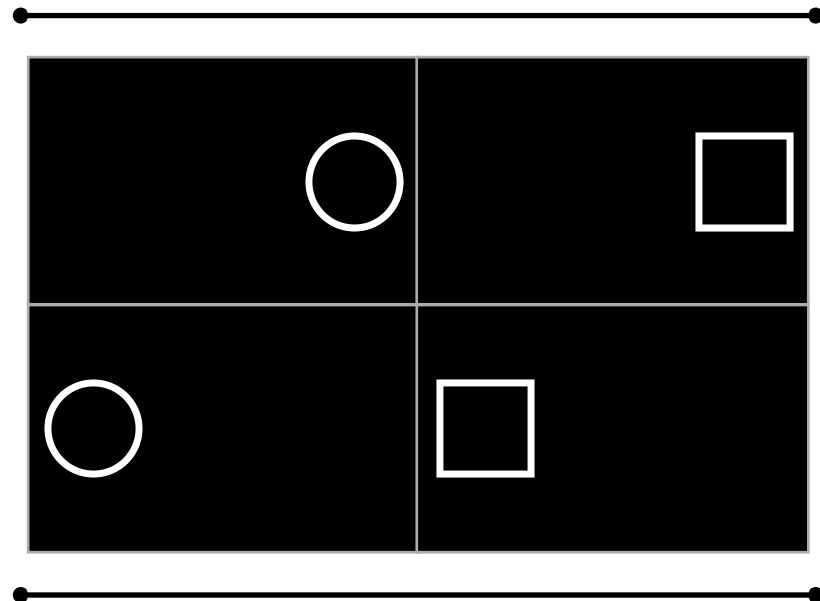
Numbers
(integer numbers from 1 to 8)

(Nuerk et al., 2005b; Wood et al., 2006)

Geometric figures
(circle and square)

(Tagliabue et al., 2009; Rubichi et al., 2000)

METHODS : TASK AND PROCEDURES (4/4)

Before the experiment

Experimental tasks

Parity Judgment Task

- Instruction and information sheet
- **Informed consent**
- **Screening form**

- In each tasks: 320 repetitions, 2 blocks (10 min each)
- Pseudo-randomized and counterbalanced

FIXATION CROSS
500ms

500ms

+

STIMULUS
∞

500ms

3

Time: 5 minutes

Time: 30 minutes
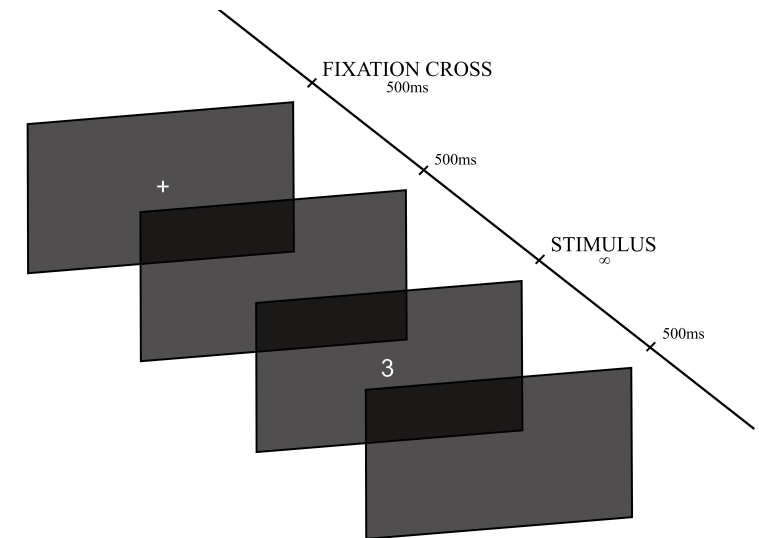
Block A	right hand (key "L") - *even* numbers left hand (key "A") - *odd* numbers
Block B	right hand (key "L") - *odd* numbers left hand (key "A") - *even* numbers

METHODS : TASK AND PROCEDURES (4/4)

Before the experiment

Experimental tasks

| Simon Task |

- Instruction and information sheet
- **Informed consent**
- **Screening form**

- In each tasks: 320 repetitions, 2 blocks (10 min each)
- Pseudo-randomized and counterbalanced

FIXATION CROSS
1000ms

STIMULUS
∞

500ms

Time: 5 minutes

Time: 30 minutes
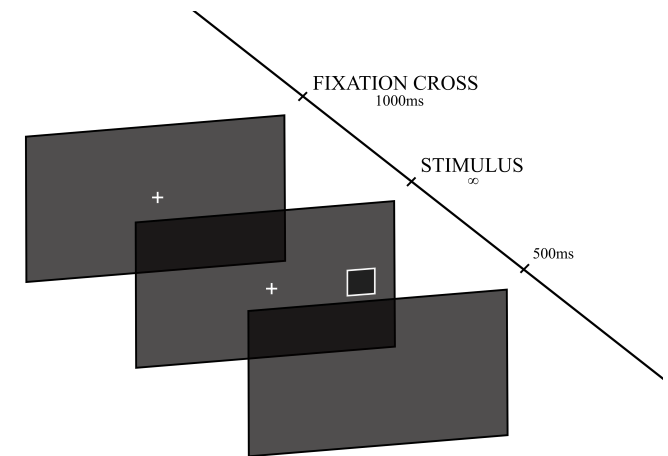
| Block A | right hand (key "L") - *circles*
 left hand (key "A") - *squares* |

| Block B | right hand (key "L") - *squares*
 left hand (key "A") - *circles* |

METHODS : TASK AND PROCEDURES (4/4)

Before the experiment	Experimental tasks	After the experiment
• Instruction and information sheet • **Informed consent** • **Screening form**	• In each tasks: 320 repetitions, 2 bloks (10 min each) • Pseudo-randomized and counterbalanced	• Anagraphic data form, dance experience • Edinburgh Handedness Inventory (EHI) • 24 mathematical operations and mathematical reasoning subtest (WAIS-IV)
Time: 10 minutes	Time: 30 minutes	Time: 20 minutes

METHODS : TASK AND PROCEDURES (4/4)

Before the experiment	Experimental tasks	After the experiment

• Instruction and information sheet • **Informed consent** • **Screening form**		• Anagraphic data form, dance experience • Edinburgh Handedness Inventory (EHI) • 24 mathematical operations and mathematical reasoning subtest (WAIS-IV)

HOW TO RUN THE EXPERIMENT DURING THE COVID-19 EMERGENCY?

THE STUDY
THE ONLINE STUDY

Before the experiment	Experimental tasks	After the experiment

Before the experiment

- Instruction and information sheet (**email**)
- Informed consent and screening (**Qualtrics**)

Experimental tasks

- Software: Psychopy 3.0
- Online platform to run the experiment: **Pavlovia.org**

(Bridges et al., 2020; Cipora et al., 2019; Sauter et al., 2020)

After the experiment

- Online anagraphic data form (**Qualtrics**)
- Mathematical reasoning subtest of WAIS-IV (**Skype**)

Preventive measures:

- Quiet room, limited distractions (no music, emails, messaging or other people)
- Computer or laptop (not tablet or smart phone)

CURRENT DISCUSSION
CRITICAL ISSUES

Design Analysis

- Retrospective design analysis
- Expert elicitation

Online Experiment

- Duration of the experiment
- Situation of emergency

Sample

- Freestyle Hip Hop Group

CURRENT DISCUSSION
CONCLUSIONS

Application issues

- Why should we study **dancers'** space-number associations?
- Embodied **training** and **sport psychology**

Further developments

- Auditory stimuli and whole-body movements
- Brain correlates

THANKS FOR YOUR ATTENTION!

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