

COS30045

DATA VISUALISATION

TOPIC 06: DESIGN

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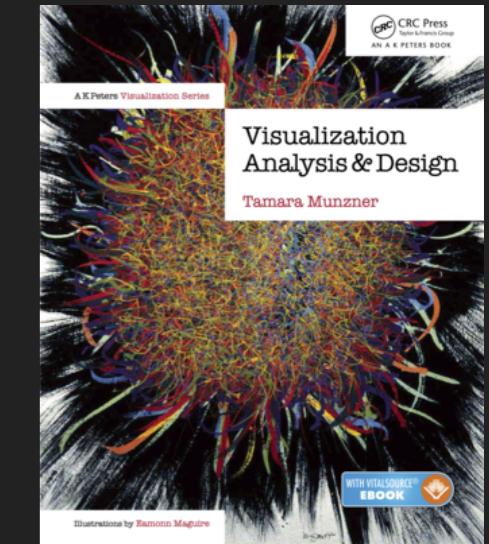
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DESIGN AND VALIDATION

Lecture Readings

- ▶ VAD Ch 4





DESIGN AND VALIDATION

What:

- ▶ the process of data visualisation design

Why:

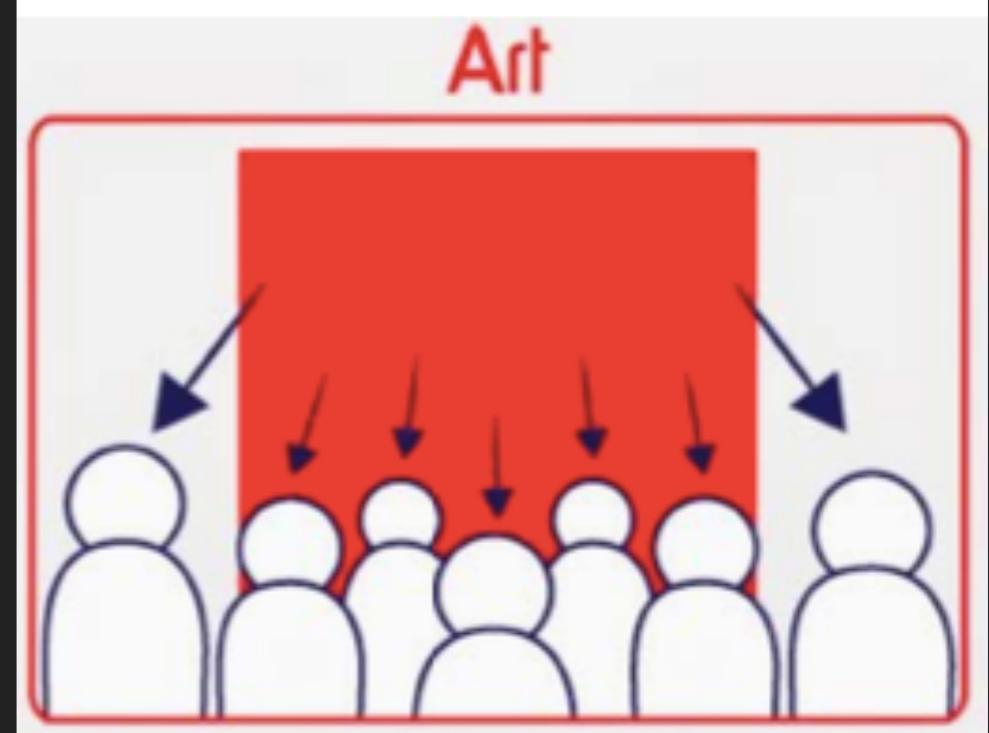
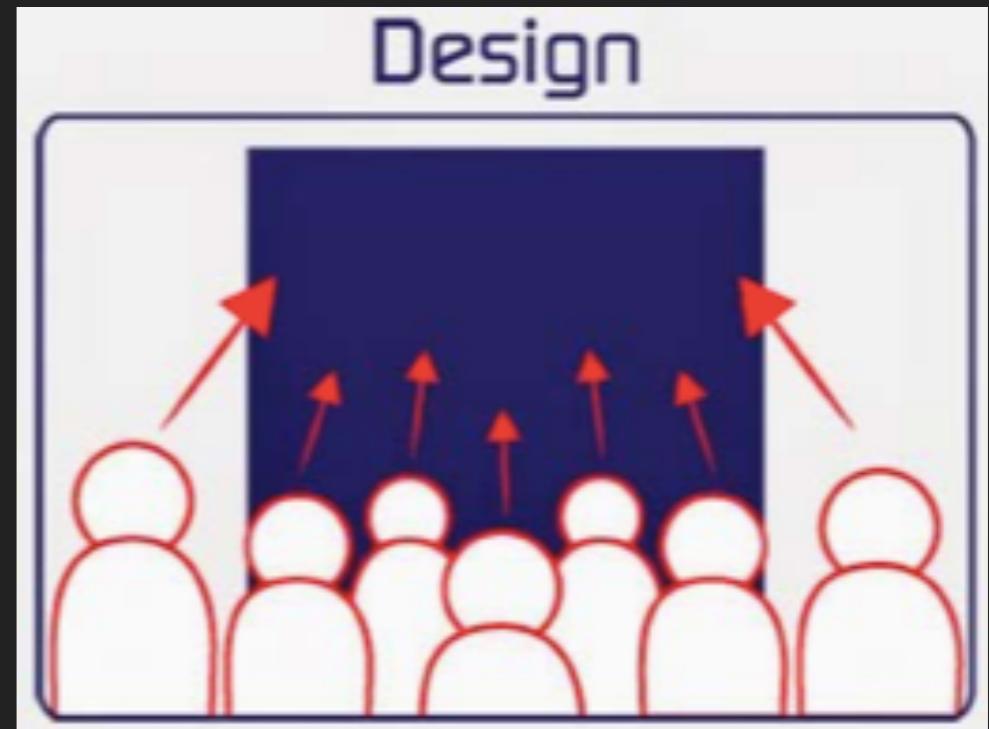
- ▶ make sure that design meets the needs of the user

How:

- ▶ develop a systematic approach to design

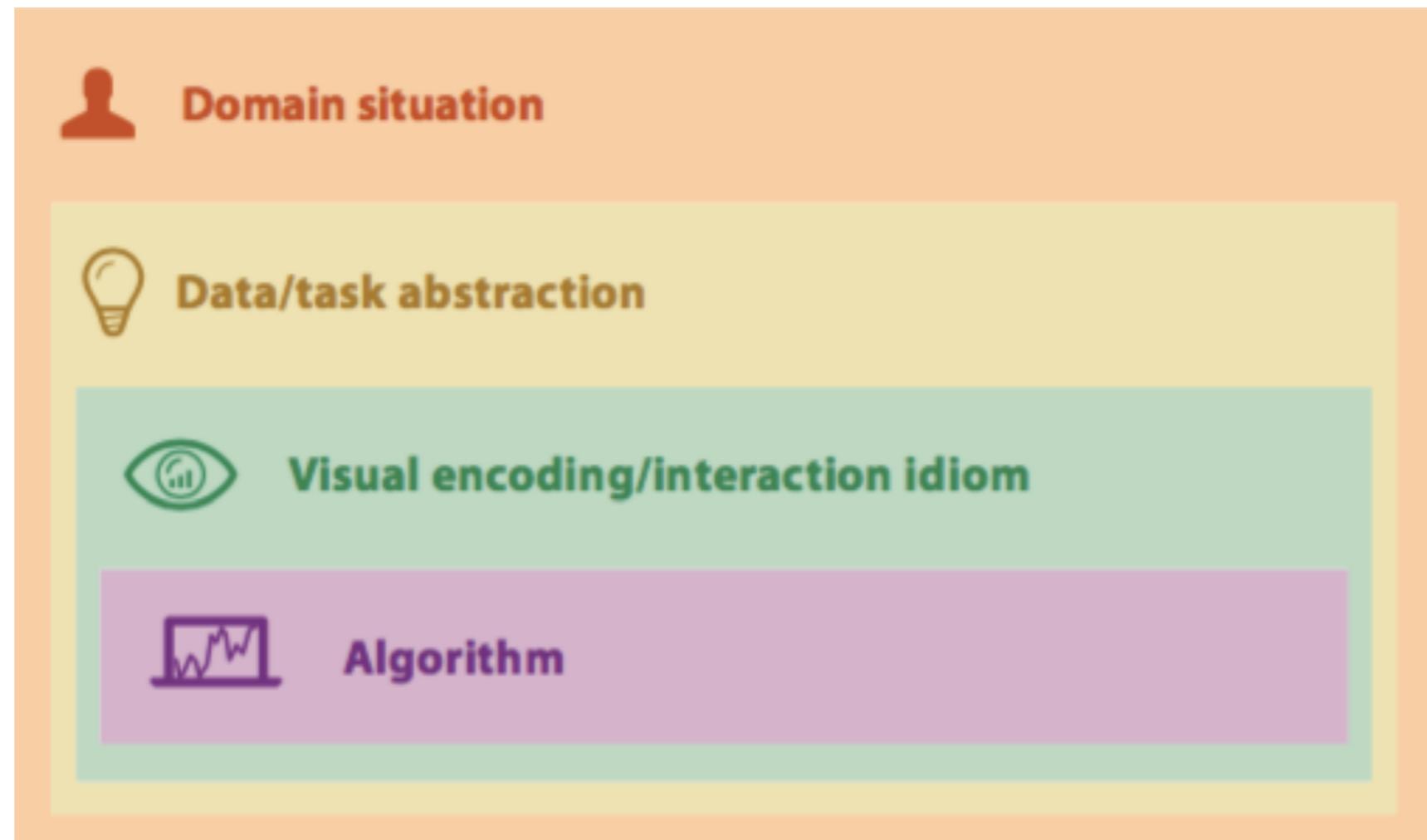
DESIGN

- ▶ What is design?
 - ▶ develop a solution to a (wicked) problem
 - ▶ has a clear purpose
-
- ▶ What design is not
 - ▶ art
 - ▶ making things pretty



MUNZNER LEVELS OF DESIGN -> HOW TO DESIGN VISUALISATION

- ▶ Nested levels
- ▶ Wrong choices at one level can cascade to lower levels

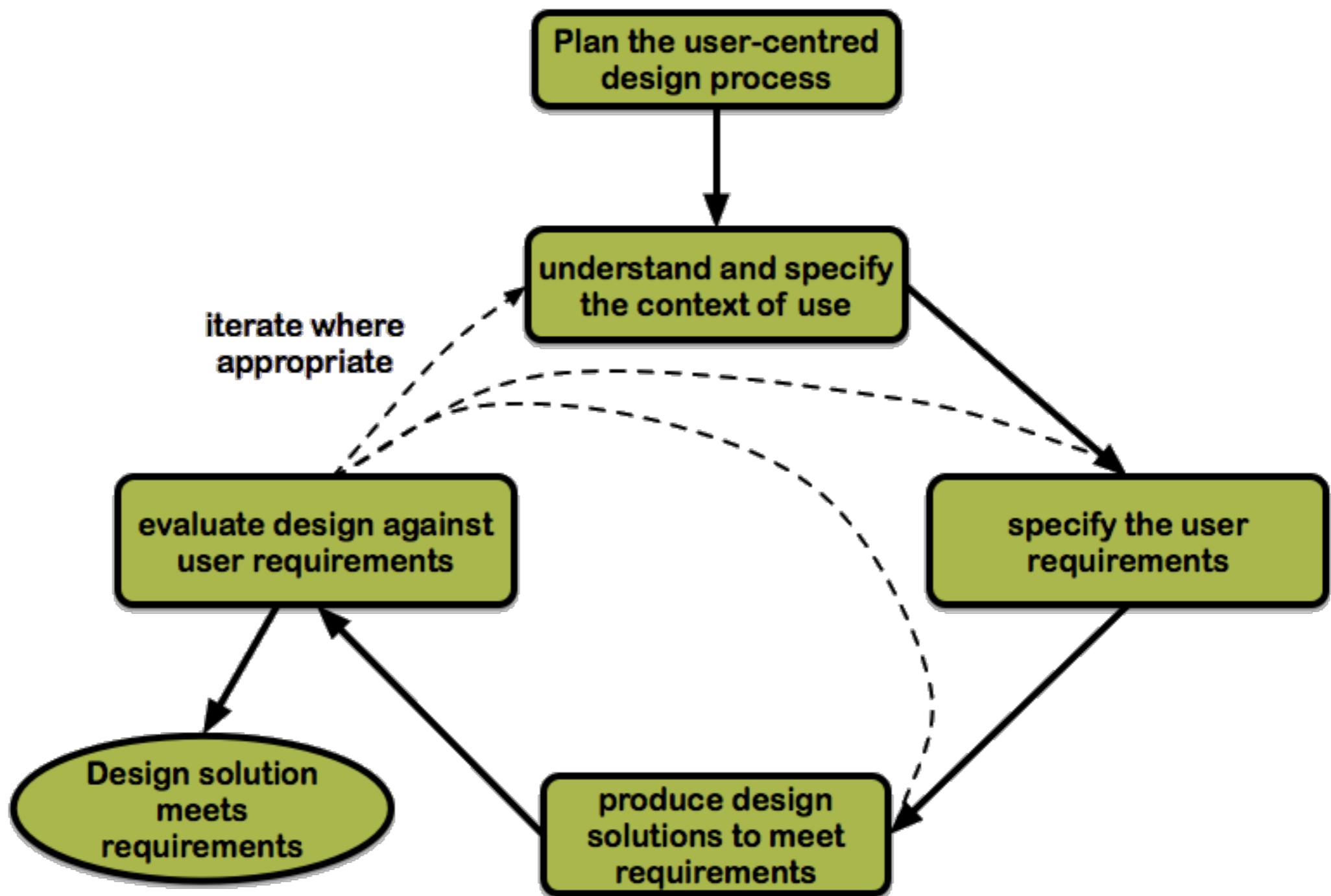


DOMAIN SITUATION

- ▶ The users, their interest, their questions and their data
- ▶ Specialised vocabulary
- ▶ Learn about domain:
 - ▶ interviews, observation, literature review... (User-Centred Design)
- ▶ Identify requirements



USER-CENTRED DESIGN



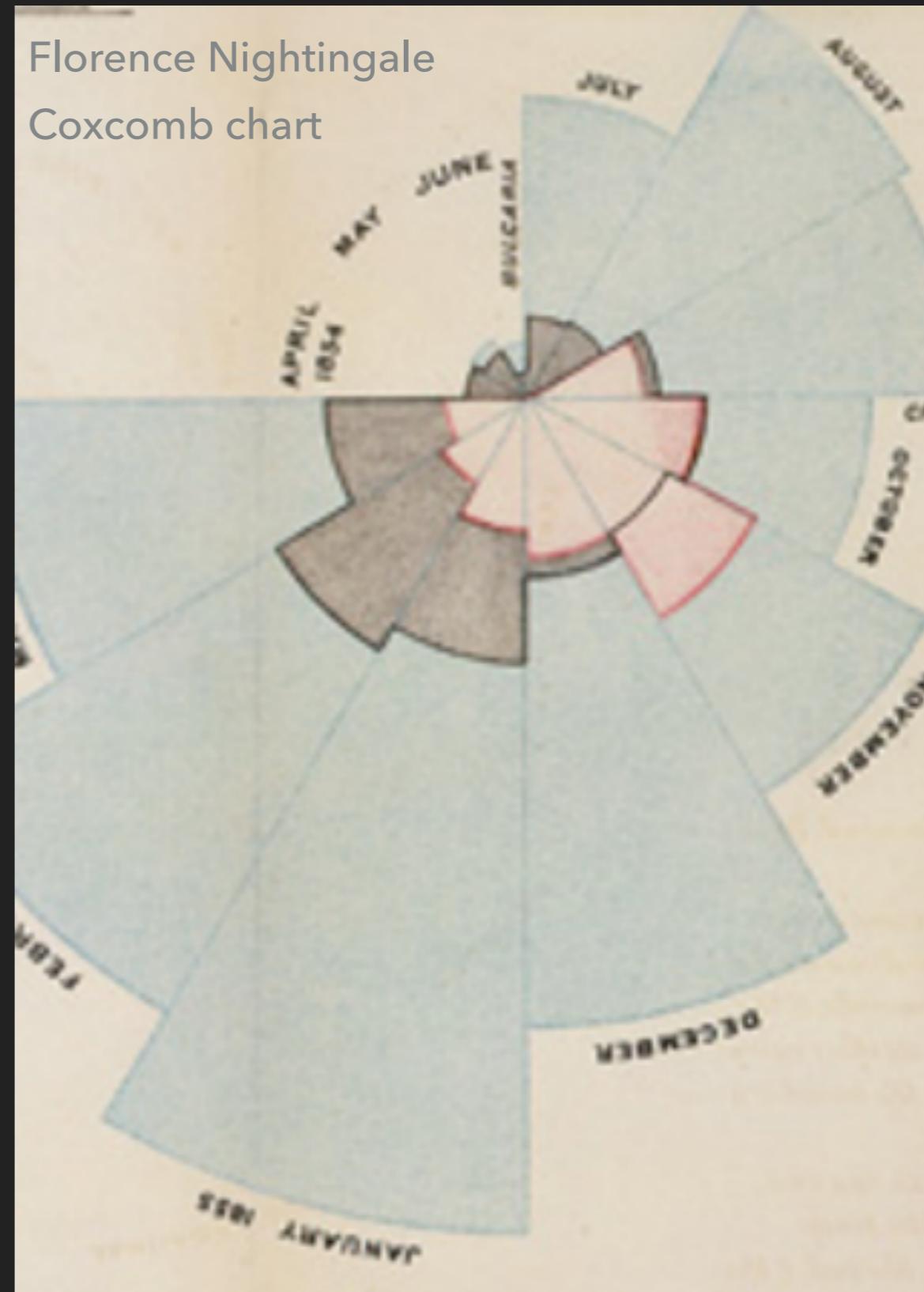
DATA/TASK ABSTRACTION

- ▶ Identify task and data types
- ▶ Try to identify domain independent task
 - ▶ “search for target in unknown location...”, “identify a trend...”, “find a correlation...”
- ▶ Work out what data to use and how
 - ▶ encoding, transformation...

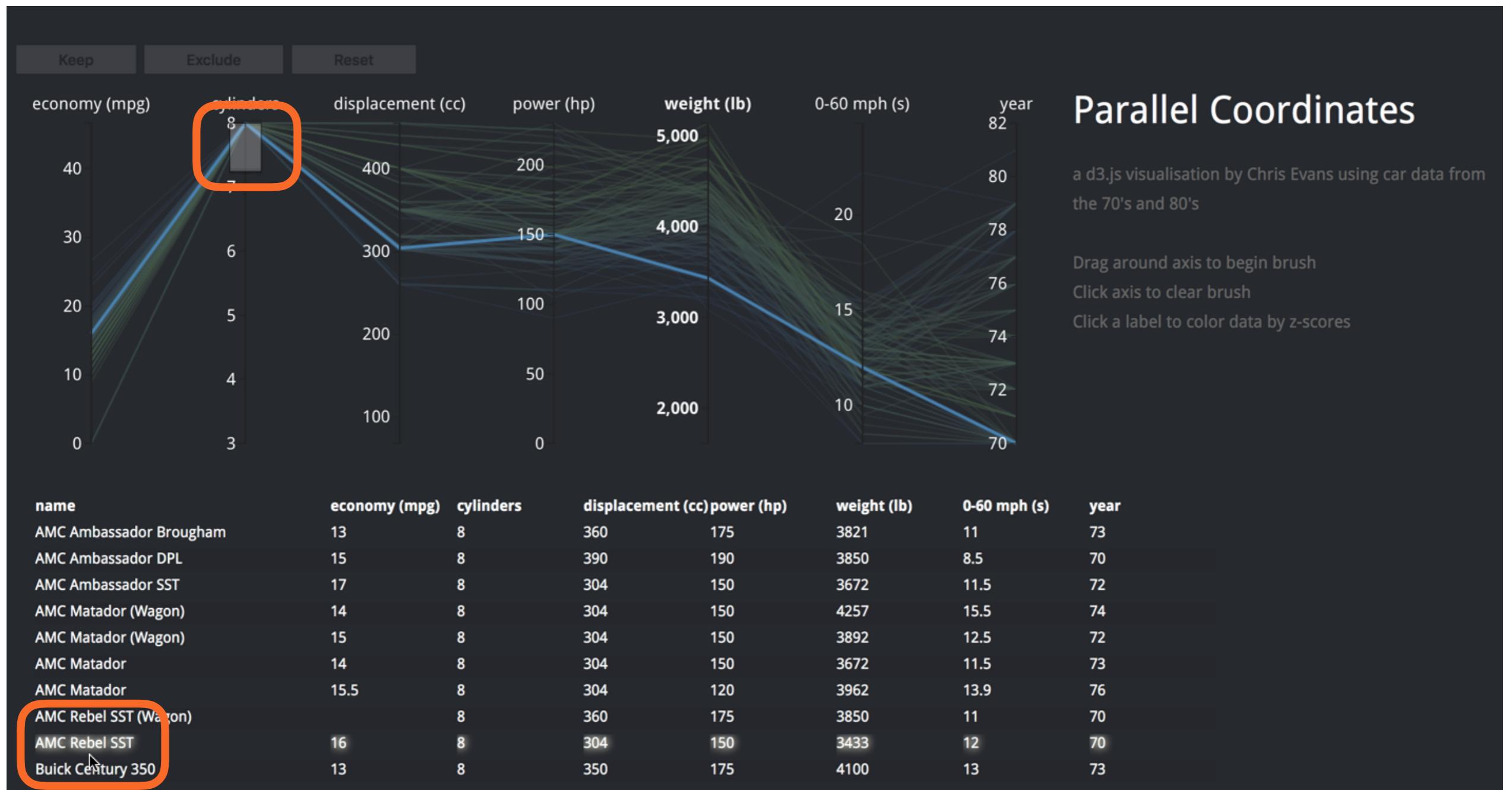


VISUAL ENCODING/INTERACTION IDIOM

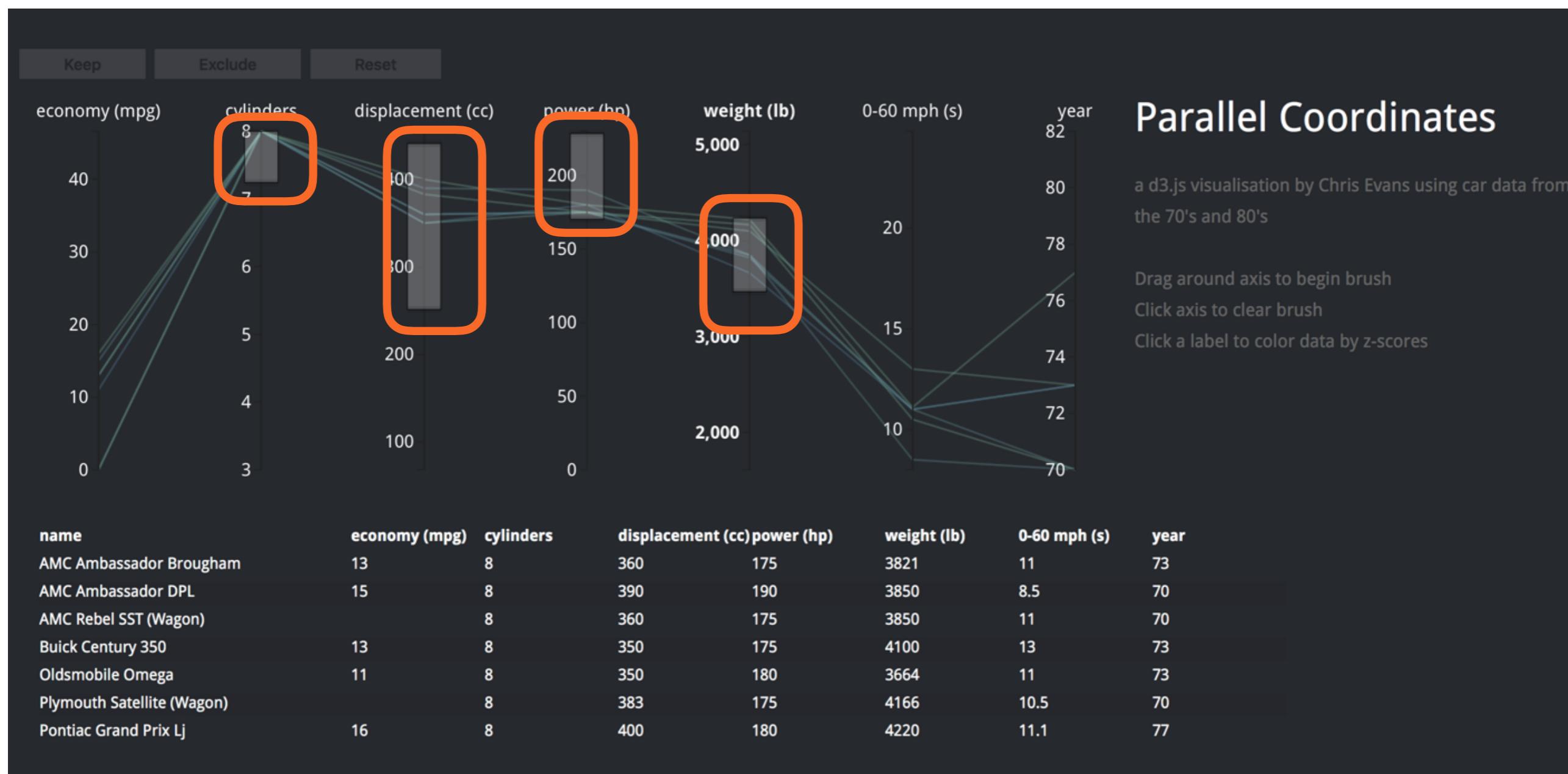
- ▶ Determine the visual representation of the data
 - ▶ **idiom:** a distinct visual approach
- ▶ Visual encoding idiom
- ▶ Interaction idiom - how users can change what they see



INTERACTION



INTERACTION



ALGORITHM

- ▶ Procedure that allows a computer to implement visualisation

```
<html>
  <head>
    <title>Parallel Coordinates</title>
    <link type="text/css" rel="stylesheet" href="ex.css?3.2"/>
    <script type="text/javascript" src="../protovis-r3.2.js"></script>
    <script type="text/javascript" src="cars.js"></script>
    <style type="text/css">

      #fig {
        width: 880px;
        height: 460px;
      }

      #title {
        position: absolute;
        top: 70px;
        left: 200px;
        padding: 10px;
        background: white;
      }

      large {
        font-size: medium;
      }

    </style>
  </head>
  <body><div id="center"><div id="fig">
    <script type="text/javascript+protovis">

      // The units and dimensions to visualize, in order.
      var units = {
        cyl: {name: "cylinders", unit: ""},
        dsp: {name: "displacement", unit: " sq in"},
        lbs: {name: "weight", unit: " lbs"},
        hp: {name: "horsepower", unit: " hp"},
        acc: {name: "acceleration (0-60 mph)", unit: " sec"},
        mpg: {name: "mileage", unit: " mpg"},
        year: {name: "year", unit: ""}
      }

      var dims = pv.keys(units);

      /* Sizing and scales. */
      var w = 820,
          h = 420,
          fudge = 0.5,
          x = pv.Scale.ordinal(dims).splitFlush(0, w),
          y = pv.dict(dims, function(t) pv.Scale.linear(
            cars.filter(function(d) !isNaN(d[t])),
            function(d) Math.floor(d[t])-fudge,
            function(d) Math.ceil(d[t]) +fudge
          ).range(0, h)),
          c = pv.dict(dims, function(t) pv.Scale.linear(
            cars.filter(function(d) !isNaN(d[t])),
            function(d) Math.floor(d[t])-fudge,
            function(d) Math.ceil(d[t]) +fudge
          ).range(0, h));
    </script>
  </div></div>
```

THREATS TO VALIDITY - WHERE IT CAN GO WRONG!

Domain situation

You misunderstood their needs

Data/task abstraction

You're showing them the wrong thing

Visual encoding/interaction idiom

The way you show it doesn't work

Algorithm

Your code is too slow

VALIDATION

Domain situation

Observe target users using existing tools



Data/task abstraction



Visual encoding/interaction idiom

Justify design with respect to alternatives



Algorithm

Measure system time/memory

Analyze computational complexity

Analyze results qualitatively

Measure human time with lab experiment (*lab study*)

Observe target users after deployment (*field study*)

Measure adoption

THREATS AND VALIDATION AT EACH LEVEL

! **Threat** Wrong problem

✓ Validate Observe and interview target users

! **Threat** Wrong task/data abstraction

! **Threat** Ineffective encoding/interaction idiom

✓ Validate Justify encoding/interaction design

! **Threat** Slow algorithm

✓ Validate Analyze computational complexity

Implement system

✓ Validate Measure system time/memory

✓ Validate Qualitative/quantitative result image analysis

Test on any users, informal usability study

✓ Validate Lab study, measure human time/errors for task

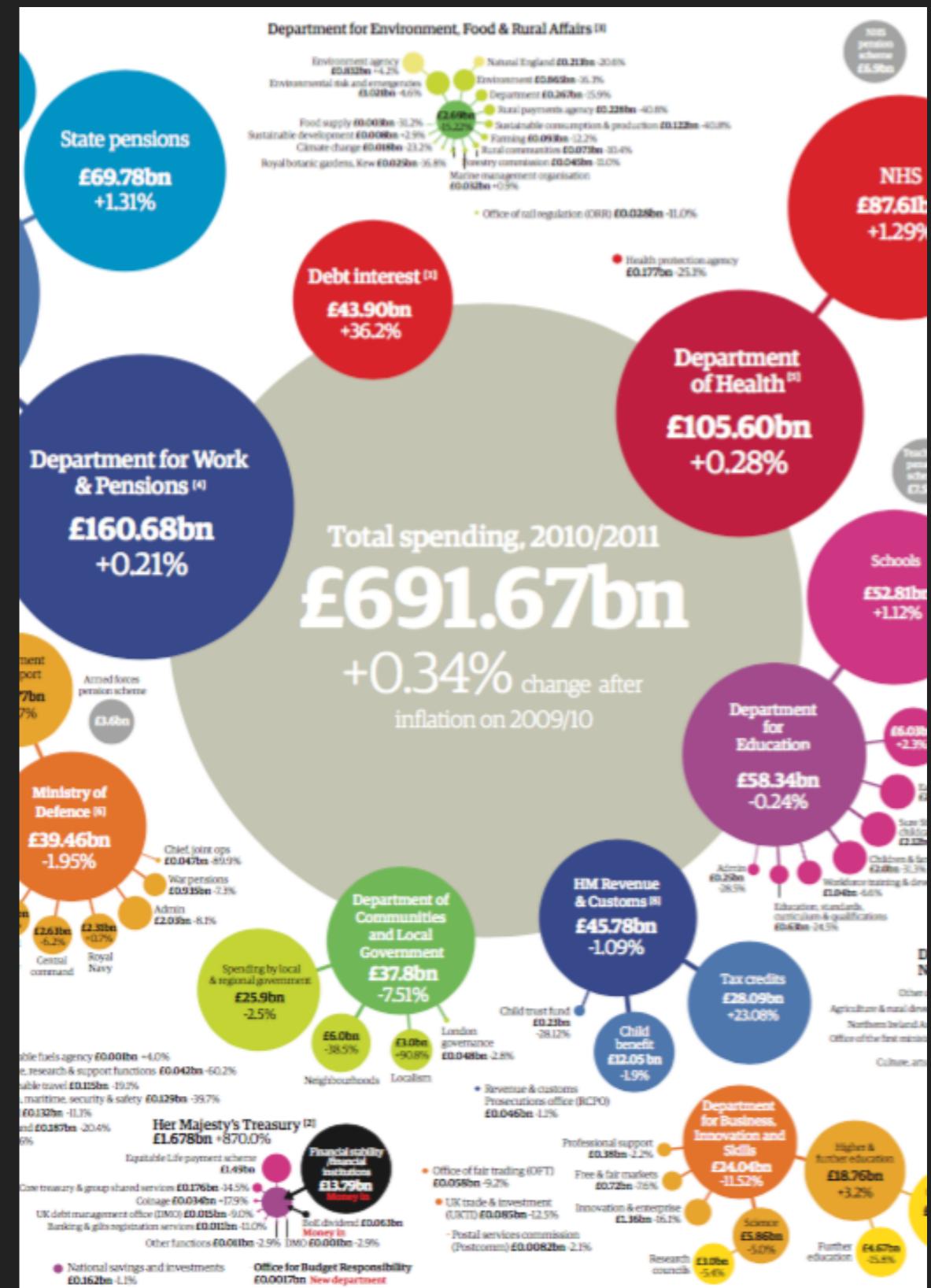
✓ Validate Test on target users, collect anecdotal evidence of utility

✓ Validate Field study, document human usage of deployed system

✓ Validate Observe adoption rates

VALIDATION

- ▶ use prototyping to validate designs with users early and often
- ▶ be prepared to iterate through or between the levels





DESIGN ENVIRONMENT

What:

- ▶ come up with design ideas

Why:

- ▶ develop a creative approach to design

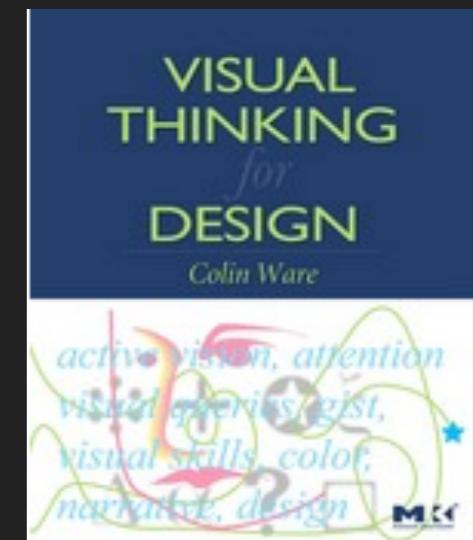
How:

- ▶ learn how to use sketches to generate and critique design ideas



DESIGN ENVISIONMENT

Design Studio
► VTD Ch 8



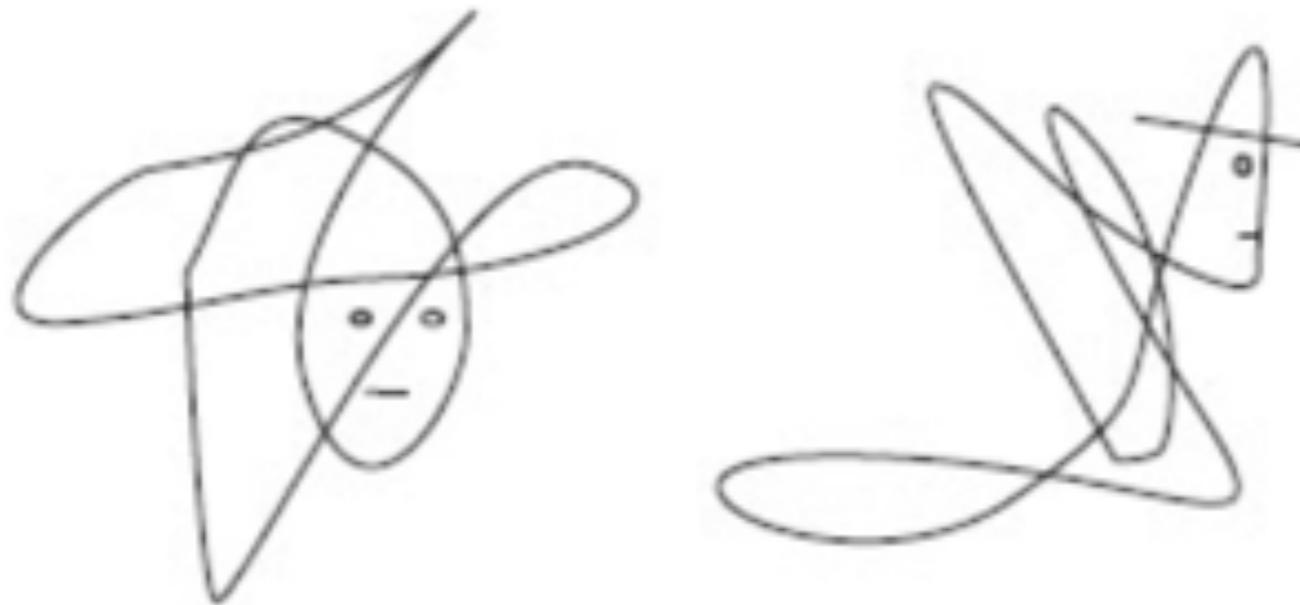
WHY SKETCH?

- ▶ a sketch is open to interpretation and discussion
- ▶ encourages exploration of ideas



Ware (2008)

SMALL ALTERATIONS... CHANGE PERCEPTION OF OBJECT



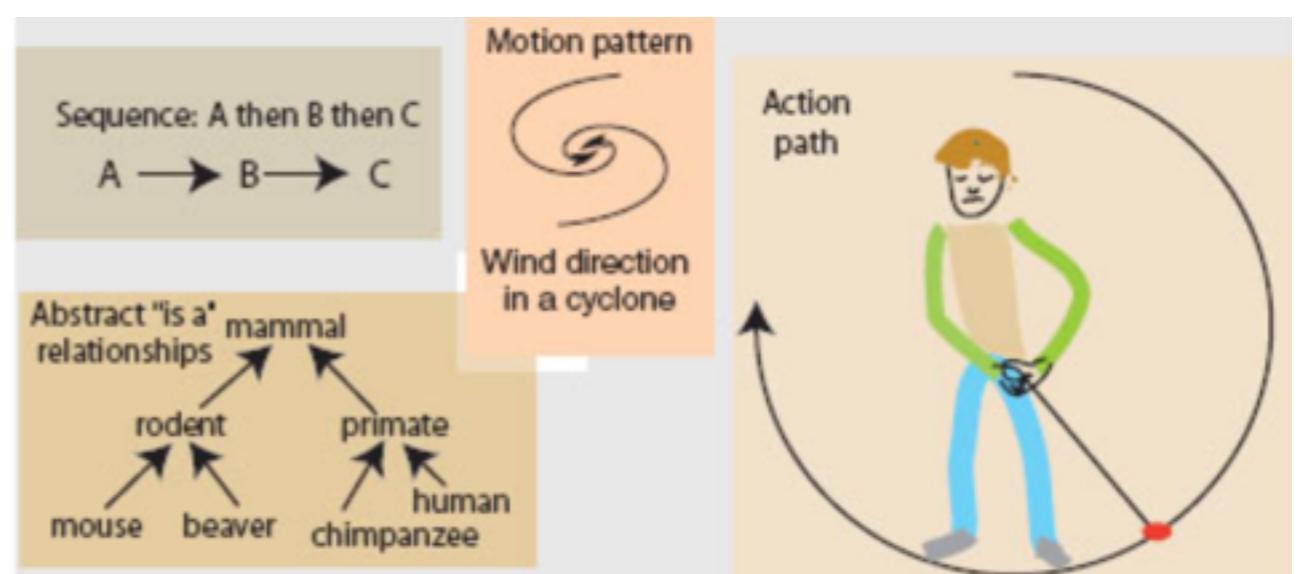
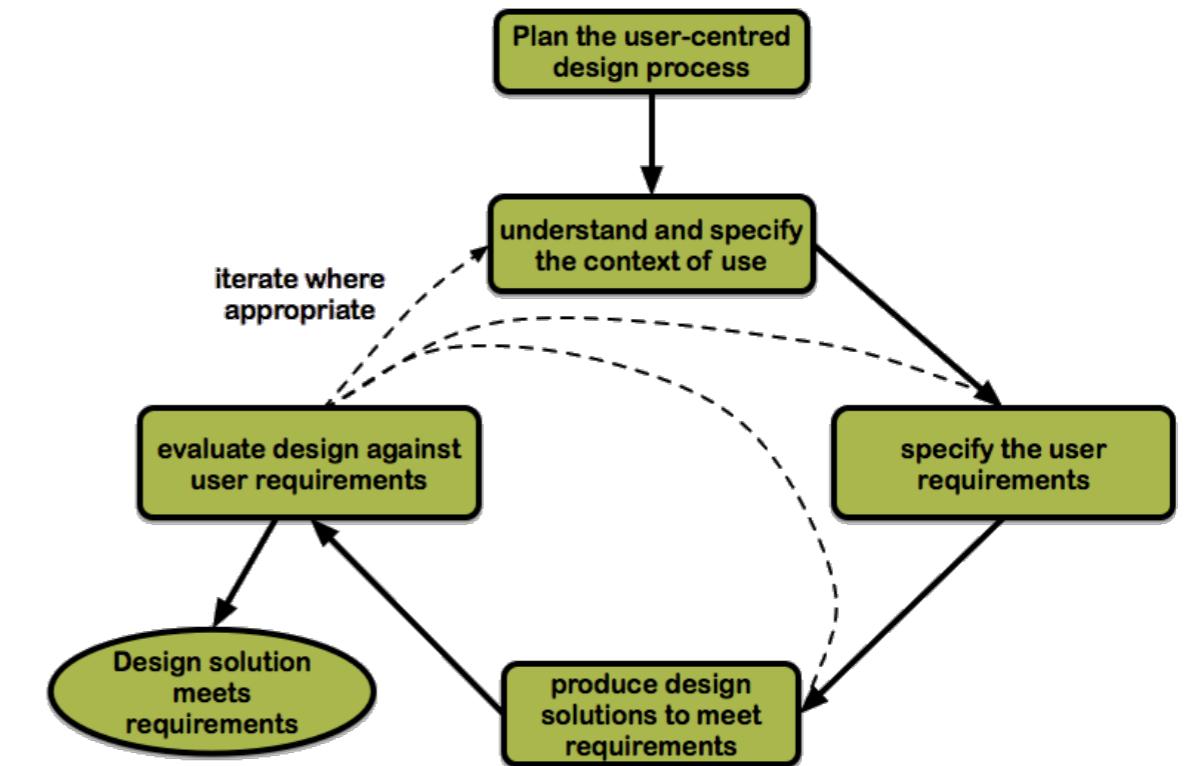
Ware (2008)

- ▶ Visual brainstorming

Massironi (20002)

DIAGRAMS – TO REPRESENT IDEAS

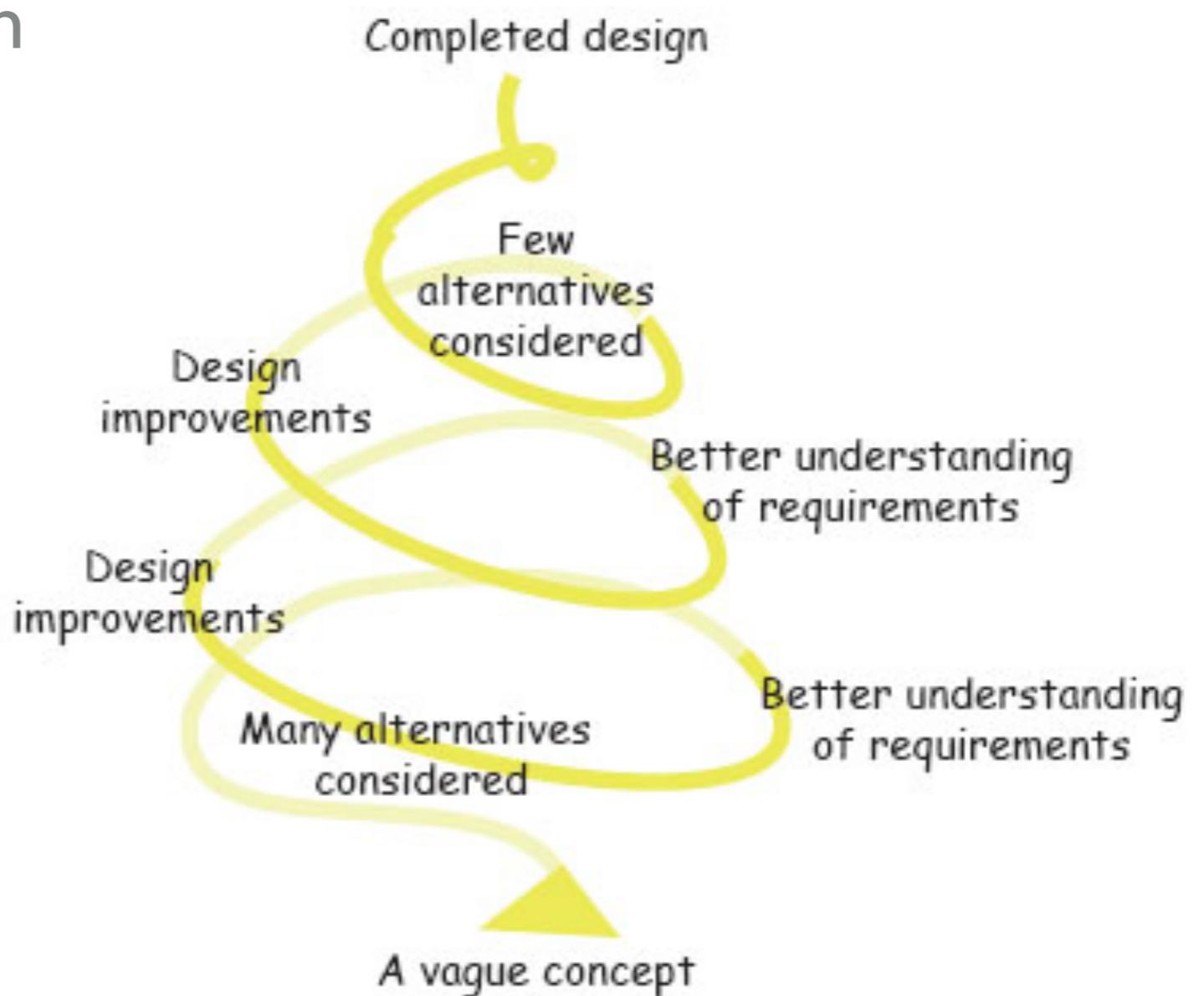
- ▶ Cognitive tool
- ▶ Conceptual structures (not literal representation)
- ▶ Arrows link to abstract meaning - motion, causal relationships, sequences, direct attention...



Ware (2008)

SPIRAL DESIGN METHOD

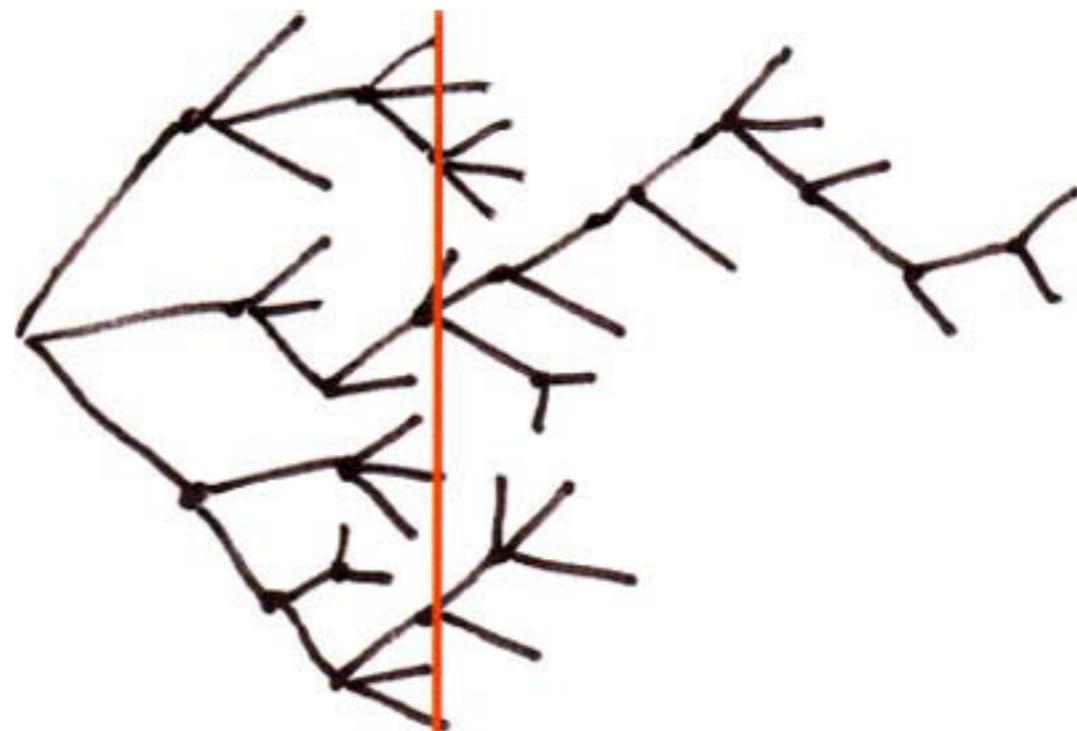
- ▶ requirements and design
- ▶ client needs to see design to appreciate what is possible
- ▶ start vague, iterate and refine
- ▶



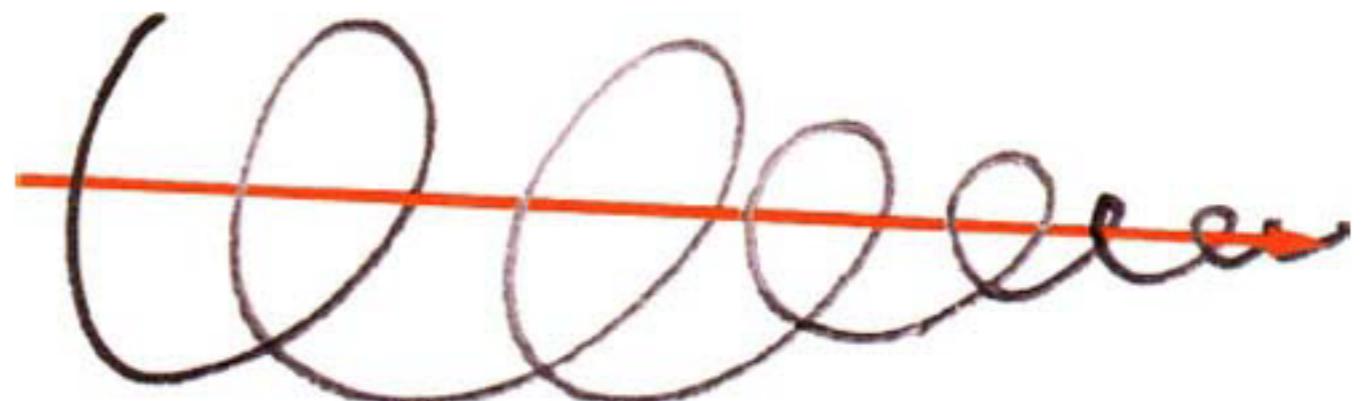
Ware (2008)

DESIGN

Concept Design

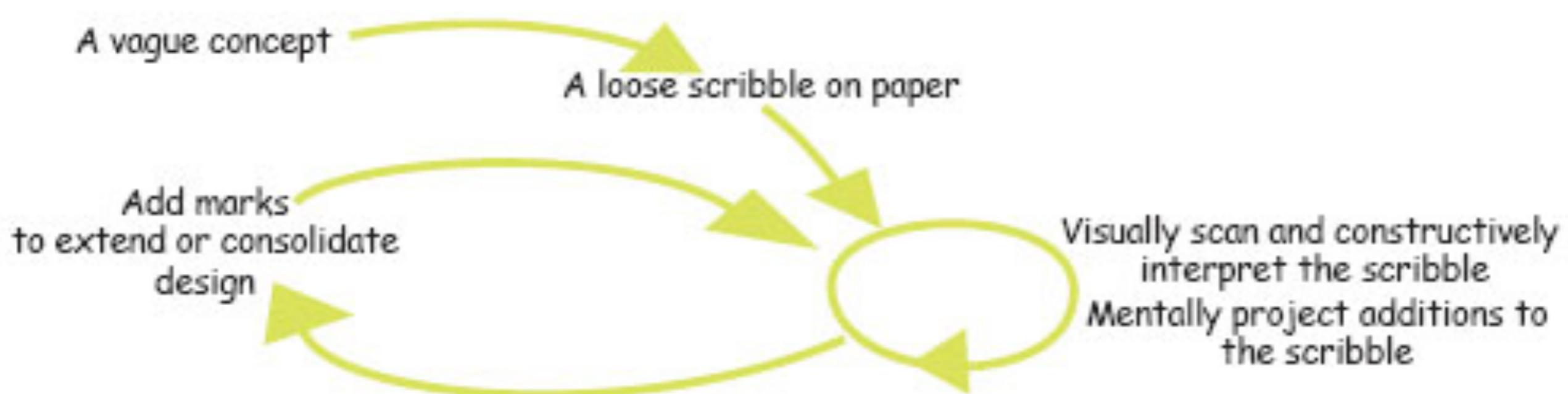


Prototype Design

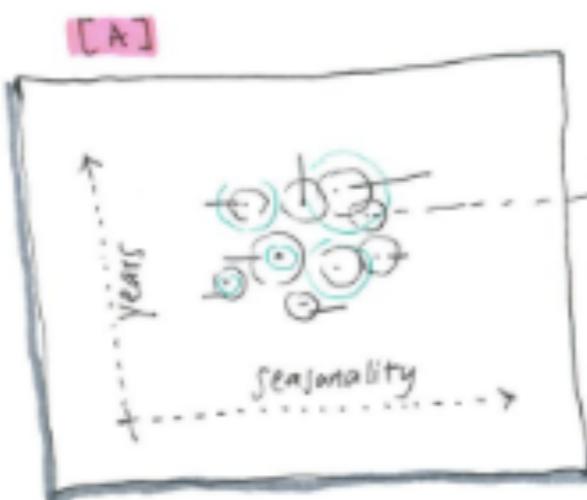


DESIGN SKETCHING

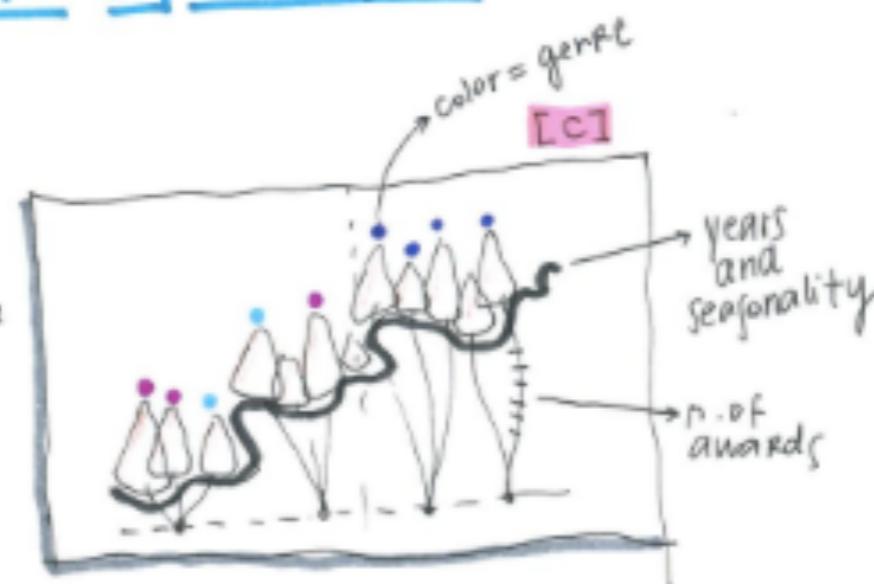
- ▶ Using the sketch to construct, explore and think through the design



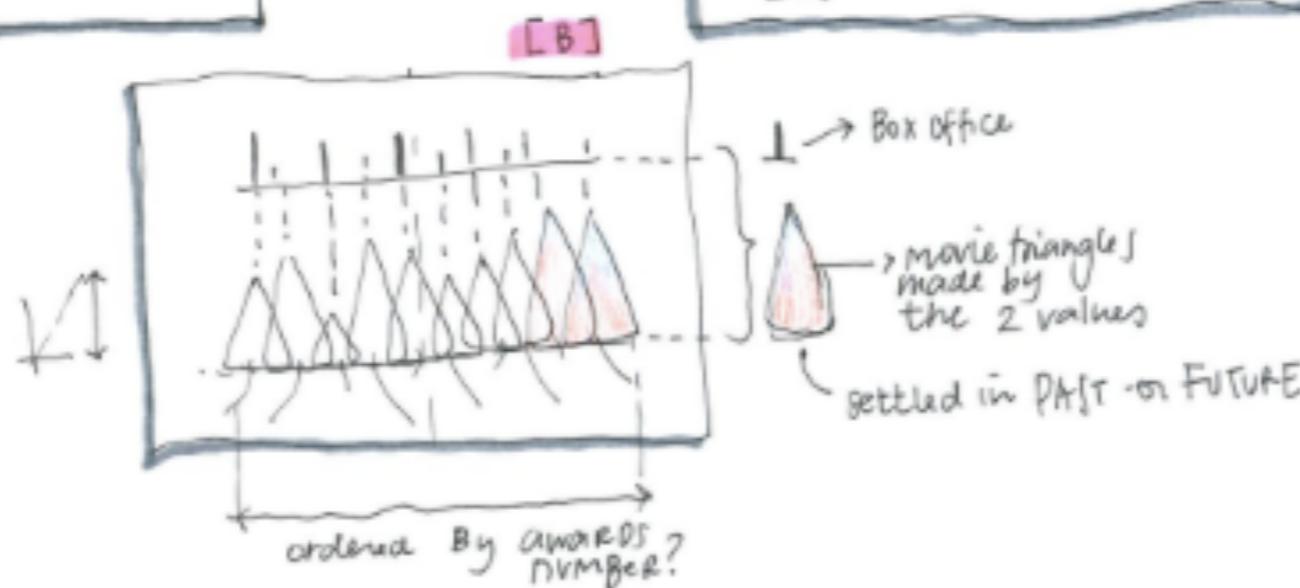
[1] DRAWING TO STRUCTURE INFORMATION



→ movie
→ (5) sale price
→ (1) budget
→ (2) box office

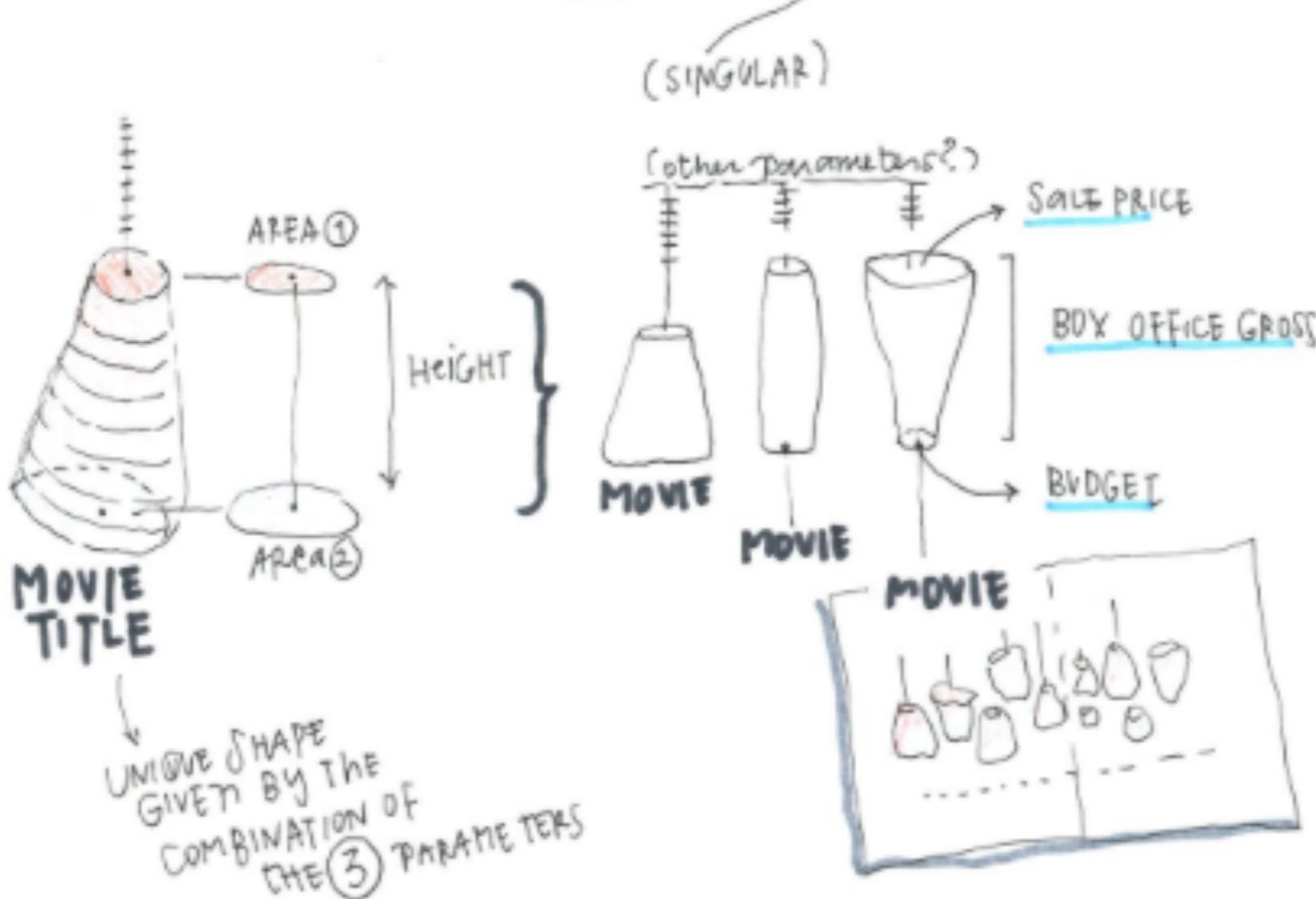


→ years and seasonality
→ n. of awards



→ Box office
→ movie triangles made by the 2 values settled in PAST or FUTURE

[2] DRAWING to EXPLORE ELEMENTS



The better defined the goals of an artefact, the narrower the variety of forms it can adopt.

Alberto Cairo

Data visualisation
educator and author

