Typical facial expression recognition without motor simulation

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INTRODUCTION

- A popular hypothesis holds that efficient facial expression recognition cannot be achieved by visual analysis alone but requires a mechanism of motor simulation — an unconscious, covert imitation of the observed facial movements.[1-3].

- Is it *possible* to achieve normotypical facial expression recognition despite a congenital absence of relevant facial motor representations?
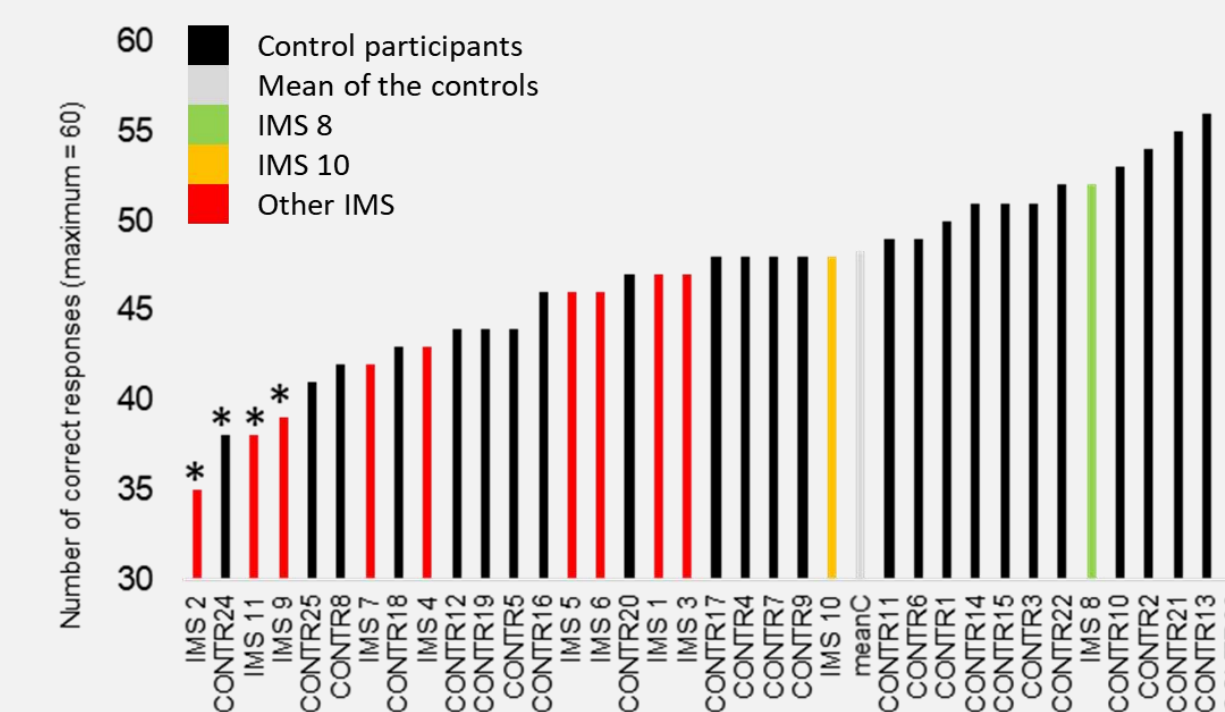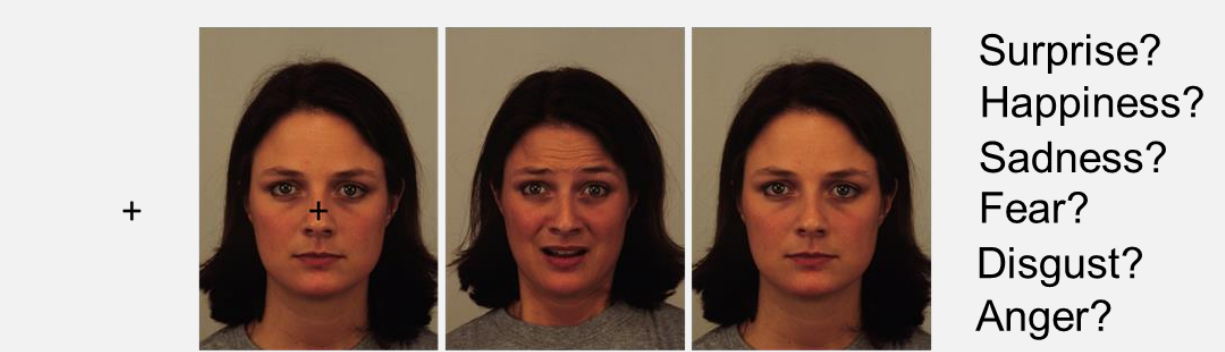
PARTICIPANTS

- 11 individuals with **congenital facial paralysis (IMS)**
  - Frequent associated cognitive/visuo-perceptual disorders
  - Heterogeneous population
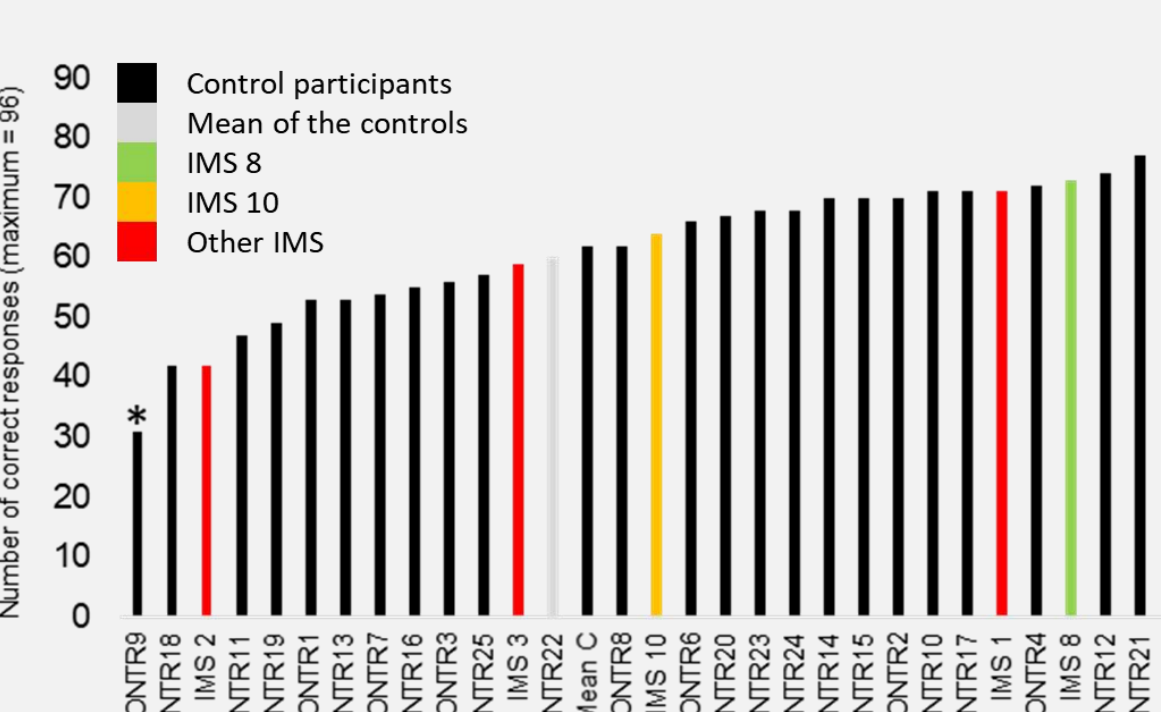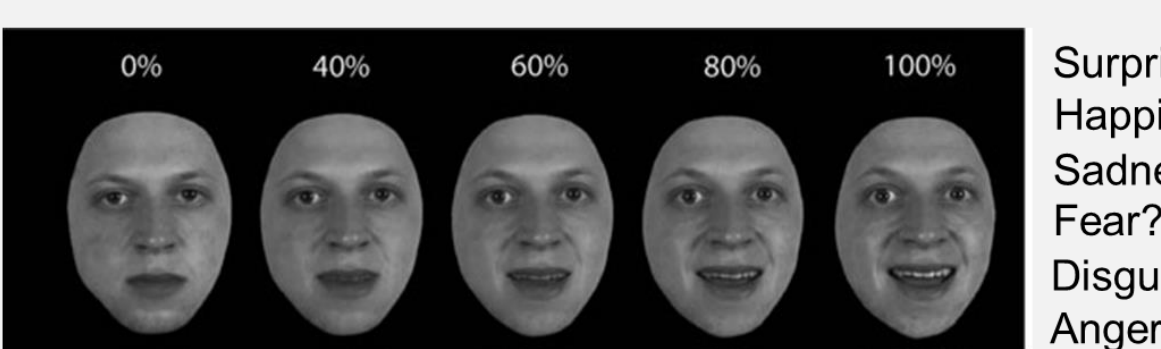- 25 typically developed highly educated young adults

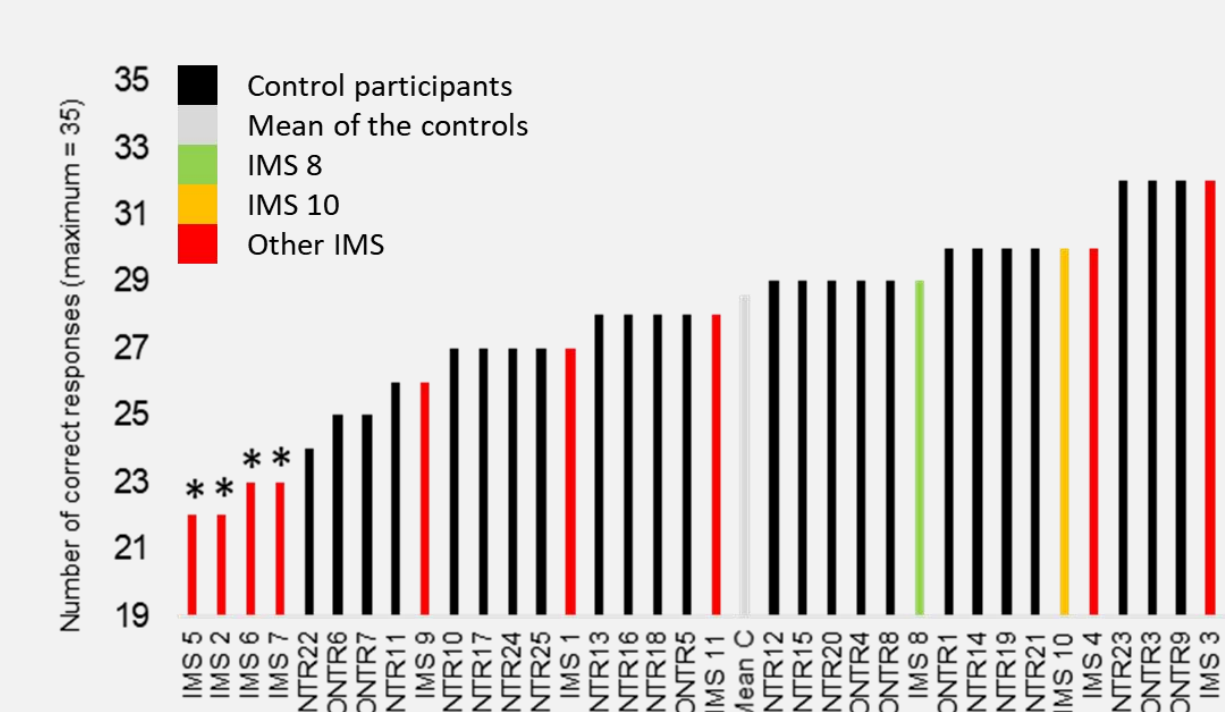## METHOD AND RESULTS

Experiment 1
Facial expression recognition[4] - 150 ms

Surprise?
Happiness?
Sadness?
Fear?
Disgust?
Anger?
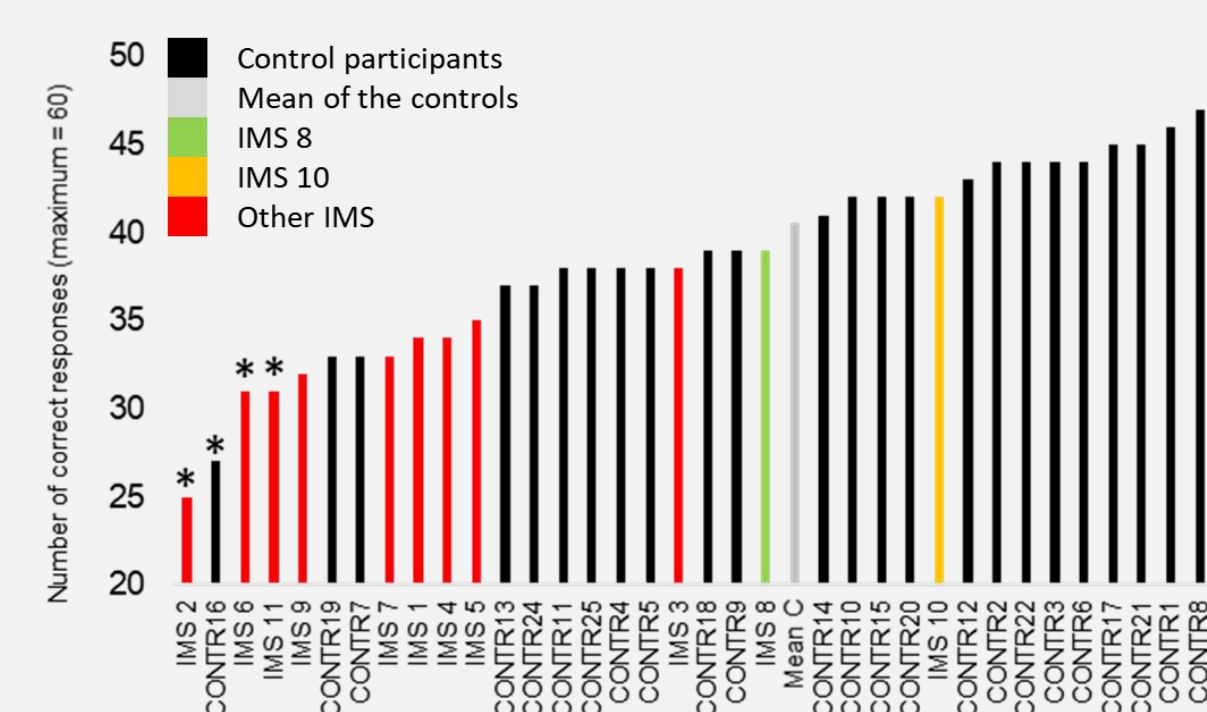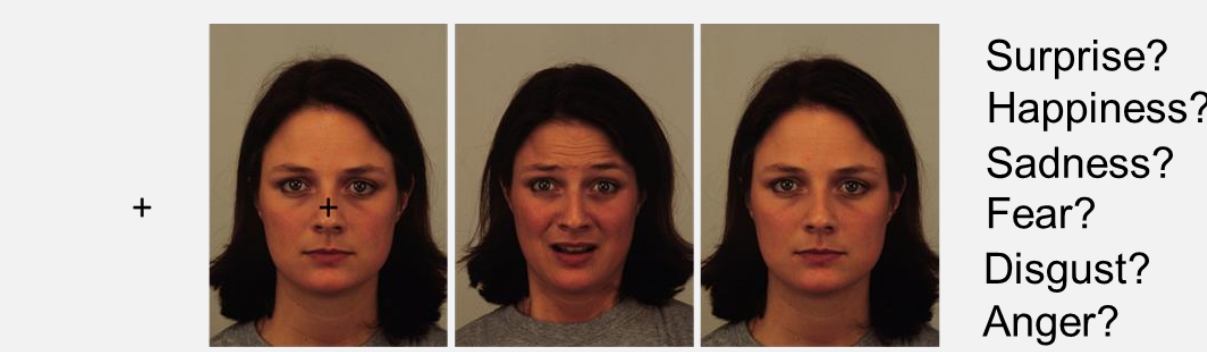
Experiment 2
Facial expression recognition[4] - 1000 ms

Surprise?
Happiness?
Sadness?
Fear?
Disgust?
Anger?

Experiment 3
Dynamic facial expression recognition[5]

0% 40% 60% 80% 100%

Surprise?
Happiness?
Sadness?
Fear?
Disgust?
Anger?

Experiment 4
Reading in the Mind's eyes[6]

Amused?
Joking?
Relaxed?
Insisting?

Experiment 5
Amusement from smile task[7]

MOVIE

Fake smile?
Real smile?
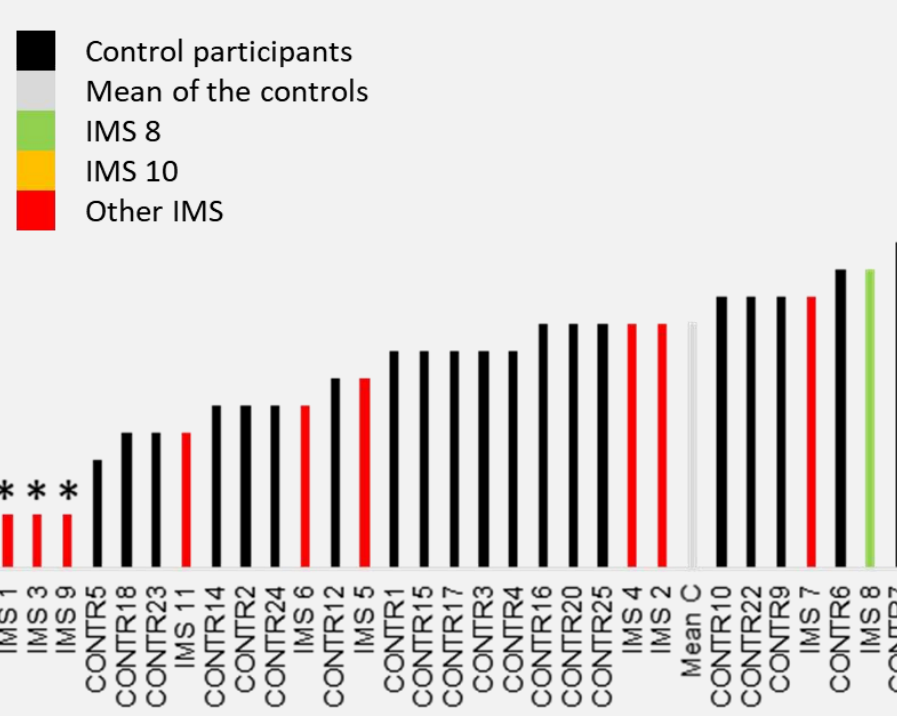
Experiment 6
Cambridge face memory task[8]

Training images

Test item-images identical to training

Test item-novel images
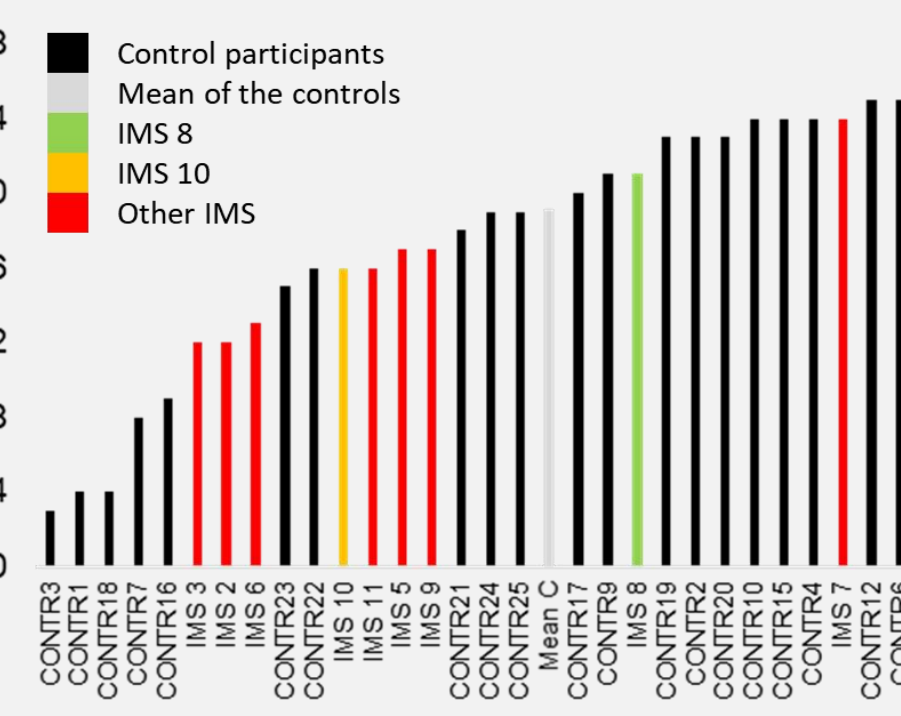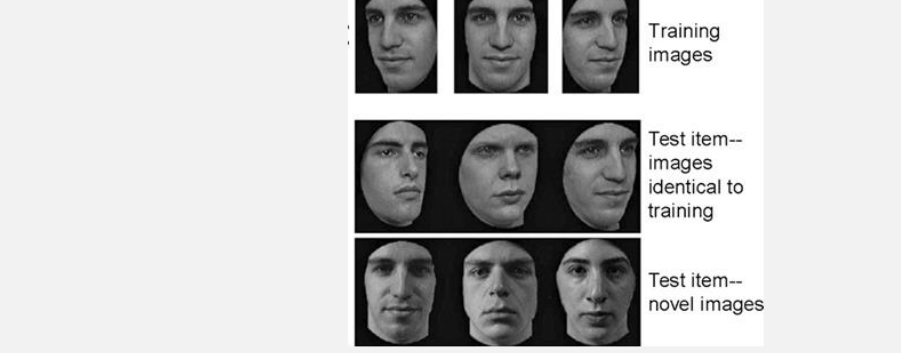
Experiment 7
Cambridge face perception task[9]

88% 76% 64% 52% 40% 28%
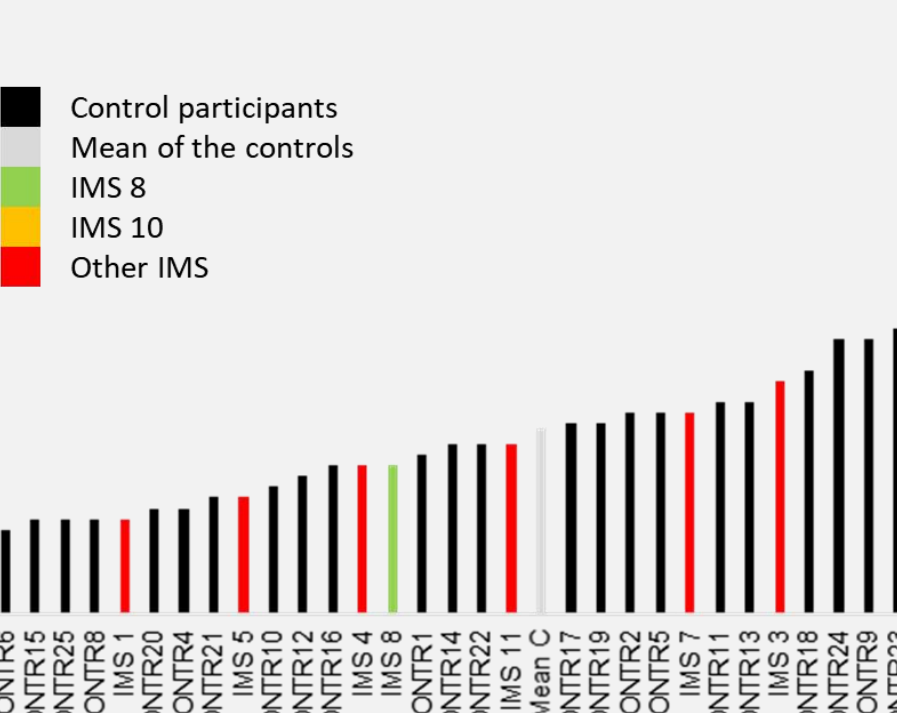
Experiment 8
Emotion from speech[10]

Surprise?
Happiness?
Sadness?
Fear?
Disgust?
Anger?
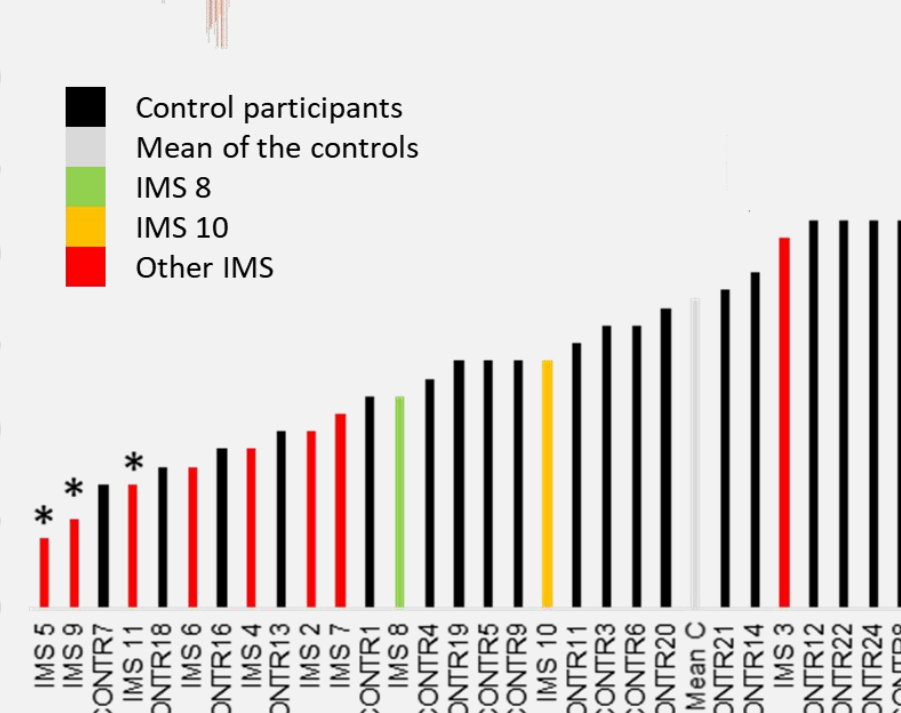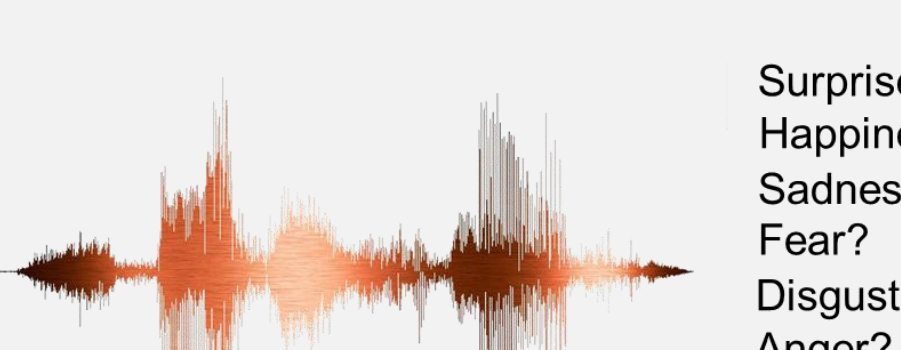
CCL: IMS 8 and 10 (yellow and green)
- scored like the controls in Experiments 1-5
- performed as well in XPs 1 – 5 than in XPs 6 - 8

QUALITATIVE ANALYSES OF IMS 8 AND 10

Experiment 1 — CONTROLS

Displayed	A	D	F	H	Sa	Su
Su	0.01	0.01	0.08	0.05	0	0.86
Sa	0.12	0.2	0.07	0	0.58	0.04
H	0	0.01	0	0.96	0.02	0.01
F	0.12	0.22	0.36	0.02	0.1	0.18
D	0.18	0.65	0.07	0.01	0.08	0.03
A	0.67	0.13	0.06	0	0.1	0.04

R (36) = 0.94

Experiment 2 — CONTROLS

Displayed	A	D	F	H	Sa	Su
Su	0	0	0.09	0.02	0	0.89
Sa	0	0.24	0.08	0	0.66	0.02
H	0	0	0	1	0	0
F	0.04	0.17	0.58	0	0.09	0.13
D	0.06	0.86	0.04	0	0.03	0
A	0.85	0.1	0.02	0	0.04	0

R (36) = 0.95

Experiment 3 — CONTROLS

Displayed	A	D	F	H	Sa	Su
Su	1	0.5	2.75	38	1	57
Sa	7.25	14.25	18	1.5	47.5	11.25
H	0.5	3	1	94	0.75	0.75
F	1.25	5.5	32.5	0.25	1.5	58.75
D	23.75	71.75	1	0	3.5	0
A	83.5	3.5	4.5	0.75	7	0.75

R (36) = 0.97

Experiment 1 — IMS 8 & 10

Displayed	A	D	F	H	Sa	Su
Su	0.05	0	0.15	0.05	0	0.75
Sa	0	0.25	0.05	0	0.7	0
H	0	0	0	1	0	0
F	0	0.55	0.15	0	0.2	0.1
D	0.1	0.75	0.05	0	0.1	0
A	0.7	0.15	0.05	0	0.05	0.05

Experiment 2 — IMS 8 & 10

Displayed	A	D	F	H	Sa	Su
Su	0	0	0	0	0	1
Sa	0	0.2	0	0	0.8	0
H	0	0	0	1	0	0
F	0	0.65	0.3	0	0.05	0
D	0	1	0	0	0	0
A	0.9	0.1	0	0	0	0

Experiment 3 — IMS 8 & 10

Displayed	A	D	F	H	Sa	Su
Su	1.25	0	7.5	41.25	0	50
Sa	6.25	10	12.5	1.25	66.25	3.75
H	1.25	2.5	0	93.75	0	2.5
F	0	1.25	27.5	0	5	66.25
D	27.5	71.25	0	0	1.25	0
A	85	2.5	1.25	0	7.5	3.75

Responses

SUPPLEMENTAL MOTOR EVALUATION OF IMS 8 & 10

Anger Disgust Fear Happiness Sadness Surprise

MODEL IMS 8 IMS 10

Input Image → Detect → Transform → Crop [11]

Deep Neural Network → Representation → Clustering / Similarity Detection / Classification

Intensity ( )	AU1	AU2	AU4	AU5	AU6	AU7	AU9	AU12	AU15	AU20	AU23	AU26

MODEL

FE2	A	D	F	H	Sa
Su	-0.07	-0.51	0.49	-0.12	-0.33
Sa	0.15	0.72	0.23	0.68	
H	-0.26	0.51	0.63		
F	-0.09	0.15			
D	0.32				

IMS8

FE2	A	D	F	H	Sa
Su	0.99	0.99	0.98	0.85	0.99
Sa	1	1	0.99	0.86	
H	0.86	0.86	0.91		
F	0.99	0.99			
D	1				

IMS10

FE2	A	D	F	H	Sa
Su	0.92	0.89	0.98	0.96	0.96
Sa	0.91	0.97	0.92	1	
H	0.91	0.97	0.92		
F	0.92	0.85			
D	0.92				

FE1

DISCUSSION OF THE RESULTS OF THE OTHER IMS

- IMS 8 and 10 were among IMS with the most severe facial paralysis.
- The performance of the other IMS in XPs 1-3 was strongly correlated with their performance on a perceptual test (three *r*s > 0.5, *p*s < 0.05)
- 7/8 of the IMS participants who failed in one (IMS 1, 3, 5, 7) or several (IMS 2, 6, 9, 11) FE experiments obtained equally weak performance in one or several control tasks.
- The IMS's variability due to associated low/mid-level visual disorders

CONCLUSION

- It is possible to achieve efficient FE recognition without "motor simulation", even in challenging experiments cited as examples of tasks in which motor simulation should support FE recognition[1,2]
- This emphasizes the need for a shift in the burden of proof regarding the role of motor simulation in FE recognition.

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