INF03 Expérience Utilisateur

7. Evaluation and tests – 3 Controlled experiments

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Evaluation and tests

Today:

- Experimental design
- Evaluation 2.0, scaling up

Last weeks:

- Introduction
- Approaches to evaluation
- Analytical methods
- Empirical methods

Experimental design

- Introduction and examples
- The elements of experiments
- Experiment definition
- Conducting an experiment
- Gathering and cleaning data
- Analyzing data
  - Exploration
  - Statistics

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Controlled experiments

A scientific approach

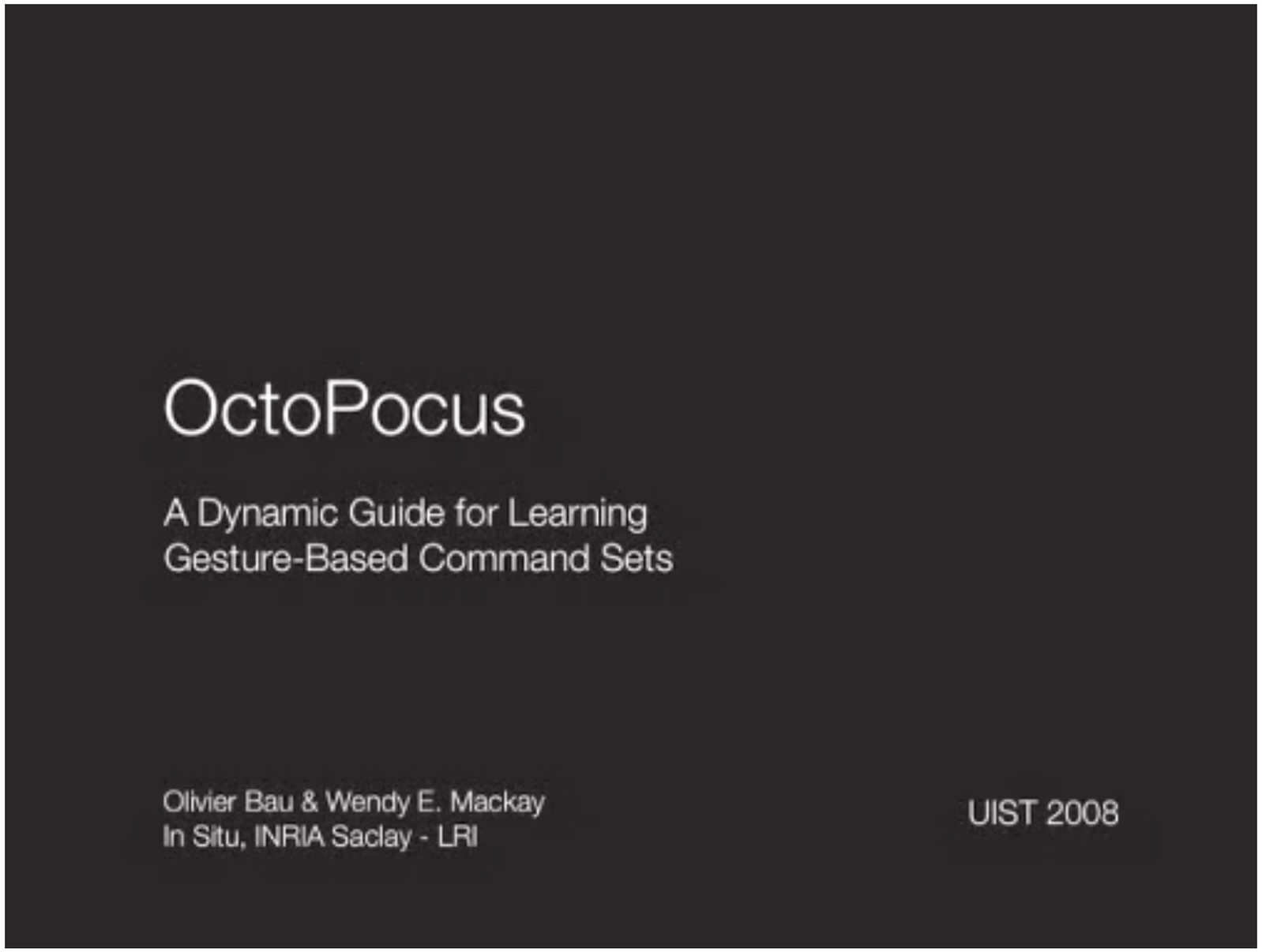
- Answering specific questions with data
  - Performance
  - Learning
  - Satisfaction
- Providing basic knowledge generalizable across contexts.
- Demonstrate causality between different factors
  - correlation: show that a change in A occurs with a change in B
  - order: show that A takes place before B
  - no hidden cause: show that there is no C with C -> A and C -> B

Example 1: what is the best input device?

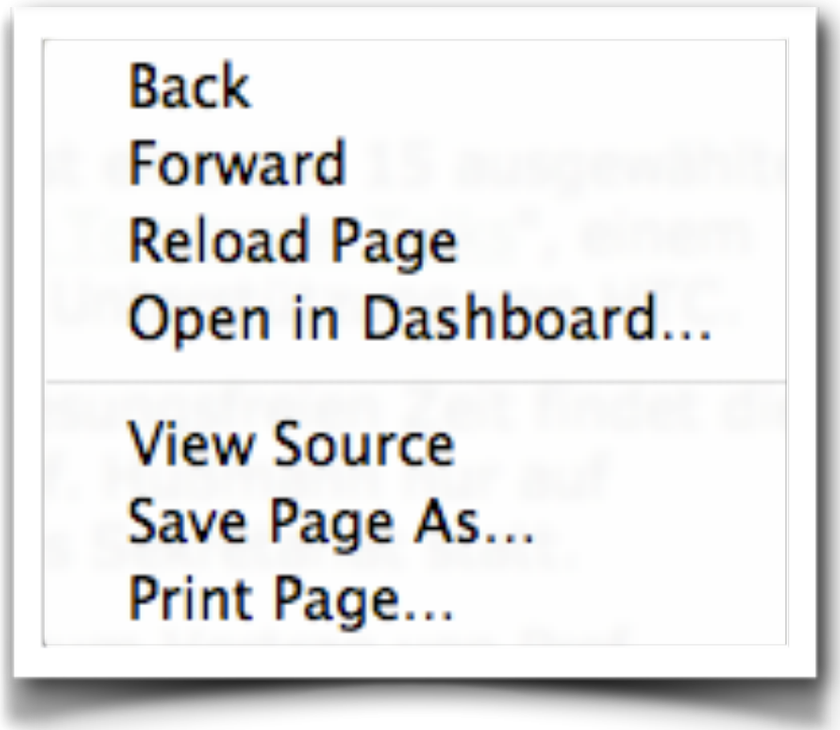
From two weeks ago:

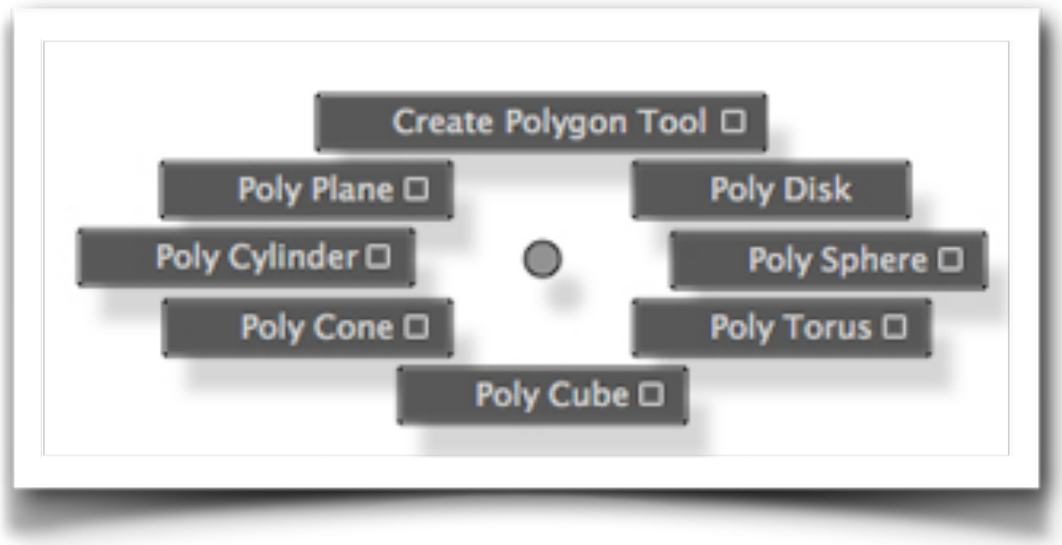
Device	Study	IP (bits/s)
Hand	Fitts (1954)	10,6
Mouse	Card, English, & Burr (1978)	10,4
Joystick	Card, English, & Burr (1978)	5
Trackball	Epps (1986)	2,9
Touchpad	Epps (1986)	1,6
Eyetracker	Ware & Mikaelian (1987)	13,7

Example 2: a better way do learn gestures?



Exemple 3: which menu design is best?





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Method (1)

1. Define what you are looking for: write down an hypothesis
   - Circular menus reduce search time
2. Design the experiment pick variables and fixed parameters
   - Define the menu structure (1 level or 2 level? how many items?)
3. Conduct a pilot to test the experiment
   - Fine tune data collection adjust the number of repetitions

Method (2)

4. Recruit participants
   - Students spending more than 2h per day in front of their computer
5. Conduct experiment and gather data
6. Analyze and clean up data, to accept or reject the original hypothesis measure the effect (between conditions)
   - Average search time: 2.26 (Circular menu), 2.64 (Usual menu)
   - Difference is significant : $p<.05$

The elements of experiments

- Factors (or independent variables)
  - Variables we manipulate in each condition
  - The quantity of menu items, the quantity of sub-menus
- Levels (a.k.a. possible values for independent variables)
  - Menu with 8 items or a menu with 12 items
- Measures (or response): dependent variable(s)
  - The measured outcome of the experiment
  - Selection time of a menu item
- Replication
  - number of subjects assigned to each level

Independent variables (factors)

The conditions of the experiment are set by independent variables

- The number of items in a list, text size, font, color

The number of different values used is the level

- The number of experimental conditions is the product of the levels
- E.g., font can be times or arial (2 levels), background can be blue, green, or white (3 levels). This results in 6 experimental conditions (times on blue, times, on green, ..., arial on white)

Dependent variables (measures)

The dependent variables are the values to be measured:

- Objective values: e.g. time to complete a task, number of errors, etc.
- Subjective values: ease of use, preferred option, etc.
- They should only be dependent on changes of the independent variables.

Exercise

Identify independent variables (factors) and dependent les variables (measures) in each scenario.
Give possible levels for independent variables.

- A study to learn whether people who have followed a digital security training use more secure password.
- A study to learn whether a joystick or a mouse is more efficient to select static targets or moving targets
- A study to learn whether teams using video Hangout/Skype are more productive than those using text-only chat.

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Participants / subjects

Within-subjects design:

- Same participant exposed to all test conditions

+Fewer participants needed (10 - 20)

- Learning effects

Between-subjects design:

- Independent groups of participants for each test condition (control and treatment)

+No learning effect

- Require more users

Randomization and control

The order of presentation can have an impact measures:

- learning
- fatigue
- contrast (1st treatment leads to behavior/answers in 2nd treatment)

Solution

- Rest between treatment
- Counter-balancing, but can become complicated
- Latin square

Latin square (Carré Latin)

via http://hci.rwth-aachen.de/~chat/StatLecture/prerequisite.pdf

- Each condition appears at each ordinal position
- Each condition precedes and follows each condition one time
- Example: six treatments: A, B, C, D, E, F

1	A	B	F	C	E	D
2	B	C	A	D	F	E
3	C	D	B	E	A	F
4	D	E	C	F	B	A
5	E	F	D	A	C	B
6	F	A	E	B	D	C

Exercise

What kind of experimental design for:

- A study to learn whether people who have followed a digital security training use more secure password.
- A study to learn whether a joystick or a mouse is more efficient to select static targets or moving targets
- A study to learn whether teams using video Hangout/Skype are more productive than those using text-only chat.

Hypotheses

- Prediction of the result of an experiment
- Stating how a change in the independent variables will affect the measured dependent variables

Usual approach to hypotheses

- Stating a working hypothesis H_1
- Stating a null hypothesis H_0
  - intuition (naive) : if H_0 is false then H_1 must be true
- Carrying out the experiment and using statistical measures to disprove the null-hypothesis
- When a statistical test shows a significant difference it is probable that the effect is not random

Exercise

Which H_0 et H_1 ?

- A study to learn whether people who have followed a digital security training use more secure password.
- A study to learn whether a joystick or a mouse is more efficient to select static targets or moving targets
- A study to learn whether teams using video Hangout/Skype are more productive than those using text-only chat.

Validity

Internal validity

- Manipulation of independent variable is cause of change in dependent variable
- Requires removing effects of confounding factors
- Requires choosing a large enough sample size, so the result couldn’t have happened by chance alone.

External validity

- Results generalize to real world situations
- Requires that the experiment be replicable
- No study “has” external validity by itself!

Practice

Compare typing speed of
a laptop keyboard vs. a smartphone keyboard.

- Which independent variables (factors)?
- Which dependent variables (measures)?
- inter- or intra- participants?
- Which hypotheses?

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Collecting data

Records of what participants did

Log data

- Data of dependent variables (measures)
- time, errors, etc.

Table structure:

userid	group	condition	executiontime	error

Practice

- Which protocol?
- Which data to collect?

Go check

- http://10fastfingers.com/

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Gathering data

Gather data from all groups in a pad in csv format (comma separated value).

Copy them on your plot.ly account

Experimental design

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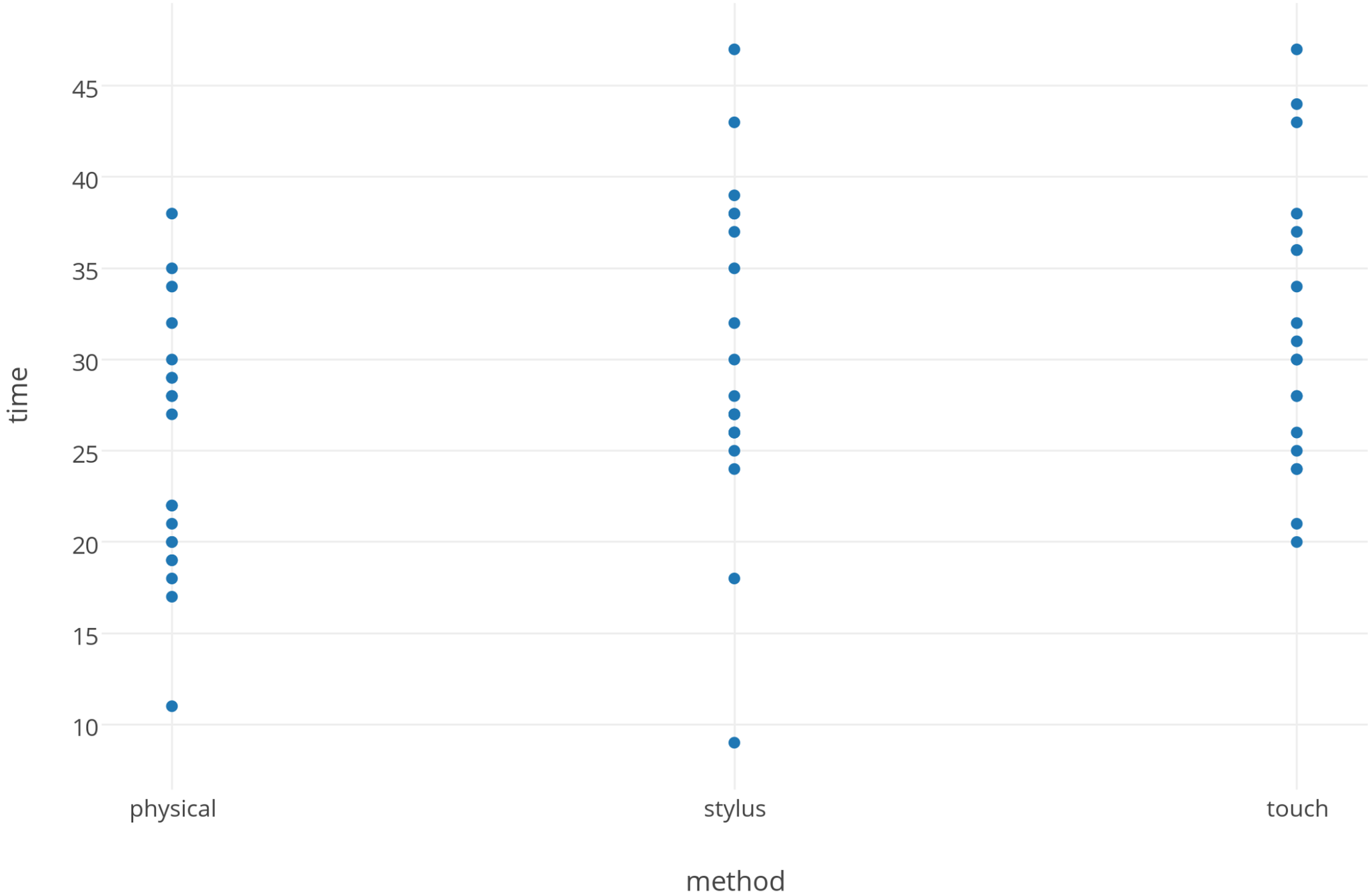
Who is fastest?

https://plot.ly/~aurelient/41/



Who is fastest?

It depends of:

- the median differences
- the data distribution (standard deviation)
- the sample size
- whether averages are significantly different

First: the exploratory part

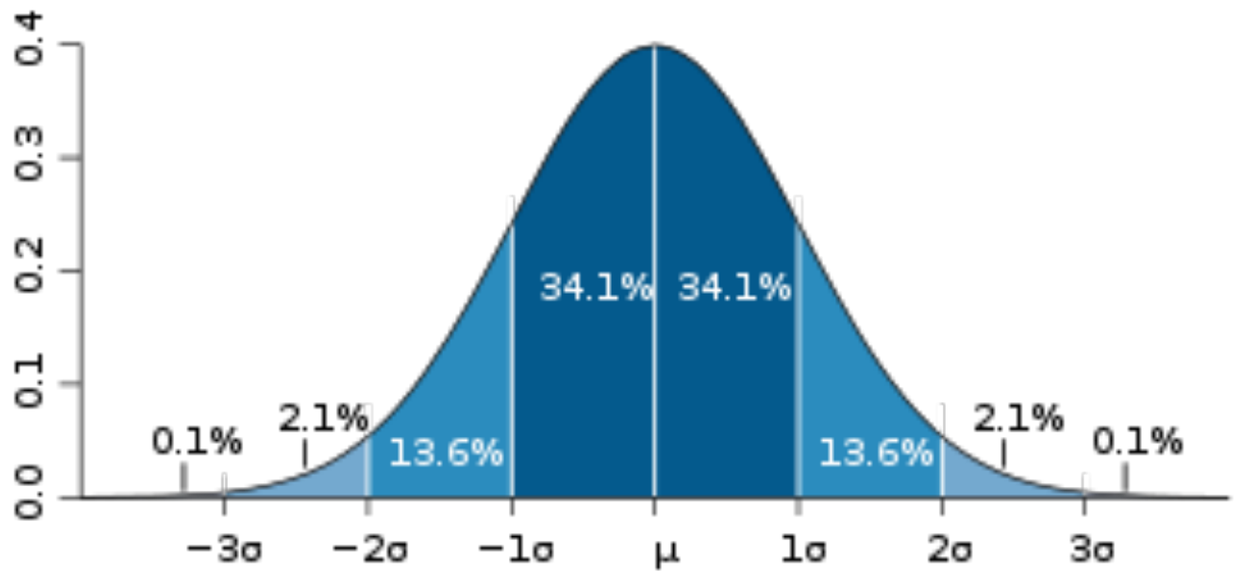
- look at the data with basic plots and statistics to get an idea.

(Student's) t-test

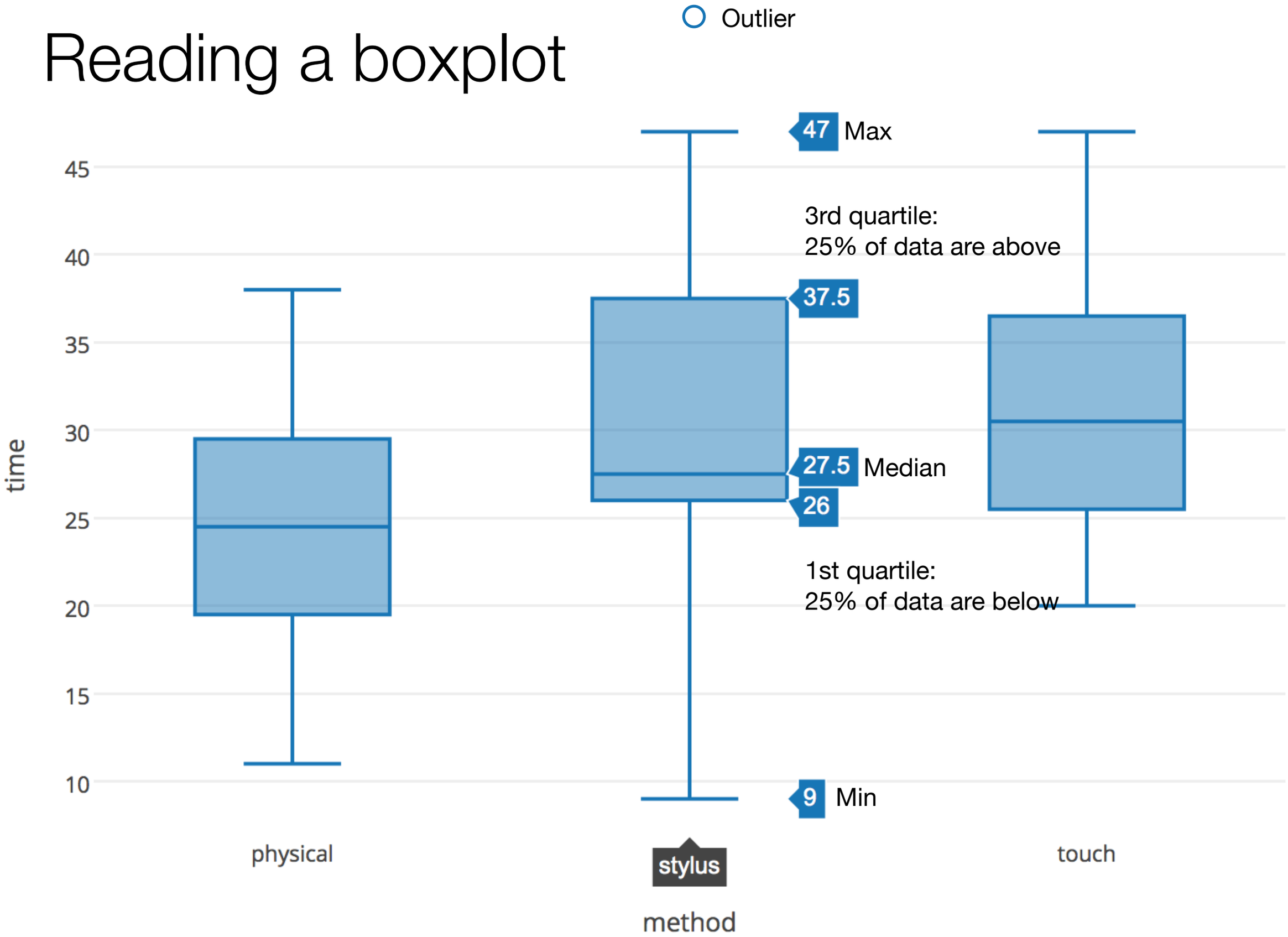
Looks at the relationship between two data sets

Designed for

- small sample (= few measurements)
- unknown (mean and) standard deviation
- but has to be **normally distributed**



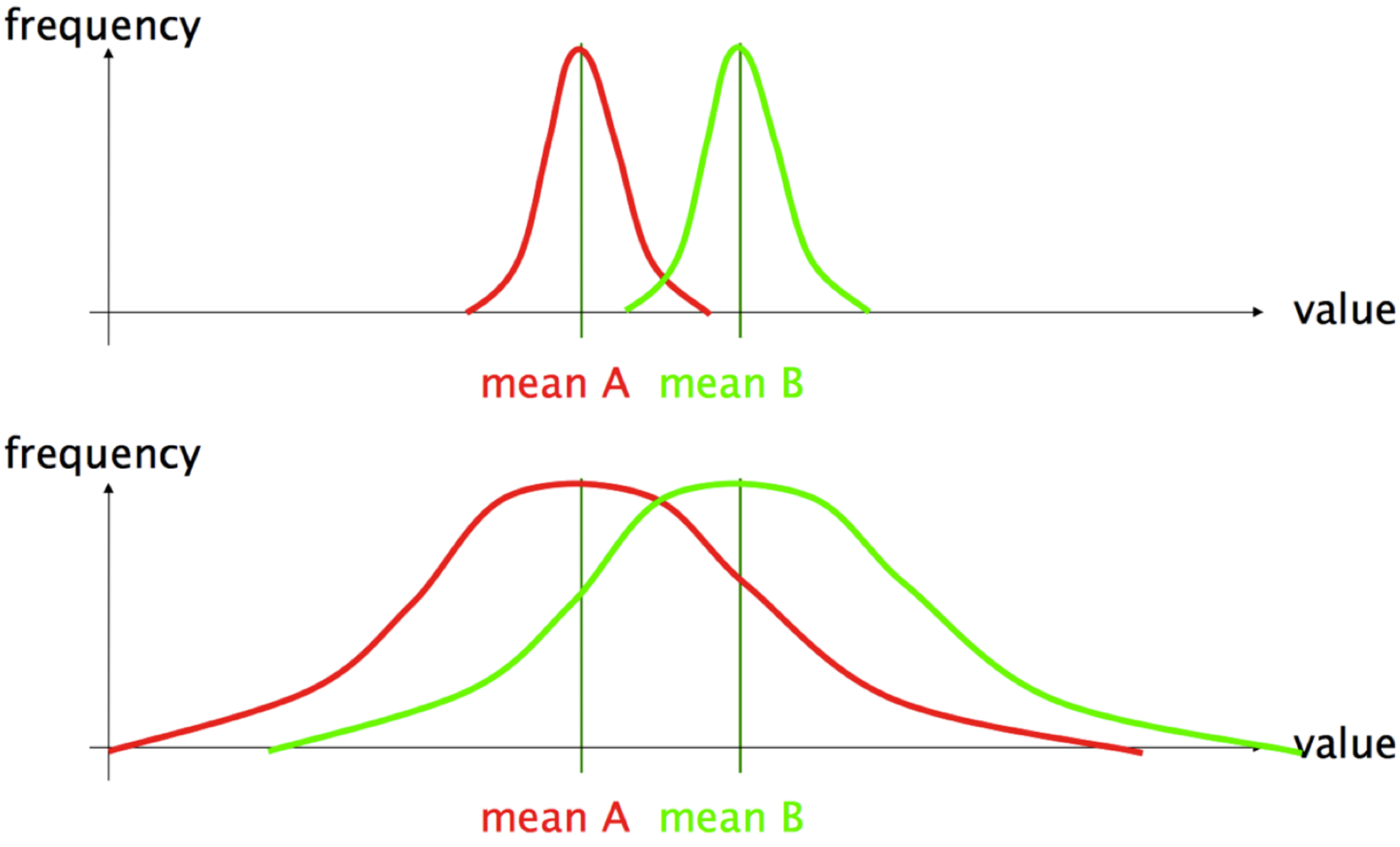
Reading a boxplot



Comparing values

via http://www.medien.ifi.lmu.de/lehre/ws1213/mmi2/uebung/slides10.pdf

Is there a significant different between two measures?



t-test

Gives *p*:

- **the probably that two population have the same mean**
- Not probability the result is due to chance…

In UX :

- p < 0.05 (= 5% probability) is a convention (or 0.01)
- a smaller p (e.g. 0.00001) doesn't make the result more significatif.
- **a significant result is different from an important result**

DO NOT

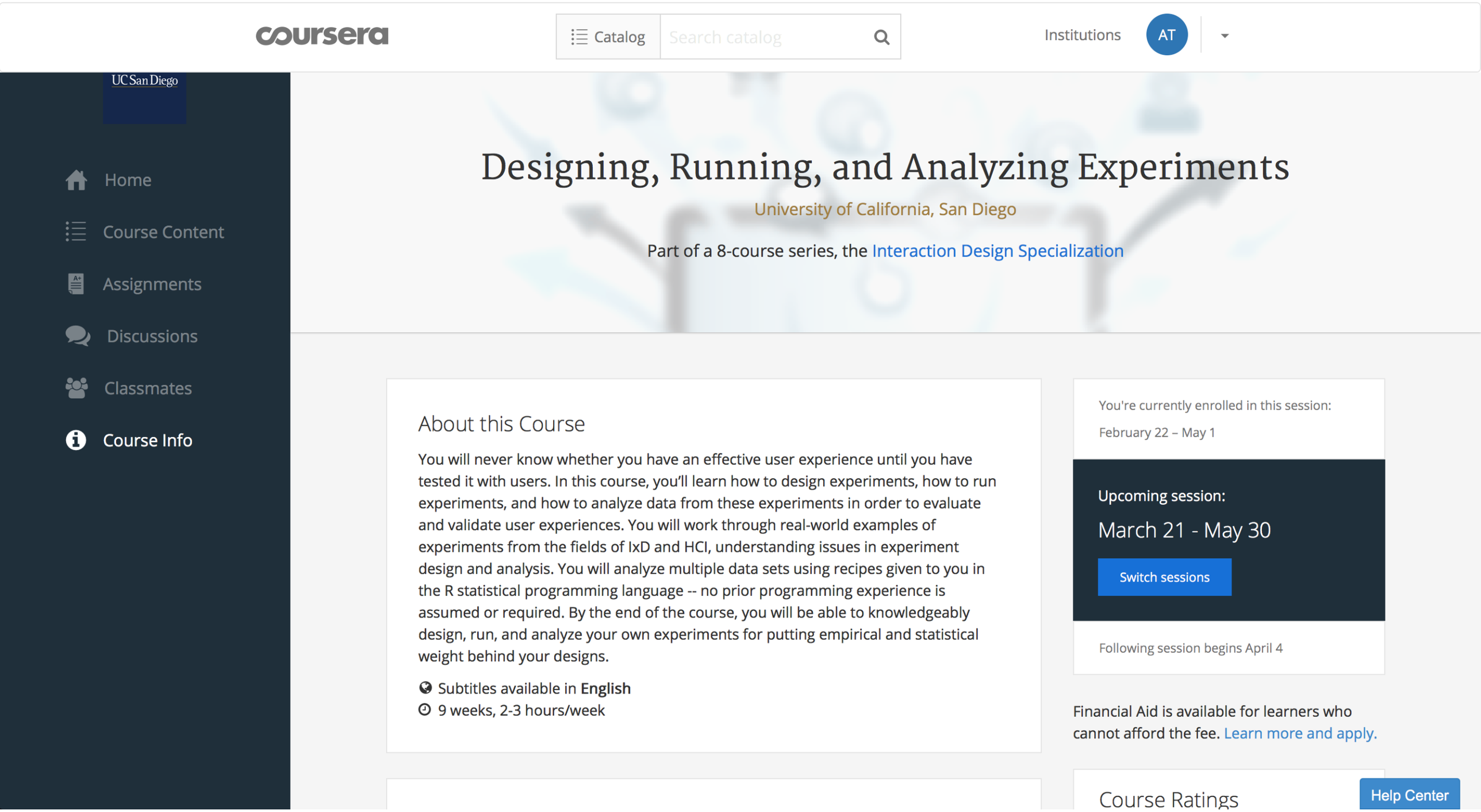
If p>0.05 say:

- *“our tests showed that there was no difference”*
- significant difference -> impact
- no significant difference -> nothing

You cannot show that there is no difference!

Going further

https://www.coursera.org/learn/designexperiments



Evaluation methods

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Today:

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Scaling user testing

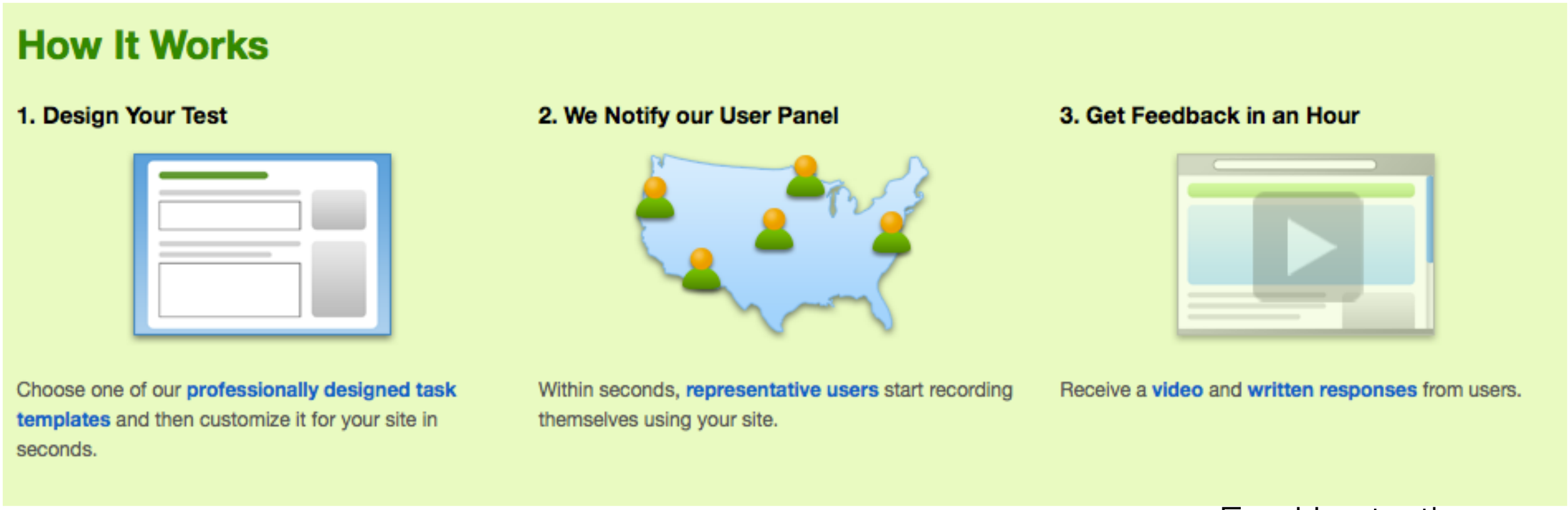
Large Web audiences

Large audiences on mobile platforms

Ease of distribution of updates

Ease of logging

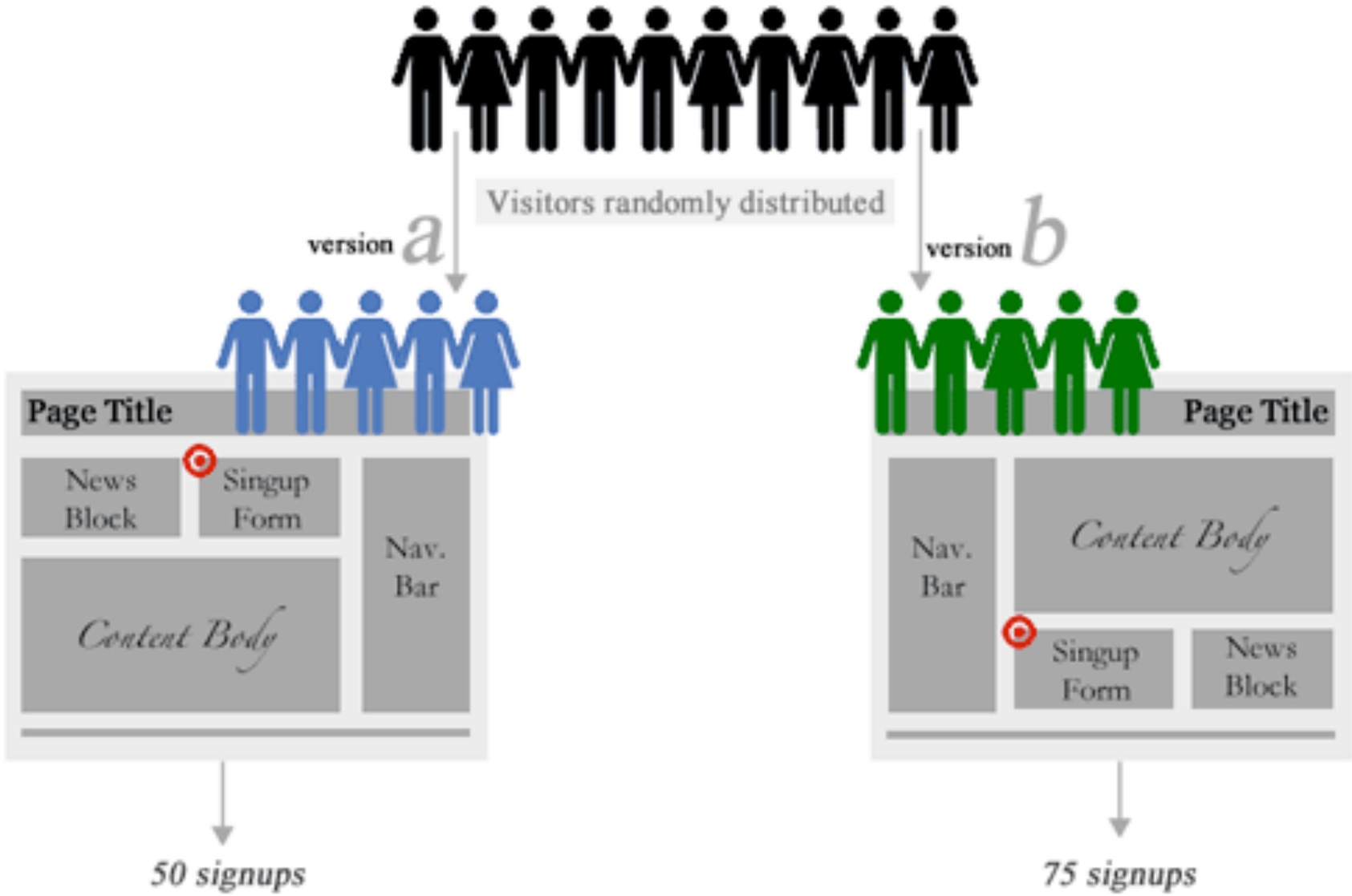
Remote usability studies



E.g. Usertesting.com

From http://www.smashingmagazine.com/2010/06/24/the-ultimate-guide-to-a-b-testing/

A/B testing



A/B testing

see http://optimizely.com/

Test the best version of a page

- a better form design
- a better conversion rate (for a newsletter)

Limits :

- You need significant traffic
- Does not replace user studies!
- Does not provide explanations
- Arbitrary changes can be disturbing.
- Complex when there is tailored and social content, e.g., Facebook.
- Often used for incremental changes, complex for full redesigns.

Controlled distribution of Beta versions

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- **Homework**

Devoir

Maintenant :

- Se mettre d'accord sur les deux modalités d'entrée

Pour la semaine prochaine (28 mars) :

- Description de l'expérience :
  variables, hypothèses, déroulé.
- Faire passer le test de frappe à 2 personnes (chacun)
- 2 conditions en alternance, 3 répétitions
  -> 3x2x1 minute d'XP, max 30 minutes par participant.

Devoir

Pour le 18 avril (seul) :

- Analyse descriptive sur un échantillon de 12 personnes (*J'assigne les participants aux groupes le 03 avril*) :
  - Boxplot avec description des données, médiane, quartiles, distribution des données
  - présence (ou non) d'outliers
  - analyse des erreurs
- Conclusion visuelle
- Bonus: T-test et conclusion statistique