

Naturalistic assessment:

Validation of the use of a mobile phone
for assessing mood and performance in
an everyday life setting

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Assessments in Everyday Life

- **Ecological validity:** Artificial constraints of lab or clinic settings are avoided
- **Frequent** objective and subjective assessments allow fluctuating conditions to be followed in detail
- **Associations** between different aspects of life can be investigated, e.g. between food intake or sleep quality and subsequent alertness or memory
- **Portable** technology allows an increasing range and scope of naturalistic assessments to be made



Ecological Validity of Alcohol Studies

Laboratory Situation is artificial

- Fixed dose given in short period
 - E.g. “128 ml of vodka in orange juice consumed in ten minutes”
- No social context
- Quiet environment, free of distractions
- Controlled



Ecological Validity of Alcohol Studies

Everyday Life Drinking

- People choose what to drink, when, and at what rate
- Usually social...
- Distracting noisy environment
- Uncontrolled

Frequency of Assessment

- 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

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

Memory Scanning

A set of five digits is shown on the phone screen



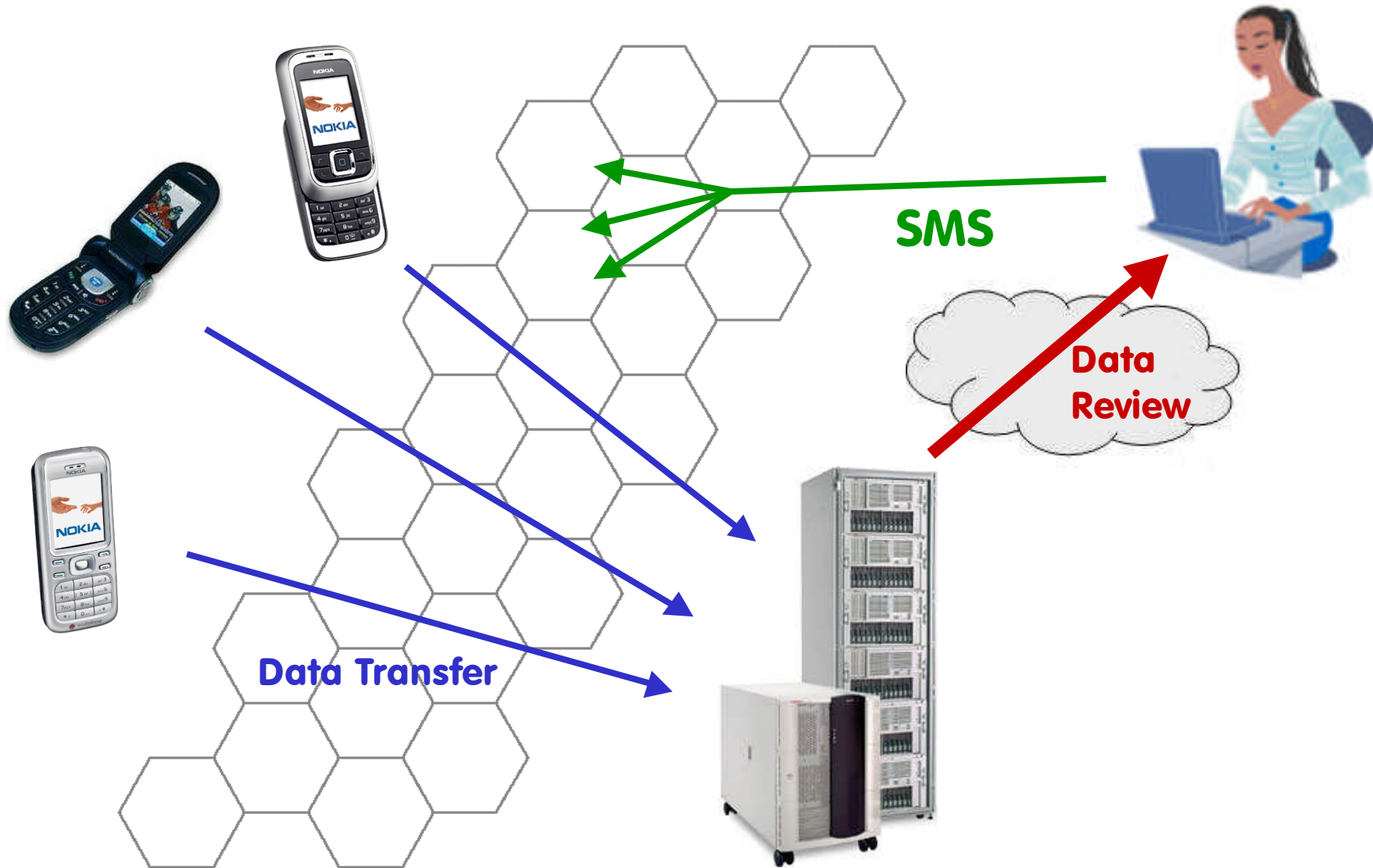
Memory Scanning

A set of five digits is shown on the phone screen

Single digits appear. The user presses YES or NO as quickly as possible



Mobile Phone Data Model



Alcohol in Everyday Life

- How do effects of alcohol 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 (Free-Range)

- 38 healthy volunteers (20 male) aged 18-54 years (mean 22.8) 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.



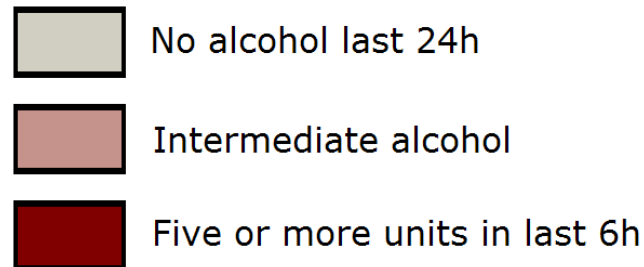
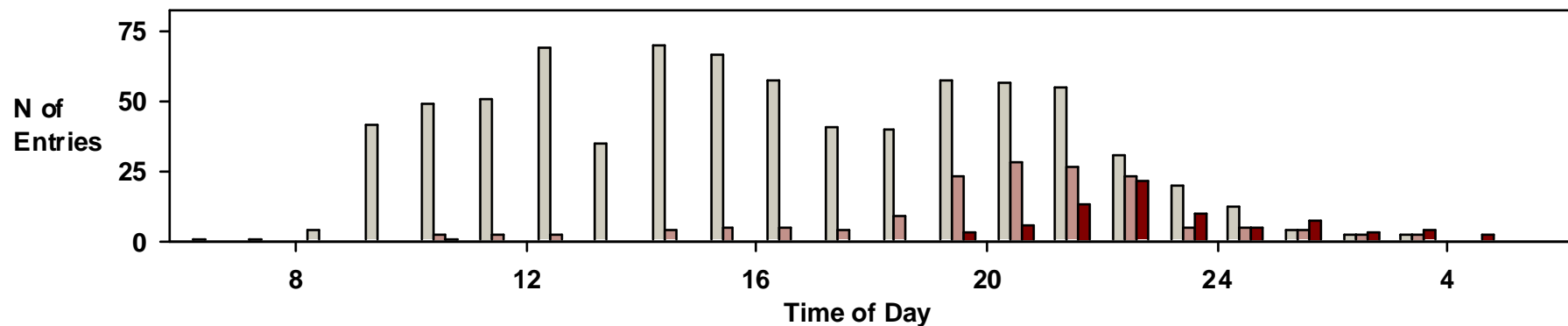
Assessments

- 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)
 - Sustained Attention to Response Task (SART: Attention and response suppression)
 - 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 over 80% of text messages (i.e. before the next message was sent).

Distribution of Entries



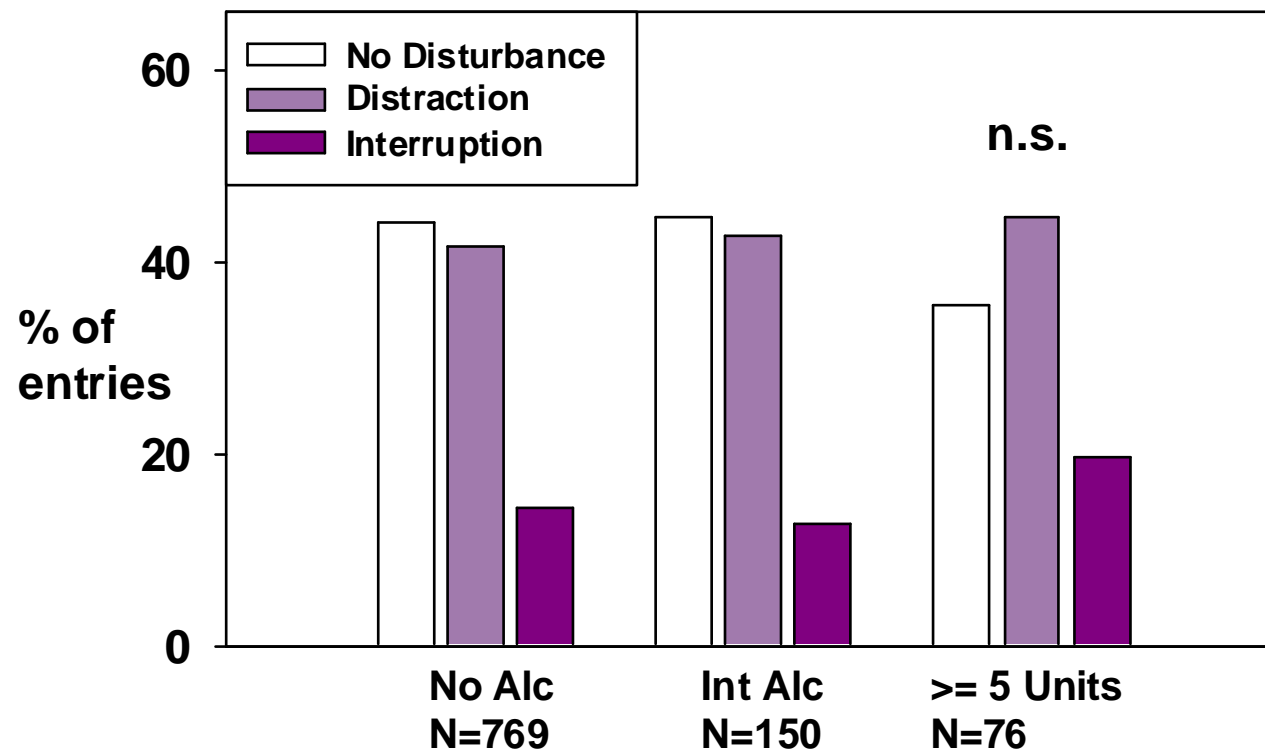
Entries with at least 5 units:

- 30/38 volunteers had at least one entry ≥ 5
- Maximum was 20 units (median 7)
- Previous work suggests that 7 units (reported) corresponds to a BAC of about 95 mg/100 ml.

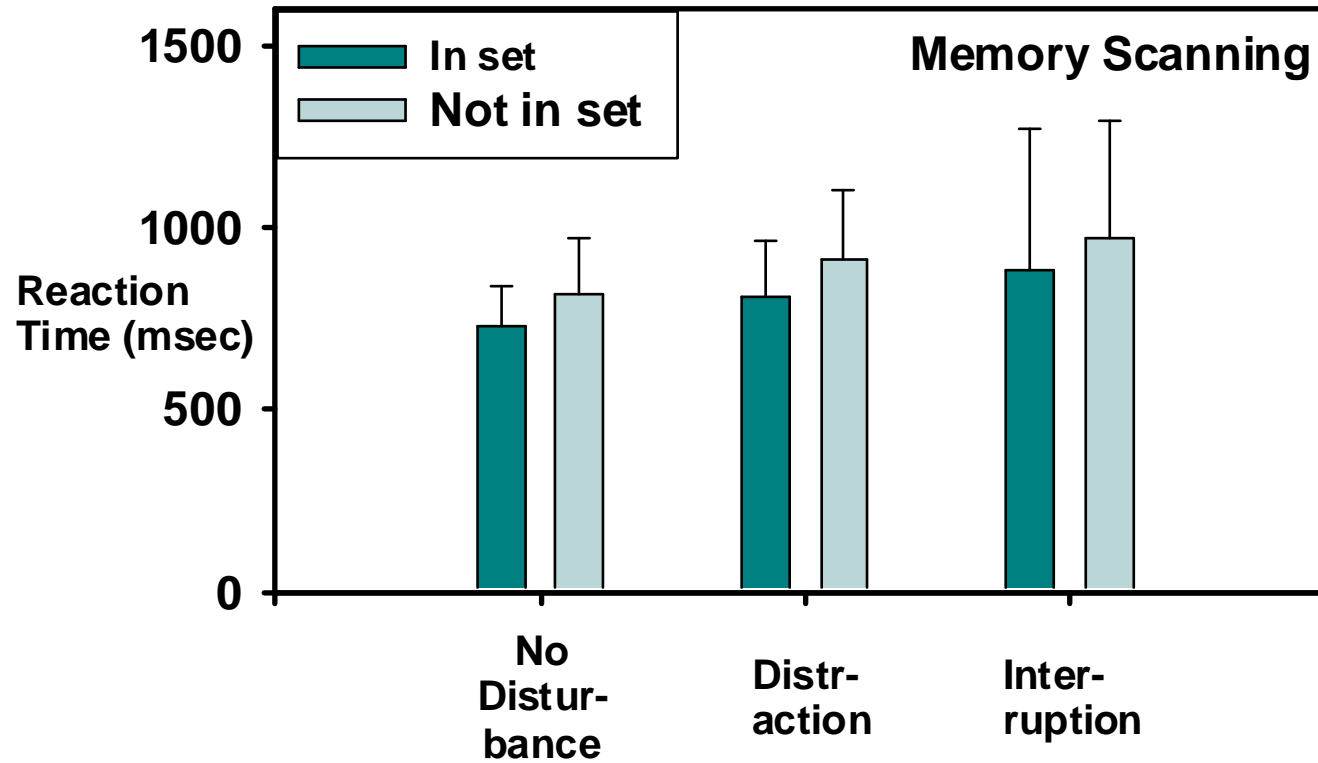
Assessing Quality

- Disturbance
 - Volunteers were asked to record whether they had been distracted or interrupted while making their entries
- Task Integrity
 - Internal consistency of performance
- Expected patterns
 - E.g. diurnal changes in performance

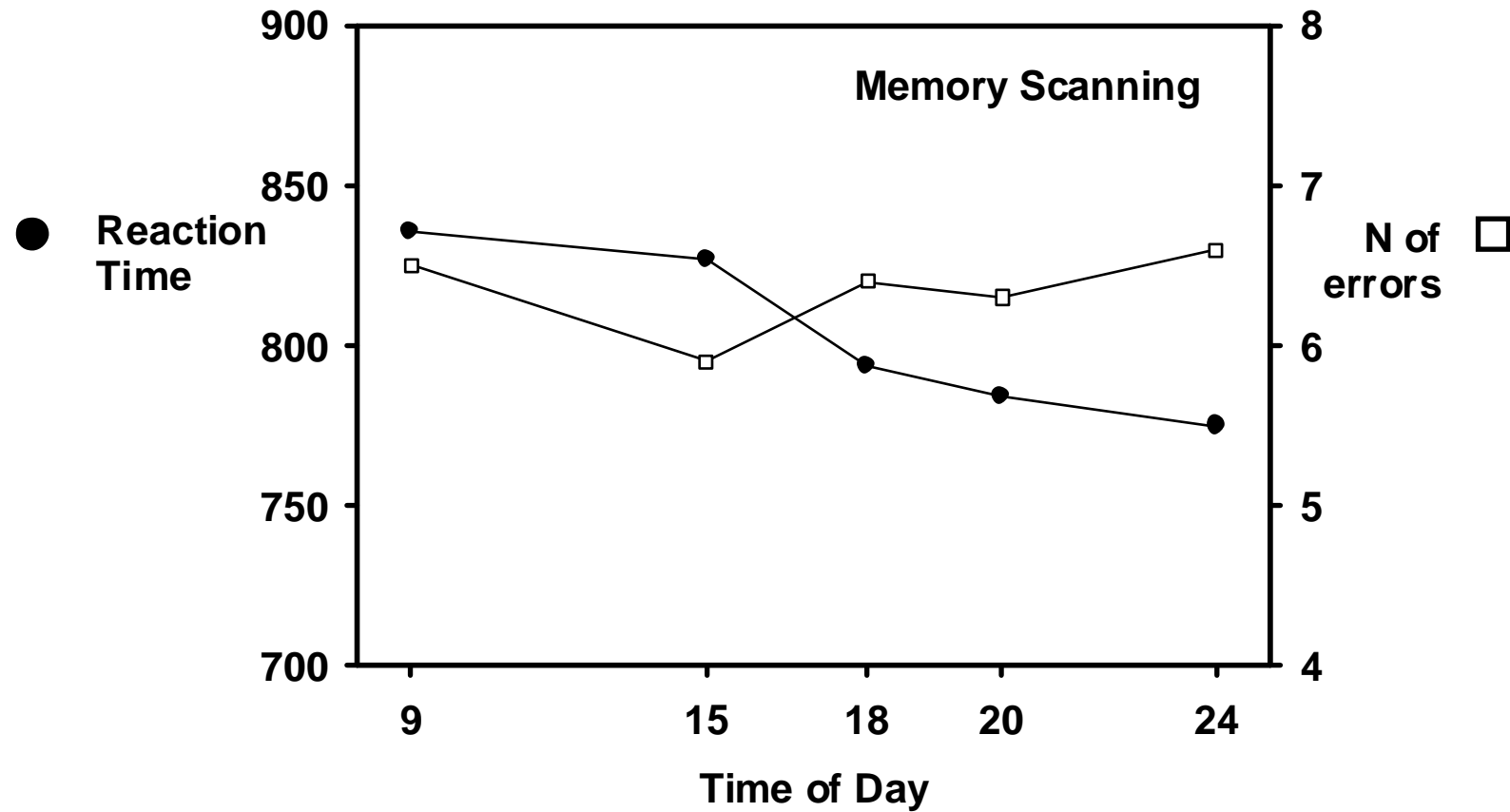
Disturbance during Assessments



Task Integrity



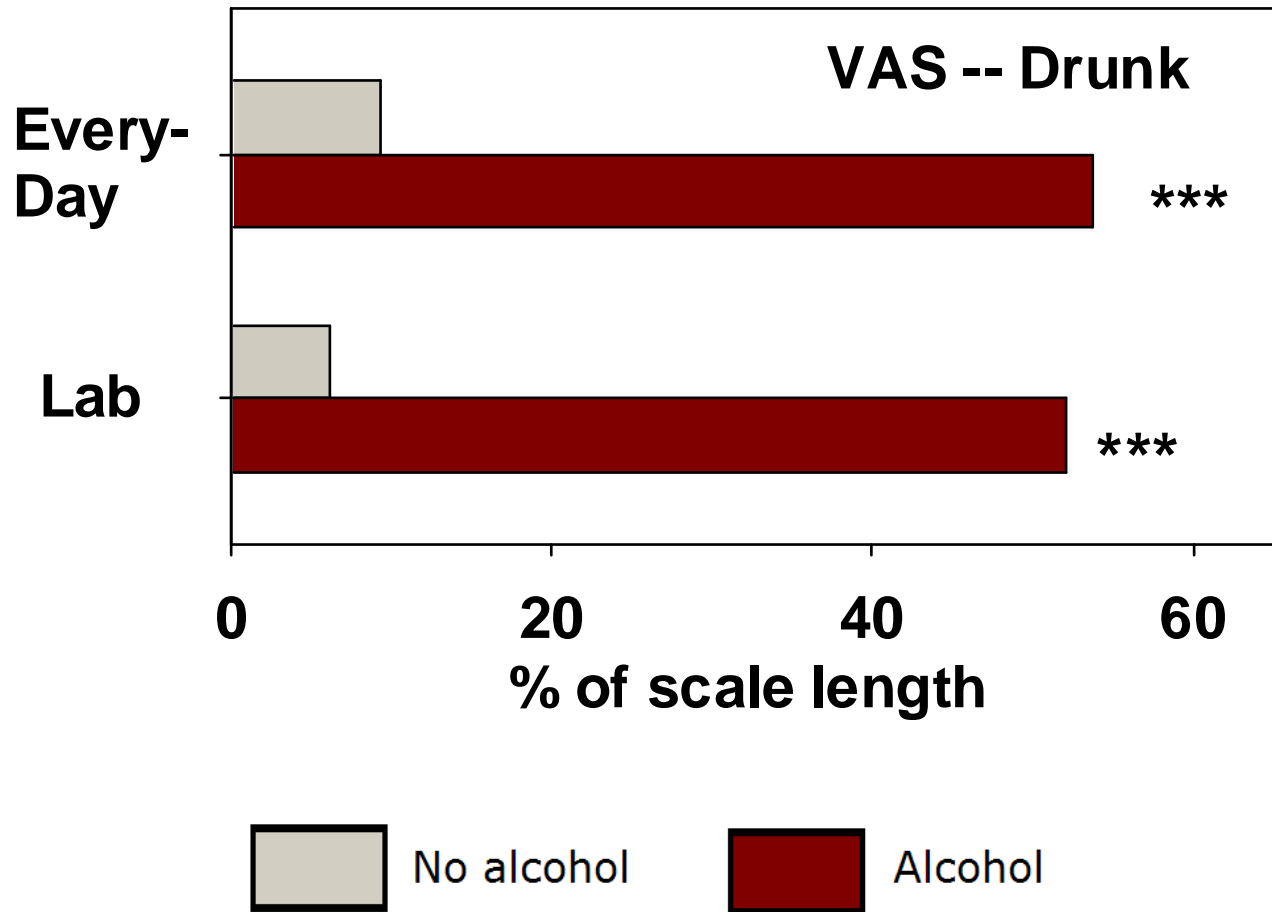
Diurnal Effects



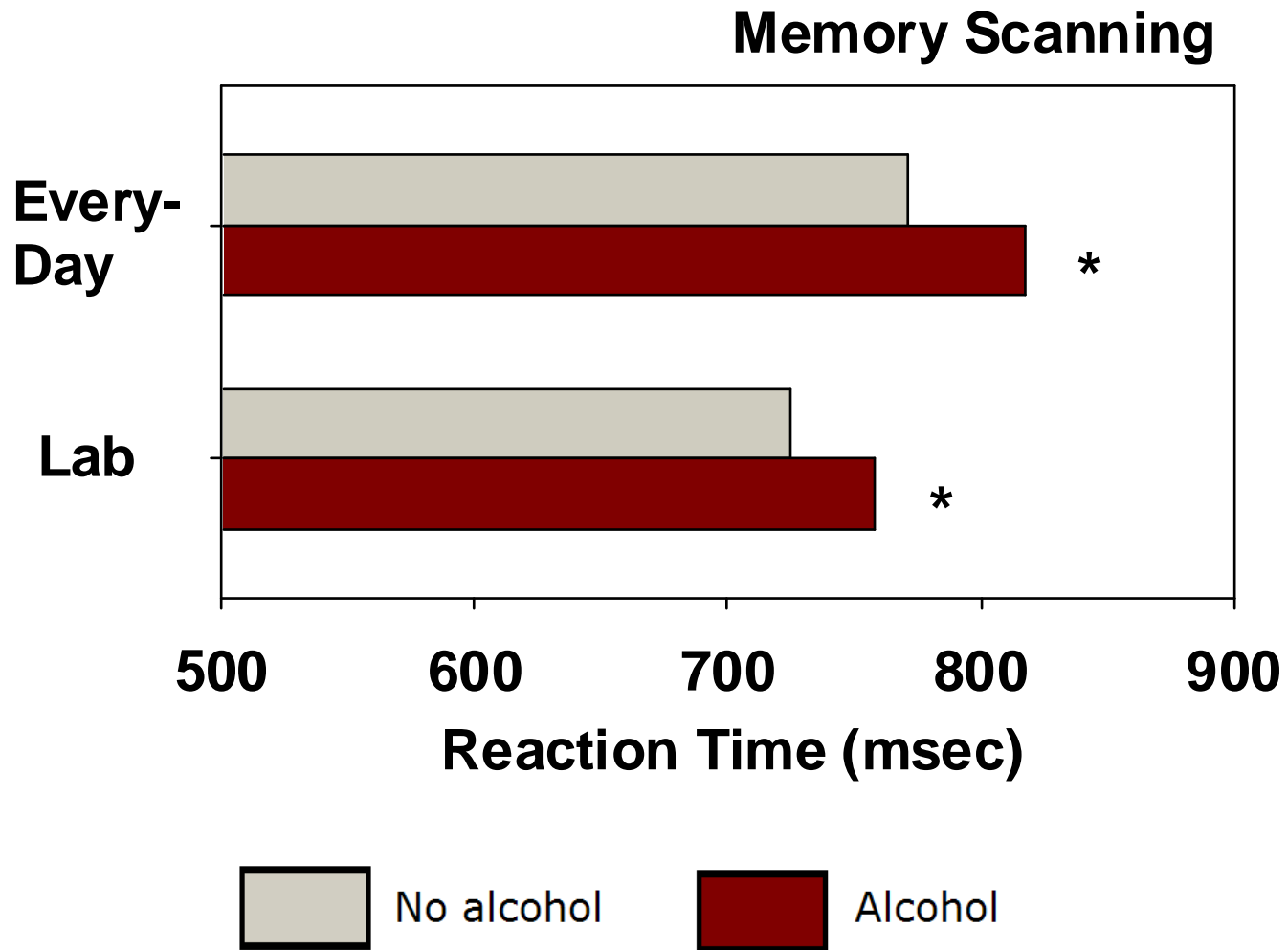
Laboratory (Battery)

- 26 of the volunteers took part in the lab study.
 - They received ethanol and placebo on separate days in random order
 - They completed assessments at intervals up to 2h after the drink.
- Mean blood alcohol concentrations were 124 mg/100 ml

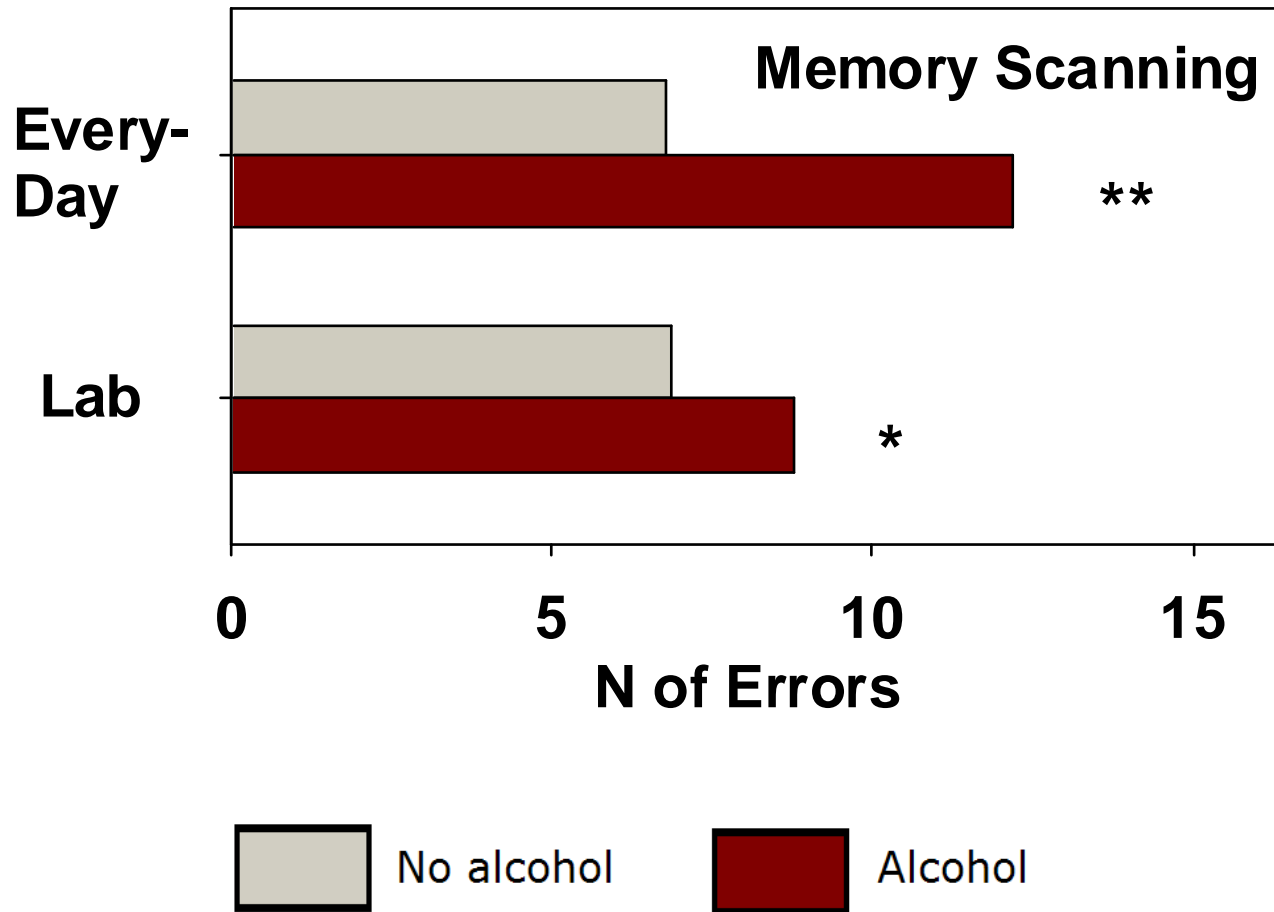
Visual Analogue Scales



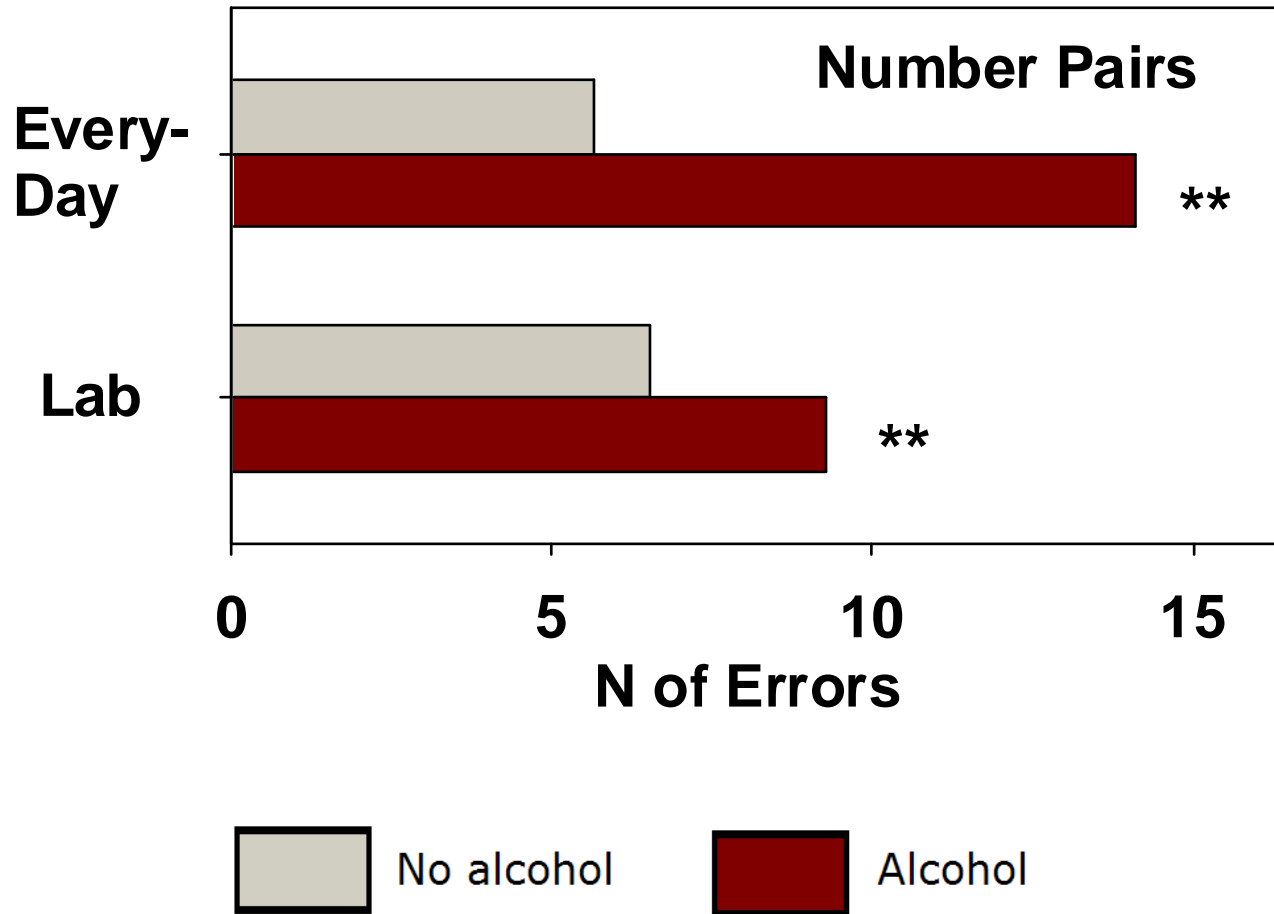
Working Memory - Speed



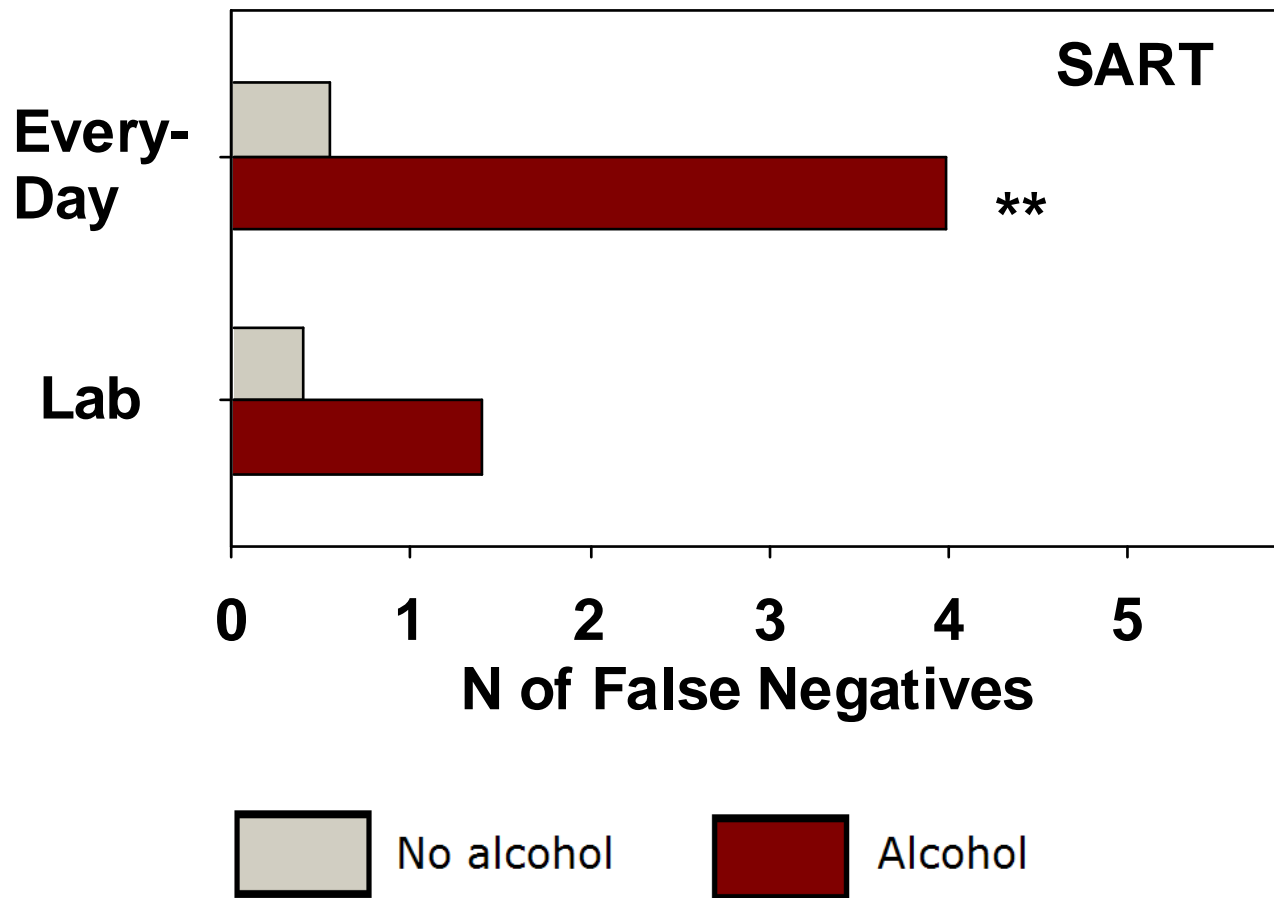
Working Memory - Accuracy



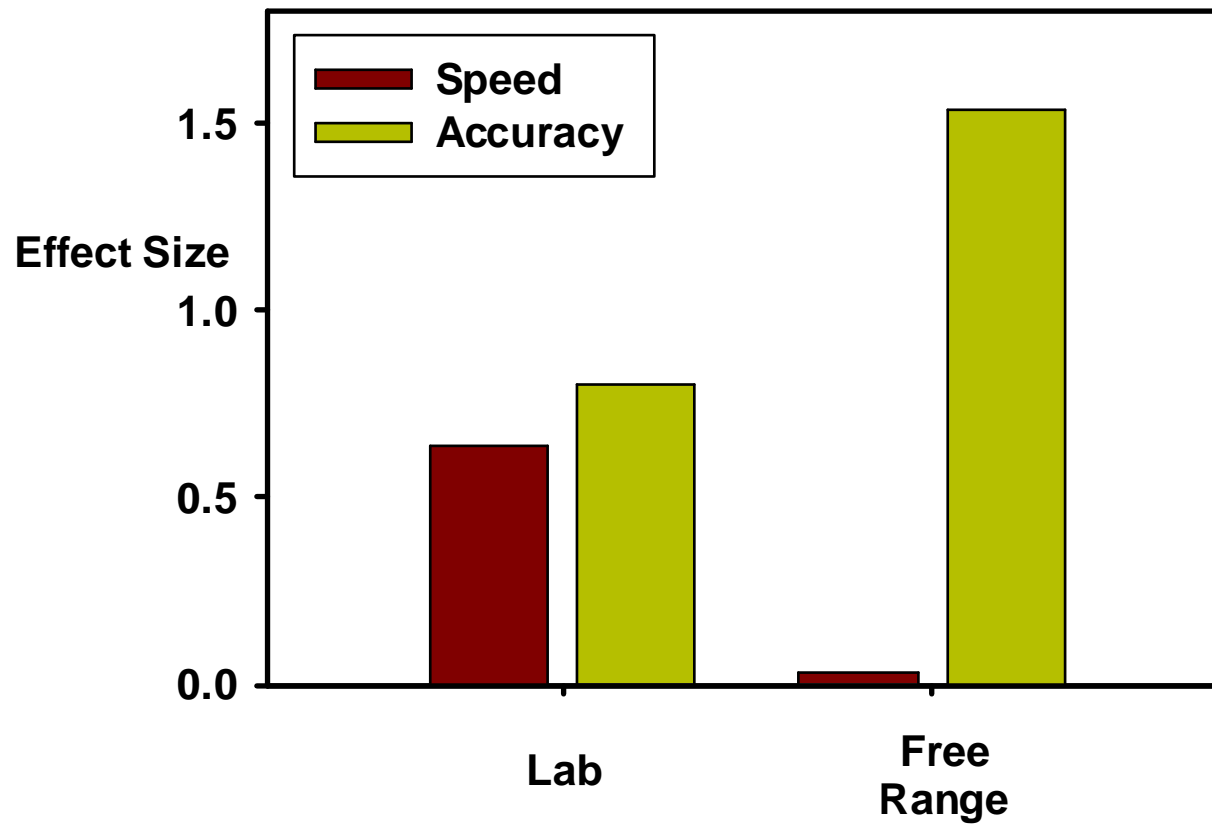
Attention with Distractors



Sustained Attention to Response



Composite Measures of Impairment



Study Conclusions

- Good compliance with study procedures
- Indicators of data quality of free-range data are positive
- Impairment and subjective effects clearly seen in both free range and lab settings
- Errors increased by alcohol more in the free range than in the lab setting, inverse effects with speed
- Mobile phones are a practical and effective method of collecting data on cognitive performance and subjective state

Where next?

- Recruitment of older volunteers
- Sleep, diurnal disturbances
- Eating
- Clinical conditions
- Integration with other methods

Recruitment of older volunteers

- Work with electronic patient diaries since early 1990s suggests that older users will not have problems with these systems
- Patients of all ages find eDiaries easy to use, and often prefer them to paper
- Careful attention to system design is needed to ensure ease of use.

Ease of Use

"I have always wished for my computer to be as easy to use as my telephone; my wish has come true because I can no longer figure out how to use my telephone."

Bjarne Stroustrup



Sleep and Waking

- Is poor sleep associated with impaired performance the next day?
- Do measures that improve sleep lead to better performance?
- Shiftwork
 - Already a large amount of field research, often using testing in workplace with custom-built portable equipment



Eating

- Do missed meals lead to performance impairments?
- Mobile phones are being developed as eating diaries.



Clinical Conditions

- Many conditions are associated with sleep disturbance and/or fatigue.
 - Cancer and its treatment
 - Multiple Sclerosis
 - Fibromyalgia
 - Depression
- Fatigue is a very unpredictable symptom, and thus hard to study in the lab

Integration with other Technologies

- Measurements of activity (Actigraphy)
 - Physical activity fluctuates during the day
 - May be associated with mood and performance
- Blood pressure/heart rate
- Blood Glucose Monitors

Some of these functions may be built into phones, e.g. accelerometers into "sports phones"

Local wireless (e.g. bluetooth) makes communication between phones and other devices practical.

Summary

- Mobile phones are a practicable way of carrying out field research on cognitive function
- Laboratory studies may underestimate the risks associated with alcohol in real life
- Mobile phones provide the basis for a wide range of wireless-based assessments