

# ADDENBROOKE'S COGNITIVE EXAMINATION – ACE-R

## *Administration and Scoring Guide - 2006*

The ACE-R<sup>1</sup> is a brief cognitive test that assesses five cognitive domains, namely attention/orientation, memory, verbal fluency, language and visuospatial abilities. Total score is 100, higher scores indicates better cognitive functioning.

Administration of the ACE-R takes, on average, 15 minutes.

These instructions have been designed in order to make the questions and their scoring clear for the tester. Please read them carefully before giving the test.

If possible, leave the scoring until the end of the session, since the participant will not be able to check whether the tester is ticking for correct answers or crossing for wrong ones. This might avoid anxiety, which can disturb the participant's performance on the test.

### **O R I E N T A T I O N – score 0 to 10**

Ask the participant for the day, date, month, year and season. Score one point for each correct answer.

Ask the participant for the name of the hospital (or building), the floor (or room), the town, county and country. Score one point for each correct answer.

Record responses. Allow mistakes for the date (+ or – 2 days). If assessing a participant at home, ask for the name of the place i.e. name of the house e.g. "The Gables", and for the floor you might ask for the name of the room (kitchen, living room, etc). If at a single storey health setting, ask about a local landmark. When the season is changing, e.g. at the end of August, and the participant says "autumn", ask them "could it be another season?". If answer is "summer", give one point, since the two seasons are in transition. Do not give one point if the answer is "winter" or "spring".

*Seasons:* spring - March, April, May; summer - June, July, August; autumn - September, October, November; winter - December, January, February.

### **R E G I S T R A T I O N – score 0 to 3**

Ask the participant to repeat and remember the words lemon, key, and ball. Speak slowly. Repeat them if necessary (maximum 3 times). Tell the participant that you will ask for this information later. Record the number of trials. Score the first attempt only.

### **A T T E N T I O N & C O N C E N T R A T I O N – score 0 to 5**

**Calculation:** Ask the participant to subtract 7 from 100, record the answer, then ask them to subtract 7 from that, record the answer. Do this 5 times. If the participant makes a mistake, carry on and check subsequent answers for scoring. Record responses (Example: 92, 85, 79, 72, 65, score 3).

**Spelling:** give this test if the participant makes a mistake on the calculation task. Start by asking the participant to spell "world". Then ask them to spell it backwards. Record responses.

Scoring for the spelling task:

- Score 1 point for each correct letter spelt. Correct sequence = D L R O W = 5 points
- Count one error for each omission, letter transposition (switching adjacent letters), insertion (inserting a new letter), or misplacement (moving W, O, R, L, D by more than one space).

**Examples (score in parentheses):**

	omission	transposition	insertion	misplacement
omission	DLOW (4)			
transposition	DOLW (3)	DLORW (4)		
	omission	transposition	insertion	misplacement
insertion	DLTOW (3)	DLRWWO (3)	DLRRROW(4)	
misplacement	LOWD (3)	LRWOD (3)	LRWOWD (3)	LROWD (4)

A response such as 'LRWWOD' has 3 errors (L and R are correct, for a score of 2). It includes transposition of the W and O, insertion of an extra W, and misplacement of the D. If the patient adds 1 or more of the same letter at the end of the word, count as one error (e.g. 'LDROWWW, would be 2 errors, 1 transposition and 1 addition).

Score one point for each correct calculation or letter spelt. Score only the better performed one.

### RECALL – score 0 to 3

Ask the participant to recall the words that you asked them to repeat and remember.  
Record responses. Score one point for each correct item.

### Anterograde Memory – score 0 to 7

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

Record responses for each trial. However, only the third score contributes to the ACE-R score (0-7points).

### Retrograde Memory – score 0 to 4

Ask the participant for the name of the current Prime Minister, the woman who was Prime Minister, the president of the US and the president of the US who was assassinated in the sixties.

Score one point each. Allow answers like Blair, Thatcher; Bush; Kennedy. Do not accept answers like Maggie, ask for surname as well.

### VERBAL FLUENCY – score 0 to 14

#### Letters – score 0 to 7

Instruct 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 the names of people or places. Are you ready? You've got a minute and the letter is P".

Participant might repeat or perseverate words, e.g. pay, paid, pays. Record and count them for the overall total number of responses but do not consider them for the final score. In the same way, intrusions such as words beginning with other letters are recorded but not scored. Proper names (Peter, Peterborough) do not count. For plurals e.g. pot, pots, total = 2, correct = 1. Use the table provided on the ACE-R sheet to obtain the final score for this test.

#### Animals – score 0 to 7

Instruct the participant: "Now can you name as many animals as possible, beginning with any letter?"

Participant might repeat words. Record and count them for the overall total number of responses, but they should not be considered for the final score. The participant may misunderstand and perseverate by naming animals beginning with "p". Repeat instructions during the 60 seconds if necessary.

If subject says e.g. "fish", and later says "salmon" and "trout", count and record as 3 for "total" but do not accept "fish" as correct (count only 2 out of the 3, e.g. "salmon" and "trout"). However, if only the category is given, e.g. fish, with no specific exemplars, then count fish as 1 for total and final correct responses. The same applies to mammals, reptiles, birds, breeds of dog, insects, etc.

**L A N G U A G E - Comprehension (Close your eyes) – score 0 or 1**

Instruct the participant: “Read this sentence and do as it says”. If the participant reads sentence aloud but does not follow the instructions, score 0.

**L A N G U A G E - Comprehension (3-stage command) - score 0 to 3**

Instruct the participant: “Take this paper in your right hand, fold it in half, and put it on the floor”. Do not allow participant to take the paper before you have finished giving the complete instruction.  
Score one point for each correct command, e.g. if participant takes the paper and puts it on the floor without folding, score 2; if participant takes the paper in their right hand, and folds it several times and leaves on the table, score 1.

**L A N G U A G E - Writing – score 0 or 1**

Instruct the participant to write a sentence.  
The sentence should contain a subject and a verb, and it should have a meaning.  
Do not accept “Happy Birthday” or “Nice day” as a sentence. If participant has difficulty thinking of something to write, prompt gently with “What’s the weather like today?”

**L A N G U A G E - Repetition – score 0 to 2**

Ask the participant to repeat the words after you. Say one word at a time. Circle the words that were repeated incorrectly. Consider first attempt only for scoring. Record responses. Score 2 if all words are correct; 1 if 3 are correct; 0 if 2 or less are correct.

**L A N G U A G E - Repetition – score 0 to 2**

Ask the participant to repeat each sentence. Do not accept partially correct repetitions, e.g. “no ifs and buts”, “above below” as correct for scoring. Score one point for each sentence.

**L A N G U A G E - Naming – score 0 to 2****Naming (watch and pencil)**

Ask the participant to name each picture. Correct answers: pencil; wristwatch or watch.

**L A N G U A G E - Naming – score 0 to 10****Naming (5 animals and 5 objects)**

Ask the participant to name each picture. Correct answers: penguin; anchor; camel or dromedary; barrel or tub; crown; crocodile or alligator; harp; rhinoceros or rhino; kangaroo or wallaby; piano accordion, accordion or squeeze box.

Score one point each.

**L A N G U A G E - Comprehension – score 0 to 4****Comprehension**

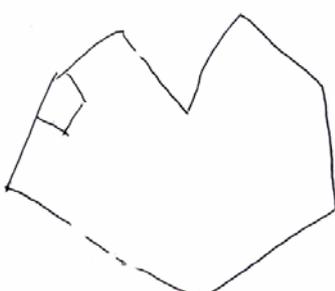
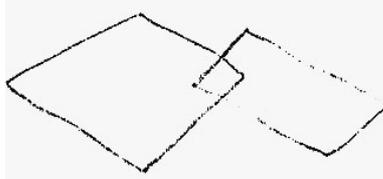
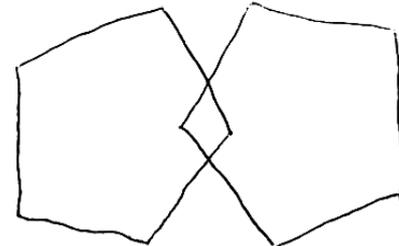
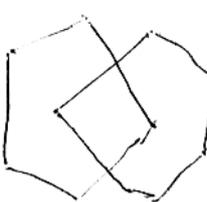
Ask the participant to point to the pictures according to the statement read.  
Score one point each. Allow self-corrections.

**LANGUAGE - Reading – score 0 or 1**

Ask the participant to read the words aloud. Score one point only if all five words are correctly read. Record the mistakes using the phonetic alphabet if possible.

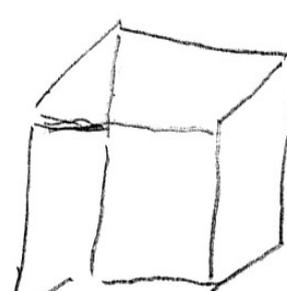
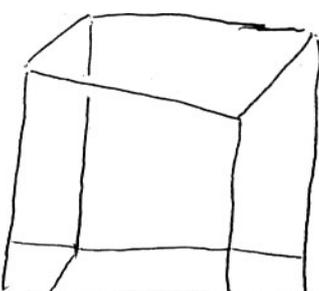
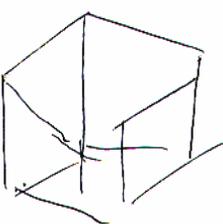
**VISUOSPATIAL ABILITIES - Overlapping pentagons – score 0 or 1**

The pentagons should clearly show 5 sides and the intersection.

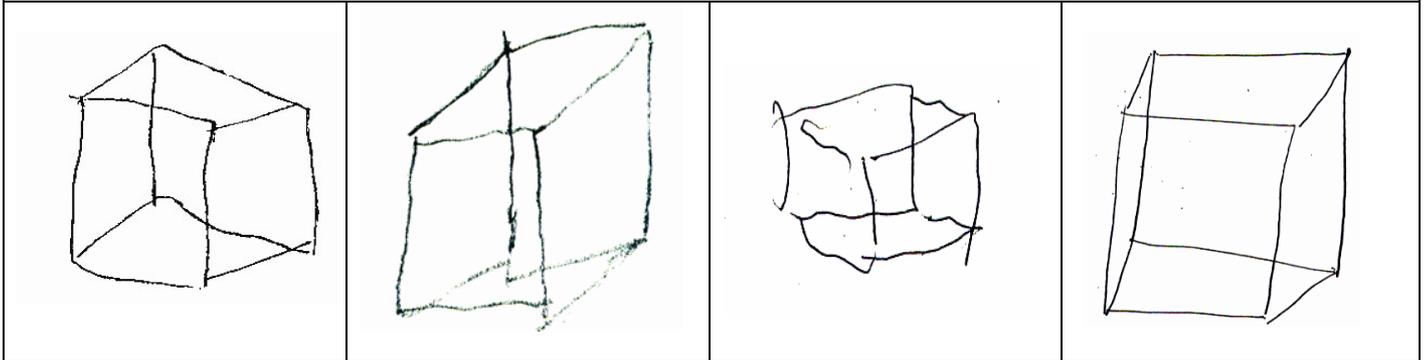
<b>Score 0</b>		
		
<b>Score 1</b>		
		

**VISUOSPATIAL ABILITIES - Wire Cube – score 0 to 2**

Cube should have 12 lines = score 2, even if the proportions are not perfect. A score of 1 is given if cube has fewer than 12 lines, but general cube shape is maintained. See examples below.

<b>Score 1</b>		
		

**Score 2**



**VISUOSPATIAL ABILITIES - Clock – score 0 to 5**

Ask the participant to draw a clock face with the numbers on it. When he/she has finished, ask them to put the hands at “ten past five”.

<b>Circle</b>	1 point maximum if it is a reasonable circle
<b>Numbers</b>	2 points if all included and well distributed 1 point if all included but poorly distributed
<b>Hands</b>	2 points if both hands are well drawn, different lengths and placed on correct numbers (you might ask which one is the small and big one) 1 point if both placed on the correct numbers but wrong lengths OR 1 point if one hand is placed on the correct number and drawn with correct length OR 1 point if only one hand is drawn and placed at the correct number i.e. 5 for ‘ten past five’

**Score 2**

<p>Circle (1); one hand placed correctly (1)</p>	<p>Circle (1); all the numbers but not placed inside the circle (1)</p>
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**Score 3**

<p>Circle (1); all the numbers but not proportionally distributed (1), one hand placed correctly (1)</p>	<p>Circle (1), all the numbers but not placed inside the circle (1), one hand placed correctly (1).</p>	<p>Circle (1), note that numbers are not inside the circle and there are 2 number 10s (0), hands placed correctly</p>
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**Score 4**

Circle(1); numbers proportionally distributed (2); one hand placed correctly (1)



Circle (1); all the numbers but not proportionally distributed (1); both hands placed correctly (2)

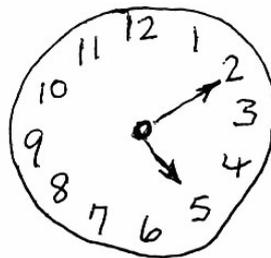


Circle (1); numbers proportionally distributed (2), one hand placed correctly (1)



**Score 5**

Circle (1); numbers proportionally distributed on both halves of the clock face (2); hands placed correctly (2)



**PERCEPTUAL ABILITIES – score 0 to 4**

**Counting dots**

Participant is *not* allowed to point to the picture. Score one point for each correct answer. Correct answers, from top left clockwise: 8, 10, 9 and 7.

**PERCEPTUAL ABILITIES – score 0 to 4**

**Identifying letters**

Participant is allowed to point to the picture. Score one point for each correct answer. Correct answers, from top left clockwise: K, M, T and A

**RECALL – score 0 to 7**

**Recall**

Say to the participant: “Now tell me what you remember of that name and address we were repeating at the beginning”. Tick and score one point for each item recalled, using the score guide provided in the test.

**Harry Barnes  
73 Orchard Close  
Kingsbridge  
Devon**

**Example 1a**

Harry Bond	1 + 0	
78 Orchard Close	0 + 1 + 1	
Kingsbury	0	
....	0	<b>Score 3/7</b>

**Example 2a**

Harry Barnes	1 + 1	
73 Kingsbridge Close	1 + 0 + 1	
....	0	
Devon	1	<b>Score 5/7</b>

**Example 3a**

Harry Bond	1 + 0	
33 Kingsbury Way	0 + 0 + 0	
Kingsbridge Close	0 + 0	
Cambridge	0	
Devon	1	<b>Score 2/7</b>

**RECOGNITION – score 0 to 5****Recognition – only to be given if participant fails to recall one or more items in the recall task.**

This task should be given to allow the participant a chance to recognise items that he or she could not recall. If the participant recalls the name and address correctly, this test is not needed and the participant scores 5. However, many participants will recall only parts. Start by ticking the correctly remembered items on the shadowed column (right hand side) and then tell them “Let me give you some hints. Was the number (or whatever was forgotten or mistaken) x, y or z?” and so on. Every recognised item scores one point. Maximum score is 5. Adding recalled items to those recognised gives the final score for this part of the test.

**Example 1b (based on example 1a)**

<p>Tester ticks “Orchard Close” on the right hand side shadowed column because participant had recalled that item. The tester should then ask:</p> <ul style="list-style-type: none"> <li>- Was it Jerry Barnes, <u>Harry Barnes</u> or Harry Bradford?</li> <li>- Was it 37, <u>73</u> or 76?</li> <li>- Was it Oakhampton, <u>Kingsbridge</u> or Dartington?</li> <li>- Was it <u>Devon</u>, Dorset or Somerset?</li> </ul>	<p>Participant's answers:</p> <p>Harry Barnes 1</p> <p>76 0</p> <p>Kingsbridge 1</p> <p>Dorset 0</p> <p>+ 1 (Orchard Close)</p>	<b>Score 3/5</b>
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**Example 2b (based on example 2a)**

<p>Tester ticks “Harry Barnes”, “73” and “Devon” on the right hand side shadowed column because participant had recalled those items. The tester should then ask:</p> <ul style="list-style-type: none"> <li>- Was it Orchard Place, Oak Close or <u>Orchard Close</u>?</li> <li>- Was it Oakhampton, <u>Kingsbridge</u> or Dartington?</li> </ul>	<p>Participant's answers:</p> <p>Orchard Close 1</p> <p>Kingsbridge 1</p> <p>+ 3 (Harry Barnes, 73, Devon)</p>	<b>Score 5/5</b>
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**Example 3b (based on example 3a)**

<p>Tester ticks “Devon”, on the right hand side shadowed column because participant had recalled that item. The tester should then ask:</p> <ul style="list-style-type: none"> <li>- Was it Jerry Barnes, <u>Harry Barnes</u> or Harry Bradford?</li> <li>- Was it 37, <u>73</u> or 76?</li> <li>- Was it <u>Orchard Place</u>, Oak Close or Orchard Close?</li> <li>- Was it Oakhampton, <u>Kingsbridge</u> or Dartington?</li> </ul>	<p>Participant's answers:</p> <p>Jerry Barnes 0</p> <p>37 0</p> <p>Orchard Place 0</p> <p>Oakhampton 0</p> <p>+1 (Devon)</p>	<b>Score 1/5</b>
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**MMSE – score 0 to 30**

The MMSE score can be obtained by adding up the scores in the shaded boxes to the right hand side of each test.

**NORMATIVE DATA**

A total of 241 subjects participated<sup>1</sup>, consisting of three groups: a dementia group (n=142), a mild cognitive impairment group (n=36) and a control group (63).

Table 1: Lower limit of normal (cut-off scores) for total ACE-R and sub-scores according to age (50-59, 60-69, 70-75), showing control mean minus two standard deviations.

Age range	Education (years)	Total ACE-R score	Attention/Orientation	Memory	Fluency	Language	Visuospatial
<b>50-59</b>	12.7	86	17	18	9	24	15
<b>60-69</b>	12.9	85	17	19	8	21	14
<b>70-75</b>	12.1	84	16	17	9	22	14

Table 2: Sensitivity, Specificity and Positive Predictive Values (PPV) at different prevalence rates of two cut-off total ACE-R scores. Values in parenthesis represent the respective Negative Predictive Values

ACE-R cut-off	Dementia		PPV at different prevalence rates			
	Sensitivity	Specificity	5%	10%	20%	40%
<b>88</b>	0.94	0.89	0.31 (1.0)	0.48	0.68	0.85 (1.0)
<b>82</b>	0.84	1.00	1.0 (0.96)	1.0	1.0	1.0 (0.90)

**Reference**

1. Mioshi E, Dawson K, Mitchell J, Arnold R, Hodges JR (2006) The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening, International Journal of Geriatric Psychiatry (in press).