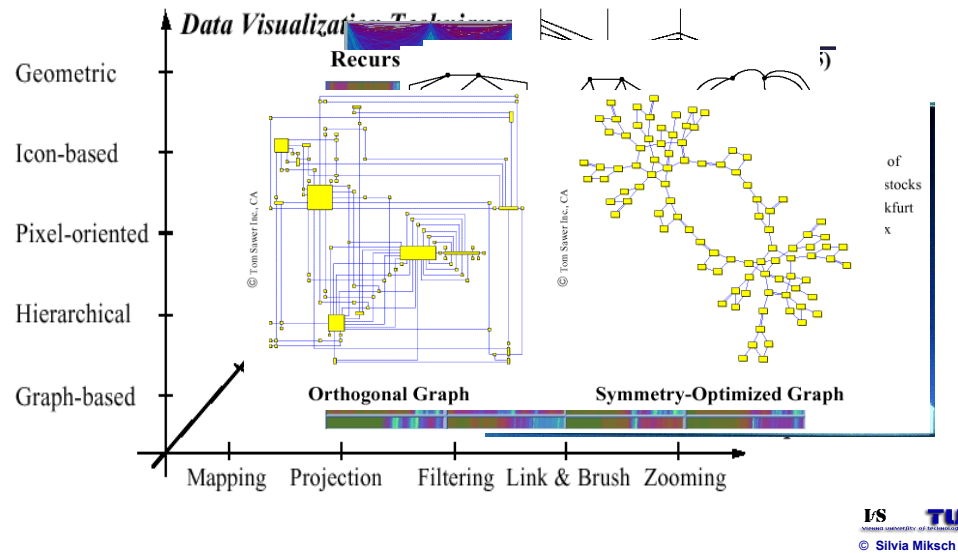## Dimensions of Exploratory Data Visualizations

[Keim, 2001]

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Focus and Context

- Usually
  - Either Detail or Full Picture
  - Lose Context When Zooming
    $\Rightarrow$ Zoom In and Out a Lot

- F+C
  - Integrate Detail and Big Picture
 - Make Better Use of Available Screen Space

Focus and Context Methods

- Spatial Methods
  - Distortion-Oriented Methods
  - Fisheye View   *[Furnas, 1986]*
- Dimensional Methods
  - Different Data about the Same Object
  - Magic Lenses   *[Stone, et al. 1994]*
- Visual Methods
  - Visual Cues
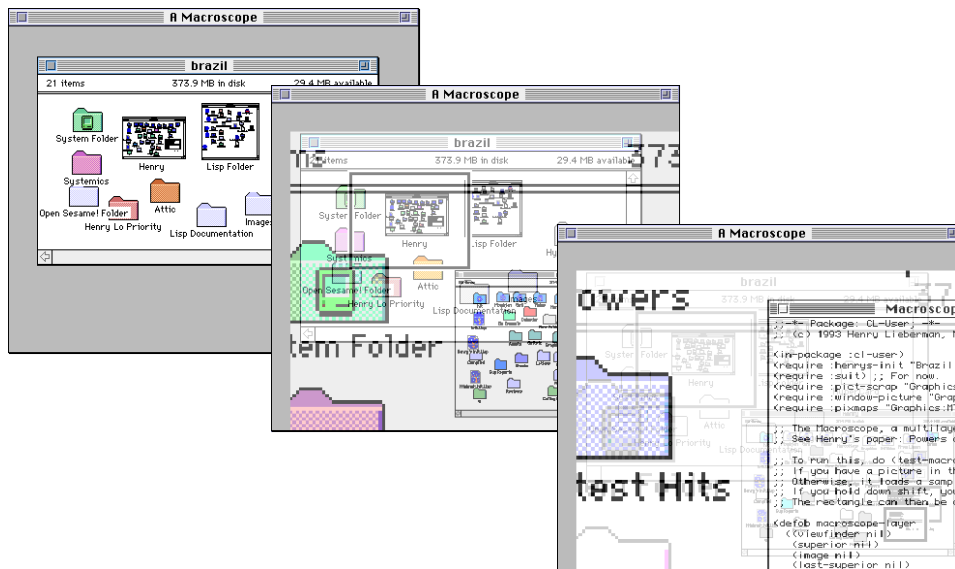 - Color Saturation and Brightness

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Focus + Context

[Lieberman, 1994 and 1997]

- The Macroscope
  - **Displays several zoom levels at same time**
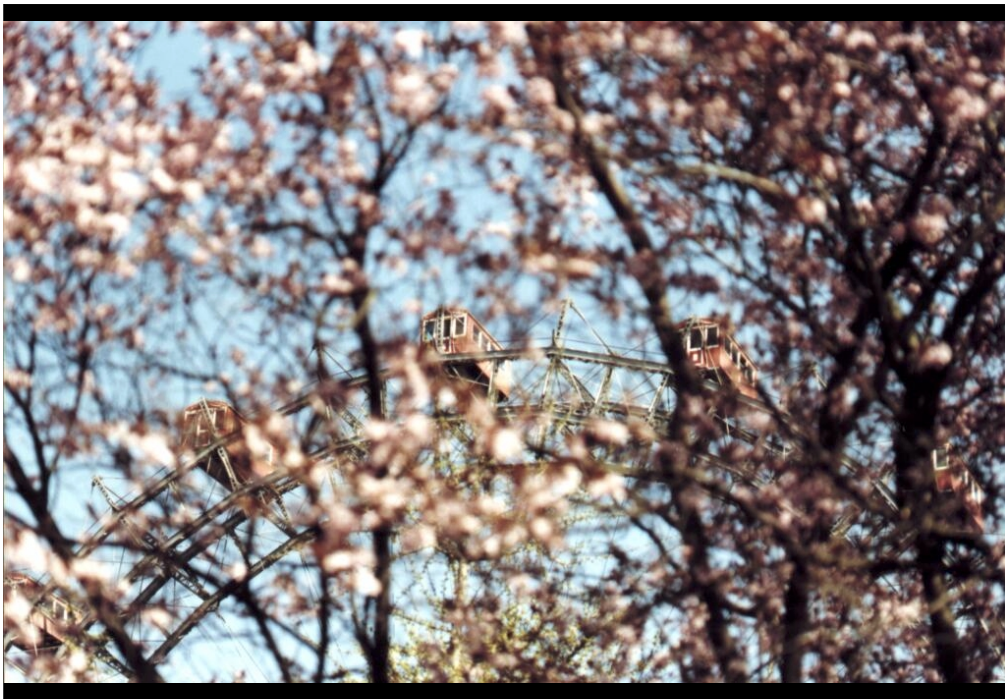 - **Different location projected over each other**

© Silvia Miksch
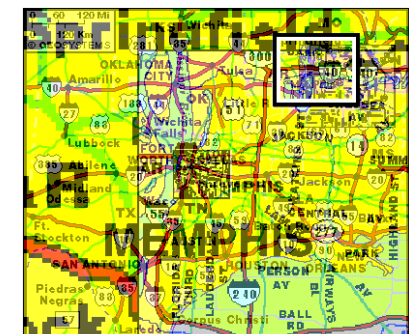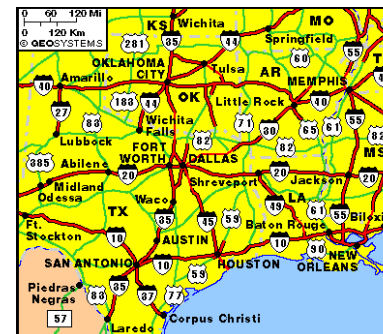
The Macroscope

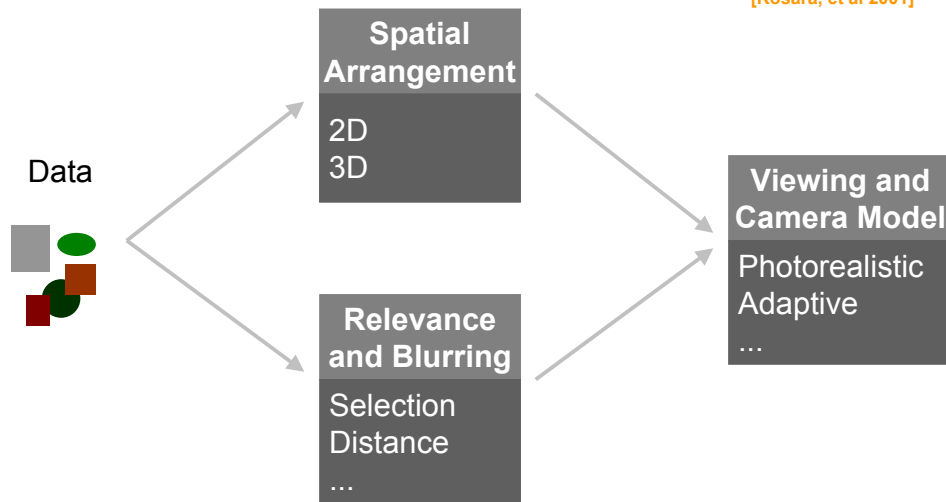## Semantic Depth of Field (SDOF)

- SDOF is based on DOF (Photography)

- Blur Depends on *Relevance*,
  Rather than on *Physical Layout*

- Well-known Visual Metaphor

- Works in 2D and 3D

- Intuitive (Eye)

- Preattentive

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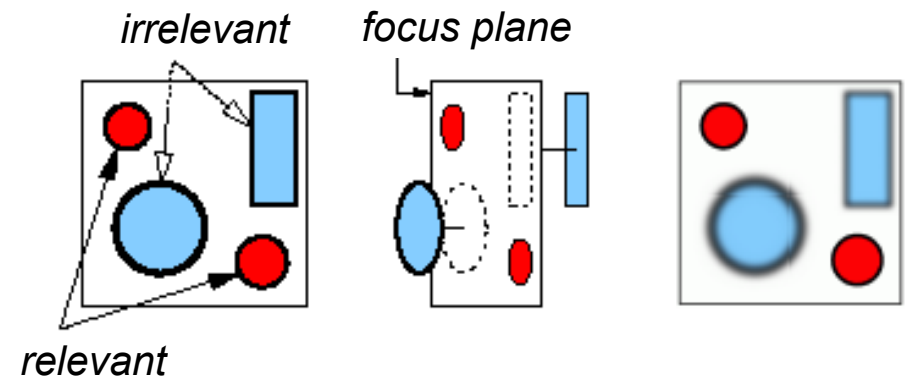
SDOF Principle

[Kosara, et al 2001]

Data

Spatial Arrangement

2D
3D

Relevance and Blurring

Selection
Distance
...

Viewing and Camera Model

Photorealistic
Adaptive
...

$r \in [0; 1] \Rightarrow b \in [1; \infty[$

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Idea: 2D SDOF Scene

[Kosara, et al 2001]

irrelevant   *focus plane*

relevant

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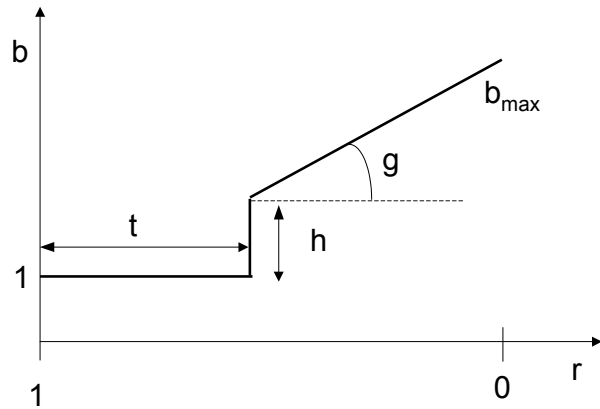
The Blur Function
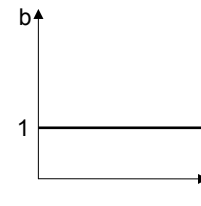
b ... blur diameter
r ... relevance

Examples of Blur Functions

Everything Sharp

Binary Blur
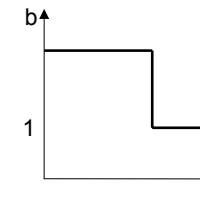
Discrete Blur Level
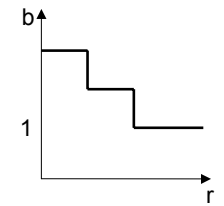
Continuous Blur
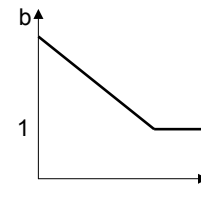
Cont. Blur With Step
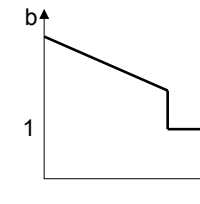
Exponential Blur
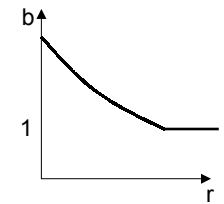
SDOF Application: MapViewer
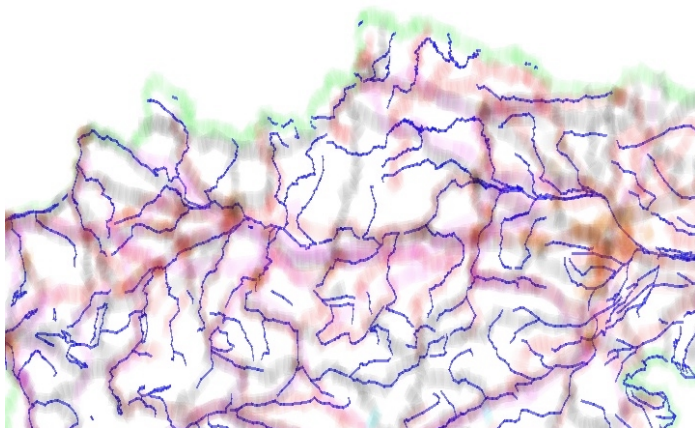
SDOF Application: MapViewer

sMapViewer

Rivers
Railways
Raw Materials
Highways
Cities
Vantage Point
Commercial A.
Natural R.
Cheap RE
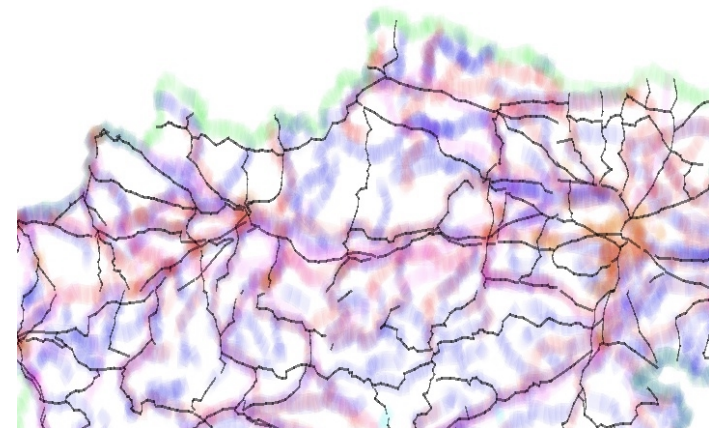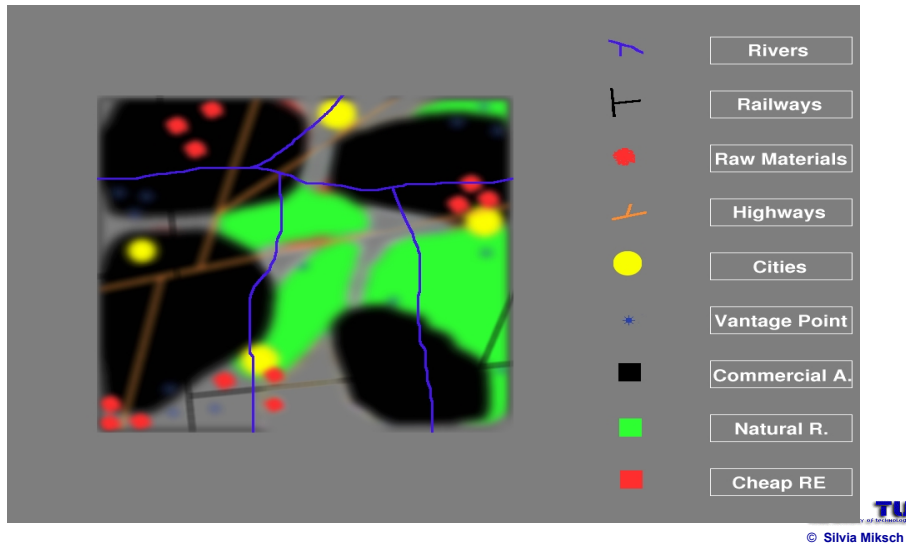
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Focus and Context: Threats?

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Focus, but no Context ...

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Focus and Context: Threats?

© Silvia Miksch

Focus and Context: Covers?
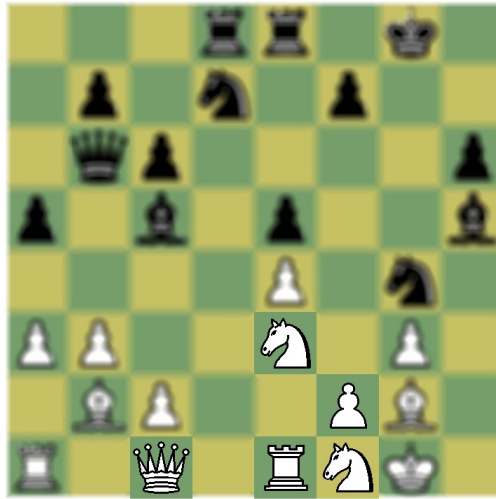
3D SDOF: Chess Board
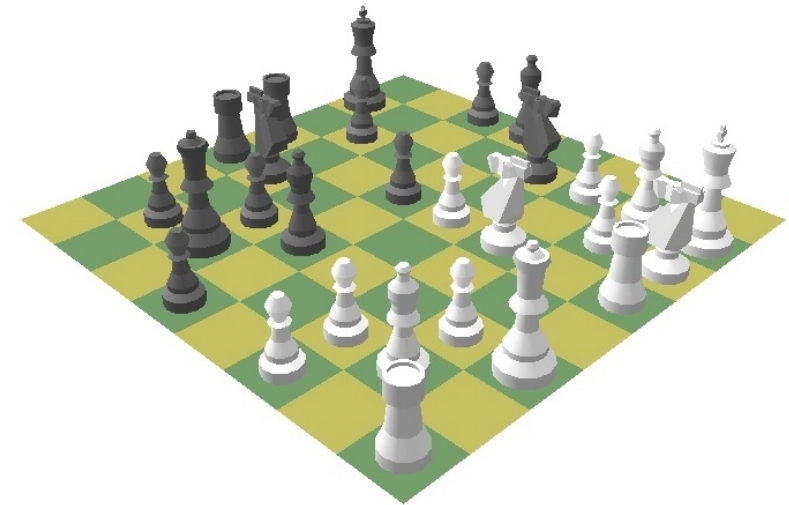
3D SDOF: Threatening Pieces
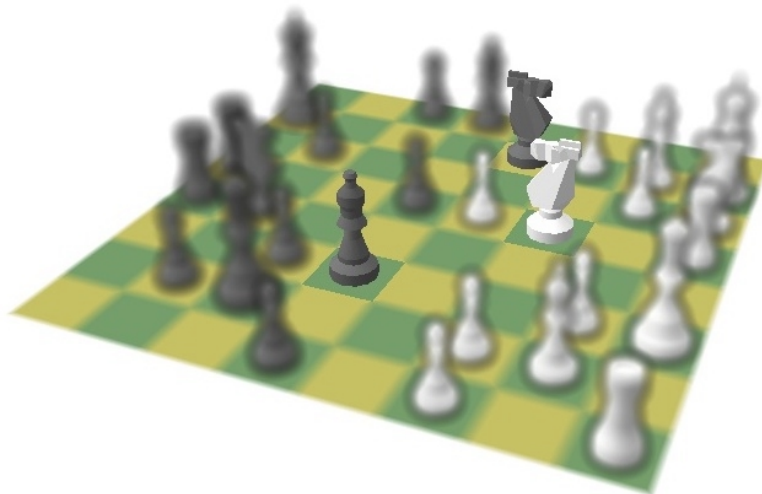
3D SDOF: Covering Pieces

lesdof: Keyword in its Context
[Kosara, et al 2001]

sfvs: Files in Focus
[Kosara, et al 2001]

sscatter: sdof Scatter Plots
[Kosara, et al 2001]

sscatter: sdof Scatter Plots
[Kosara, et al 2001]

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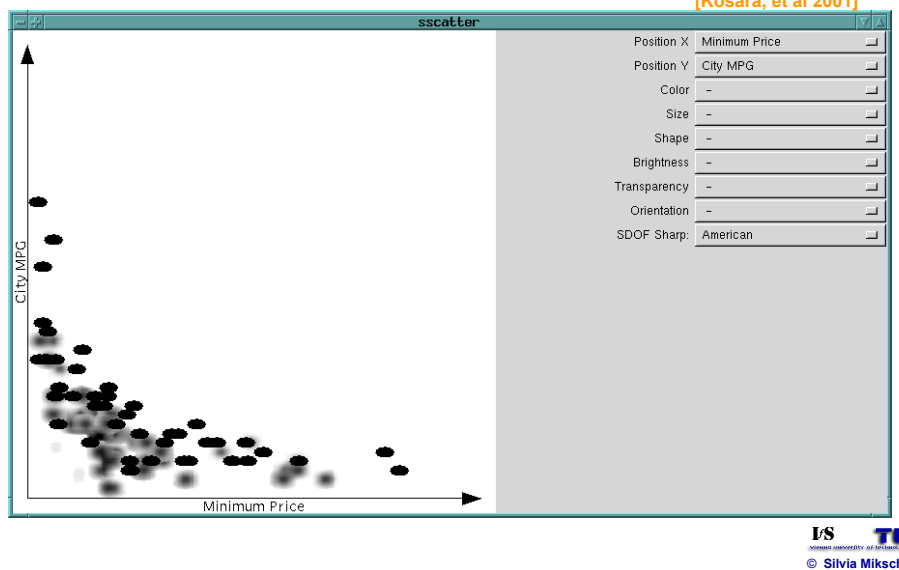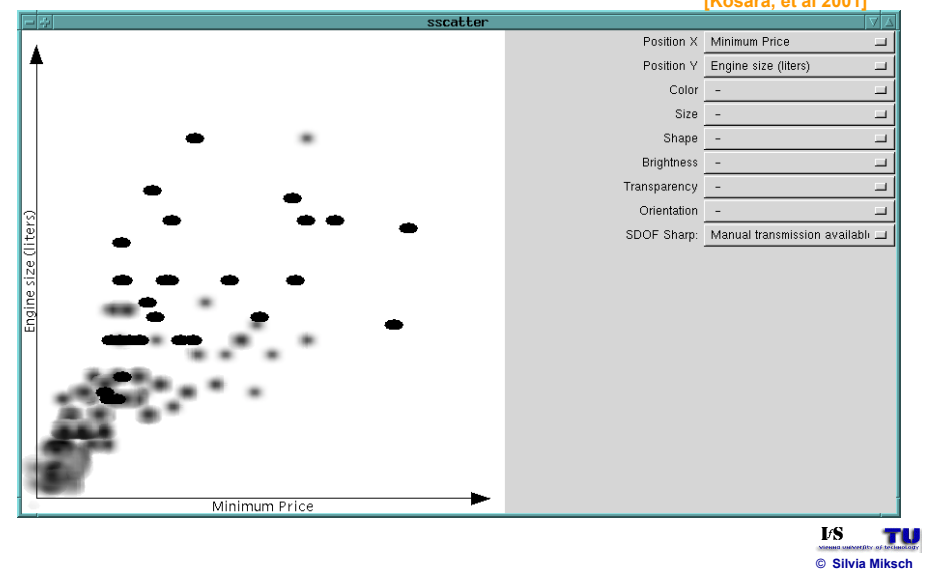
SDOF: Properties

- F+C Technique
- Based on Technique From Photography

- Non-distorting
- Independent of Color
- Intuitive

- (Probably) Preattentive

Preattentive Perception

[Kosara, et al 2002]

- Preattentive Perception
  - after ~200ms
  - parallel, high bandwidth
  - detection of target, location, percentage
- User Study
  - 16 participants
  - 2 hours each
  - professional usability lab
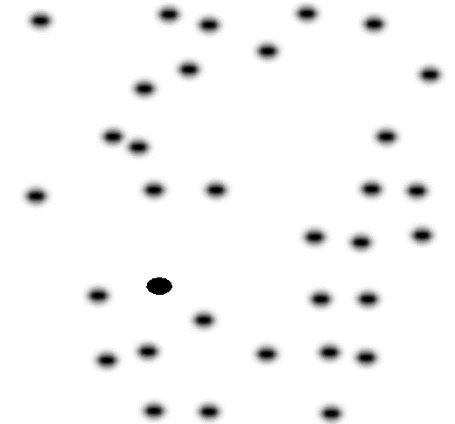
Overview of Results (1/2)

[Kosara, et al 2002]

- Participants Can Preattentively
  - Detect Targets
  - Locate Targets
  - Estimate Number of Targets

- High Precision
  - Dependant on Blur Levels of Distractors
  - Dependant on Number of Distractors

Overview of Results (2/2)

[Kosara, et al 2002]

- Distinction Between Blur Levels Difficult
- Very Weak Perception of Blur Difference
- Blur and Orientation not Slower Than Orientation alone
- Blur not Significantly Slower Than Color!

- Some did not like blurred text

Conclusions

- SDOF is an Effective and Efficient F+C Technique
- Does Not Provide More Space, but Better Discrimination
- Natural, Intuitive, *Preattentive*
- Future
  - Combination with Other F+C Methods
  - Combination with Other Cues to Encode More Information

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Outline

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Visual Encoding Techniques 1

[Card, Mackinlay & Shneiderman 1999]

- Different ways in encoding information visually:
  - space (absolute dominant)
  - marks (in space)
  - connections & enclosures
  - retinal properties
  - temporal changes
  - viewpoint transformations

five main techniques, we will talk about later

- crispness
- shape
- resolution
- transparency
- color (value, hue & saturation)
- grayscale

points
lines
areas
volumes

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Visual Encoding Techniques 2

[Card, Mackinlay & Shneiderman 1999]

- Five major spatial encoding techniques:
  - Composition
  - Alignment
  - Folding
  - Recursion
  - Overloading

The orthogonal placement of axes, creating a 2D metric space

The repetition of an axis at a different position in the space

The continuation of an axis in an orthogonal direction

The repeated subdivision of space

The reuse of the same space for the same Data Table

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Outline

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Summary: InfoVis...

- ... is a very complex task
- ... can help to get insight into data more quickly
- ... requires preparation and sensible handling of the information
- ... should make use of the properties of human visual perception
- ... requires sensible handling, relative to the task
- ... is a big challenge, if you want to do it good

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