Aubinet C, Chatelle C, Gosseries O, Carrière M, Laureys S, Majerus S.

INTERNATIONAL BRAIN INJURY ASSOCIATION

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Residual implicit versus explicit language abilities in patients with disorders of consciousness

Disorders of Consciousness: Insights From Neuroimaging,
Clinical Neurophysiology, and Neurogenetics
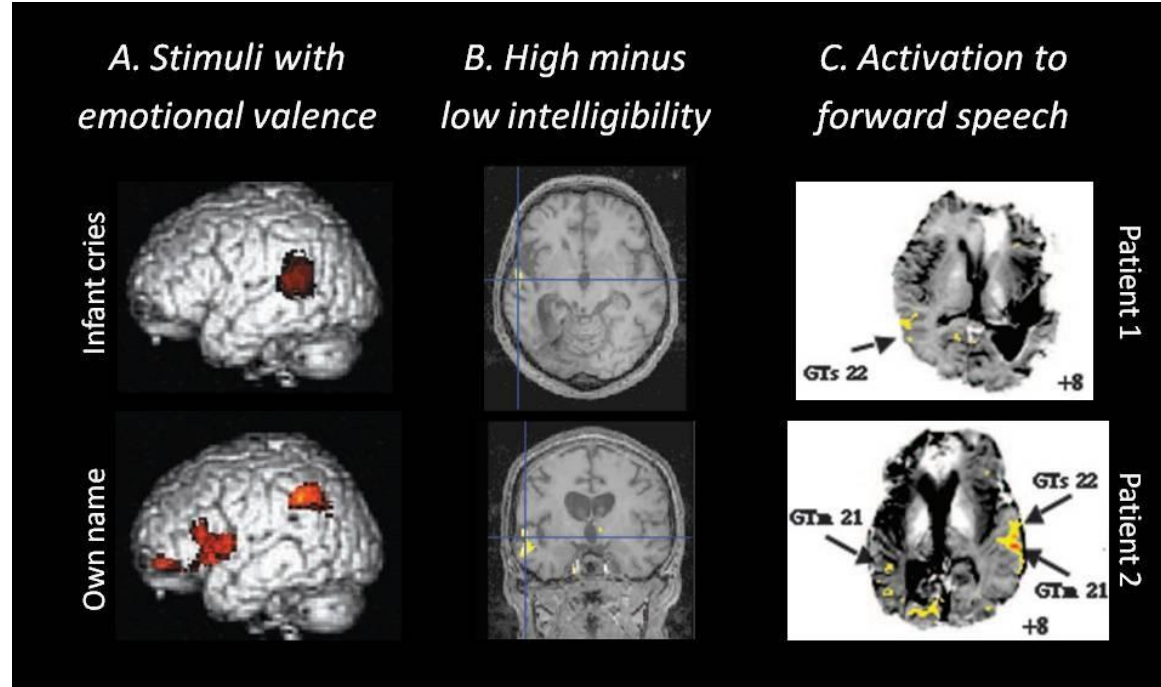
IBIA Congress
April 1st, 2023

COMA
SCIENCE GROUP

PsyNCog
Psychologie & Neuroscience Cognitives
Psychology & Neuroscience of Cognition

Disclosure

No interest to disclose.

Insights of residual language-related cortical processing in post-comatose patients

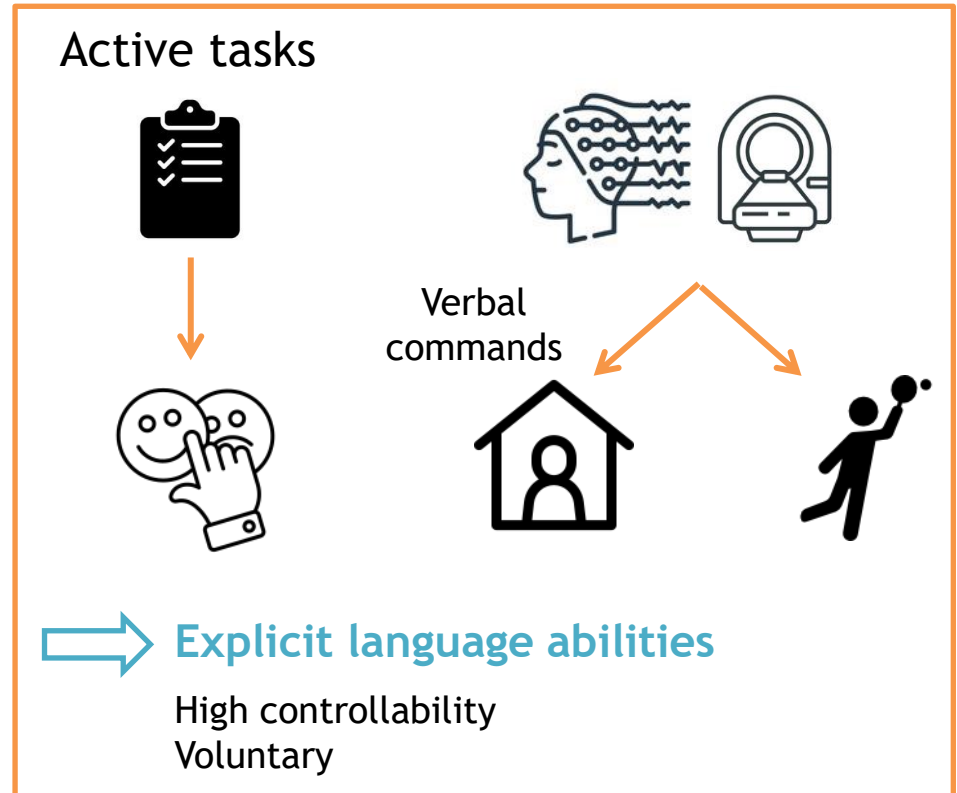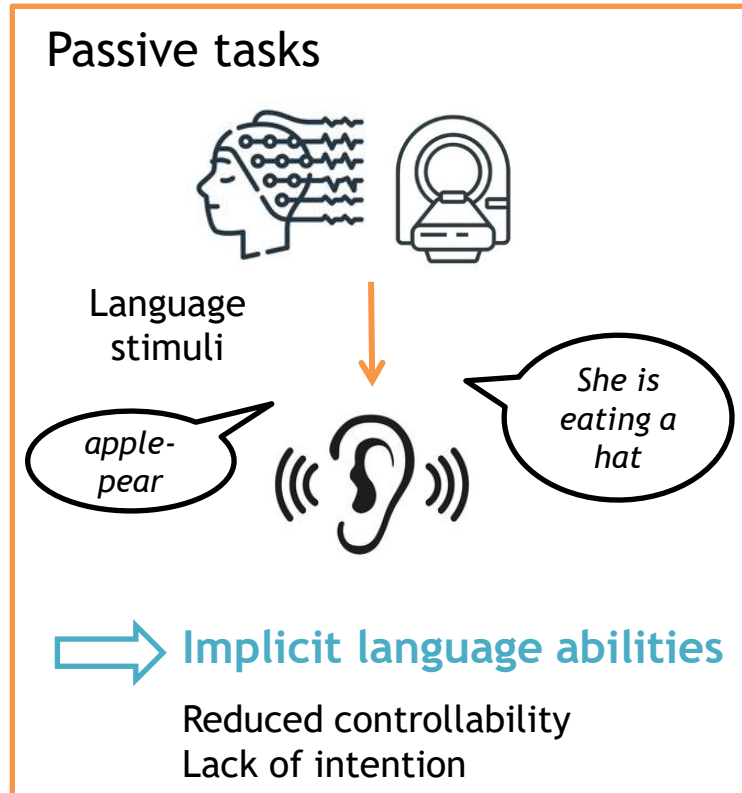A. Stimuli with emotional valence — Infant cries / Own name (Laureys et al., 2004)

B. High minus low intelligibility (Owen et al., 2005)

C. Activation to forward speech — Patient 1 / Patient 2 (Schiff et al., 2005)

Laureys et al., 2004   Owen et al., 2005   Schiff et al., 2005

Aubinet, Schnakers & Majerus, *Semin. Neurol.*, 2022

Implicit vs. explicit language abilities in DoC patients

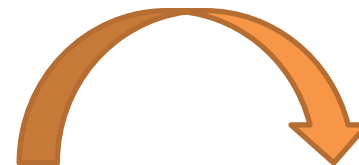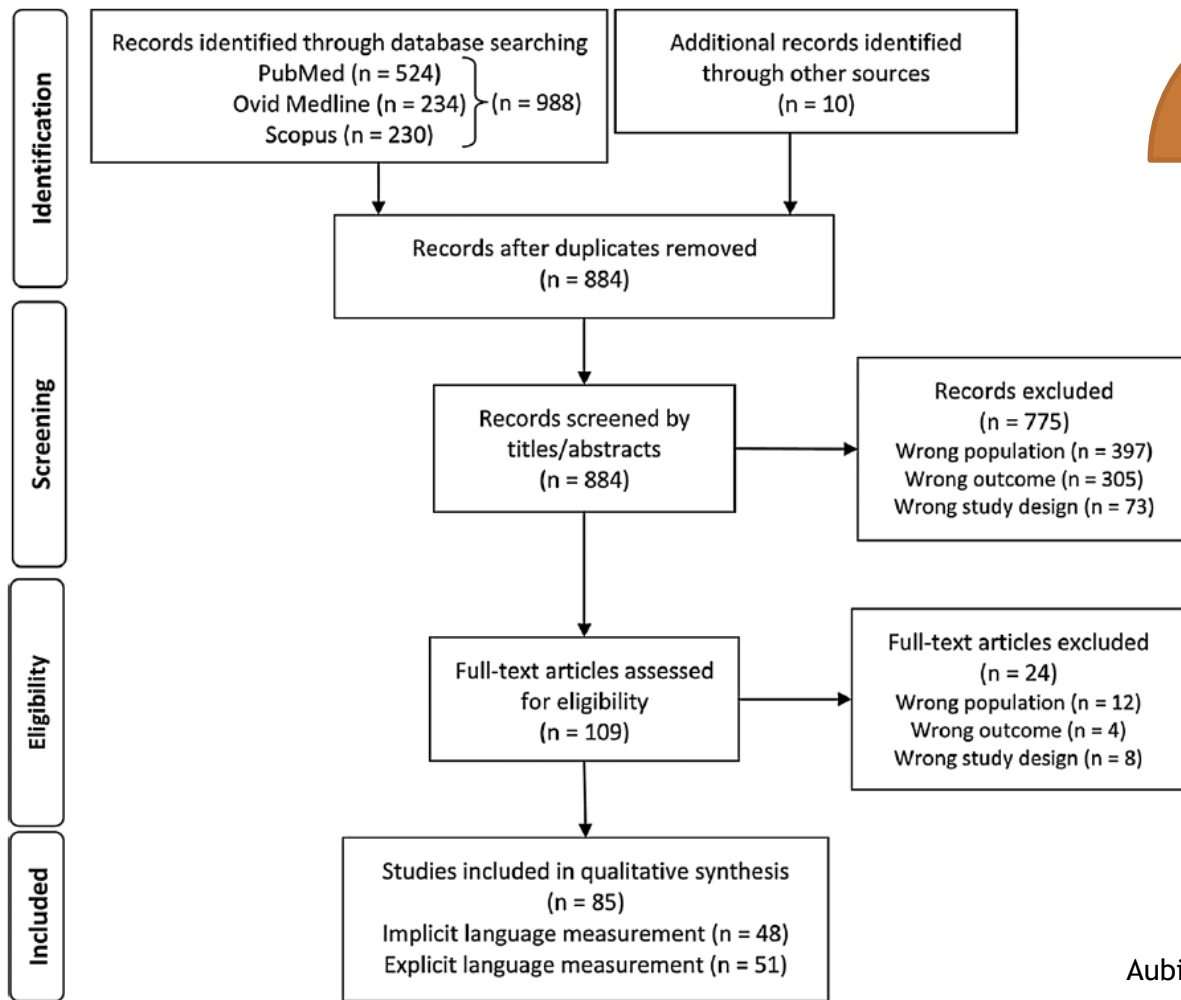Aubinet et al., *Neurosci. Biobehav. Rev.*, 2022

Objectives

1) Identify the level and quality of **language residual abilities** as a function of DoC diagnosis

2) Examine *how, when* **and** *where* **implicit and explicit language abilities reappear** after severe brain injury associated with impaired consciousness

→ Review question:

Which residual language abilities were observed in patients with DoC following severe acquired brain injury using neuroimaging, electrophysiological and behavioral bedside assessment methods?

Systematic review process

Identification

Records identified through database searching
PubMed (n = 524)
Ovid Medline (n = 234) } (n = 988)
Scopus (n = 230)

Additional records identified
through other sources
(n = 10)

Records after duplicates removed
(n = 884)

Screening

Records screened by
titles/abstracts
(n = 884)

Records excluded
(n = 775)
Wrong population (n = 397)
Wrong outcome (n = 305)
Wrong study design (n = 73)

Eligibility

Full-text articles assessed
for eligibility
(n = 109)

Full-text articles excluded
(n = 24)
Wrong population (n = 12)
Wrong outcome (n = 4)
Wrong study design (n = 8)

Included

Studies included in qualitative synthesis
(n = 85)
Implicit language measurement (n = 48)
Explicit language measurement (n = 51)

Data extraction:
language assessment
techniques,
% of UWS/MCS/EMCS
patients with implicit or
explicit language
abilities,...

Quality assessment:
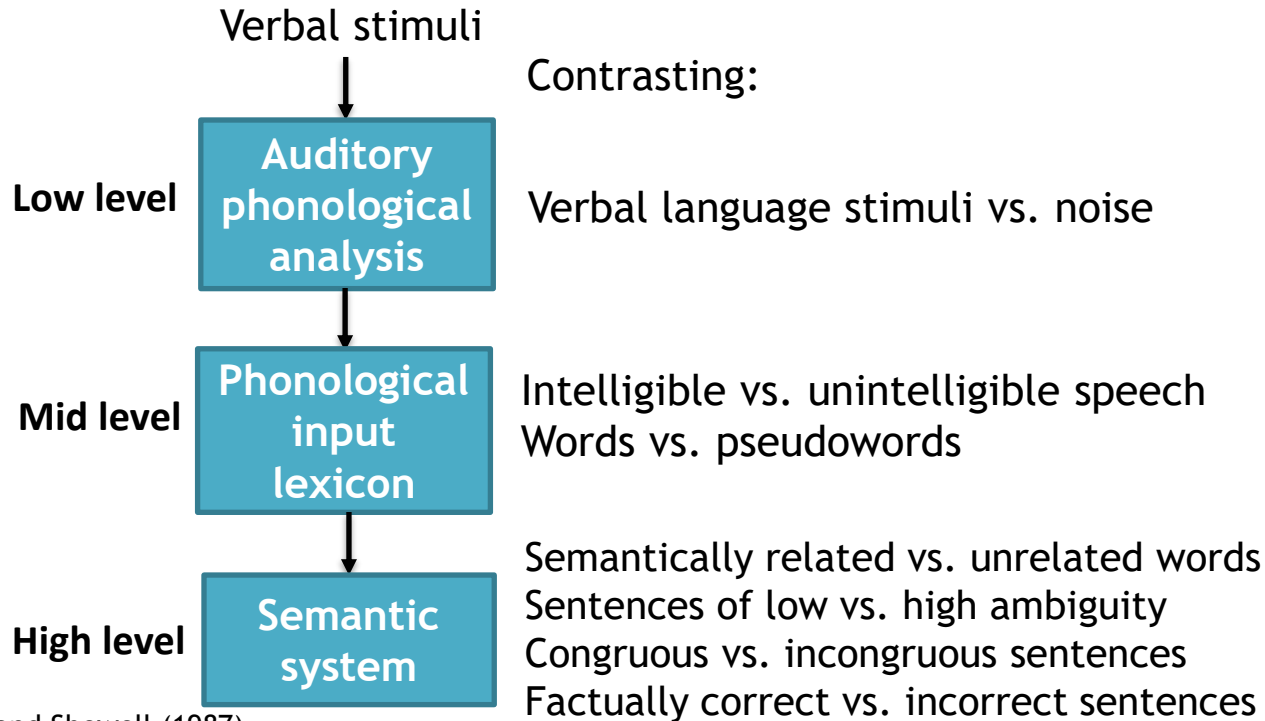QUADAS-2

→ Blinded investigators

Data synthesis:
PRISMA guidelines

Aubinet et al., *Neurosci. Biobehav. Rev.*, 2022

1) Which residual language abilities in the DoC entities?

Implicit language processing

Verbal stimuli

Contrasting:

Low level

Auditory phonological analysis

Verbal language stimuli vs. noise

Mid level

Phonological input lexicon

Intelligible vs. unintelligible speech
Words vs. pseudowords

High level

Semantic system

Semantically related vs. unrelated words
Sentences of low vs. high ambiguity
Congruous vs. incongruous sentences
Factually correct vs. incorrect sentences

Patterson and Shewell (1987)

All language levels in all DoC → High level also in UWS!

Brain response: UWS < MCS < EMCS

E.g.: Formisano et al., 2019; Kotchoubey et al., 2013; Balconi & Arangio, 2015; Kempny et al., 2018; Lechinger et al., 2016, Risetti et al., 2013, Rohaut et al., 2015; Tomaiuolo et al., 2016; …
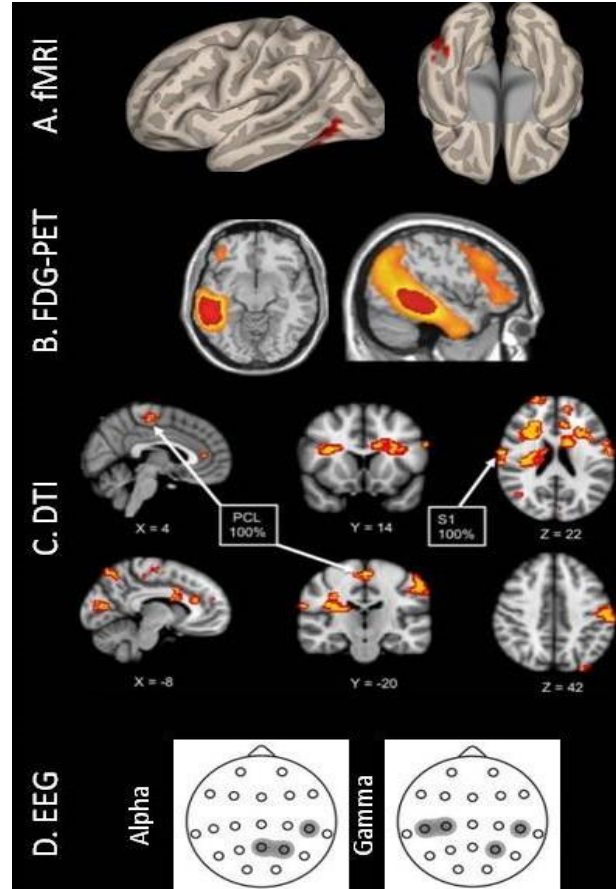
1) Which residual language abilities in the DoC entities?

Explicit language processing

Command-following ability
- Overt

MCS- < MCS+

move arm

Aubinet et al., 2018

Aubinet et al., 2020

Zheng et al., 2017

Claassen et al., 2016

1) Which residual language abilities in the DoC entities?

Explicit language processing

Command-following ability

- Overt: language-specific assessments?

Look at me

Look at the two images

Look at + 'TARGET WORD OR SENTENCE'

Brief Evaluation of Receptive Aphasia (BERA)

Look at the two images

'TARGET WORD OR SENTENCE'

Aubinet et al., *Brain Inj.*, 2021

1) Which residual language abilities in the DoC entities?

Explicit language processing

Command-following ability

- Covert

Mental tasks

Motor imagery

- Tennis, navigation, swimming, hand moving,…

E.g.: Coleman et al., 2009; Braiman et al., 2018, Edlow et al., 2017; Bodien et al., 2017

Counting

- Subject's own name, targeted sound or word

E.g.: Hauger et al., 2015; Naci & Owen, 2013; Haug et al., 2018
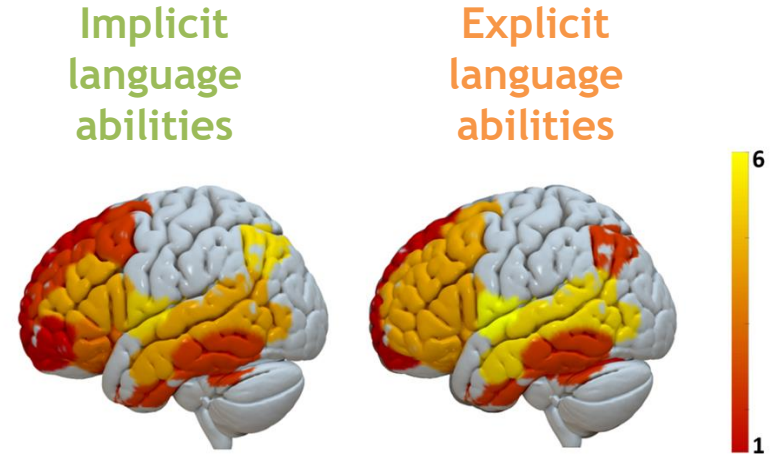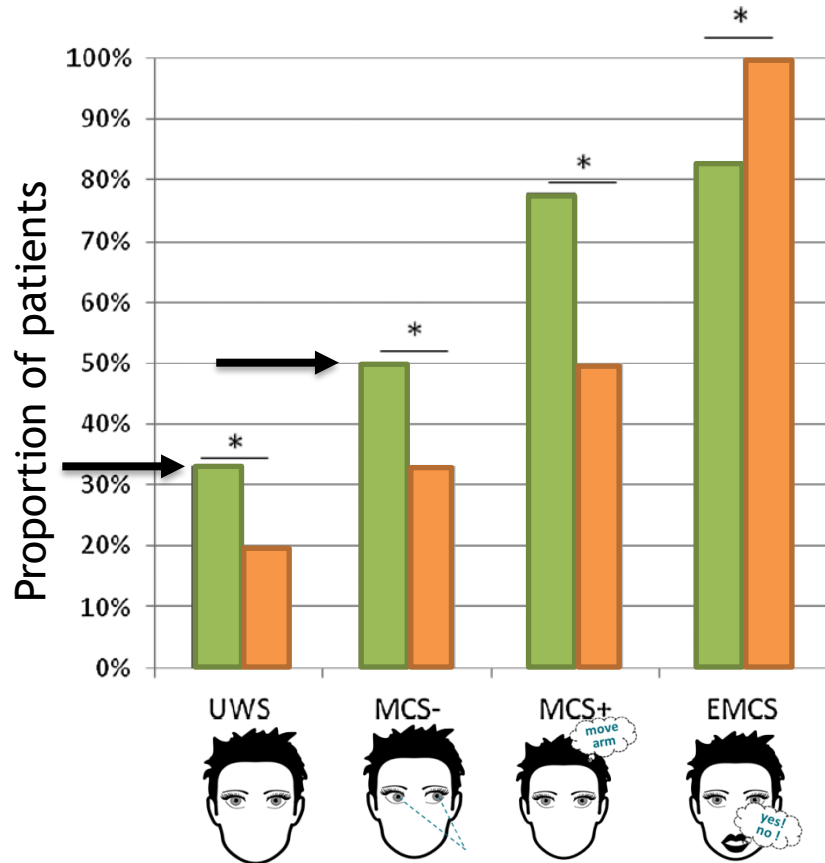
Picture naming

Rodriguez-Moreno et al., 2010

Potential residual brain response in all DoC categories
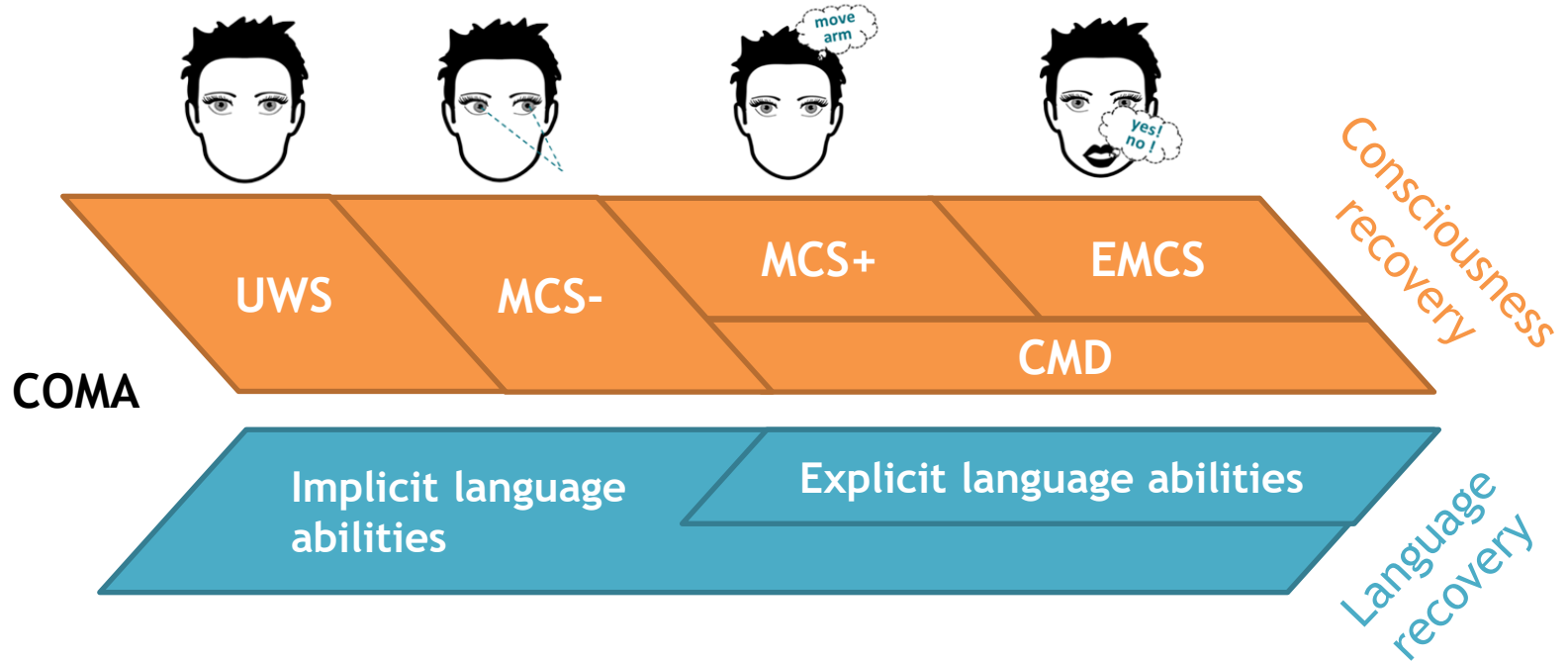
→ ~20% UWS and ~33% MCS-

= CMD!

2) How, when and where do language abilities reappear?

Implicit language abilities

Explicit language abilities

Aubinet et al., *Neurosci. Biobeh. Rev.*, 2022

Recovery trajectory of both language functions and consciousness

Implicit vs. explicit language assessment

Implicit language assessment

- UWS patients with residual brain activity reflecting semantic processing

→ « Covert cortical processing »

→ *Is the presence of complex language processing in the absence of 'consciousness' possible?*

- DoC taxonomy

Explicit language assessment

- CMD detection

→ Reduce DoC misdiagnosis

Melloni et al., *Science*, 2021
Edlow et al., *Brain*, 2017

Conclusion

- Residual language processing in all DoC categories
  - From low to high levels

- Language recovery // consciousness recovery

- But early implicit language recovery
  → Covert cortical processing: implicit language processing in absence of behavioral response

- Left-sided language network
  - Neural correlates of command-following
  - Passive & active paradigms
  - fMRI, EEG (ERPs), FDG-PET

- Standardized and sensitive multimodal language assessments

Questions?

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Aubinet C, Chatelle C, Gosseries O, Carrière M, Laureys S, Majerus S. Residual implicit and explicit language abilities in patients with disorders of consciousness: A systematic review. *Neurosci Biobehav Rev.* 2022 Jan;132:391-409.