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IMPROVING CLINICAL DEVELOPMENT TOGETHER!



## **Ambulatory Cognitive Assessment:**

**Measurement of Attention,  
Psychomotor Performance and  
Memory in an Everyday Life Setting**

**Brian Tiplady  
University of Edinburgh**



# Disclaimer

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# Cognitive Assessment in Clinical Research

- Disorders where cognitive dysfunction is primary
  - Neurodegenerative disorders/dementia
  - Brain injury/stroke
- Disorders where cognitive dysfunction is secondary, or related to treatment
  - Cancer/chemotherapy
  - Anticholinergic treatment of overactive bladder
  - Alcohol/drug interactions

# Assessments in Everyday Life

- Setting is familiar
- Frequent assessments can be made at different times of day
- Associations between different aspects of life can be investigated
- Portable technology is becoming increasingly powerful
  - Mobile (cell) phones
  - Palmtops/small tablet PCs

# Familiar Setting

- Artificial and possibility threatening setting of lab or clinic is avoided
  - Anxiety and association with adverse effects of treatment
  - The “white-coat effect”
- Performance is assessed in the context of normal routine



# Frequent Assessments

- Lab studies usually have short duration
- Performance and mood fluctuate with time
- Frequent assessments allow a full profile to be built up
  - Diurnal changes
  - Following conditions such as chronic fatigue syndrome
- Variability of performance may be an important indicator in its own right

# Associations

- Mood and performance may be affected by variables that are hard to control
  - Sleep quality
  - Anxiety
- Even where factors can be controlled, studying relations in real life may have advantages
  - Eating
  - Drinking

# Mobile Phones

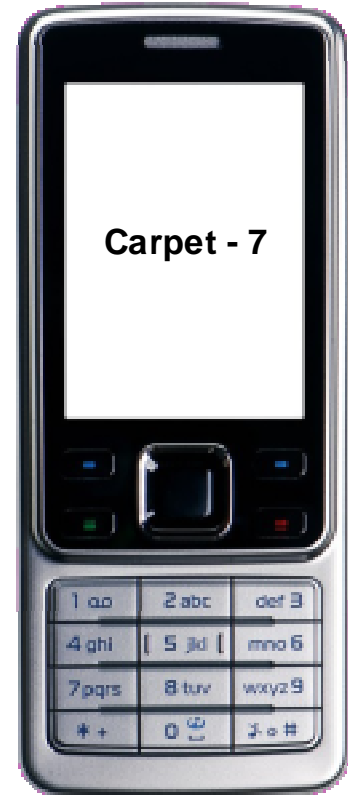


- Widespread and Familiar
- Standard: Applications can be written to run on a wide range of phones, and transmit securely to a web sever.
- Small and portable: In many ways an advantage, but leads to the main limitation of mobile phones, which is screen size.

**Mobile phones allow a wide range of assessments to be set up and used in an everyday life setting**

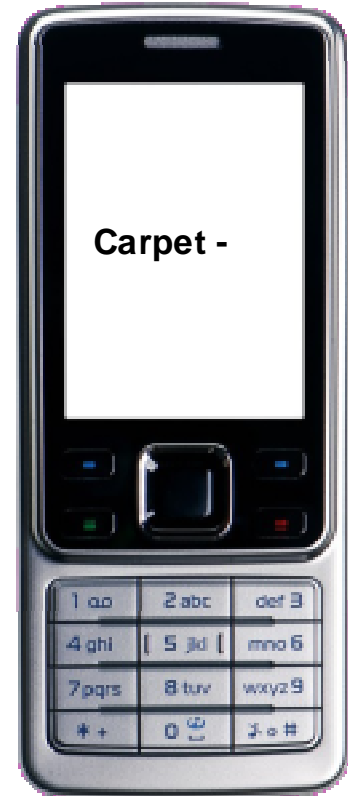
# Word-Number Test

- Eight words are paired with the digits 1 – 8
- Word-number pairs appear one at a time on the phone screen



# Word-Number Test

- Words then appear alone
- The user enters a number on the phone keypad, which appears next to the number
- And so on



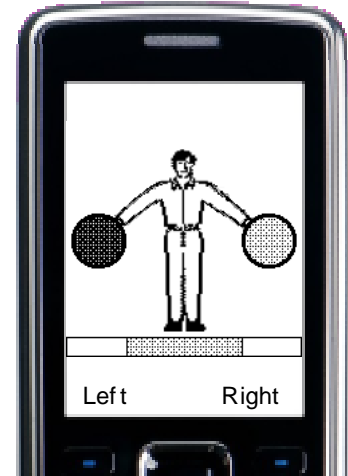
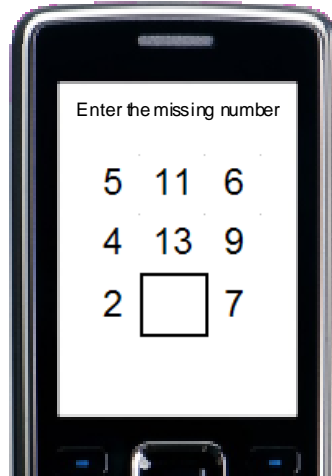
# Word-Number Test

- Words then appear alone
- The user enters a number on the phone keypad, which appears next to the number
- And so on
- With no error feedback

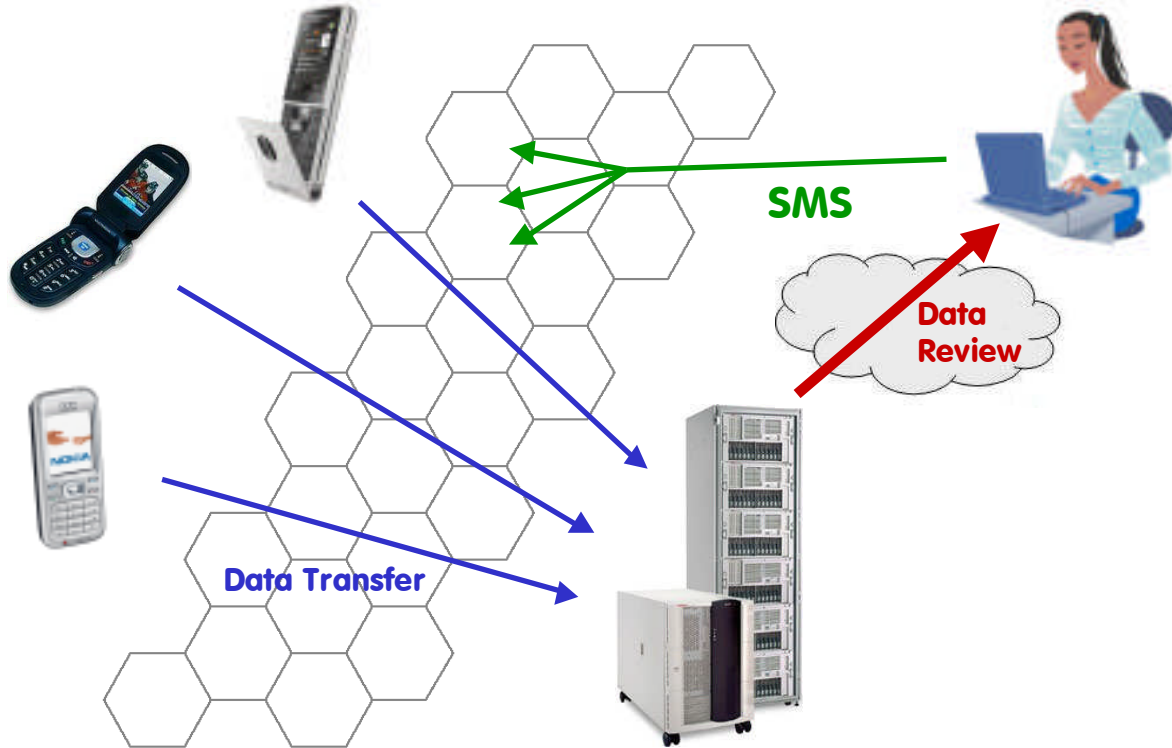


# Screen Size

- Some tests cannot be set up on a mobile phone screen
- A wide range of tests, covering most cognitive domains, can be readily implemented:



# Mobile Phone Data Model



# A Validation Study: Alcohol in Everyday Life

- How do effects of alcohol assessed in everyday life compare with lab findings?
- Is the mobile phone a practical and effective way of collecting data?
- Study compared laboratory and everyday life assessments in the same volunteers

# Everyday Life

- Thirty volunteers, 16 males and 14 females, aged 19-64 years (mean 37.4) took part
- Text (SMS) messages were sent twice a day at different times to the phones over 14 days.
- Volunteers were asked to complete assessments as soon as possible after receiving each text message.



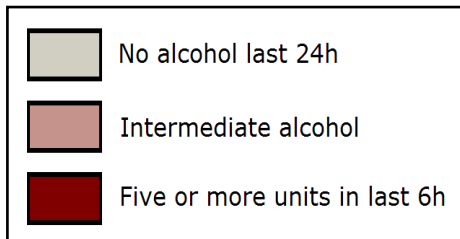
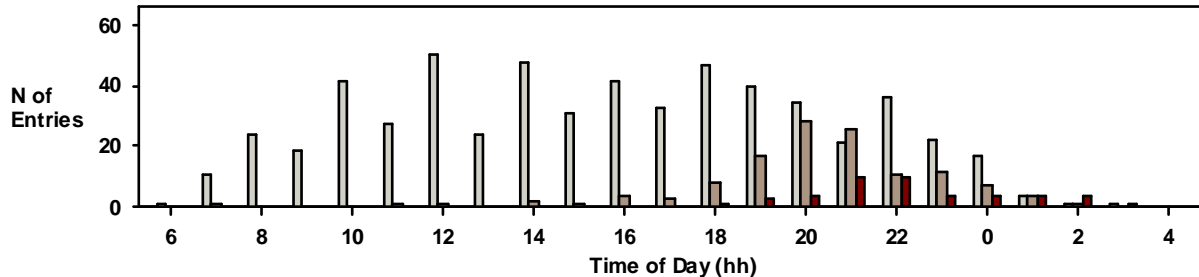
# Assessments

- They recorded number of alcoholic drinks consumed, having been asked not to change their normal drinking during the study.
- They carried out the following tests:
  - Memory Scanning (Working memory)
  - Number-Pair Matching (Attention with distractors)
  - Word-number Test (Verbal recollective memory)
  - Visual Analogue Scales. Drunkenness, drowsiness, and mood (Happy–Sad).

# Compliance

- No specific time-windows were set for completing assessments, as the aim was to obtain data over a wide range of times, not at defined intervals.
- Entries were made to 85% of text messages (i.e. before the next message was sent).
- Compliance was similar in older (> 33 years) and younger volunteers

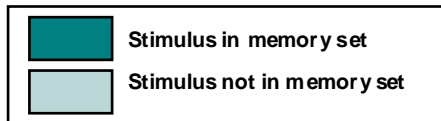
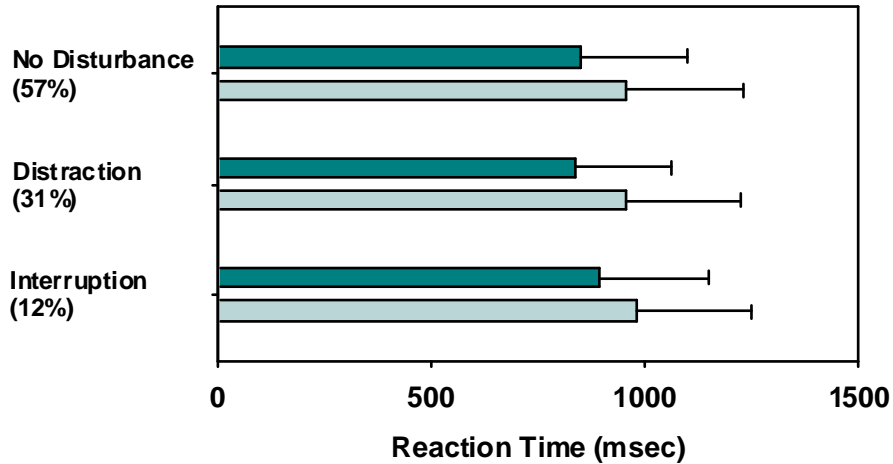
# Distribution of Entries



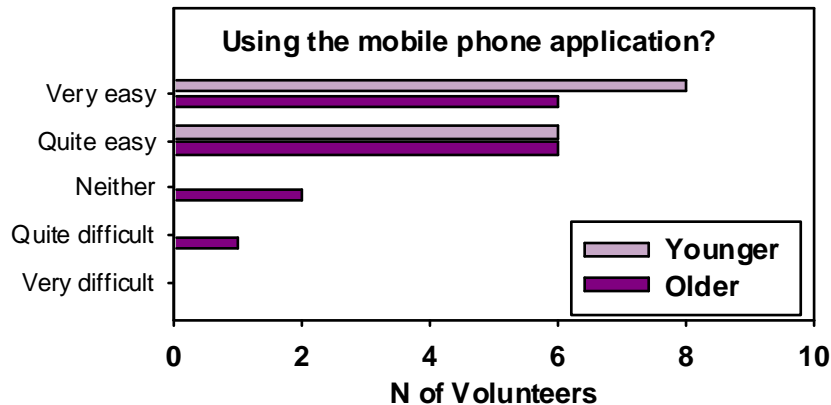
## Entries with at least 5 units:

- 19/30 volunteers had at least one entry  $\geq 5$
- Maximum was 26 units (median 6)
- Previous work suggests that 6 units (reported) corresponds to a BAC of about 82 mg/100 ml, about the UK legal limit for driving

# Task Integrity - Memory Scanning



# Ease of Use



All the younger volunteers, and the majority (11/14) of the older volunteers found the application either very or quite easy to use.

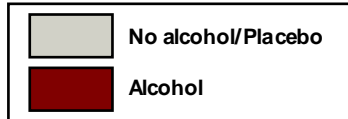
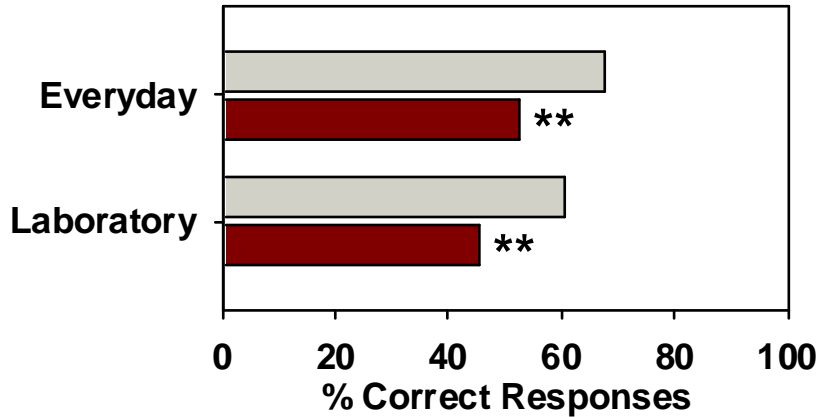
**Mobile given was different from my own.  
Took me a while to get started**



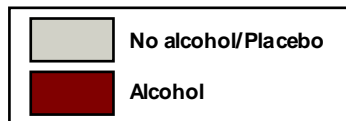
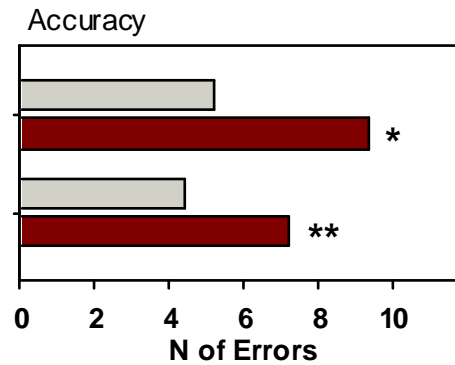
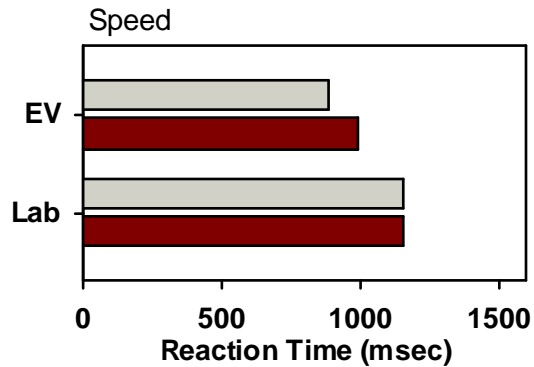
# Laboratory

- Volunteers took part in the lab study after completing everyday assessments.
  - They received alcohol and placebo on separate days in random order
  - They completed assessments at intervals up to 2h after the drink.
- Mean peak blood alcohol concentrations were 110 mg/100 ml (UK legal limit 80)

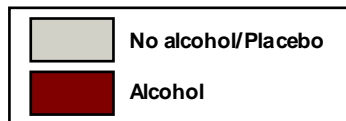
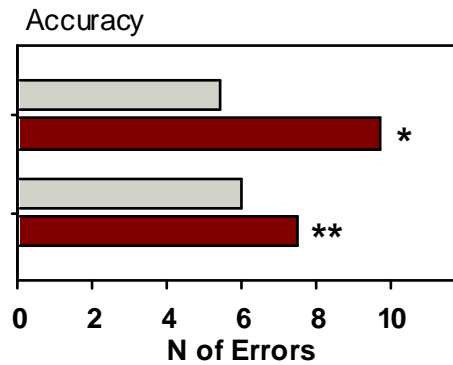
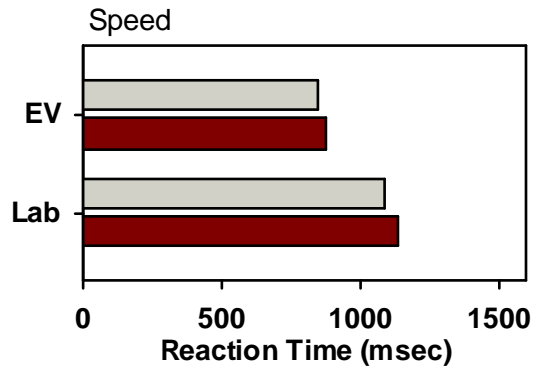
# Word-Number Test



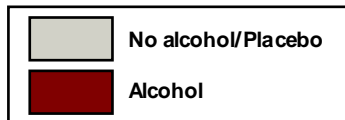
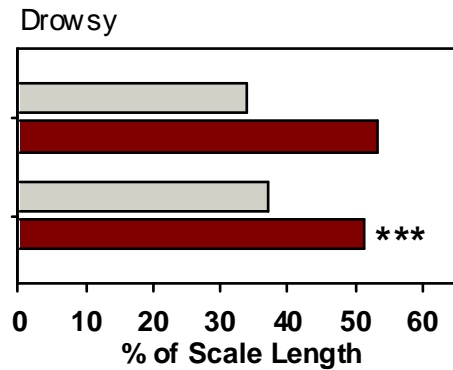
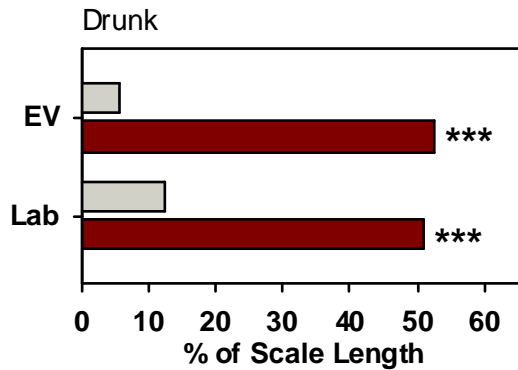
# Memory Scanning Test



# Number Pairs Test

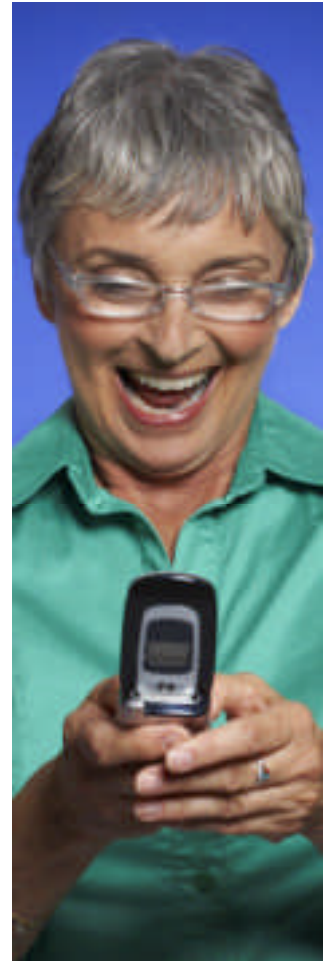


# Visual Analogue Scales



# Study Conclusions

- Good compliance with study procedures
- Indicators of data quality of everyday data are positive
- Impairment and subjective effects clearly seen in both everyday and lab settings
- Pattern of changes similar in two settings, with errors particularly affected in both cases
- Mobile phones are a practical and effective method of collecting data on cognitive performance and subjective state



## Other Recent Work on Portable Cognitive Tests

- Field investigations of effects of alcohol in pub drinkers
- Effects of caffeine on sleep and subsequent daytime performance
- Effects of eating behaviour on performance
- Roadside assessment for driver impairment
- Assessment of sedation during anaesthetic procedures

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Contact: Brian Tiplady  
[brian@penscreen.com](mailto:brian@penscreen.com)  
[www.penscreen.com](http://www.penscreen.com)

