

## TraumaCtrl

# Trauma & Control: Self-Regulation of Brain Networks in PTSD

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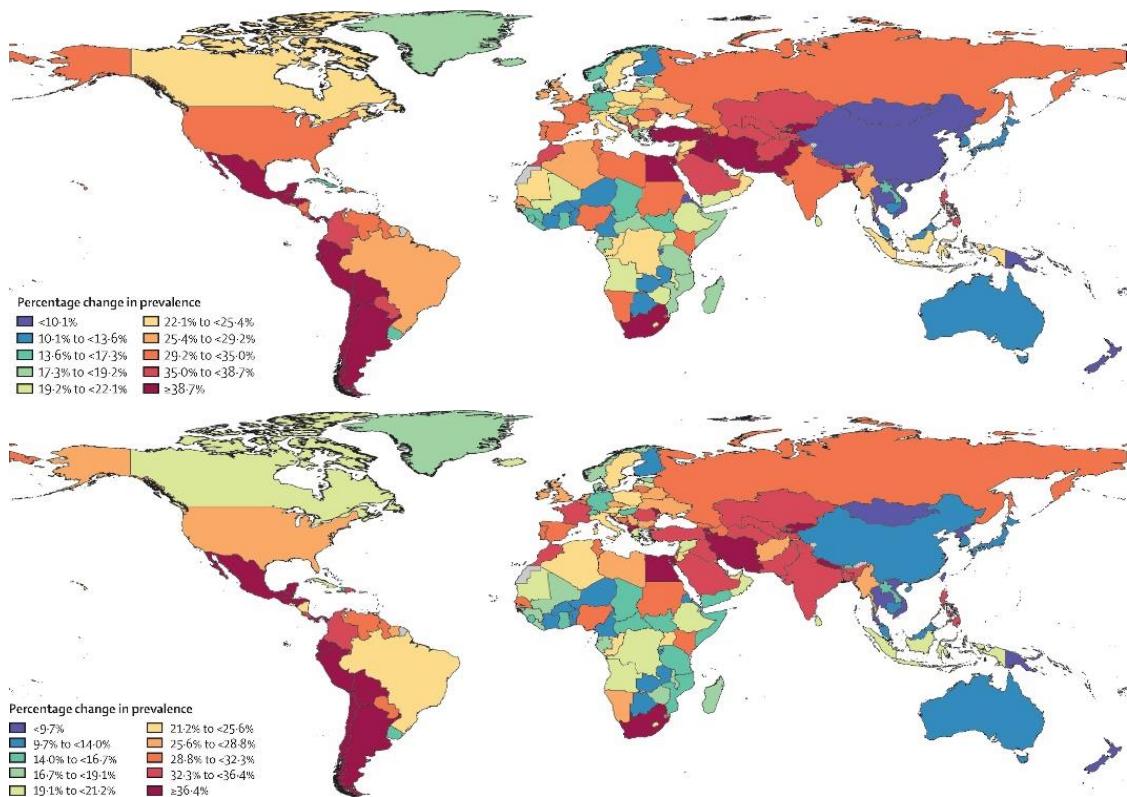
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## Background

# Mental disorders & Resilience



**Years Lived with Disability (YLDs)**

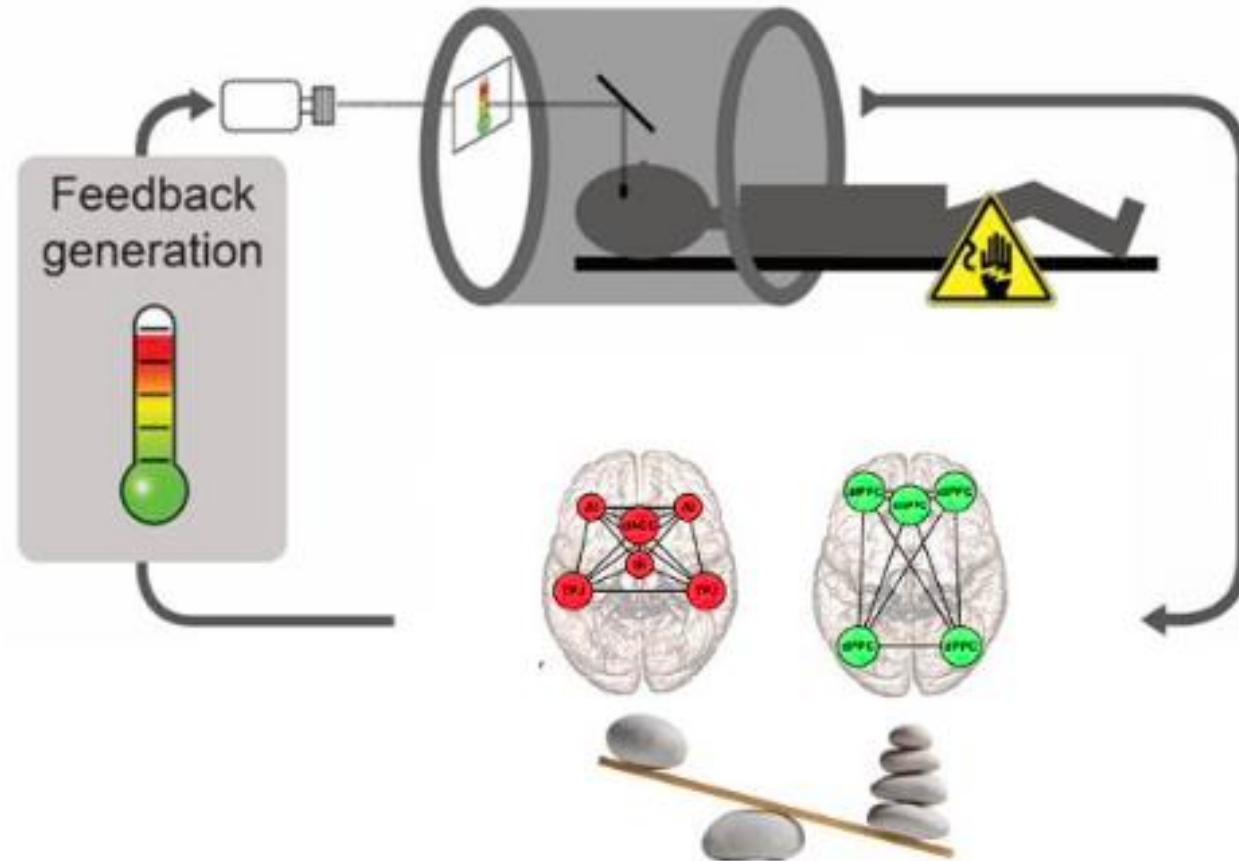
YLDs

All ages	0-14 years	15-24 years	25-49 years	50-69 years	≥70 years
2 Depressive disorders	5 Conduct disorder	2 Depressive disorders	3 Depressive disorders	5 Depressive disorders	11 Depressive disorders
8 Anxiety disorders	8 Anxiety disorders	4 Anxiety disorders	6 Anxiety disorders	16 Anxiety disorders	19 Anxiety disorders
20 Schizophrenia	18 Idiopathic developmental intellectual disability	12 Bipolar disorder	9 Schizophrenia	19 Schizophrenia	27 Other mental disorders
27 Other mental disorders	23 Autism spectrum disorders	13 Conduct disorder	19 Other mental disorders	22 Other mental disorders	36 Schizophrenia
28 Bipolar disorder	24 Depressive disorders	22 Schizophrenia	20 Bipolar disorder	27 Bipolar disorder	45 Bipolar disorder
38 Conduct disorder	39 ADHD	28 Eating disorders	36 Eating disorders	52 Autism spectrum disorders	63 Autism spectrum disorders
43 Idiopathic developmental intellectual disability	54 Bipolar disorder	30 Idiopathic developmental intellectual disability	42 Autism spectrum disorders	64 Idiopathic developmental intellectual disability	87 Idiopathic developmental intellectual disability
46 Autism spectrum disorders	65 Eating disorders	32 Autism spectrum disorders	44 Idiopathic developmental intellectual disability	133 ADHD	152 ADHD
55 Eating disorders	92 Schizophrenia	36 Other mental disorders	86 ADHD	NA Eating disorders	NA Eating disorders
84 ADHD	94 Other mental disorders	60 ADHD	NA Conduct disorder	NA Conduct disorder	NA Conduct disorder



Neurofeedback

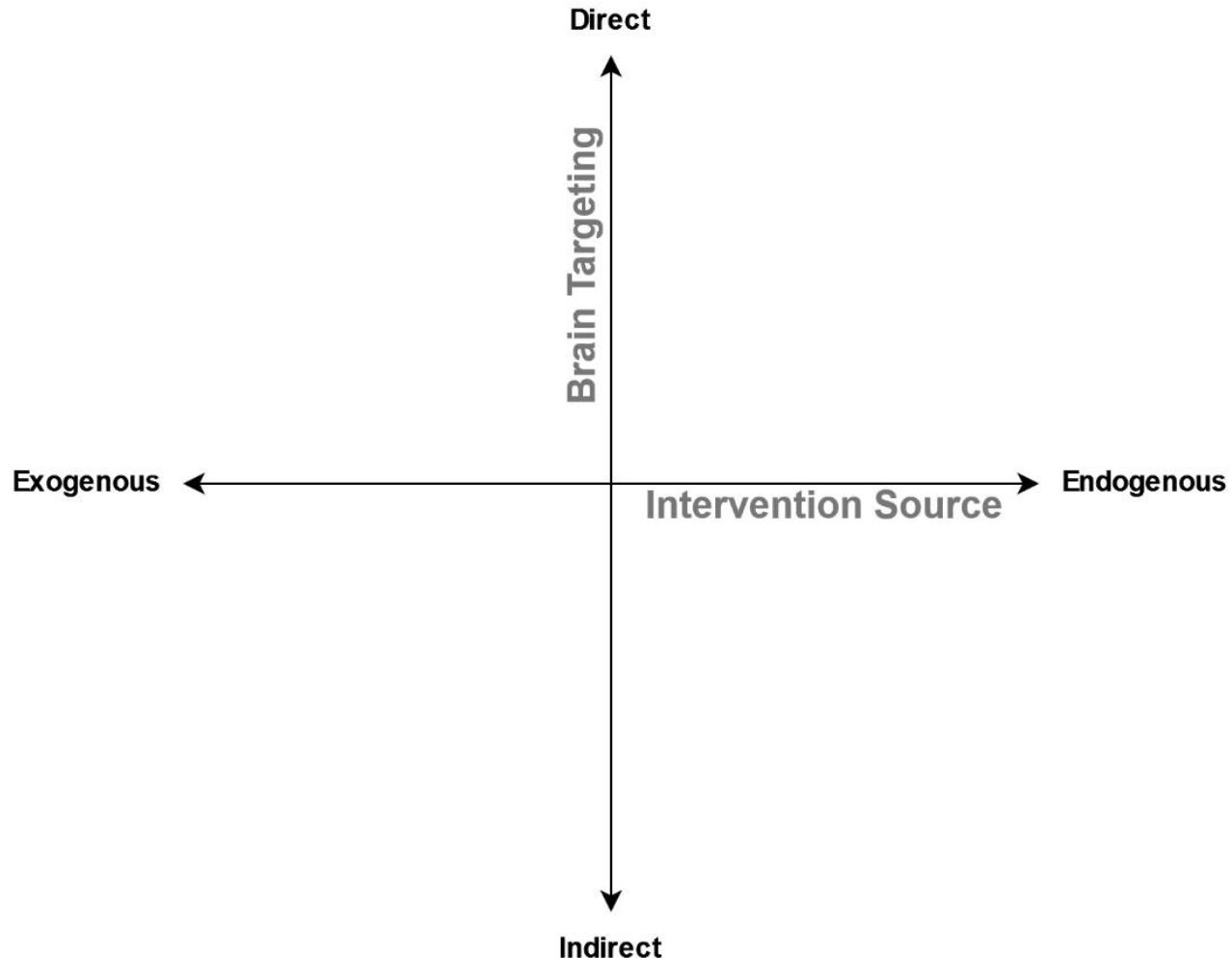
## Real-time fMRI neurofeedback





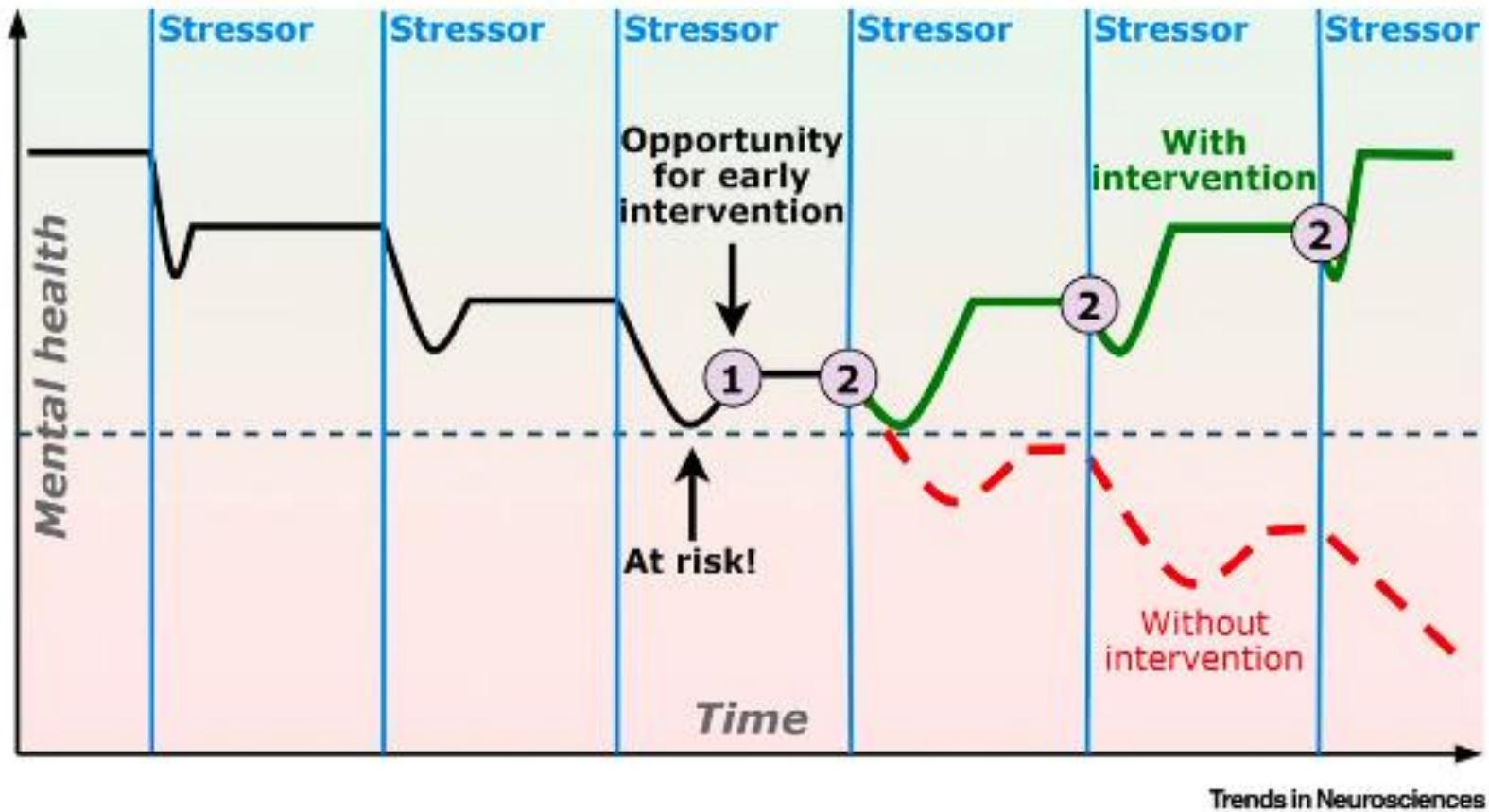
Neurofeedback

## Direct endogenous neuromodulation



## Background

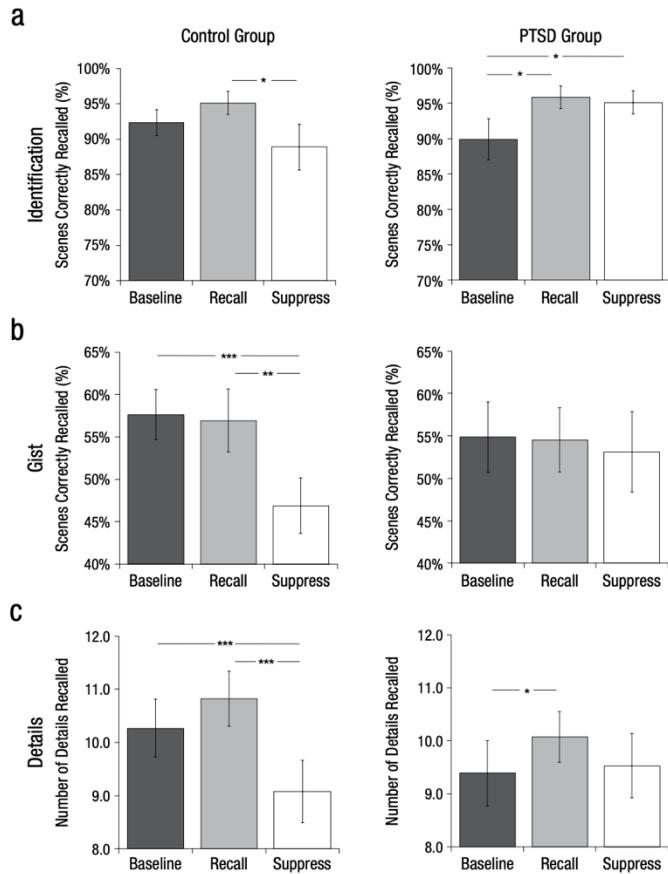
# Neuroscience based intervention strategy



# PTSD and intrusions of unwanted memories and thoughts

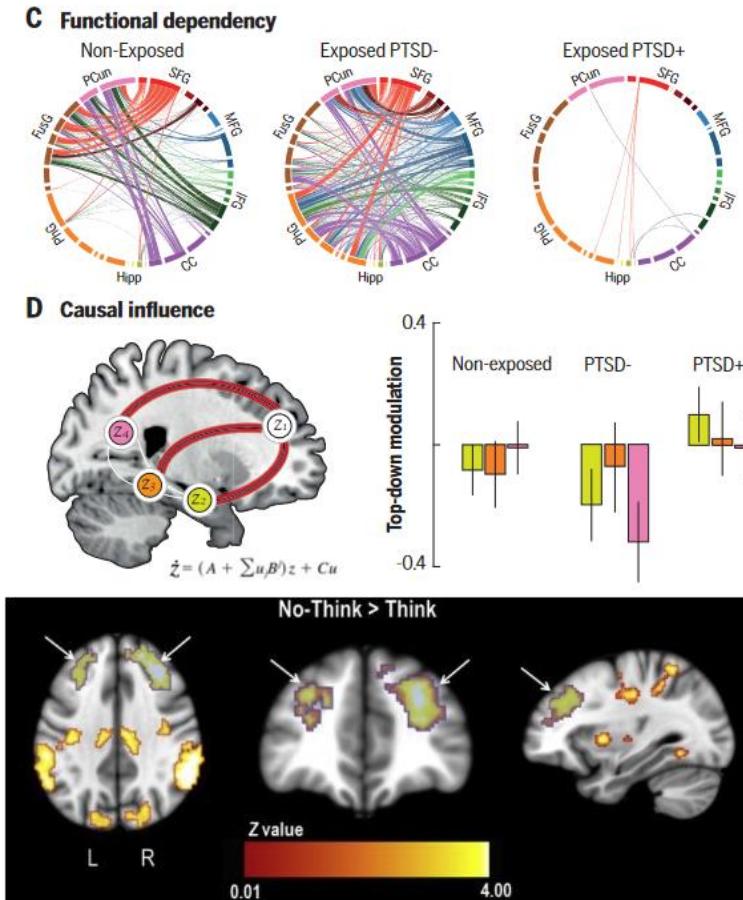


## Memory suppression deficits



Catarino et al, 2015

## Lack of executive control over intrusions

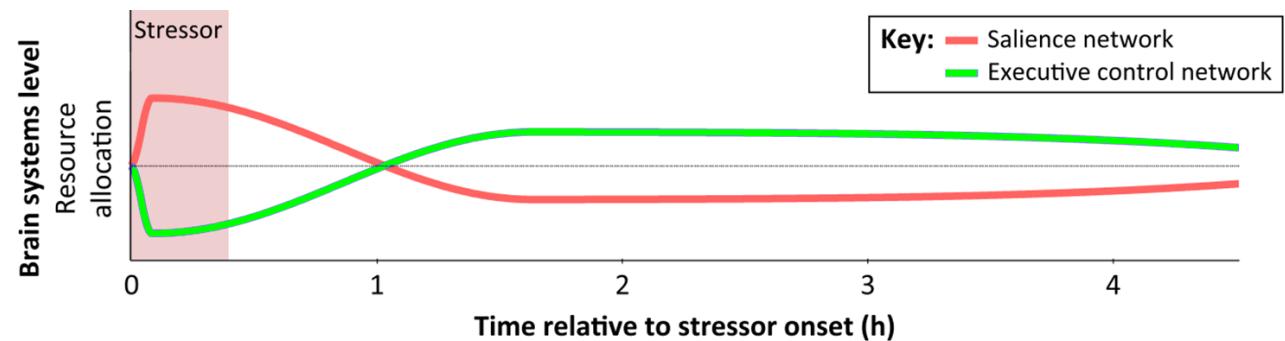
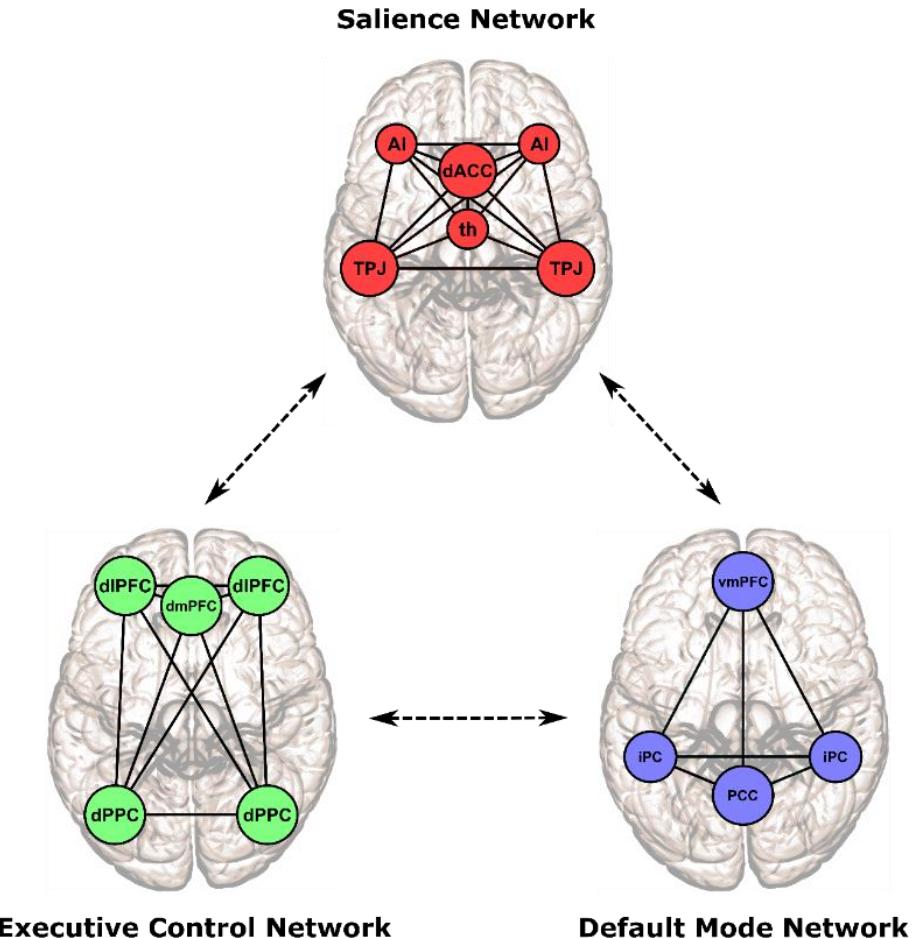


Mary et al., Science, 2020; Sullivan et al., 2019



Neurofeedback

# A network solution for network disorders

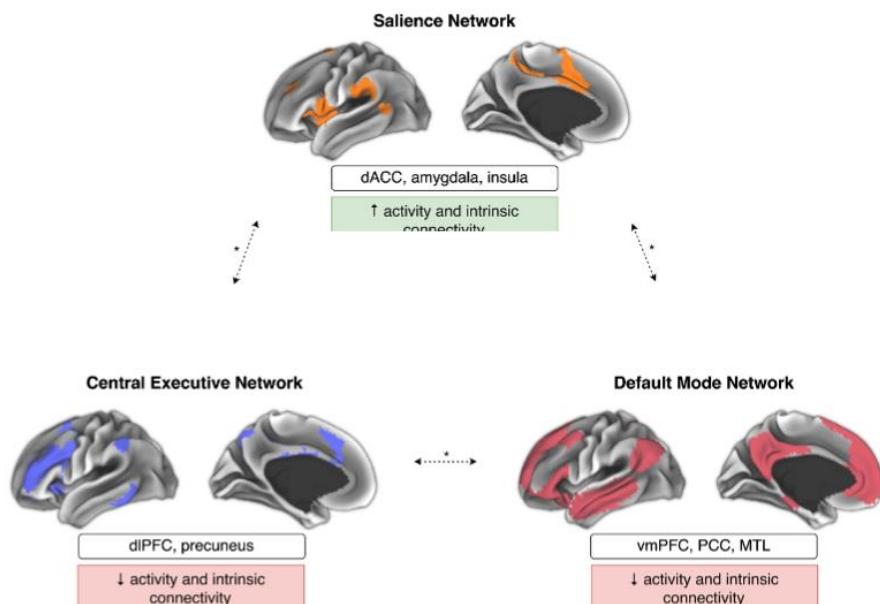




## Application: PTSD

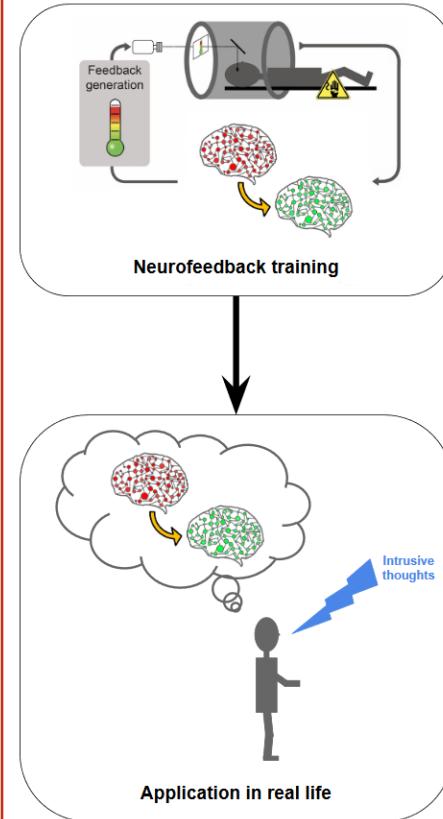
# PTSD and large-scale brain networks

### PTSD network changes



Akiki et al., 2017; Szeszko & Yehuda, 2019

### SN-ECN balance neurofeedback



Can we *restore active suppression of memories*?

Can we equip patients with the means to optimally control *forthcoming intrusive thoughts*?

Krause et al., 2021

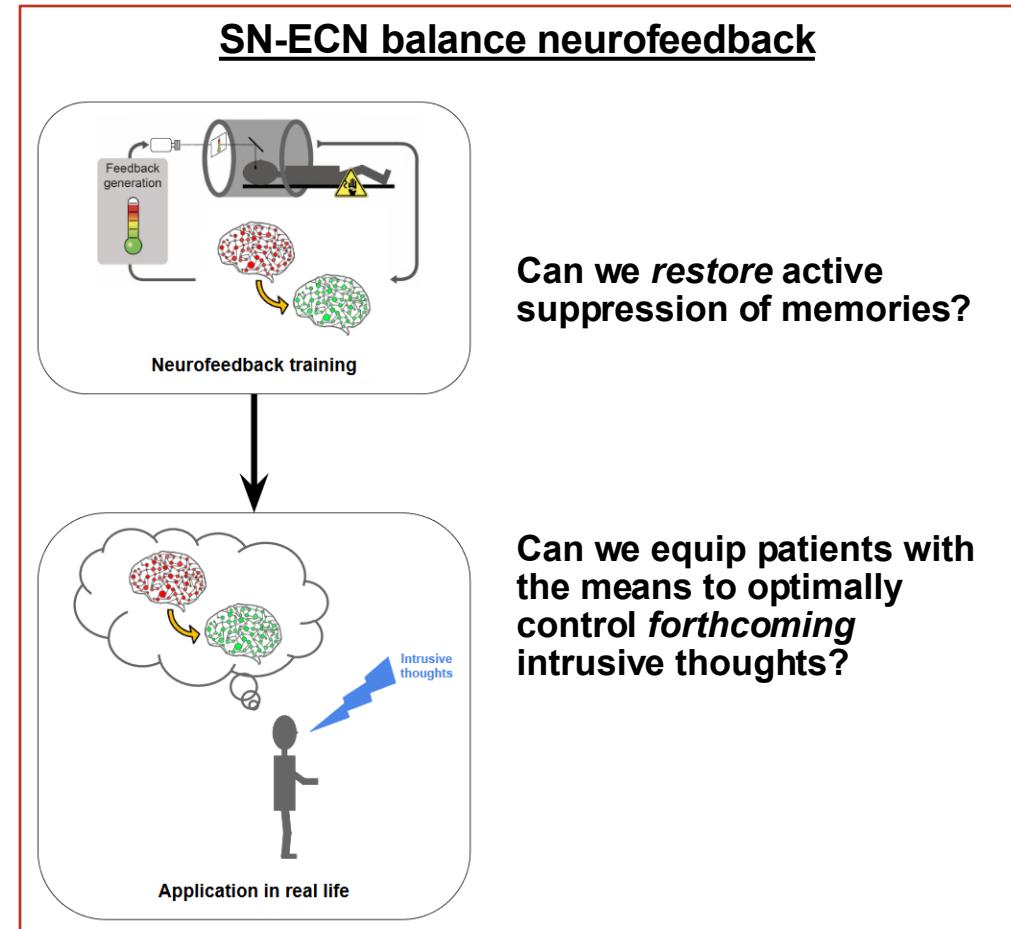
## Sample

# From patients to healthy participants

- Collaboration
- Access to patient populations

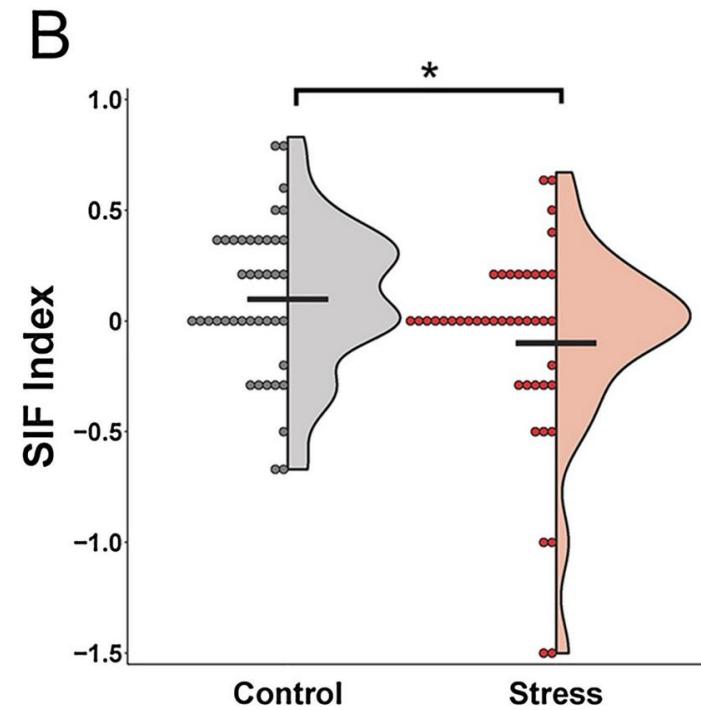
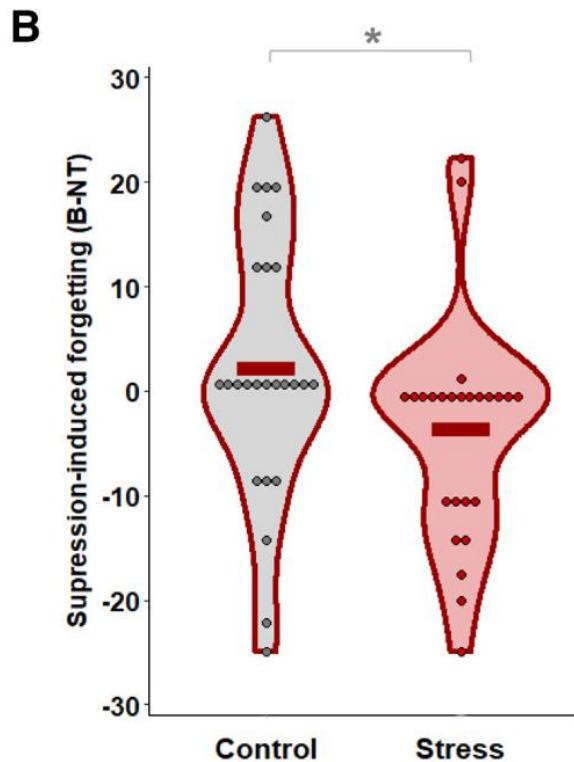
Problems related to change

- Behavioural deficits in TNT
- Intrusions



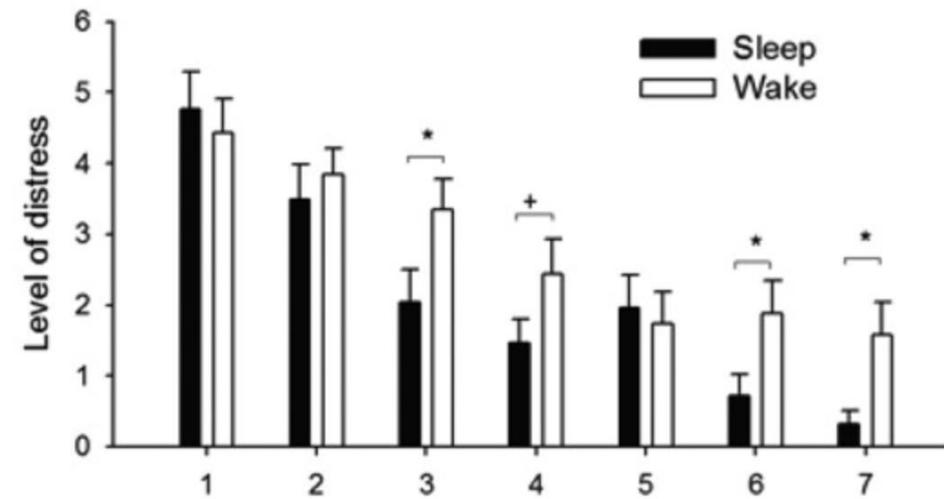
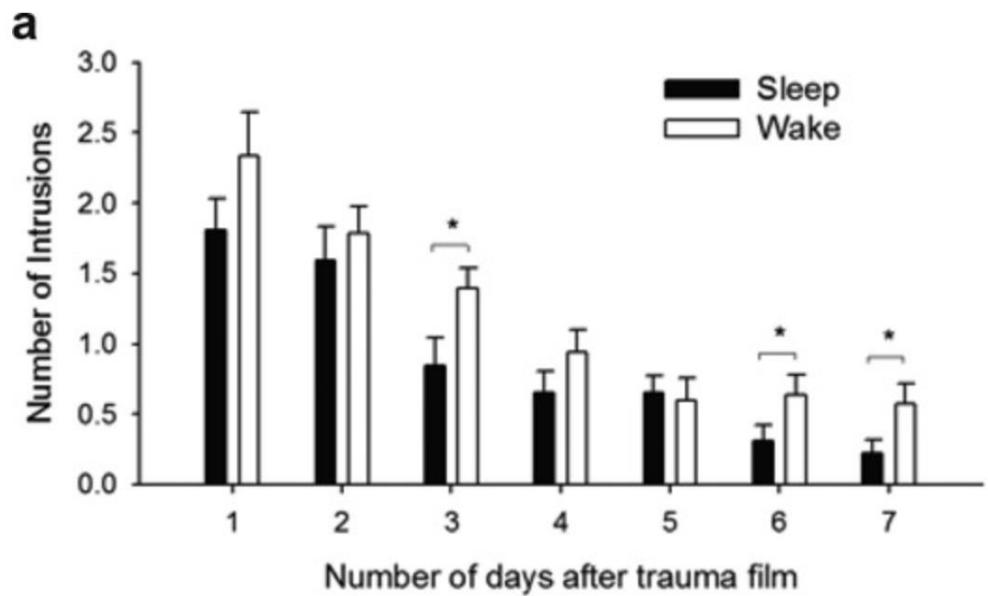
Stress induction

## Stress induction in healthy participants



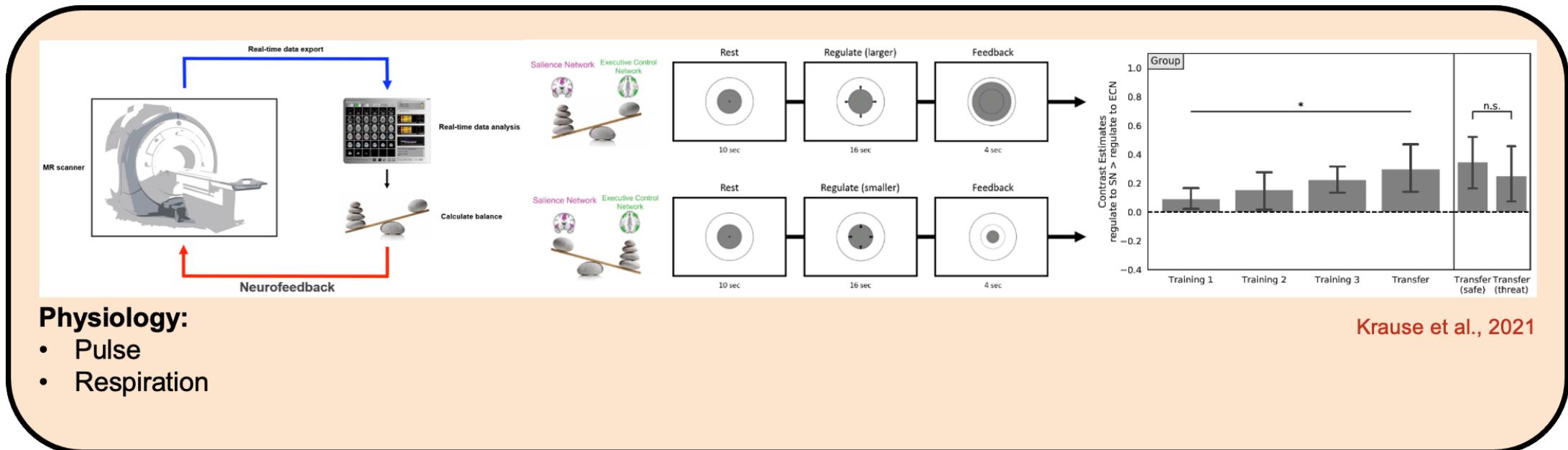
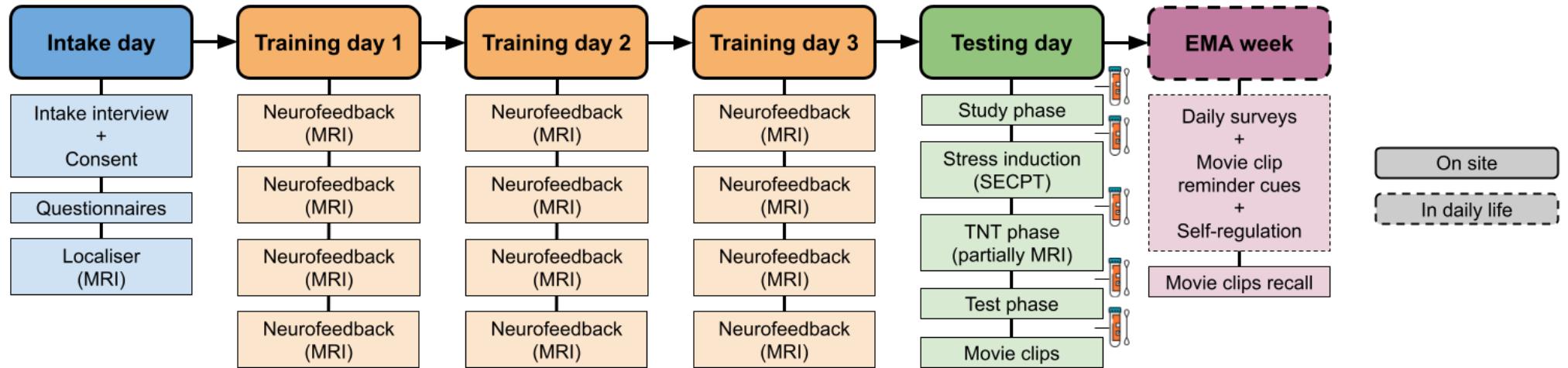
Trauma films

## Healthy participants - intrusions





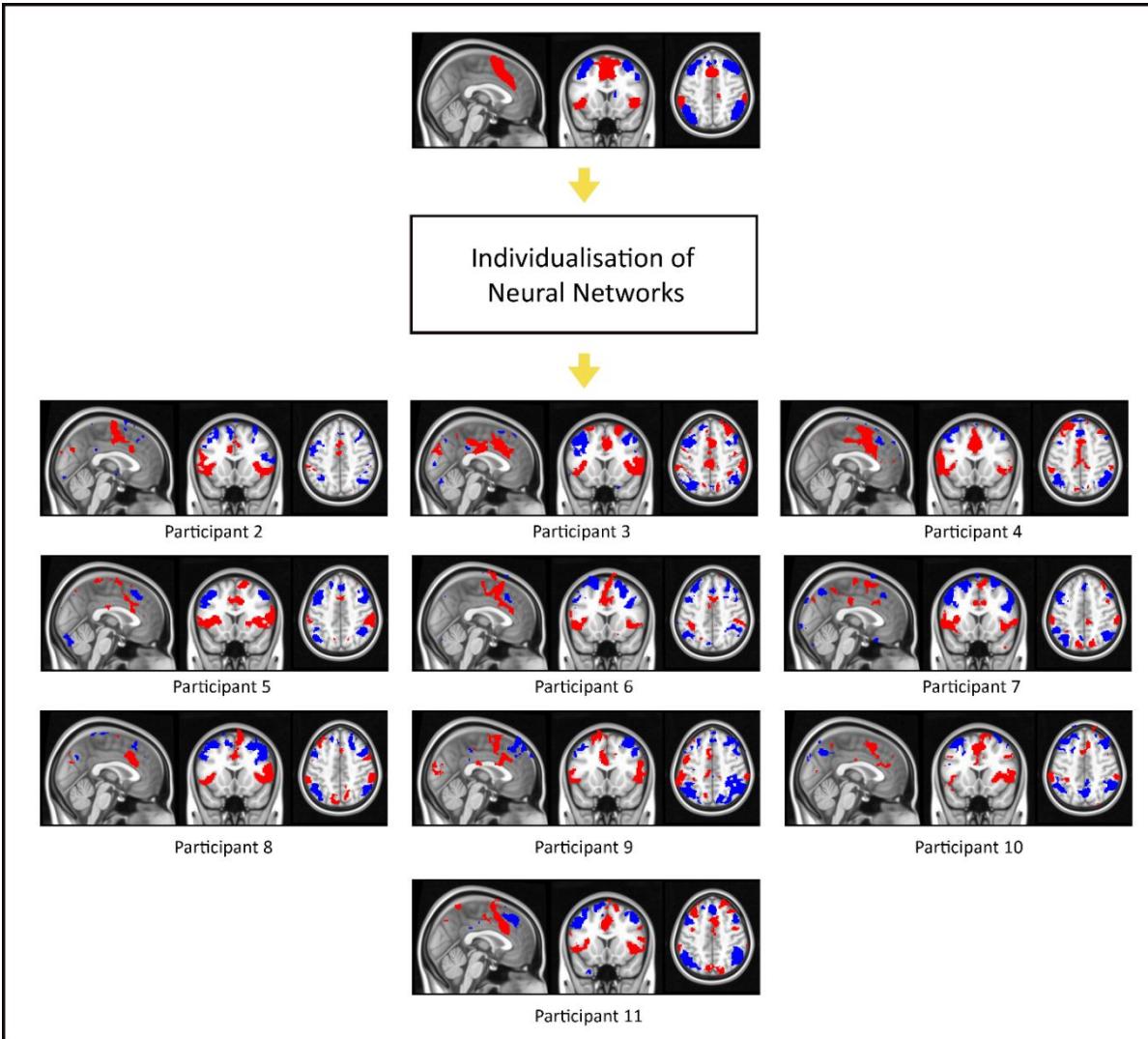
## Overview of experimental sessions





Neurofeedback

# Localiser

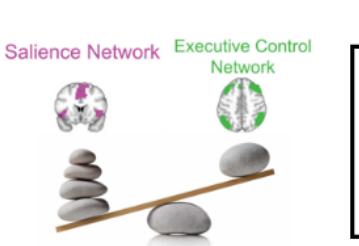
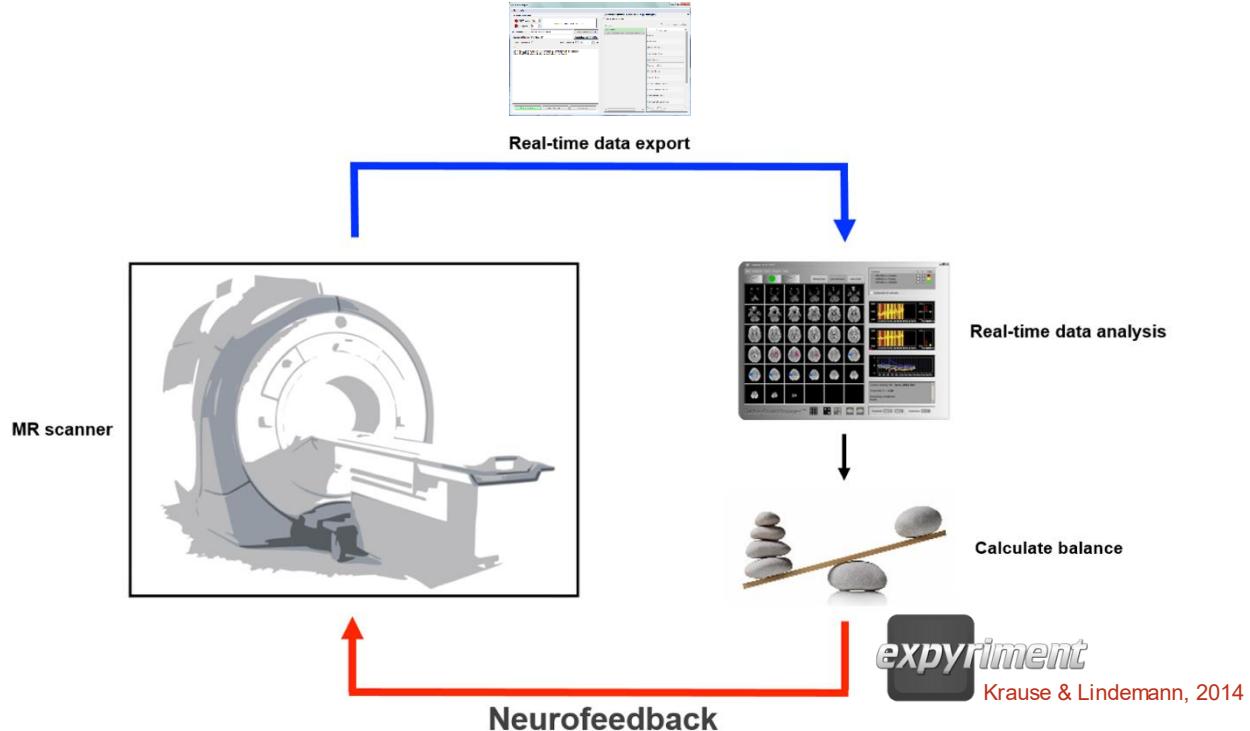


**IndNet (Krause & Kogias)**  
<https://github.com/can-lab/IndNet>



# Neurofeedback

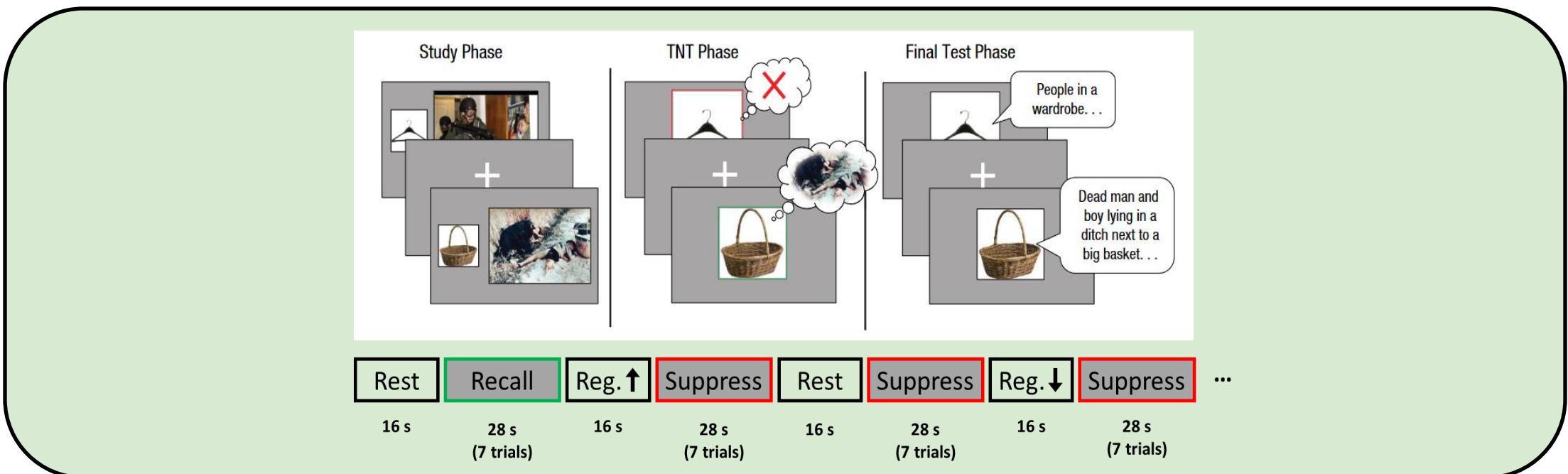
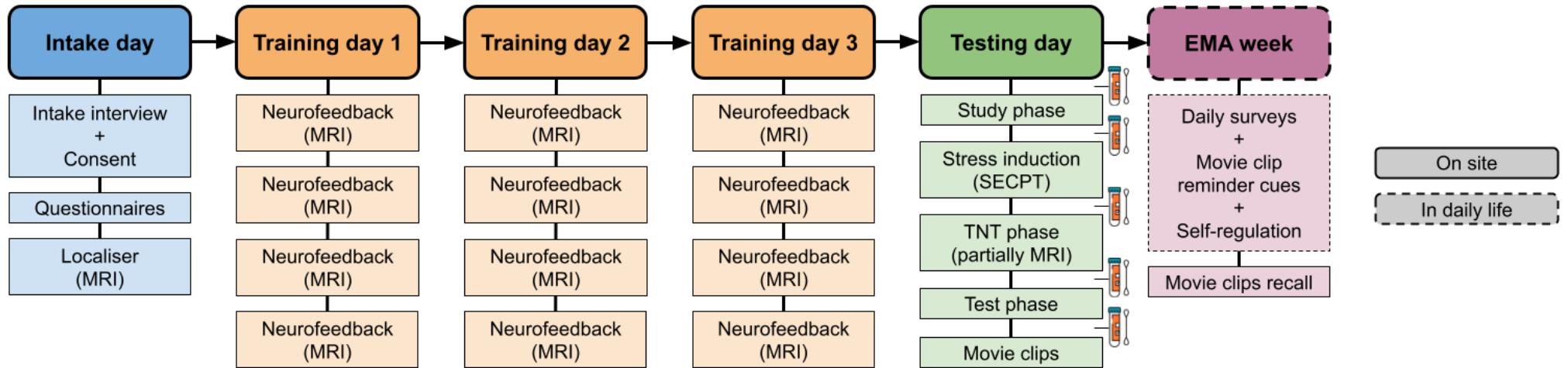
## Training



"Try to either increase or decrease the size of the disc on the screen with your brain, depending on the orientation of the surrounding arrows in each trial. You can achieve this by thinking of something specific, performing some mental task internally, or getting into a certain mood, emotion, feeling, or state of mind."

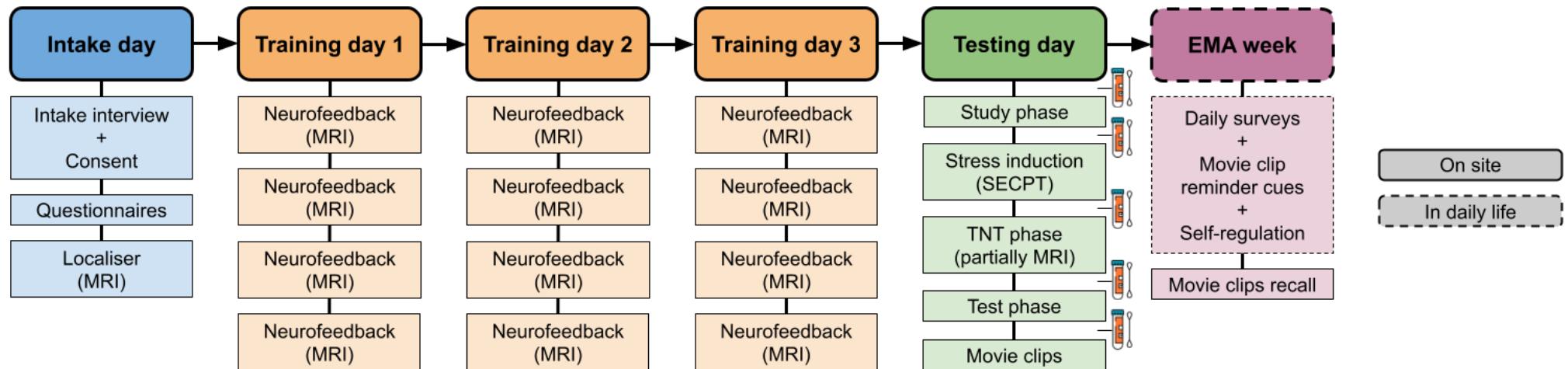


## Overview of experimental sessions





## Overview of experimental sessions

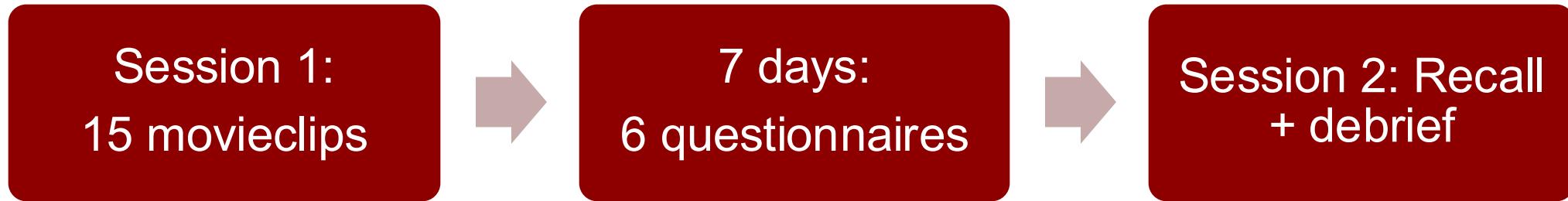


- **6 surveys (2-4 min) per day (M-path app):**
  - Mood, event-related/activity-related/social/physical stress
  - Intrusion/dissociation occurrence/frequency/quality
- **Wearable data**
  - Heart rate, skin conductance, temperature, motion
- **Perform self-regulation task**



Block 1

## EMA pilot





EMA pilot

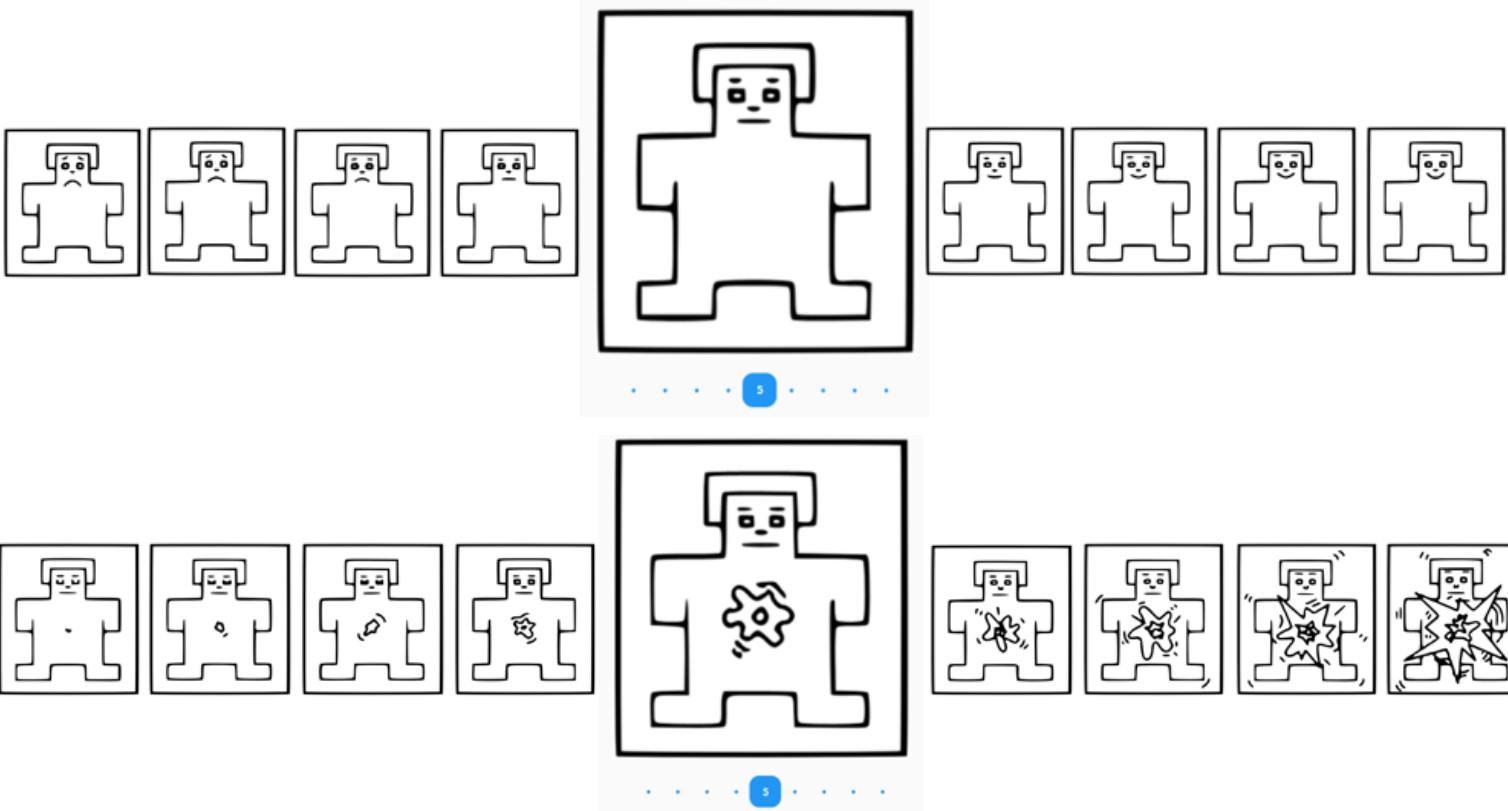
## Session 1





Movieclips

## Self-Assessment Manikins





## Questionnaires EMA

### Block 1

- I feel cheerful
- I feel irritated
- I feel anxious
- I feel satisfied
- I feel insecure
- I feel relaxed
- I feel sad
- I feel stressed
- My thoughts won't leave me alone
- Since the last questionnaire, I have spent approximately ... minutes on physical activity.  
(slider: 0 minutes – 180 minutes)



## Questionnaires EMA

### Block 2

- What were you just doing? (multiple choice):
  - Leisure – active (e.g., playing a game, going out)
  - Leisure – passive (e.g., watching TV, reading)
  - School or work
  - Household chores
  - Traveling
  - Personal hygiene (e.g., washing, getting dressed)
  - Physical activity (sports)
  - Eating/drinking
  - Social contact
  - Something else
  - Nothing
- I enjoy this
- I would rather be doing something else
- I am good at this
- I feel bored doing nothing



## Questionnaires EMA

### Block 3

- **Spontaneous film memories**

Have you had one or more spontaneous memories of the film clips since the last questionnaire? (Yes/No)

#### If YES:

- Which film clips did you recall spontaneously? (multiple select)
- Which clip brought the most intense spontaneous memories?
- How many spontaneous memories did you have of that clip?
- What type(s) of spontaneous memories were they? (e.g., image, sound, feeling, bodily sensation, thought)
- How distressing were the memories?
- How vivid were they?
- How much control did you have over them?

#### If NO:

- Think of the most important event since the last questionnaire.
  - How pleasant was this event? ( $-3$  = very unpleasant →  $+3$  = very pleasant)
  - Was this a stressful event?
- What activities have you done since the last questionnaire? (multiple select)
- Which activity took up the most time?
  - How much time did you spend on it?
  - To what extent did you feel in control of its duration?

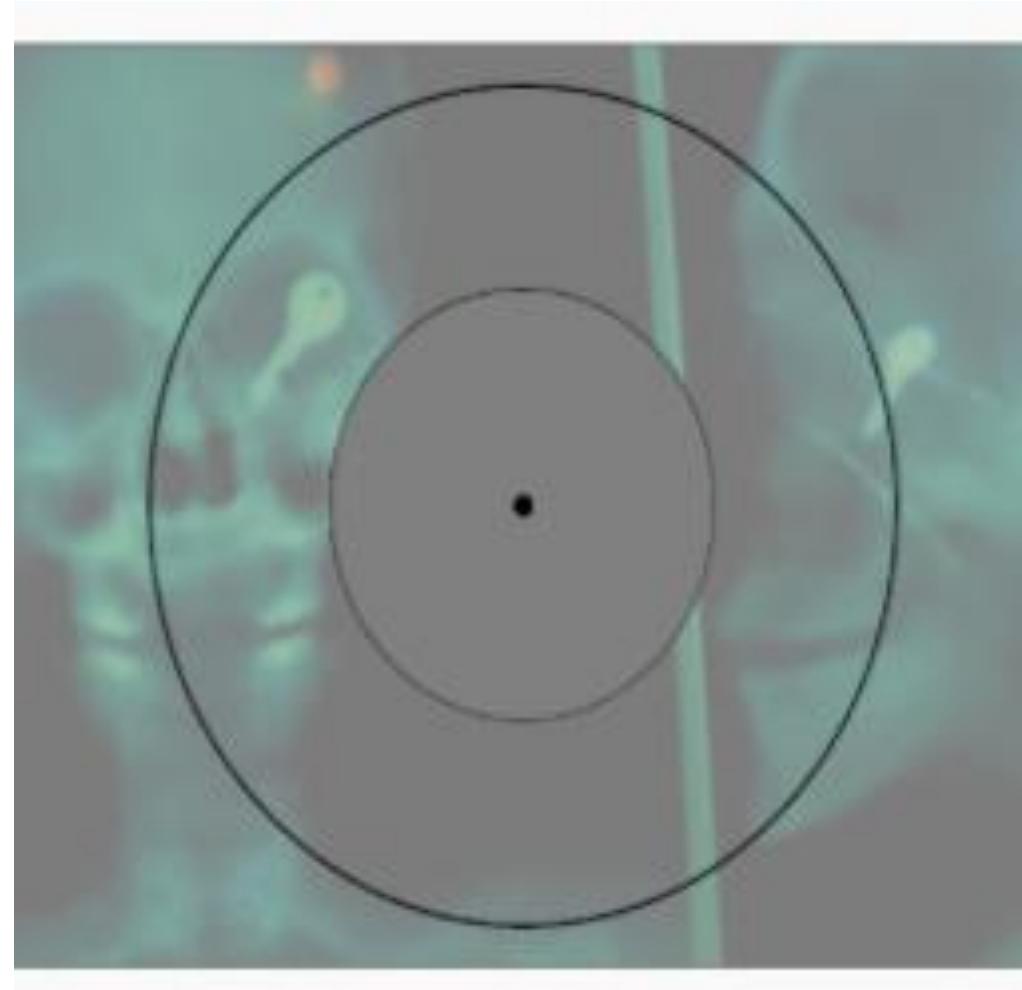


Movie clip cues

## Block 4



10 seconds

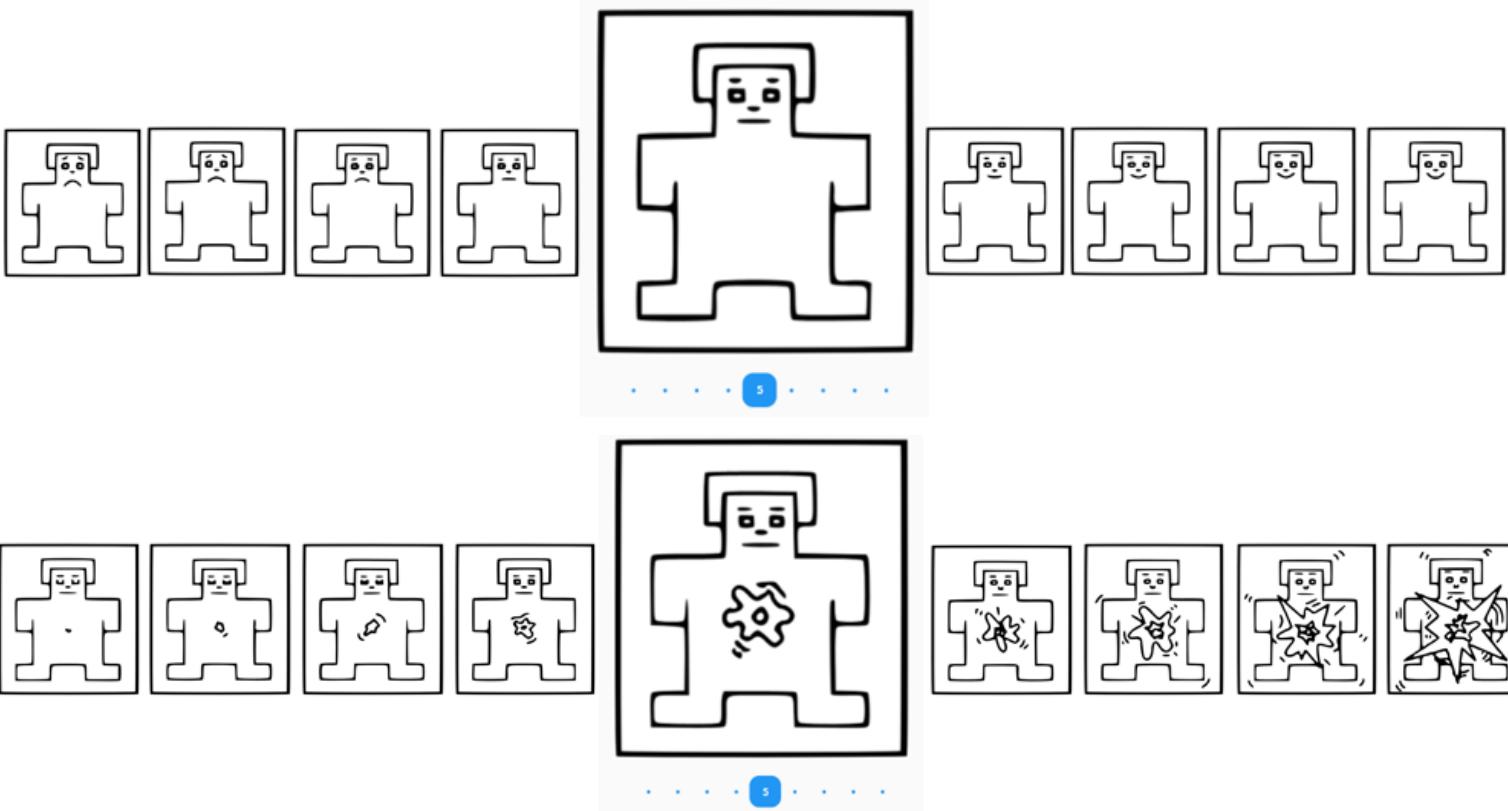


20 seconds



## Block 4

# Self-Assessment Manikins





## Substance use

Since the last questionnaire, have you used any of the following: medication, alcohol, caffeine, cigarettes, cannabis, or other drugs? (Yes/No)

**If YES:**

What did you use? (multiple select)

*Examples: prescribed or non-prescribed medication, cannabis, hallucinogens, stimulants, sedatives, caffeine, cigarettes, alcohol.*

**If applicable:**

*Caffeine:* How many caffeinated drinks have you had?

*Cigarettes:* How many cigarettes have you smoked?

*Alcohol:* How many alcoholic drinks have you had?

*(Response options: 1 / 2 / 3 / 4 / more than 4)*

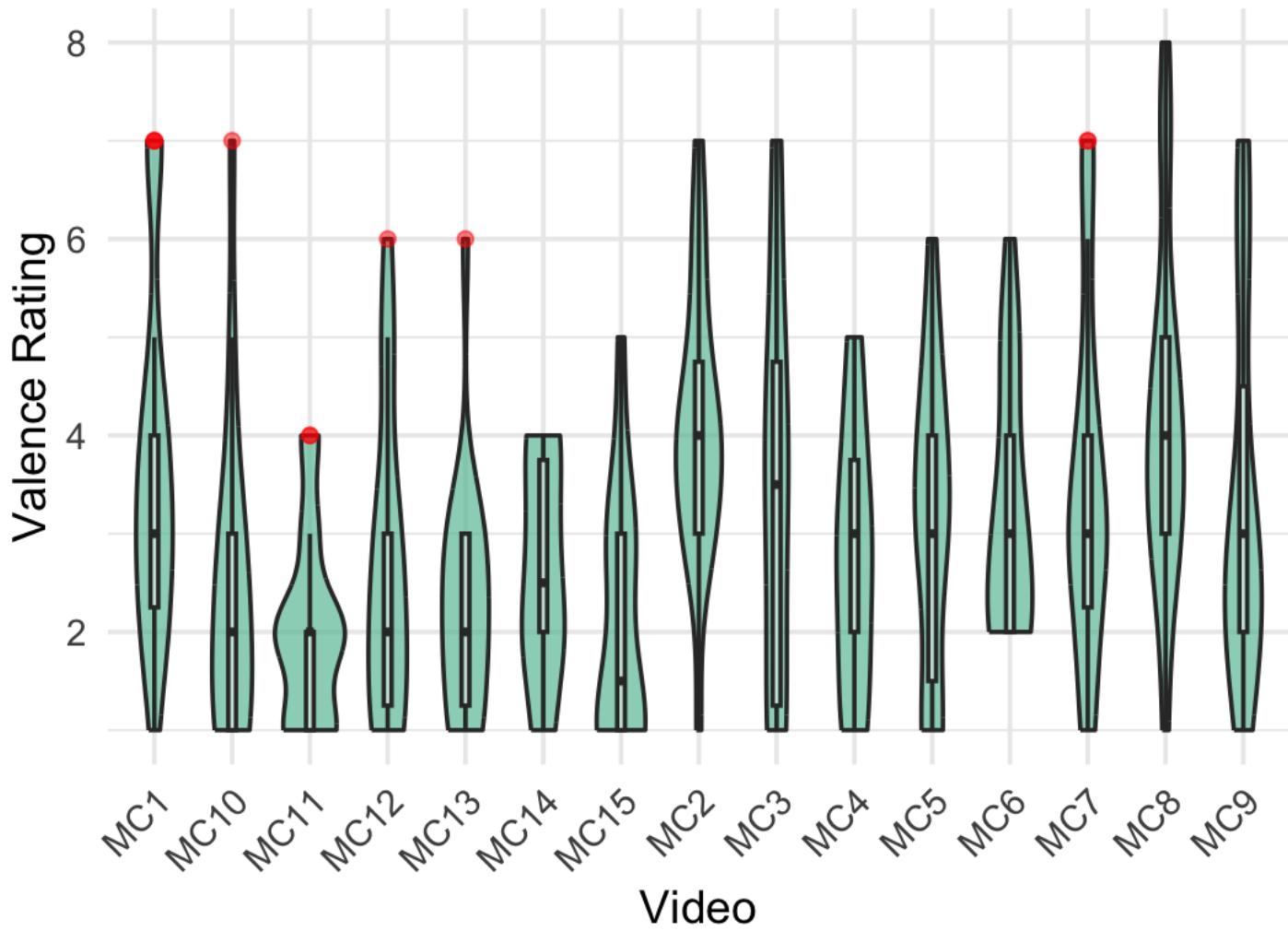


## Pilot Preliminary results

- Response rate: 74%
- Intrusions
  - Often about same movieclips
  - 2 different movieclips
  - 4 intrusions (0-16)
  - During the first day
  - Mental Images & thoughts

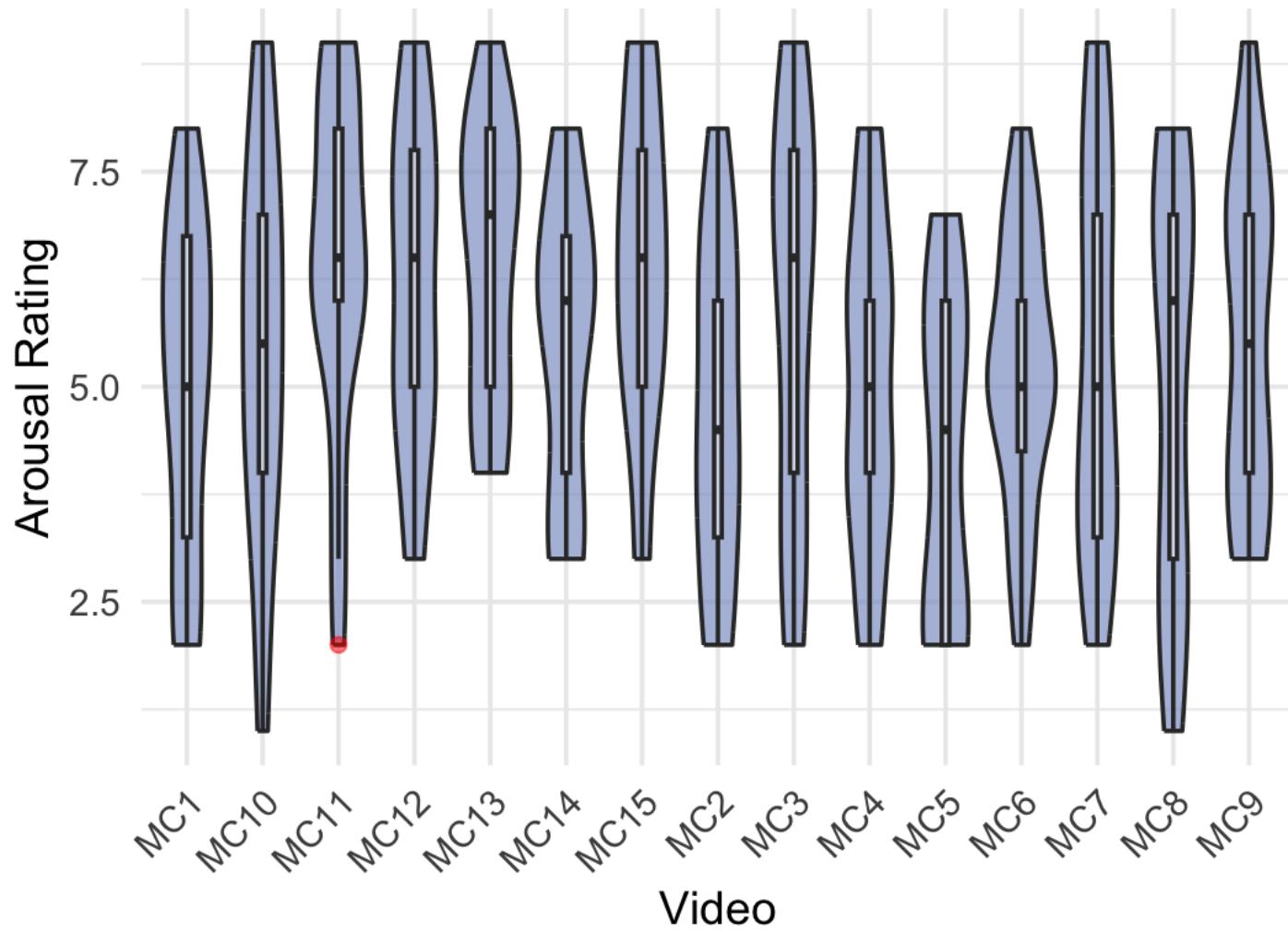


## Distribution of Valence Ratings per Video





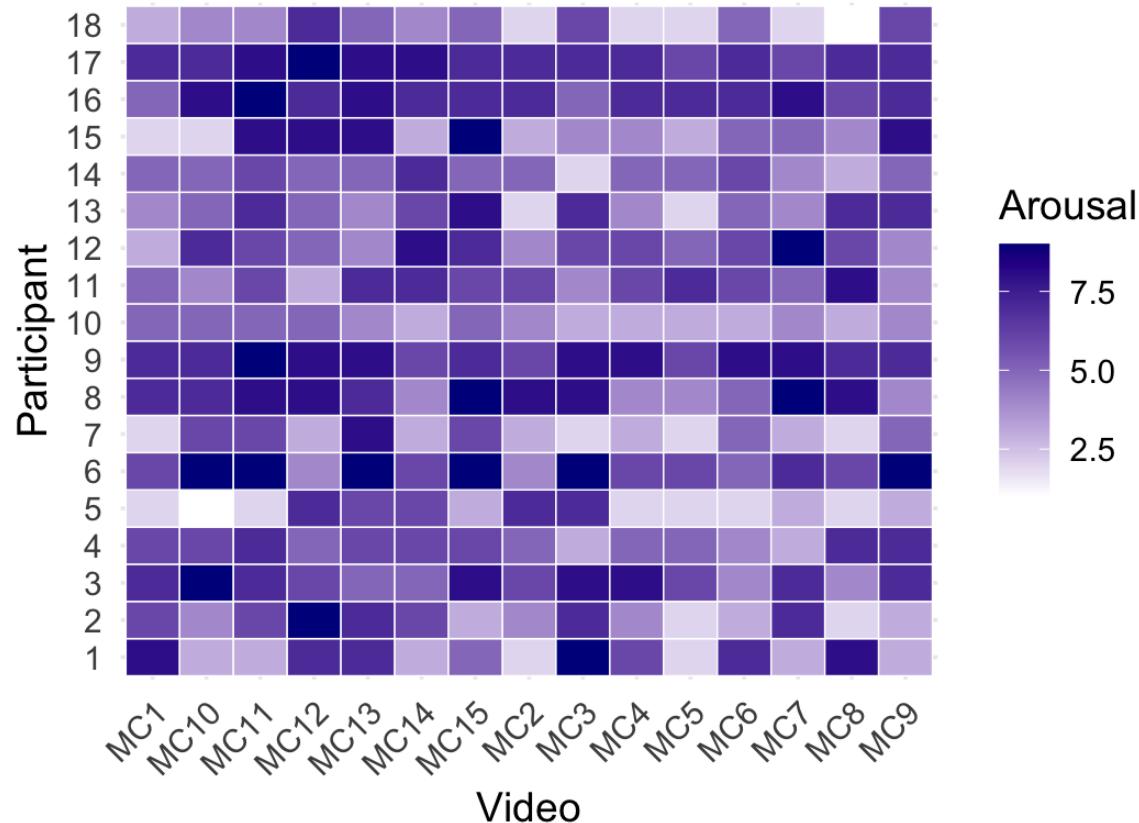
## Distribution of Arousal Ratings per Video



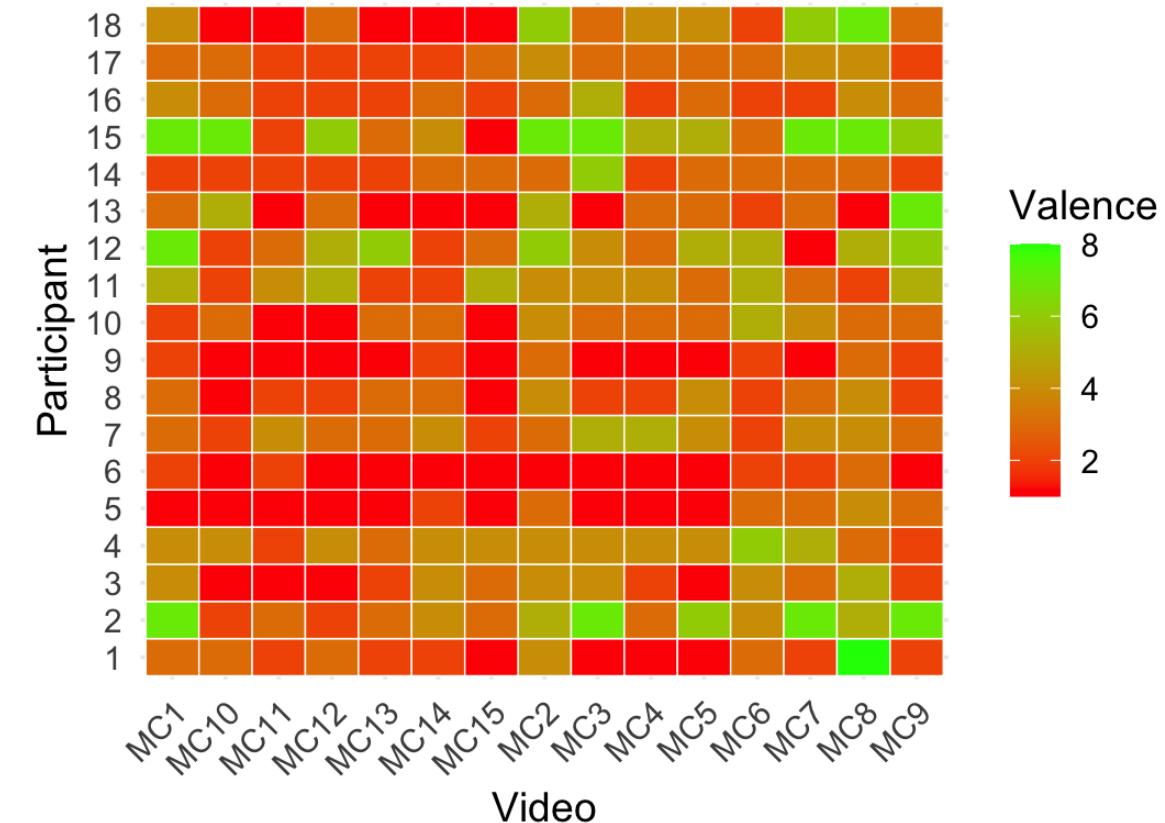
# Which three movieclips should we exclude?



## Arousal Ratings per Video and Participant

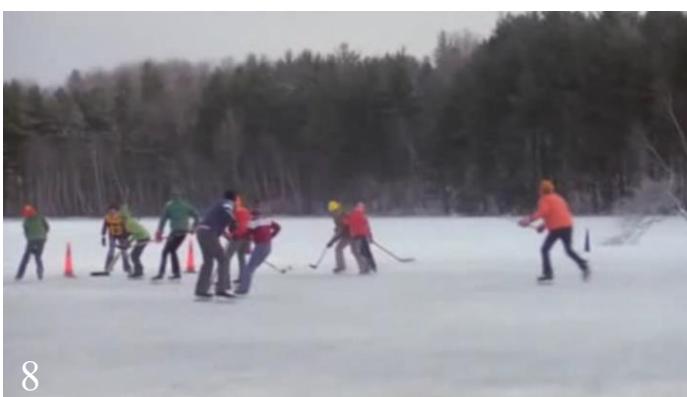


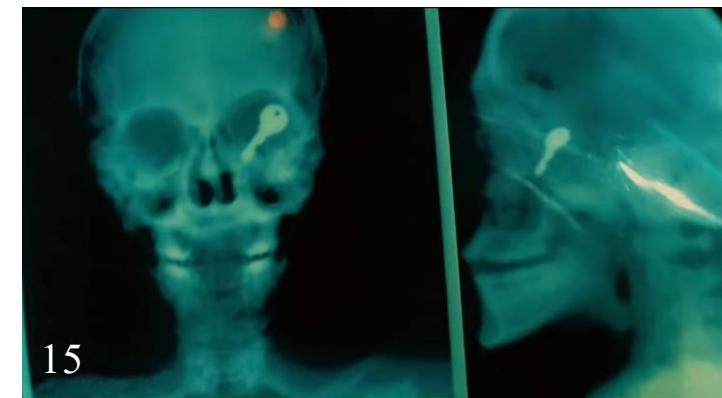
# Valence Ratings per Video and Participant





[www.ru.nl/donders](http://www.ru.nl/donders)





**Ratings per Video**

Video	mean_val	sd_val	mean_ar	sd_ar
MC1	3.67	1.81	5.00	1.94
MC2	4.06	1.39	4.72	1.90
MC3	3.44	2.04	5.83	2.33
MC4	2.72	1.32	5.00	1.88
MC5	3.06	1.55	4.17	1.92
MC6	3.22	1.31	5.17	1.58
MC7	3.50	1.79	5.39	2.28
MC8	4.17	1.79	5.06	2.41
MC9	3.39	1.91	5.56	1.89
MC10	2.44	1.62	5.50	2.26
MC11	2.00	0.97	6.44	2.01
MC12	2.61	1.54	6.17	1.89
MC13	2.28	1.23	6.44	1.62
MC14	2.61	1.09	5.44	1.72
MC15	2.06	1.26	6.39	1.85

**Ratings per Participant**

Subject	mean_val	sd_val	mean_ar	sd_ar
	12.53	1.77	5.07	2.46
	24.53	1.88	4.87	2.13
	32.73	1.39	6.47	1.51
	43.80	1.01	5.40	1.30
	51.80	1.08	3.67	2.23
	61.40	0.63	6.93	1.91
	73.40	0.99	3.93	1.91
	82.53	0.99	6.67	1.91
	91.53	0.74	7.33	0.90
	102.80	1.15	3.93	0.88
	113.67	1.23	5.60	1.40
	124.20	1.78	5.73	1.62
	132.67	1.84	5.13	1.85
	142.73	1.03	4.87	1.19
	155.13	2.07	5.07	2.46
	162.80	0.94	7.00	1.07
	172.87	0.74	7.20	0.78
	183.13	2.03	3.87	1.81