



Improving People's Lives Through Innovations in Personalized Health Care

SAGE (Self-Administered Gerocognitive Examination): A Cognitive Assessment Tool

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THE OHIO STATE UNIVERSITY

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Introduction

- Individuals with cognitive impairment are identified too late
- We developed **SAGE**: a brief, inexpensive, practical, reliable, validated, self-administered cognitive assessment tool
- To reducing the typical delay in identifying mild cognitive impairment (MCI) and early dementia in individuals
- To be sensitive to detect a person's cognitive changes over time



Self-Administered Gerocognitive Exam (SAGE)

- **Brief** ≈ 10-15 minutes, pen and paper, self-administered
- **Free** download for individual or noncommercial educational use: sagetest.osu.edu
- Not requiring office personnel time or equipment & easily incorporated in any healthcare setting
- 20 seconds to score
- **Four** distinct, equivalent **forms**
- Can rapidly screen large numbers of individuals
- Validation of digital SAGE for tablet use pending



SAGE TEST

Self-Administered Geometric Reasoning - SAGE01 Form 1

How Well Are You Thinking?

Please complete this form in ink without the assistance of others.

Name: _____ Date of Birth: _____

How did you get in school? _____ (Jan a Man, Woman)

Last: Asian, Black, Hispanic, White, Other _____

Have you had any problems with memory or thinking? Yes _____ Only Occasionally _____ No _____

Have you had any blood relatives that have had problems with memory or thinking? Yes _____ No _____

Do you have balance problems? Yes _____ No _____

If yes, do you know the cause? Yes (specify amount) _____ No _____

Have you ever had a major stroke? Yes _____ No _____ If minor or mini-stroke? Yes _____ No _____

Do you currently feel sad or depressed? Yes _____ Only Occasionally _____ No _____

Have you had any changes in your personality? Yes (specify changes) _____ No _____

Do you have more difficulties doing everyday activities due to thinking problems? Yes _____ No _____

1. What is today's date? (Use memory - no cheating!) Month: _____ Day: _____ Year: _____

2. Name the following pictures (do not worry about spelling)




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www.sage01.com

Page 1 of 4 CONTINUE NEXT PAGE

Self-Administered Geometric Reasoning - SAGE02 Form 1

Answer these questions:


3. How are a pencil and a cube similar? What does how they are alike. They both are _____ alike?

4. How many sides are in 10 sides?

5. You are buying 10 lbs of grapes. How much change would you receive back from a \$20 bill?

6. Memory Test (remember these instructions). Do later only after completing this entire test.
At the bottom of the very last page, Write "I am done" with the black ink provided.

7. Copy this picture:



8. Drawing test

- Draw a large face of a cube and place in the bottom.
- Produce the hands for 2 minutes after 11 o'clock.
- On your clock, label "L" for the long hand and "H" for the short hand.

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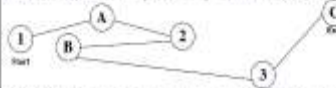
Self-Administered Geometric Reasoning - SAGE03 Form 1

9. Write down the names of 12 different animals (do not worry about spelling)

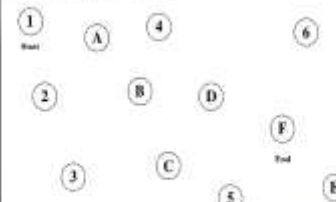
10. Write down the names of 12 different outside (do not worry about spelling)

Review this example (this first one is done for you) then go to question 11 below:

Draw a line through each to another number in 1 and starting number and then 1 to A in 2 to B to C to C



11. Do the following: There is the form on which to number starting 1 and starting number and then to write before writing of 1 to A to 2 to B and so on.



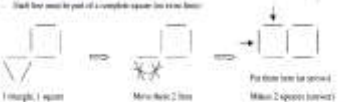
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Self-Administered Geometric Reasoning - SAGE04 Form 1

Review this example (this first one is done for you) then answer question 11 below:

- Beginning with 1 triangle and 1 square
- Move 2 lines (marked with an X)
- To make 2 squares and no triangle
- Mark the lines to be part of a complete square but not done:

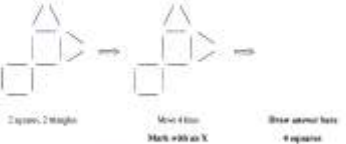


For these items be careful

(Example) (Example) (Example)

11. Solve the following problem:

- Beginning with 2 squares and 2 triangles
- Move 4 lines (mark with an X)
- To make 4 squares and no triangle
- Mark the lines to be part of a complete square but not done:



2 squares, 2 triangles (Example) Move 4 lines (Mark with an X) (Draw answer here) 4 squares

12. Have you finished? _____

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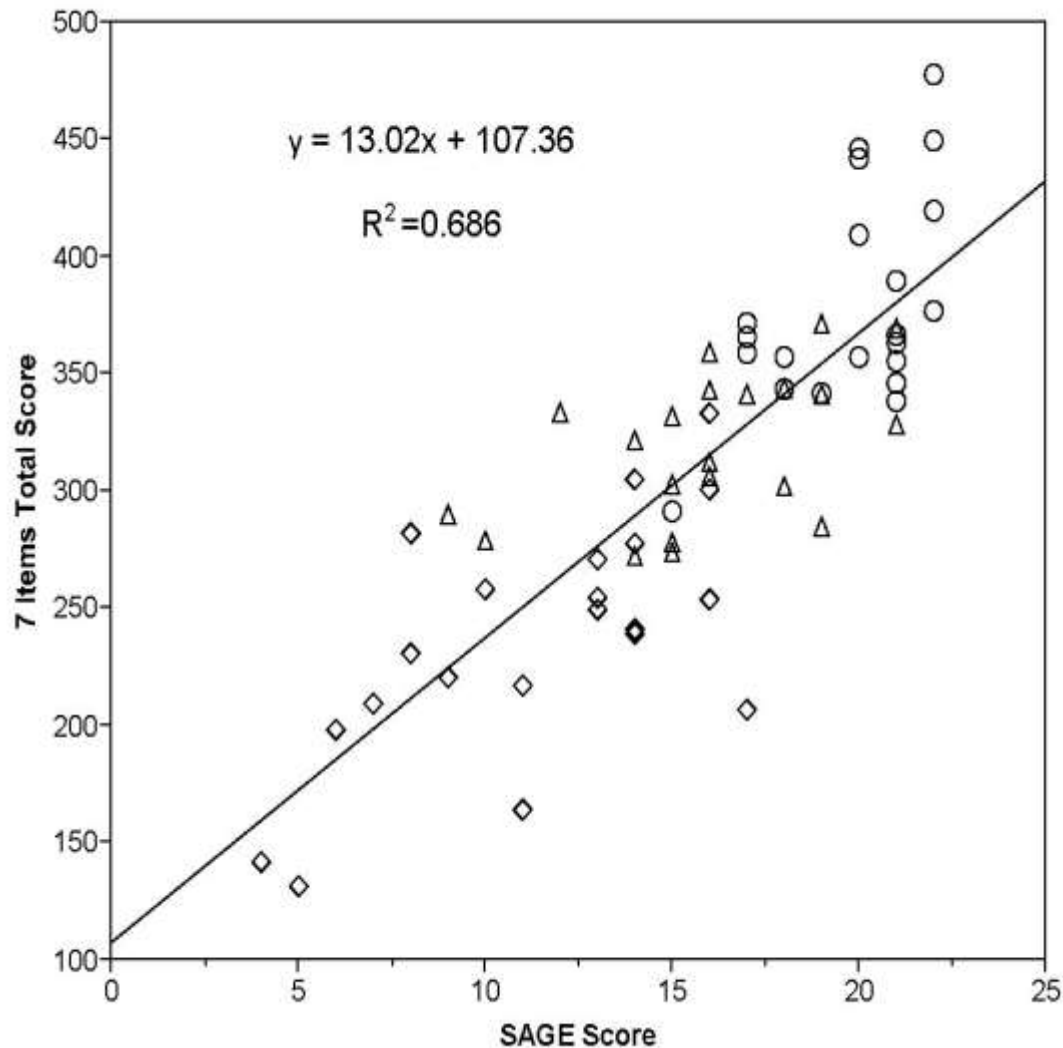
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SAGE

- SAGE download: sagetest.osu.edu
- Score range: 0-22
- **Orientation:** month, date, year (4 points)
- **Language:** picture naming (2 points) and verbal fluency (2 points)
- **Reasoning/Computation:** Abstraction (2 points) and Calculations (2 points)
- **Memory:** (2 points)
- **Executive:** modified Trails B (2 points) and problem solving task (2 points)
- **Visuospatial:** copying 3-dimensional constructions (2 points) and clock draw (2 points)



SAGE Validation Study against Neuropsychology Tests



R=0.84

Scharre et al. Alzheimer
Dis Assoc Disord
2010;24:64-71 at
sagetest.osu.edu



Sum 7, SAGE and MMSE scores: Normal, MCI, and Dementia

		Normal (n=21)	MCI (n=21)	Dementia (n=21)
Sum 7	Mean \pm SD (Range)	380 \pm 45 (478 – 292)	318 \pm 31 (371- 272)	238 \pm 52 (333 – 132)
SAGE max = 22	Mean \pm SD (Range)	19.8 \pm 2.0 (22-15)	16.0 \pm 3.2 (21-9)	11.4 \pm 3.9 (17-4)
MMSE max = 30	Mean \pm SD (Range)	28.7 \pm 1.1 (30-26)	27.7 \pm 2.2 (30-23)	22.1 \pm 3.5 (28-16)

Sum 7: Total summed score of the 7 neuropsychological tests

Scharre et al. Alzheimer Dis Assoc Disord 2010 at sagetest.osu.edu



ROC for SAGE: Differentiating Normal vs Cognitive Impaired

Area under curve for SAGE = 0.92
(0.80 for MMSE)

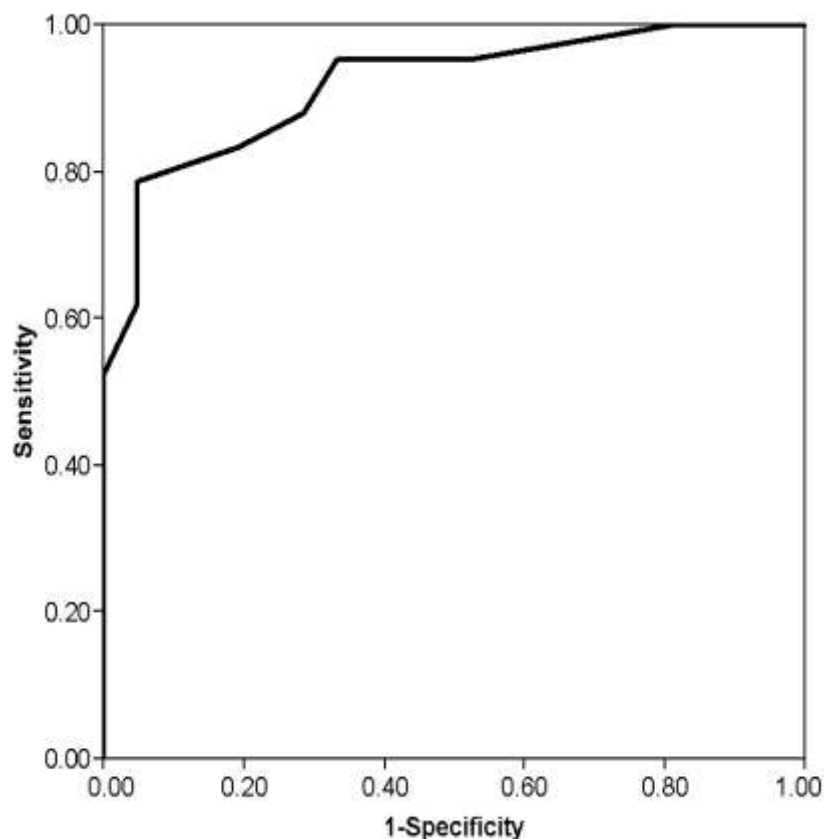
SAGE specificity is 95%
(90% for MMSE)

SAGE sensitivity is 79%
(71% for MMSE)

17-22: Very likely to be **normal**: no further evaluation

15-16: Likely to have **MCI**: screening evaluation recommended

0-14: Likely to have a **dementia** condition: screening evaluation recommended



Scharre et al. Alzheimer Dis Assoc Disord 2010; 24:64-71
sagetest.osu.edu



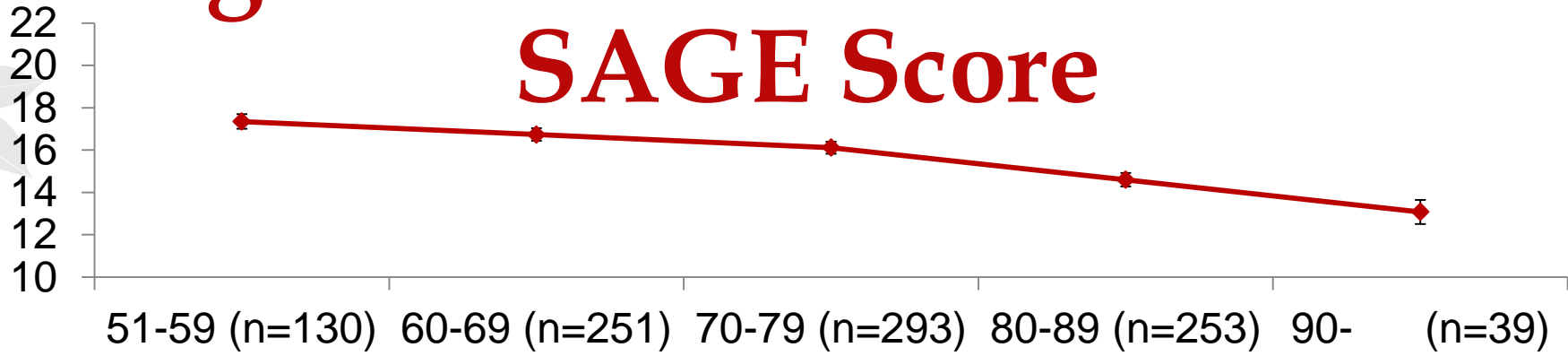
SAGE Community Cognitive Screening Study

- 1047 individuals (mean age 73) recruited from community events
- Screened with SAGE; scored on the spot and given score to individual
- MCI and dementia identified in 28%
- Lower education and older age associated with lower SAGE scores ($p < 0.05$)

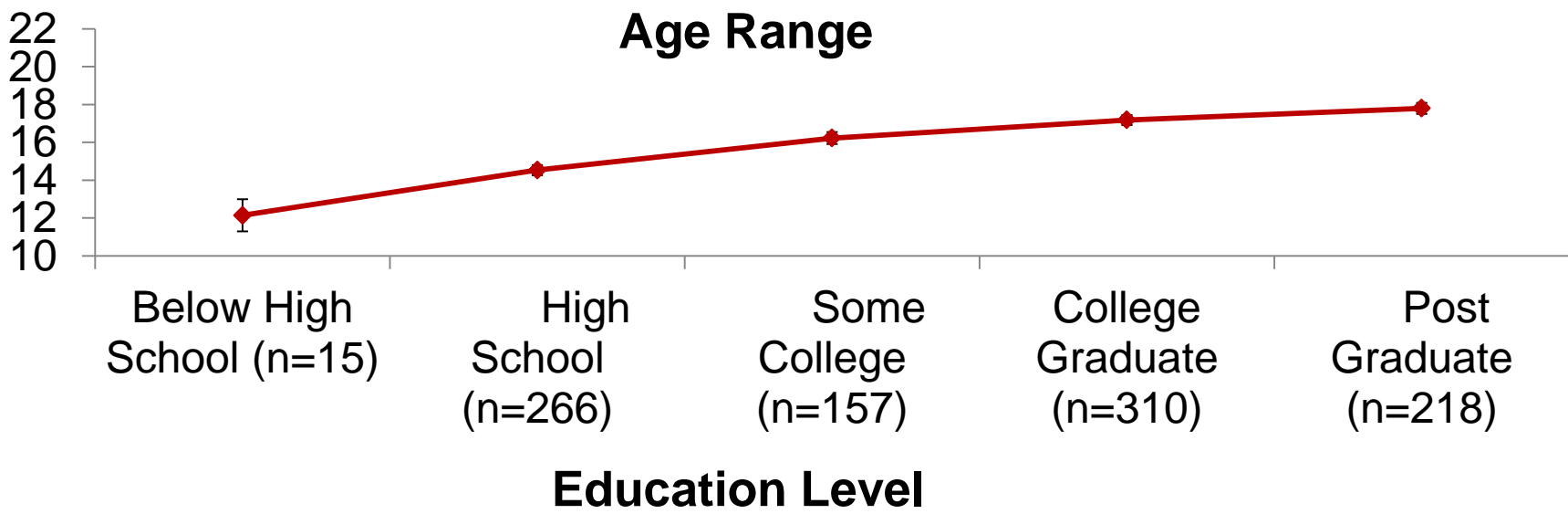


Age and Education Effect on SAGE Score

SAGE LS Mean



SAGE LS Mean



- ❖ One point should be added to those age ≥ 80 .
- ❖ SAGE test may be hard to interpret in those with under 12th grade education.
- ❖ One point should be added for those with 12 years or less of education

Characteristics of SAGE

SAGE Item Correlation to Total Score

Domains of SAGE	Correlation
Orientation = Month + Date + Year (max = 4 points)	0.295
Memory (max = 2 points)	0.611
Language = Verbal Fluency + Naming (max = 4 points)	0.621
Reasoning/Computation = Similarity + Calculations (max = 4 points)	0.622
Visuospatial = 3D Construction + Clock (max = 4 points)	0.701
Executive = Trails B + Problem Solving (max = 4 points)	0.798



Characteristics of SAGE

SAGE Domains: Principal-Component Analysis

Domains of SAGE	Weights for the First PC	Weights for the Second PC
Orientation = Month + Date + Year (max = 4 points)	0.1584	0.9163
Memory (max = 2 points)	0.3635	0.0571
Language = Verbal Fluency + Naming (max = 4 points)	0.4876	-0.2314
Reasoning/Computation = Similarity + Calculations (max = 4 points)	0.3783	0.1993
Visuospatial = 3D Construction + Clock (max = 4 points)	0.5046	-0.2526
Executive = Trails B + Problem Solving (max = 4 points)	0.4553	-0.0020
Total Variation explained by the PC	42%	17%

SAGE is an internally consistent test that is well balanced with the domains (except orientation) each contributing equally and similarly to the variability of the data

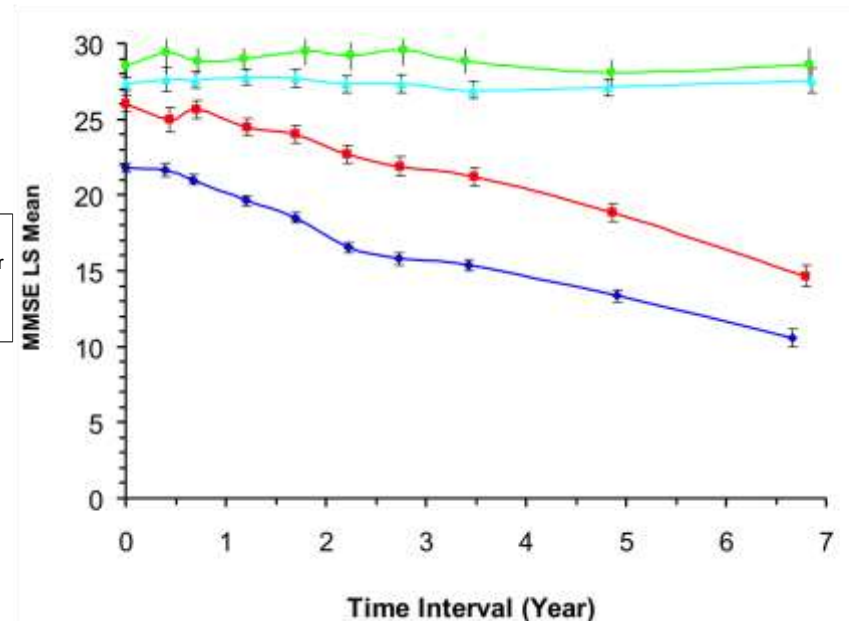
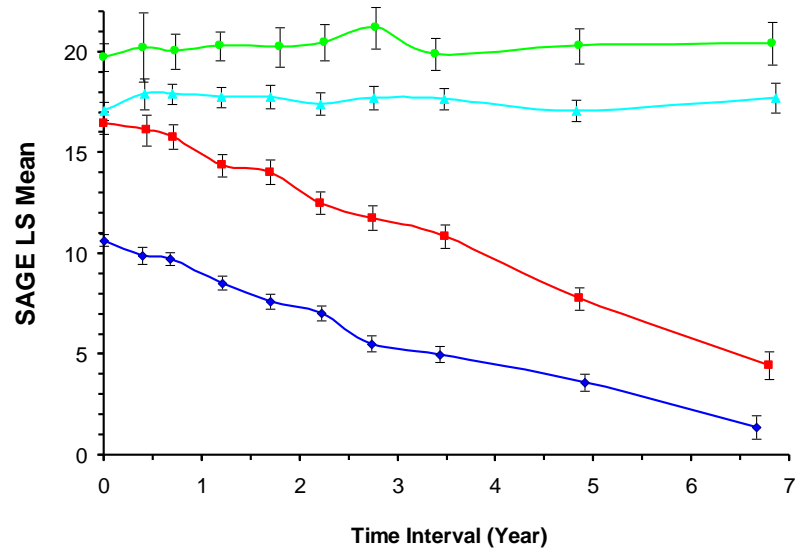


SAGE /MMSE Score Changes over time in SCI /MCI /Converter /AD

SAGE

N = 441

MMSE



- ❖ SAGE scores were stable over time in SCI and MCI who did not convert to dementia
- ❖ SAGE detects the conversion from MCI to all-cause dementia at least 6 months earlier than MMSE based on significant change scores
- ❖ SAGE differentiates SCI from MCI ($p=0.0012$) while MMSE does not ($p=0.16$).
- ❖ The ease of repetitively giving the self-administered SAGE and identification of score stability or decline provides clinicians significant diagnostic assistance



SAGE Summary

- SAGE is a brief, reliable, validated, **self-administered cognitive assessment tool** with 4 equivalent interchangeable forms **reducing the typical delay** in identifying cognitive impairment in individuals and **sensitive to changes over time**
- **“Starts the conversation”** regarding cognitive changes much earlier with primary care physicians
- Ideal for screening **in any setting**: clinic, home, community, **rural, minorities and underserved**
- **Practical to rapidly screen large numbers** of individuals in the community at the same time
- Easier to **find research participants** at early and prodromal dementia stages to evaluate therapies



SAGE Summary

- No single cognitive domain is over or under represented in its scoring
- Significant declining SAGE scores indicate a high risk for dementia diagnosis
- SAGE's self-administration feature, community screening, and routine clinic use may promote earlier diagnosis and treatment of cognitive conditions

