Evaluation

Why Evaluate?

- In HCI we evaluate interfaces and systems to:
  - Determine how usable they are for different user groups
  - Identify good and bad features to inform future design
  - Compare design choices to assist us in making decisions
  - Observe the effects of specific interfaces on users

Why now?

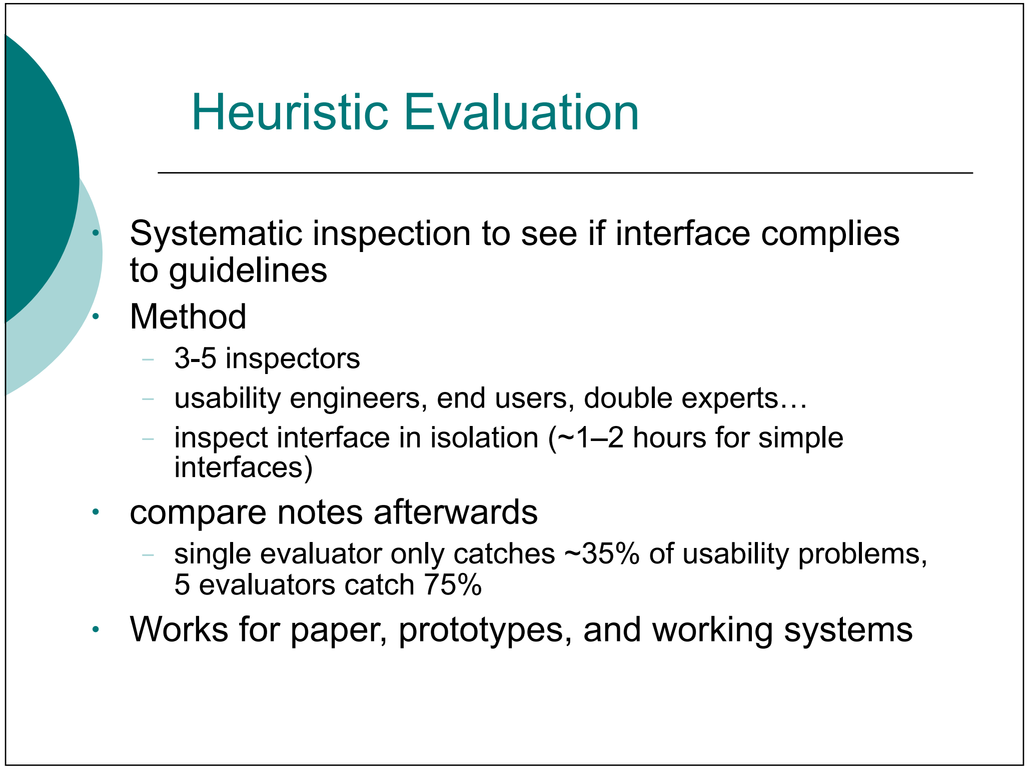
- Evaluation is key component of HCI
- Evaluation is a process, not an event
- Design ideas from evaluation of existing technologies
- Making things better starts by evaluation

Evaluation Methods

- Inspection methods (no users needed!)
  - Heuristic evaluations
  - Walkthroughs
  - Other Inspections
- User Tests (users needed!)
  - Observations/Ethnography
  - Usability tests/ Controlled Experiments

Heuristic Evaluation

- Heuristic evaluation *(what is it?)*
  - Method for finding usability problems
  - Popularised by Jakob Nielsen
- “Discount” usability engineering
  - Use with working interface or scenario
  - Convenient
  - Fast
  - Easy to use



Heuristic Evaluation

- Systematic inspection to see if interface complies to guidelines
- Method
  - 3-5 inspectors
  - usability engineers, end users, double experts…
  - inspect interface in isolation (~1–2 hours for simple interfaces)
- compare notes afterwards
  - single evaluator only catches ~35% of usability problems, 5 evaluators catch 75%
- Works for paper, prototypes, and working systems

Points of Variation

- Evaluators
- Heuristics used
- Method employed during inspection

Evaluators

- These people can be novices or experts
  - “novice evaluators”
  - “regular specialists”
  - “double specialists” *(- Nielsen)*
- Each evaluator finds different problems
- The best evaluators find both hard and easy problems

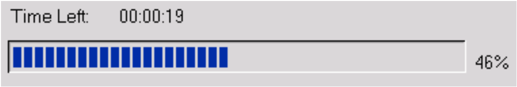
Heuristics

- Heuristics are rules that are used to inform the inspection…
- There are many heuristic sets

Nielsen's Heuristics

- Visibility of system status
- Match between system & real world
- User control and freedom
- Consistency & standards
- Error prevention
- Recognition rather than recall
- Flexibility & efficiency of use
- Minimalist design
- Help error recovery
- Help & documentation

Example 1. Visibility of system status



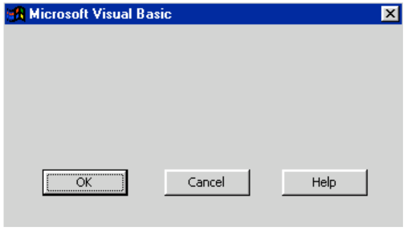
Time Left: 00:00:19

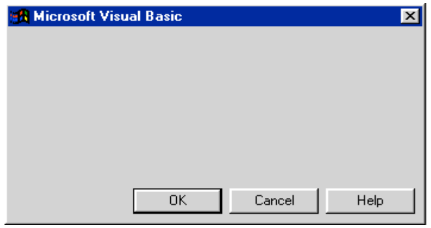
46%

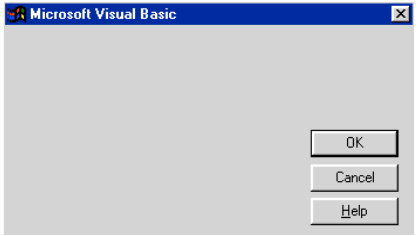
What is “reasonable time”?

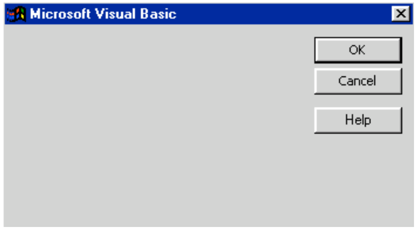
- 0.1 sec: Feels immediate to the user. No additional feedback needed.
- 1.0 sec: Tolerable, but doesn’t feel immediate. Some feedback needed.
- 10 sec: Maximum duration for keeping user’s focus on the action.
- For longer delays, use % done progress bars.

Example 2. Consistency & Standards

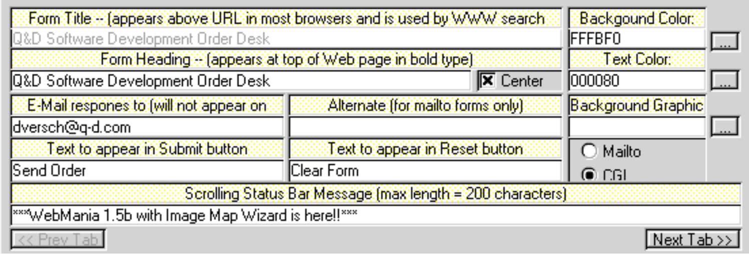








Example 3. Aesthetic and minimalist design



Form Title -- (appears above URL in most browsers and is used by WWW search

Q&D Software Development Order Desk

Form Heading -- (appears at top of Web page in bold type)

Q&D Software Development Order Desk ☒ Center

E-Mail respones to (will not appear on

dversch@q-d.com

Alternate (for mailto forms only)

Text to appear in Submit button

Send Order

Text to appear in Reset button

Clear Form

Backgound Color:

FFFBF0

Text Color:

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Background Graphic

○ Mailto

● CGI

Scrolling Status Bar Message (max length = 200 characters)

WebMania 1.5b with Image Map Wizard is here!!

Phases of a heuristic evaluation

- 1. Pre-evaluation training – give evaluators needed domain knowledge and information on the scenario
- 2. Evaluate interface independently
- 3. Rate each problem for severity
- 4. Aggregate results
- 5. Debrief: Report the results to the interface designers

Severity ratings

- Each evaluator rates individually:
  - 0 - don’t agree that this is a usability problem
  - 1 - cosmetic problem
  - 2 - minor usability problem
  - 3 - major usability problem; important to fix
  - 4 - usability catastrophe; imperative to fix
- Consider both impact and frequency.

Styles of Heuristic evaluation

- Problems found by a single inspector
- Problems found by multiple inspectors
- Individuals vs. teams
- Goal or task?
- Structured or free exploration?

Problems found by a single inspector

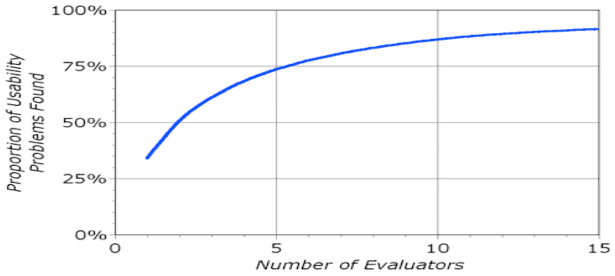
- Average over six case studies
  - 35% of all usability problems;
  - 42% of the major problems
  - 32% of the minor problems
- Not great, but finding some problems with one evaluator is much better than finding no problems with no evaluators!

Problems found by a single inspector

- **Varies according to**
  - difficulty of the interface being evaluated
  - the expertise of the inspectors
- **Average problems found by:**
  - novice evaluators - no usability expertise - 22%
  - regular specialists - expertise in usability - 41%
  - double specialists - experience in both usability and the particular kind of interface being evaluated – 60%
  - also find domain-related problems
- **Tradeoff**
  - novices poorer, but cheaper!

Problems found by multiple evaluators

- 3-5 evaluators find 66-75% of usability problems
  - different people find different usability problems
  - only modest overlap between the sets of problems found



Individuals vs. teams

- Nielsen
  - recommends individual evaluators inspect the interface alone
- Why?
  - evaluation is not influenced by others
  - independent and unbiased
  - greater variability in the kinds of errors found
  - no overhead required to organize group meetings

Self Guided vs. Scenario Exploration

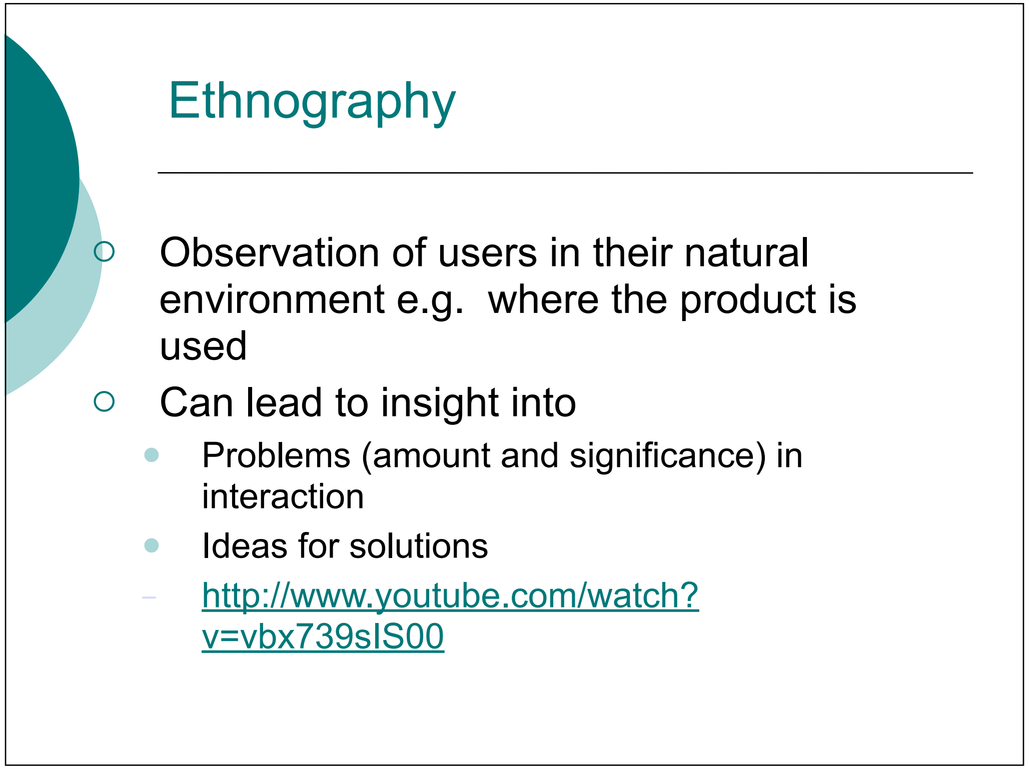
- Self-guided
  - open-ended exploration
  - Not necessarily task-directed
  - good for exploring diverse aspects of the interface, and to follow potential pitfalls
- Scenarios
  - step through the interface using representative end user tasks
  - ensures problems identified in relevant portions of the interface
  - ensures that specific features of interest are evaluated
  - but limits the scope of the evaluation - problems can be missed

How useful are they?

- Inspection methods are discount methods for practitioners. They are not rigorous scientific methods.
  - All inspection methods are subjective.
  - No inspection method can compensate for inexperience or poor judgement.
  - Using multiple analysts results in an inter-subjective synthesis.

How useful are multiple analysts?

- However, this also
  - a) raises the false alarm rate, unless a voting system is applied
  - b) reduces the hit rate if a voting system is applied!
  - Group synthesis of a prioritized problem list seems to be the most effective current practical approach.



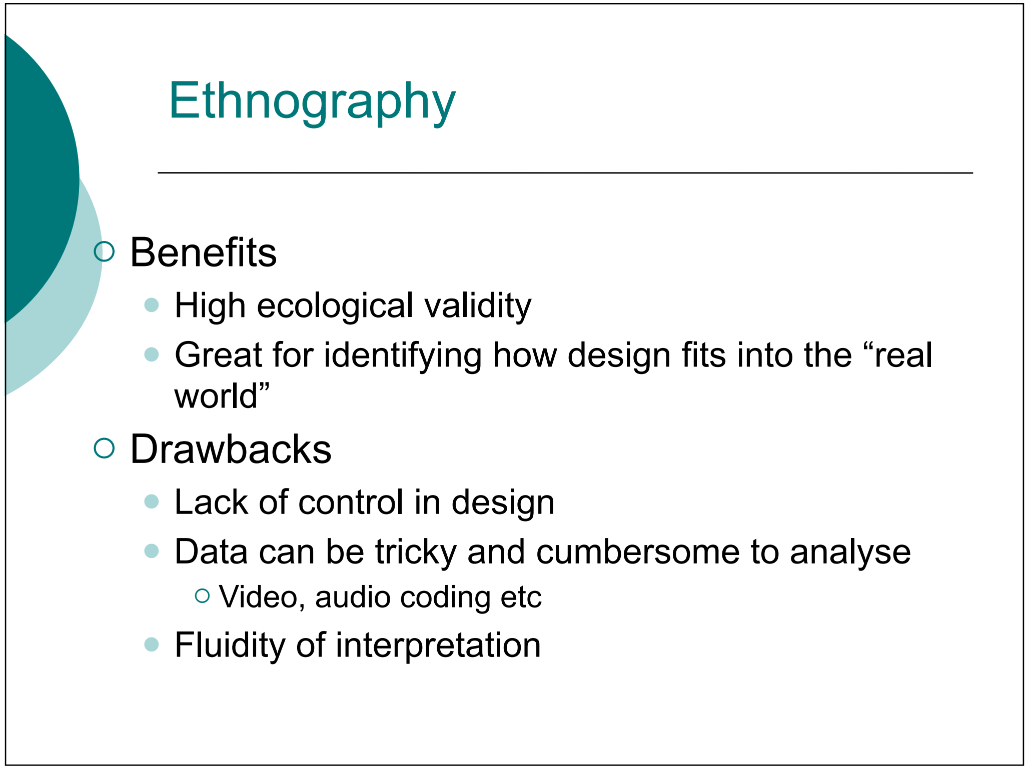
Ethnography

- Observation of users in their natural environment e.g. where the product is used
- Can lead to insight into
  - Problems (amount and significance) in interaction
  - Ideas for solutions
  - http://www.youtube.com/watch?v=vbx739sIS00

A bit like a professional stalker/ interviewer

Ethnography

○ Examples of data collected
  - Conversations and semi structured interviews
  - Researcher observations and question answers
  - Descriptions of activities or environments
  - Memos and notices in the environment
  - User stories



Ethnography

- Benefits
  - High ecological validity
  - Great for identifying how design fits into the “real world”
- Drawbacks
  - Lack of control in design
  - Data can be tricky and cumbersome to analyse
    - Video, audio coding etc
  - Fluidity of interpretation

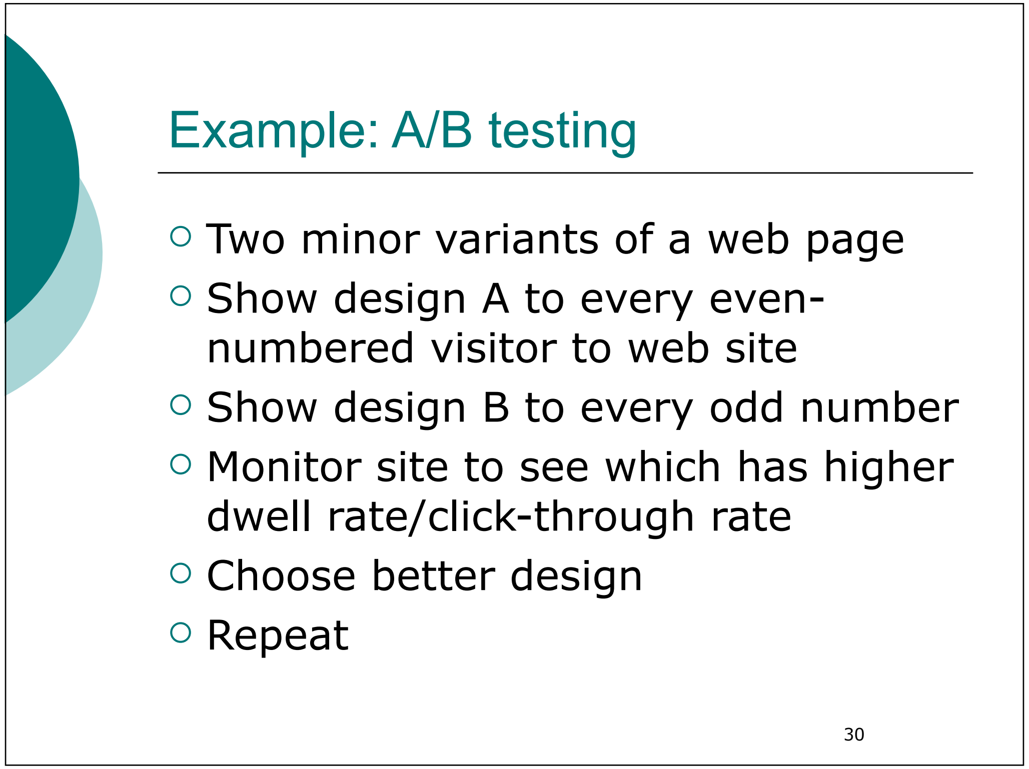
Information free for all

Controlled Experiments/ User Studies

- More Scientific Method
- Control is key
  - Reduction of confounds
- Aim to investigate hypotheses about how the designs affect:
  - User Performance (Time or Error rate)
  - Satisfaction
  - Emotions/other psychological constructs
- Pre-defined task/goal

Controlled Experiments/ User Studies

- Comparison of design solutions
- Results can feedback into redesign
- Typically termed *usability engineering*
- Robust study design
  - Randomisation/Counterbalancing
  - Ensures effect is due to the manipulation of your independent variable

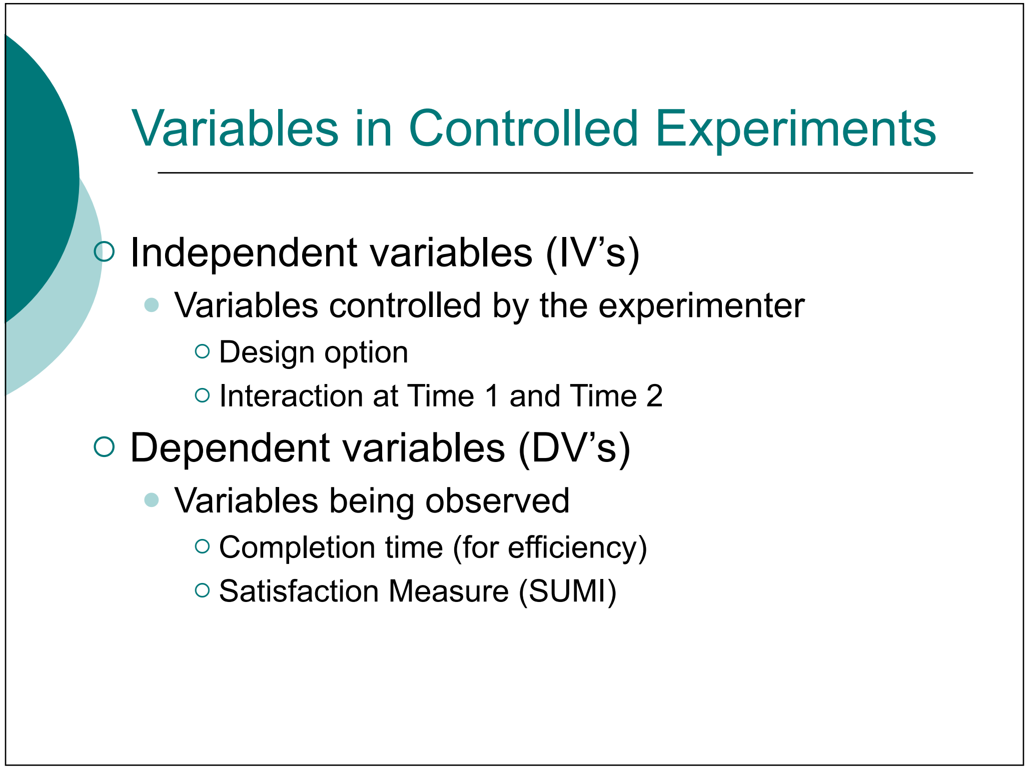


Example: A/B testing

- Two minor variants of a web page
- Show design A to every even-numbered visitor to web site
- Show design B to every odd number
- Monitor site to see which has higher dwell rate/click-through rate
- Choose better design
- Repeat

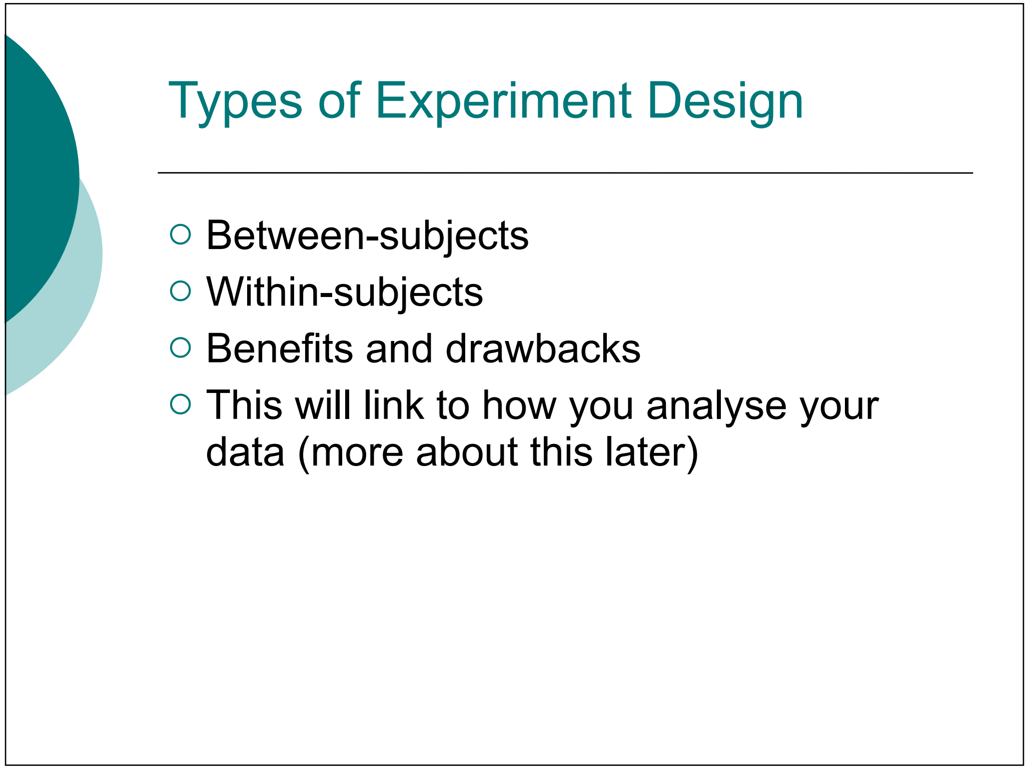
Good news

- Google can do this for you
- https://support.google.com/analytics/bin/answer.py?hl=en&answer=1745147&topic=1745207&ctx=topic



Variables in Controlled Experiments

- Independent variables (IV’s)
  - Variables controlled by the experimenter
    - Design option
    - Interaction at Time 1 and Time 2
- Dependent variables (DV’s)
  - Variables being observed
    - Completion time (for efficiency)
    - Satisfaction Measure (SUMI)



Types of Experiment Design

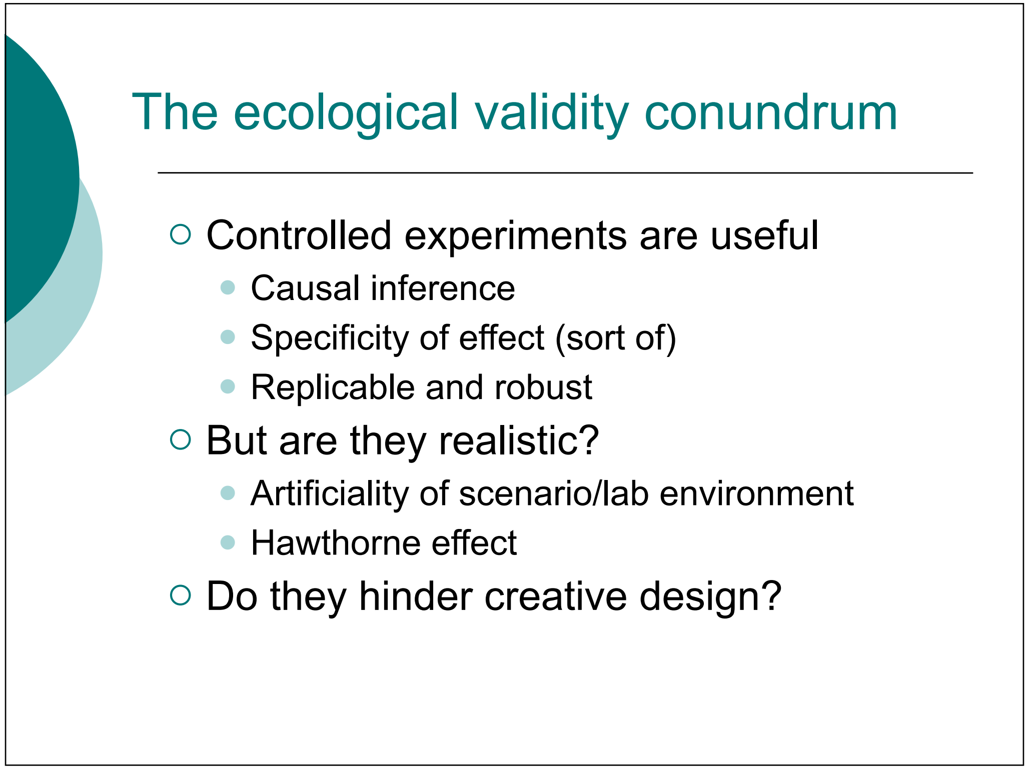
- Between-subjects
- Within-subjects
- Benefits and drawbacks
- This will link to how you analyse your data (more about this later)

BS- positives- independent groups ; no experience effect;

BS- negatives- individual abilities affect the data (although this can be minimised by random allocation to conditions; heavy need for participants for a valid experiment

WS- positives- takes into account individual differences; less participants to have good robust statistics

WS- negatives- practice effect (although this can be minimised by counterbalancing of conditions)



The ecological validity conundrum

- Controlled experiments are useful
  - Causal inference
  - Specificity of effect (sort of)
  - Replicable and robust
- But are they realistic?
  - Artificiality of scenario/lab environment
  - Hawthorne effect
- Do they hinder creative design?

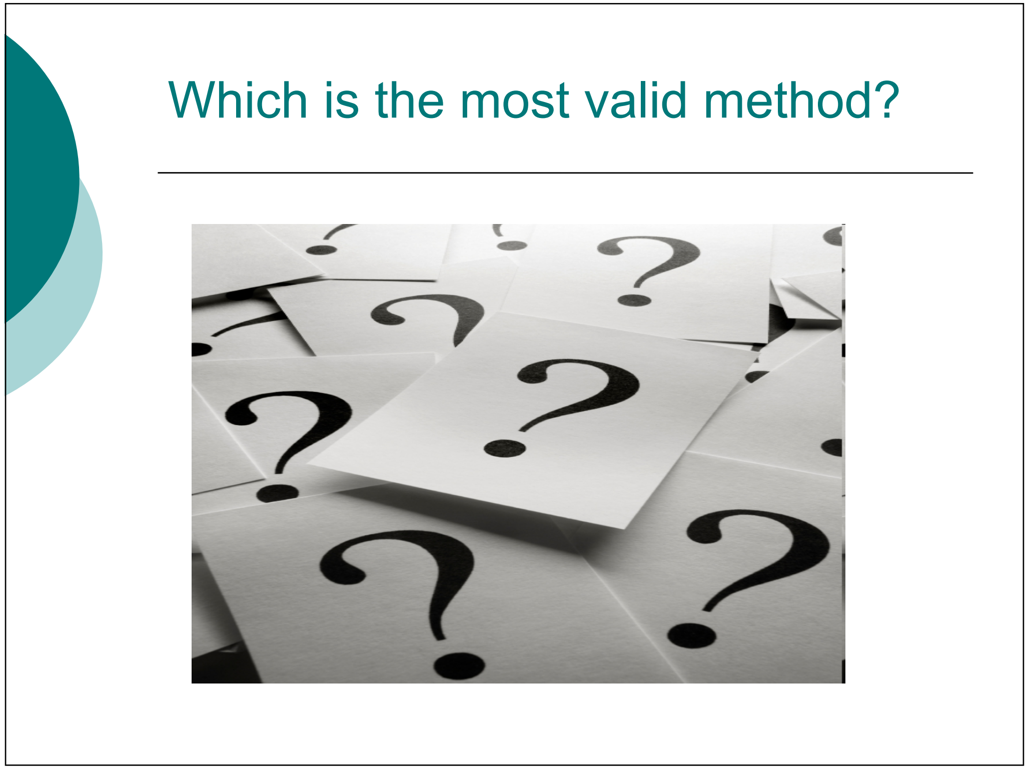
We can never tell if a variable is influenced by something we haven’t measured. In fact it is likely I.e. individual differences of the users in cognitive ability or personality for instance but random allocation of users to conditions helps with this.

An Example

- Designing IT devices for health professionals
- Is this a good environment to test in for this device?
- Probably not….

Increasing ecological validity in experiments

- Use representative participants
- Make the environment as realistic as possible
- Make the tasks and scenario as realistic as possible



Which is the most valid method?

Triangulation is the key and some will be more valid in certain scenarios e.g. where you have some designs you want to test then experiments might be good but if you are at an early stage then inspection methods or observations may be better.

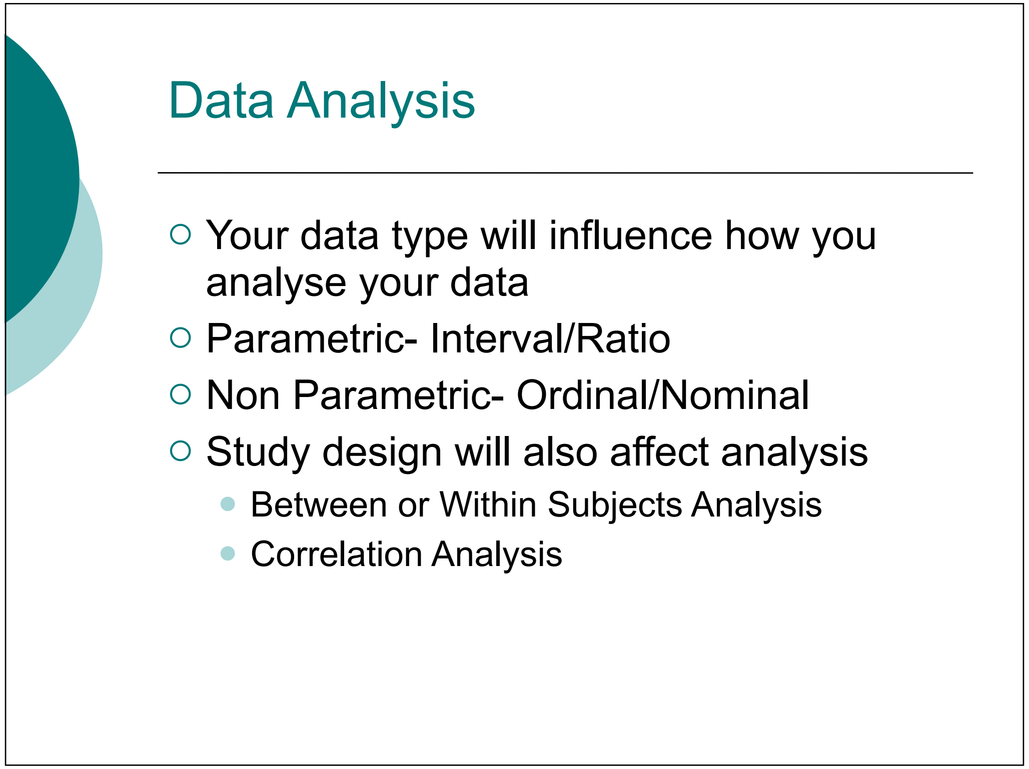
Whether you want to be theoretical I.e. see the effect of interfaces on users (in which case the psychological methods of controlled experiments will give you sound scientific data) or want to design a product where causal inference may not be so important

Dependent on constraints (time/budget)

Statistics for evaluation

Data Types

- Quantitative
  - Interval/Ratio
  - Temperature, height, weight, questionnaire scale (?)
- Qualitative
  - Ordinal/Nominal
  - The ranked rating of 3 interfaces
  - Number of times an option is selected



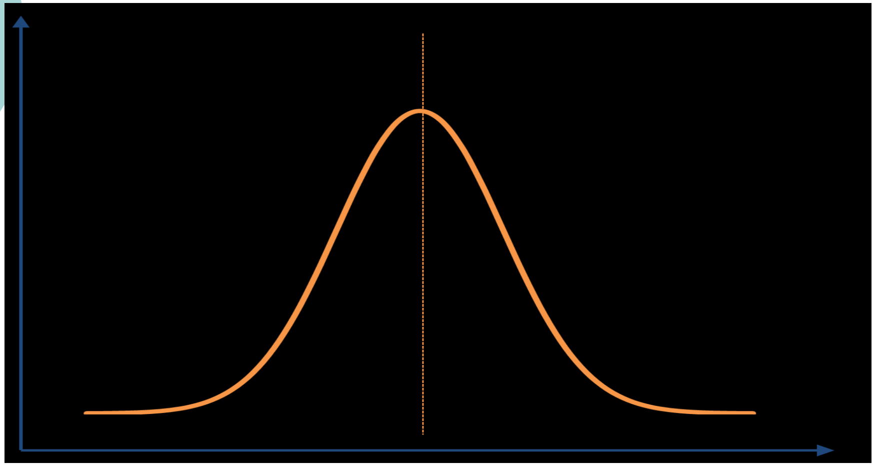
Data Analysis

- Your data type will influence how you analyse your data
- Parametric- Interval/Ratio
- Non Parametric- Ordinal/Nominal
- Study design will also affect analysis
  - Between or Within Subjects Analysis
  - Correlation Analysis

Statistical Assumptions

- Very important and again will influence your analysis
  - The most important one of these needs to be demonstrated……
  - Tall
  - Medium Height
  - Smaller

For whom the bell (curve) tolls….



Other assumptions of parametric analysis

- Interval/Ratio data
- Equality of variance/ Sphericity
  - Depends on study design
- Independence of data
  - Depends on study design

Help….my data meets none of these!

○ Qualitative analysis should be used

○ But….

- Less power than parametric
- Lose quantity differences when comparing measures
- Ranked data

Statistical Significance

- What does it mean?
  - The probability that the difference/ relationship between the groups/variables is due to chance
  - Conventional levels
    - $p<0.05$, $p<0.01$, $p<0.001$
    - Infer strength of relationship

Available tests

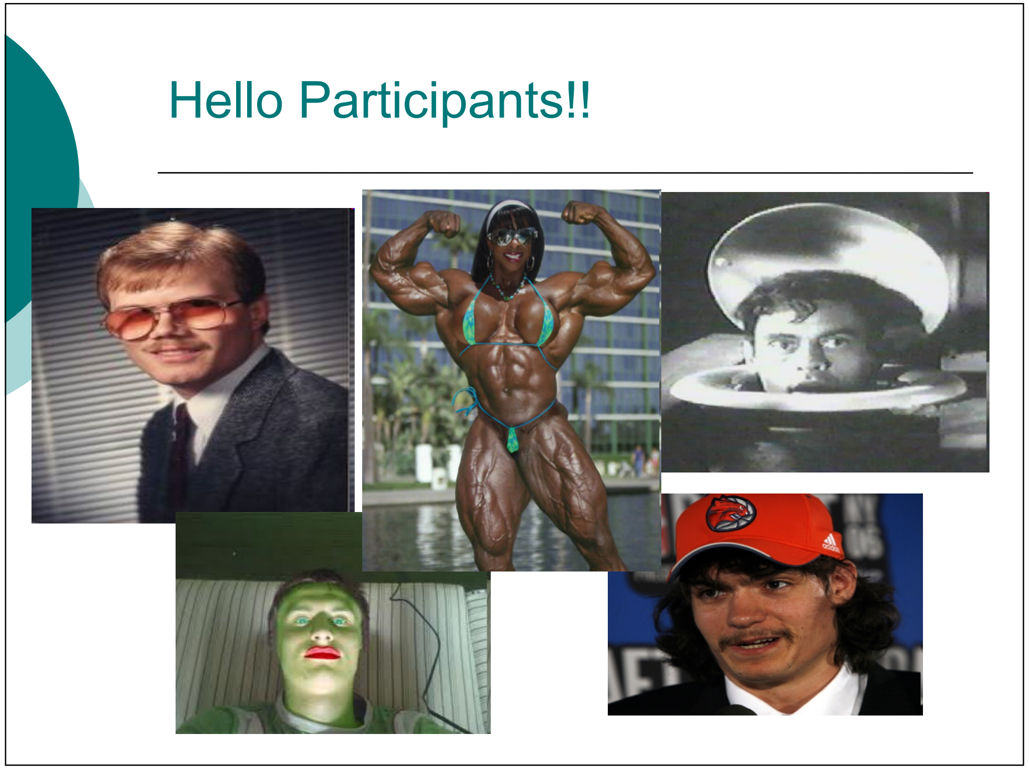
- Correlation analysis (Pearson’s r)
  - Linear relationship between two continuous variables
  - Pearson’s r= strength of that relationship
  - + or - = Direction
  - No causality only relationship!
- Student t-test
  - Compares means of 2 groups on the DV to see if they are *significantly* different
  - E.g. Interface 1 vs Interface 2
  - Between (independent) or Within (dependent) t-tests

Available tests

- ANOVA
  - Compares means of 3 or more groups on the DV to see if they are *significantly* different
  - Between, Within and Mixed
  - Interaction Effects

The Importance of N

- The amount of participants (N) is important
  - Effect size/Statistical Power
  - Central limit theorem and normality of data
  - Reduces effects of outliers on statistics
  - Representative sample
  - Nielsen’s 5 = bad stats if used for experiments
  - Why?



Hello Participants!!

Poor generalisability from these sets of users- where would they fit on the normal distribution?

The Importance of Test Focus

- Family-wise error rate
  - As you increase the amount of tests on the data the chance of gaining a false positive (Type 1 error) is increased
- Keep sight of what you are measuring
  - E.g. Spurious correlations (Long hair and IQ)
- With lots of tests (e.g. Correlation matrix) the strength of effect is important

What we have covered today

- Evaluation methods
  - No users needed (e.g. Heuristic Eval, Cognitive Walkthrough)
  - Users needed (e.g. Ethnography, Experiments)
  - Comparative validity of these methods
- Statistics in evaluation
  - Data types
  - Assumptions
  - Tests
  - Critical aspects of analysis design

Some Resources

- Methods
  - Book: Cairn & Cox (2009) Research Methods in HCI. (Also covered in all good HCI texts)
  - Jakob Nielsen's Alertbox Site
    - www.useit.com/alertbox/
- Statistics
  - Andy Field's Statistics Hell Site
    - www.statisticshell.com - actually more heaven than hell