

# DESIGN

Crafting better data visualisations

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# “DESIGN” AS A PROCESS, RATHER THAN BEING THE ICING ON THE CAKE

**BIOVISUALISATION EDUCATION**  
WHAT SHOULD STUDENTS KNOW?  
MATT WARD

DATA MINING + BIO STATS + BIO VIS?

7 WEEK COURSE OF LECTURES PLUS 7 WEEKS OF READING

COMBINED GRAD/UNDERGRAD

STRUCTURED WEEKS

PROGRAMMING LANGUAGES TEXT BOOKS

TREES ... ... NETWORKS CONVENTIONS ... DESIGN & EVALUATION

DESIGN & EVALUATION

TOO LITTLE, TOO LATE IN THE LECTURES?  
\* DIFFERENTIATING GOOD VS BAD VISUALISATION  
\* WAYS OF EVALUATING VISUALISATIONS

RETROSPECTIVE

TOO MUCH TO TRY AND COVER?  
BETTER AS A SEQUENCE OF COURSES?  
SEPARATE BIOLOGY & CS STUDENTS? (NO!)  
PUT DESIGN & EVALUATION EARLIER ON

\* CURRICULUM?  
\* TARGET AUDIENCE? (EXPERTISE)  
\* SKILLS TAUGHT & ACHIEVED?

TECHNOLOGY BUILDERS

TECHNOLOGY USERS

\* CS STUDENTS → SHORT BIOLOGY COURSES  
SHALLOW BIO KNOWLEDGE SURVEY?

\* BIOLOGY STUDENTS → COURSES ON USING SPECIFIC BIO VIZ TOOLS & TECHNIQUES

\* EVERYONE → DELIVER A COURSE THAT IS RELEVANT TO BOTH. LANGUAGE

ZOMBIES VS HUMANS

COMMON REPRESENTATIONS IN BIOLOGY

WK1. WK2. WK3. WK4.

READING GROUPS

DISCUSSION (PARTIALLY GUIDED)

GRAD STUDENTS

ORIPS

\* SHOW LOTS OF WORKING EXAMPLES  
\* USE A PROGRAMMING ENV. THAT SUPPORTS RAPID DEV  
\* PROVIDE LOTS OF SAMPLE DATASETS  
\* FIGURE OUT HOW TO FIND TIME TO DISCUSS PERCEPTION & COGNITION

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# SCHEDULE

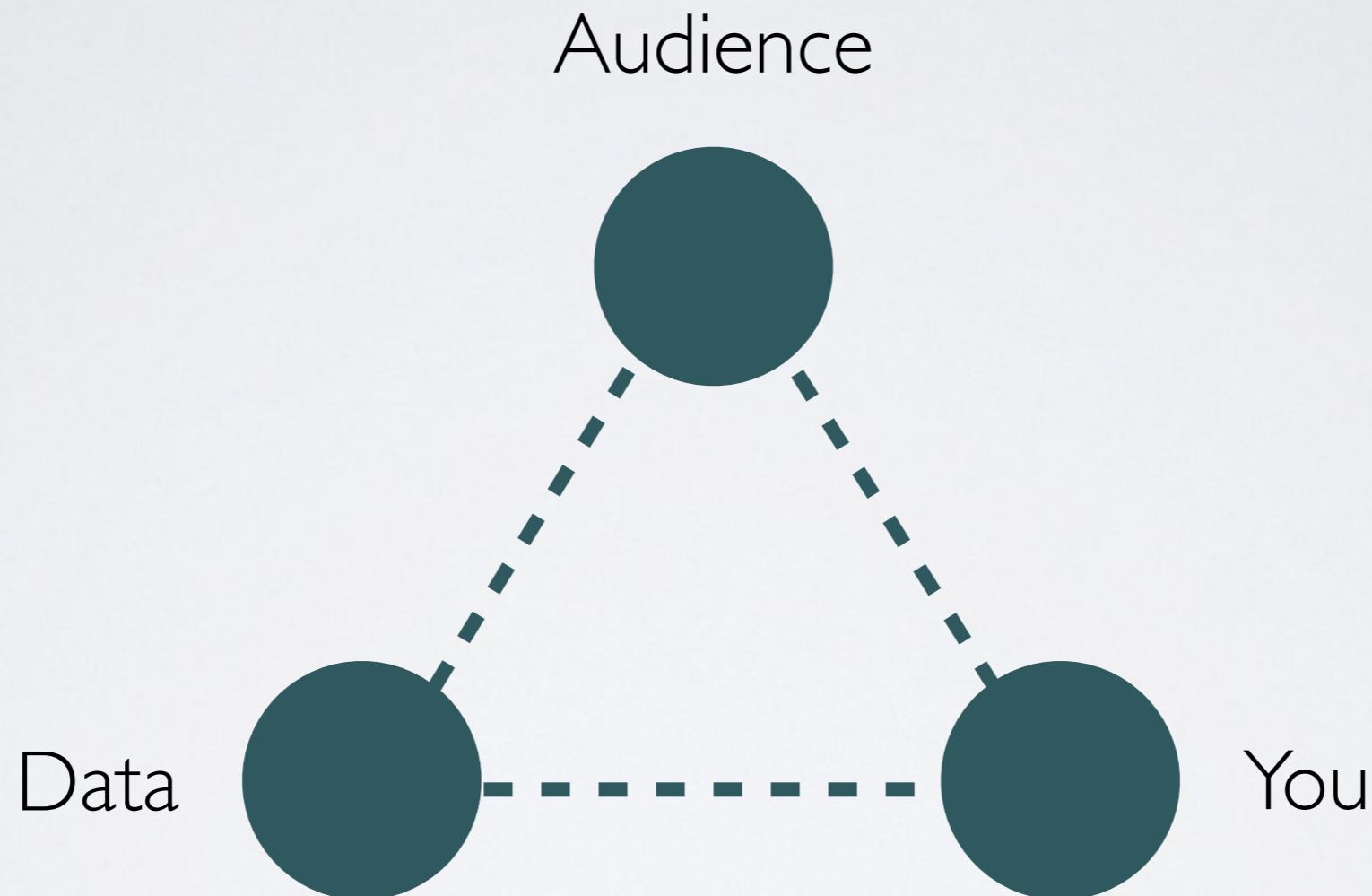
1. FRAMING THE PROBLEM
2. COMMUNICATION & INTERACTION
3. SKETCHING (an introduction)
4. IDEA GENERATION
5. SKETCHING (developing possible solutions)
6. CRITIQUE

# I. FRAMING THE PROBLEM

# WHY ARE YOU MAKING THIS DATA VISUALISATION?

For more on asking questions, see... <http://bit.ly/1iX4u7H>

# THINGS THAT INFLUENCE HOW YOU VISUALISE DATA



# DATA

- \* Dimensions, properties, and relationships
- \* Conventions?
- \* Constraints?

# YOU

- \* What do you want to achieve?
- \* Are you trying to use data to tell a story?
- \* Do you want to provide insight into data, for exploration?

# AUDIENCE

- \* Who are they?
- \* What are they trying to achieve?
- \* Where does this visualisation fit in with their research or their work?
- \* What activities do they need to perform or knowledge do they need to gain?



**Cole Nussbaumer**  
@storywithdata

Nov 9, 2015

After identifying who our audience is and what we need from them, THEN we can think about the data. #SWDbook

THE MORE COMPLEX THE SCENARIO, THE  
MORE TIME YOU SHOULD SPEND ON  
ARTICULATING YOUR GOALS AND THE  
PROBLEMS YOU AIM TO SOLVE

USE DIFFERENT KINDS OF  
“DESIGN STATEMENTS” TO  
FRAME A PROBLEM

# PROBLEM STATEMENT

Context \_\_\_\_\_

Observation(s) \_\_\_\_\_

How might we... \_\_\_\_\_

So that... \_\_\_\_\_

(Download a [template + example](#))

# PROBLEM STATEMENT: EXAMPLE

The target-disease relationship page **is designed to** present data from different sources in a single page, providing conceptual integration of these, and an indication our our confidence in the relationship.

**We have observed** that people struggle to “join up” those data, and understand the overall message, and this makes the page confusing and less valuable than we want it to be.

**How can we** improve the target-disease relationship page, **so that** it makes more sense to people, so that they more easily get a idea of data coverage and confidence, and so that it demonstrates value?

# STATEMENT OF GOALS

after Noah Iliinsky

“Show the relationship between A and B [and C...]  
across X [and Y] from m to n”

and you might add

“in order to determine our best and worst  
performing algorithms.”

# HYPOTHESIS STATEMENT

We believe that [doing this/building this feature/creating this experience] for [these people/personas] will achieve [this outcome].

We will know this is true when we see [this feedback, quantitative measure, or qualitative insight].

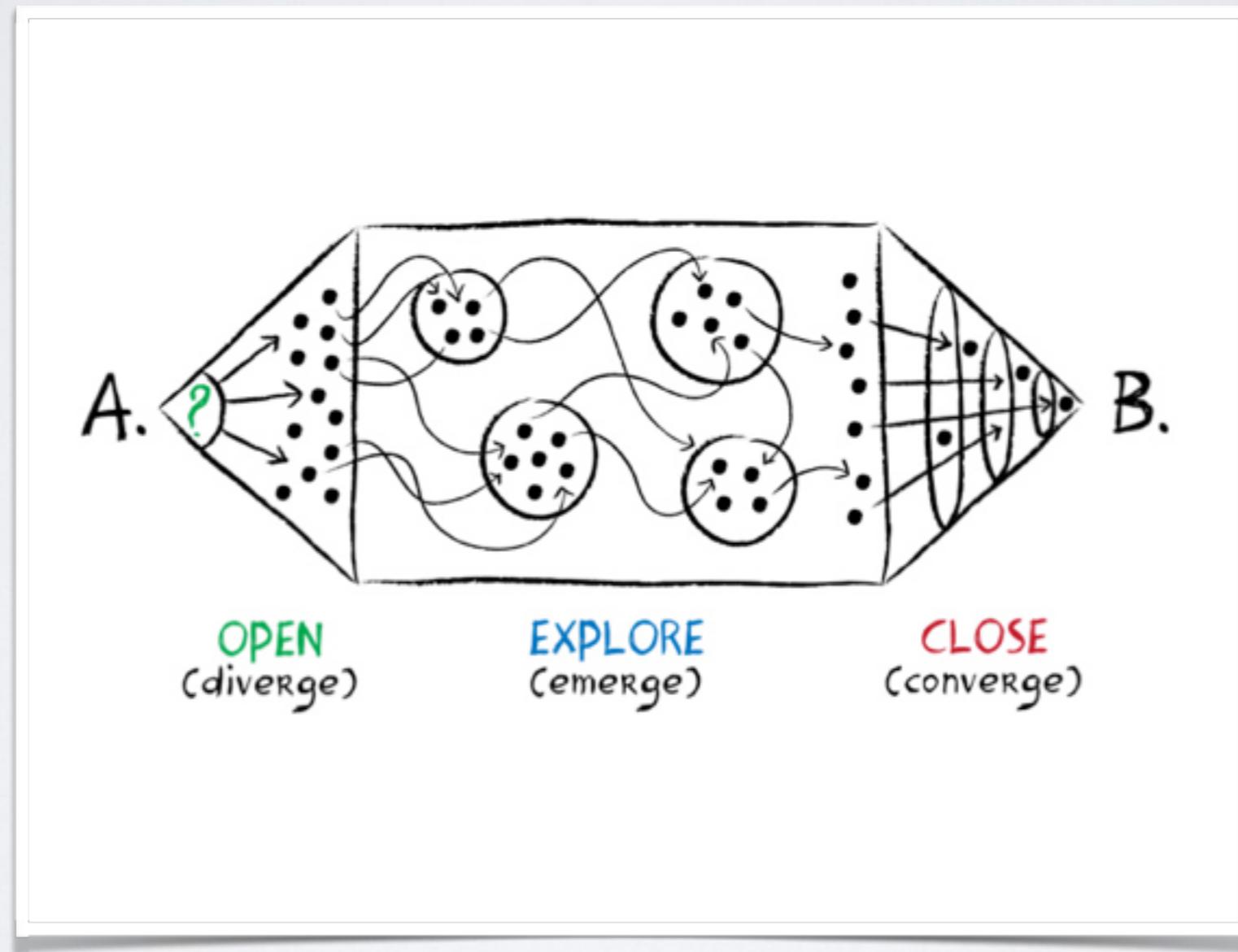
(Download a [template + example](#))

# HYPOTHESIS STATEMENT: EXAMPLE

We believe that creating a simple data visualisation that gives an overview of data from different sources for biological researchers and disease experts will allow them to quickly see the relevance of a particular gene.

We will know this is true when we see greater engagement with target-disease relationship pages, and our users tell us about the value they provide.

# FROM HYPOTHESIS TO EXPERIMENT



© Sunni Brown (used with permission) – co-author of Gamestorming  
<http://bit.ly/1MpRlw>

# SPEND TIME ON ARTICULATION

“A good problem statement [or similar articulation...] is worth a thousand prototypes”

– Will Evans –

“Fall in love with problems first, then with solutions”

– Tomer Sharon –

# ARTICULATION ACTIVITY



Try using the different “design statement” templates to articulate what you could do with your data, why, and for whom. You’re going to need these later.

- \* Problem statement
- \* Hypothesis statement
- \* Statement of goals

# 2. COMMUNICATION & INTERACTION

IT'S ABOUT THE PEOPLE, PEOPLE!

# SIMPLICITY?

~~Complexity vs Simplicity~~

Complexity + Clarity

Let's aim to displace complexity into the algorithms behind-the-scenes.

“The ability to simplify means to eliminate the unnecessary so that the necessary may speak”

– Hans Hofmann –

# SOME MORE ARTICULATION

Characterising our audience and their key activities



# “PROTO” PERSONA

Picture, name, role	Behaviours & characteristics
Needs or pain points	Would be served by...



# “PROTO” PERSONA: EXAMPLE



Yun;  
clinical researcher

## Behaviour & Characteristics

Yun spends about half of her time in the lab but uses bioinformatics tools and software to analyse and process disease-related data.  
Often stays late (experiments!).

## Needs & pain points

Often doesn't have time to remember how to use certain software;  
Feels overwhelmed by latest huge datasets!  
Finds some visualisations overly-complex

## Would be served by...

Summary reports of data with highlights;  
Focus on certain genes by default;  
Add and mix data, perhaps in “layers”

# KEY ACTIVITY DESCRIPTION

KEY ACTIVITY DESCRIPTION	Project:	Author:	Date:
ACTIVITY	Purpose & motivations		
Participants	Tools	Rules & conventions	Who does what
<small>Icon credits: Checklist by Rafael Farias Leão, Pulse by Nico Tzogalis, Scale by Stephanie Wauters, Person by Andrew Was from The Noun Project</small>			

Note: Tamara Munzner equates activities with “intended tasks”

@francisrowland / @emblebi

# KEY ACTIVITY DESCRIPTION: EXAMPLE

KEY ACTIVITY DESCRIPTION	Project:	Author:	Date:
 <b>ACTIVITY</b>  Comparison of genes across different lists		 <b>Purpose &amp; motivations</b>  Quickly visualise genes common between lists / unique to a list Show someone else that few genes are shared between lists	
 <b>Participants</b>  Yun; senior supervisor;  EMBL-EBI; NCBI; Orphanet	 <b>Tools</b>  HGNC Human Genome Nomenclature Committee; OMIM On-line Mendelian Inheritance in Man; Orphanet; custom program	 <b>Rules &amp; conventions</b>  Used to seeing Venn diagrams (these quickly get big and complicated!)	 <b>Who does what</b>  Supervisor defines lists; Yun identifies relevant genes for each list; Uses R to generate commonality Venn diagrams; and shares with supervisor;  Organisations offer access to data;
<small>Icon credits: Checklist by Rafael Farias Leão, Pulse by Nico Tzogalis, Scale by Stephanie Wauters, Person by Andrew Was from The Noun Project</small>			



# PEOPLE-FOCUSED ACTIVITY



Think about the audience for your data visualisation.

Why do they need to see the visualisation?

How will it help them?

What do they need to do?

Can you describe **people** from that audience?

Can you describe **key activities** that they might need to perform?

We'll use a couple of templates to help with this.

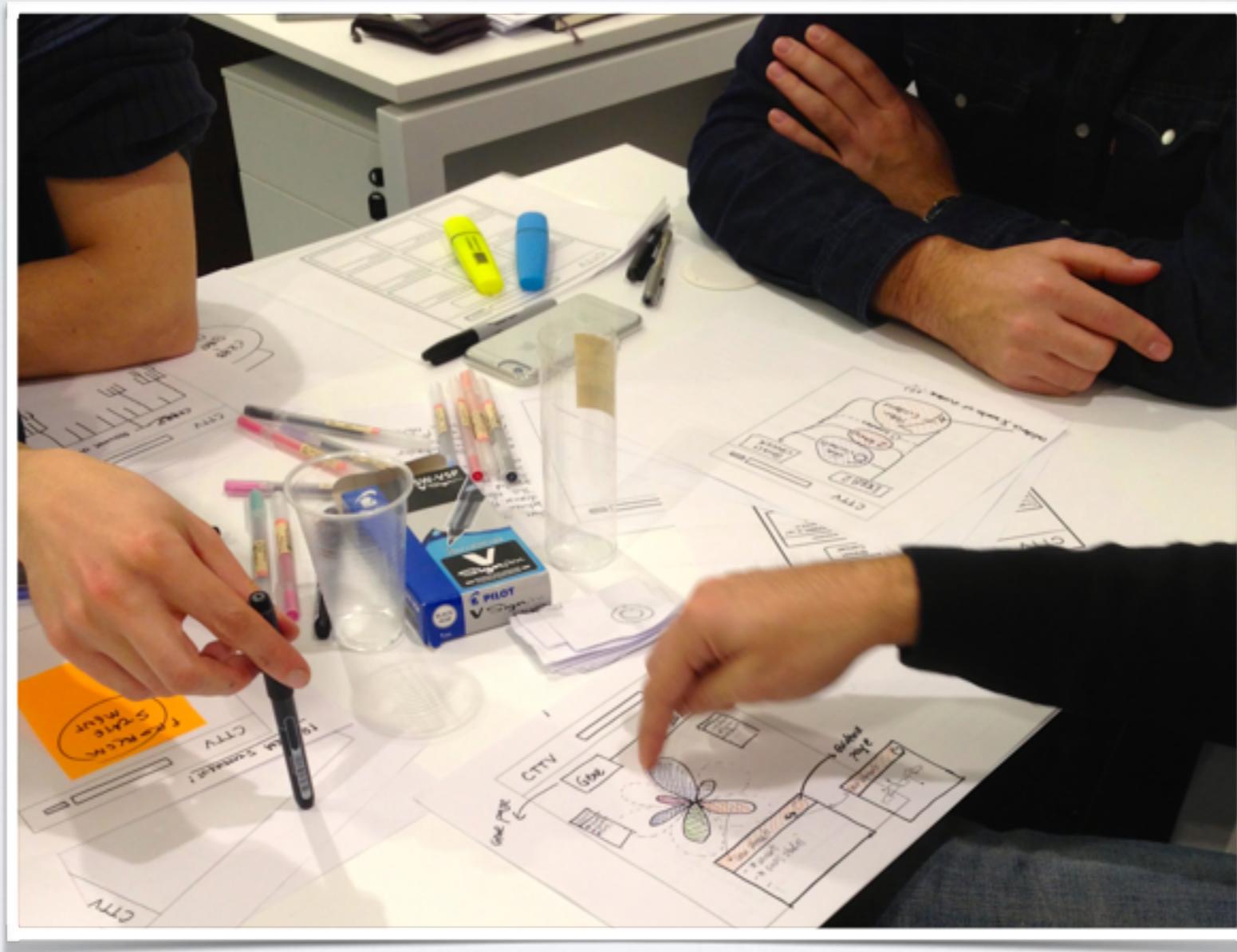
# RECOGNISE ASSUMPTIONS AND GAPS IN YOUR KNOWLEDGE

- \* Perhaps go back to your client
- \* Seek further articulation and definition
- \* Understand WHY

# 3. SKETCHING

an introduction

# USING PEN & PAPER



“Get the big things right during lofi, and the little things will follow in future iterations”

– *Marc Rettig* –

# SRSLY? SKETCHING FOR DATA VISUALISATION?!

OH YES.



Stef Posavec & Giorgia Lupi  
<http://www.dear-data.com/>

Eurographics Conference on Visualization (EuroVis) 2015  
H. Carr, K.-L. Ma, and G. Santucci  
(Guest Editors)

Volume 34 (2015), Number 3

**An Exploratory Study of Data Sketching for Visual Representation**

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<sup>1</sup>University of Calgary, Canada, <sup>2</sup>IRI Centre Pompidou, Paris, France

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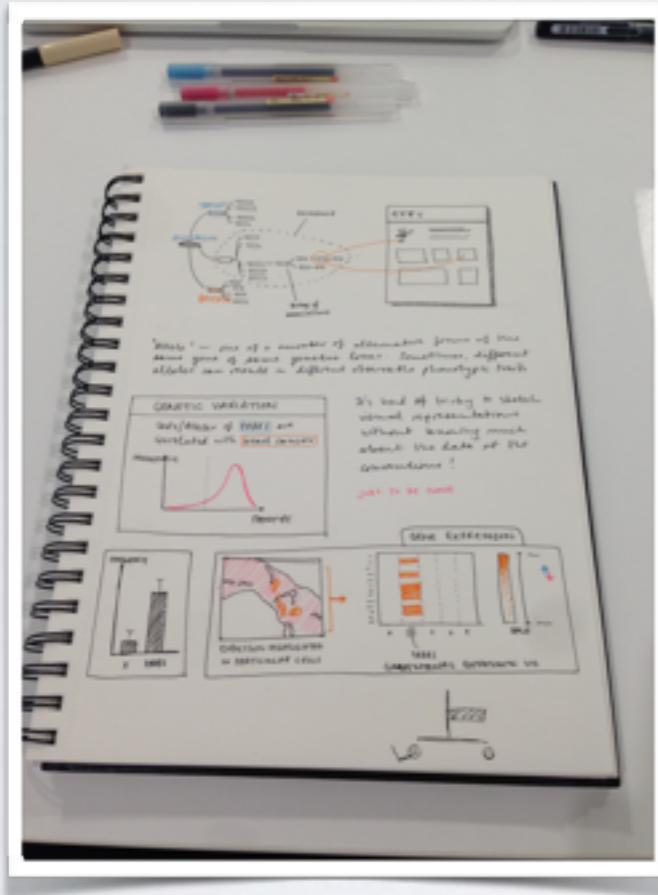
**Abstract**  
*Hand-drawn sketching on napkins or whiteboards is a common, accessible method for generating visual representations. This practice is shared by experts and non-experts and is probably one of the faster and more expressive ways to draft a visual representation of data. In order to better understand the types of and variations in what people produce when sketching data, we conducted a qualitative study. We asked people with varying degrees of visualization expertise, from novices to experts, to manually sketch representations of a small, easily understandable dataset using pencils and paper and to report on what they learned or found interesting about the data. From this study, we extract a data sketching representation continuum from numeracy to abstraction; a data report spectrum from individual data items to speculative data hypothesis; and show the correspondence between the representation types and the data reports from our results set. From these observations we discuss the participants' representations in relation to their data reports, indicating implications for design and potentially fruitful directions for research.*

Categories and Subject Descriptors (according to ACM CCS): H.5.2 [Information Interfaces and Presentation]: User Interfaces—

<http://bit.ly/1QyILRd>

# APPROACHES TO SKETCHING

Solo



Paired

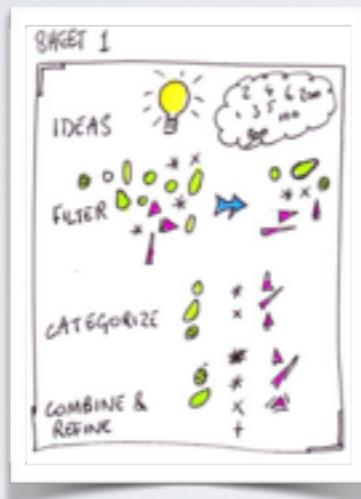


In groups



# METHODOLOGIES

Five design Sheets



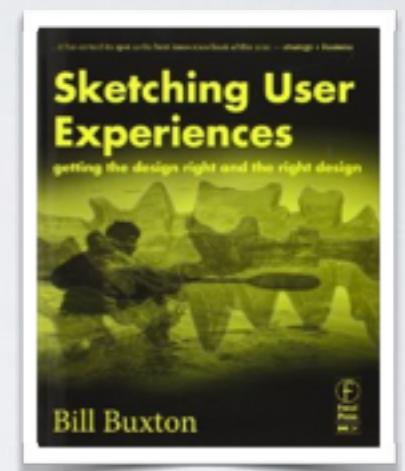
Design Studio



Five Sketches™



10 + 10



<http://fds.design/>

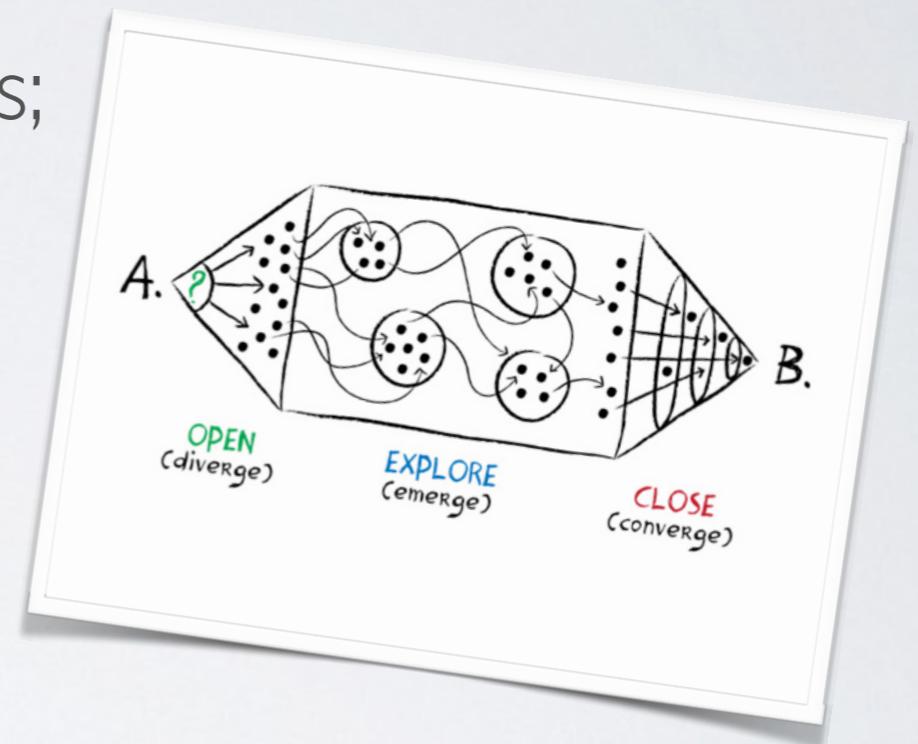
<http://bit.ly/1QxL9I0>

<http://bit.ly/1NNeXzt>

<http://bit.ly/1LdmvFx>

# COMMON FEATURES OF SKETCHING ACTIVITIES

- \* divergent thinking; emergent ideas; iteration; convergence on the good stuff
- \* time limits
- \* quantity, then quality



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<http://bit.ly/1MpRlww>

@francisrowland / @emblebi

“The way to get a good idea, is to get a lot of ideas”

– *Linus Pauling* –

# SKETCHING EXERCISES



1. Taking a line for a walk



2. Filling up pages

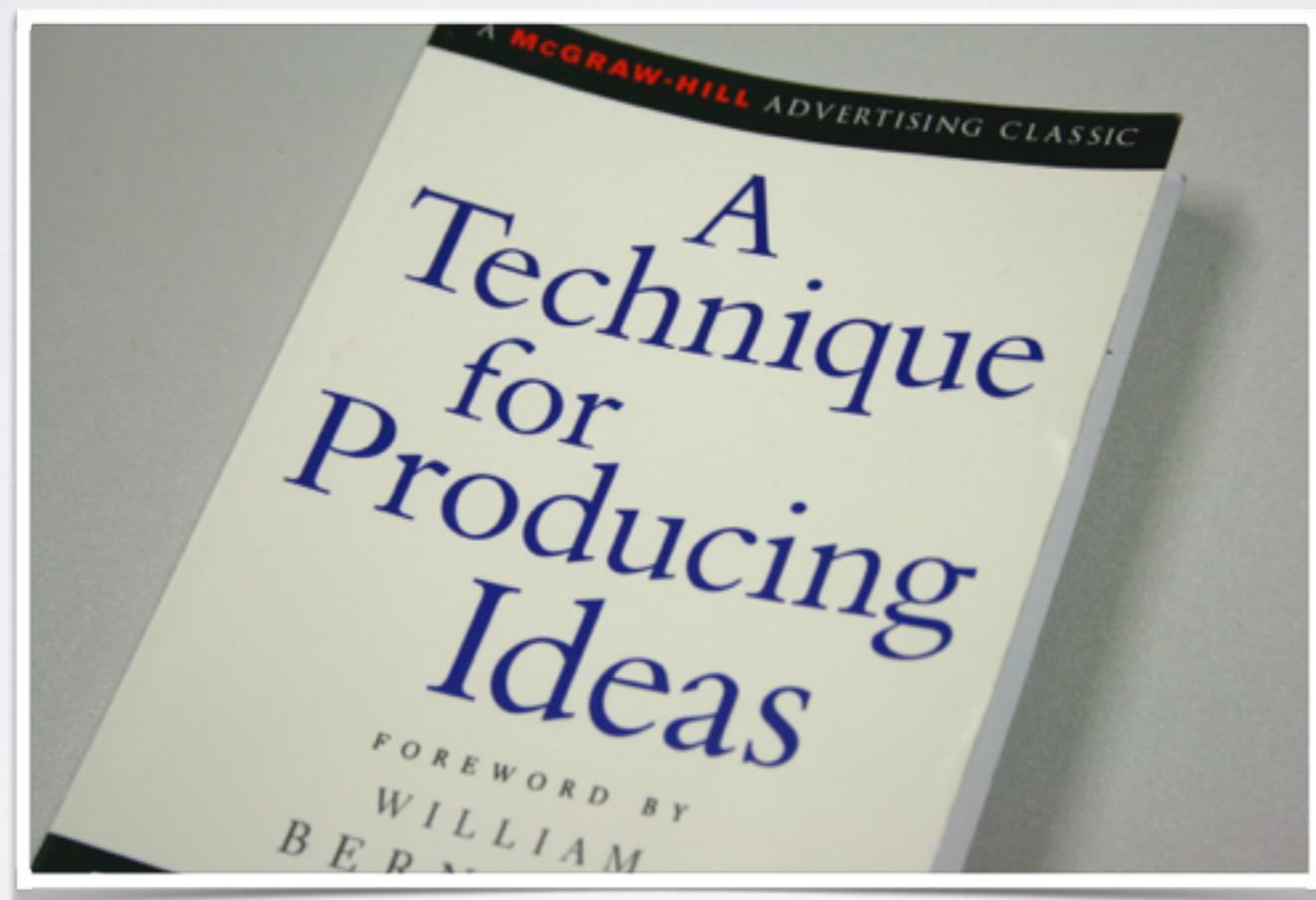


# 4. IDEA GENERATION

(sometimes called “ideation”)

# “A TECHNIQUE FOR PRODUCING IDEAS”

James Webb Young



<https://books.google.co.uk/books?isbn=0071426256>

# CARDS & CARD DECKS

# VISUALISATION CATALOGUE

Jonas Löwgren



<http://jonas.lowgren.info/visCat/>

# INSPIRATION CARDS

Dan Ramsden



**Inspiration is everywhere.**

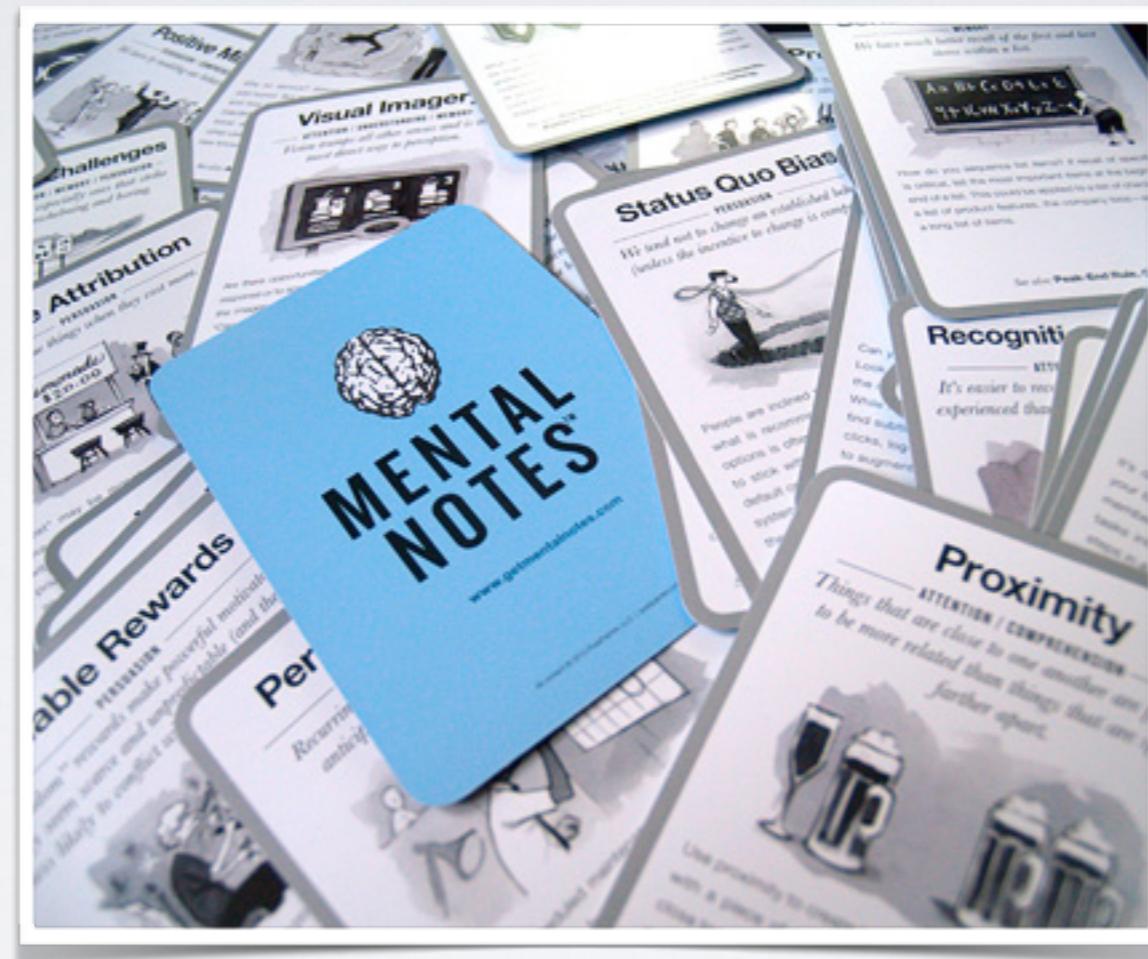
Even the best of us get stuck sometimes. These cards are designed to help you when you're stuck. Pick a card – think about it for a bit, then go back to your design. A solution should be easier to find.

[www.danramdsden.com](http://danramdsden.com)

<http://danramdsden.com/portfolio/ia-inspiration-cards/>

# MENTAL NOTES

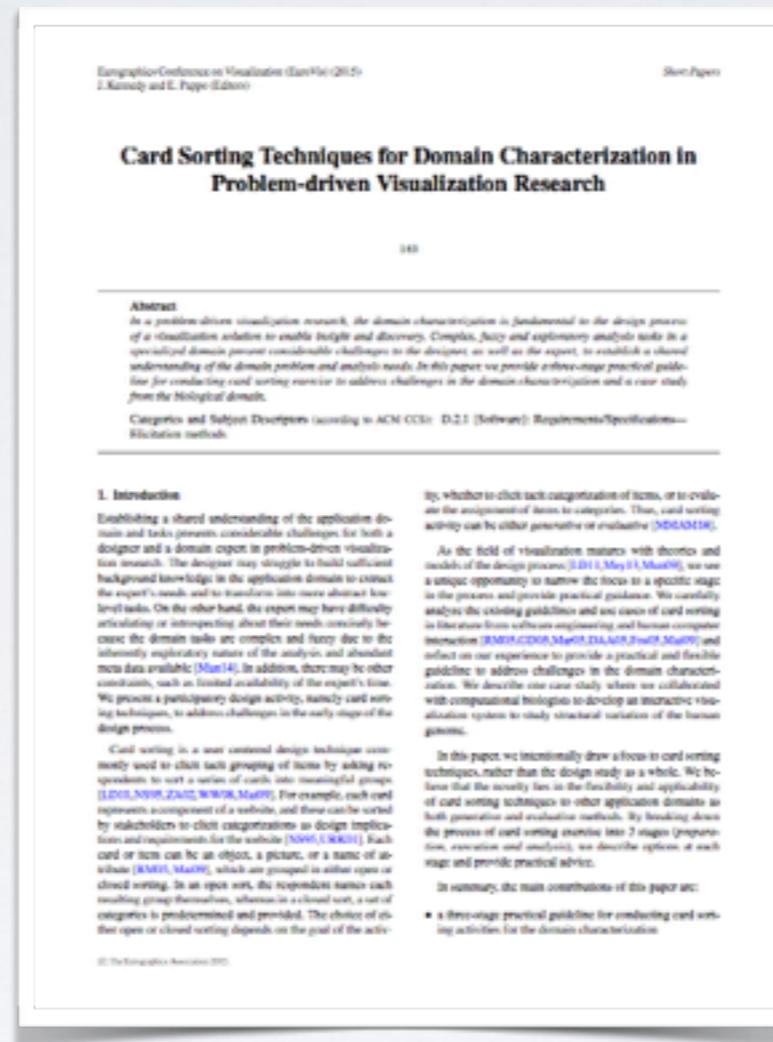
Stephen P. Anderson



<http://getmentalnotes.com/>

# CARD SORTING TECHNIQUE

Ryo Sakai



<ftp://ftp.esat.kuleuven.be/pub/sista/rsakai/CardSorting.pdf>

# ANTI-SOLUTIONS



Based on <http://gamestorming.com/games-for-fresh-thinking-and-ideas/the-anti-problem/>

# ANTI-SOLUTION ACTIVITY



1. Make groups of 5
2. Remember those “design statements”? Choose someone’s problem statement to focus on
3. Come up with as many anti-solutions as possible – start with individual ideas, then pool these and work as a group



# 5. SKETCHING

developing possible solutions

# SOLUTIONS

Now you get to problem-solving!

Yet more divergent thinking

Viable alternative solutions

Viable complementary solutions



# SKETCHING ACTIVITY

## (warm-up)



- \* Get a pen & a blank sheet of paper
- \* Divide the page into 9 squares
- \* Now we're going to do some quick sketching...

# SKETCHING ACTIVITY: 9 + 9

based on an activity described by Bill Buxton



- \* In your groups of 5...
- \* Refer back to your own “design statements”
- \* Divide a blank page into 9 squares
- \* Individually generate **9 different designs** – as creative and diverse as possible – to address your statements
- \* Reduce the number of design concepts
- \* Choose the most promising designs as a starting point
- \* **Sketch 9 details and/or variations** of design concepts
- \* Present ideas to a group

# ON INNOVATION....

"If you don't innovate in order to solve a problem for someone, they you'll definitely create new problems"

– *Eric Reiss* –

# 6. CRITIQUE

The critical counterpart of sketching

# BETTER IDEAS

“One of the most positive forms of criticism is a better idea, and frequently that better idea would never have come about were it not for the idea that it replaces”

– *Bill Buxton* –

DIALOGUE BASED ON  
INTENT

# GIVING CRITIQUE

A couple of suggested formats:

- \* 2+2
- \* Stop / start / continue

# THE “CRITIQUE CROSS”



[https://youtu.be/VXMZHc\\_vrXk](https://youtu.be/VXMZHc_vrXk)

# THE “CRITIQUE CROSS”



<https://ebiinterfaces.wordpress.com/2015/05/29/the-critique-cross/>

# CRITIQUE ACTIVITY



- \* Take the things you've worked on so far – design statements and sketches
- \* In groups of 5, each person should present what they have:
  1. max. 5 minutes
  2. describe what needs your visualisation is meeting, or problems you aim to solve
  3. explain any project or business objectives
  4. present your ideas, and explain choices / thinking
- \* Group provides critique (e.g. 2+2, stop/start/continue)
- \* On to the next person in the group, and repeat

# CONCLUSION

Taking approaches and techniques from user experience design, and using them to help craft better data visualisations.

1. **FRAMING THE PROBLEM**
2. **COMMUNICATION & INTERACTION**
3. **SKETCHING** (an introduction)
4. **IDEA GENERATION**
5. **SKETCHING** (developing possible solutions)
6. **CRITIQUE**