

# The *Simplified Evaluation of Consciousness Disorders* (**SECONDS**)



# Outline



Introduction

Administration guidelines

Validation

Perspectives

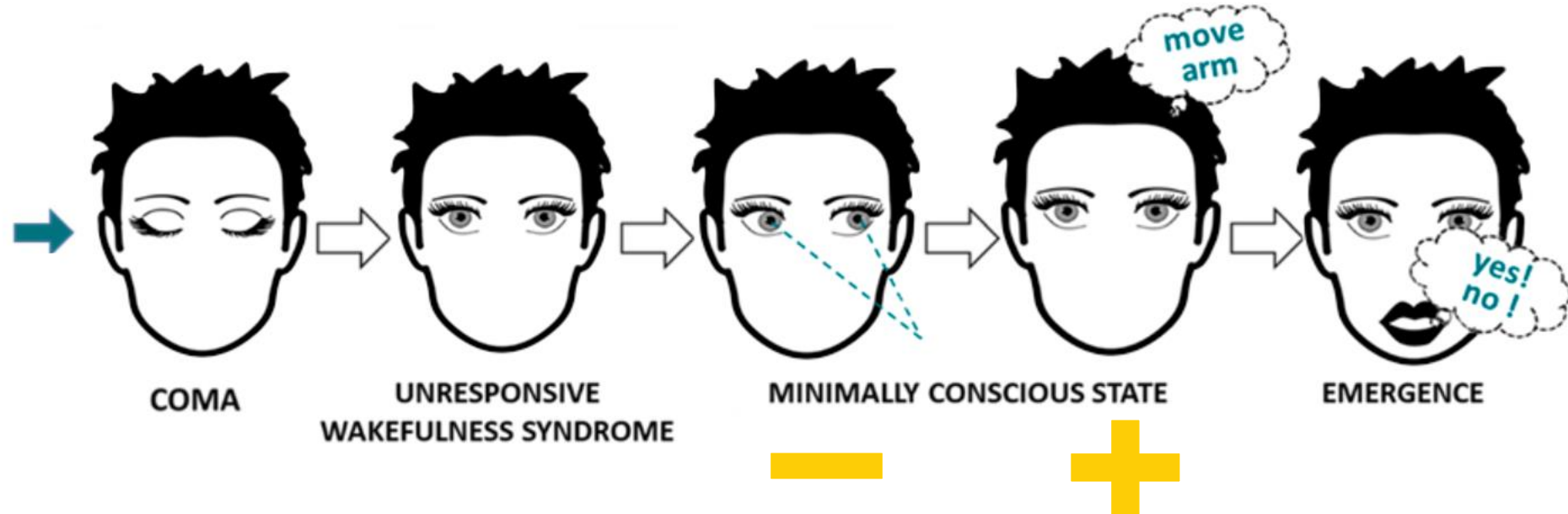
Conclusion



# Introduction

## Disorders of consciousness

Trauma  
Anoxia  
Hemorrhage  
Metabolic  
Infection  
Inflammation



DoC diagnosis is crucial!

- Prognosis
- Therapeutic options
- Ethical implications

Thibaut et al. *Annals of Neurol.*, 2021  
Sanz et al., *Rev. Neuropsychol.*, 2018  
Giacino et al., *Neurology*, 2002



# Introduction

## *Coma Recovery Scale Revised (CRS-R)*

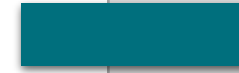
23 items assessing:

- Auditory perception
- Visual perception
- Motor abilities
- Oro-motor abilities
- Communication
- Arousal

+ Brainstem reflexes and contingent behaviors



- Standardized instructions
- Hierarchical
- Validated
- Most sensitive for MCS



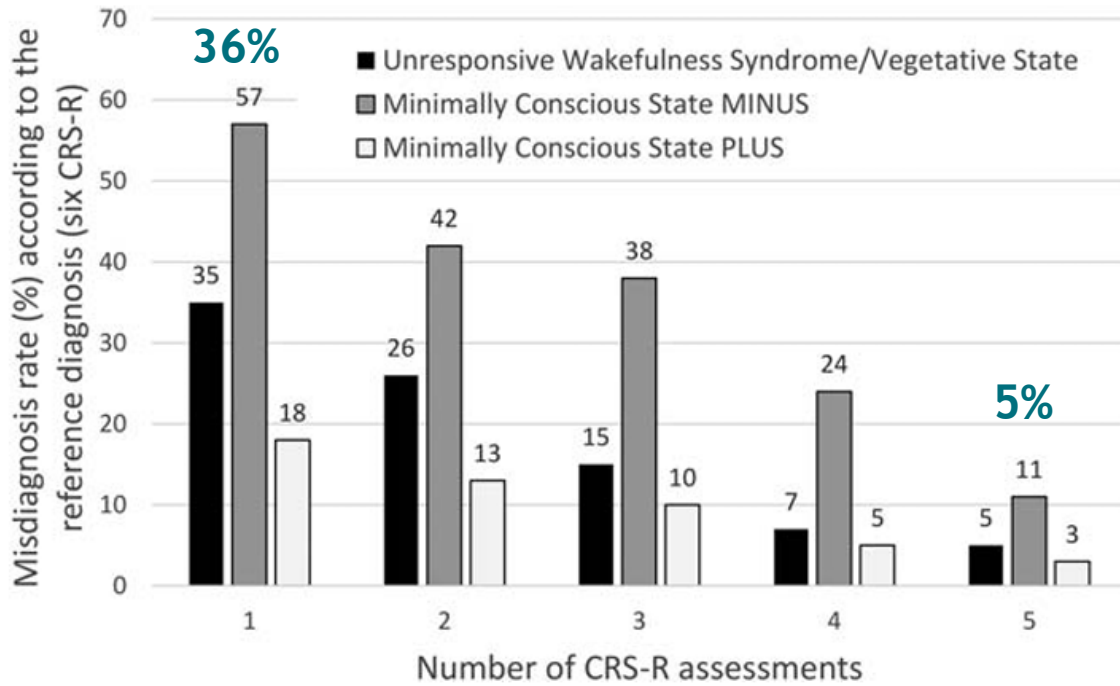
- Total score not linked to diagnosis
- Long to administer
- Need a lot of training



# Introduction

## Coma Recovery Scale Revised (CRS-R)

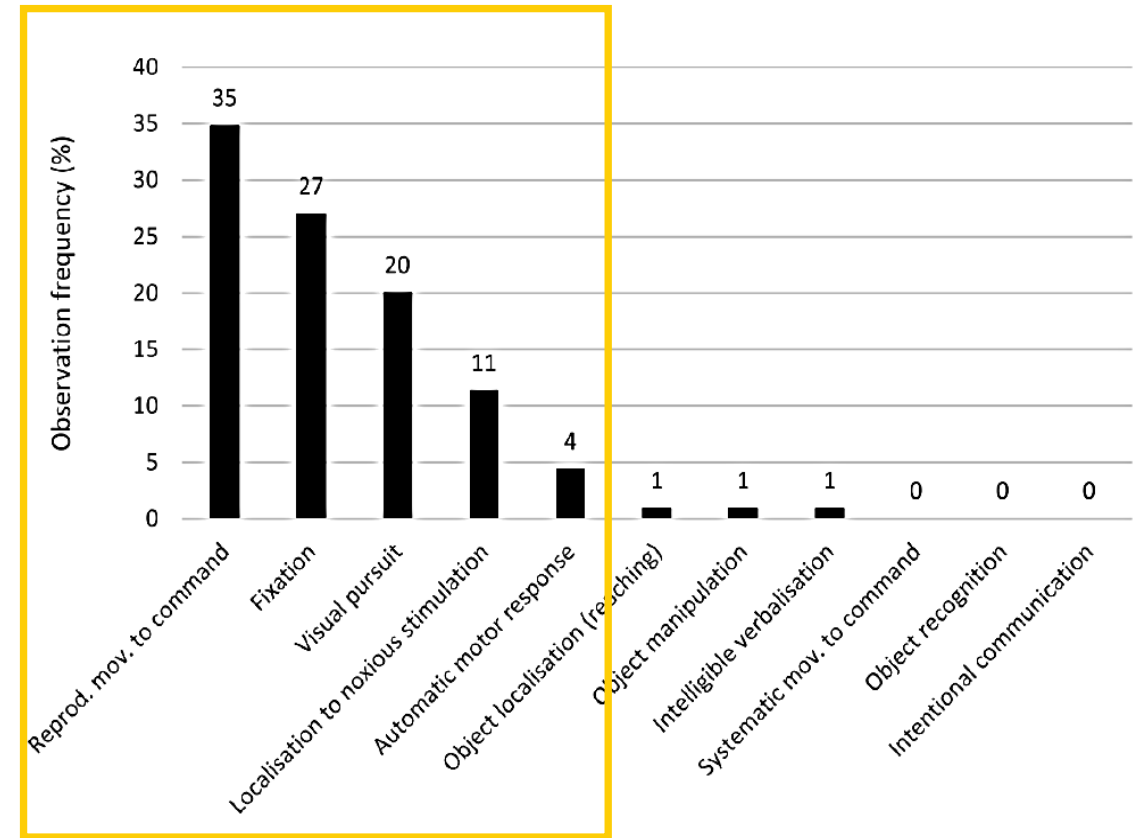
n = 123



**FIGURE 1: Misdiagnosis rates (%) of patients after n CRS-R assessments according to the diagnosis. CRS-R = Coma Recovery Scale-Revised.**

Wannez et al, *Ann Neurol*, 2017

n = 282



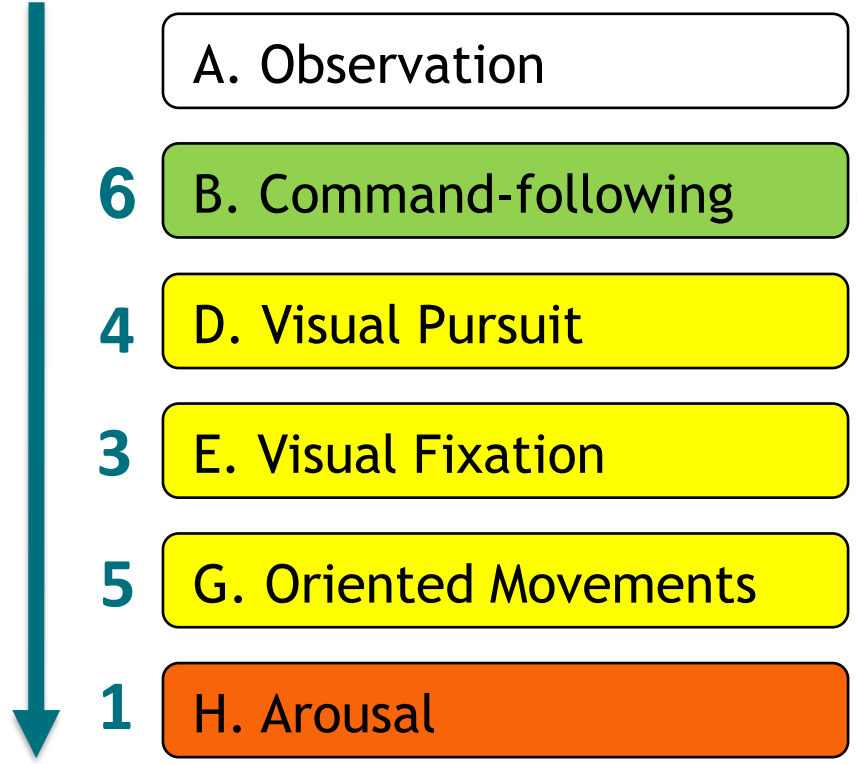
99% MCS

Wannez et al, *Neuropsychol Rehabil*, 2017

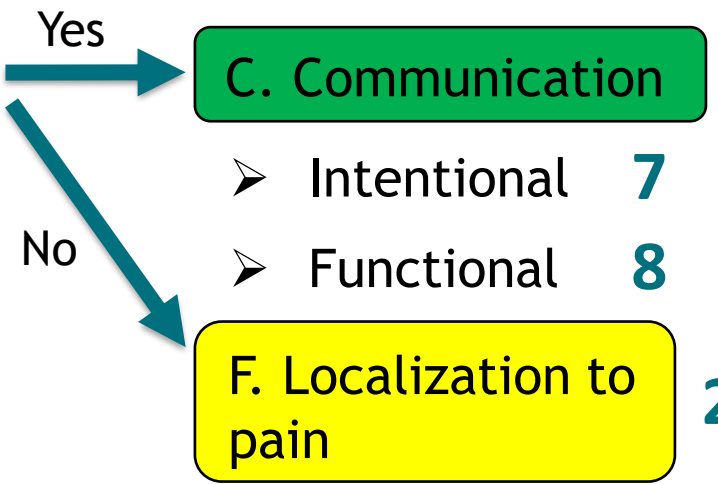
# SECONDS Content



## Items



## Optional items



- Based on frequently observed MCS behaviors
- Fast administration
- Material required : one mirror

UWS MCS- MCS+ EMCS

Final score: highest successful item (0 to 8)

# SECONDS

## Scoring sheet



Patient : ..... Examiner : ..... Date : ..... Time : .....

### Simplified Evaluation of CONsciousness Disorders (SECONDS)

.....  
 .....

Command 1: ...../3  
 2: ...../3  
 3: ...../3  
 Written command: ...../3  
 → The patient responds at least twice for one of the commands (= score 6)

If command-following

Code yes : .....  
 Code no : .....  
 Responses : .../5     Verbal     Autobiographical  
 Correct : .../5     Written     Situational  
 → The patient responds (even incorrectly) to at least 3 questions (= score 7)  
 → The patient correctly responds to the 5 questions (= score 8)

Horizontal : .../2                      Vertical : .../2  
 Spontaneous     Mirror                       Manual eye-opening  
 → The patient shows at least 2 visual pursuits of at least 2 seconds (= score 4)

#### A. Observation



#### B. Command-following (score 6)

3 x 3 spoken commands  
 10" interval between commands  
 (1 x 3 written command if 0/3)  
 Stop if 2 commands 3/3



#### C. Communication

- Intentional (score 7)
- Functional (score 8)



Autobiographical questions  
*Name (no), birth date (yes), name (yes), birth date (no), children (yes/no)*  
 If incorrect answer(s): Situational questions  
*Place (yes), wearing a hat (no), place (no), touching hand (yes), touching face (no)*

#### D. Visual pursuit (score 4)

Person/mirror, 30 cm from face  
 Each movement on horizontal or vertical axes = 4" (→←↓↑)



Sup L : .../1                      Sup R : .../1  
 Inf L : .../1                      Inf R : .../1  
 Spontaneous     Mirror                       Manual eye-opening  
 → The patient shows at least 2 visual fixations of at least 2 seconds (= score 3)

- E. Visual fixation (score 3)  
 Person/mirror, 30 cm from face  
 Present stimulus in each quadrant



If no command-following

Localization: L : .../1    R : .../1  
 Anticipation: L : .../1    R : .../1  
 → The patient touches the point of stimulation at least once with the non-stimulated hand (= score 2)  
 → The patient shows 2 anticipations (= score 6)

- F. Pain localization (score 2)  
 Inform patient  
 5" pressure on nail bed  
 1 trial on each hand



.....  
 ..... Nb : .....  
 → The patient shows at least one oriented behavior (= score 5)

- G. Oriented behaviors (score 5)  
 E.g., scratching, grabbing sheets, holding bed, laughing or crying contextually,...



0-25% / 25-50% / 50-75% / 75-100%  
 Spontaneously / Auditory / Tactile / Pain stimulations  
 → The patient shows at least one eye-opening during the whole assessment (= score 1)

- H. Arousal
- Eye-opening (score 1)
- No arousal (score 0)  
 Report the percentage of eye-opening time and administered stimulations



**Diagnosis :** Coma (0) / UWS (1) / MCS- (2-5) / MCS+ (6-7) / EMCS (8)

**Additional index point :** ... /100



# SECONDS

## Administration



### A. Observation

- Observe the patient for **one minute** and report spontaneous behaviors.
- Pay attention to vocalizations, spontaneous movements of the four limbs, head, lips, or eyes, as well as spontaneous interactions with the environment.
- Administer an arousal protocol if indicated





# SECONDS

## Administration



### B. Command-following (score = 6)

- Select **3 simple commands** (not repetitive spontaneously) - at least one oculomotor movement if suspected Locked-In Syndrome
- Test each command in **3 trials**, with a 10 second interval between trials
- Don't test the third command if 3/3 successful on the 2 first
- Administer at least 1 written command if no response to any command
- **Score item if 2/3 successful at one command**



# SECONDS

## Administration



### C. Communication (CONDITIONAL - score = 7 or 8)

- Administer only if command-following
- Clearly define a communication code with a distinct “yes” and “no”
- Ask 5 binary autobiographical questions
- If patient fails, ask 5 situational questions
- **Score item “intentional communication” (score = 7) if 3/5 questions answered (even if incorrect)**
- **Score item “functional communication” (score = 8) if 5/5 correct answers**



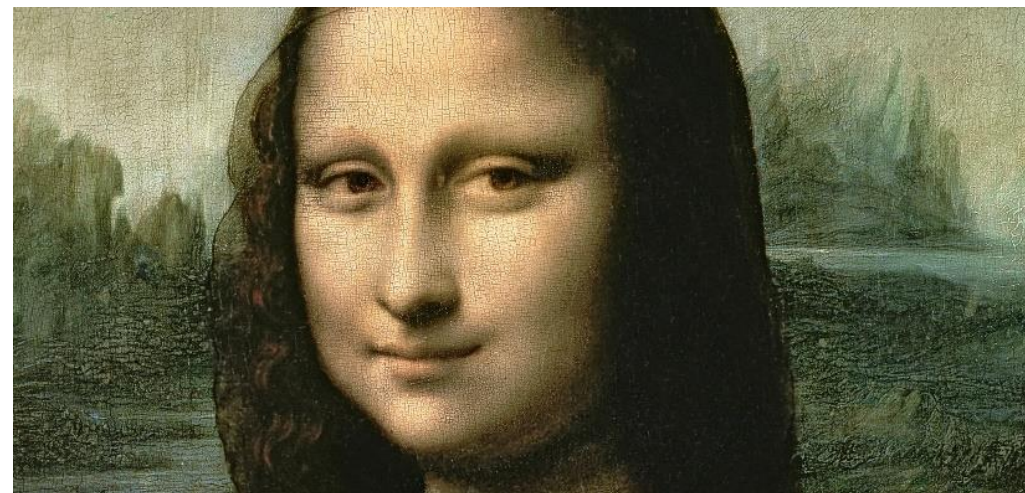
# SECONDS

## Administration



### D. Visual pursuit (score = 4)

- Move silently around the bed and observe any spontaneous pursuit
- Else, assess pursuit with mirror in 4 directions (start from the extremity, not center)
- **Score item “visual pursuit” (score = 4) if uninterrupted pursuit observed in 2 directions for >2sec**



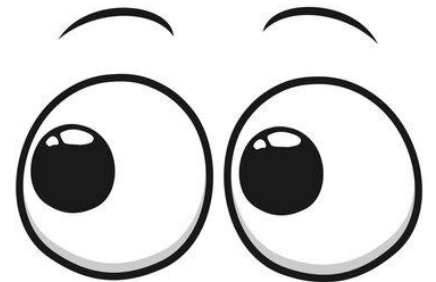
# SECONDS

## Administration



### E. Visual fixation (score = 3)

- Enter the patient's field of view and observe any spontaneous fixation
- Else, assess fixation with mirror in 4 directions (start from outside field of view, enter from one quadrant)
- **Score item “visual fixation” (score = 3) if clear fixation observed in 2 quadrants for >2sec**



# SECONDS

## Administration



### F. Localization to pain (CONDITIONAL - score = 2 or 6)

- Administer only if no response to command
- Place a pencil on patient's nailbed for 5 seconds and instruct to remove their hand to avoid pain
- If no anticipation response, apply pressure for 5 seconds
- **Repeat procedure on the other side**
- **Score item “localization to pain” (score = 2) if patient reaches for the stimulated hand on 1 side**
- **Score item “command following” (score = 6) if patient anticipates pressure on both sides**

# SECONDS

## Administration



### G. Oriented behaviors (score = 5)

- Observe patient during the whole assessment
- Report any non-reflexive behavior: scratching, grabbing bedsheets, bed holding, pulling tubes,...
- NB: yawning is not an oriented behavior
- **Score item (score = 5) if patient shows at least 1 oriented behavior.**



# SECONDS

## Administration



### H. Arousal (score = 1)

- Observe eye opening during the whole assessment
- **Score item “arousal” (score = 1) if patient opens their eyes at least once during the assessment**
- **Score “no arousal” (score = 0) if patient never opens their eyes**
- Report eye-opening time and stimulations required to achieve eye-opening





# SECONDS

## Differences with CRS-R



- Administration **order**: no subscales
- Number of **trials** (e.g. command-following)
- Different **procedures** (e.g. mirror placement)
- **Conditional** items  
(communication, localization to pain)
- No assessment of brainstem **reflexes**
- Total score = only **one** possible **diagnosis**
- **Index** points calculation



# SECONDS

## Additional index score



Diagnosis	Score	Item	Sub-item	Additional index points
EMCS	8	Communication*	5 answers (accurate)	29
MCS+	7		3 or 4 answers (accurate)	21
			5 answers (inaccurate OK)	14
			3 or 4 answers (inaccurate OK)	7
		6	Command-following	2 commands 3/3
	2 commands 2/3			18
	1 command 3/3			12
	1 command 2/3			6
	MCS-	5	Oriented behaviors	More than two different movements
Two different movements				10
One movement				5
4		Visual pursuit	On four (all) occasions	16
			On three occasions	12
			On two occasions	8
3		Visual fixation	On four (all) occasions	12
			On three occasions	9
			On two occasions	6
2		Pain localization*	On both hands	4
			On one hand	2
UWS		1	Arousal	Spontaneously
	To auditory stimulation			3
	To tactile stimulation			2
	To pain			1
Coma	0		None	0



[Abstract](#) [Introduction](#) [Protocol](#) [Results](#) [Discussion](#) [Materials](#) [References](#)

## Behavior

# SECONDS Administration Guidelines: A Fast Tool to Assess Consciousness in Brain-injured Patients

doi: [10.3791/61968](https://doi.org/10.3791/61968) Published: February 6, 2021

Leandro R. D. Sanz\*<sup>1,2</sup>, Charlène Aubinet\*<sup>1,2</sup>, Helena Cassol<sup>1,2</sup>, Olivier Bodart<sup>1,2</sup>, Sarah Wannez<sup>1,2</sup>, Estelle A. C. Bonin<sup>1,2</sup>, Alice Barra<sup>1,2</sup>, Nicolas Lejeune<sup>1,2,3,4</sup>, Charlotte Martial<sup>1,2</sup>, Camille Chatelle<sup>1,2</sup>, Didier Ledoux<sup>5,6</sup>, Steven Laureys<sup>1,2</sup>, Aurore Thibaut<sup>1,2</sup>, Olivia Gosseries<sup>1,2</sup>

Video-illustrated guidelines :



# SECONDS Validation

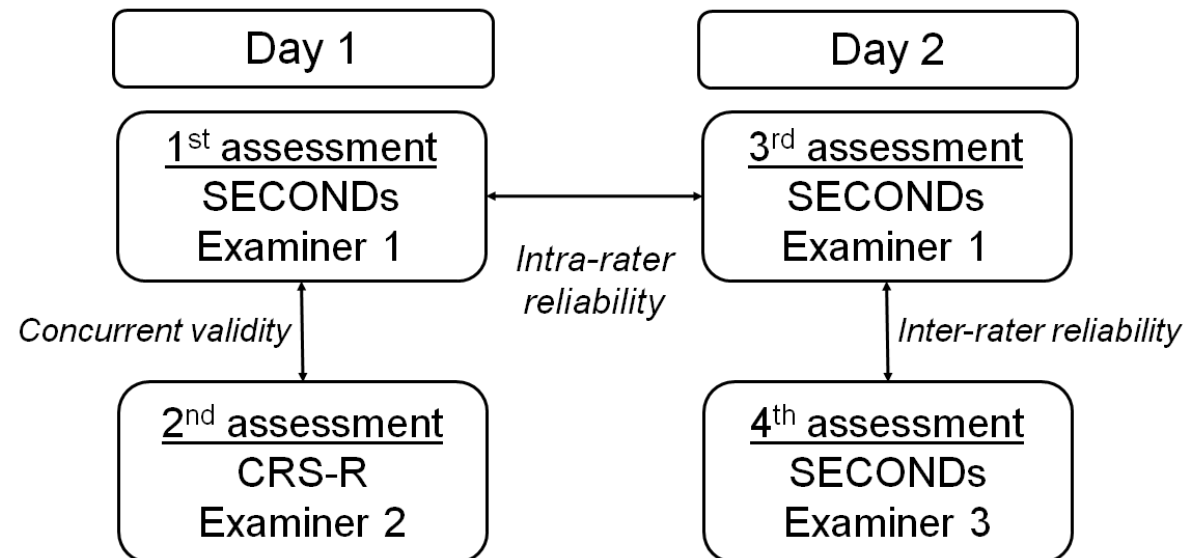


➤ [Ann Phys Rehabil Med.](#) 2020 Sep 26;S1877-0657(20)30160-3. doi: 10.1016/j.rehab.2020.09.001.  
Online ahead of print.

## Simplified Evaluation of CONsciousness Disorders (SECONDS) in individuals with severe brain injury: a validation study

Charlène Aubinet <sup>1</sup>, Helena Cassol <sup>2</sup>, Olivier Bodart <sup>2</sup>, Leandro R D Sanz <sup>2</sup>, Sarah Wannez <sup>2</sup>,  
Charlotte Martial <sup>2</sup>, Aurore Thibaut <sup>2</sup>, Géraldine Martens <sup>2</sup>, Manon Carrière <sup>2</sup>, Olivia Gosseries <sup>2</sup>,  
Steven Laureys <sup>2</sup>, Camille Chatelle <sup>2</sup>

- 57 chronic DoC patients
- 3 SECONDS / 1 CRS-R
- 3 examiners “blind” to clinical info



# SECONDS Validation



## Discrepancies between CRS-R and SECONDS diagnoses

**Table 2**

Number of patients showing agreements and discrepancies between the Coma Recovery Scale-Revised (CRS-R) and the Simplified Evaluation of CONsciousness Disorders (SECONDS).

		Same-day SECONDS				Best SECONDS			
		UWS	MCS-	MCS+	EMCS	UWS	MCS-	MCS+	EMCS
CRS-R	UWS	11	1	0	0	10	2	0	0
	MCS-	3	8	3	0	3	8	3	0
	MCS+	0	4	8	2	0	1	11	2
	EMCS	0	0	3	14	0	0	0	17

Left: comparison between the CRS-R and the SECONDS administered on the same day. Right: comparison between the CRS-R and the best SECONDS diagnosis. Shaded cells show disagreement in diagnosis. Light grey cells include patients with a better diagnosis using the SECONDS versus the CRS-R. Dark grey cells include patients with a better diagnosis using the CRS-R versus the SECONDS. Specifically, P3 was diagnosed as MCS- with the SECONDS and UWS with the CRS-R, whereas the opposite was found in P1, P6 and P31. Regarding both categories of MCS, P21, P28 and P55 were diagnosed as MCS+ with the SECONDS and MCS- with the CRS-R, whereas the opposite was observed in P2, P26, P54 and P57. Finally, P33 and P50 were diagnosed as EMCS with the SECONDS and MCS+ with the CRS-R, whereas the opposite was found in P18, P24 and P38. UWS, unresponsive wakefulness syndrome; MCS-, minimally conscious state minus; MCS+, minimally conscious state plus; EMCS, emergence from the minimally conscious state.

→ Detection of behaviors assessed differently: visual pursuit, command-following and functional communication

# SECONDS

## Validation



## Concordance

### Concurrent validation

- CRS-R vs. SECONDS same day :  $\kappa = 0.78$  (substantial)
- CRS-R vs. SECONDS best:  $\kappa = 0.85$  (almost perfect)

+ significant correlations  
between scores

Intra-rater validity (same examiner) :  $\kappa = 0.85$  (almost perfect)

Inter-rater validity (different examiner):  $\kappa = 0.85$  (almost perfect)

## Administration time

- SECONDS: median = 7 min (IQR = 5-9min)
- CRS-R: median = 17 min (IQR = 12-22min)

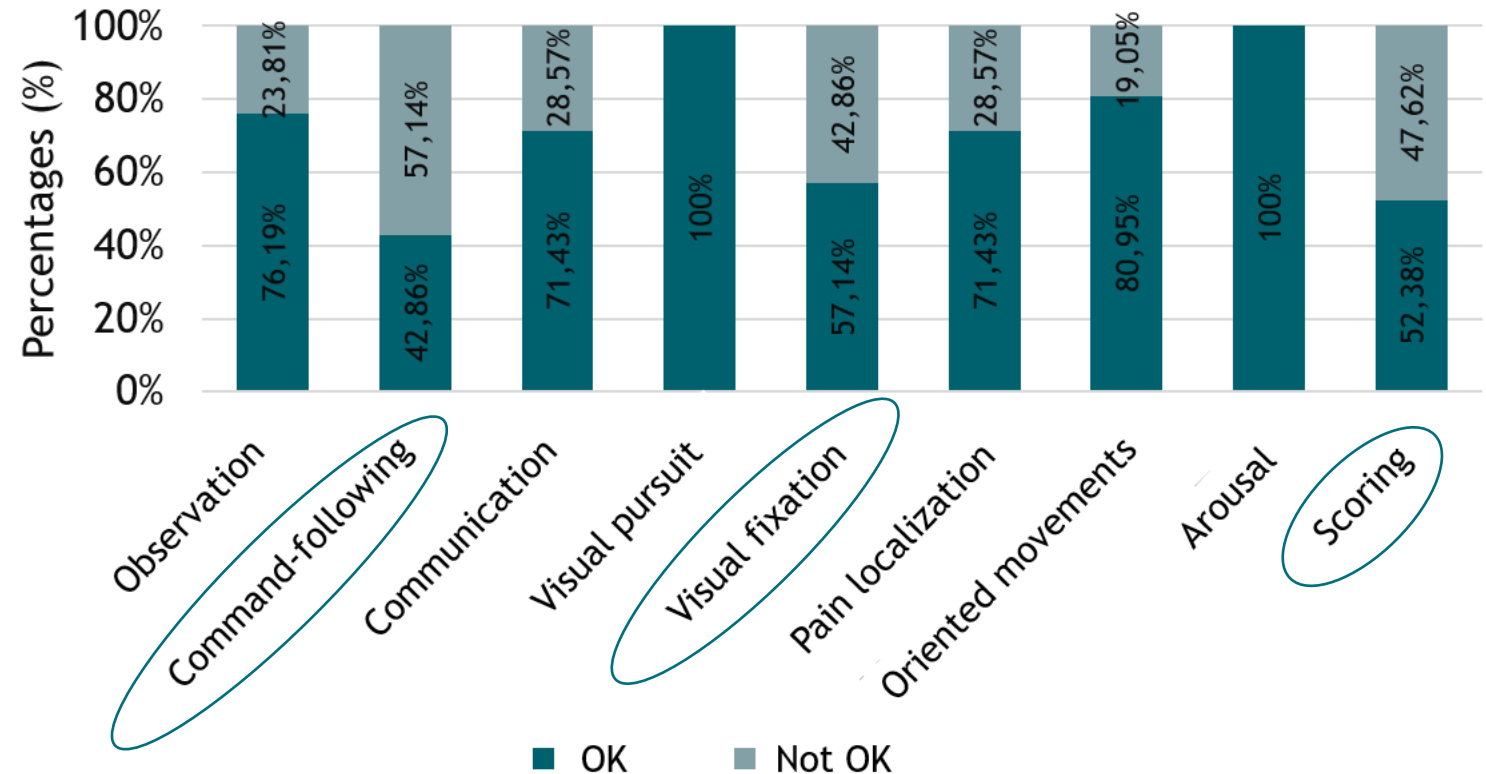
# SECONDS Perspectives



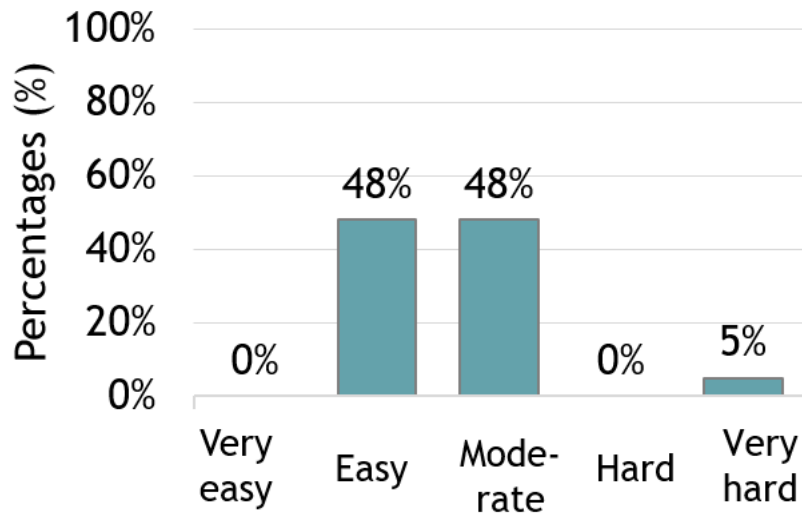
## Reliability when performed by non-trained medical staff?

- N=21 DoC patients (14 in ICU, 7 in rehab)
- Comparison of DoC diagnoses obtained by
  - 1 CRS-R+SECONDS expert
  - 1 non-trained nurse or MD

Correct administration rate of items



Learning ease





# SECONDS

## Perspectives



1. Larger sample of DoC patients assessed by non-expert examiners
2. Bring new clear guidelines regarding the items and scoring
3. Translation and validation of the SECONDS in other languages
4. Validate the SECONDS assessment in acute settings
5. Assess the sensitivity to change of the index score in acute patients and the cut-off score (unconscious vs. conscious)
6. Cross-modal validation: FDG-PET, MRI, hdEEG

# SECONDS

## Conclusion



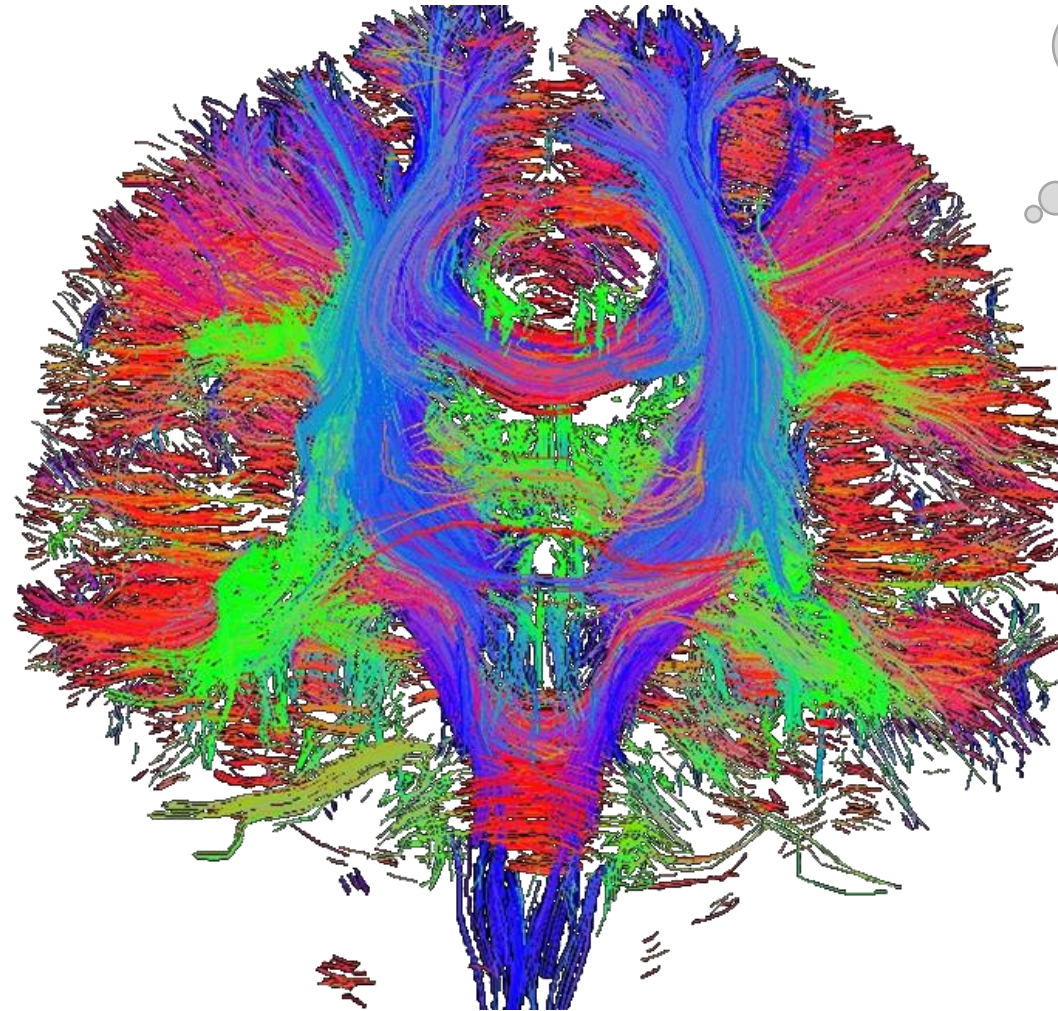
- **Fast** validated scale to assess consciousness
- Adapted for clinicians with **limited time**
- Allows easy **repetition**
- Practical **screening** tool
- Doesn't replace the GCS/CRS-R  
(select scale according to **context**)



Keep just a mirror  
and a scoring sheet  
in your pockets!



Questions?



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<https://www.coma.uliege.be/severe-brain-injury/#dc-diagnosis>

[www.gigacoma.uliege.be](http://www.gigacoma.uliege.be)