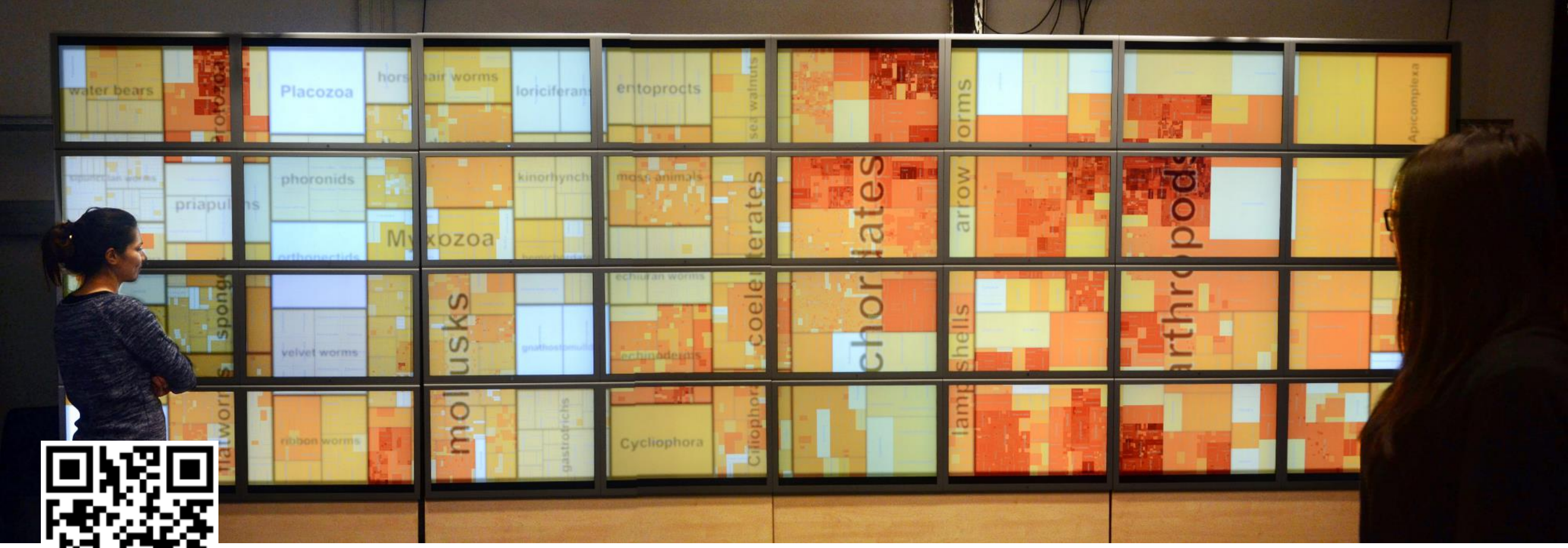


Hybrid-Image Visualization for Large Viewing Environments

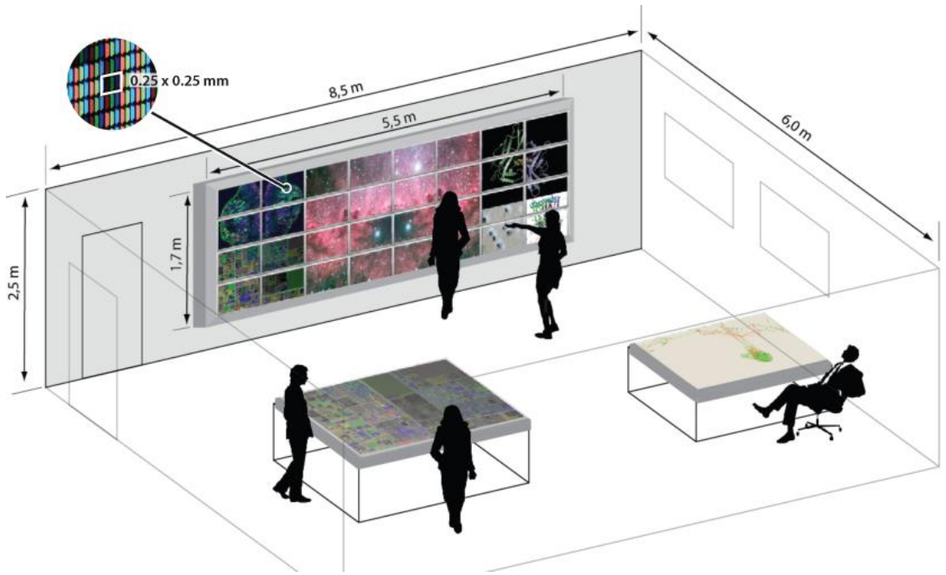
Petra Isenberg, Pierre Dragicevic,
Wesley Willett, Anastasia Bezerianos, Jean-Daniel Fekete

Aviz
Visual Analytics Project

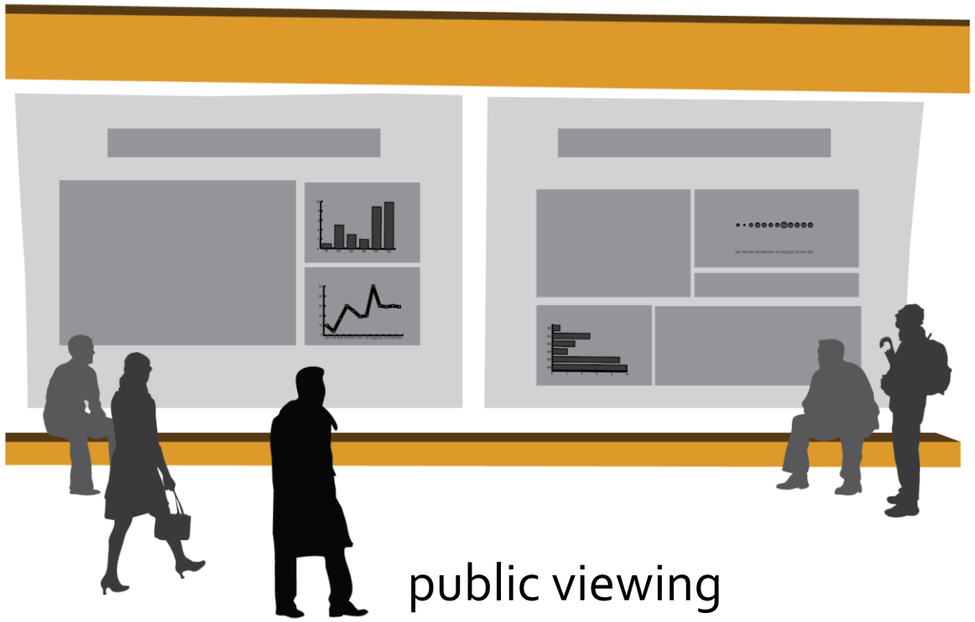
informatics mathematics
Inria

LABORATOIRE DE RECHERCHE EN INFORMATIQUE

Large Viewing Environments

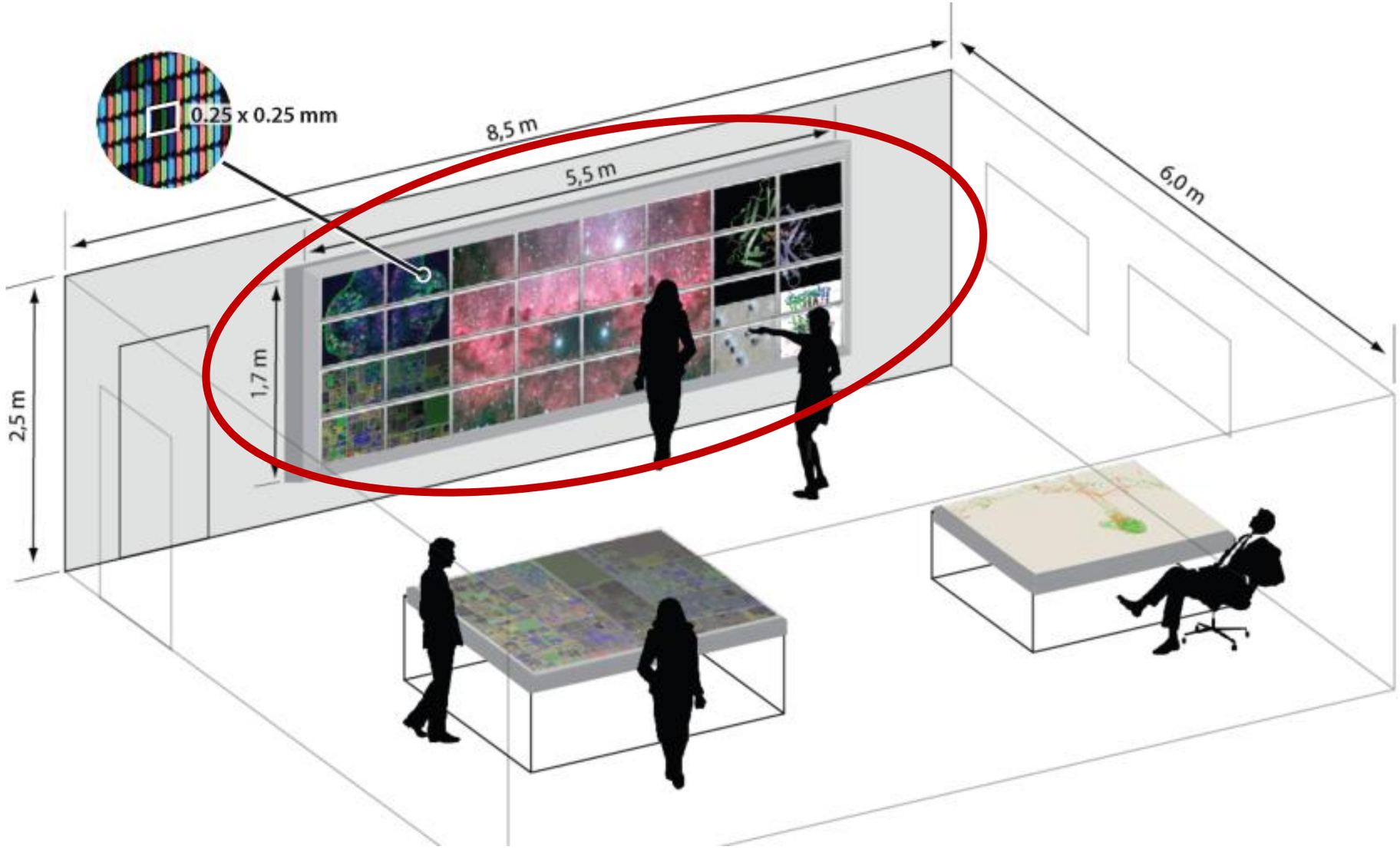


large displays
meeting rooms / war rooms
emergency response rooms

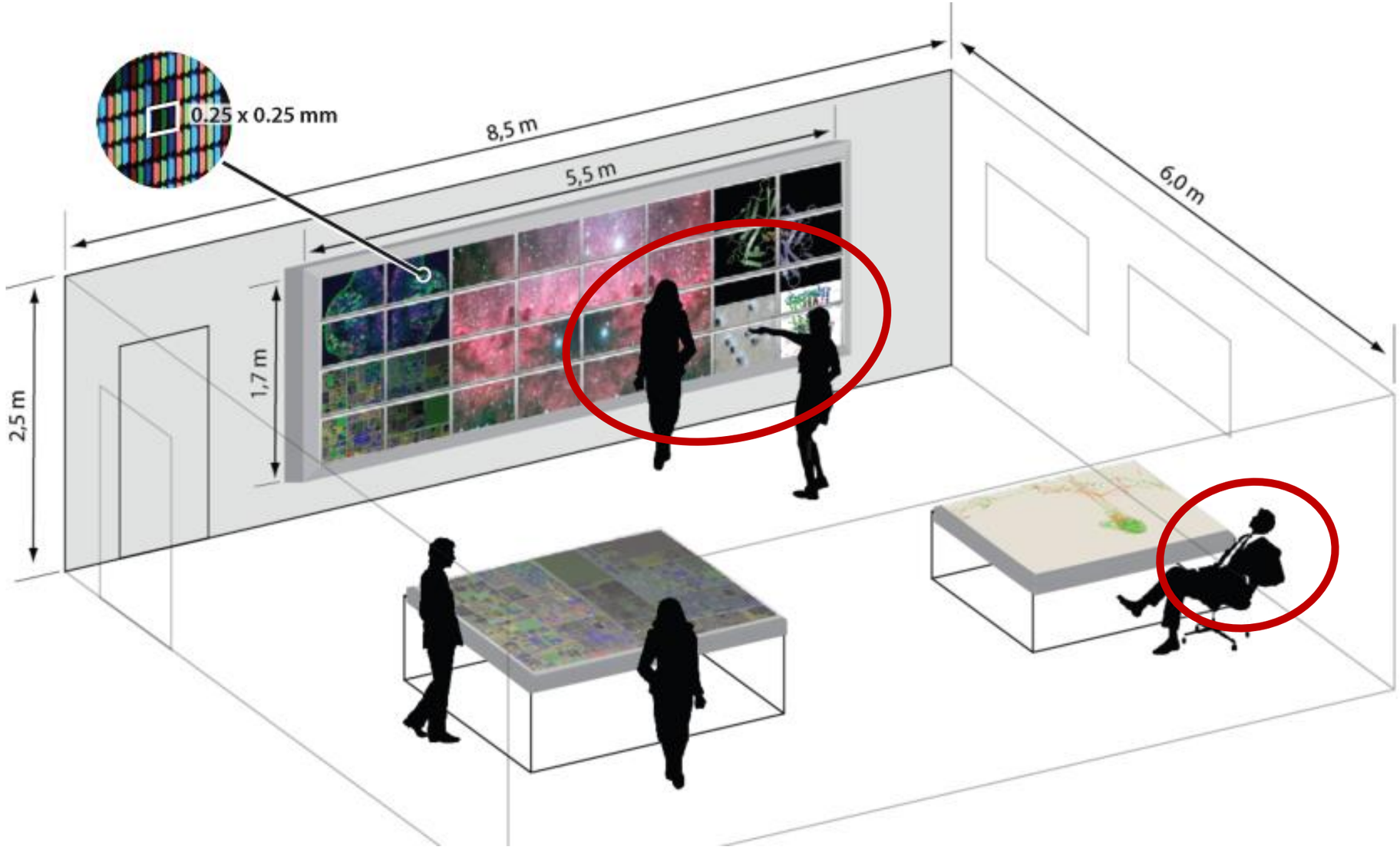


public viewing
open spaces
museums

Scenario: WILD Display Environment



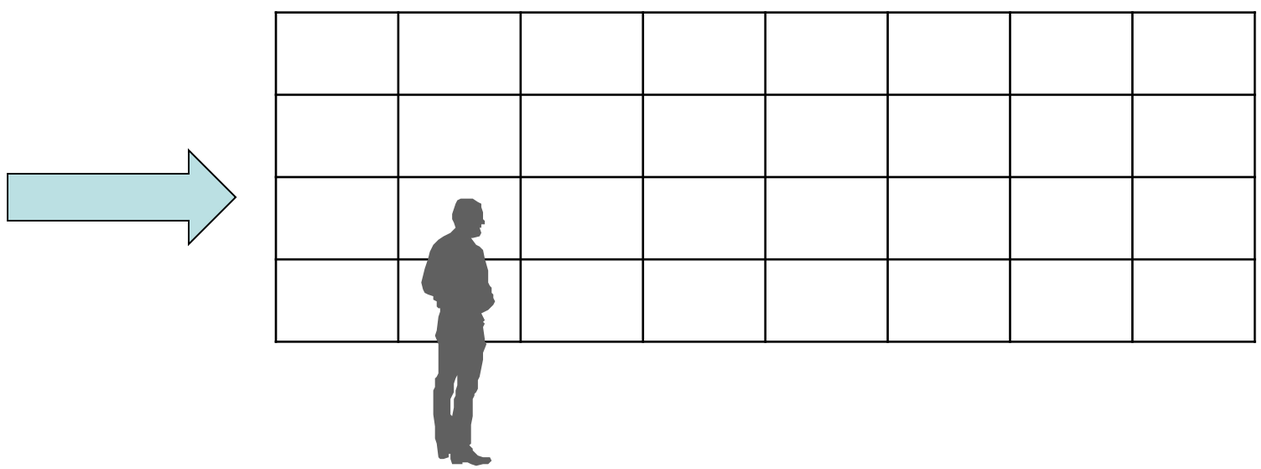
Who to Optimize For?



Example Data

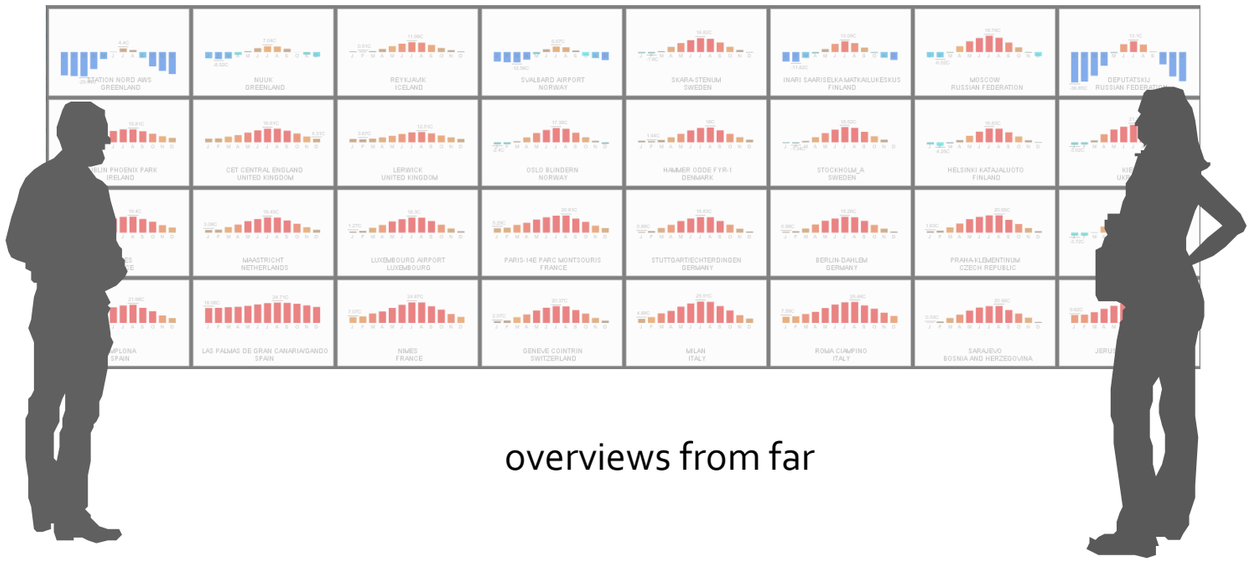
23 years of daily temperatures for 32 cities

Station, Country, Station ID,	SOUID,	Date,	Temperature (decidegrees Celsius),	Temperature Quality
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-01,	-21,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-02,	-13,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-03,	-2,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-04,	-12,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-05,	0,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-06,	-13,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-07,	-40,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-08,	6,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-09,	35,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-10,	44,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-11,	48,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-12,	60,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-13,	22,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-14,	30,	0
BERLIN-DAHLEM, GERMANY, 41,	133,	1990-01-15,	42,	0



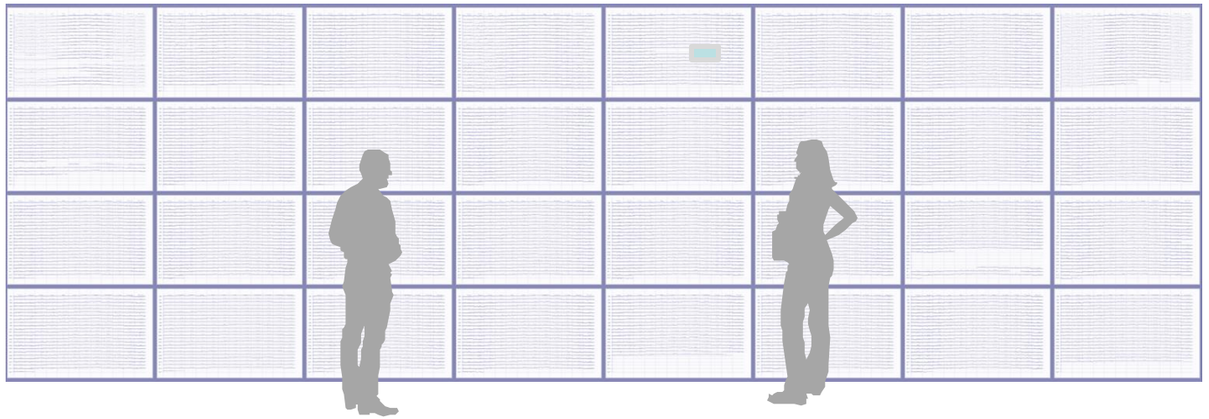
Naïve Approach

Optimize for one specific viewing distance



overviews from far

Problem:
detailed information lost

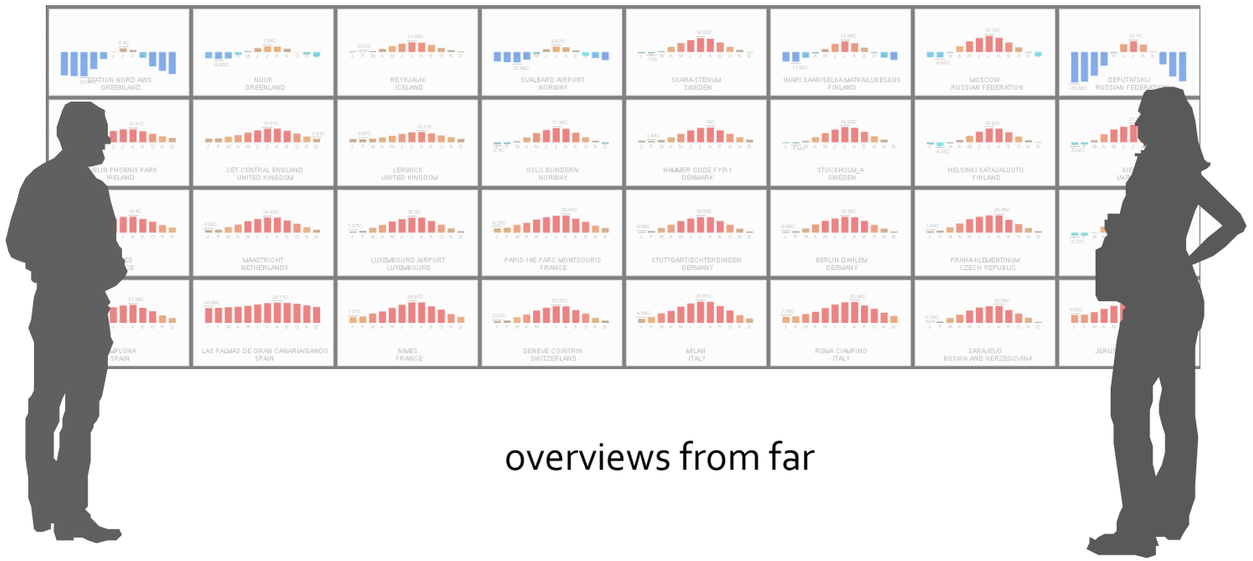


detail from close

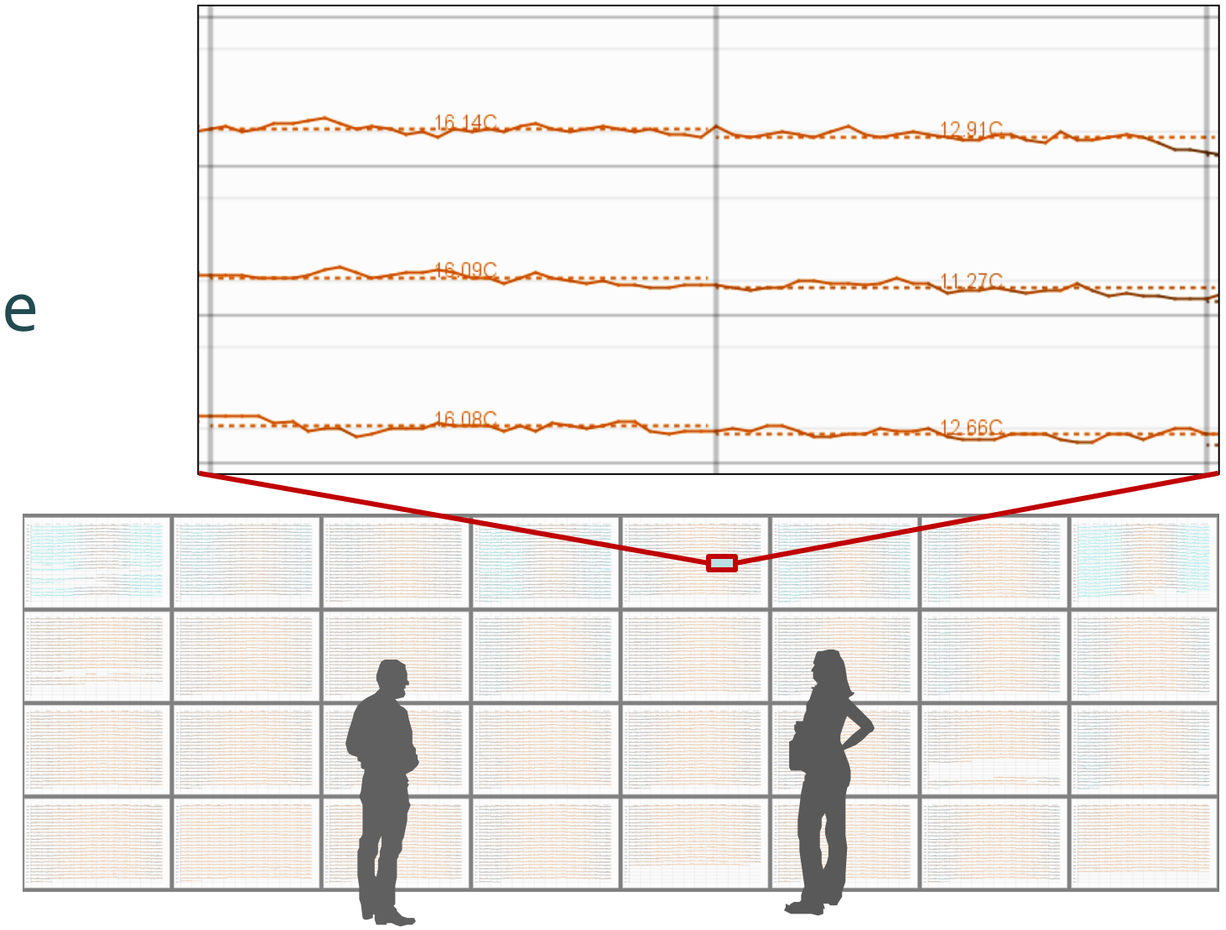
Problem:
mental aggregation, comparison

Naïve Approach

Optimize for one specific viewing distance



overviews from far



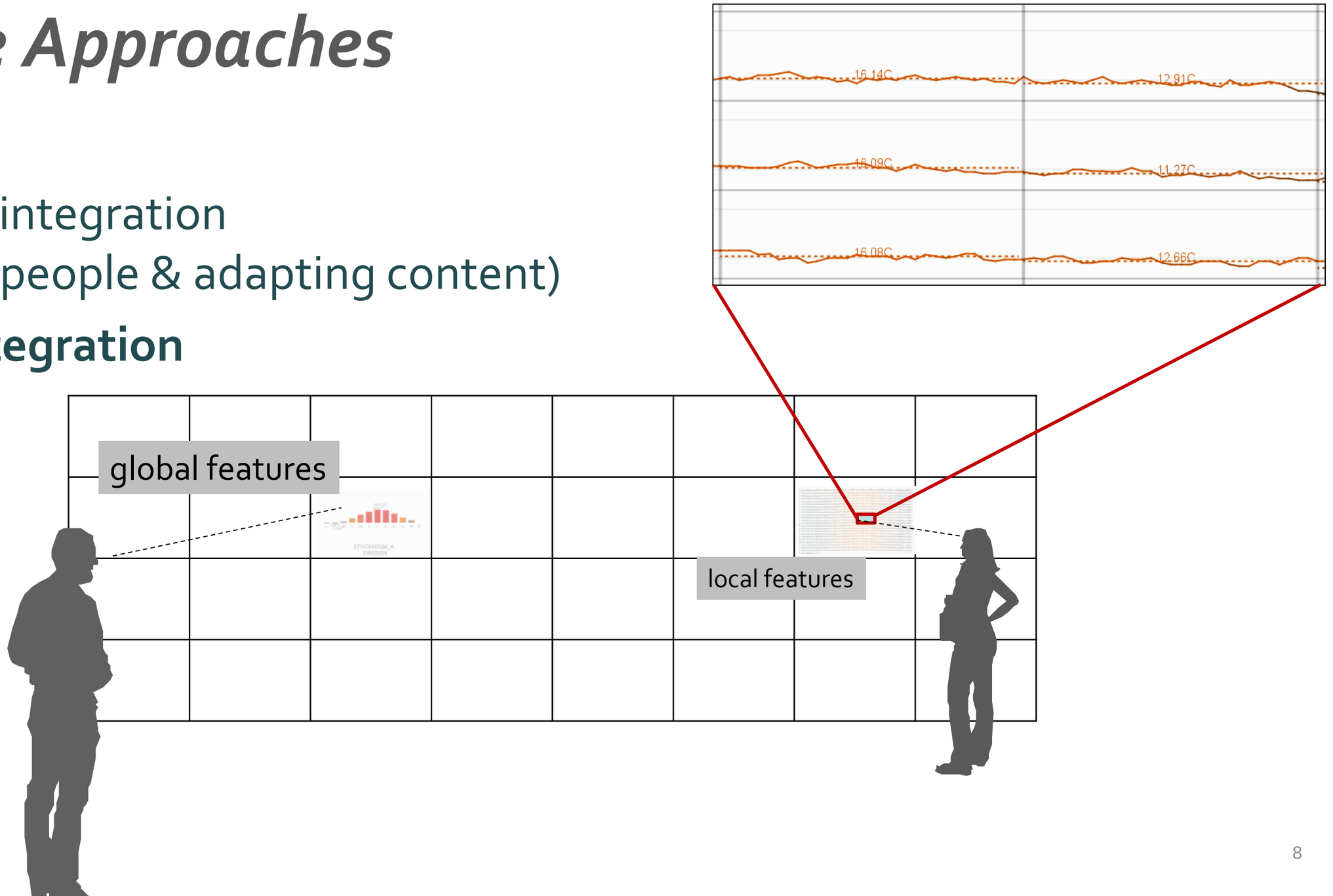
detail from close

Problem:
detailed information lost

Problem:
mental aggregation, comparison

Possible Approaches

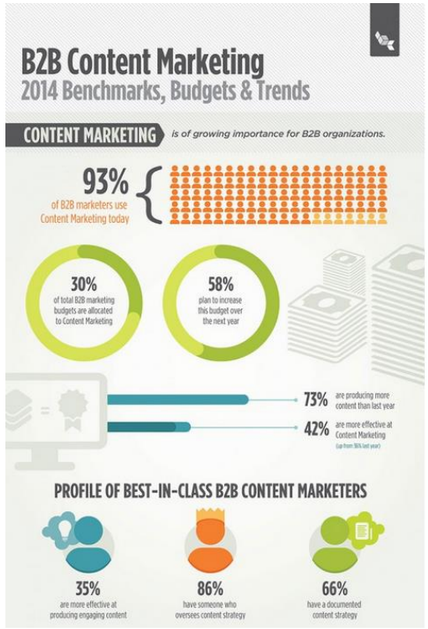
- Dynamic integration
  (tracking people & adapting content)
- **Static integration**



Static Approaches

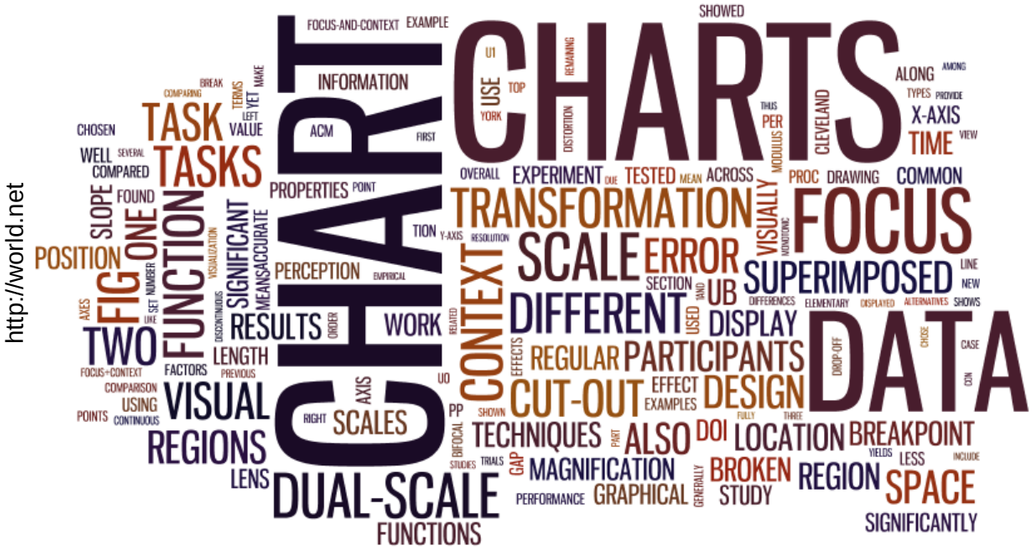
Juxtaposition: global & local features next to each other

http://visual.ly/b2b-content-marketing-2014-benchmarks-budgets-and-trends



Infographic Layout

http://world.net

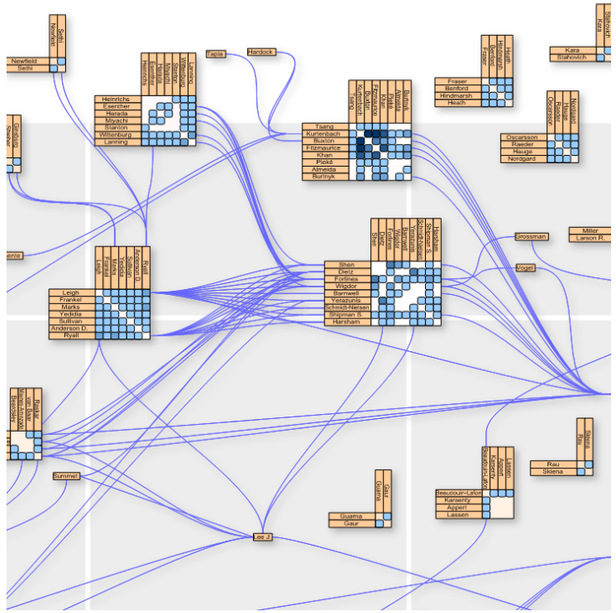


Large Tag Clouds

Static Approaches

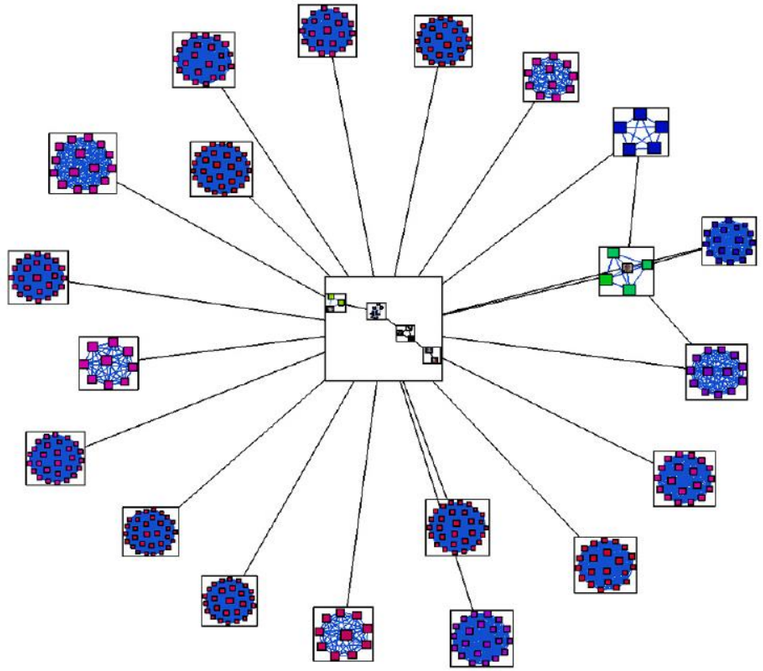
Nesting: local inside global features

[NodeTrix: Henry et al., InfoVis 2007]



NodeTrix

[SWViz: Auber et al., InfoVis 2003]

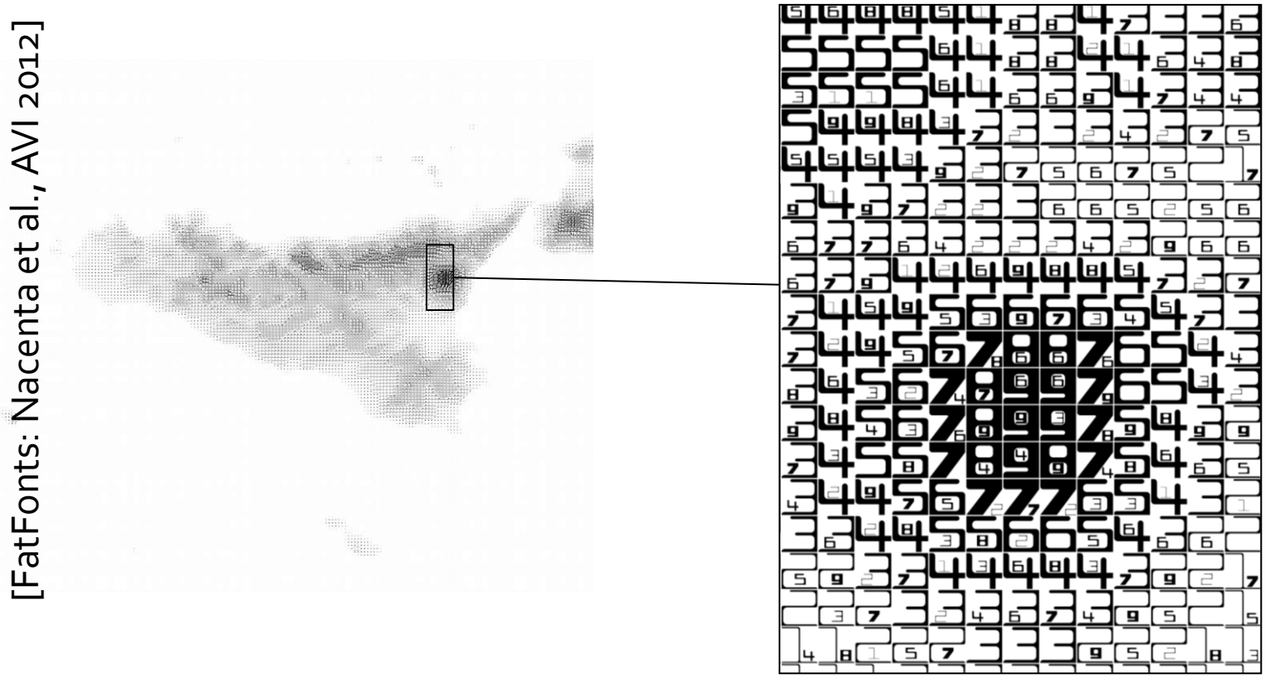


SWViz

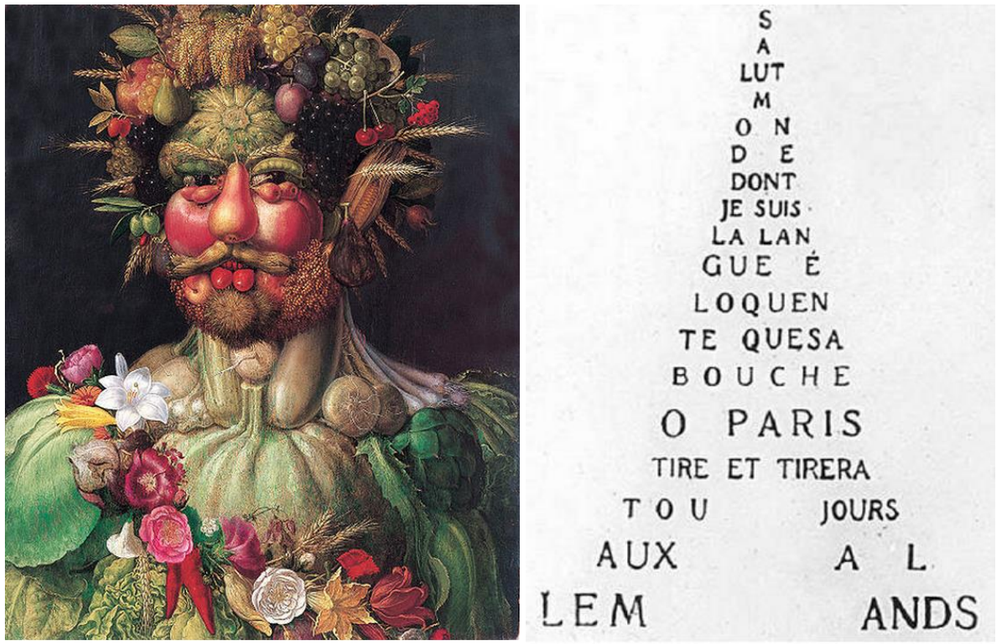
Static Approaches

Visual aggregation: local form global features

[FatFonts: Nacenta et al., AVI 2012]



FatFonts

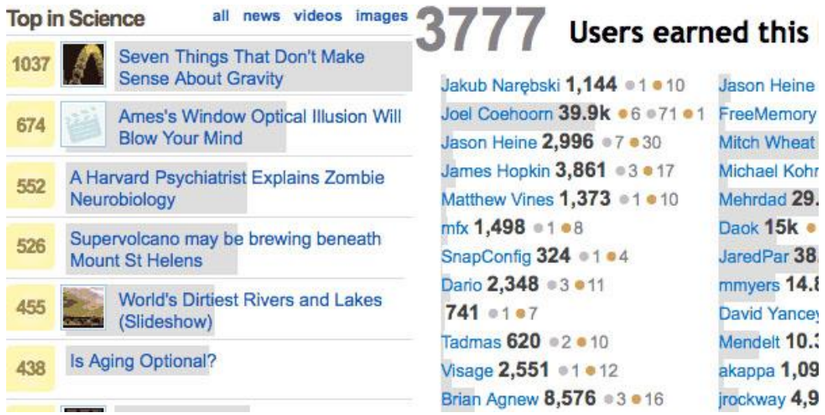


Arcimboldo Paintings, Calligrams

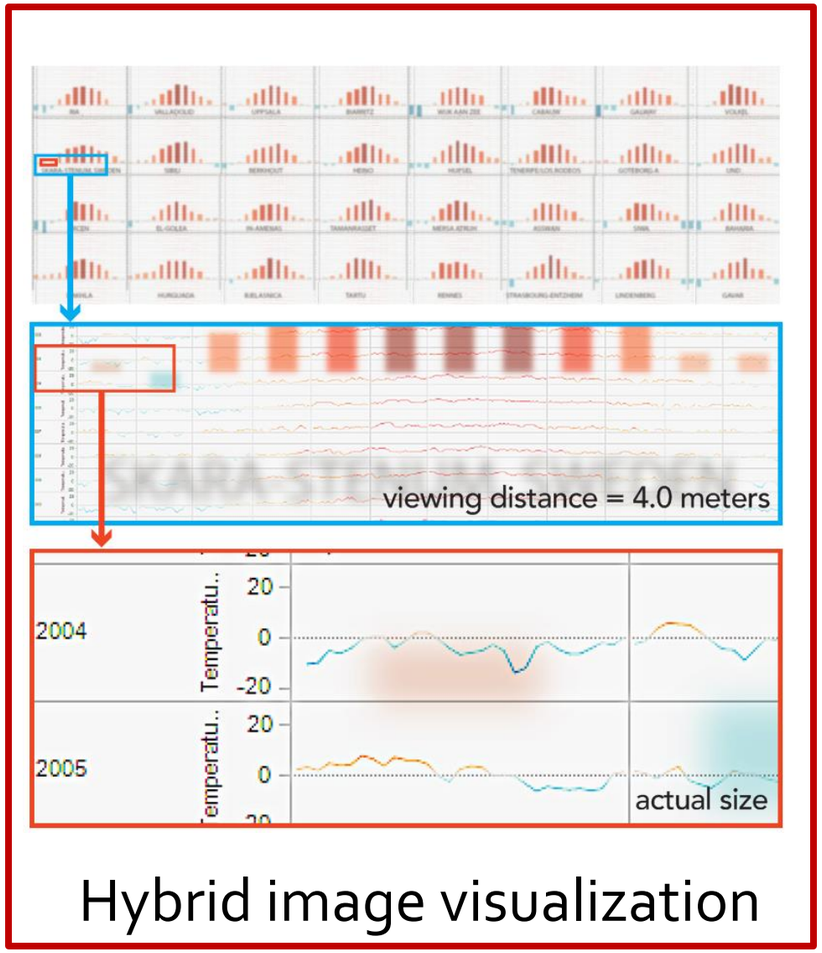
Static Approaches

Blending: local & global features overlap

Map regions over map detail

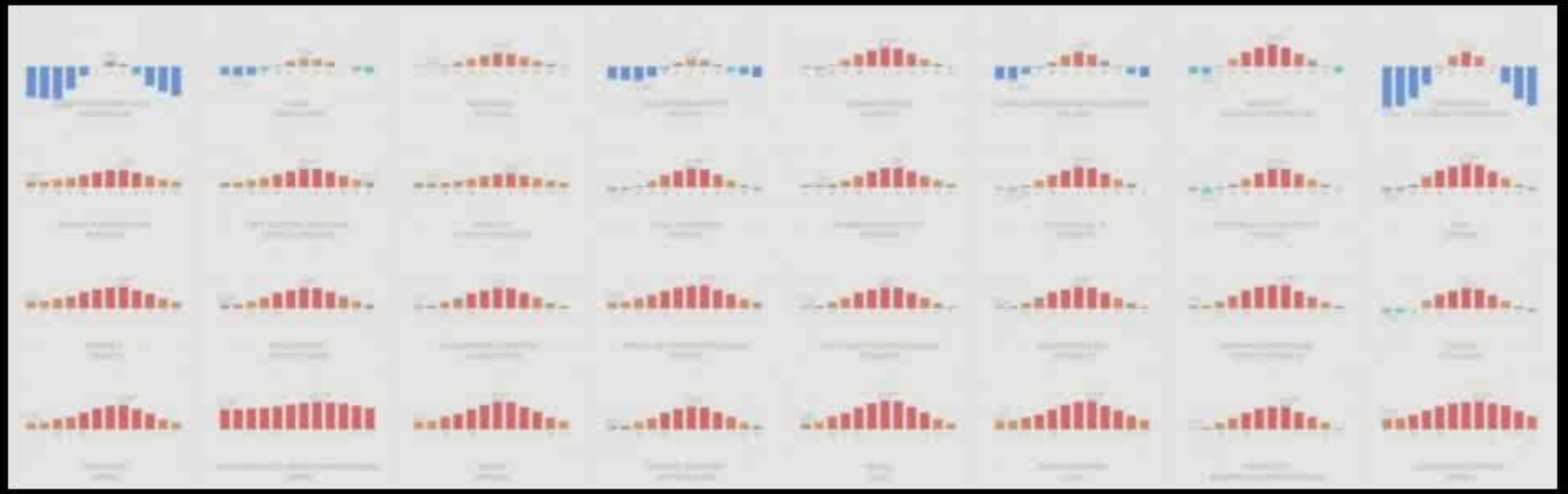


Label detail over bar chart



Hybrid image visualization

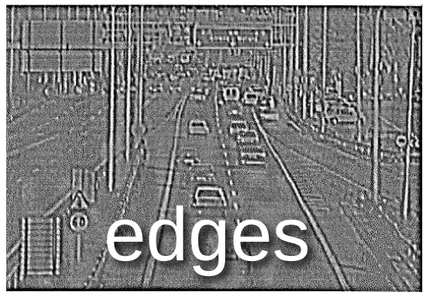
www.fraps.com



Hybrid Images

- Schyns & Oliva, 1994

+



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Hybrid Images

- Oliva, Torralba & Schyns, 2006

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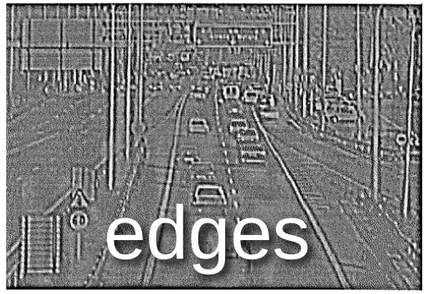


Our Contributions

- **Theoretical grounding**

  why & when use hybrid images?

- **Too**

  ho their creation?

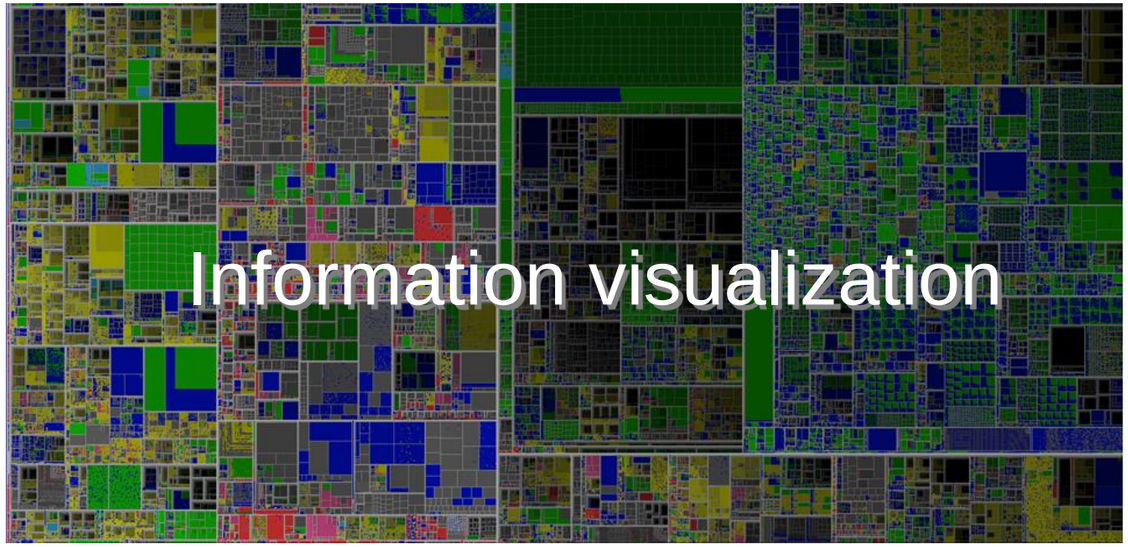
- **Examples**

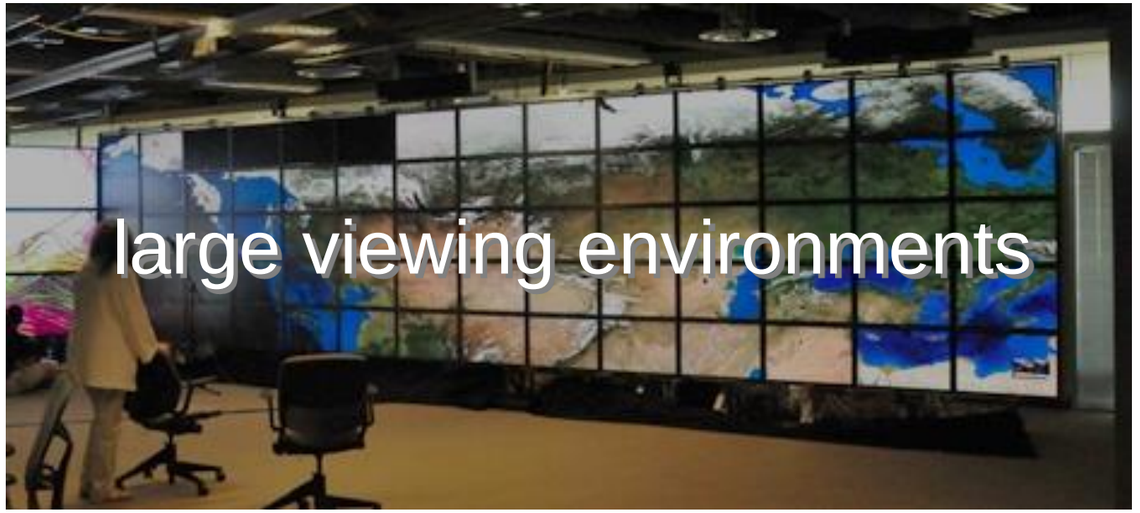
  wh ally good for?

- **Des s**

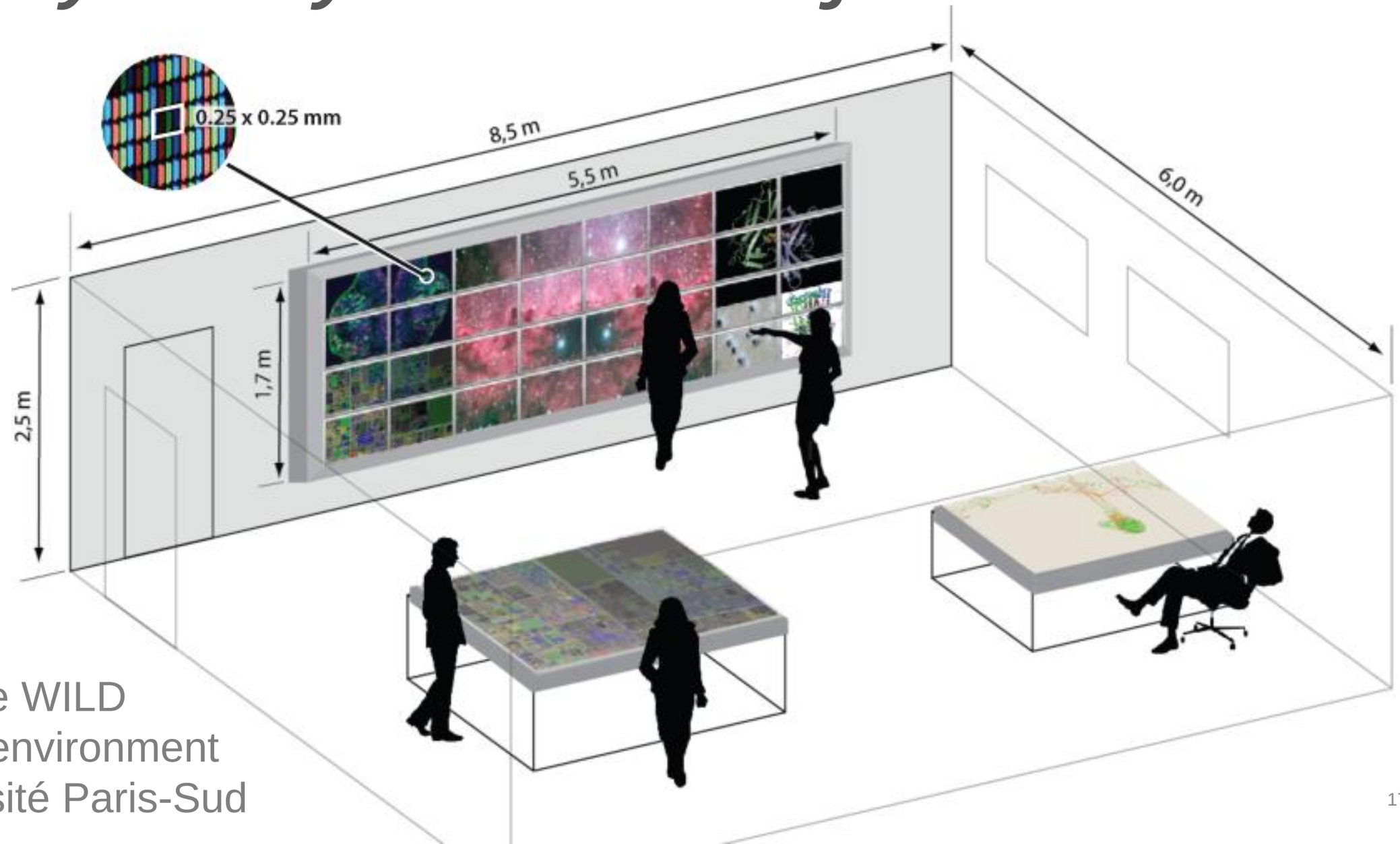
  how to build effective ones?

+





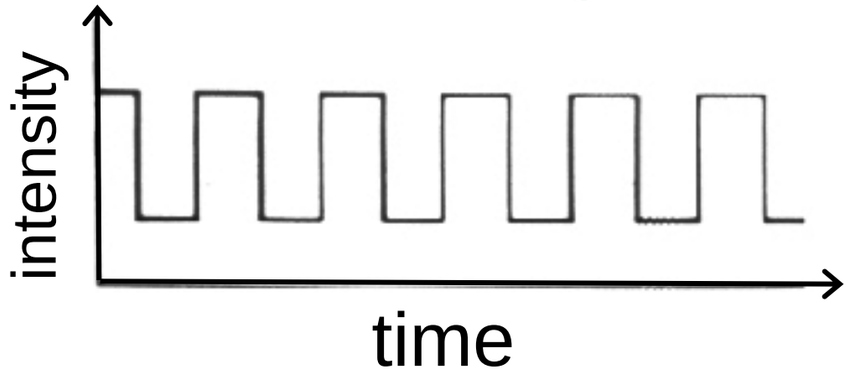
Can they Convey More Visual Information?



The WILD
display environment
at Université Paris-Sud

Frequency Domain Approach

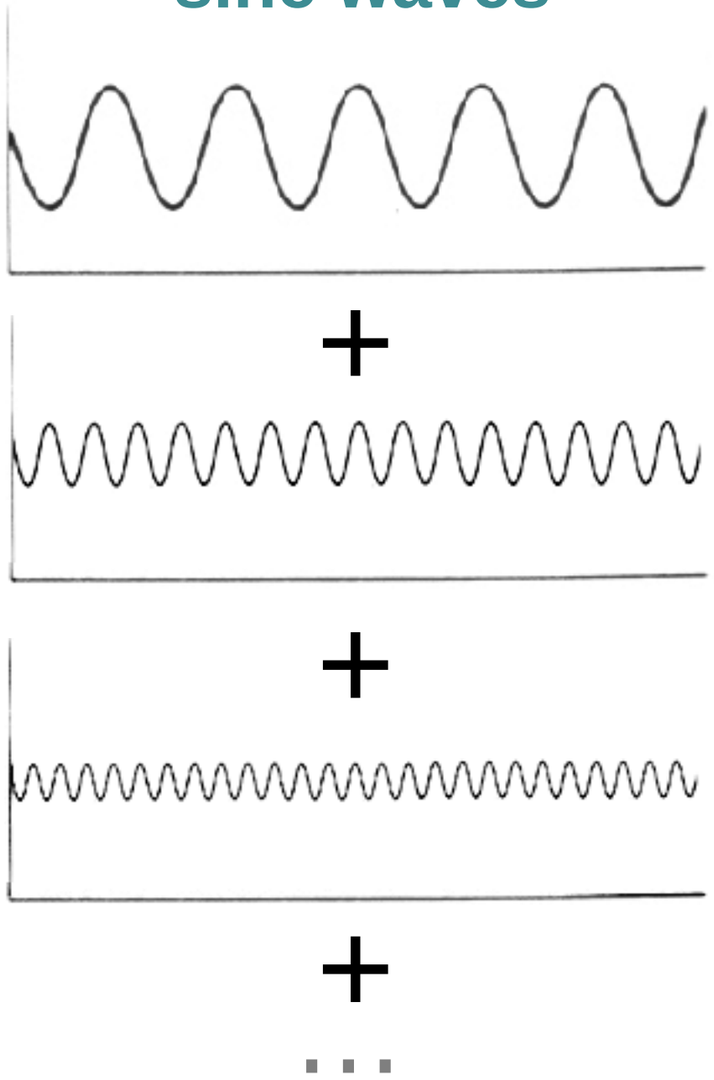
acoustic signal



Fourier Transform

=

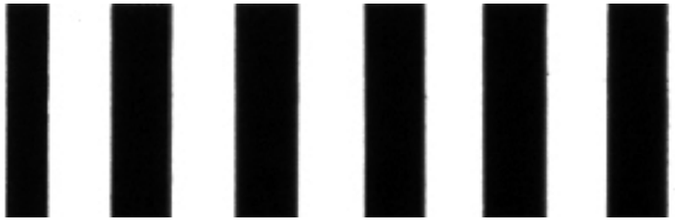
sine waves



frequencies in Hertz

Frequency Domain Approach

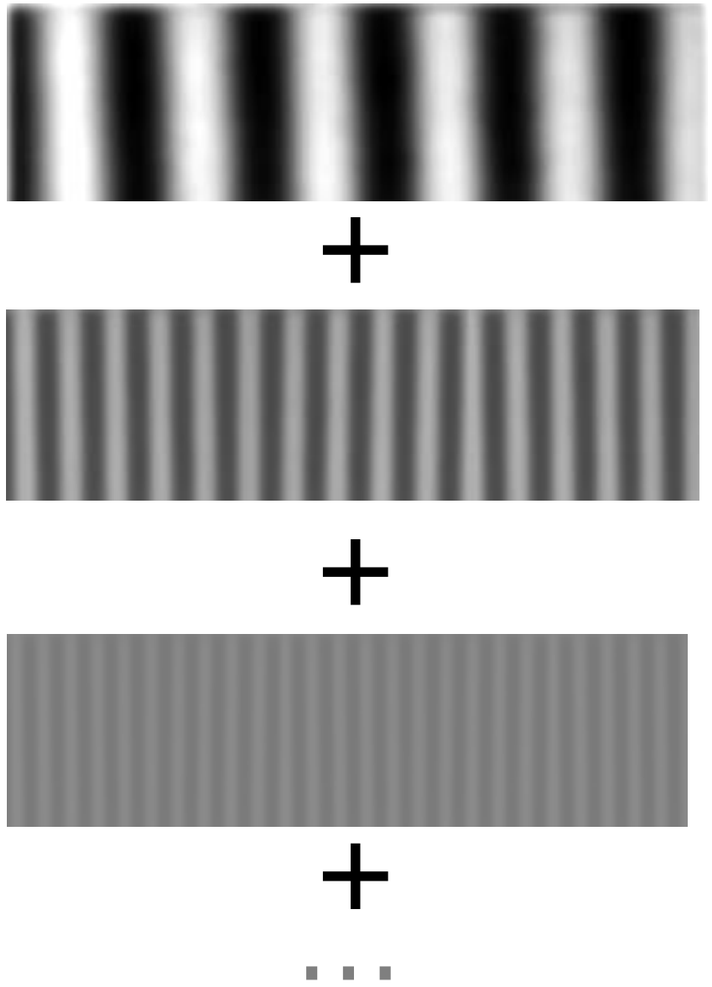
image



(1D) Fourier Transform

=

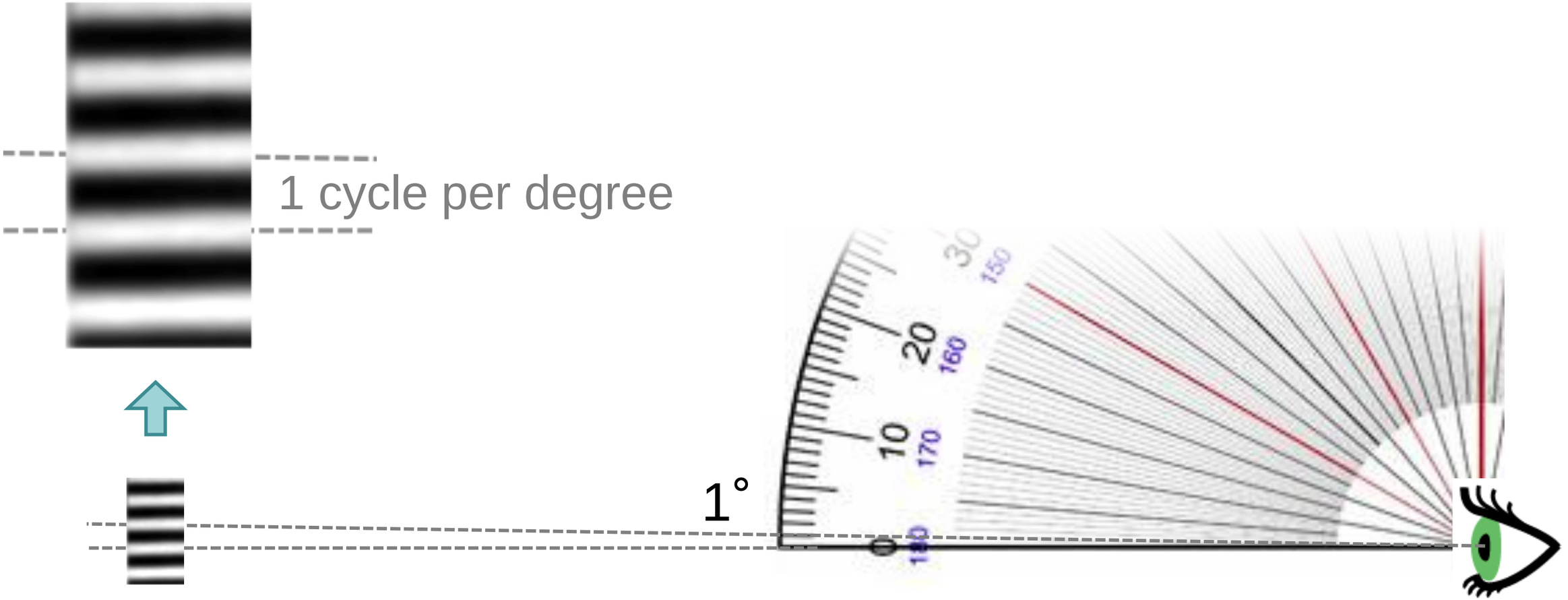
sinusoidal gratings



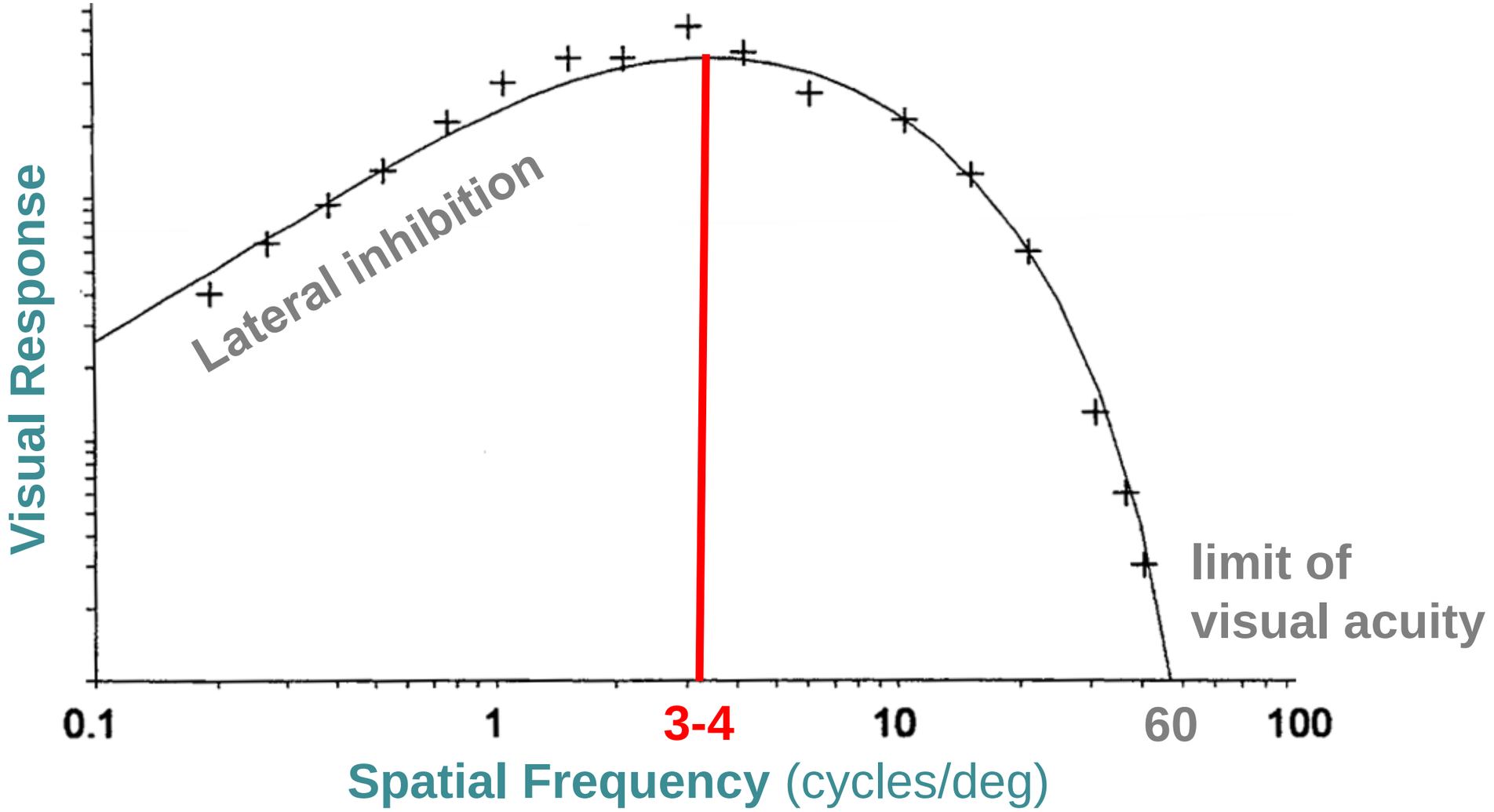
frequencies in

cycles/degree
of visual angle

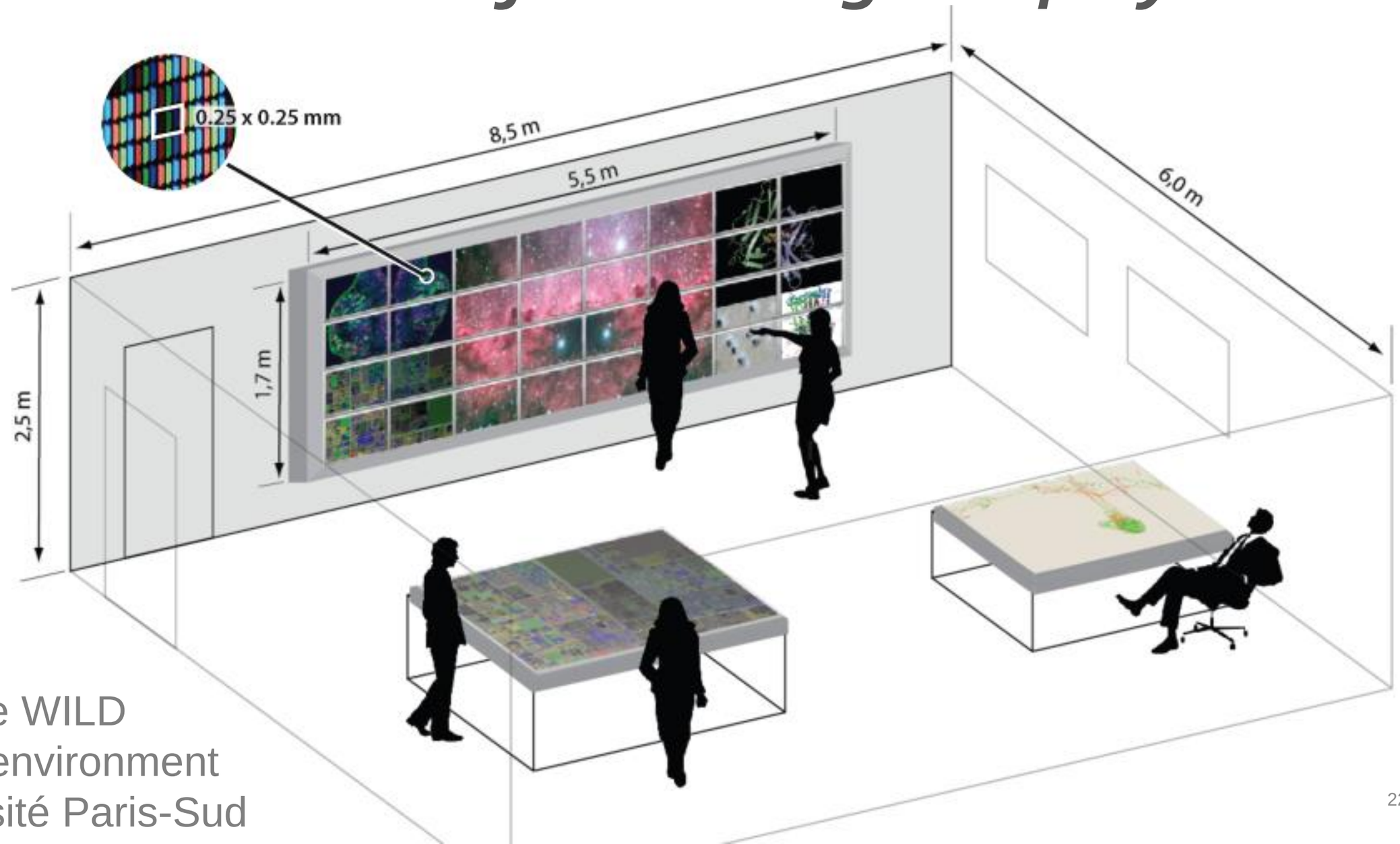
Contrast Sensitivity Function



Contrast Sensitivity Function



What do we Perceive from a Large Display?



The WILD
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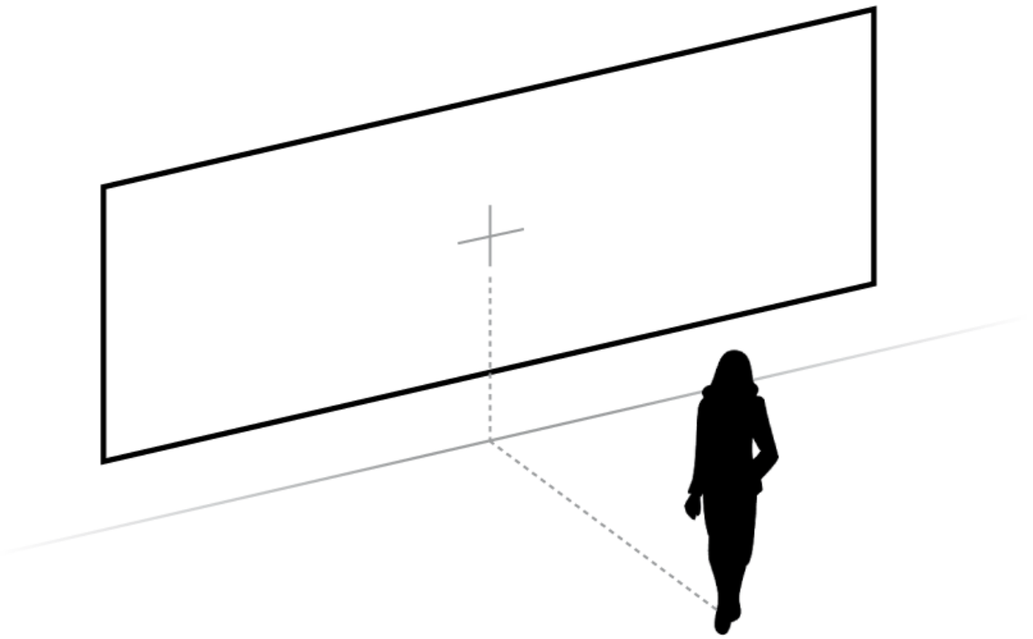

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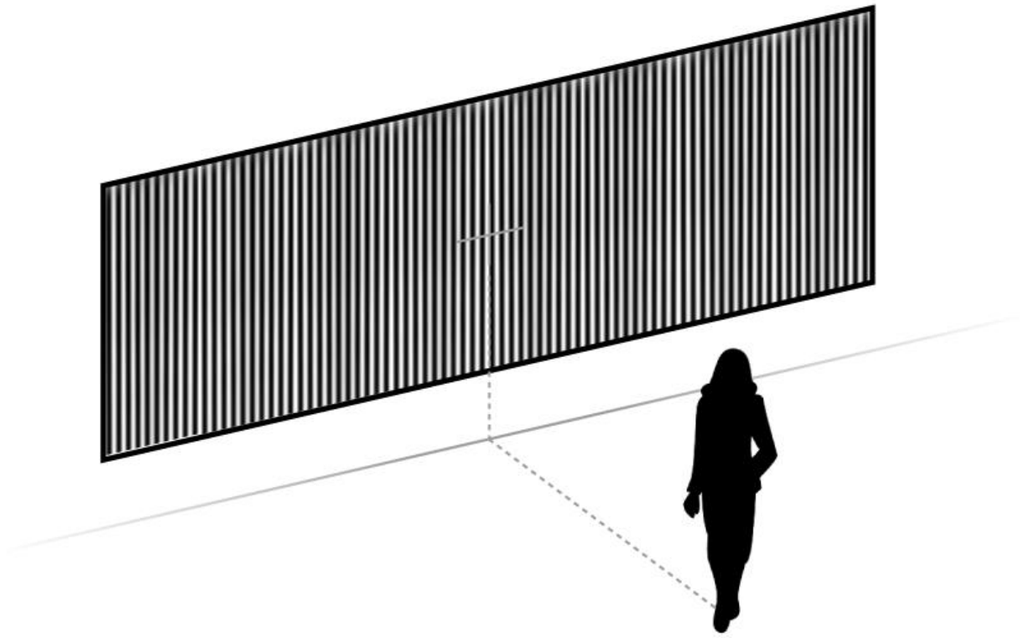

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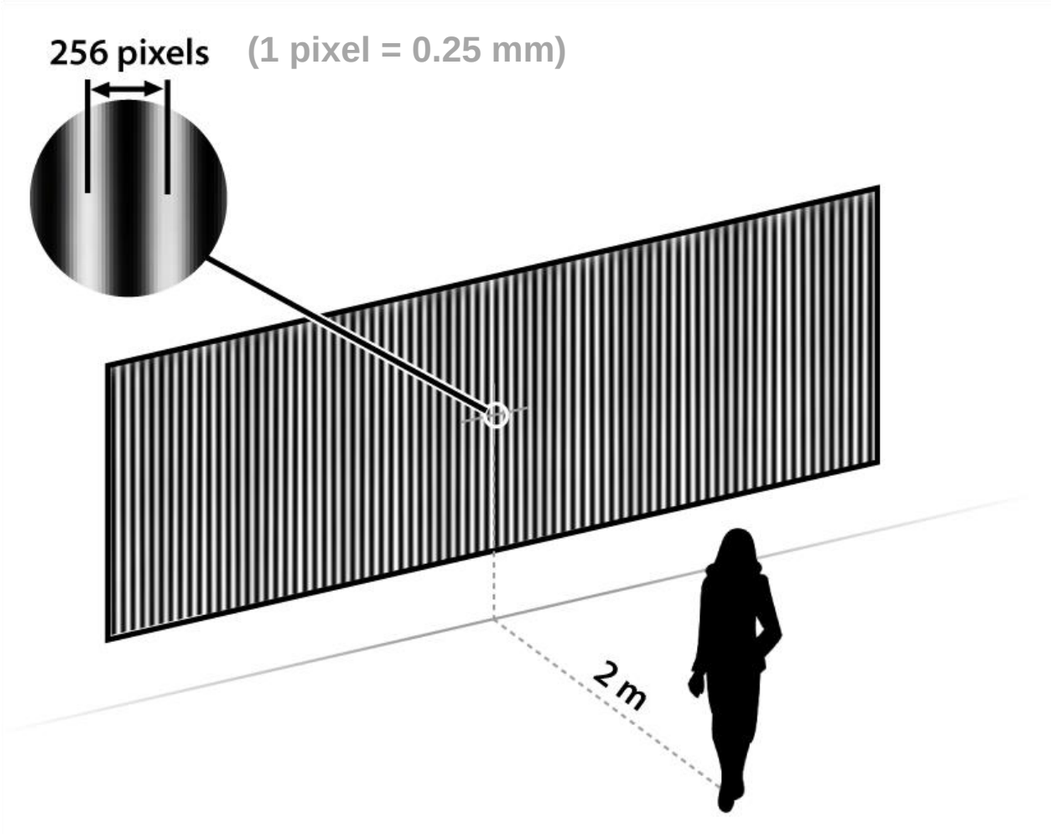
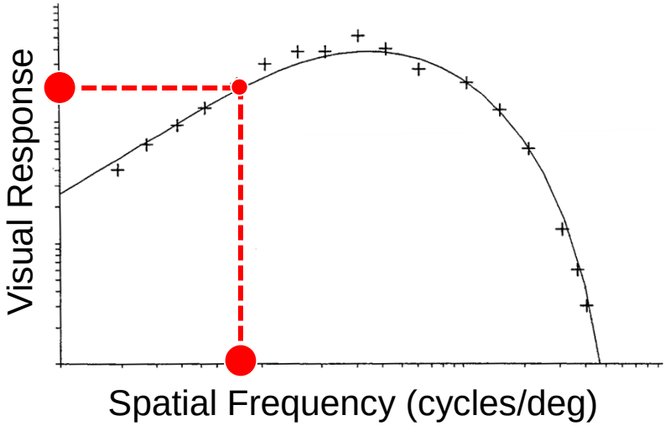
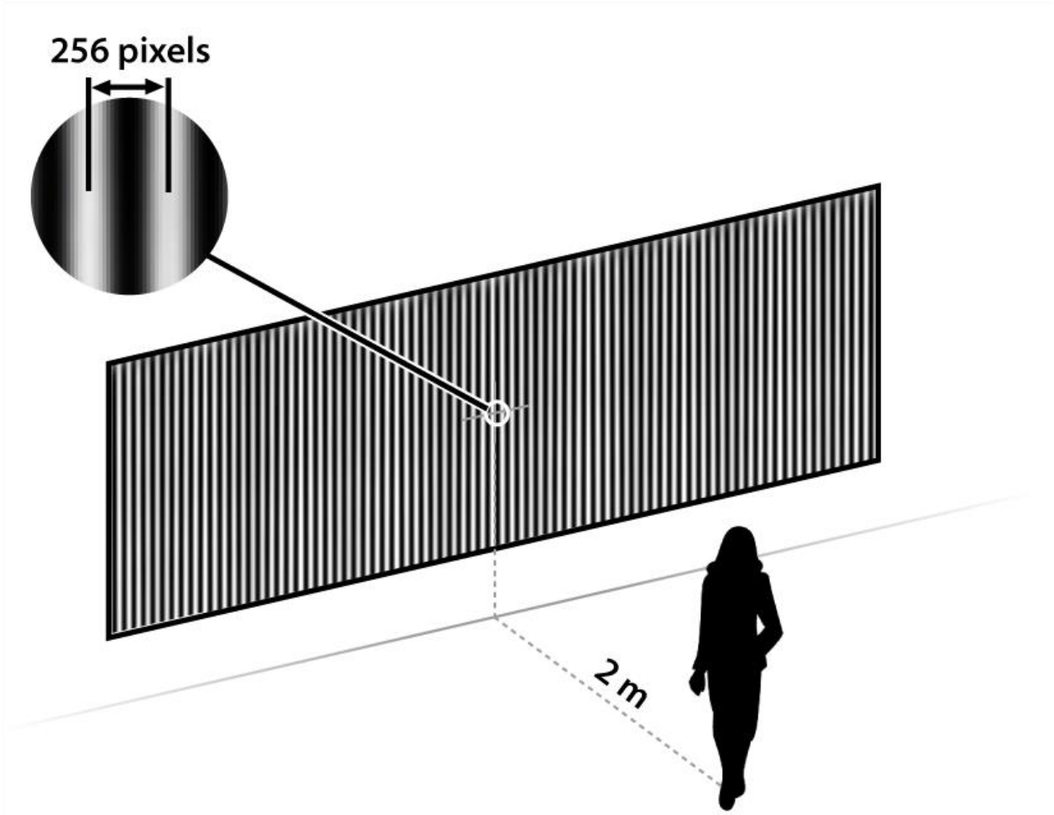


What do we Perceive from a Large Display?





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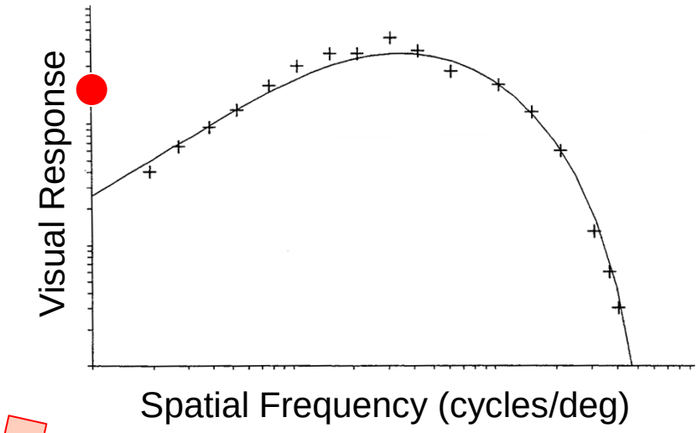

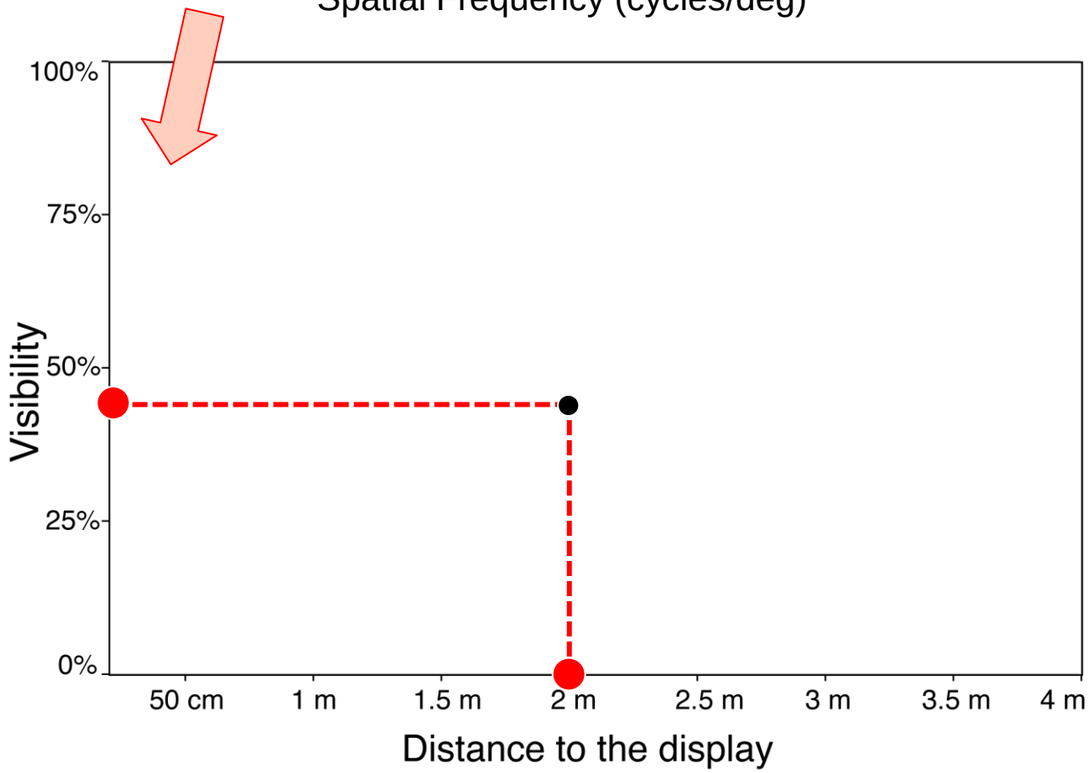

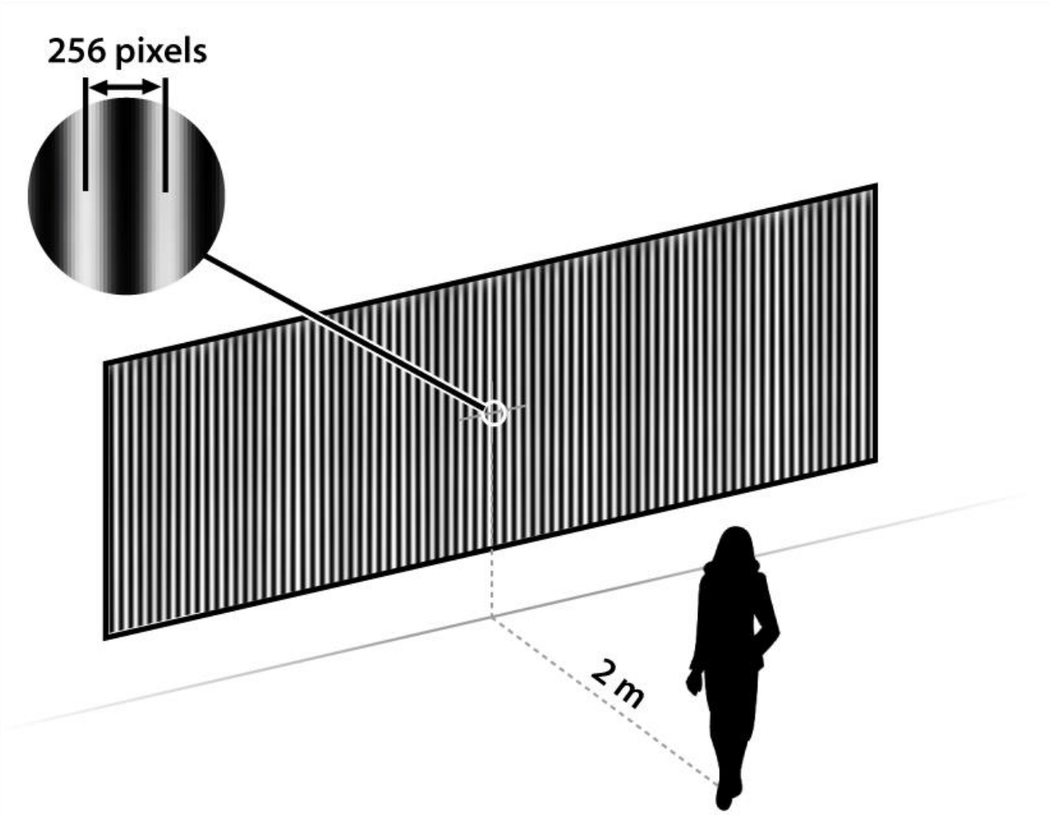

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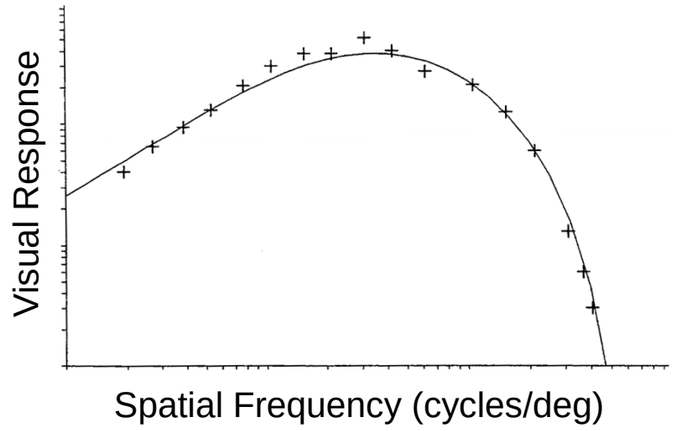

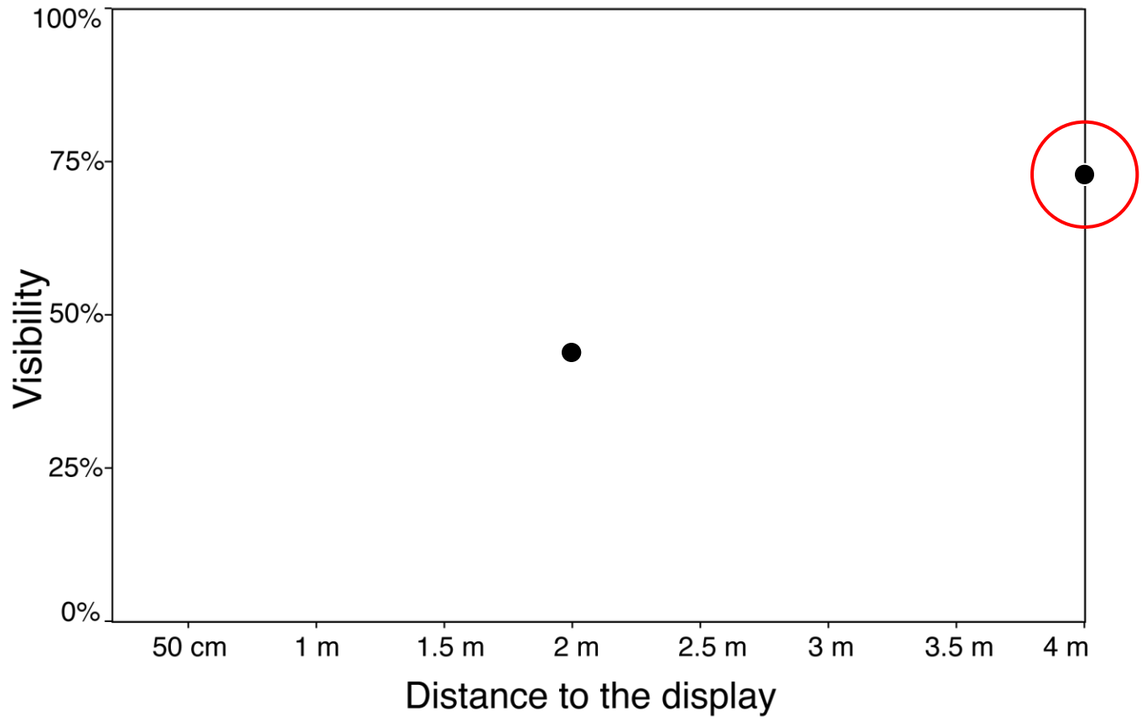

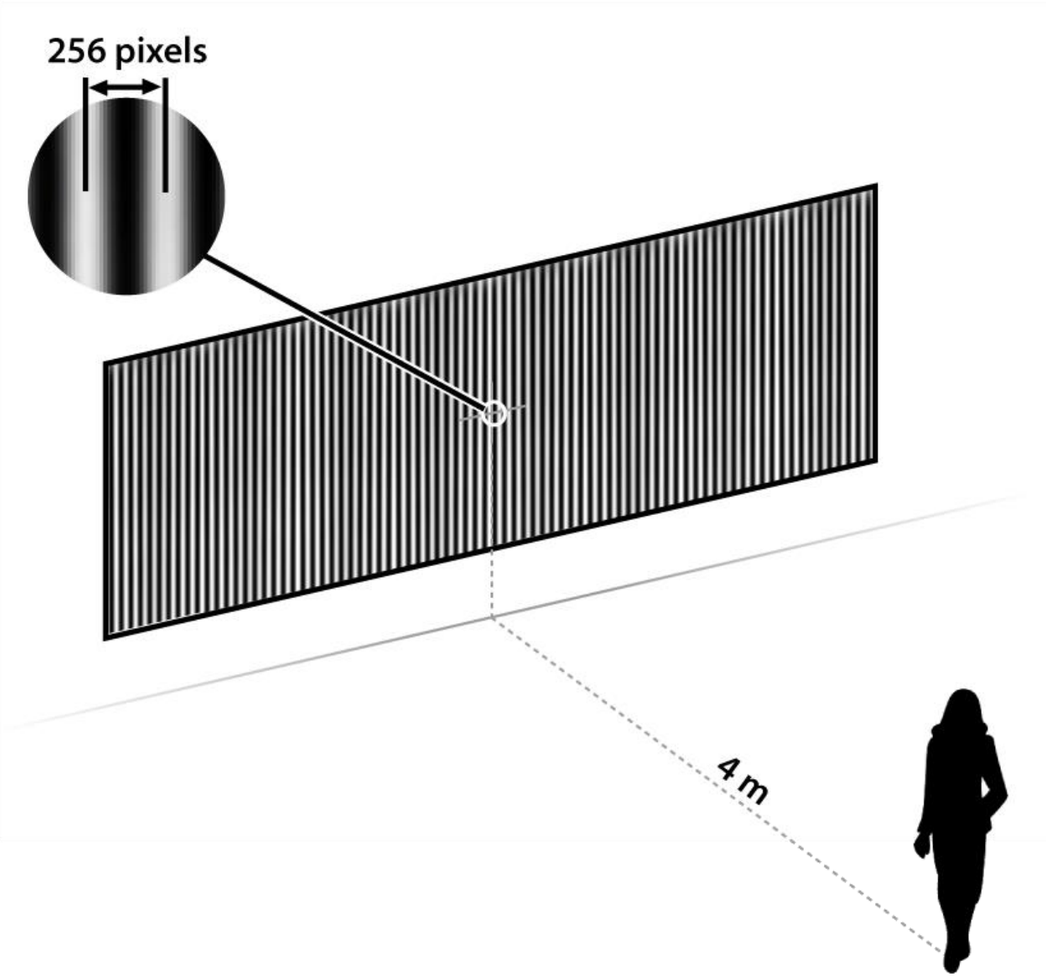

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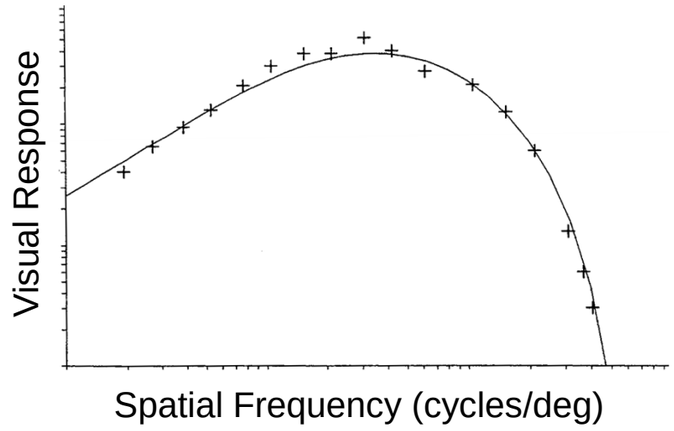

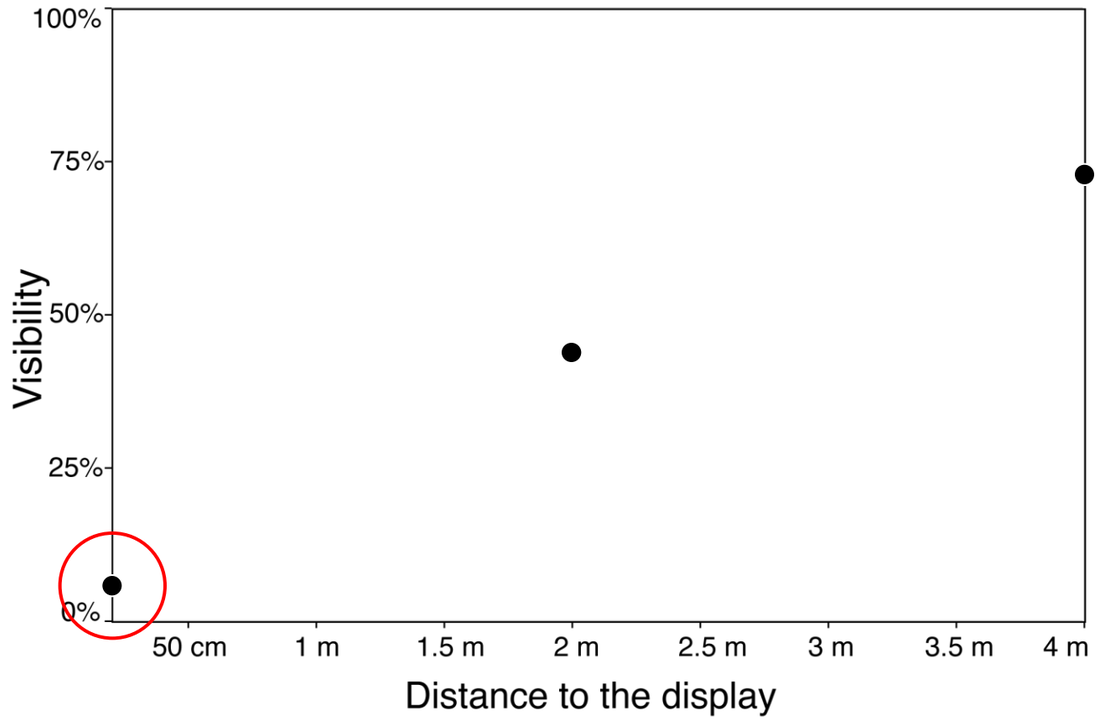

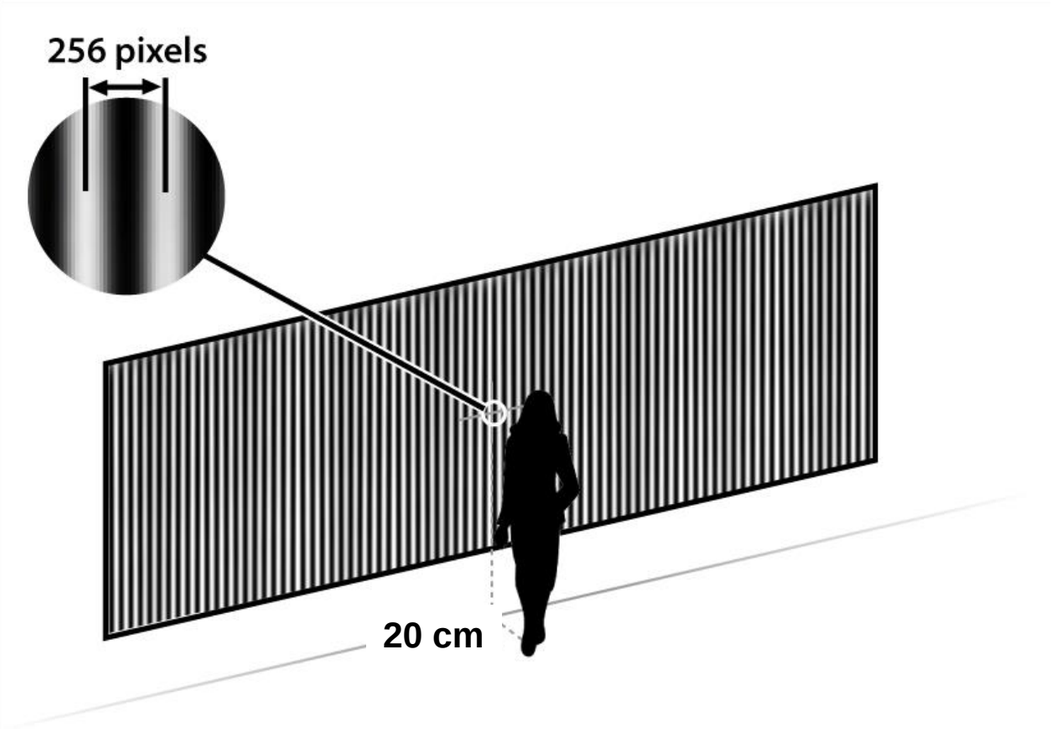

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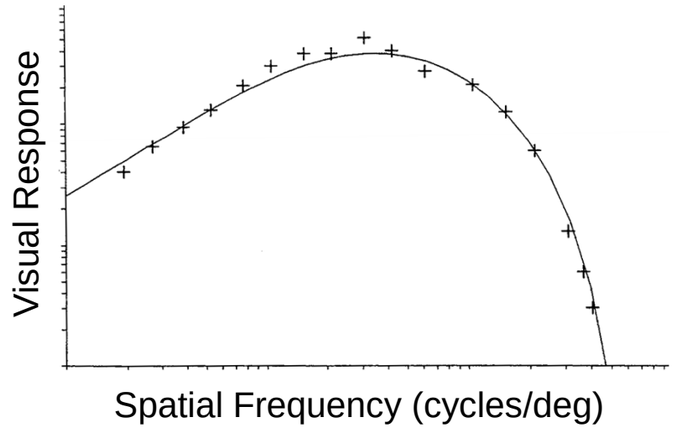

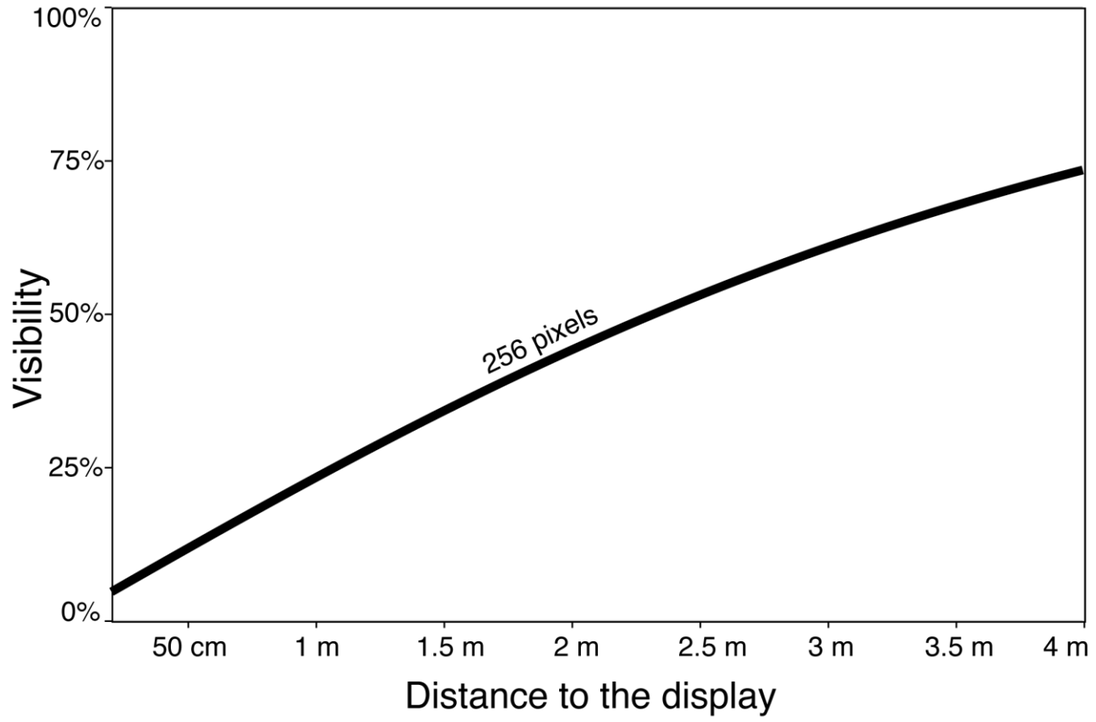

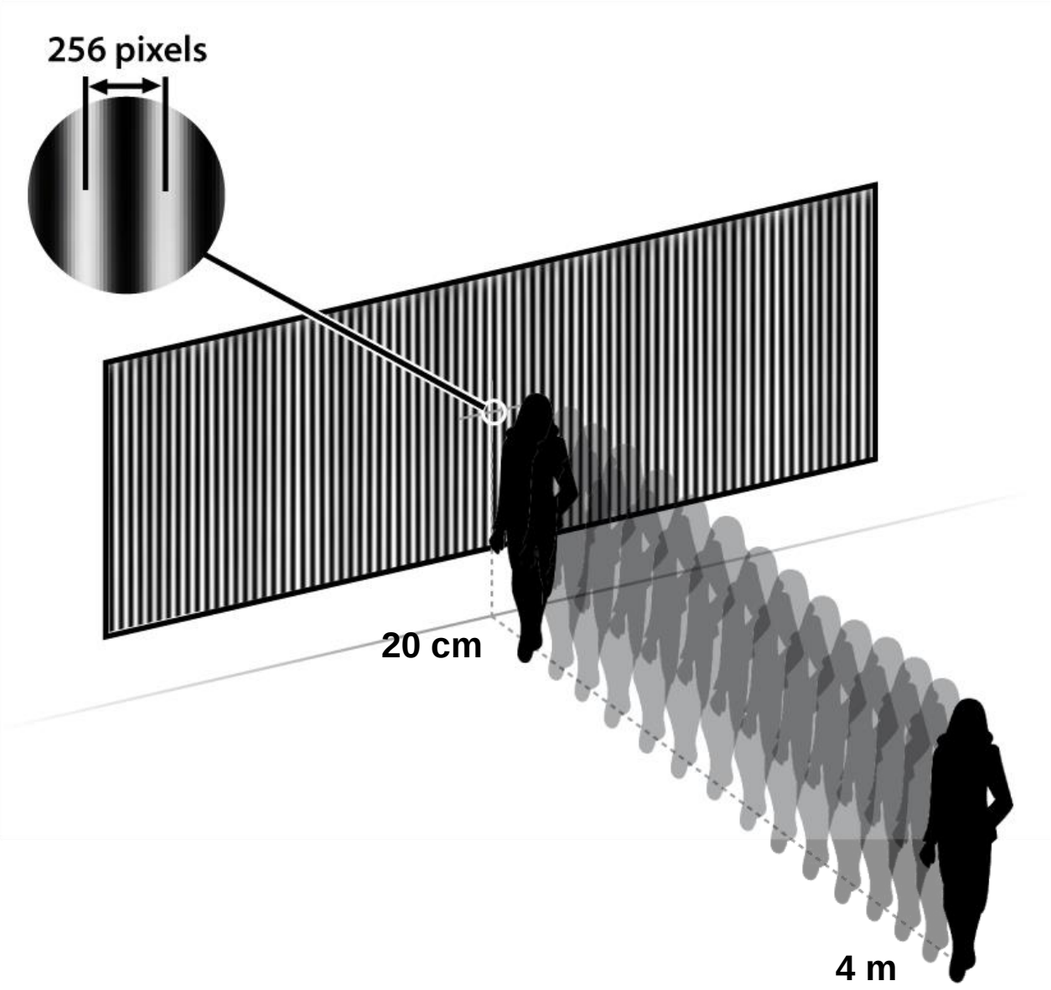

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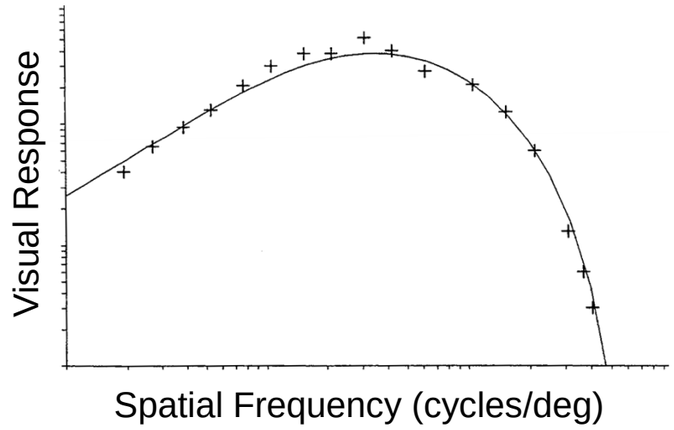
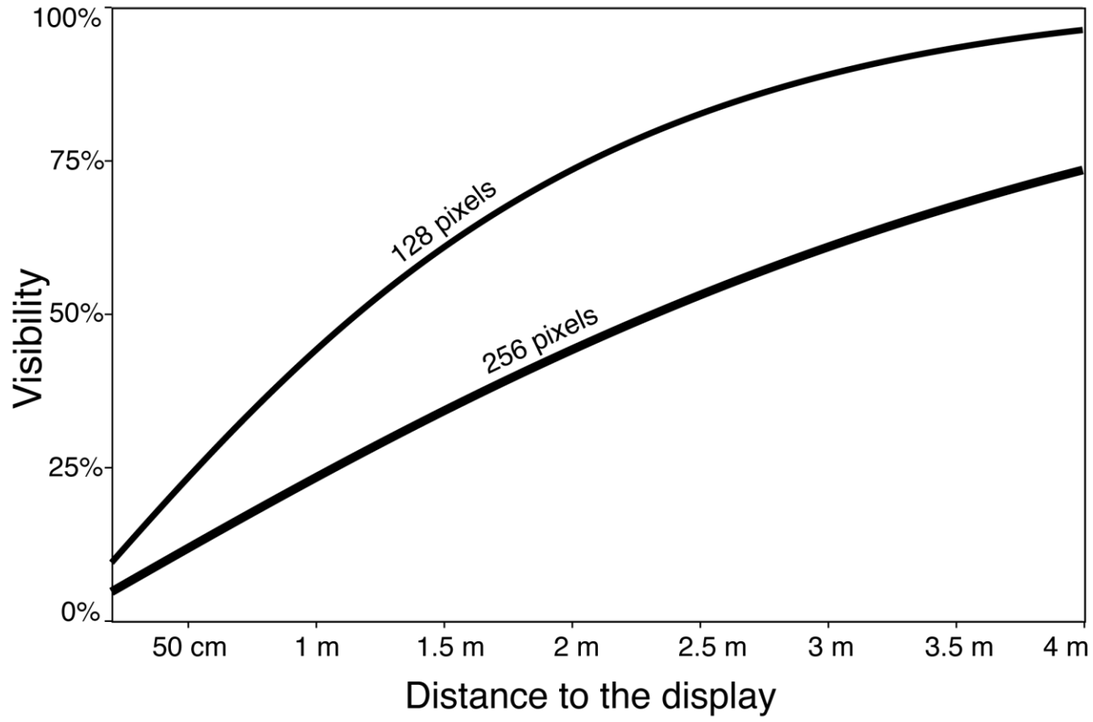
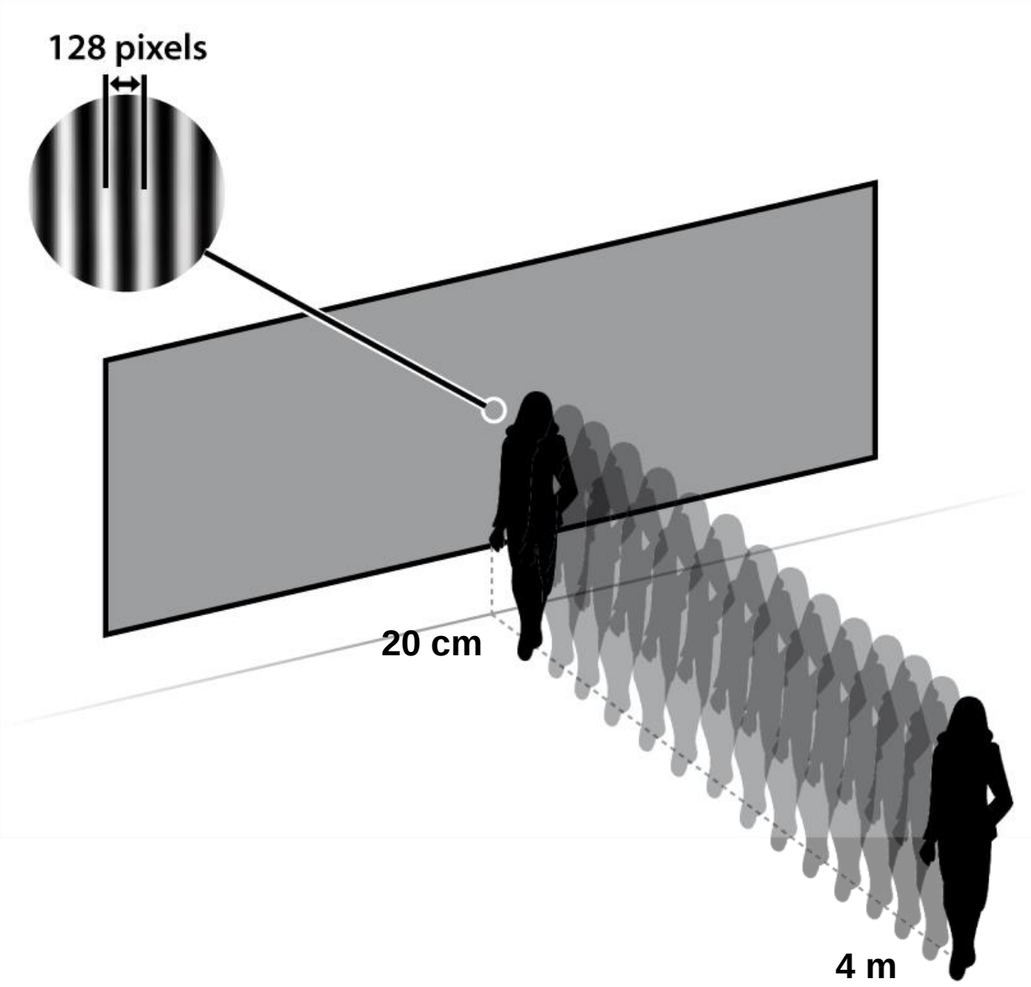
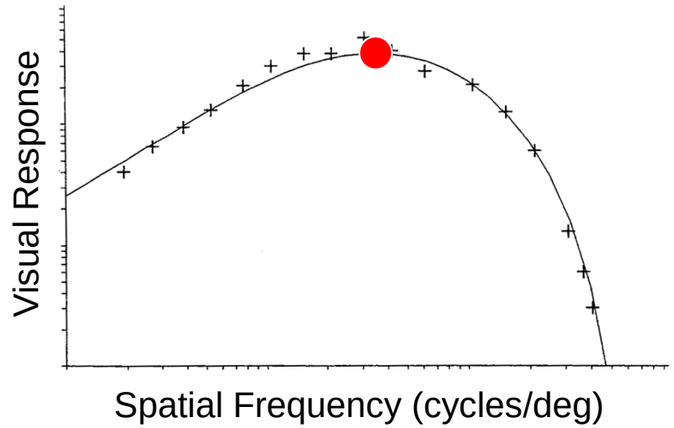
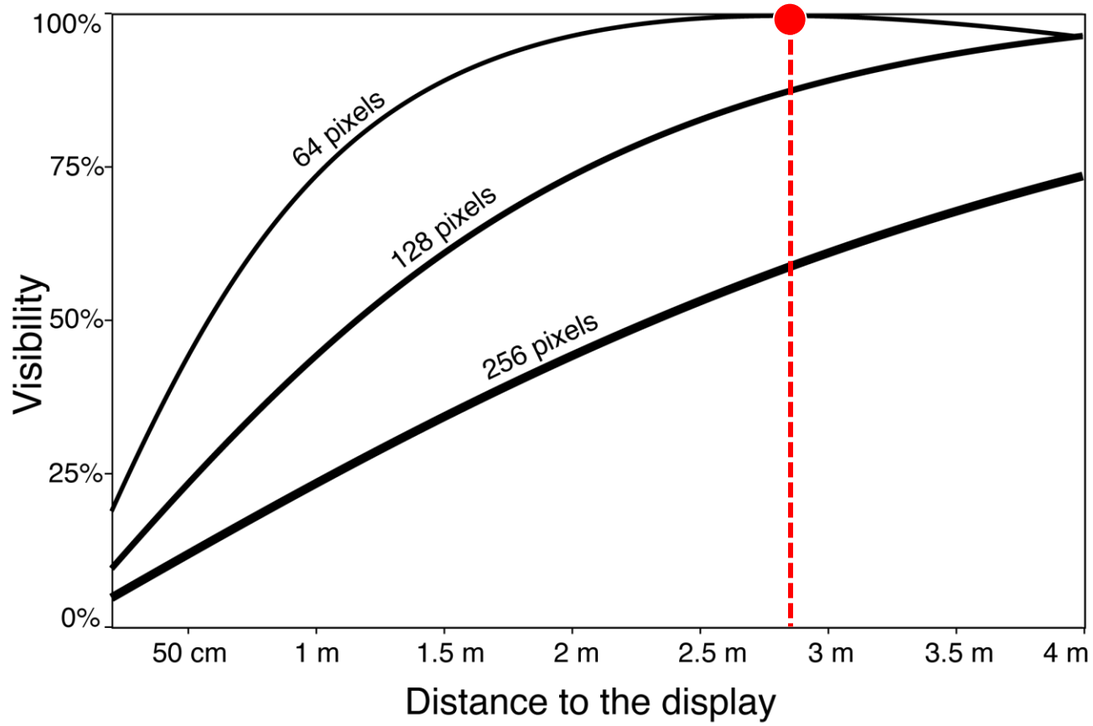


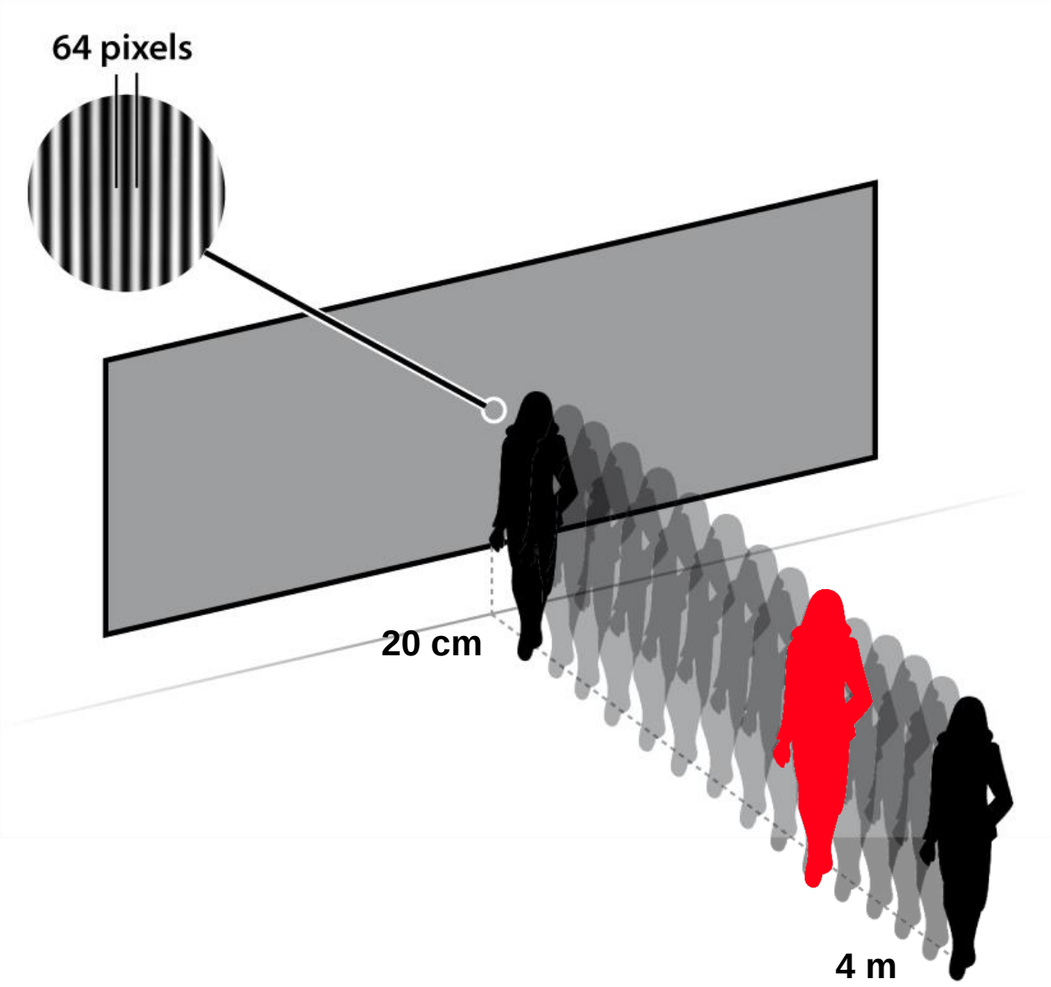




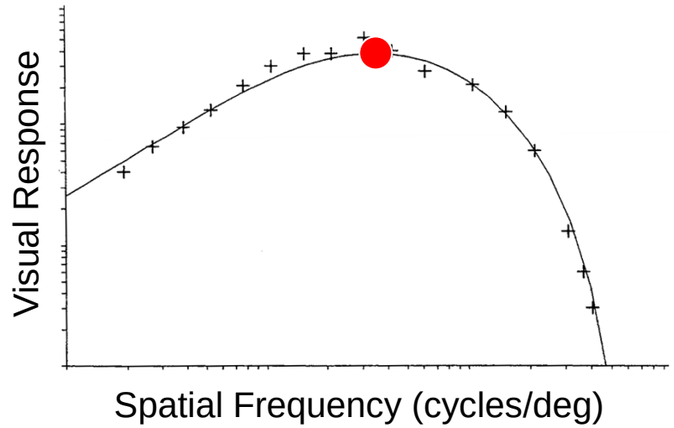
What do we Perceive from a Large Display?

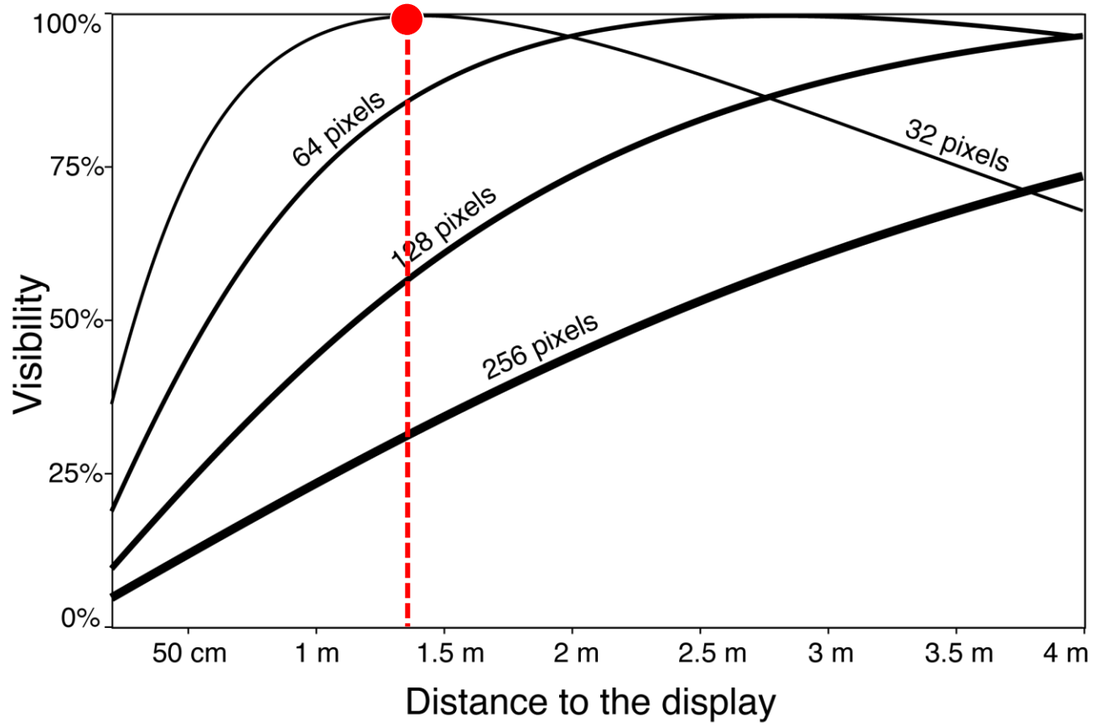


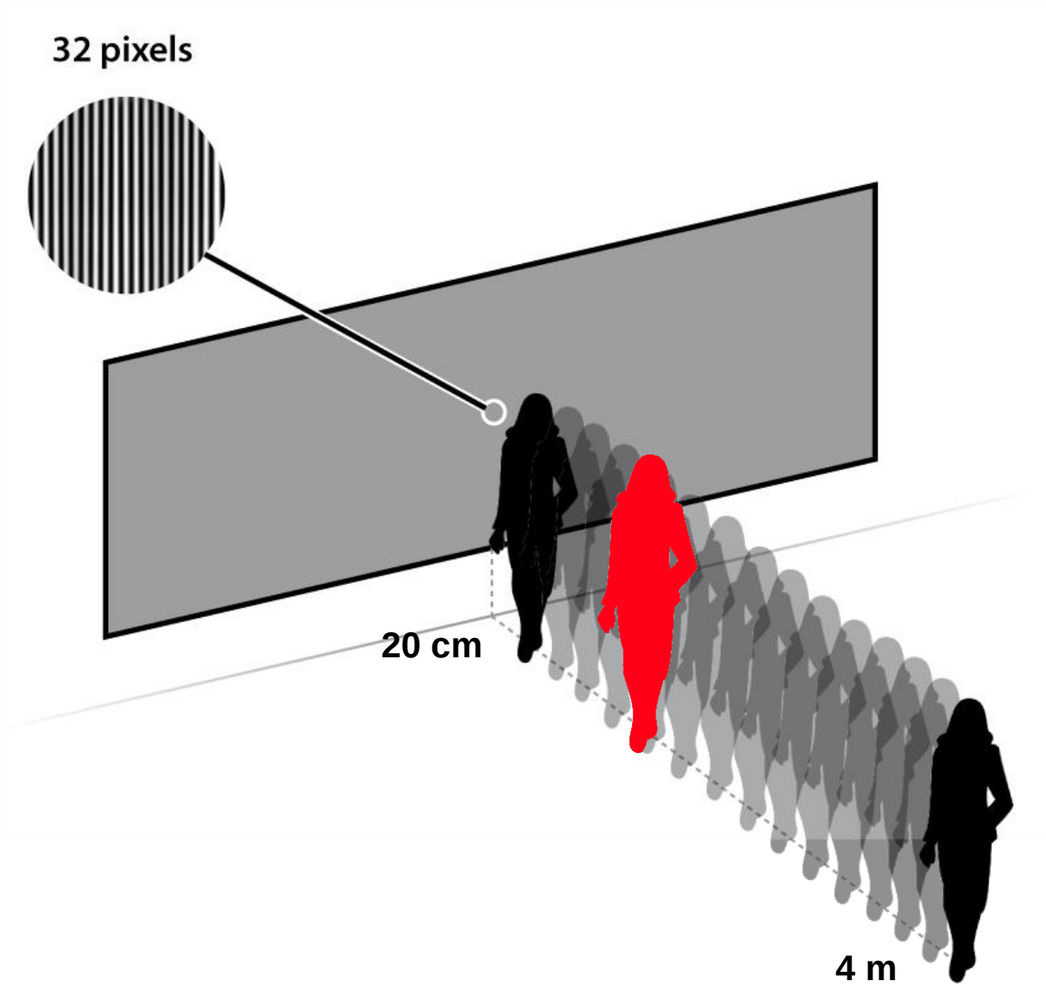




What do we Perceive from a Large Display?







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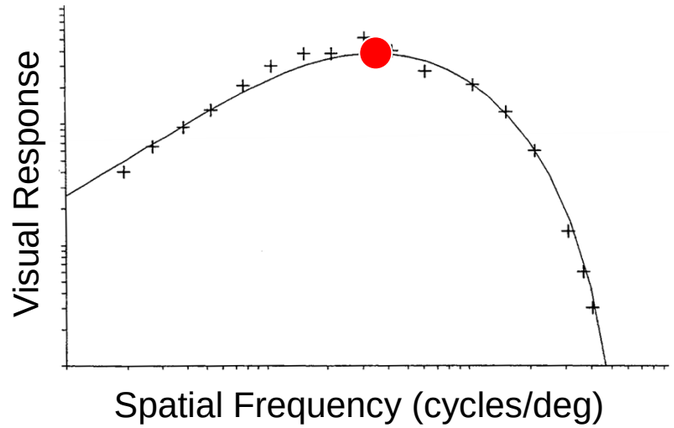

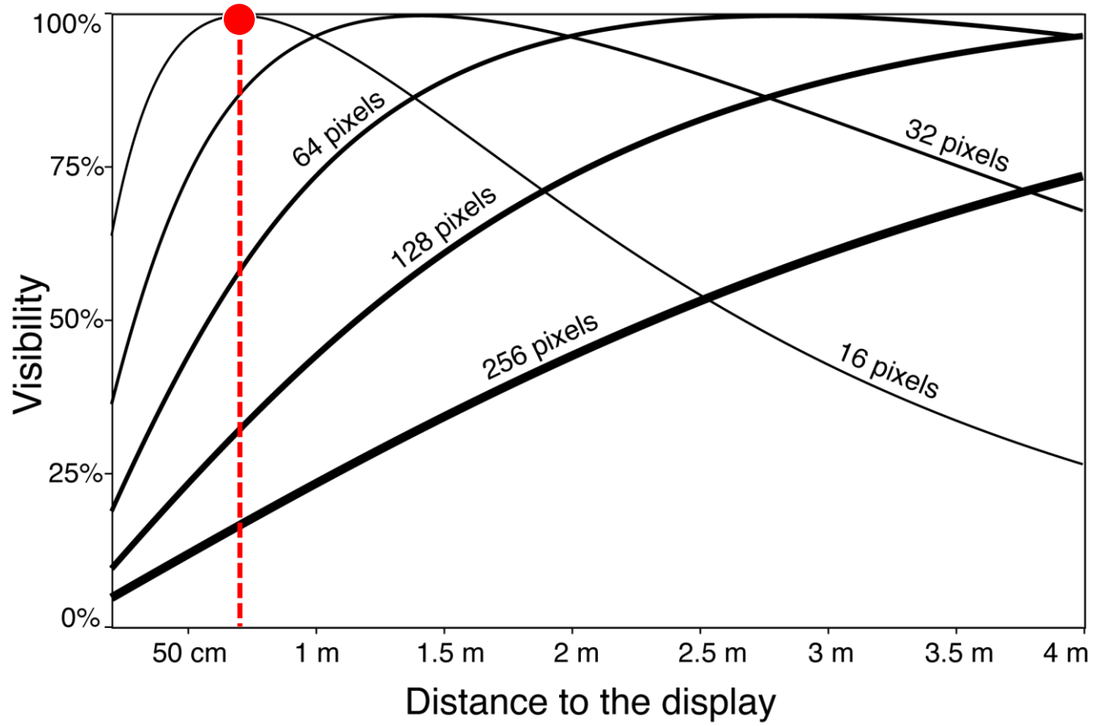

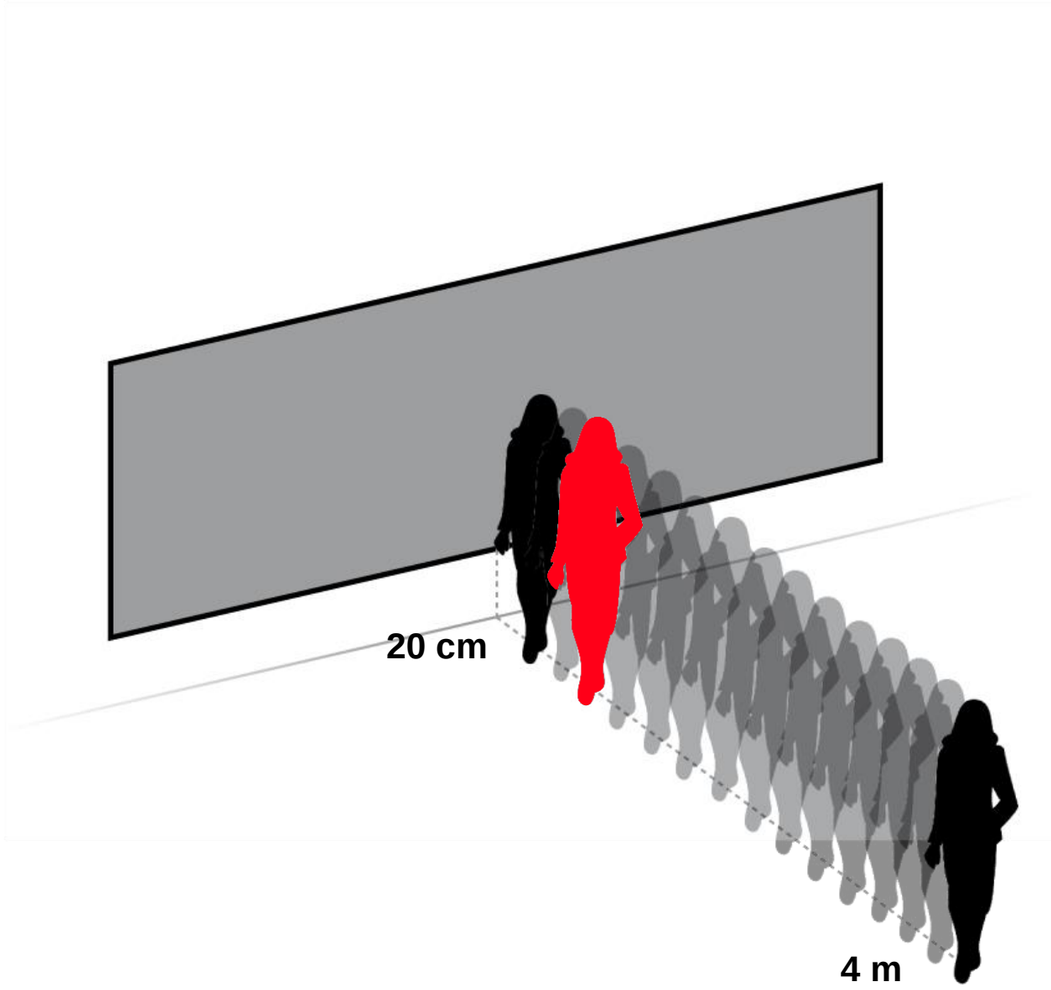

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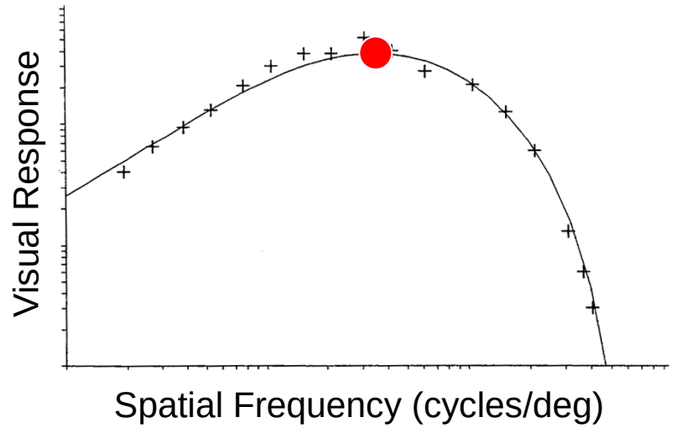

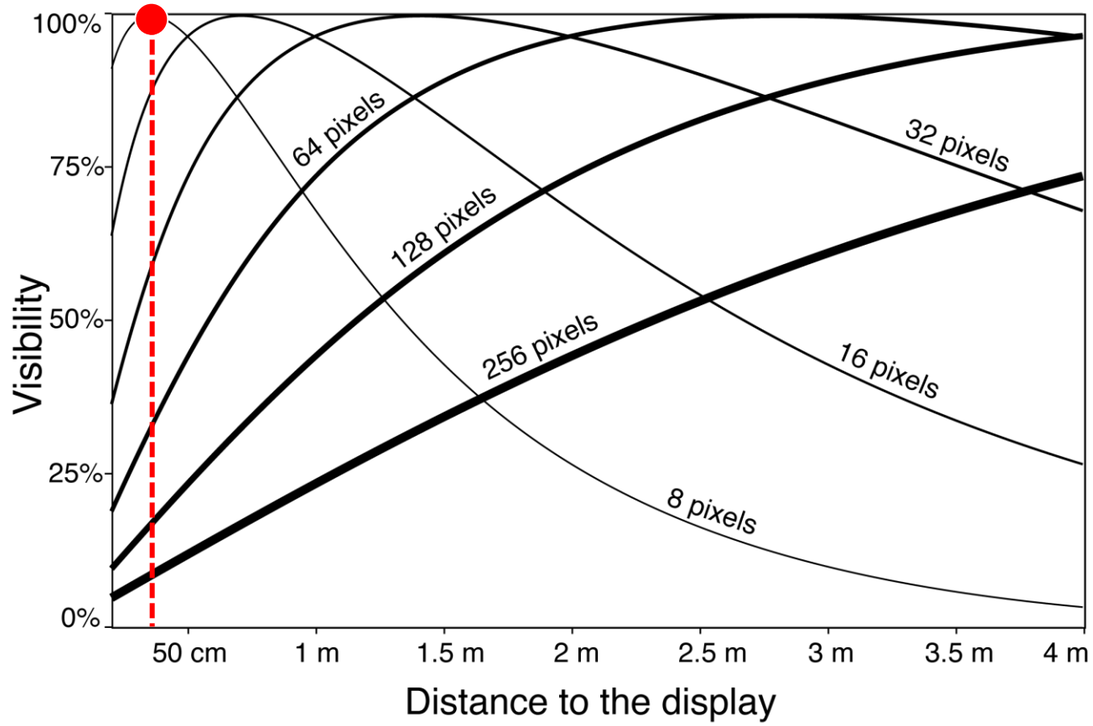

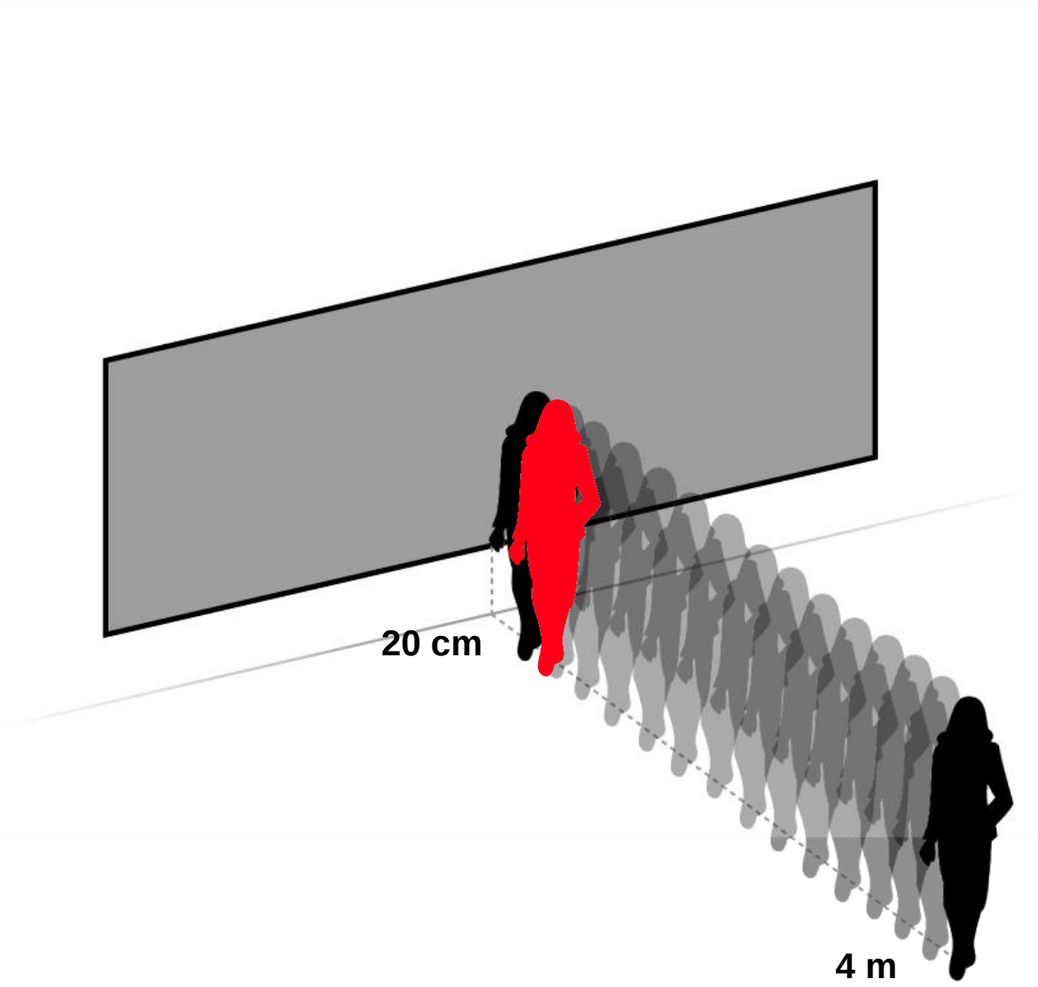

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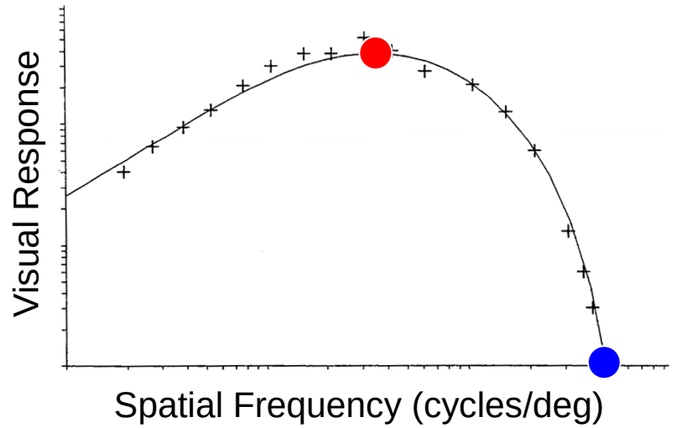

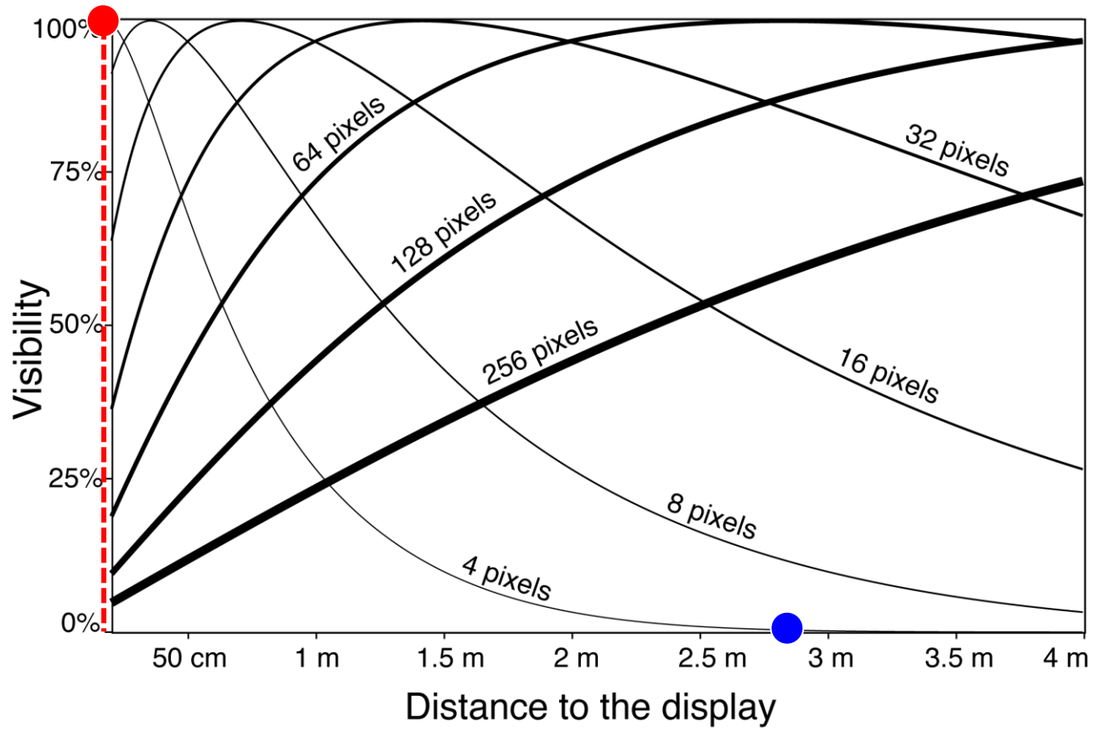

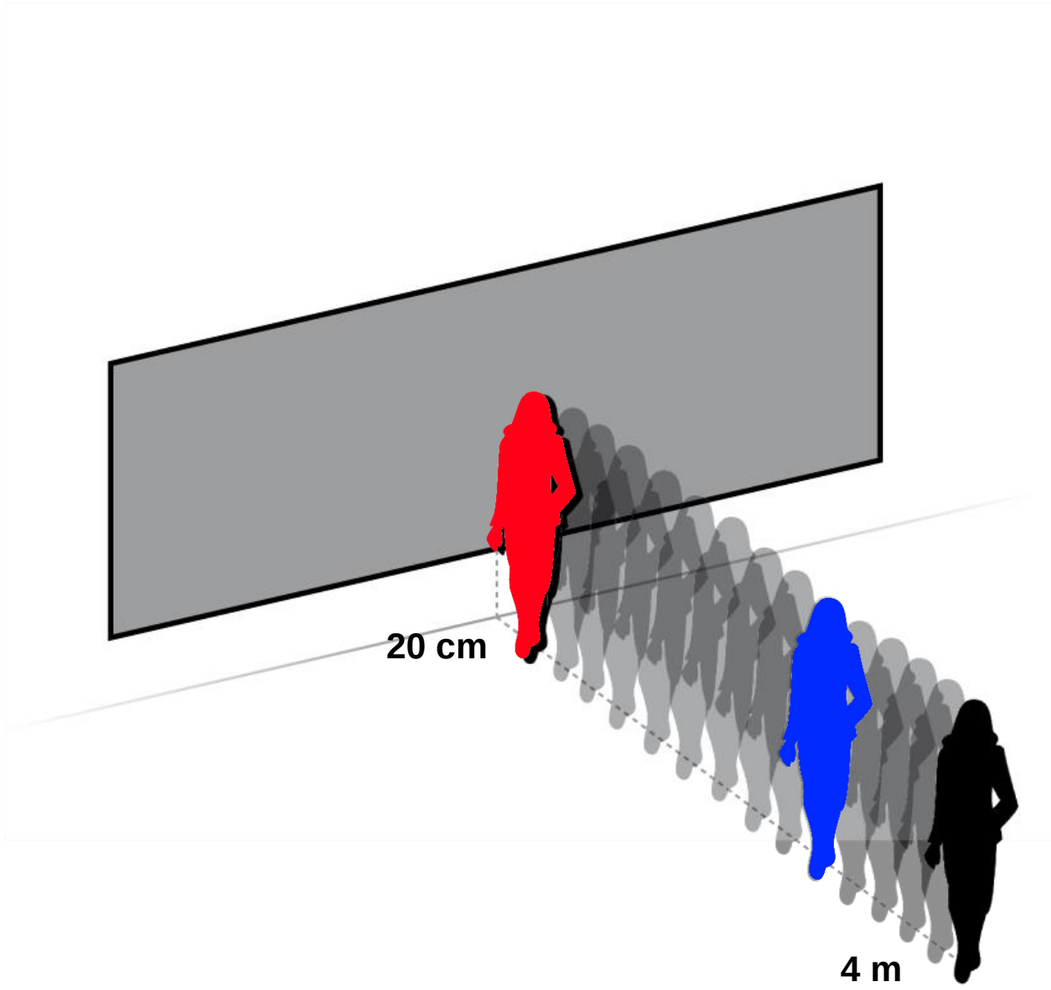

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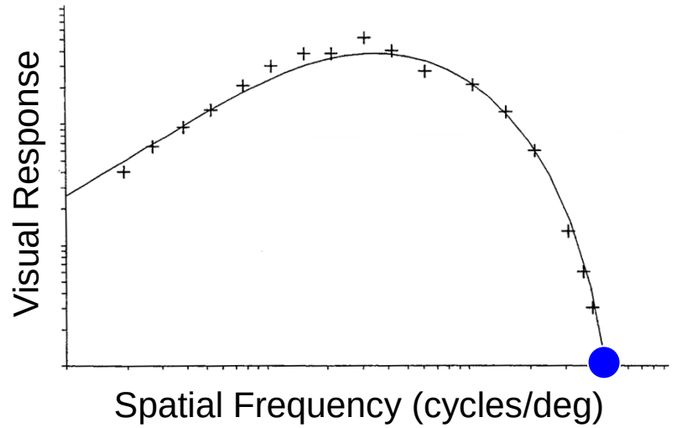

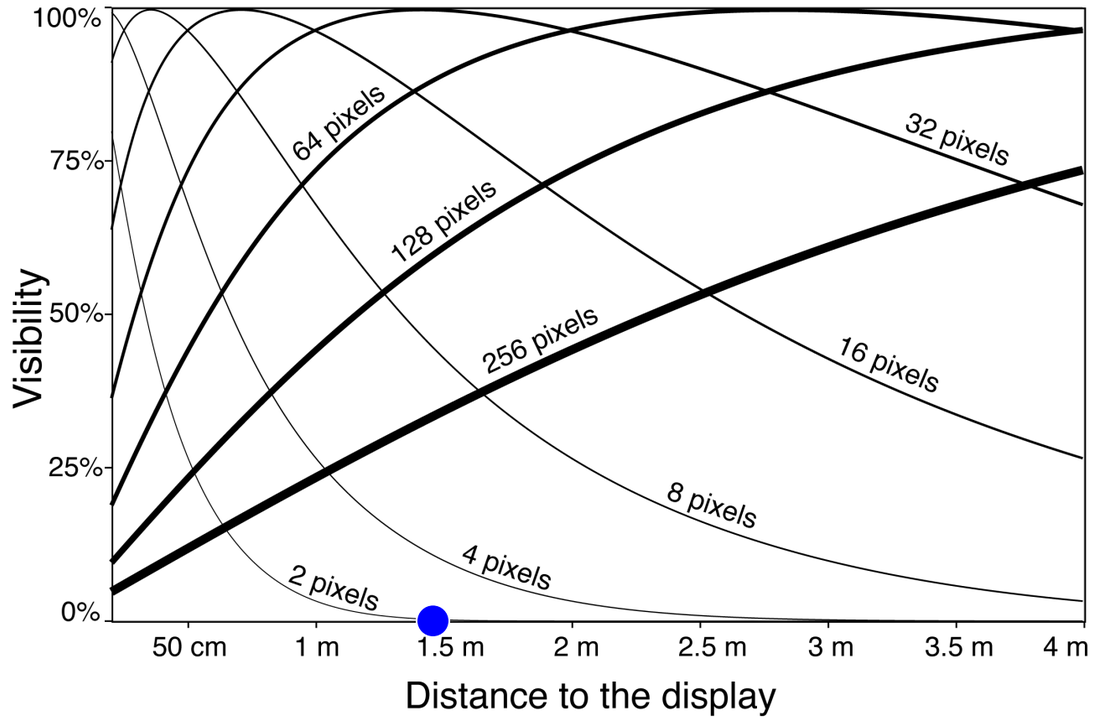

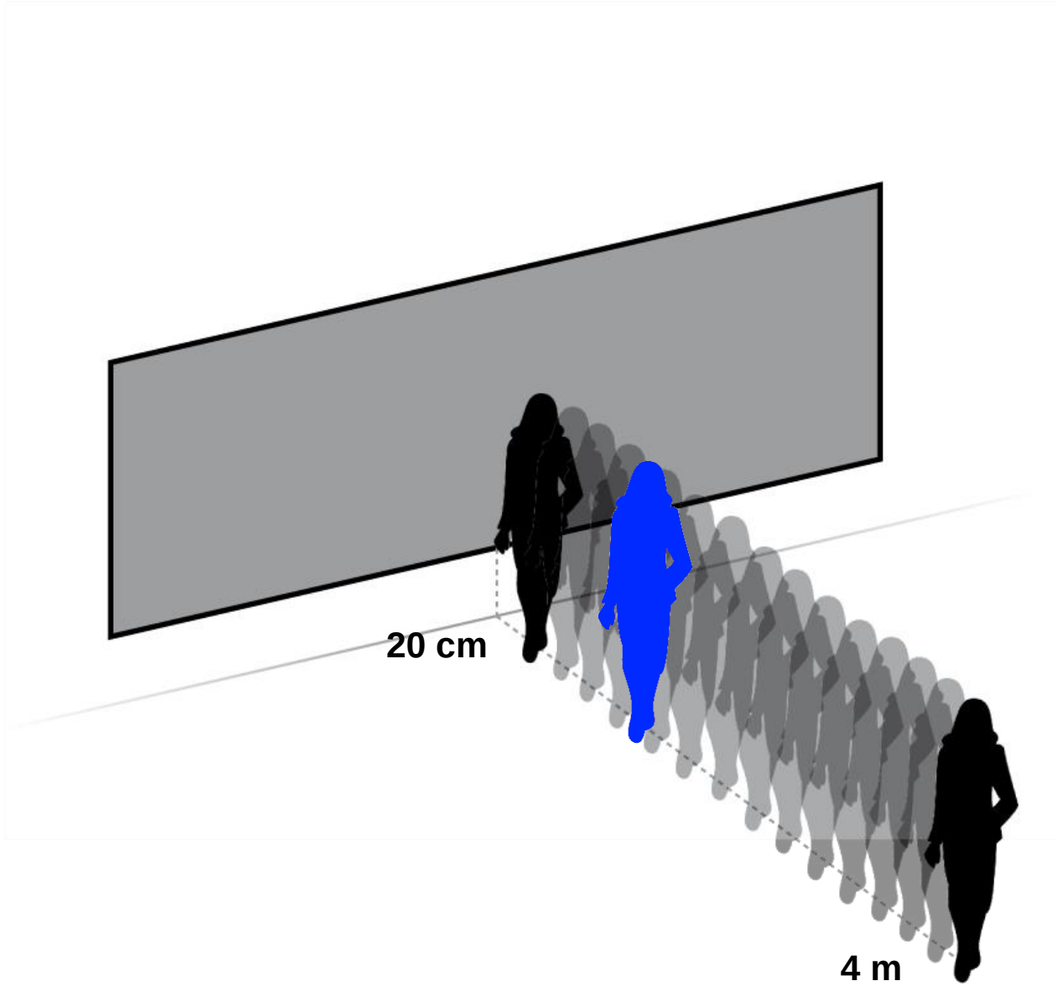

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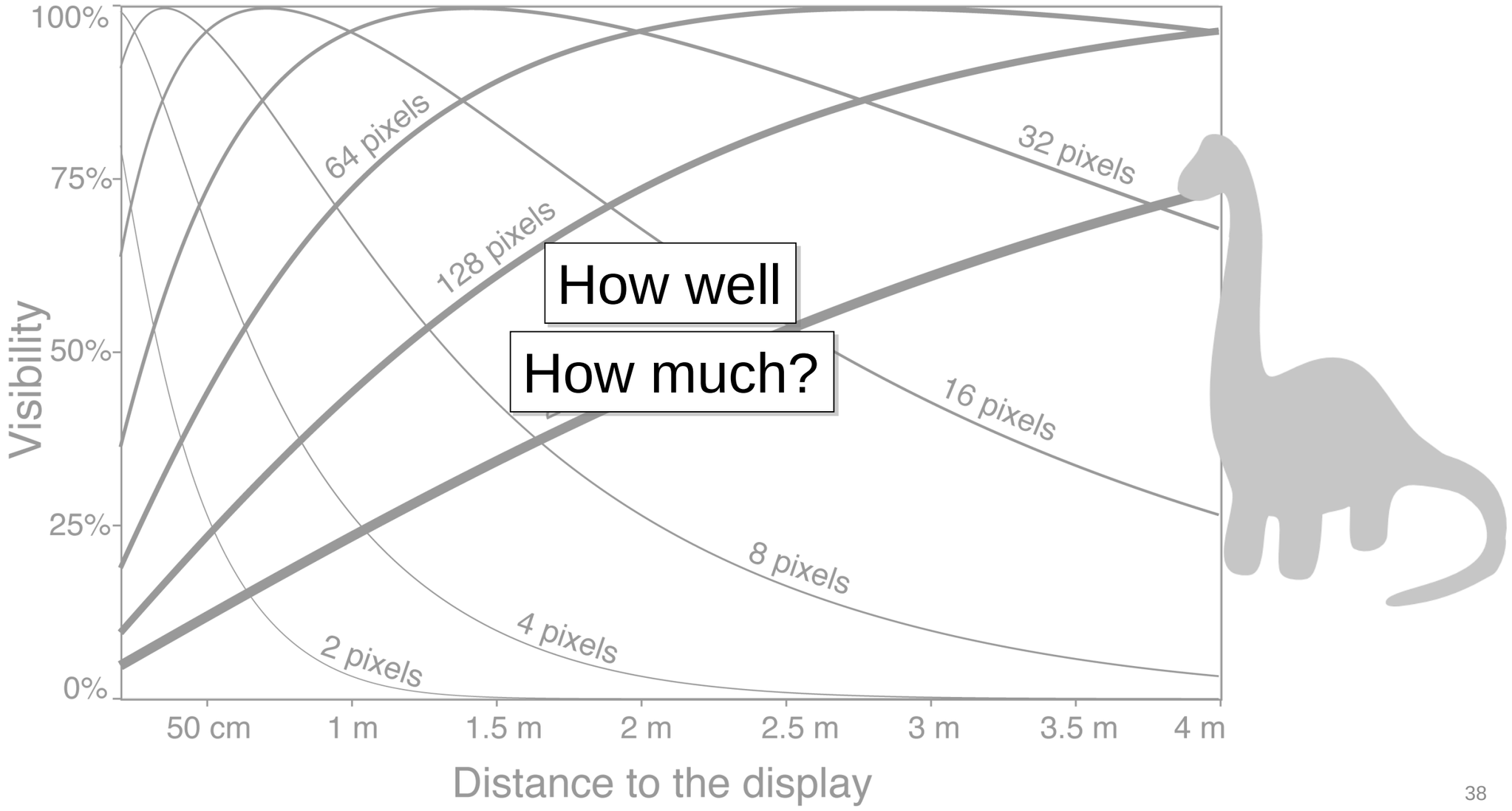
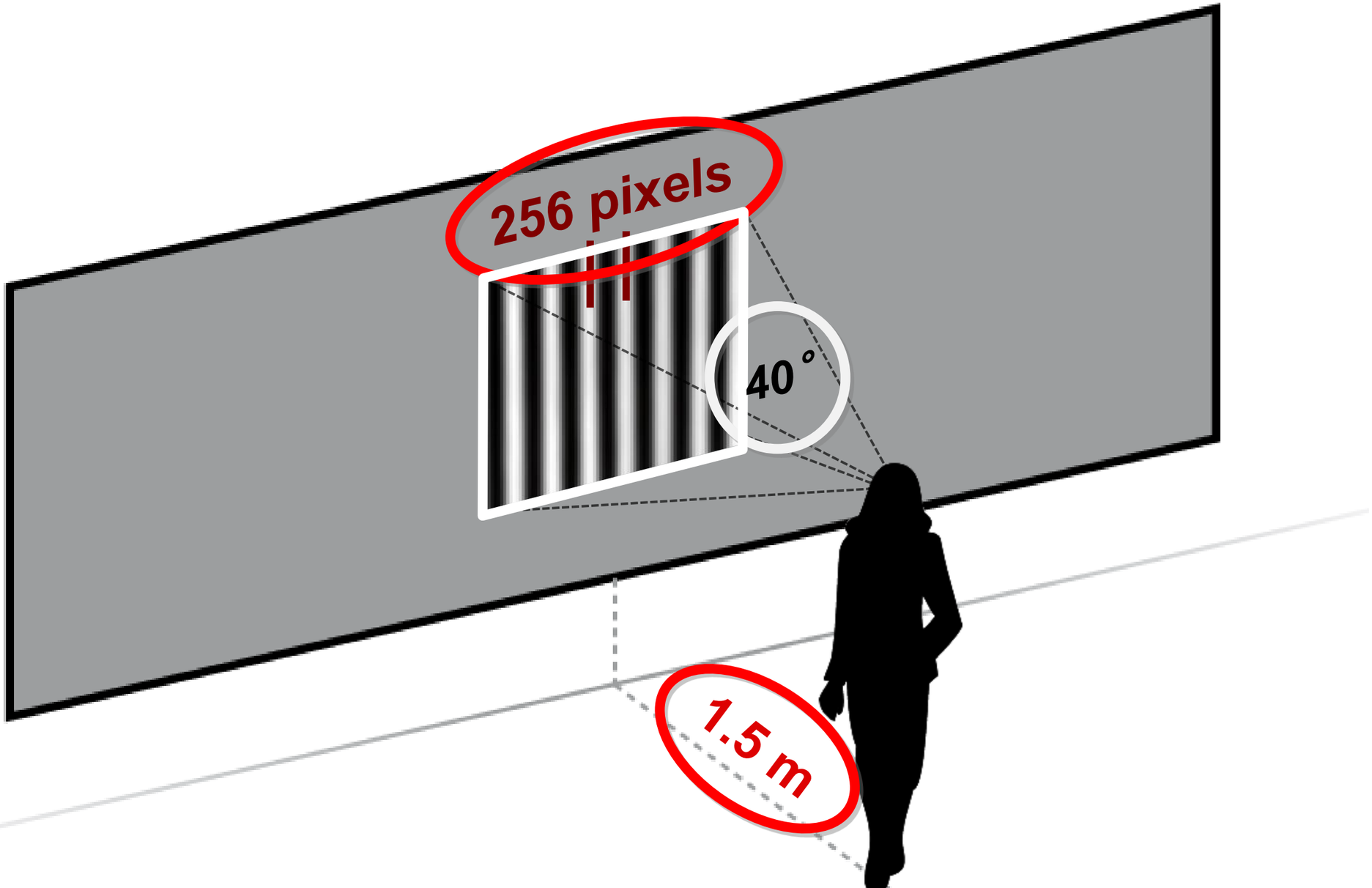
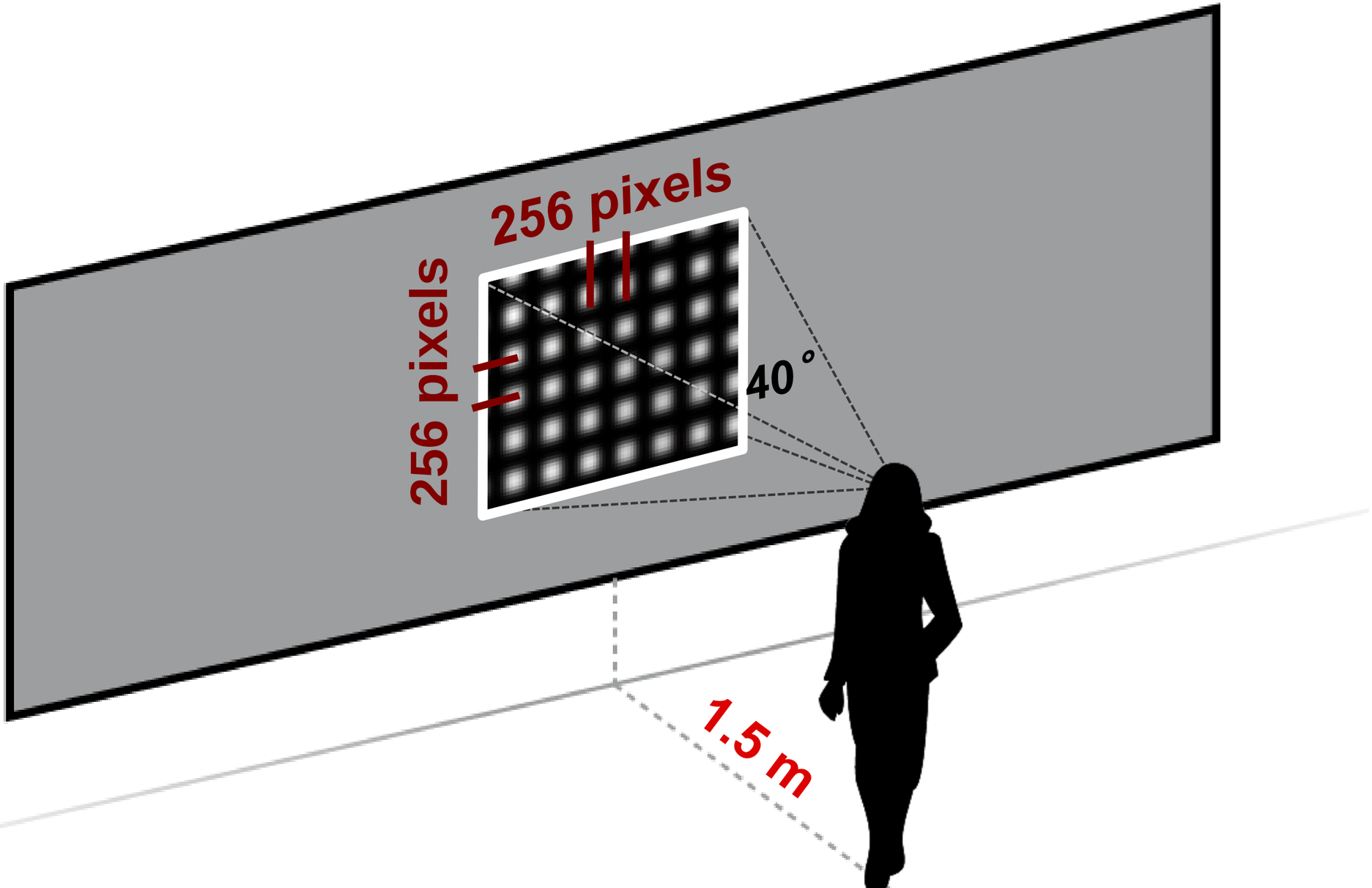


Information Capacity



Information Capacity



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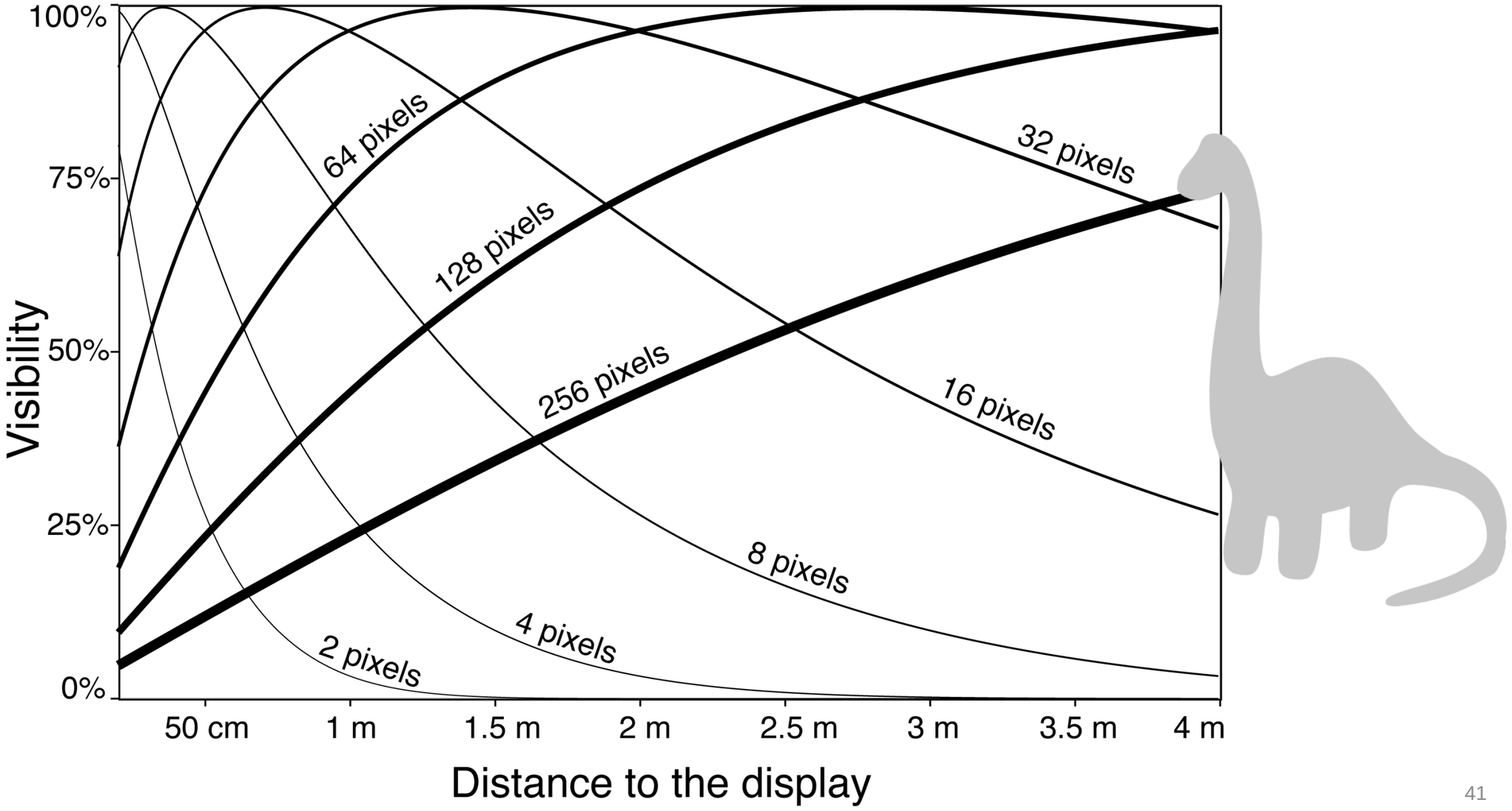

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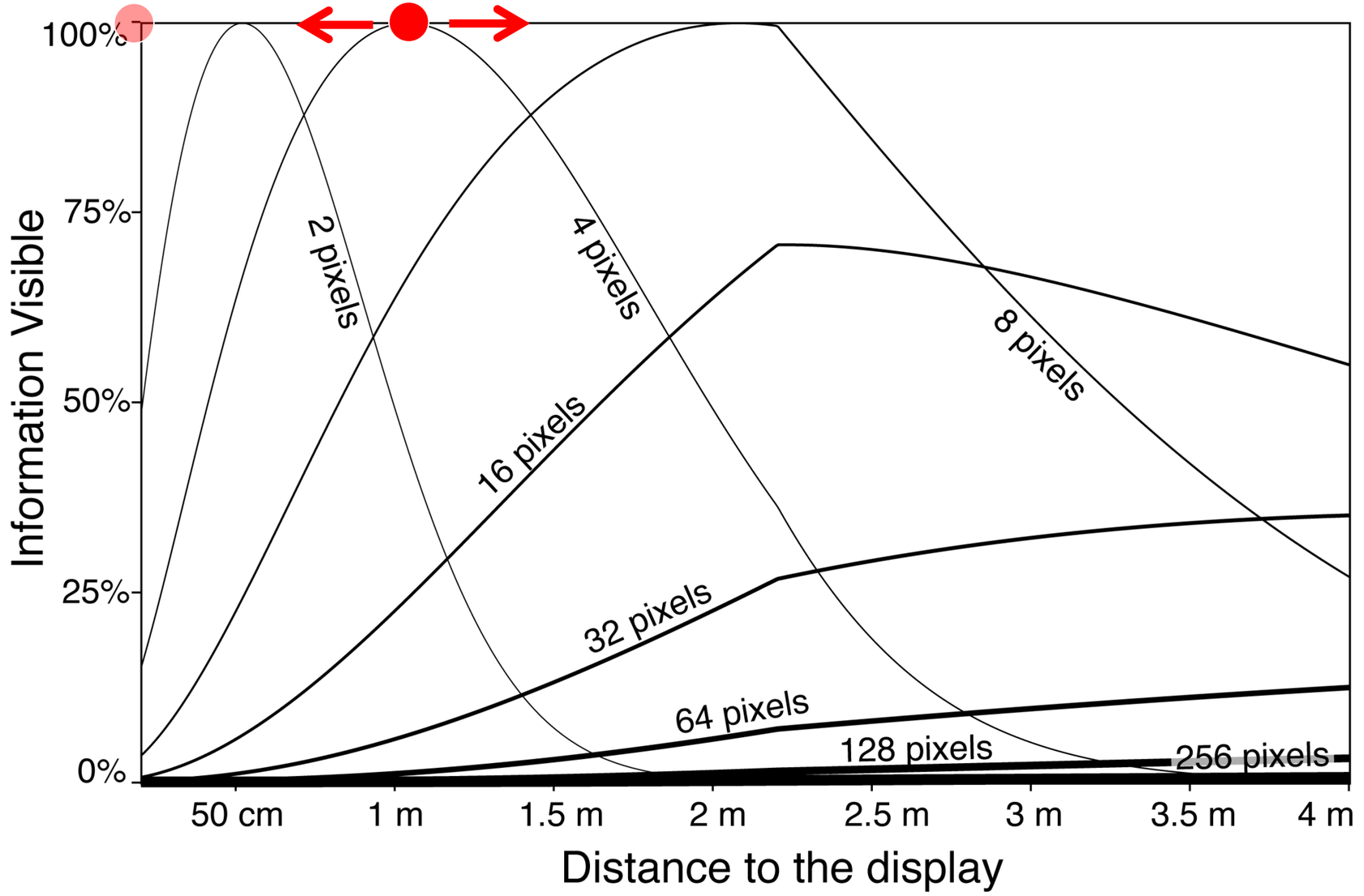
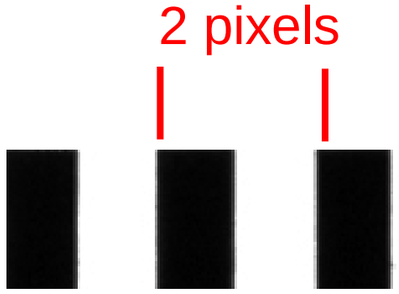
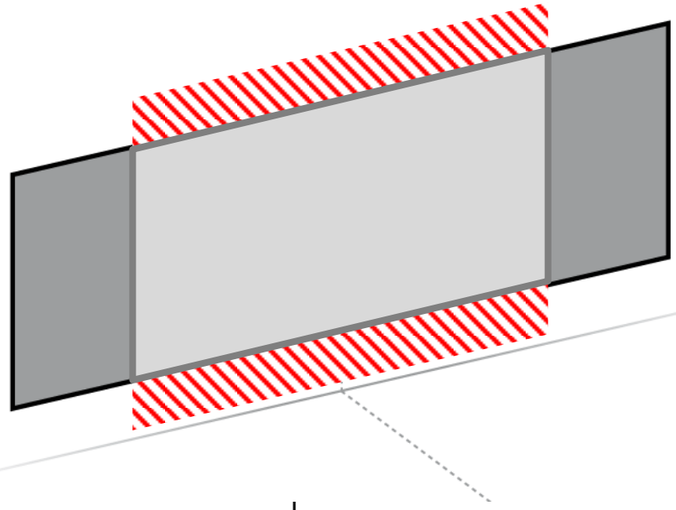
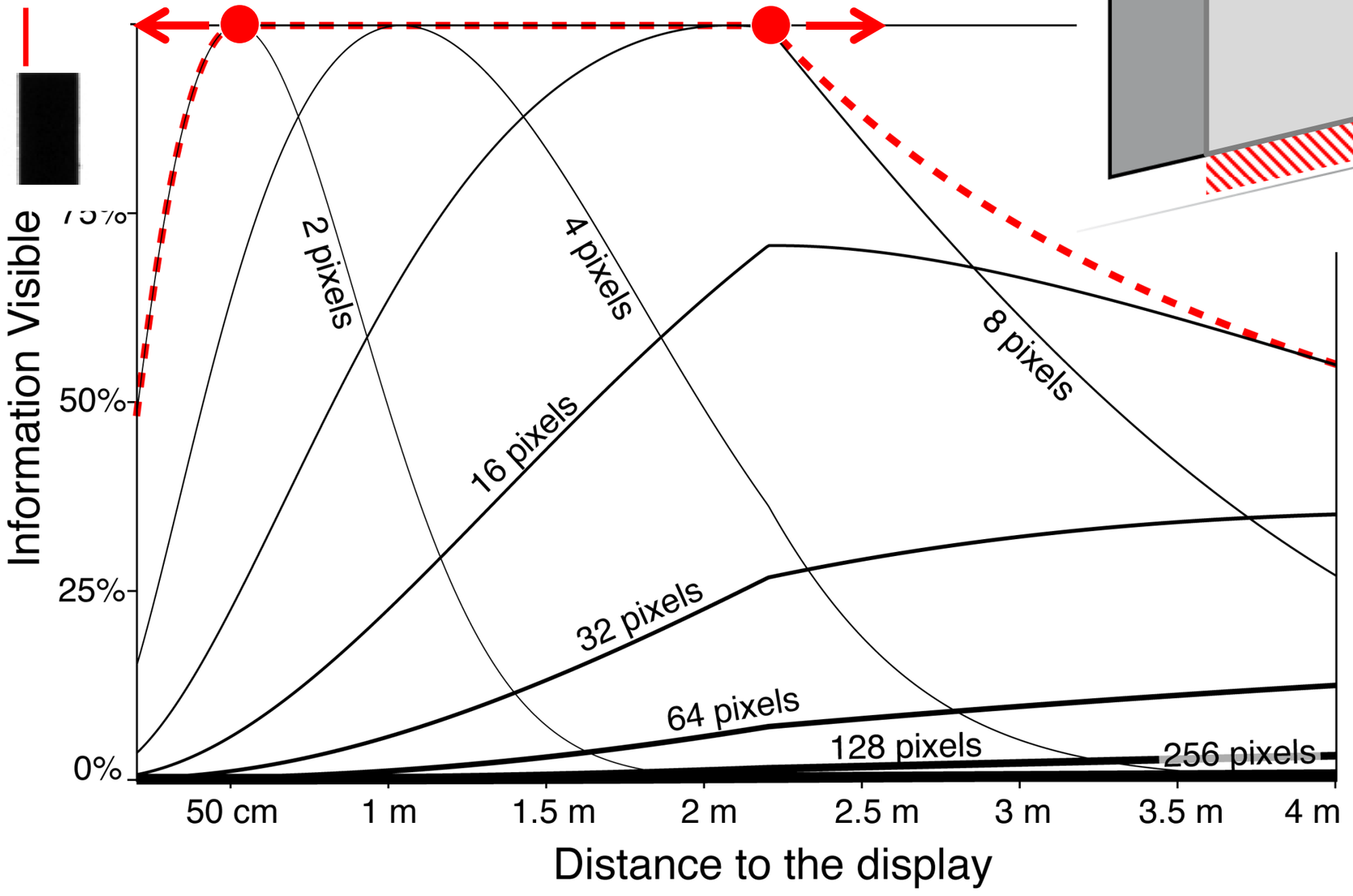


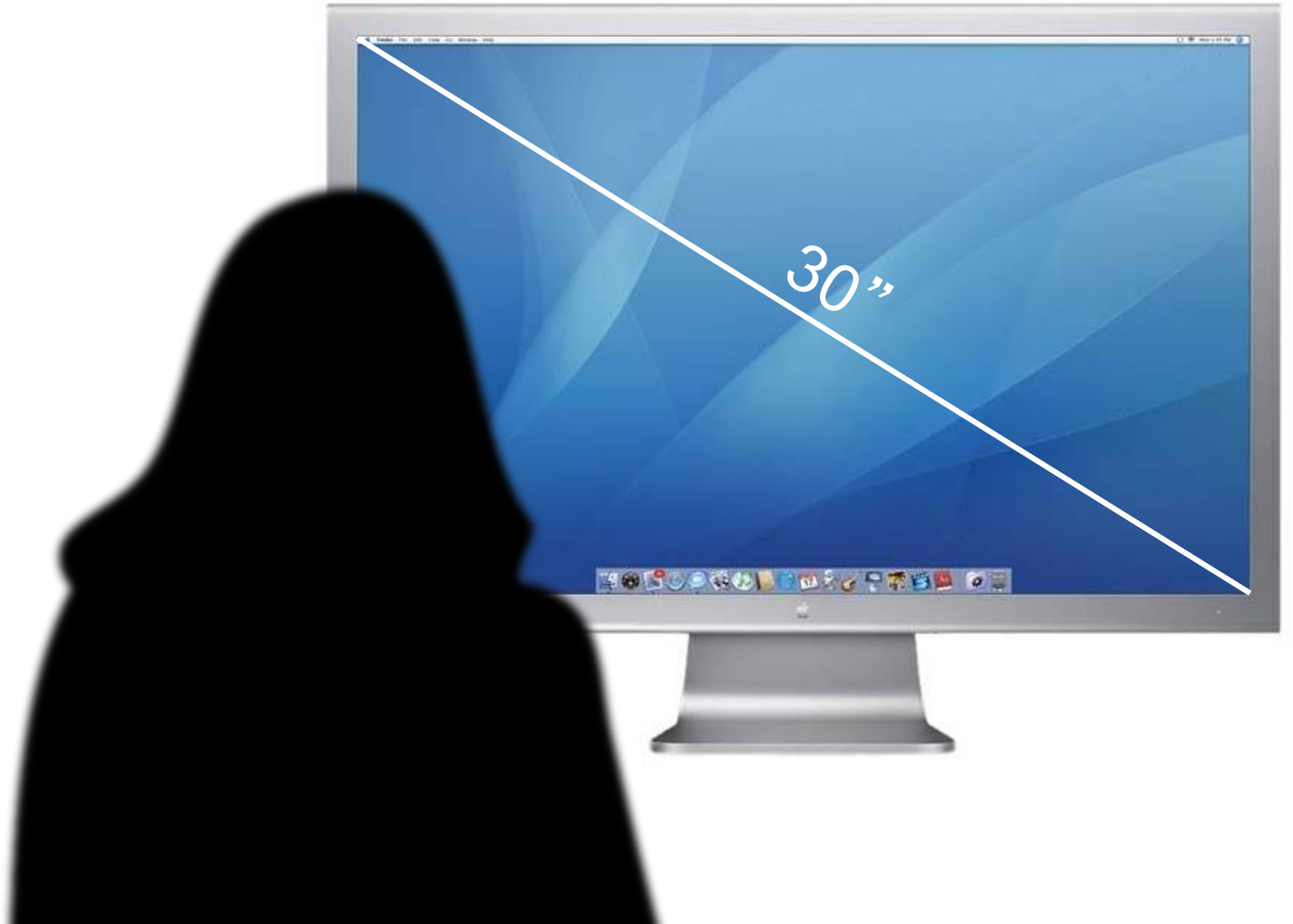
What do we Perceive from a Large I



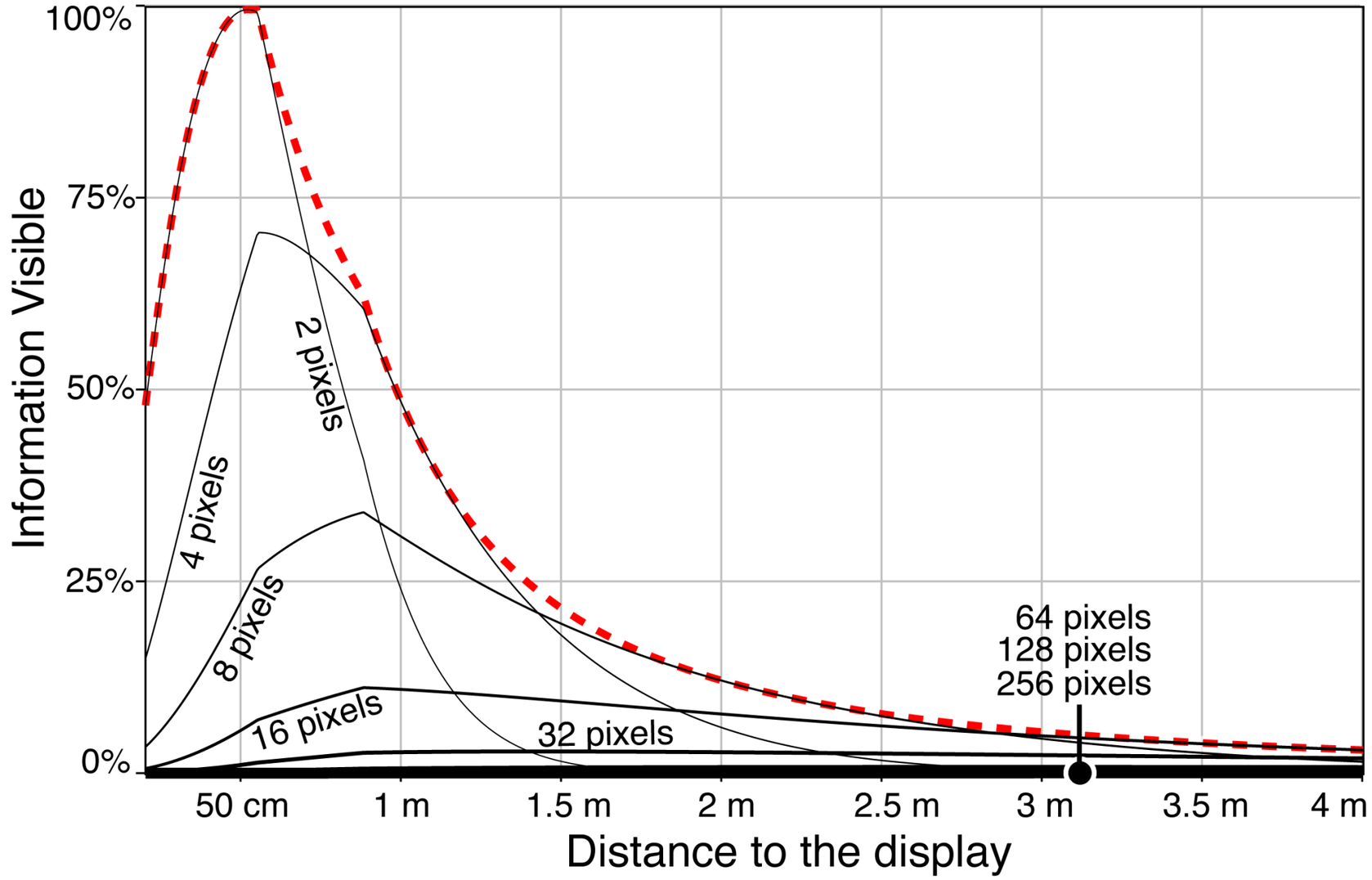




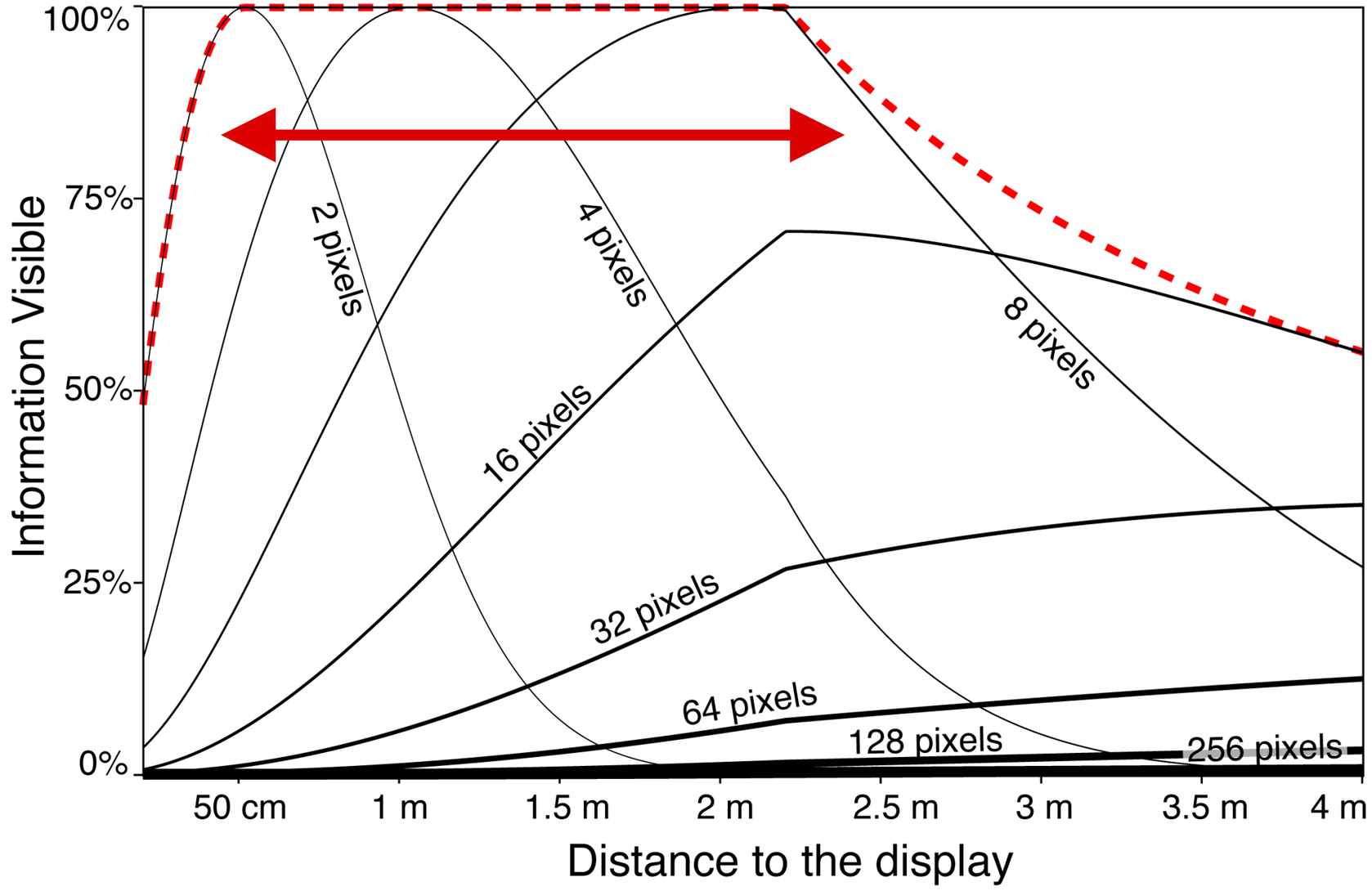
Comparison with a Desktop Display



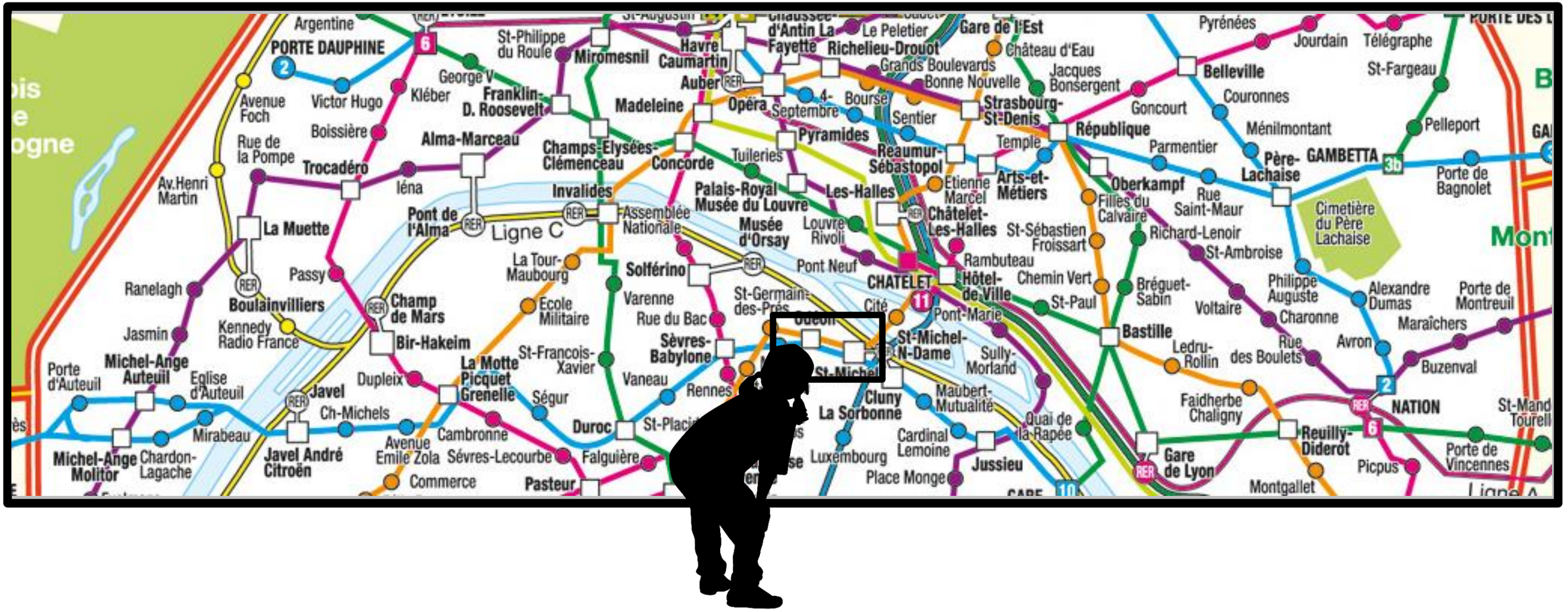
Comparison with a Desktop Display



Leveraging Large Displays

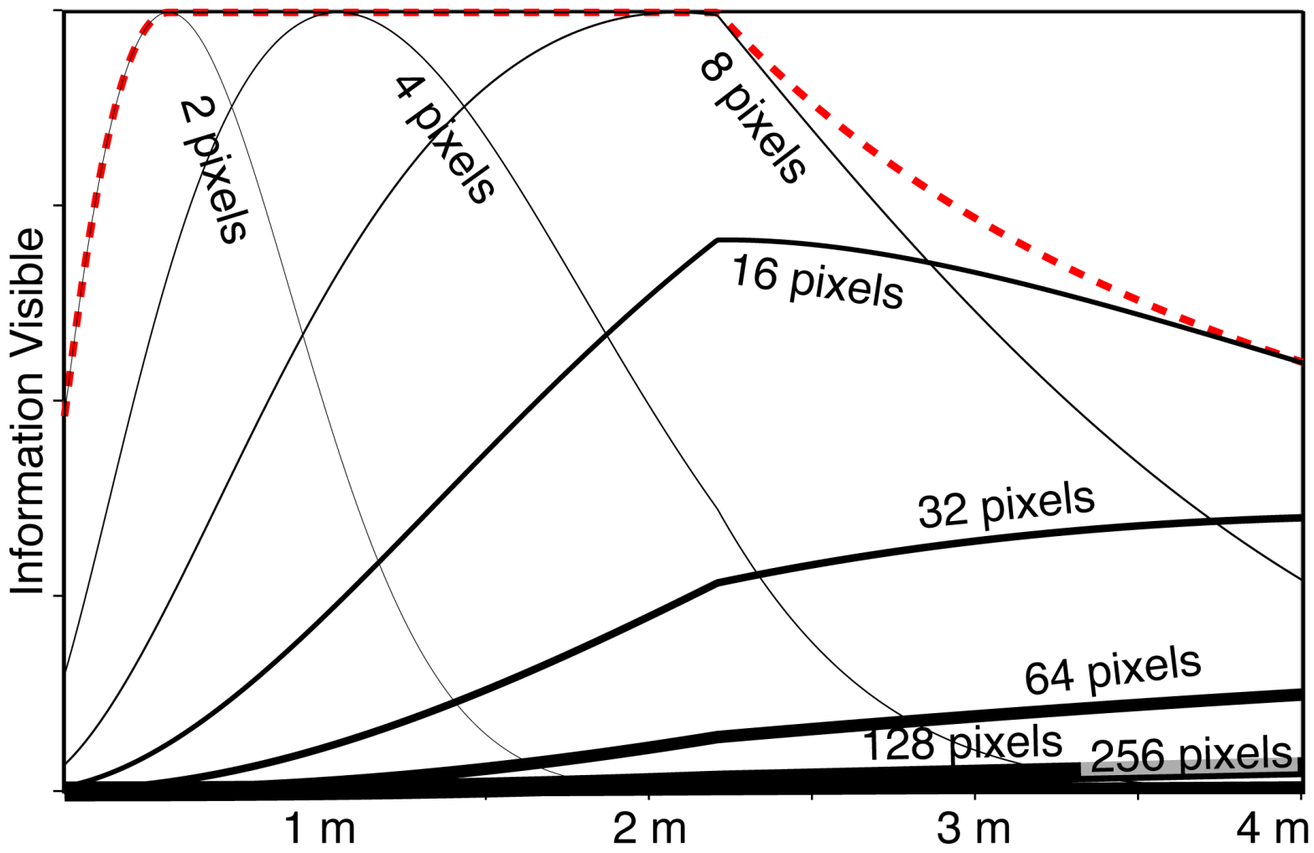


Ineffective Visualizations

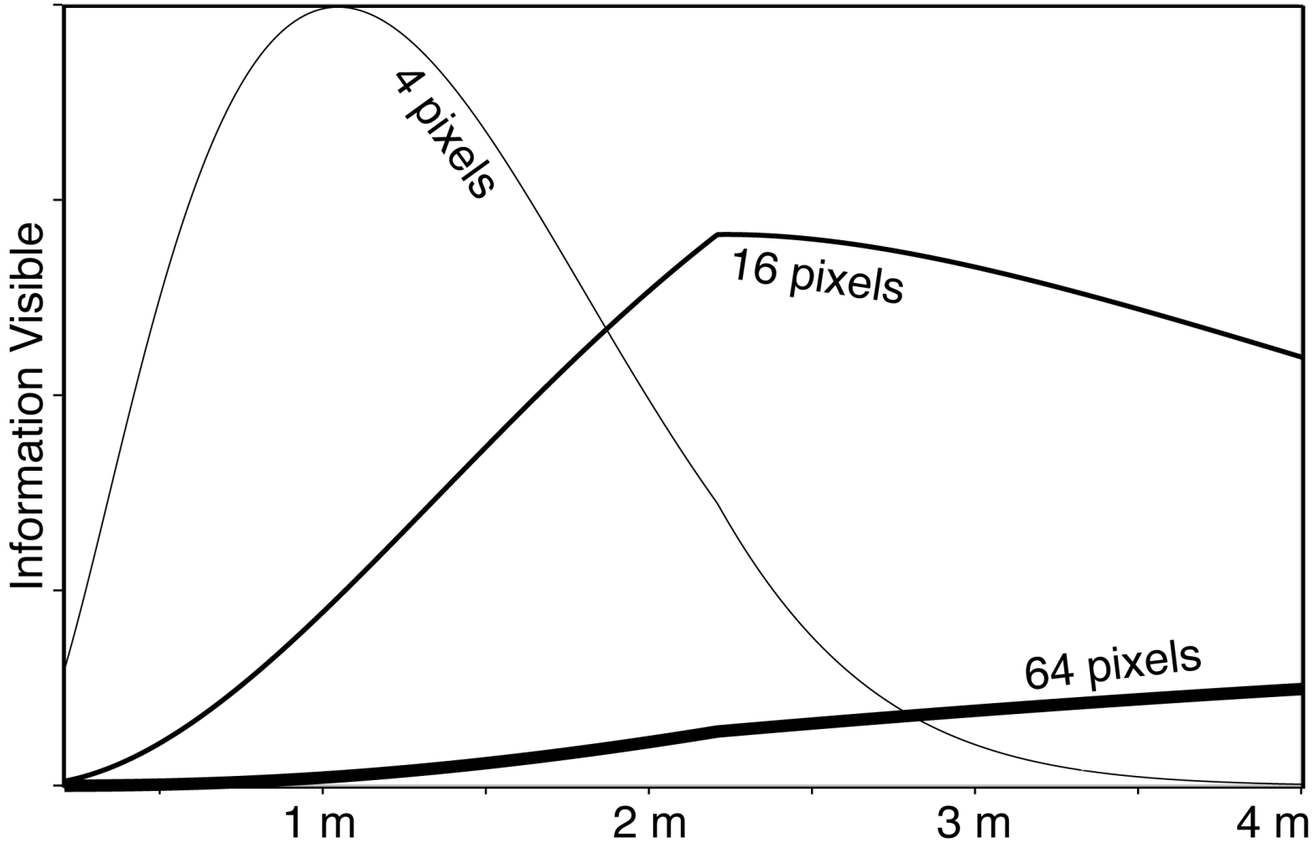



Odéon
abillon
St-Michel

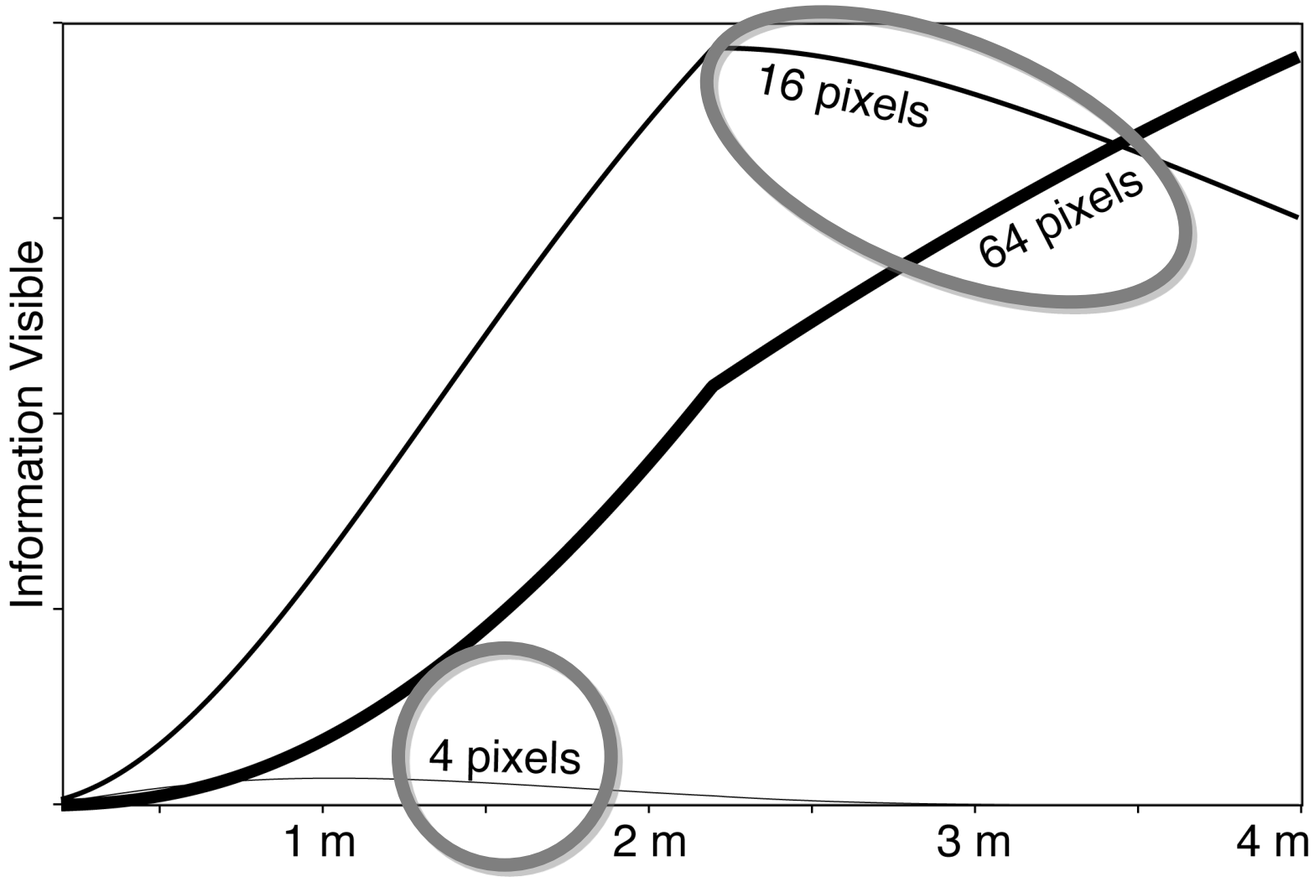
Ineffective Visualizations



Ineffective Visualizations



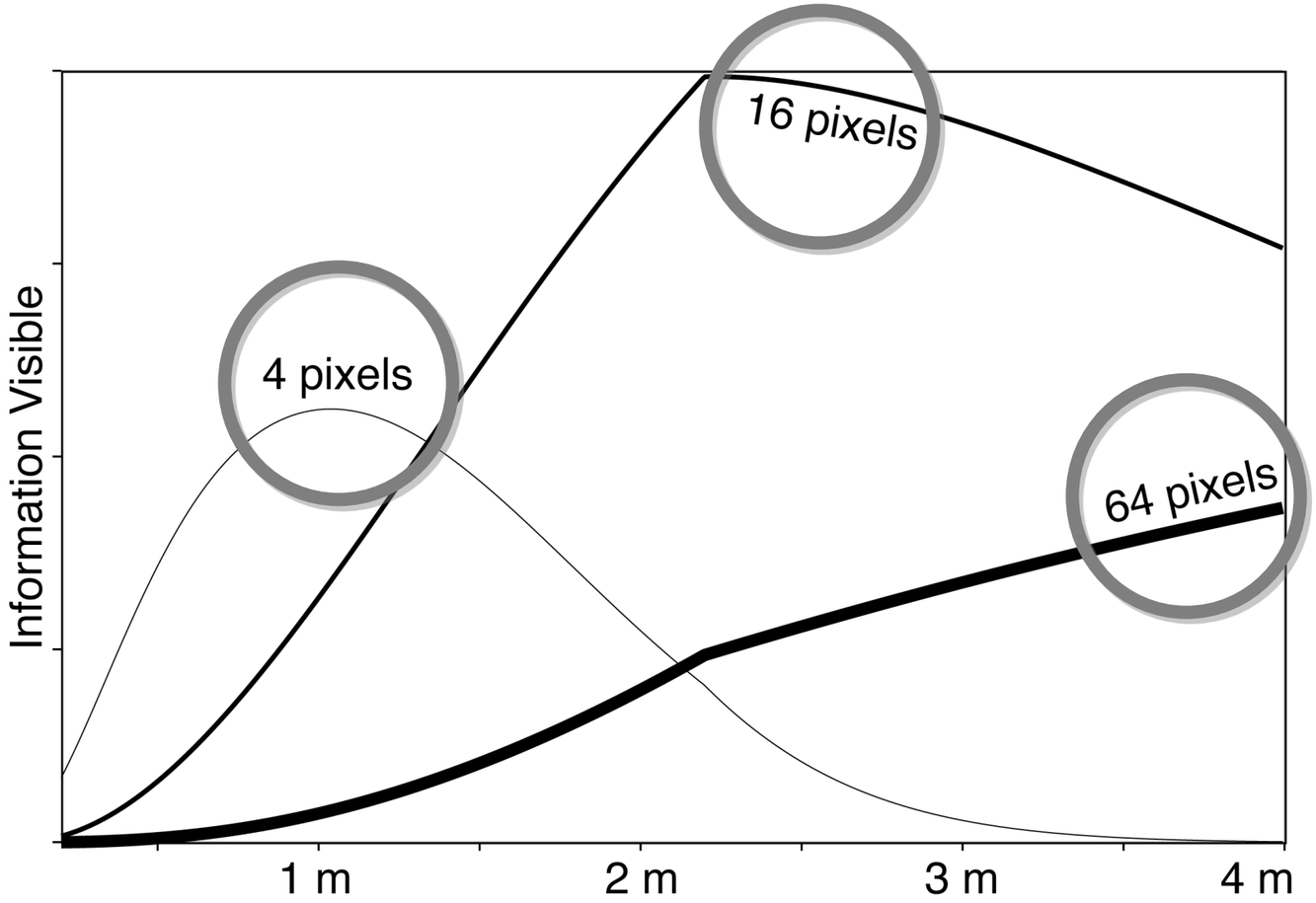
Ineffective Visualizations




Hôtel Dauphine Saint Germain
Hôtel Relais Christine
Rue de Savoie
Rue des Grands
Rue Séguier
Quai des Grands-Augustins
Relais Hotel Vieux Paris
Rue Dauphine
Rue de Buci
Rue Saint-André des Arts
Cours du Commerce Saint-André
Hotel Villa d'Estrees
Saint-Michel
Quai Saint-Michel
RER
Hotel left bank saint germain
Lycée Fénelon
Hotel Eugenie Paris
Place Saint-André-des-Arts
Albe
Holiday Inn Paris - Notre Dame
Bd Saint-Germain
École Élémentaire
Rue Hautefeuille
Bd Saint-Michel
Rue Saint-Séve
Place Henri Mondor
Rue Danton
Théatr'Hall
HOTEL DU LYS
Rue Serpente
Hôtel Parc Saint-Séverin - Paris
Odéon
Miss Coquines
Hotel Le Relais Saint Germain
Hotel du Globe
UFR Biomédicale
Square Andr
Lefevre

Ineffective Visualizations

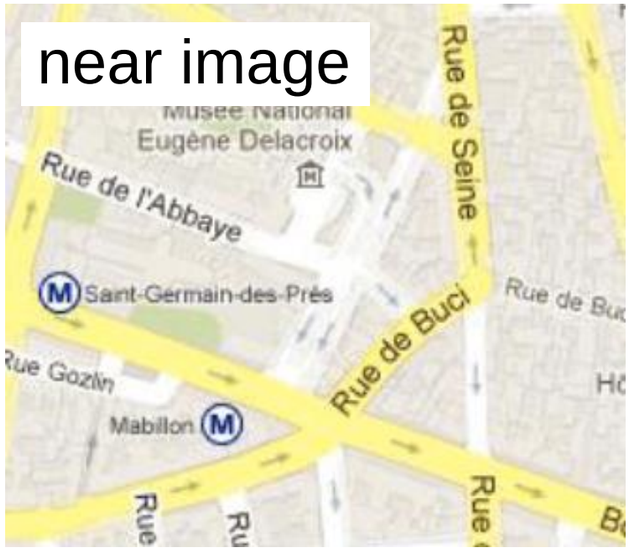
Ineffective Visualizations



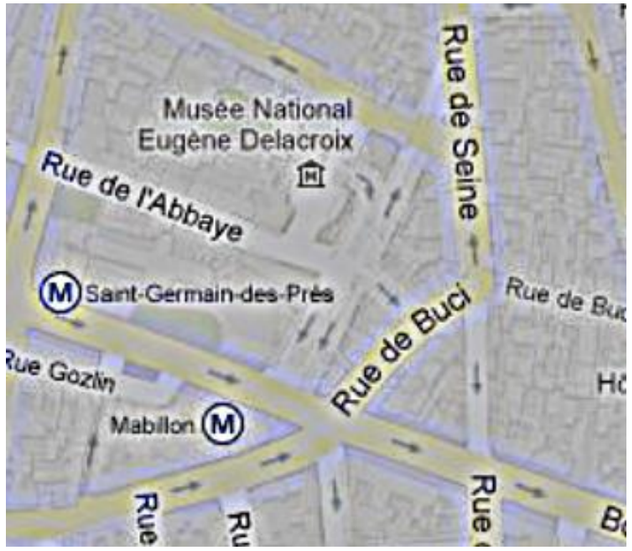
Ineffective Visualizations

Hybrid-Image Visualization

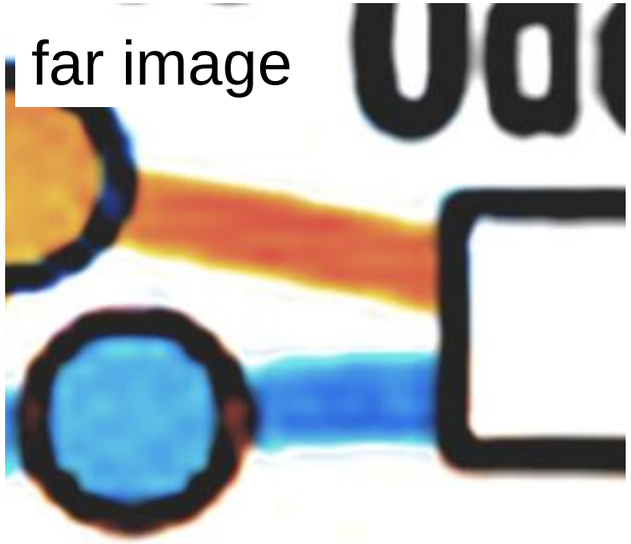
near image



Hi-pass Filter
+ contrast

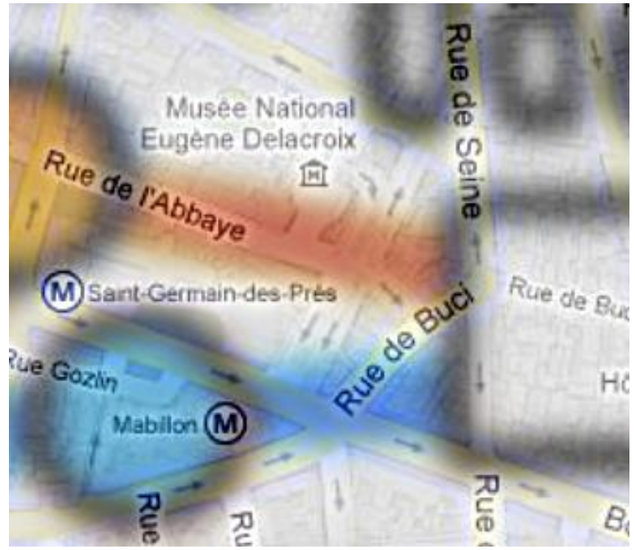


far image



Lo-pass Filter

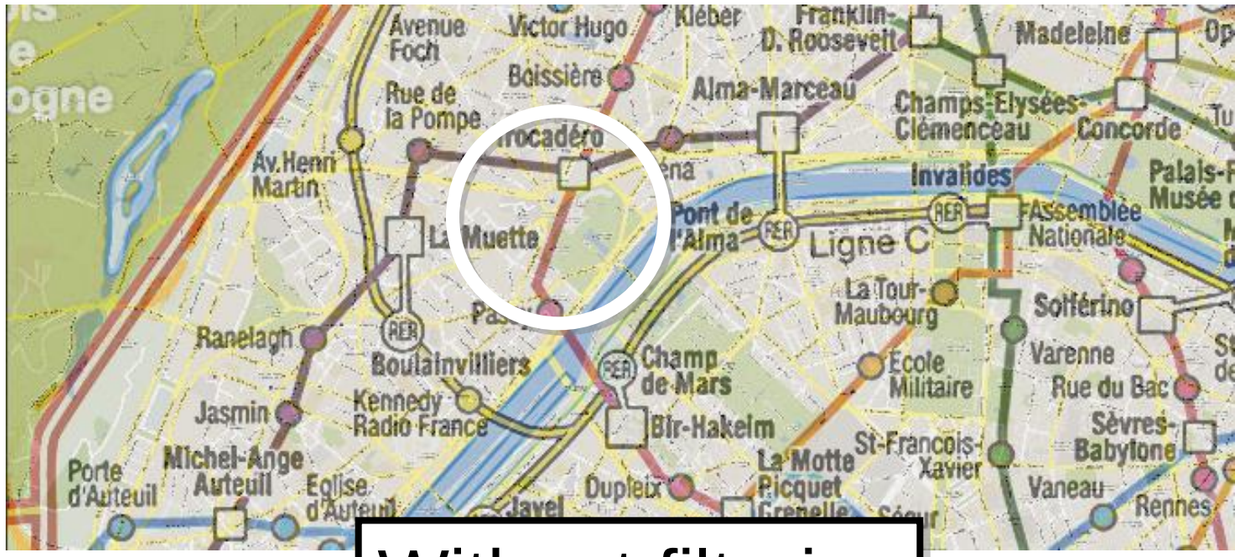
Alpha Blending
+ contrast



Hybrid-Image Visualization

Hybrid-Image Visualization

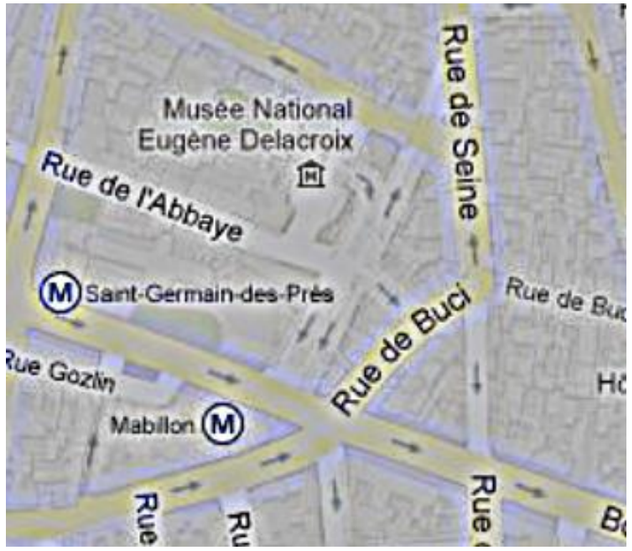
With filtering



Without filtering

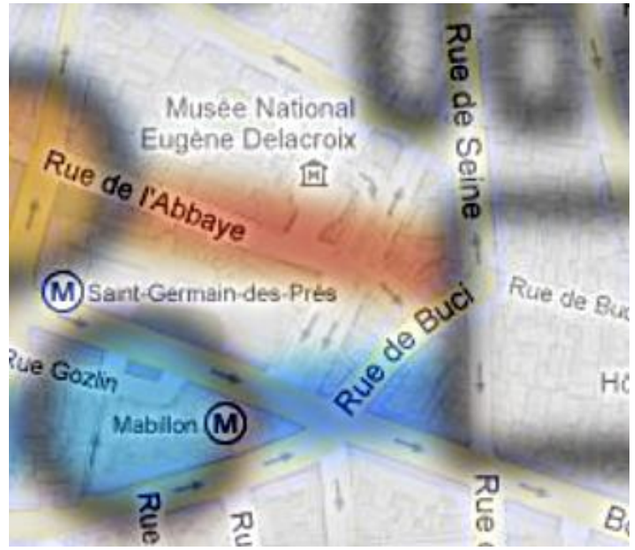
Hybrid-Image Visualization

Hi-pass Filter
+ contrast



Lo-pass Filter

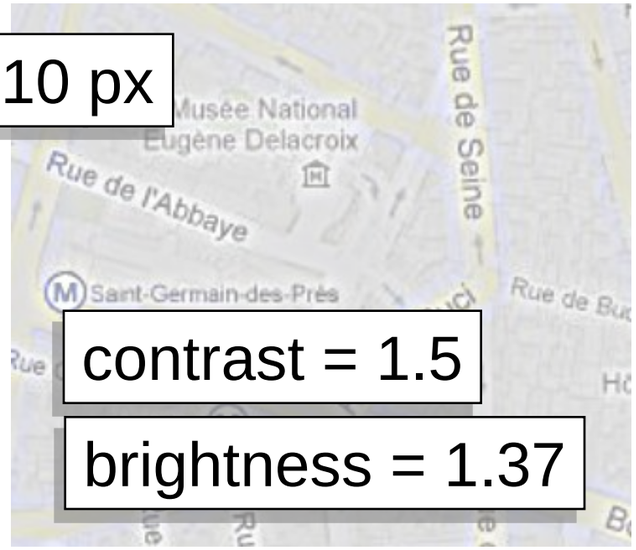
Alpha Blending
+ contrast



Hybrid-Image Visualization

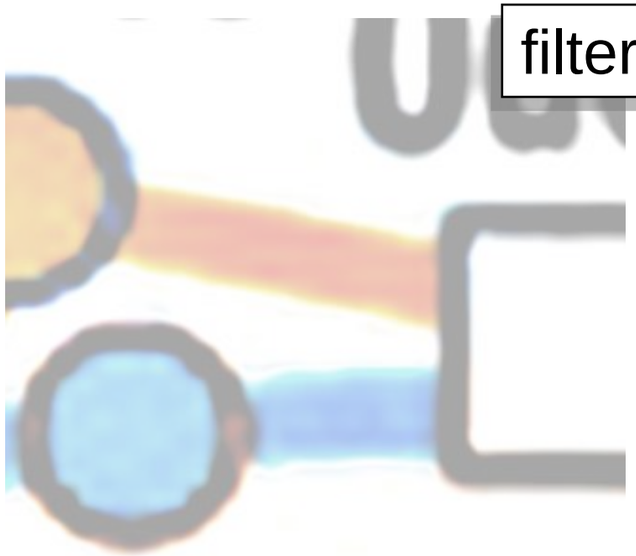
filter radius = 10 px

Hi-pass Filter
+ contrast



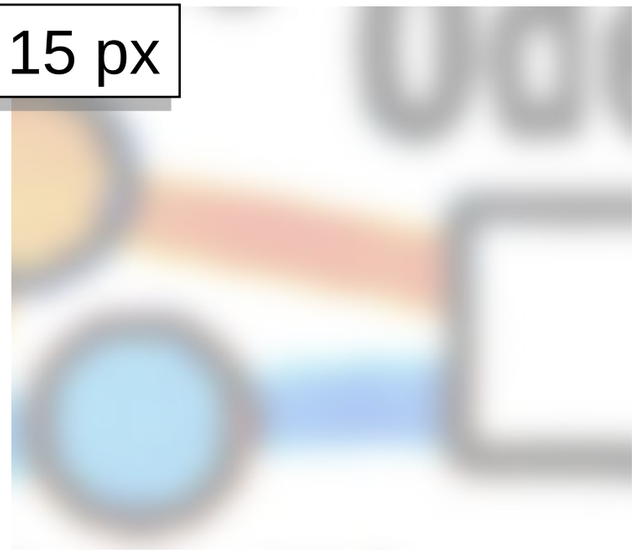
contrast = 1.5

brightness = 1.37



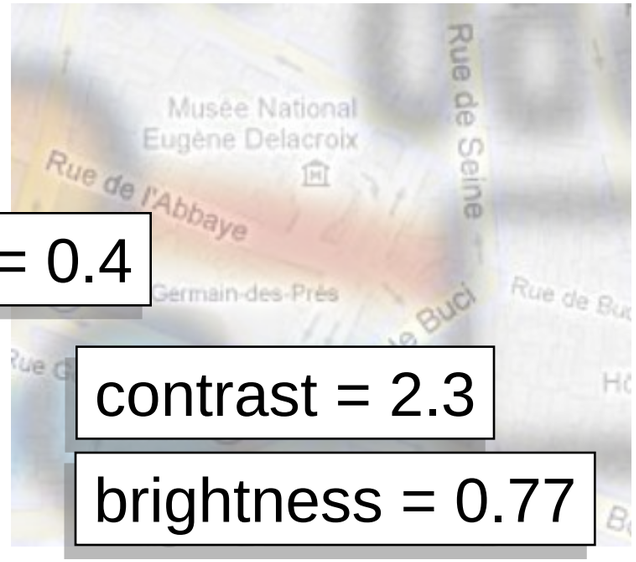
filter radius = 15 px

Lo-pass Filter



Alpha Blending
+ contrast

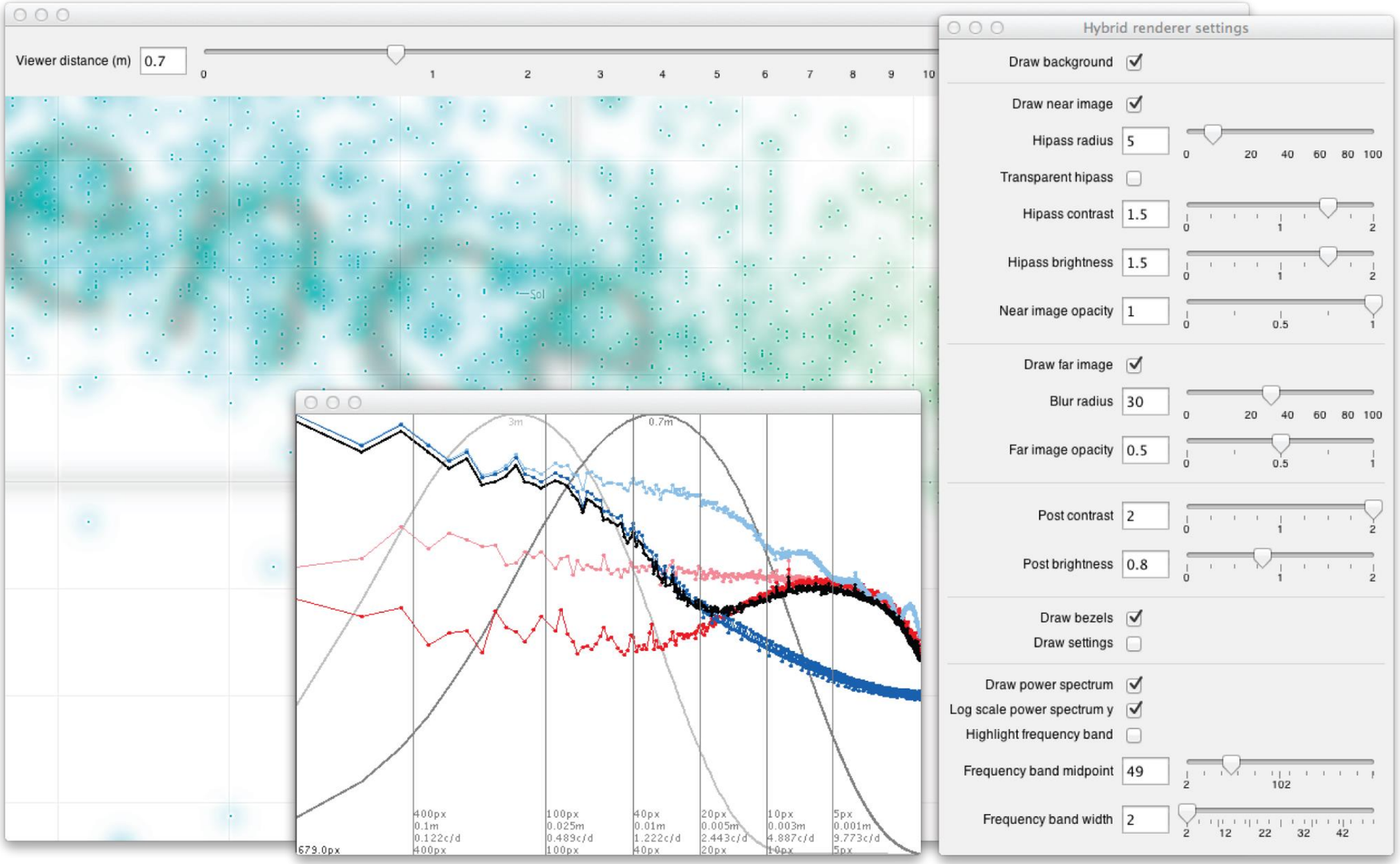
opacity = 0.4



contrast = 2.3

brightness = 0.77

Hybrid Image Maker



Hybrid Images for Large-Scale Visualizations

- **Theoretical grounding**

  why & when use hybrid images?

- **Tools**

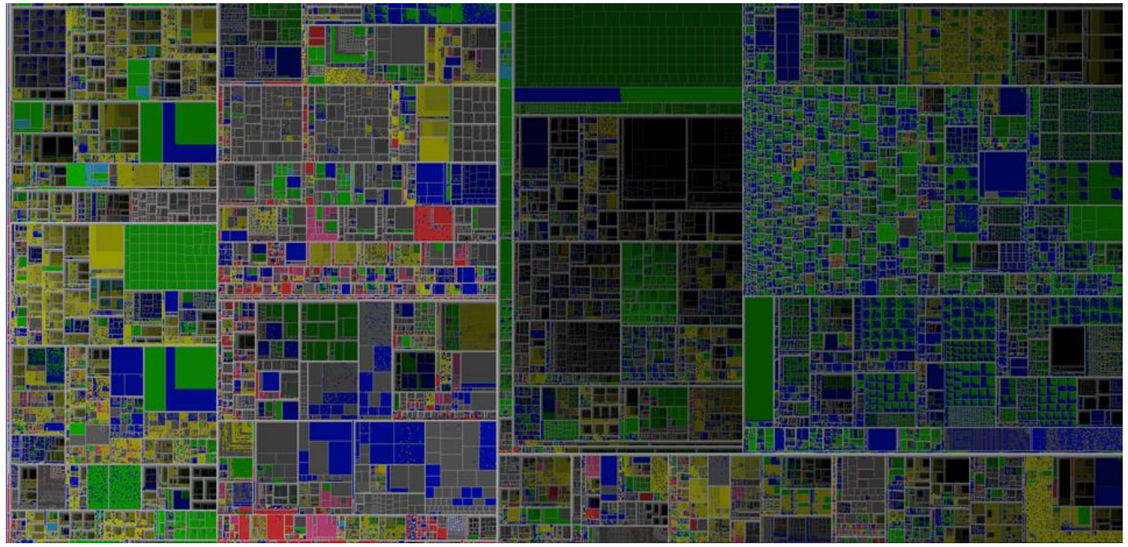
  how to support their creation?

- **Examples**

  what are they really good for?

- **Design principles**

  how to build effective ones?



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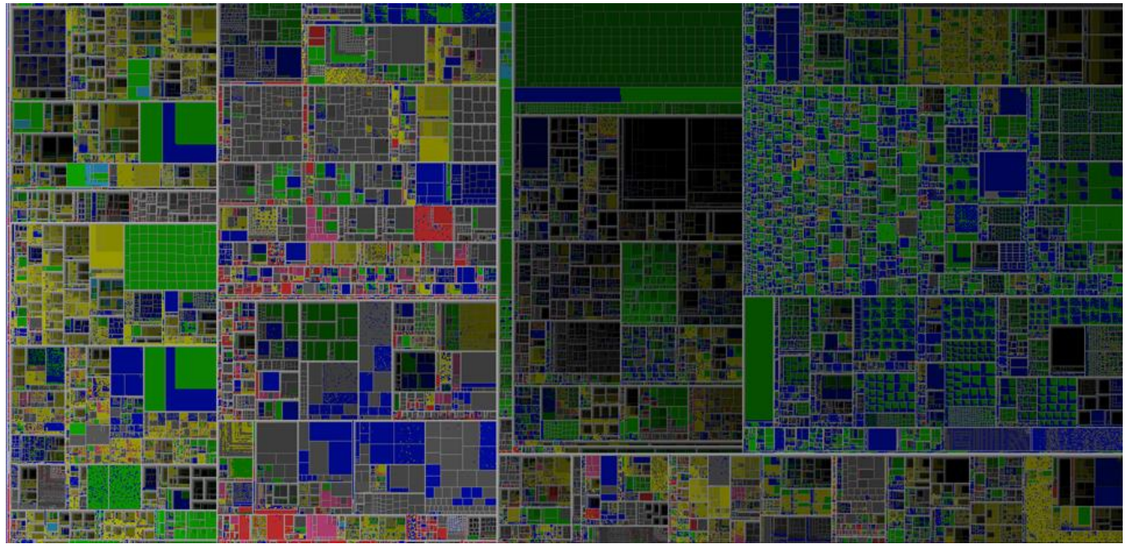
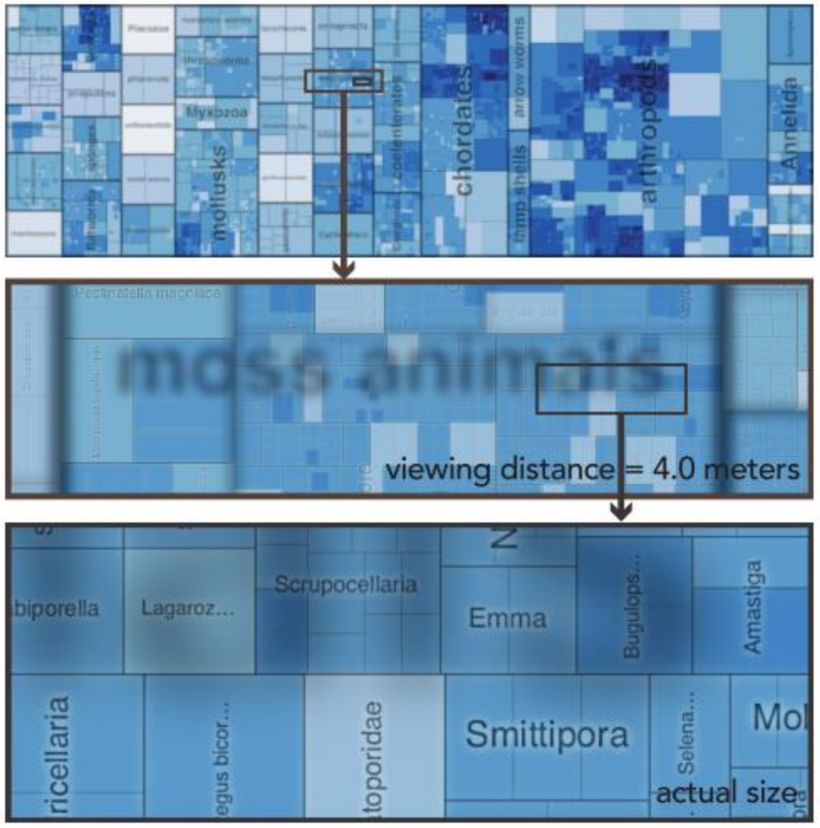
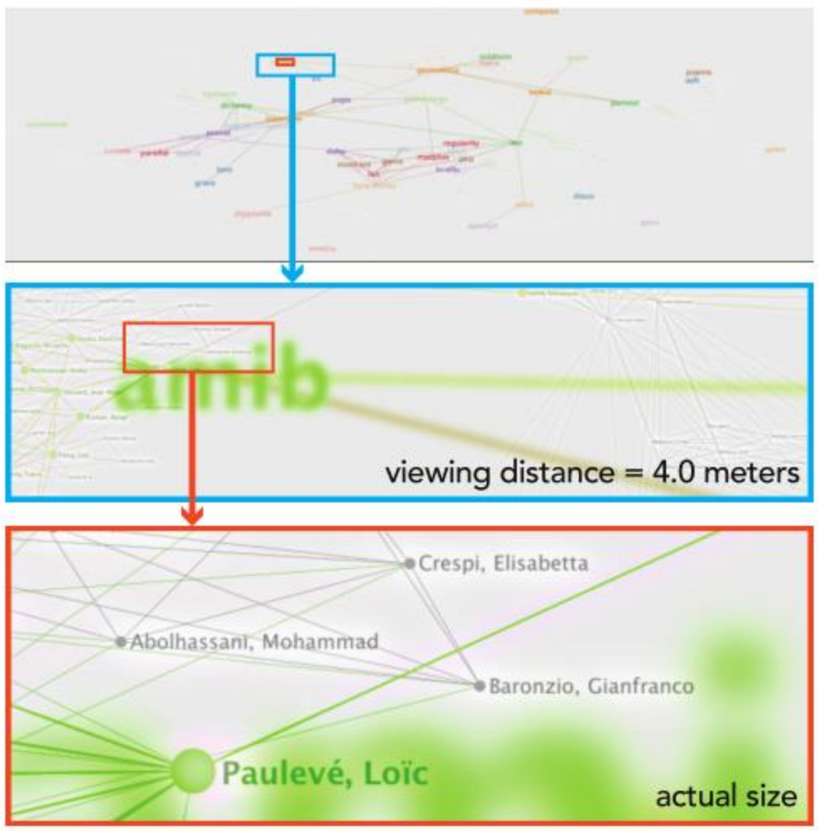


Examples

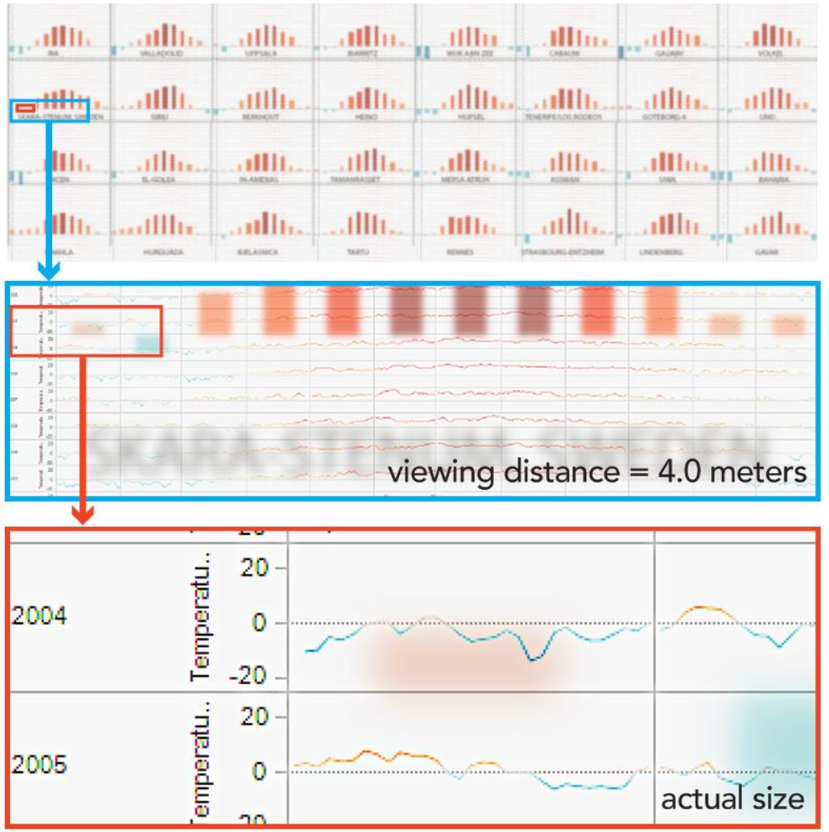
http://aviz.fr/hybridvis



Tree of Life Treemap



co-authorship network



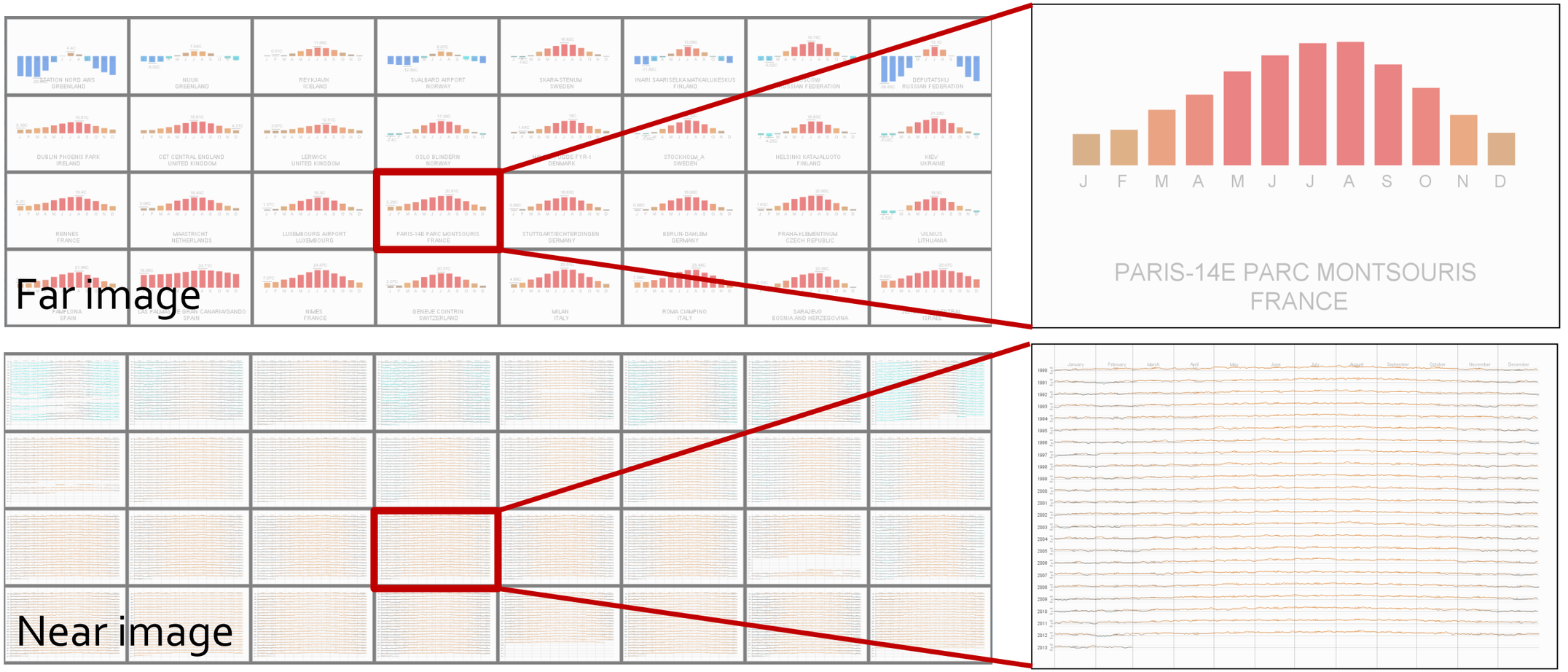
temperature data

...and more

http://aviz.fr/hybridvis

HI-Visualization Techniques

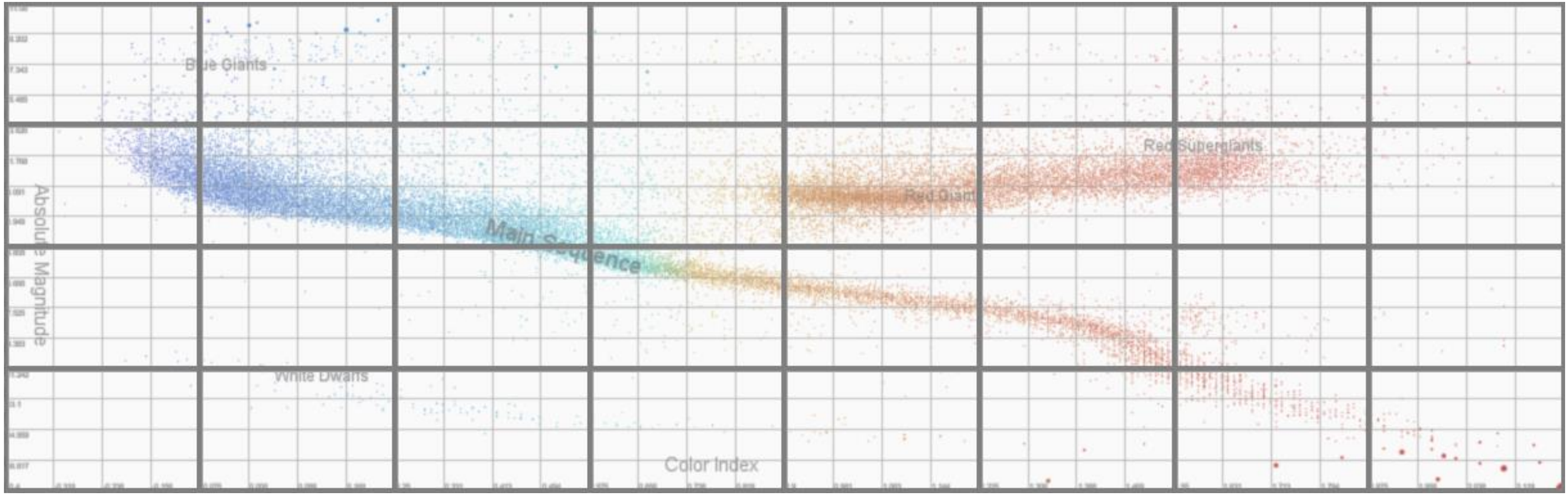
- Mixing multiple visualizations
- Navigation aids & summaries



http://aviz.fr/hybridvis

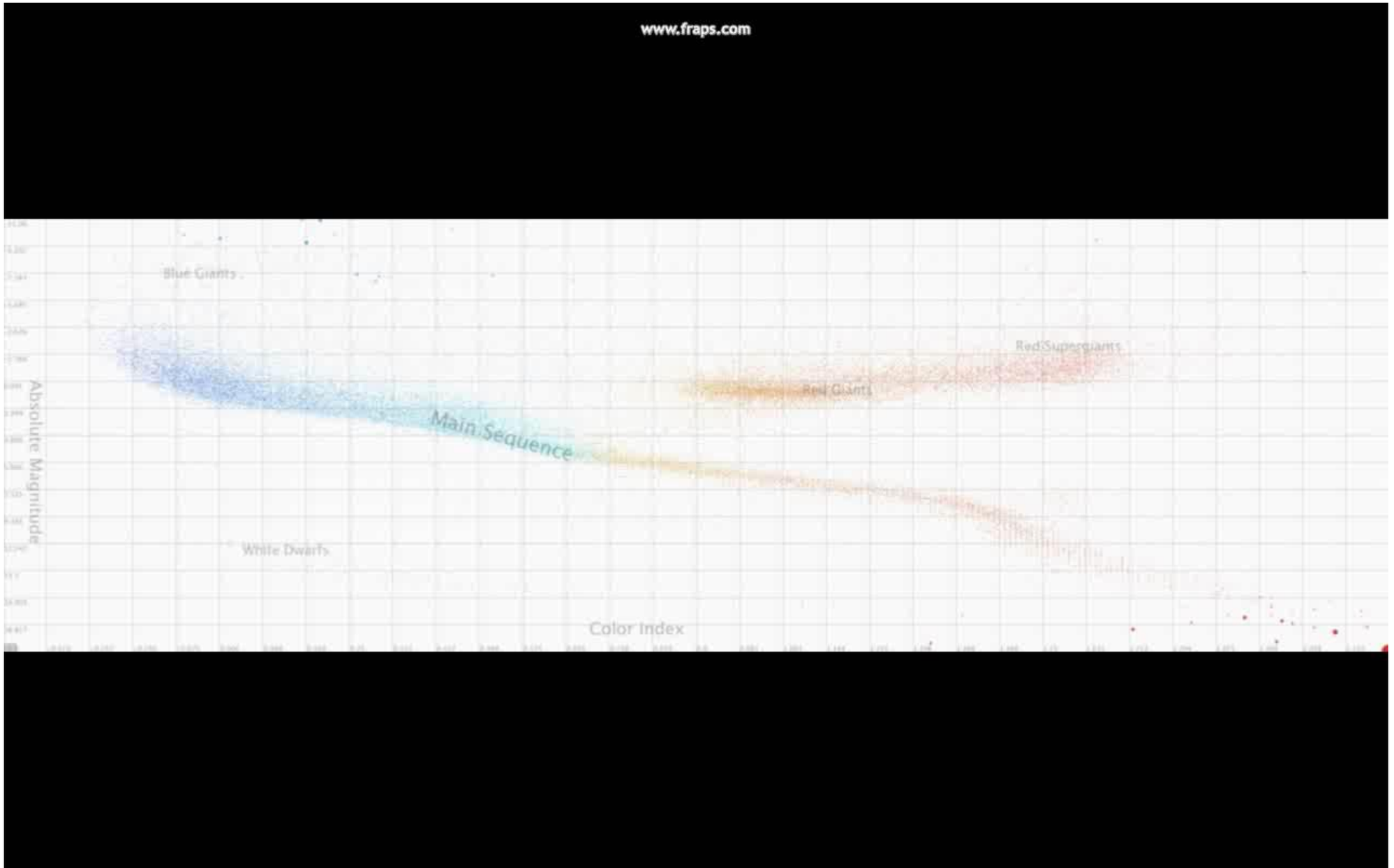
HI-Visualization Techniques

- Support perceptual grouping
- Highlight values
- Dual-scale reference structures



Hertzsprung-Russell diagram (think of this as a scatterplot)

Video


www.fraps.com
Blue Giants
Red Supergiants
Red Giants
Main Sequence
White Dwarfs
Absolute Magnitude
Color Index

Video


www.fraps.com
water bears
priapulans
sponges
flatworms
rhombozoans
Placozoa
phoronids
orthonectids
horsehair worms
threadworms
Myxozoa
mollusks
loriciferans
kinorhynchs
gastrotrichs
entoprocts
Cyclophora
coelenterates
chordates
arrow worms
lamp shells
arthropods
Annelida

Limitations

- No fully-automated hybrid-image visualization possible
  - visibility != legibility
  - yet, some feature legibility can be predicted (text, grids)
  - color may change due to filtering
  - contrast removed through blending
- Fast preview but final image production slow in full res (hardware acceleration possible)

Conclusion

- **Theoretical grounding**

  why & when use hybrid images?

- **Tools**

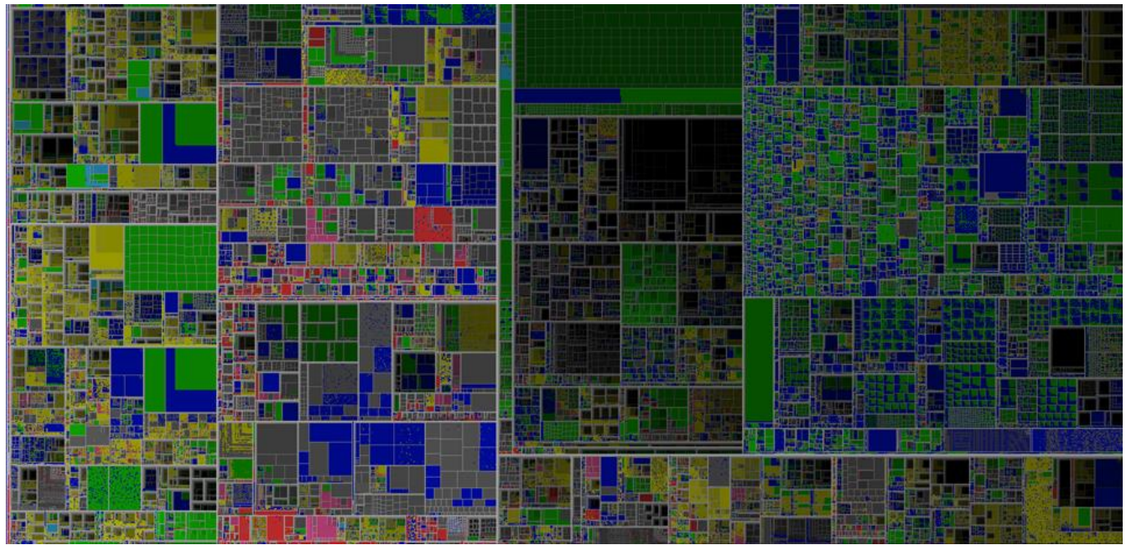
  how to support their creation?

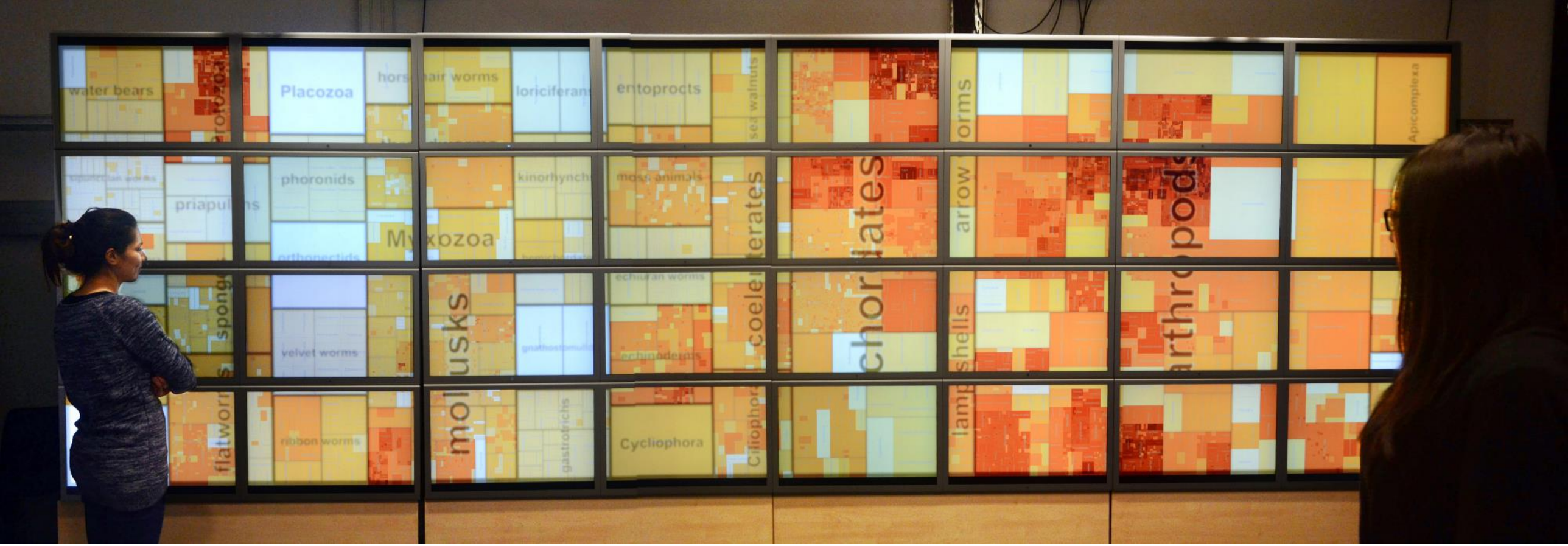
- **Examples**

  what are they really good for?

- **Design principles**

  how to build effective ones?





Aviz
Visual Analytics Project

Inria
informatics mathematics

LABORATOIRE DE RECHERCHE EN INFORMATIQUE

http:aviz.fr/hybridvis

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