Assessing Communication Abilities

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Learning objectives

At the conclusion of this activity, participants will be able to:

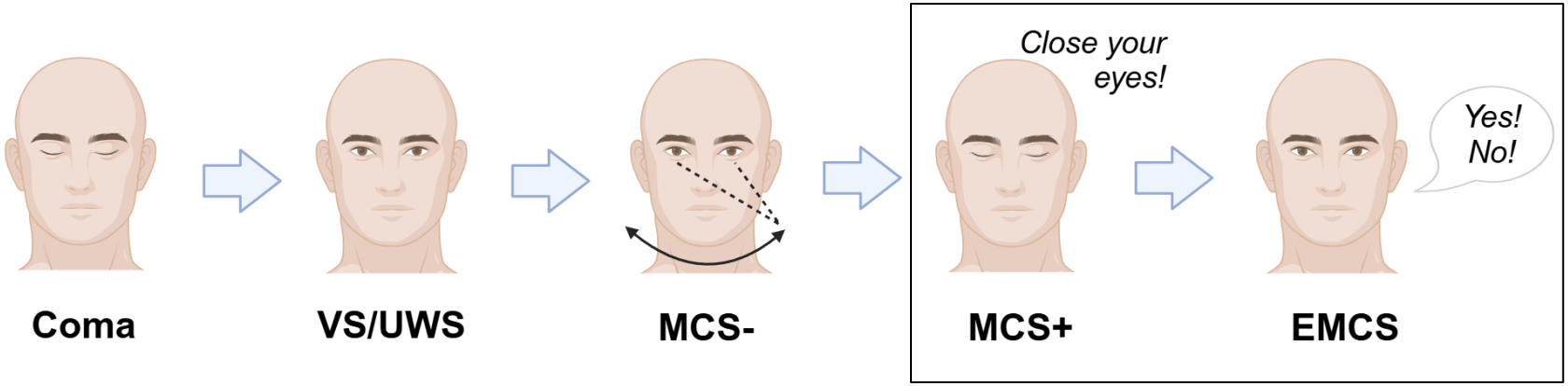
1. **Discuss** the association between language, communication and consciousness disorders following severe brain injury

2. Better **identify** language and communication disorders in adult population with pDoCs

3. **Select** appropriate tools for assessing language and communication abilities in pDoCs

Language and communication in the assessment of DoC

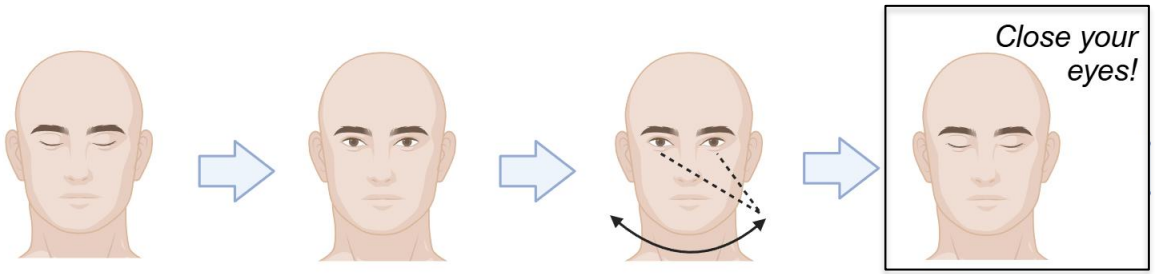
Disorders of consciousness (DoC) following severe brain injury



Residual language skills

Giacino et al. (2004), *APMR*

MCS+ diagnosis: recovery of language function



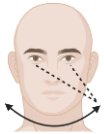
Reproducible language signs of consciousness

CRS-R guidelines:

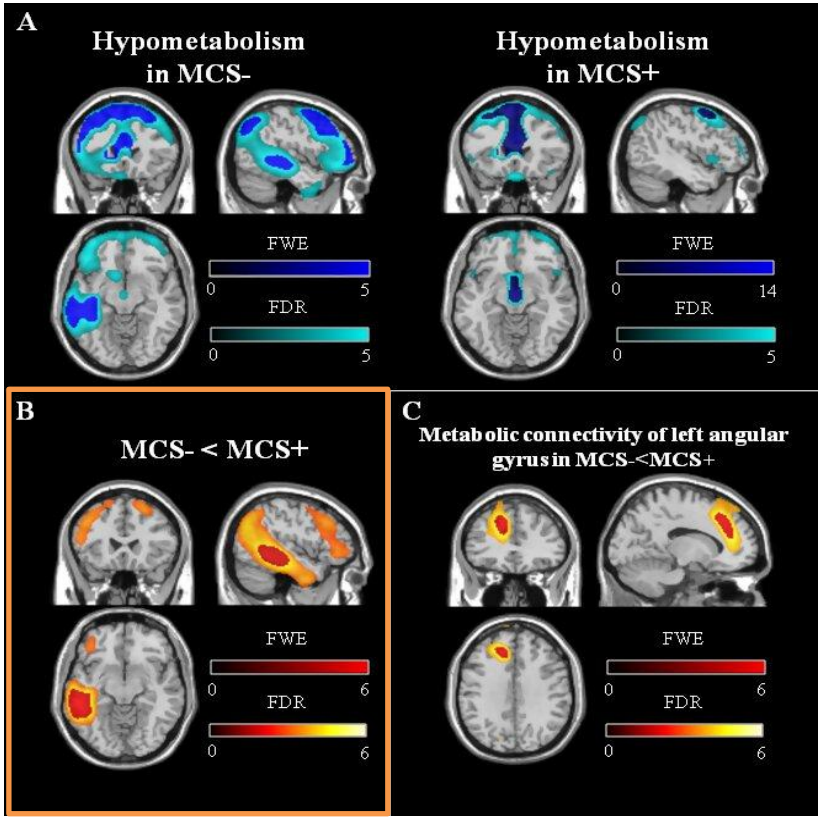
Auditory subscale: 3/4 or 4/4 = **command-following**
Oro-motor/verbal subscale: 2/3 or 3/3 = **intelligible verbalization**
Communication subscale: 1/2 = **intentional communication**

Bruno et al. (2011), *J Neurol*
Thibaut et al. (2020), *J Neurol*
Giacino et al. (2004), *APMR*

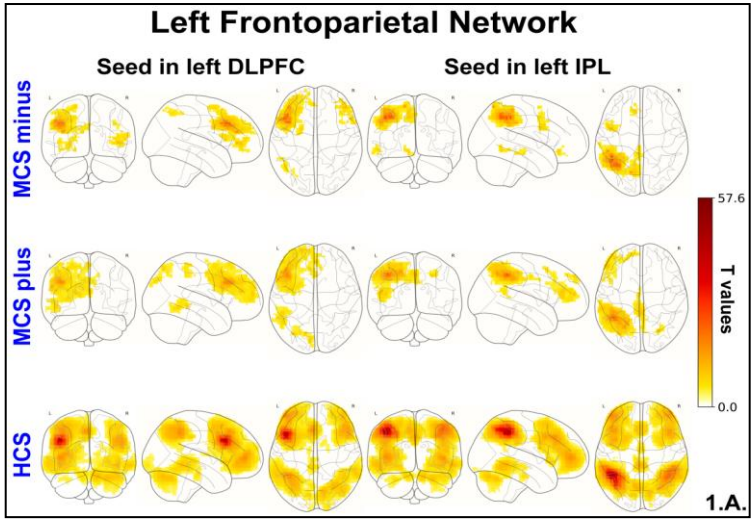
MCS+ diagnosis: language function or consciousness level?

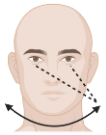


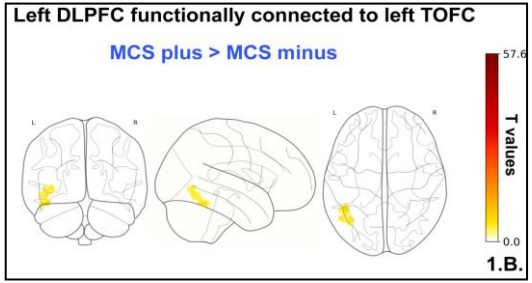
FDG-PET



rsfMRI

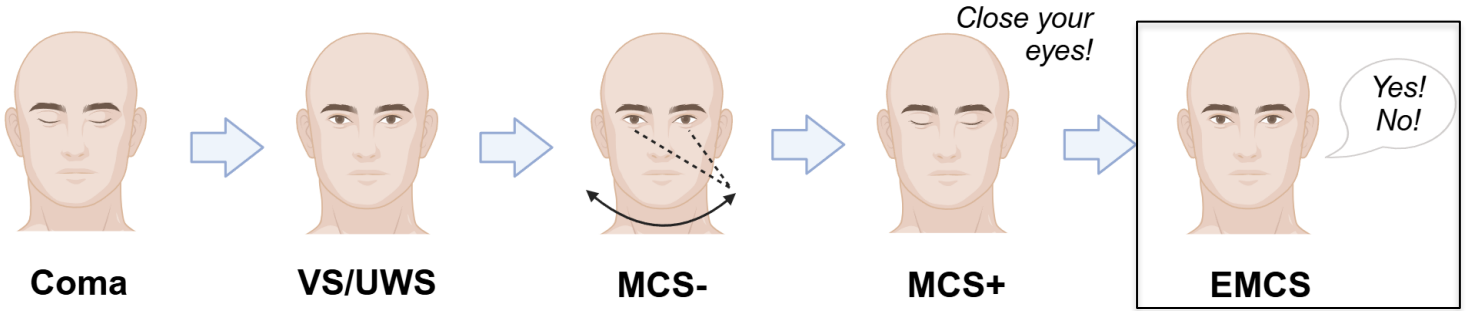






Aubinet et al. (2020), *NNR*
Aubinet et al. (2018), *HBM*

EMCS diagnosis: recovery of communication



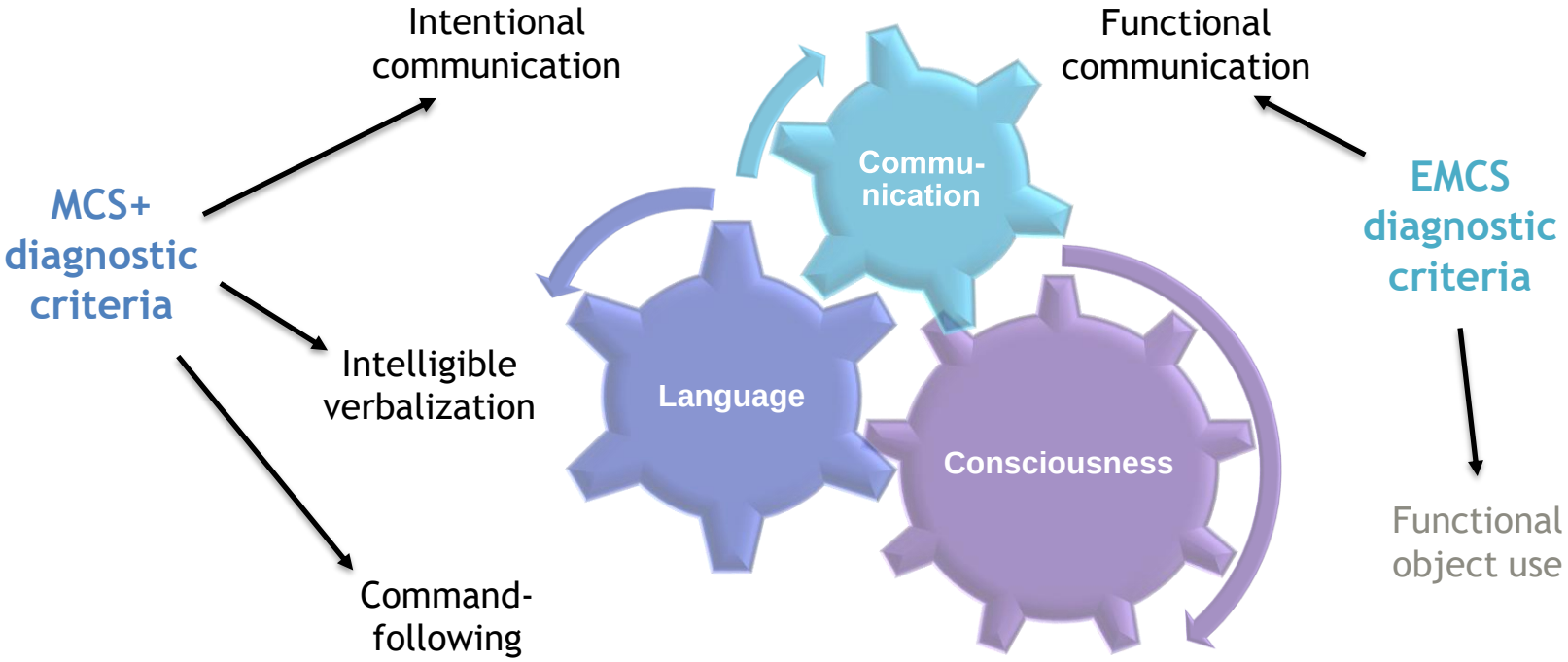
CRS-R guidelines:

4/4 on use of 2 common objects = functional object use
6/6 on situational yes/no questions = **functional communication**

- Auditory (e.g., 'Am I clapping my hand right now?')
- Visual (e.g., 'Am I touching my ear right now?')

Giacino et al. (2004), *APMR*

Diagnosis of DoC



Coma Recovery Scale-Revised (CRS-R)

AUDITORY FUNCTION SCALE
4 – Consistent Movement to Command▪
3 – Reproducible Movement to Command▪
2 – Localization to Sound
1 – Auditory Startle
0 – None
VISUAL FUNCTION SCALE
5 – Object Recognition▪
4 – Object localization: Reaching*
3 – Visual Pursuit*
2 – Fixation*
1 – Visual Startle
0 – None
MOTOR FUNCTION SCALE
6 – Functional Object Use†
5 – Automatic Motor Response*
4 – Object Manipulation*
3 – Localisation to Noxious Stimulation*
2 – Flexion Withdrawal
1 – Abnormal Posturing
0 – None
OROMOTOR/VERBAL FUNCTION SCALE
3 – Intelligible Verbalization▪
2 – Vocalization/Oral Movement
1 – Oral Reflexive Movement
0 – None
COMMUNICATION SCALE
2 – Functional: Accurate†
1 – Non-functional: Intentional▪
0 – None
AROUSAL SCALE
3 – Attention
2 – Eye Opening w/o Stimulation
1 – Eye Opening with Stimulation
0 – Unarousable
TOTAL SCORE

→ Items relying on language processing

Aphasia ←
= confounding factor

according to the latest international guidelines on DoC practices

Test Completion Codes	
1	test completed in full - results valid
Test attempted, not completed due to:	
2.1	impaired sensory function (cortical or peripheral)
2.2	aphasia
2.3	physical injury (e.g., fracture, brachial plexus, hemiparesis)
2.4	primary language barrier
2.5	illness/medical instability
2.6	examiner error
2.7	logistical reasons
2.8	other (specify):
Test not attempted due to:	
3.1	impaired sensory function (cortical or peripheral)
3.2	aphasia
3.3	physical injury (e.g., fracture, brachial plexus, hemiparesis)
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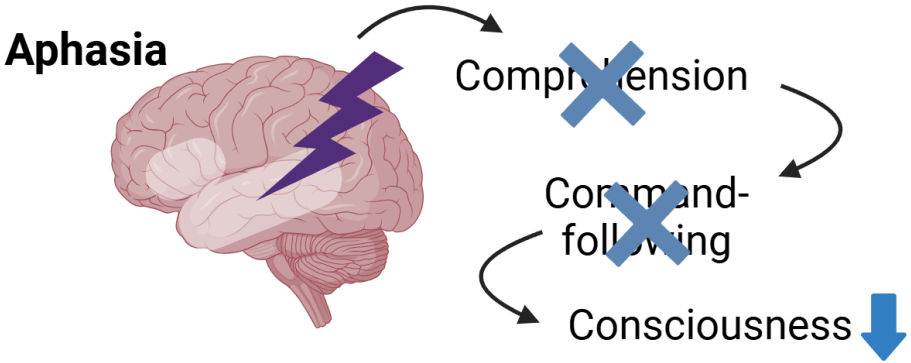
3.6	examiner error
3.7	logistical reasons
3.8	other (specify):

Giacino et al. (2004), *APMR*
Giacino et al. (2018), *Neurology*
Kondziella et al. (2020), *EJN*

Aphasia in behavioral DoC diagnosis



24 conscious aphasic patients

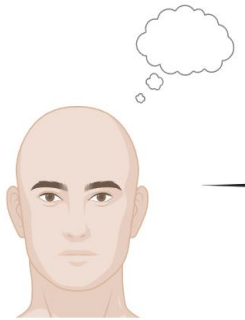
→ CRS-R assessment

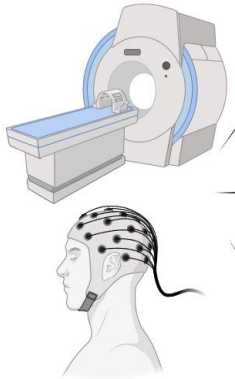
→ 54% of patients with global aphasia: diagnosis = MCS!

Crucial need to better characterize language impairments in post-comatose DoC patients

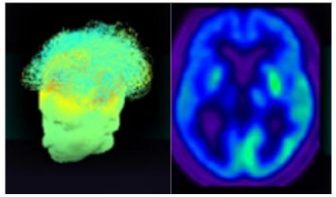
Schnakers et al. (2015), *NNR*
Majerus et al. (2009), *PBR*

Detection of covert consciousness





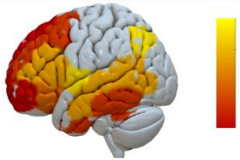
Resting paradigms



Non-behavioral MCS (**MCS***)

Thibaut et al., *Ann Neurol*, 2021

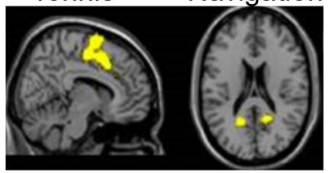
Passive paradigms



Covert cortical processing (**CCP**)

Edlow et al., *Nat Rev Neurol*, 2021

Active paradigms



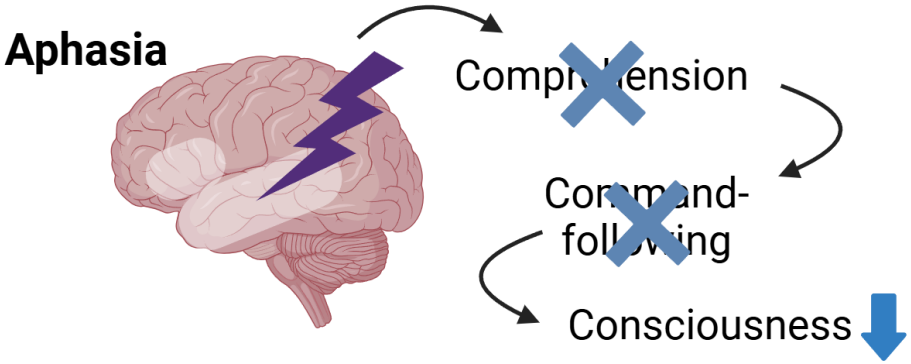
Cognitive motor dissociation (**CMD**)

Monti et al., *NEJM*, 2010

Bodien et al., *NEJM*, 2024

Reliance on language processing

Aphasia in detection of covert consciousness



50 conscious aphasic patients

- Comprehensive aphasia assessment
- EEG-based motor command task

→Appropriate EEG responses 4x less likely in patients with receptive or global aphasia

Crucial need to better characterize language impairments in post-comatose DoC patients

Jacobson et al., *Neurocrit Care, 2024*

Current speech-language therapy practices

International survey on SLT practices

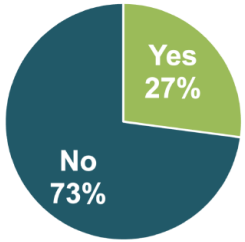
DoCSIG Project

Aims:

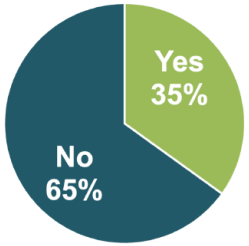
1) Identify the tools and practices to rehabilitate language and swallowing that are preferentially used by therapists, in particular SLTs, in population with DoC
2) Improve the assessment and clinical management of language and swallowing disorders

→ We collected 166 valid questionnaires
→ Rapid Reports Session 1 – Disorders of consciousness (A. Regnier, 03/20)

Introduction to DoC during higher education?



Introduction to DoC during professional career?



Regnier et al. (*in prep*)

Language/communication assessment and management

Percentage of therapists who…

- Have already assessed language/communication abilities – **82%**
- Create/adapt their own tools to assess language/communication abilities – **29%**
- Include observation of communicative behaviors of patients in a range of settings, including with families and friends – **89%**
- Gather information from families and friends regarding patients' specific interests and potentially motivating stimuli – **96%**
- Regularly monitor for changes in communicative behaviors – **94%**
- Assess post-comatose patients' ability to use AAC – **72%**
- Have already managed language/communication abilities in post-comatose patients –**76%**

Regnier et al. (*in prep*)

Reported language assessment tools

- Glasgow Coma Scale (**GCS**)
- Coma Recovery Scale-Revised (**CRS-R**)
- Simplified Evaluation of CONsciousness Disorders (**SECONDs**)
- …
- Mississippi Aphasia Screening Test (**MAST**)
- Language Screening Test (**LAST**)
- Cognitive Assessment by Visual Election (**CAVE**)
- Brief Evaluation of Receptive Aphasia (**BERA**)

Regnier et al. (*in prep*)

Language assessment tools

Language screening tests (stroke patients)

Mississippi Aphasia Screening Test (MAST)

→ 9 subtests: naming, automatic speech, repetition, yes/no responses, object recognition, following instructions, reading instructions, verbal fluency, writing/spelling

Nakase-Thompson et al. (2005), *Brain Inj*

Language Screening Test (LAST)

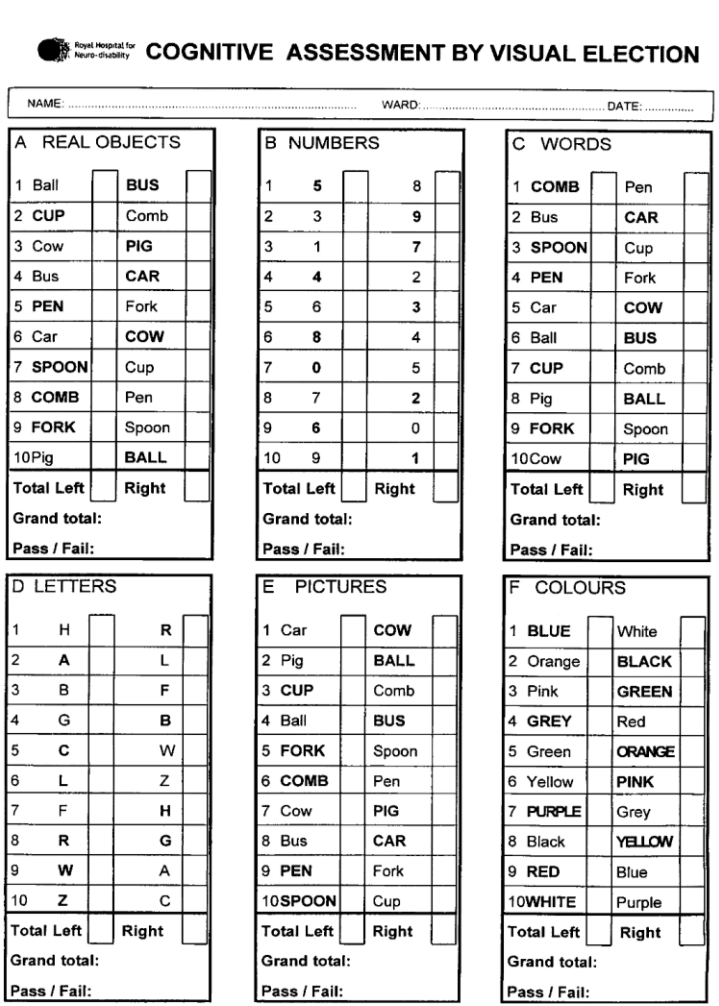
→ 5 subtests: naming, repetition, automatic speech, picture recognition, verbal instructions

Flamand-Roze et al. (2011), *Stroke*

Brief and repeatable screening measures for individuals with severely impaired communication/language skills

→ Only a few items in DoC patients

Cognitive Assessment by Visual Election (CAVE)



Royal Hospital for Neuro-disability **COGNITIVE ASSESSMENT BY VISUAL ELECTION**

NAME: ..... WARD: ..... DATE: .....

A REAL OBJECTS			
1 Ball		**BUS**	
2 **CUP**		Comb	
3 Cow		**PIG**	
4 Bus		**CAR**	
5 **PEN**		Fork	
6 Car		**COW**	
7 **SPOON**		Cup	
8 **COMB**		Pen	
9 **FORK**		Spoon	
10 Pig		**BALL**	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

B NUMBERS			
1 **5**		8	
2 3		**9**	
3 1		**7**	
4 **4**		2	
5 6		**3**	
6 **8**		4	
7 **0**		5	
8 7		**2**	
9 **6**		0	
10 9		**1**	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

C WORDS			
1 **COMB**		Pen	
2 Bus		**CAR**	
3 **SPOON**		Cup	
4 **PEN**		Fork	
5 Car		**COW**	
6 Ball		**BUS**	
7 **CUP**		Comb	
8 Pig		**BALL**	
9 **FORK**		Spoon	
10 Cow		**PIG**	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

D LETTERS			
1 H		**R**	
2 **A**		L	
3 B		**F**	
4 G		**B**	
5 **C**		W	
6 L		Z	
7 F		**H**	
8 **R**		G	
9 **W**		A	
10 **Z**		C	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

E PICTURES			
1 Car		**COW**	
2 Pig		**BALL**	
3 **CUP**		Comb	
4 Ball		**BUS**	
5 **FORK**		Spoon	
6 **COMB**		Pen	
7 Cow		**PIG**	
8 Bus		**CAR**	
9 **PEN**		Fork	
10 **SPOON**		Cup	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

F COLOURS			
1 **BLUE**		White	
2 Orange		**BLACK**	
3 Pink		**GREEN**	
4 **GREY**		Red	
5 Green		**ORANGE**	
6 Yellow		**PINK**	
7 **PURPLE**		Grey	
8 Black		**YELLOW**	
9 **RED**		Blue	
10 **WHITE**		Purple	
Total Left		**Right**	
Grand total:			
Pass / Fail:			

6 subtests :

- Object recognition (object and pictures)
- Symbol recognition (numbers and letters)
- Color recognition
- Reading

→ Very familiar, simple constructs

DRS subtest scores	CAVE *p*
Eye opening	n/a
Verbalisation	0.377
Motor response	0.095
Cognitive ability	0.03*
Dependence	0.097
Employability	n/a
DRS total	0.023*

*$p < .05$.

Murphy et al. (2018), *Neuropsychol Rehabil*

Brief Evaluation of Receptive Aphasia (BERA)

Language-specific assessment

Language components
- Phonology
- Semantics
- Morphosyntax

Psycholinguistic variables
- Phonological similarity
- Semantic category and word frequency
- Item length

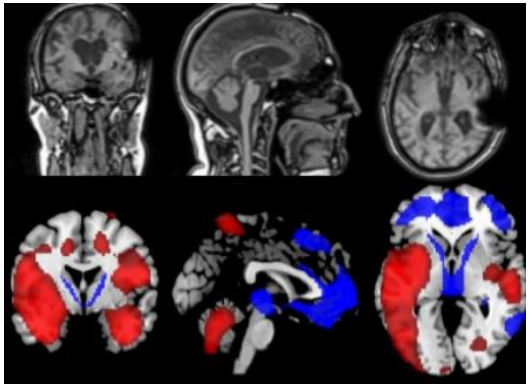
Aubinet et al. (2021), *Brain Inj*.
Aubinet et al. (in prep)

Brief Evaluation of Receptive Aphasia (BERA)

EMCS

BERA: 22/30
Phonology: 7/10
Semantics: 8/10
Morphosyntax: 7/10

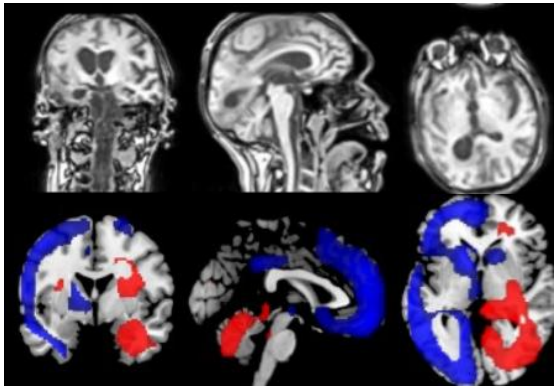
CRS-R: 23/23



MCS-

BERA: 16/30
Phonology: 7/10
Semantics: 6/10
Morphosyntax: 3/10

CRS-R: 9/23



- Feasible in this population
- Validity in aphasic conscious patients
- Complementary to other scales (CRS-R, SECONDs)
- Refined cognitive and language profiles

Aubinet, Chatelle et al. (2021), *Brain Injury*

Brief Evaluation of Receptive Aphasia (BERA)

Validation in post-comatose patients

- French validation

→ Moderate to Severe TBI in Adults – Oral Scientific Paper Presentations (C. Aubinet, 03/21)

- Translation and adaptation

→ Italian, Spanish, English, Polish, German

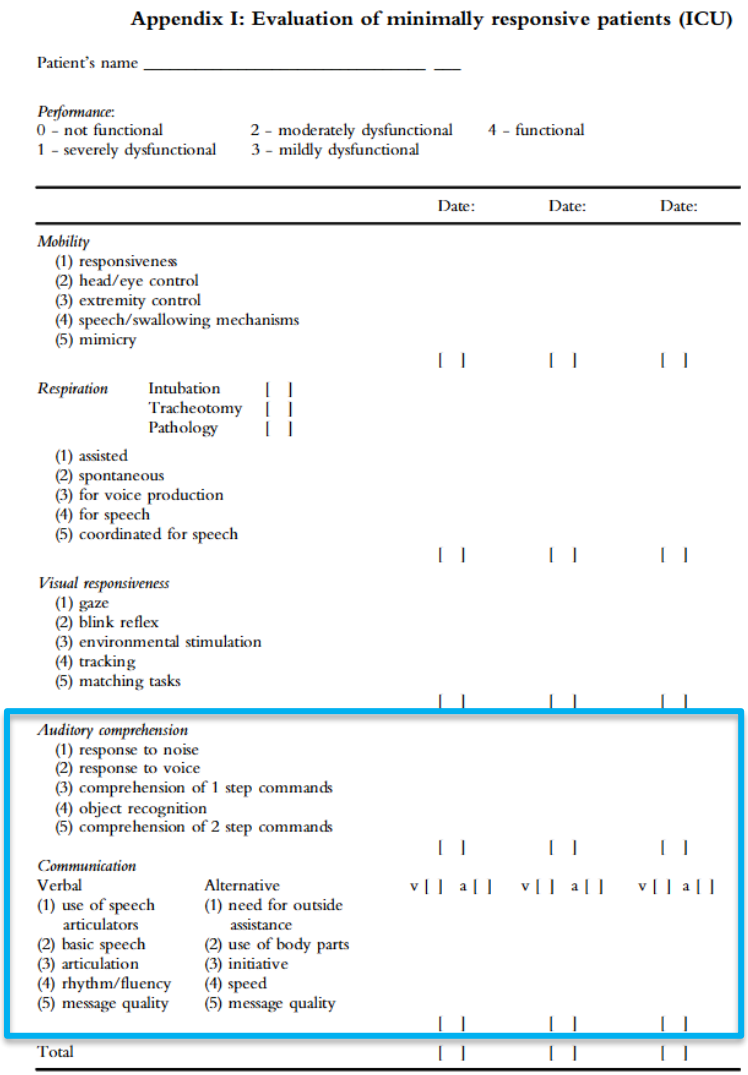
DoCSIG Project

EU DoCBox project

Computerized version using an eye-tracker

- Development of the BERAwET
- Starting validation in healthy and DoC subjects

Communication assessment tools



Appendix I: Evaluation of minimally responsive patients (ICU)

Patient's name _____ ___

Performance:
0 – not functional
1 – severely dysfunctional
2 – moderately dysfunctional
3 – mildly dysfunctional
4 – functional

	Date:	Date:	Date:
Mobility			
(1) responsiveness			
(2) head/eye control			
(3) extremity control			
(4) speech/swallowing mechanisms			
(5) mimicry	| |	| |	| |
Respiration Intubation	| |		
Tracheotomy	| |		
Pathology	| |		
(1) assisted			
(2) spontaneous			
(3) for voice production			
(4) for speech			
(5) coordinated for speech	| |	| |	| |
Visual responsiveness			
(1) gaze			
(2) blink reflex			
(3) environmental stimulation			
(4) tracking			
(5) matching tasks	| |	| |	| |
Auditory comprehension			
(1) response to noise			
(2) response to voice			
(3) comprehension of 1 step commands			
(4) object recognition			
(5) comprehension of 2 step commands	| |	| |	| |
Communication			
Verbal / Alternative	v | | a | |	v | | a | |	v | | a | |
(1) use of speech articulators / (1) need for outside assistance			
(2) basic speech / (2) use of body parts			
(3) articulation / (3) initiative			
(4) rhythm/fluency / (4) speed			
(5) message quality / (5) message quality	| |	| |	| |
Total	| |	| |	| |

Loewenstein Communication Scale (LCS)

- Auditory comprehension:

Response to noise, response to voice, comprehension of 1-step commands, object recognition, comprehension of 2-step commands

- Verbal communication:

Speech articulators, basic speech, articulation, rhythm/fluency, message quality

- Alternative communication:

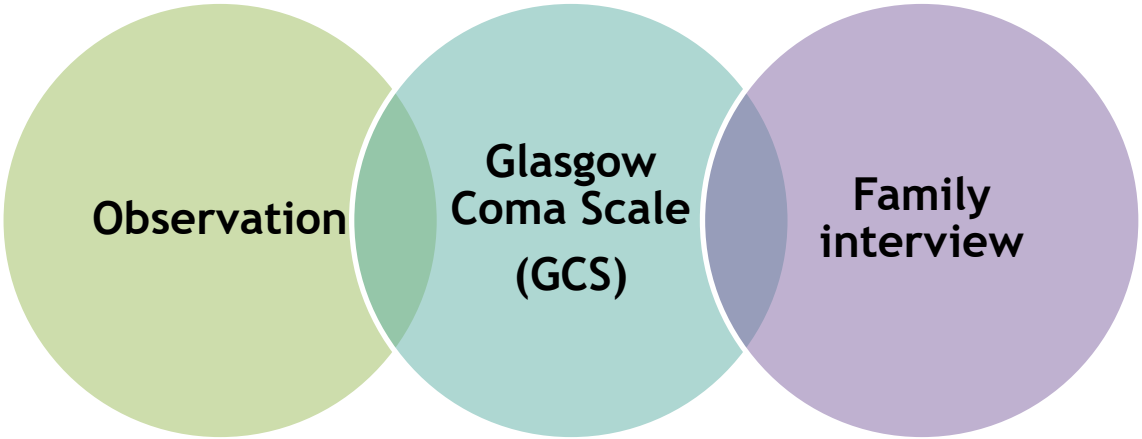
Need for outside assistance, use of body parts, initiative, speed, message quality

→ Good inter-rater reliability and predictive of rehabilitation progress

Borer-Alafi et al. (2002), *Brain Inj*

Individual Nonverbal Communication Rating Scale (INCRS)

Attempts at establishing communication (physiological changes, minimal body movements, eye movements)



Mimic expression, observed face contortion, body restlessness or physiological reactions

- Estimation of preverbal, verbal and interpersonal communication as well as creative expression
- Emotional, language and cognitive or social levels

Rasmus et al. (2019), *Ann Agric Environ Med*

Functional Communication Measures (FCMs)

- 15 FCMs developed by ASHA to describe aspects of communication and swallowing abilities over the course of SLT intervention
- Series of 7-point rating scales: from least functional (Level 1) to most functional (Level 7)
- Italian version of 7 selected FCMs for patients with severe brain injury:
  - Cognitive domains: attention, memory
  - Communication-related functions: AAC, motor speech, spoken language comprehension, spoken language expression, swallowing

De Bellis et al. (2021), *Neurol Sci*
Mullen et al. (2004), *J Commun Disord*
Giacino et al. *(2014)*

Functional Communication Measures (FCMs)

- Non-DoC patients with severe brain injury (n=19):
  - Almost perfect inter-rater agreement
  - Substantial inter-rater agreement

FCM item	*N*	Median, examiner 1	Median, examiner 2	*K*	*p*
Attention	19	5	6	0.870	<0.001
Memory	19	5	5	0.869	<0.001
Communicative-augmentative communication	19	5	4	0.747	<0.001
Motor speech	19	6	5	0.612	<0.001
Spoken language expression	19	5	5	0.685	<0.001
Spoken language comprehension	19	5	5	0.734	<0.001
Swallowing	19	5	5	0.861	<0.001

De Bellis et al. (2021), *Neurol Sci*

Functional Communication Measures (FCMs)

EU DoCBox project

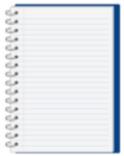
- EMCS patients (n=2):
  - Case 1: 64 yo female, massive intraparenchymal hemorrhage due to the right middle cerebral artery's rupture, tso = 6 months
  - Case 2: 74 yo female, rupture of an aneurysm of the anterior communicant artery; tso = 4 months

Patient	FCM							CRS-R total score	CRS-R communication subscore	DRS total score
	Swallowing	Motor speech	Spoken language expression	Spoken language comprehension	Augmentative-alternative communication	Memory	Attention			
Case 1	3	NE	NE	3	2	3	2	18	1	18
Case 2	4	2	1	3	2	3	4	19	1	18

De Bellis et al. (2021), *Neurol Sci*

Use of alternative communication pathways

Alternative Augmentative Communication (AAC)



- *Low-tech*: picture boards, communication books, or simple yes/no signals
- *High-tech*: tablets, speech-generating devices, and eye-tracking technology

→ effectiveness in post-stroke aphasia, LIS, ALS, and TBI

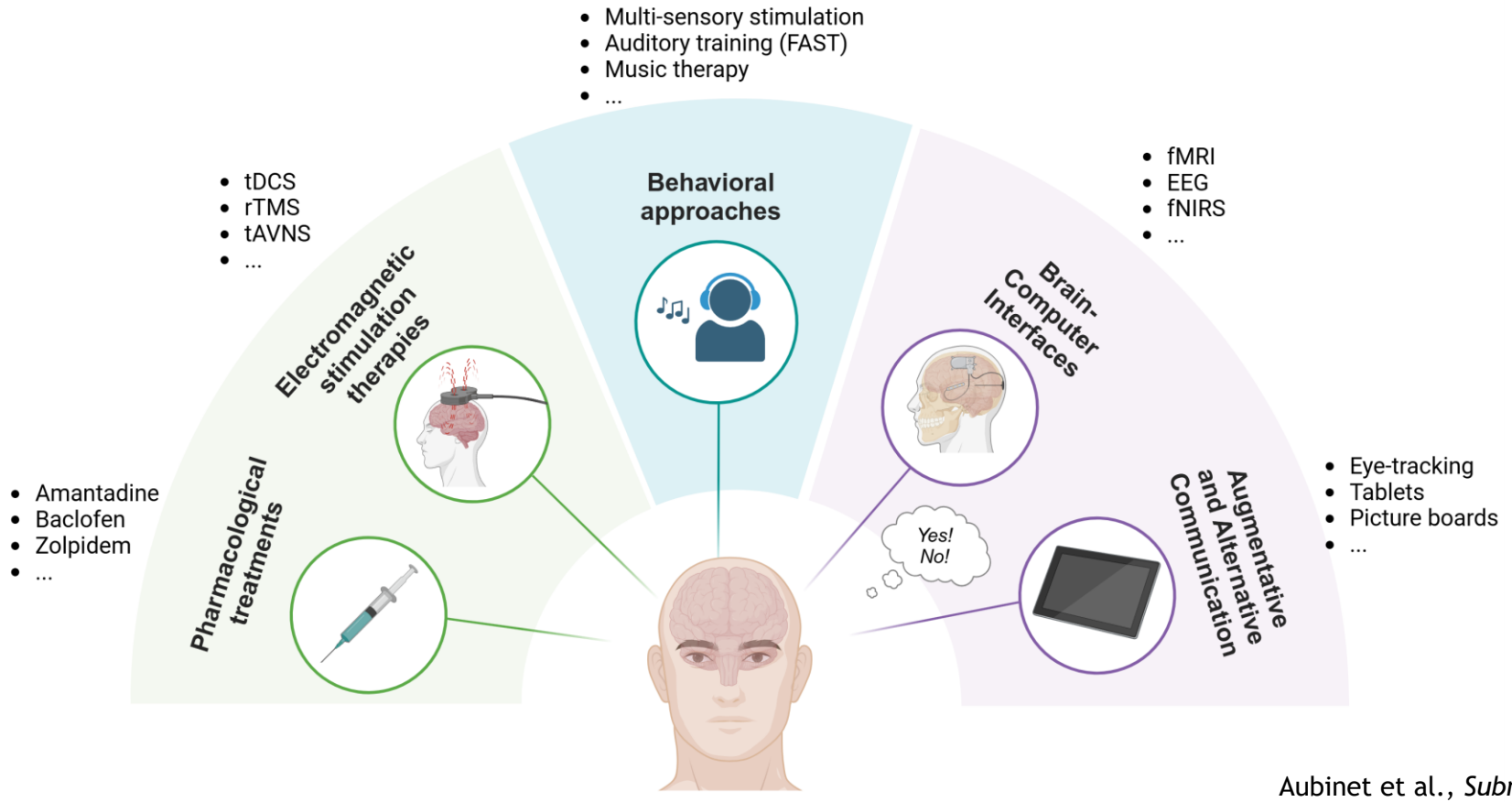
→ enhance communication abilities but also positively impact social skills, anxiety levels, depression, and overall quality of life for patients

Formica et al. (2024), *Brain Sci*

Brain-Computer Interfaces (BCIs)

Neuroimaging/electrophysiological techniques

Communication rehabilitation



Aubinet et al., *Submitted*

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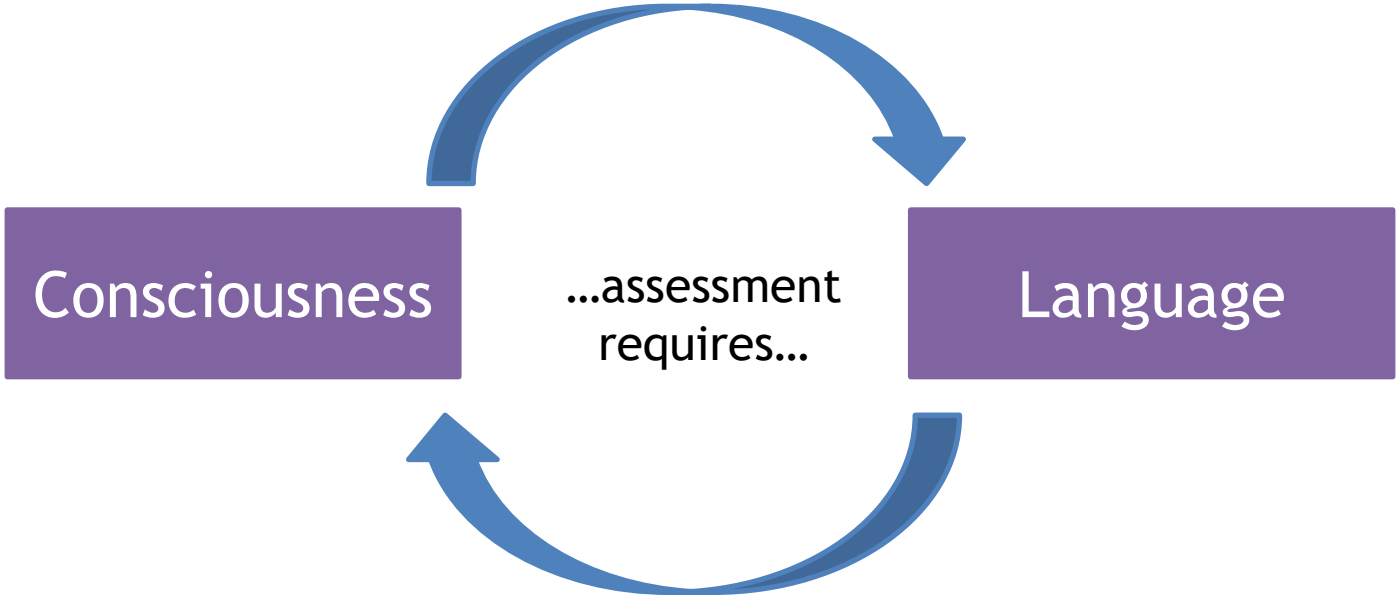
Conclusion

Language and consciousness: the circularity issue



→ How to disentangle language and consciousness processes?

→ Bilateral functional interactions between them?

Assessing (language and) communication abilities

- Dissociation of consciousness, language and communication disorders
- Language assessment tools:
  - CRS-R & other DoC scales
  - Language screening tools dedicated to aphasic (conscious) patients
  - CAVE, BERA

  → MCS/EMCS patients
- Communication assessment tools:
  - CRS-R & other DoC scales
  - LCS, INCRS, FCMs
  - AAC and BCIs

  → EMCS patients

References and bibliography

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Thank you!

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www.coma.uliege.be

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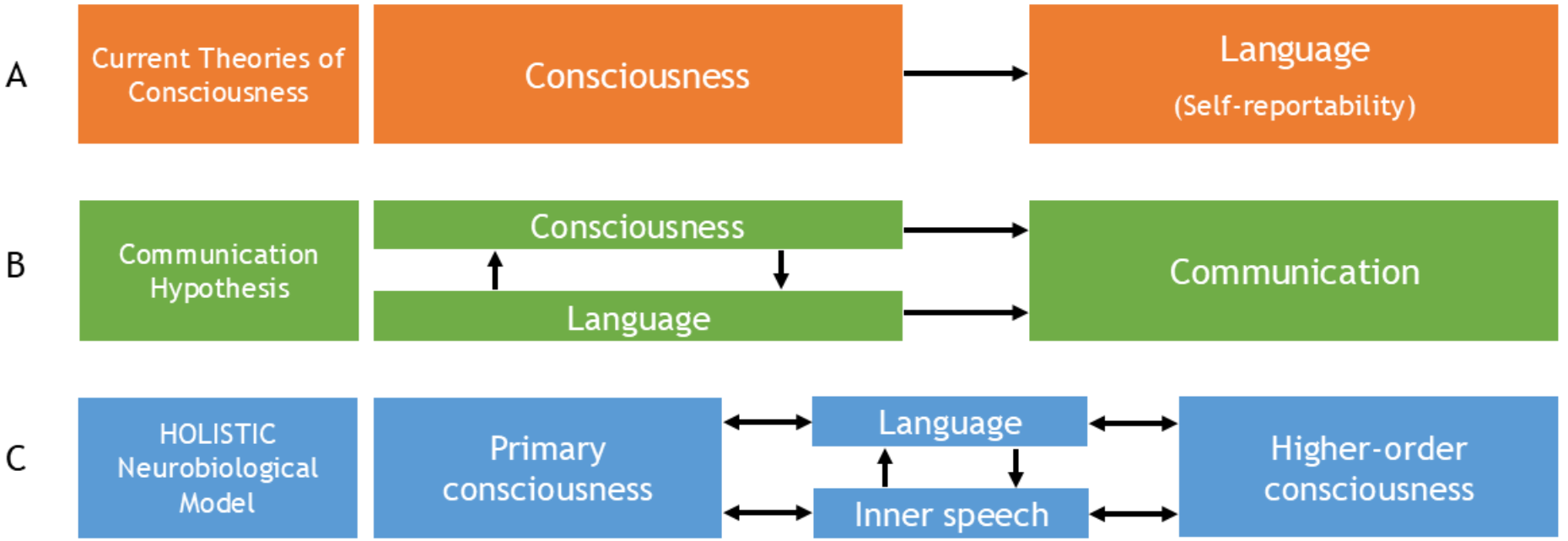
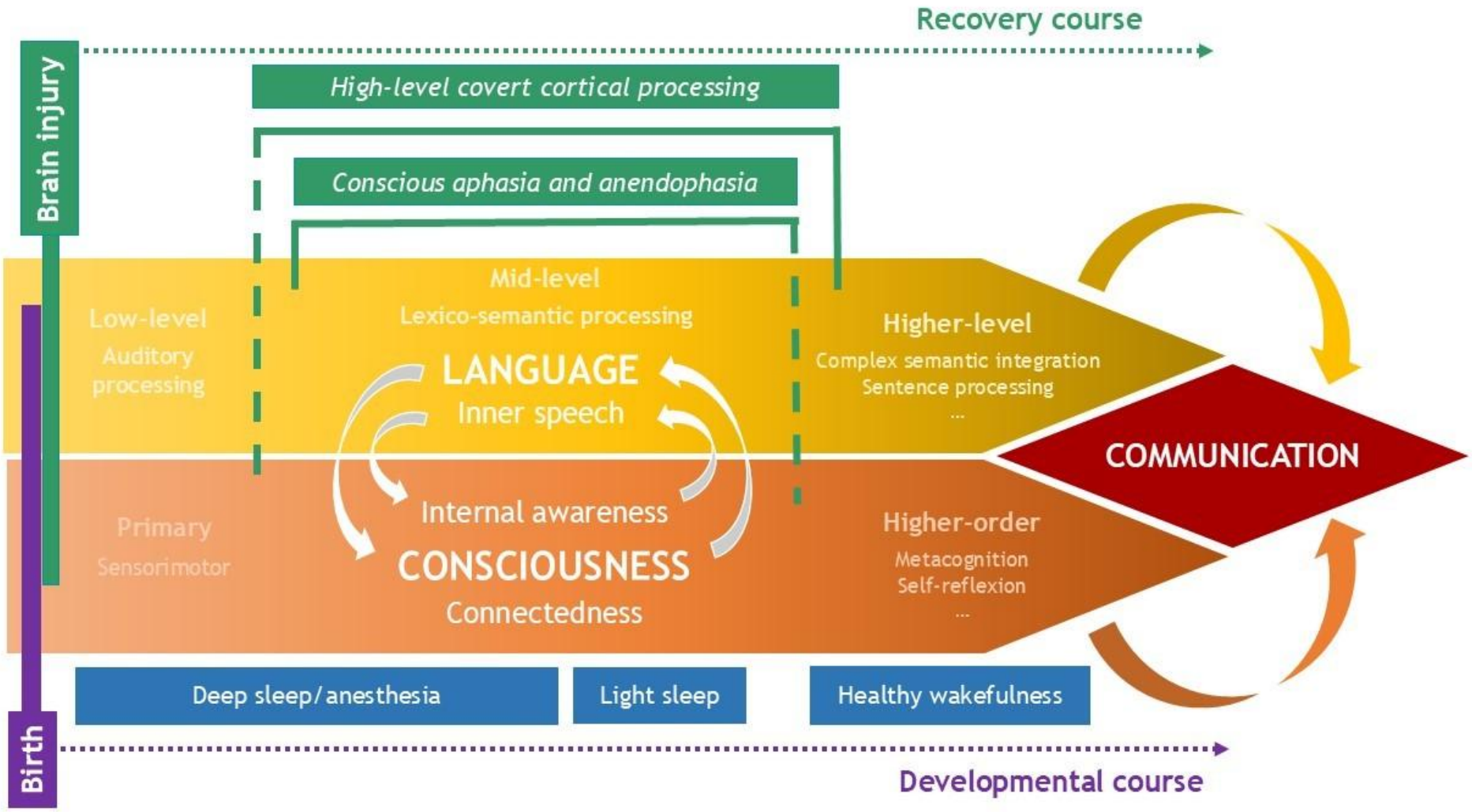
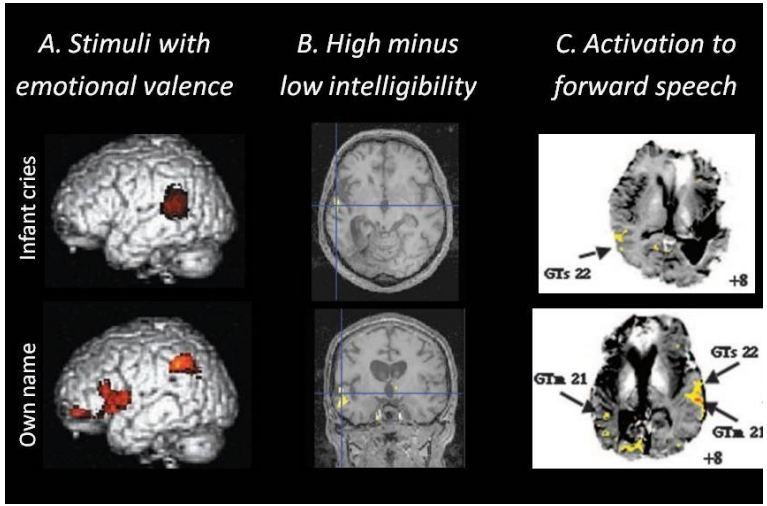



Recovery course
Brain injury
High-level covert cortical processing
Conscious aphasia and anendophasia
Low-level
Auditory processing
Mid-level
Lexico-semantic processing
LANGUAGE
Inner speech
Higher-level
Complex semantic integration
Sentence processing
...
COMMUNICATION
Primary
Sensorimotor
Internal awareness
CONSCIOUSNESS
Connectedness
Higher-order
Metacognition
Self-reflexion
...
Deep sleep/anesthesia
Light sleep
Healthy wakefulness
Birth
Developmental course

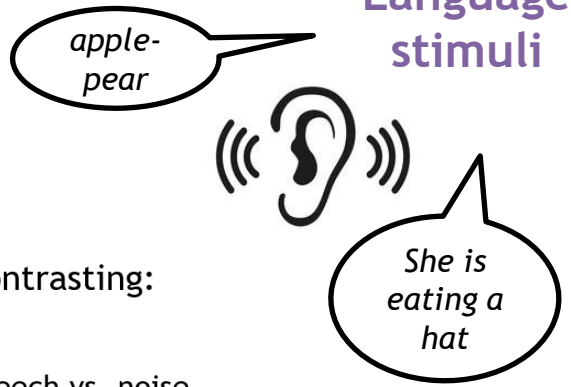
Detection of covert cortical processing

Historically…



Laureys et al., *Neurology*, 2004
Owen et al., *Neuropsychol. Rehabil.*, 2005
Schiff et al., *Neurology*, 2005

…and nowadays



Language stimuli

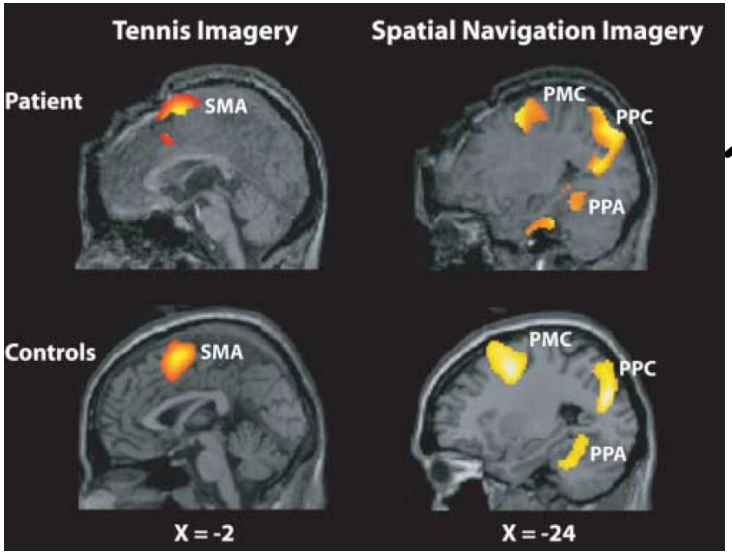
Verbal stimuli

		Contrasting:
Low level	**Auditory phonological analysis**	Speech 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

Aubinet et al., *SIN*, 2022

Detection of cognitive motor dissociation

Historically…



…and nowadays

Motor imagery

- Tennis, navigation, swimming, hand moving,…

Counting

- Subject's own name, targeted sound or word

Silent picture naming

Verbal commands in mental tasks

Owen et al., *Science*, 2006

Aubinet et al., *SIN*, 2022

Administration and scoring of the BERA tool

- Word comprehension (= phonology and semantics) then sentence comprehension **if** the patient succeeds at least for half of word targets
- For each item, indicate whether the fixation was:
  - Correct (C)
  - Incorrect (E) = towards the distractor
  - Hesitant (H) = from one image to the other one
  - Random (A) = elsewhere, anywhere
- Words /20 + Sentences /10
  - Subscales /10 → simple /5 vs. complex /5
  - + Semantics: /10 → frequent /5 vs. non-frequent /5
  - Left /10 or /15 vs. right /10 or /15
- Stop criterion : no visual fixation (either correct or incorrect) for 5 consecutive items