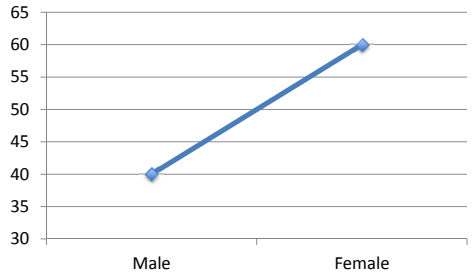
Research Skills: Graphing

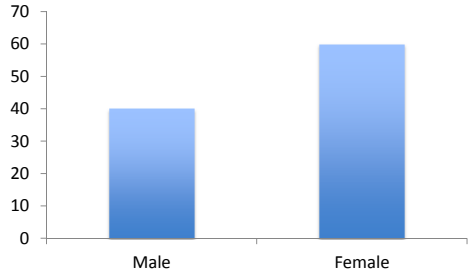
Alan Blackwell

AN EXAMPLE

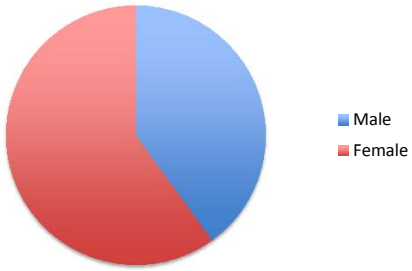
Experimental Sample



Experimental Sample



Experimental Sample



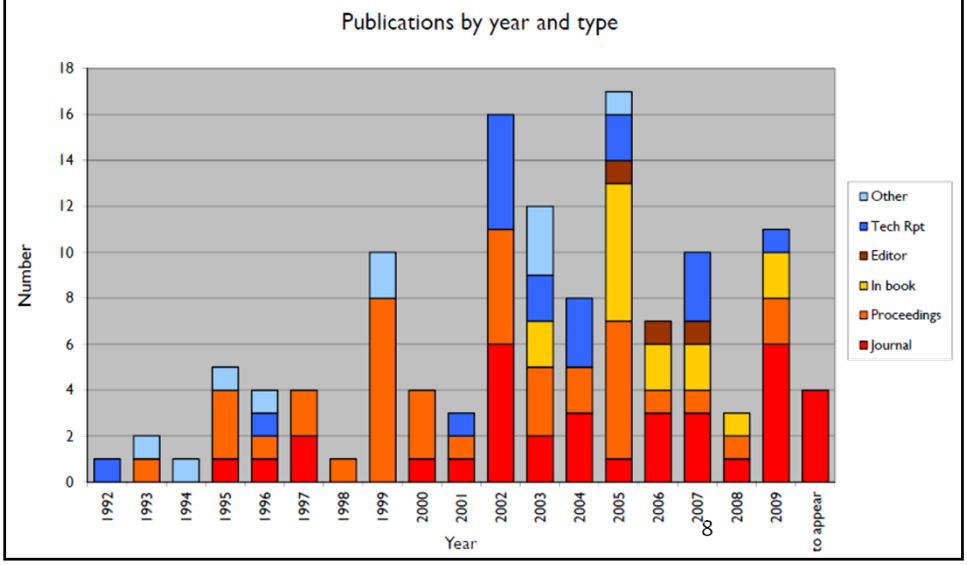
Experimental Sample

60% of the sample were female

CHOOSING A CHART

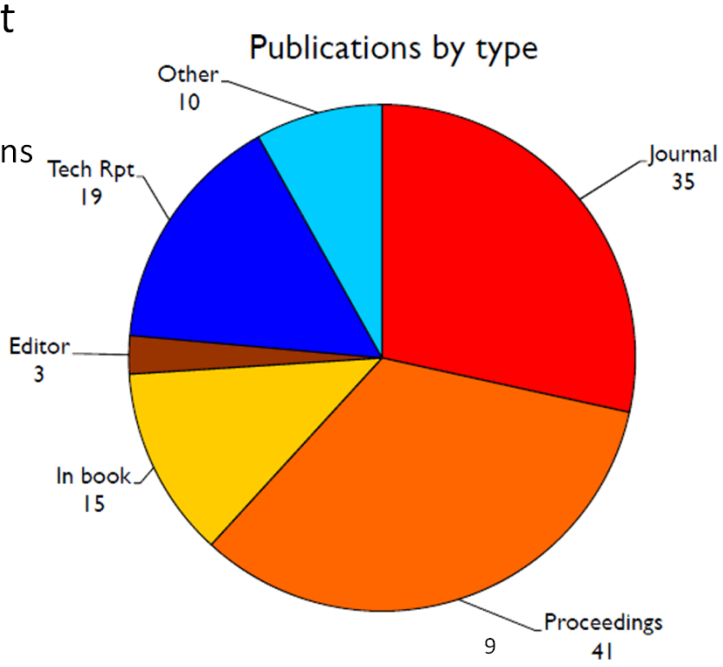
Bar and column charts

- Compare data with discrete ordinates



Pie chart

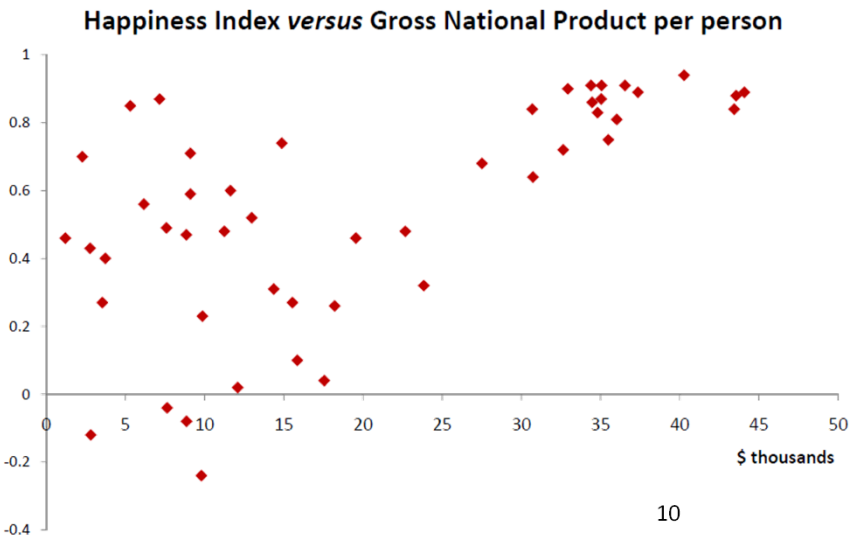
- Compare proportions of one thing



9

Scatter chart

- Plot two variables against one another



10

Graphs – the basics

- Work out what "story" you want to tell
- Choose the correct type of graph
  - (or text, or table)
- Label appropriately
  - Title to whole graph
  - Title on each axis
  - Labels on each axis
- Make it as clear as possible
  - No "chart junk"
  - No distortion

11

The Tufte "chart junk" message

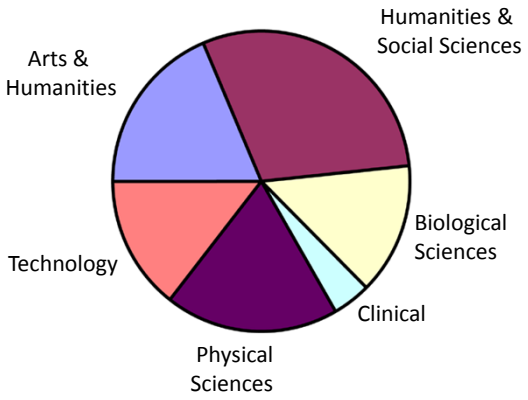
- If the story is simple, keep it simple
- If the story is complex, make it simple
- Don't distort the data

Designing a graphic story

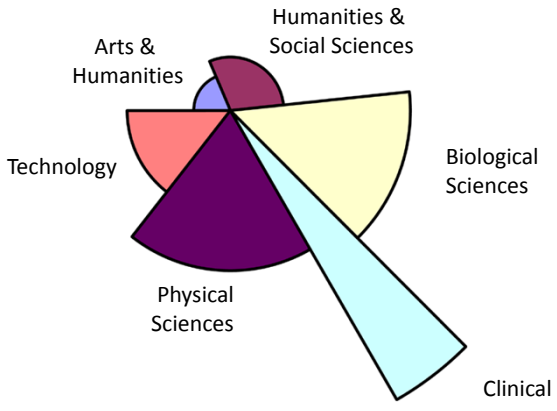
- Distribution (model)
  - Pie chart
  - Histogram
  - Probability density function (in R)
- Correlation
  - Scatter graph
  - Line graph (to model a continuous function)
- Comparison
  - Bar chart
  - Box (and whisker) plot

DISTRIBUTION

students in Cambridge

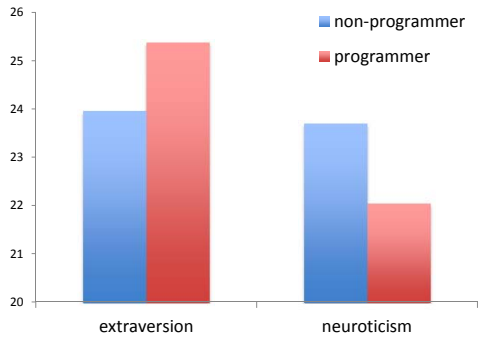


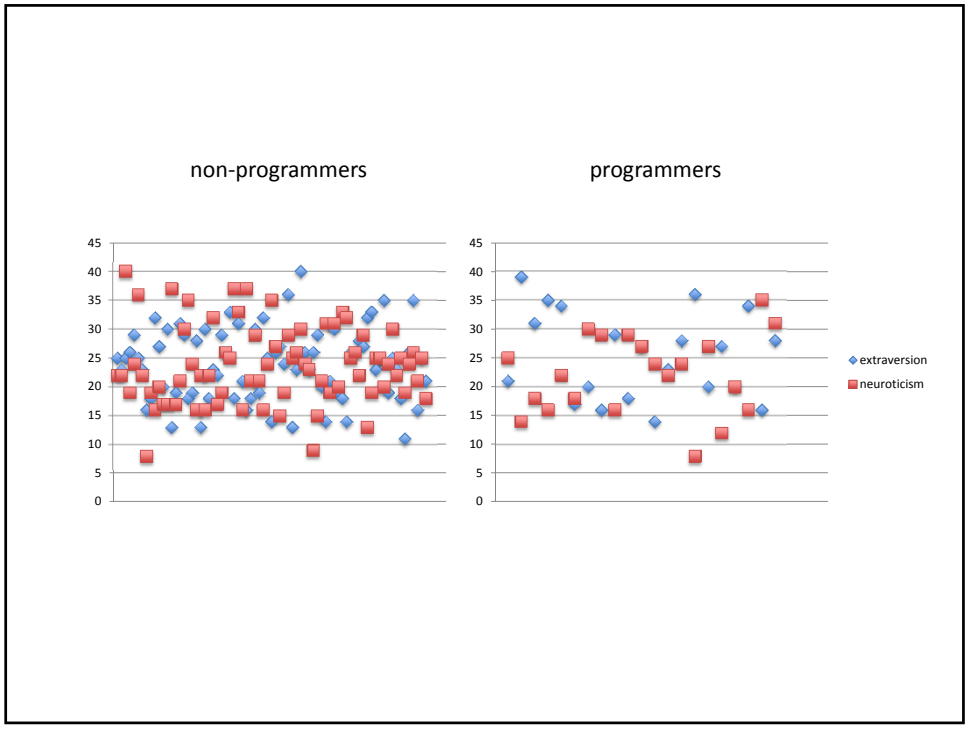
revenue in Cambridge

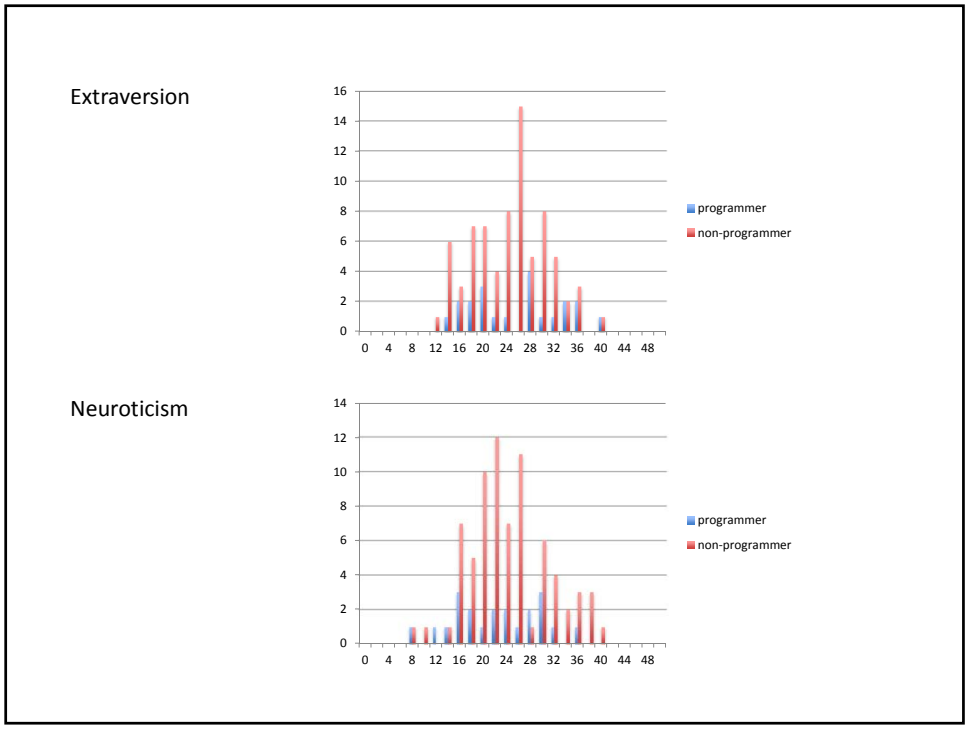


COMPARISON

Personality and programming experience




non-programmers
programmers
45
40
35
30
25
20
15
10
5
0
extraversion
neuroticism


Extraversion
16
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40 44 48
programmer
non-programmer
Neuroticism
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40 44 48
programmer
non-programmer

Mean

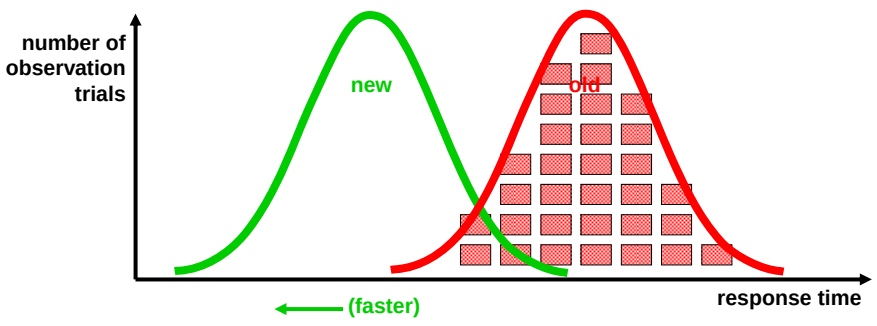
	extraversion	neuroticism
non-programmer	23.96	23.69
programmer	25.38	22.04

Variance

	extraversion	neuroticism
non-programmer	39.28	45.37
programmer	57.24	49.14

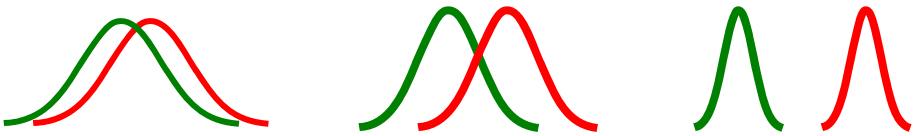
Controlled experiments

- Experimental *treatment* leads to an *effect* on system performance (e.g. response time)



Hypothesis testing

- Compare effect size to observed variance

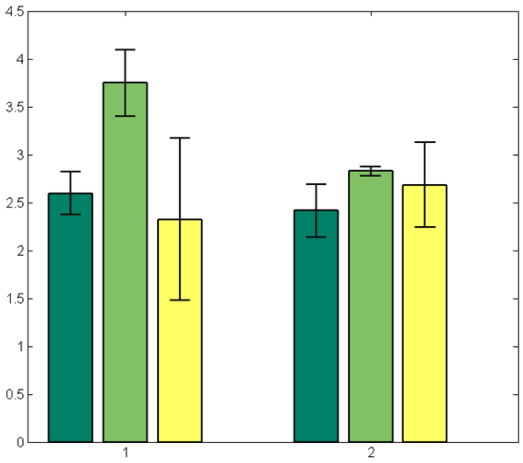


no effect (null hypothesis) only random variation observed

statistically significant variation between treatment groups

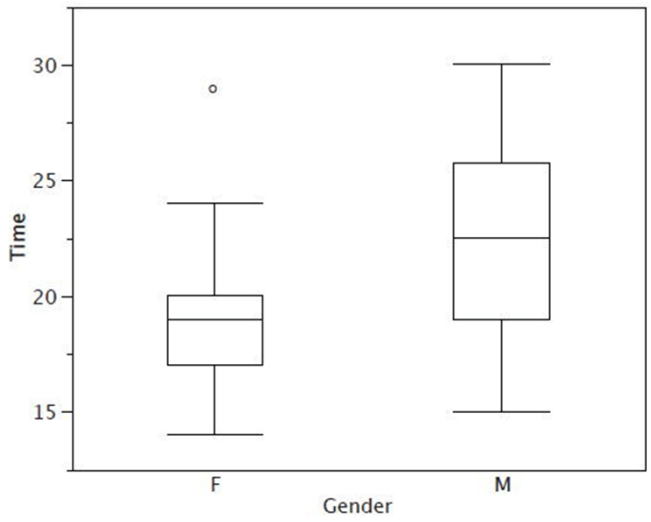
highly significant effect of treatment

Comparing means relative to variance*

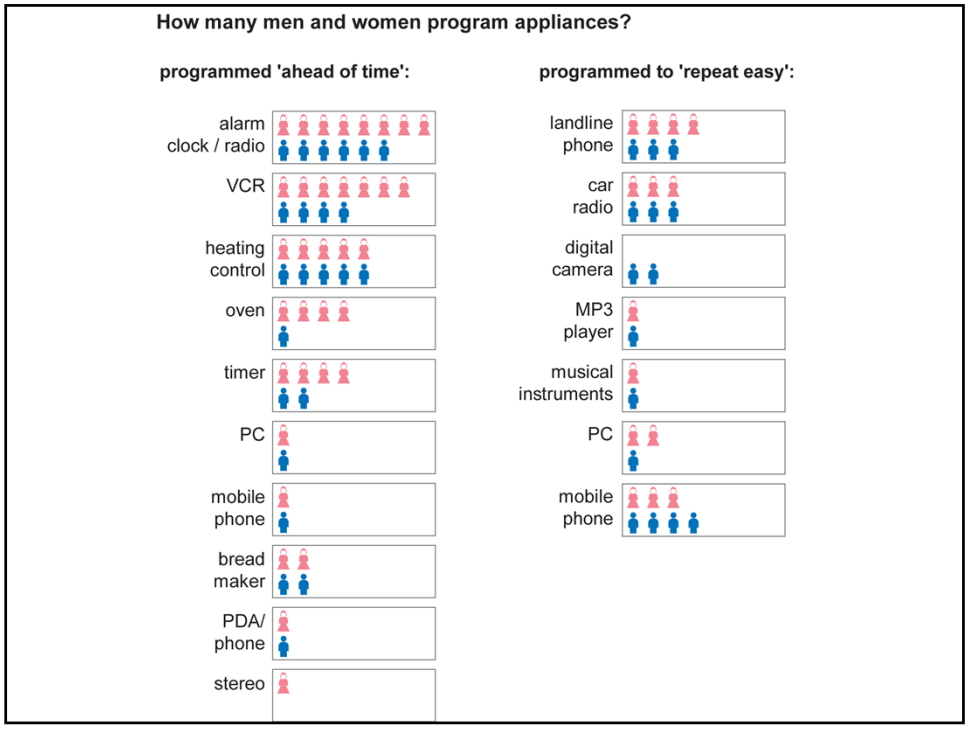


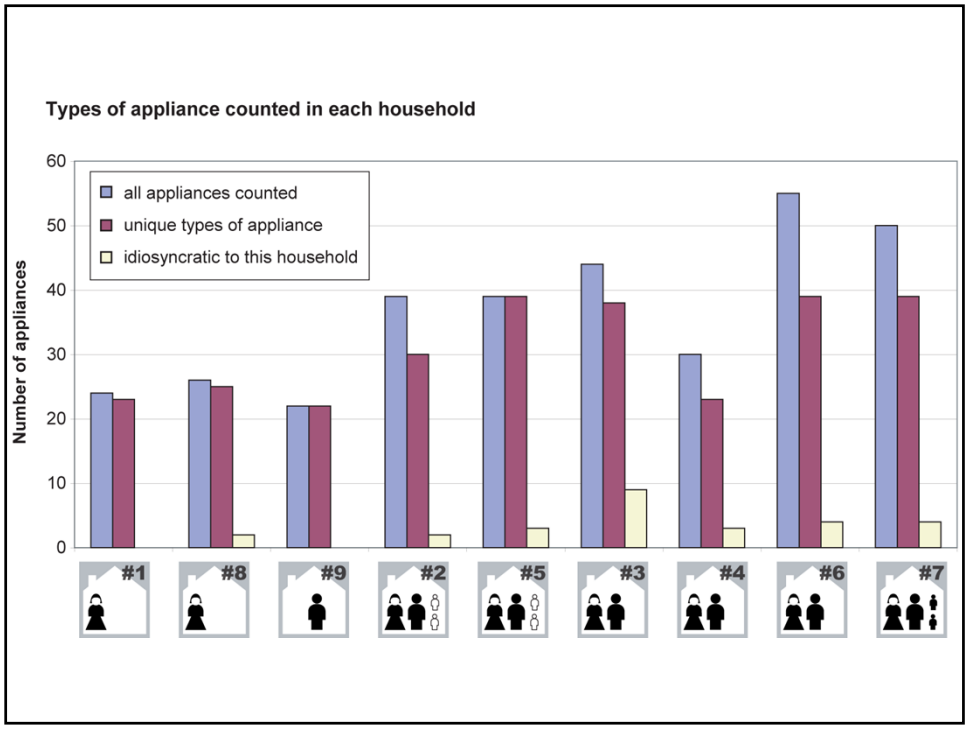
* usually standard error

Comparing distributions with box plots

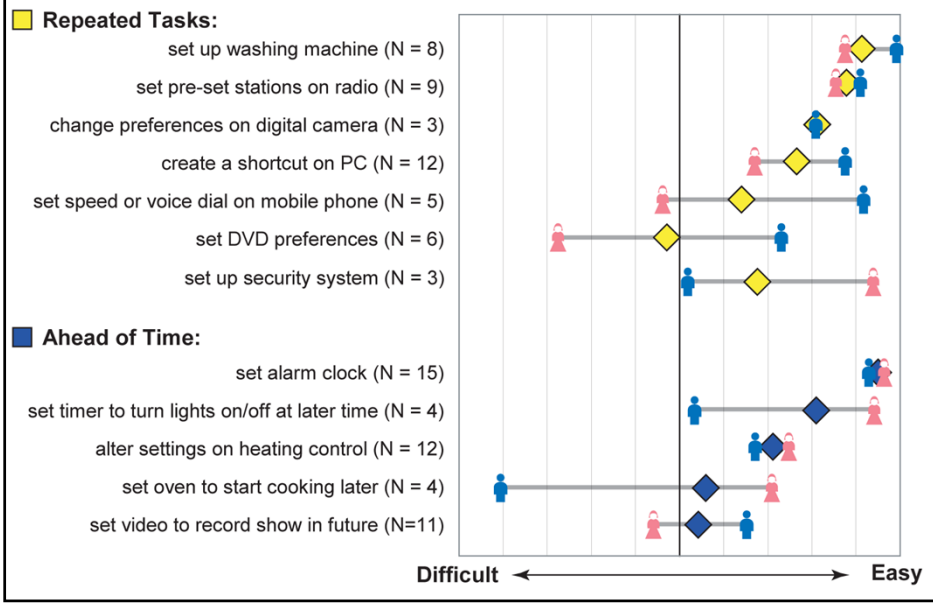


SMALL NUMBERS - ISOTYPE

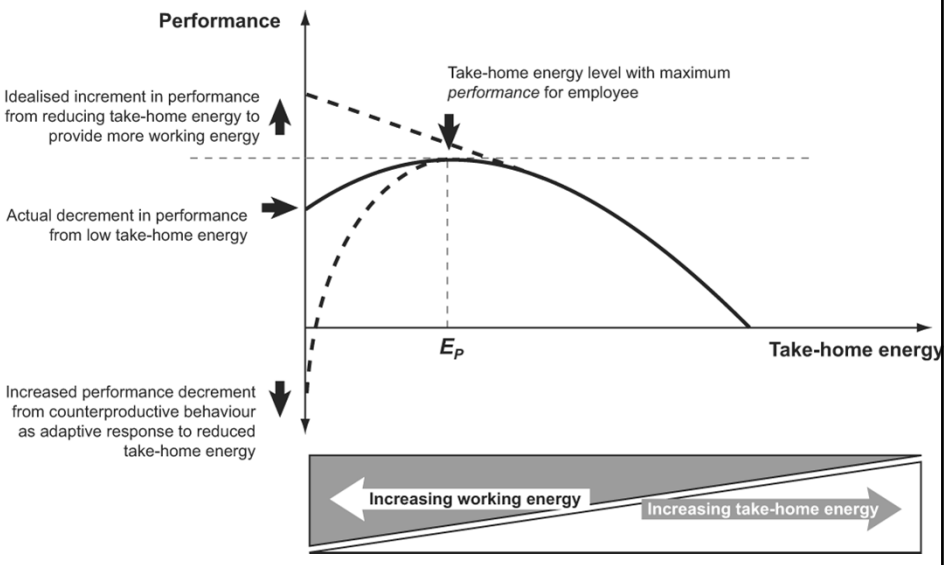

How many men and women program appliances?
programmed 'ahead of time':
alarm clock / radio
VCR
heating control
oven
timer
PC
mobile phone
bread maker
PDA/ phone
stereo
programmed to 'repeat easy':
landline phone
car radio
digital camera
MP3 player
musical instruments
PC
mobile phone

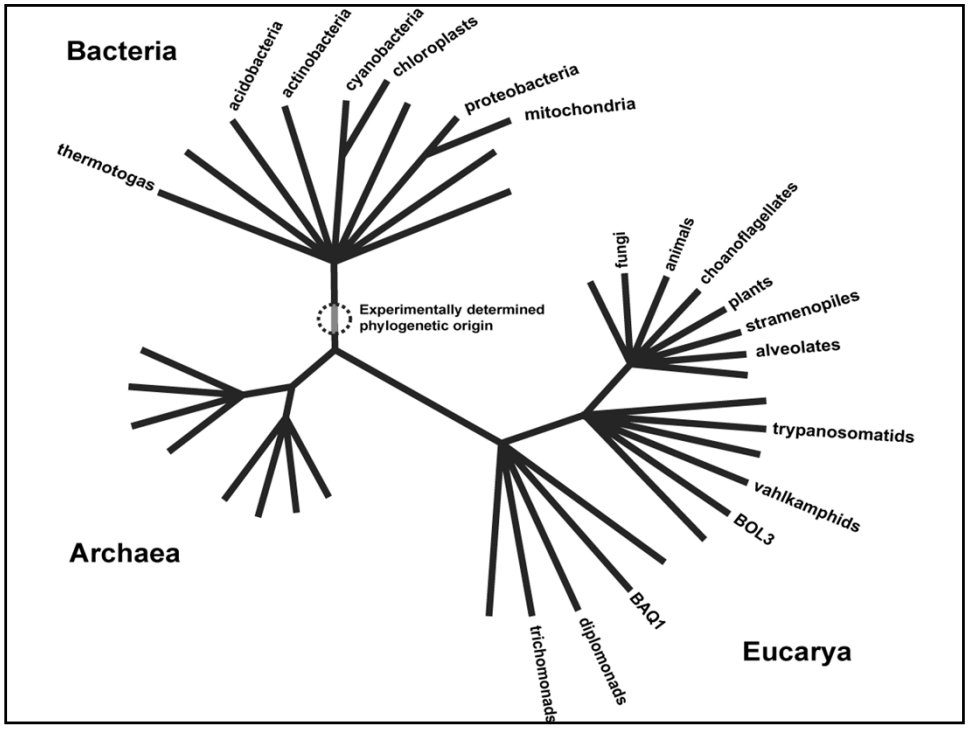

Types of appliance counted in each household
Number of appliances
60
50
40
30
20
10
0
all appliances counted
unique types of appliance
idiosyncratic to this household
#1
#8
#9
#2
#5
#3
#4
#6
#7

Telling more complex stories

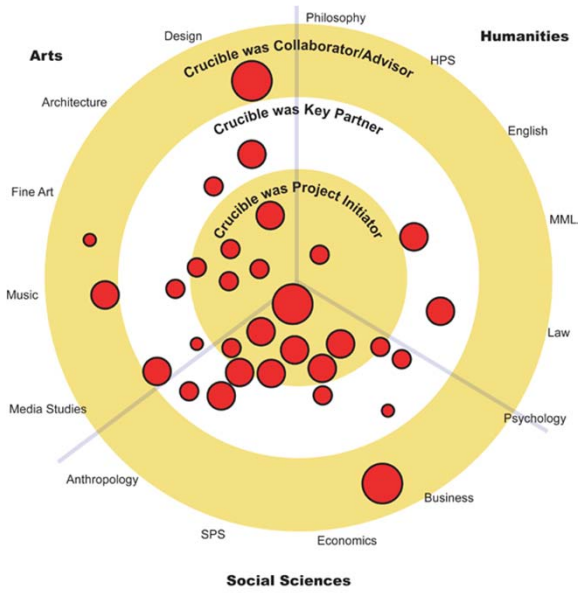


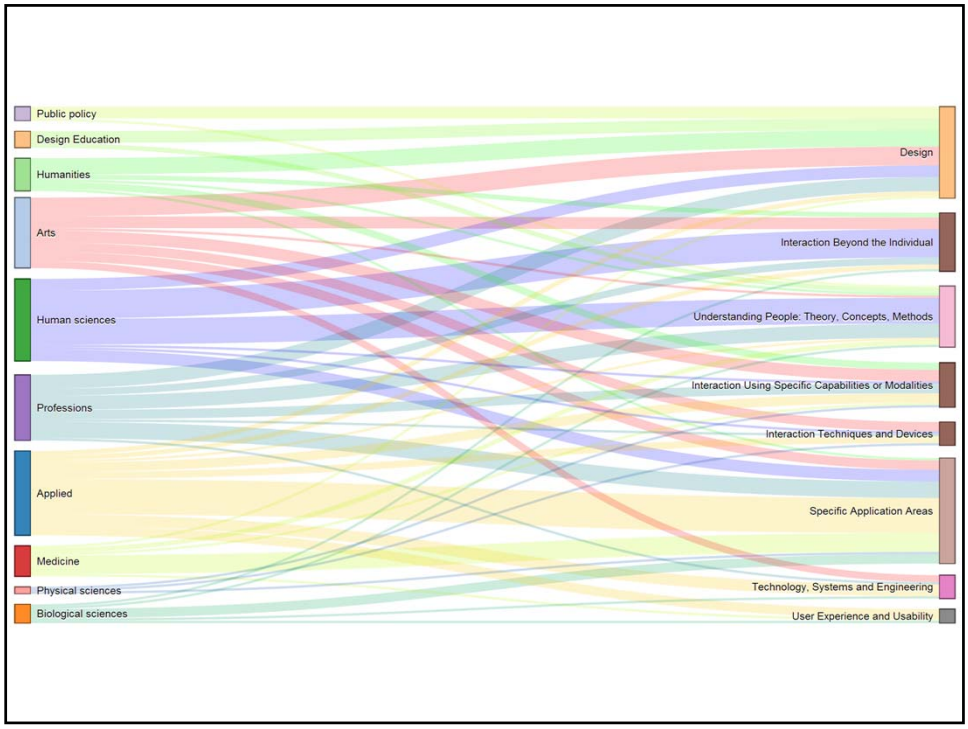
Explanatory models

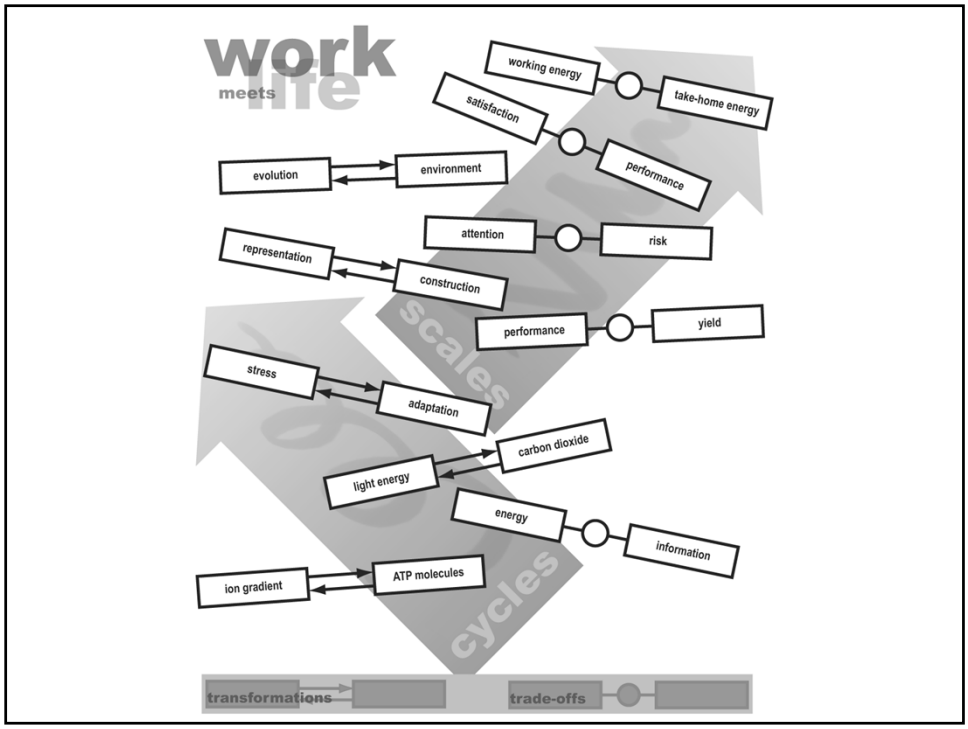




Descriptive models




Public policy
Design Education
Humanities
Arts
Human sciences
Professions
Applied
Medicine
Physical sciences
Biological sciences
Design
Interaction Beyond the Individual
Understanding People: Theory, Concepts, Methods
Interaction Using Specific Capabilities or Modalities
Interaction Techniques and Devices
Specific Application Areas
Technology, Systems and Engineering
User Experience and Usability


work
meets
life
working energy
take-home energy
satisfaction
performance
evolution
environment
attention
risk
representation
construction
performance
yield
stress
adaptation
carbon dioxide
light energy
energy
information
ion gradient
ATP molecules
scales
cycles
transformations
trade-offs

TABLES

Chart junk in tables

Local Authority	GOR Code	GOR Name	Health Deprivation	Rank Score
Kensington and Chelsea	H	London	-3.10	32482
Wokingham	J	South East	-3.05	32481
Richmond upon Thames	H	London	-2.99	32480

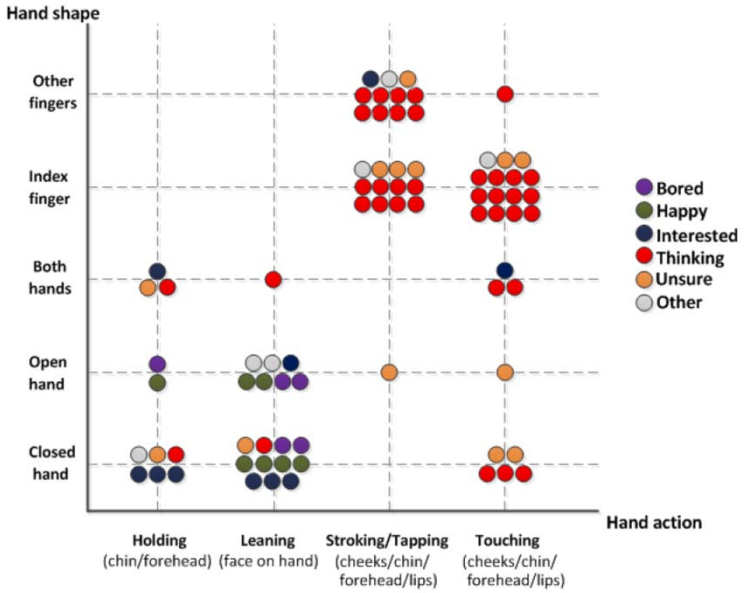
Data ink ratio in tables

Local Authority	GOR Code	GOR Name	Health Deprivation	Rank Score
Kensington and Chelsea	H	London	-3.10	32482
Wokingham	J	South East	-3.05	32481
Richmond upon Thames	H	London	-2.99	32480

Telling stories in tables

	Vibrato amplitude				
Q value	0%	0.5%	1%	2%	3%
$Q/2$	2.6	5.1	6.7	6.6	6.8
Q	2.2	4.6	6.8	6.0	5.1
$Q\times2$	1.3	4.5	6.5	5.3	4.6

Table or graph?



A THEORY OF VISUAL LANGUAGE

INTERACTION DESIGN FOUNDATION
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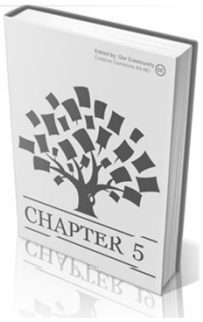
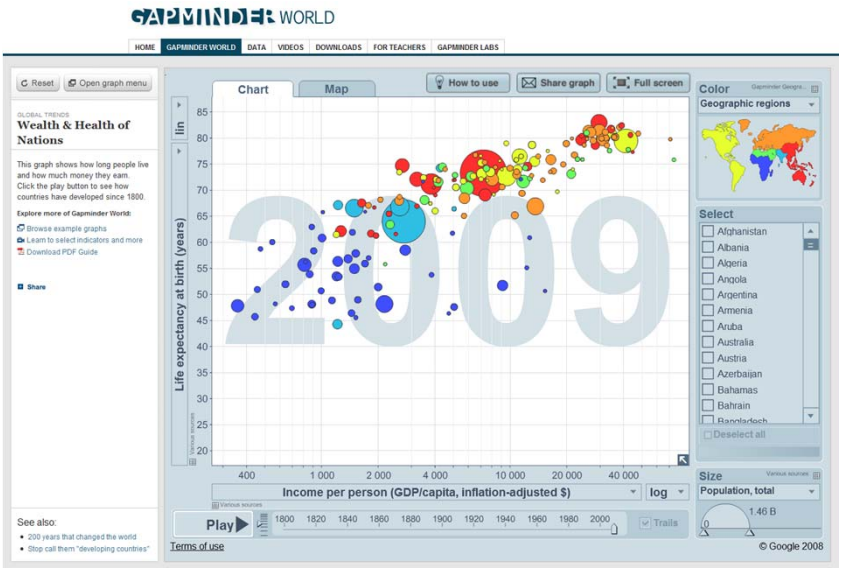
5. Visual Representation

by Alan Blackwell. How to cite in your report.



How can you design computer displays that are as meaningful as possible to human viewers? Answering this question requires understanding of visual representation - the principles by which markings on a surface are made and interpreted. The analysis in this article addresses the most important principles of visual representation for screen design, introduced with examples from the early history of graphical user interfaces. In most cases, these principles have been developed and elaborated within whole fields of study and professional skill - typography, cartography, engineering and architectural draughting, art criticism and semiotics. Improving on the current conventions requires serious skill and understanding. Nevertheless, interaction designers should be able, when necessary, to invent new visual representations.

	Graphic Resources	Correspondence	Design Uses
Marks	Shape Orientation Size Texture Saturation Colour Line	Literal (visual imitation of physical features) Mapping (quantity, relative scale) Conventional (arbitrary)	Mark position, identify category (shape, texture colour) Indicate direction (orientation, line) Express magnitude (saturation, size, length) Simple symbols and colour codes
Symbols	Geometric elements Letter forms Logos and icons Picture elements Connective elements	Topological (linking) Depictive (pictorial conventions) Figurative (metonym, visual puns) Connotative (professional and cultural association) Acquired (specialist literacies)	Texts and symbolic calculi Diagram elements Branding Visual rhetoric Definition of regions
Regions	Alignment grids Borders and frames Area fills White space Gestalt integration	Containment Separation Framing (composition, photography) Layering	Identifying shared membership Segregating or nesting multiple surface conventions in panels Accommodating labels, captions or legends
Surfaces	The plane Material object on which the marks are imposed (paper, stone) Mounting, orientation and display context Display medium	Literal (map) Euclidean (scale and angle) Metrical (quantitative axes) Juxtaposed or ordered (regions, catalogues) Image-schematic Embodied/situated	Typographic layouts Graphs and charts Relational diagrams Visual interfaces Secondary notations Signs and displays



LECTURE 13: “RESEARCH”

Methods and Disciplines

- Statistical data exploration
- Controlled experiments
- Engineering construction
- Mathematical proof
- Ethnography
- Survey research

- Which ones are computer science?

Research Method Questions

- What is the most commonly used research method in this group?
- Where can I find the clearest description of how to do it?
- What are the criteria by which rigour is judged in application of this method?
- Is this the method I will be using in my own project?