

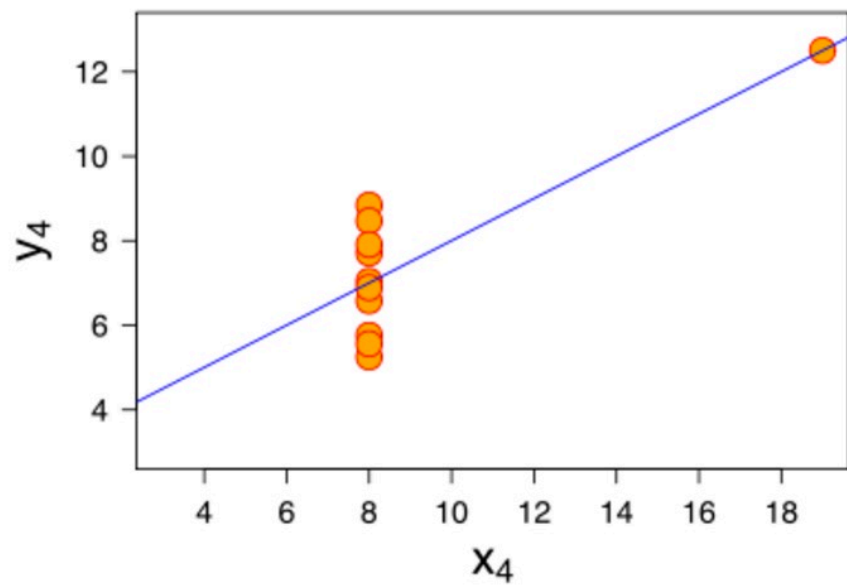
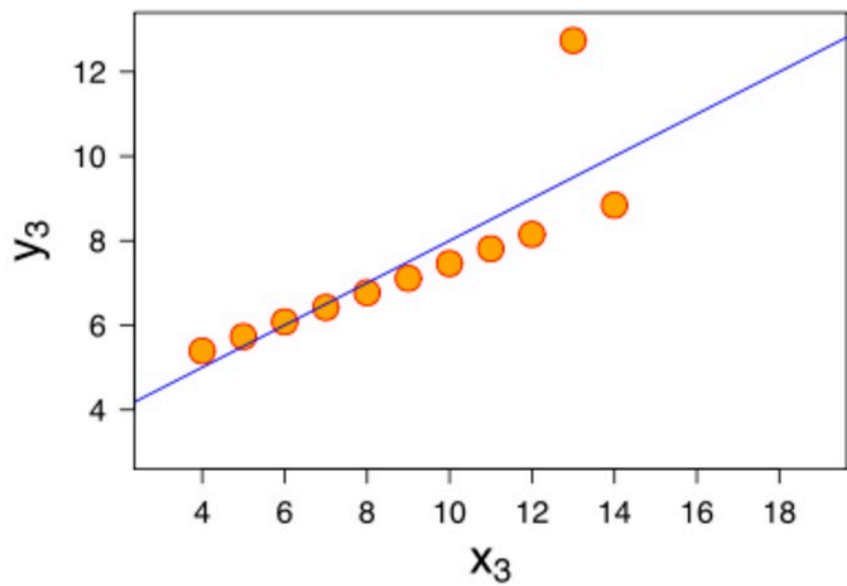
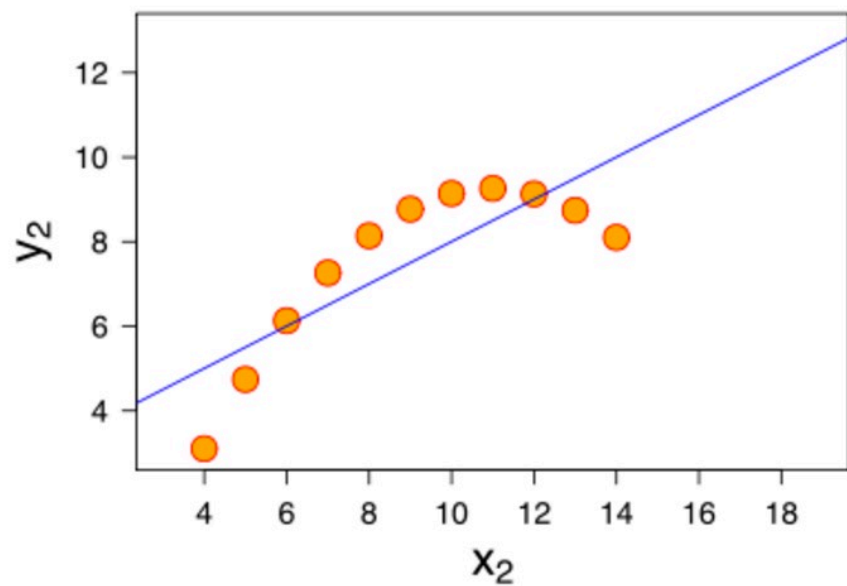
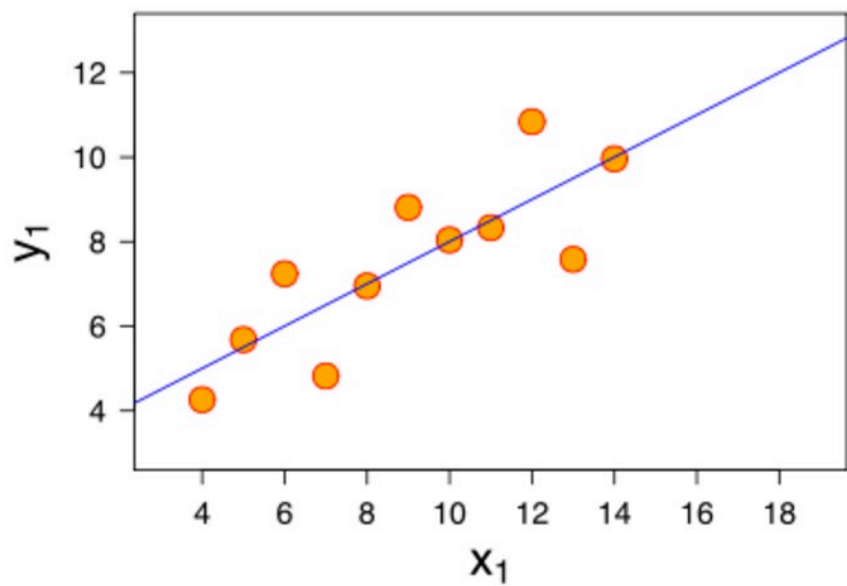
Perception, cognition et design

VISUALISATION D'INFORMATION

Anscombe's quartet

I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Property	Value
Mean of x in each case	9 (exact)
Sample variance of x in each case	11 (exact)
Mean of y in each case	7.50 (to 2 decimal places)
Sample variance of y in each case	4.122 or 4.127 (to 3 decimal places)
Correlation between x and y in each case	0.816 (to 3 decimal places)
Linear regression line in each case	$y = 3.00 + 0.500x$ (to 2 and 3 decimal places, respectively)



Traitement de l'information

Infinity - Lewis Carroll

Infinity - Zeno

Infinity - Paradoxes

Infinity - Halting problem

Zeno - Lewis Carroll

Paradoxes - Lewis Carroll

Paradoxes - Epimenides

Paradoxes - Self-ref

Epimenides - Self-ref

Epimenides - Tarski

Tarski - Epimenides

Halting problem - Decision procedures

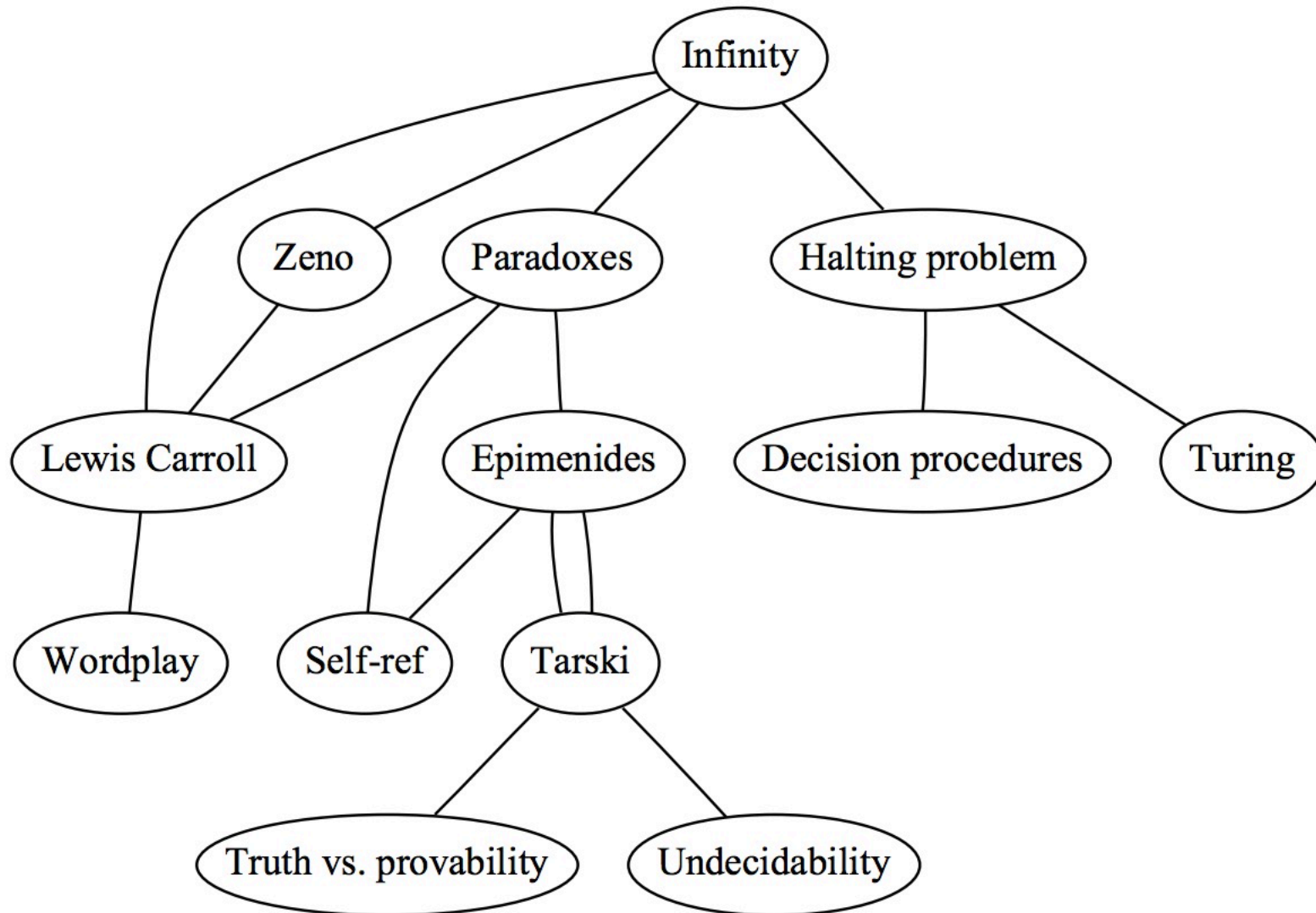
Halting problem - Turing

Lewis Carroll - Wordplay

Tarski - Truth vs. provability

Tarski - Undecidability

Traitement de l'information



Systeme de visualisation d'info - contraintes

- Computationnelle
 - Fluidité
 - Complexité algorithmique
- Perception et cognition (humain)
 - Mémoire et attention limitée
- Dispositif physique (écran)
 - Information density (Tufte)

Visualisation d'information

- Perception, cognition
- Design - Règles et bonnes pratiques
 - Variables visuelles
 - Interactions

PERCEPTION

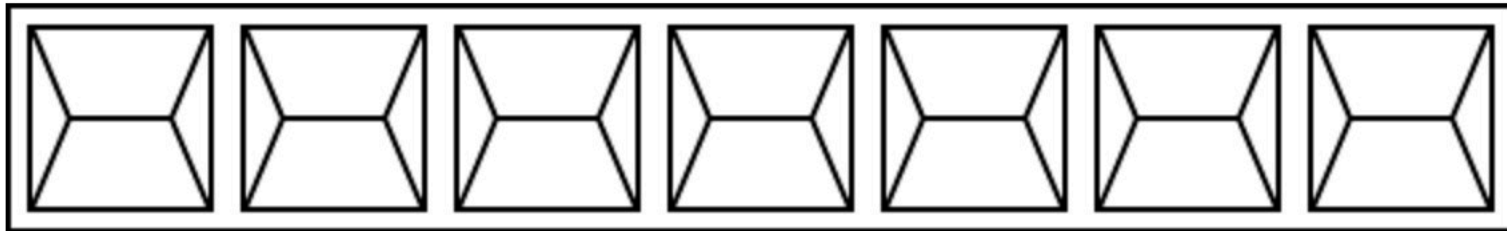
Perception et cognition

- Perception
 - Physiology
 - Pre-attentive processing
- Cognition (humain)
 - Gestalt principles
 - Mémoire et attention limitée

Perception – Illusion d'optique

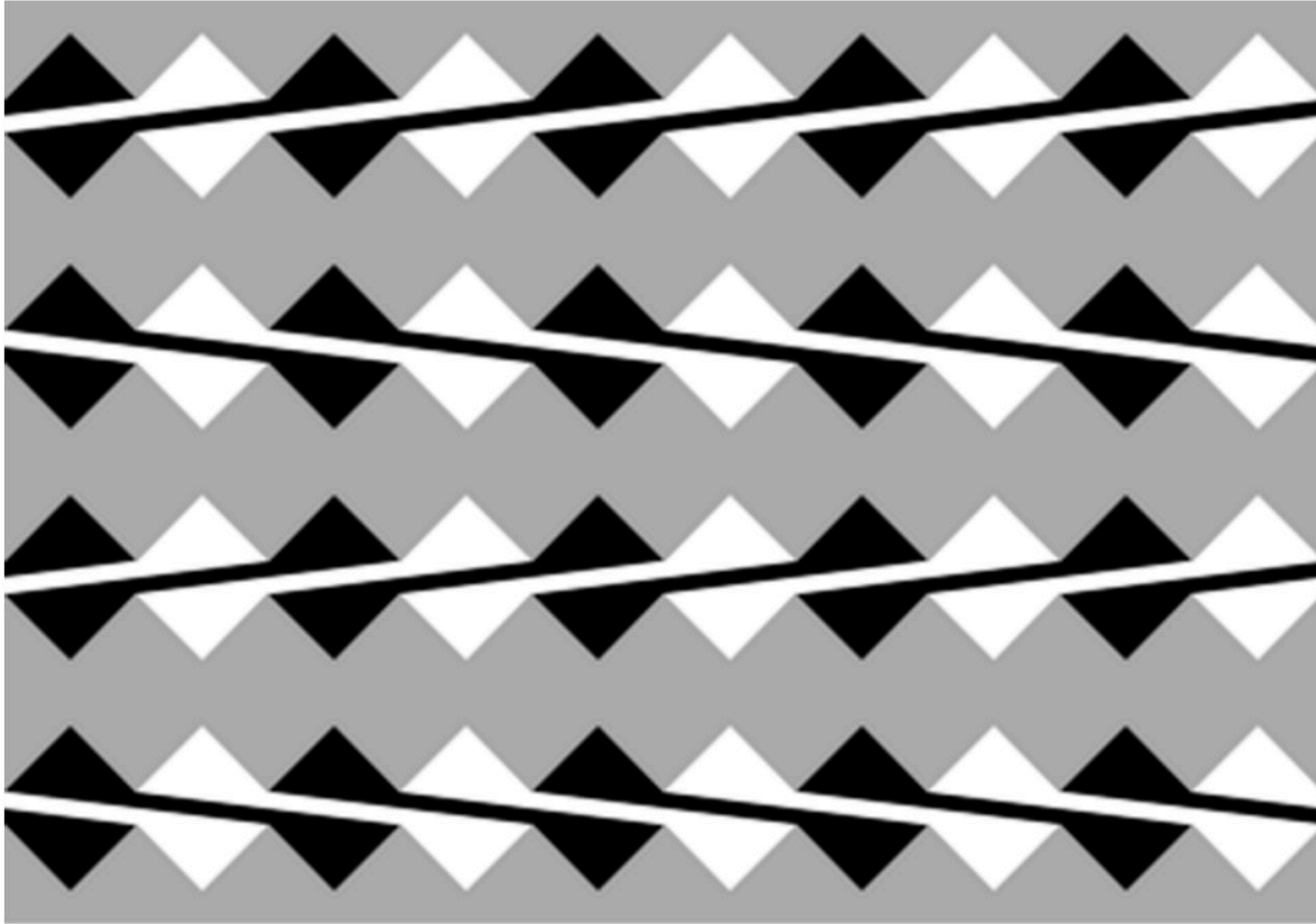
- Physiology
 - Virtual objects
 - Visual distortion
 - Shape distortion

Perception – Virtual objects



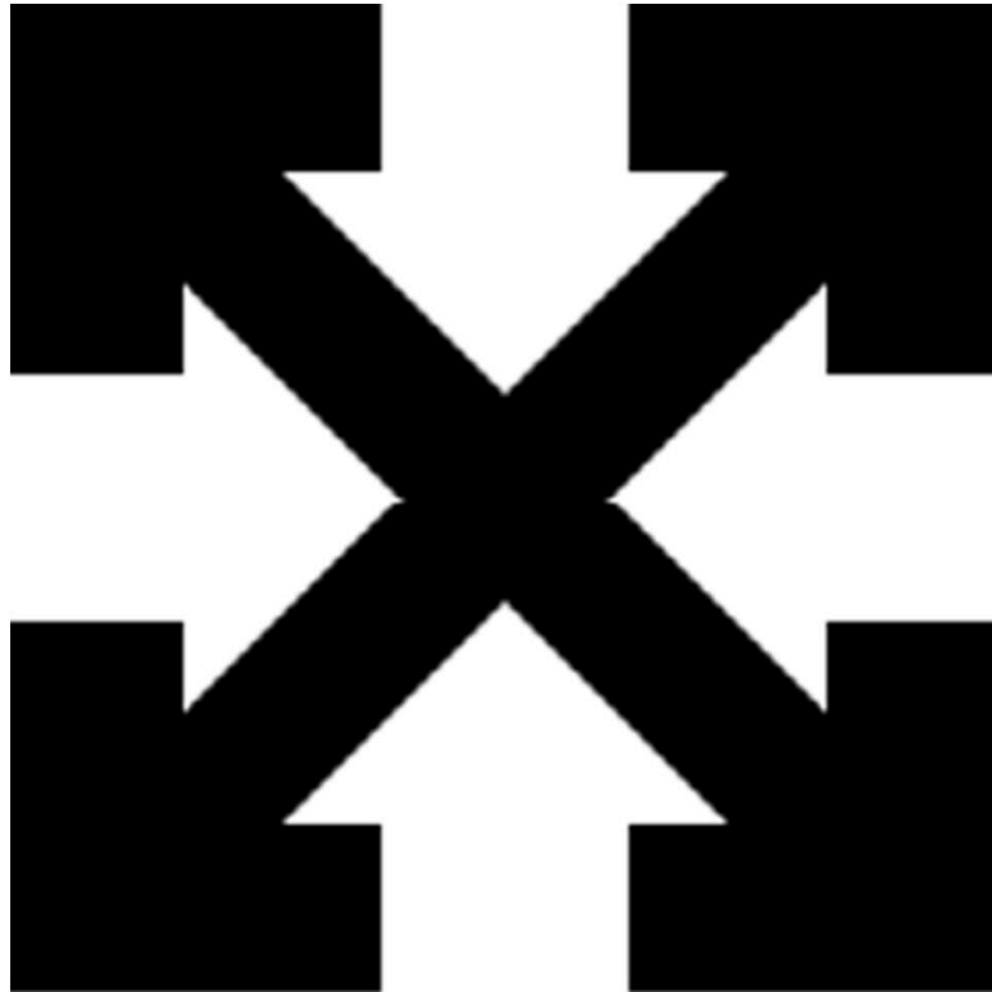
In or Out?

Perception – Virtual objects



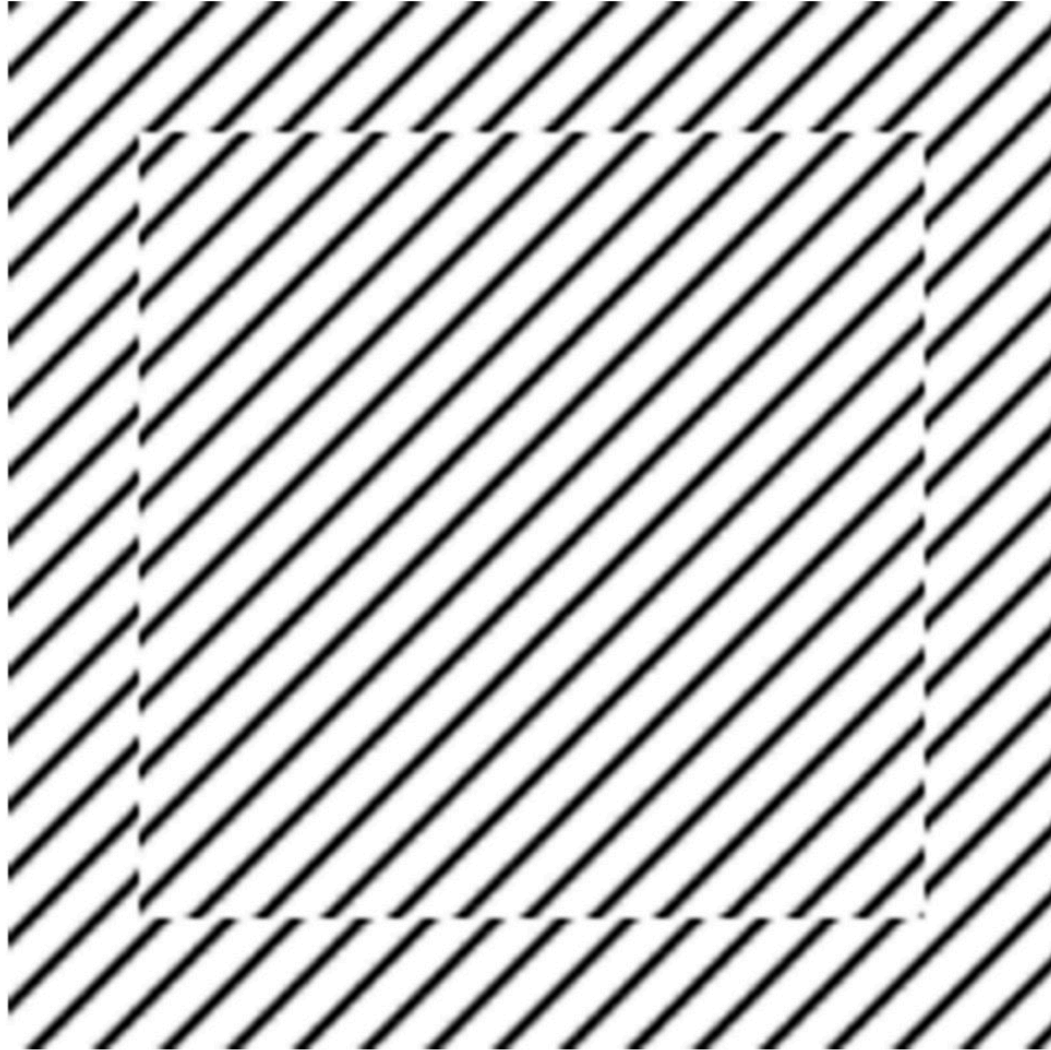
Do the lines actually exist?

Perception – Virtual objects



Do the white arrows exist?

Perception – Virtual objects

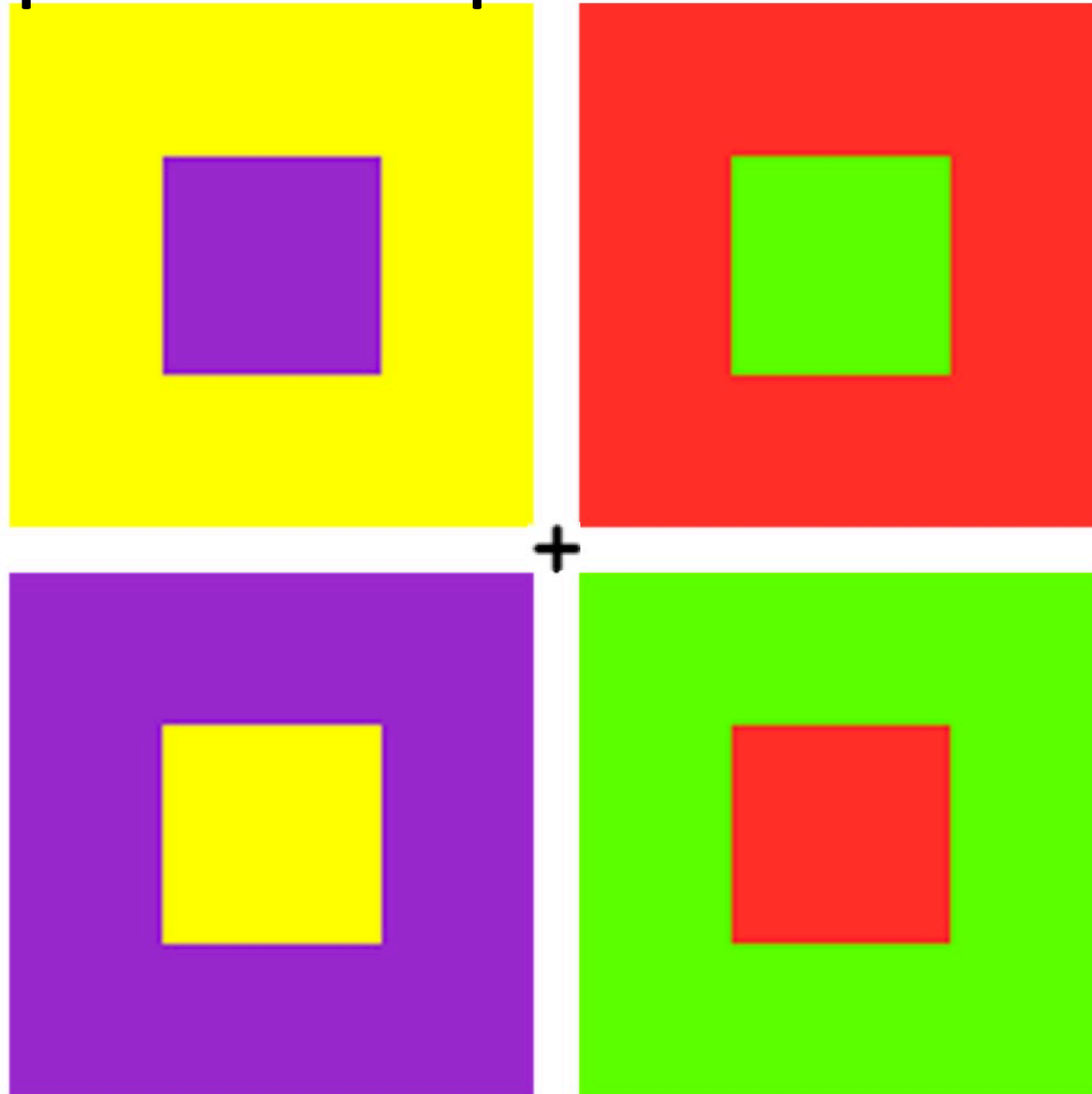


Is the square really there?

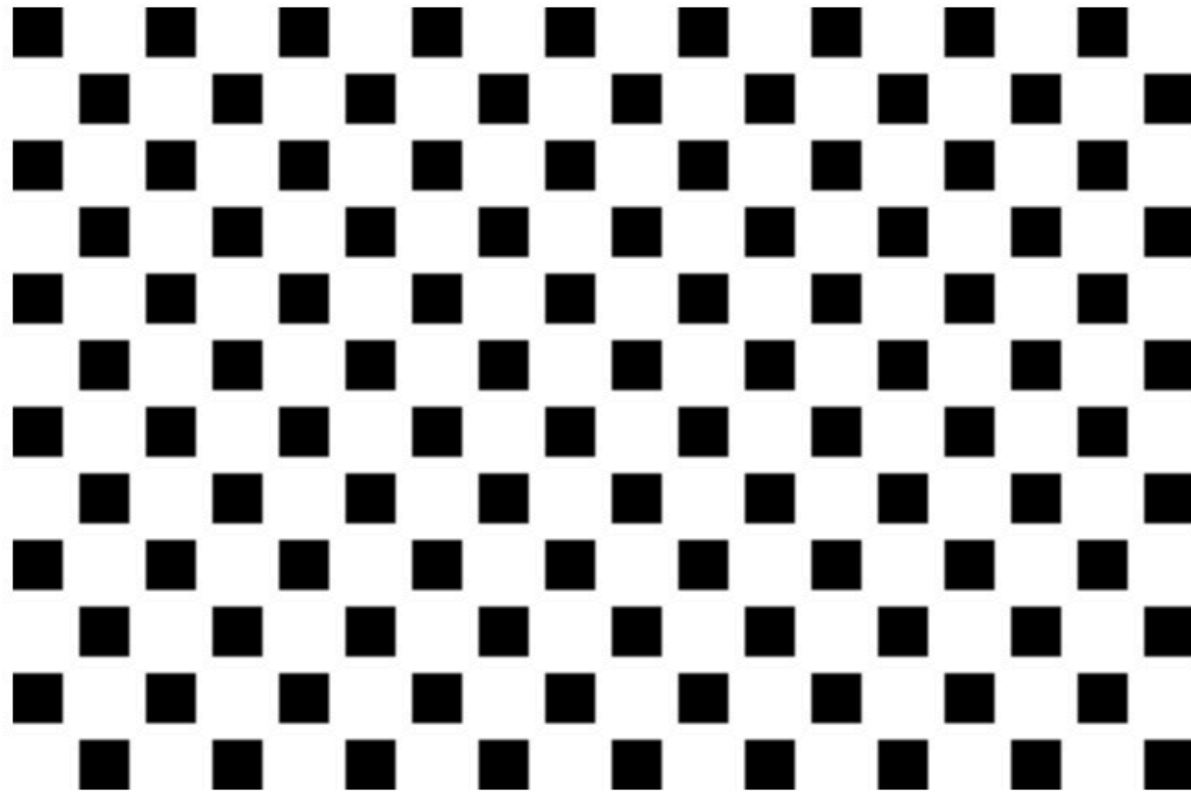
Perception – Visual Distorsion



Perception – Impression rétinienne

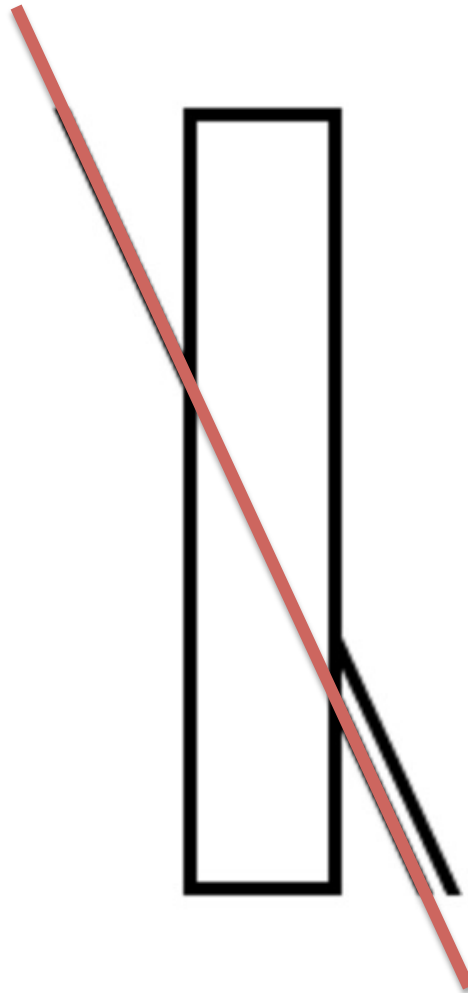


Perception – Visual Distorsion



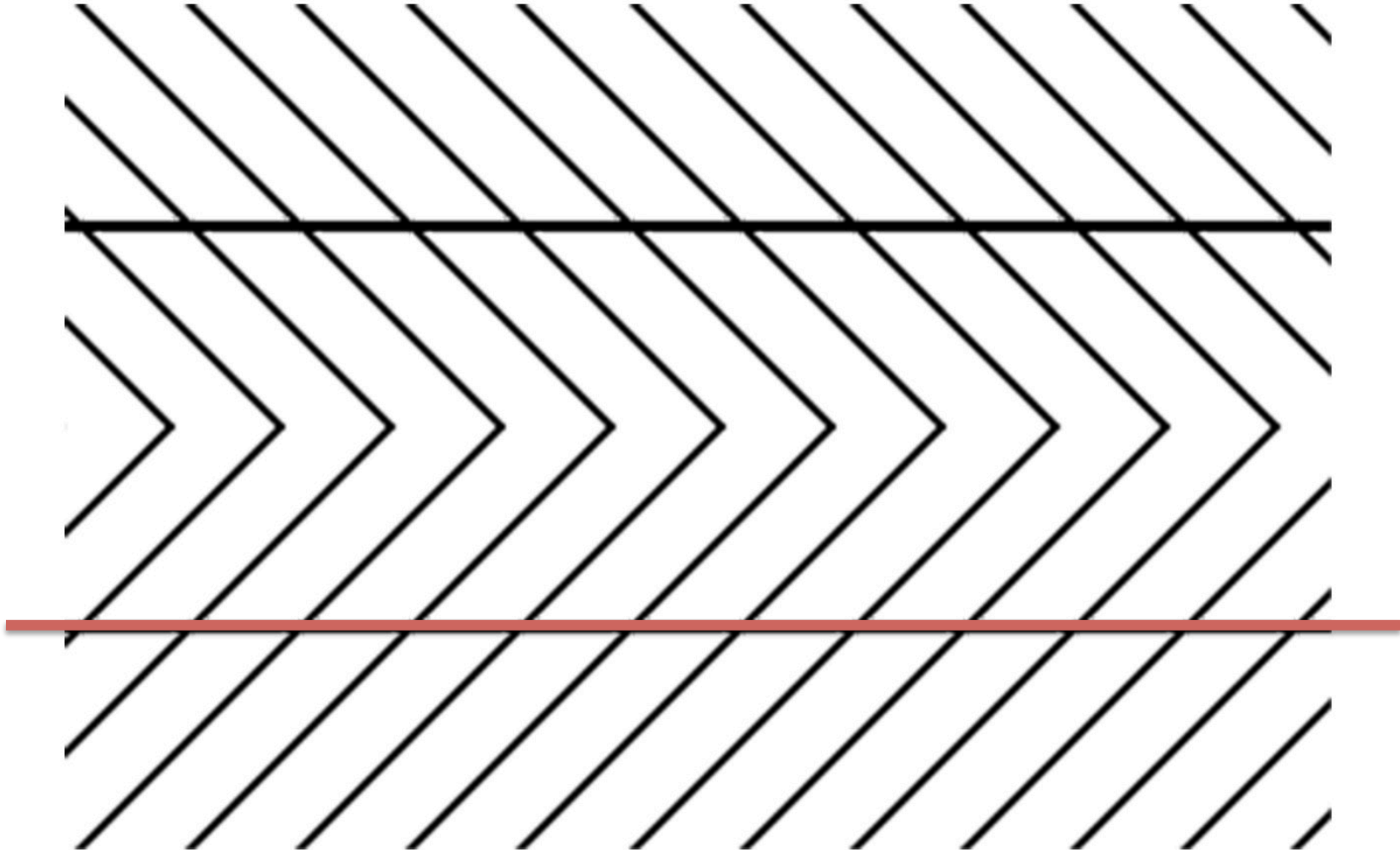
Grey Diagonals

Perception – Visual Distorsion



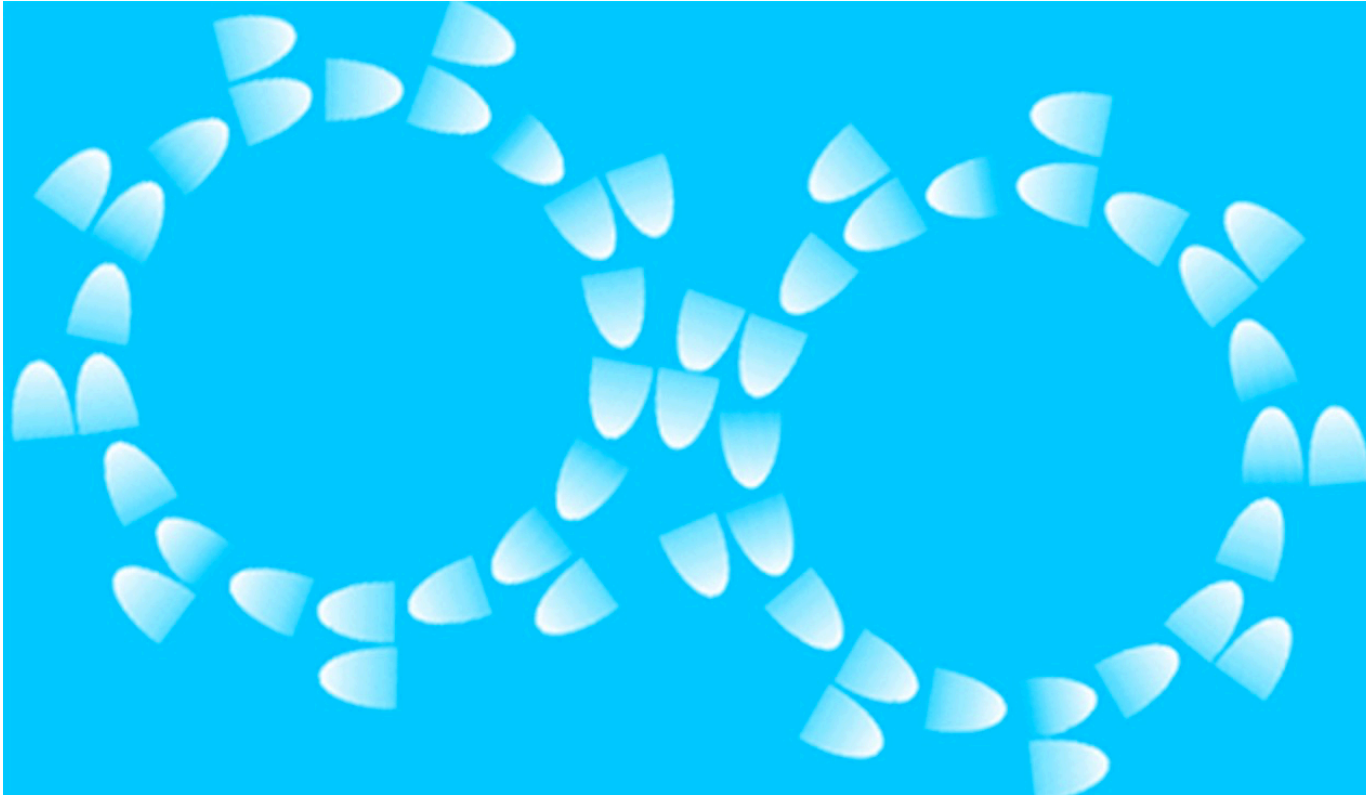
Which line continues the straw?

Perception – Shape Distorsion



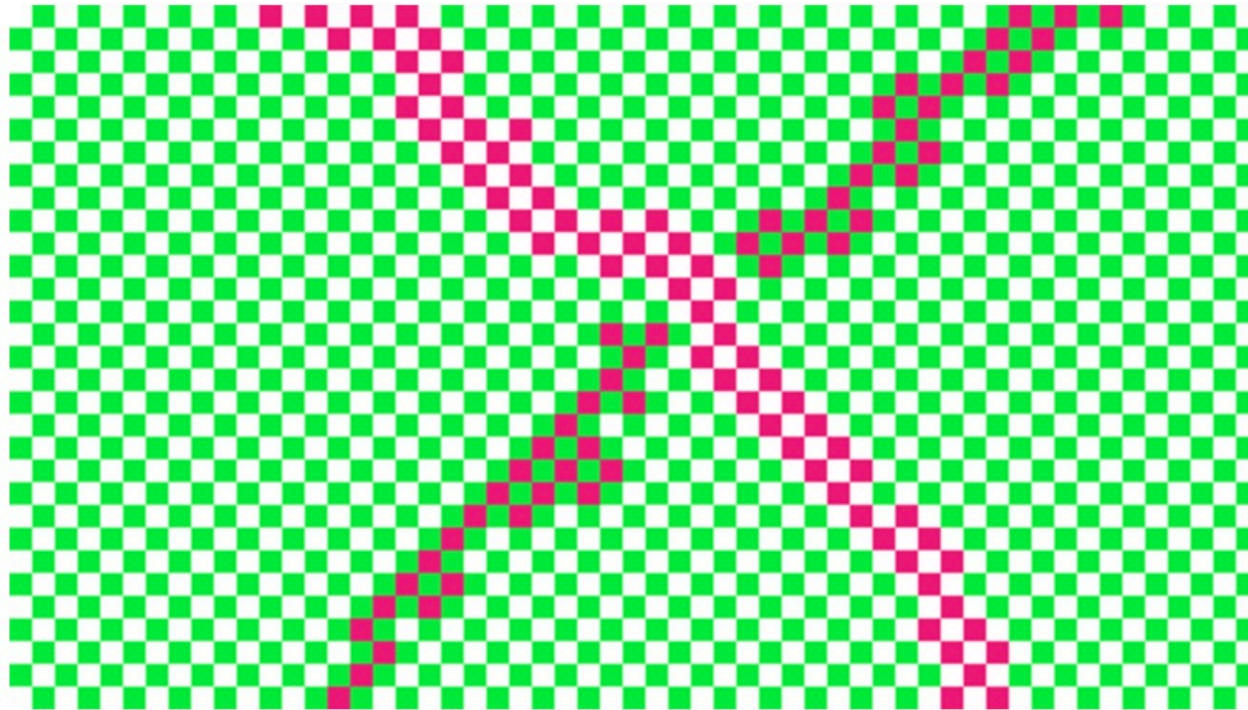
Are these lines parallel?

Perception – Shape Distorsion



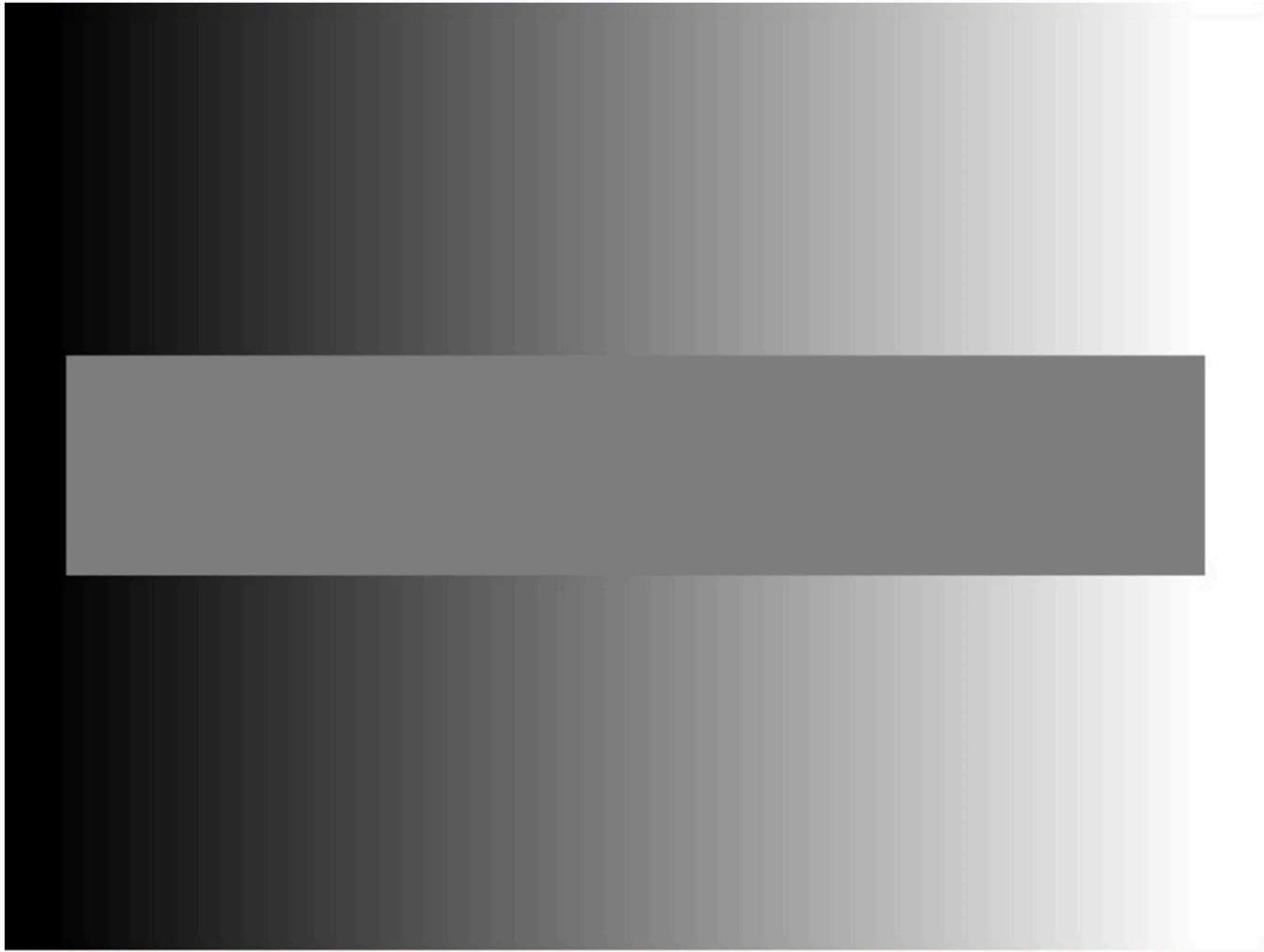
Slow rotation

Perception – Color contrast



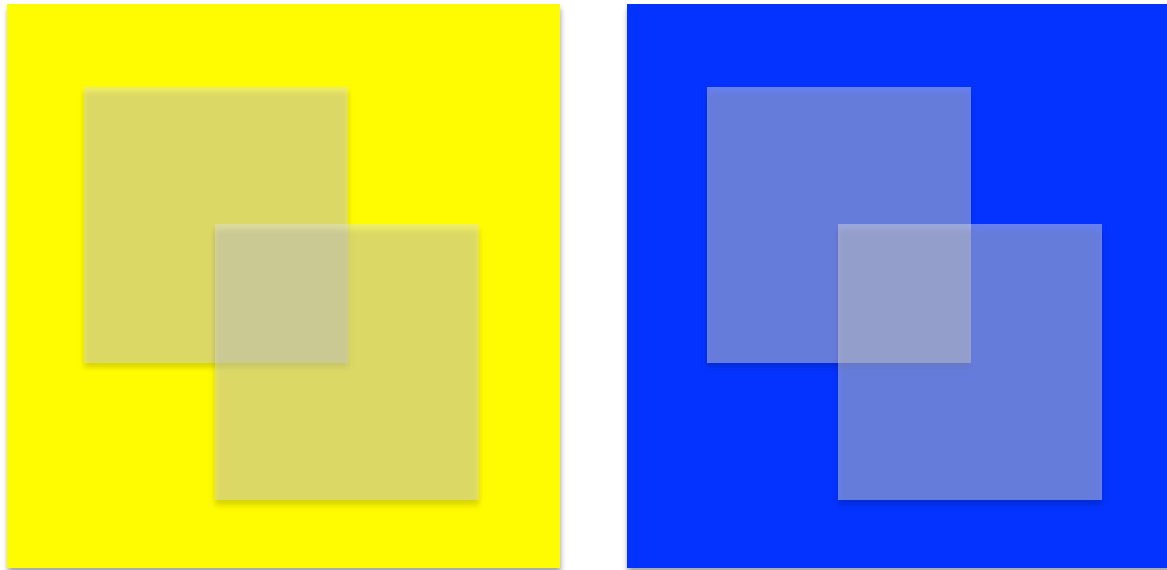
How many colors?

Perception – Color contrast



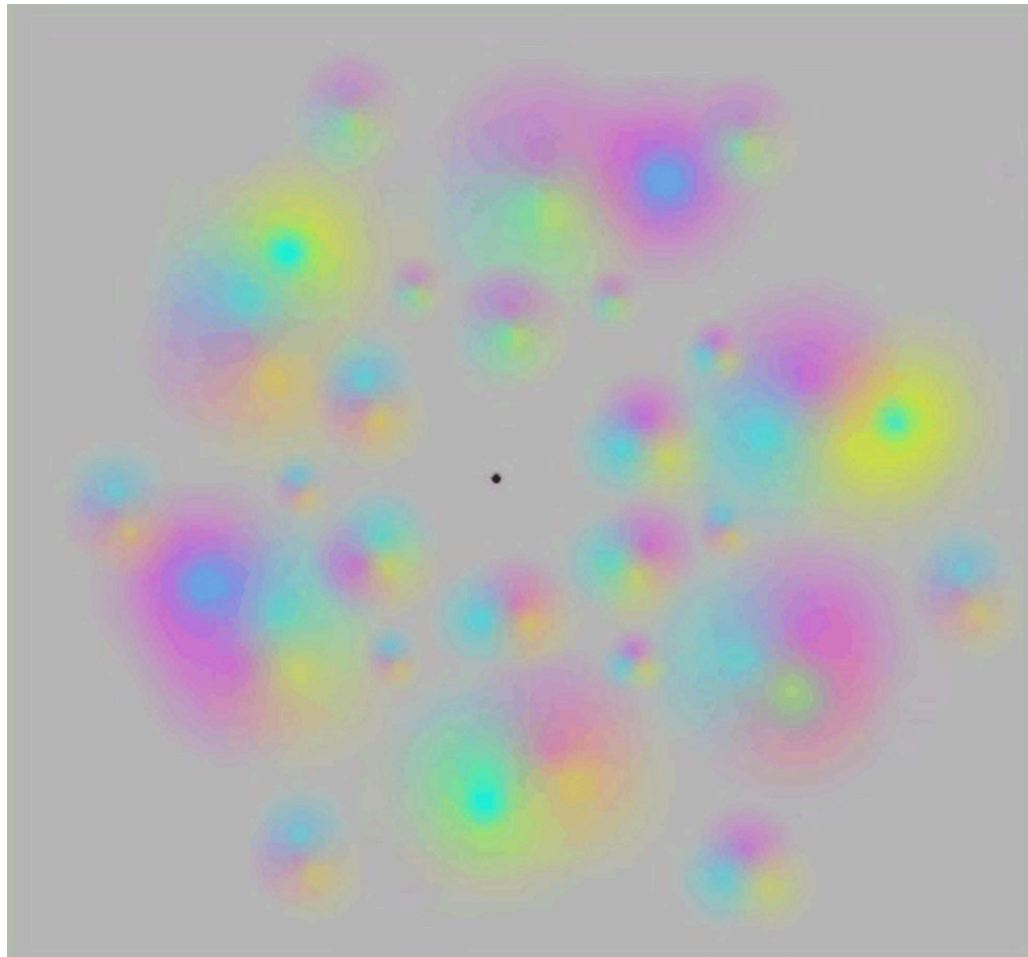
Uniform grey?

Perception – Color contrast



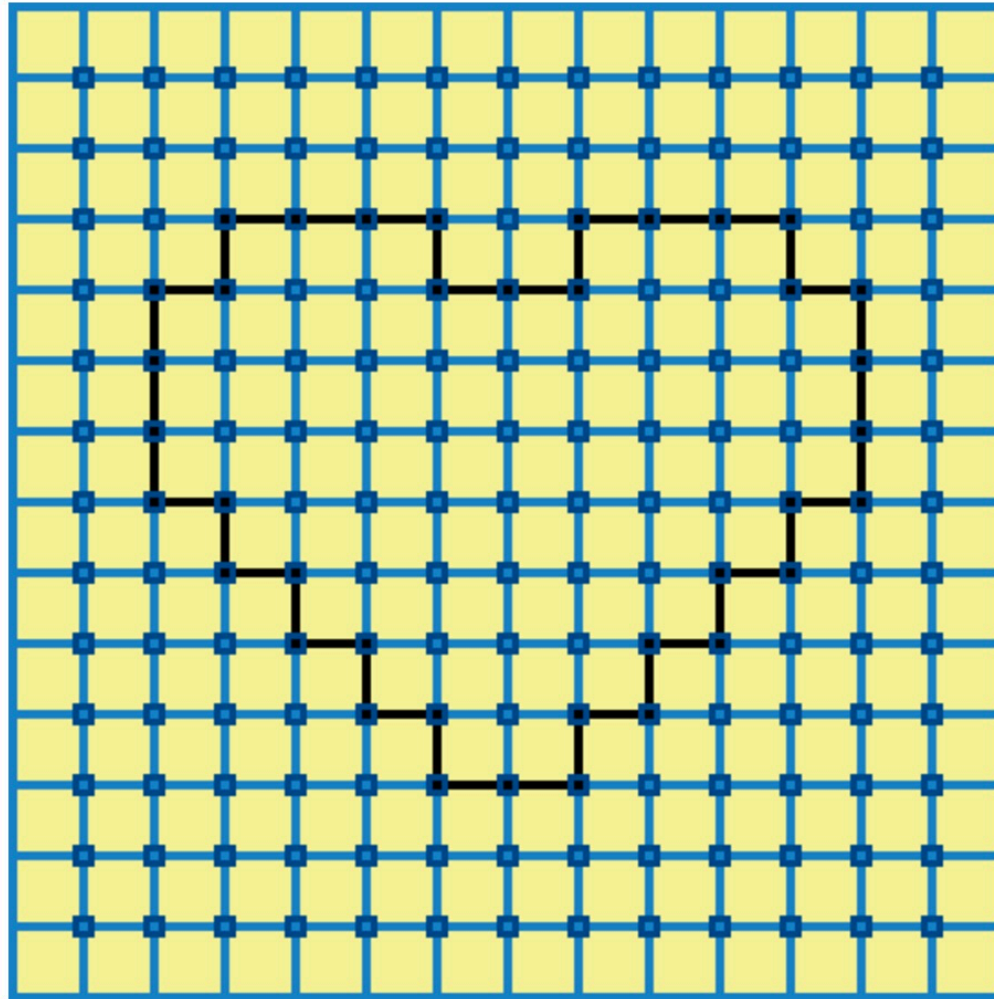
Same color square

Perception – Color contrast



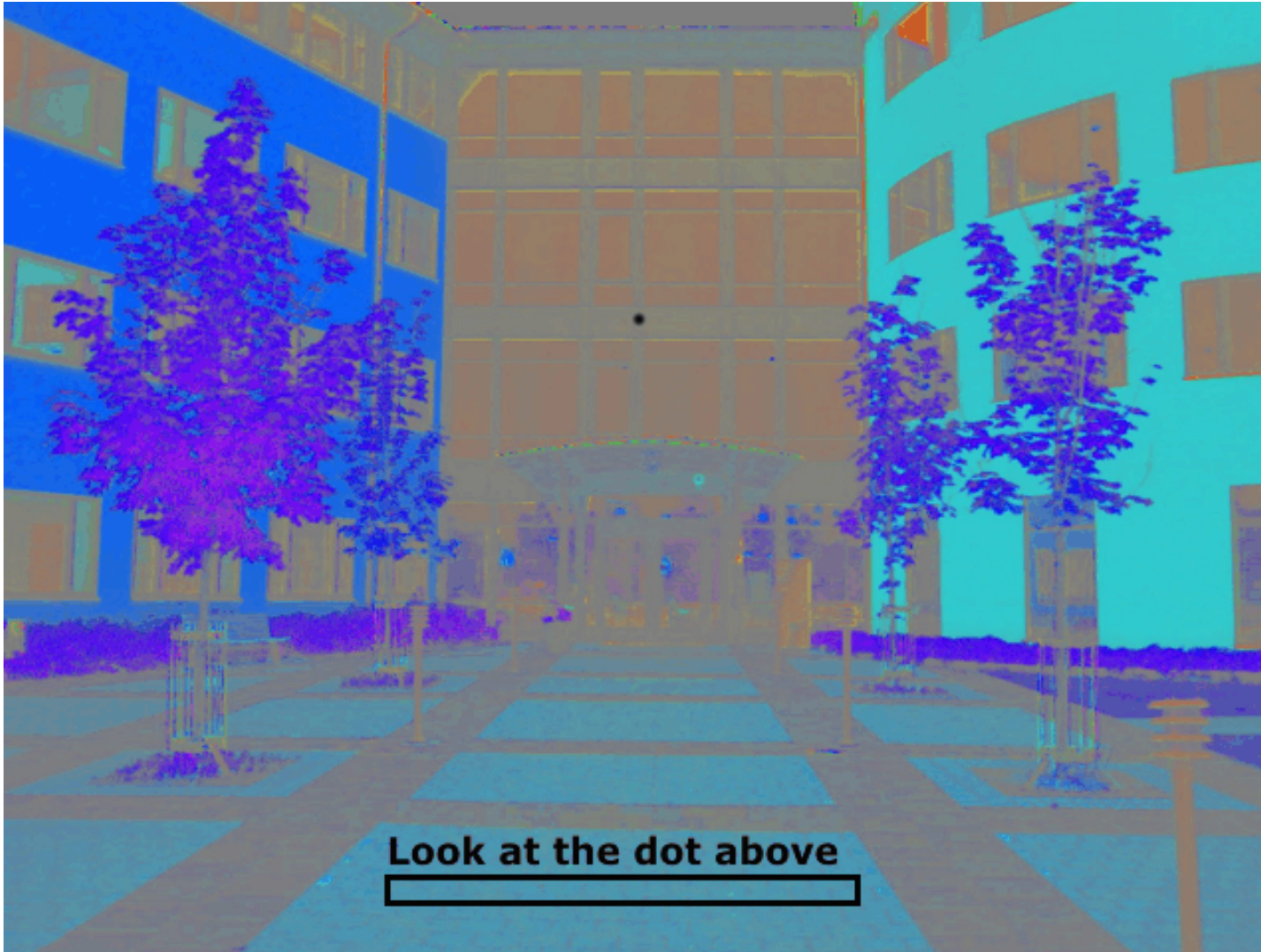
Colours eventually disappears

Perception – Color contrast



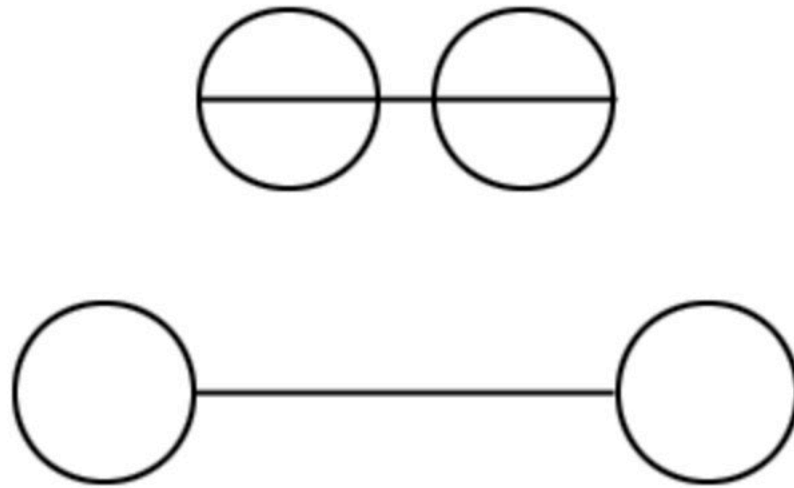
Orange heart

Perception – Color contrast



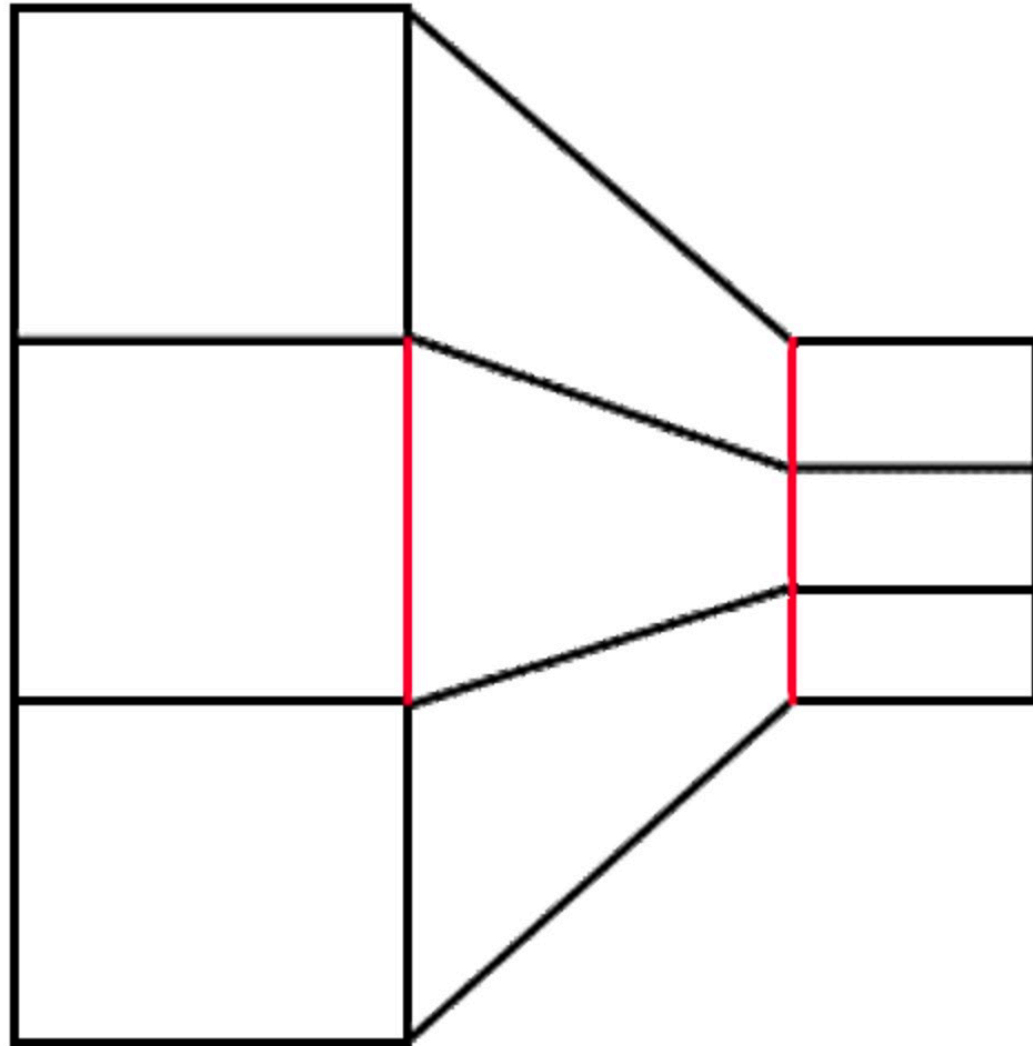
Color or black & white?

Perception – Size Distorsion



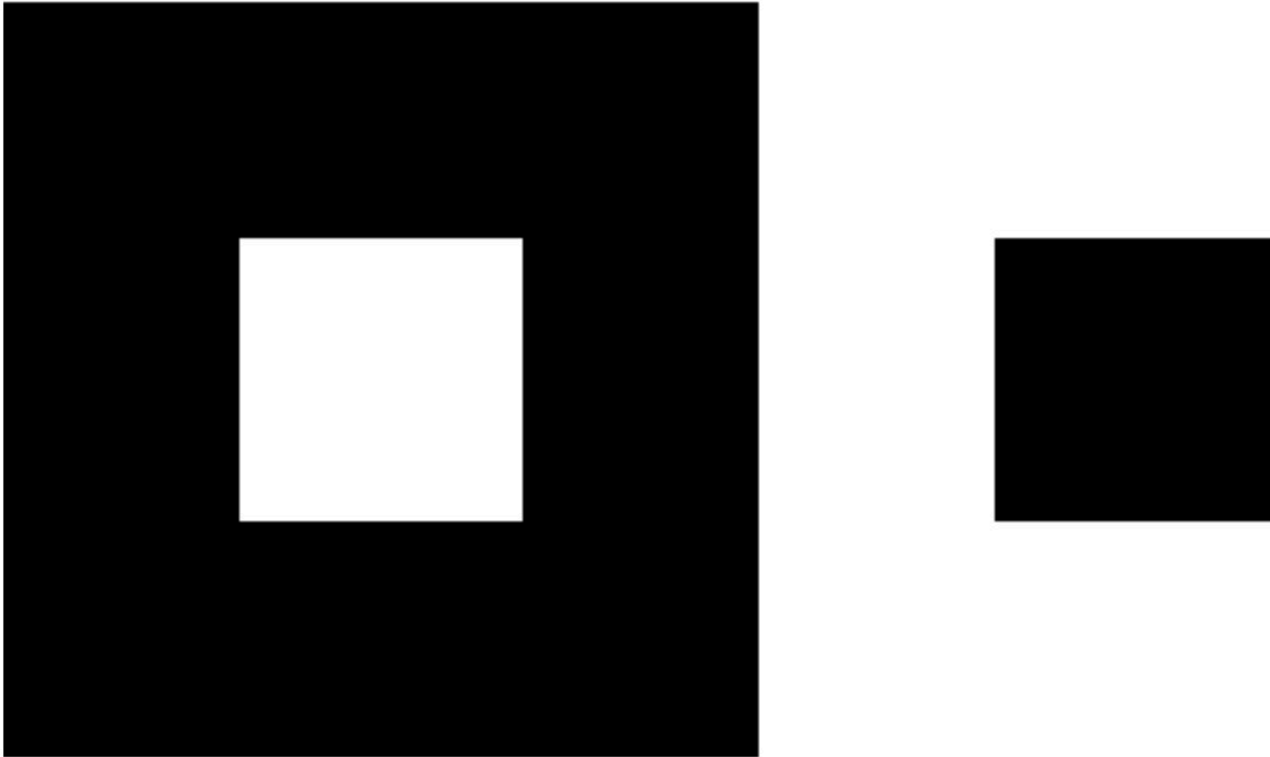
Which line is longer?

Perception – Size Distorsion



Same length (red lines)?

Perception – Size Distorsion



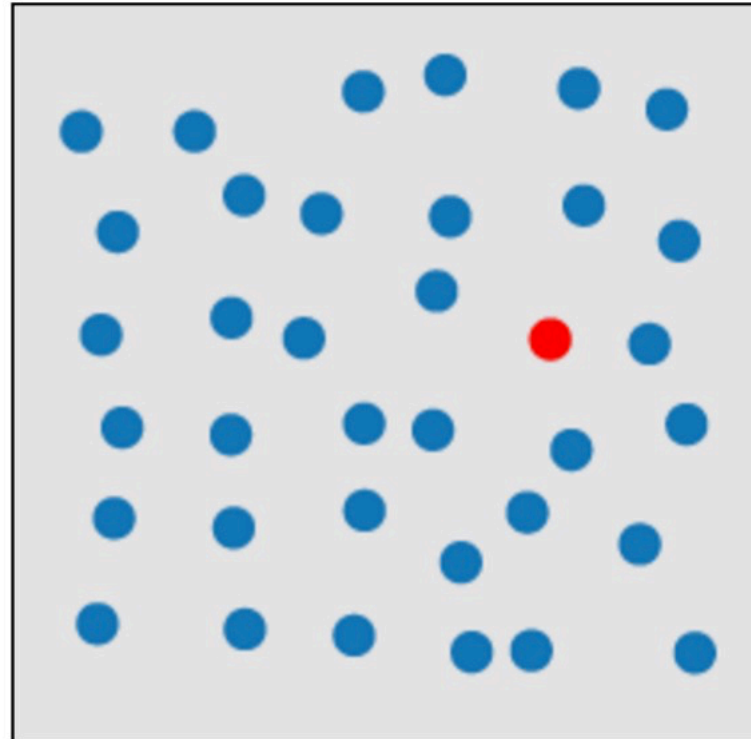
Same size?

PRE-ATTENTIVE PROCESSING

Perception – Pre-attentive processing

- < 200 - 250ms qualifies as pre-attentive
 - eye movements take at least 200ms
- can be done very quickly
- low-level processing in parallel

Perception – Pre-attentive processing

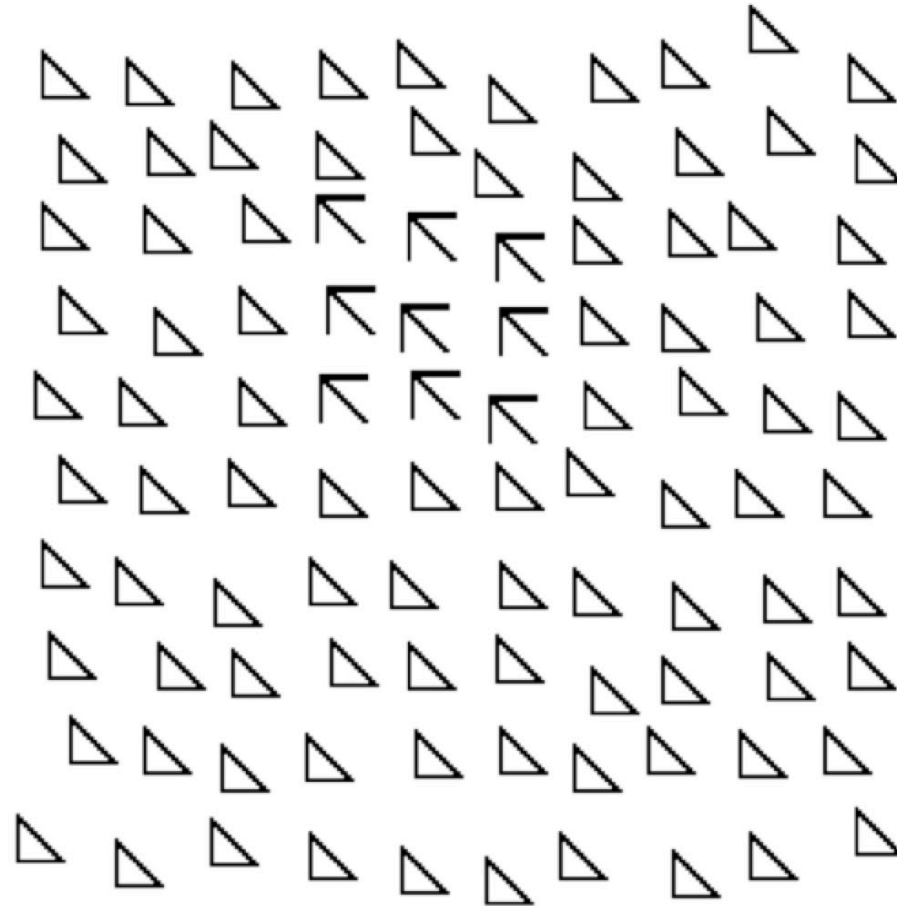


Perception – Pre-attentive processing

- [Healey video](#)

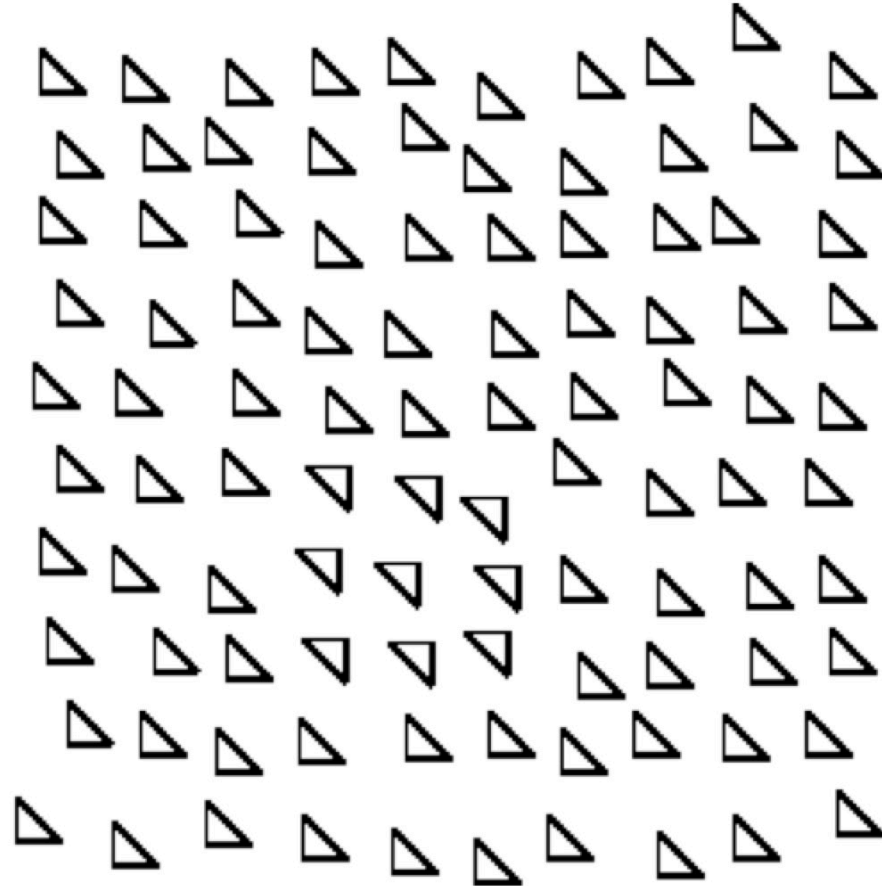
Perception – Pre-attentive processing

- Target ∇
 - has a unique feature



Perception – Pre-attentive processing

- Target ▽
 - *does not* have a unique feature



Perception – Pre-attentive processing

SUBJECT PUNCHED QUICKLY OXIDIZED TCEJBUS DEHCNUP YLKCIUQ DEZIDIXO
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC
GOVERNS PRECISE EXAMPLE MERCURY SNREVOG ESICERP ELPMAXE YRUCREM
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
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CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC

Text not pre-attentive

GESTALT, MÉMOIRE ET ATTENTION

Perception et cognition

- Perception
 - Physiology
 - Pre-attentive processing
- Cognition (humain)
 - Mémoire et attention limitée
 - Gestalt principles

Cognition - Change blindness

- Daniel Simons and Daniel Levin (1997)
 - [Movie perception test](#)
 - [Change in static image](#)

Cognition - Change blindness

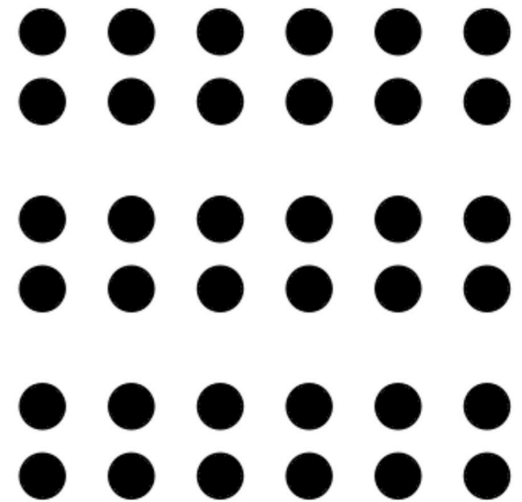
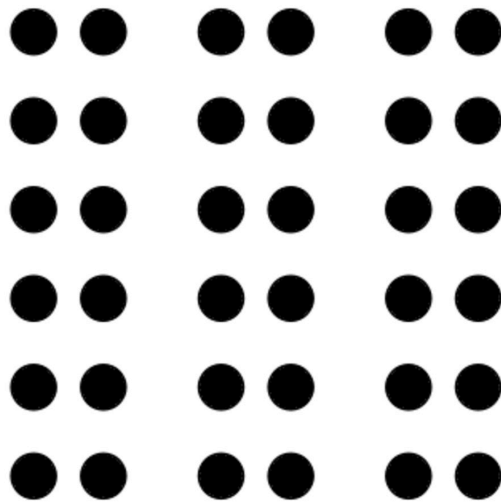
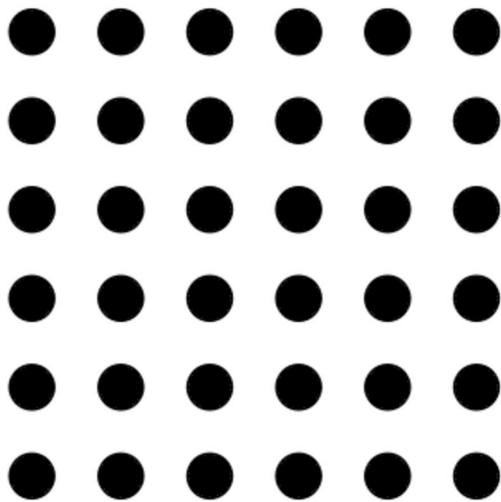
- Daniel Simons and Daniel Levin (1997)
 - [Movie perception test](#)
 - [Change in static image](#)

Cognition – Gestalt principles

- Why do patterns emerge?
 - Under what circumstances?
 - Idea: forms or patterns *transcend* the stimuli used to create them
 - « Le tout est plus que la somme des parties »

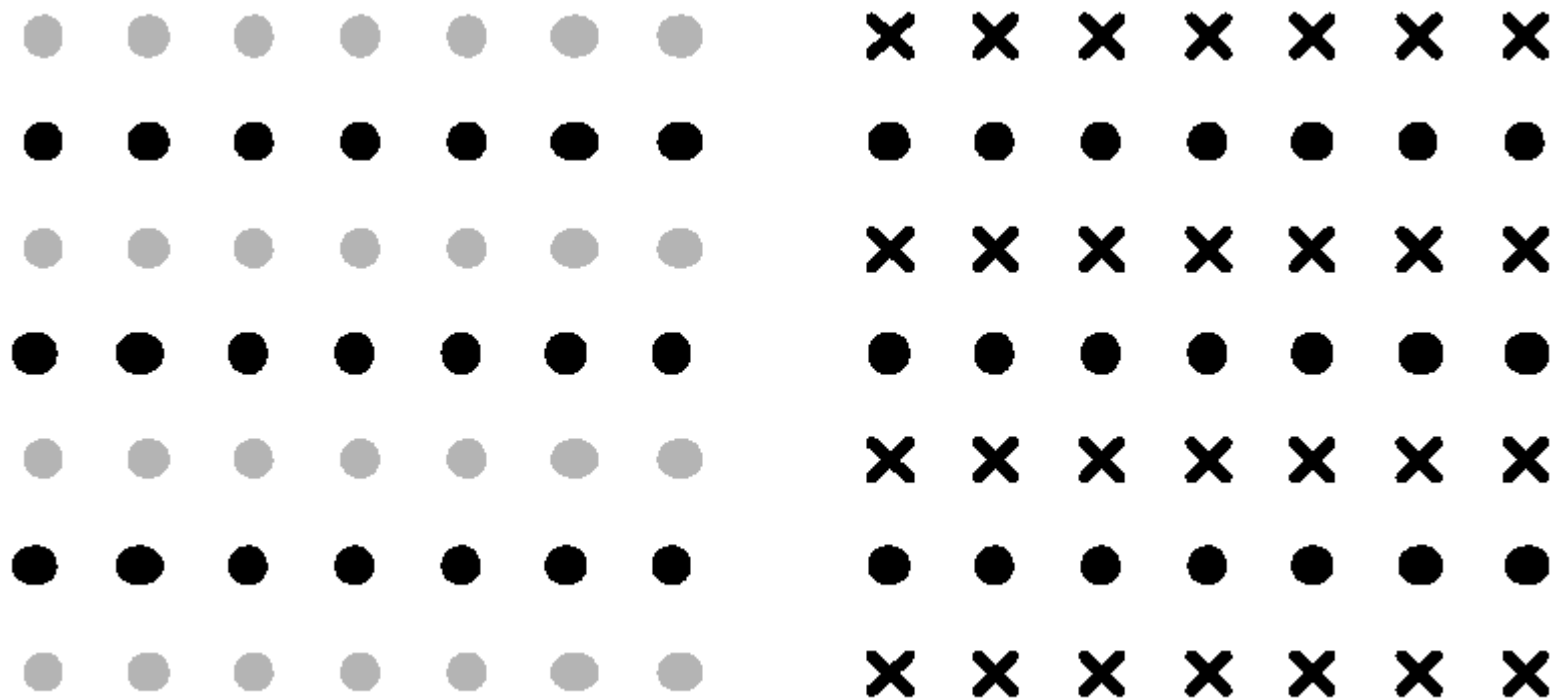
Cognition – Gestalt principles

- Proximity



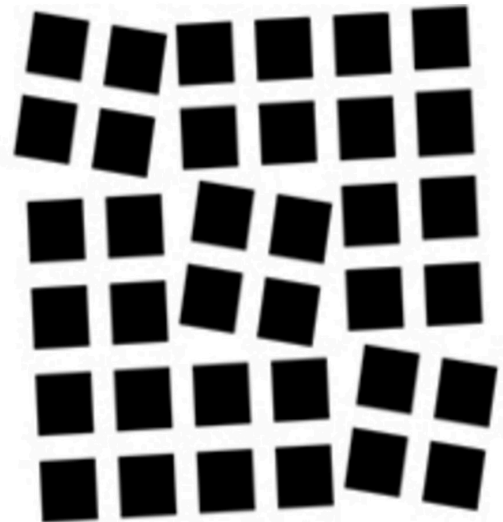
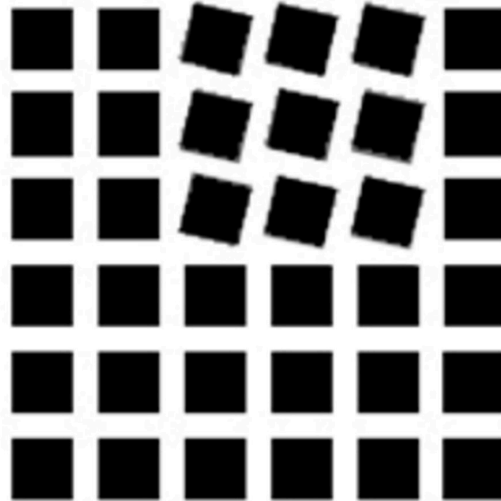
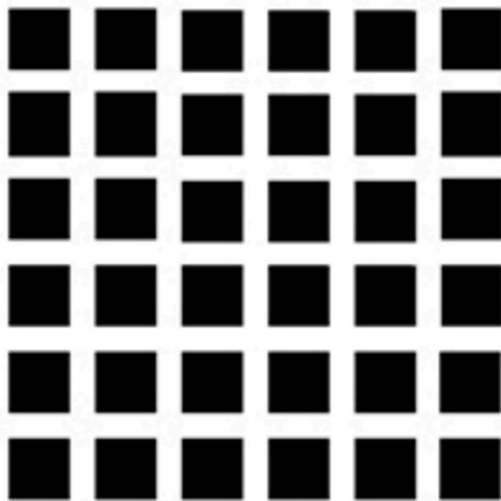
Cognition – Gestalt principles

- Similarity



Cognition – Gestalt principles

- Law of common fate



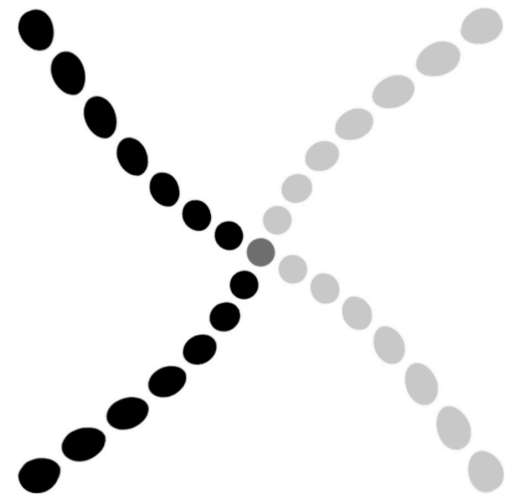
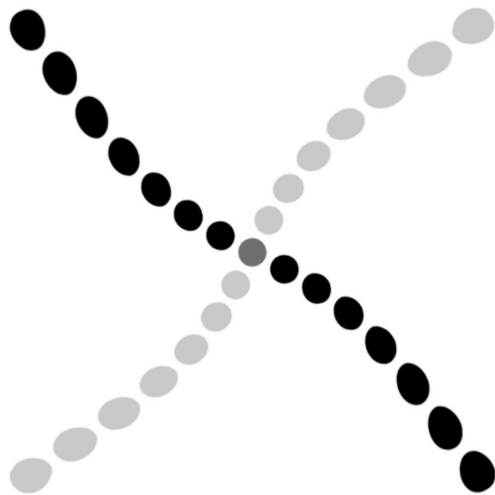
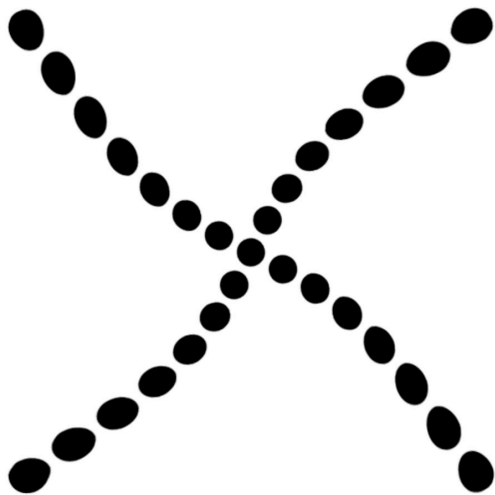
Cognition – Gestalt principles

- Continuity



Cognition – Gestalt principles

- Continuity



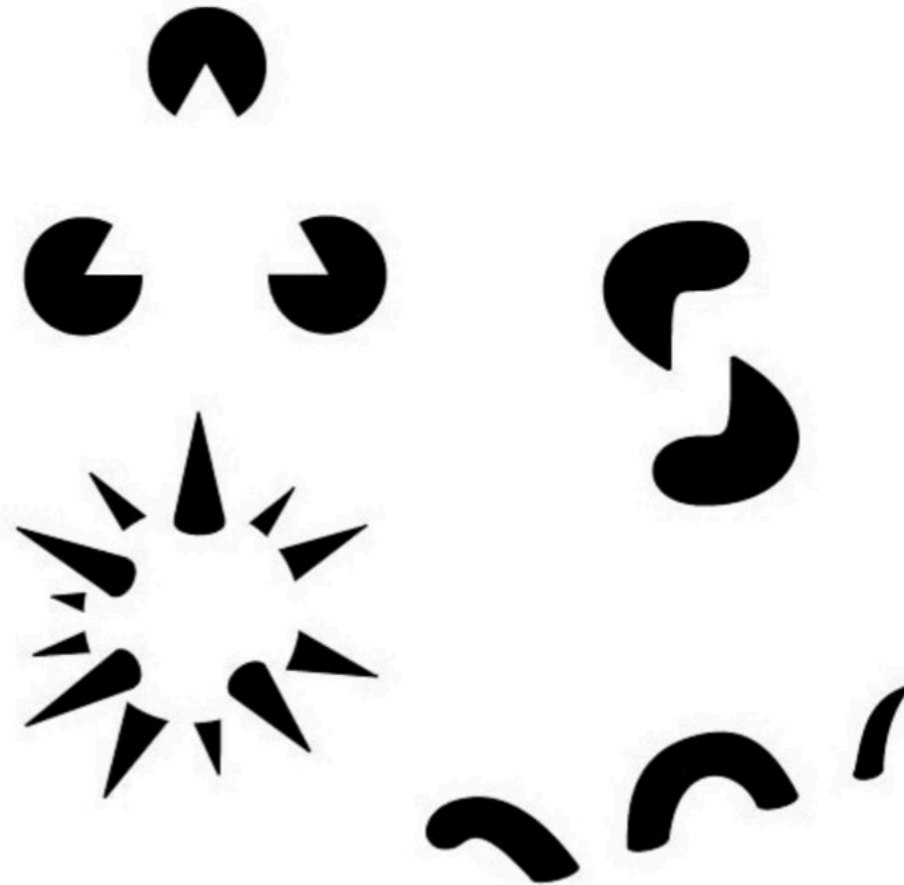
Cognition – Gestalt principles

- Emergence



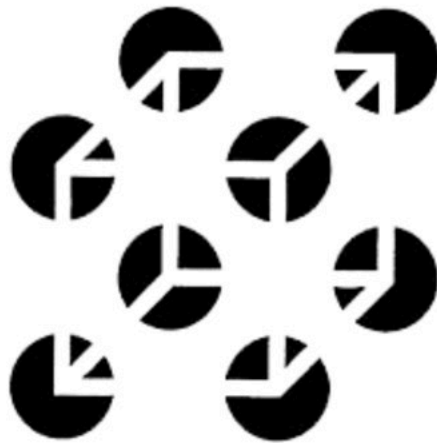
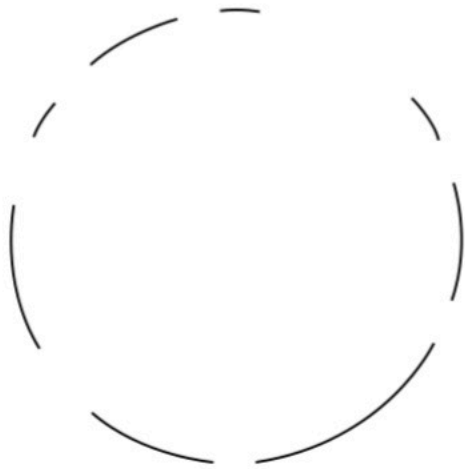
Cognition – Gestalt principles

- Reification

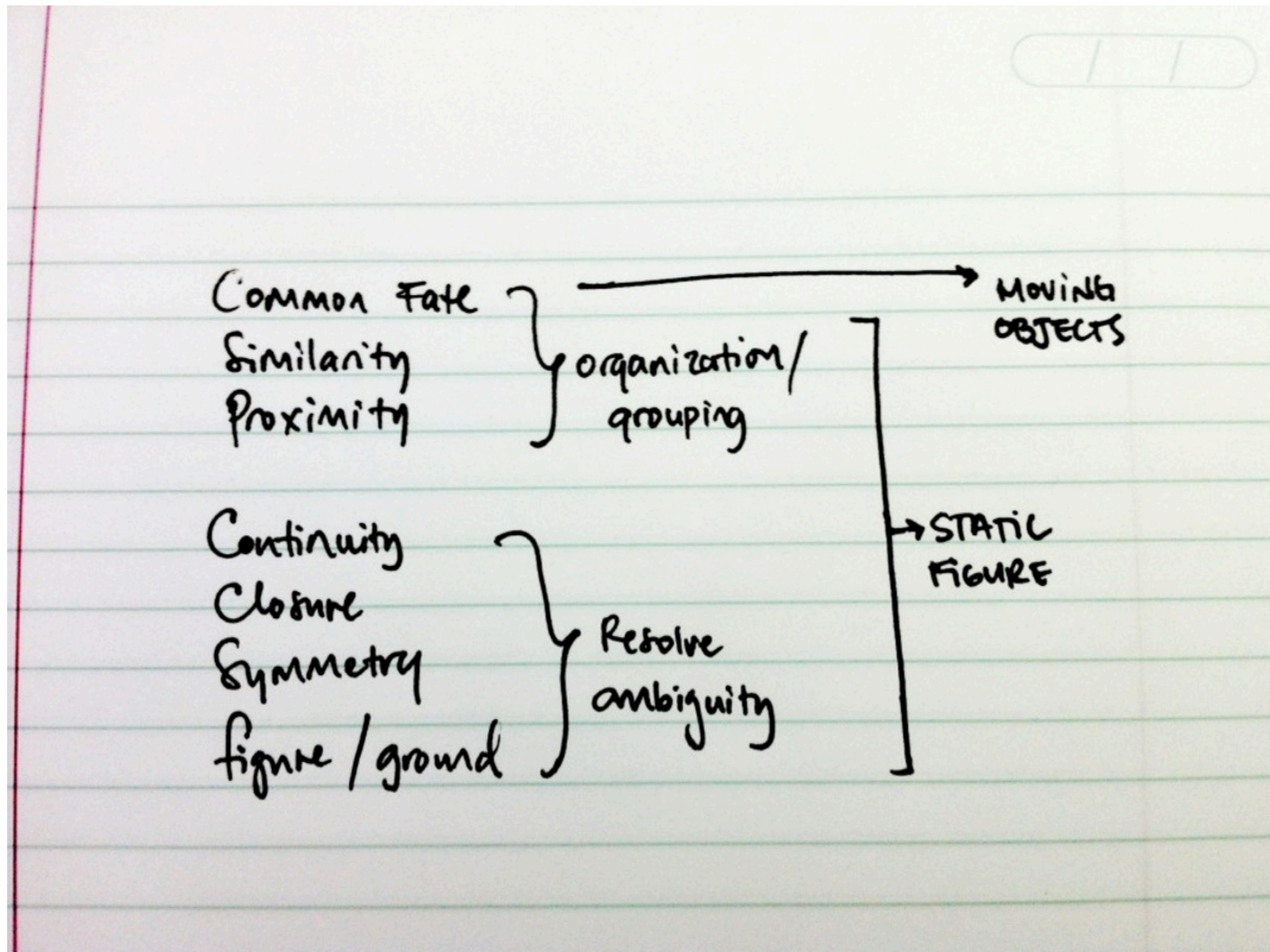


Cognition – Gestalt principles

- Closure



Cognition – Gestalt principles



SÉMIOTIQUE: GRAMMAIRE DE LA CARTOGRAPHIE

« Grammaire visuelle »

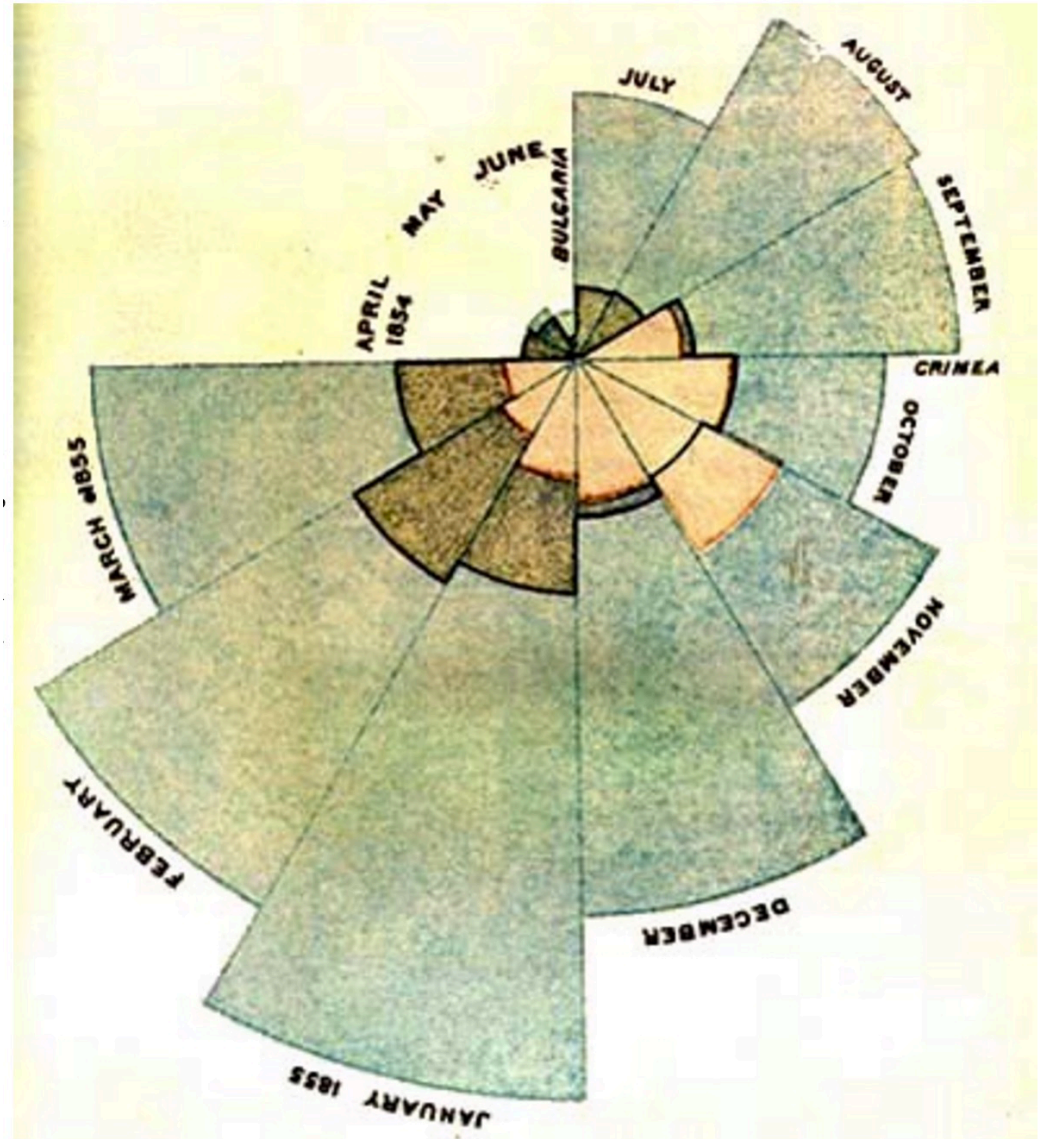
- Principes sémiotiques
 - Jacques Bertin (géographe)
- Théorie de la communication
 - Distance opérationnelle (perception / physiologie)
 - Distance articulatoire (accessibilité)
 - Distance sémantique (interprétation, références culturelles)

« Grammaire visuelle »

- Principes sémiotiques
 - Jacques Bertin (géographe)
- Cartastrophe
 - Apprendre des mauvais exemples

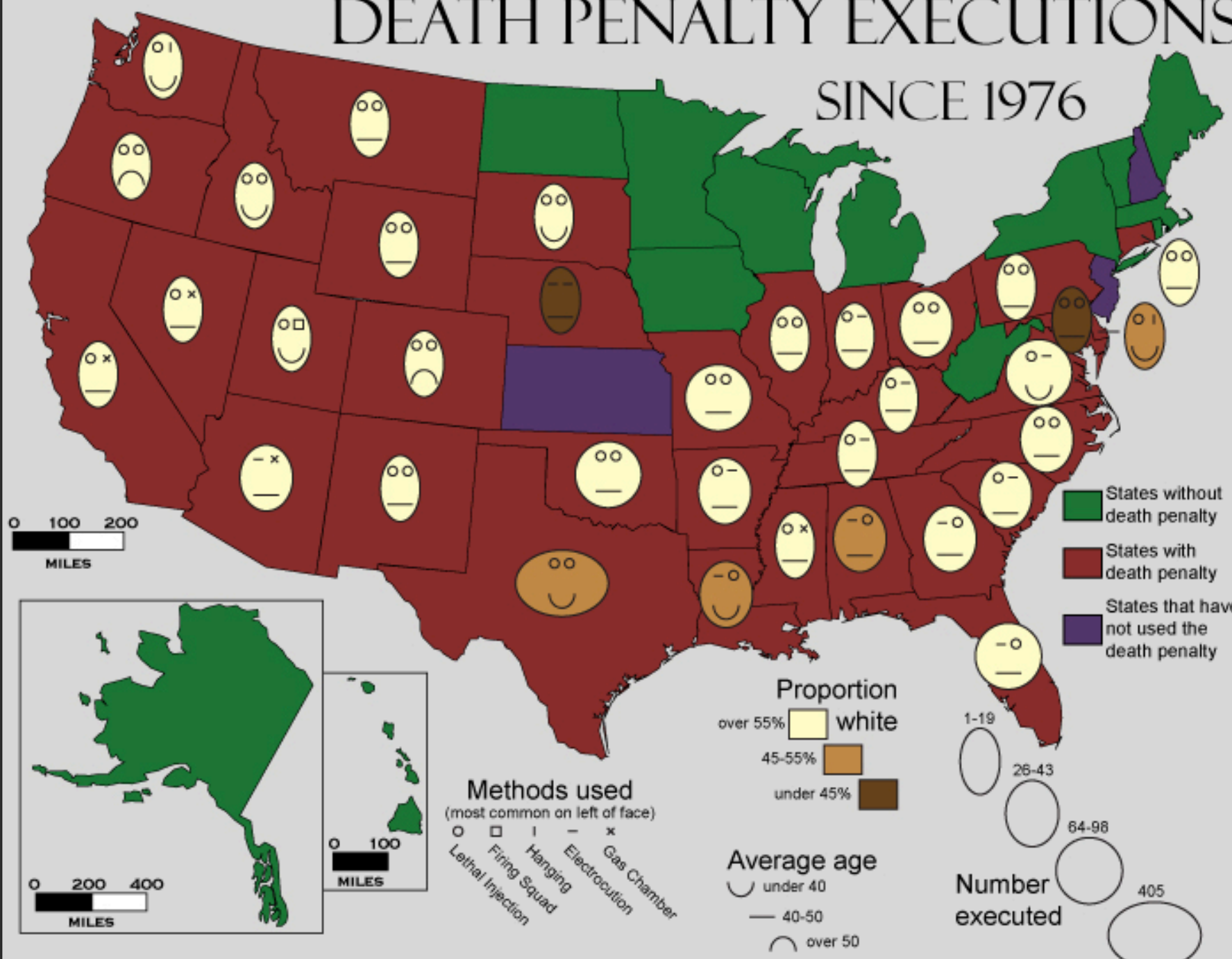
« Grammaire visuelle »

- Principes sémiotiques
 - Florence Nightingale (1854)



DEATH PENALTY EXECUTIONS

SINCE 1976

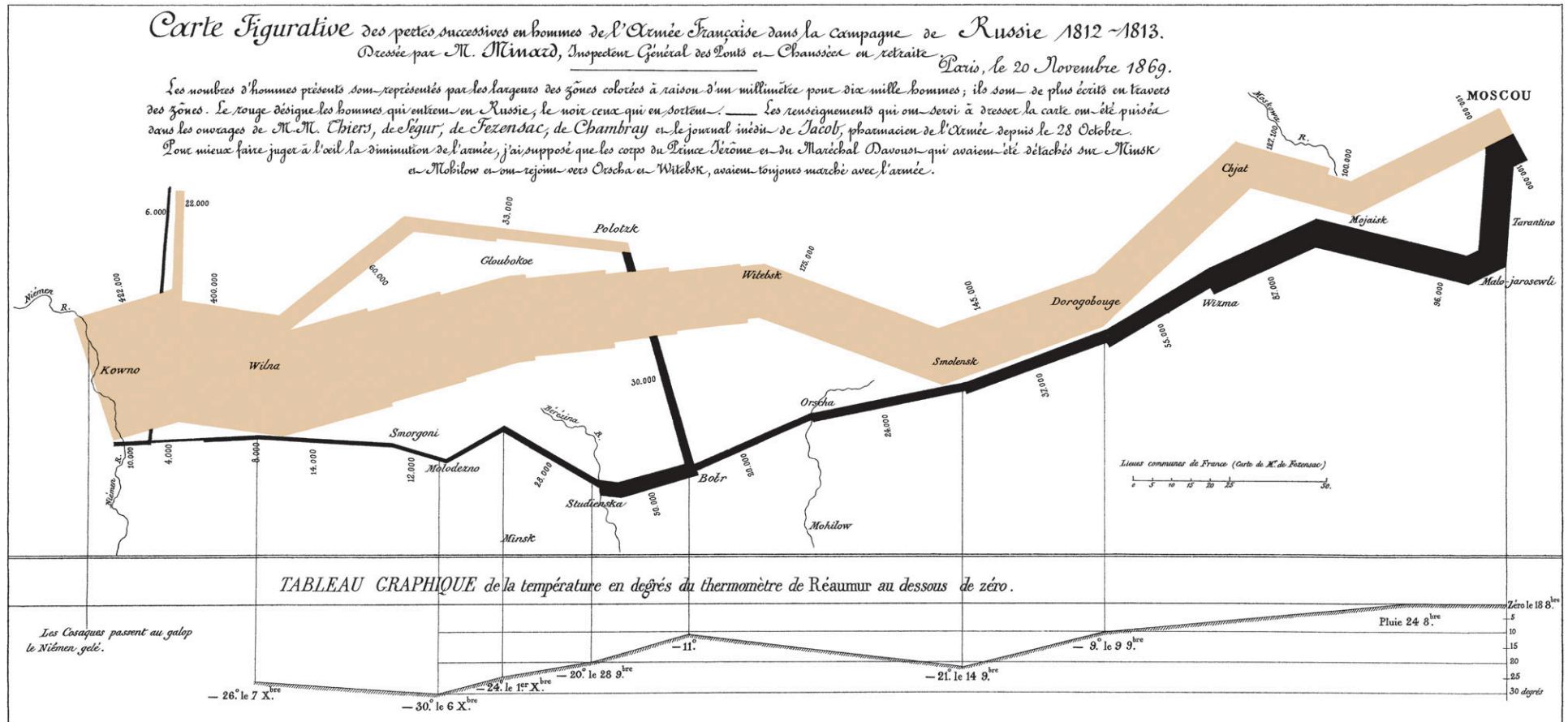


« Grammaire visuelle »

- Cartastrophe
 - [American English Dialect](#)

« Grammaire visuelle »

- Principes sémiotiques
 - Apprendre des *bons* exemples: Minard (1869)



**UNE SCIENCE DE LA
VISUALISATION ?**

Visualization Design

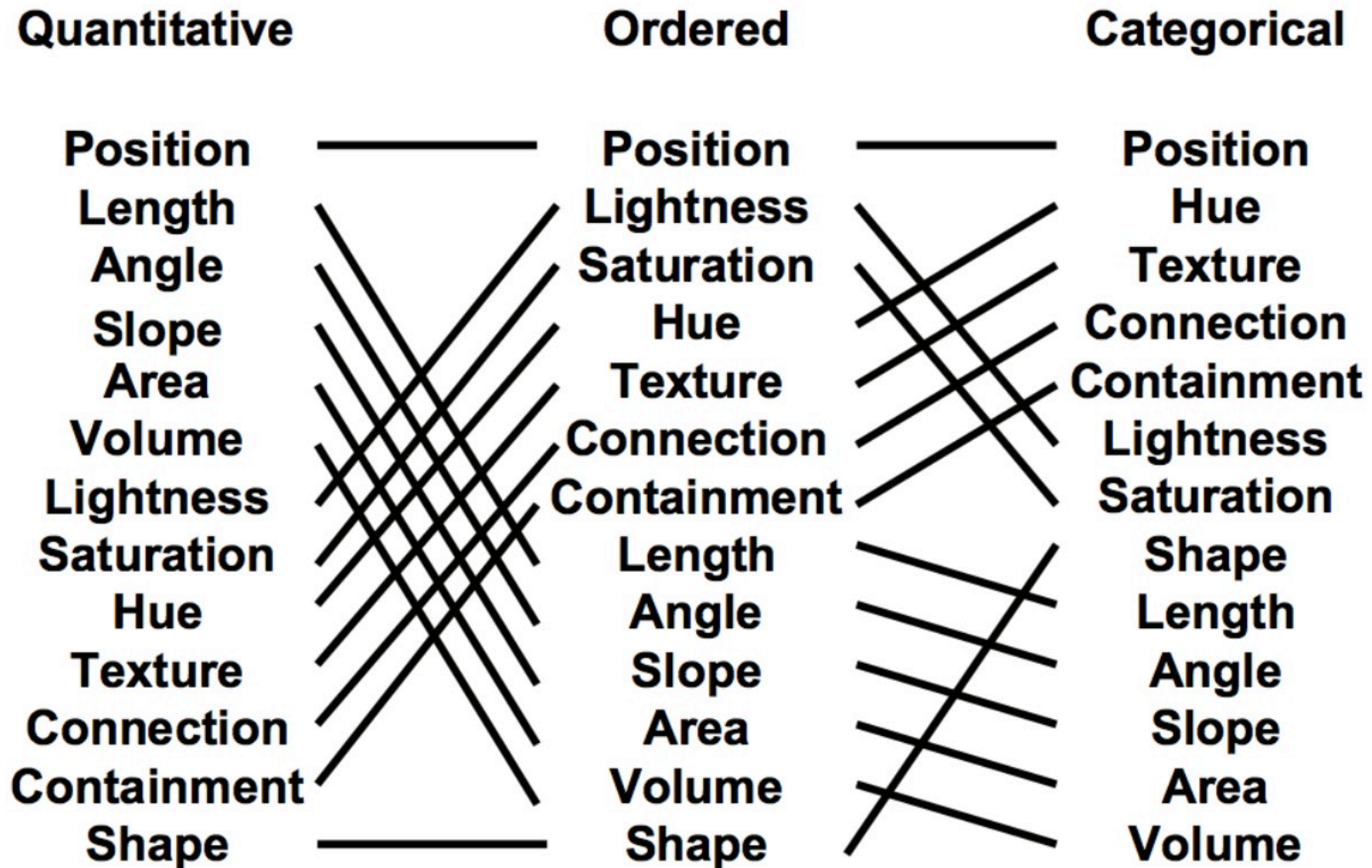
- Règles et bonnes pratique
 - Variables visuelles
 - Données et tâches
 - Dashboard

Visualization Design

- "Position is everything, color is difficult."

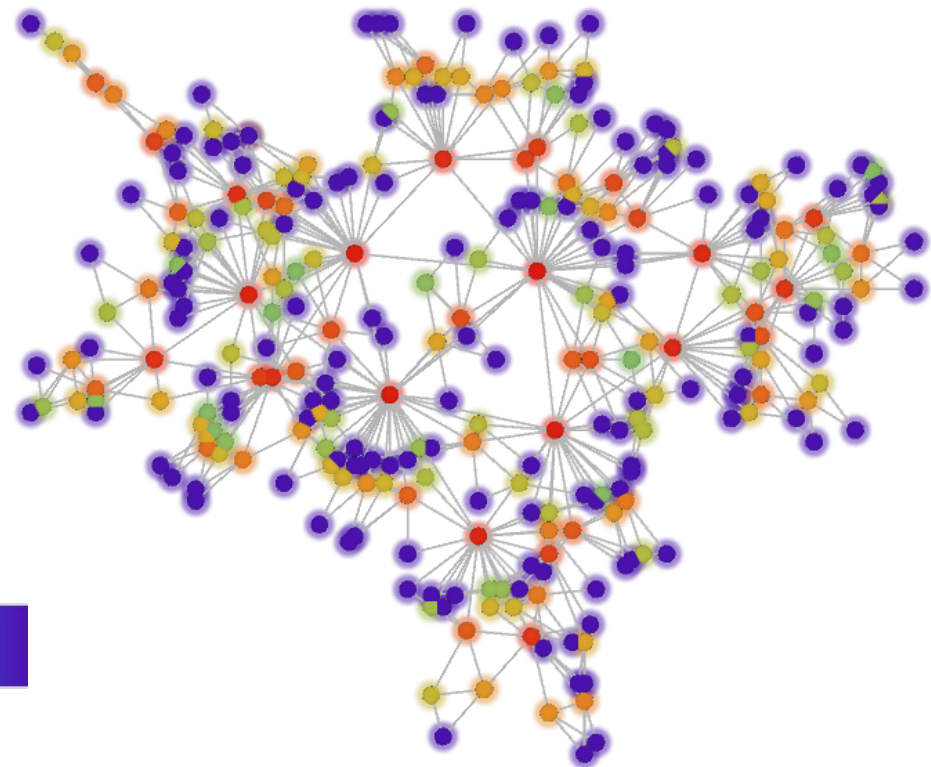
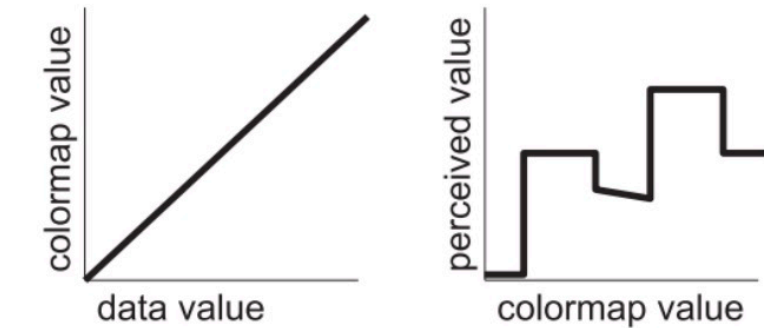
Moritz Stefaner

Visualization Design

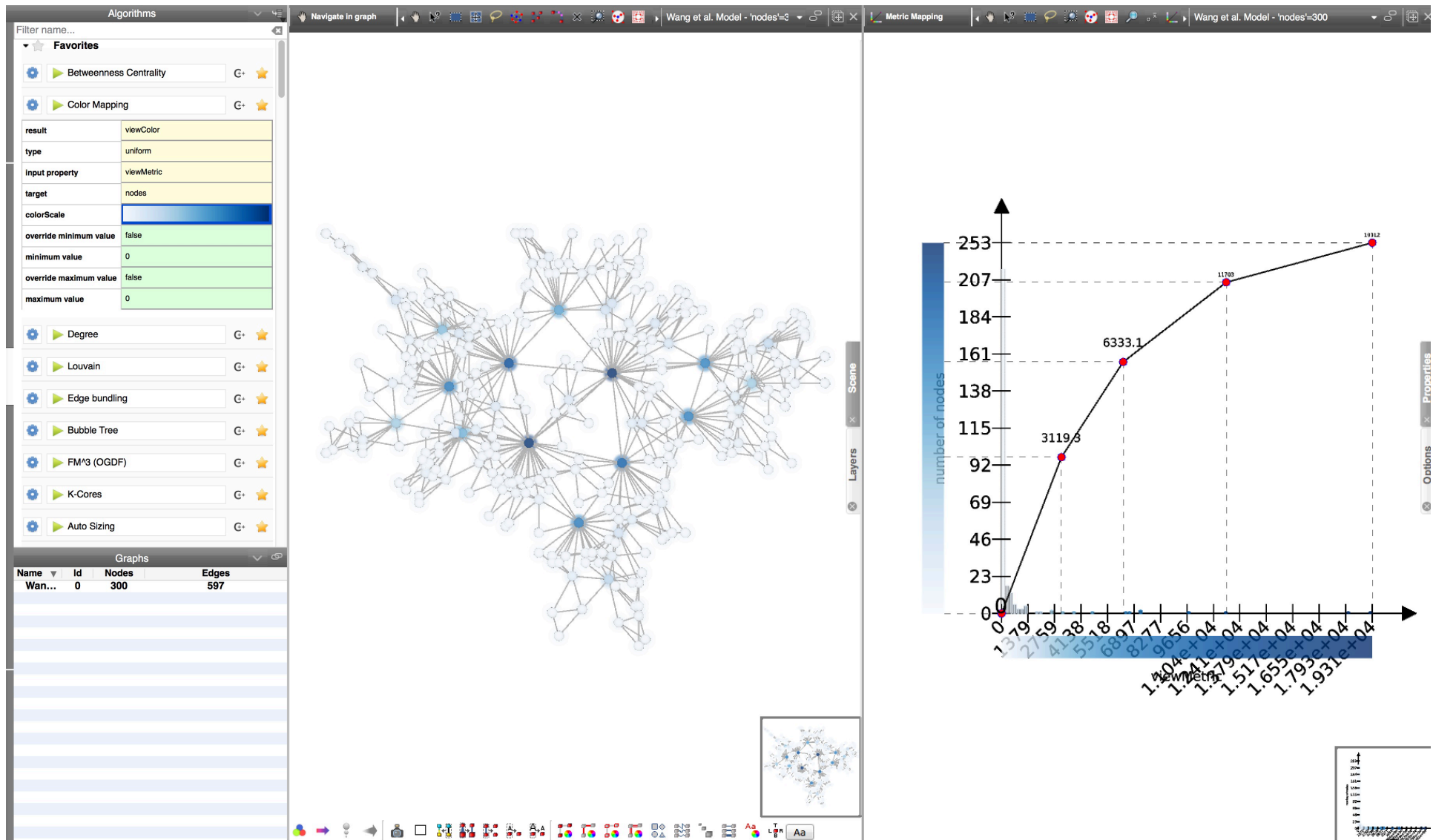


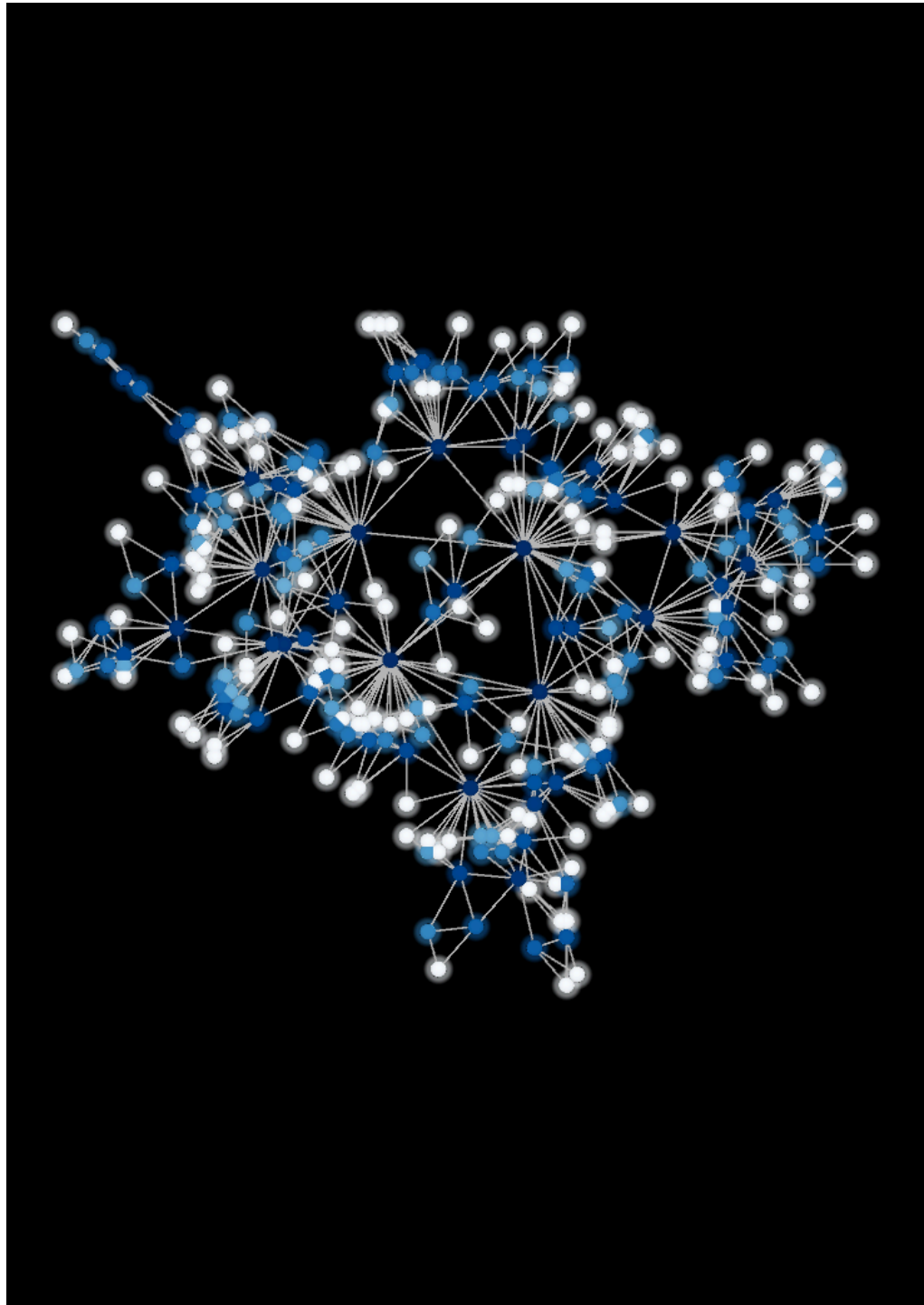
Visualization Design

- Color is difficult
 - Rainbow colormap



Visualization Design





Visualization Design

- Choix des couleurs
 - [ColorBrewer](#)

Visualization Design

- Shneiderman mantra

Overview First,

Zoom and Filter,

Details on Demand

Shneiderman taxonomy

Data Types

1D Linear	Document Lens, Seesoft™, Information Mural, TextArc
2D Map	Geographic information systems, ESRI ArcInfo™, ThemeView™, newspaper layout, self-organizing maps
3D World	Desktops, WebBook™, VRML™, Web3D™, architecture, computer-assisted design, medicine, molecules
Multidimensional	Parallel coordinates, scattergram matrices, hierarchical clustering, Spotfire®, Tableau®, GGobi®, DataDesk®, TableLens®, InfoZoom®
Temporal	DataMontage, Palantir, Project Managers, LifeLines, TimeSearcher
Tree	Outliners, degree-of-interest trees, cone/cam trees, hyperbolic trees, SpaceTree, treemaps
Network	NetMap™, netViz™, Pajek, JUNG, UCInet, NetDraw, TouchGraph, SocialAction, NodeXL

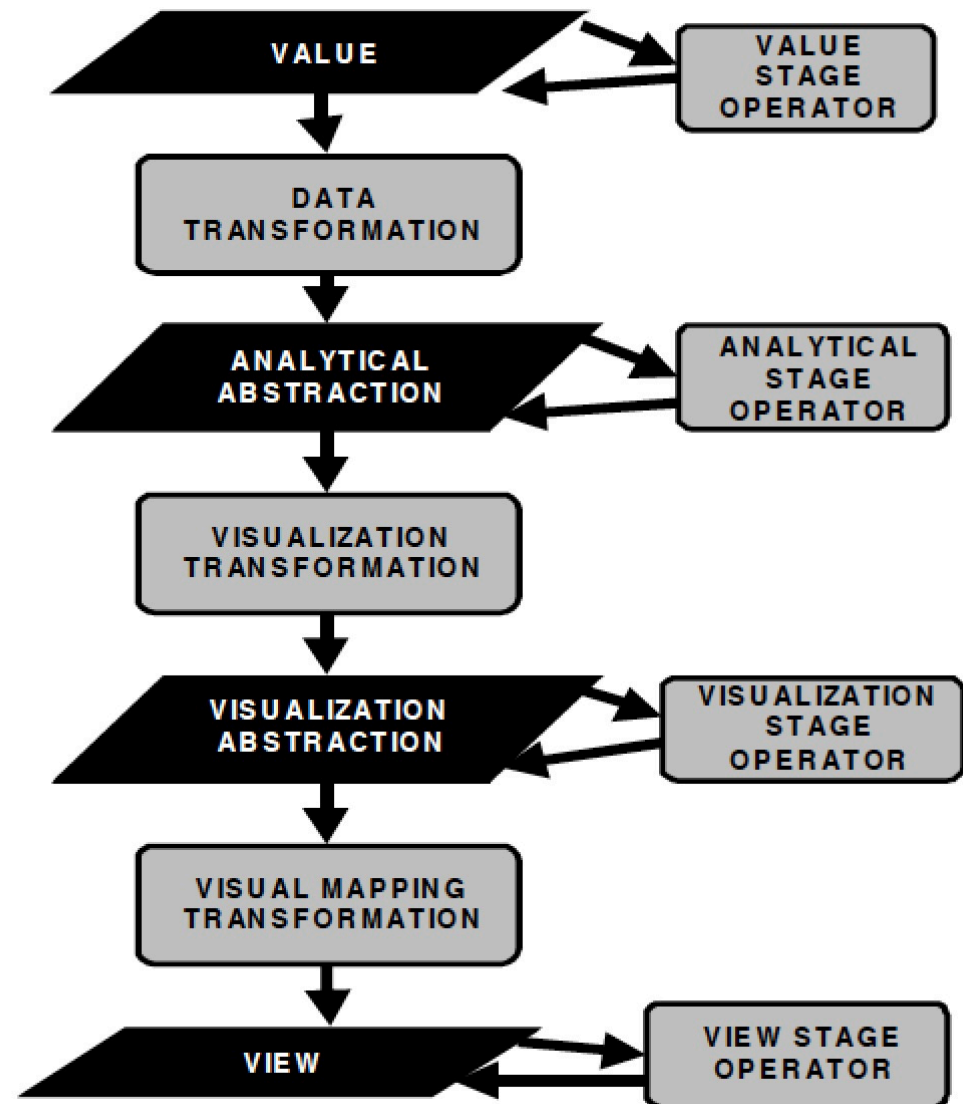
Shneiderman taxonomy

Tasks

Overview	Gain an overview of the entire collection
Zoom	Zoom in on items of interest
Filter	Filter out uninteresting items
Details-on-demand	Select an item or group and get details when needed
Relate	View relationships among items
History	Keep a history of actions to support undo, replay, and progressive refinement
Extract	Allow extraction of subcollections and of the query parameters

Visualization Design

- Ed Chi Data State Reference Model



Visualization Design

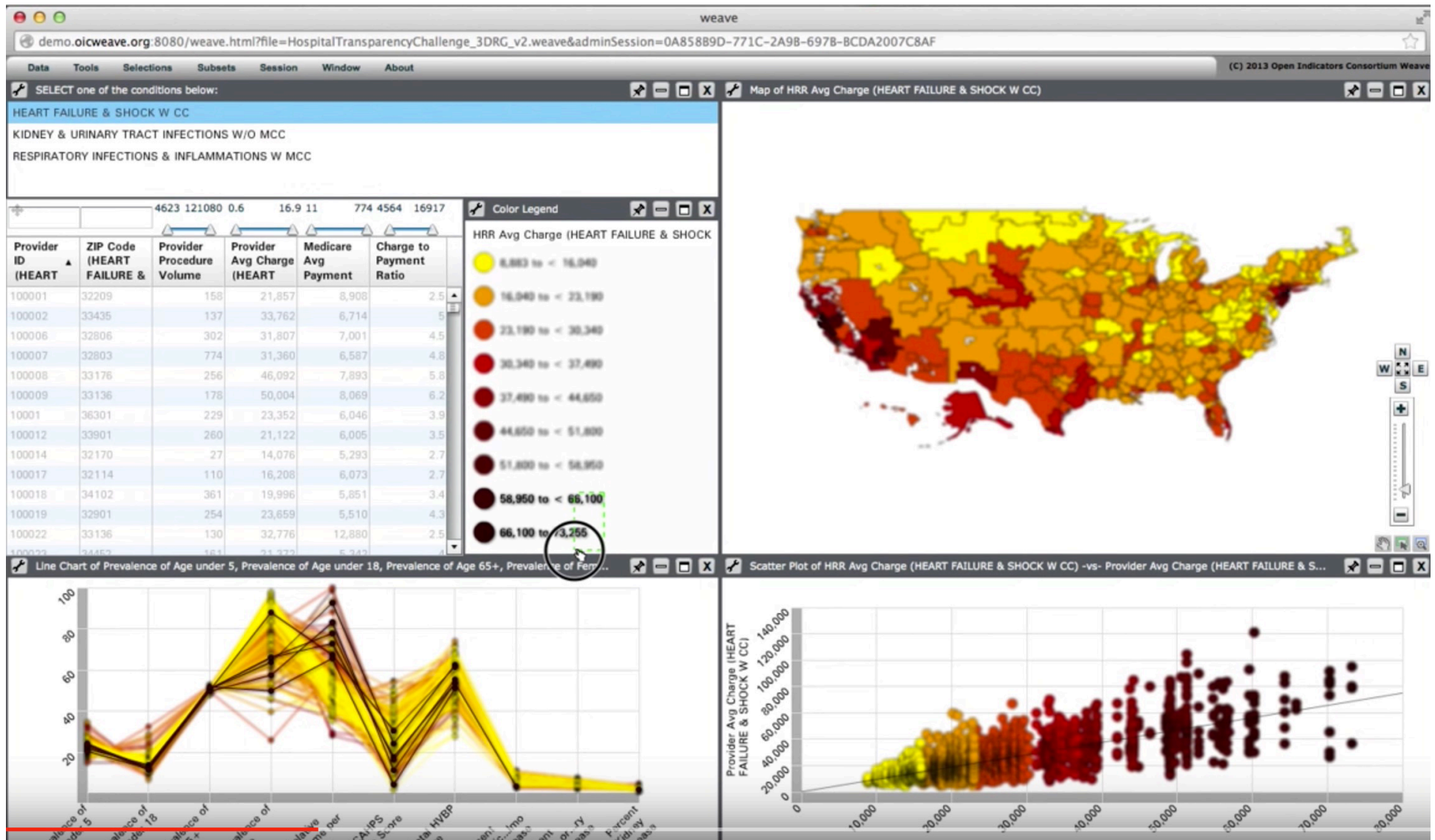
Interaction Principles

- Overview
- Reconfigure: show me a different arrangement
- Encode: show me a different representation
- Filter
 - show me something conditionally
 - Context-maintained Filter
 - Reduction Filter
- Dynamic Queries
- Brushing
- Click-n-Drag
- Explore: show me something else
 - Connect: show me related items
 - Abstract/Elaborate: show me more or less detail
 - Details-on-demand
- Navigation
 - Navigation Box
 - Spatial Navigation
- Select: mark something as interesting
 - Single Direct Selection
 - Multiple Direct Selection
 - Bounding Box
 - Single Direct Selection+Keyboard
 - Bounding Box+Keyboard

Visualization Design

- Règles et bonnes pratique
 - Dashboard

Visualization Design

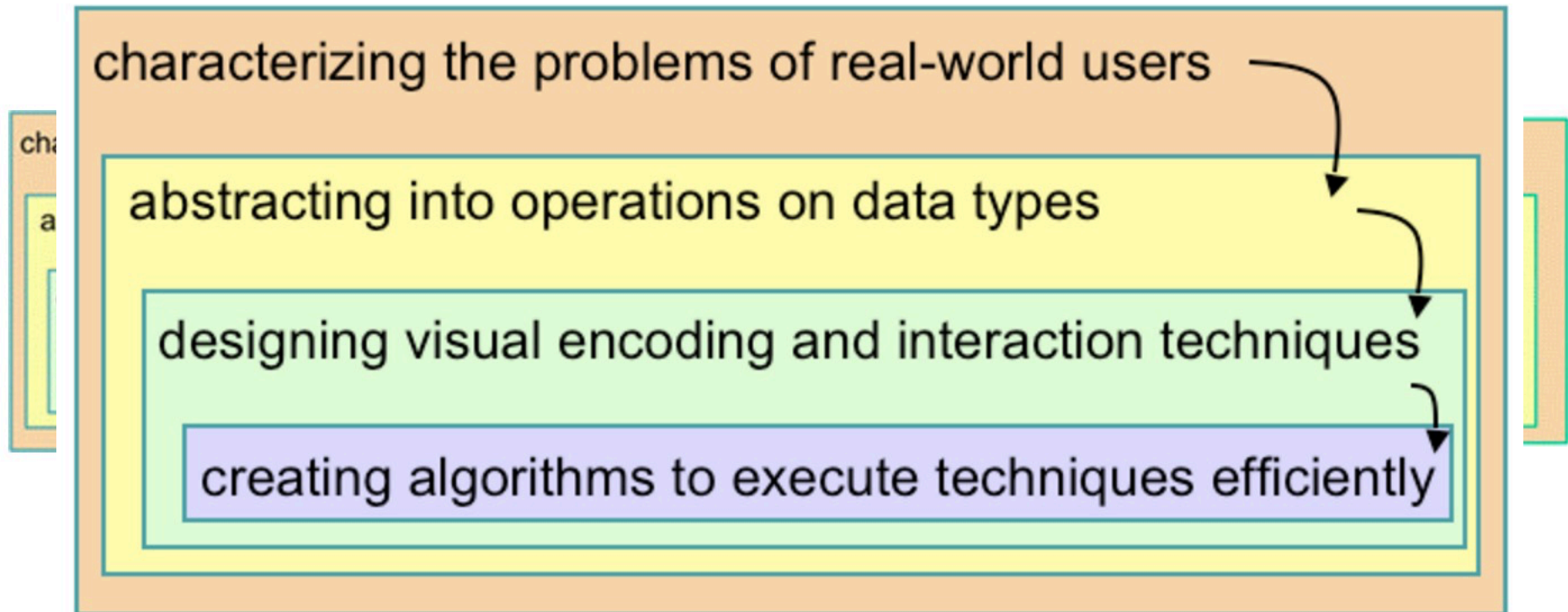


Visual Dashboard - Le jeu des 13 erreurs

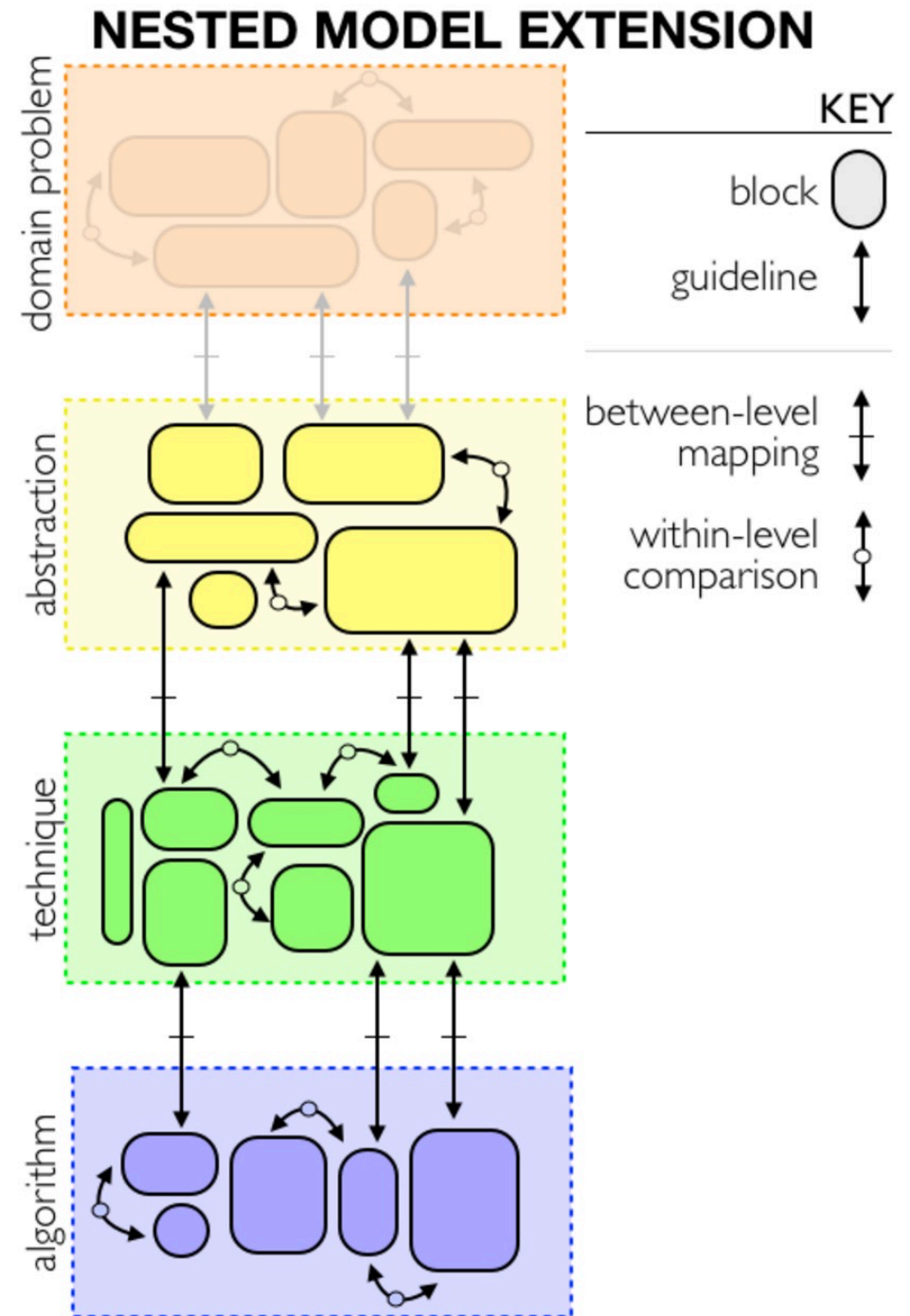
- Exceeding the boundaries of a single screen
- Choosing inappropriate display media
- Using poorly designed display media
- Supplying inadequate context for the data
- Displaying excessive detail or precision
- Highlighting important data ineffectively or not at all
- Introducing meaningless variety
- Choosing a deficient measure
- Encoding quantitative data inaccurately
- Misusing or overusing color
- Arranging the data poorly
- Designing an unattractive visual display
- Cluttering the display with useless decoration

Stephen Few (2006)
Information Dashboard Design,
O'Reilly

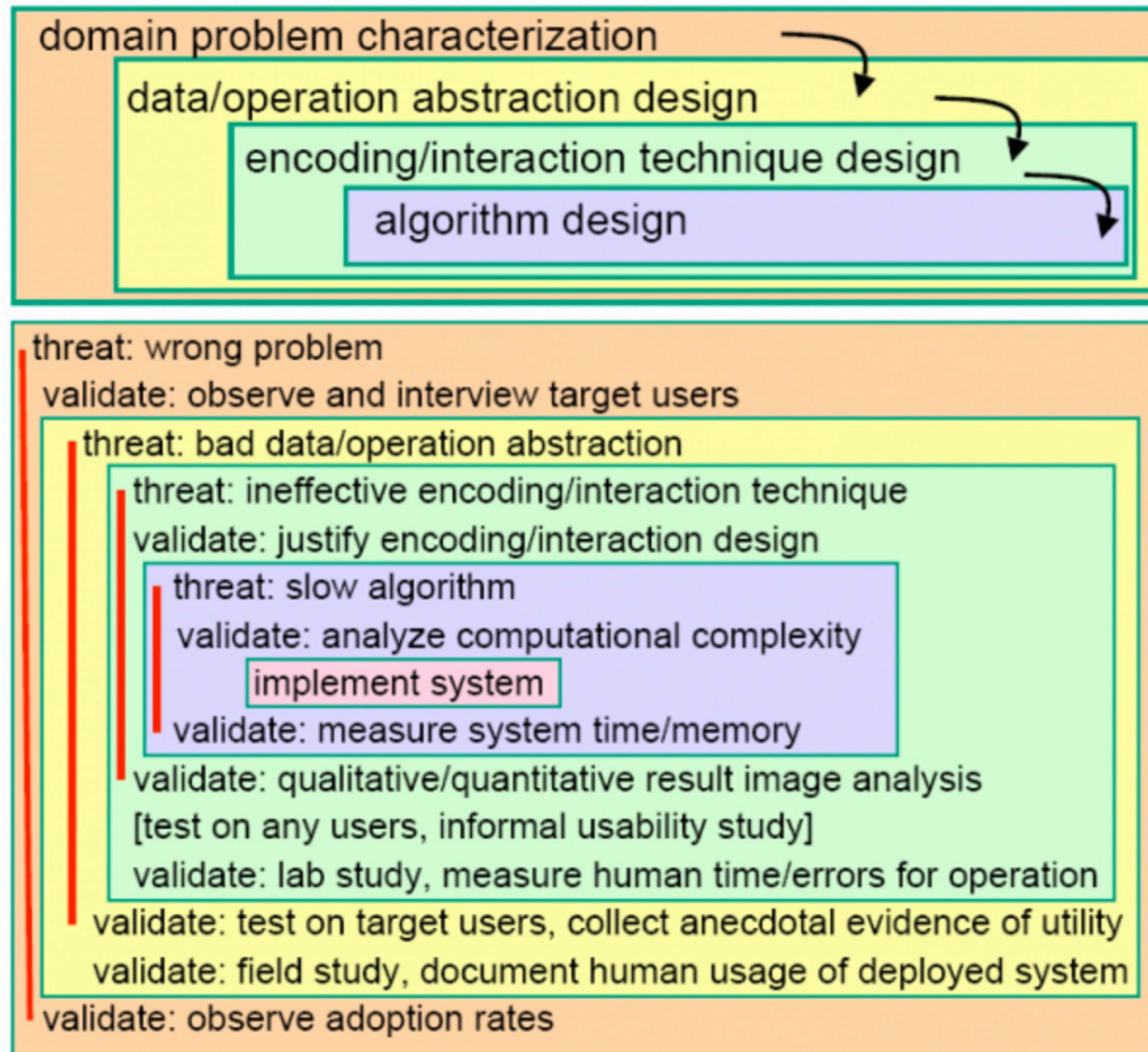
Visual Design Model



Visual Design Model



Visual Design Model



[http://www.labri.fr/perso/melancon/
Visual_Analytics_Course/doku.php?
id=introduction](http://www.labri.fr/perso/melancon/Visual_Analytics_Course/doku.php?id=introduction)