

South African ACE-III and M-ACE Administration and Scoring Guide – 2021

The Addenbrooke's Cognitive Examination-III (ACE-III) is a brief cognitive test that assesses five cognitive domains: (1) Attention, (2) Memory, (3) Verbal fluency, (4) Language, and (5) Visuospatial abilities. The ACE-III replaces the previous Addenbrooke's Cognitive Examination-Revised (ACE-R) and was developed by the FRONTIER Research Group (www.frontierfd.org). The total score of the ACE-III is 100 with higher scores indicating better cognitive functioning. Administration of the ACE-III takes approximately 15 minutes and scoring takes about 5 minutes.

The Mini-ACE (M-ACE) is a shorter version of the ACE-III developed for use in settings where administration of the full ACE-III is not practical. The total score of the M-ACE is 30, with higher scores indicating better cognitive functioning. The administration of the M-ACE takes approximately 5 minutes, and scoring should take no longer than 1-2 minutes.

This scoring guide has been designed to make the test items and their scoring clear for the tester. Please read them carefully before administering the test. Items contributing to the M-ACE are noted in the item subheadings in this guide (i.e., "**M-ACE**"). If possible, leave the scoring until the end of testing, as the participant will not be able to check whether the tester is ticking for correct answers or crossing for wrong answers. This may minimise participant anxiety, which can impact on their performance on the test.

To download the ACE-III and M-ACE, as well as updates on publications and language translations, please go to the following website: www.frontierfd.org

ATTENTION – Orientation (Score 0 to 10)

M-ACE

Administration: Ask the participant for the Day, Date, Month, Year, Season, as well as the name of the floor of building (or room number or ward if in hospital), street (if an address)/hospital name, suburb or town, province, and country.

Scoring: Score 1 point for each correct answer. Date: A mistake of ± 2 days is allowed for the date (e.g., 5th when the actual date is the 7th). Month: If the participant says "23rd of the 3rd", prompt for the name of the month. Season: When the season is changing (e.g., at the end of February) and the participant says, "Autumn" then ask, "could it be another season?" If the answer is "Summer", give 1 point since the two seasons are in transition. Do not give 1 point if the answer is "Winter" or "Spring". Floor/Street: If the participant is at home, ask for the name of the place such as the apartment complex/retirement village and, for the floor, you might ask for the name of the room (e.g., kitchen, living room, etc.). If at a single storey health setting, you could ask about a local landmark. Suburb/town: If participants come from another province, orientation for suburb can be scored somewhat more liberally. For instance, participants may say Cape Town for suburb but when further prompted, neighbouring suburbs may be accepted as correct (e.g., Bellville instead of Parow). Province: If the participant says 'Cape province' you can prompt by asking which part of the Cape. Give 1 point if then answered correctly e.g., 'Western Cape'

Seasons: Spring (September, October, November); Summer (December, January, February); Autumn (March, April, May); Winter (June, July, August).

For aphasic patients: Allow patients to write down their answer, if unable to give verbal responses.

*Please note for M-ACE scoring, add only the day, date, month, and year. Do not include Season. Score 0 to 4.

ATTENTION – Registration of 3 Items (Score 0 to 3)

Administration: Ask the participant to repeat and remember the three words. Speak slowly. Repeat the words if necessary but up to a maximum of 3 times only. Tell the participant that you will ask for this information later.

Scoring: Score the first attempt only. Record the number of trials it takes to learn all 3 words.

ATTENTION – Serial 7 Subtraction (Score 0 to 5)

Administration: Ask the participant to subtract 7 from 100, record the answer, and then ask the participant to keep subtracting 7 from each new number until you ask them to stop. Stop the participant after 5 subtractions.

Scoring: Record responses and do not stop or correct the participant if they make a mistake. Allow them to carry on and check subsequent answers for scoring (e.g., 92, **85**, 79, **72**, **65** – Score = 3).

MEMORY – Recall of 3 Items (Score 0 to 3)

Administration: Ask the participant to recall the three words that you asked them to repeat and remember earlier.

Scoring: Record responses and score 1 point for each correct item. Do not prompt the participant for the items. The order in which they repeat the words does not matter.

VERBAL FLUENCY – Letter (Score 0 to 7)

Administration: Tell the participant: *“I’m going to give you a letter of the alphabet and I’d like you to generate as many words as you can beginning with that letter, but not names of people or places. For example, if I give you the letter “C”, you could give me words like “cat, cry, clock” and so on. But you cannot give me words like Catherine or Canada. Do you understand? Are you ready? You have one minute. The letter I want you to use is the letter “P”.*

Scoring: First, record the total number of words the participant generates. Then, count the total number of correct words—these do not include: (1) repetitions, (2) perseverations (e.g., pay, paid, pays – score = 1), (3) intrusions (i.e., words beginning with other letters), (4) proper nouns (i.e., names of people or places) and (5) plurals (e.g., pot, pots – total = 2, correct = 1). Use the table provided on the ACE-III sheet to obtain the final score for this test.

For additional interpretation: Note which words were generated in the first 30s and in the second 30s.

VERBAL FLUENCY – Animals (Score 0 to 7)**M-ACE**

Administration: Tell the participant: *“Now, I want you to name as many animals as possible. It can begin with any letter. I’ll give you one minute again”*

Scoring: Again, record the total number of animals the participant generates. Then, count the total number of correct words—these do not include higher order categories when specific exemplars are given (e.g., *“fish”* followed by *“salmon”* and *“trout”* – total = 3; correct = 2; *fish* is not scored as 1 in this case). No additional points are given for different sex/genders for the same type of animal (e.g., *“deer”* followed by *“doe, fawn, stag”* scores only 1 point). All types of animals are accepted, including insects, humans, prehistoric, extinct as well as mythical creatures (e.g., *unicorn*). If the participant misunderstands the instructions and perseverates from the previous item by naming animals beginning with the letter “P” (e.g., *panda, possum, platypus* etc.), then reiterate to the participant that they should name animals beginning with any letter. Do not stop timing when doing this.

For additional interpretation: Note which animals were generated in the first 30s and in the second 30s.

MEMORY – Anterograde Memory – Name and Address (Score 0 to 7)**M-ACE**

Administration: Instruct the participant: *“I’m going to give you a name and address and I’d like you to repeat the name and address after me. We’ll be doing that 3 times, so you have a chance to learn it. I’ll ask you the name and address later.”* If the participant starts repeating along with you, ask them to wait until you give it in full.

Scoring: Record responses for each trial but only score responses in the third trial (0-7 points).

MEMORY – Retrograde Memory – Famous People (Score 0 to 4)

Administration: Ask the participant for the name of the (1) current President of South Africa, (2) the previous president of South Africa, (3) the President elected in the first democratic elections in SA in 1994, and (4) current President of the USA.

Scoring: Score 1 point each. Allow surnames (e.g., “*Beiden*”) and ask for a surname if only the first name is given (e.g., “*Joe*”). If the full name given is incorrect (e.g., “*Kevin Beiden*”), the score would be 0. If there has been a recent change in leaders, probe for the name of the outgoing politician.

LANGUAGE – Comprehension (Score 0 to 3)

Administration: Place a pencil and a piece of paper in front of the participant side-by-side. As a practice trial, ask the participant to “*pick up the pencil and then the paper*”. If this is incorrectly performed, score 0 and do not continue with this item. Otherwise, continue with the three other commands listed on the protocol. Before beginning each trial, always replace the pencil and piece of paper in front of the participant. For the command “Pass me the pencil after touching the paper” the subject may first pick up the pencil before touching the paper, as long as they touch the paper before passing the pencil.

Scoring: A score of 1 is given for each command performed correctly.

Note: If you don’t have a pencil available you can use a pen.

LANGUAGE – Sentence Writing (Score 0 to 2)

Administration: Ask the participant to write two full sentences. If they are unable to think of anything to write, suggest a few topics (e.g., recent holiday, hobbies, family, or childhood) if they are unable to come up with anything to write. Importantly, if the participant writes only one sentence, prompt for a second.

Scoring: Sentences must contain a subject and a verb. We are looking for spelling and grammar errors. Sentences can be unrelated—they do not need to be about the same topic. If a patient can only write one sentence, despite prompting, this is penalised.

Points	Description of Sentence
2	<ul style="list-style-type: none"> Two sentences with no errors in grammar or spelling. <i>*Note:</i> Sentences do not need to be centred on the one topic. <p>E.g., “<i>I like to go to the beach. I have three grandchildren.</i>”</p>
1	<ul style="list-style-type: none"> Two sentences with either incorrect grammar OR incorrect spelling. Only one sentence with correct grammar and spelling is provided. <p>E.g., “<i>I like to go to the <u>beech</u>. I also like dancing.</i>” “<i>I like go beach. I like dance.</i>” “<i>I like swimming.</i>” (i.e., the patient does not write another sentence despite prompting)</p>
0	<ul style="list-style-type: none"> One sentence with incorrect grammar and/or spelling. A few words that is a phrase (e.g., “<i>like dancing</i>”), place (e.g., “<i>Royal Hospita</i>”) or a person’s name. Unable to write a sentence

LANGUAGE – Single Word Repetition (Score 0 to 2)

Administration: Ask the participant to repeat each word after you, saying only one word at a time.

Scoring: If the repetition does not sound normal (e.g., halting, laboured, slurred) then it is incorrect. Only the first attempt is scored. Score 2 if all words are correct; Score 1 if only 3 are correct; Score 0 if 2 or less are correct.

LANGUAGE – Proverb Repetition (Score 0 to 2)

Administration: Ask the participant to repeat each proverb.

Scoring: Do not accept partially correct repetitions (e.g., “*all that glistens is not gold*”). Score 1 point for each proverb.

**Note:* Following the repetition of each proverb, you may wish to ask the participant “*What does this proverb mean?*” or “*How would you explain this proverb to someone who has not heard it before?*” This additional measure can aid the clinician in the qualitative assessment of verbal abstract thinking.

LANGUAGE – Object Naming (Score 0 to 12)

Administration: Ask the participant to name each picture.

Scoring: Correct answers are spoon; book; kangaroo or wallaby; penguin; anchor; camel (or dromedary); harp; rhinoceros (or rhino); barrel (or keg, or tub); crown; crocodile (or alligator); piano accordion (or accordion or squeeze box). Score 1 point for each item.

Note: If the person is multilingual and can name the object correctly in another language that can also be accepted as correct.

LANGUAGE – Comprehension (Score 0 to 4)

Administration: Ask the participant to point to the pictures according to the statement read. Do not provide any feedback regarding the word meaning.

Scoring: Score 1 point for each item. Self-corrections are permitted.

LANGUAGE – Reading (Score 0 or 1)

Administration: Ask the participant to read the words aloud.

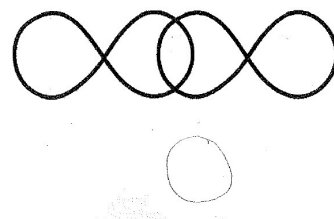
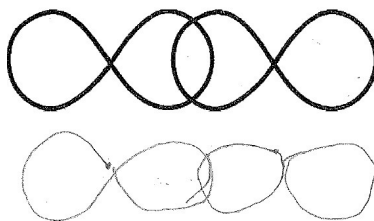
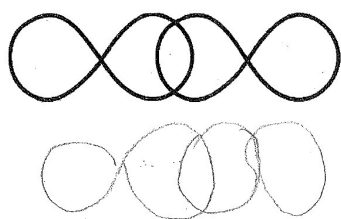
Scoring: Score 1 point if all five words are read correctly. Score 0 if any word is read incorrectly. Record mistakes using the phonetic alphabet, if possible.

VISUOSPATIAL ABILITIES – Intersecting Infinity Loops (Score 0 or 1)

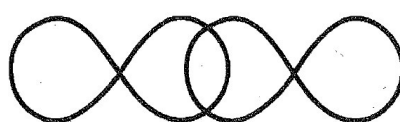
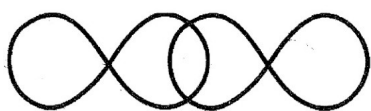
Administration: Ask the participant to copy the intersecting infinity loops.

Scoring: A score of 1 is given if two infinity loops are drawn and overlap. Both infinity loops must come to a point/cross and do not look like circles.

Score = 0



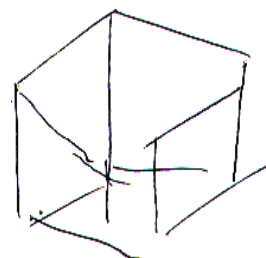
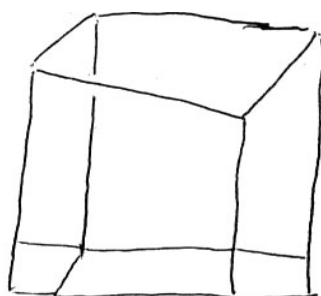
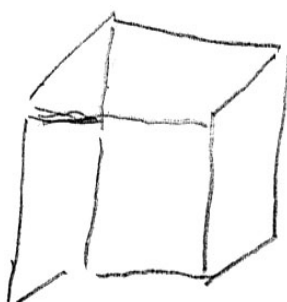
Score = 1

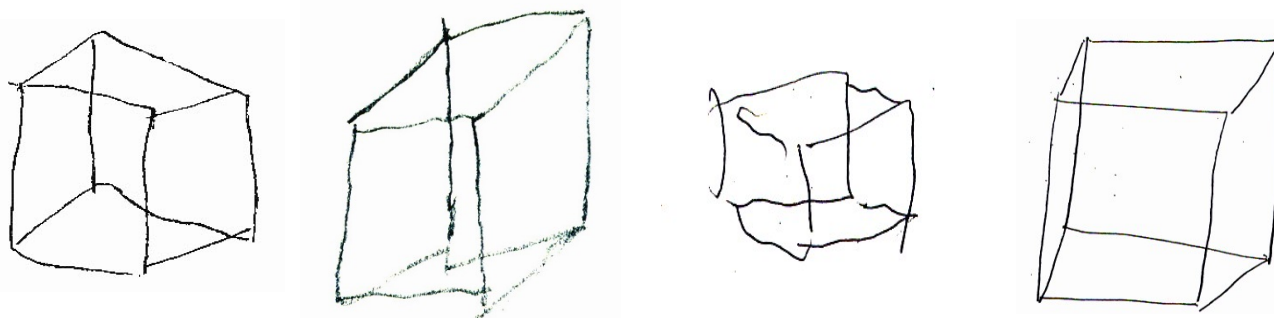
**VISUOSPATIAL ABILITIES – 3D Wire Cube – score 0 to 2**

Administration: Ask the participant to copy the 3D wire cube.

Scoring: The cube should have 12 lines to score 2 points, even if the proportions are not perfect. A score of 1 is given if the cube has fewer than 12 lines but a general cube shape is maintained.

Score = 1








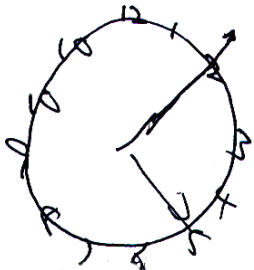

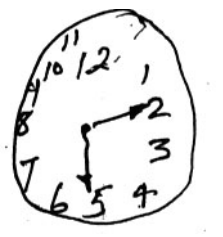

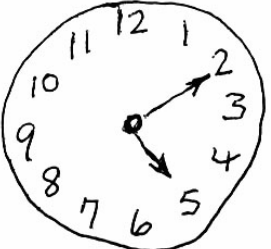
Score = 2**VISUOSPATIAL ABILITIES – Clock – score 0 to 5****M-ACE**

Administration: Ask the participant to draw a clock face with numbers on it. When he/she has finished, ask them to put the hands at “ten past five”. If the participant does not like their first drawing and would like to do it again, you can allow for that and score the second clock. Participants may correct their mistakes by erasing it while drawing.

Scoring: The following scoring criteria are used below to give a total of 5 points.

Circle	1 point maximum if it is a reasonable circle
Numbers	2 points if all numbers are included within the circle and numbers are evenly distributed. A slight rotation to the overall clock face is acceptable. 1 point if all numbers are included but the numbers are either outside of the circle or the numbers are unevenly spaced. 0 points if not all numbers are included.
Hands	2 points if both hands are drawn, lengths are correct, and placed on correct numbers (you may ask the participant which one is the small and big hand). 1 point if both hands are drawn and placed on the correct numbers but lengths are incorrect. 1 point if both hands are drawn but only one hand is placed on the correct number and lengths are correct. 0 points if two hands are drawn with one number correct but both lengths are incorrect 0 point if two hands are drawn but both numbers and lengths are incorrect. 0 point if only one hand is drawn.

Score 1	Score 2	Score 2
Circle (1); not clear that all numbers are present (0); not clear where the hands are positioned 	Circle (1); one hand placed on the correct number and has the correct length (1) 	Circle (1); all the numbers but not placed inside the circle (1) 

Score 2	Score 3	Score 3
<p>Circle (1); all the numbers but not placed inside the circle (1); two hands with one number correct but lengths are even (0)</p> 	<p>Circle (1); all the numbers present and proportionally distributed (a slight rotation of the whole clock face is OK) (2); one hand only (0)</p> 	<p>Circle (1); numbers are not inside the circle and there are 2 number 10s (0); hands placed correctly and correct lengths (2)</p> 
Score 3	Score 4	Score 4
<p>Circle (1); numbers are unevenly spaced (1); one hand placed correctly and has the correct length (1)</p> 	<p>Circle (1); all the numbers but not proportionally distributed (1); both hands placed correctly and has the correct length (2)</p> 	<p>Circle (1); numbers are proportionally distributed (2); one hand placed correctly and has the correct length (1)</p> 
Score 5		
<p>Circle (1); numbers proportionally distributed on both halves of the clock face (2); hands placed correctly (2)</p> 		

PERCEPTUAL ABILITIES – Counting Dots – score 0 to 4

Administration: Ask the participant for the number of dots in each square. The participant is not allowed to point.

Scoring: Score 1 point for each correct answer. Correct answers (clockwise): 8, 10, 9 and 7.

For aphasic patients: If the participant is unable to say the number of dots, allow them to write their answer.

PERCEPTUAL ABILITIES – Identifying Letters – score 0 to 4

Administration: Ask the participant to identify the letter in each square. The participant is allowed to point.

Scoring: Score 1 point for each correct answer. Correct answers: K, M, A and T.

For aphasic patients: If the participant is unable to say the letter name, allow them to write their answer or say the correct letter sounds (e.g., “mmm”).

MEMORY – Recall of Name and Address – score 0 to 7**M-ACE**

Administration: Say to the participant: “Now tell me what you remember of that name and address we were repeating at the beginning”.

Scoring: Score 1 point for each item recalled, using the score guide provided in the test.

**Patricia Williams
73 Market Street
Goodwood
Cape Town**

Example 1a

Patricia Willemse	1 + 0	
78 Market Street	0 + 1 + 1	
Goodhope	0	
....	0	Score 3/7

Example 2a

Patricia Williams	1 + 1	
73 Goodwood Street	1 + 0 + 1	
....	0	
Cape Town	1	Score 5/7

Example 3a

Patricia Willemse	1 + 0	
33 Good Way	0 + 0 + 0	
Goodwood Street	0 + 0	
Parow	0	
Cape Town	1	Score 2/7

MEMORY – Recognition of Name and Address – score 0 to 5

Administration: This item is given to participants if they fail to recall one or more items in the Recall condition. This task is given to allow the participant a chance to recognise items that he/she could not recall. If all of the items in the name and address are correctly recalled, this condition is not needed, and the participant automatically scores 5 points. However, many participants will recall only parts of the name and address. First, tick the correctly remembered items on the shaded column (right hand side) and then tell the participant, “Let me give you some hints. Was it x, y or z?” and so on.

Scoring: Every item recognised correctly scores 1 point. Add the correctly recalled and recognised items to give a potential total of 5 points.

Example 1b (based on Example 1a)

Tester ticks "Market Street" on the right hand side shadowed column because participant had recalled that item. The tester should then ask:	Participant answers:	
- Was it Paulina Williams, Patricia Williams, or Patricia Walker?	Patricia Williams	1
- Was it 37, 73 or 76?	76	0
- Was it Edgemead, Goodwood, or Maitland?	Goodwood	1
- Was it Cape Town, George, or Port Elizabeth?	George	0
		+ 1 Recall score (Market Street) Score 3/5

Example 2b (based on Example 2a)

Tester ticks "Patricia Williams", "73" and "Cape Town" on the right hand side shadowed column because participant had recalled those items. The tester should then ask:	Participant answers:	
- Was it on Market Road, Martin Street or Market Street?	Market Street	1
- Was it Edgemead, Goodwood, or Maitland?	Goodwood	1
		+ 3 Recall score (Patricia Williams, 73, Cape Town) Score 5/5

Example 3b (based on Example 3a)

Tester ticks "Cape Town", on the right-hand side shadowed column because participant had recalled that item. The tester should then ask:	Participant answers:	
- Was it Paulina Williams, Patricia Williams, or Patricia Walker?	Paulina Williams	0
- Was it 37, 73 or 76?	37	0
- Was it Market Road, Martin Street or Market Street?	Martin Street	0
- Was it Edgemead, Goodwood, or Maitland?	Maitland	0
		+1 Recall score (Cape Town) Score 1/5

SCORES – Domain and Total Score of the ACE-III

Scoring: Sum the items for each of the five domains (Attention, Memory, Fluency, Language, Visuospatial) to give the Domain Scores for the ACE-III. The Total ACE-III score (/100) consists of the sum of the five subdomain scores. Sum together the shaded boxes for the M-ACE score (/30). Note: The Orientation score for the M-ACE is scored out of a maximum of 4 only—the Season item is not included in the M-ACE.

For the ACE-III, the same cut-off scores as the ACE-R of 88 and 82 out of 100 are recommended for suspicion of dementia. Similarly, for the M-ACE, cut-off scores of 25 and 21 out of 30 are recommended. The cut-off that is used depends on the sensitivity and specificity required for the context in which these measures are implemented (e.g., clinical or research settings). See table below for details regarding the sensitivity and specificity of these cut-off scores.

Note: Cut-off scores not determined in a South African sample. Take education and cultural background into consideration when interpreting the scores.

Cut-off	Sensitivity	Specificity
ACE-III		
88	1.00	0.96
82	0.93	1.00
M-ACE		
25	0.85	0.87
21	0.61	1.00