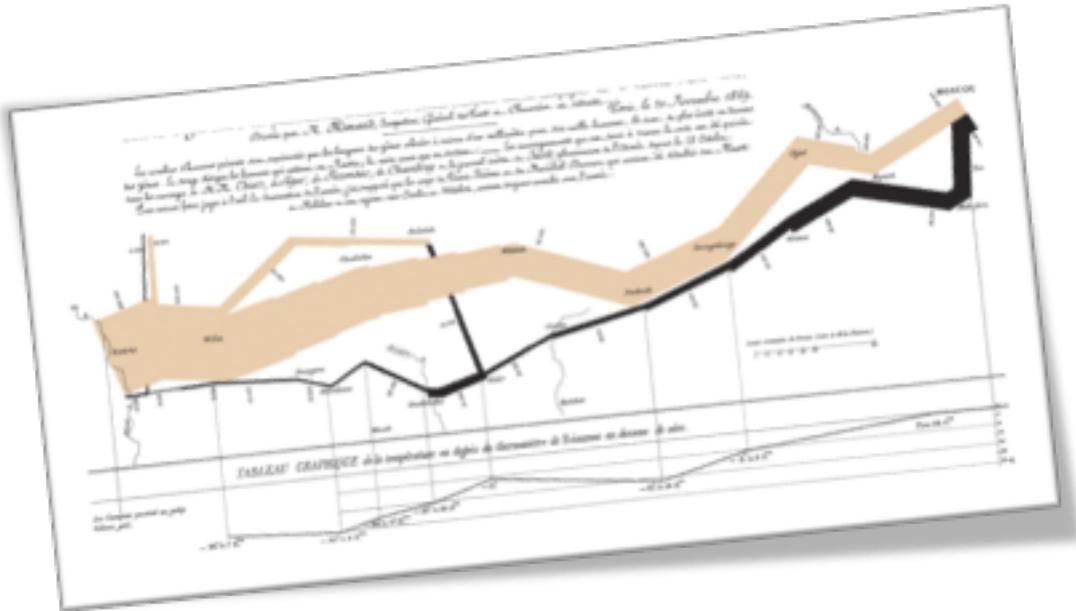


Visualisation d'Information

Introduction



Sylvain Malacria

Master 2 IVI

Note: Transparents réalisés par Fanny Chevalier et très largement inspirés des cours de Petra Isenberg, Jean-Daniel Fekete, Pierre Dragicevic, Wesley Willet et Frédéric Vernier (www.aviz.fr) et Jeffrey Heer (<http://courses.cs.washington.edu/courses/cse512/14wi/>).

Pourquoi

La visualisation d'information





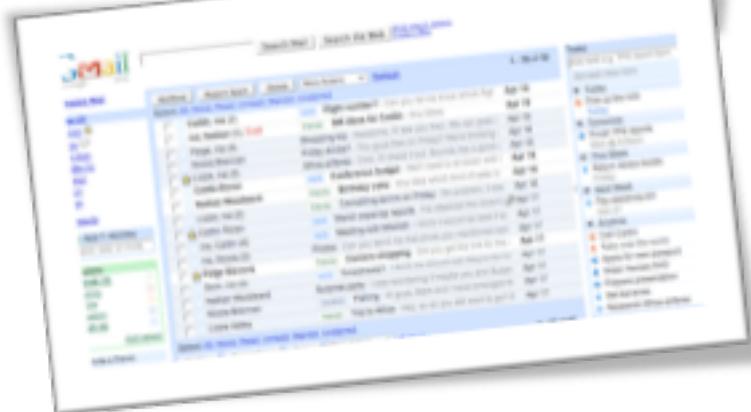
800 exabytes (800×10^{19}) d'**information digitale**
ont été générés en 2009

[source: The Diverse and Exploding Digital Universe, IDC, 2008]

[credit: Did You Know; Fisch, McLeod, Brenman]

La Révolution “Big Data”

Toujours plus de données collectées et **stockées**.



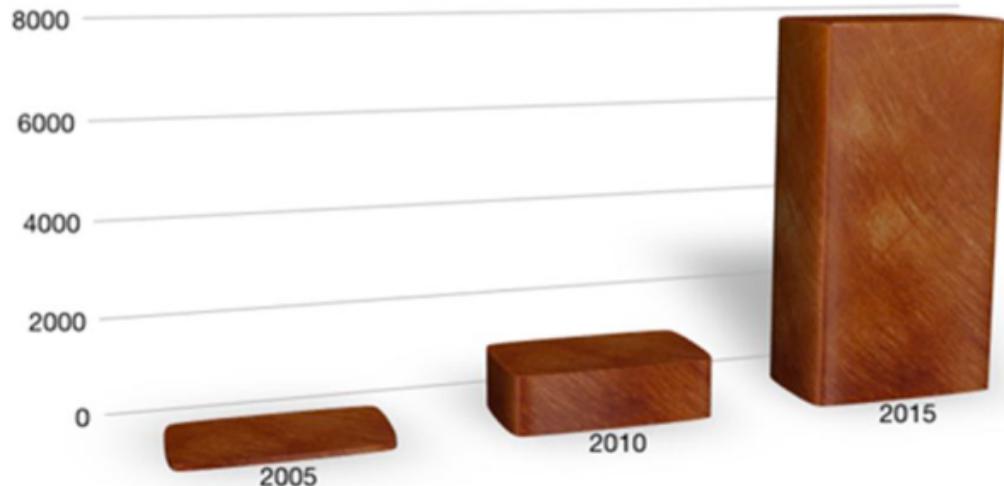
La Révolution "Big Data"

Toujours plus de données collectées et **stockées**.

L'univers digital explose:

- 2007: 281 Exabytes (281 billions de Gigabytes)
- 2010: Zetabytes atteint
- 2011: 1.8 Zetabytes
- 2015: 7 910 Zetabytes

A Decade of Digital Universe Growth: Storage in Exabytes



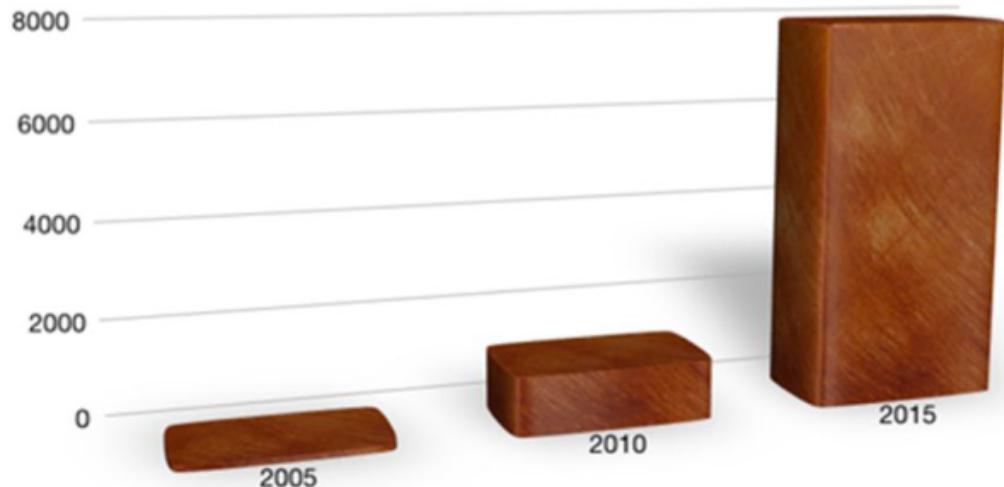
La Révolution "Big Data"

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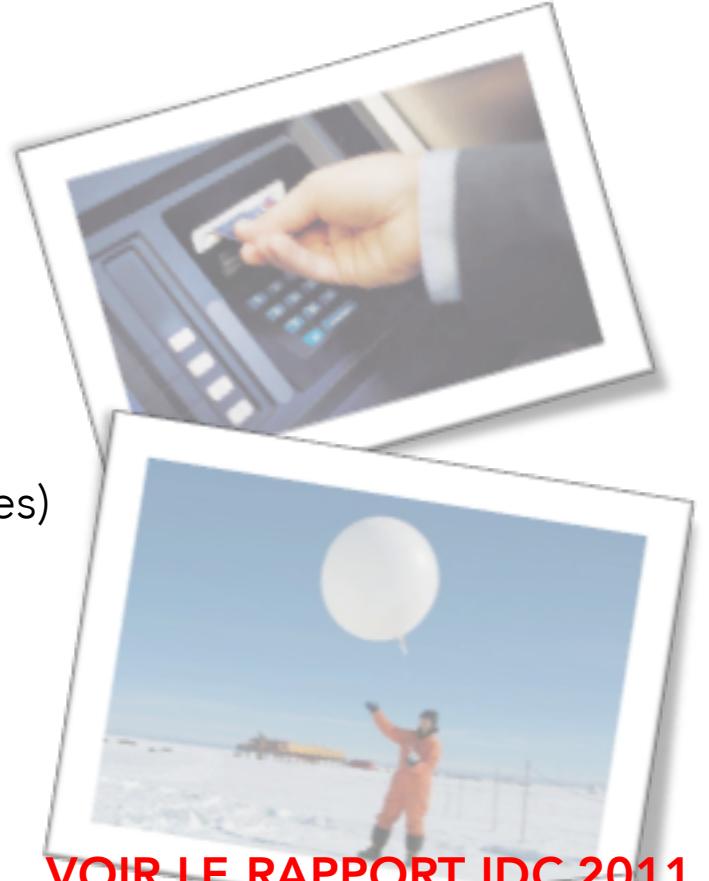
L'univers digital explose:

- 2007: 281 Exabytes (281 billions de Gigabytes)
- 2010: Zetabytes atteint
- 2011: 1.8 Zetabytes
- 2015: 7,910 Zetabytes

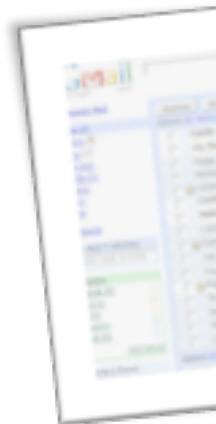
A Decade of Digital Universe Growth: Storage in Exabytes



[Source: IDC's Digital Universe Study, sponsored by EMC, June 2011]



VOIR LE RAPPORT IDC 2011



Data Science



“La capacité à s'approprier les données

– être capable de comprendre les données, de les traiter, d'en extraire de l'information, de les visualiser et de les communiquer –

va devenir une compétence incommensurable dans les prochaines décennies.”

Hal Varian

Chef économiste chez Google

Google™

[Source: Hal Varian on how the Web challenges managers, McKinsey & Company, Jan. 2009]

Questions

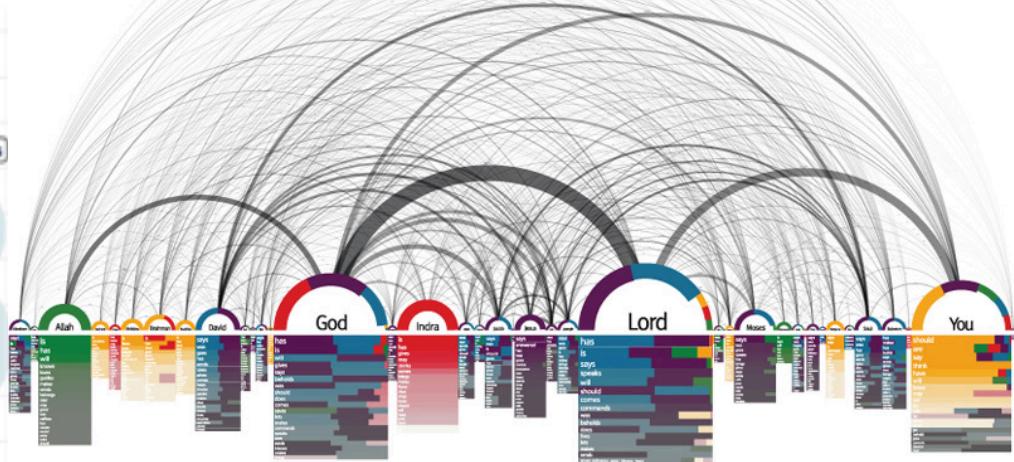
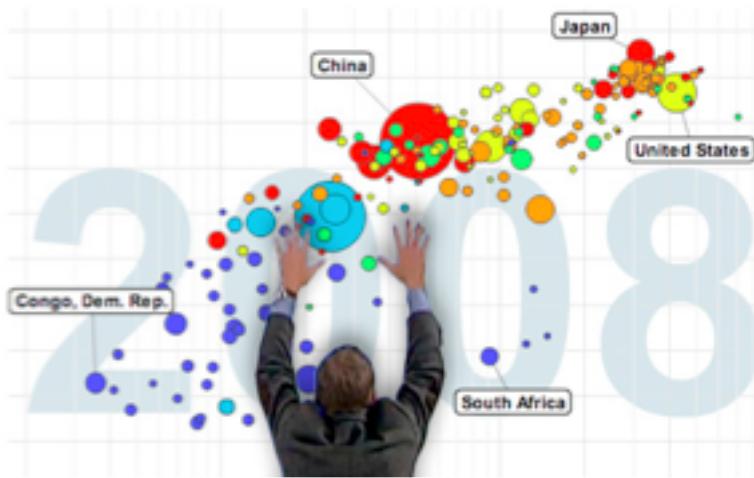


Comment peut-on accéder à l'information efficacement ?

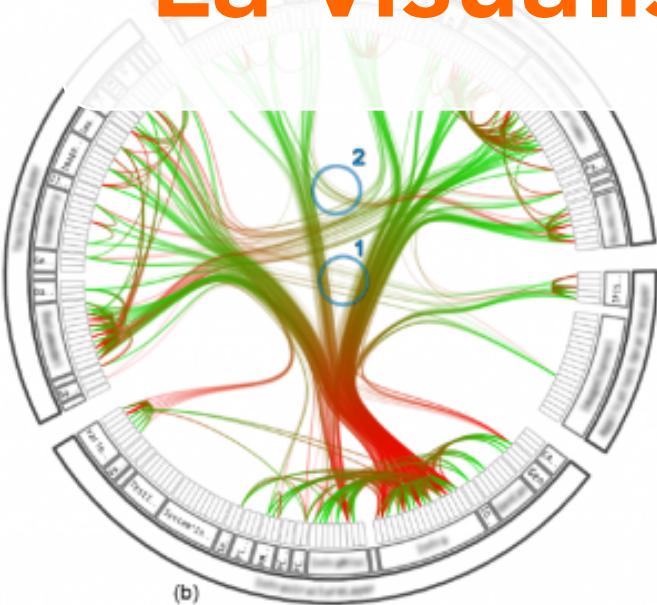
- Comprendre la structure des données ?
- Faire des comparaisons ?
- Prendre des décisions ?
- Découvrir de nouvelles connaissances ?
- Communiquer aux autres ?
- Convaincre ?
- ...



Une solution...



La visualisation d'information



La valeur de la visualisation

| 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 |

Les données brutes du Quartet d'Anscombe

La valeur de la visualisation

L'analyse statistique suggère que les données sont équivalentes

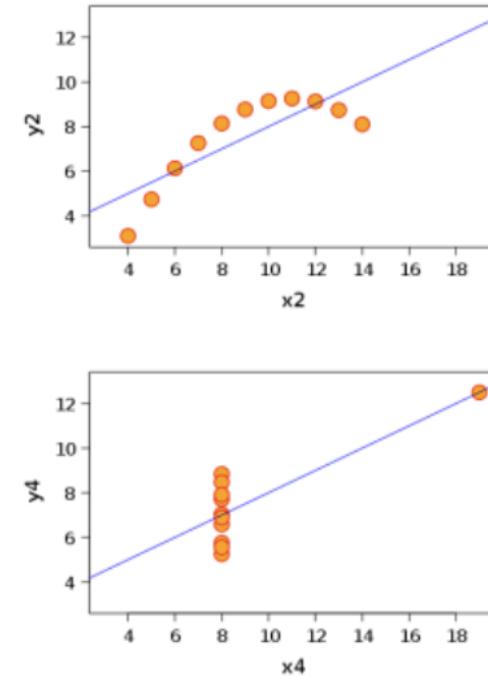
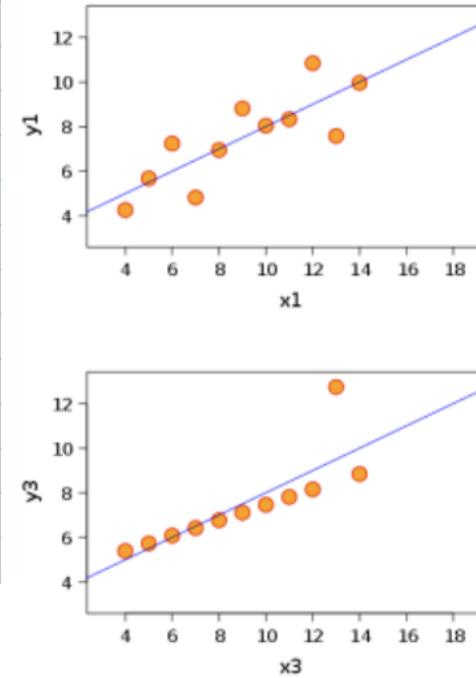
| I | | II | | III | | IV | |
|------|-------|------|------|------|-------|------|-------|
| x | y | x | y | x | y | x | y |
| 10.0 | 8.04 | 10.0 | 9.14 | 10.0 | 7.46 | 8.0 | 6.58 |
| 8.0 | 6.95 | 8.0 | 8.14 | 8.0 | 6.77 | 8.0 | 5.76 |
| 13.0 | 7.58 | 13.0 | 8.74 | 13.0 | 12.74 | 8.0 | 7.71 |
| 9.0 | 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 |

| | |
|--------------------------|----------------------|
| Moyenne en x | 9 |
| Variance en x | 11 |
| Moyenne en y | 7,5 |
| Variance en y | 4,12 |
| Correlation entre x et y | 0,816 |
| Régression linéaire | $y = 3 + 0,5 \times$ |

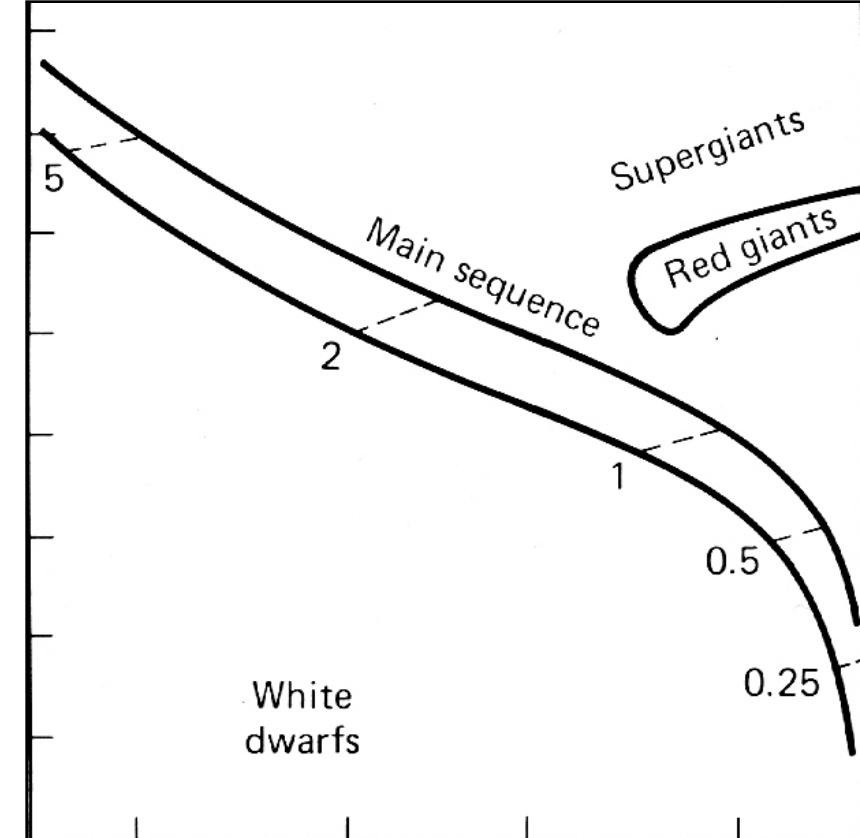
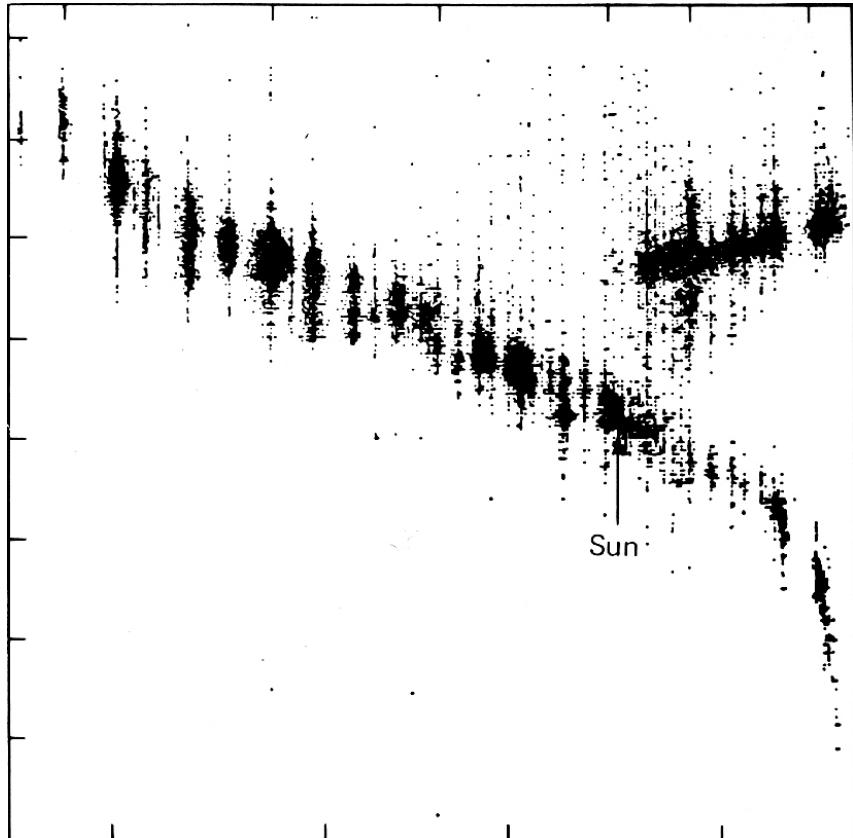
La valeur de la visualisation

La représentation visuelle raconte une toute autre histoire...

| 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 |
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| 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 |
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| 5.0 | 5.68 | 5.0 | 4.74 | 5.0 | 5.73 | 8.0 | 6.89 |



Capacité d'abstraction

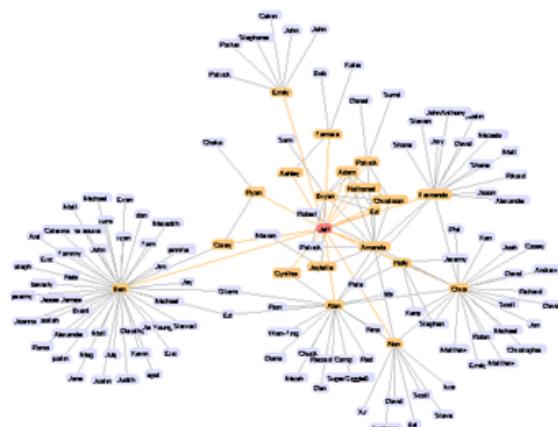


Le diagramme de Hertzsprung Russell Diagram et son interpretation

Pourquoi des représentations visuelles?

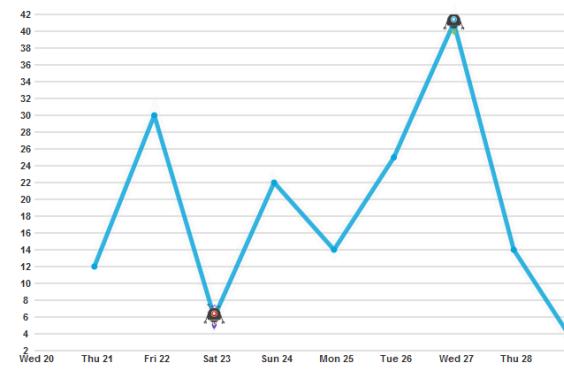
- La vision est notre sens dominant
- Nous sommes très bons à identifier des motifs
- Nous avons besoin de voir et comprendre, afin d'expliquer, raisonner, et prendre des décisions

Hiérarchies et réseaux



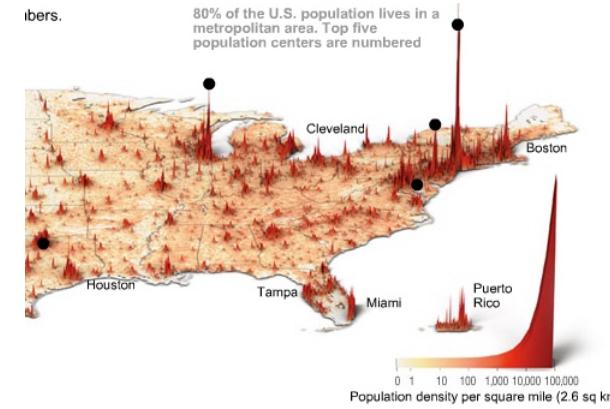
Source: prefuse.org

Graphiques



Source: wijmo.com/

Cartes



Source: New York Times

Pourquoi des représentations visuelles?

- La vision est notre sens dominant
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Hiérarchies et réseaux



Source: prefuse.org

Graphiques



Source: wijmo.com/

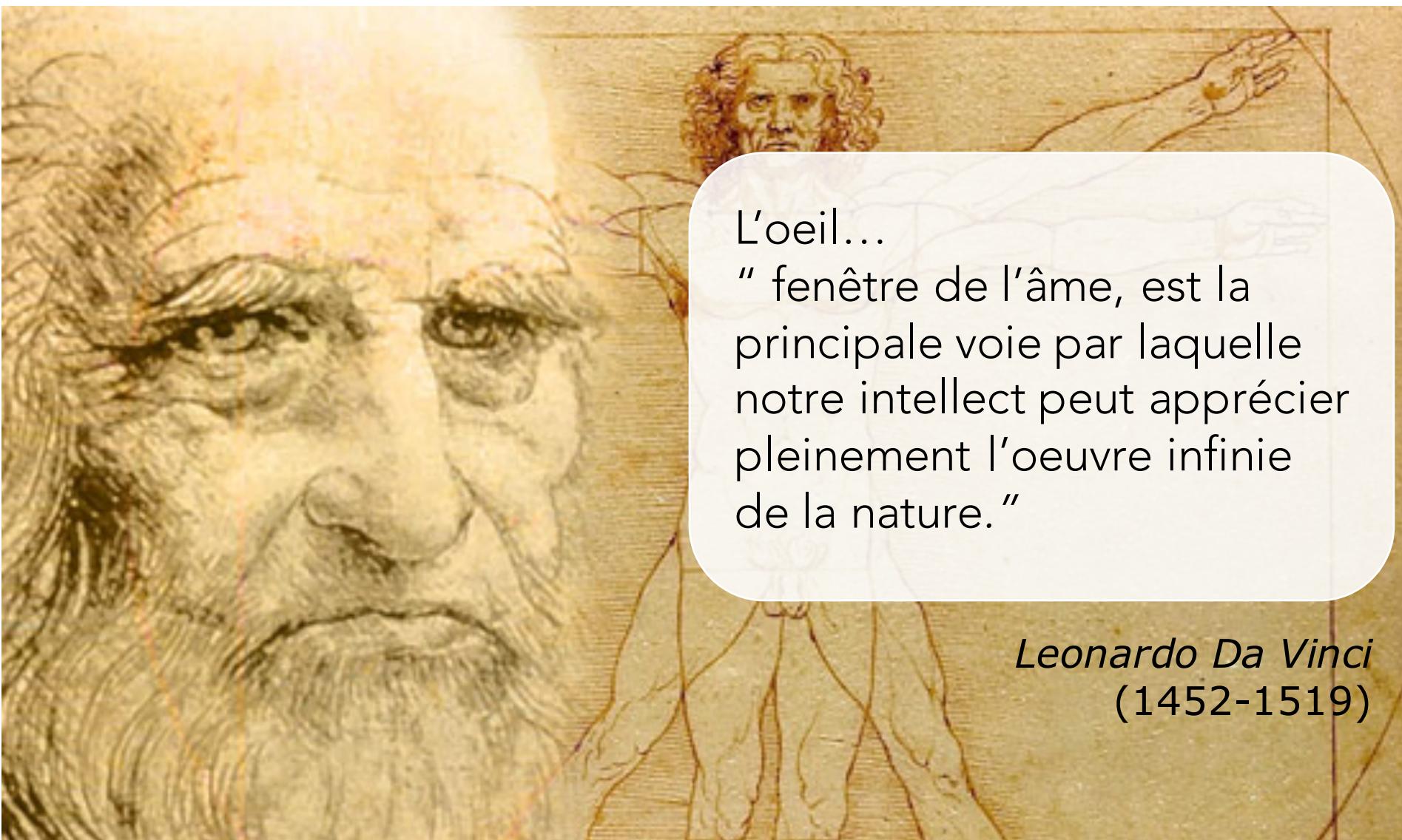
Cartes



Population density per square mile (2.6 sq km)

Source: [New York Times](http://www.nytimes.com)

Vision



L'oeil...

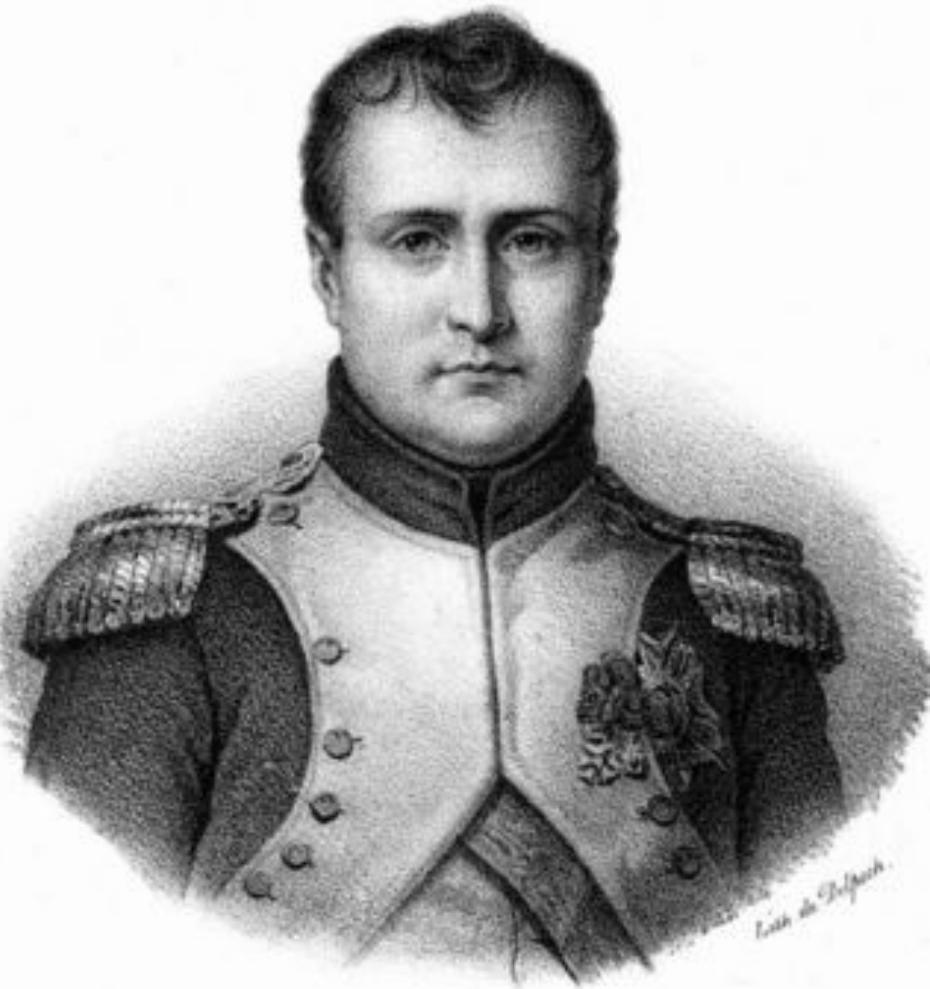
“ fenêtre de l’âme, est la principale voie par laquelle notre intellect peut apprécier pleinement l’œuvre infinie de la nature.”

Leonardo Da Vinci
(1452-1519)

"A picture is worth a 1,000 words"



Confucius



Napoléon Bonaparte

百聞不如一見

"One hundred rumors are not comparable to one look."

An Old Chinese Inscription

Qu'est-ce que la visualisation ?



1. Action de rendre visible d'une façon matérielle l'action et les effets d'un phénomène

2. Présentation visuelle sur un écran, sous forme d'image alphanumérique ou graphique, d'un ensemble d'informations traitées par des moyens informatiques.

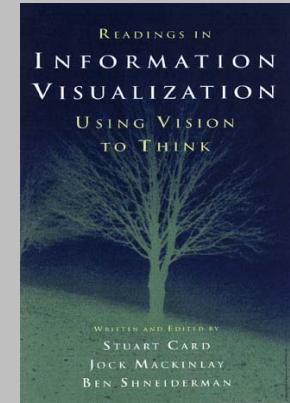
Visualisation d'information

- Concevoir des représentations visuelles
- Concerne les **données abstraites**
- Inclut l'interaction

Définition officielle

The use of computer-supported, interactive, visual representations of abstract data to amplify cognition.

[Card et al. 1999]



La visualisation d'information ne date pas d'hier...

Exemples Historiques



La marche de Moscou de Napoléon

Charles Minard, 1869

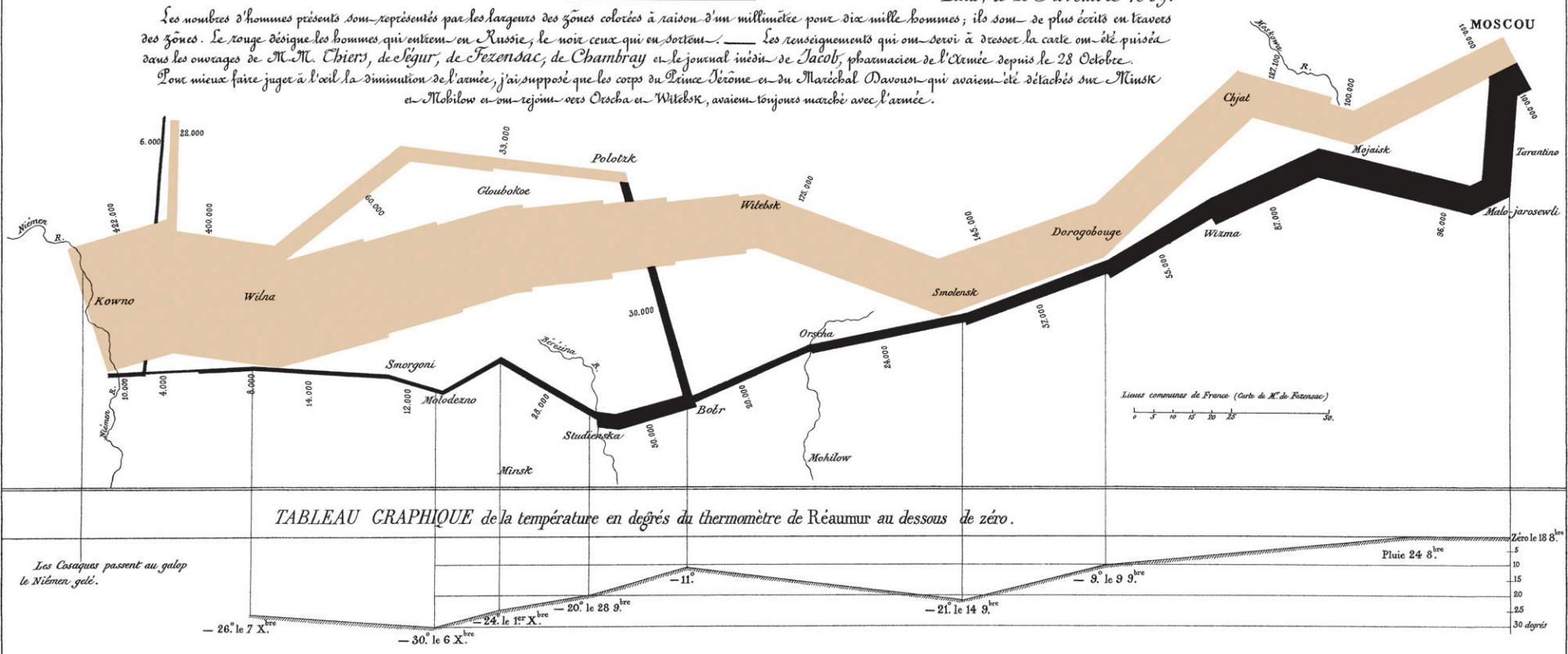
Qualifiée par Edward Tufte comme la meilleure représentation statistique de tous les temps



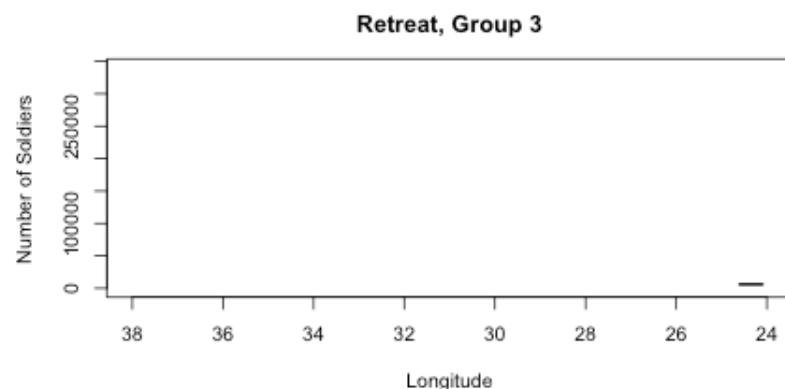
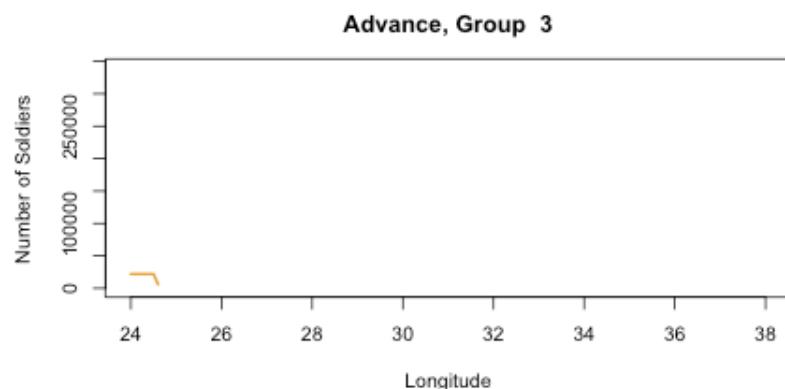
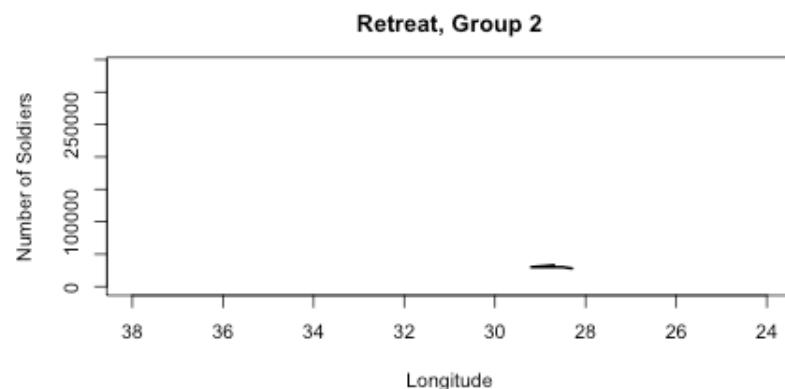
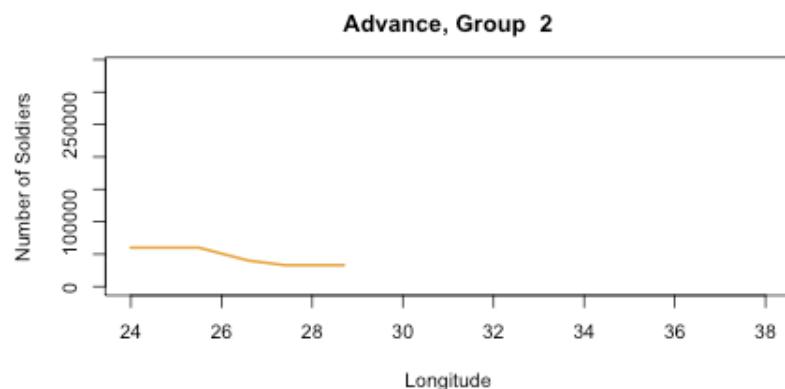
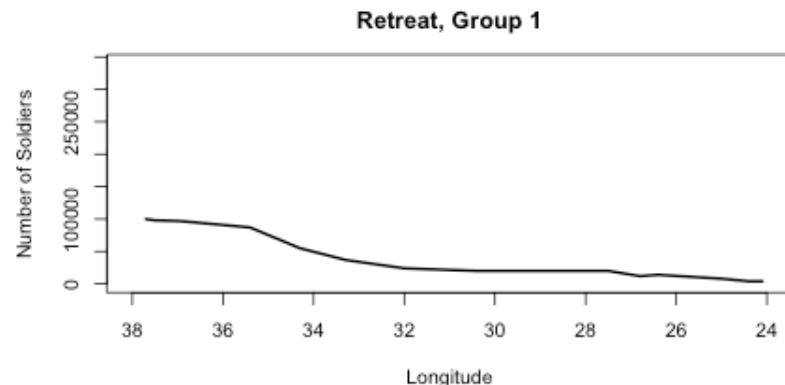
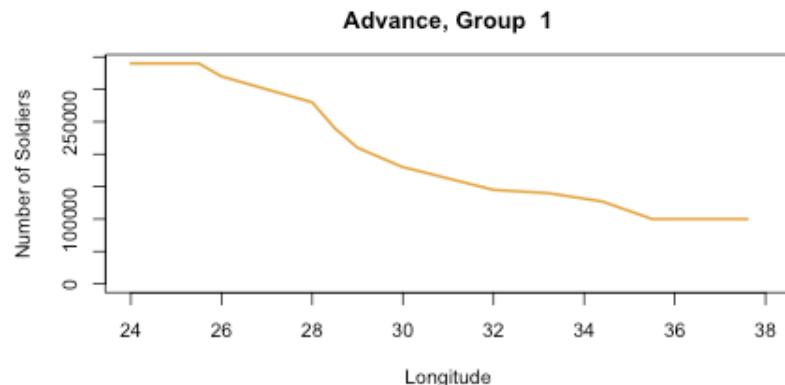
Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
Dessinée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie; le noir ceux qui en sortent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Clément, de Fezensac, de Chambray et le journal médical de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

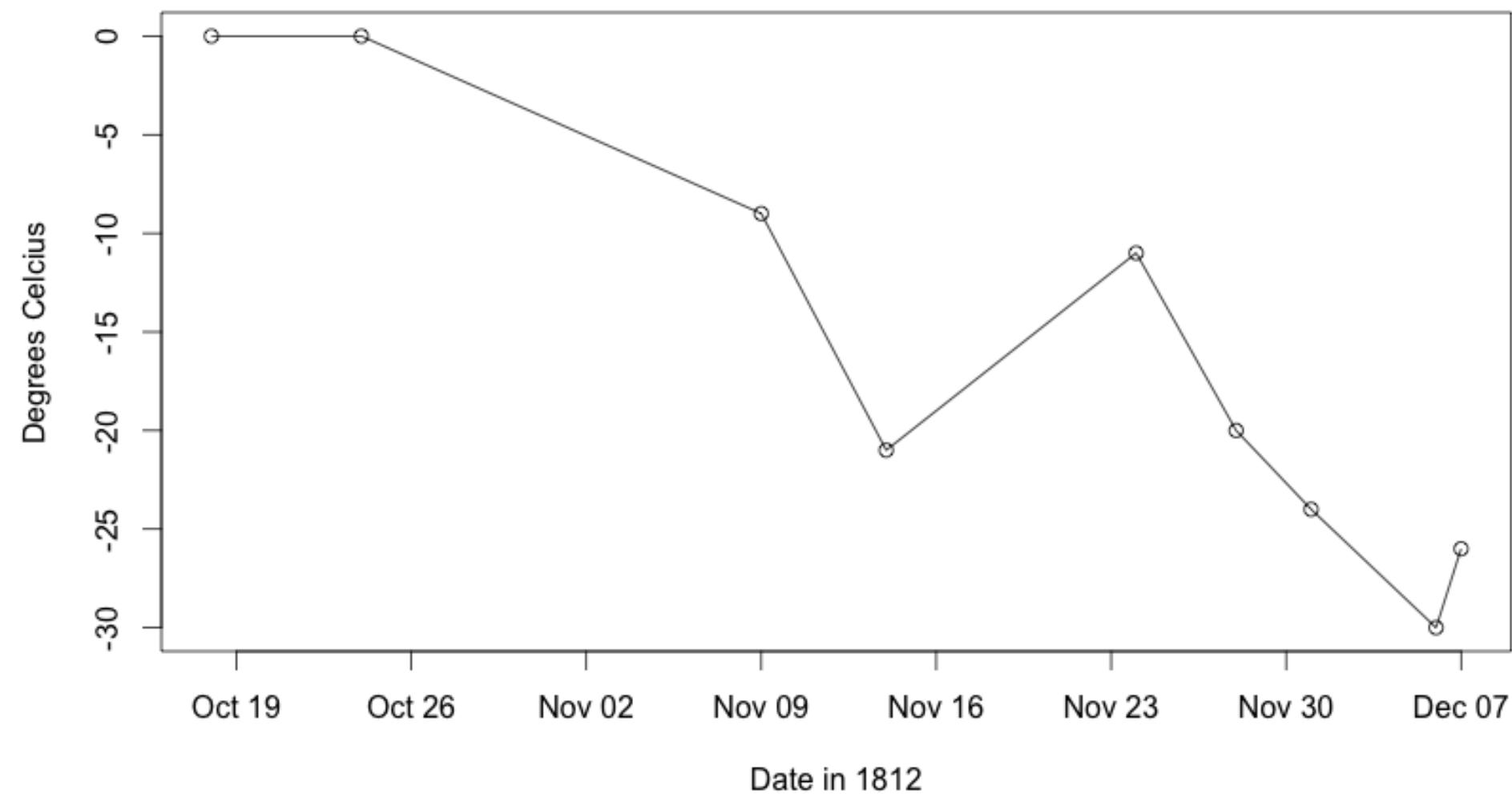
Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk en Maliblow et en rejoigné vers Oroscha et Witelk, avaient toujours marché avec l'armée.



En savoir plus: The Visual Display of Quantitative Information (Tufte)



Temperature During The Retreat





Advance
Retreat

La marche de Moscou de Napoléon

Charles Minard, 1869

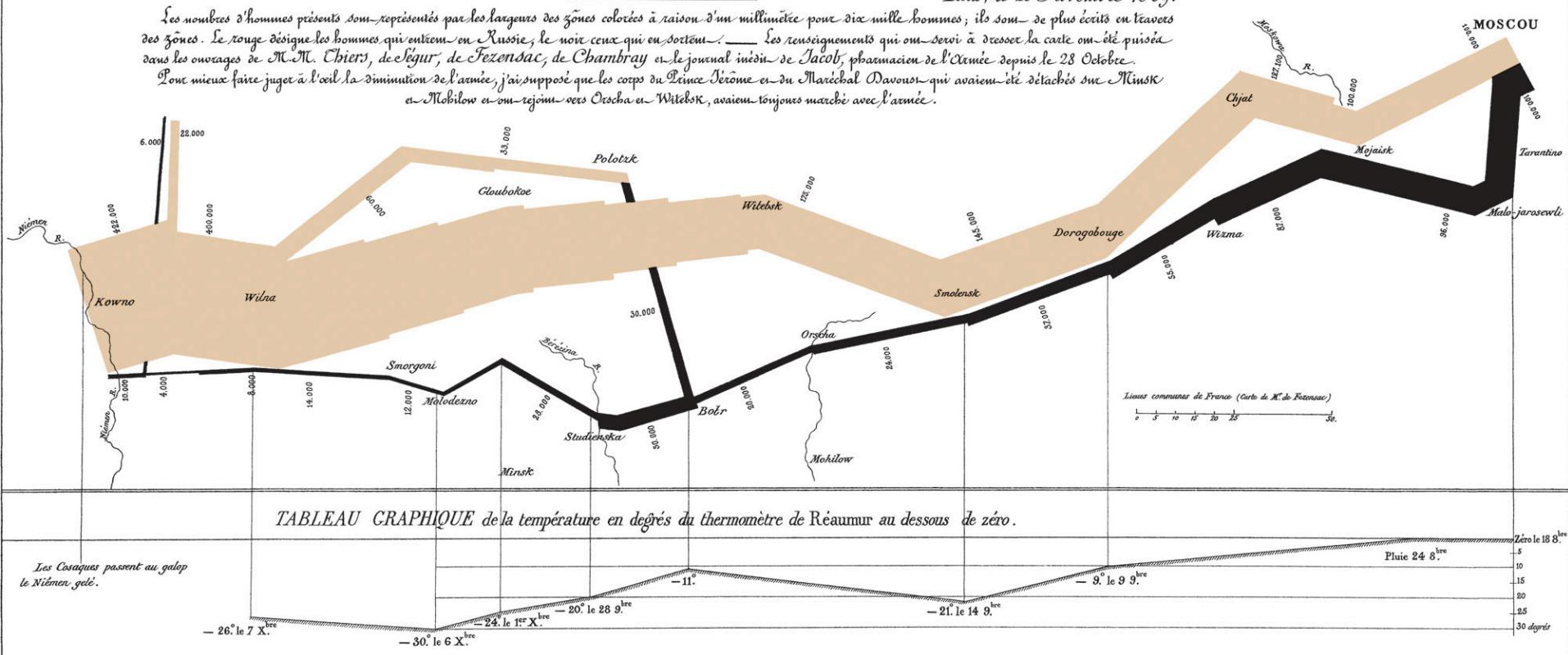
Qualifiée par Edward Tufte comme la meilleure représentation statistique de tous les temps



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En savoir plus: The Visual Display of Quantitative Information (Tufte)

Épidémie de choléra de Broad Street (1854)

"La pire épidémie de choléra qui soit jamais arrivée dans ce royaume"
– John Snow

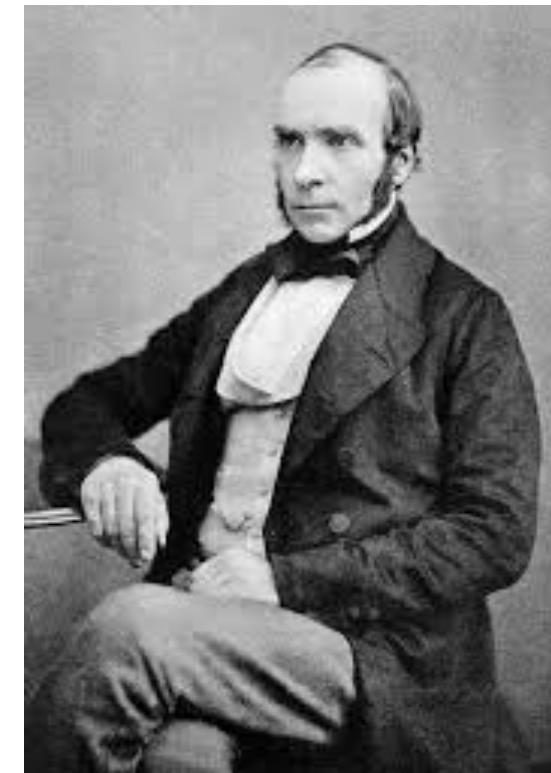
En 1854, Londres a été victime d'une épidémie de choléra

- 127 personnes près de Broad Street ont trouvé la mort dans l'espace de 3 jours
- 616 personnes sont mortes en 30 jours

Le Dr. John Snow a été le premier à faire le lien entre l'eau contaminée des pompes et la propagation de la maladie

Comment a-t'il fait?

- Il a parlé aux résidents locaux
- Il a identifié la pompe à eau comme source potentielle
- Il a utilisé des cartes pour illustrer sa théorie
- Il a convaincu les autorités de condamner les pompes



John Snow

Épidémie de choléra de Broad Street (1854)



En savoir plus: The Visual Display of Quantitative Information (Tufte)

La navette spatiale Challenger (1986)



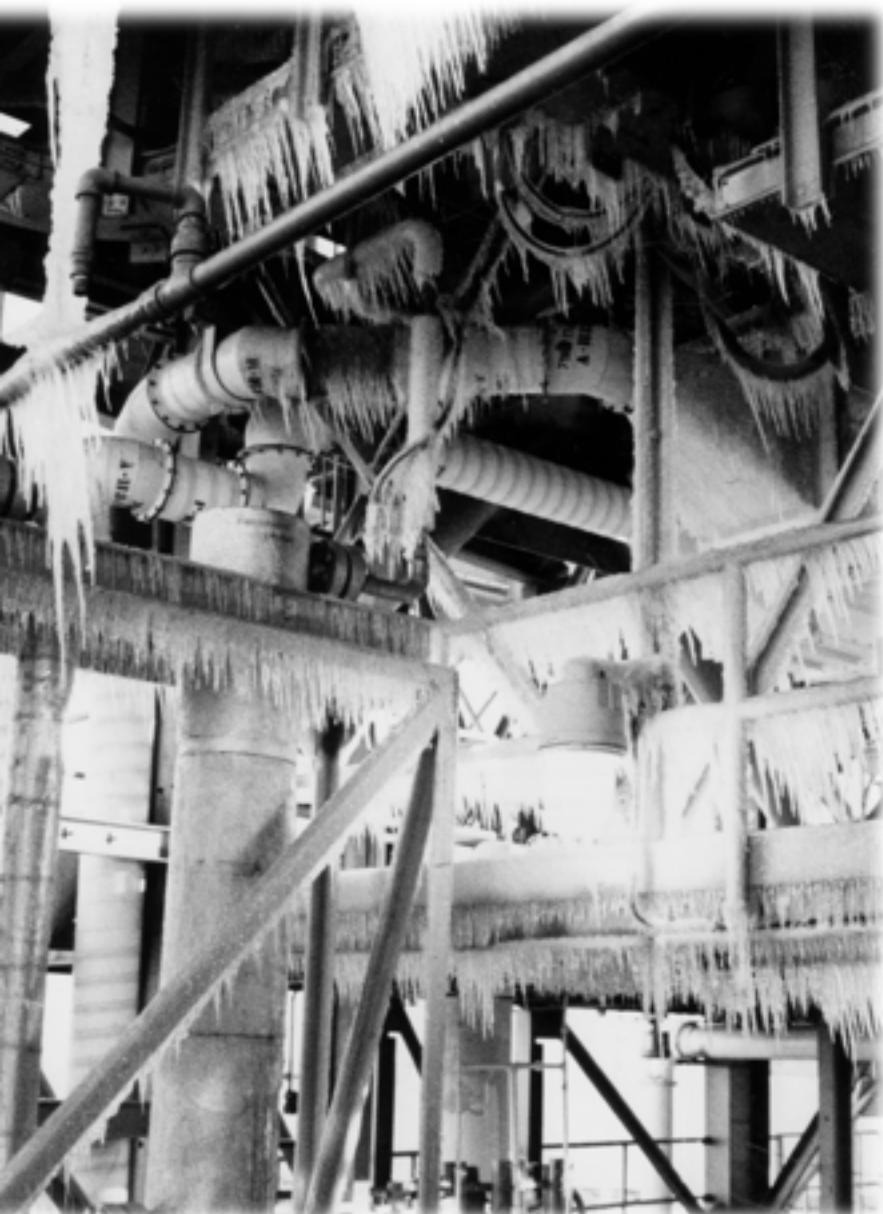
Source: Wikipédia "Space Shuttle Challenger disaster"

La navette spatiale Challenger (1986)



Source: Wikipédia "Space Shuttle Challenger disaster"

Accident de la navette spatiale Challenger (1986)



- 7 personnes de l'équipage sont mortes dans l'explosion

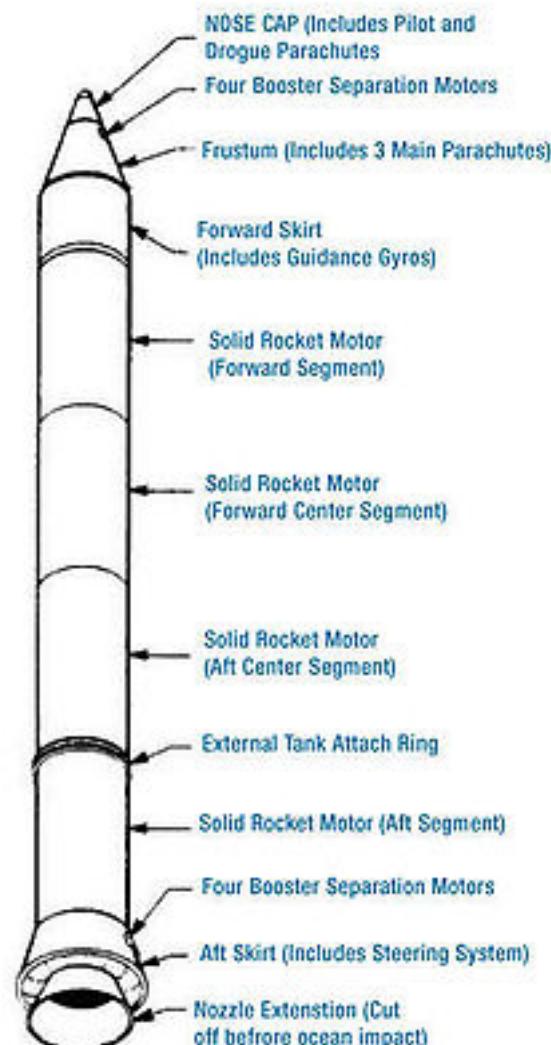
La catastrophe aurait pu être évitée

- Les prévisions pour le 28 janvier avaient annoncé une matinée exceptionnellement froide, avec des températures proches de -0,5 °C
- Les basses températures ont suscité l'inquiétude des ingénieurs de Morton Thiokol, chargé de la maintenance du propulseur d'appoint à poudre (SRB)
- Les ingénieurs redoutaient l'effet de la température sur la résistance des joints toriques en caoutchouc qui permettaient de sceller les joints du SRB

Accident de la navette spatiale Challenger (1986)

Propulseur d'appoint à poudre de la navette spatiale américaine

Ils permettent d'apporter la poussée supplémentaire nécessaire à la navette dans la première phase de son ascension



Accident de la navette spatiale Challenger (1986)

| HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS | | | | | | | |
|--|---------|------------------------|--|-----------------------|--|-------------------------------------|----------------------------|
| | SRM No. | Erosion Depth [in.] | Cross Sectional View Affected (deg) | Nominal Dia. (in.) | Top View Length Of Max Erosion (in.) | Total Heat Affected Length (in.) | Clocking Location (deg) |
| 61A LH Center Field** | 22A | None | None | 0.280 | None | None | 36° - 66° |
| 61A LH CENTER FIELD** | 22A | NONE | NONE | 0.280 | NONE | NONE | 338°-18° |
| 51C LH Forward Field** | 15A | 0.010 | 154.0 | 0.280 | 4.25 | 5.25 | 163 |
| 51C RH Center Field (prim)*** | 15B | 0.038 | 130.0 | 0.280 | 12.50 | 58.75 | 354 |
| 51C RH Center Field (sec)*** | 15D | None | 45.0 | 0.280 | None | 29.50 | 354 |
| 41D RH Forward Field | 13B | 0.026 | 110.0 | 0.280 | 3.00 | None | 275 |
| 41C LH Aft Field* | 11A | None | None | 0.280 | None | None | -- |
| 41B LH Forward Field | 10A | 0.040 | 217.0 | 0.280 | 3.00 | 14.50 | 351 |
| STS-2 RH Aft Field | 2B | 0.053 | 116.0 | 0.280 | -- | -- | 90 |

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
**Soot behind primary O-ring.
***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port = 0 deg.

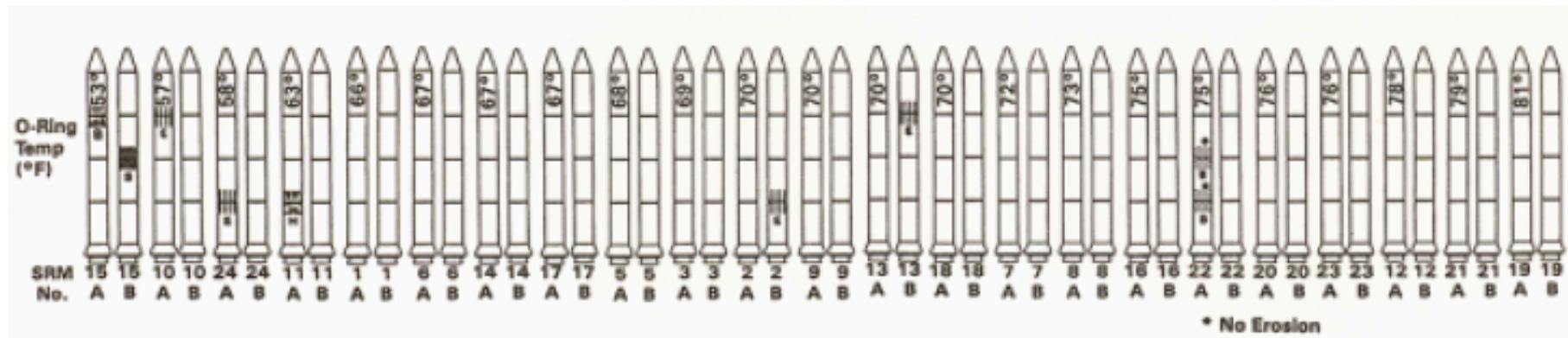
OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

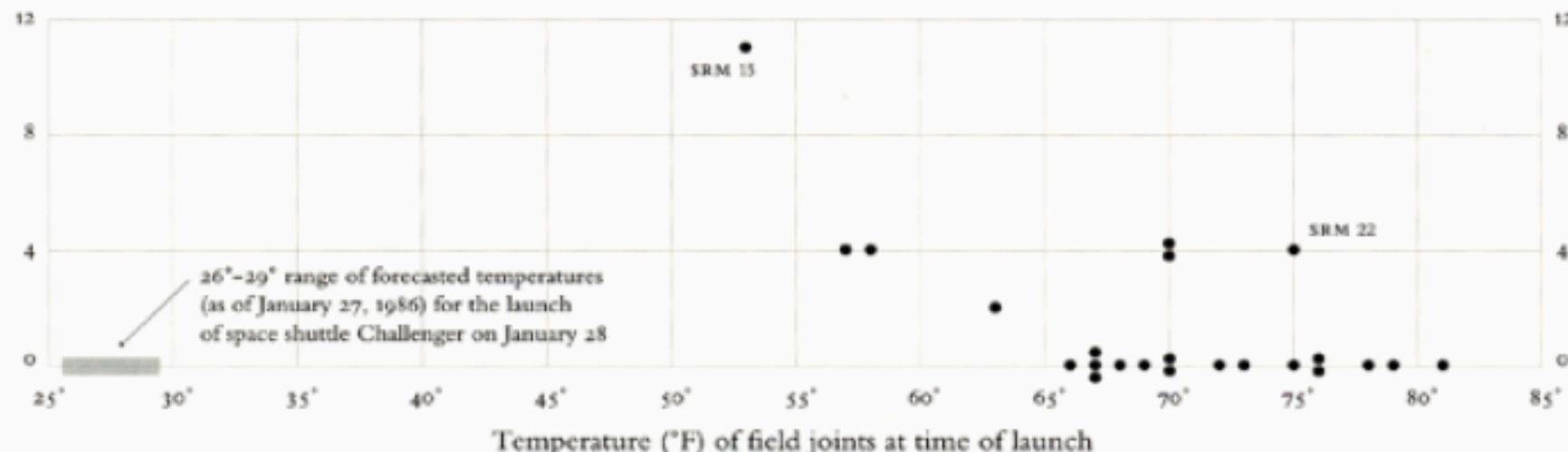
| BLOW BY HISTORY | HISTORY OF O-RING TEMPERATURES (DEGREES - F) | | | | |
|-----------------------------------|--|------|-----|--------|--------|
| SRM-15 WORST BLOW-BY | MOTOR | MBT | AMB | O-RING | WIND |
| ○ 2 CASE JOINTS (30°), (110°) ARC | DM-1 | 68 | 36 | 47 | 10 MPH |
| ○ MUCH WORSE VISUALLY THAN SRM-22 | DM-2 | 76 | 45 | 52 | 10 MPH |
| SRM 22 Blow-by | DM-3 | 72.5 | 40 | 48 | 10 MPH |
| ○ 2 CASE JOINTS (30-40°) | DM-4 | 76 | 48 | 51 | 10 MPH |
| SRM-13A, 15, 16A, 18, 23A 24A | SRM-15 | 52 | 64 | 53 | 10 MPH |
| ○ NOZZLE Blow-by | SRM-22 | 77 | 78 | 75 | 10 MPH |
| | SRM-25 | 55 | 26 | 29 | 10 MPH |
| | | | | 27 | 25 MPH |

2 of 13 pages of material faxed to NASA by Morton Thiokol [from Tufte 1997]

Accident de la navette spatiale Challenger (1986)



O-ring damage index, each launch



Les données dans leur contexte

Les nombres deviennent des preuves lorsqu'ils sont mis en relation les uns avec les autres et dans leur contexte.

Edward Tufte (1997)



Et bien plus récemment...

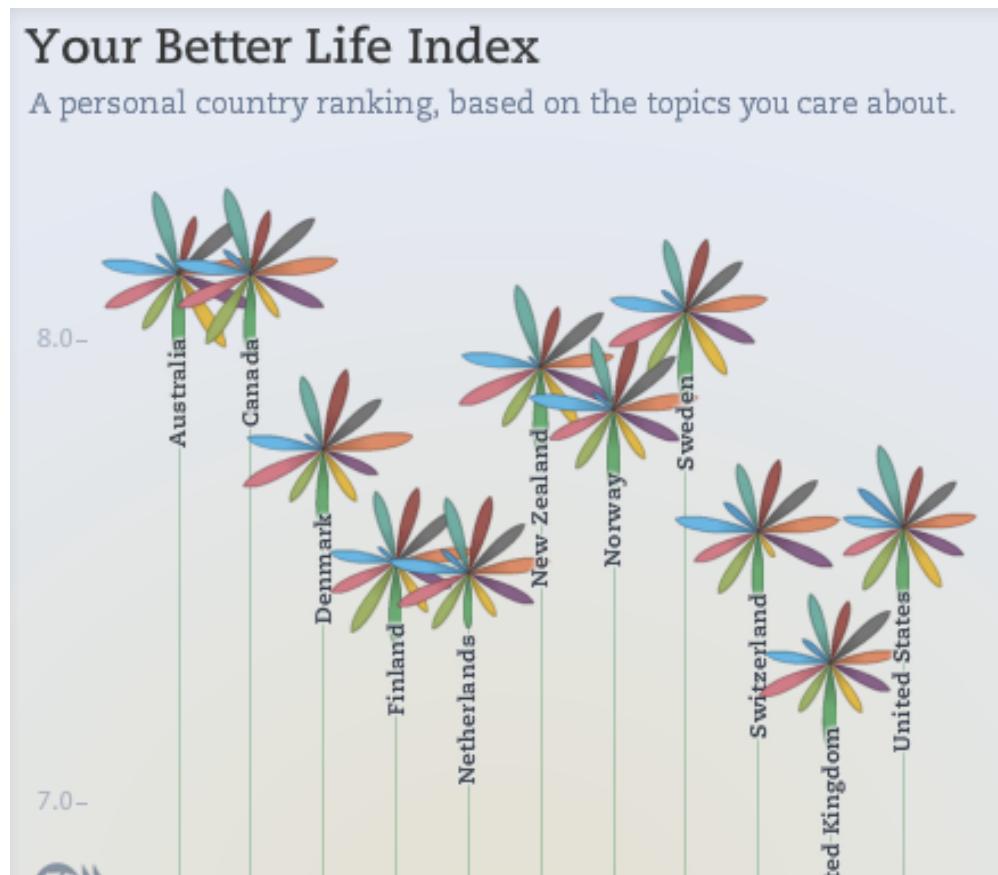


Trash Track (MIT, 2009)



Open Data

- Mouvement pour rendre les données gouvernementales publiques et gratuites
- Encourage la participation de tout le monde



Many Eyes (IBM, 2009)

Sign in

data sets search

explore
visualizations
data sets
comments
topic hubs

participate
register
create visualization
upload data set
create topic hub

learn more
quick start
visualization types
about Many Eyes



many eyes beta

for shared visualization and discovery

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Perchlorate in Food, 2005-2006 Gospel of John
Hindu Universe US Government Receipts

 From FDA survey data
by Watchmen

 Jesus answered... sath etc.
by O'Neill

 India is at the center.
by Anonymous

 As percentage of GDP, 1936-2008. Remarkably constant, post-war.
by iamburious

Featured Topic Hubs

(dive into a topic of interest, or create a hub of your own)

Food Safety Transportation OECD Factbook 2007

 **Food Safety**
Food safety statistics, food recalls and alerts, etc.

 **Transportation**
Planes, trains, and automobiles!

 **OECD Factbook 2007**
Official statistics.

Embed

live visualizations on your site

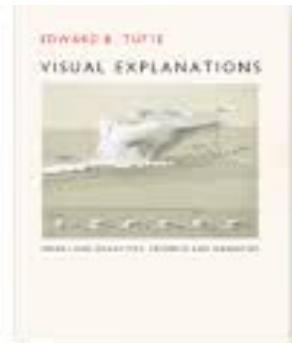
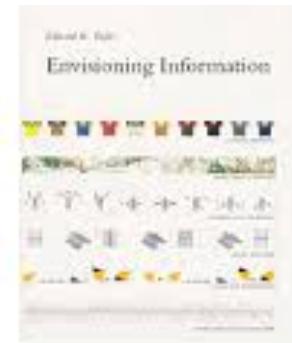
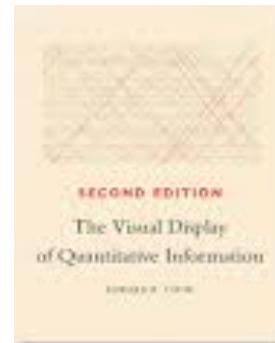
brought to you by 

Resources pour plus d'exemples

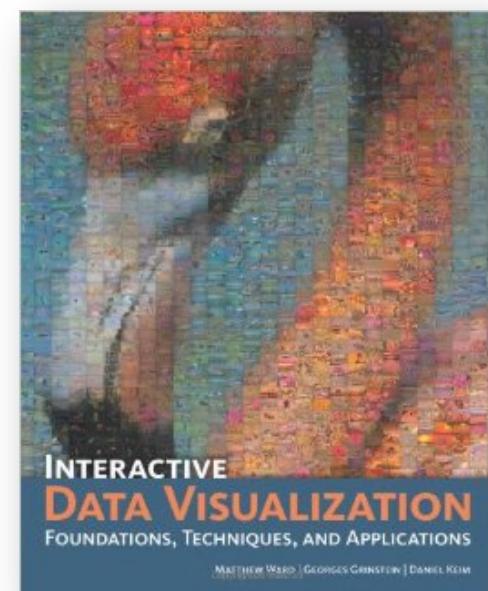
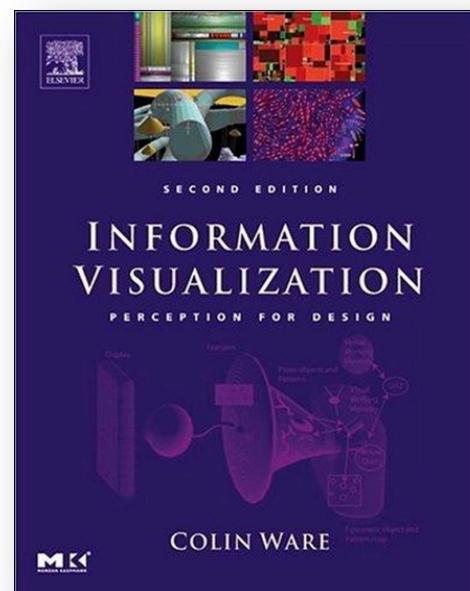
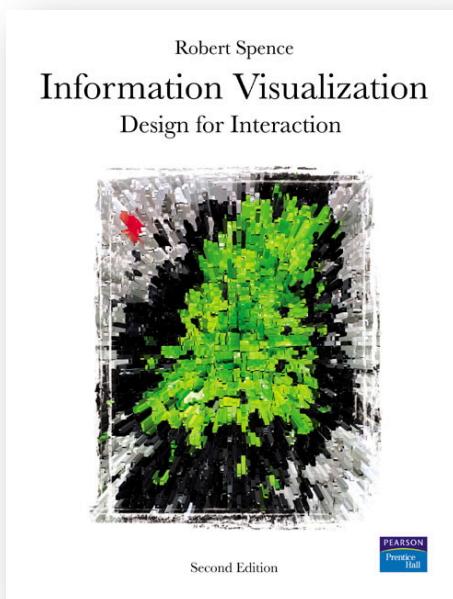
Blogs

- <http://infosthetics.com/>
- <http://flowingdata.com/>
- <http://fellinlovewithdata.com/>
- <http://eagereyes.org/>

Tufte



Livres



Pourquoi ça marche ?

Représentations et perception



Il n'est pas facile de créer de **bonnes** visualisations

Parmis toutes les représentations possibles, seules un petit nombre d'entre elles sont efficaces



Qu'est-ce qu'une représentation ?

1. Un système formel via lequel l'information peut être décrite (D. Marr)
2. Un système de signes et symboles tel qu'il représente autre chose que lui-même

Exemple: le nombre trente-quatre

34

décimal

100010

binaire

XXXIV

chiffres romains

Présentation

Différentes représentations révèlent différents aspects de l'information

décimal: compte et information dans la base 10,

binnaire: compte et information dans la base 2,

chiffres romains: pour impressionner vos amis

Présentation

comment la représentation est placée ou organisée sur le dispositif d'affichage

34, 34, 34

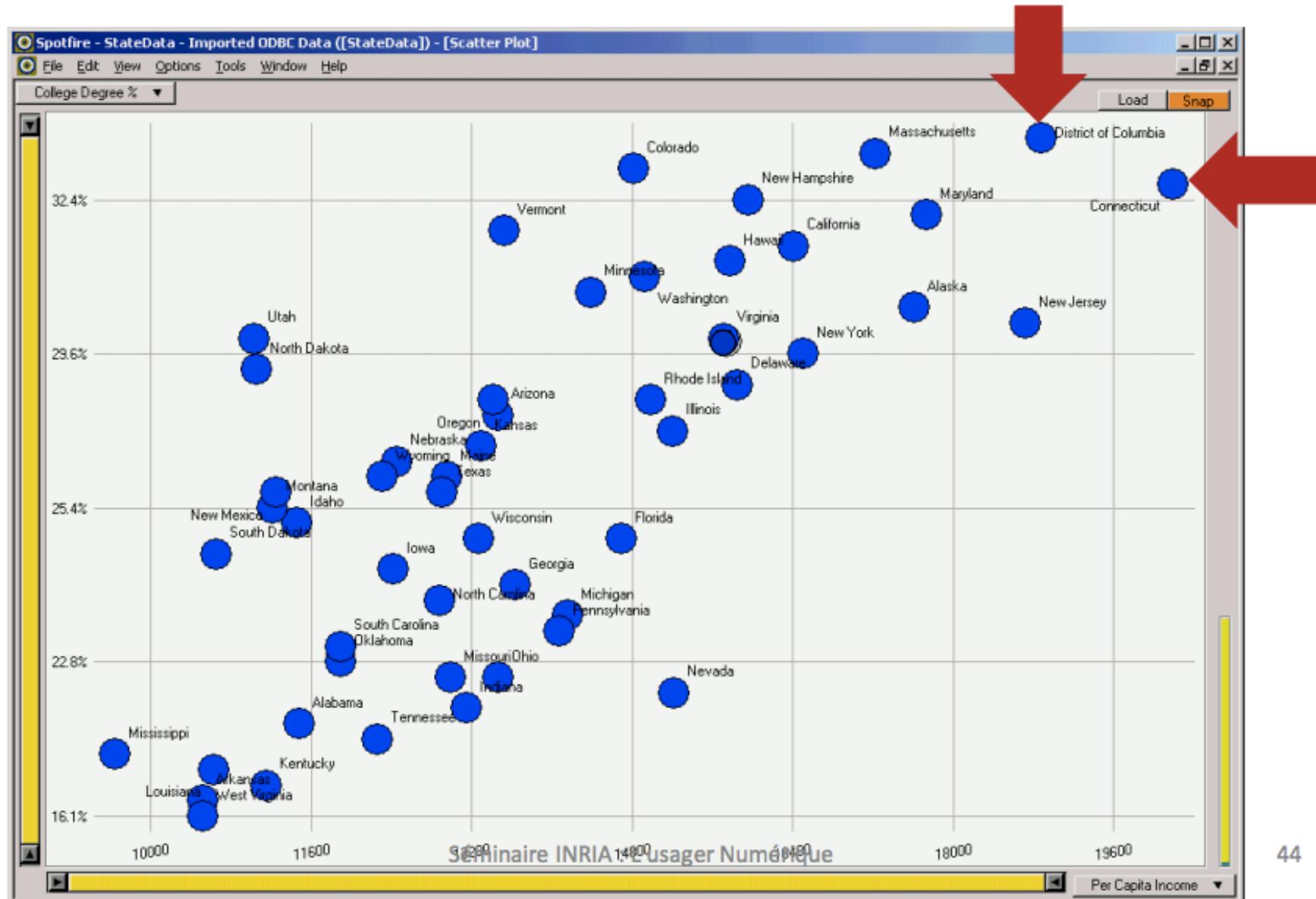
Bonne représentation ?

Table - StateData()

| | | Load | Snap | |
|----------------------|------------------|-------------------|-------|-------|
| State | College Degree % | Per Capita Income | | |
| Alabama | 20.6% | 11486 | | |
| Alaska | 30.3% | 17610 | | |
| Arizona | 27.1% | 13461 | | |
| Arkansas | 17.0% | 10520 | | |
| California | 31.3% | 16409 | | |
| Colorado | 33.9% | 14821 | | |
| Connecticut | 33.8% | 20189 | | |
| Delaware | 27.9% | 15854 | | |
| District of Columbia | 36.4% | 18881 | | |
| Florida | 24.9% | 14698 | | |
| Georgia | 24.3% | 13631 | | |
| Hawaii | 31.2% | 15770 | | |
| Idaho | 25.2% | 11457 | | |
| Illinois | 26.8% | 15201 | | |
| Indiana | 20.9% | 13149 | | |
| Iowa | 24.5% | 12422 | | |
| Kansas | 26.5% | 13300 | | |
| Kentucky | 17.7% | 11153 | | |
| Louisiana | 19.4% | 10635 | | |
| Maine | 25.7% | 12957 | | |
| Maryland | 31.7% | 17730 | | |
| Massachusetts | 34.5% | 17224 | | |
| Michigan | 24.1% | 14154 | | |
| Minnesota | 30.4% | 14389 | | |
| Michigan | | | | |
| Minnesota | | | 30.4% | 14389 |
| Mississippi | | | 19.9% | 9648 |
| Missouri | | | 22.3% | 12989 |
| Montana | | | 25.4% | 11213 |
| Nebraska | | | 26.0% | 12452 |
| Nevada | | | 21.5% | 15214 |
| New Hampshire | | | 32.4% | 15959 |
| New Jersey | | | 30.1% | 18714 |
| New Mexico | | | 25.5% | 11246 |
| New York | | | 29.6% | 16501 |
| North Carolina | | | 24.2% | 12885 |
| North Dakota | | | 28.1% | 11051 |
| Ohio | | | 22.3% | 13461 |
| Oklahoma | | | 22.8% | 11893 |
| Oregon | | | 27.5% | 13418 |
| Pennsylvania | | | 23.2% | 14068 |
| Rhode Island | | | 27.5% | 14981 |
| South Carolina | | | 23.0% | 11897 |
| South Dakota | | | 24.6% | 10661 |
| Tennessee | | | 20.1% | 12255 |
| Texas | | | 25.5% | 12904 |
| Utah | | | 30.0% | 11029 |
| Vermont | | | 31.5% | 13527 |
| Virginia | | | 30.0% | 15713 |
| Washington | | | 30.9% | 14923 |
| West Virginia | | | 16.1% | 10520 |
| Wisconsin | | | 24.9% | 13276 |
| Wyoming | | | 25.7% | 12311 |

[Source: J.D. Fekete et al. "The Value of Information Visualization", 2008]

Bonne représentation !



[Source: J.D. Fekete et al. "The Value of Information Visualization", 2008]

Perception préattentive

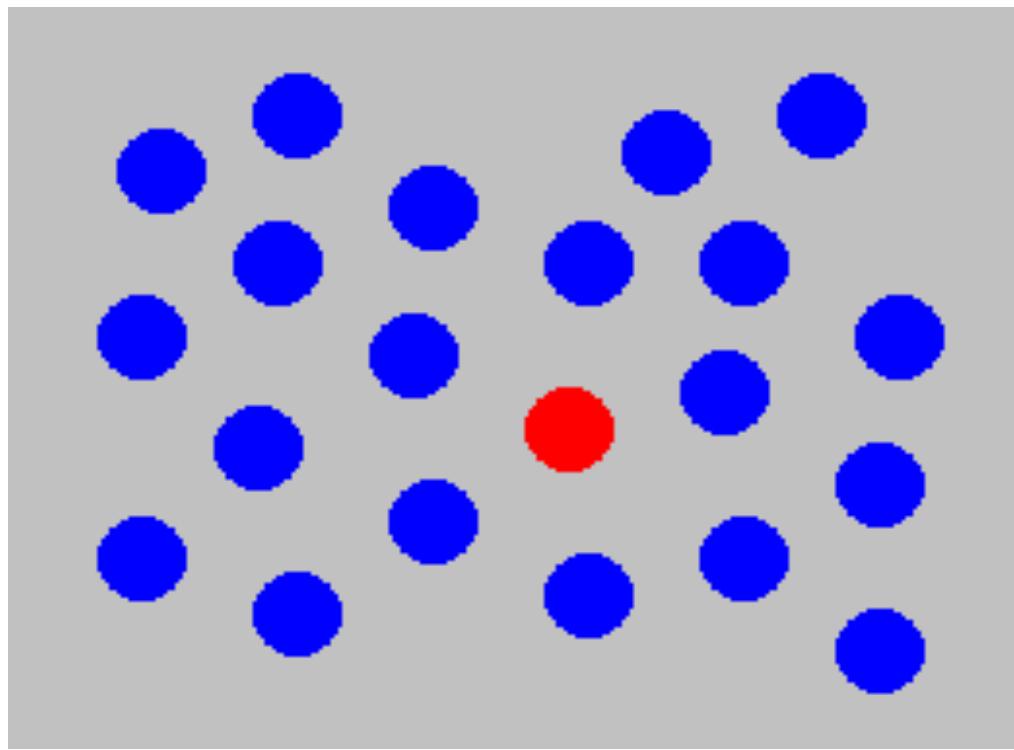
On a appris des psychologues que certaines variables visuelles sont perçue

- sans aucun effort
- d'un simple coup d'oeil
- en un temps constant

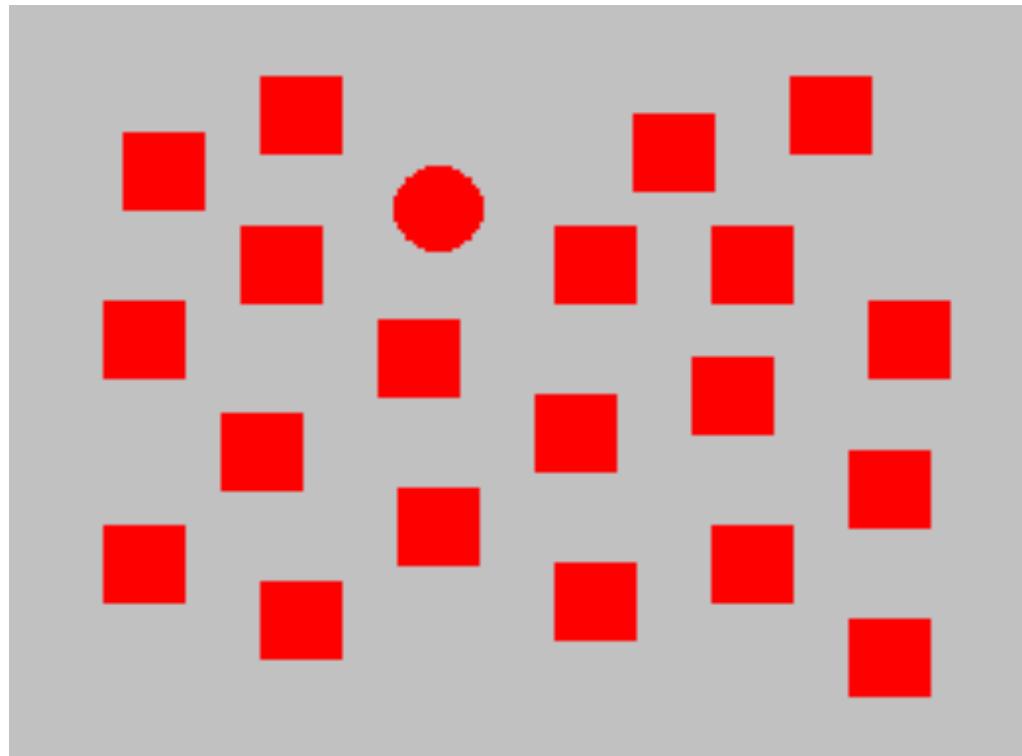
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90910302099059595772564675050678904567
8845789809821677654876364908560912949686

12817687561**3**8976546984506985604982826762
980985845822450985645894509845098094**3**585
90910**3**02099059595772564675050678904567
8845789809821677654876**3**64908560912949686

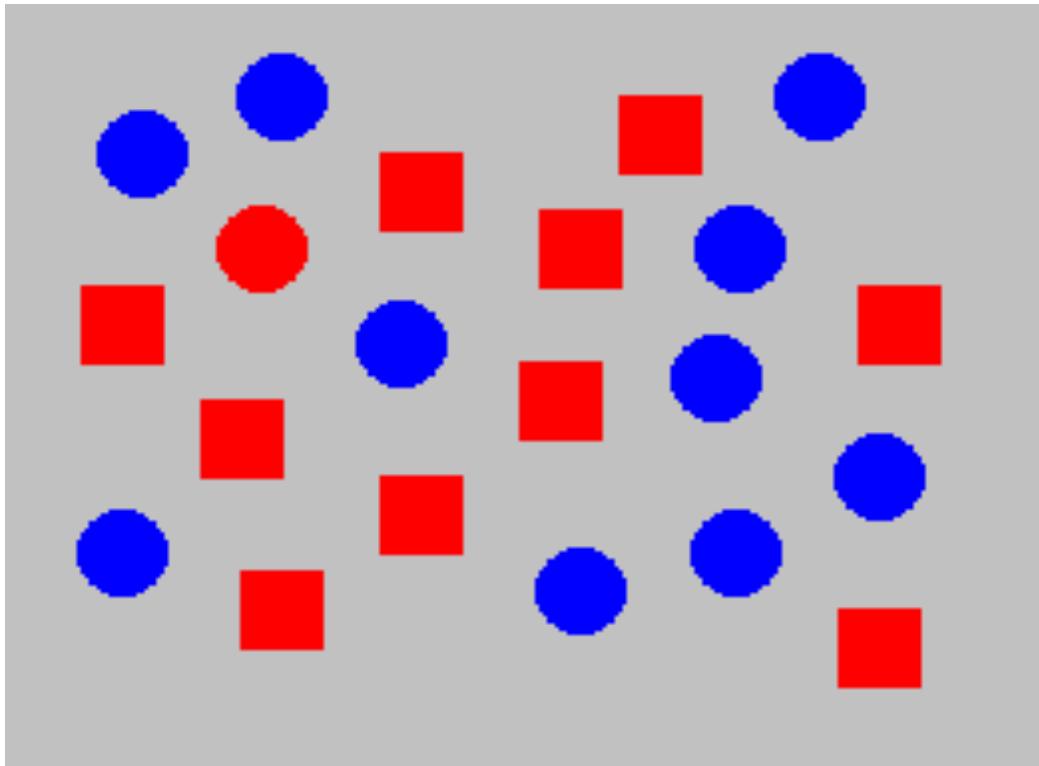
Localiser l'objet rouge



Localiser le cercle



Localiser le cercle rouge

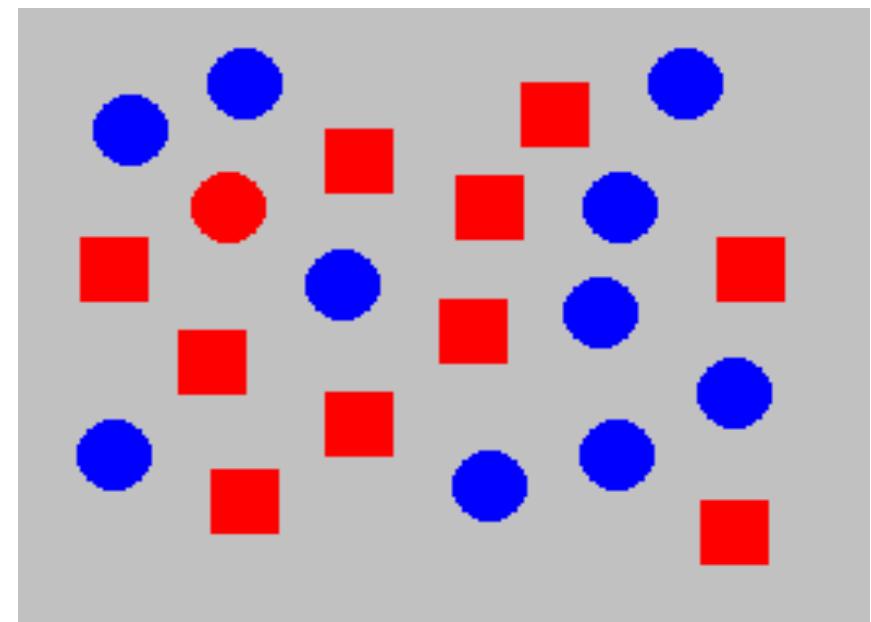


Perception préattentive: problèmes

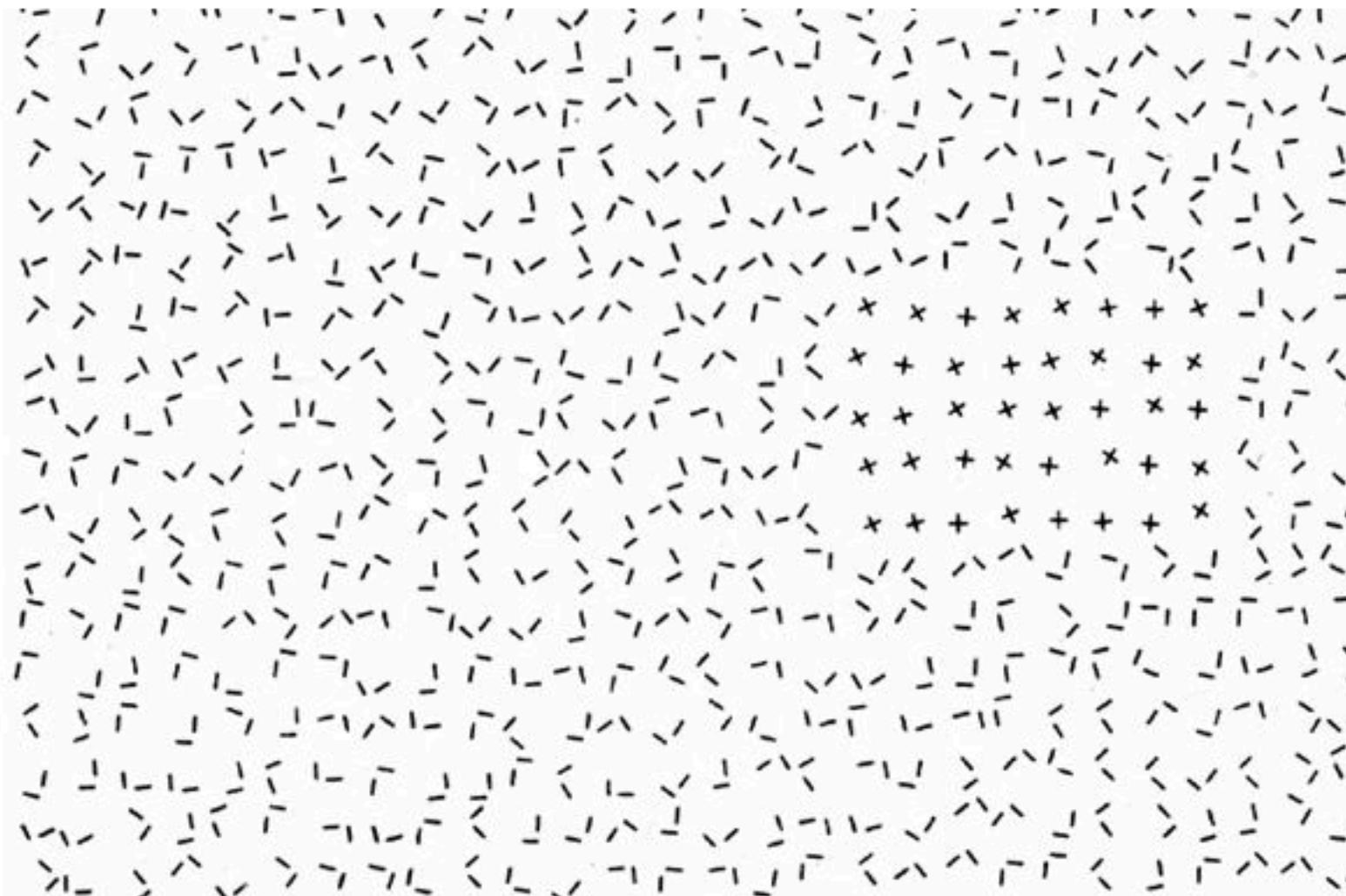
Les variables visuelles préattentives interfèrent les unes avec les autres.

Les variables visuelles préattentives restent préattentives dans certaines limites

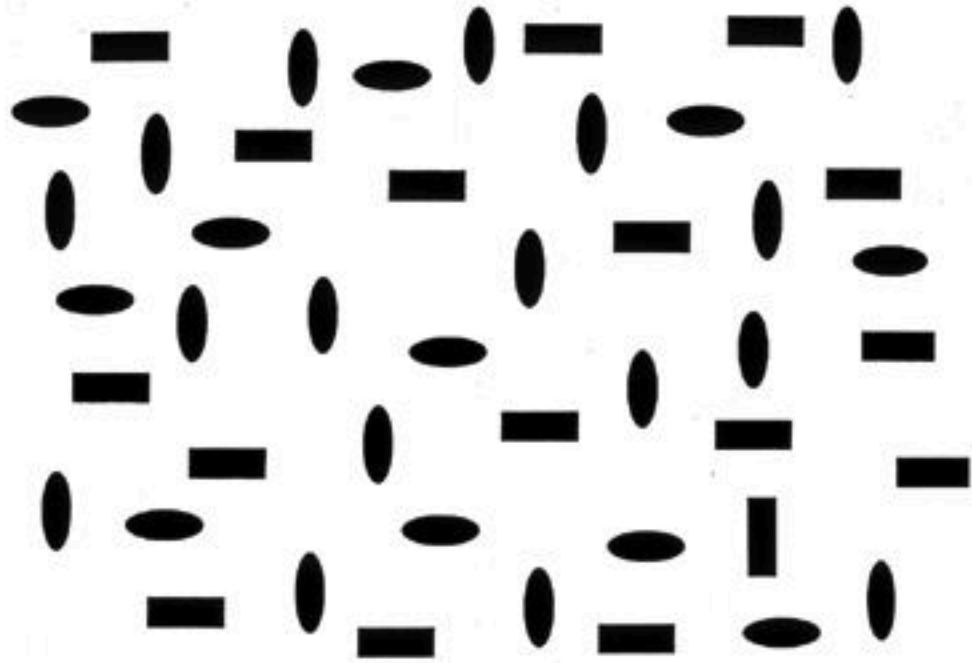
- 7 couleurs maximum
- 2 ou 3 formes
- ...



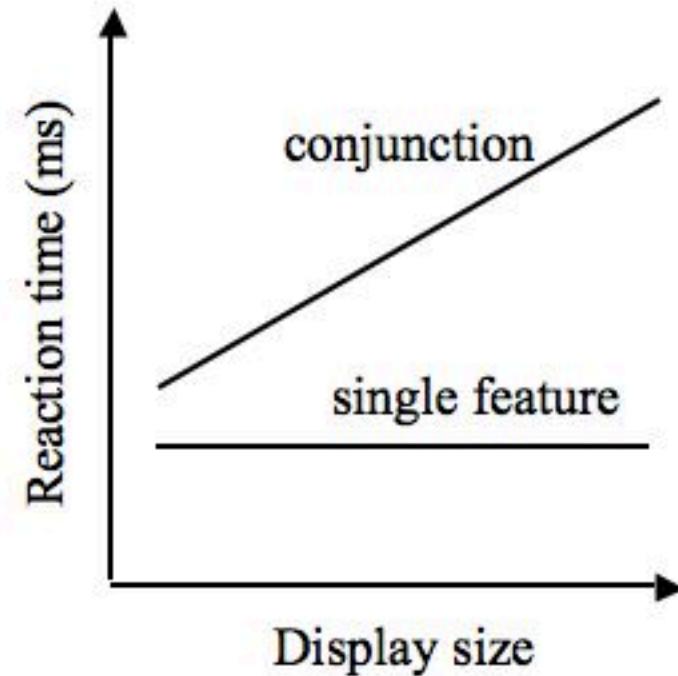
Visual search



Feature integration theory

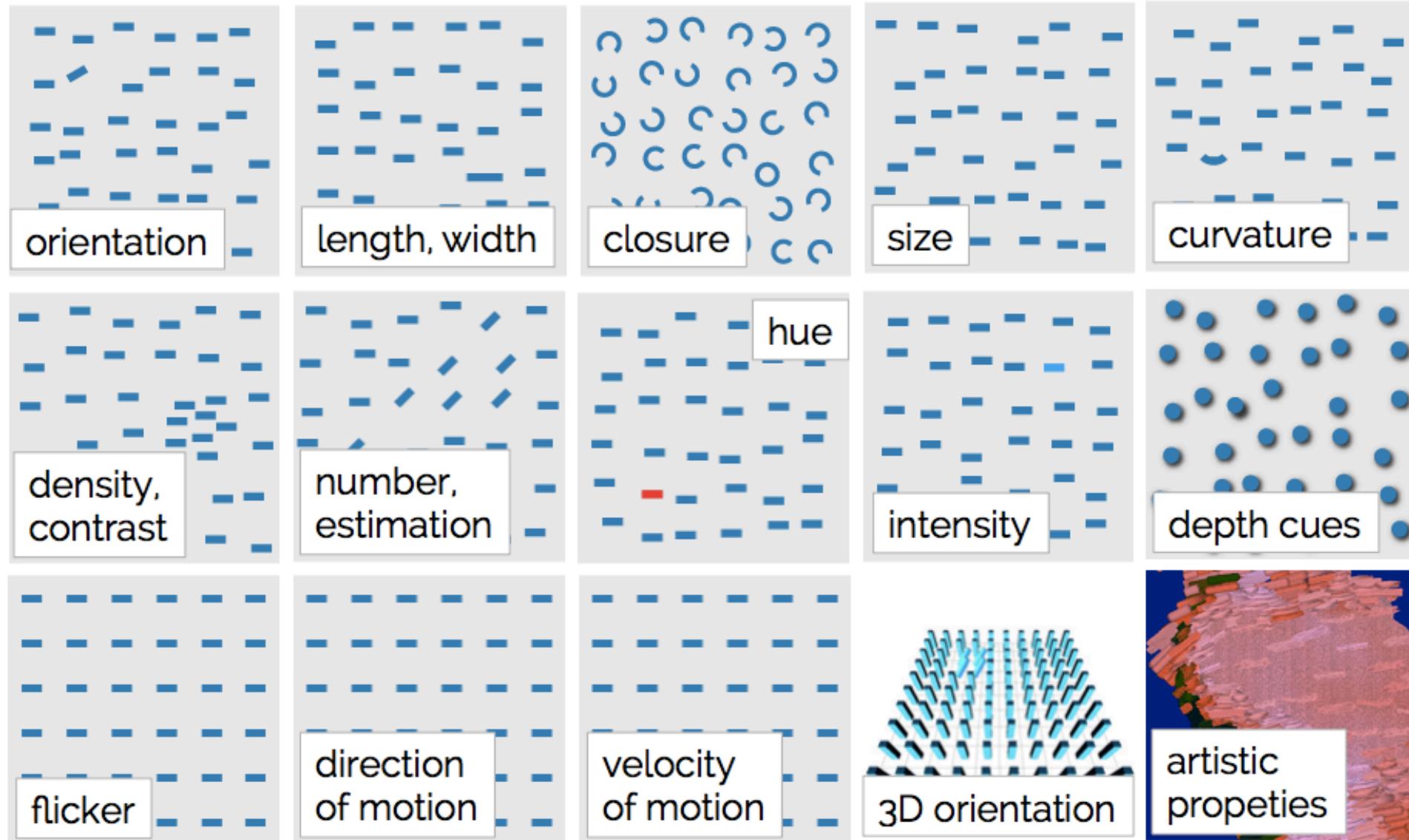


Conjunction search: find vertical rectangle



Set size effect

Les variables visuelles préattentives

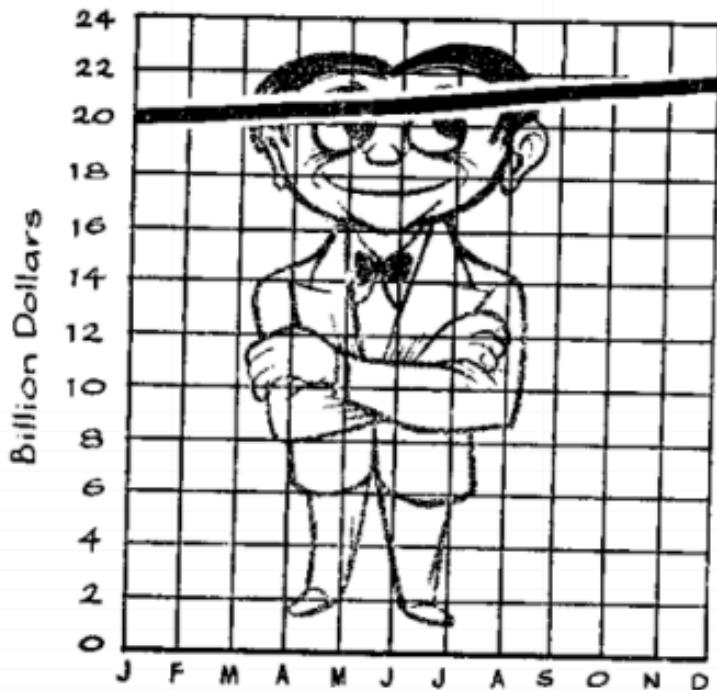


Je ne crois que ce que je vois !

Biais des représentations visuelles

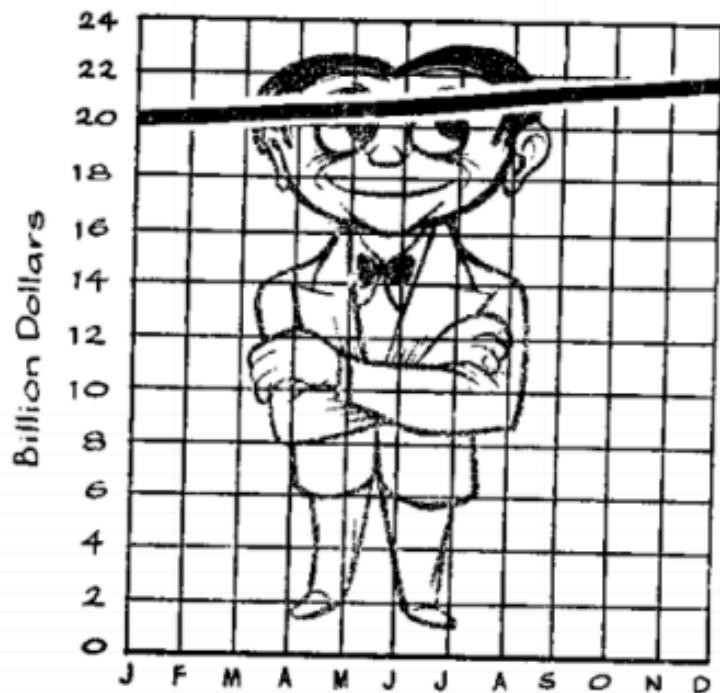


- Provide a proper baseline



A 10% increase. Good!

- Provide a proper baseline

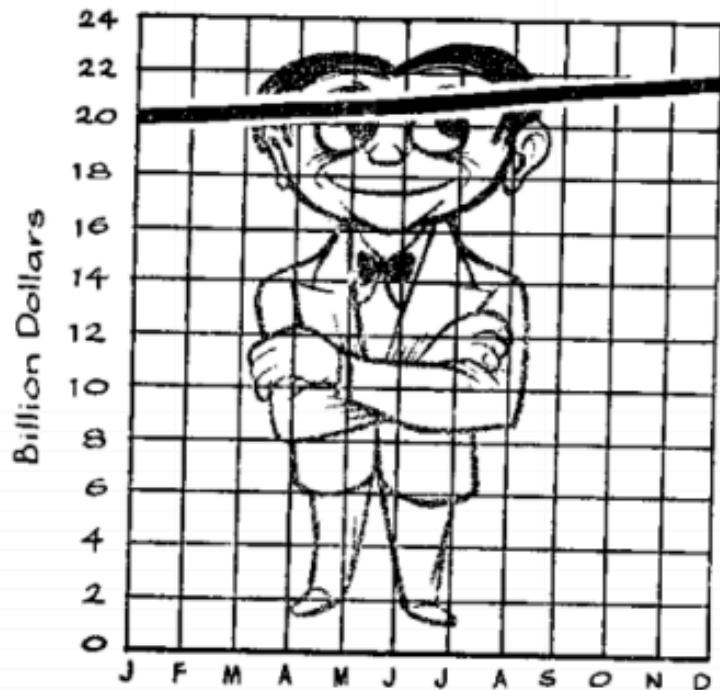


A 10% increase. Good!



Already looks more impressive

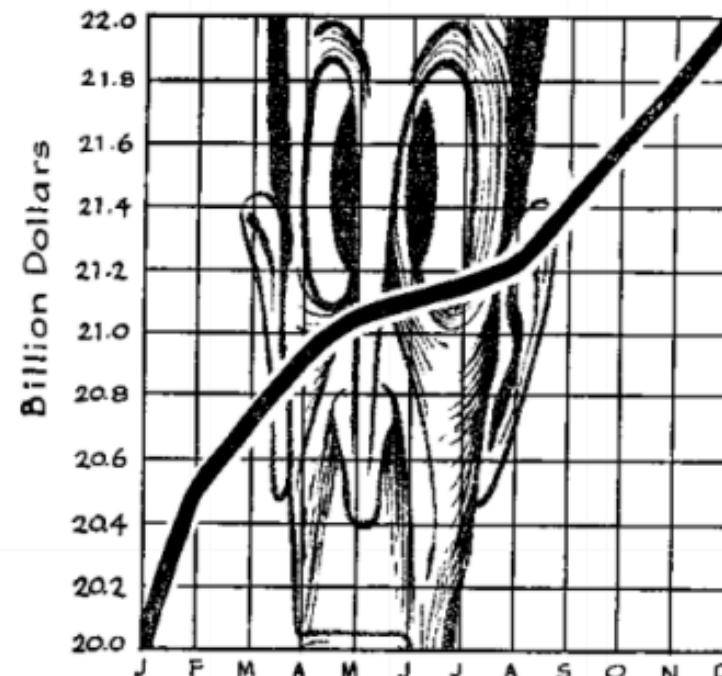
- Provide a proper baseline



A 10% increase. Good!

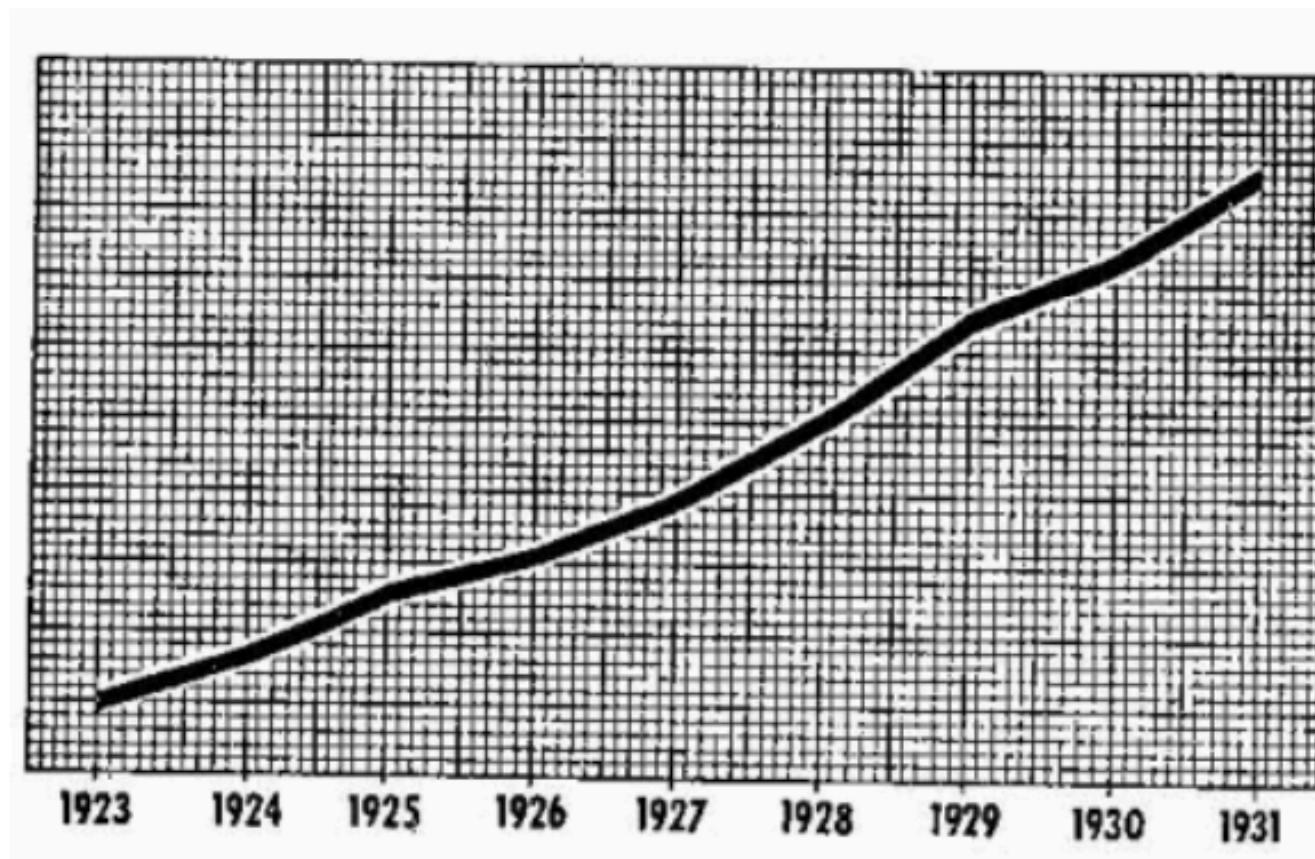


Already looks more impressive



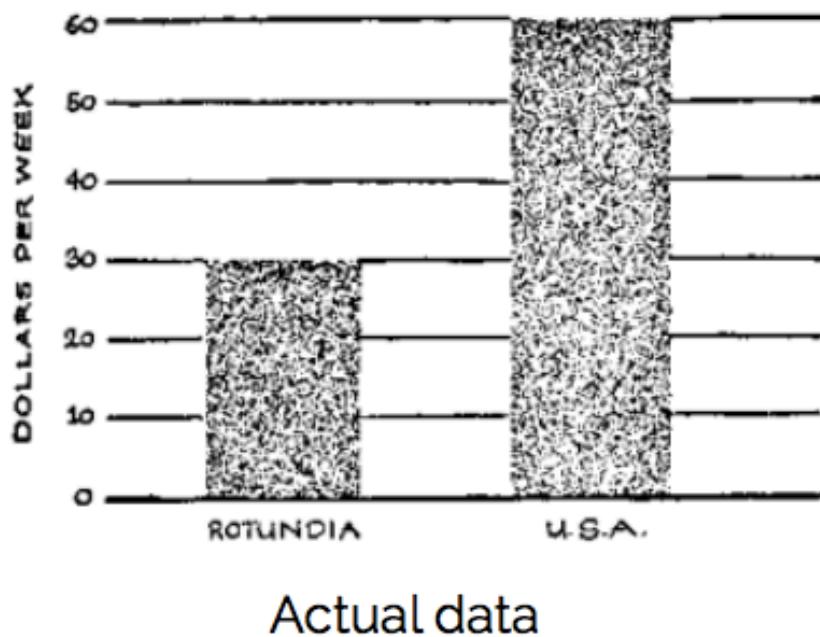
Wow!

- Provide a **proper baseline & label your axes**



[Source: How to lie with statistics]

- Provide a **proper baseline & label your axes**
- Avoid **eye-candy**

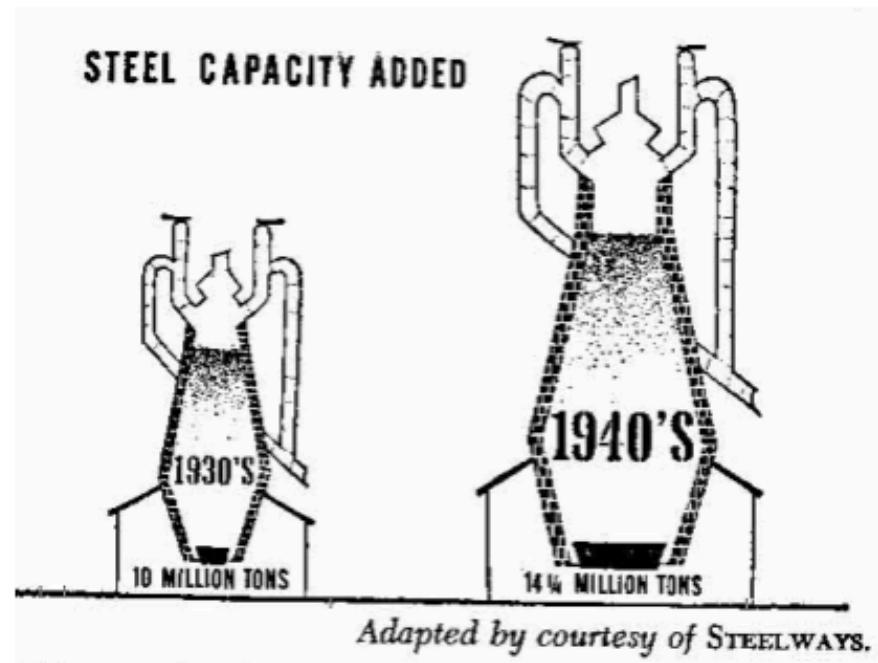


The same data with eye-candy & no numbers ... but at least it tells the same general story.



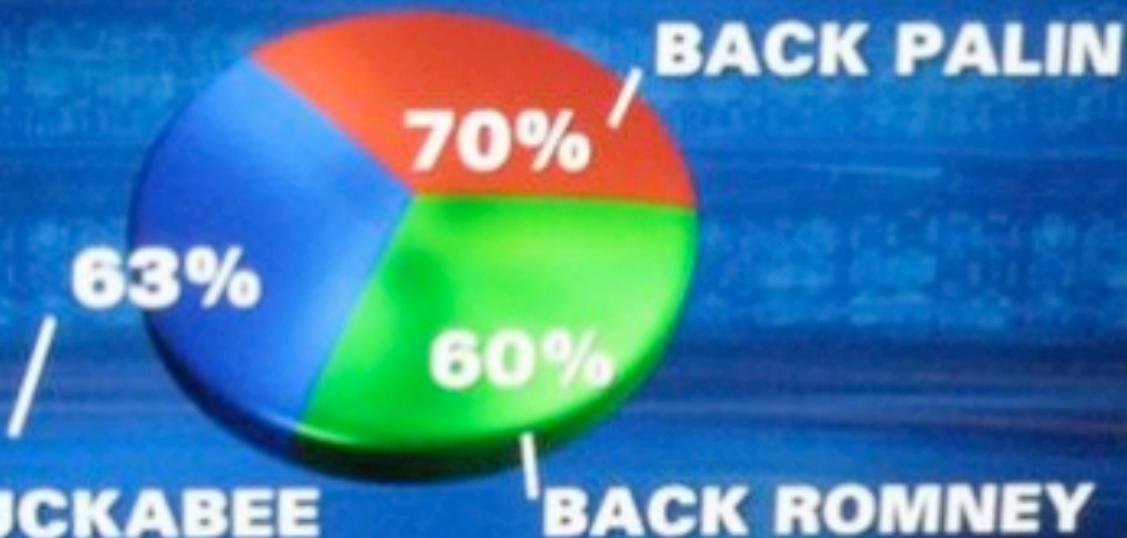
Impressive, but a lie!

- Provide a **proper baseline & label your axes**
- Avoid **eye-candy**
- Avoid **area comparisons** whenever possible



2012 PRESIDENTIAL RUN

GOP CANDIDATES

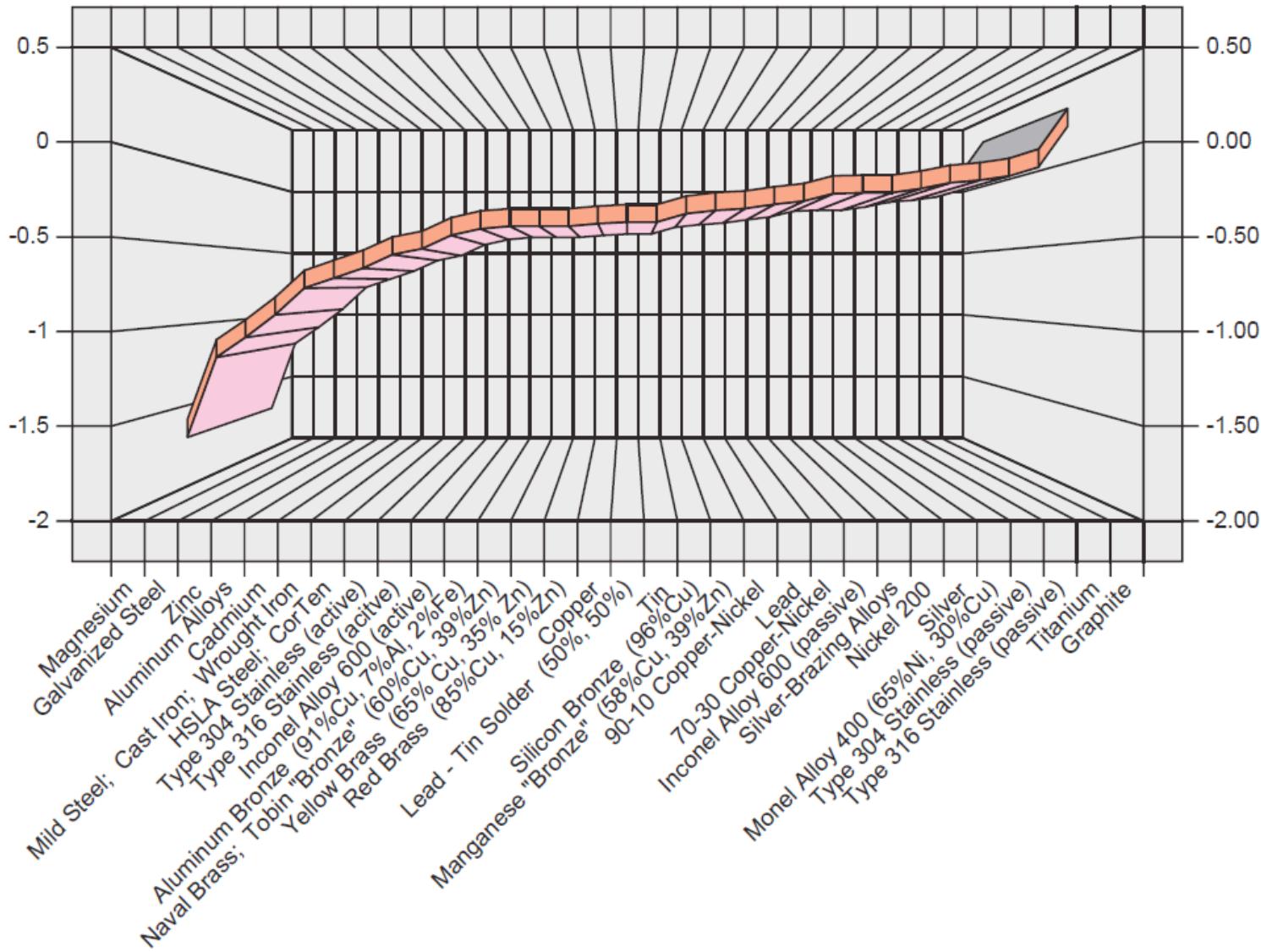


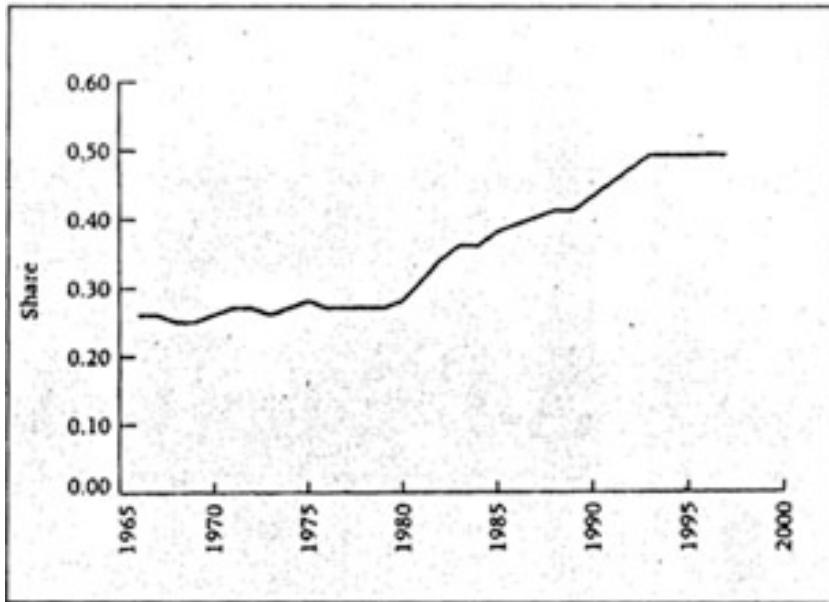
SOURCE: OPINIONS
DYNAMIC

FOX

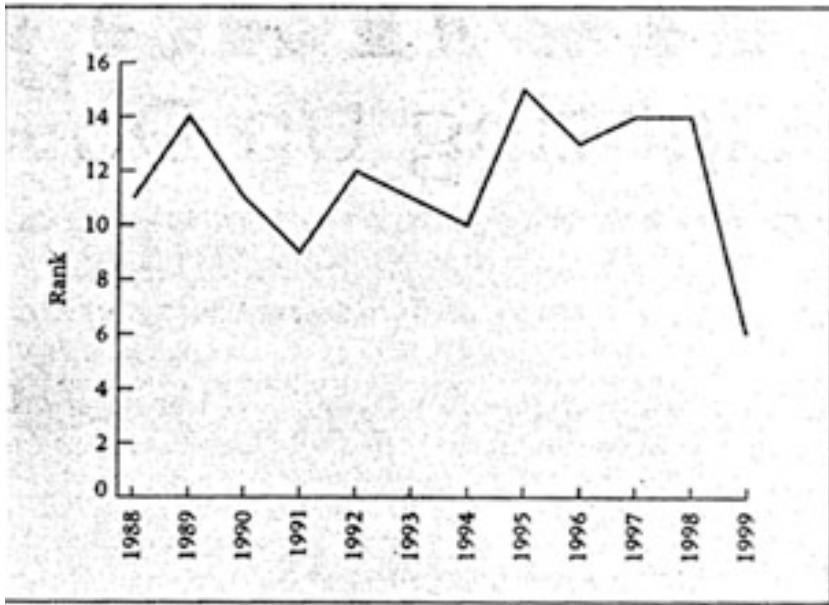
47°

Average Voltage in Seawater





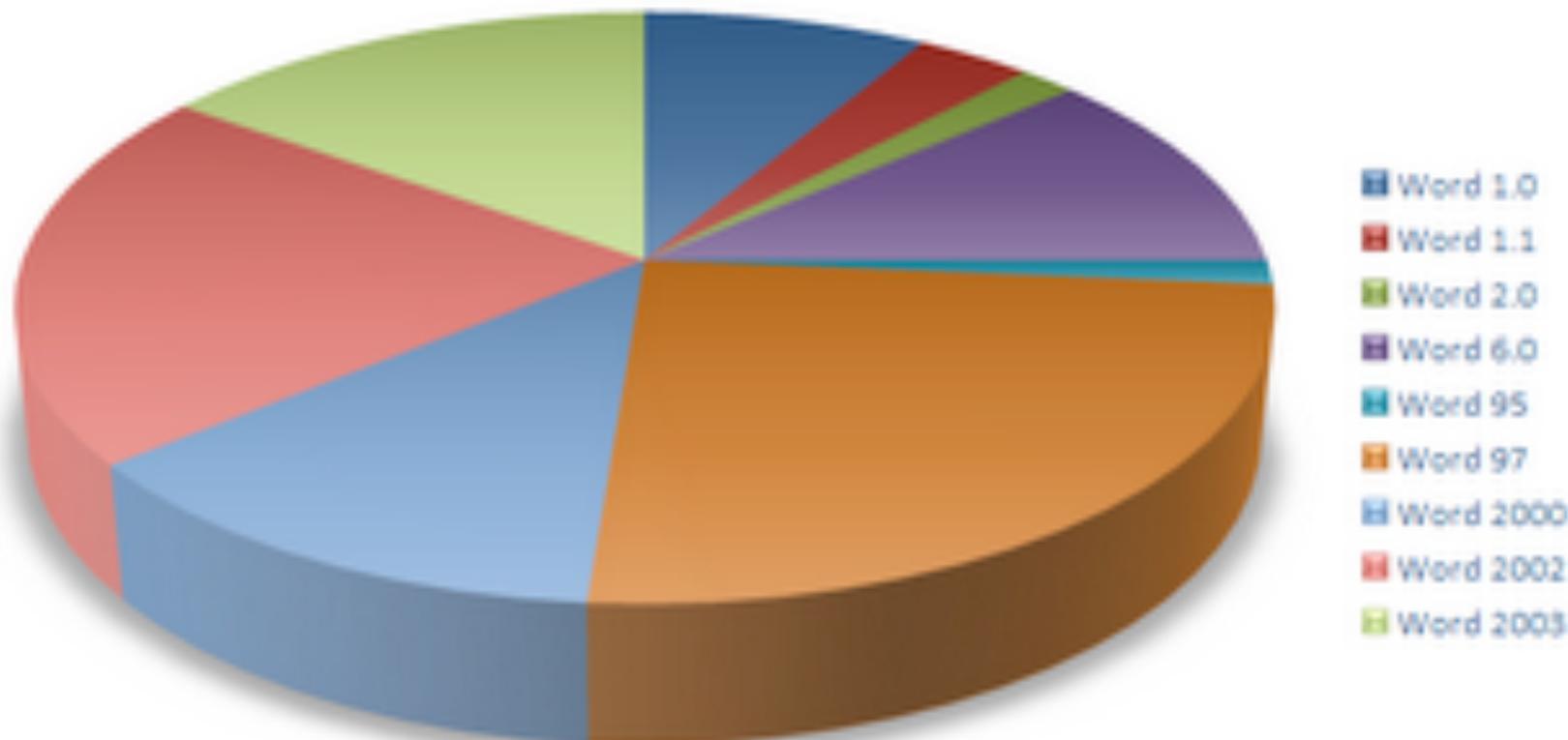
BY THE NUMBERS: OVER 35 YEARS, CORNELL'S TUITION HAS TAKEN AN INCREASINGLY LARGER SHARE OF ITS MEDIAN STUDENT FAMILY INCOME.



PECKING ORDER: OVER 12 YEARS, CORNELL'S RANKING IN *US NEWS & WORLD REPORT* HAS RISEN AND FALLEN ERRATICALLY.

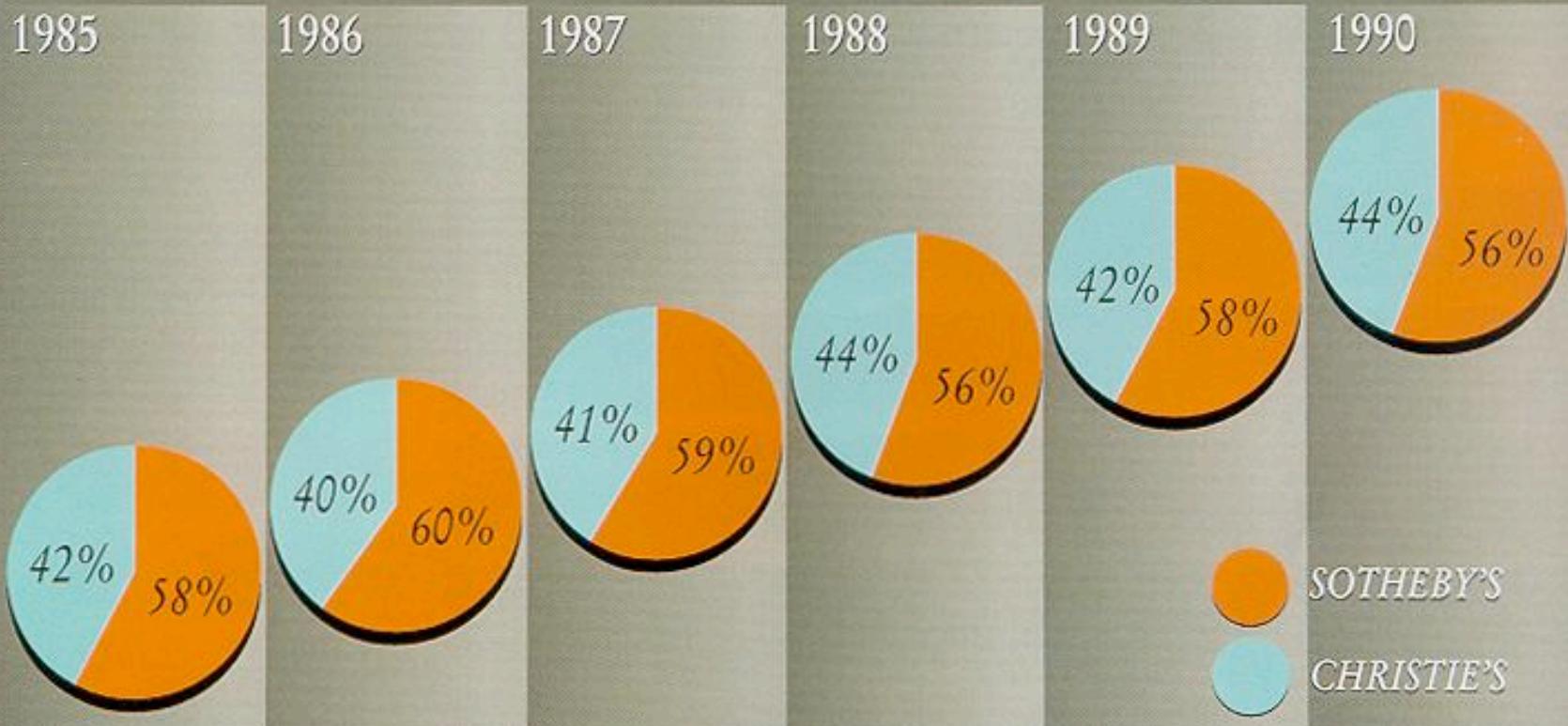
[Source: How to lie with statistics]

Microsoft Word Features By Version Added

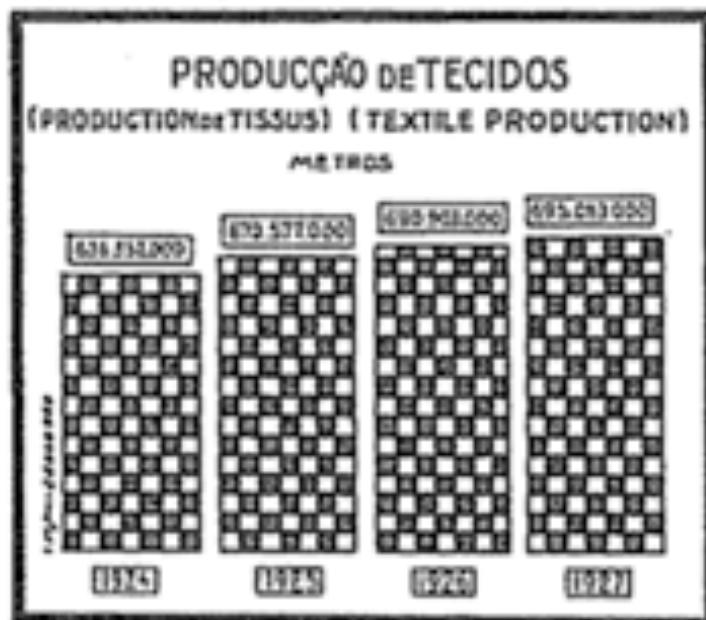


Sotheby's / Christie's

Worldwide Sales Market Share Analysis



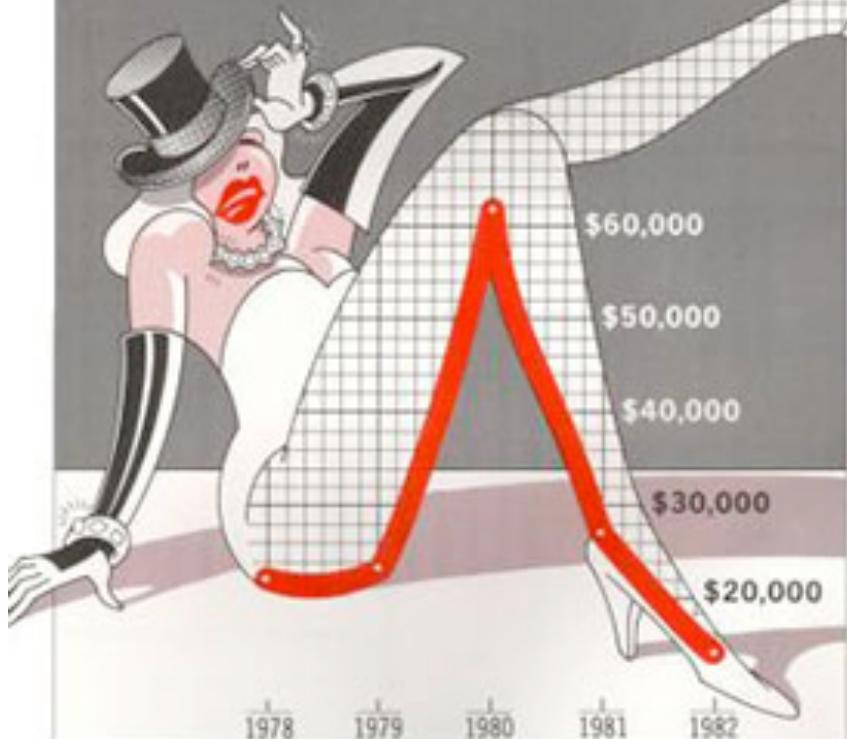
Market Share Analysis With Buyer's Premium



[Source: How to lie with statistics]

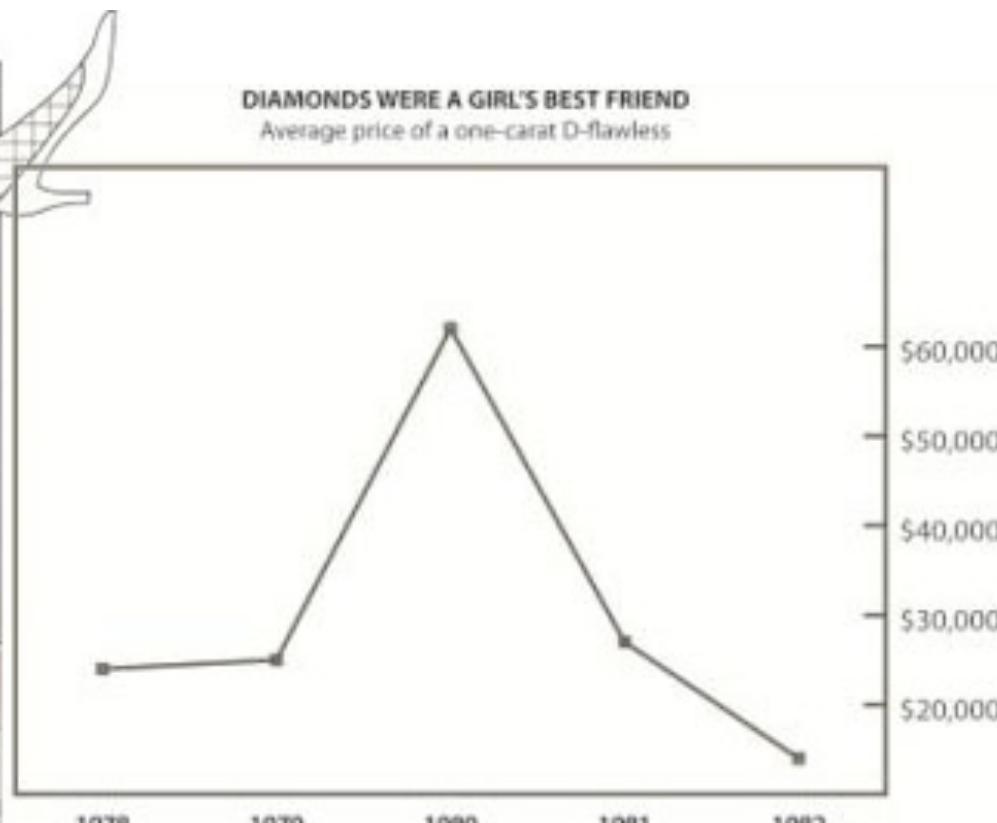
DIAMONDS WERE A GIRL'S BEST FRIEND

Average price of a one-carat D-flawless



DIAMONDS WERE A GIRL'S BEST FRIEND

Average price of a one-carat D-flawless



Je ne crois que ce que je vois !

Biais de notre perception





[Rensing, 2002]

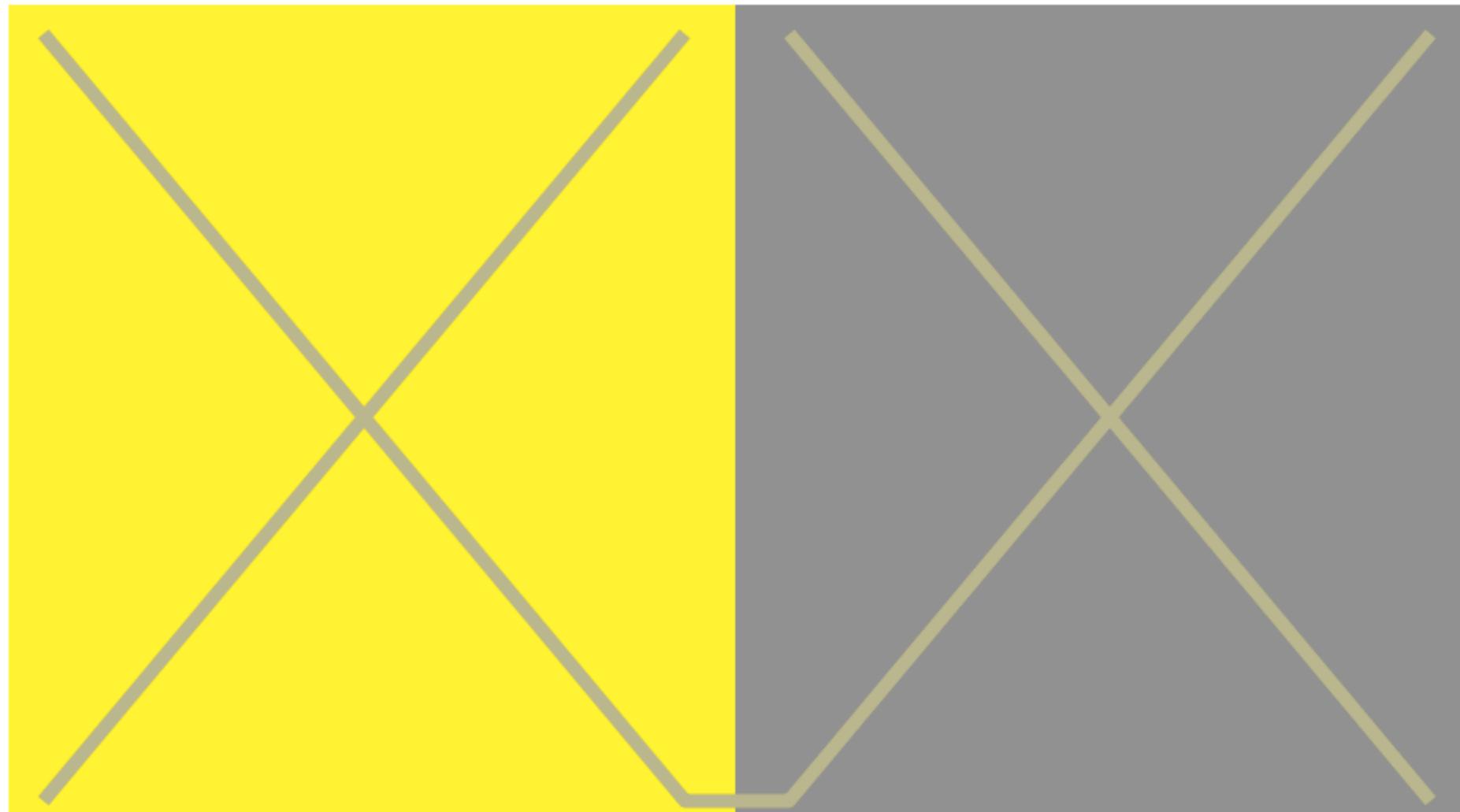


[Rensing, 2002]

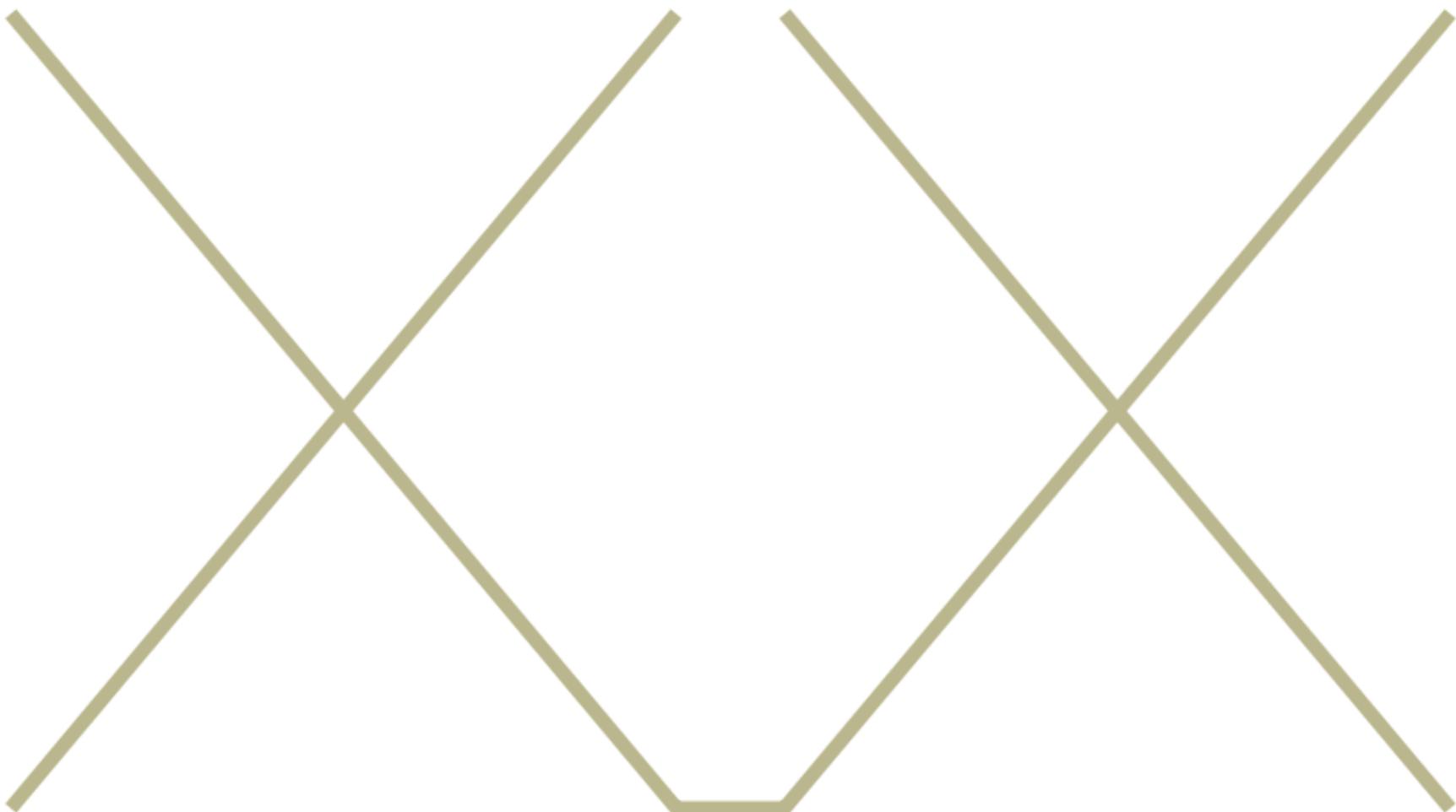
Peut-on vraiment croire
ce que l'on voit ?



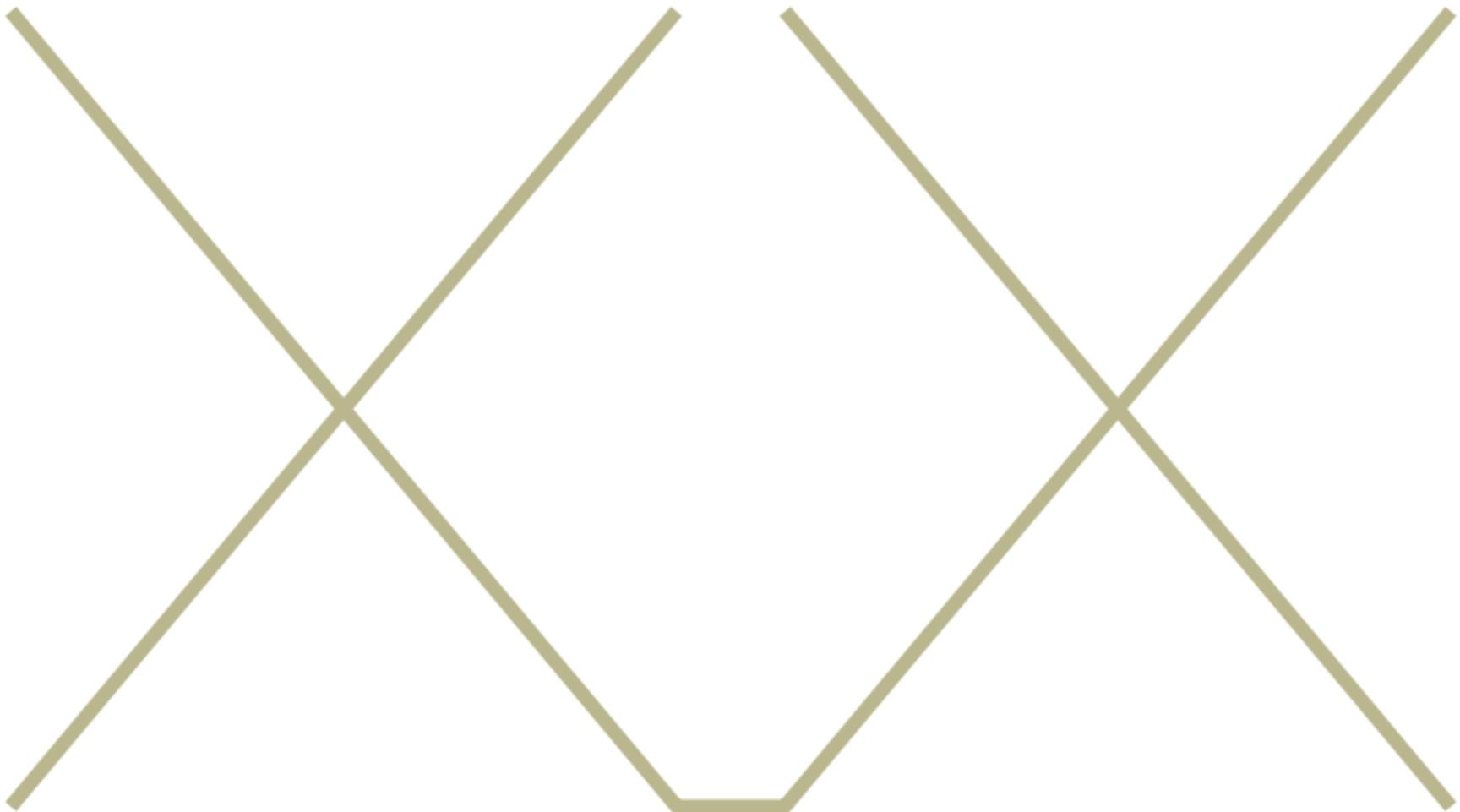
Perception des couleurs



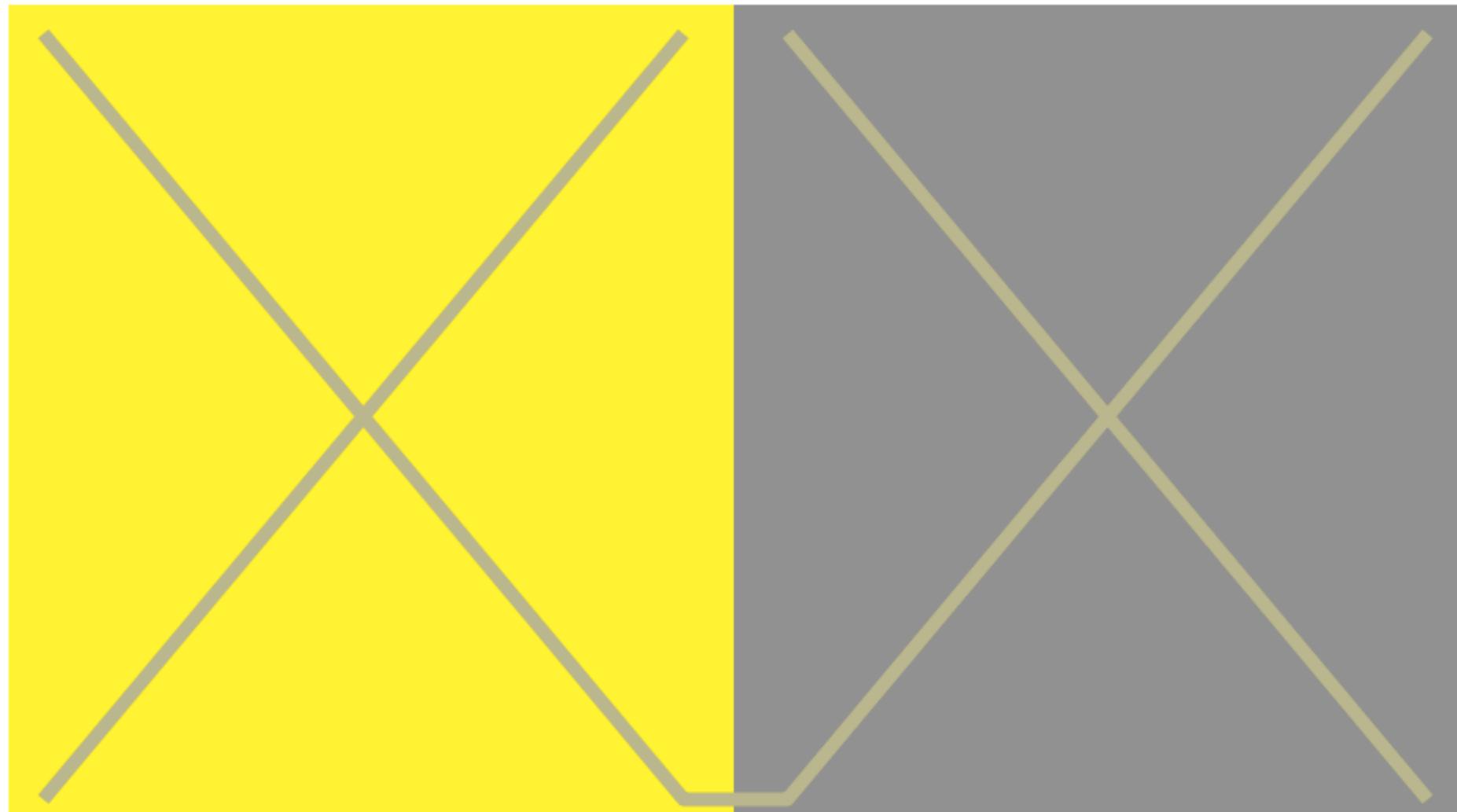
Perception des couleurs



Contraste simultané



Contraste simultané

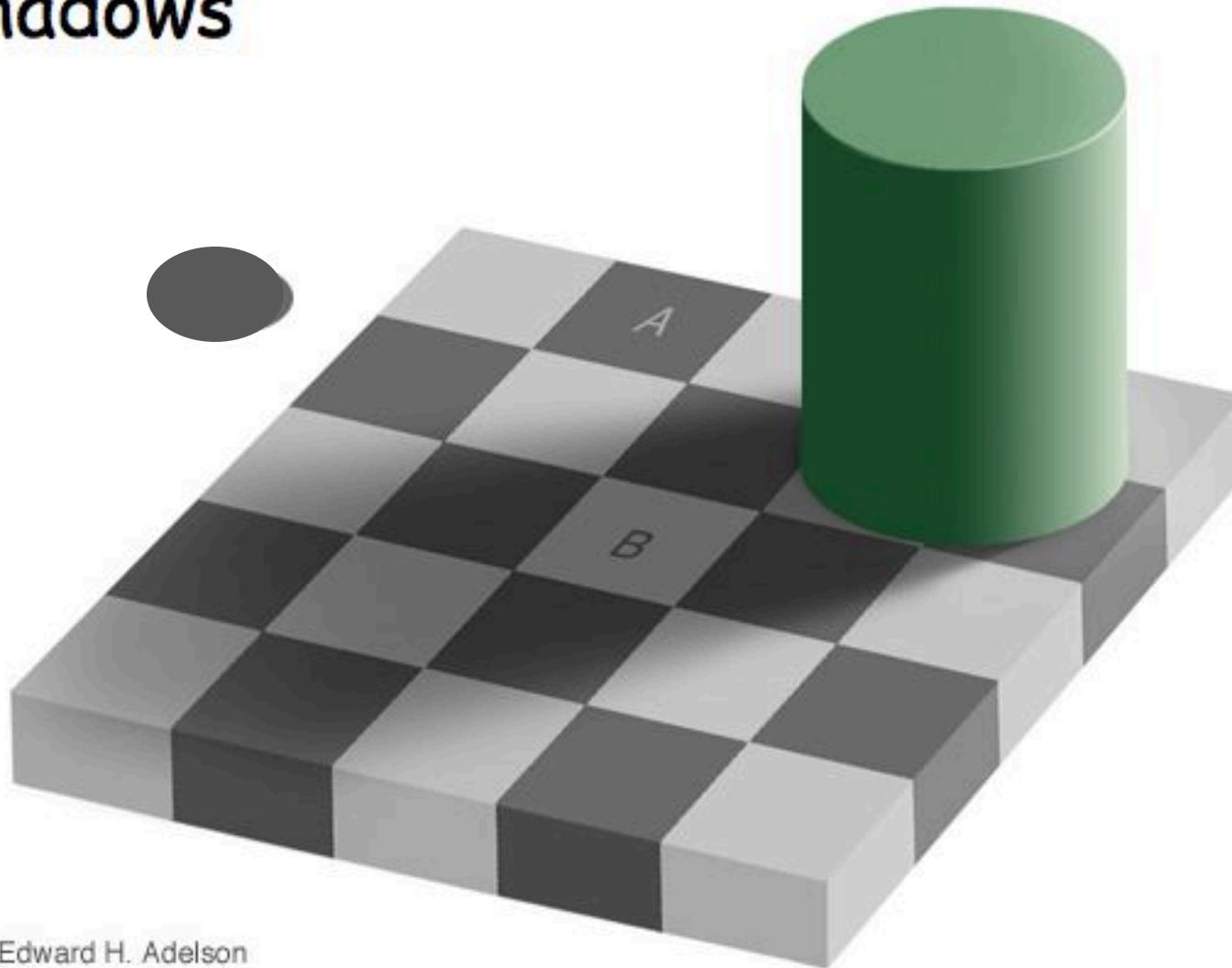


Effet de Bezold





Shadows



Edward H. Adelson

Koffka ring illusion

Top: A gray ring on a light/dark background looks uniform.



Middle: But when the halves are split they look quite different. This is like a variant of the simultaneous brightness contrast illusion.



Bottom: A version in which the halves are slid vertically, giving an impression of transparency.



Even though the half-rings are set against the same backgrounds, their appearance depends on the overall spatial configuration.

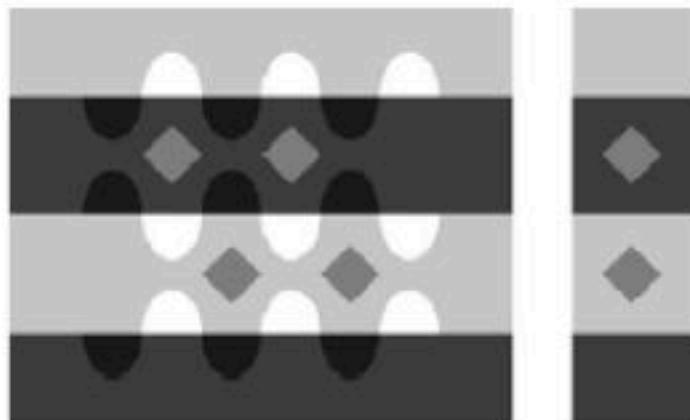
Adelson snake illusion

Top: Strong illusion. The lightness of the diamonds are compared with the other grays in the same horizontal strip. The diamonds are the brightest features within the dim strip at the top, but they are the darkest feature within the light strip at the bottom.

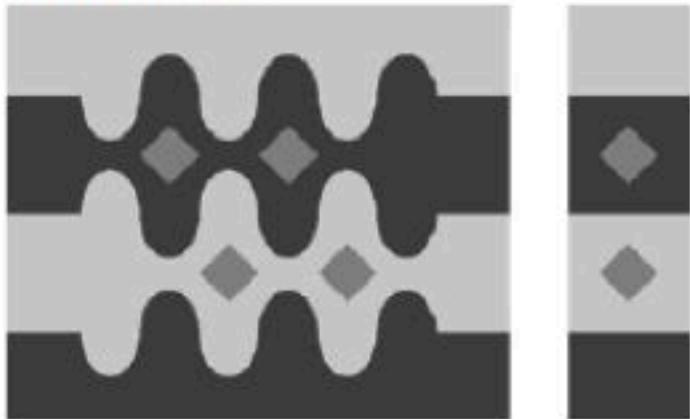
Bottom: Weak illusion without the horizontal strips, from simultaneous brightness contrast.

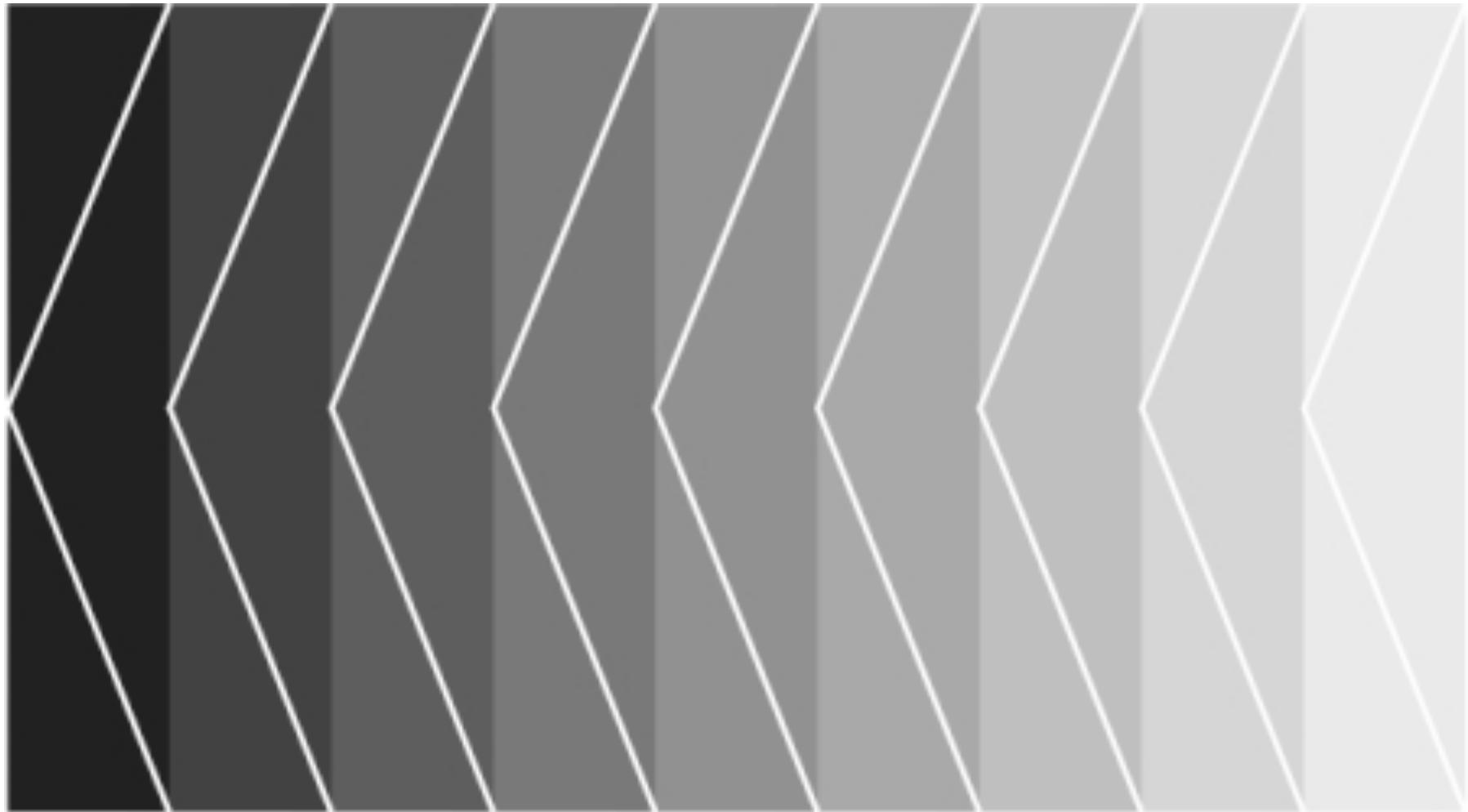
The only difference between the snake and anti-snake is the addition of some half-ellipses that define the horizontal strips.

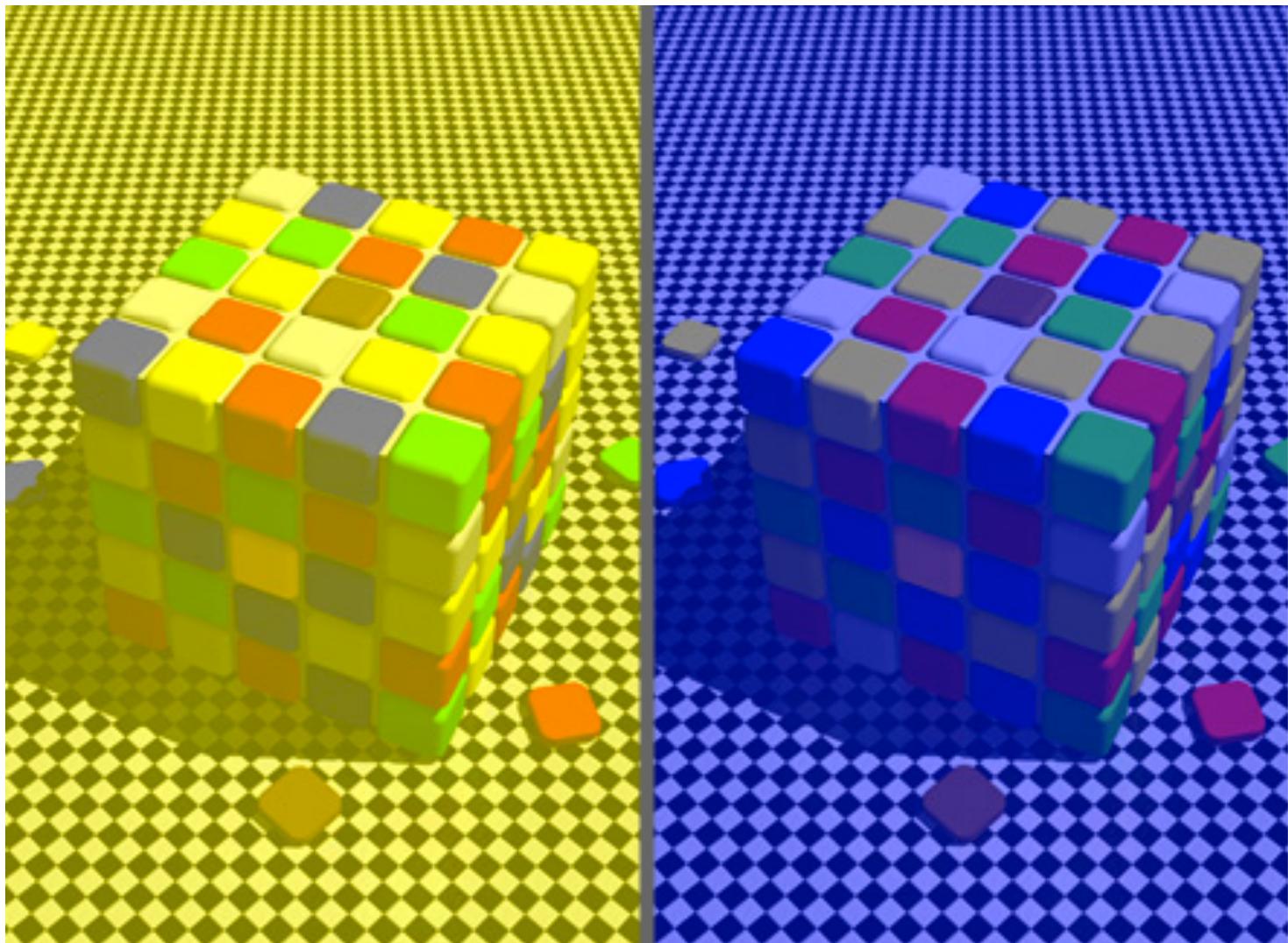
snake



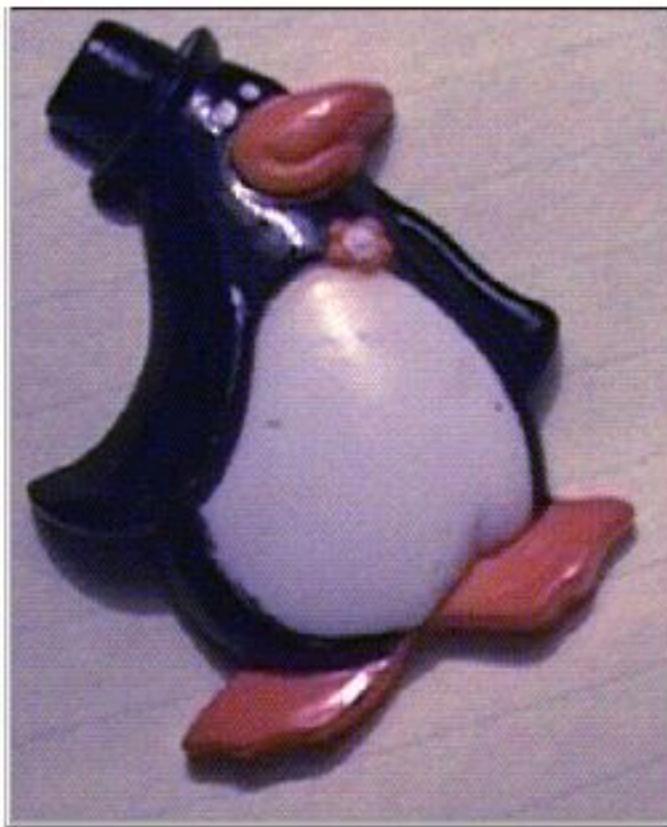
anti-snake



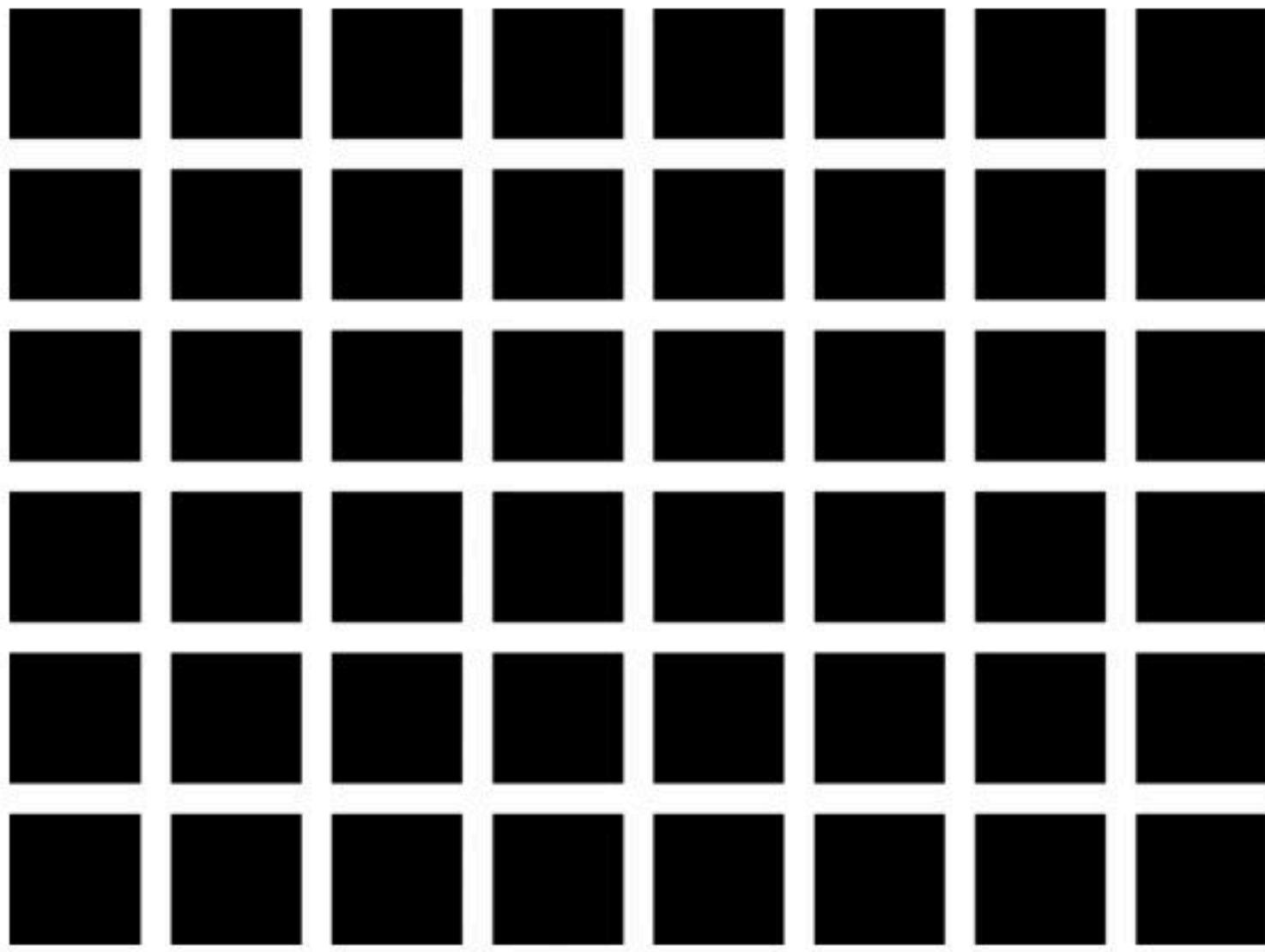




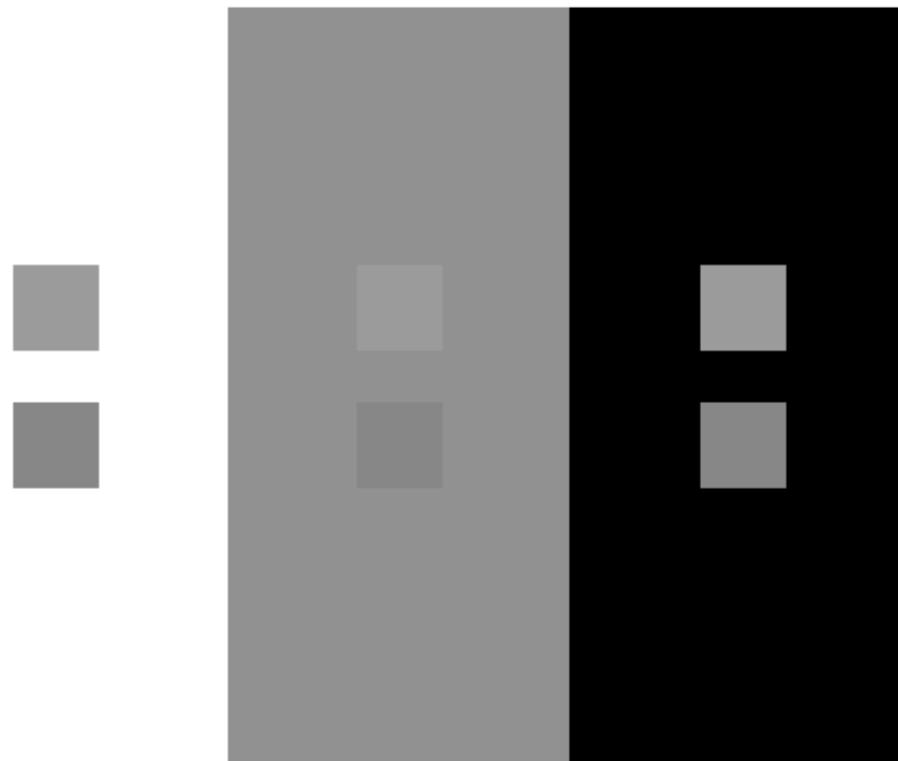
Chromatic adaptation

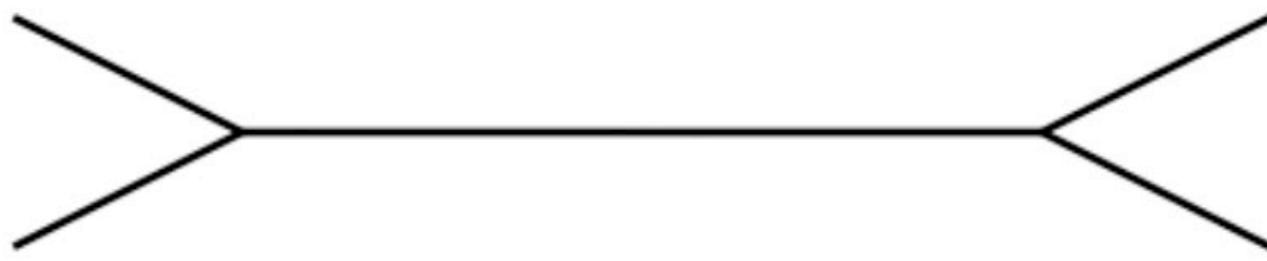
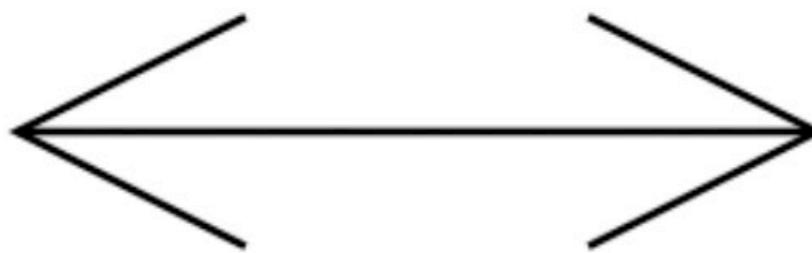


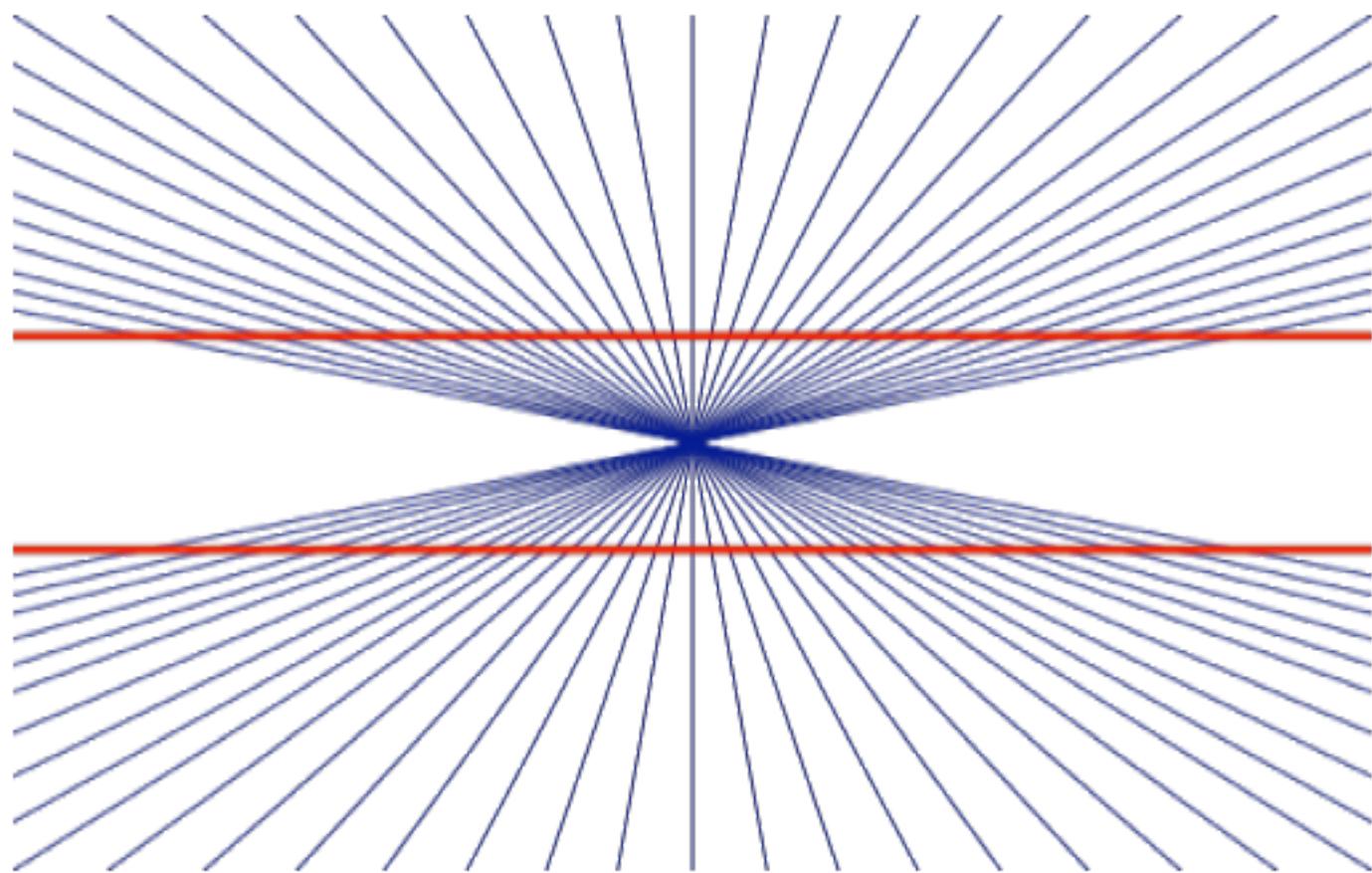
Hermann grid

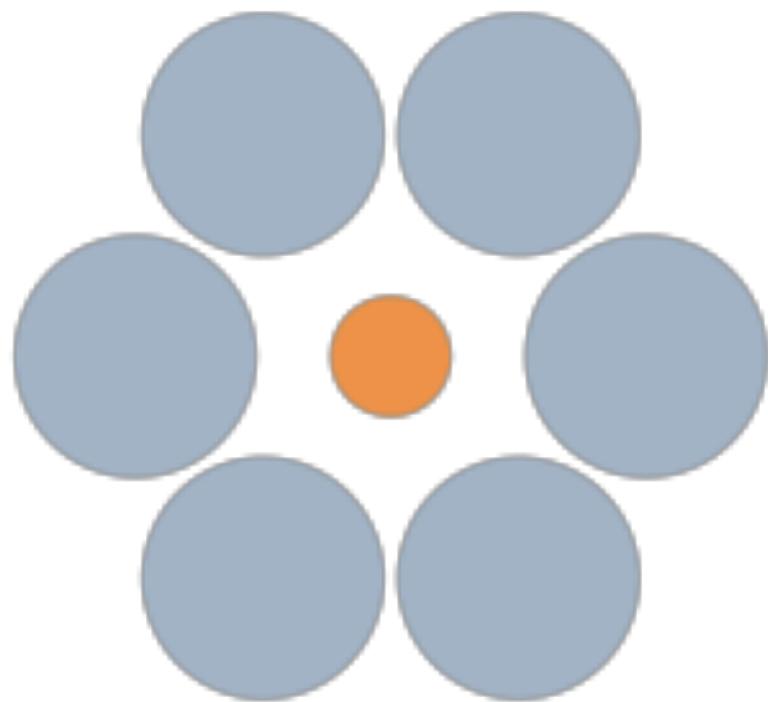


La perception de différences dépend du background (contexte)

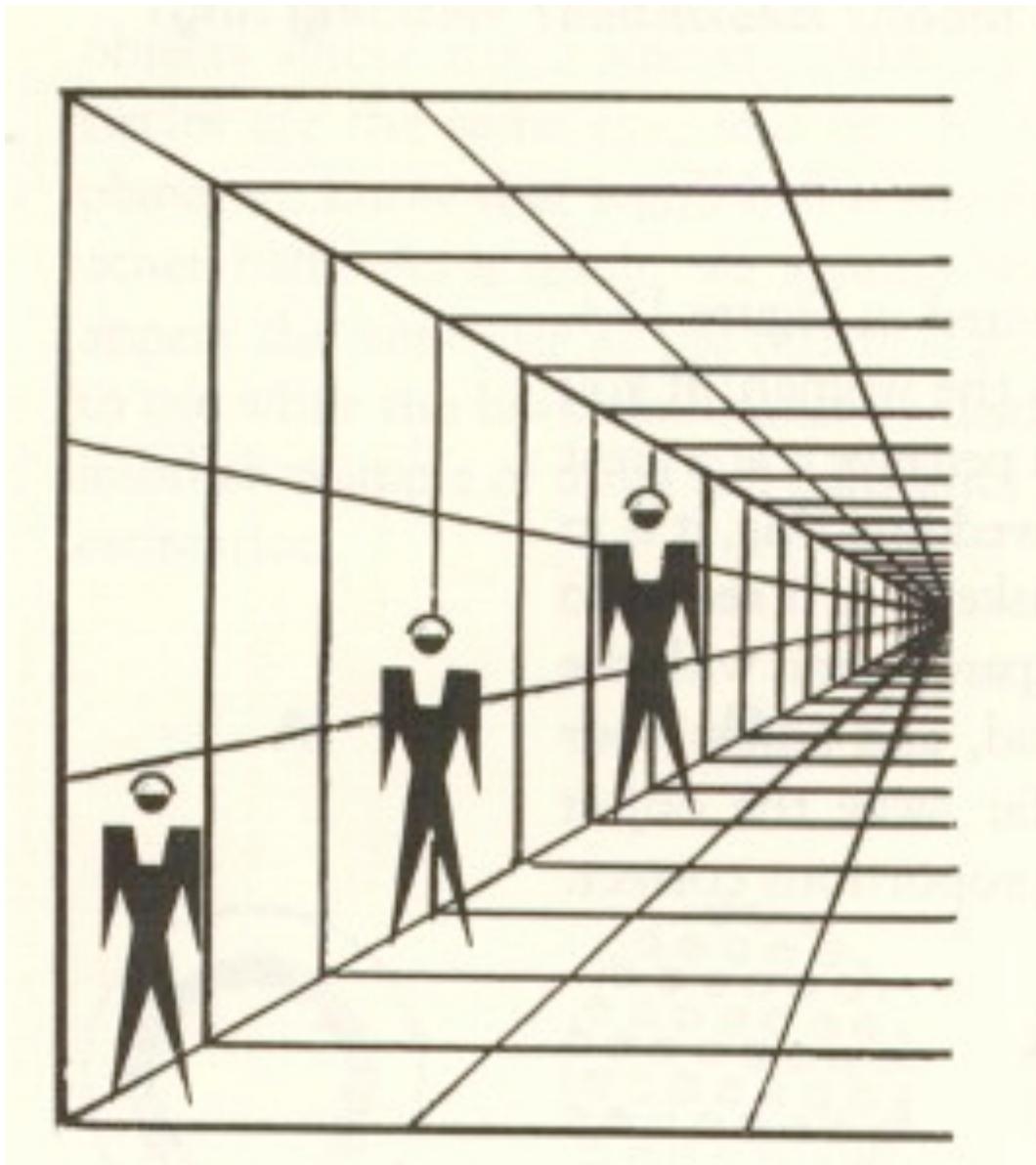




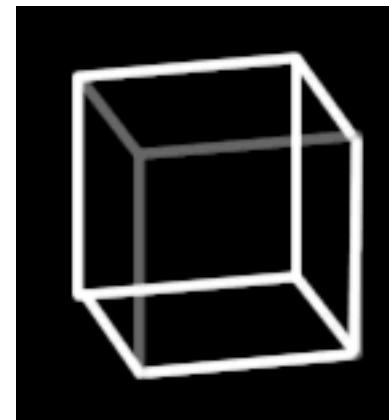
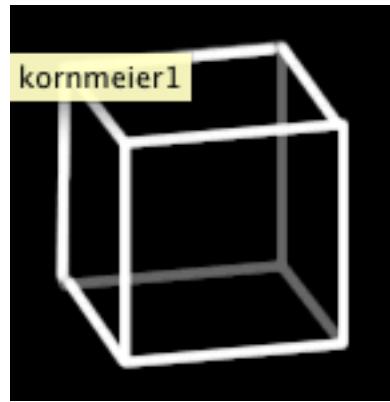
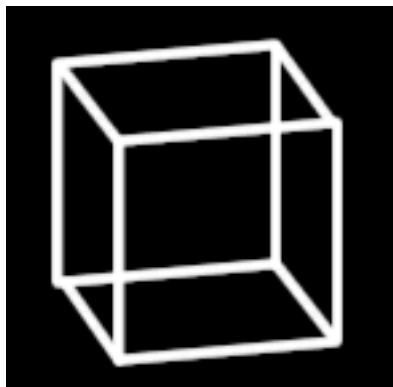




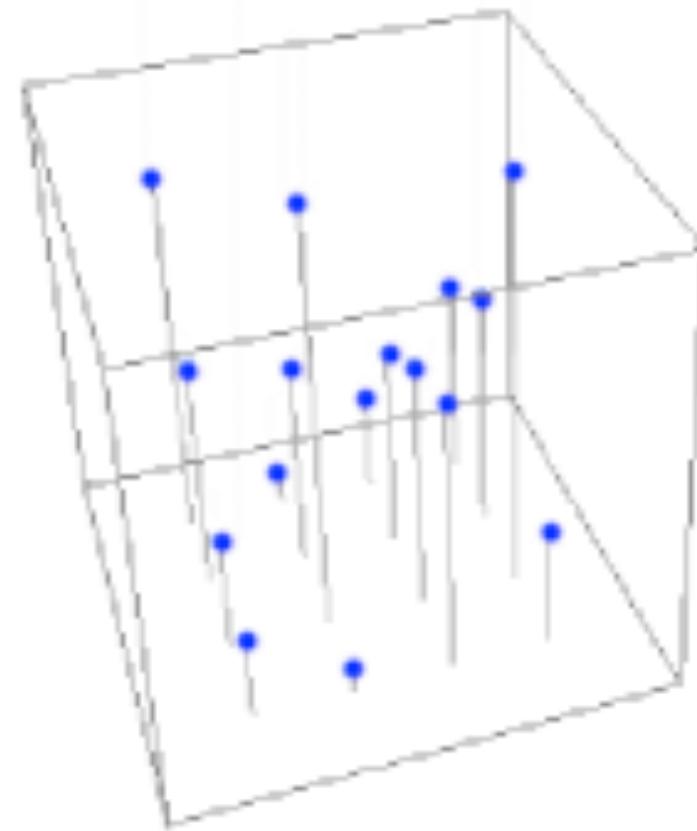
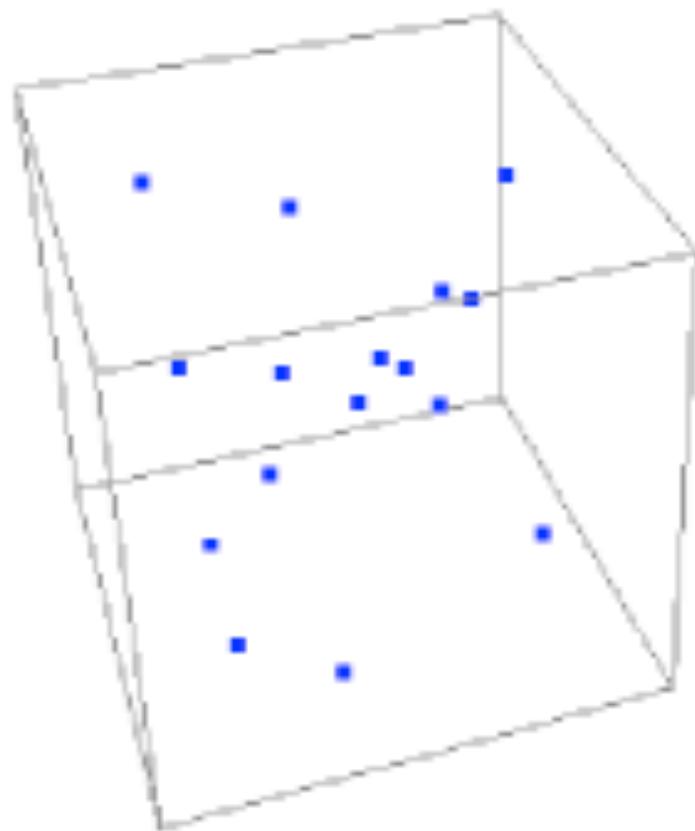
Perception de profondeur



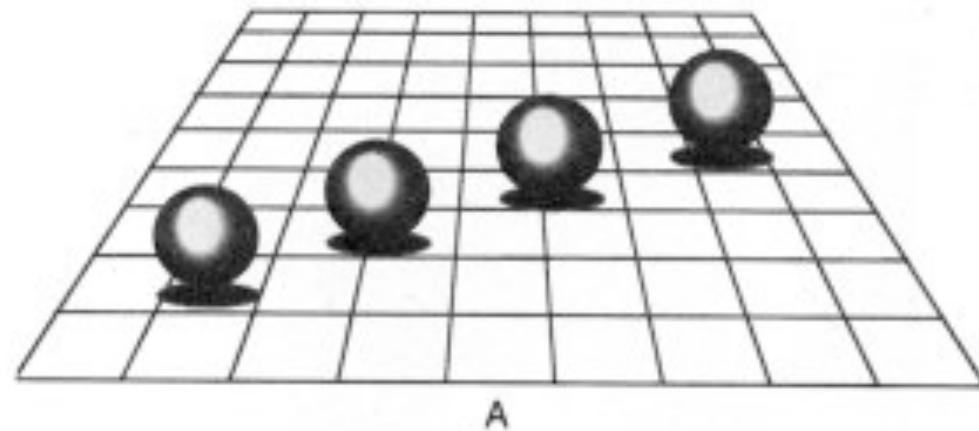
Perception de profondeur



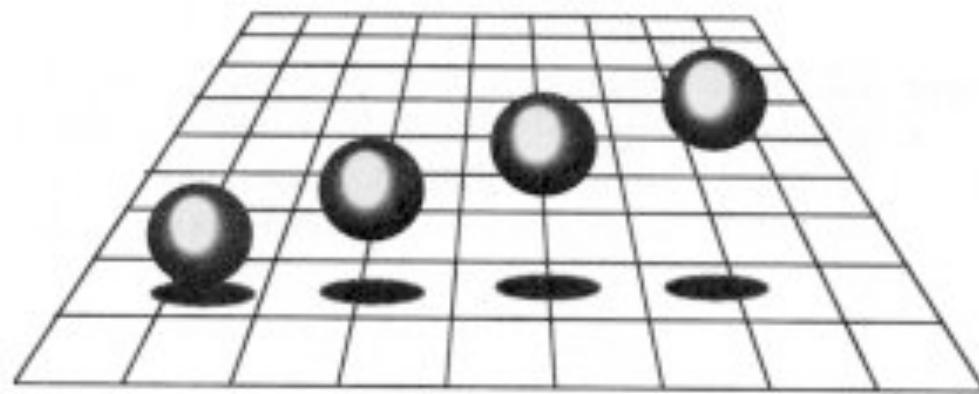
Perception de profondeur



Perception de profondeur

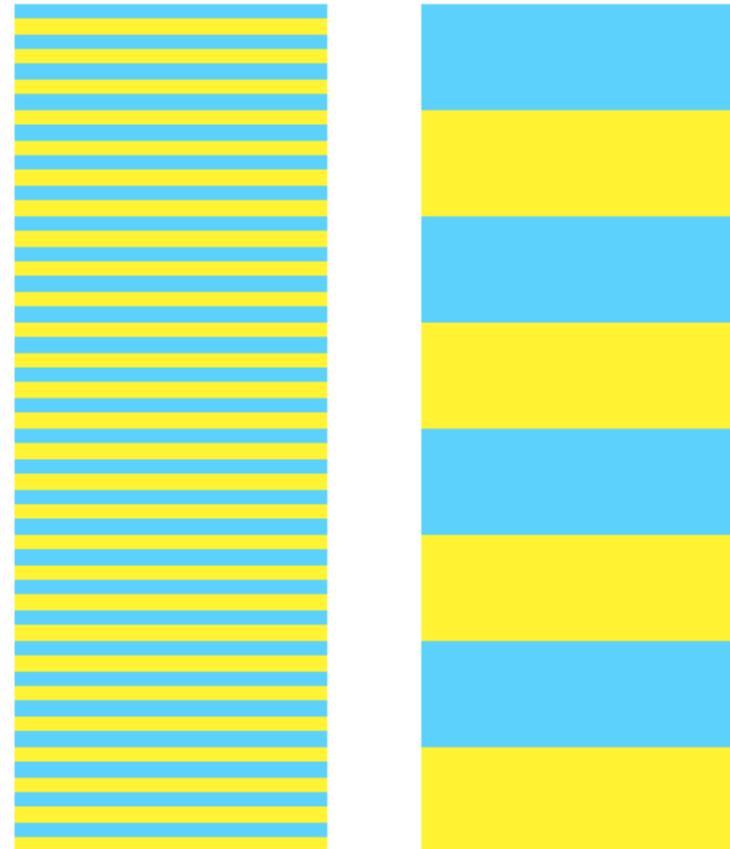


A



B

Les couleurs adjacentes, lorsqu'elles sont placées à plus haute fréquence spatiale, se mélangent



Redrawn from *Foundations of Vision*
© Brian Wandell, Stanford University

gestalt laws of grouping



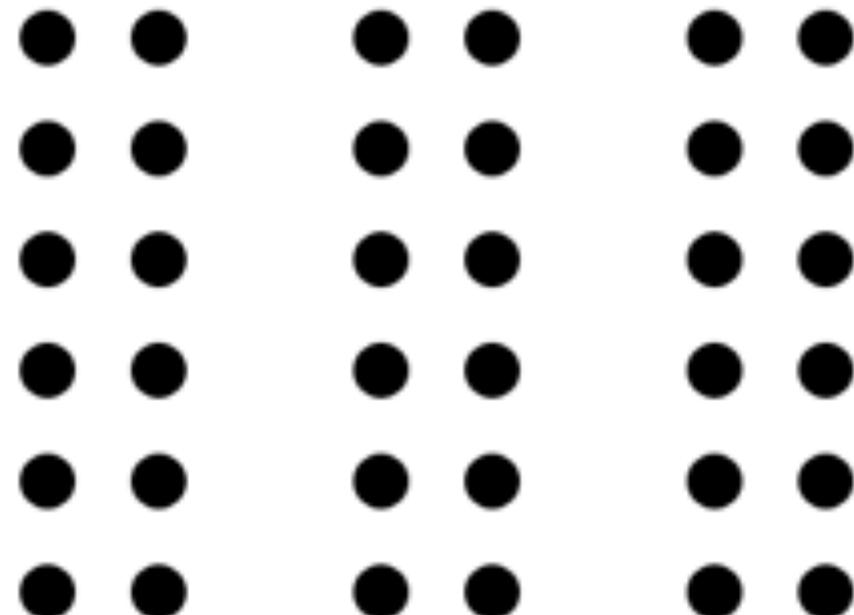
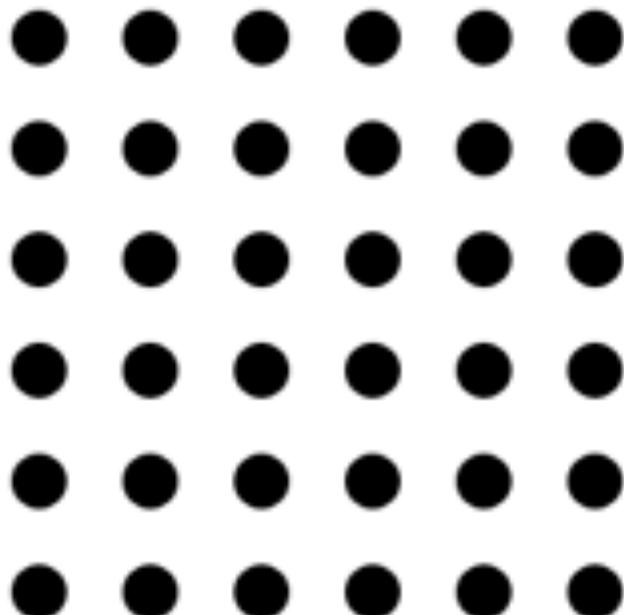
The **laws of grouping** state how **low-level perceptions** are **grouped** into higher-level objects.

Good Gestalt

We tend to order our experience in a manner that is regular, orderly, symmetric, and simple.

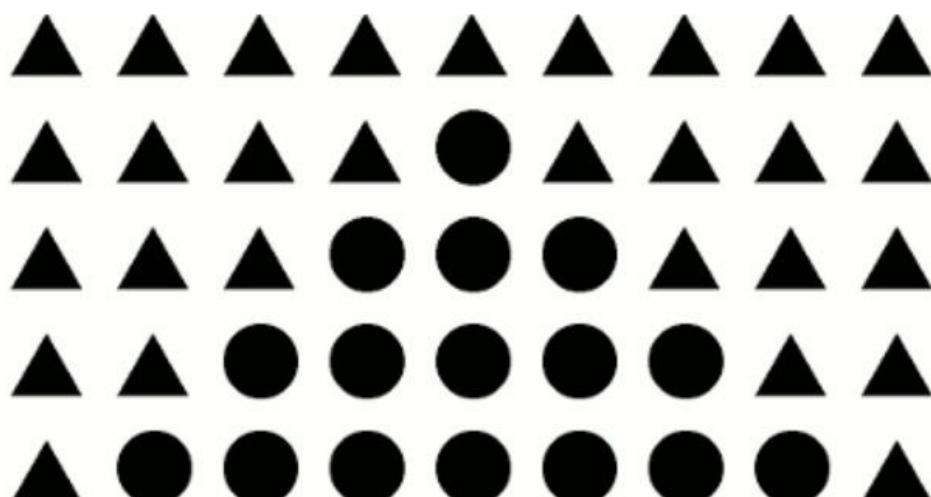
law of Proximity

Objects that are close tend to be perceived as a group.



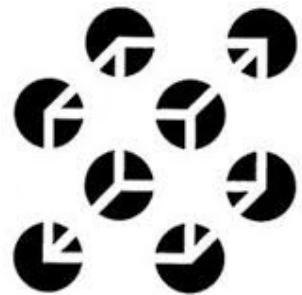
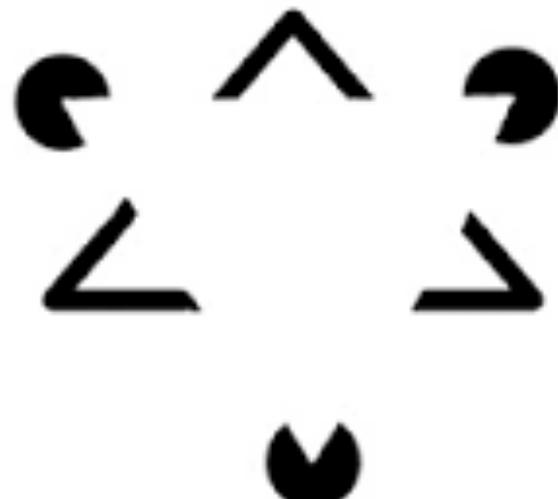
Law of SIMILARITY

Objects that are similar (in shape, color, shading, etc.) tend to form a group.



Law of CLOSURE

The perception fills gaps in stimuli.



Law of Symmetry

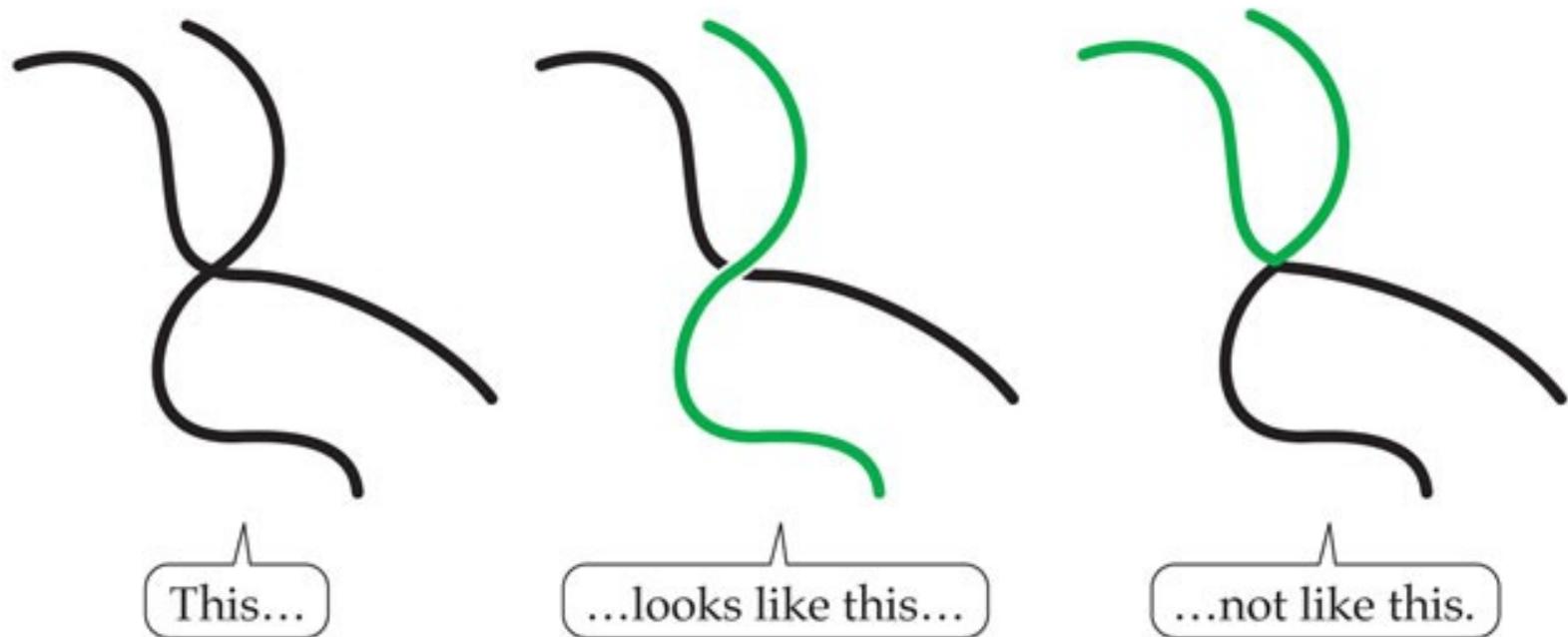
Objects with symmetric disposition tend to be perceived as forming a whole.

[] { } []

How many groups of elements are there?

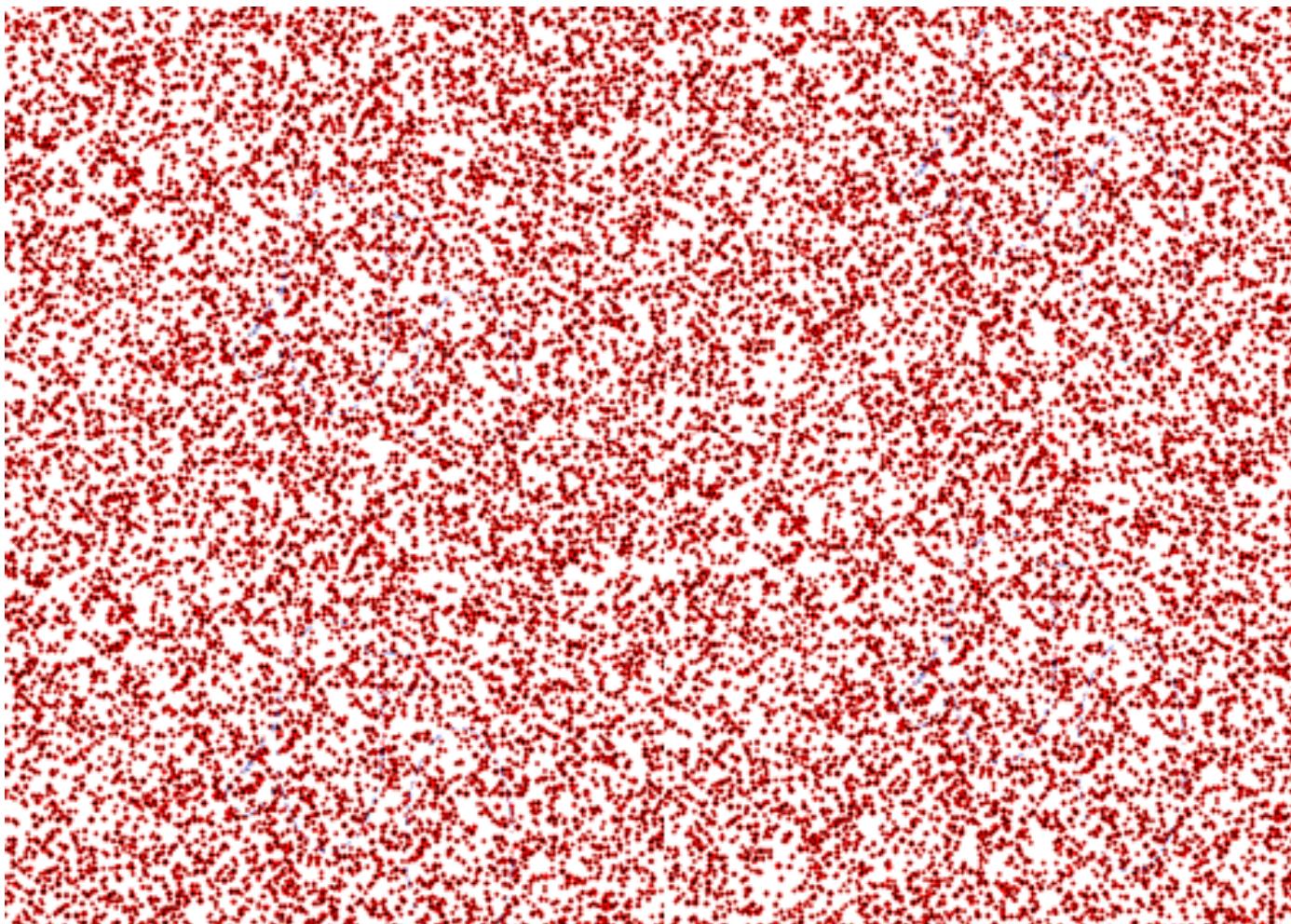
Law of Continuity

Ambiguous stimuli are perceived preferentially with the interpretation that is the most continuous.



Law of common fate

Objects evolving together are perceived as a group.



LAW of Figure & Ground

Elements are perceived as either a **figure** (element of focus) or **ground** (background on which the figure sits)

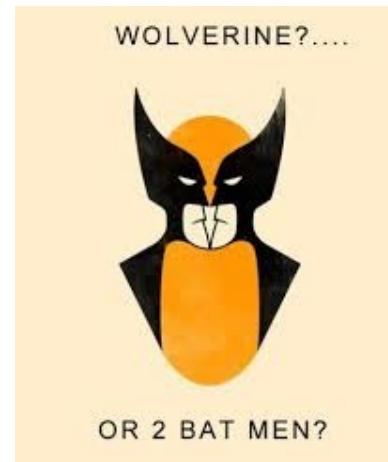
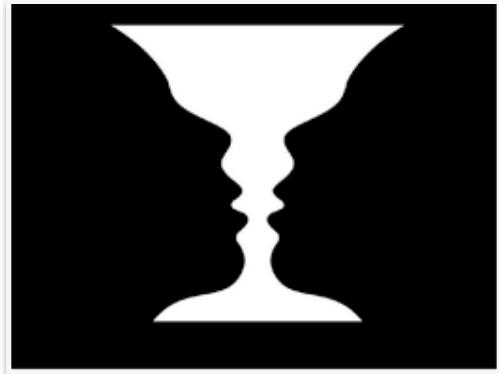


Figure & Ground in art



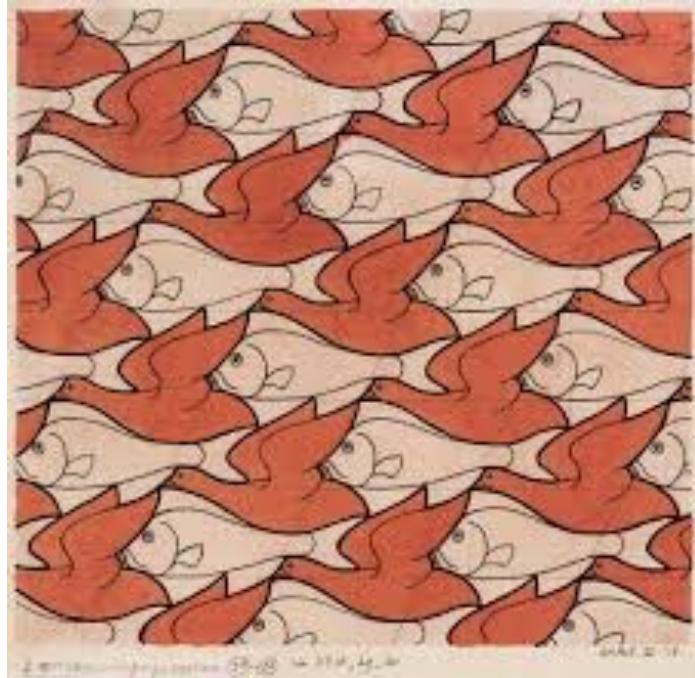
Figure & Ground in art



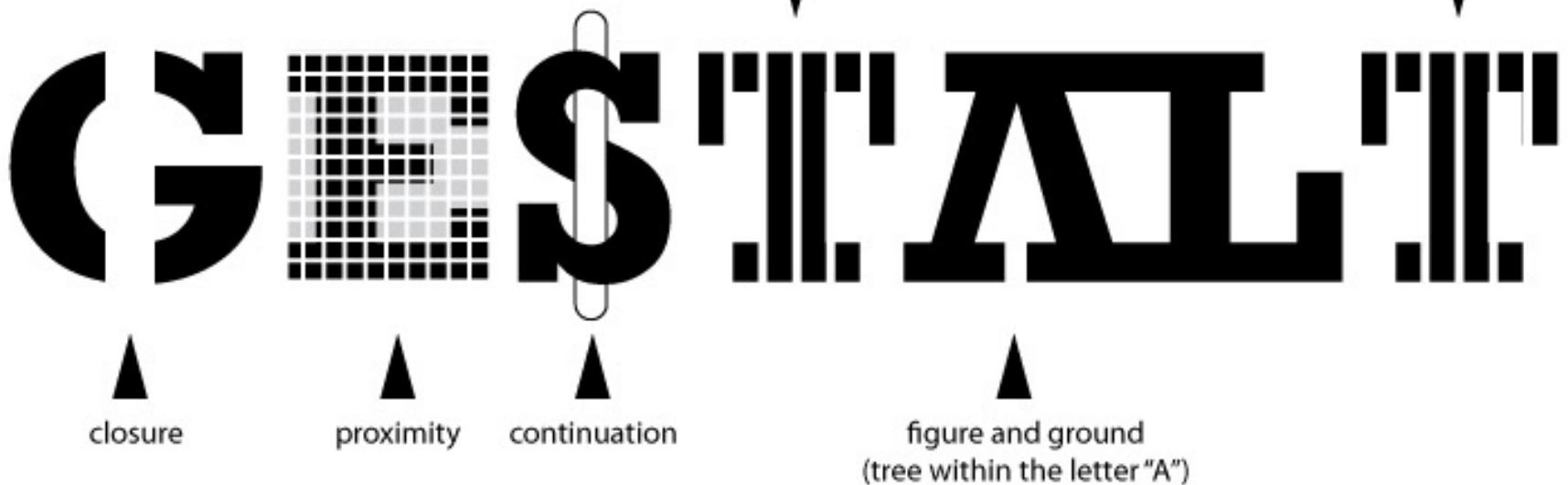
Figure & Ground in design



Figure & Ground: before gestalt



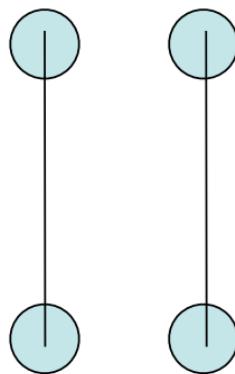
Escher's Metamorphosis



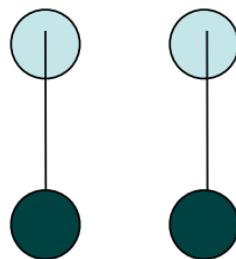
More Laws!

law of Connectedness

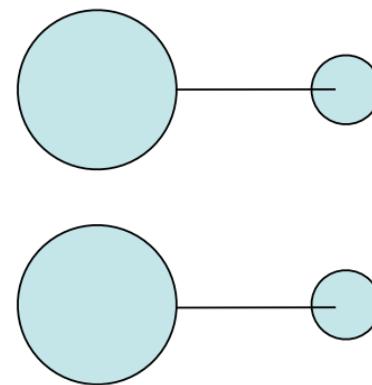
Things that are linked are perceived as belonging to the same group.



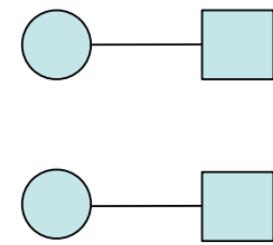
proximity



color



size



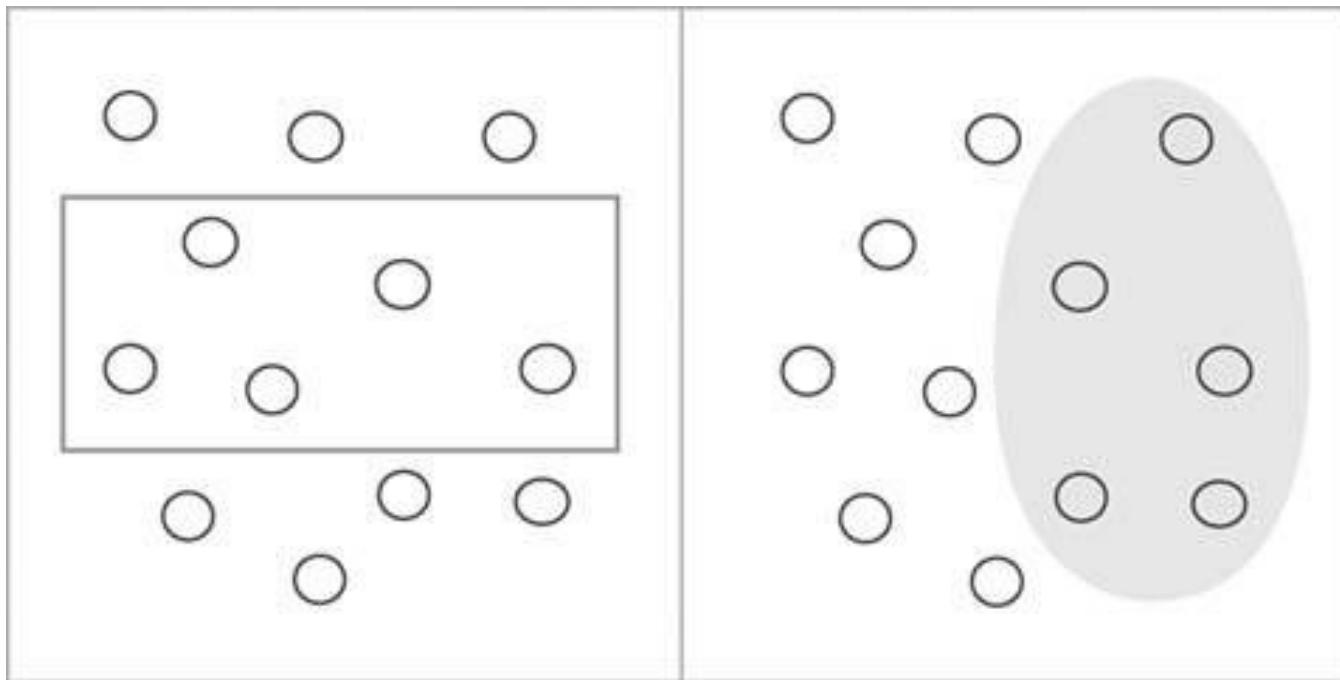
shape

More powerful than proximity, color, size, shape...

More Laws!

law of ENCLOSURE

Objects that are enclosed are perceived as a group



Again, more powerful than proximity, color, size, shape...

in Summary

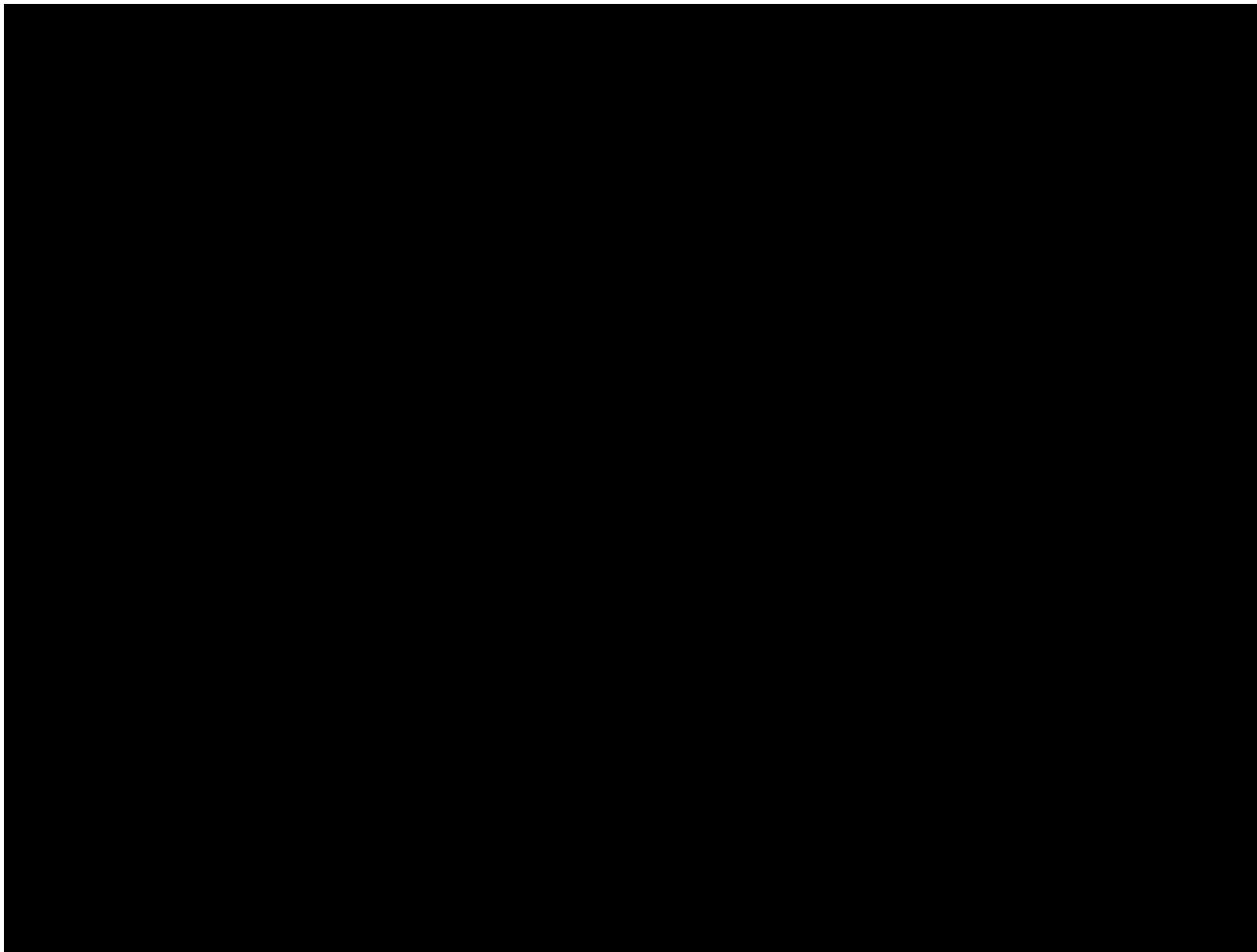
Our brains take lots of perceptual “shortcuts”...

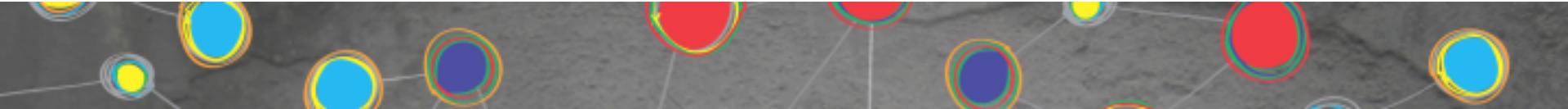
... which can either help or harm our visualizations!

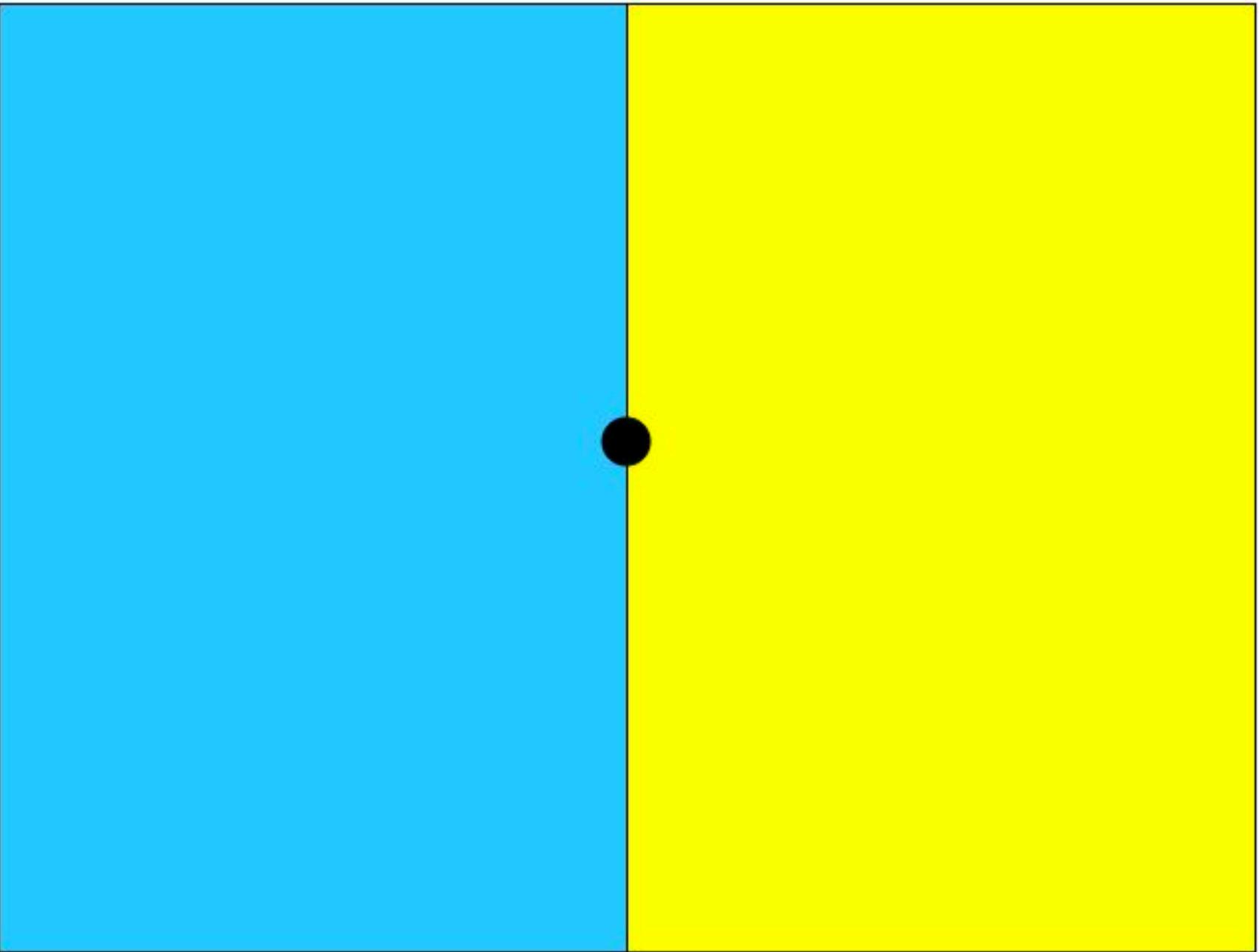
It is not enough to simply show something, we need to pay attention when and how it is shown.

A GOOD UNDERSTANDING OF PERCEPTUAL AND COGNITIVE PROCESSES IS CRITICAL!

Pour finir







Chromatic adaptation

