Integrating digital health tools to improve detection of cognitive decline

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Smartphone-based Ecological Momentary Cognitive Tests (EMCT)

“Frequent, brief and repeated self-administered mobile assessments of cognitive function, conducted in everyday life settings, are a promising complementary tool to traditional assessment approaches.” Moore et al., 2017 (systematic review)
Smartphone-based Ecological Momentary Cognitive Tests (EMCT)

Pros:
- More frequent assessment – may be able to detect subtle changes
- Potentially more ecologically valid
- Can be paired with EMA or other devices

Cons:
- Non-standard environment
- “cheating”
- Participant cannot ask questions for clarification
- Ethical/Privacy considerations
- Different phones may impact performance

Roller Coaster.
Day-to-day variability in testing can overshadow a true change in cognitive function. [Courtesy of Jason Hassenstab.]

Alzforum (2017)
Objective vs. Subjective Lifestyle Factors and Cognition

- **Lifestyle factors:**
  - Self-report is often very discrepant from objective measures (over and underreporting)
    - E.g., studies have shown that adults generally overestimate physical activity on self-report retrospective questionnaires

- **Subjective Cognition & Everyday Functioning**
  - Can be biased:
    - Insight/Anosognosia
    - Relies on retrospective recall
    - Psychiatric factors are often found to be more associated with subjective functioning
  - Not all participants have someone who can provide collateral information
EMCT can be paired with EMA or other devices to examine dynamic associations

- Using objective measures like actigraphy watches and other devices may provide more accurate information (and more information).

- Using frequent assessment (e.g., EMA), which is less reliant on retrospective recall, may provide more accurate information.

- Ultimately, we can integrate these technologies to learn more about dynamic associations between several different variables and cognition/everyday functioning.
EPAC Study Design

Visit 1:
- ~57 Persons with HIV (PWH) and ~33 HIV-aged 50+
- Questionnaires & Comprehensive Neuropsychological Testing
- Given and trained how to use smartphone
  - Given an Actigraph Watch

14-day EMA study
- EMA questionnaires and mobile cognitive tests 4x per day
- Paid $1 per survey
  - Wearing actigraphy watch

Visit 2:
- Collect smartphone and Actigraph watch feedback

PI: Raeanne Moore, Ph.D.
Objective: Investigate if there are daily-level associations between accelerometer-measured physical activity and smartphone-based EMCT performance (i.e., learning and executive function).
Better Executive Function Performance

More Daily Physical Activity
Objective: Use smartphone-based EMCT to examine the real-world relationships between daily activities (i.e., cognitively stimulating activities, passive leisure activities, and instrumental activities of daily living [IADLs]) and neurocognitive performance (i.e., executive functioning and learning)
Cognitively stimulating activities were associated with better performance. Passive leisure activities were associated with worse performance.

**Within-person:** Daily activities were related to a mobile color-word interference task (but effect sizes were small)

**Between person:** Overall activities were associated with average performance on a mobile list-learning test (but effect sizes were small)
### Implications & Opportunities for Research

**Implications:**
- These methods *may* be useful for detecting cognitive change
  - Earlier detection
  - Better detection of change over time
- This research *could* be used to inform interventions
  - Individualized interventions
  - More personalized feedback
  - Real-time interventions

**Future Research:**
- More research in general is needed
- These methods are time-intensive for participants
  - What are some more passive ways we can collect meaningful information?
- What is the best way to validate these methods?
- Research needs to be multidisciplinary
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