MRC Unit for Lifelong Health and Ageing

UCL

Adopting new technologies in the MRC National Survey of Health and Development

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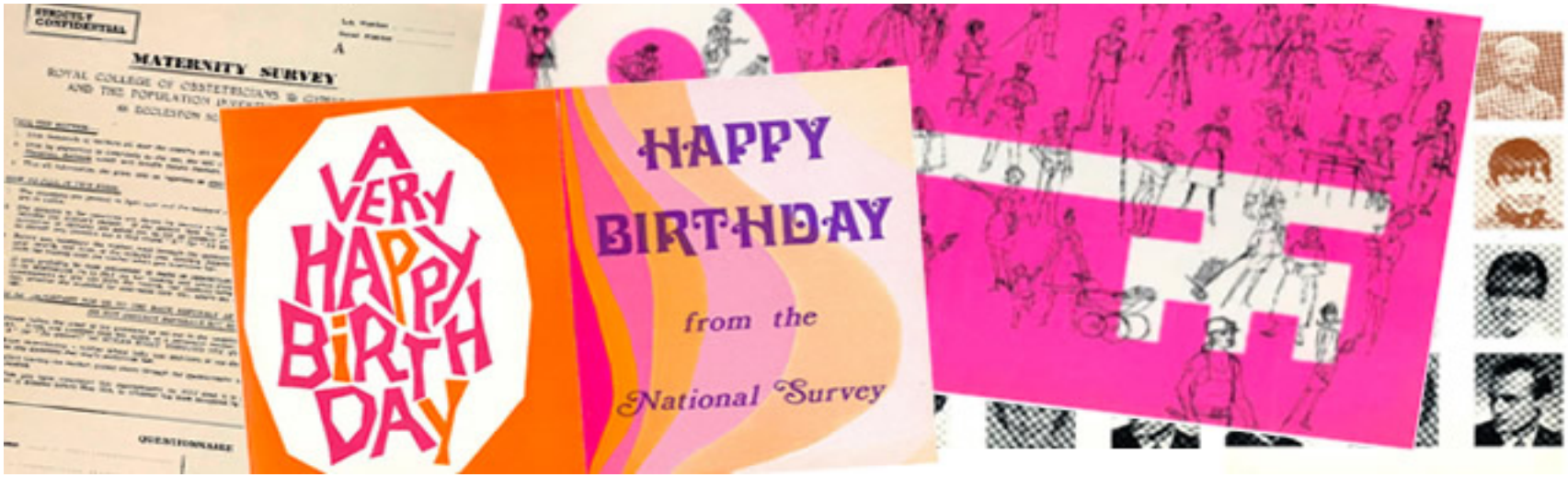
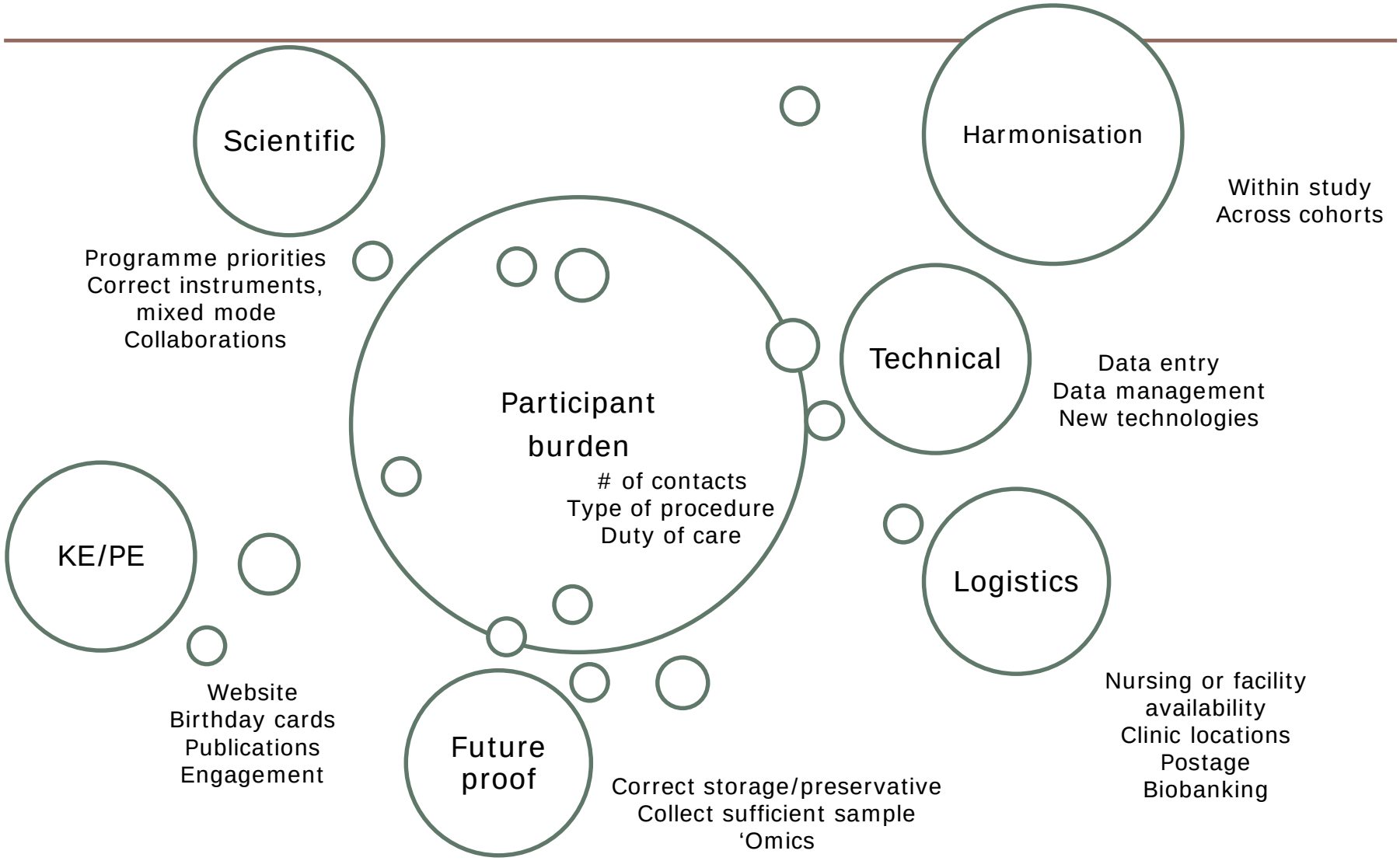
MRC National Survey of Health and Development (NSHD)

Stratified random sample of all single, legitimate births in 1 week of March 1946 (n=5,362) in England, Scotland & Wales

Data collected on cohort members across childhood and adolescence and at ages 20, 26, 36, 43, 53, 60-64 and 69 years in adulthood [see Wadsworth et al, *IJE* 2006;35:49-54; Kuh et al, *IJE* 2011;40:e1-9 & *EJE* 2016; 31: 1135-1147]



Challenges for data collections



Why use new technology?

- What is the scientific question?

- The promise of innovative techniques

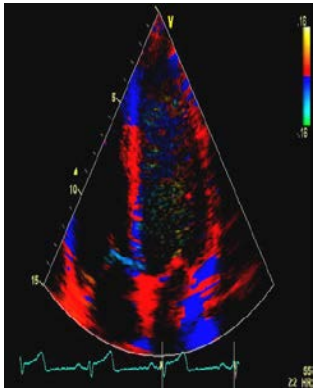
Better quality/resolution/precision data

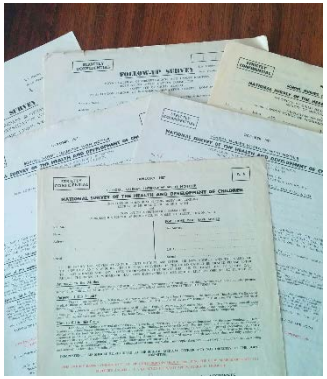
Increased response rates

Quicker data capture

Cost effective

Reduces burden





Use of new technologies

Overview of NSHD home visit content (2015)

Nurse Interview (40 mins)

- Consent (inc hospital records)
- Medical review of chronic conditions & self efficacy*
- Blood pressure
- Blood Sample
- Further parental deaths*
- Sources of income, financial hardship
- GHQ28
- Reported functional limitations
- Short activity & sedentary behaviour

Physical capability & musculoskeletal ageing (13 mins)

- Grip strength
- Walking speed
- Balance and coordination
- Chair rises

Cognition (30 mins)

- Visual Search
- Word list memory
- Addenbrooke's Cognitive Examination

ADLs, IADLs & need for care, expectations of care, caring for others*, proxy consent (5 mins)

Anthropometry (13 mins)

- Height and Weight
- Waist and hip circumference
- Lung function

Accelerometry (1 min)

**Shortened questionnaire for those unwilling/unable to have a home visit*

Blood sampling

Rationale

Biomarkers measurement is sensitive to storage and processing times, in particular inflammatory markers such as interleukins, cytokines

Cole-Parmer centrifuge (WZ-83058-02)

- *Relatively* portable and lightweight (26x30x20cm, 6.8kg)
- Prompt serum processing (SST BD vacutainer)
- Protocol built into CAPI program

Implementation

- 'Buy in' from nursing agency and nurses
- Discuss alternative options

NSHD experience of using this device

Overall positive response

- 2006-10 (N=2229 in clinic/home)
  - N=2143 (96%) provided a blood sample
    - over 80% were complete
- 2015 (N=2149 seen in home)
  - N=1963 (91%) provided a blood sample
    - over 80% were complete
  - Over 99% were centrifuged

Limitations

- No analytes of interest measured yet
- User acceptability
- Blood sampling in further waves

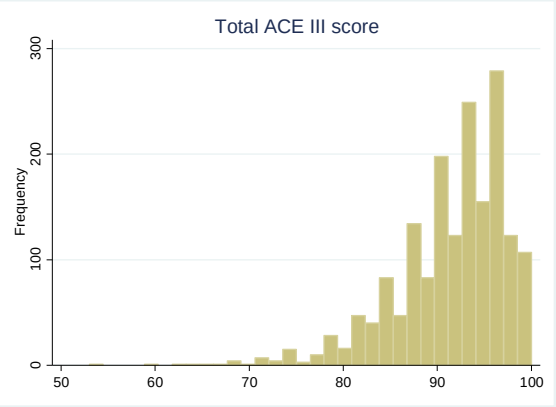
Addenbrooke's Cognitive Examination

Rationale

- Cognitive screening tool used in many clinical settings
- Contains equivalent/similar items from the MMSE, allowing cross-cohort comparisons & linkage with medical records
- The ACE-III is a screen-implemented test of cognitive state

Five domains

- attention & orientation (scored 0-18);
- verbal fluency (0-14);
- memory (0-26);
- language (0-26);
- visuospatial function (0-16).



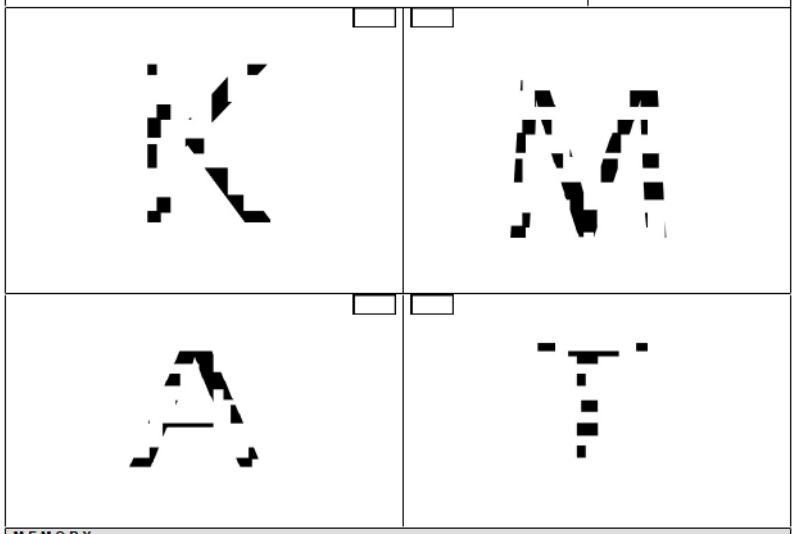
Due to the inclusion of verbal fluency, the distribution of the total score is quasi-normal and avoids the pronounced ceiling effect of most cognitive state tests.

Paper and pencil vs iPad

VISUOSPATIAL ABILITIES

➢ Ask the subject to identify the letters

Visuospatial [Score 0-4]



MEMORY

➢ Ask "Now tell me what you remember about that name and address we were repeating at the beginning"

John Marshall
24 Market Street
Silsby
Lincolnshire

Memory [Score 0-7]

MEMORY

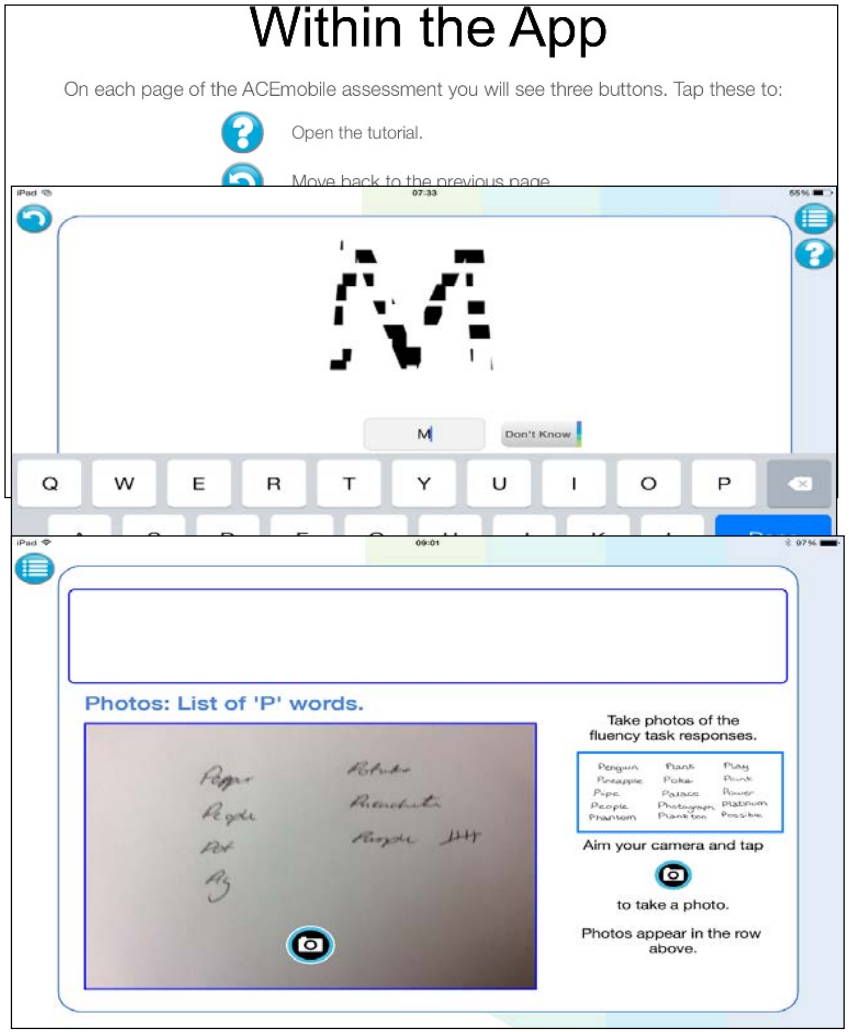
➢ This test should be done if the subject failed to recall one or more items above. If all items were recalled, skip the test and score 5. If only part was recalled start by ticking items recalled in the shadowed column on the right hand side; and then test not recalled items by telling the subject "ok, I'll give you some hints: was the name X, Y or Z?" and so on. Each recognised item scores one point, which is added to the point gained by recalling.

Memory [Score 0-5]

John Simons		John Marshall		Joseph Marshall		recalled	
42		28		24		recalled	
Market Street		High Street		Market Square		recalled	
Spilsby		Horncastle		Sleaford		recalled	
Northamptonshire		Lincolnshire		Leicestershire		recalled	

SCORES

TOTAL ACE-III SCORE	/100
TOTAL M-ACE SCORE	/30
Attention	/18
Memory	/26
Fluency	/14
Language	/26
Visuospatial	/16



NSHD experience of using this device

Implementation

- Contract to negotiate use of app, data, data storage & transfer
- A customized version of the ACE-III was administered by iPad using ACEMobile (http://www.acemobile.org/); where this was not possible, a paper version was used
- 20 minutes to administer
- Installation/management of app on nursing agency iPads
- All offline scoring was undertaken by trained personnel

ACE-III attempted by 2117 (98.5%):

- 35 undertook but did not complete this;
- Data for 353 were lost through equipment failure.
- Data available for 1729 participants, 80.5% of those who received home visit.

Choice of accelerometer at 60-64yr

Rationale

- Strategic: recommended by collaborators from another MRC Unit with expertise in PA assessment
- Potential benefits of capturing data on movement AND heart rate

Actiheart (CamNtech Ltd)

- Chest worn
- Measures uniaxial movement and heart rate
- 30 second epochs
- Worn for 5 days (incl. during sleep but not bathing and swimming)
- 8 minute incremental step test performed in clinic prior to free-living assessment

Data

Monitors sent to MRC Epidemiology Unit (Cambridge) for data download and processing:

- Step test data to estimate HR – PAEE relationship
- Activity intensity estimated using data on movement and 'calibrated' HR using a branched equation framework [Brage et al, J Appl Physiol 2004;96:343-51]

Derived variables provided for analyses

- Total physical activity energy expenditure (PAEE)
- Time spent sedentary (<1.5 METs) and in different intensities of activity (i.e. light (1.5 – 3) and moderate to vigorous (>3 METs))

Caveats

- Validity of intensity cut-points
- Validity of assumptions made re. the HR – EE association [See: Schrack et al, PLoS One, 2014;9(4):e93520]
- Suitability of branched equations in older populations
- Bouts of activity not yet identified

NSHD experience of using this device

At 60-64yr, 1690 attended a clinic and 539 received a nurse home visit (maximum N=2229)

Step test at clinic

- Attempted by 1222 (72% of those who attended clinic)
- 932 (76% of those who attempted test) completed 8 minutes
- Selected sample [Stafford et al, Eur J Ageing 2013;10:145-57]

5 day free-living assessment

- 1978 (89% of those invited) were willing to participate
- Reasons unable/unwilling: time restraints (n=40); does not want to (no reason) (n=25); perceives it to be a nuisance (n=19); health problems (n=23); hairy chest (n=3)
- 1829 (82%) returned monitors with some data
- Mean number of days worn (max. 5 days): 4.8 (sd=0.8)

- 1787 with valid data after 'cleaning' (including exclusion of those with <48 hours of data (n=42))

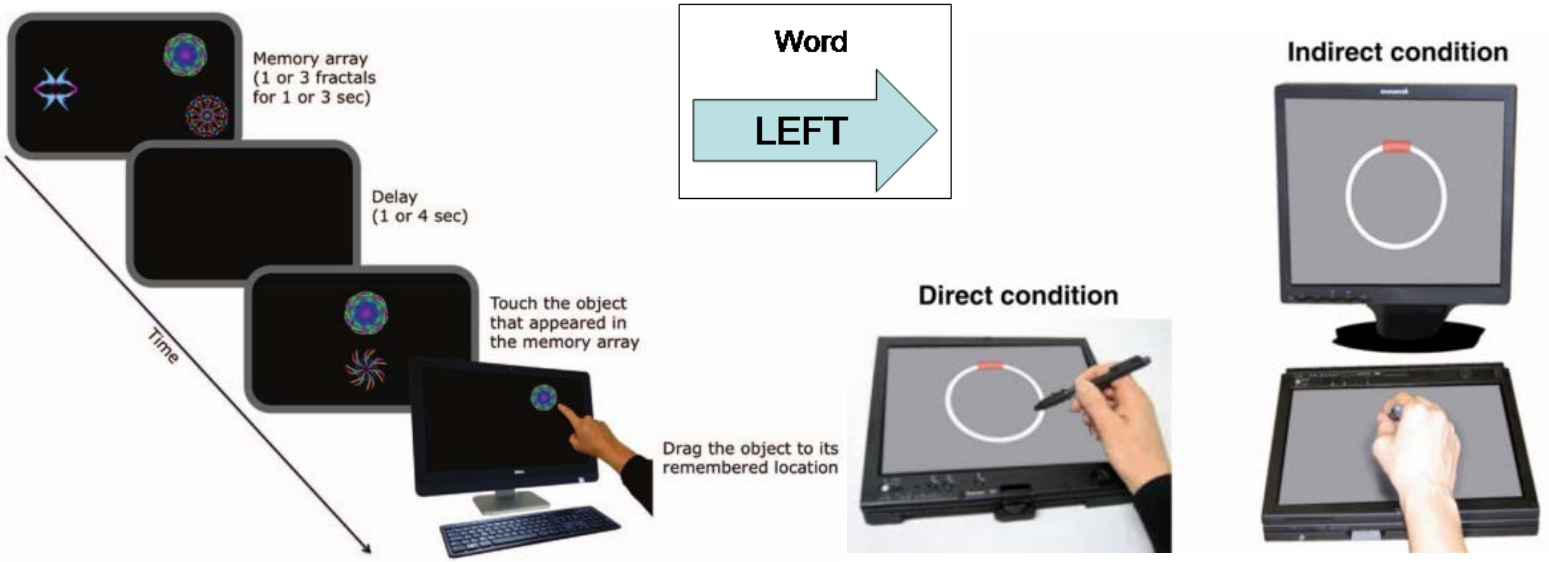
Neuroscience sub-study: Insight 46

Lane C et al. BMC Neurology, 2017, 17:75

- Random sample of 500 NSHD study members
- Inclusion criteria: attended 60-64 year clinic visit; key life course data (e.g. childhood cognition); no scan contraindications
- Baseline at age 69-70; repeat scan 24 months later
- Aβ load and cerebral perfusion (PET F18 florbetapir imaging); cerebrovascular disease, cerebral volumes, cerebral connectivity and resting state cerebral activity (3T MRI)
- Complementary measures: detailed neuropsychology, family history, sensory, motor, wet biomarkers

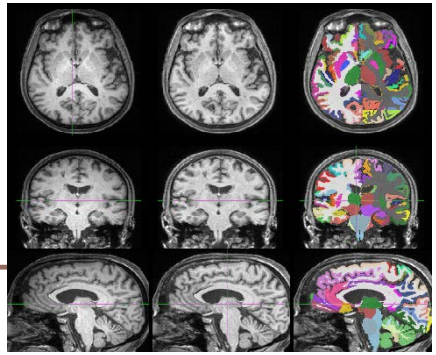
Neuropsychology

- In a controlled, clinical setting touchscreen and computers enable testing of complex paradigms

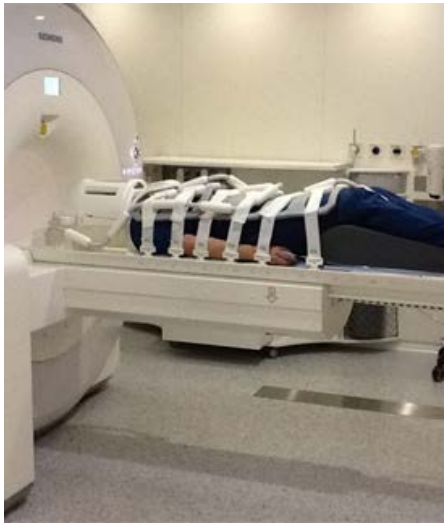


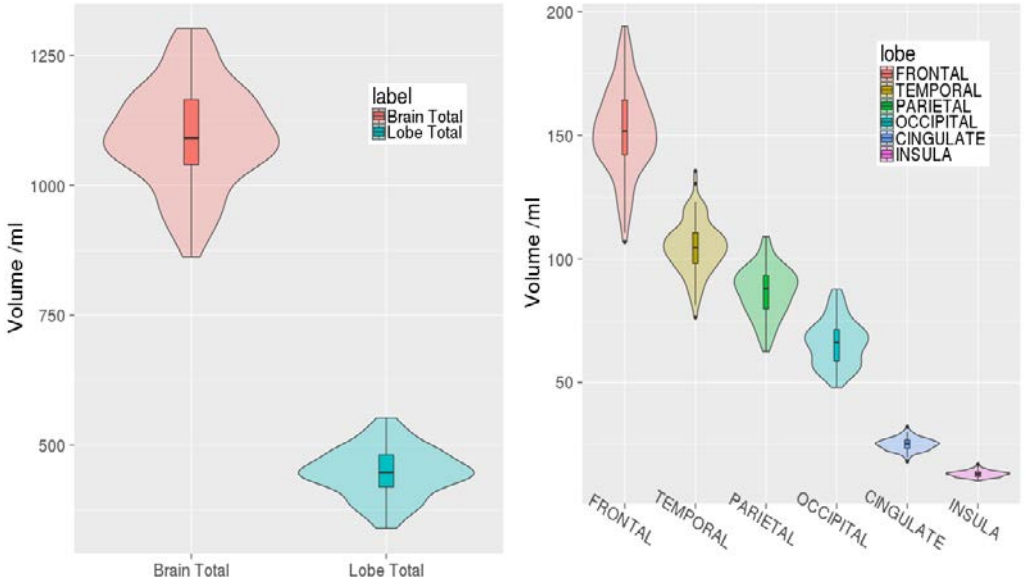
(L-R)Visual Short-term Memory Binding; Task-set Switching / Response Inhibition. An example stimulus display for an incongruent word trial. Visuomotor Integration apparatus. (Note that in the indirect condition, the participant's hand is covered by a box, not shown here.)

Neuroimaging



- Duel PET/MRI scanner at UCLH
  - Simulataneous acquisition of dynamic amyloid-PET and MRI data
  - Reduced scanning time, radiation exposure, scan misalignment





Violin plots demonstrating total brain and total lobar volumes (*left*) and regional lobar volumes (*right*) calculated on the first 100 T1 scans in Insight 46 using the automated segmentation pipeline

- Benefits are invaluable, but the considerations of implementing are many…
  - Participant burden
  - Duty of care and incidental findings
  - Logistics
  - Cost
  - Ethics
  - Data analysis
  - Data storage
  - Training and capacity

Equipment comparison study

Carli Lessof, Andy Wong, Rebecca Hardy & CLOSER Equipment Comparison Team

closer
Cohort & Longitudinal Studies Enhancement Resources

- Aim: To aid longitudinal comparisons within studies and comparisons across cohorts, compare measurement of lung function, blood pressure and grip strength from different machines
  - lung function (micromedical plus, NDD Easy-on)
  - BP (Omron 705-CP, 907)
  - Grip strength (Nottingham, Jamar manual & electronic, Smedley)
- Study design:
  - Ethical approval from UCL
  - 120 participants selected from TNS Omnibus Study
  - Random allocation to order of machines within each measure
- Practicalities
  - TNS staff to contact participants and arrange appointments
  - Study participants will be seen October-December 2015
  - Appointments to take place at LHA
  - Measurements taken by trained LHA research staff and PhD students

Example of grip strength

- Biomedical surveys use different equipment to measure grip strength.
  - How do we comparing within and across studies?

Figure 1 Comparison of grip strength using different devices based on four summary measures (kg)

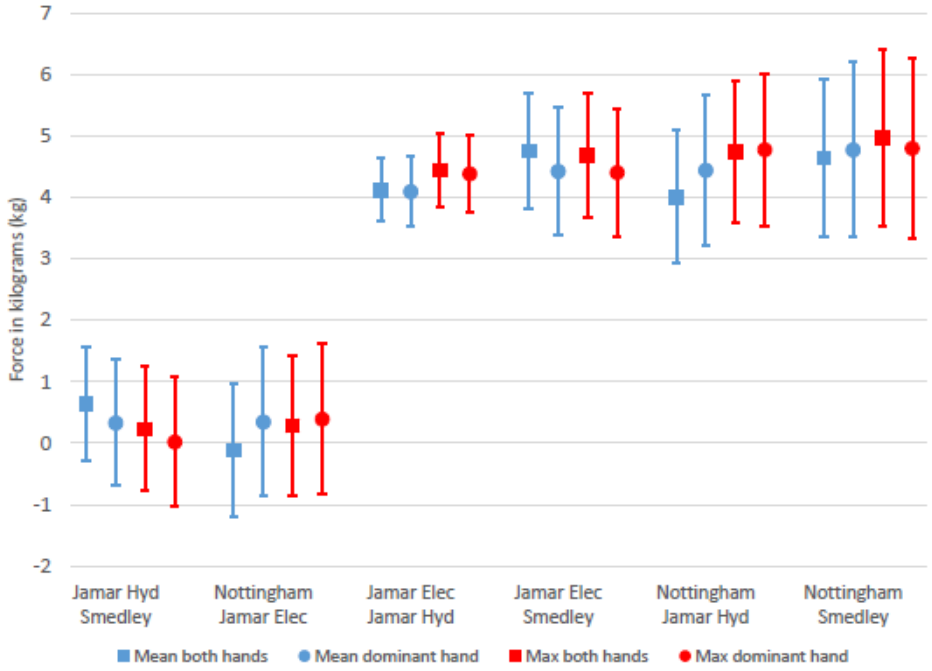
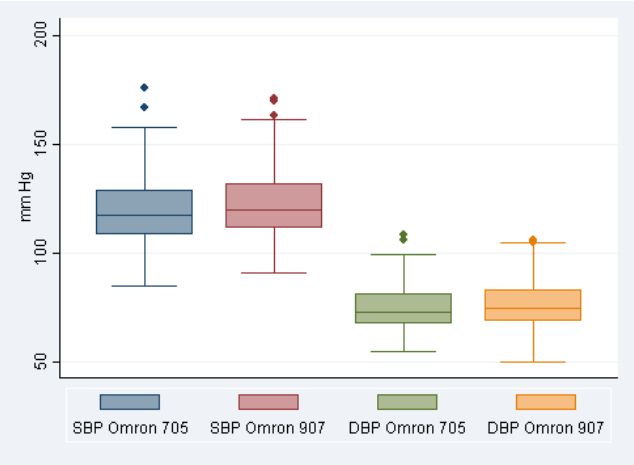


Table 1 Slight benefits of multilevel models (red ink) over simple comparisons using t-tests (black ink)

	Difference	Std Error
Jamar Electronic – Jamar Hydraulic	*kg*	
Multilevel model using 4 readings	4.2	0.28
Mean (four readings)	4.1	0.27
Max (four readings)	4.4	0.30
Jamar Electronic – Smedley		
Multilevel model using 4 readings	4.8	0.28
Mean (four readings)	4.8	0.49
Max (four readings)	4.7	0.52
Nottingham Electronic – Jamar Hydraulic		
Multilevel model using 4 readings	4.0	0.28
Mean (four readings)	4.0	0.55
Max (four readings)	4.7	0.59
Nottingham Electronic – Smedley		
Multilevel model using 4 readings	4.6	0.28
Mean (four readings)	4.6	0.65
Max (four readings)	5.0	0.73

Example of blood pressure

Is there a difference in mean SBP and DBP by device or an order effect?



	SBP	DBP
Omron 705 first (n=55)	1.60 (95%CI: 0.17, 3.03)	2.87 (95%CI: 1.17, 4.58)
Omron 907 first (n=57)	1.46 (95%CI:- 0.20, 2.93)	4.59 (95%CI: 2.49, 6.68)
Difference (mm Hg)	0.14 (95%CI: -1.89, 2.17)	-1.71 (CI -4.40, 0.97)
Independent t-test	0.140	-1.266
p=	0.889	0.208

Does SBP & DBP measure differently on the new and old device?

n=112	SBP	DBP
Omron 907-Omron 705	123.21 - 119.46	76.61 - 75.08
Difference (907-705)	3.75 (SD=7.19)	1.53 (SD=5.40)
Paired t-test	5.52	2.99
p=	0.0000	0.0003

What are the implications?

Conclusions

Lessons for analysts:

- Even simple “objective” health measures vary if different equipment is used. Correction factors may need to be applied.

Lessons for survey practitioners:

- We need consistent measurement and to build experiments into future surveys.

Lessons learnt

- Ensure there is a clear paper trail
- Ensure appropriate data management infrastructure is in place to handle data (e.g. large files, anonymisation) & do not underestimate the importance of this
- Establish good collaborations with groups with relevant expertise to handle and process these types of data (if no-one within the study team has the relevant skills)
- Be prepared to ask difficult questions
- Agree on deliverables (variables and documentation) and deadlines in advance
- 'Future proof' the resource – ensure that the raw data & all relevant information are archived (for future methodological advancements, new opportunities for collaboration and cross-cohort comparison)
- Mindful of burden and impact on future response rate

Thanks to study members

Thanks to the team