Smartphone-Based Assessments for Alzheimer’s Disease Risk Detection & Prevention

Rhoda Au, Ph.D.
2020 Spring ADRC Meeting
May 1, 2020
What We Keep Doing


Alzheimer’s Disease

1984
NINCDS-ADRDA Criteria
Clinical-Pathological definition

2011
NIA-AA Criteria
Clinical syndrome with biomarkers for amyloid and neurodegeneration

2018
NIA-AA Framework
Alzheimer’s disease as a biological entity defined by positive biomarkers for amyloid and tau
Clinical Spectra Independent
What We Keep Finding

THE LANCET Neurology
Volume 10, Issue 9, September 2011, Pages 785-796

Articles

Neuropathologically defined subtypes of Alzheimer's disease with distinct clinical characteristics: a retroperspective study.


Melissa E M, Petersen MC

Topographical Heterogeneity of Alzheimer's Disease Based on MR Imaging, Tau PET, and Amyloid PET.

Jeon S1, Kang JM2, Seo S3, Jeong HJ4, Funck T1, Lee SY3, Park KH5, Lee YB5, Yeon BK2, Ido T4, Okamura N6, Evans AC1, Na DL7,8, Noh Y5,9.


Cognitive heterogeneity in probable Alzheimer disease: Clinical and neuropathologic features.

Qiu Y1, Jacobs DM1, Messer K1, Salmon DP1, Feldman HH2.
In Shocking Reversal, Biogen to Submit Experimental Alzheimer’s Drug for Approval

The decision contradicts an earlier one to halt studies of the therapy, which followed a series of failed drugs that targeted diseased brain protein.

By Matthew Herper, STAT on October 22, 2019

Eli Lilly’s Experimental Alzheimer’s Drug to Launch Global Trials Amid Skepticism

By PAM BELLUCK  November 23, 2015

Chinese Alzheimer’s Drug to Launch Global Trials Amid Skepticism

Bloomberg News
December 29, 2019, 4:00 AM EST
What We Can Do Differently
Why Smartphones?

331,002,651 people in U.S.

275,660,000+ have a smartphone

83.3%
What About the Racial Disparity Divide?

Blacks and Hispanics own mobile devices at similar shares to whites

% of U.S. adults in each group who say they have the following

<table>
<thead>
<tr>
<th>Device</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone</td>
<td>82</td>
<td>80</td>
<td>79</td>
</tr>
<tr>
<td>Tablet computer</td>
<td>53</td>
<td>58</td>
<td>43</td>
</tr>
</tbody>
</table>

What About the Income Disparity Divide?

Lower-income Americans have lower levels of technology adoption

% of U.S. adults who say they have the following...

<table>
<thead>
<tr>
<th>Technology</th>
<th>&lt;$30K</th>
<th>$30K-$99,999</th>
<th>$100K+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone</td>
<td>71</td>
<td>85</td>
<td>97</td>
</tr>
<tr>
<td>Desktop or laptop</td>
<td>54</td>
<td>83</td>
<td>94</td>
</tr>
<tr>
<td>computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home broadband</td>
<td>56</td>
<td>81</td>
<td>94</td>
</tr>
<tr>
<td>Tablet computer</td>
<td>36</td>
<td>55</td>
<td>70</td>
</tr>
</tbody>
</table>

17% of Americans are “smartphone only” internet users

% of U.S. adults who say they own a smartphone, but do not have a high-speed internet connection at home

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Less than $30,000</th>
<th>$30,000-$74,999</th>
<th>$75,000 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS or less</td>
<td>26</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Some college</td>
<td>16</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>College+</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PEW RESEARCH CENTER
What About the Age Disparity Divide?

Older adults continue to adopt all forms of modern technology devices. Device adoption rates among adults ages 50 and older, 2017 (n=1,520) and 2019 (n=2,597)

Older adults tend not to be early adopters, although half bought a tech item in the past year.

Behavior towards new tech

Most smartphone owners use their smartphones daily.

Smartphone owners reporting daily usage

- Nine in ten adults ages 50 and older who own smartphones use their smartphone daily.
- Among adults ages 50 and older who own smartphones, those ages 50–59 were the most likely to report daily smartphone usage.

Smartphone daily use rates among owners age 50+

- 94%
- 97%
- 95%
- 88% ▼

Base: Total Respondents (n=2,579)
Q. NEWTech13. Which of the following best describes your life easier or better? (mark)
50+, 50–59, 60–69, and 70+ Base: Those who own a smartphone (n=1,994). Q. Tech14. How often do you currently use the following?

▲ Statistically higher than both groups at the 95% confidence level
▼ Statistically lower than both groups at the 95% confidence level
Ambulatory Research in Cognition (ARC)

The ARC app administers very brief cognitive tests up to four times per day for one week. Each test session takes less than 3 minutes.

Participants use their personal smartphone, we call it BYOD (Bring Your Own Device).

The idea behind ARC is simple:
1. Test often and everywhere.
2. Keep it short.
3. Combine the results.
Participants setup availability (wake and sleep times) for one week of testing.

Get a notification that it is “Time to take a quick test”, tap on the notification and begin the test.
GRIDS Test (30-40 seconds)
Spatial Working Memory
Participants are asked which pair below matches one of the pairs on top?

Primary outcome: Number correct and response time.
PRICES Test (60 seconds)
Associate Memory

- **Test Parameters:**
  - 10 Price-Item pairs per test.
  - 3s presentation
  - Primary Outcome: Percent Errors

[Images showing study and recall phases]
Adherence: User Progress

Today’s Sessions
3 Complete  Done for the day!

This Week
Day 6 of 7
Start Date
Sunday, March 5

This Study
4 Weeks Completed
8 Weeks Remaining*

Joined Date
December 3, 2018

Estimated Finish Date*
December 3, 2020

Time Between Testing Weeks
2 Months

Next Testing Cycle
Tue, March 5 – Mon, March 11

You’ve Finished This Testing Cycle!
Thank you for contributing to our research. Your time and hard work are truly valuable.

NEXT
Adherence Strategies cont’d

- Gamification
- Badges, Achievements, Confetti, etc
- Reimbursement
- $0.50 per test completed.
- Bonuses for streaks and overall completion rates. Up to $30 per “visit”.

[Image of a mobile app with features for tracking earnings and goals]
ECOSYSTEM
In the next section you will be asked a series of questions. Please base your answers on how you have been feeling over the past two weeks.

Over the last 2 weeks, how often have you been bothered by any of the following problems?

Little interest or pleasure in doing things.

- Not at all
- Several days
- More than half the days
- Nearly every day
TEST 1 OF 4
Listen to the following story carefully, and remember as much as you can.

Kyle Jespersen, chef and owner of Big K's Roadside Diner, was hospitalized for hypothermia...

TEST 1 OF 4
Now, retell the story as you remember it.
Culture-Language Agnostic
Achieve World Wide Representativeness

How Many People Have Smartphones In The World?

- 3.50 Billion smartphone users in the world today
- 45.04% of people have smartphones today

By 2023, mobile device users will increase to 7.33 billion
Think Different, Be Different