

Introspective Visualizations

The algebra of clarity

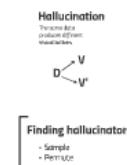
Aneesh Karve, CTO at Quilt Data



Bibliography

A Algebraic Study of Invariance, Unambiguity, Correspondence, and Hallucination in Deep Networks
S. Hochreiter, S. Kindermann, and R. Stärk
arXiv preprint arXiv:1705.07874, 2017
https://arxiv.org/abs/1705.07874
https://arxiv.org/pdf/1705.07874.pdf

- Invariance
- Unambiguity
- Correspondence



Finding hallucinators
- Sample
- Permute



Finding confusion
- Loss of dimensionality
- Human or computer

Visualization

Universe $\xrightarrow{\text{Data}} \text{Representation} \xrightarrow{\text{Image}} \text{Mind}$



Unambiguity
Different data
maps to different
representations
 $D \rightarrow V$
 $D' \rightarrow V'$



Correspondence

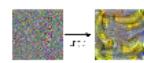
Same data
maps to the same
representation
 $D \xrightarrow{\text{Data}} \text{Representation} \xrightarrow{\text{Image}} \text{Mind}$

Thanks

- Kindermann & Scheidiger
- Steve Horoz
- Kevin Moore
- Richard Stark



- Inceptionism for transparency
• Assess difference between
algorithm's rank and our own
• Know our own biases



Does the scanner see clearly or darkly?



Introspective Visualizations

The algebra of clarity

Aneesh Karve, CTO at Quilt Data



Oracles

examples maxims models perceptual code

APIs

[KS16]

Oracles

examples

maxims

examples

maxims

models

perceptual

[KS16]

odels

perceptual

code

APIs

Oracles

examples maxims models perceptual code

APIs

[KS16]



Kindlmann & Scheidegger, 2014 [KS2014]

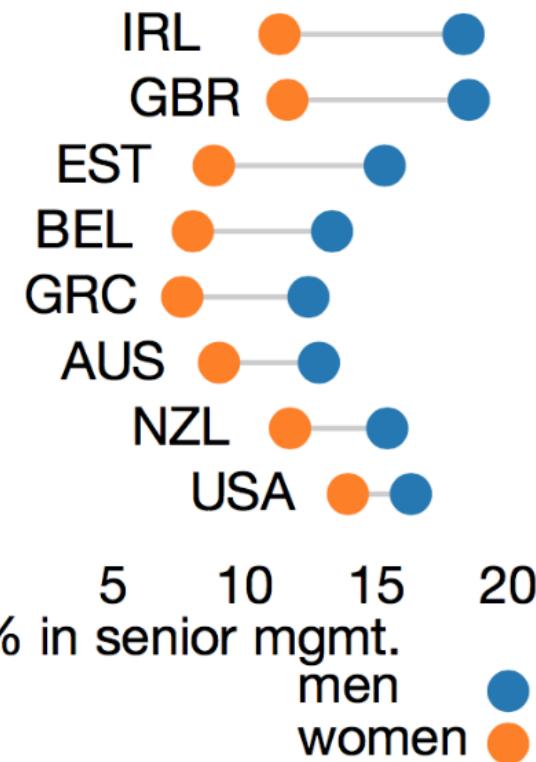
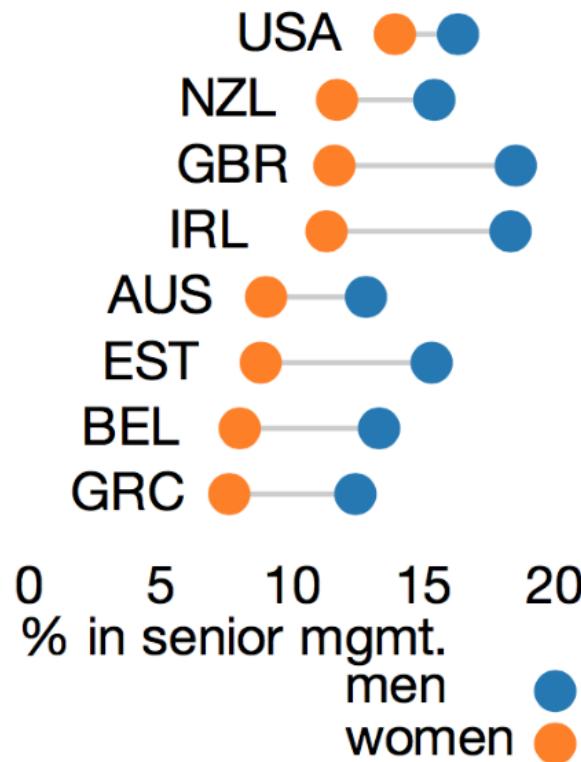
- Invariance
- Unambiguity
- Correspondence

Invariance

The same data
always produces
the same
visualization

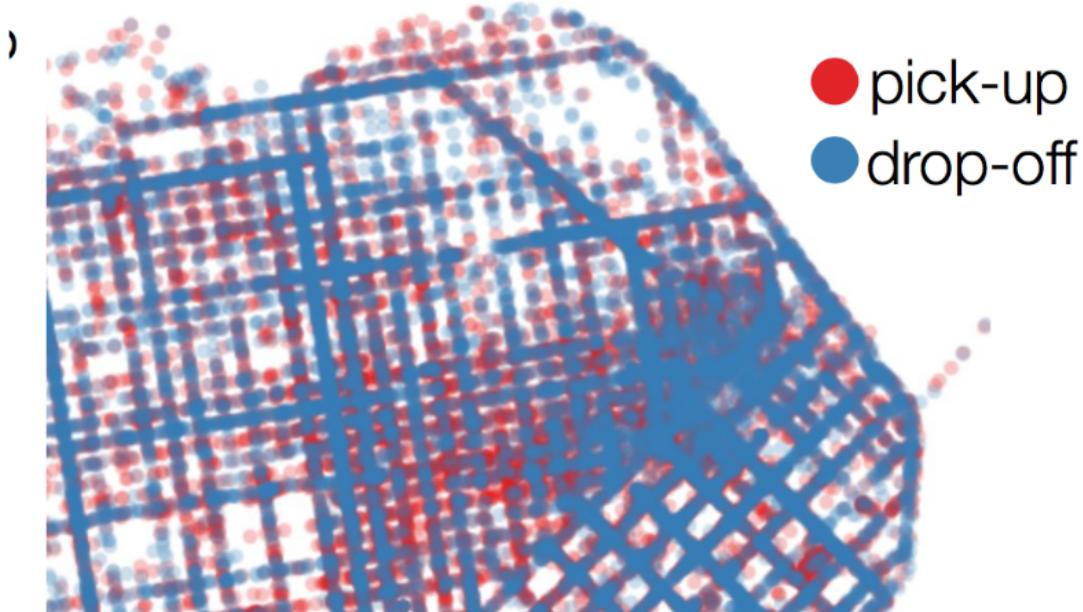
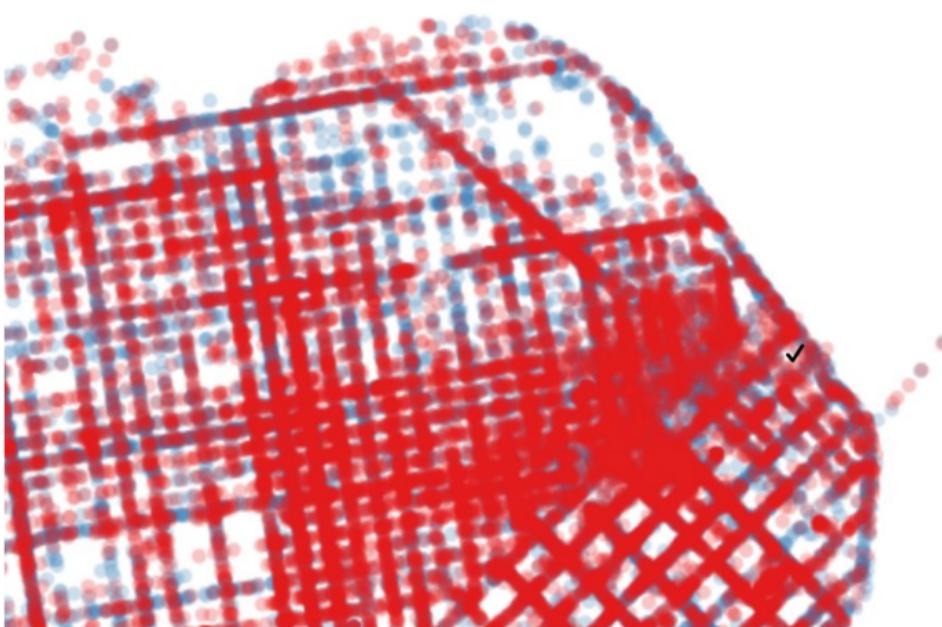
$$D \rightarrow V$$

Same data, different impression



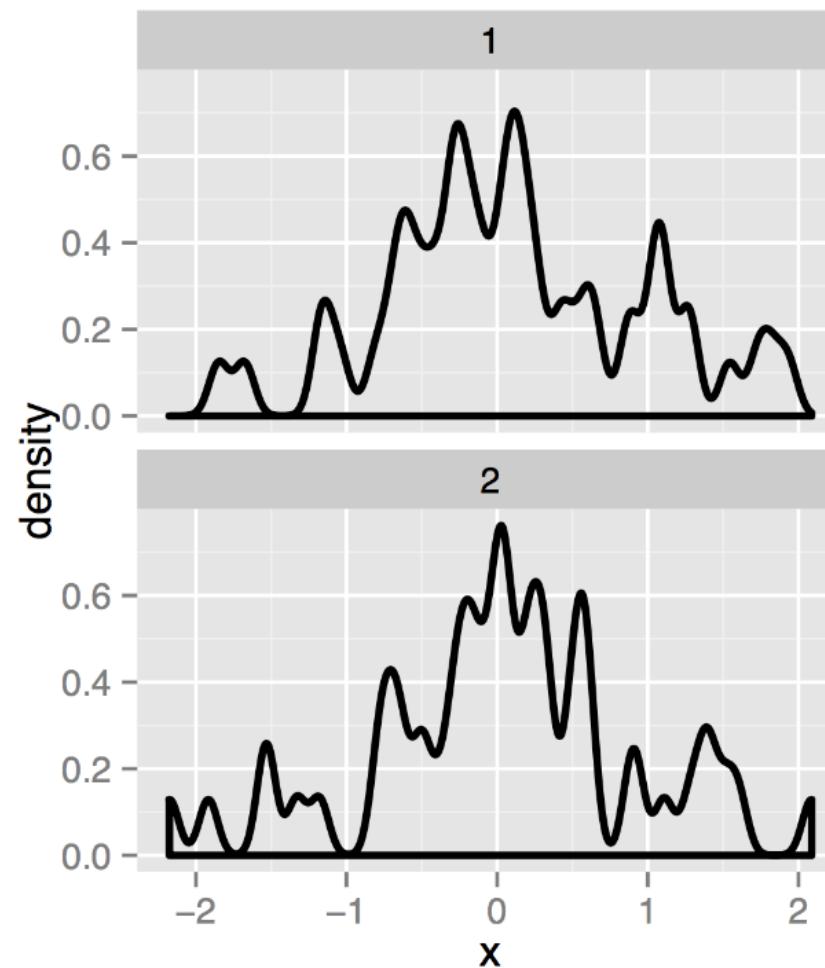
[KS14]

Same data, opposite viz



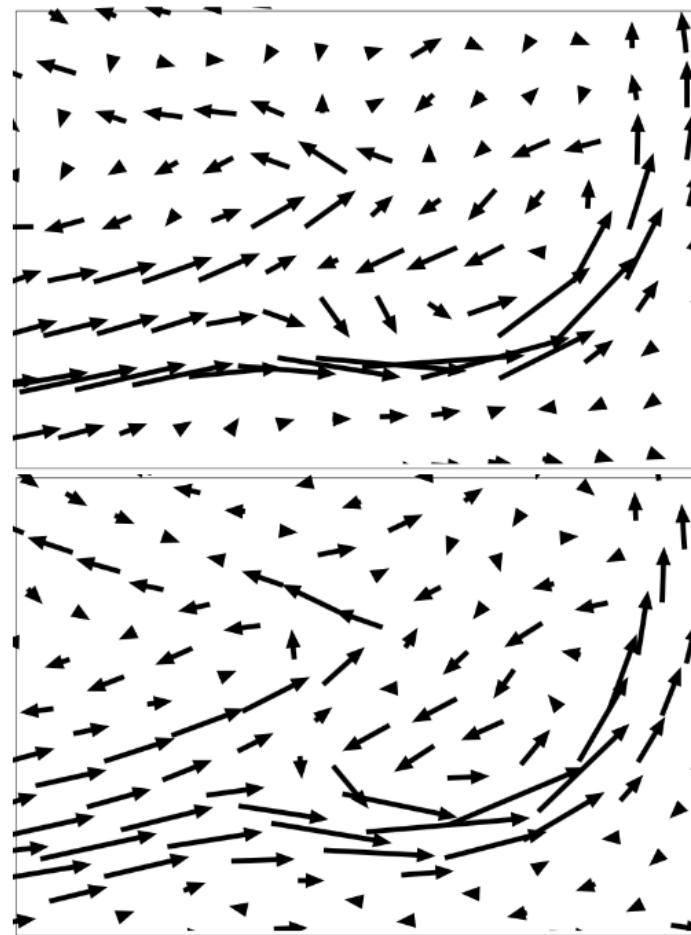
[KS14]

Same population, different samples



[KS14]

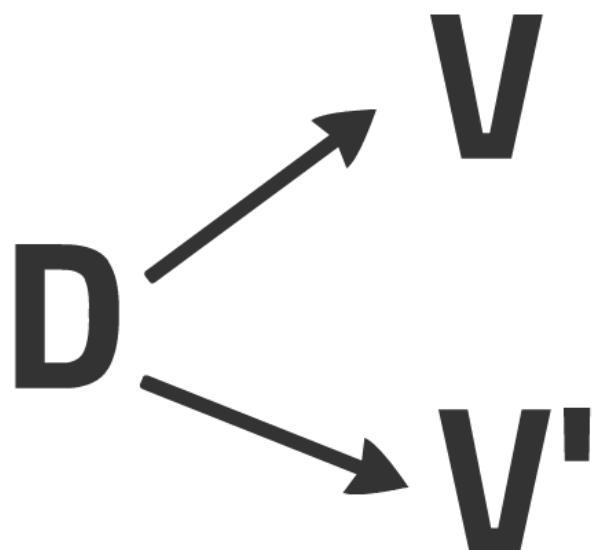
Same population, different samples



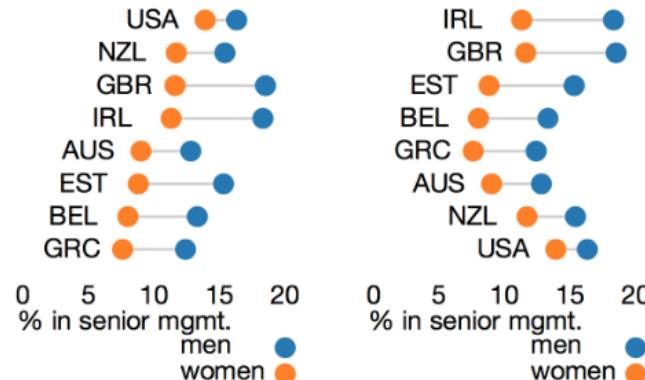
[KS14]

Hallucination

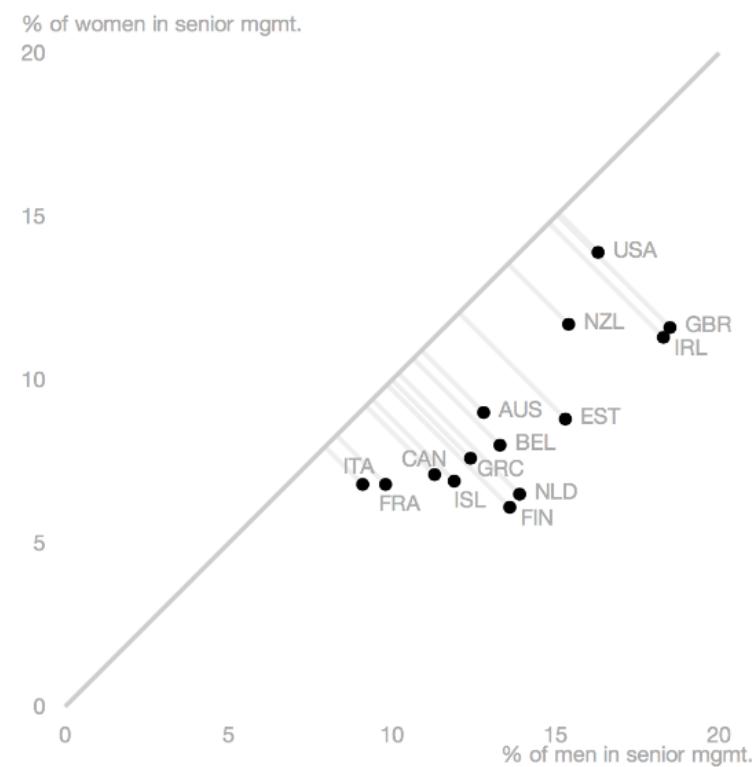
The same data
produces different
visualizations



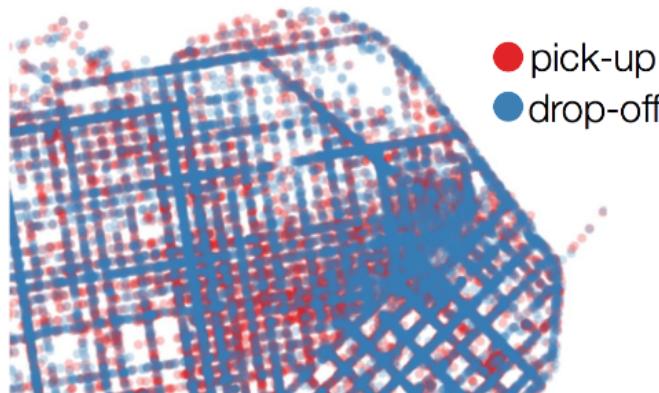
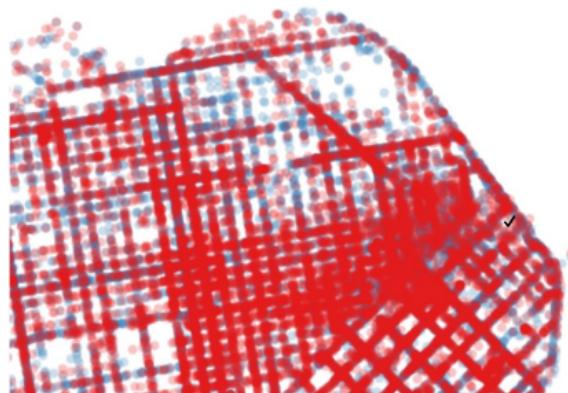
Same data, different impression



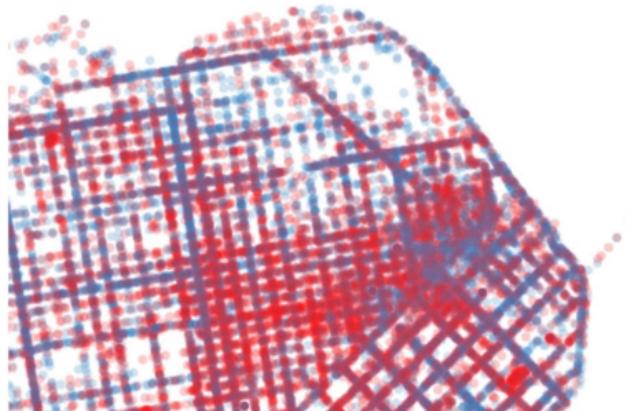
[KS14]



Same data, opposite viz



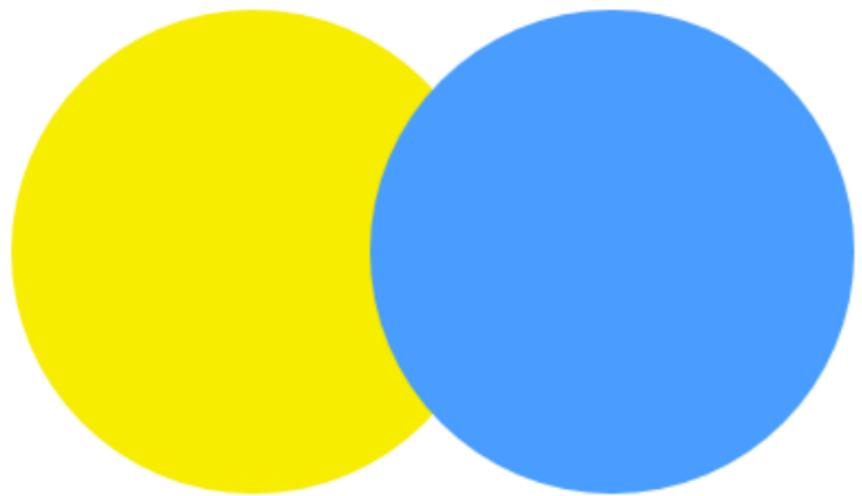
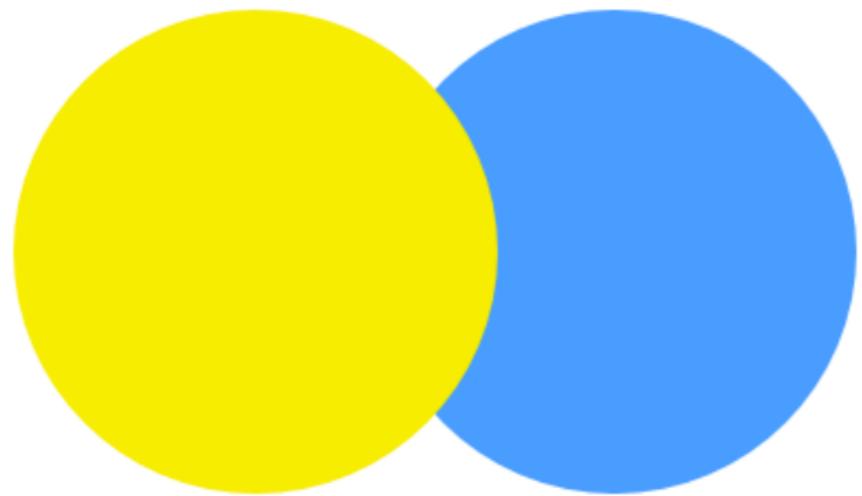
[KS14]

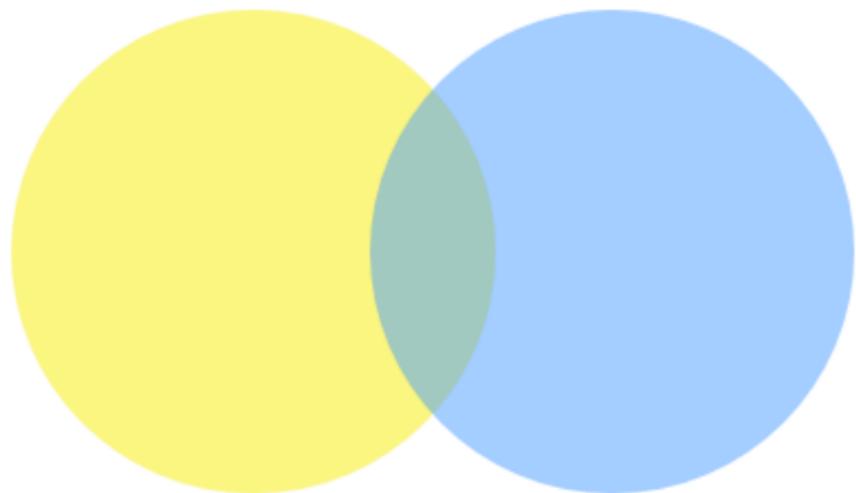
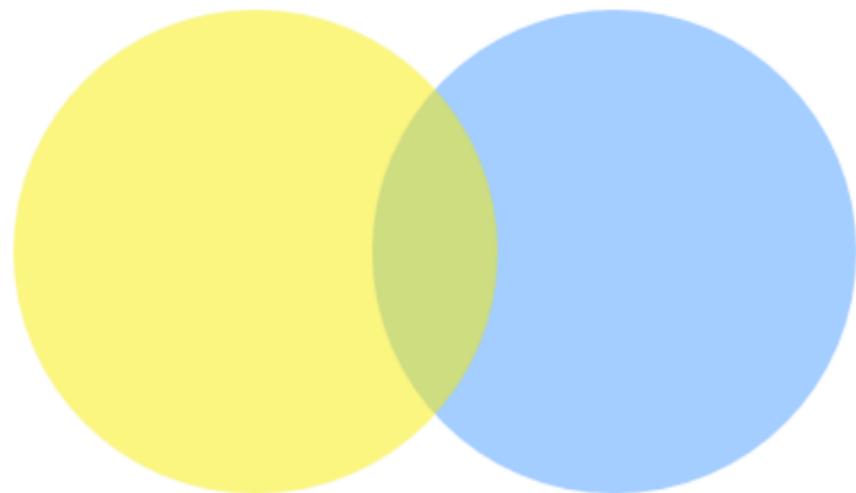


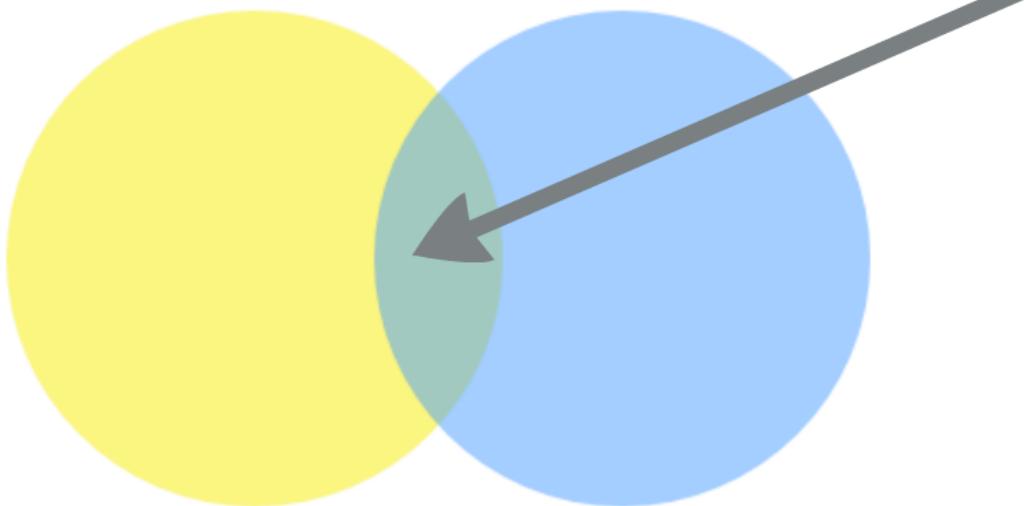
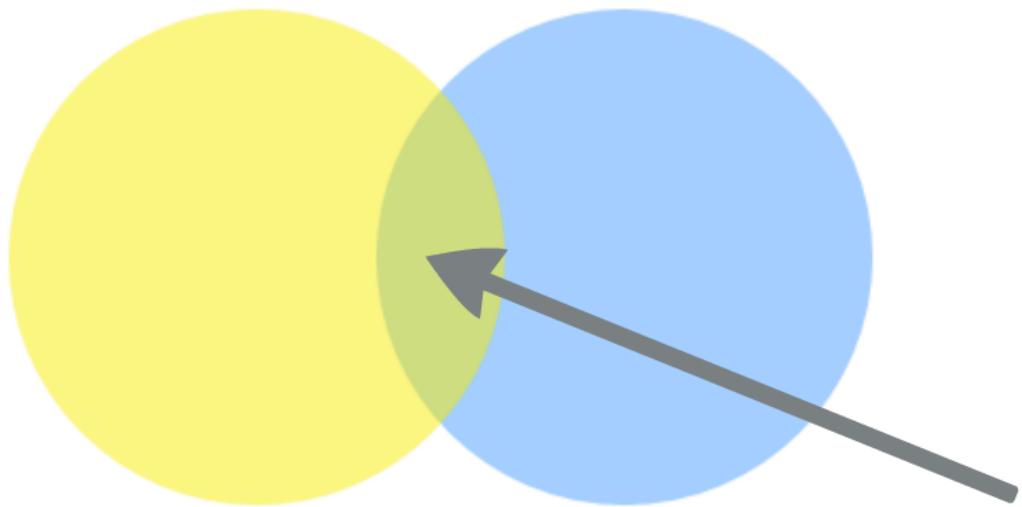
Data has different semantics from viz

Pick-up \cap Drop-off = Drop-off \cap Pick-up
but

A over B \neq B over A

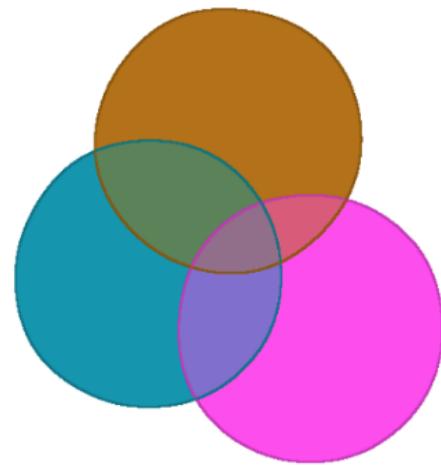




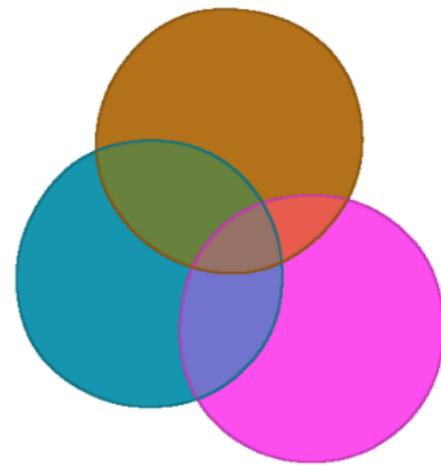


- Commutative blending
- Custom blending
- Sampling

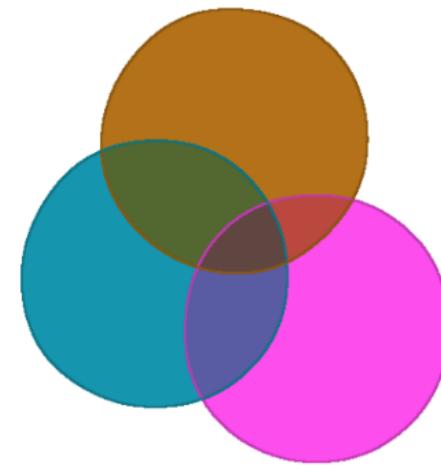
Splatterplots



(a) RGB
blending



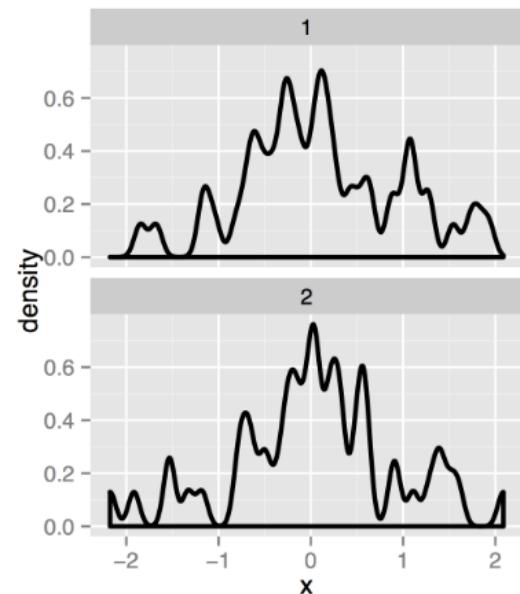
(b) LAB
blending



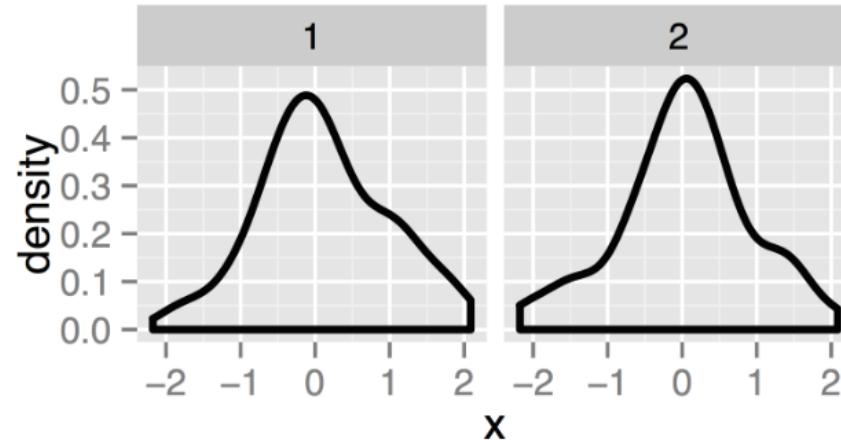
(c) With
attenuation

[MG13]

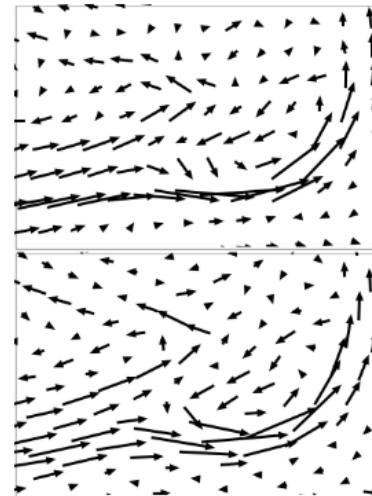
Same population, different samples



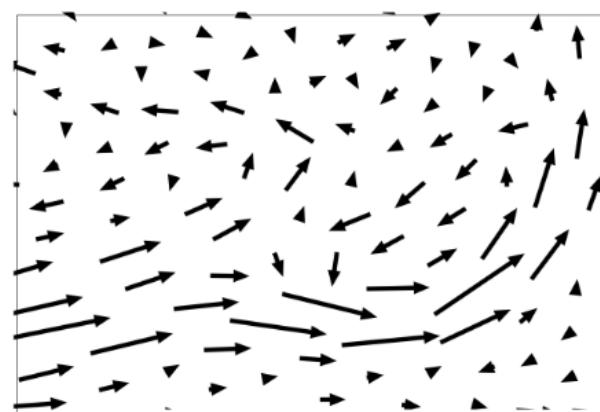
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Same population, different samples



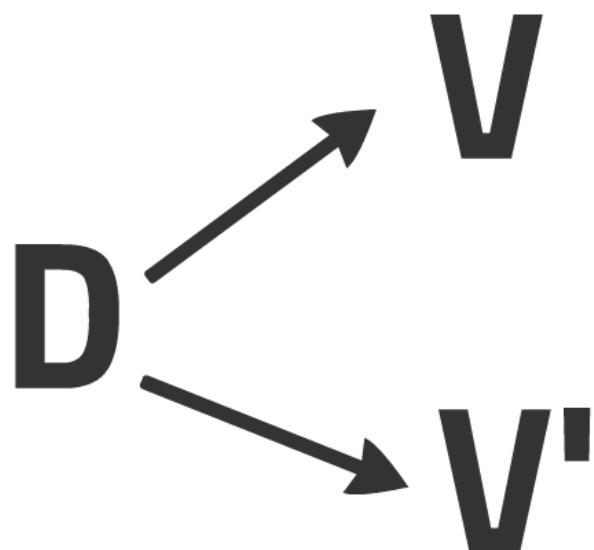
[KS14]



G. Turk and D. Banks. Image-guided streamline placement.
In Proc. ACM SIGGRAPH, pages 453–460, 1996.

Hallucination

The same data
produces different
visualizations



Finding hallucinators

- Sample
- Permute

- Invariance
- Unambiguity
- Correspondence

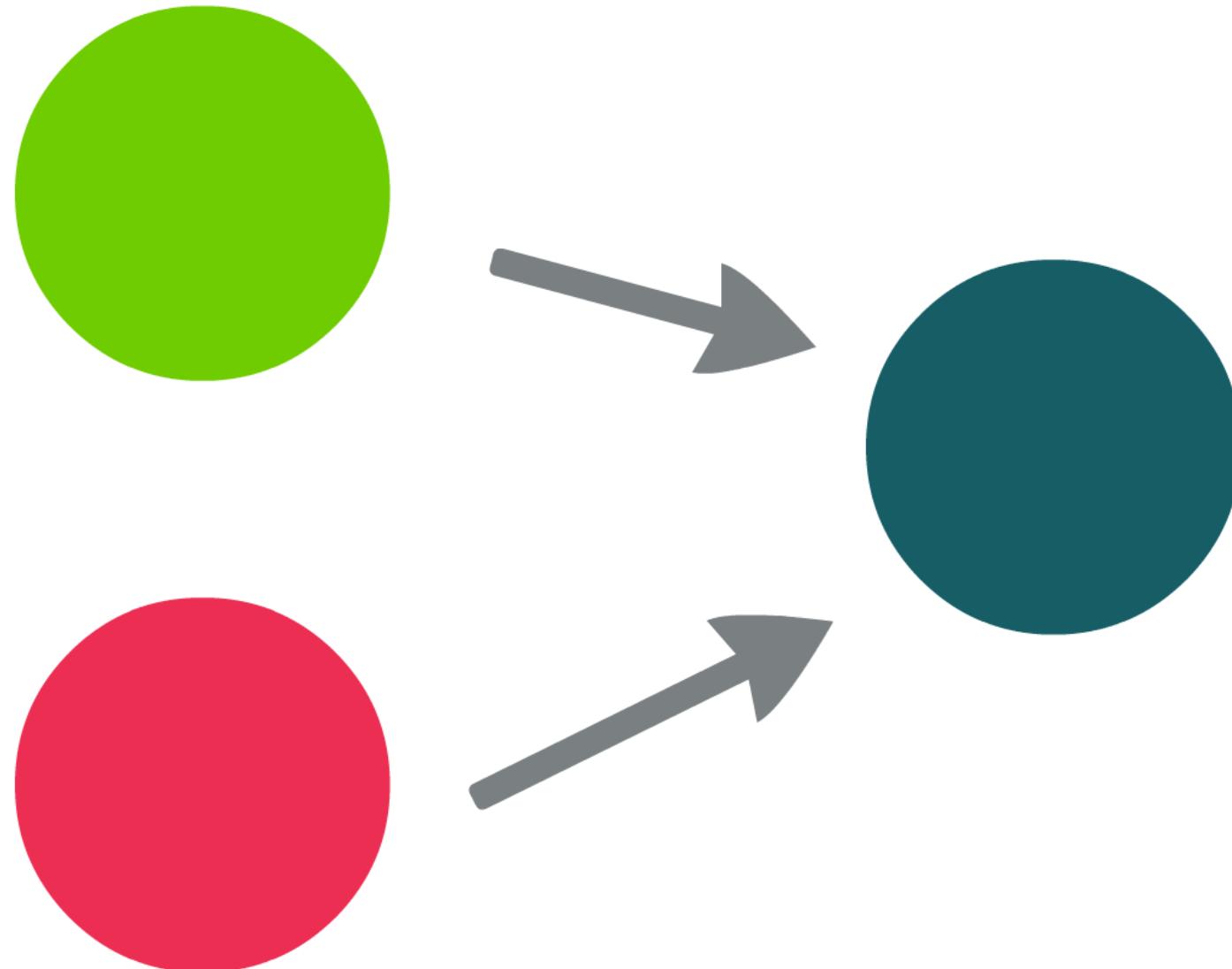
Unambiguity

Different data
always produces
different
visualizations

$$D \rightarrow V$$

$$D' \rightarrow V'$$

Color blindness

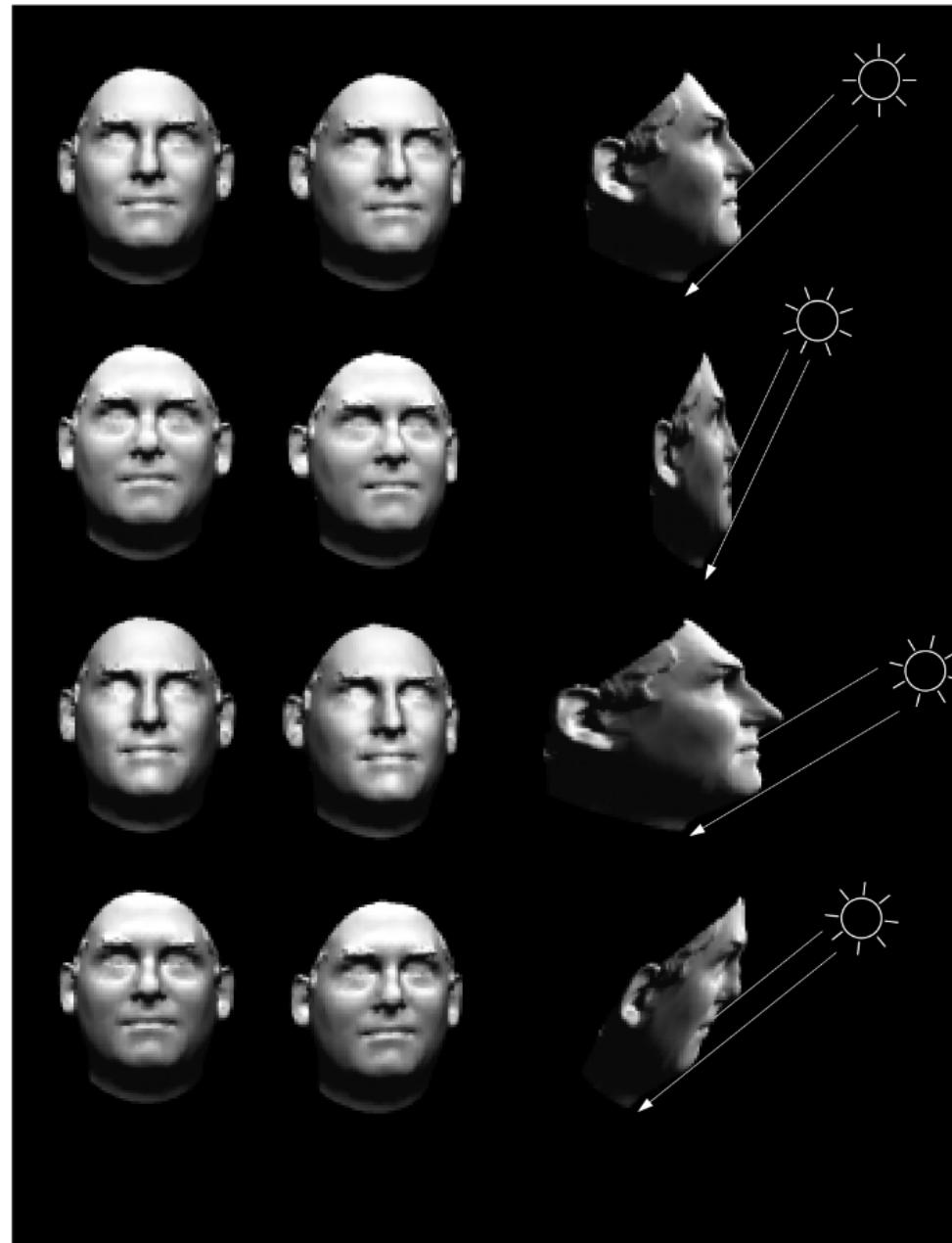


Confusion



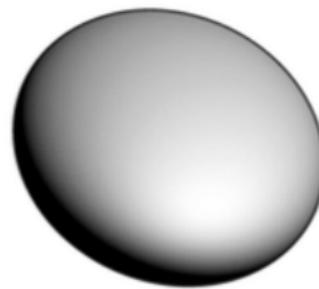
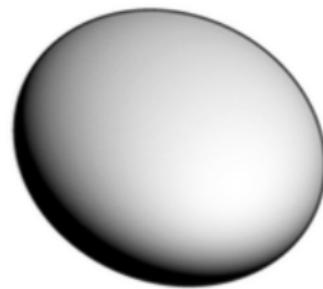
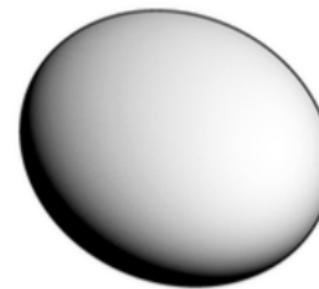
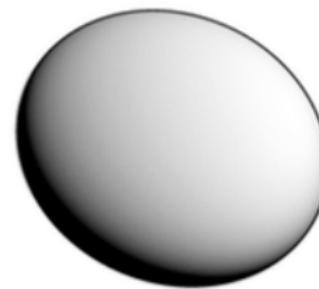
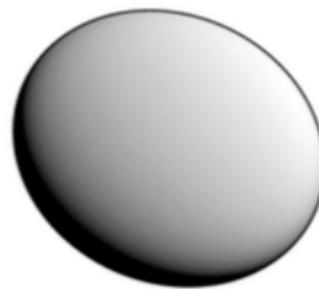
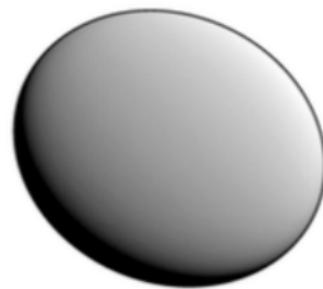
[In15]

Bas-relief ambiguity

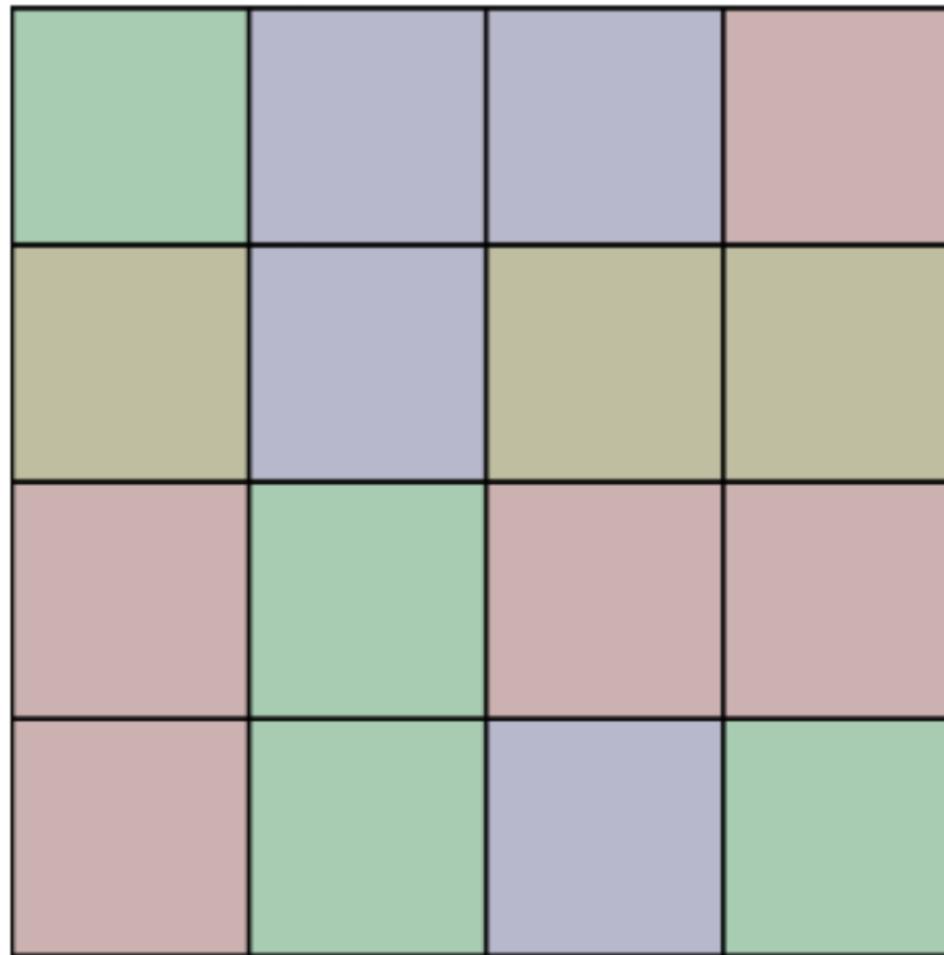


[BKY97]

Very different tensors look similar

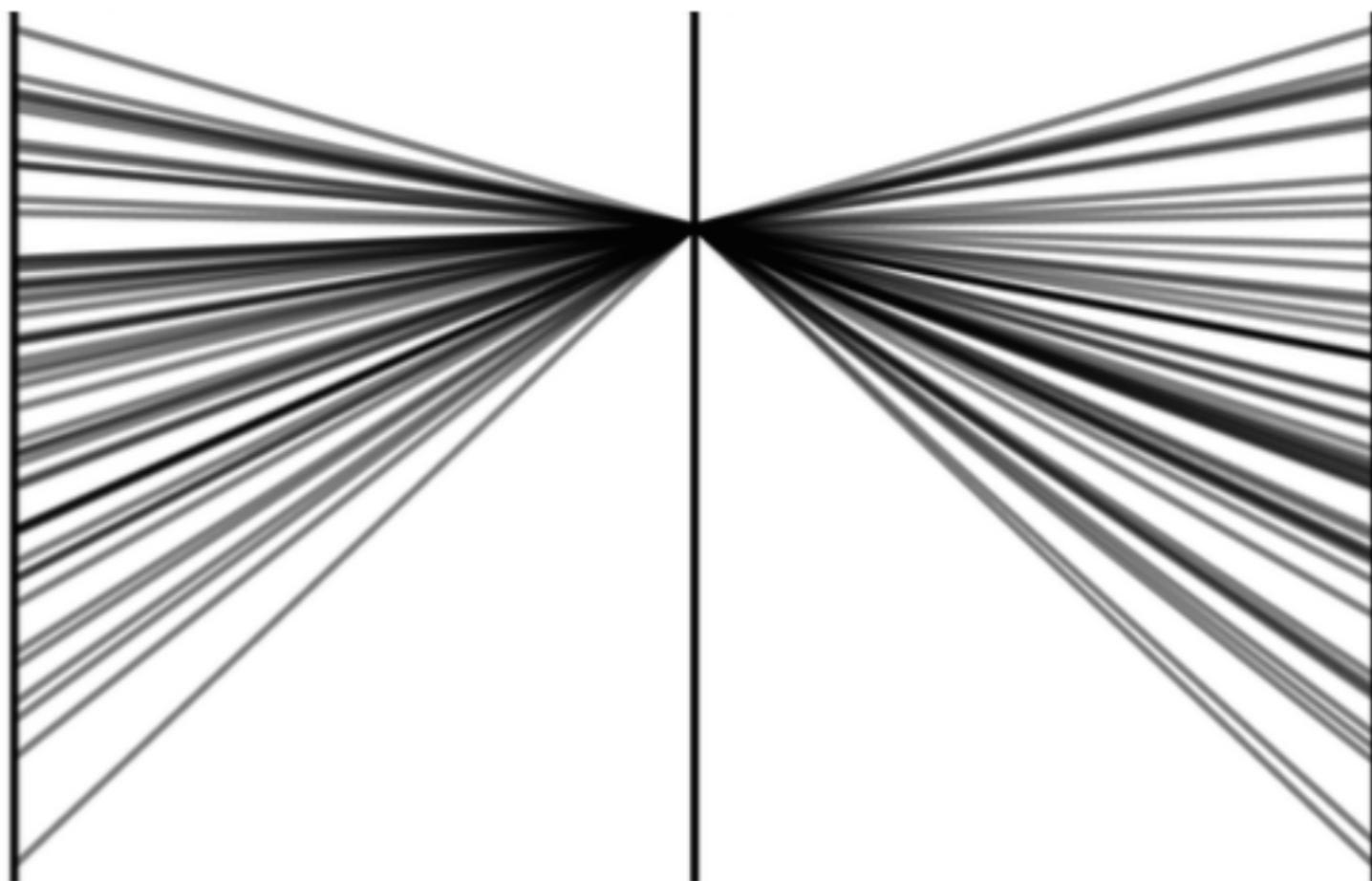


Different trees, same treemap



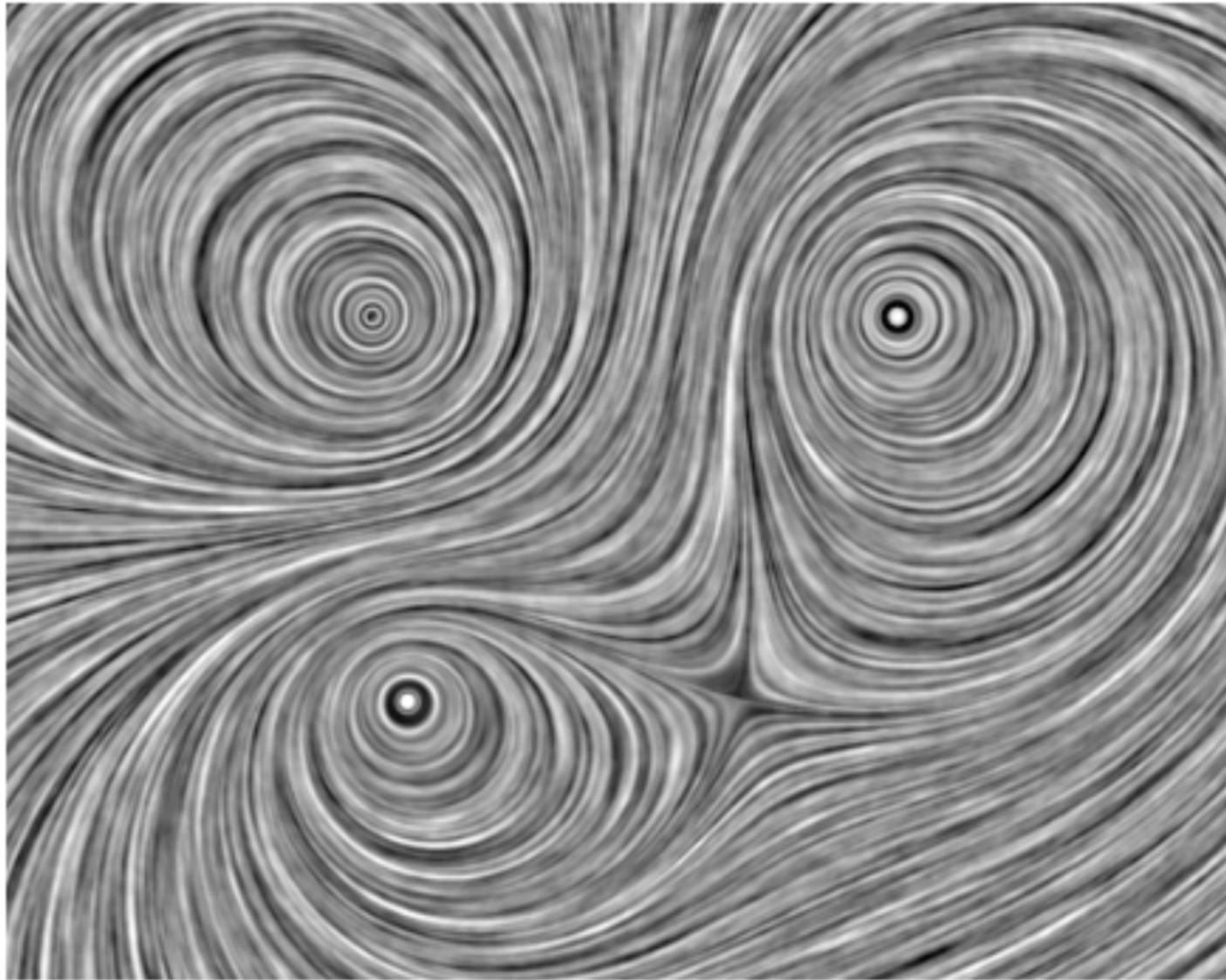
[KS14]

Different data sets, same plot



[KS14]

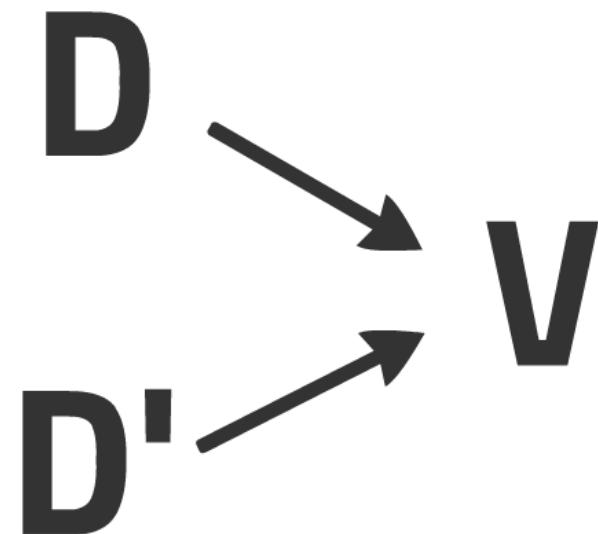
Different velocities, same streamlines



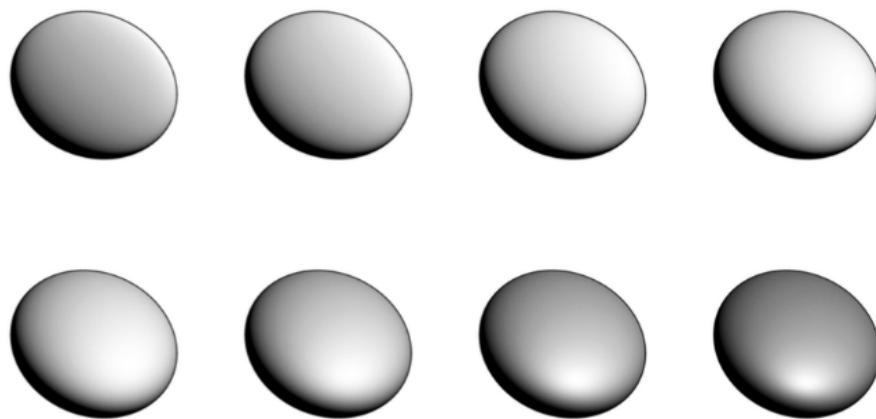
[KS14]

Confusion

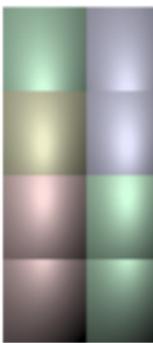
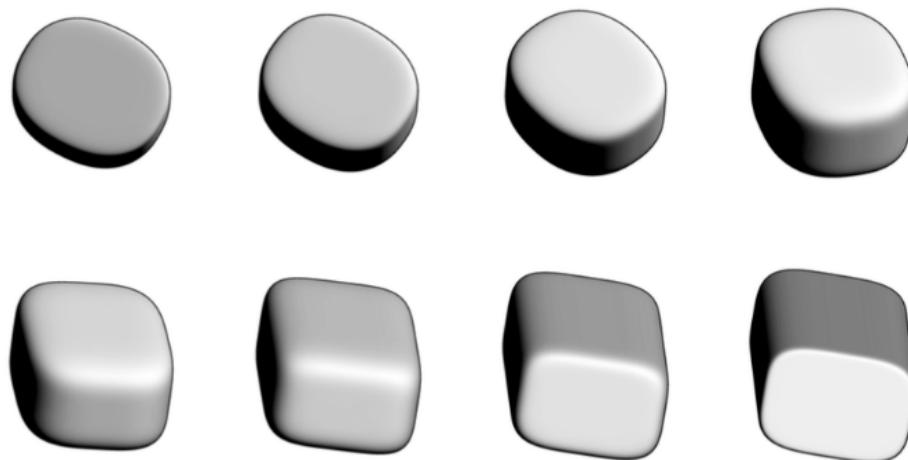
Different data
produces the same
visualization



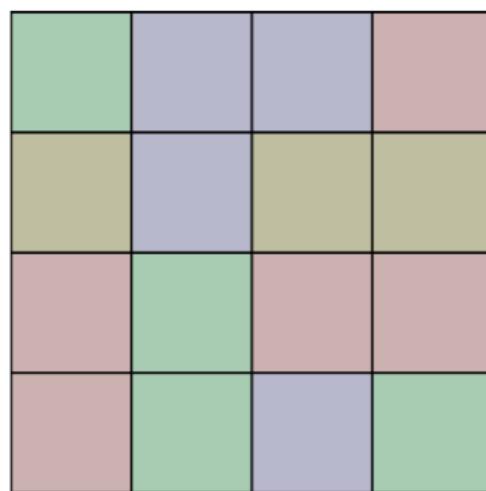
Very different tensors look similar



[KS14]



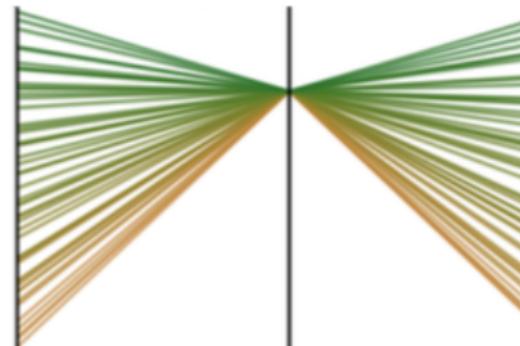
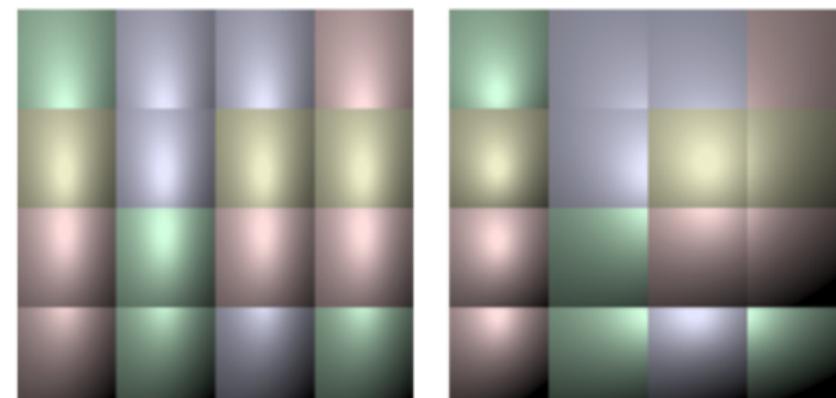
Different trees, same treemap



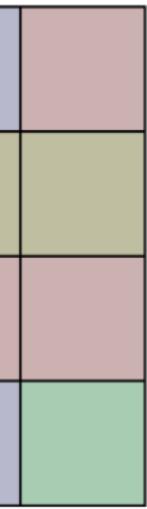
[KS14]

[KS14]

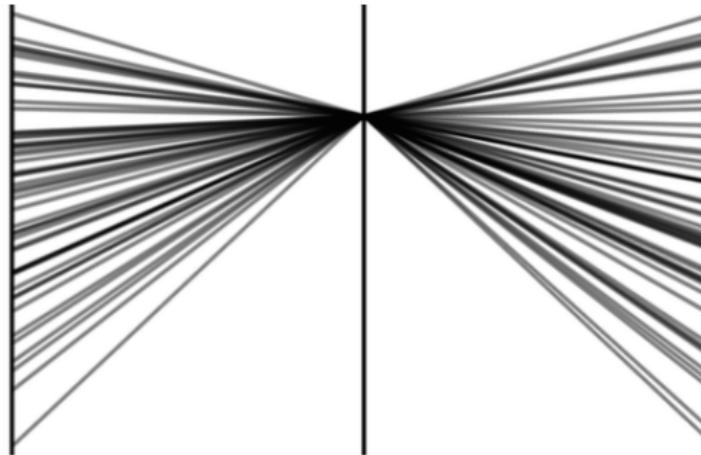
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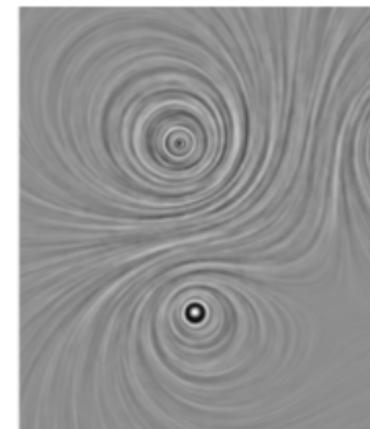
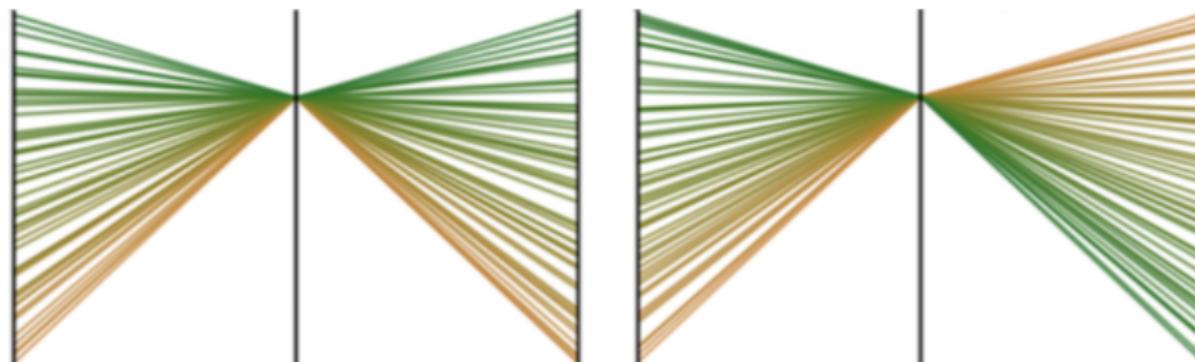
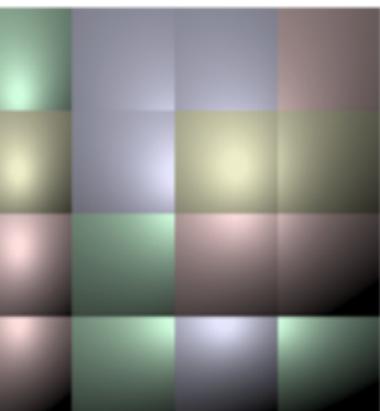
treemap



Different data sets, same plot

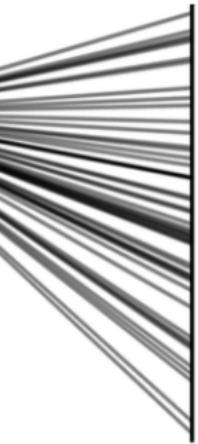


[KS14]

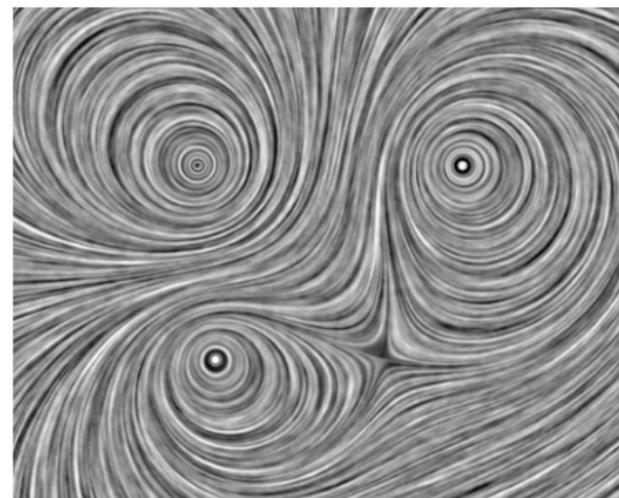


DI

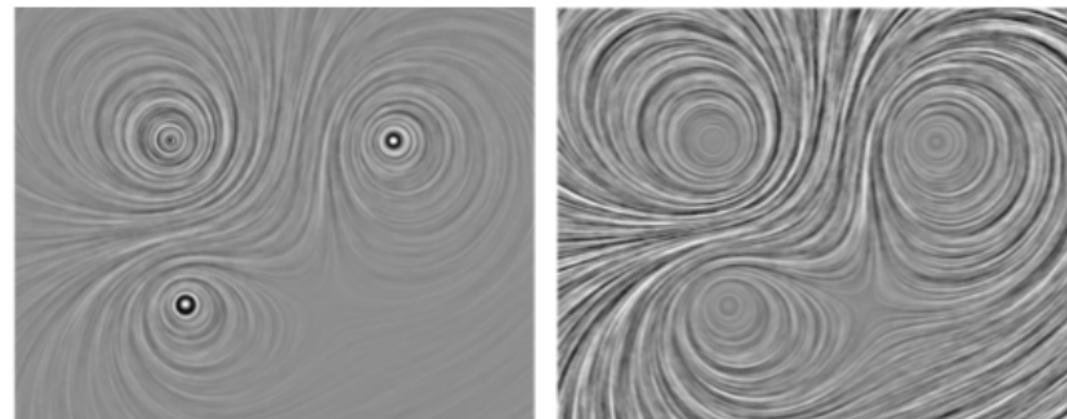
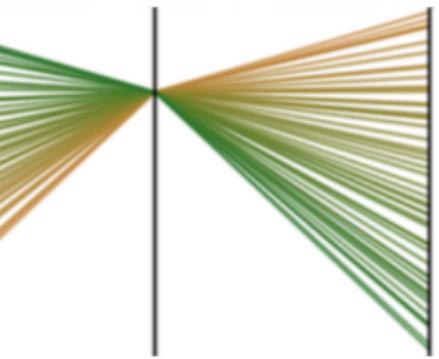
plot



Different velocities, same streamlines

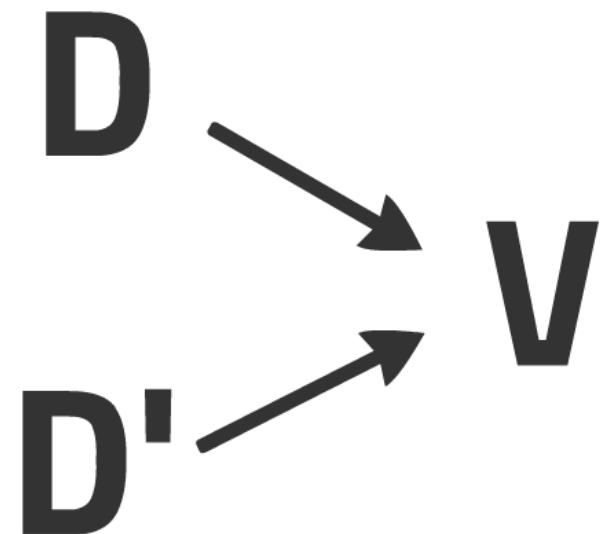


[KS14]



Confusion

Different data
produces the same
visualization



Finding confusion

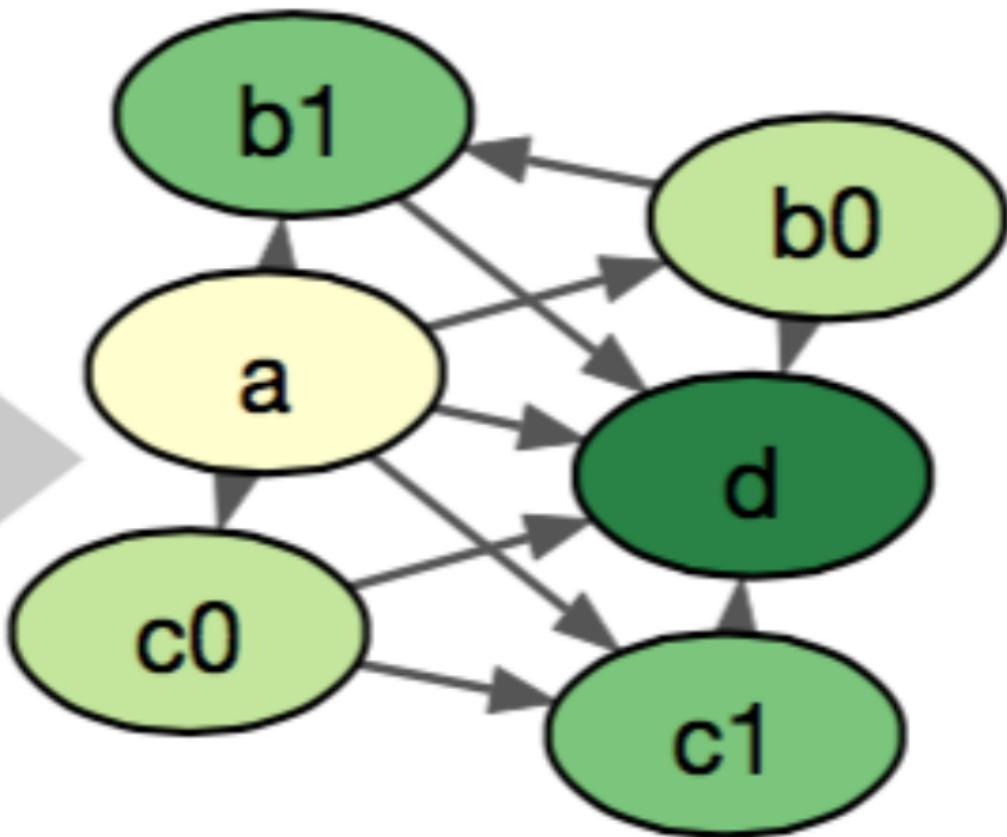
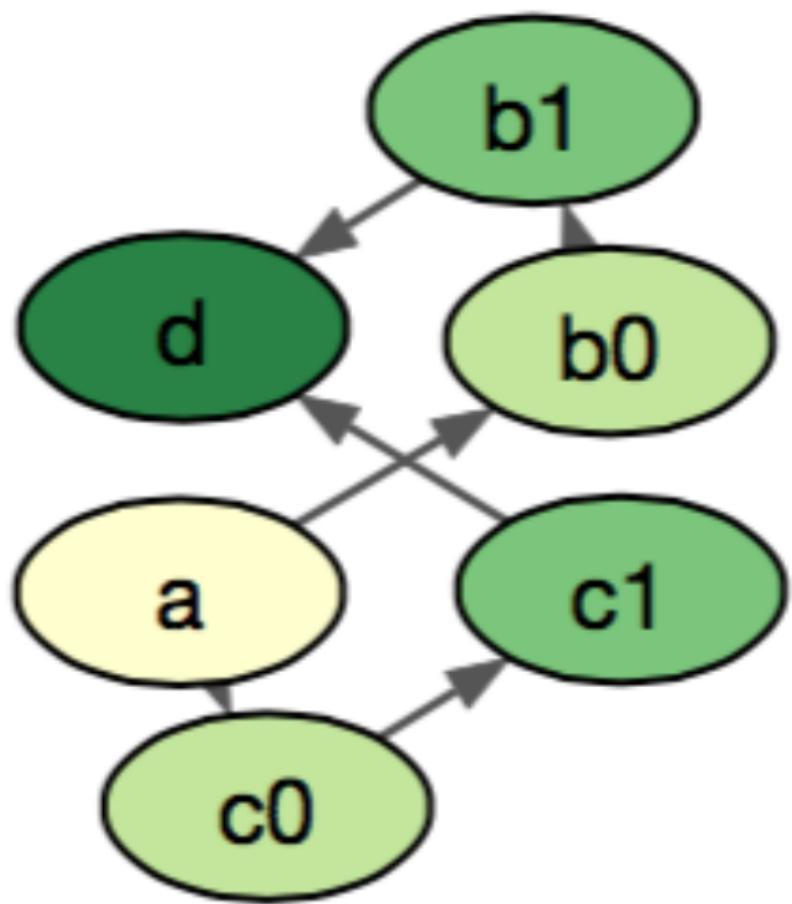
- Loss of dimensionality
- Human or computer

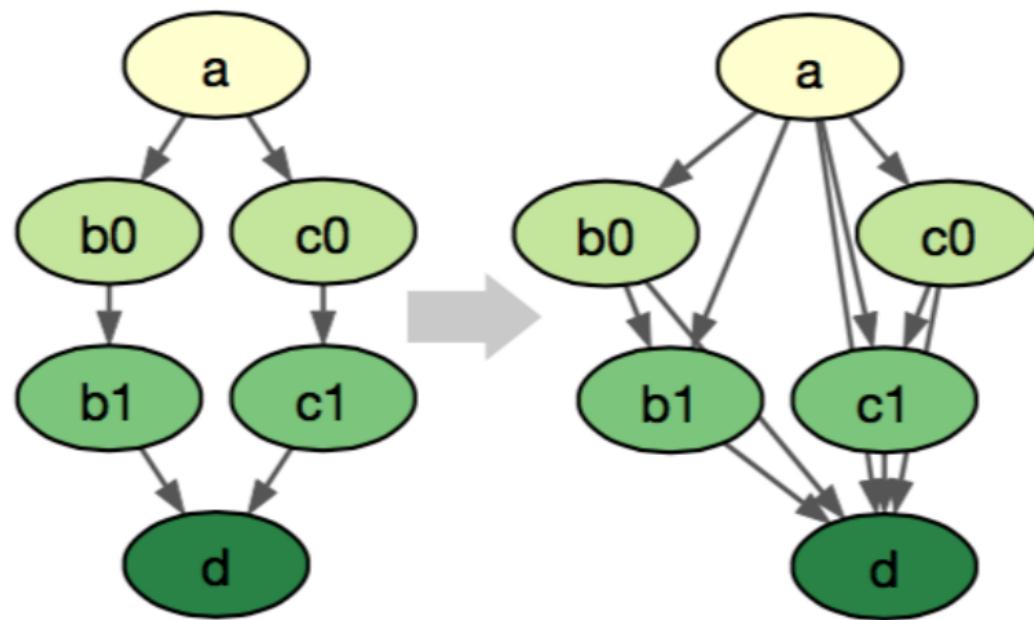
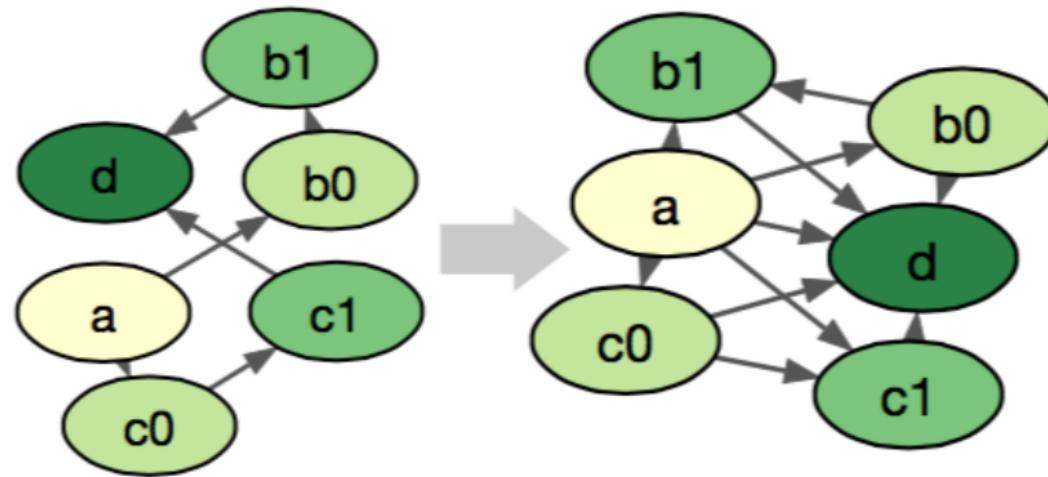
- Invariance
- Unambiguity
- Correspondence

Correspondence

- Invariant and Unambiguous
- Meaningful changes to the data lead to meaningful changes in the visualization (and vice versa)

$$D \cong V$$





[KS14]

Data → Marks

Visualization

Visualization is a composition of mapping from the real world to the visual.
Data → Marks → Representation
Plus user interaction

[Data → Marks]



e

select



D

- cherry picking
- sampling error
- **algorithmic bias**

represent



- loss of dimensionality
- floating point error
- sampling
- tractability bias
- aliasing
- modeling error

display



- resolution
- color gamut
- pie charts
- rainbow color schemes

perceive & understand



- disability
- personal bias
- perceptual limits

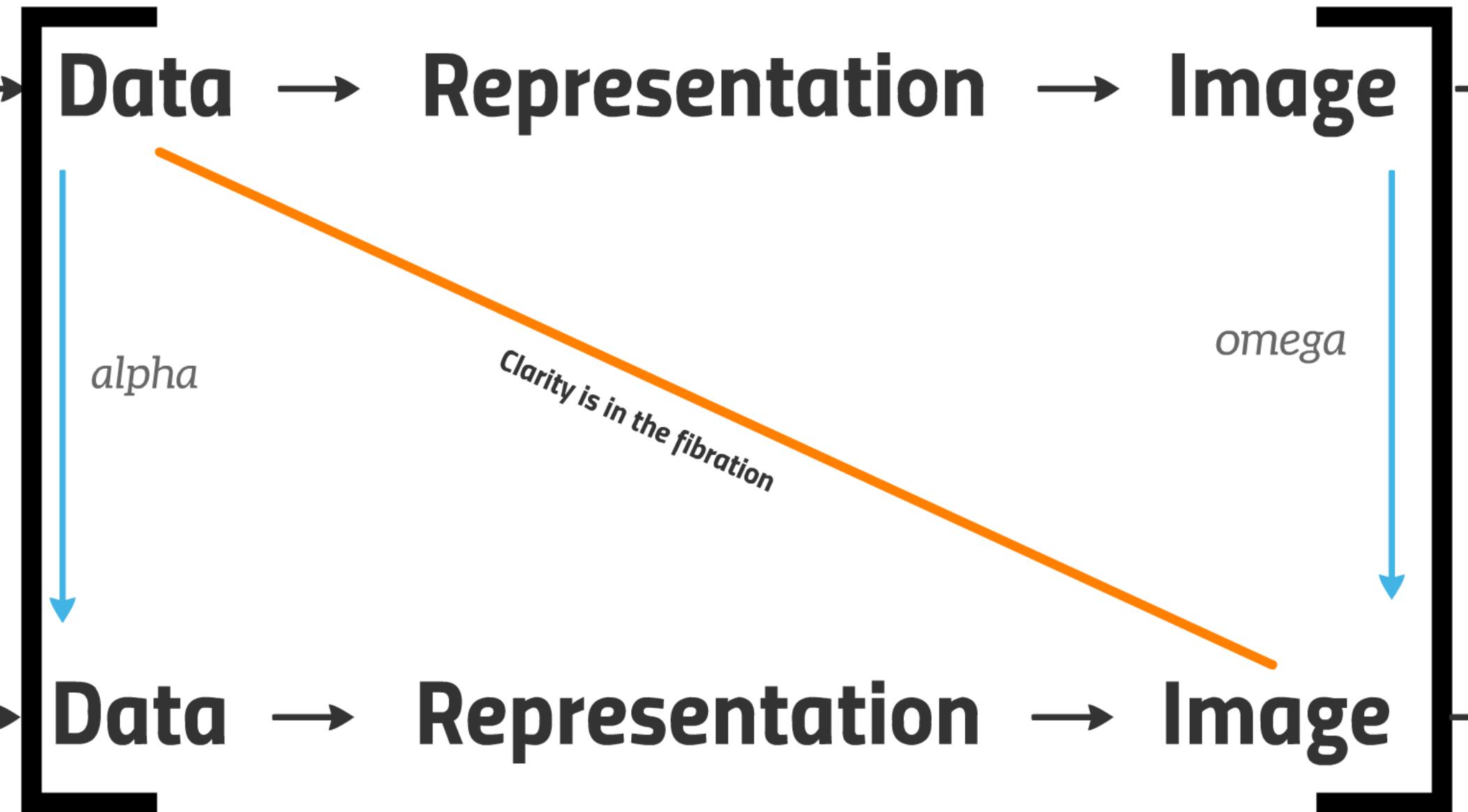
Visualization

Visualizations are created by
interpreting data to make meaningful
information.

[Data → Marks]

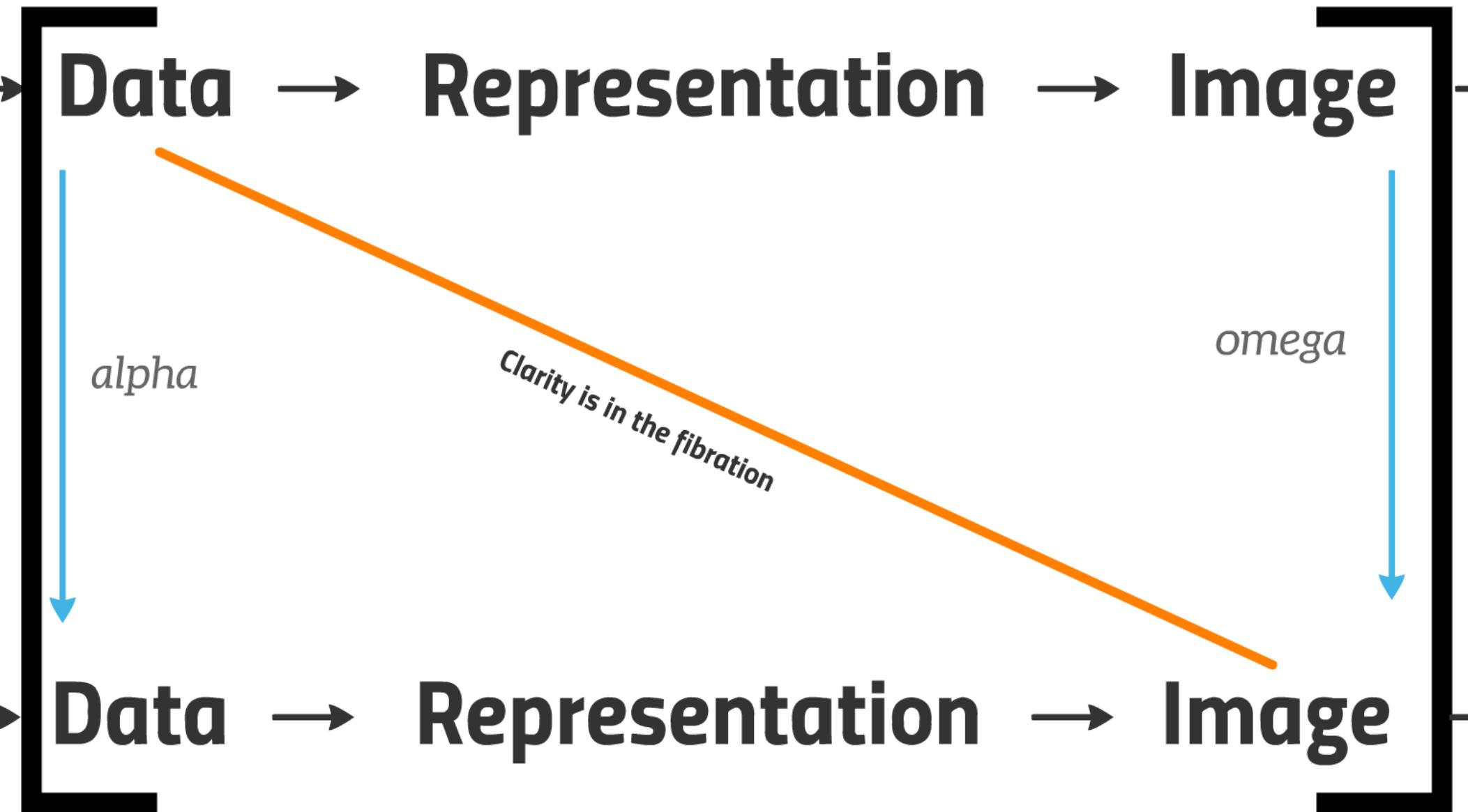


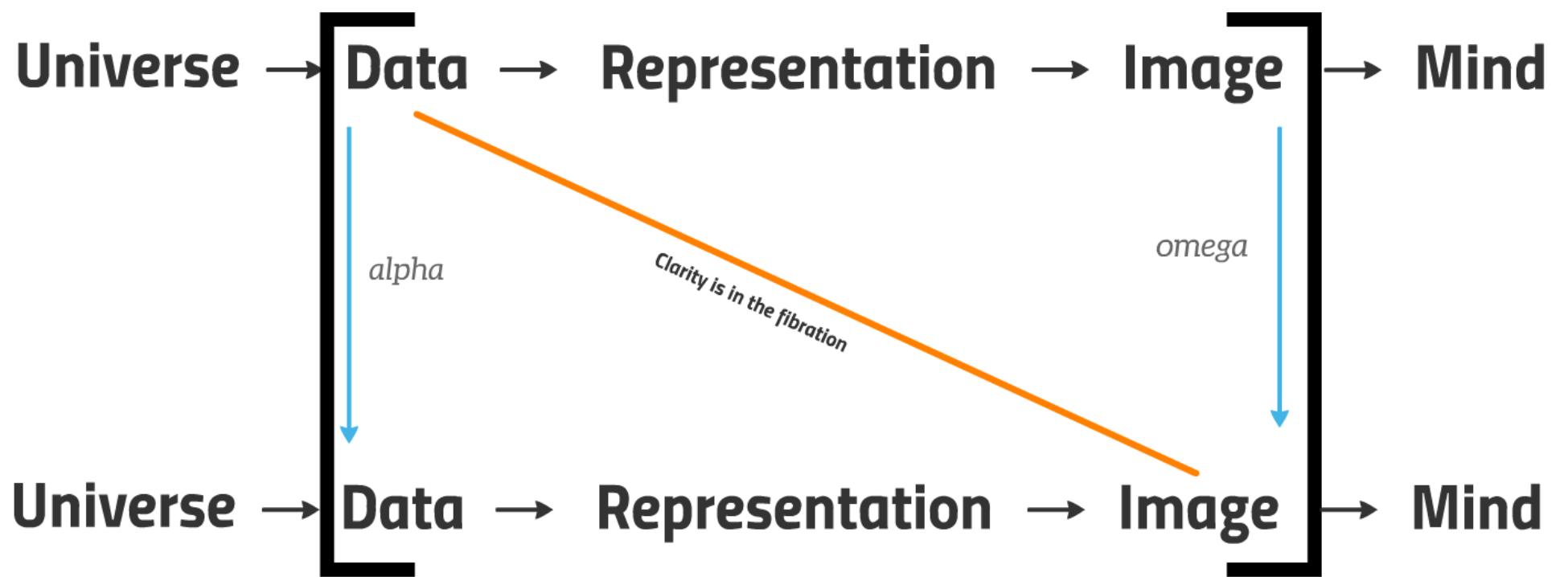
**Visualization is a composition of
mappings from the real world to the mind.
Mappings can be lossy and opinionated.
Fix your mappings.**





Clarity is in the fibration





Visualization

Visualizations are created by
interpreting data to make meaningful
information visible.

[Data → Marks]



e

select



D

- cherry picking
- sampling error
- **algorithmic bias**

uw madison - Google Search × Twitter / Notifications × Rotation in Prezi | Prezi Super User × a scanner darkly - Google Search × Facebook × Aneesh

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Search Facebook

Derek Herrera 1 hr · San Clemente, CA, United States ·

I've been off the grid for the past few months focused on building a business. I am humbled and honored to have completed the YCombinator program as a part of the W16 batch.

I am also proud to be an alumni of an organization that is forward thinking and leads by example, setting a new course for solving grand challenges by including less-traditional tech ventures like Spinal Singularity.

To see behind the curtain read more in this article from the Atlantic!... See More



Inside Silicon Valley's Big Pitch Day

Cutting through the reality show vibes, and "Uber for ____" business models, a writer finds a ray of hope at Y Combinator's vaunted startup showcase.

THEATLANTIC.COM | BY ANNA WIENER

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Levi Herrera Congratulations!

Adam Gengler That was a pretty bleak intro to the article before you brought a ray of hope for the author! Congrats buddy.

Zach Goldstein Too modest, Derek. YC is hands down the most respected incubator in the world.

Zachary Iscol Boom!

Write a comment...

Jason Vasquez shared Scrap Production's video.

GAMES

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TRENDING AMONG FRIENDS

Heather Michelle Young shared Davion Teahart's video. This is the awesome & as always makes it look so easy! K thought I was watching a GIF. #breakingrecords

Jonathan Stambolis Oh dear, time to call in the undertakers get again...

Prophete J. Charles

Charlie Pinto 17m

Matt Jayne

Daniel Toloudis

Mark Daniel

Calen Ipaloak 1m

Håkon Erichsen 5h

Monica Anna Zaucha

Mark Goadrich

Aaron Kenney

Cameron Drake

Preston Rutherford

Steffanee White Tay...

Laura Hunter

GROUP CONVERSATIONS

Ellie, Matt, Matt, A others

Search

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A Scanner Darkly (2006) - IMDb
www.imdb.com/title/tt0405296/ Internet Movie Database
★★★★★ Rating: 7.1/10 - 87,481 votes

An undercover cop in a not-too-distant future becomes involved with a dangerous new drug and begins to lose his own identity as a result. ... Keanu Reeves, Winona Ryder, Robert Downey Jr. ... Favorite film based on a Philip K. Dick story?

A Scanner Darkly (film) - Wikipedia, the free encyclopedia
[https://en.wikipedia.org/wiki/A_Scanner_Darkly_\(film\)](https://en.wikipedia.org/wiki/A_Scanner_Darkly_(film)) Wikipedia

A Scanner Darkly is a 2006 American adult animated science fiction thriller film directed by Richard Linklater based on the novel of the same name by Philip K. Plot - Cast - Production - Reception

A Scanner Darkly - Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/A_Scanner_Darkly Wikipedia

A Scanner Darkly is a BSFA Award-winning 1977 science fiction novel by American writer Philip K. Dick. The semi-autobiographical story is set in a dystopian ...

Author: Philip K. Dick Publication date: 1977
Pages: 220 pp (1st edition) Publisher: Doubleday

A Scanner Darkly (2006) Official Trailer - Keanu Reeves ...
<https://www.youtube.com/watch?v=hkjDUERgCQw>
May 27, 2014 - Uploaded by Movieclips Trailer Vault
A Scanner Darkly (2006) Official Trailer - Keanu Reeves, Robert Downey Jr. Movie HD. Movieclips Trailer ...

Amazon.com: A Scanner Darkly (Widescreen): Keanu ...
www.amazon.com/.../Science%20Fiction%20Animation Amazon.com, Inc.

Amazon.com: A Scanner Darkly (Widescreen): Keanu Reeves, Robert Downey Jr., Woody Harrelson, Winona Ryder, Rory Cochrane, Dameon Clarke, Richard ...

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More images

A Scanner Darkly

2006 · Mystery/Science fiction film · 1h 40m

[Play trailer on YouTube](#)

7.1/10 IMDb 69% Rotten Tomatoes 73% Metacritic

In the near future, as America virtually loses the war on drugs, Robert Arctor (Keanu Reeves), a narcotics cop in Orange County, Calif., is undercover so deep that he has become an addict. He is wooing Donna (Winona Ryder), a dealer, to ferret out her supplier. At the same time, he receives orders t... [More](#)

Release date: July 7, 2006 (USA)
Director: Richard Linklater
Box office: 7.7 million USD
Initial DVD release: December 5, 2006 (Hungary)
Budget: 6 million USD

Available on

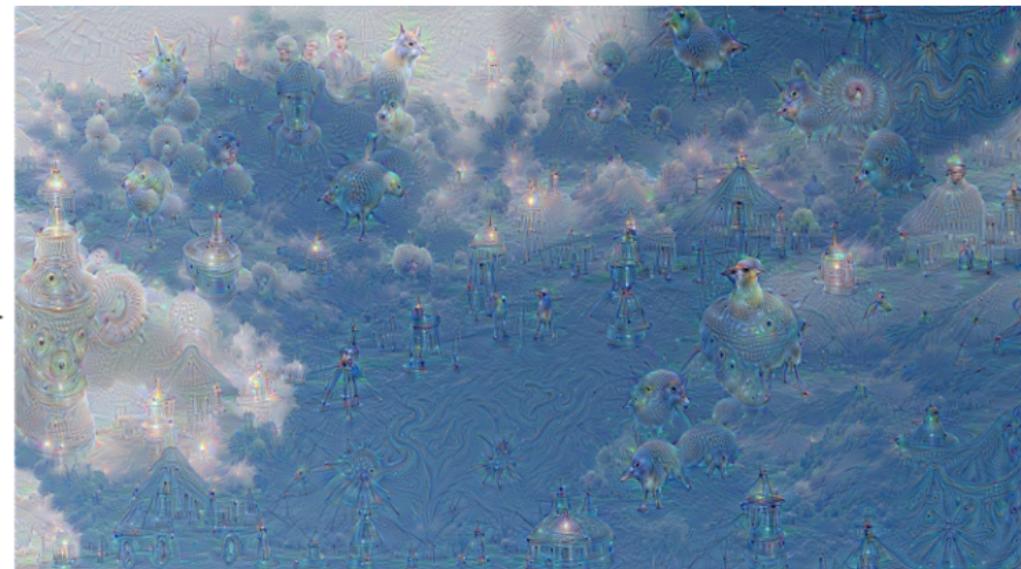
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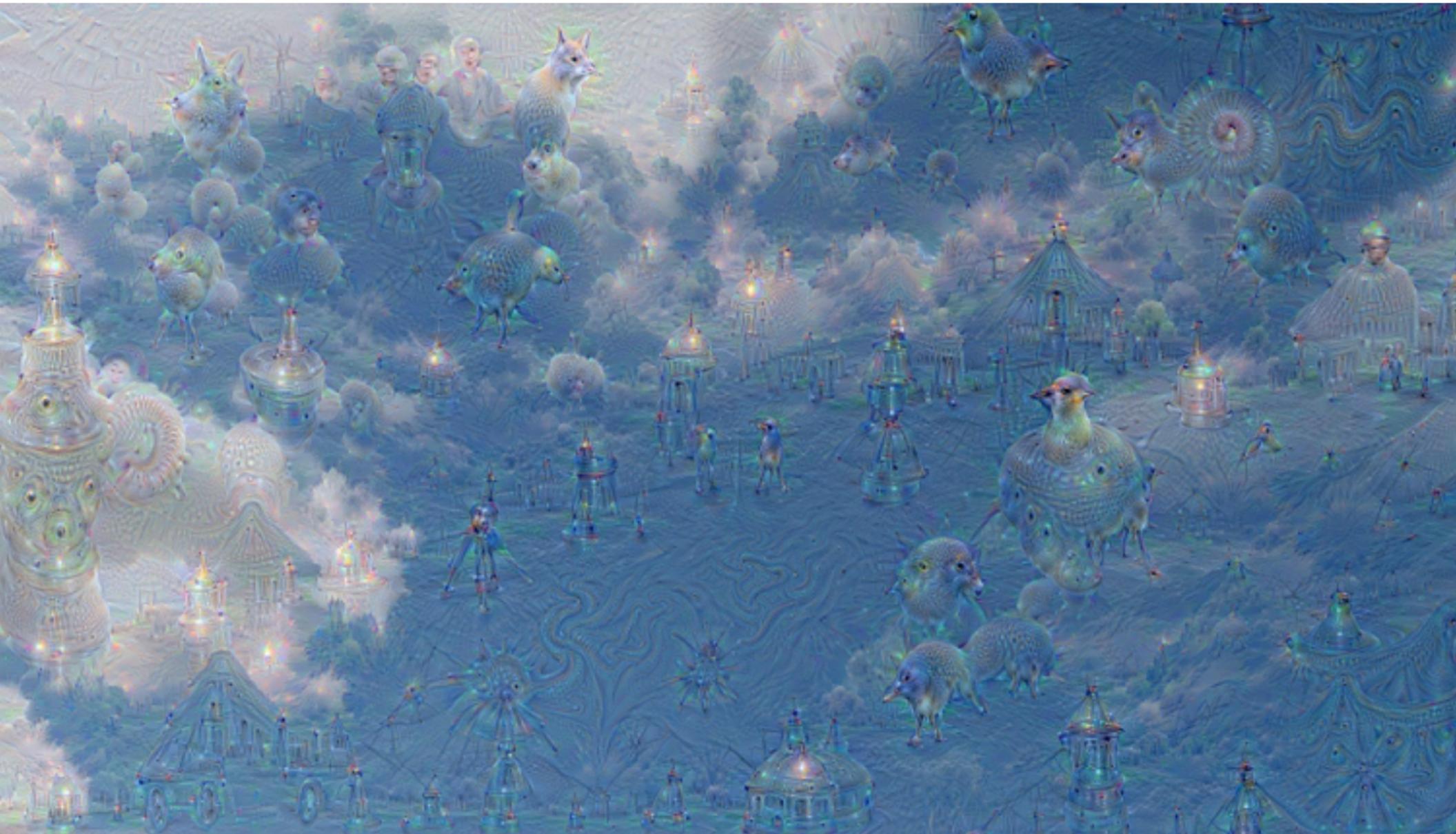
"If all you have is a hammer, you will tend to regard everything as a nail."

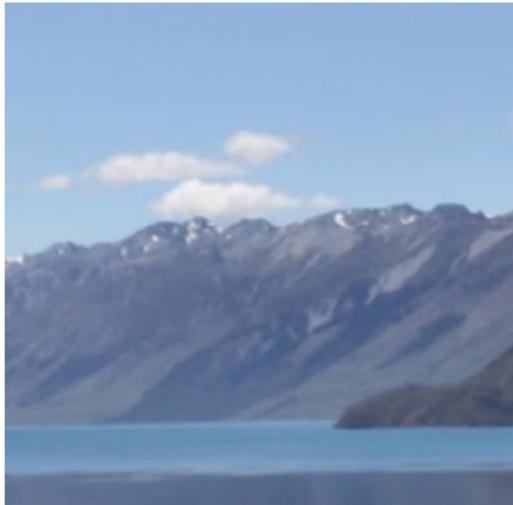
-Maslow



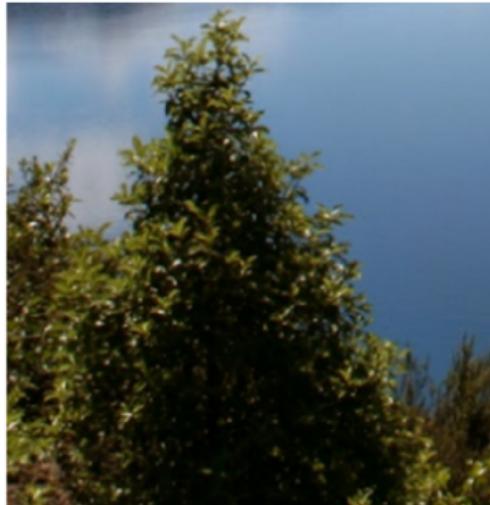
"If all you have is a hammer, you will tend to regard everything as a nail."
-Maslow

[In15]





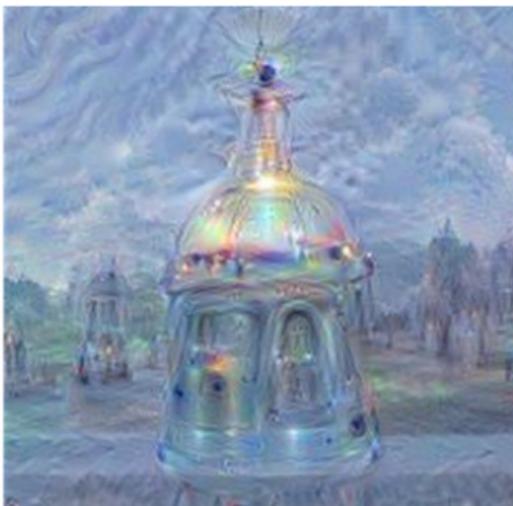
Horizon



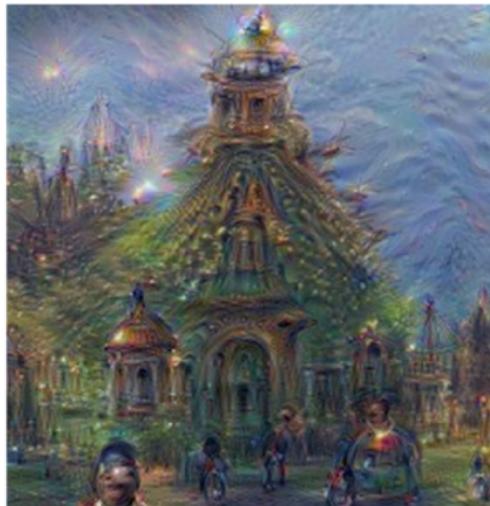
Trees



Leaves



Towers & Pagodas

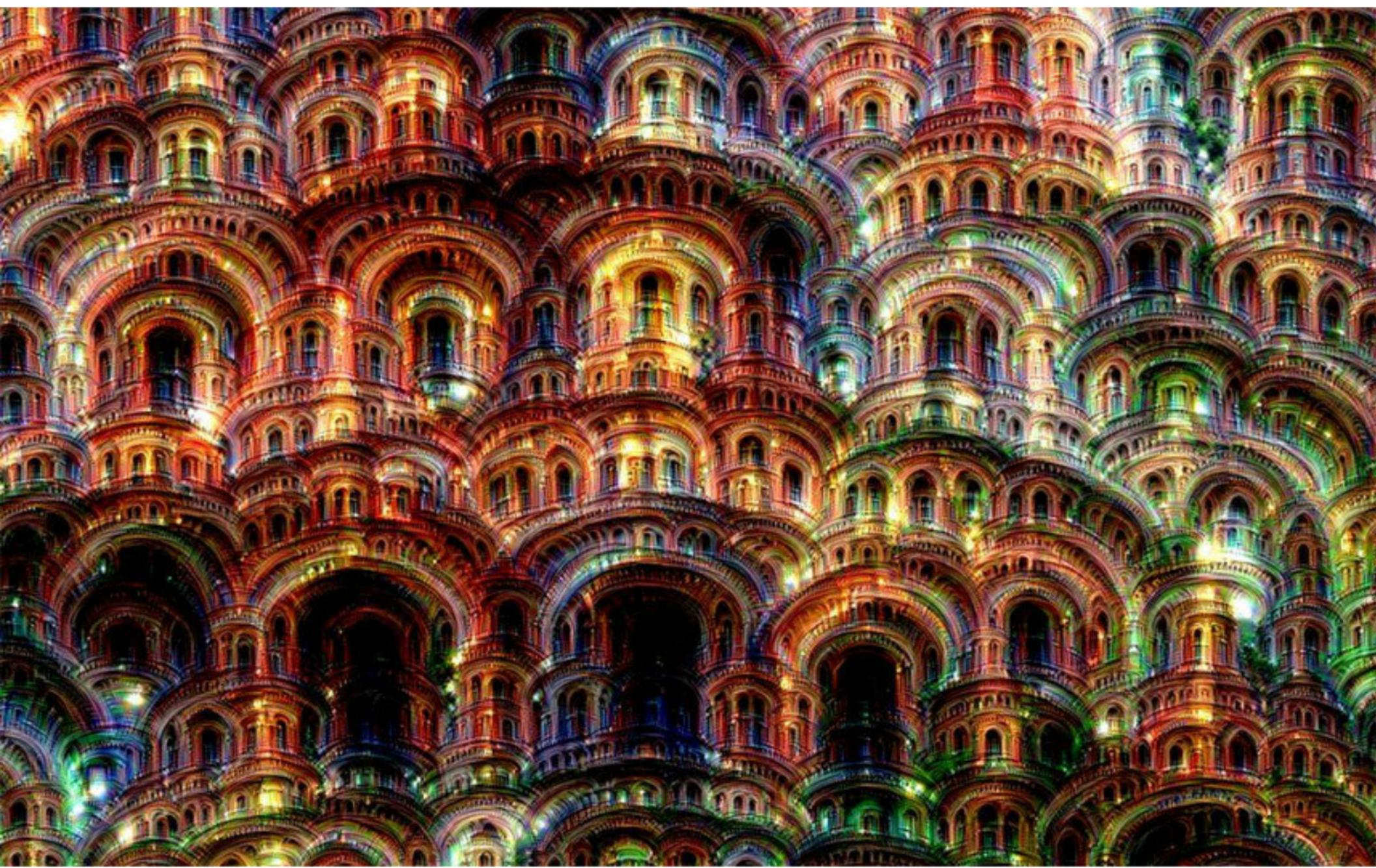


Buildings



Birds & Insects

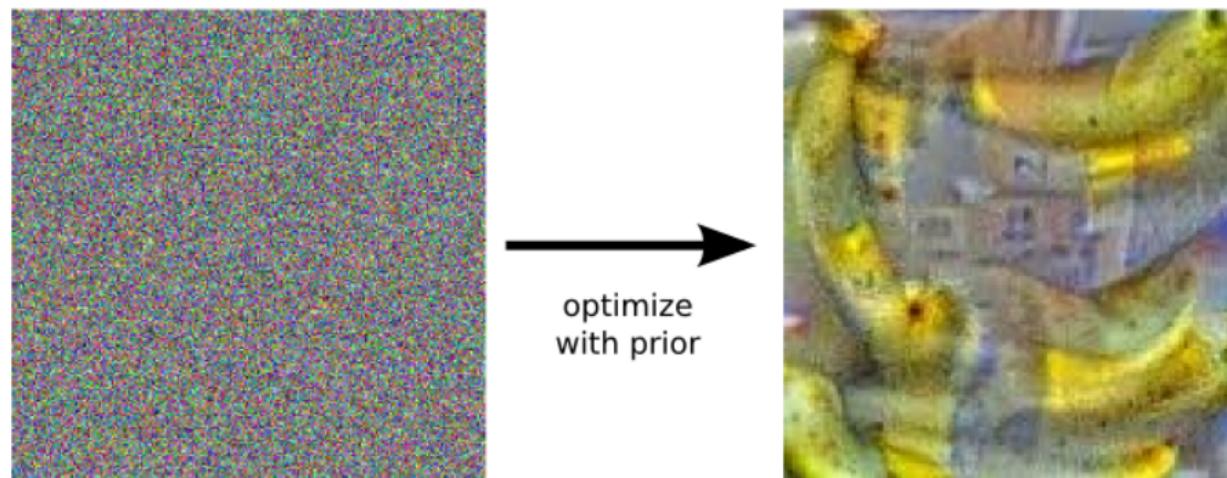
[In15]



[In15]

Inceptionism for transparency

- Assess difference between algorithm's rank and our own
- Know our own biases

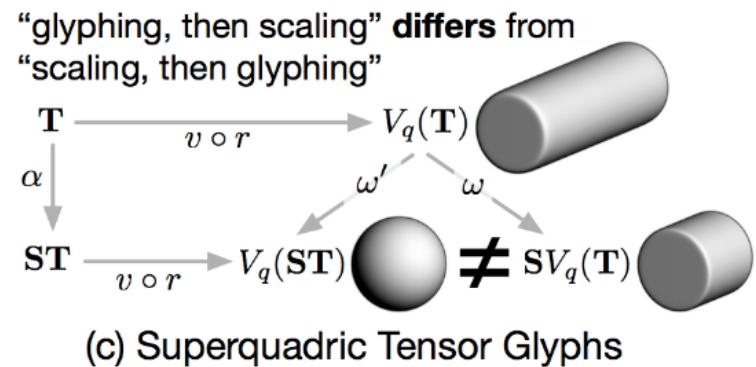
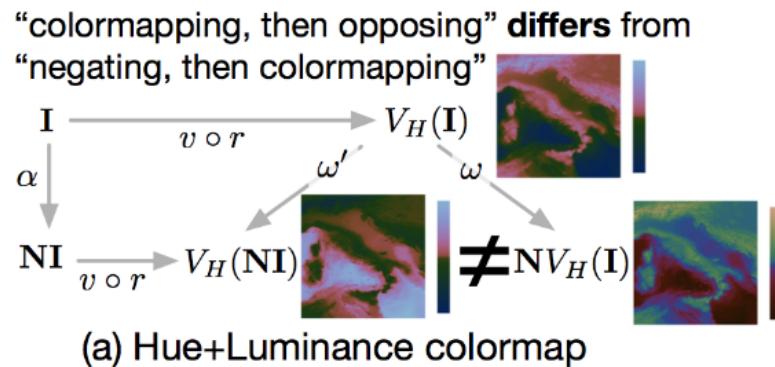


Does the scanner see clearly or darkly?

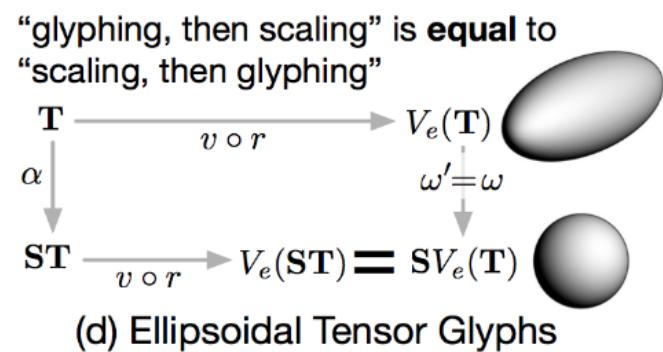
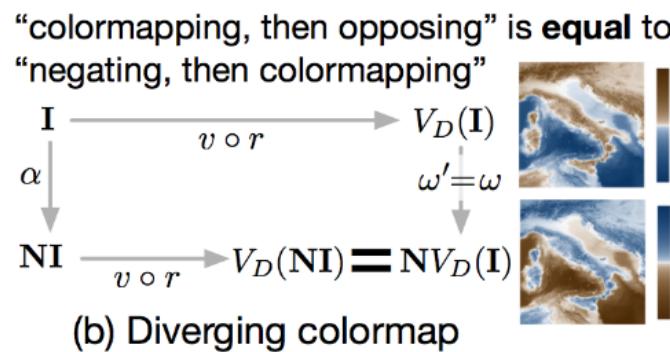


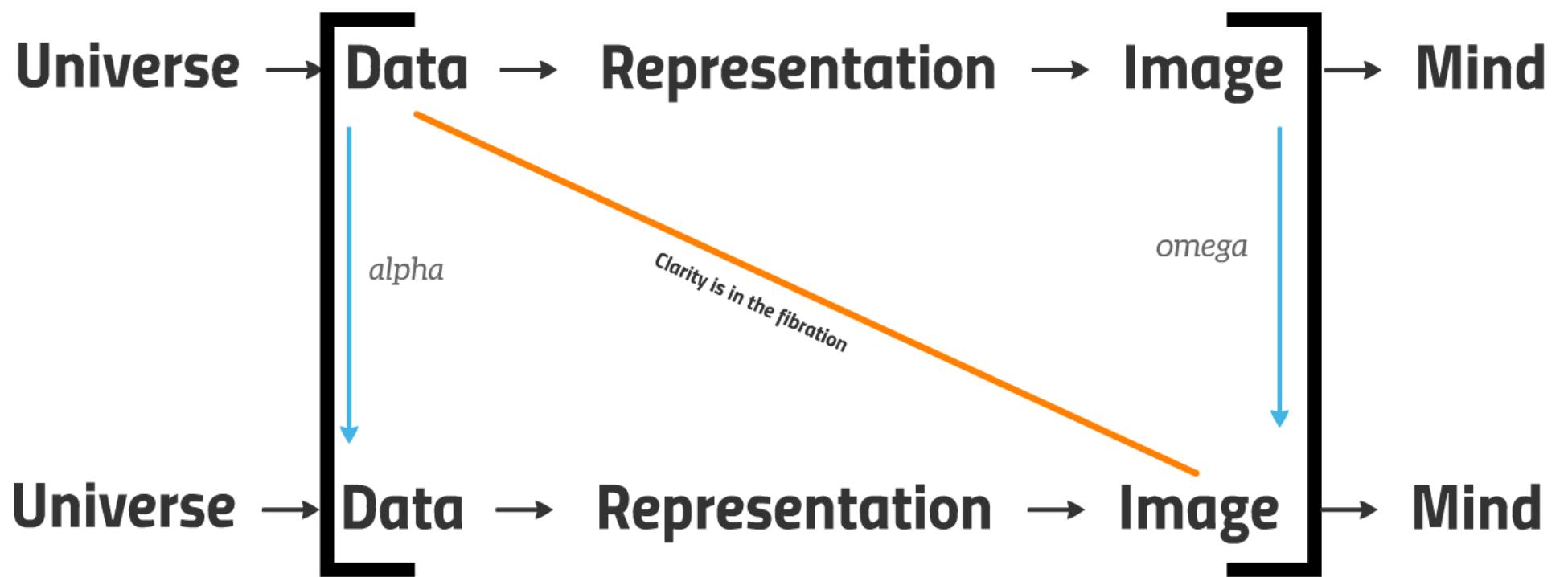
[ln15]

Failures of Visual-Data Correspondence



Visualizations satisfying Correspondence





Thanks

- Kindlmann & Scheidigger
- Steve Haroz
- Kevin Moore
- Richard Stark

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