Sport Concussion Assessment Tool 6 (SCAT6)

The Science, Research, and Process Underlying the New SCAT6 Tools for Evaluating a Sports-Related Concussion

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Disclosures

- I have no conflicts of interest to disclose

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Learning Objectives

1. Provide a brief overview of the changes in the SCAT6
2. Discuss the development of the SCAT6 and the underlying science
3. Review best practices when utilizing the SCAT6

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Development

- Developed alongside the international consensus and systematic review pertaining to the SCAT 6
  - Screened 12,192 articles, included 612 in the review
- Recommendations were proposed and voted upon by a committee of 28 members
- Key recommendations were then presented and utilized to make modifications to the SCAT, Child SCAT, and develop the SCOAT

Box 1 Key recommendations for Sport Concussion Assessment Tool (SCAT6) and Child SCAT6 tools modifications

SCAT6:

⇒ Create both paper and electronic formats.
⇒ Explore the development of alternate forms for serial evaluation.
⇒ Improve psychometric properties by including only the 10-item word list and eliminating the 5-item word option.
⇒ Develop a cognitive composite score to improve test–retest reliability and reduce the number of false positives.
⇒ Due to differences found among the existing 10-item word list forms consider regression-based norms to equate versions (particularly for an electronic version).
⇒ Increase complexity of the digit backward subtest to reduce ceiling effects.
⇒ Revise months in reverse to include a component of timed information processing.
⇒ Consider addition of other tasks where speed is measured (eg, timed serial 7's).
⇒ Add 'time to complete' in tandem gait.
⇒ Add a dual-task paradigm (ie, counting backward by a specified integer).
⇒ Consider tests and/or procedures to assess performance validity of baseline testing.
⇒ Consider mobile Post-Concussion Symptom Scale symptom option (particularly Child SCAT).
⇒ Add a more robust set of visible signs to the SCAT/Child SCAT/CRT including:
  ⇒ Falling with no protective action.
  ⇒ Tonic posturing.
  ⇒ Impact seizure.
  ⇒ Ataxia/motor incoordination.
  ⇒ Altered mental status.
  ⇒ Blank/vacant/dazed look.
⇒ Create stratified normative databases that include age, education, cultural background, para-athletes.
⇒ Consider adding Vestibular Ocular Motor Screen as an optional task.

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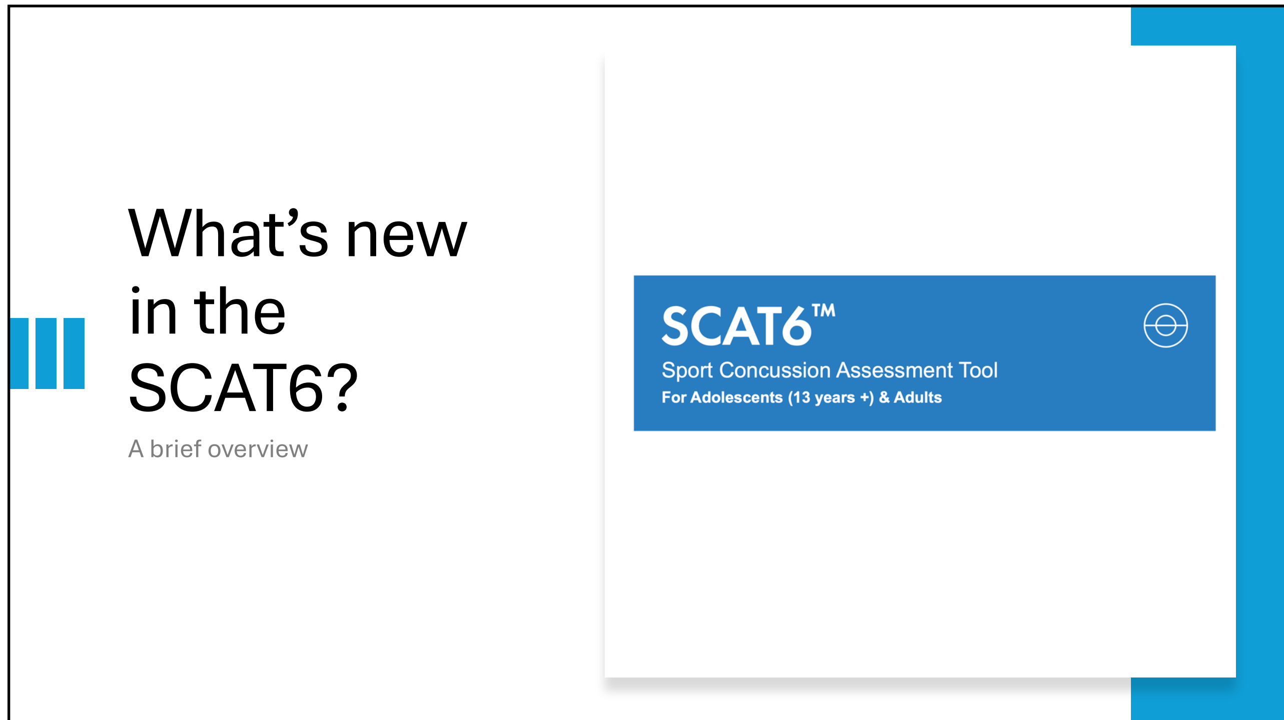

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What's new?

- General changes:
  - Improved instructions within SCAT6 document
    - *Blue Italics*: instructions for patient
    - Red: words for clinician
  - Additional detailed instruction form as separate document
  - Some quality of life changes
    - Electronic version being developed
    - Better document organization
    - Improved wording throughout
    - Deferred option for diagnosis
    - Etc.

SCAT6™
Supplement: Guidelines to using the Sport Concussion Assessment Tool 6 (SCAT6)™

Detailed Instructions

Immediate Assessment/Neuro Screen

RED FLAGS | YES | NO

Remove from Play for Immediate Medical Assessment or Transport to Hospital/Medical Centre

For use by Health Care Professionals Only — SCAT6™

Developed by: The Concussion in Sport Group (CISG)

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What's new?

- Revised recognize and remove section
- Patient details section removed
- Color-coded completion guide
  - **Blue**:
    - SCAT6: Required
    - SCOAT 6: Complete only at first assessment
  - **Orange**: Optional part of assessment
  - **Green (SCOAT6 Only)**: Recommended

SCAT6™
Sport Concussion Assessment Tool
For Adolescents (13 years +) & Adults

What is the SCAT6?

Key Points

Recognise and Remove

Remember

Completion Guide

Orange: Optional part of assessment

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FEI FIA FIFA

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What's new?

- Enhanced demographics section
  - First/preferred language
  - Past concussion information
  - Etc.
- Revised immediate assessment/neuro screen

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SCAT6™ Sport Concussion Assessment Tool
For Adolescents (13 years +) & Adults

Concussion History

Immediate Assessment/Neuro Screen (Not Required at Baseline)

YES RED FLAGS NO

Remove from Play for Immediate Medical Assessment or Transport to Hospital/Medical Centre

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What’s new?

- Enhanced Red Flags section
- Observable signs
  - Falling unprotected to the surface
  - High-risk mechanism
- Cervical Spine Assessment
  - Tenderness to palpation
- New Coordination and Ocular/Motor Screen Section

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Step 1: Observable Signs

Witnessed ☐ Observed on Video ☐

Sign		
Lying motionless on playing surface	Y	N
Falling unprotected to the surface	Y	N
Balance/gait difficulties, motor incoordination, ataxia: stumbling, slow/laboured movements	Y	N
Disorientation or confusion, staring or limited responsiveness, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N
Impact seizure	Y	N
High-risk mechanism of injury (sport-dependent)	Y	N

Step 2: Glasgow Coma Scale

Typically, GCS is assessed once. Additional scoring columns are provided for monitoring over time, if needed.

Time of Assessment:

Date of Assessment:

Best Eye Response (E)			
No eye opening	1	1	1
Eye opening to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best Verbal Response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best Motor Response (V)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion/withdrawal to pain	4	4	4
Localized to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma Score (E + V + M)			

Box 1: Red Flags

- Neck pain or tenderness
- Seizure or convulsion
- Double vision
- Loss of consciousness
- Weakness or tingling/burning in more than 1 arm or in the legs
- Deteriorating conscious state
- Vomiting
- Severe or increasing headache
- Increasingly restless, agitated or combative
- GCS <15
- Visible deformity of the skull

Step 3: Cervical Spine Assessment

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed and spinal precautions taken.

Question		
Does the athlete report neck pain at rest?	Y	N
Is there tenderness to palpation?	Y	N
If NO neck pain and NO tenderness, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Are limb strength and sensation normal?	Y	N

Step 4: Coordination & Ocular/Motor Screen

Question		
Coordination: Is finger-to-nose normal for both hands with eyes open and closed?	Y	N
Ocular/Motor: Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Are observed extraocular eye movements normal? If not, describe:	Y	N

Step 5: Memory Assessment Maddocks Questions[1]

Say *“I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?”*

Modified Maddocks questions (Modified appropriately for each sport; 1 point for each correct answer)

Question		
What venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1
Maddocks Score		/5

Note: Appropriate sport-specific questions may be substituted

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What’s new?

- Clear instructions for Off-Field Assessment
- Removal of “read-aloud” component of the symptom evaluation
- Note: PCSS and SCOAT6*

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Off-Field Assessment

Please note that the cognitive assessment should be done in a distraction-free environment with the athlete in a resting state **after** completion of the Immediate Assessment/Neuro Screen.

Step 1: Athlete Background

Has the athlete ever been:

Question		
Hospitalised for head injury? (If yes, describe below)	Y	N
Diagnosed/treated for headache disorder or migraine?	Y	N
Diagnosed with a learning disability/dyslexia?	Y	N
Diagnosed with attention deficit hyperactivity disorder (ADHD)?	Y	N
Diagnosed with depression, anxiety, or other psychological disorder?	Y	N

Notes:

Current medications? If yes, please list:

Step 2: Symptom Evaluation

Baseline: ☐ Suspected/Post-injury: ☐ Time elapsed since suspected injury: mins/hours/days

The athlete will complete the symptom scale (below) after you provide instructions. Please note that the instructions are different for baseline versus suspected/post-injury evaluations.

Baseline: Say *“Please rate your symptoms below based on how you typically feel with “1” representing a very mild symptom and “6” representing a severe symptom.”*

Suspected/Post-injury: Say *“Please rate your symptoms below based on how you feel now with “1” representing a very mild symptom and “6” representing a severe symptom.”*

PLEASE HAND THE FORM TO THE ATHLETE

Symptom	Rating						
Headaches	0	1	2	3	4	5	6
Pressure in head	0	1	2	3	4	5	6
Neck pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like “in a fog”	0	1	2	3	4	5	6
“Don’t feel right”	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6

Question		
Do your symptoms get worse with physical activity?	Y	N
Do your symptoms get worse with mental activity?	Y	N

If 100% is feeling perfectly normal, what percent of normal do you feel?

If not 100%, why?

PLEASE HAND THE FORM BACK TO THE EXAMINER

Once the athlete has completed answering all symptom items, it may be useful for the clinician to revisit items that were endorsed positively to gather more detail about each symptom.

Total number of symptoms: of 22 Symptom severity score: of 132

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What's new?

- Removal of 5-word list in Immediate Memory Section
  - 10-Word lists standard
  - Optional 15-word lists available (SCOAT6)

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Step 3: Cognitive Screening (Based on Standardized Assessment of Concussion; SAC)[2]

Orientation

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation Score		of 5

Immediate Memory

All 3 trials must be administered irrespective of the number correct on Trial 1. Administer at the rate of one word per second.

Trial 1: Say *"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order."*

Trials 2 and 3: Say *"I am going to repeat the same list. Repeat back as many words as you can remember in any order, even if you said the word before in a previous trial."*

Word list used: A ☐ B ☐ C ☐

								Alternate Lists	
List A	Trial 1		Trial 2		Trial 3			List B	List C
Jacket	0	1	0	1	0	1		Finger	Baby
Arrow	0	1	0	1	0	1		Penny	Monkey
Pepper	0	1	0	1	0	1		Blanket	Perfume
Cotton	0	1	0	1	0	1		Lemon	Sunset
Movie	0	1	0	1	0	1		Insect	Iron
Dollar	0	1	0	1	0	1		Candle	Elbow
Honey	0	1	0	1	0	1		Paper	Apple
Mirror	0	1	0	1	0	1		Sugar	Carpet
Saddle	0	1	0	1	0	1		Sandwich	Saddle
Anchor	0	1	0	1	0	1		Wagon	Bubble
Trial Total									

Immediate Memory Score ___ of 30 Time Last Trial Completed: ___

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What's new?

- Great example of the QoL changes
  - Improved Digits Backward instructions
- Changes to Months in Reverse Order Section
  - Timed
  - Errors counted

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Step 3: Cognitive Screening (Continued)

Concentration

Digits Backward:

Administer at the rate of one digit per second reading DOWN the selected column. If a string is completed correctly, move on to the string with next higher number of digits; if the string is completed incorrectly, use the alternate string with the same number of digits; if this is failed again, end the test.

Say *"I'm going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7. So, if I said 9-6-8 you would say? (8-6-9)"*

Digit list used: A ☐ B ☐ C ☐

List A	List B	List C				
4-9-3	5-2-6	1-4-2	Y	N	0	1
6-2-9	4-1-5	6-5-8	Y	N		
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0	1
3-2-7-9	4-9-6-8	3-4-8-1	Y	N		
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0	1
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N		
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0	1
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N		
			Digits Score			of 4

Months in Reverse Order:

Say *"Now tell me the months of the year in reverse order as QUICKLY and as accurately as possible. Start with the last month and go backward. So, you'll say December, November… go ahead"*

Start stopwatch and CIRCLE each correct response:

December November October September August July June May April March February January

Time Taken to Complete (secs): ___ Number of Errors: ___

1 point if no errors and completion under 30 seconds

Months Score: ___ of 1

Concentration Score (Digits + Months) ___ of 5

Step 4: Coordination and Balance Examination

Modified Balance Error Scoring System (mBESS)[3] testing

(see detailed administration instructions)

Foot Tested: Left ☐ Right ☐ (i.e. test the **non-dominant** foot)

Testing Surface (hard floor, field, etc.): ___

Footwear (shoes, barefoot, braces, tape etc.): ___

OPTIONAL (depending on clinical presentation and setting resources): For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm) with the same instructions and scoring.

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What's new?

- Optional on foam section to the mBESS
- Addition of Timed Tandem Gait
- Optional Dual Task Gait testing

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Step 4: Coordination and Balance Examination (Continued)

Modified BESS (20 seconds each)

Double Leg Stance:		of 10
Tandem Stance:		of 10
Single Leg Stance:		of 10
Total Errors:		of 30

On Foam (Optional)

Double Leg Stance:		of 10
Tandem Stance:		of 10
Single Leg Stance:		of 10
Total Errors:		of 30

Note: If the **mBESS** yields normal findings then proceed to the **Tandem Gait/Dual Task Tandem Gait**.

If the **mBESS** reveals abnormal findings or clinically significant difficulties, **Tandem Gait** is not necessary at this time.

Both the **Tandem Gait** and optional **Dual Task** component may be administered later in the office setting as needed (see SCOAT6).

Timed Tandem Gait

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed. Please complete all 3 trials.

Say *"Please walk heel-to-toe quickly to the end of the tape, turn around and come back as fast as you can without separating your feet or stepping off the line."*

Single Task:

Time to Complete Tandem Gait Walking (seconds)				
Trial 1	Trial 2	Trial 3	Average 3 Trials	Fastest Trial

Dual Task Gait (Optional. Timed Tandem Gait must be completed first)

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed.

Say *"Now, while you are walking heel-to-toe, I will ask you to count backwards out loud by 7s. For example, if we started at 100, you would say 100, 93, 86, 79. Let's practise counting. Starting with 93, count backward by sevens until I say "stop"."* Note that this practice only involves counting backwards.

Dual Task Practice: Circle correct responses; record number of subtraction counting errors.

Task									Errors	Time
Practice	93	86	79	72	65	58	51	44		

Say *"Good. Now I will ask you to walk heel-to-toe and count backwards out loud at the same time. Are you ready? The number to start with is 88. Go!"*

Dual Task Cognitive Performance: Circle correct responses; record number of subtraction counting errors.

Task														Errors	Time (circle fastest)
Trial 1	88	81	74	67	60	53	46	39	32	25	18	11	4		
Trial 2	90	83	76	69	62	55	48	41	34	27	20	13	6		
Trial 3	98	91	84	77	70	63	56	49	42	35	28	21	14		

Alternate double number starting integers may be used and recorded below.

Starting Integer: **Errors:** **Time:**

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What's new?

- Minimal changes
- Some QoL changes
  - Words for delayed recall are present

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Step 4: Coordination and Balance Examination (Continued)

Were any single- or dual-task, timed tandem gait trials not completed due to walking errors or other reasons?

Yes ☐ **No** ☐

If yes, please explain why:

Step 5: Delayed Recall

The Delayed Recall should be performed after **at least 5 minutes** have elapsed since the end of the Immediate Memory section: **Score 1 point for each correct response.**

Say *"Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order."*

Time started:

Word list used: A ☐ B ☐ C ☐

List A	Score	List B (Alternate Lists)	List C (Alternate Lists)
Jacket	0 1	Finger	Baby
Arrow	0 1	Penny	Monkey
Pepper	0 1	Blanket	Perfume
Cotton	0 1	Lemon	Sunset
Movie	0 1	Insect	Iron
Dollar	0 1	Candle	Elbow
Honey	0 1	Paper	Apple
Mirror	0 1	Sugar	Carpet
Saddle	0 1	Sandwich	Saddle
Anchor	0 1	Wagon	Bubble
Delayed Recall Score	of 10		

Total Cognitive Score

Orientation:		of 5
Immediate Memory:		of 30
Concentration:		of 5
Delayed Recall:		of 10
Total:		of 50

If the athlete was known to you prior to their injury, are they different from their usual self?

Yes ☐ **No** ☐ **Not applicable** ☐ (If different, describe why In the clinical notes section)

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What's new?

- Deferred option
  - Words matter
- Health Care Professional Attestation

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Step 6: Decision

Domain	Date:	Date:	Date:
Neurological Exam (Acute Injury evaluation only)	Normal/Abnormal	Normal/Abnormal	Normal/Abnormal
Symptom number (of 22)			
Symptom Severity (of 132)			
Orientation (of 5)			
Immediate Memory (of 30)			
Concentration (of 5)			
Delayed Recall (of 10)			
Cognitive Total Score (of 50)			
mBESS Total Errors (of 30)			
Tandem Gait fastest time			
Dual Task fastest time			

Disposition

Concussion diagnosed?

Yes ☐ No ☐ Deferred ☐

Health Care Professional Attestation

I am an HCP and I have personally administered or supervised the administration of this SCAT6.

Name:

Signature: Title/Speciality:

Registration/License number (if applicable): Date:

Additional Clinical Notes

Note: Scoring on the SCAT6 should not be used as a stand-alone method to diagnose concussion, measure recovery, or make decisions about an athlete's readiness to return to sport after concussion. Remember: An athlete can score within normal limits on the SCAT6 and still have a concussion.

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Best Practices and Practical Tips

- The SCAT6 should not be used as a stand-alone tool
  - Use as a testing battery and clinical framework
- SCAT is effective in determining concussed and non-concussed athletes within 72 hours of injury.
  - The SCAT post-concussion symptom scale (PCSS) is the only tool with continued utility beyond 7 days post injury.
  - PCSS continues to be the best measure for acute and post-concussive symptoms.
- Don't be afraid of serial SCAT6 evaluations
- The SCAT6 takes 10-15 minutes to complete at a minimum.
  - Don't rush!

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