Hybrid-Image Visualization for Large Viewing Environments

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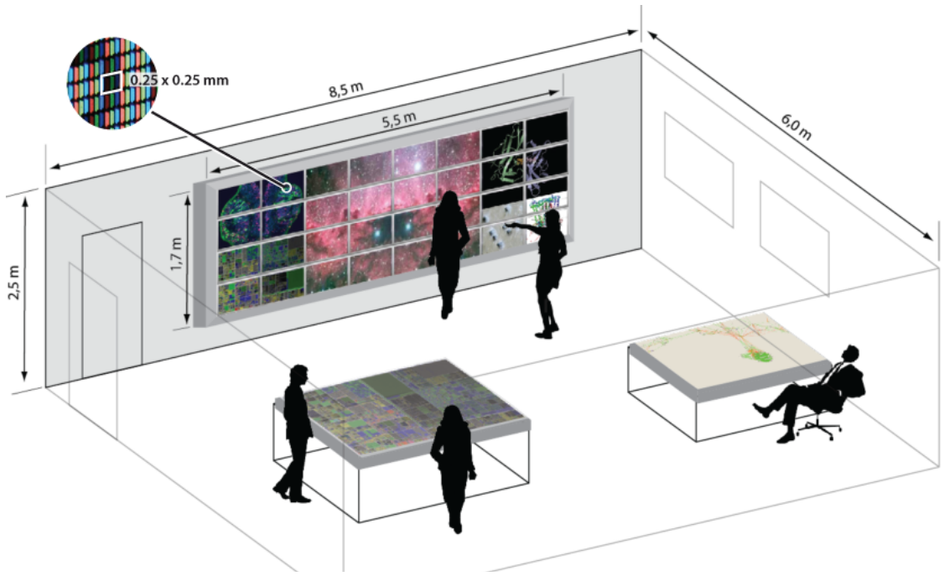
Aviz Visual Analytics Project

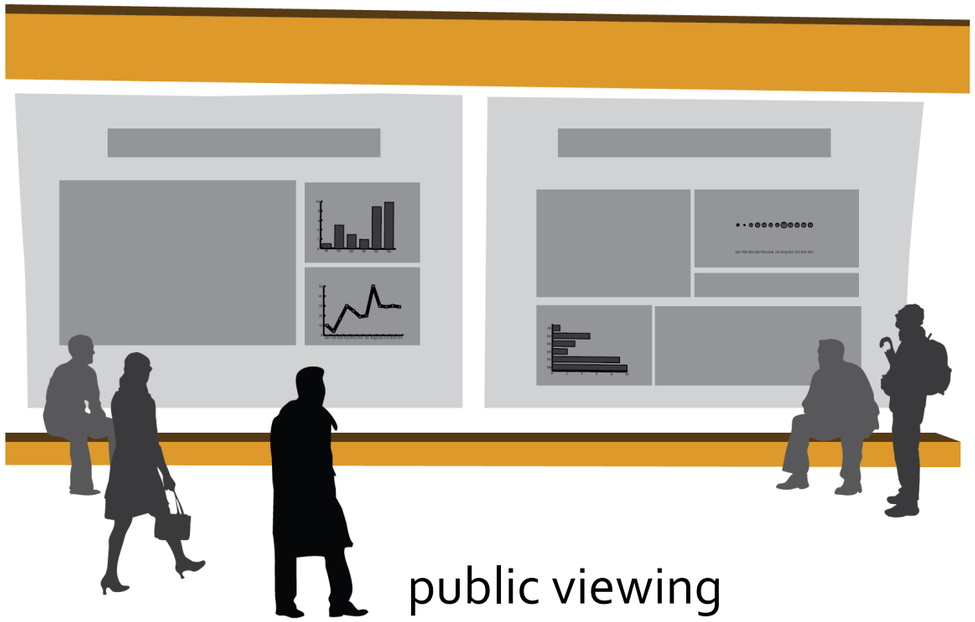
informatics mathematics Inria

LABORATOIRE DE RECHERCHE EN INFORMATIQUE

Large Viewing Environments

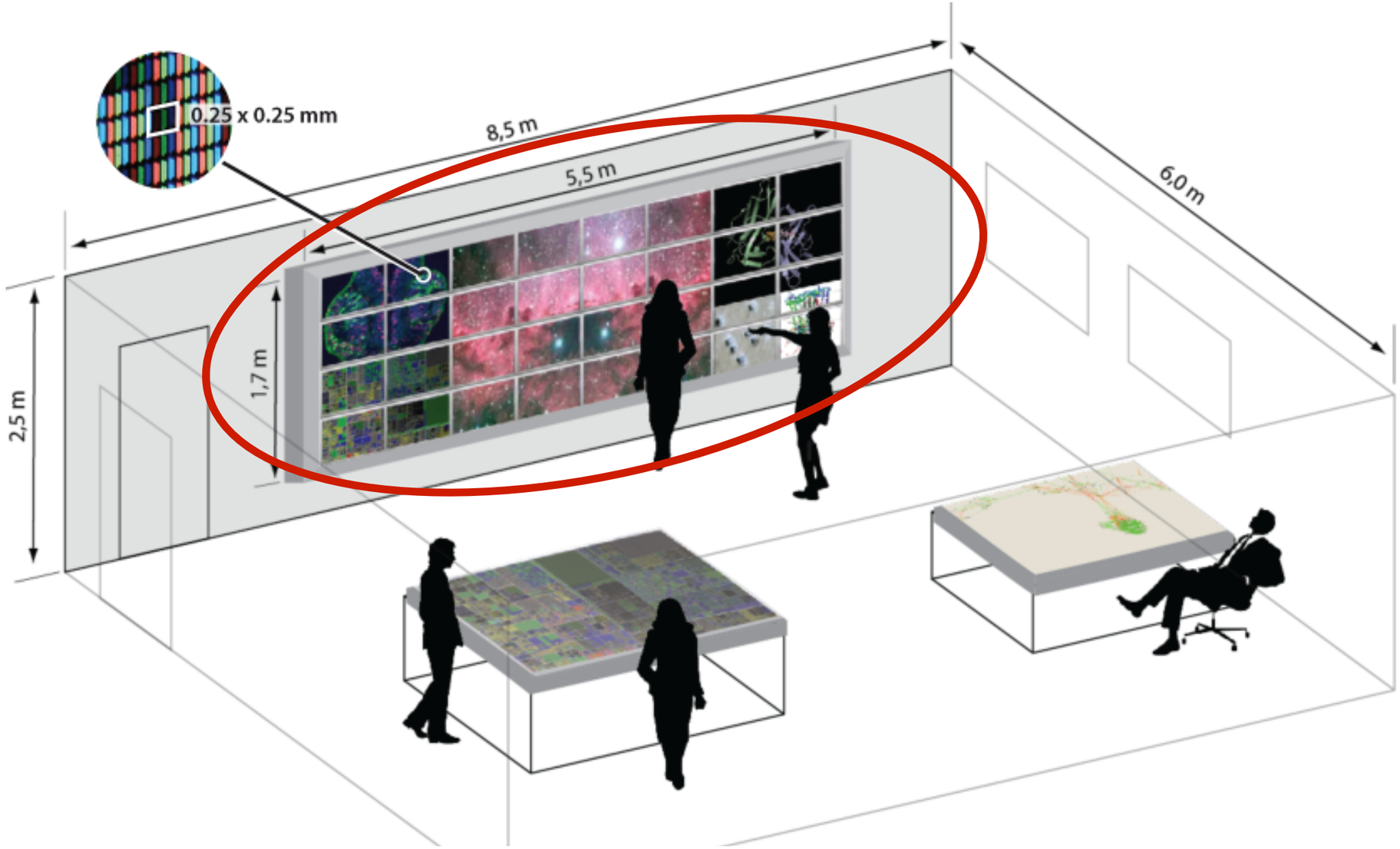


large displays
meeting rooms / war rooms
emergency response rooms

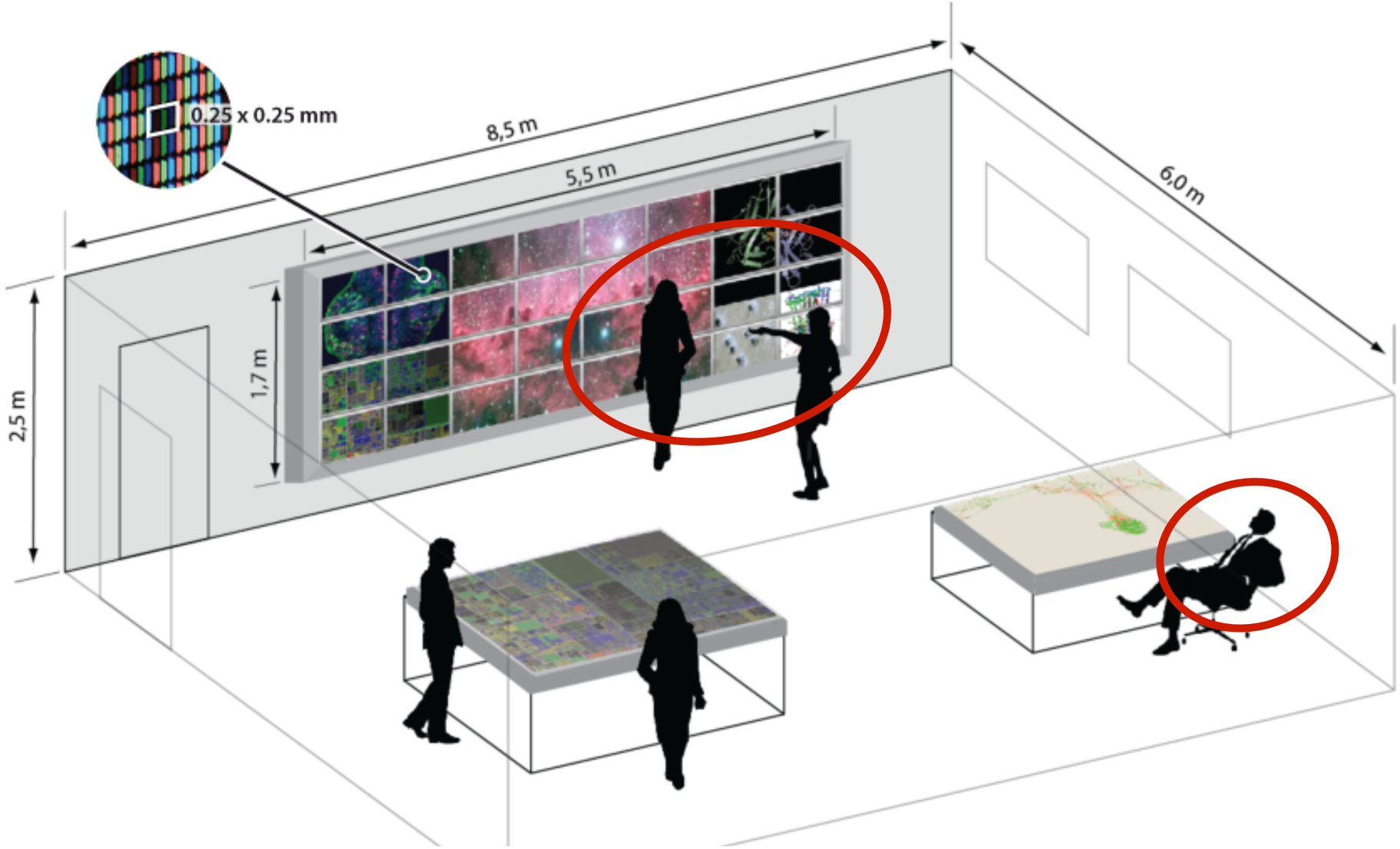


public viewing
open spaces
museums

Scenario: WILD Display Environment



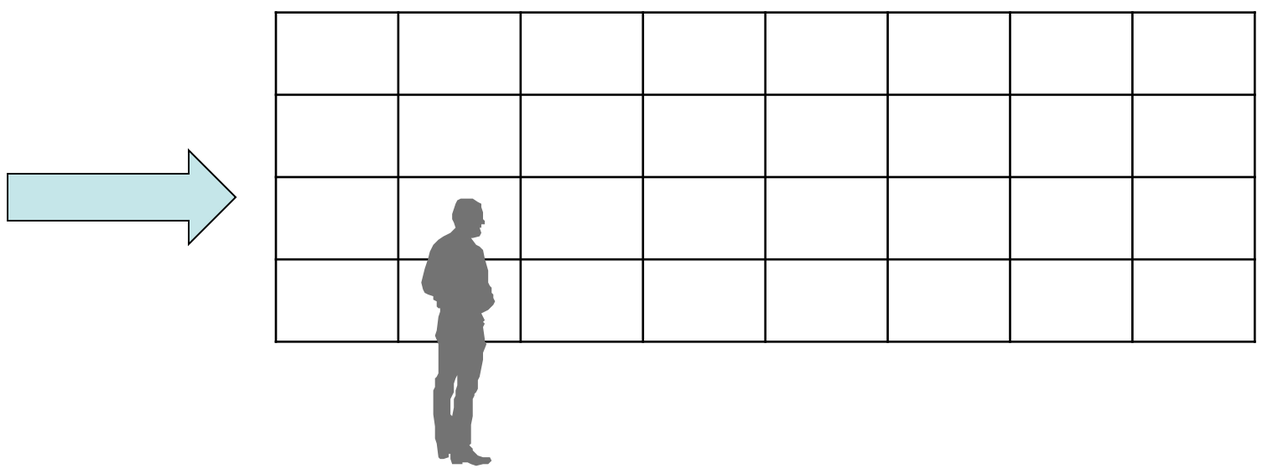
Who to Optimize For?



Example Data

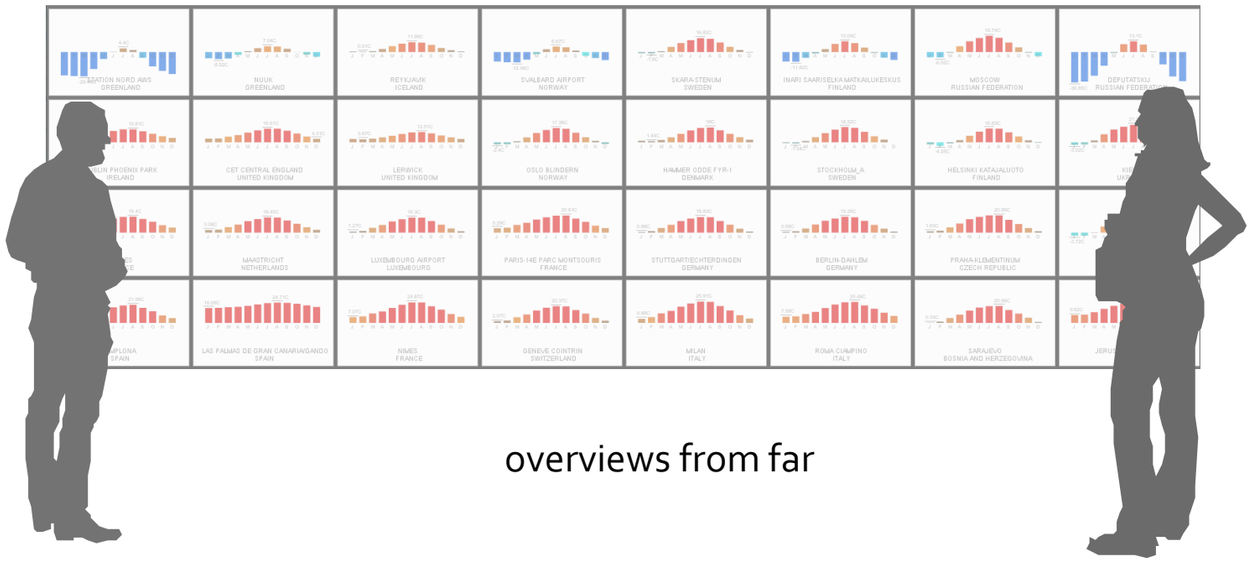
23 years of daily temperatures for 32 cities

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

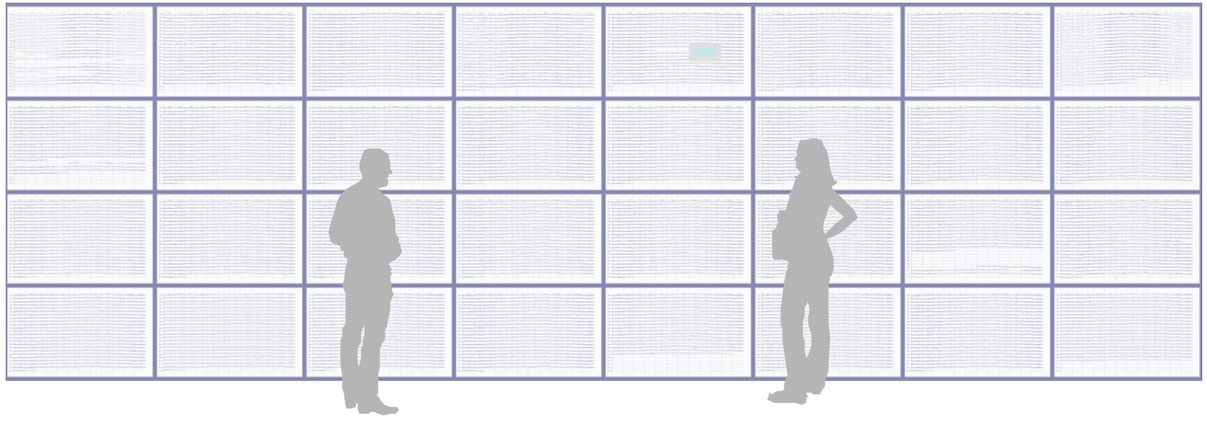


Naïve Approach

Optimize for one specific viewing distance



overviews from far

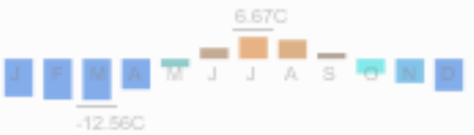


detail from close

Problem:
mental aggregation, comparison

NUUK
GREENLAND

REYKJAVIK
ICELAND

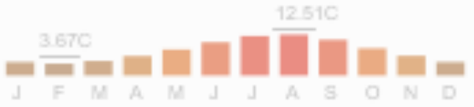


SVALBARD AIRPORT
NORWAY

SKARA-STENUM
SWEDEN

INARI SAARISELKA
FINLA

CET CENTRAL ENGLAND
UNITED KINGDOM



LERWICK
UNITED KINGDOM

OSLO BLINDERN
NORWAY

HAMMER ODDE FYR-1
DENMARK

STOCKHO
SWED

MAASTRICHT
NETHERLANDS

LUXEMBOURG AIRPORT
LUXEMBOURG

PARIS-14E PARC MONTSOURIS
FRANCE

STUTTGART/ECHTERDINGEN
GERMANY

BERLIN-D
GERMA

LAS PALMAS DE GRAN CANARIA/GANDO
SPAIN

NIMES
FRANCE

GENEVE COINTRIN
SWITZERLAND

MILAN
ITALY

ROMA CIA
ITAL

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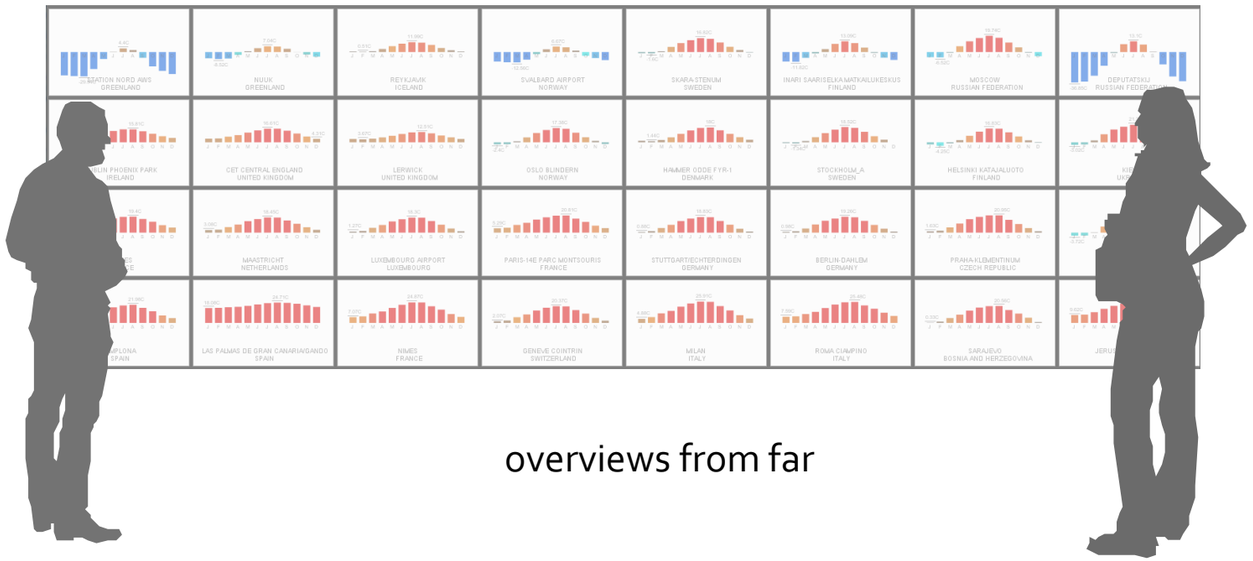
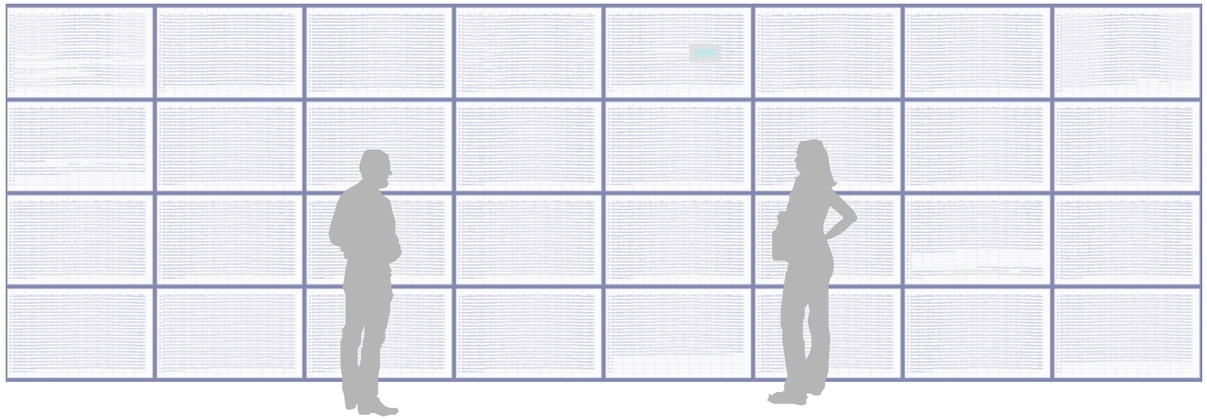


overviews from far



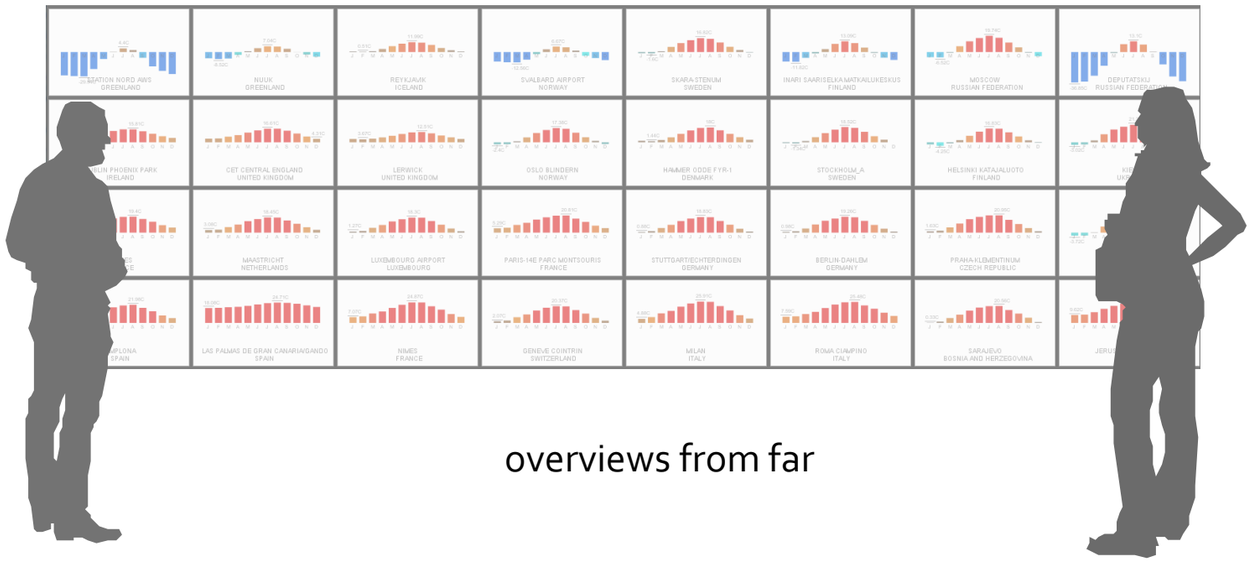
detail from close

Problem:
detailed information lost

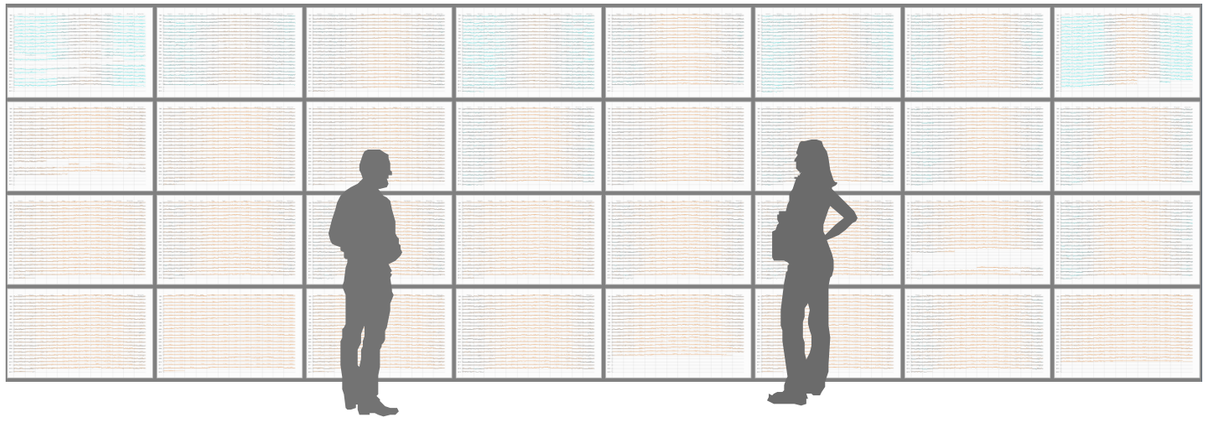
Problem:
mental aggregation, comparison

Naïve Approach

Optimize for one specific viewing distance



overviews from far



detail from close

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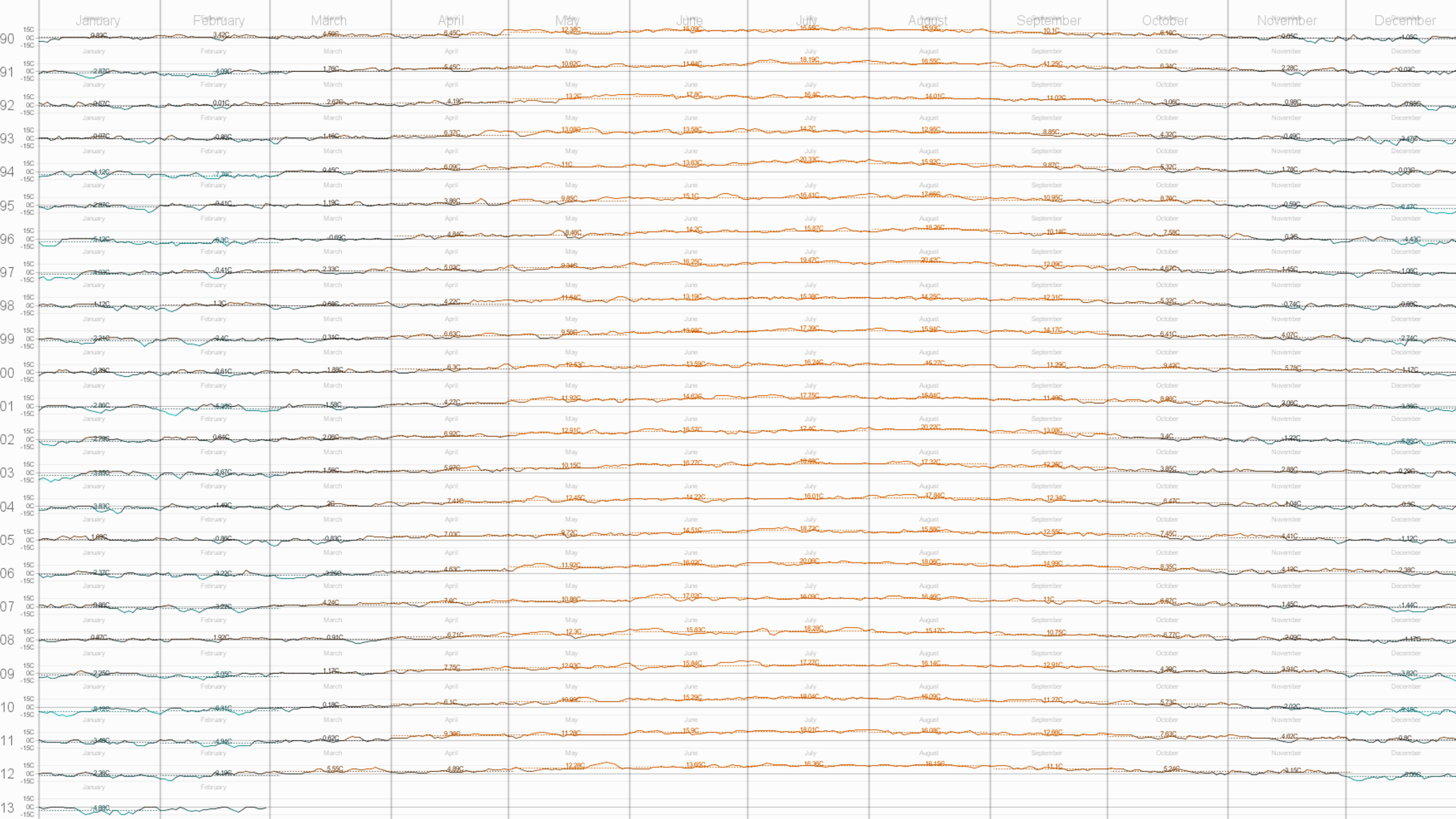
detailed information lost


January
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-15C

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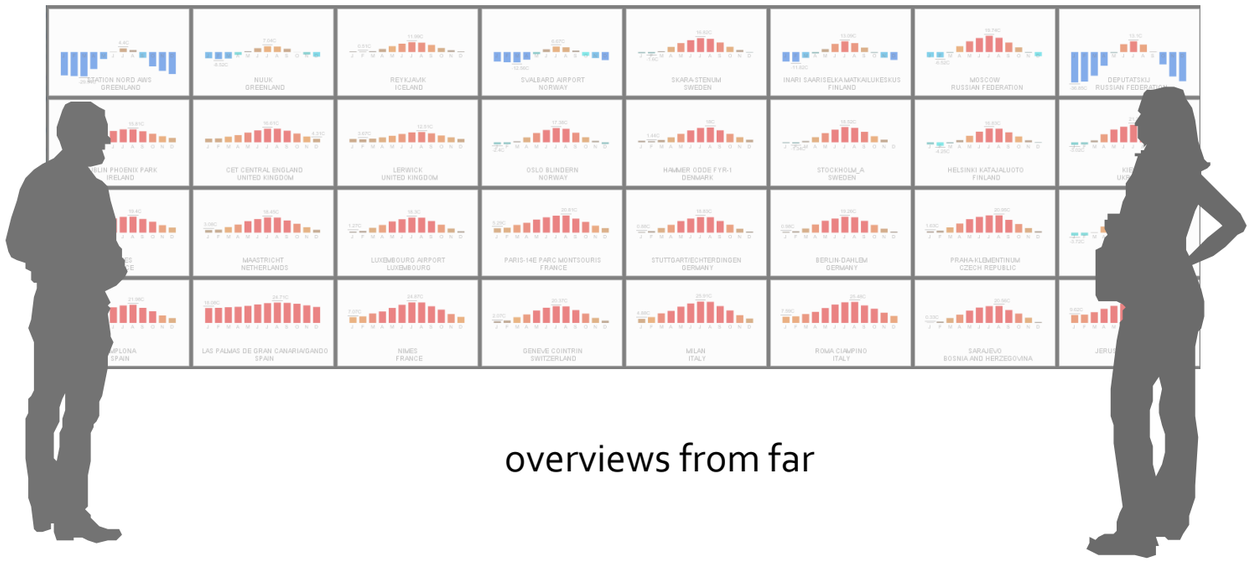

overviews from far

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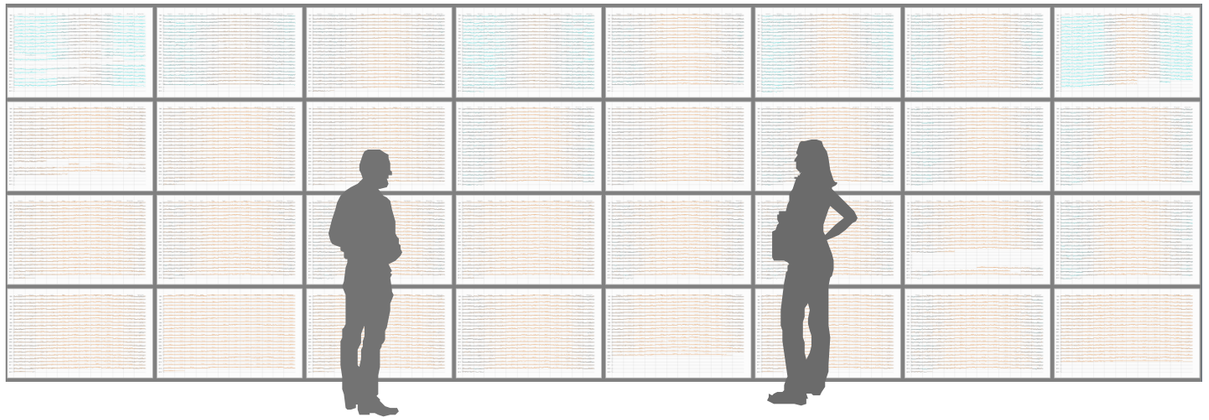
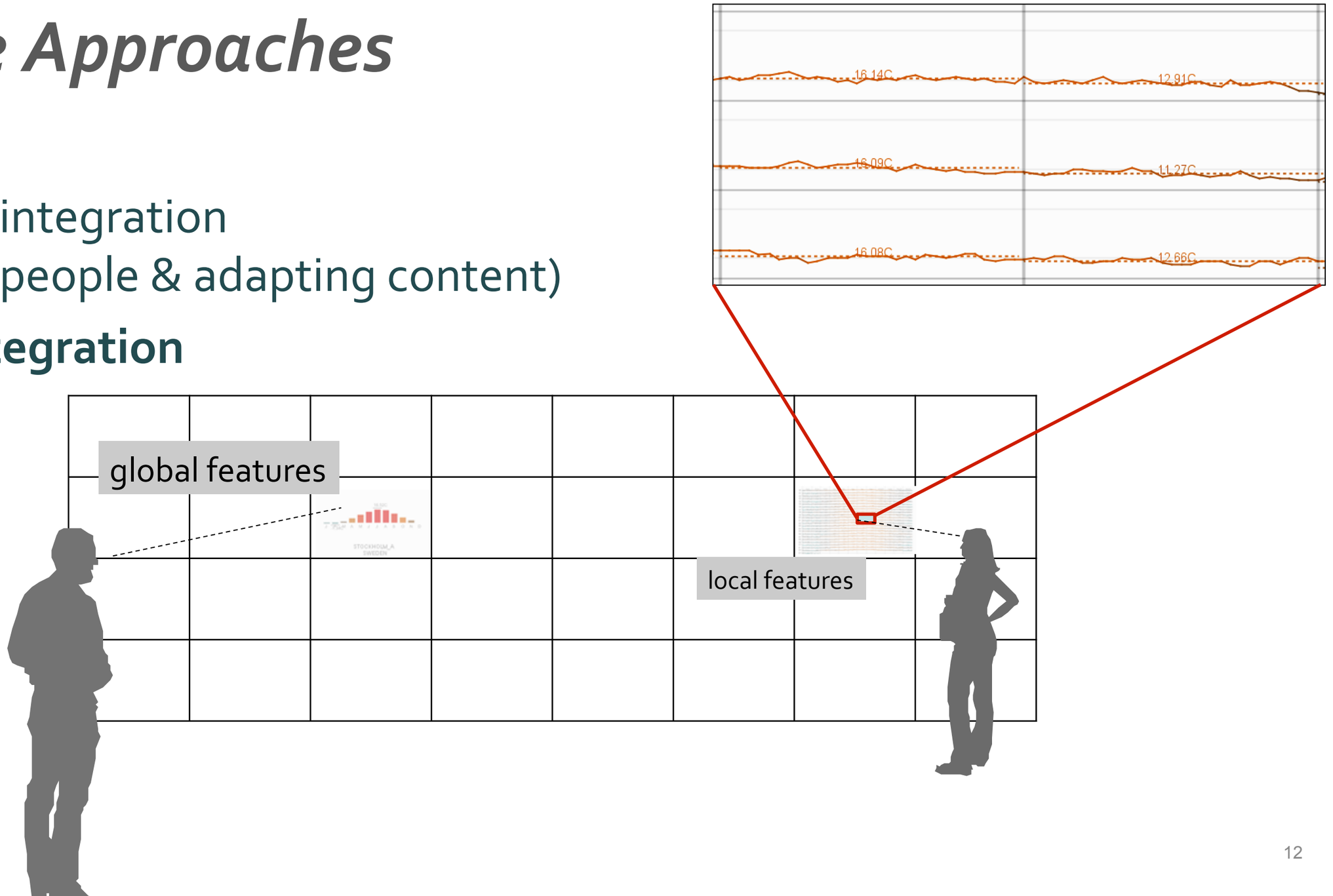


detail from close

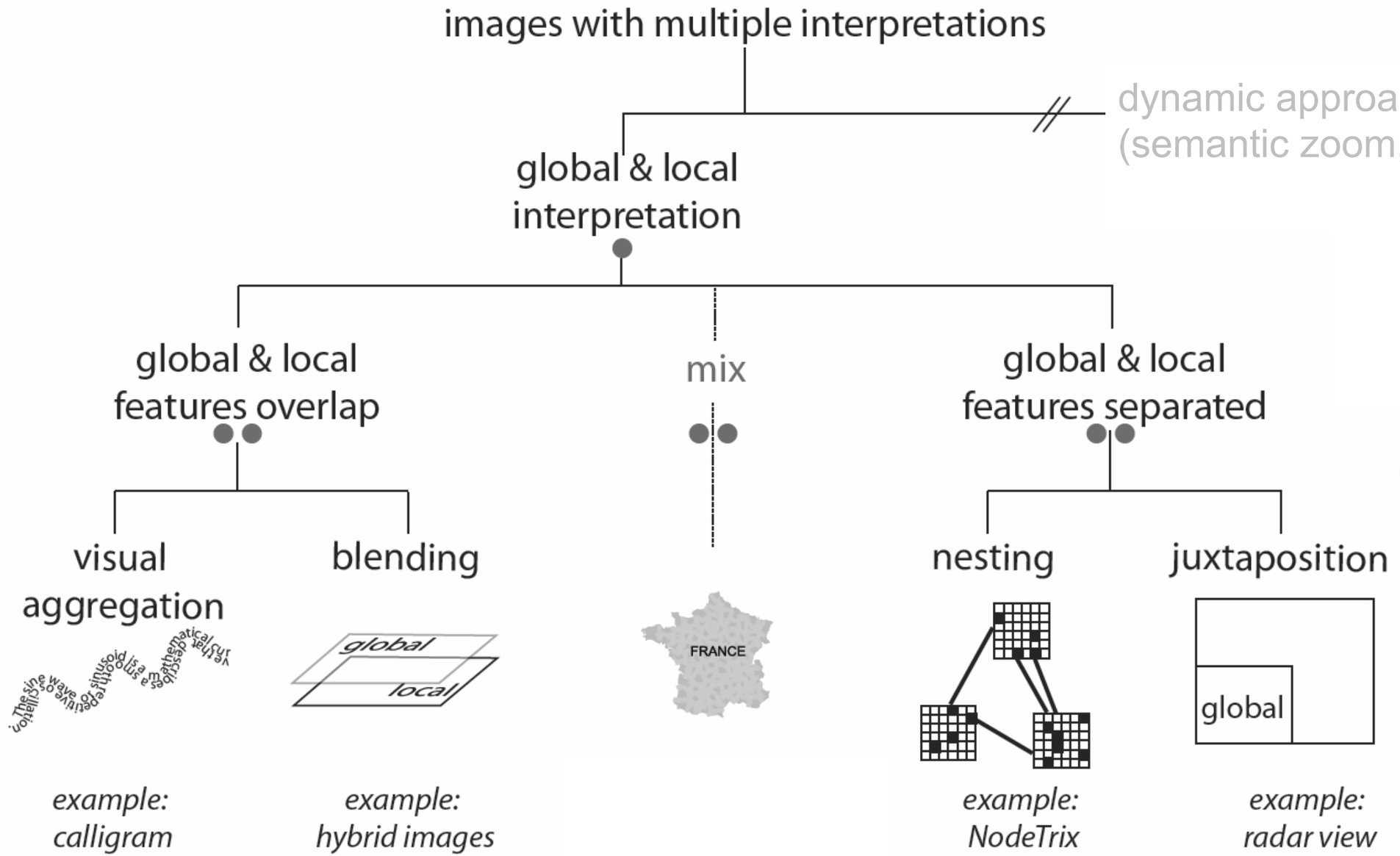
Problem:
mental aggregation, comparison

Possible Approaches

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



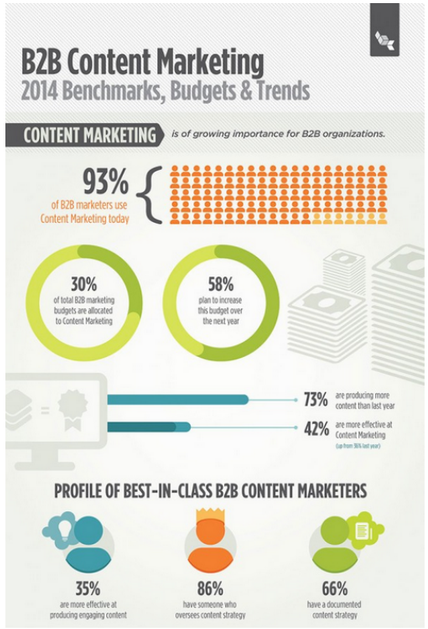
Static Approaches



Static Approaches

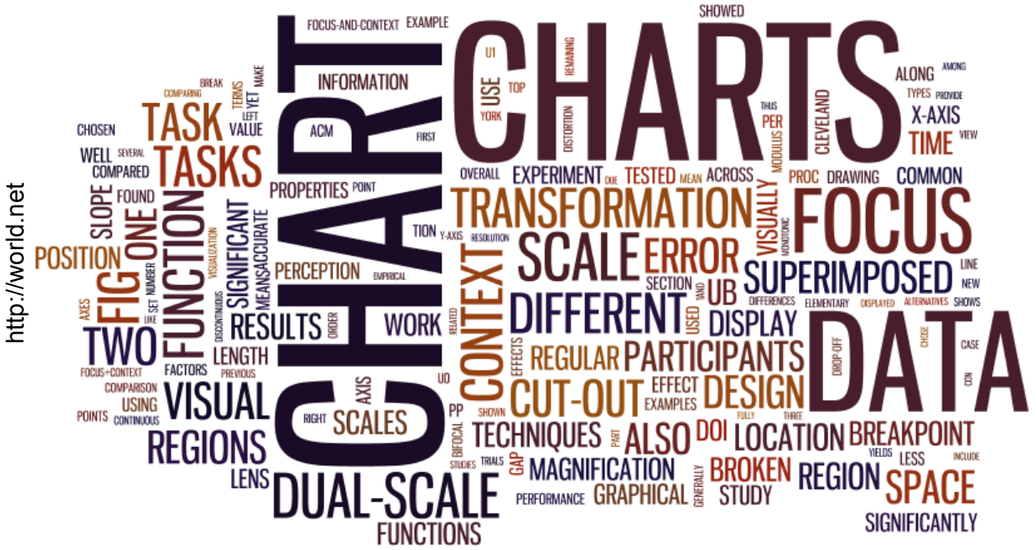
Juxtaposition: global & local features next to each other

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



Infographic Layout

http://world.net

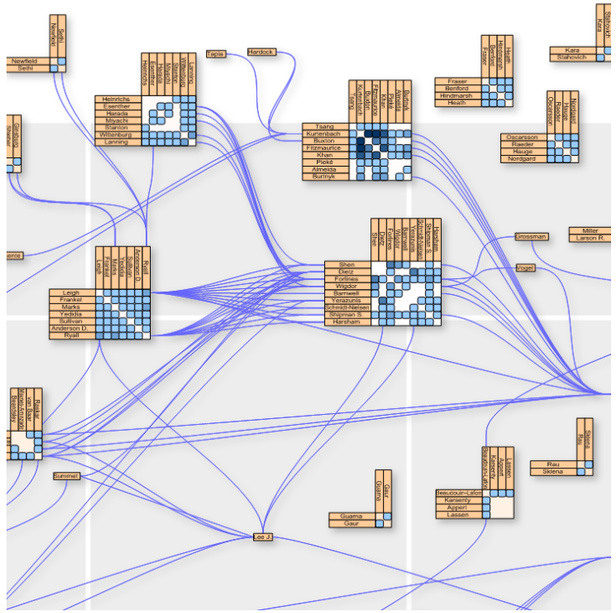


Large Tag Clouds

Static Approaches

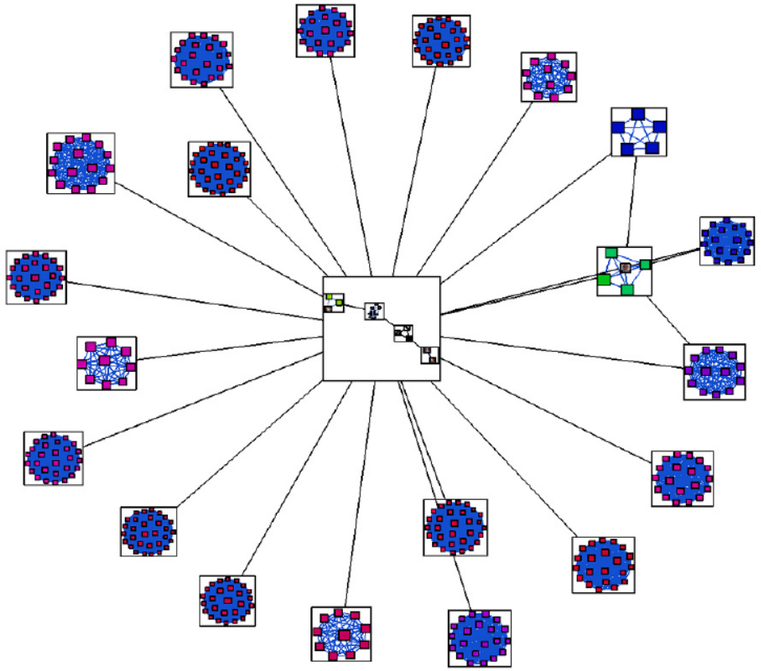
Nesting: local inside global features

[NodeTrix: Henry et al., InfoVis 2007]



NodeTrix

[SWViz: Auber et al., InfoVis 2003]

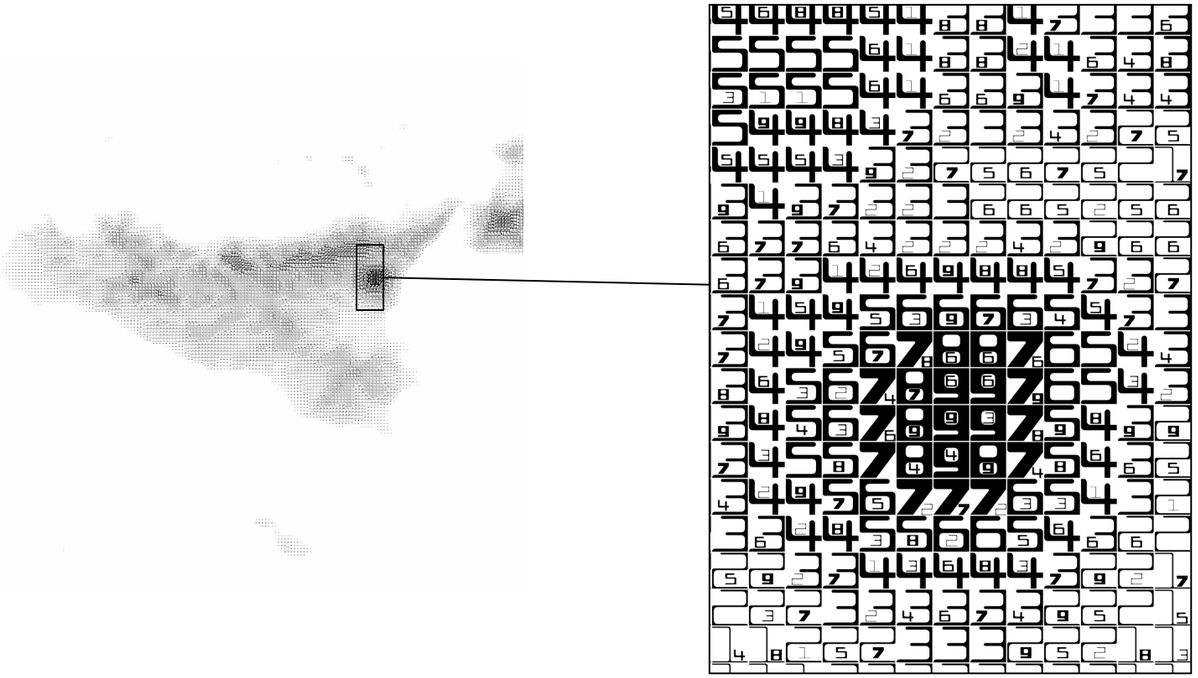


SWViz

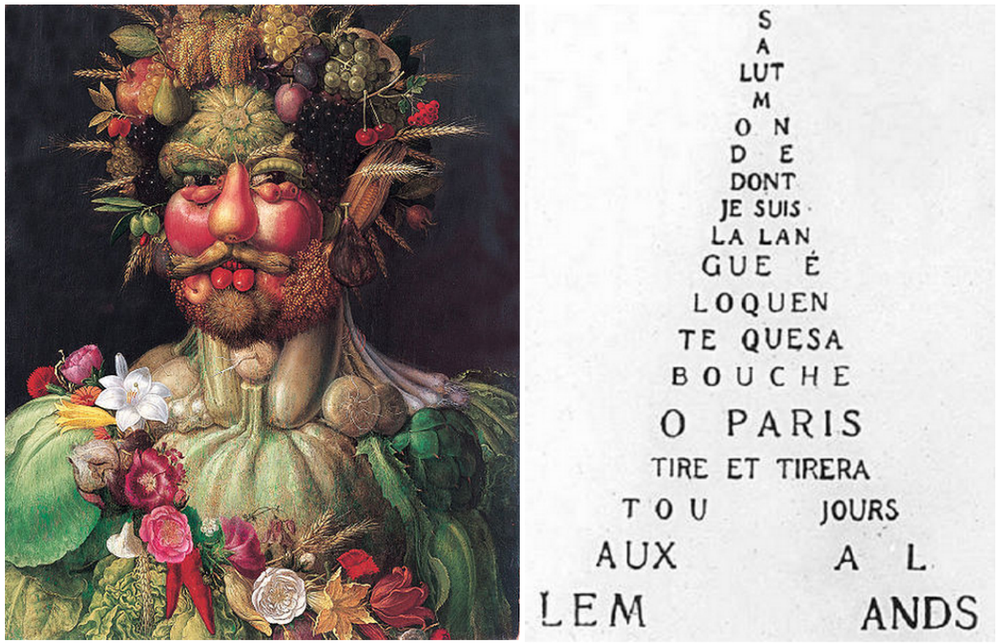
Static Approaches

Visual aggregation: local form global features

[FatFonts: Nacenta et al., AVI 2012]



FatFonts

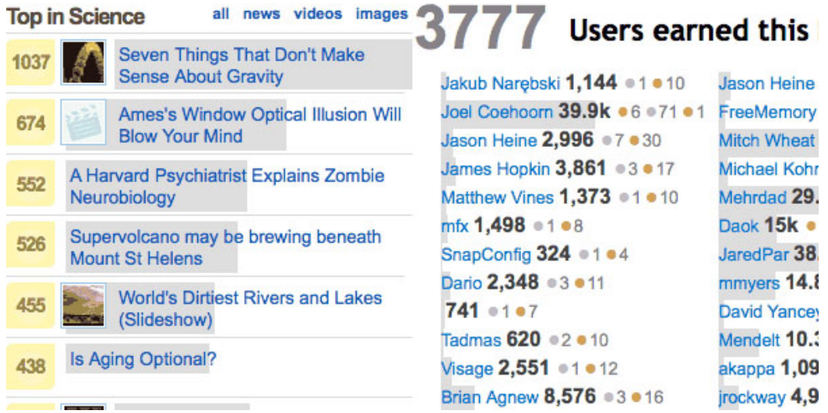


Arcimboldo Paintings, Calligrams

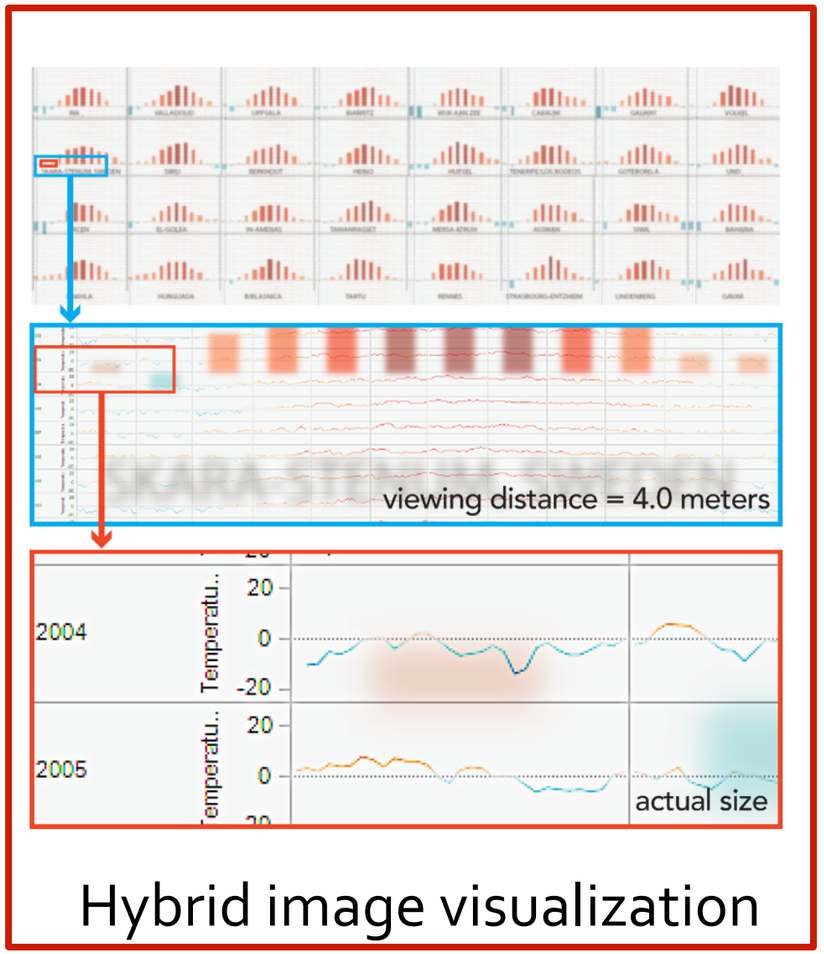
Static Approaches

Blending: local & global features overlap

Map regions over map detail

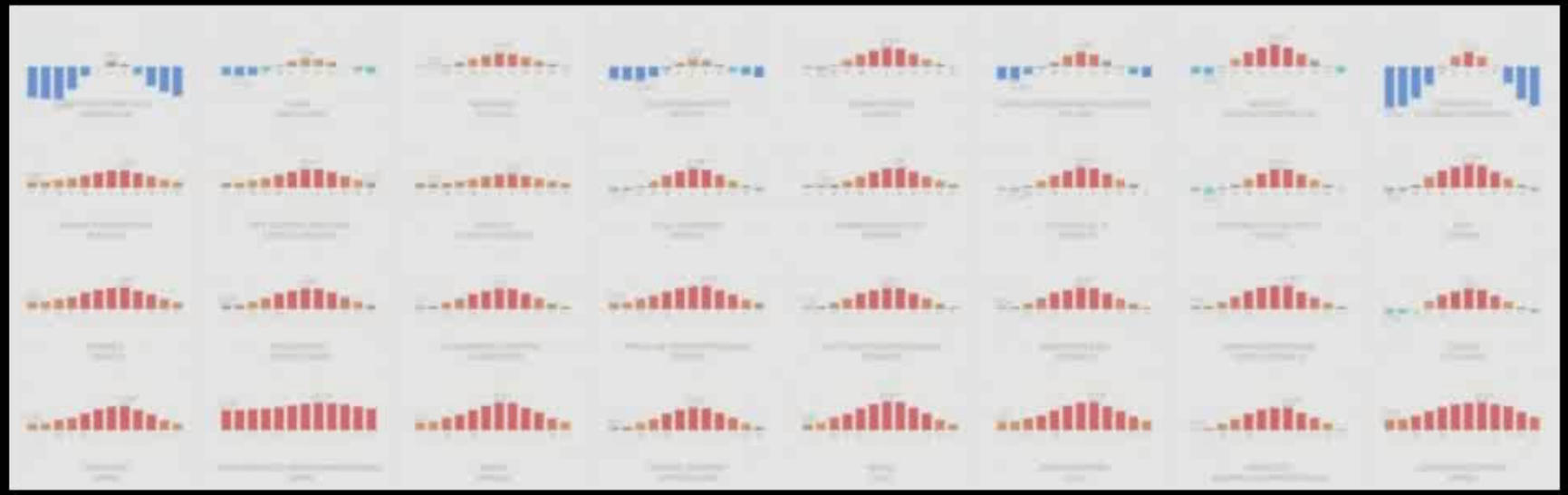


Label detail over bar chart



Hybrid image visualization

www.fraps.com

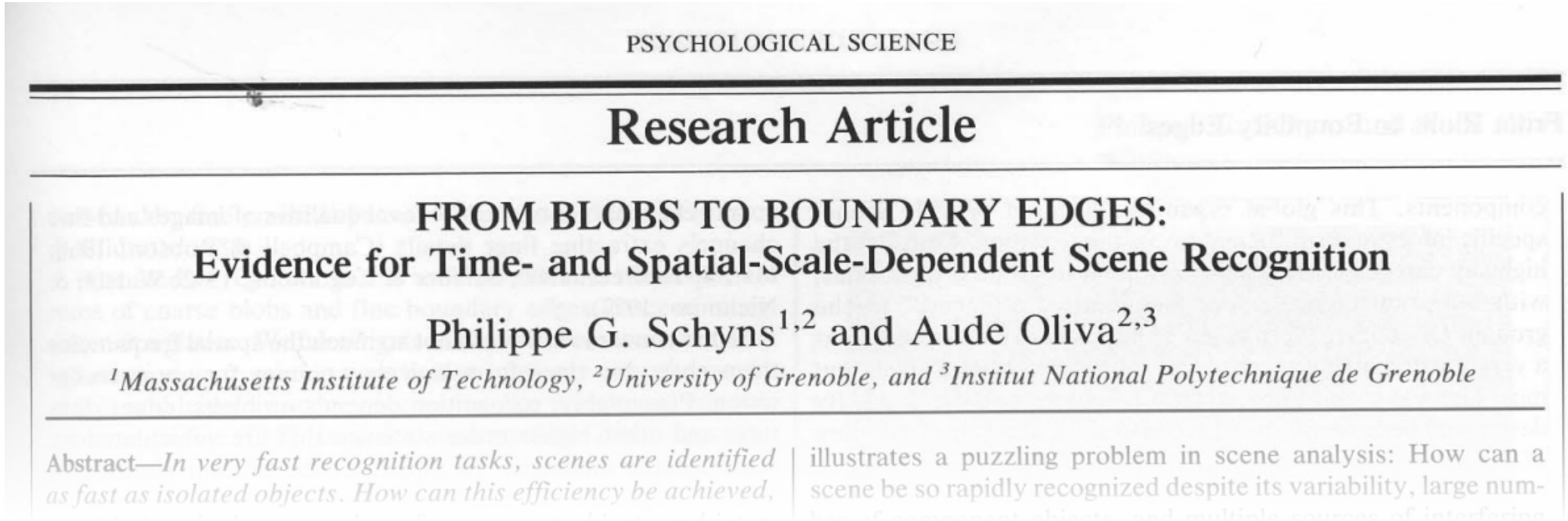


www.fraps.com

Hybrid Images

Hybrid Stimuli

- Schyns & Oliva, 1994



PSYCHOLOGICAL SCIENCE

Research Article

FROM BLOBS TO BOUNDARY EDGES: Evidence for Time- and Spatial-Scale-Dependent Scene Recognition

Philippe G. Schyns[1,2] and Aude Oliva[2,3]

[1]*Massachusetts Institute of Technology,* [2]*University of Grenoble, and* [3]*Institut National Polytechnique de Grenoble*

Abstract—*In very fast recognition tasks, scenes are identified as fast as isolated objects. How can this efficiency be achieved,* illustrates a puzzling problem in scene analysis: How can a scene be so rapidly recognized despite its variability, large num-

Hybrid Stimuli

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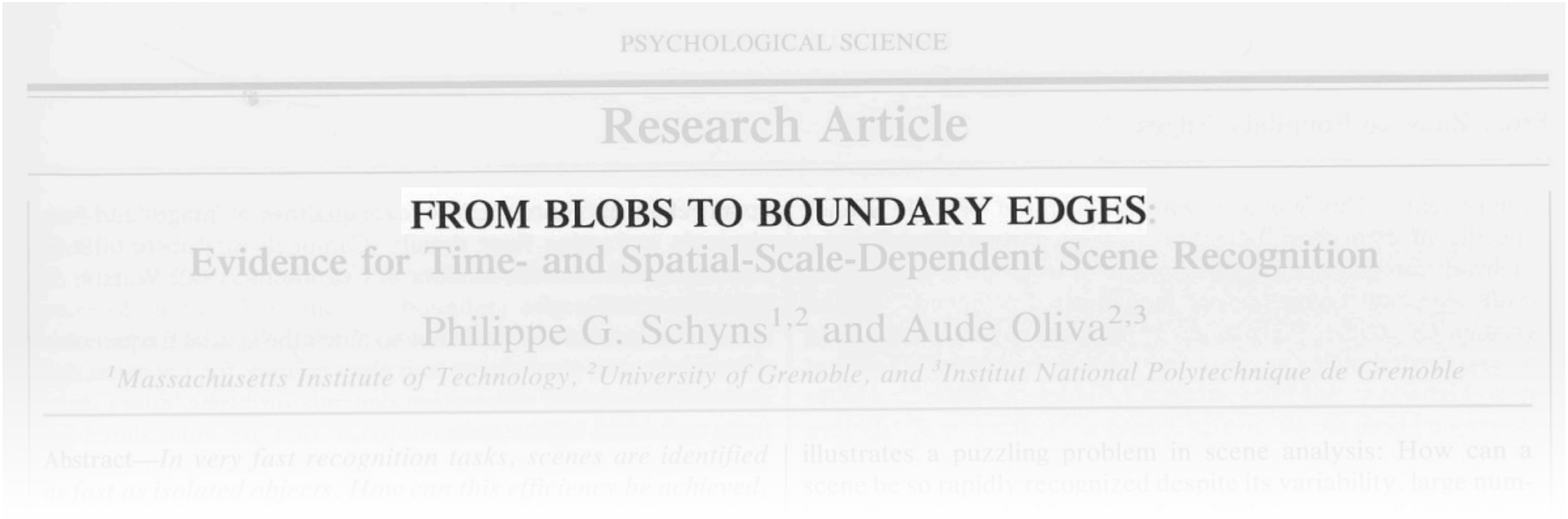

PSYCHOLOGICAL SCIENCE

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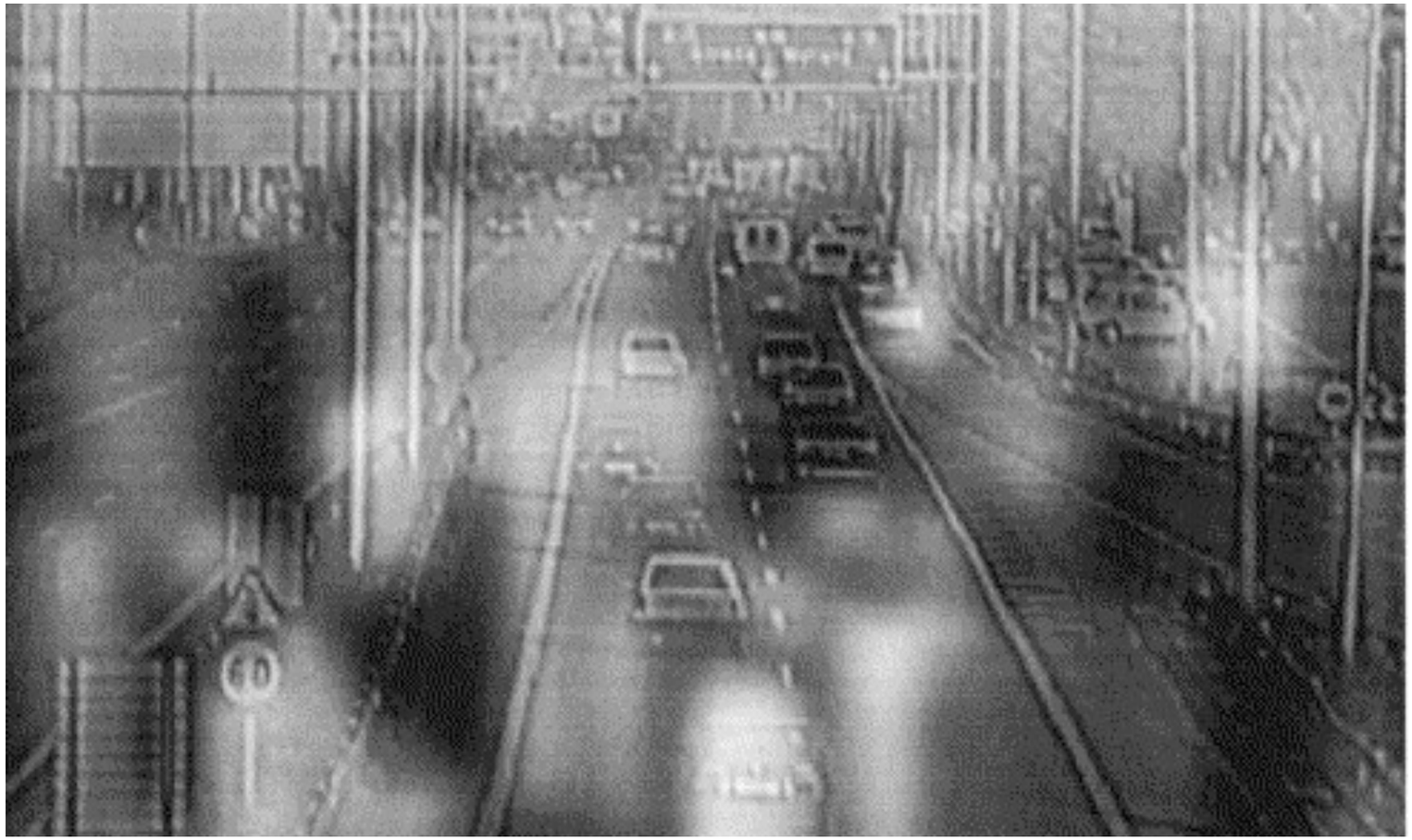
Hybrid Stimuli

- Schyns & Oliva, 1994

City (blurred)

Highway (edges)



30 ms

Subject sees
a City

120 ms

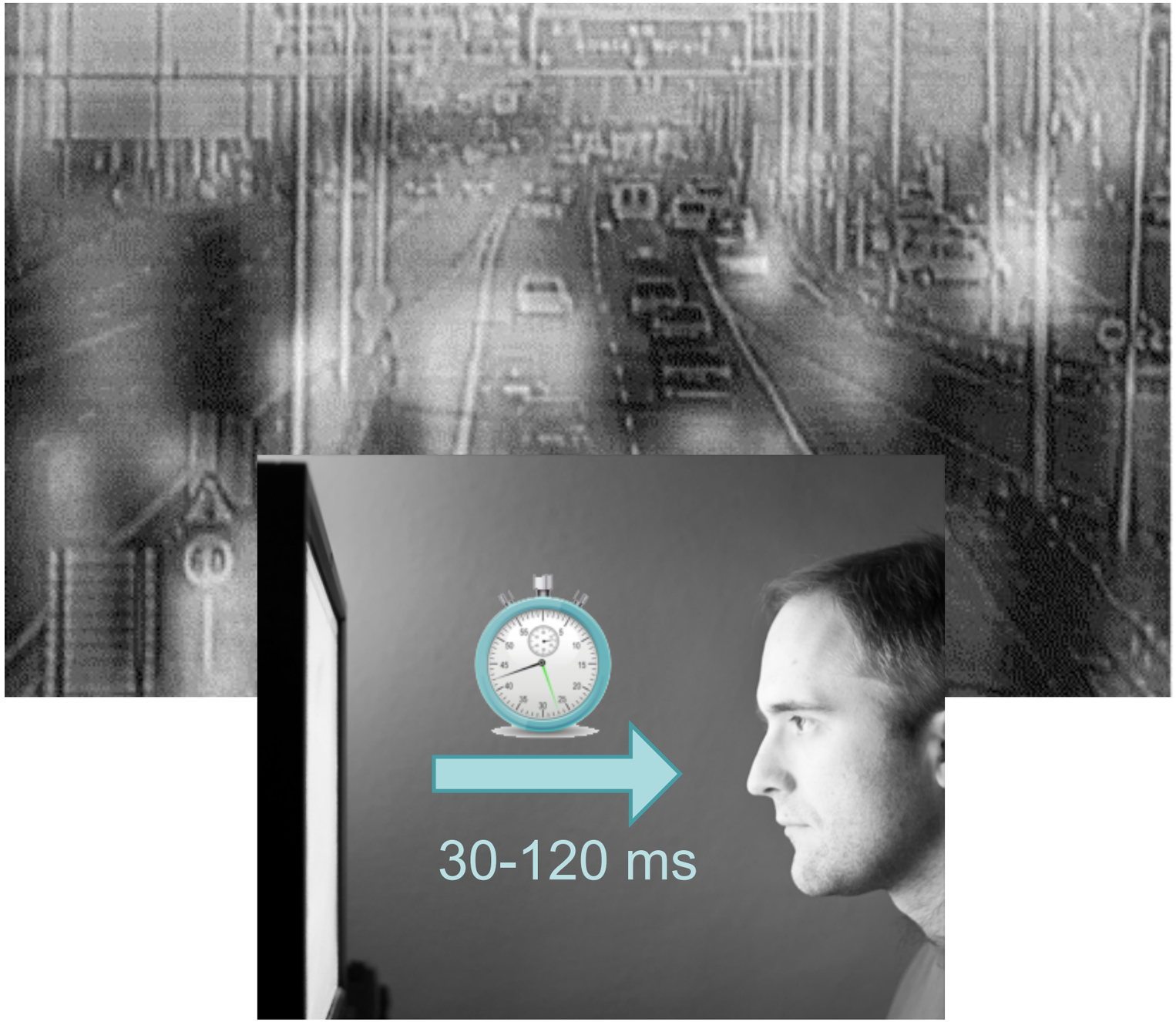
Sees a highway

Hybrid Stimuli

- Schyns & Oliva, 1994

City (blurred)

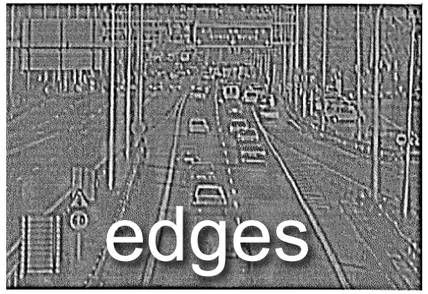
Highway (edges)



Hybrid Images

- Oliva, Torralba & Schyns, 2006

+



Our Contributions

- **Theoretical grounding**

  why & when use hybrid images?

- **Too**

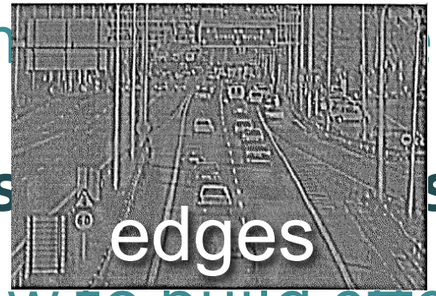
  ho their creation?

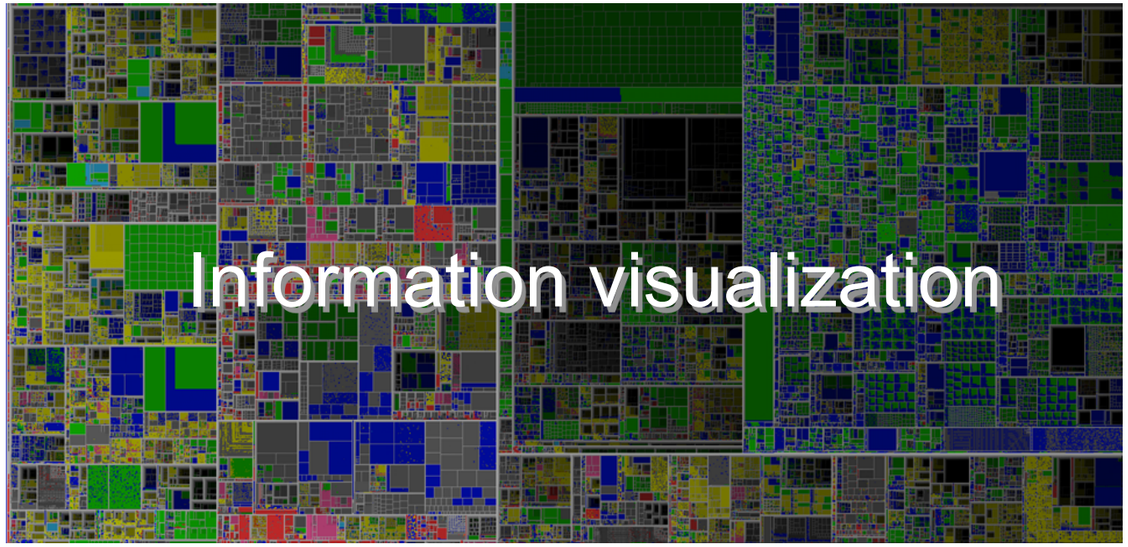
- **Examples**

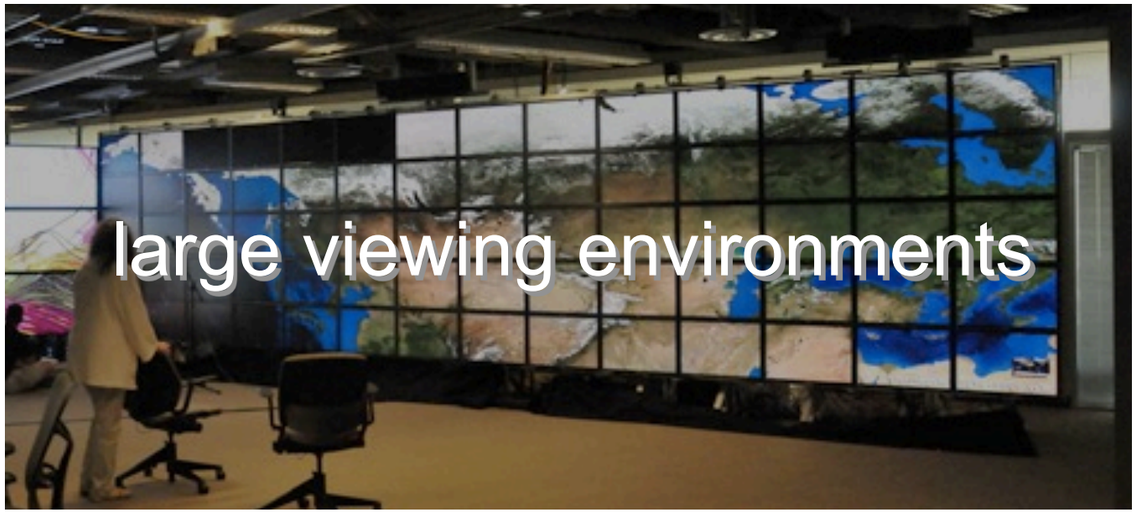
  wh ally good for?

- **Des s**

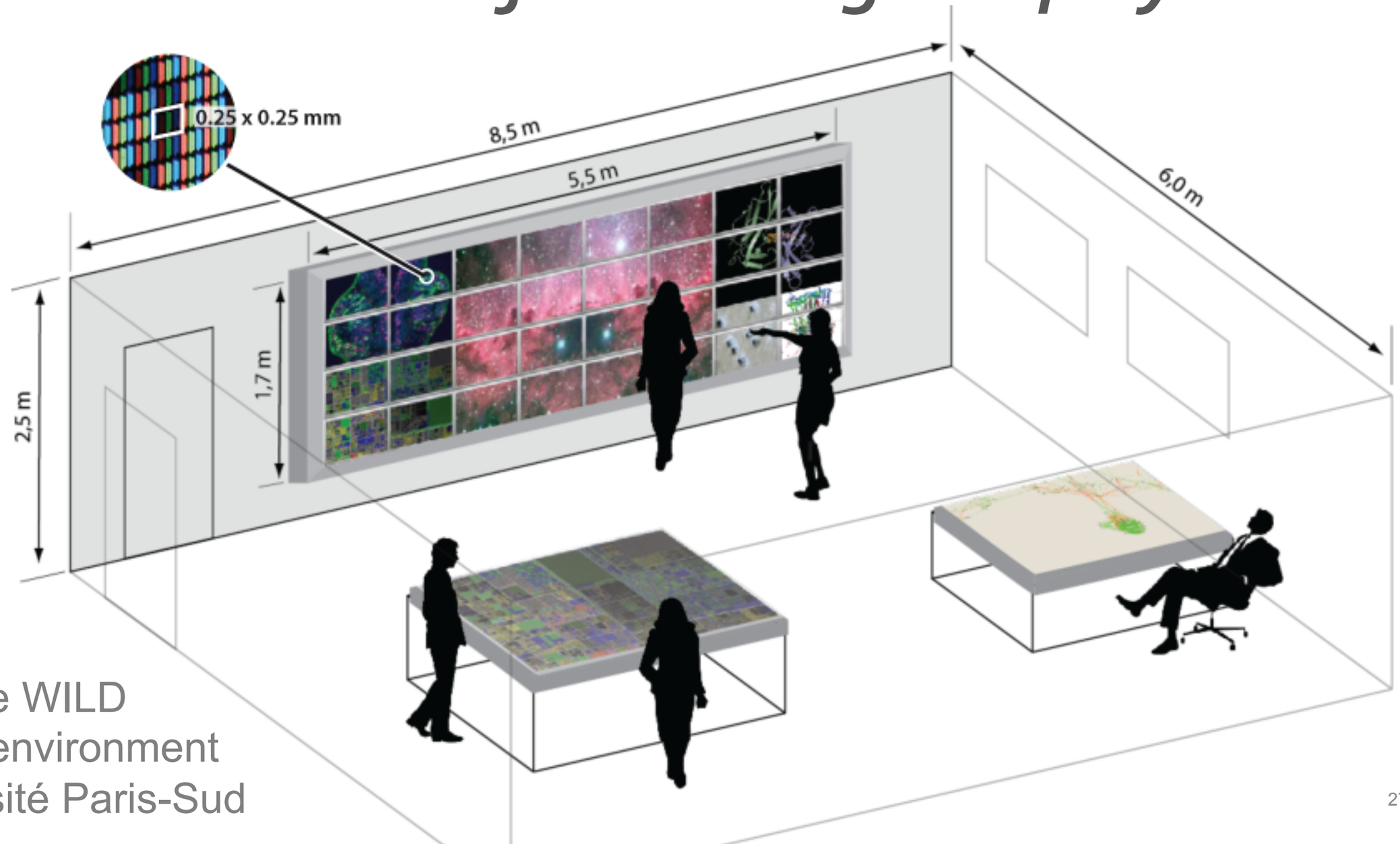
  how to build effective ones?







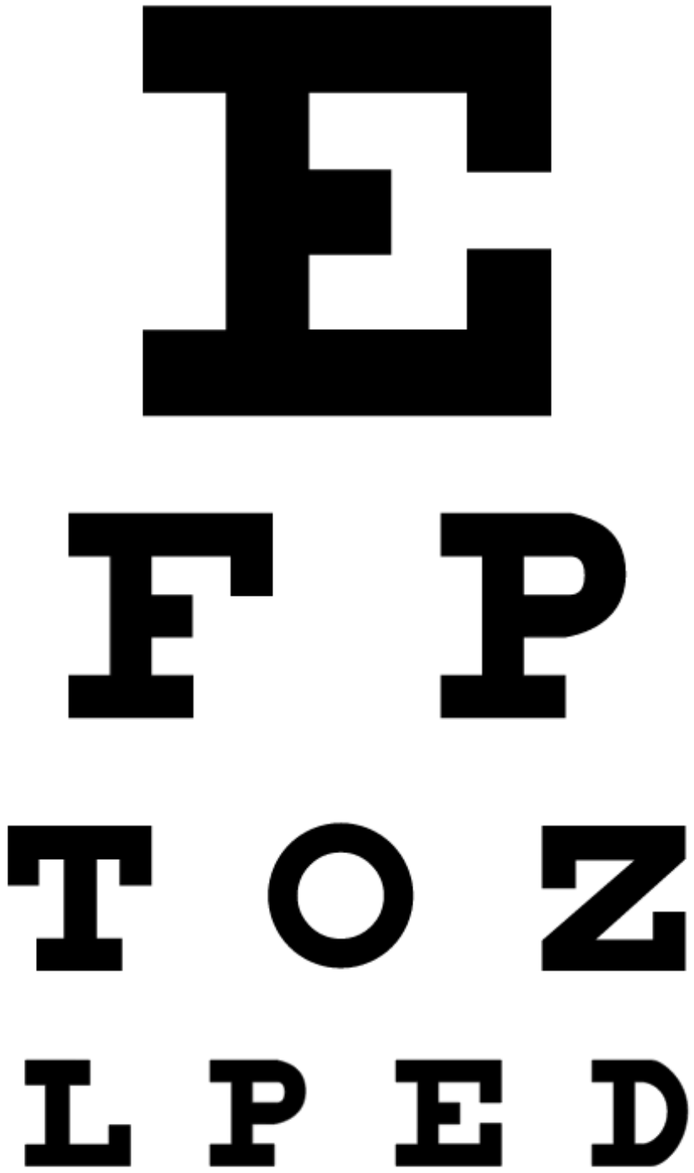
What do we Perceive from a Large Display?

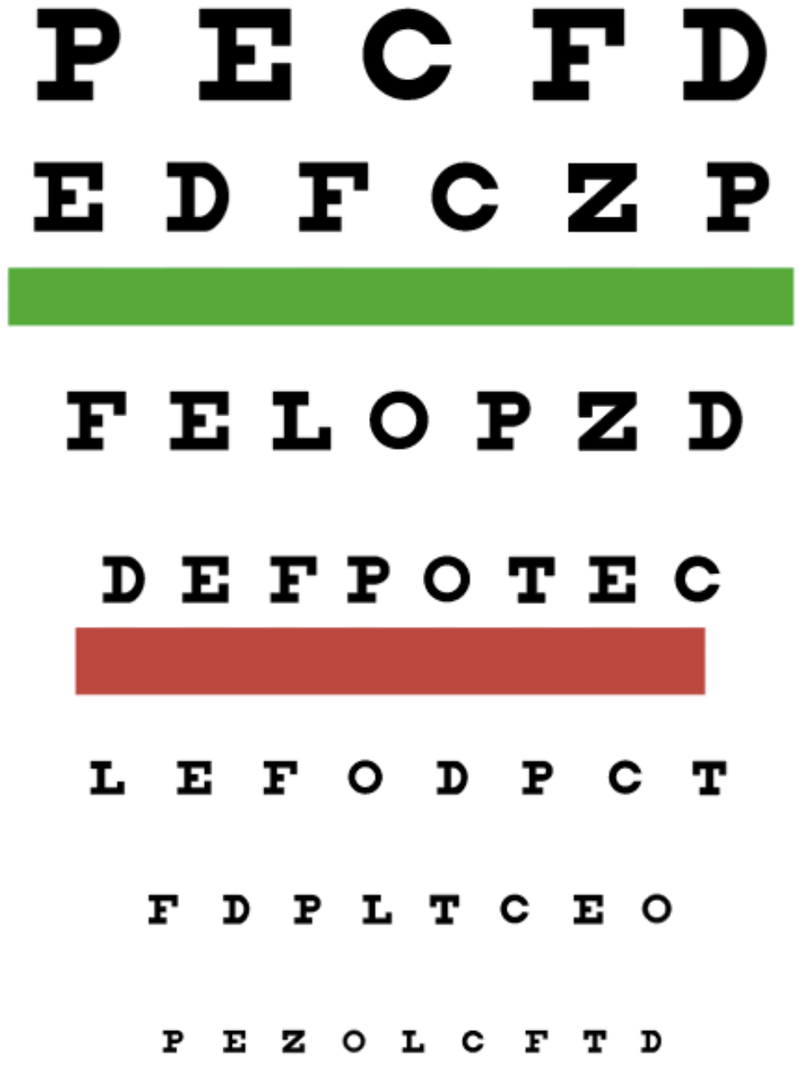


The WILD
display environment
at Université Paris-Sud

Object-based Approach

e.g., Snellen Charts





Object-based Approach

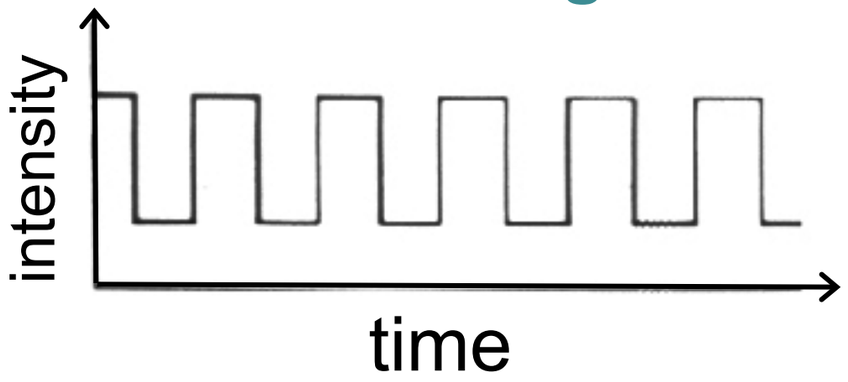
Object-based Approach

Object-based Approach

Frequency Domain Approach

Frequency Domain Approach

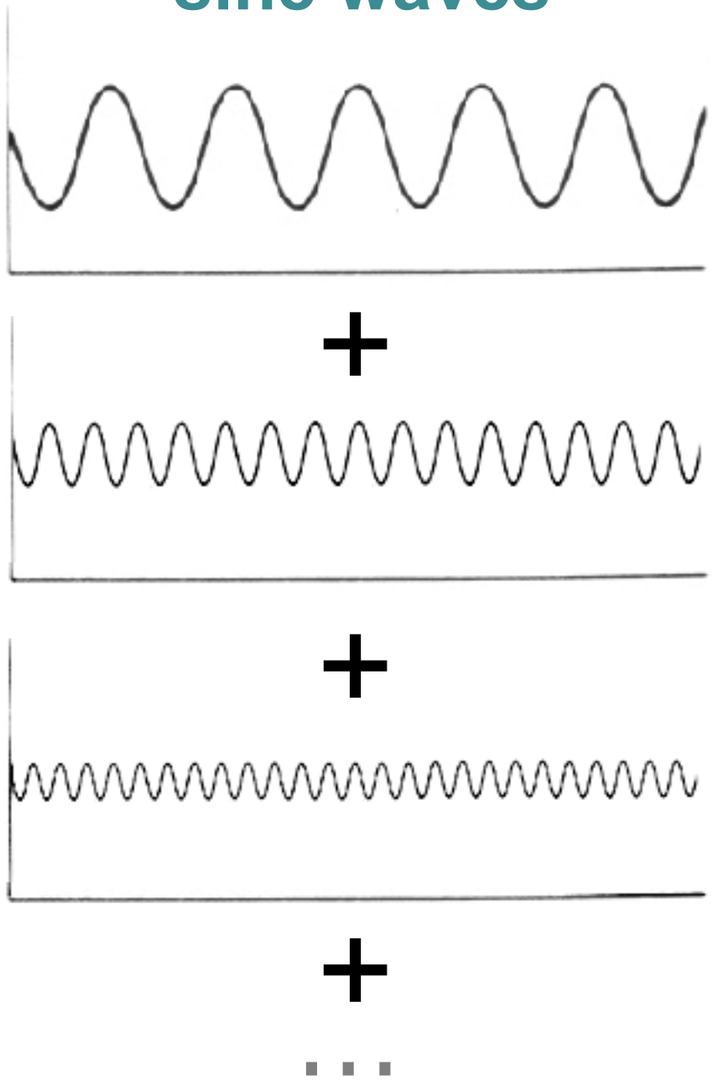
acoustic signal



Fourier Transform

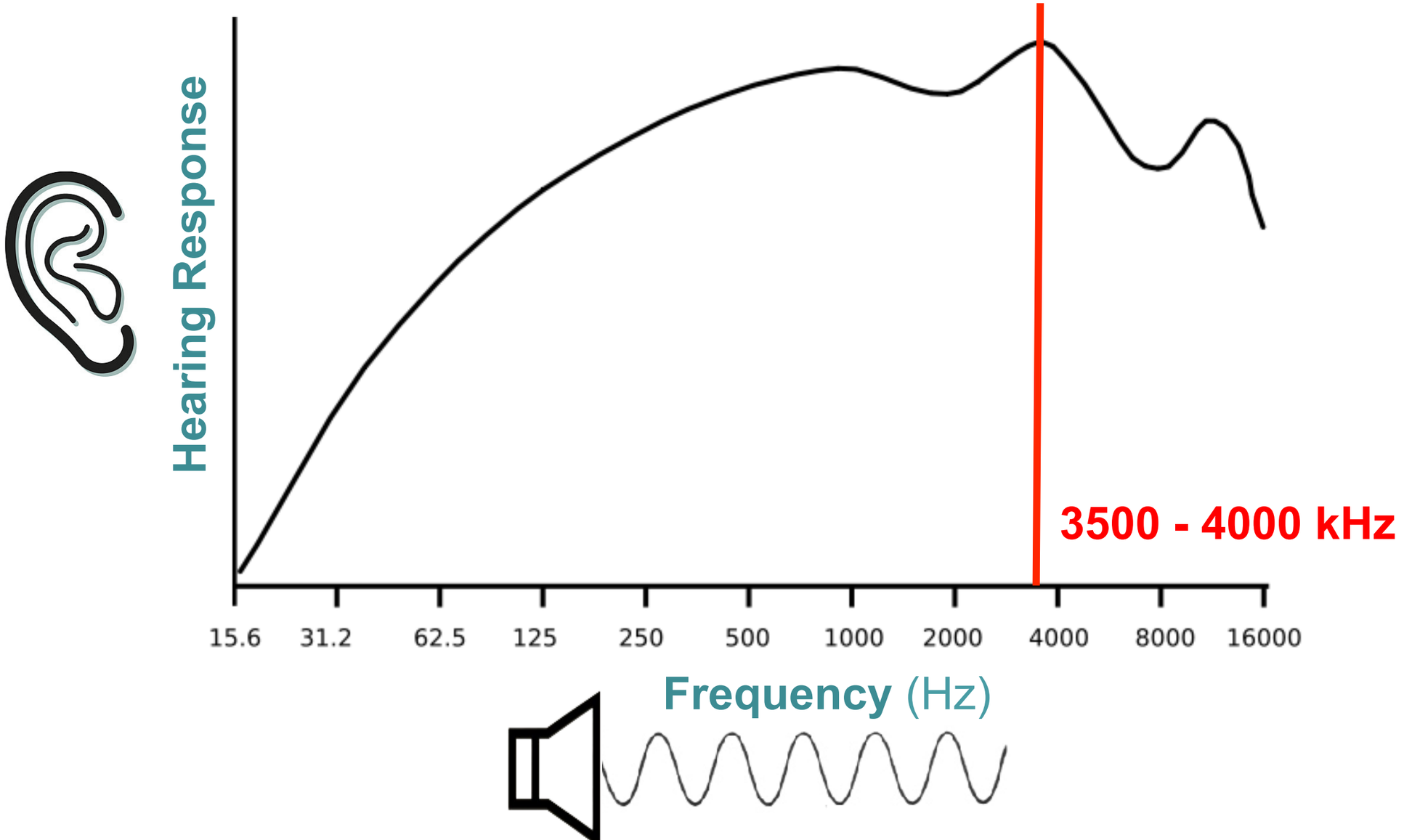
=

sine waves



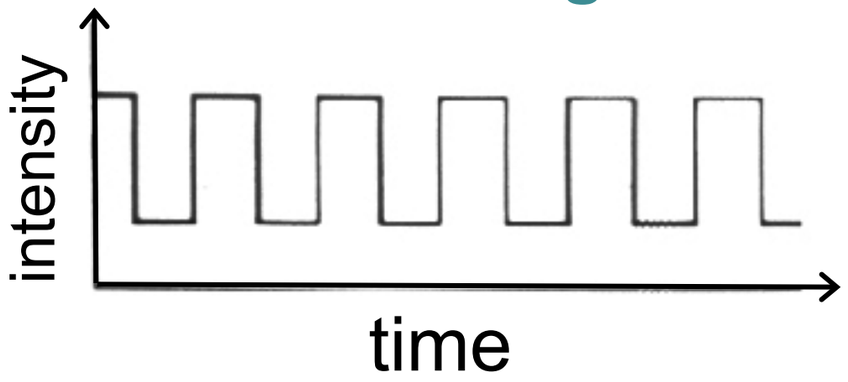
frequencies in **Hertz**

Frequency Domain Approach



Frequency Domain Approach

acoustic signal



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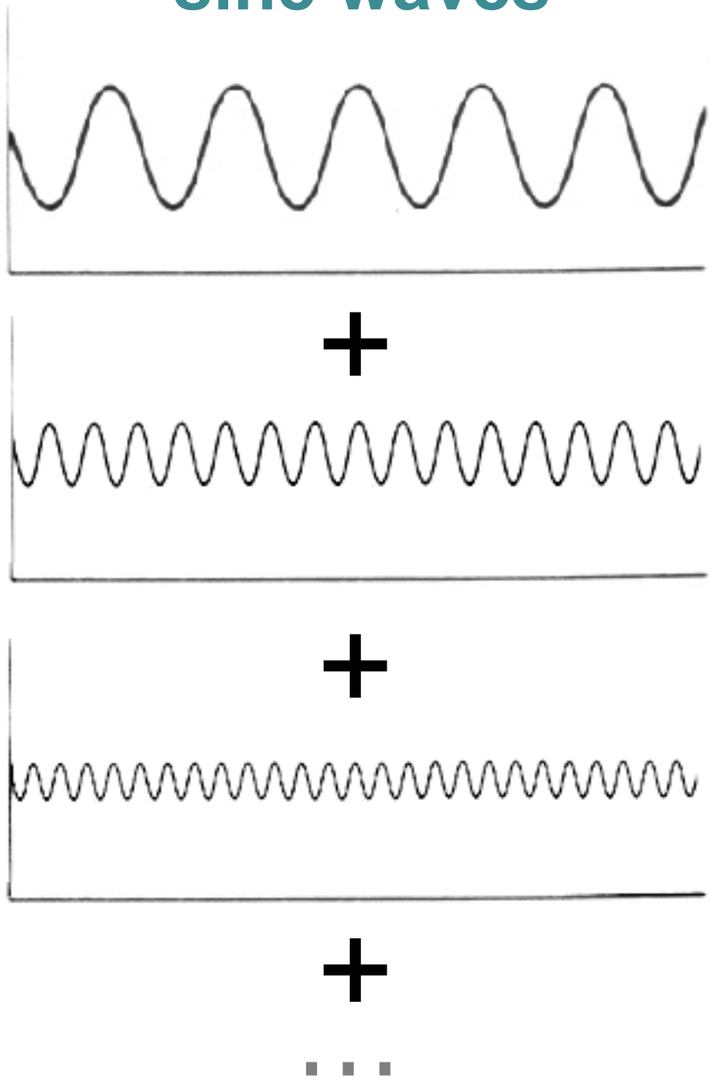
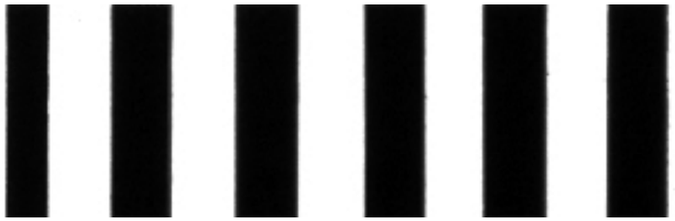


frequencies in **Hertz**

Frequency Domain Approach

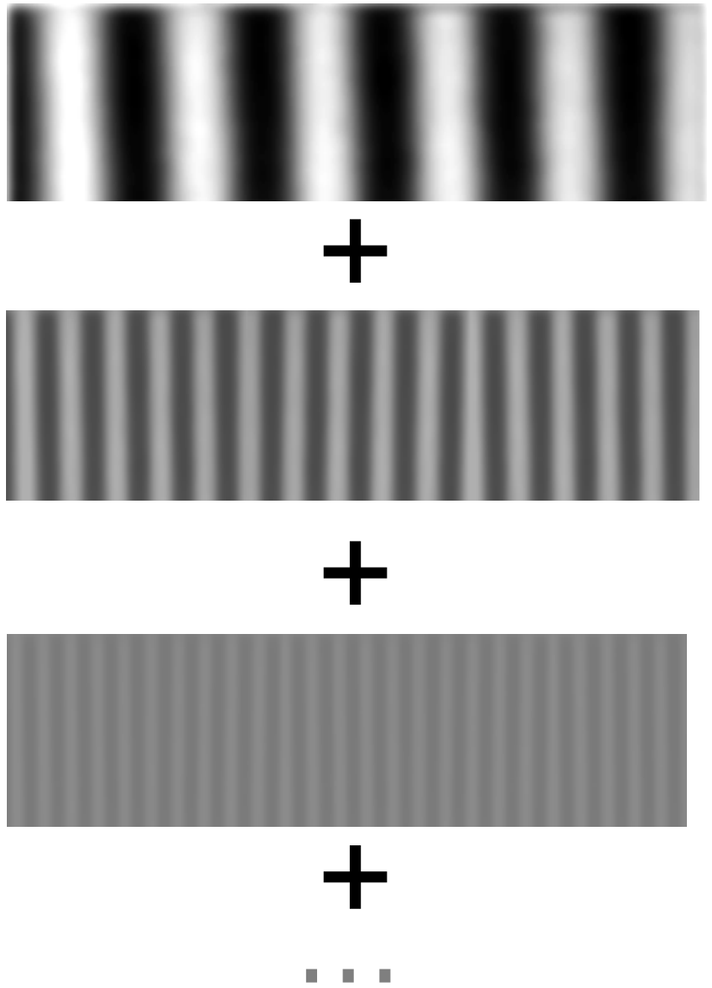
image



(1D) Fourier Transform

=

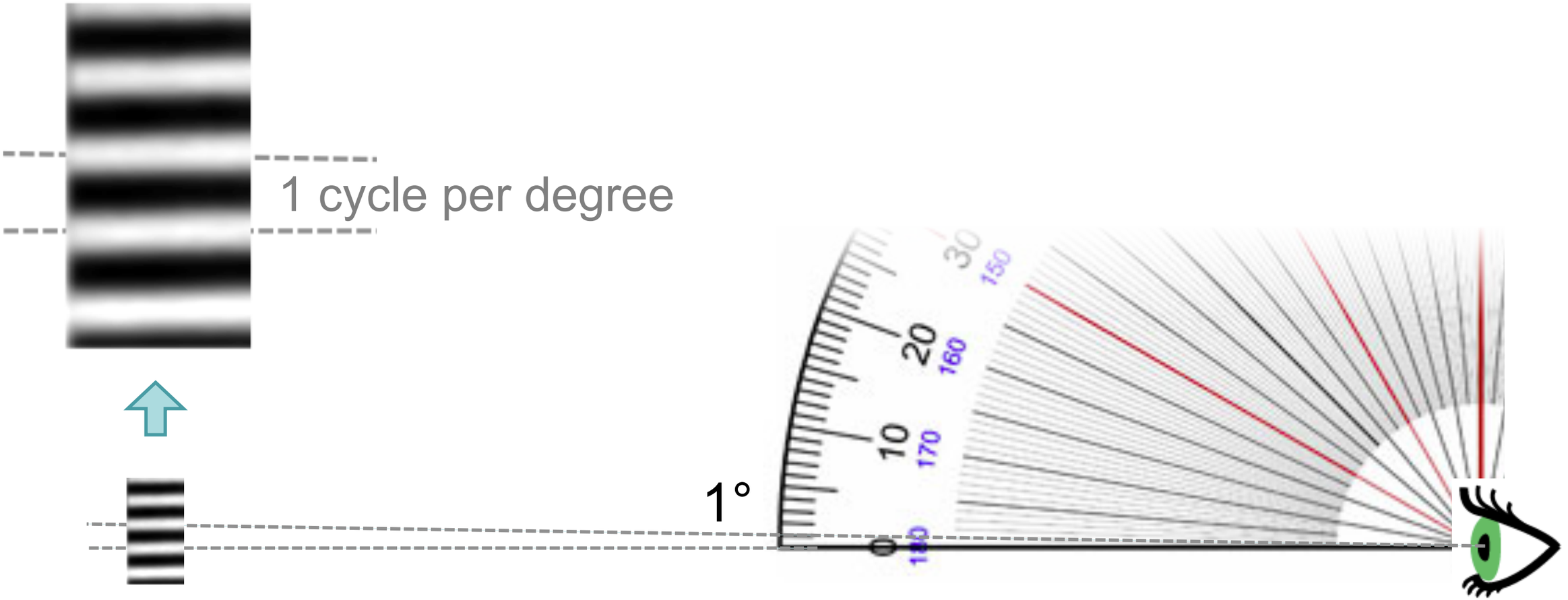
sinusoidal gratings



frequencies in

cycles/degree
of visual angle

Contrast Sensitivity Function



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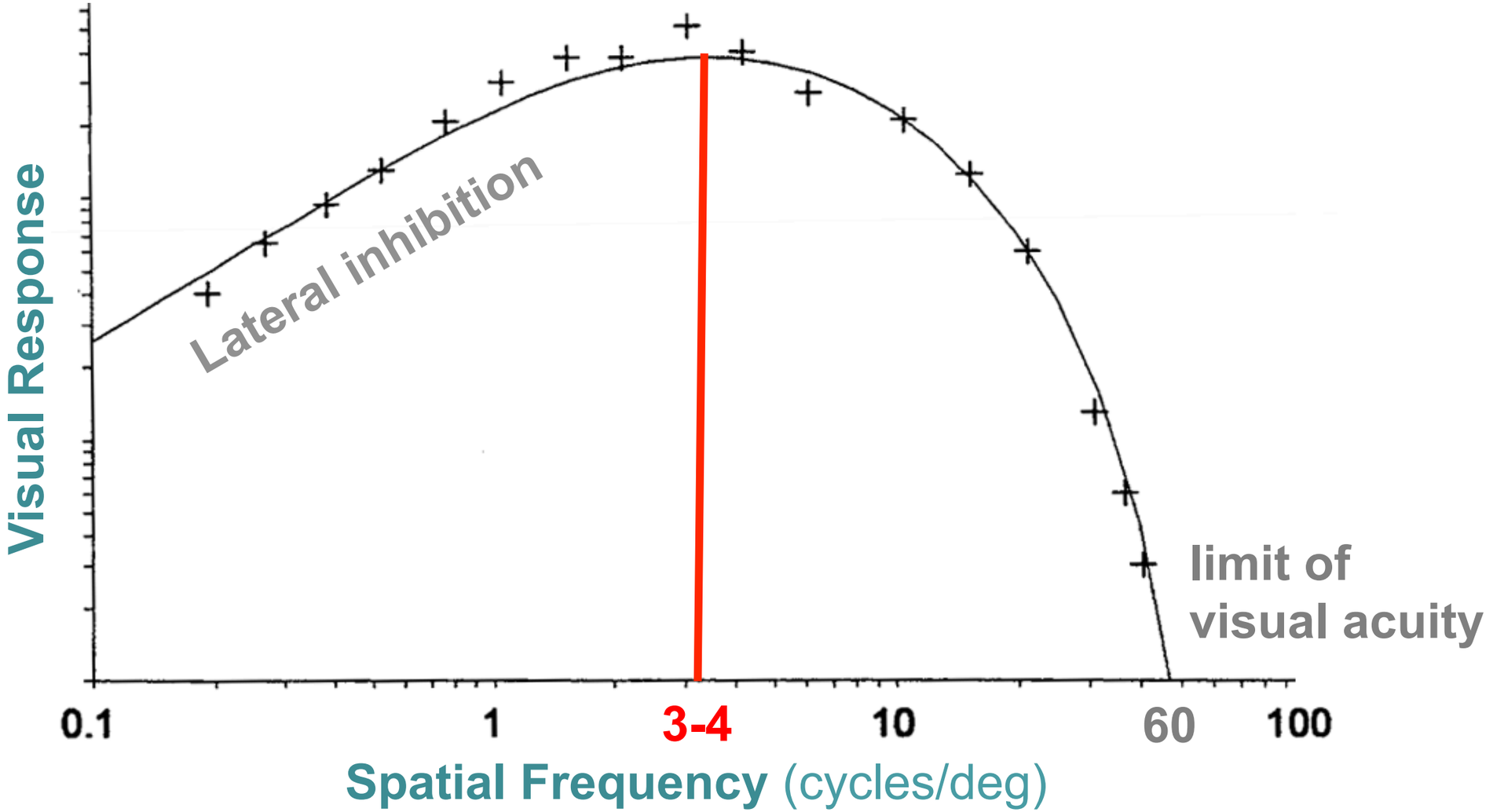
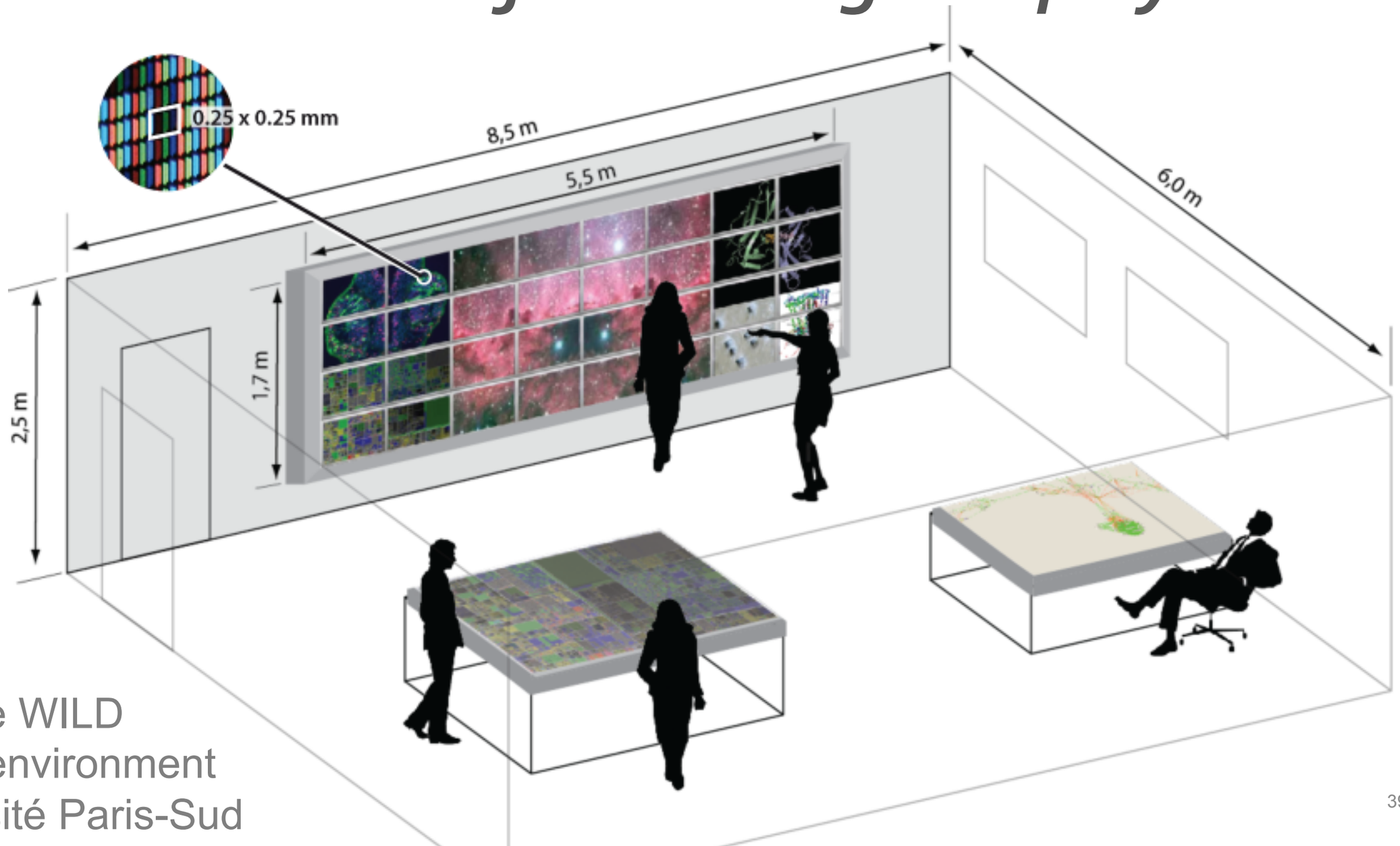


What do we Perceive from a Large Display?



The WILD
display environment
at Université Paris-Sud

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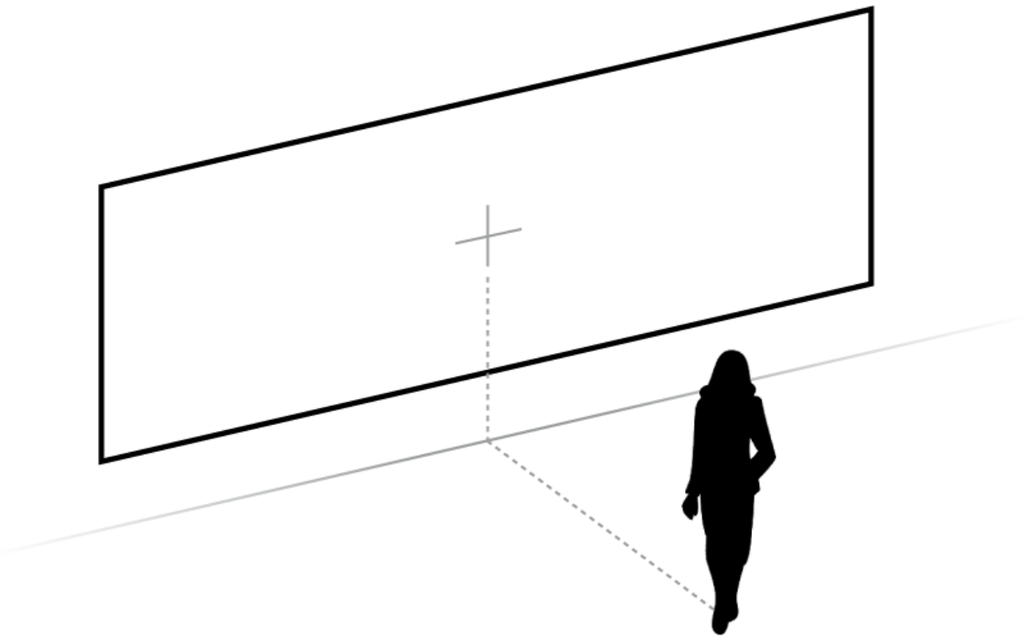

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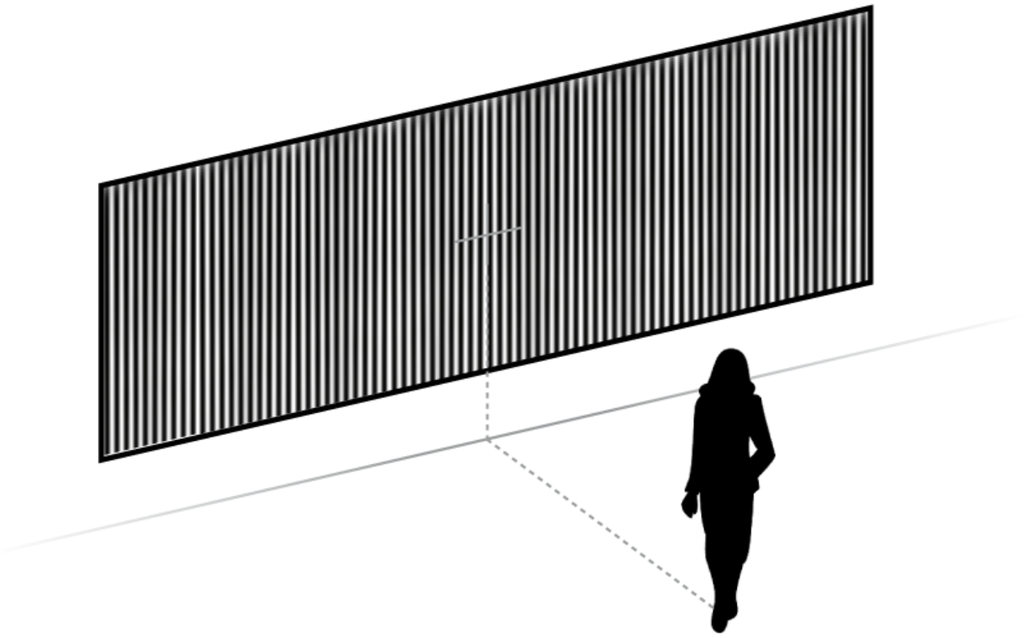

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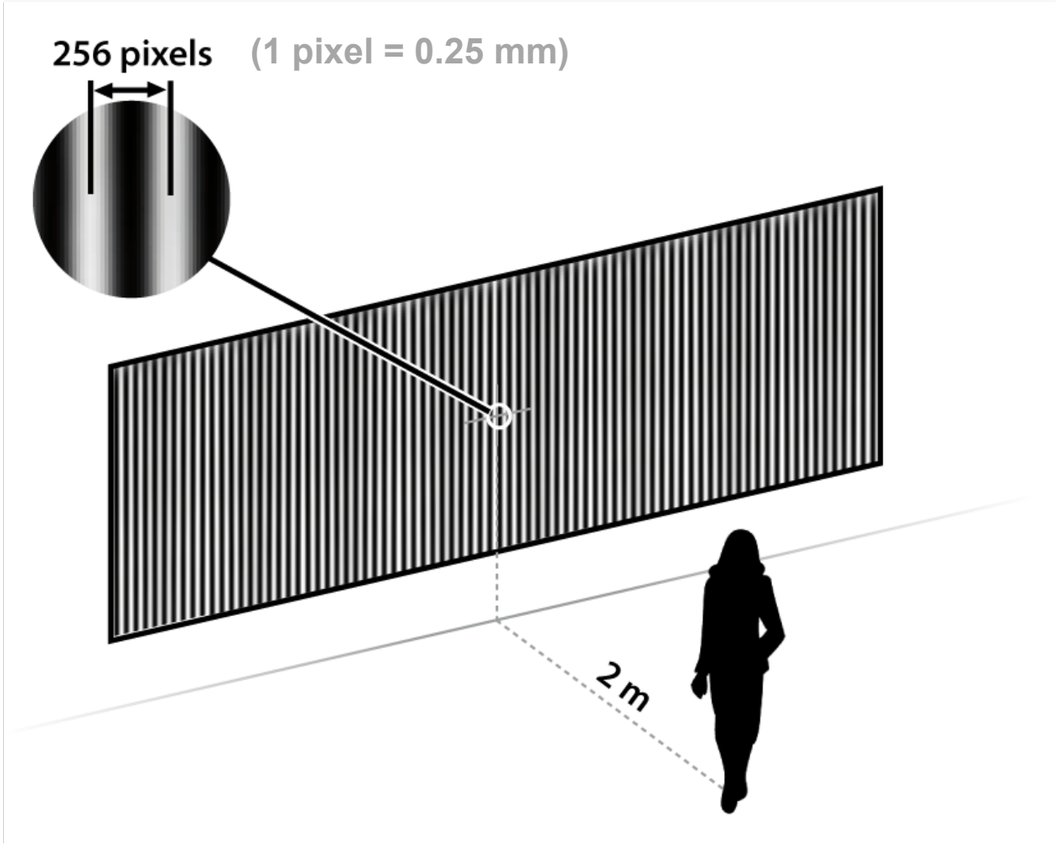

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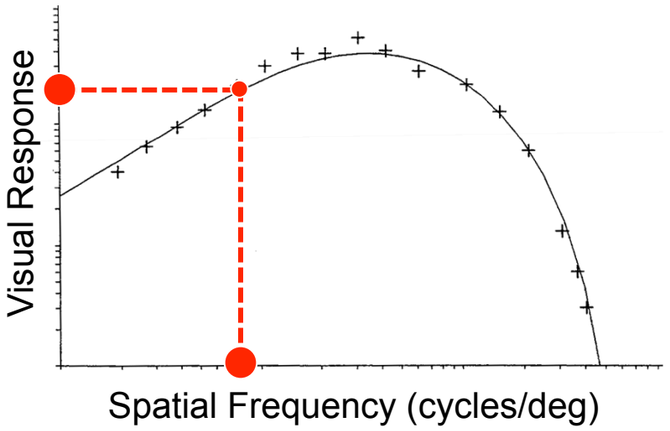

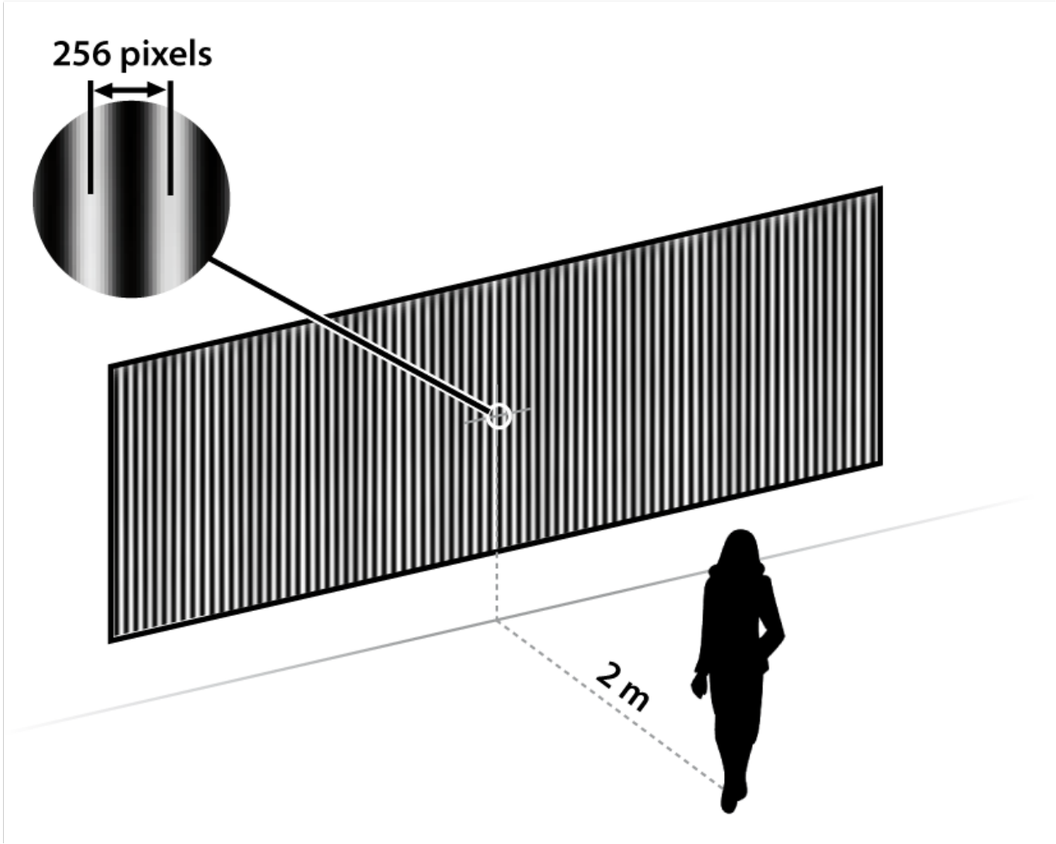

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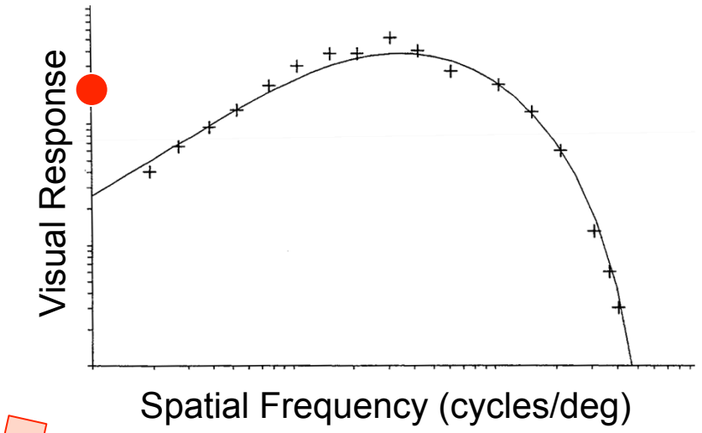

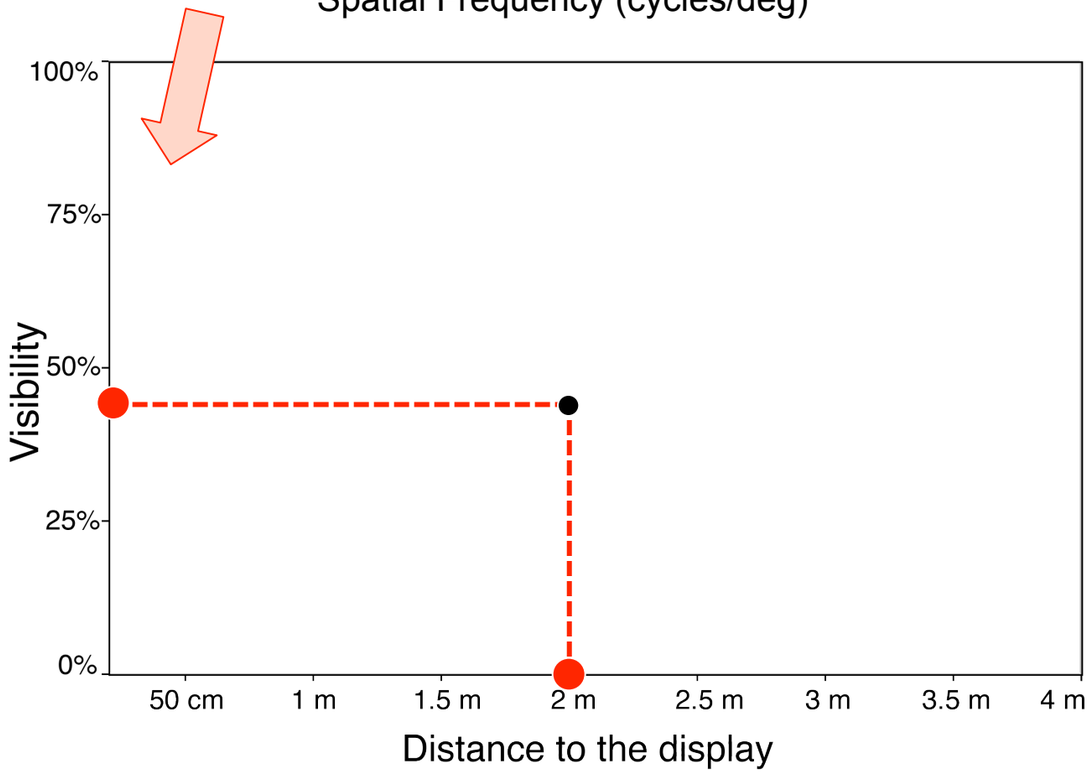

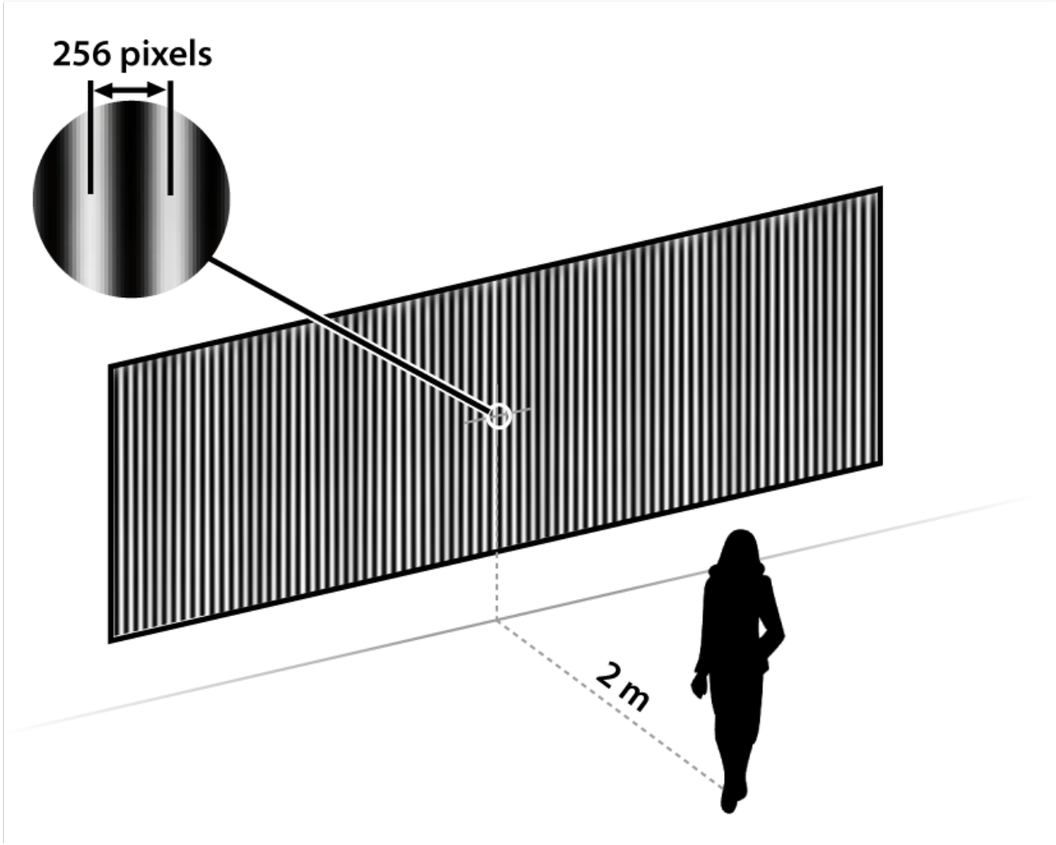

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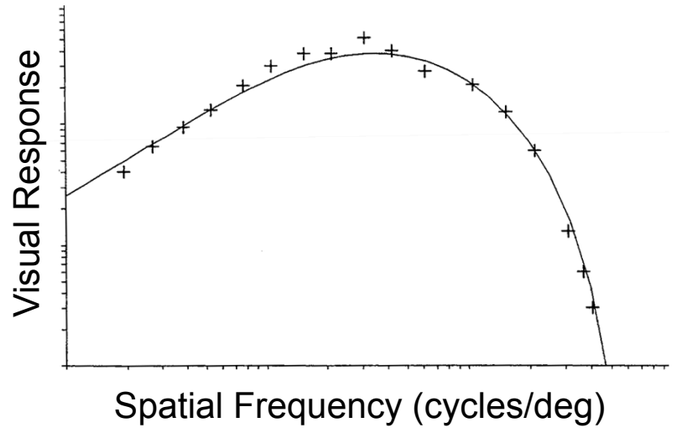

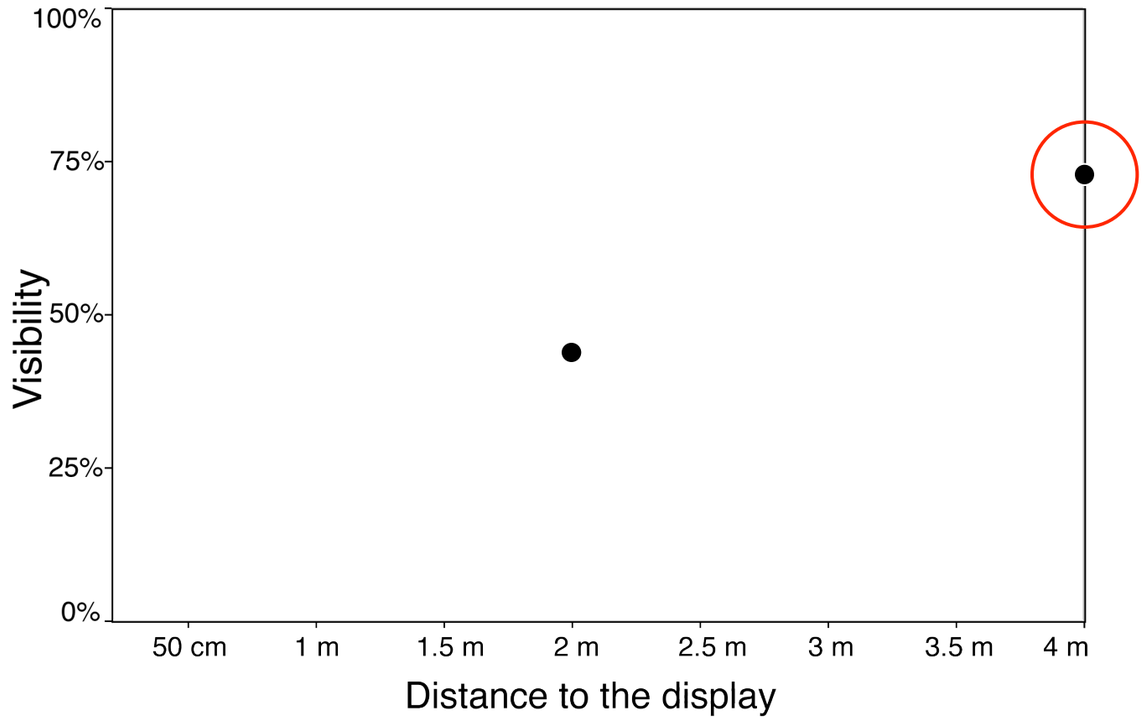

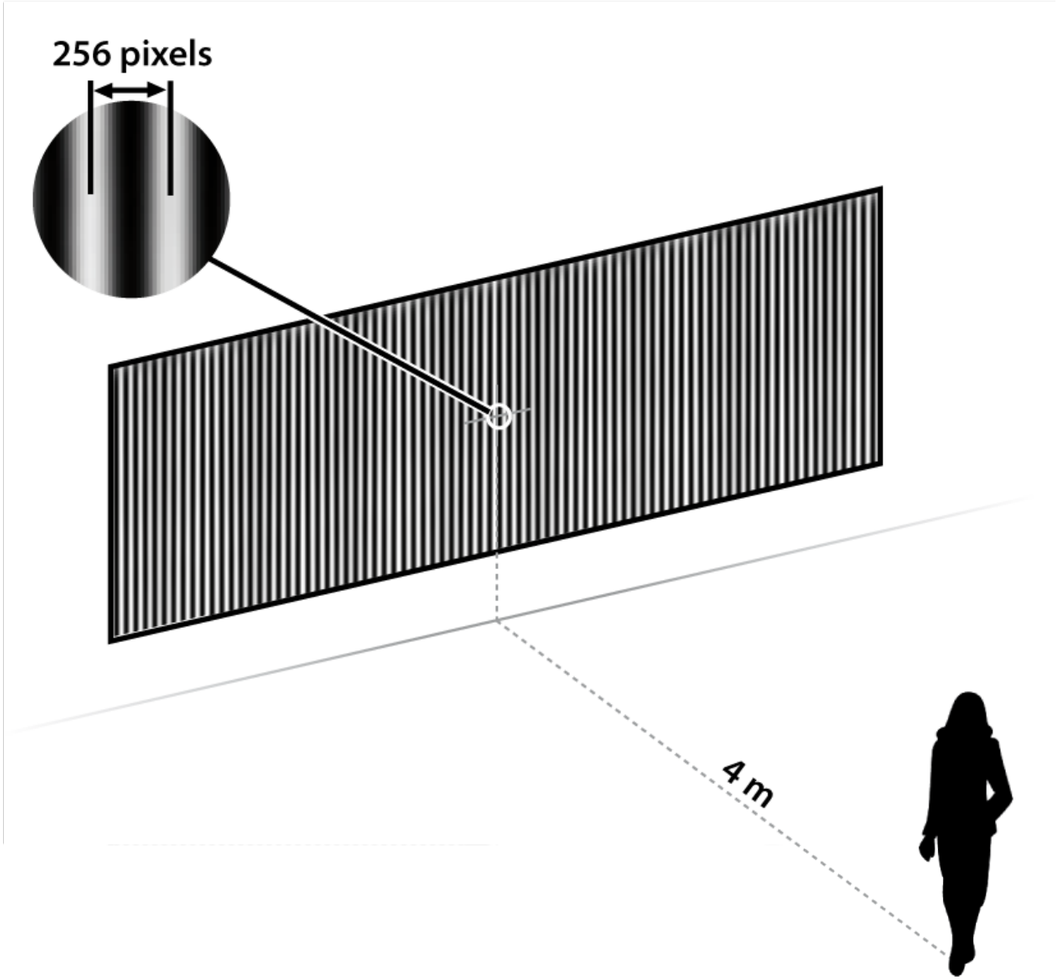

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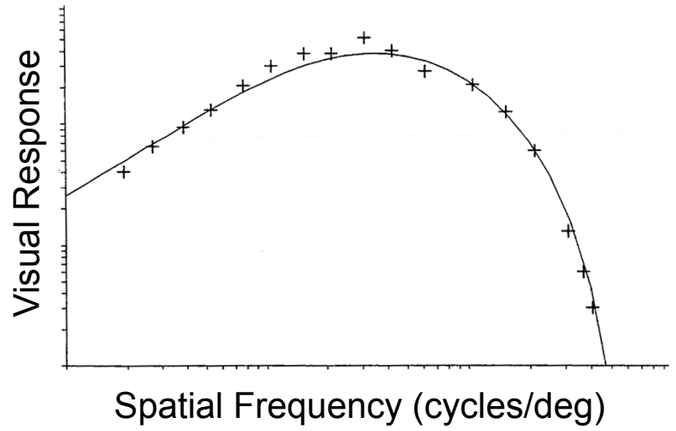

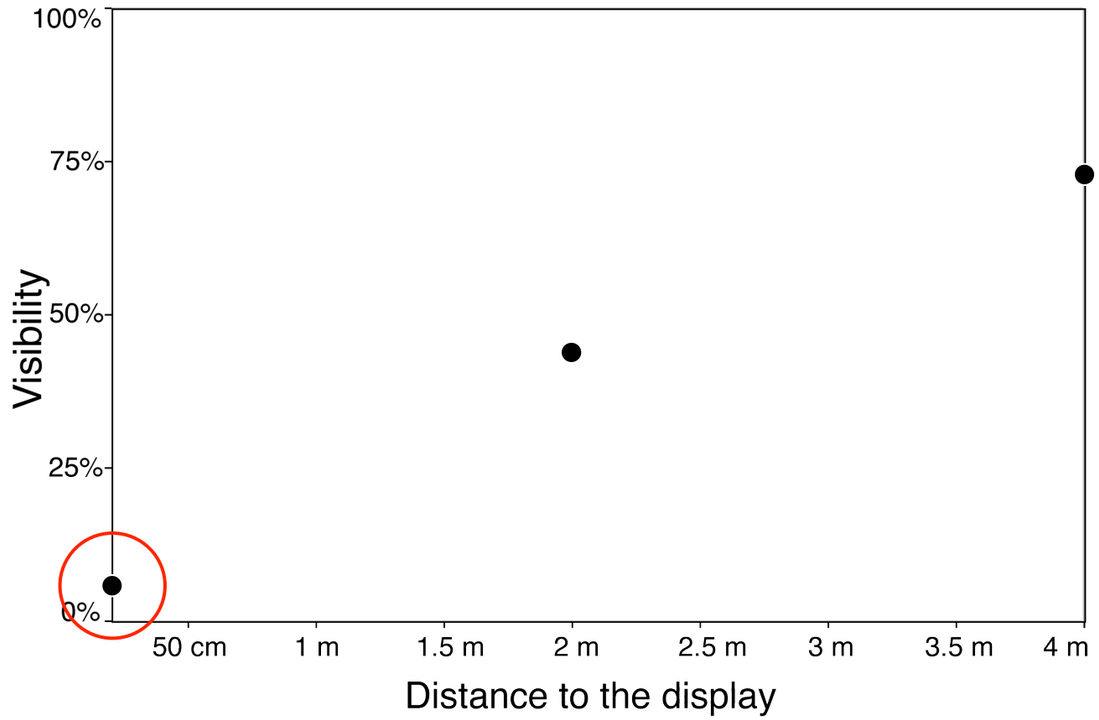

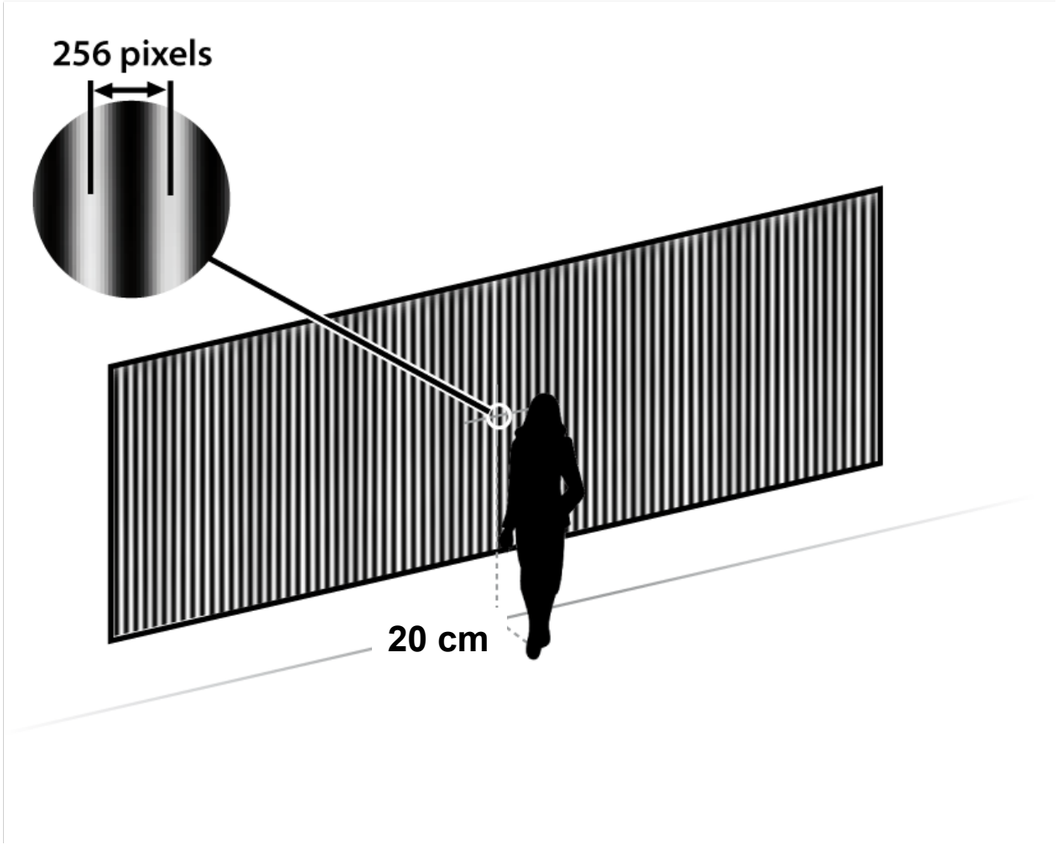

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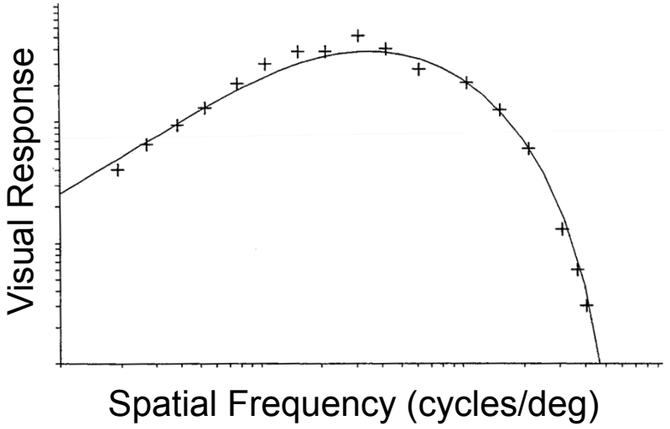

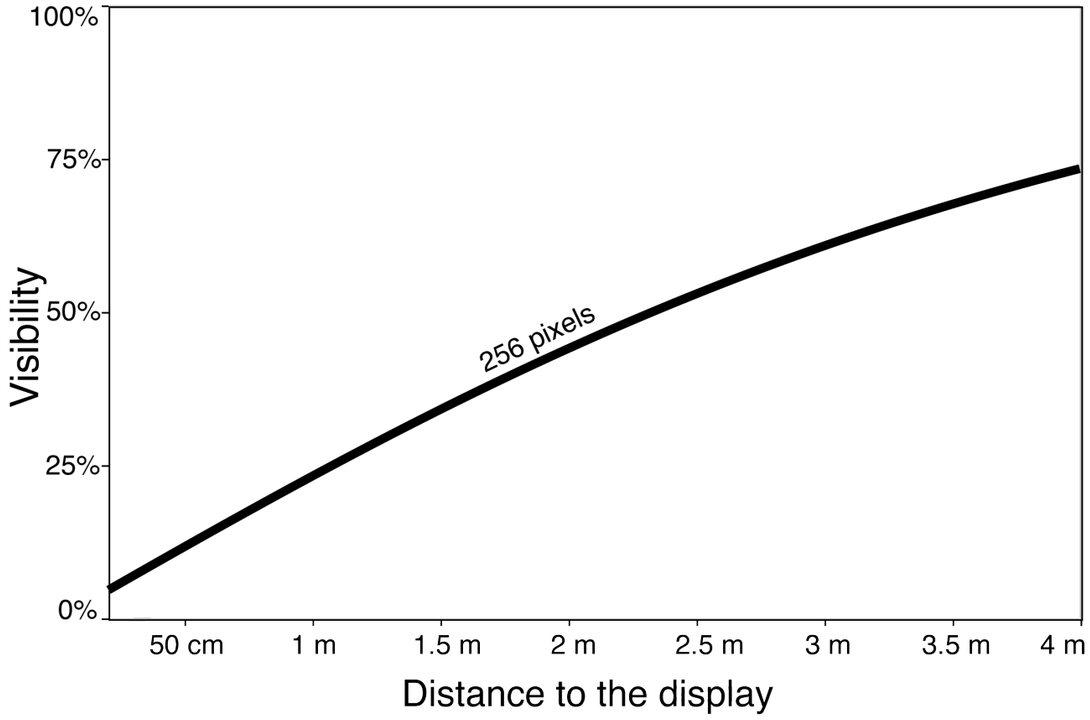

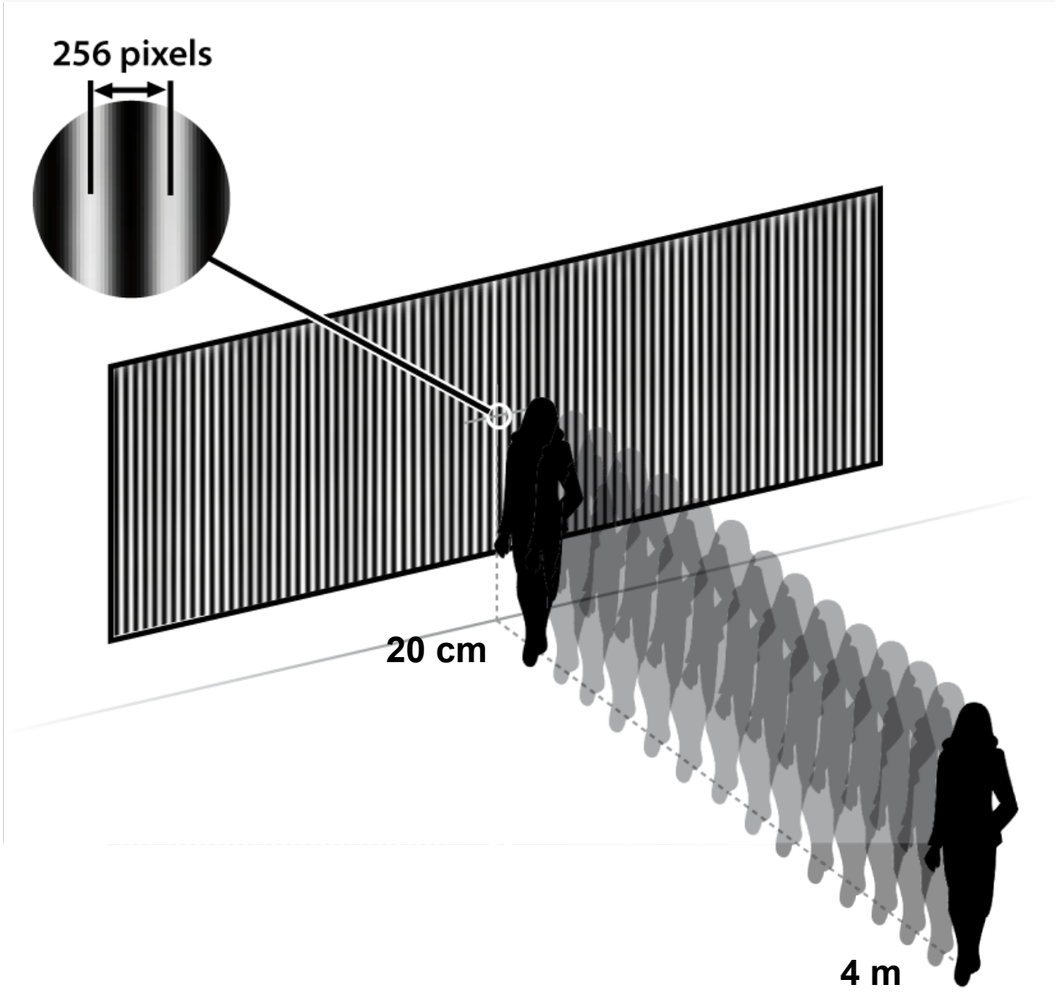

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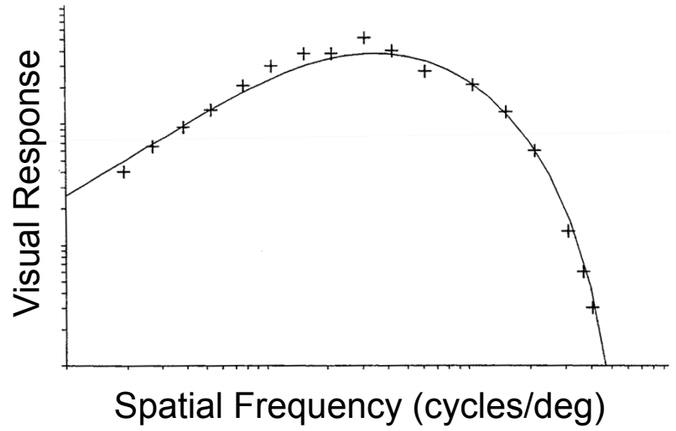

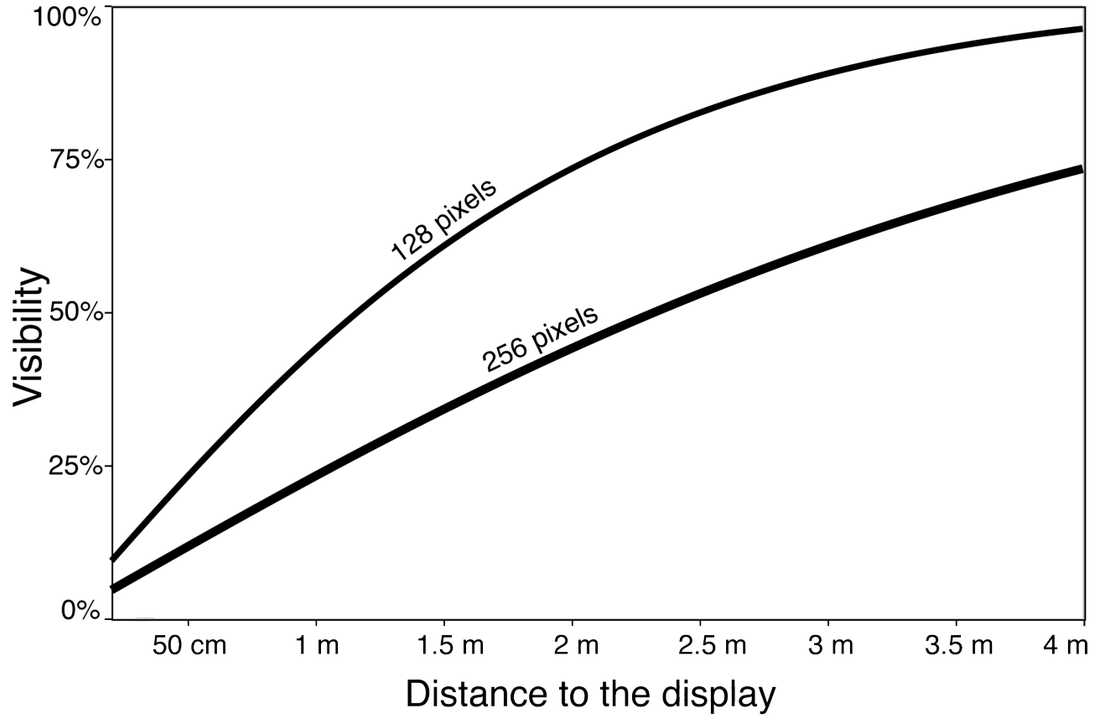

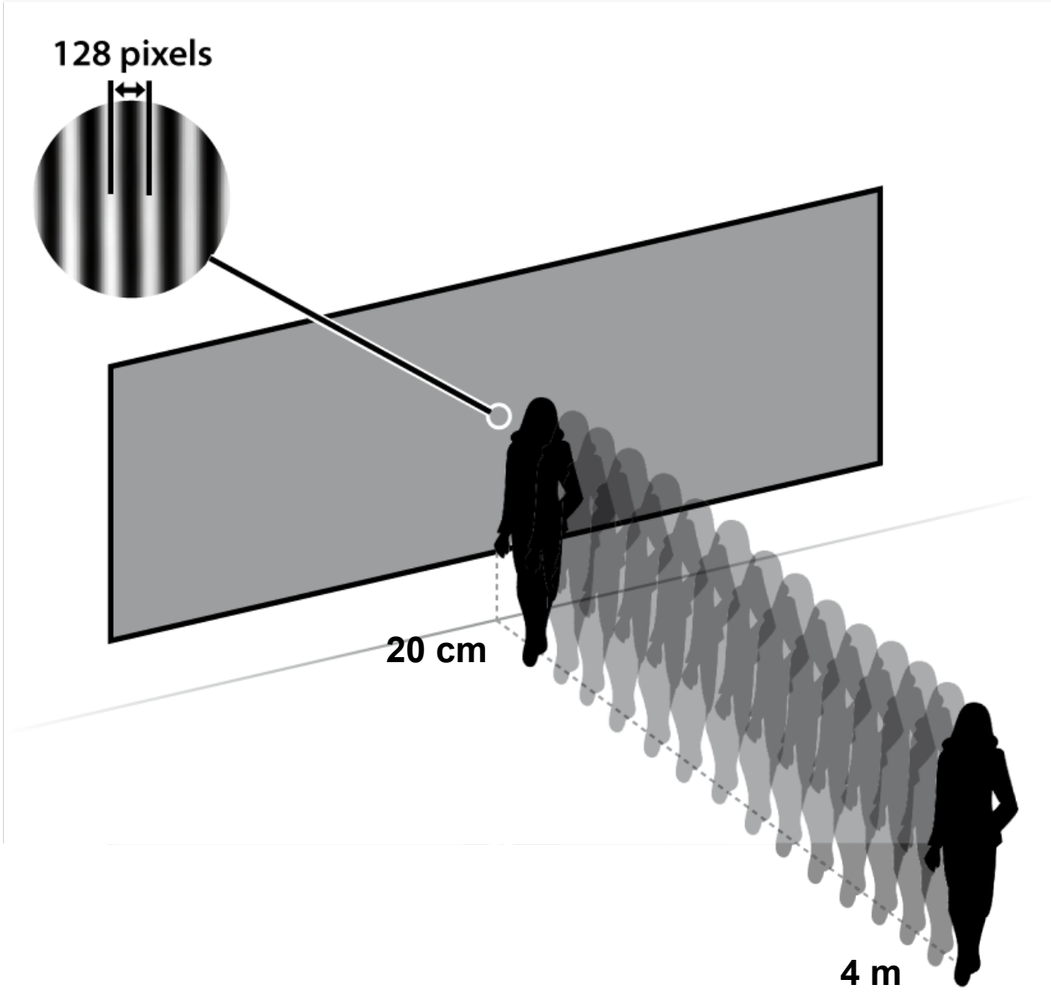

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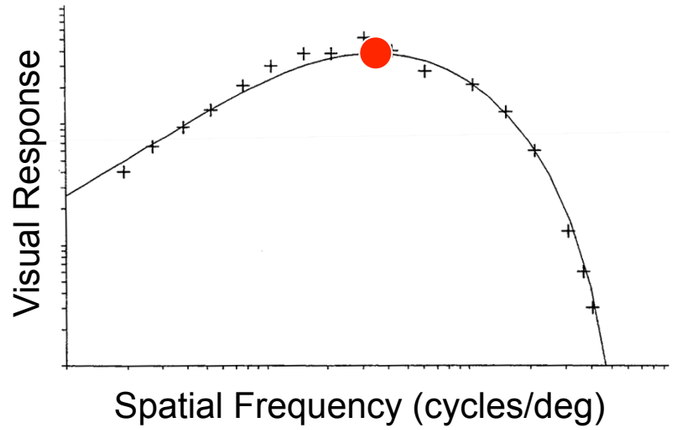

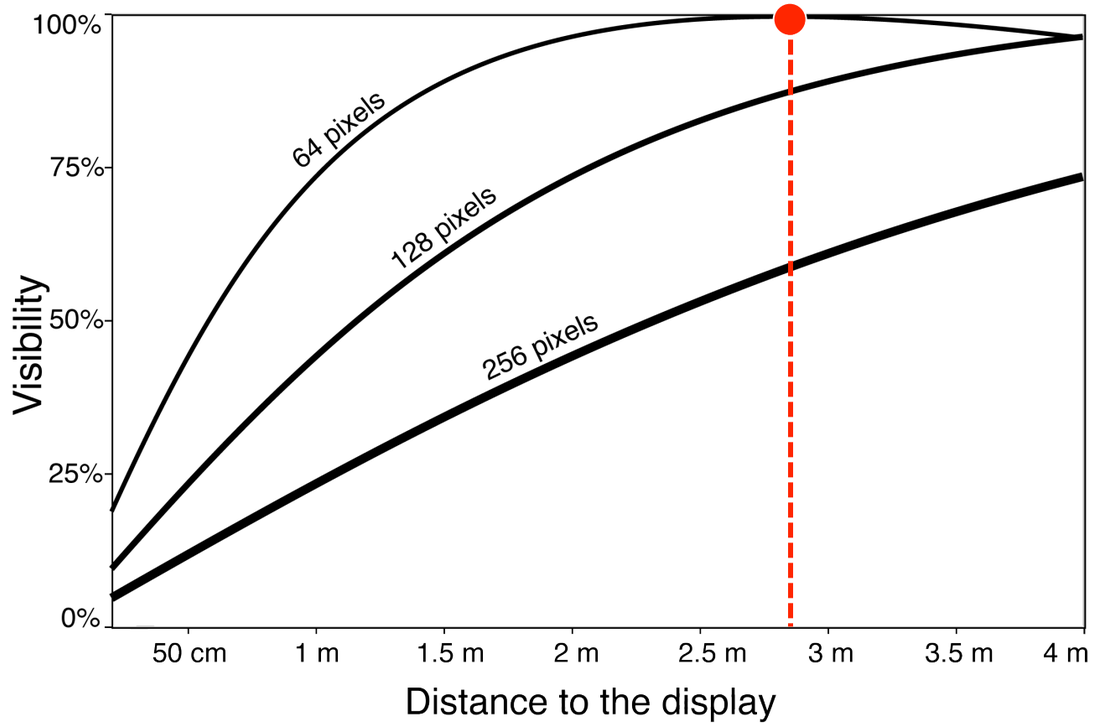

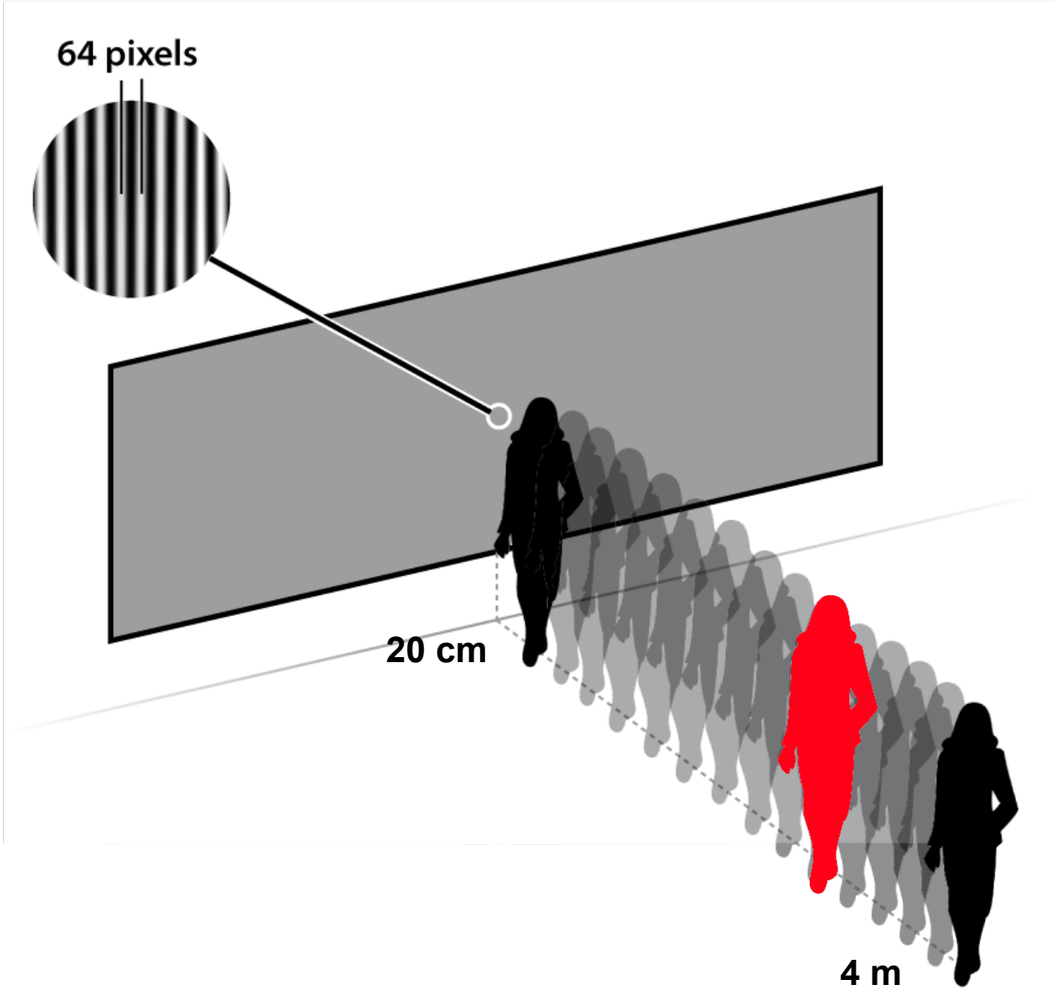

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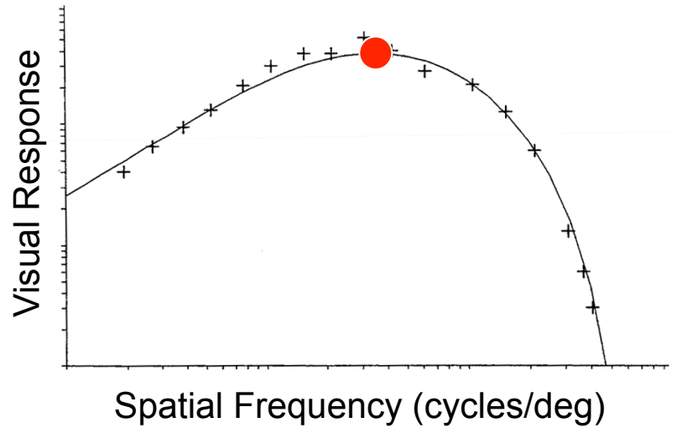

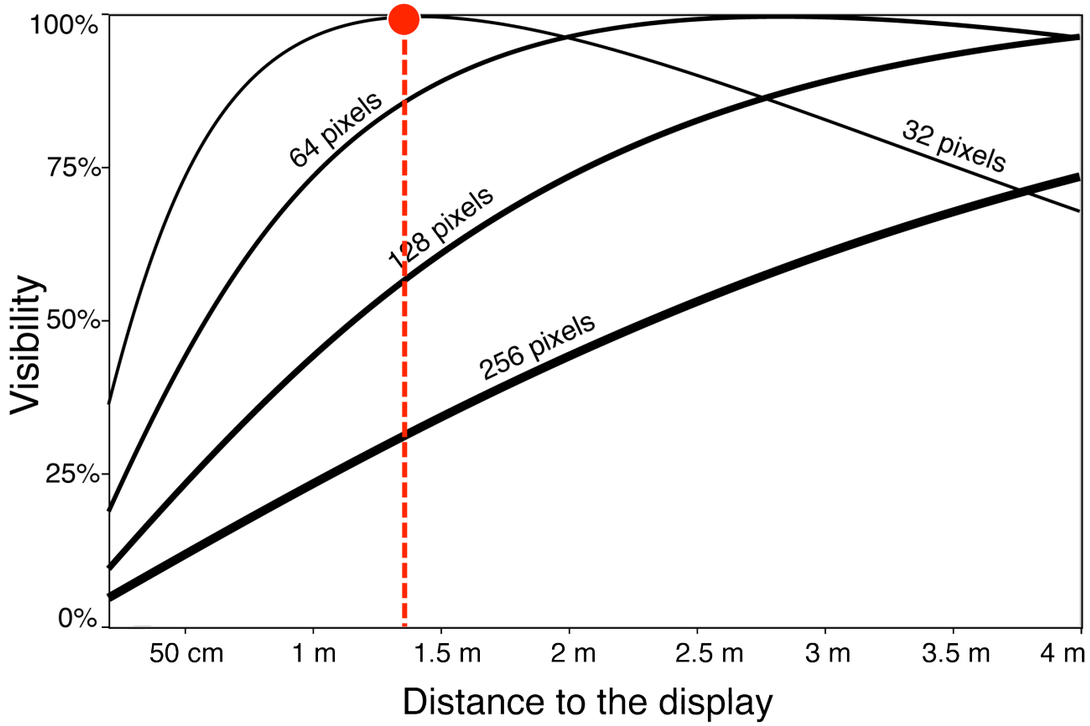

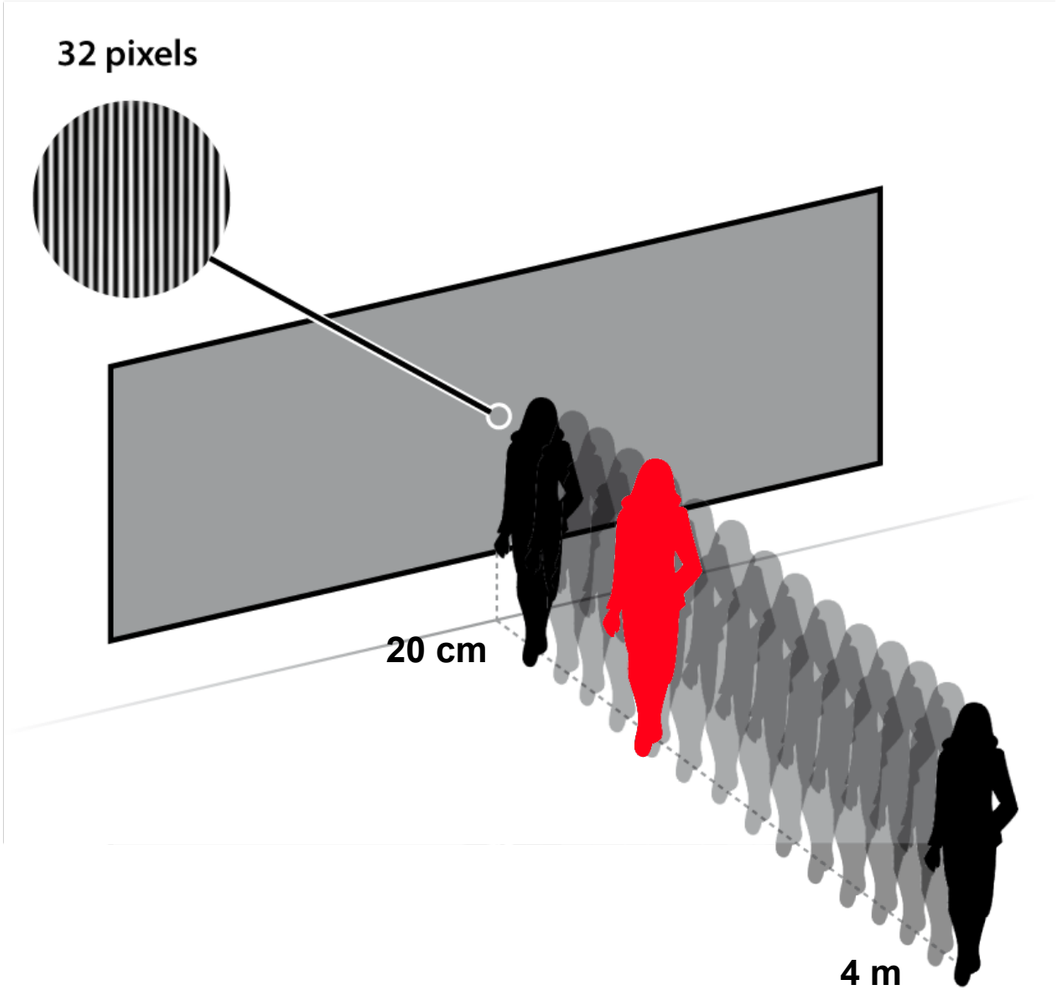

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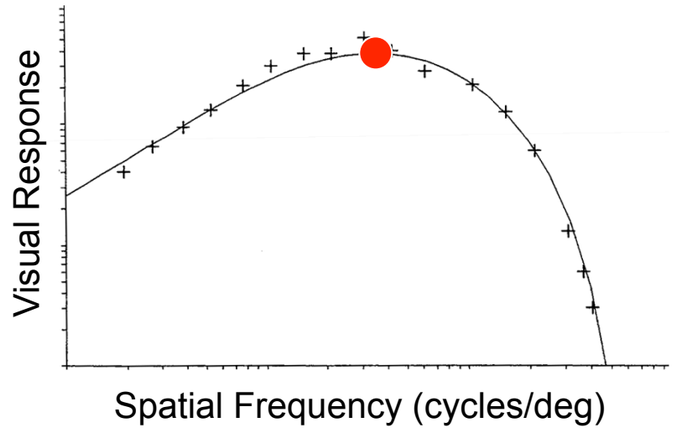

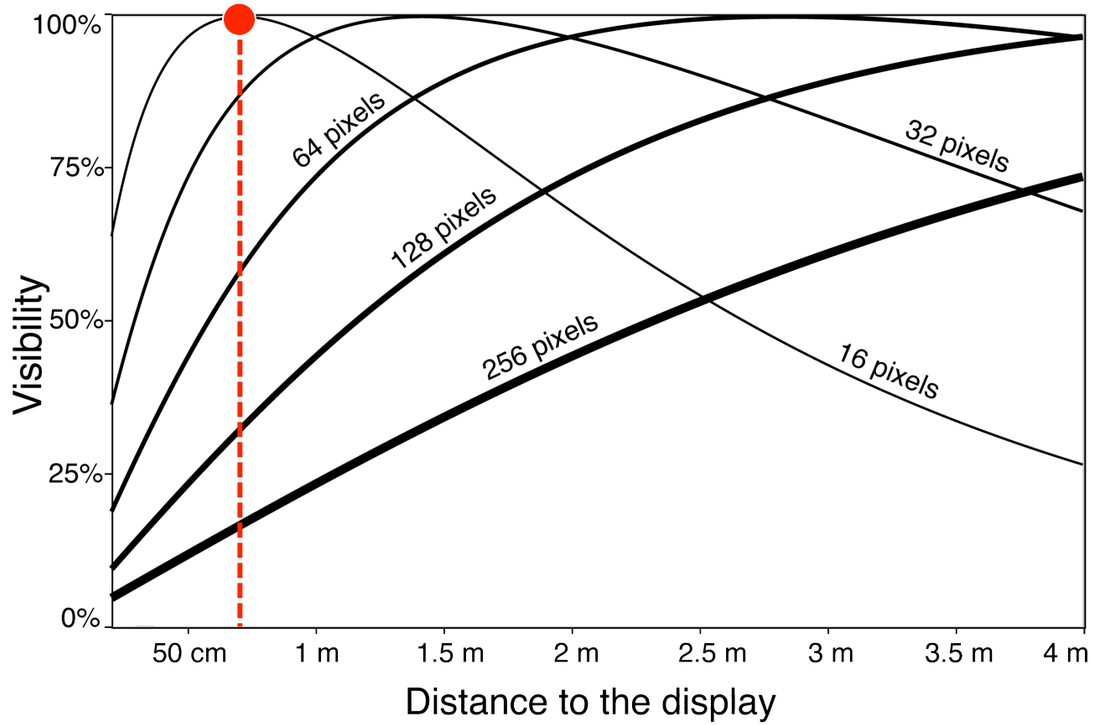

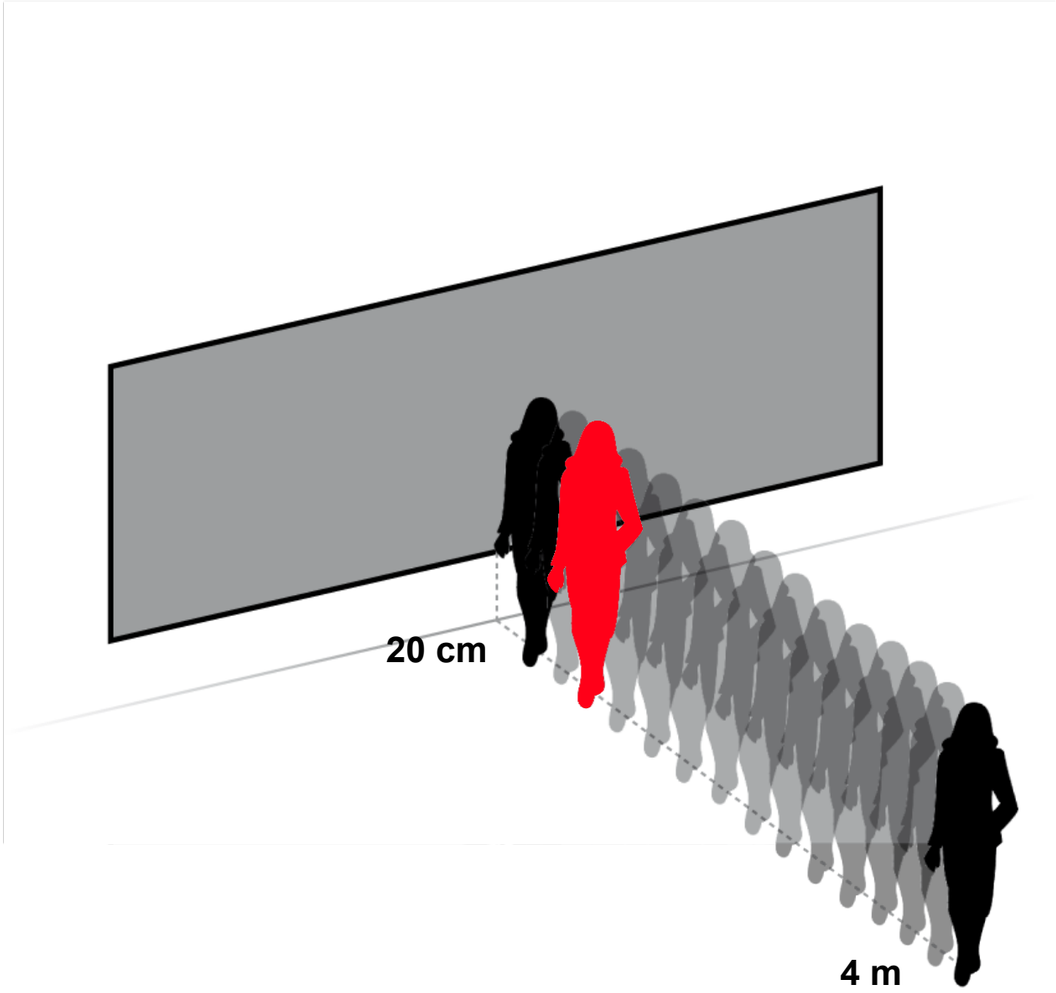

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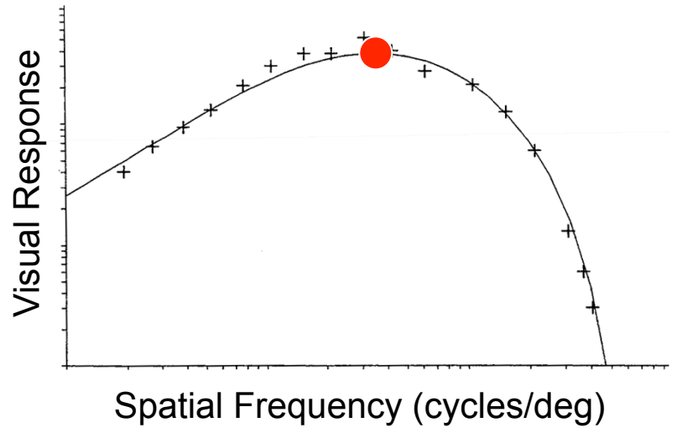

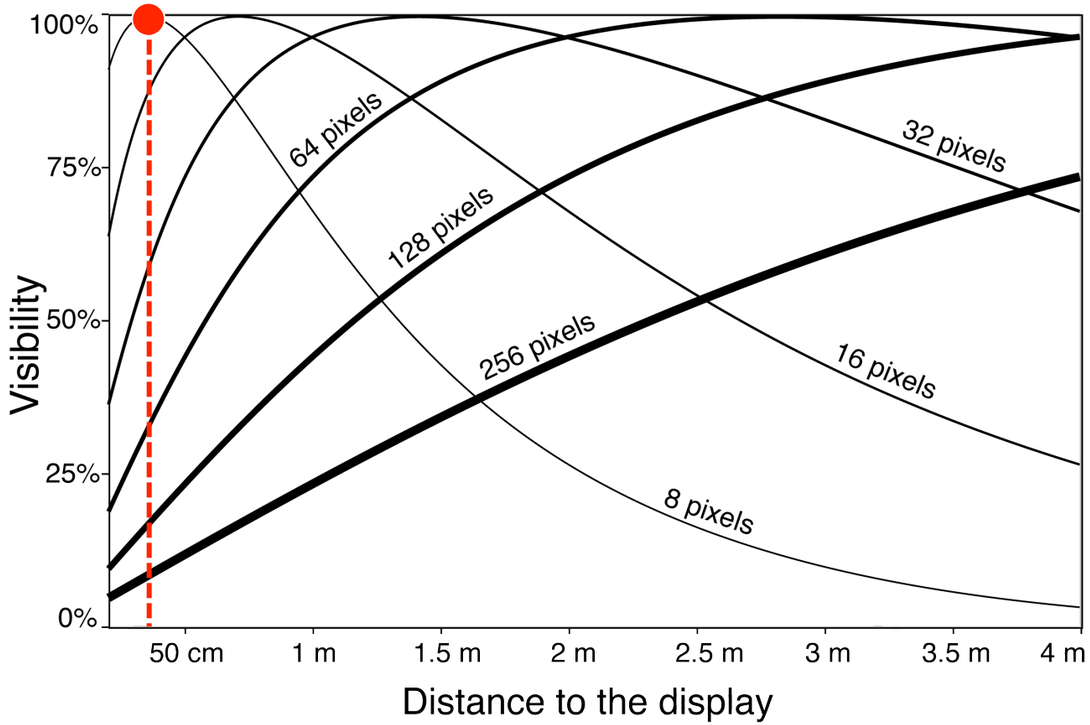

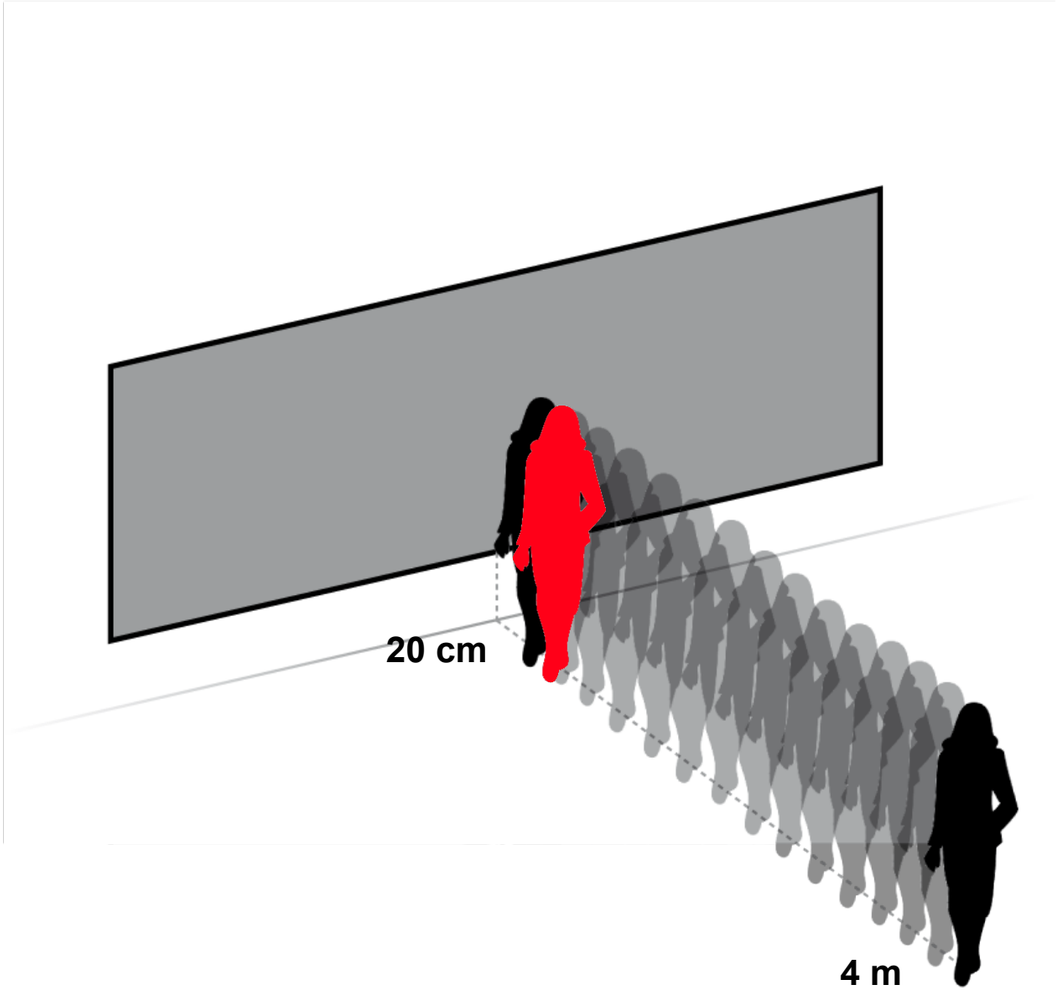

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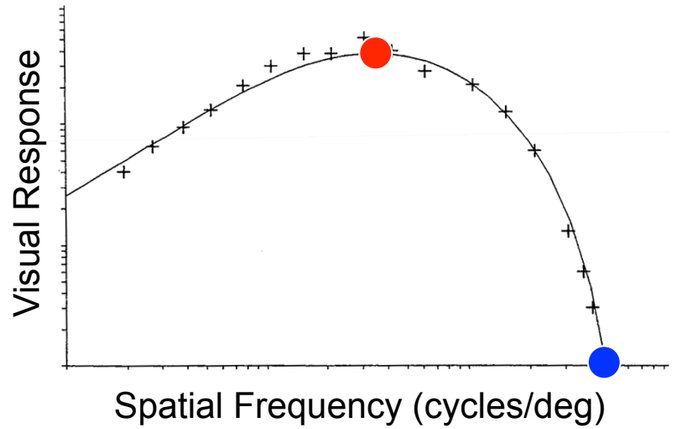

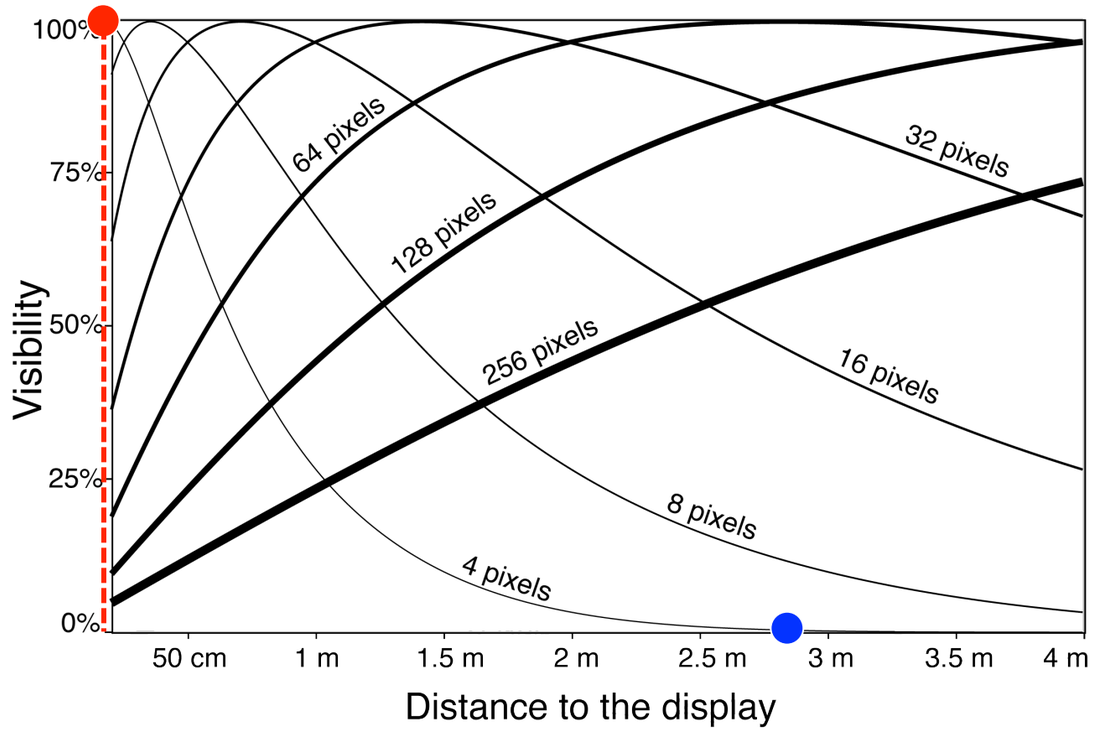

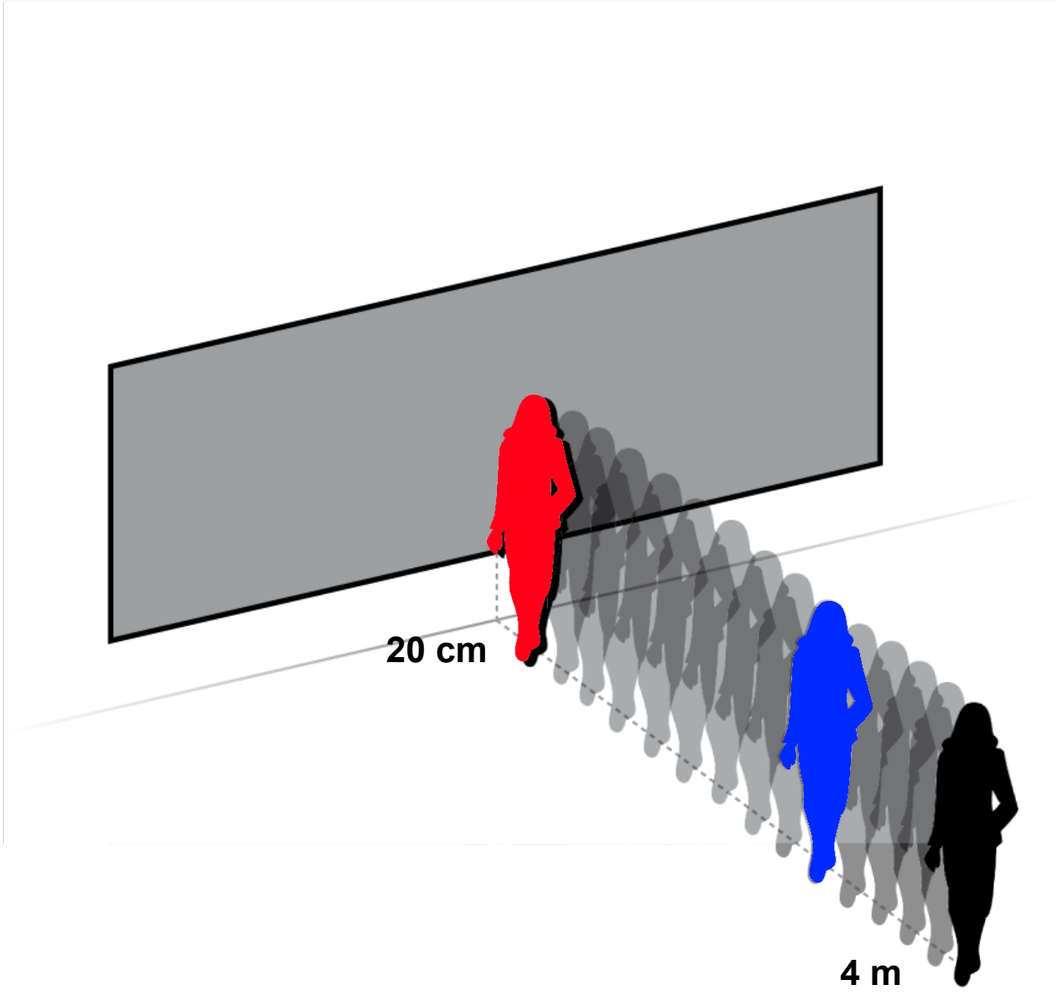

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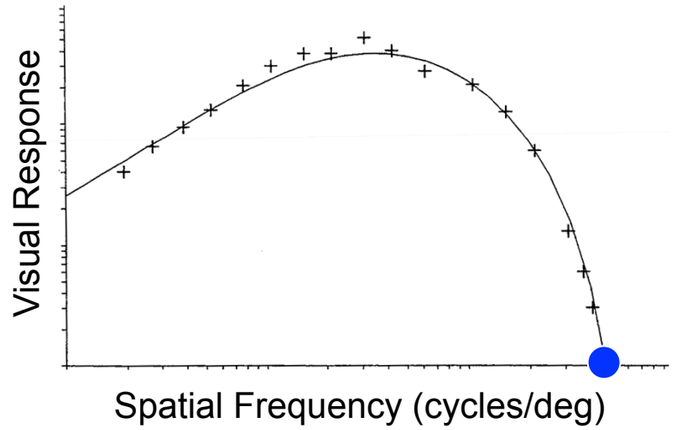

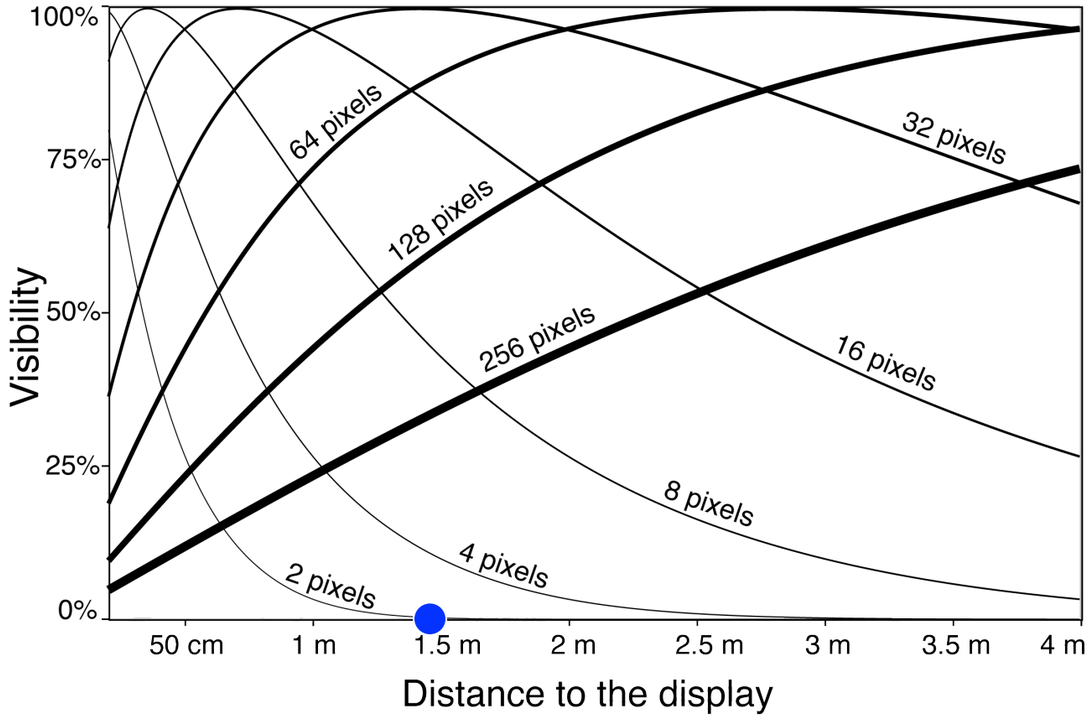

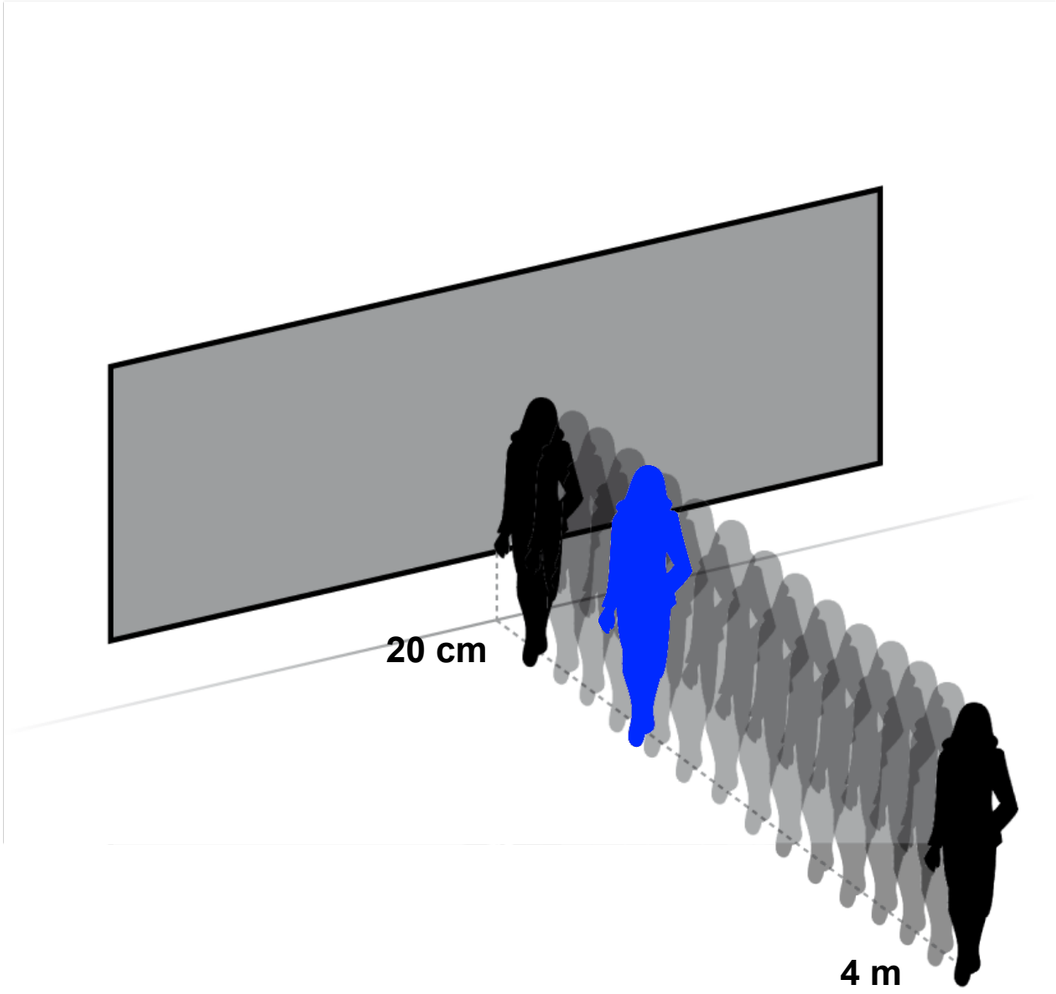

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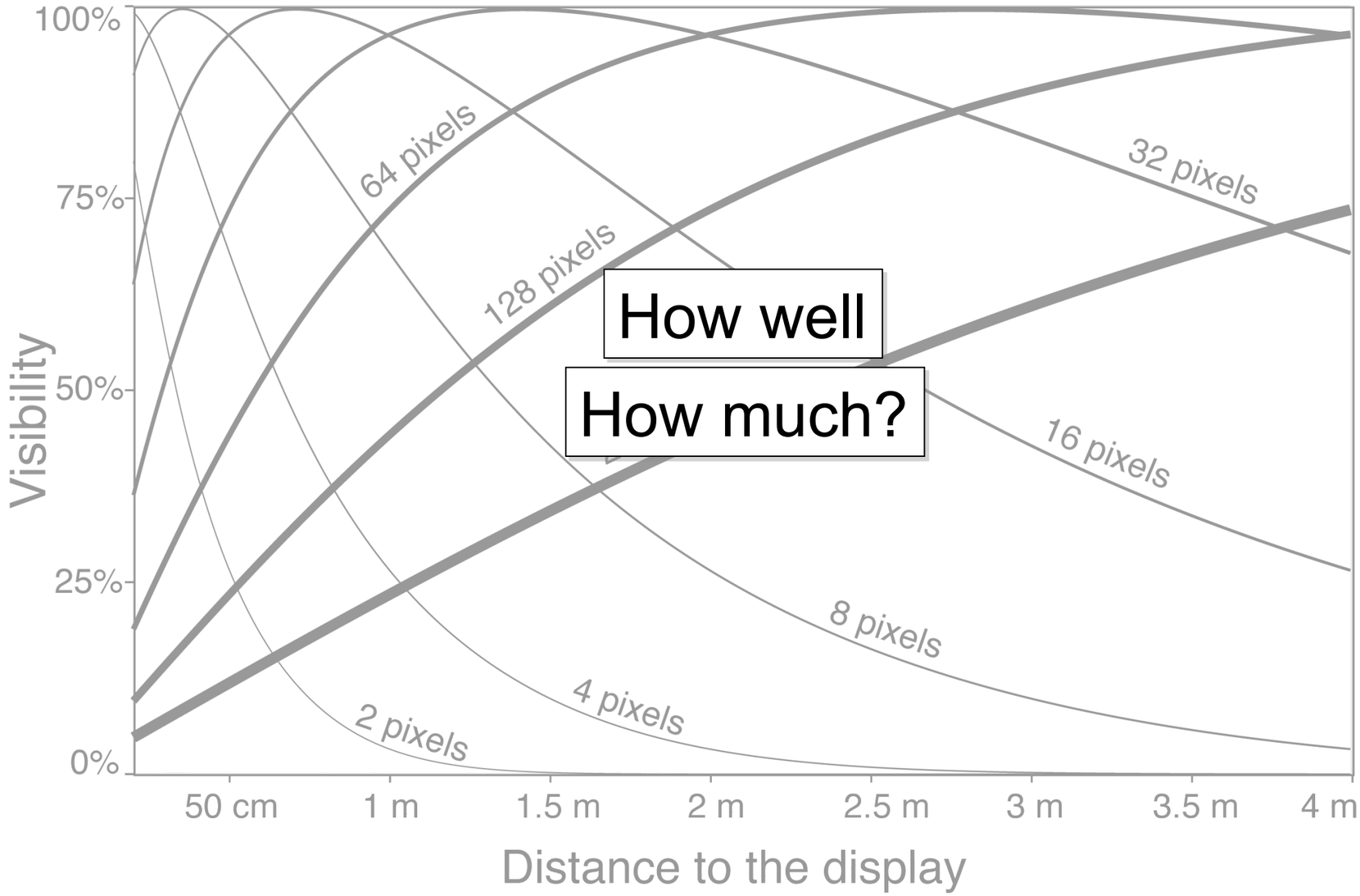

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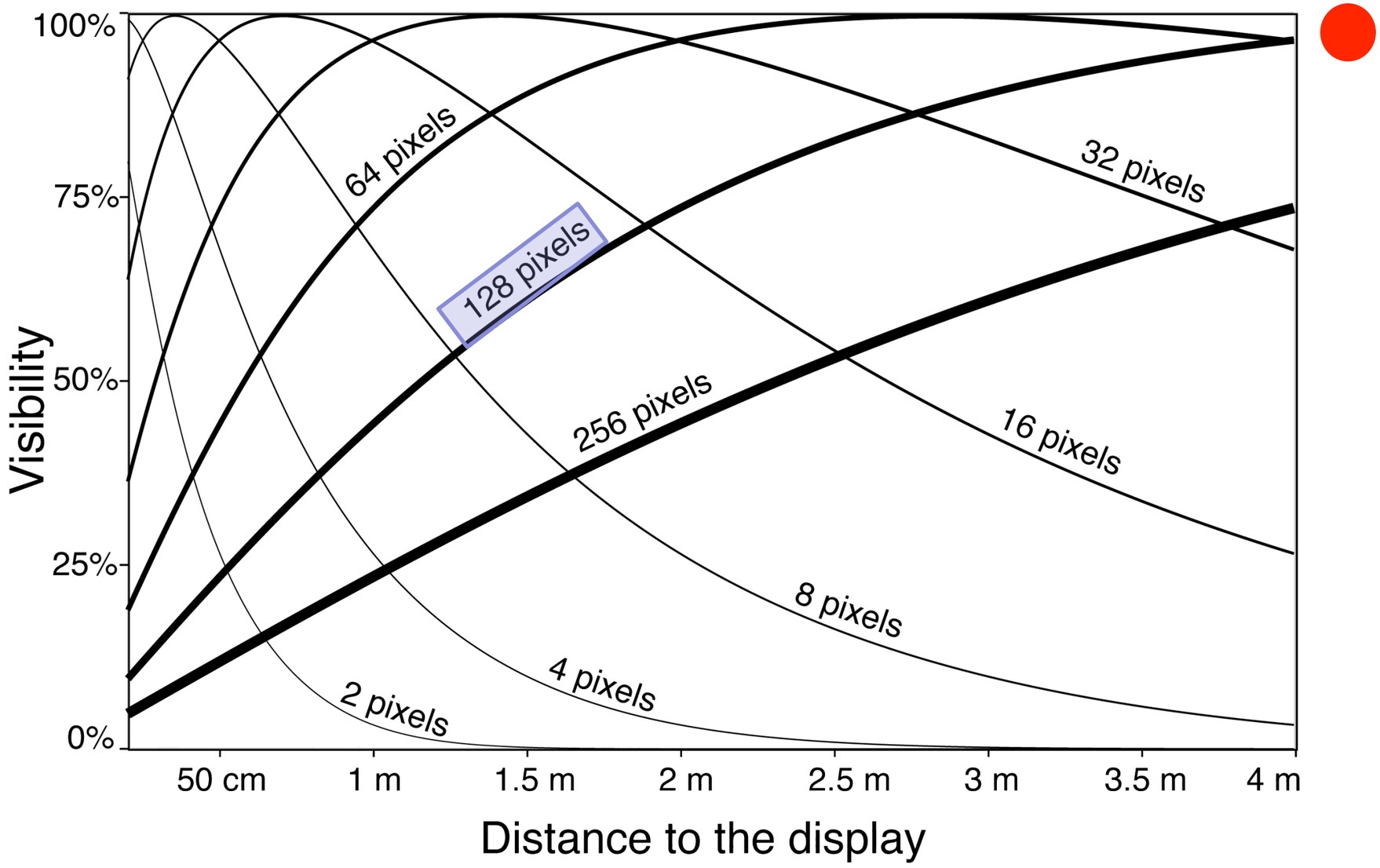

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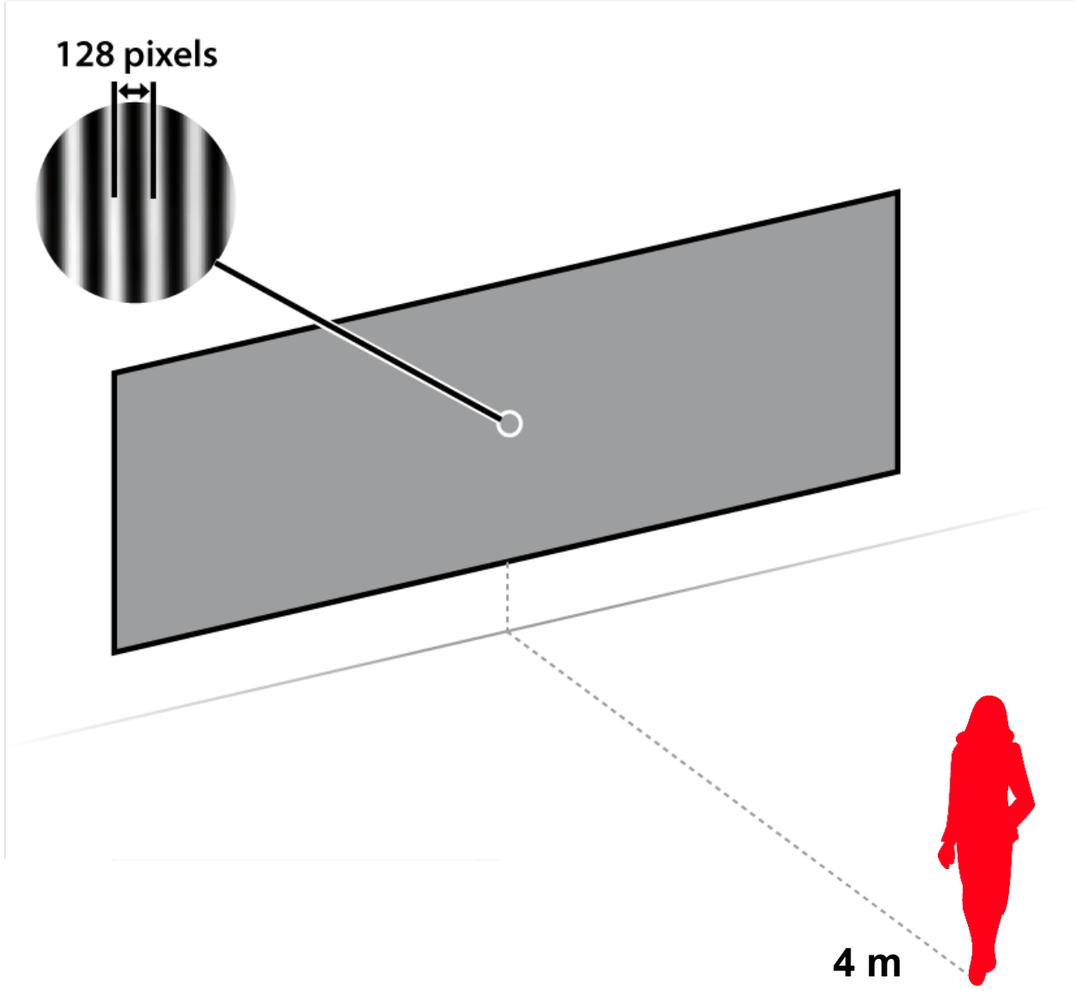

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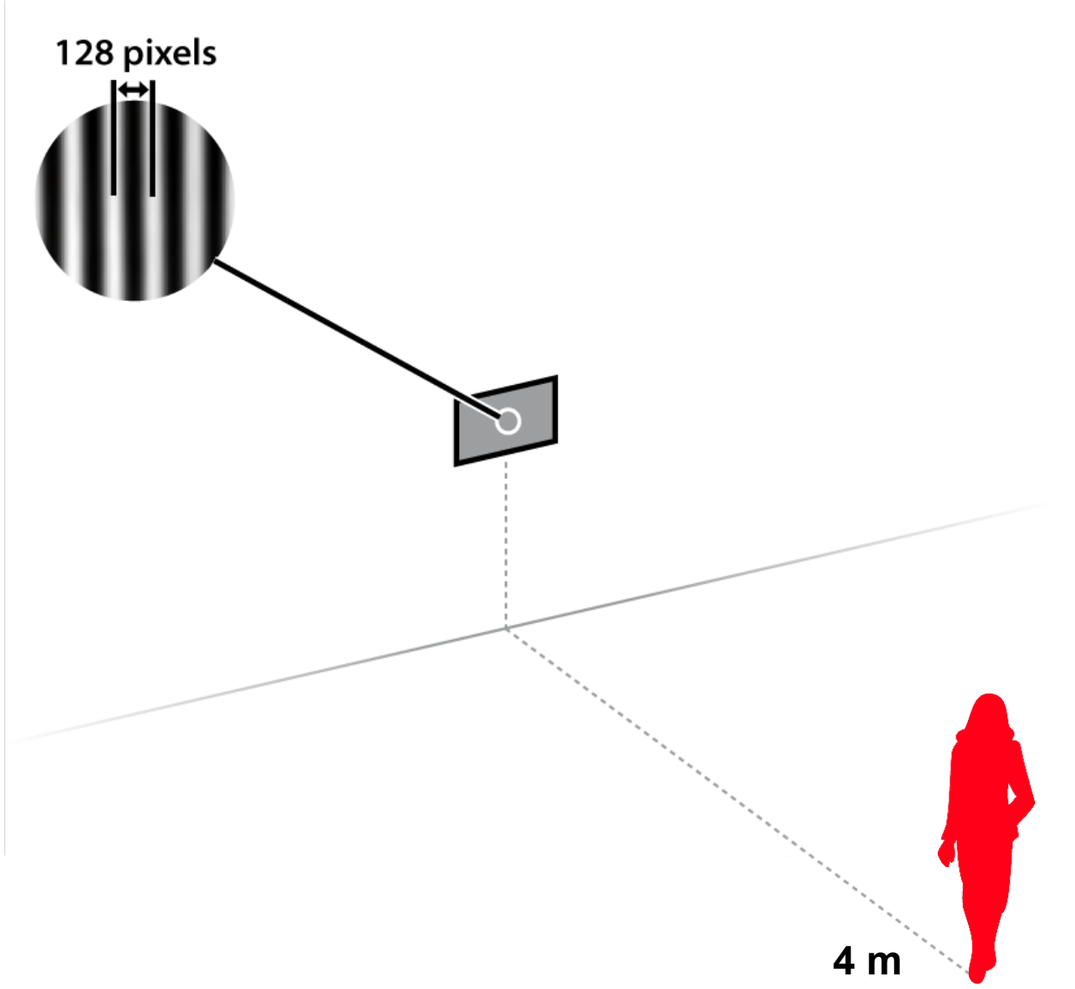

Grating Information Capacity

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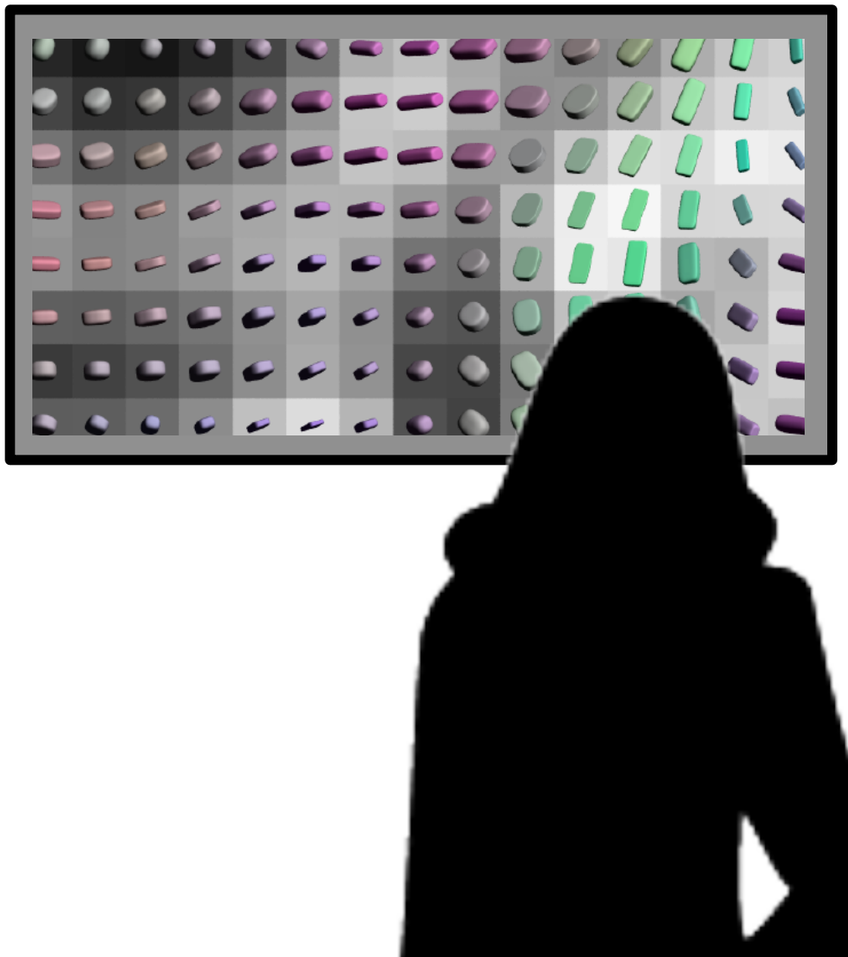
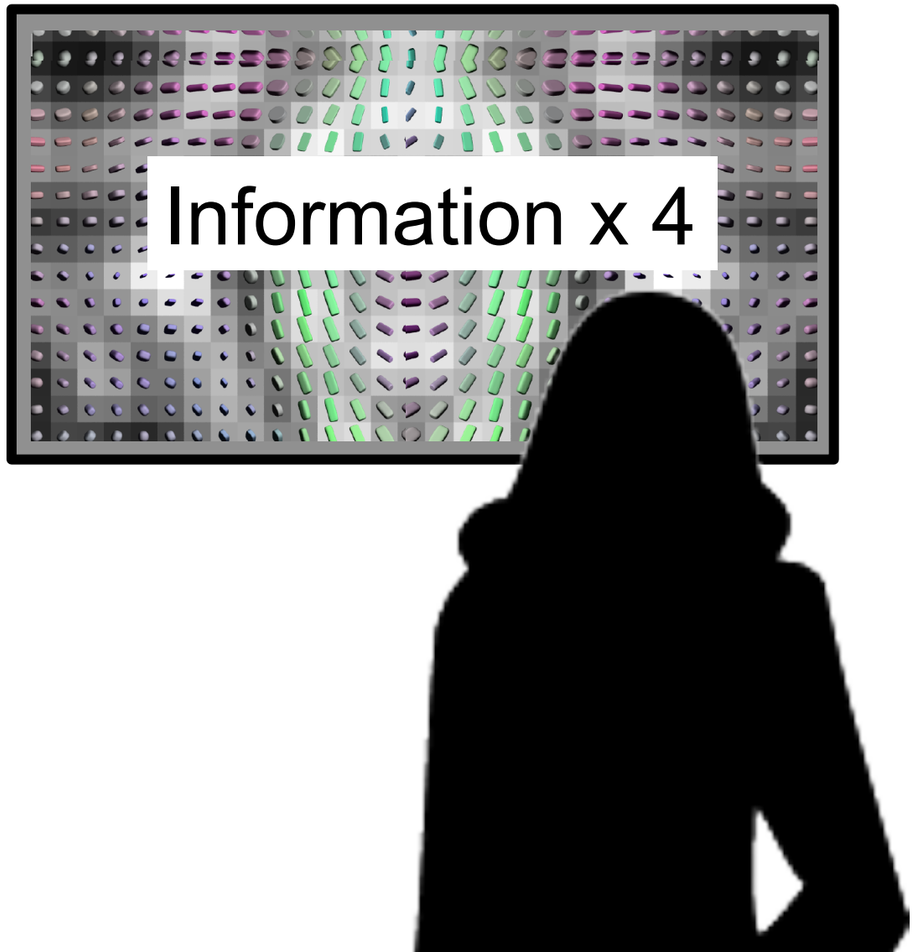


Frequency x 2



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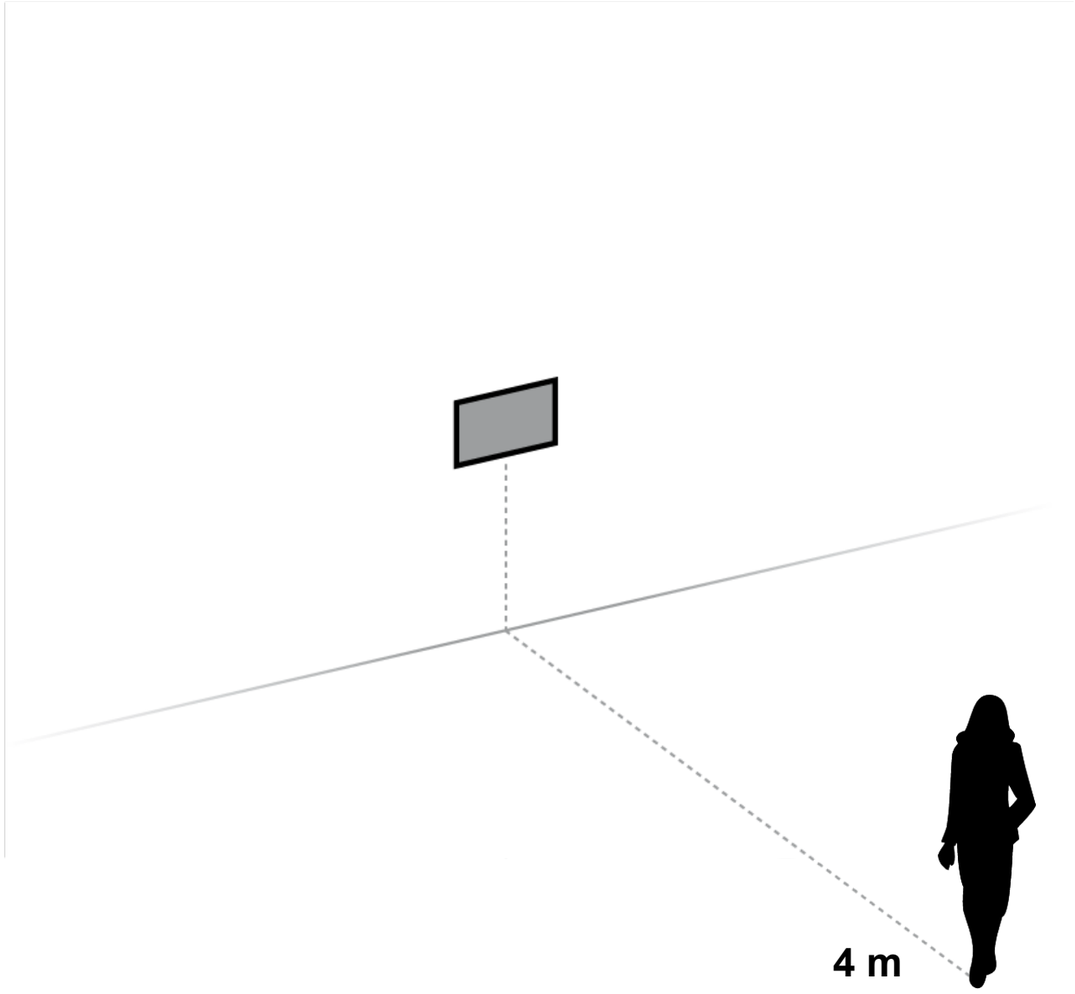

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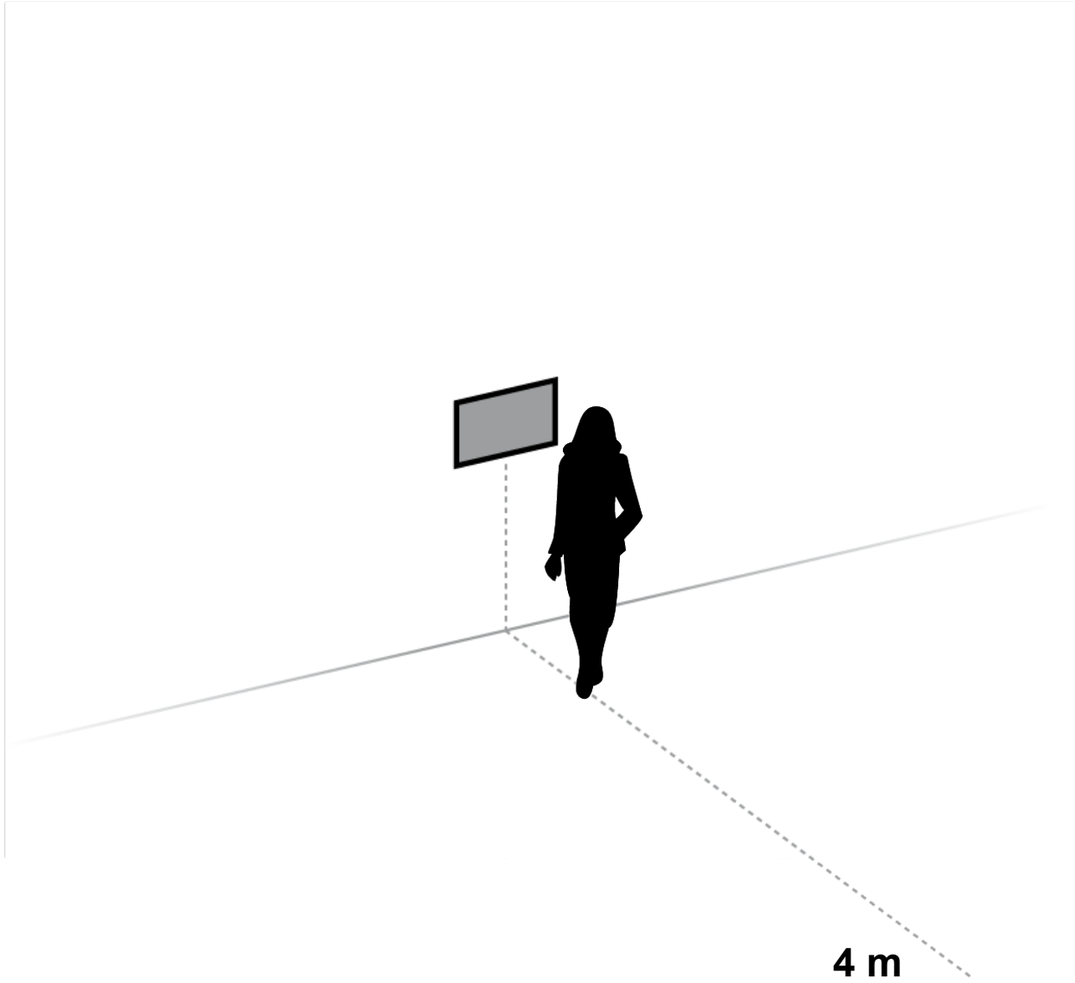

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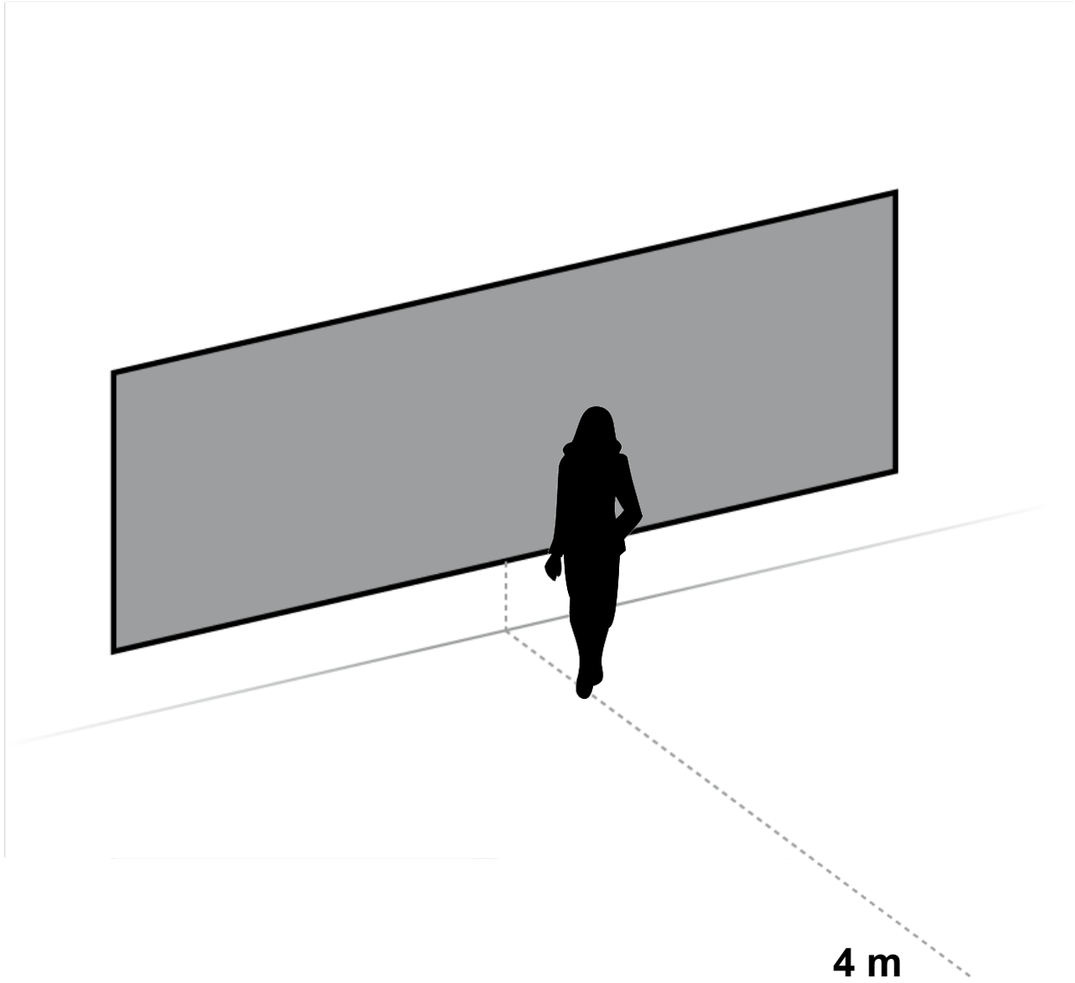
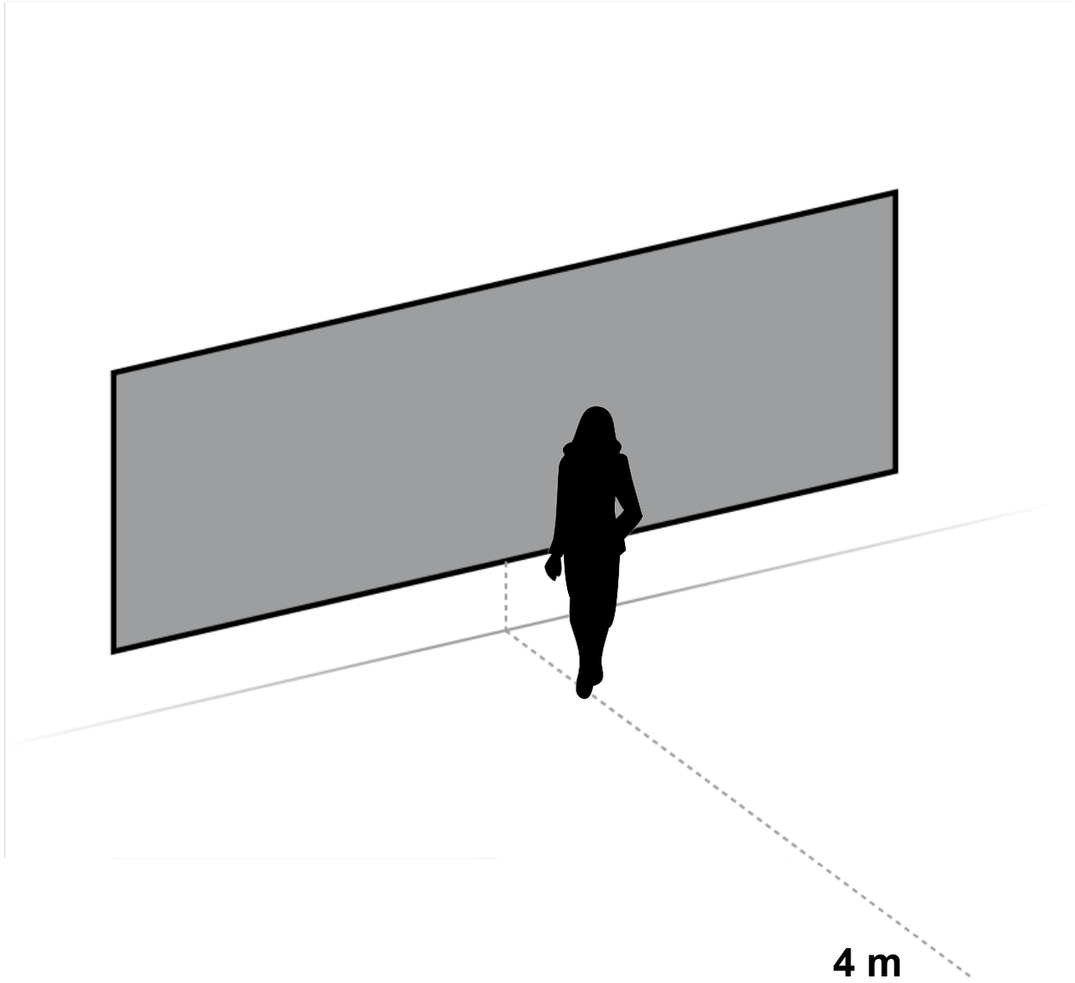


Visual « Clipping » Effect



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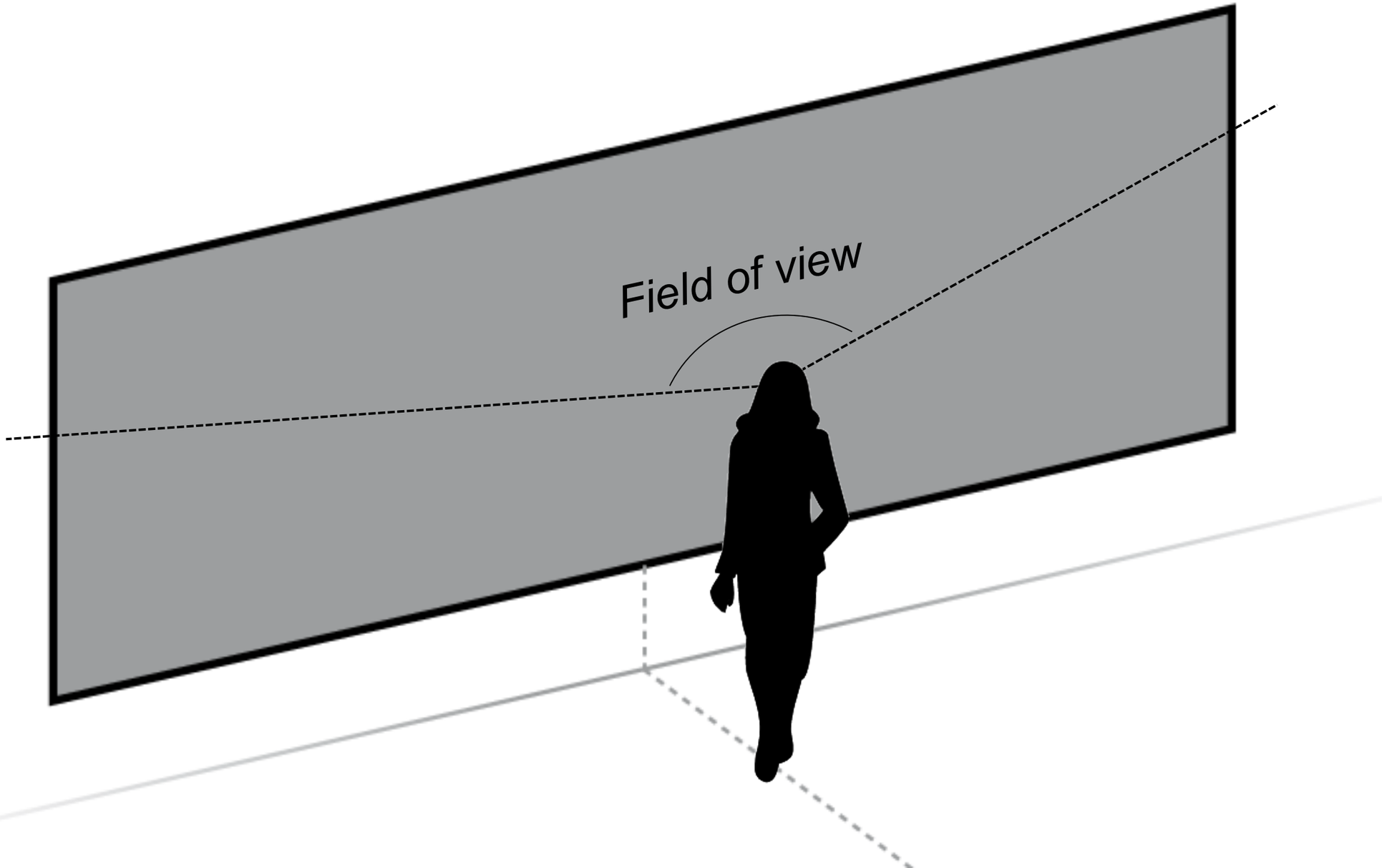

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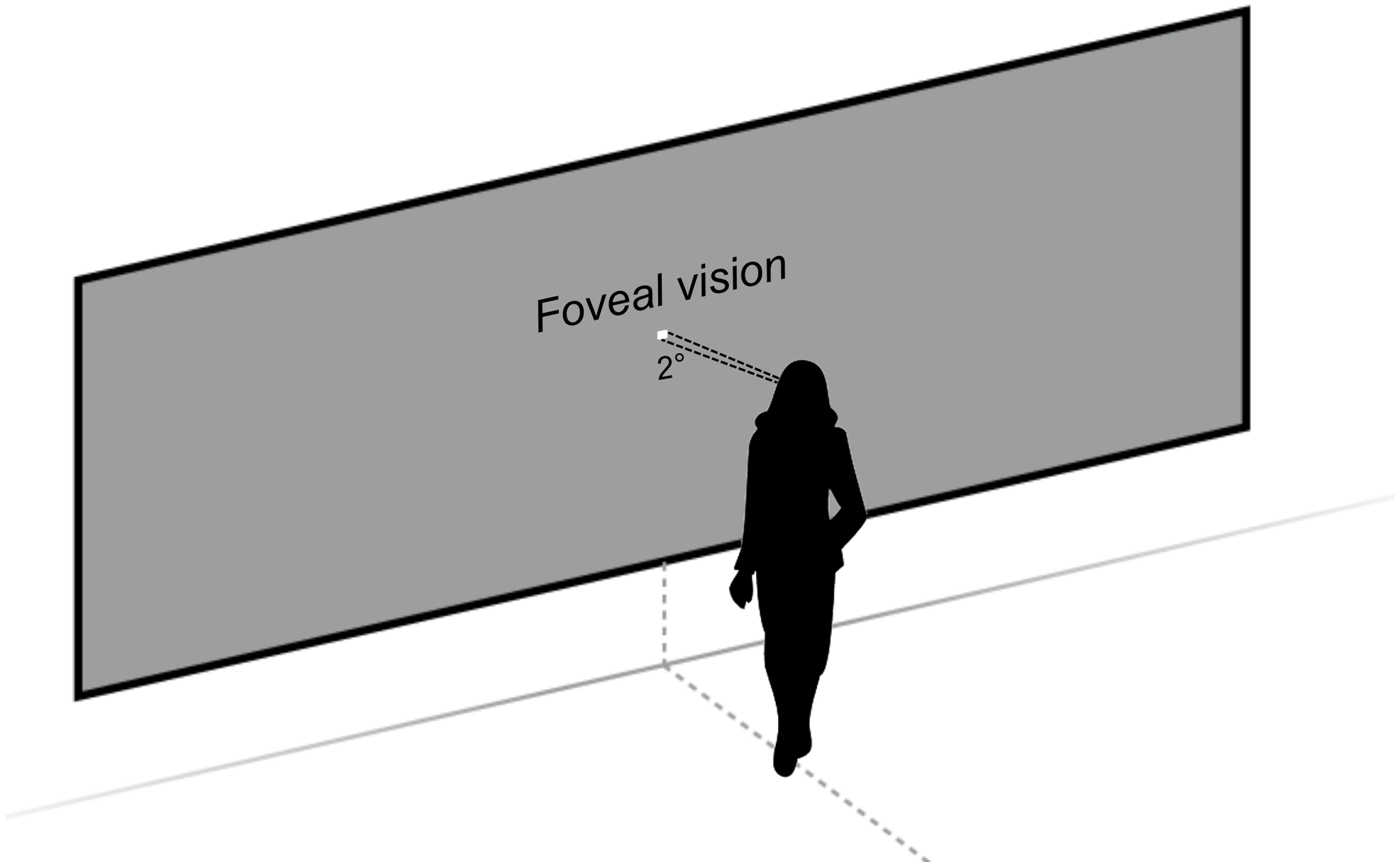
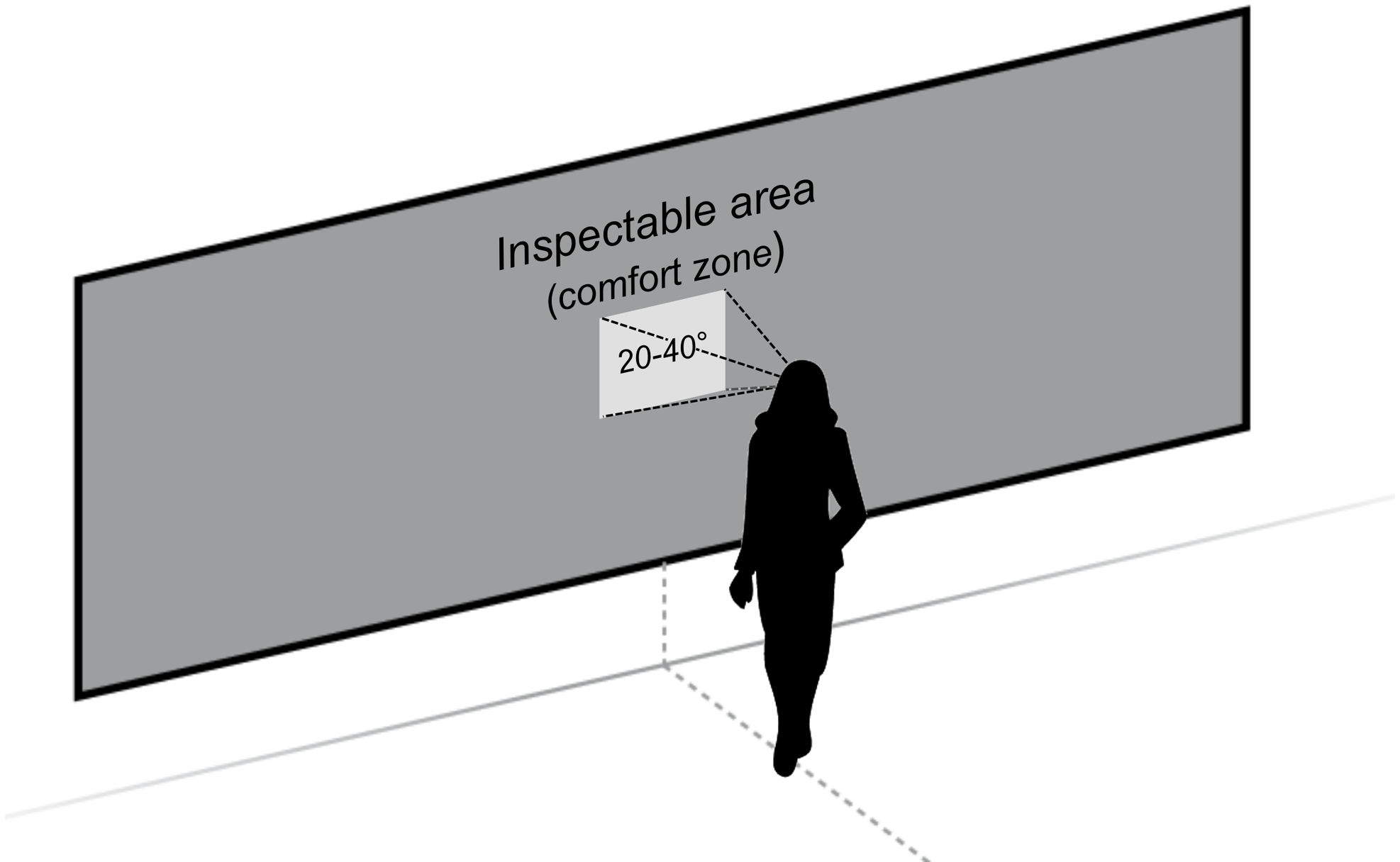
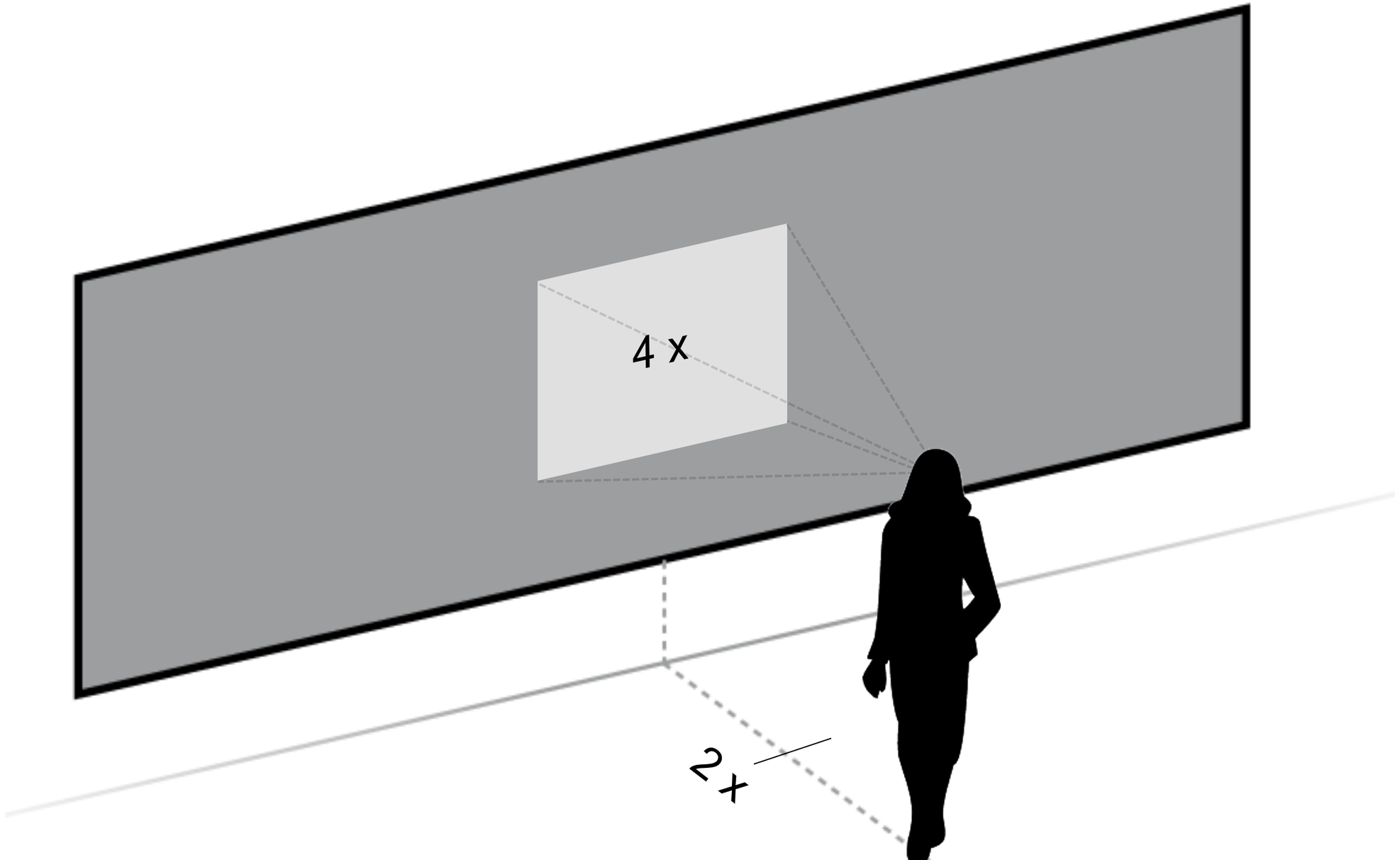


Visual « Clipping » Effect



Visual « Clipping » Effect



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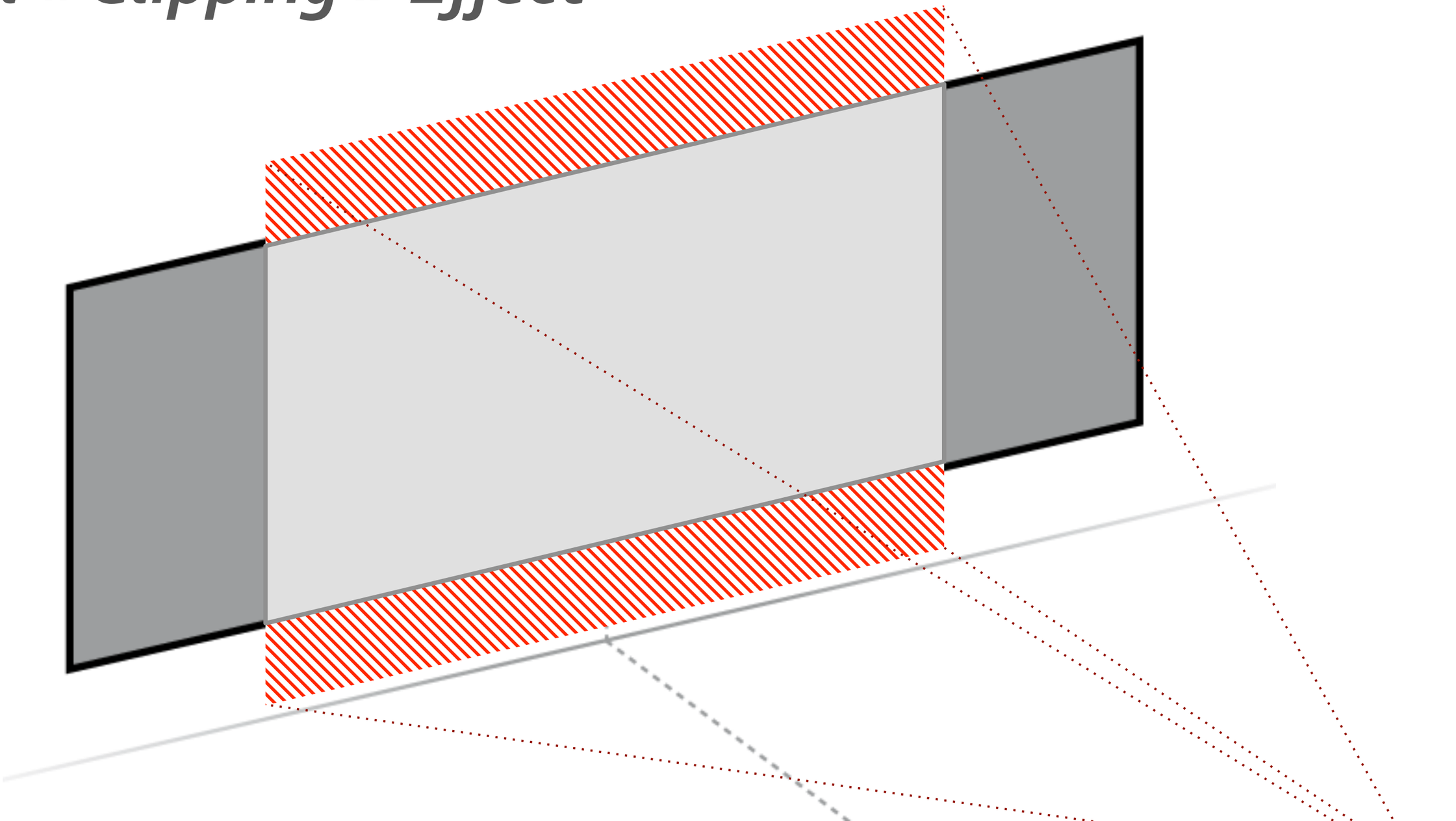
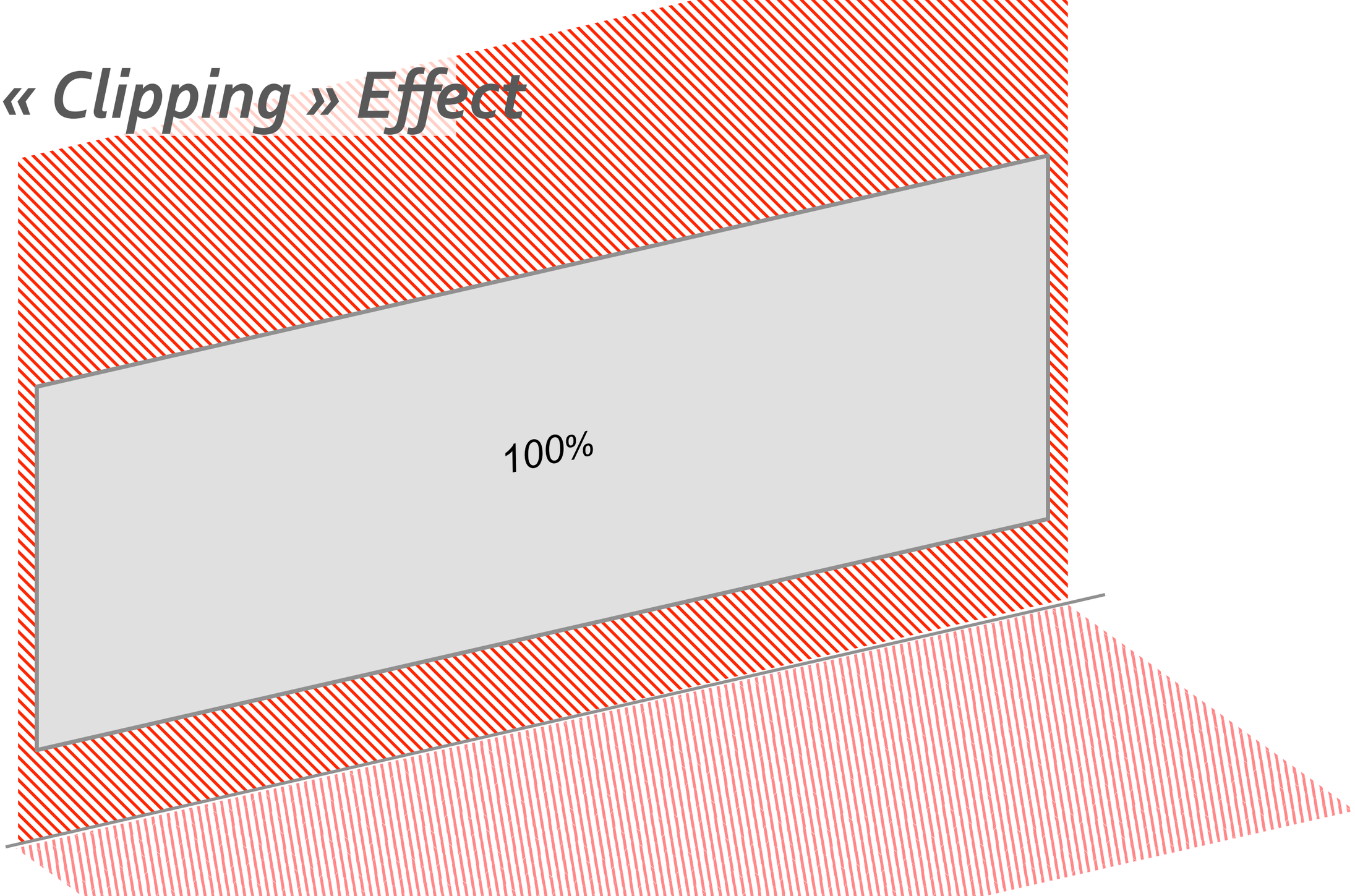
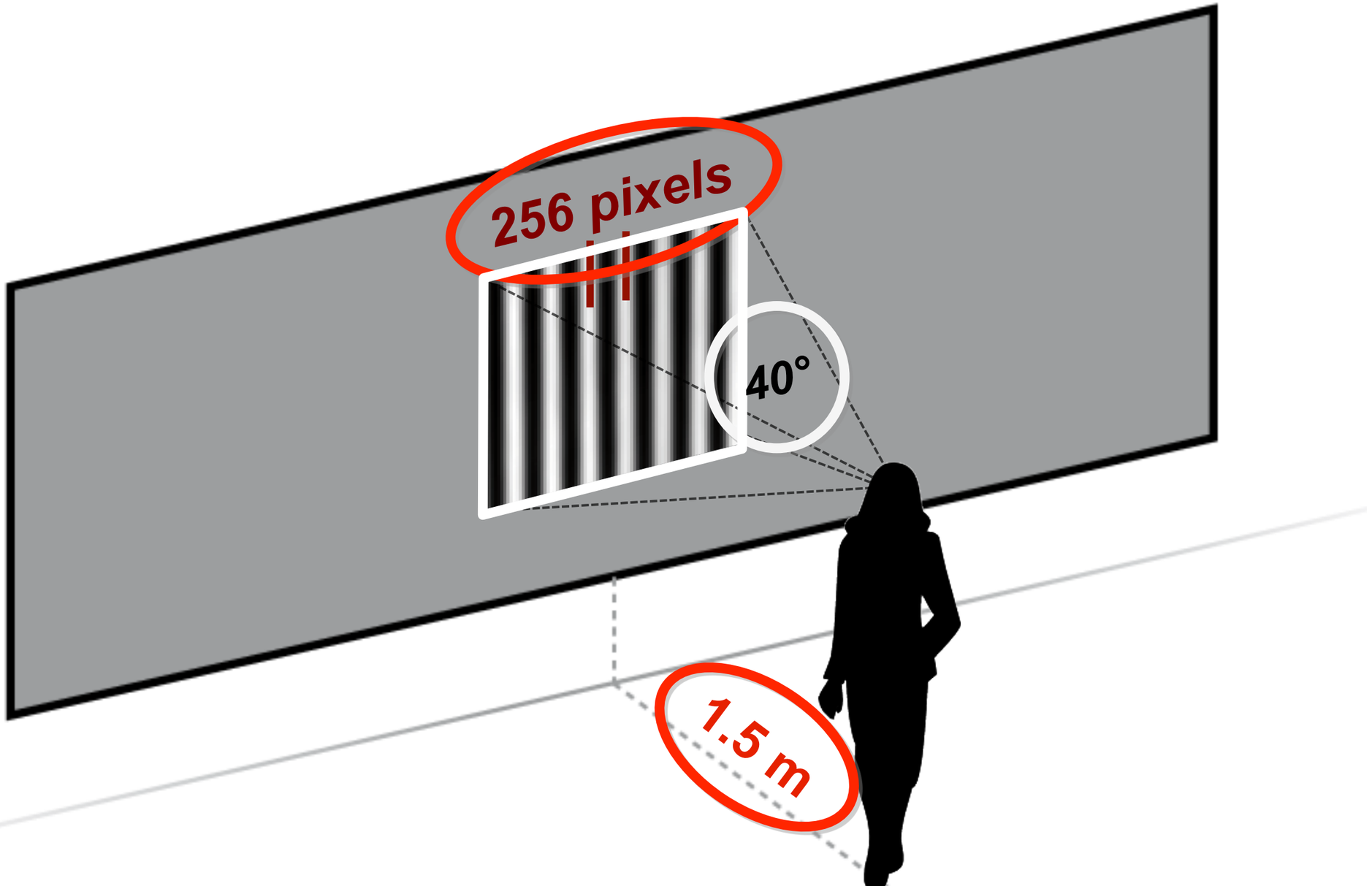


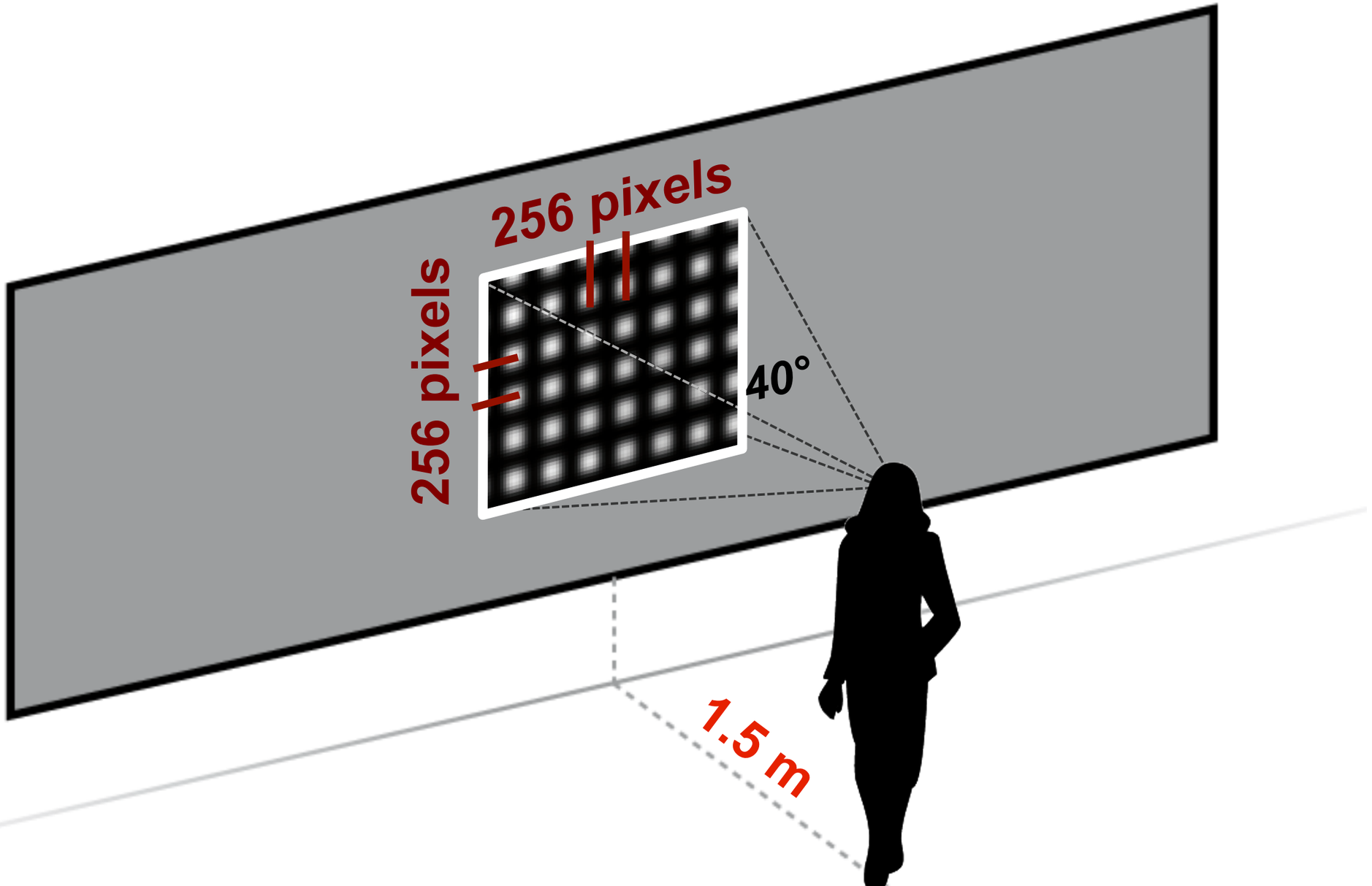
Visual « Clipping » Effect



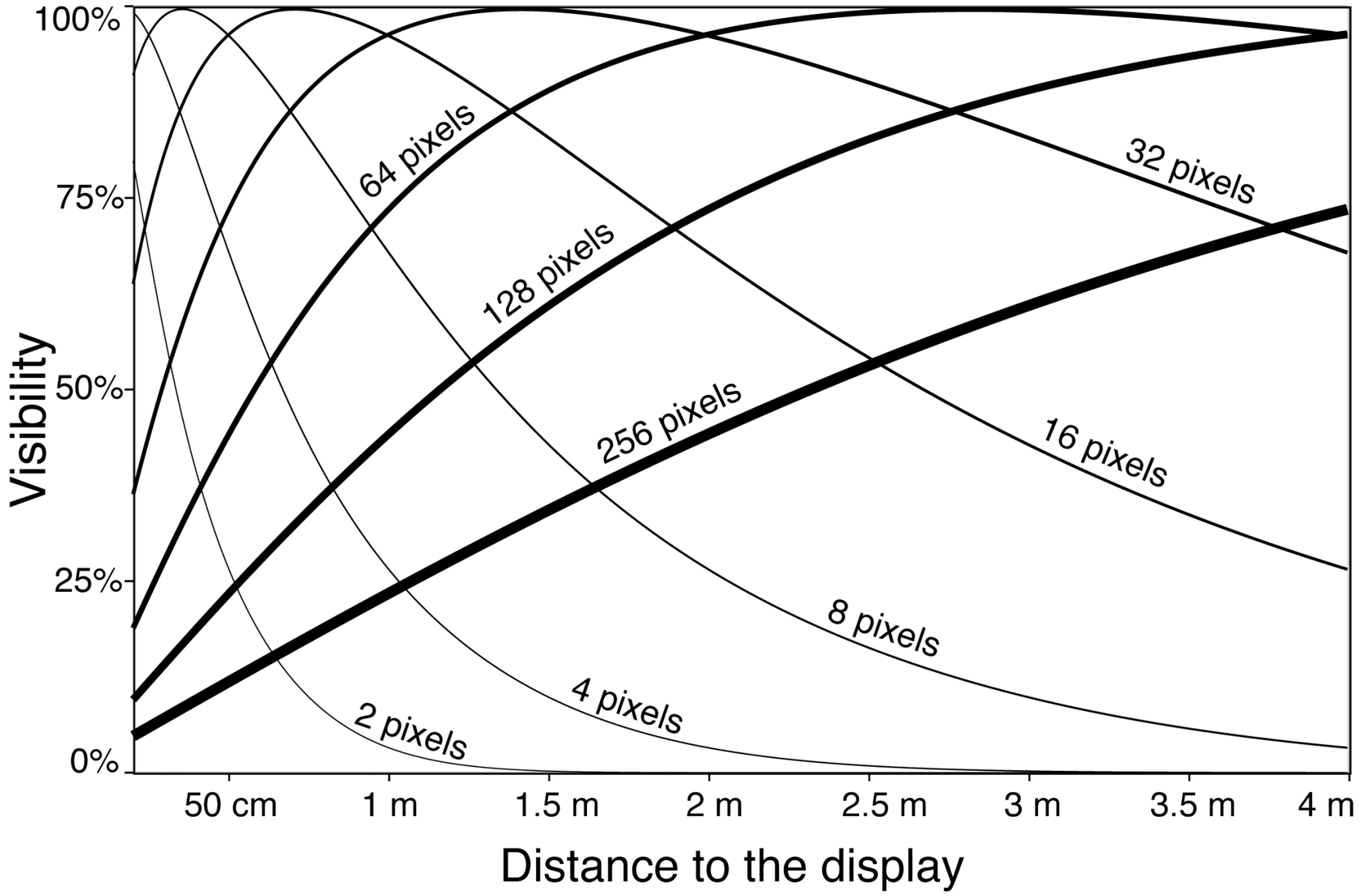
Information Capacity



Information Capacity



What do we Perceive from a Large Display?



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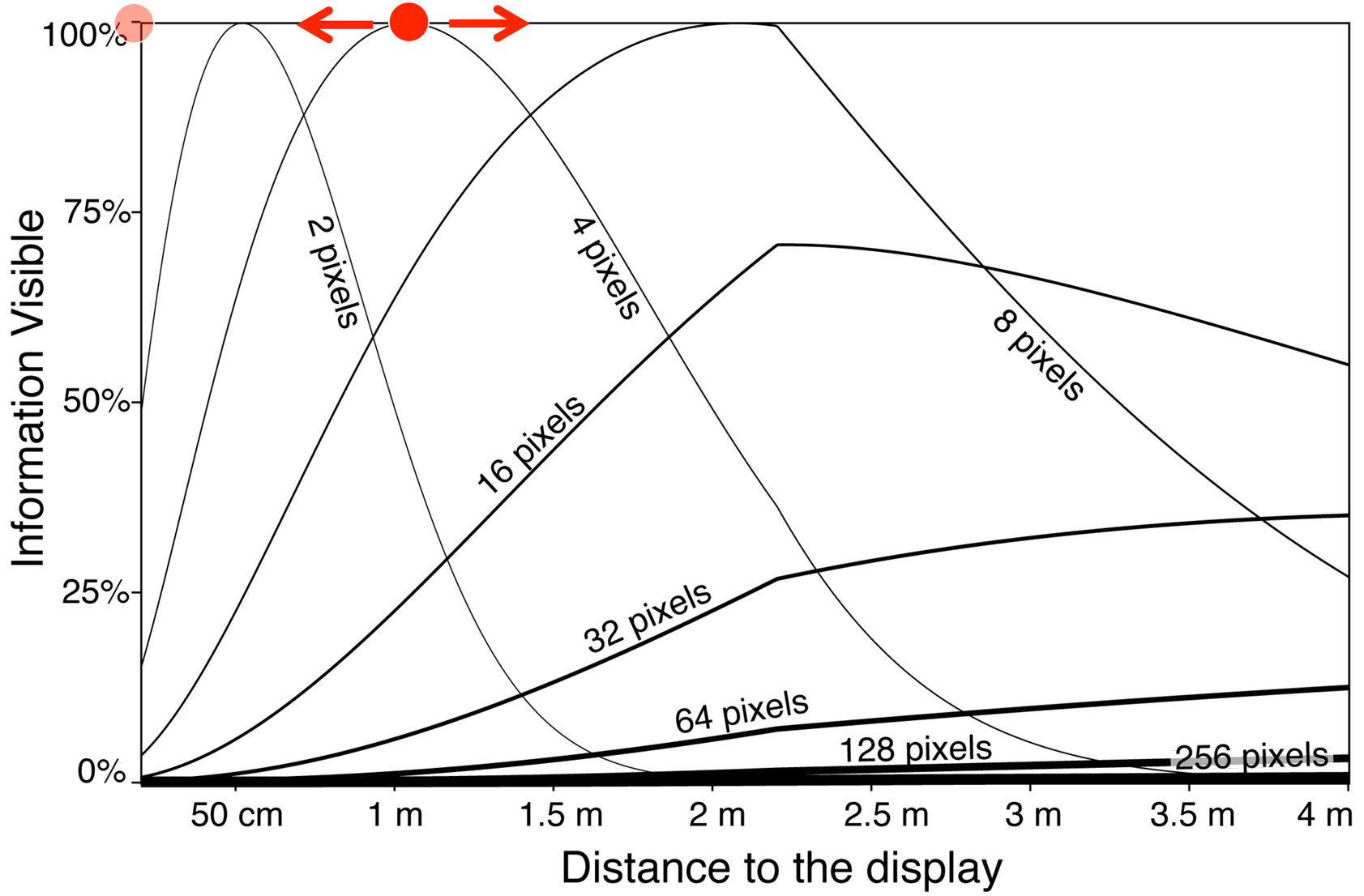
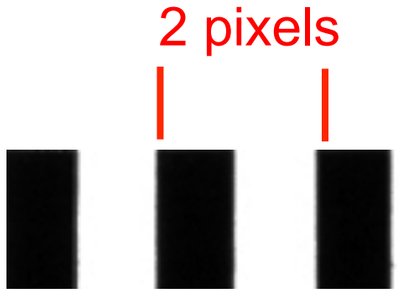
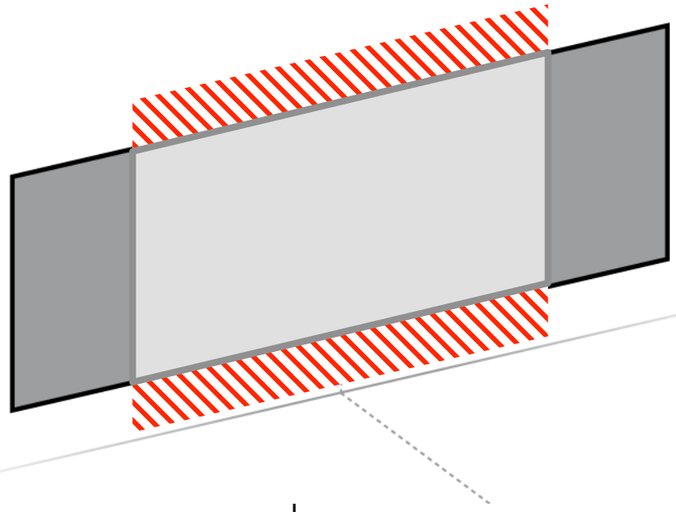
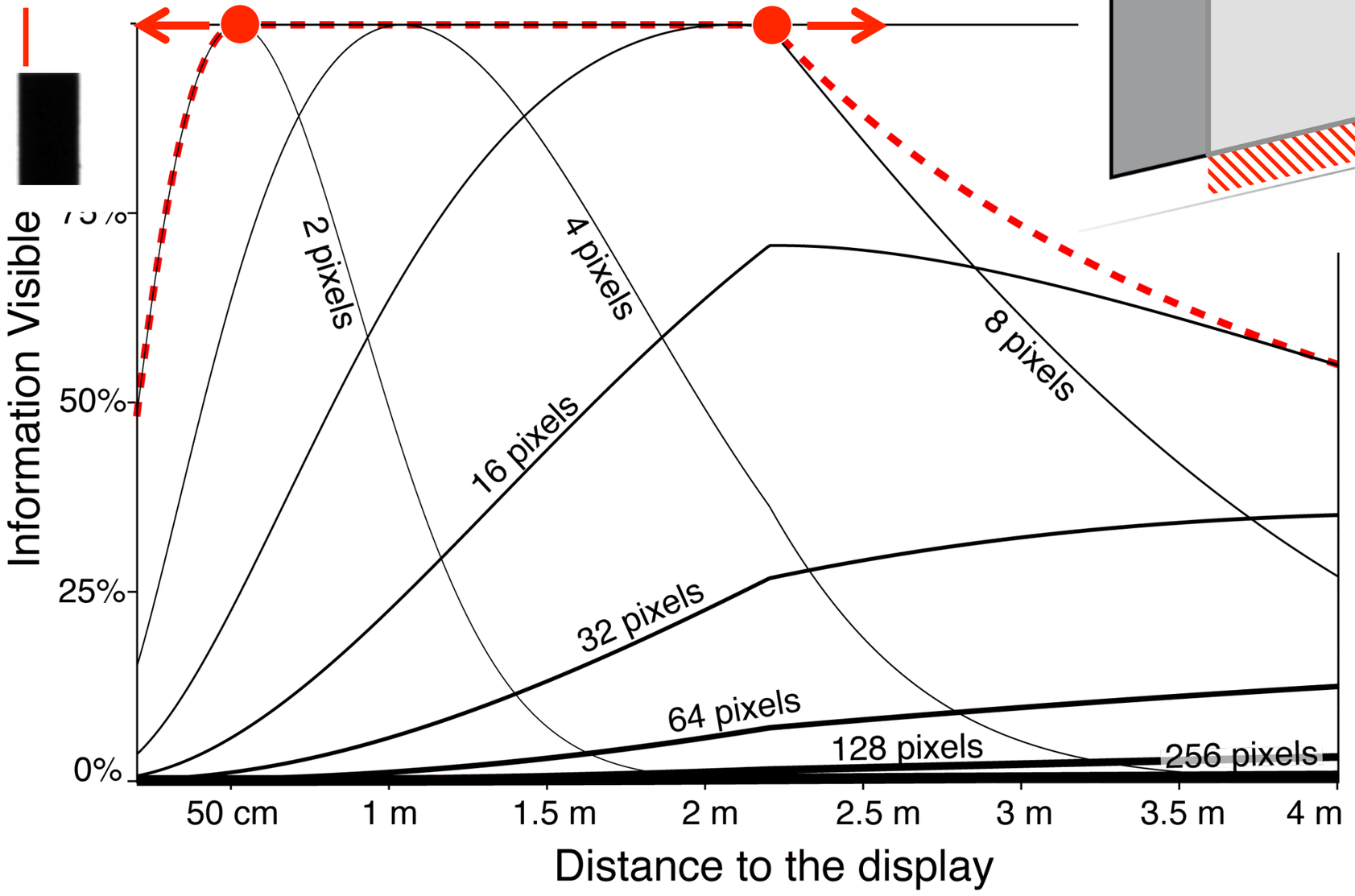


What do we Perceive from a Large I

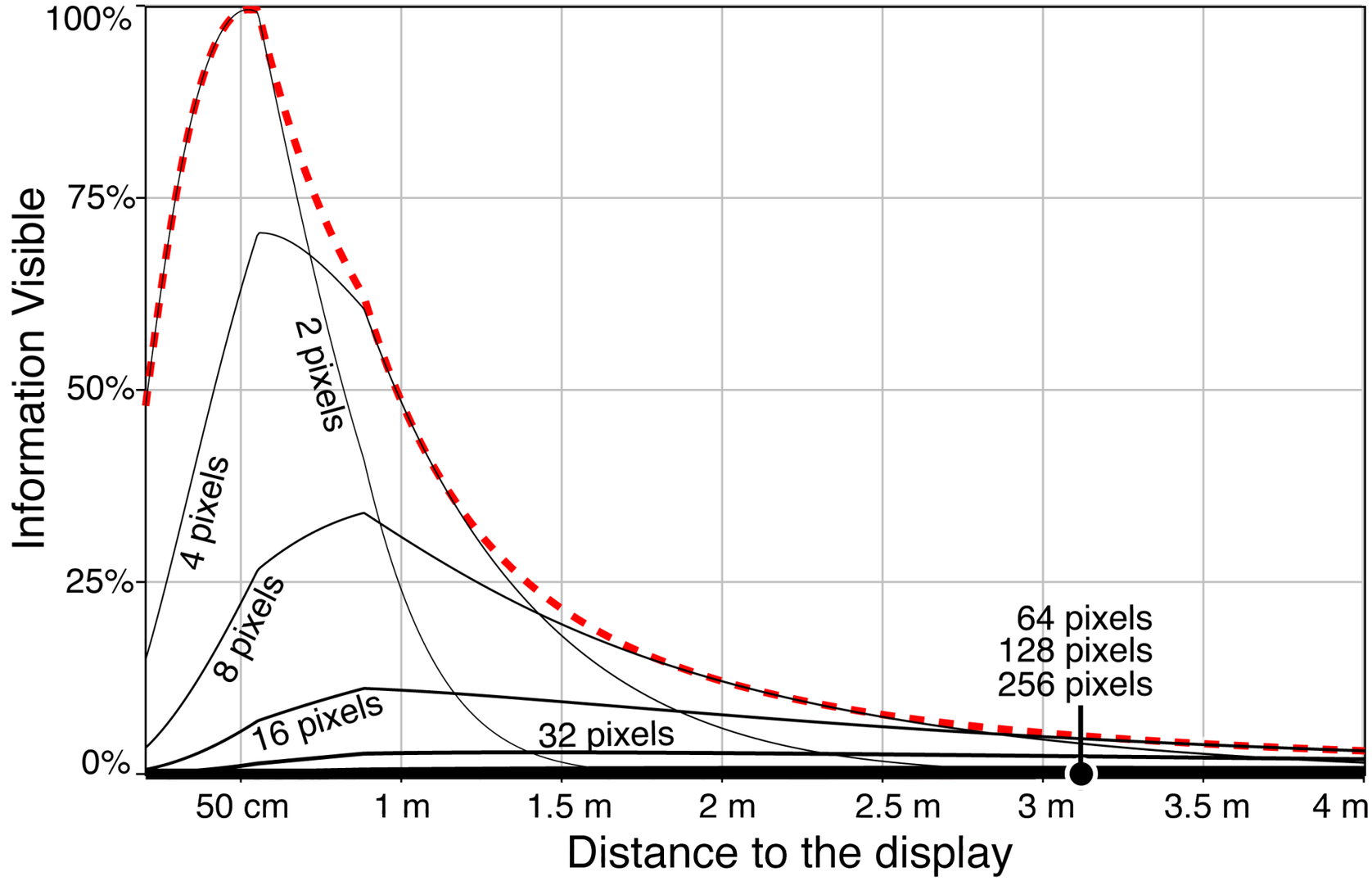




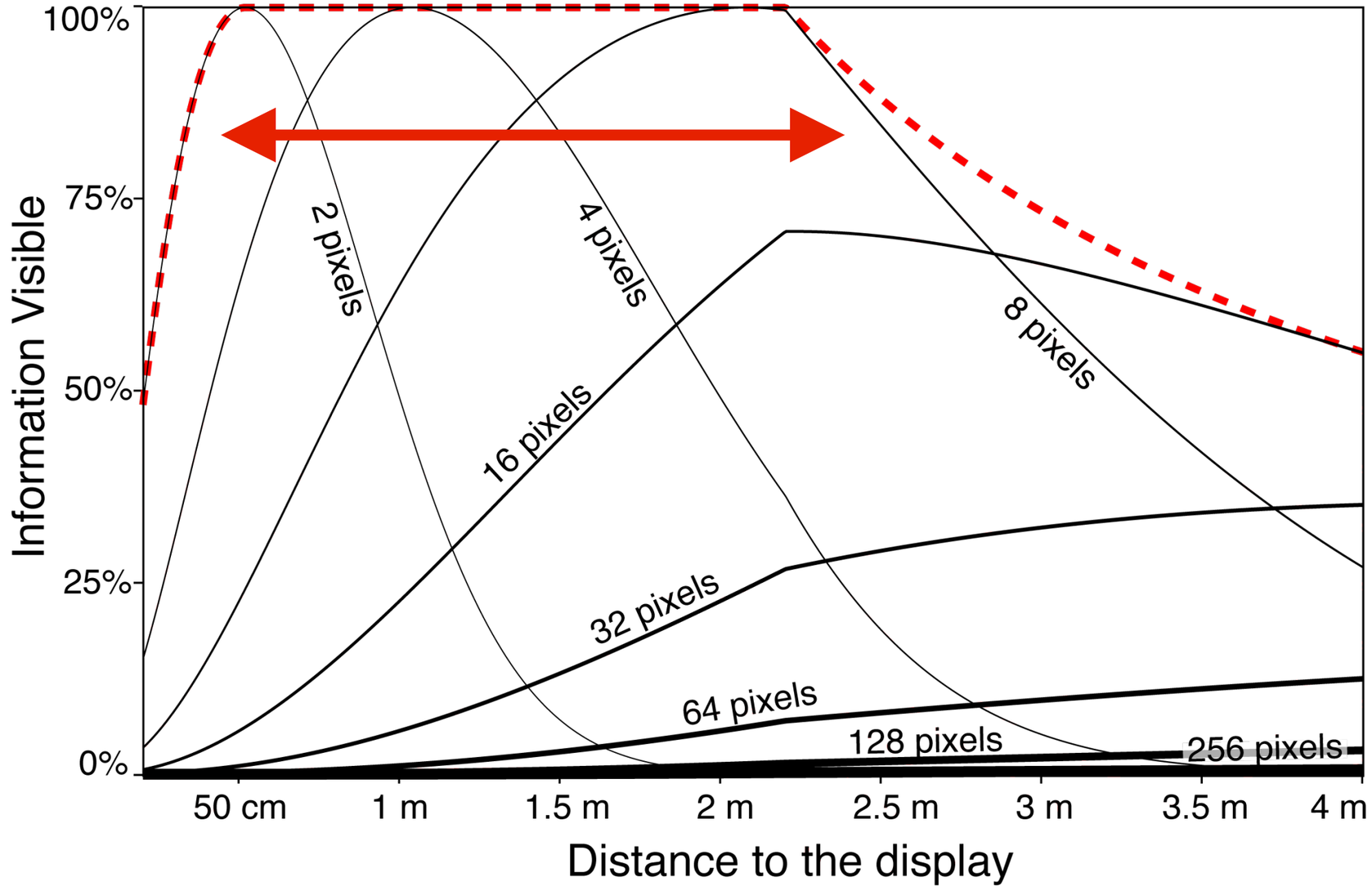


Comparison with a Desktop Display

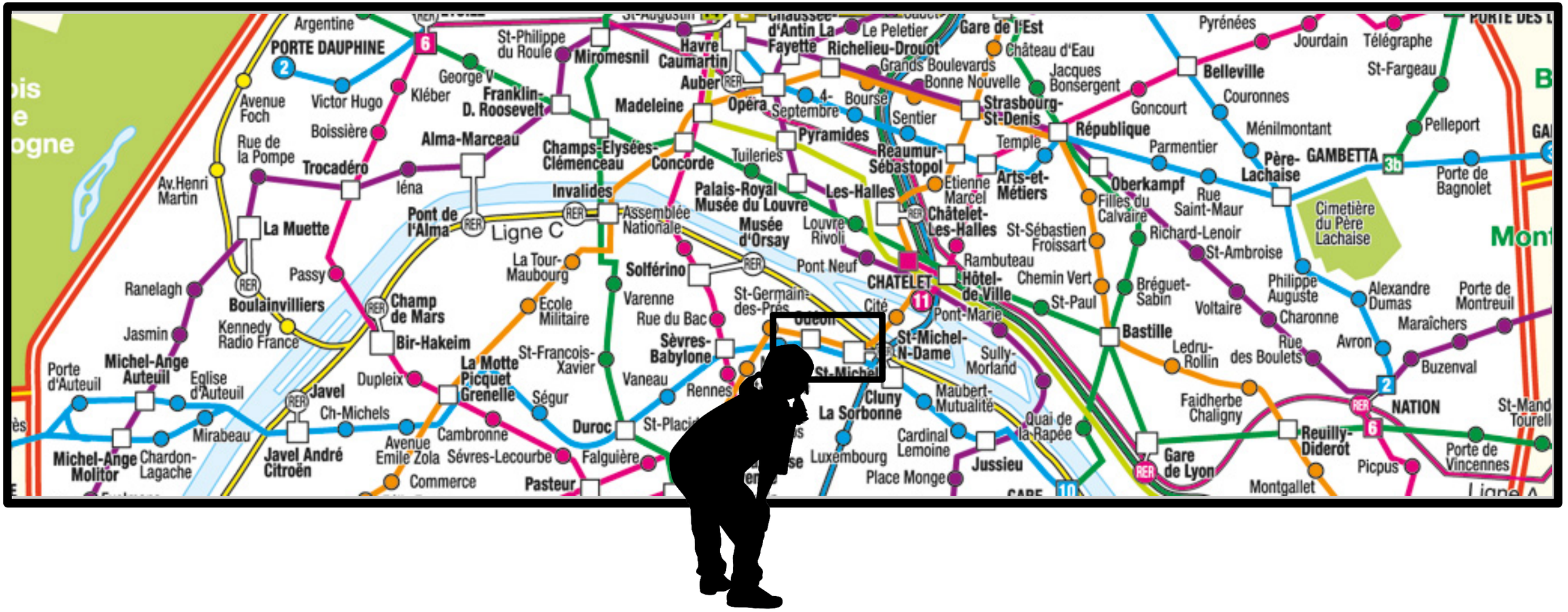
Comparison with a Desktop Display



Leveraging Large Displays

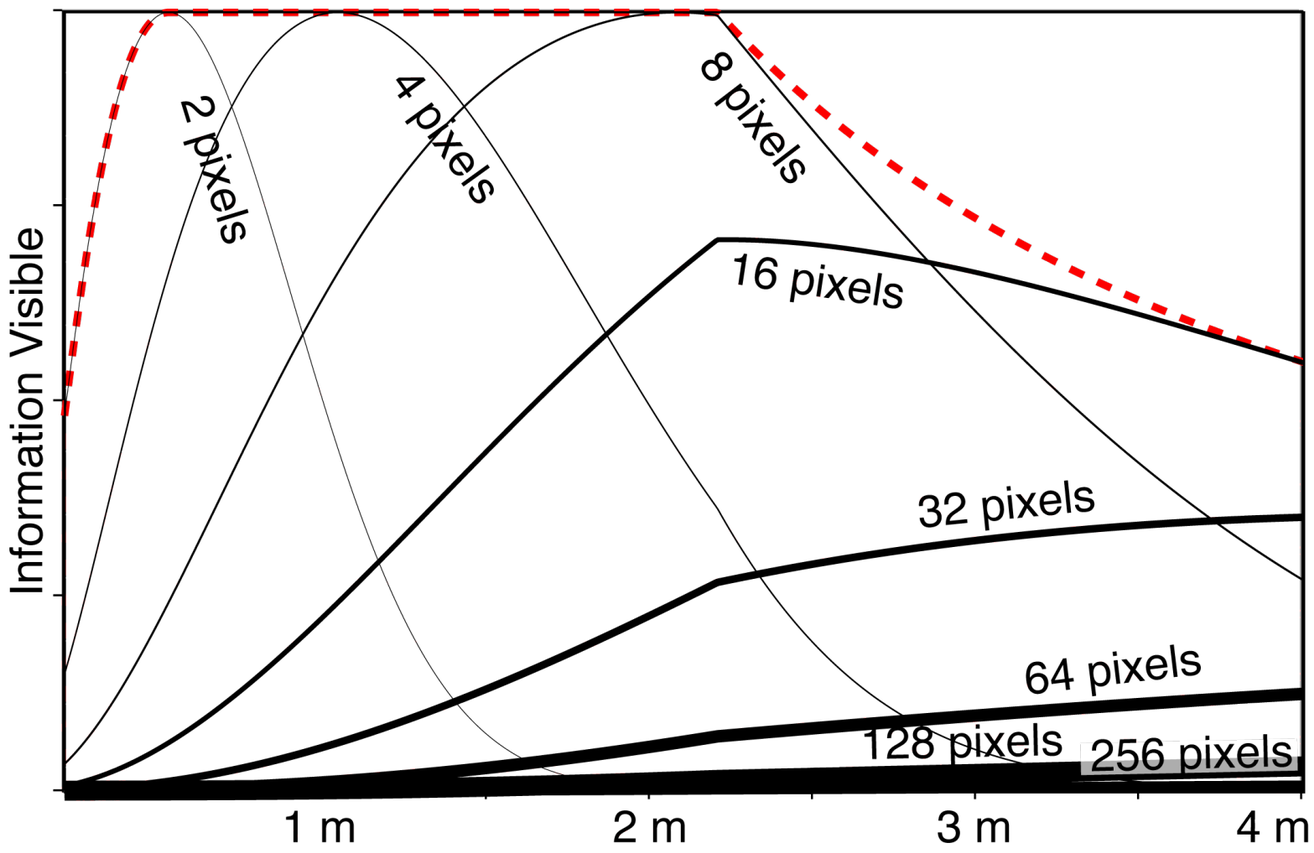


Ineffective Visualizations

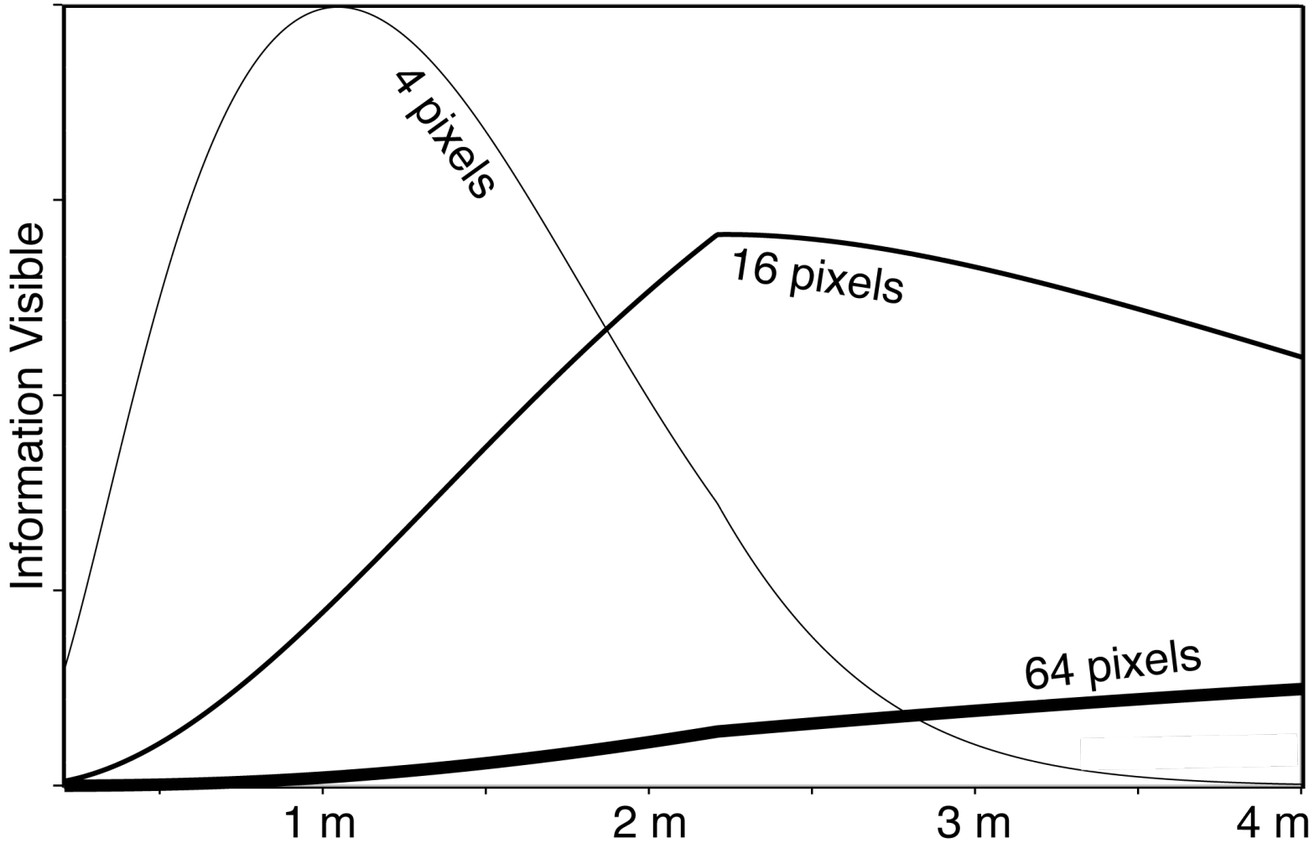


Odéon
abillon
St-Michel

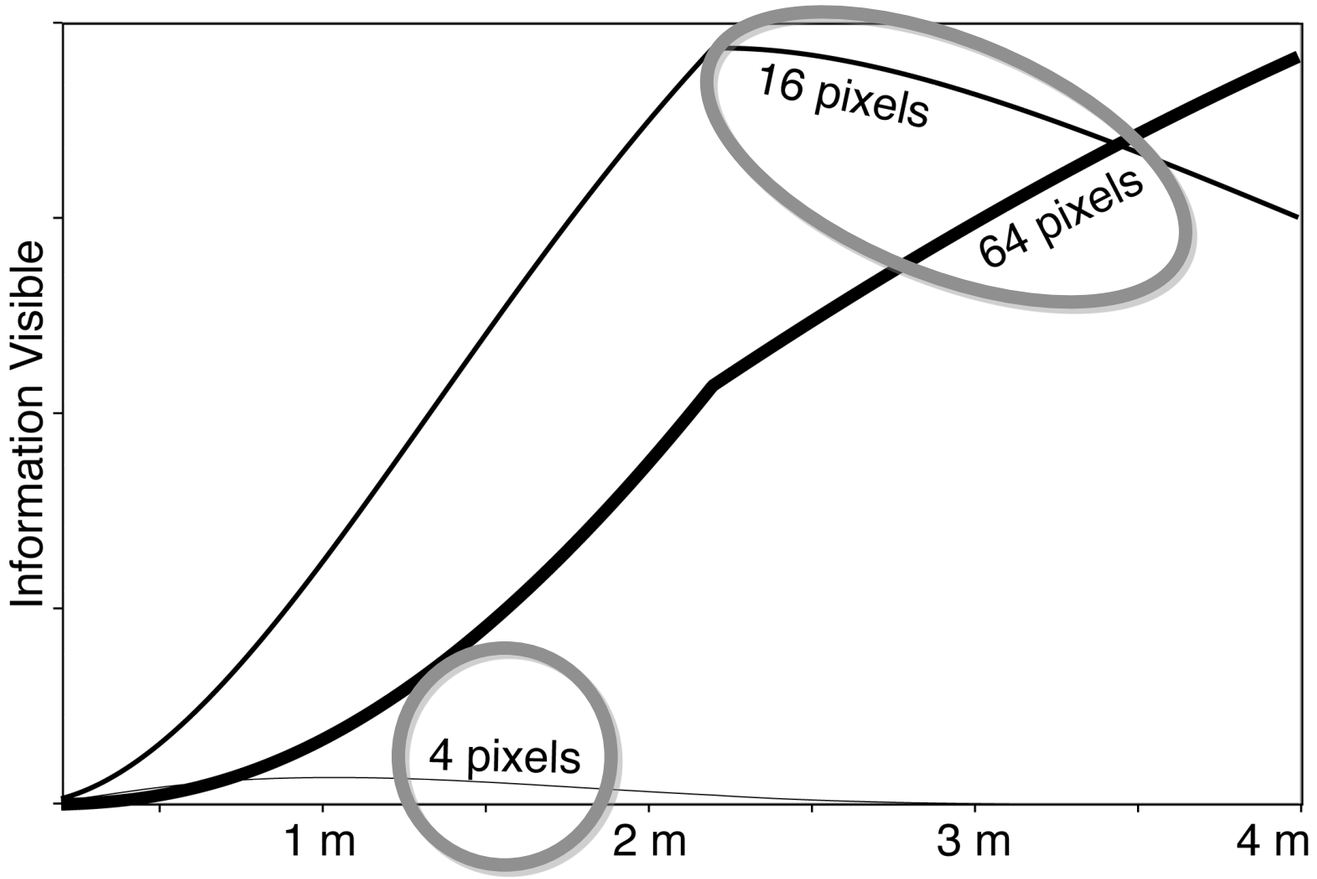
Ineffective Visualizations

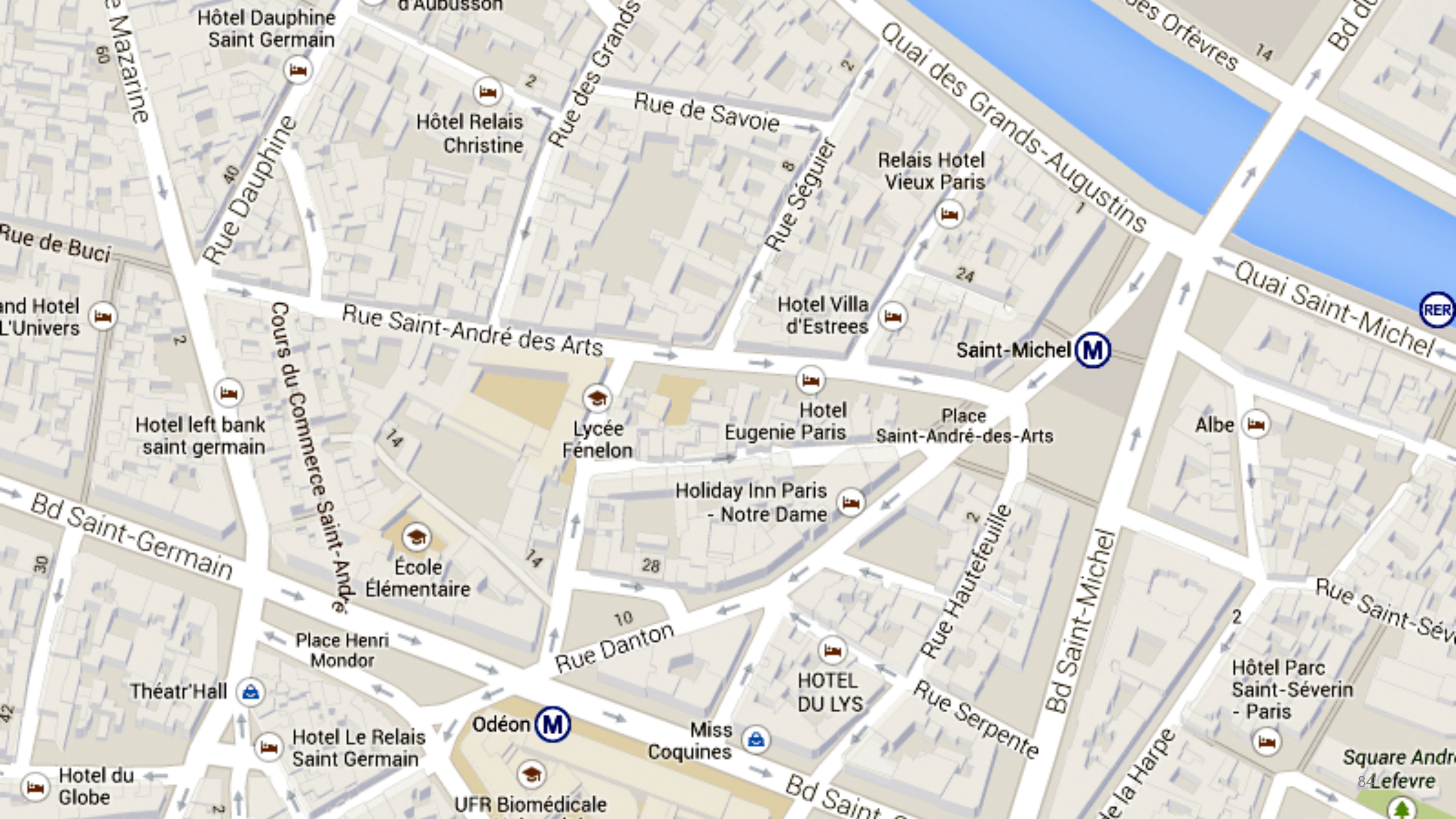


Ineffective Visualizations



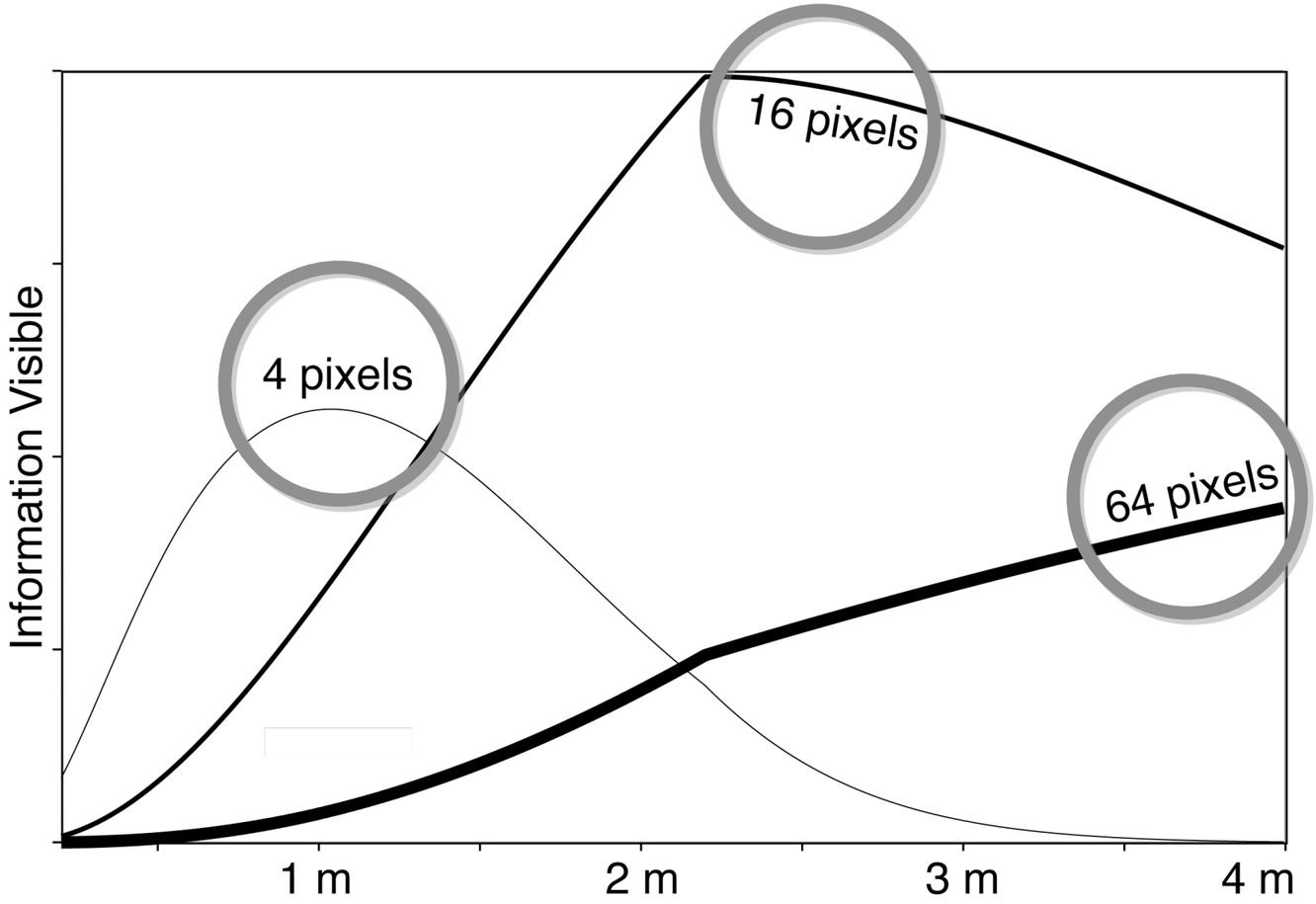
Ineffective Visualizations




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
Hotel Le Relais Saint Germain
Miss Coquines
Hotel du Globe
UFR Biomédicale
Square Andr
Lefevre

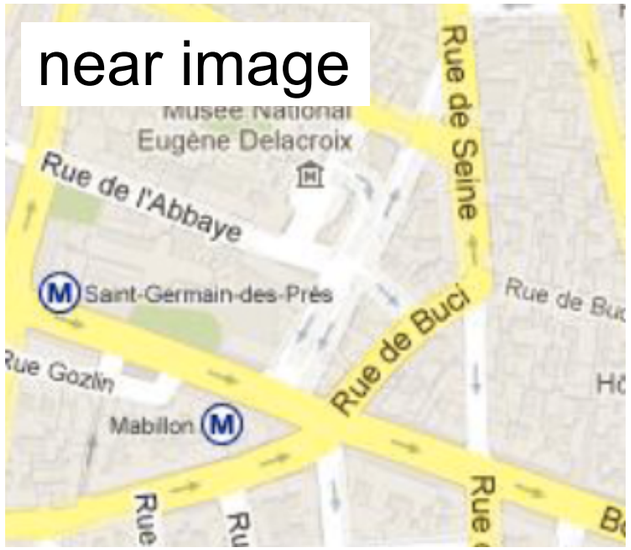
Ineffective Visualizations

Ineffective Visualizations

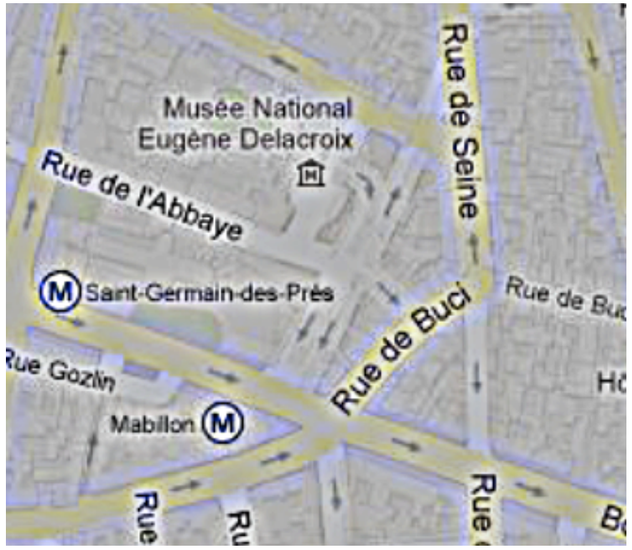


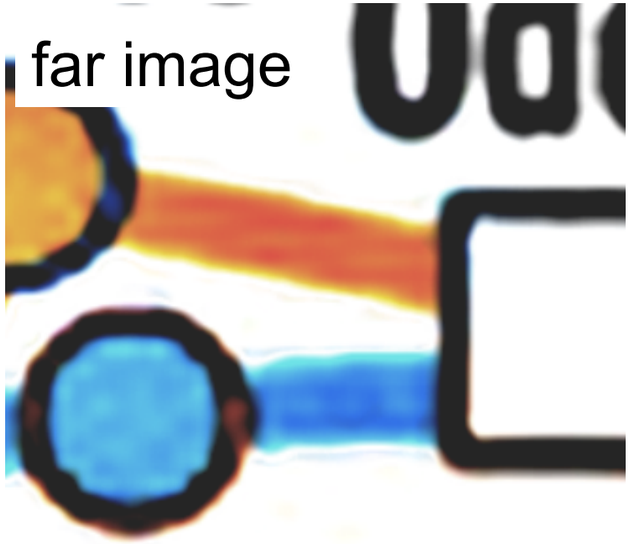
Ineffective Visualizations

Hybrid-Image Visualization



Hi-pass Filter + contrast





Lo-pass Filter

Alpha Blending + contrast

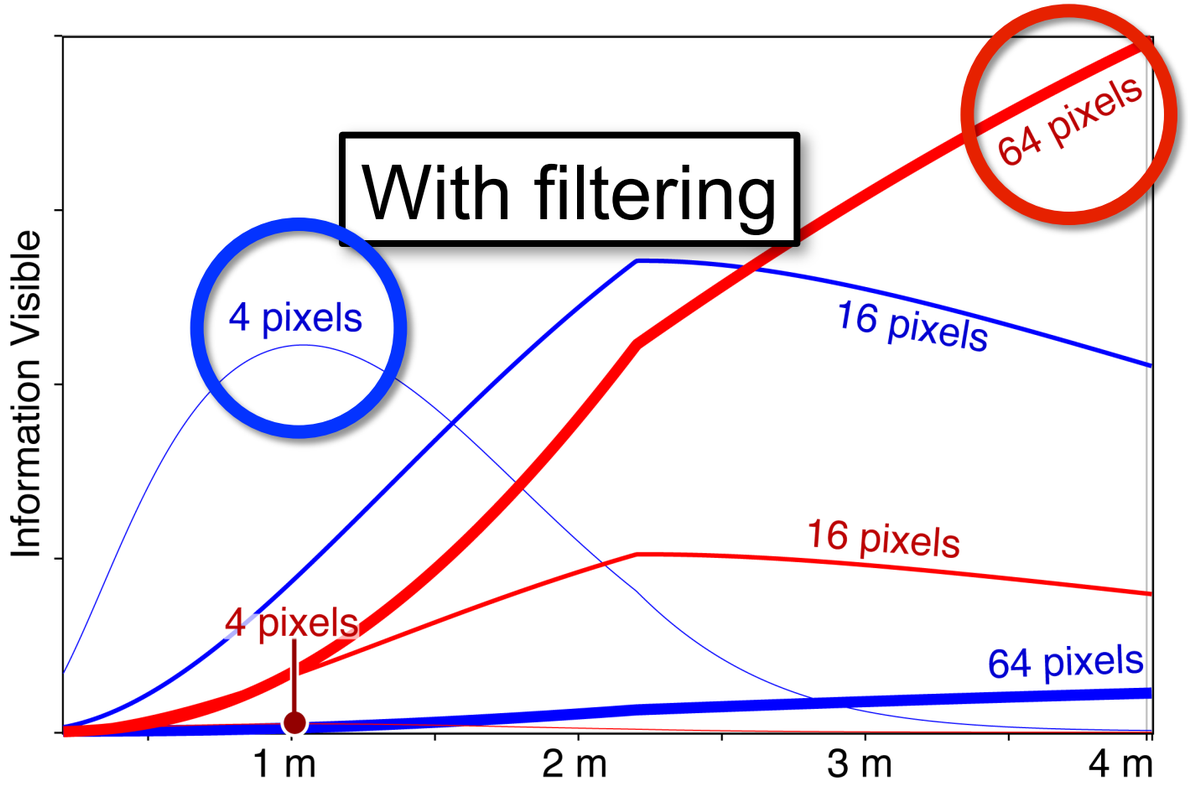
Hybrid-Image Visualization

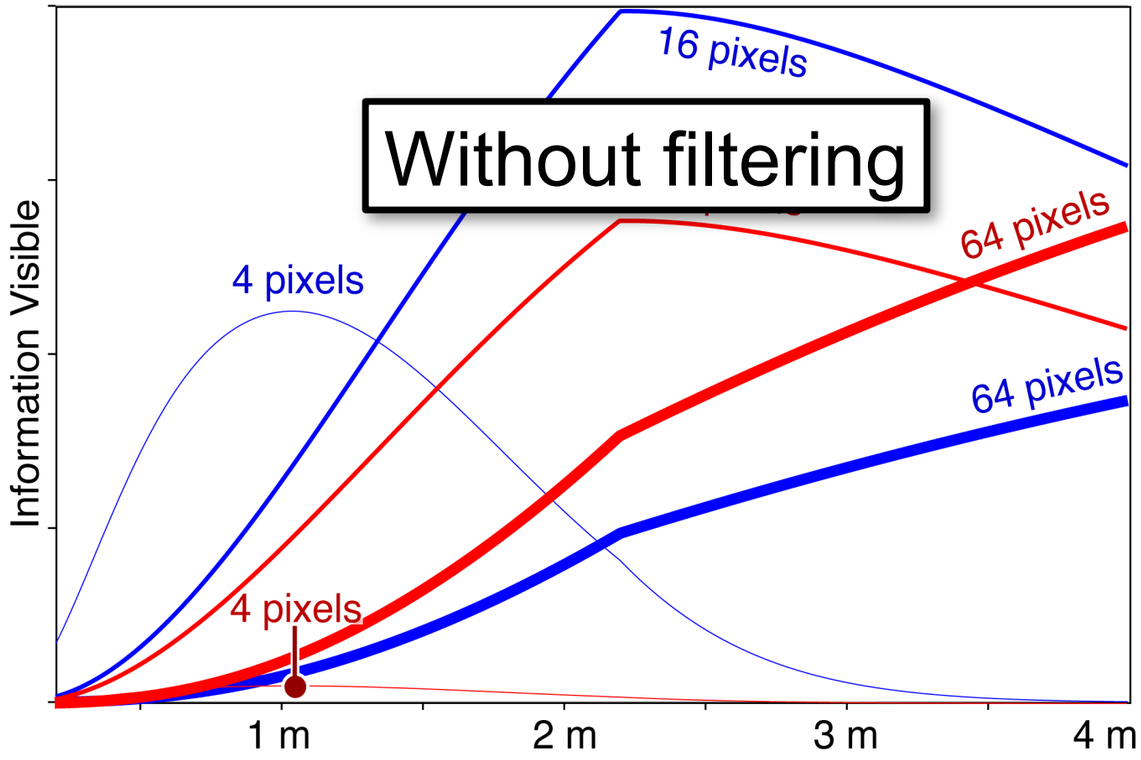
Hybrid-Image Visualization

Hybrid-Image Visualization

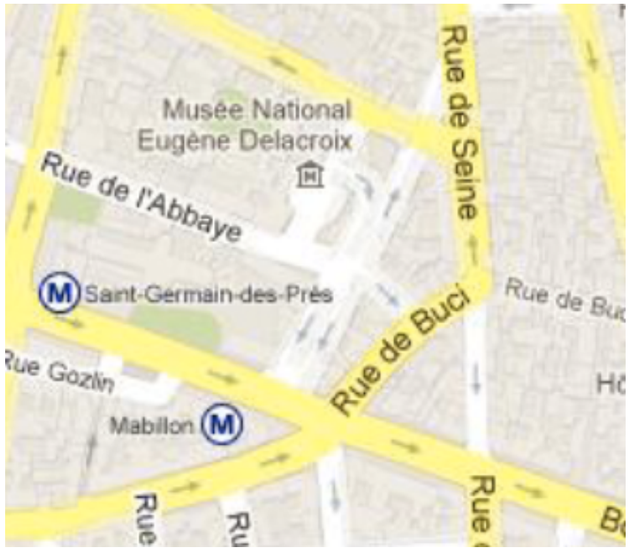
Near image

Far image

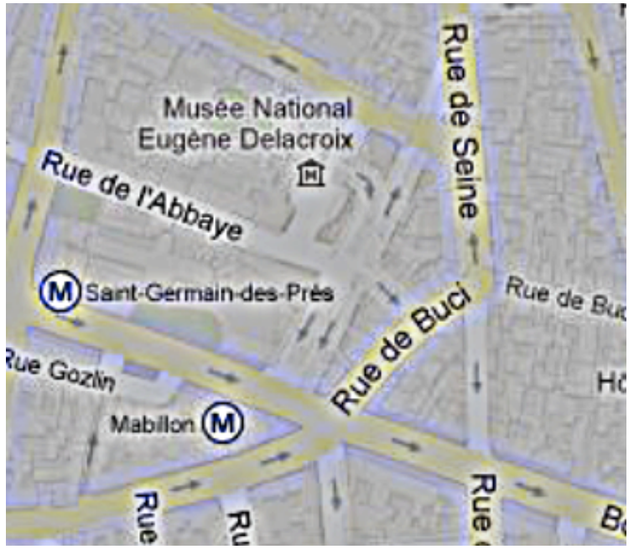




Hybrid-Image Visualization



Hi-pass Filter + contrast



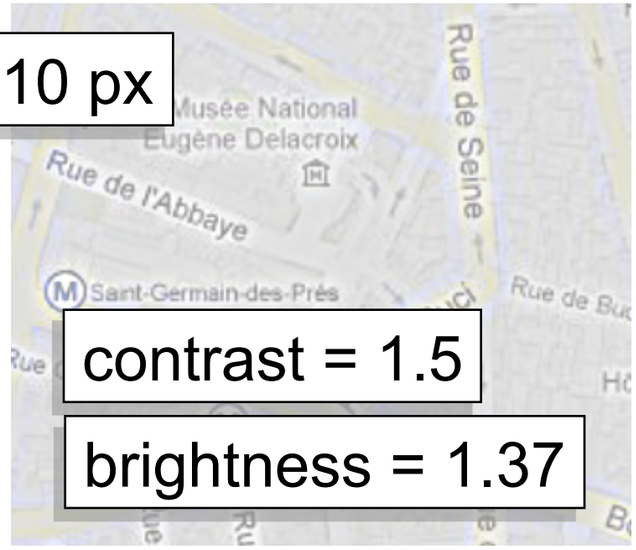
Lo-pass Filter

Alpha Blending + contrast

Hybrid-Image Visualization

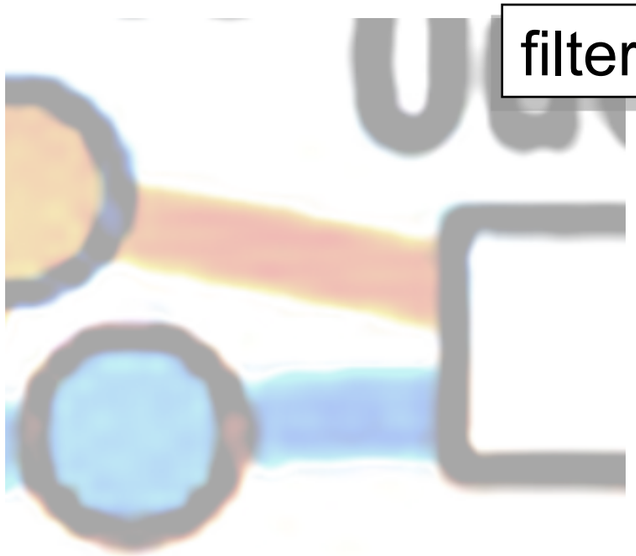
filter radius = 10 px

Hi-pass Filter
+ contrast



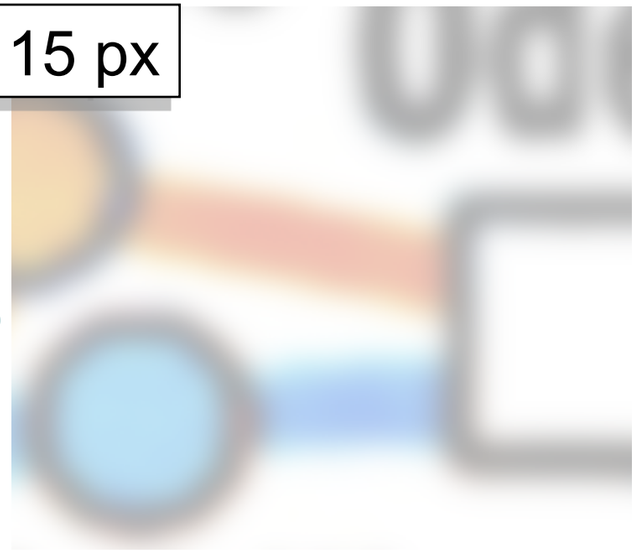
contrast = 1.5

brightness = 1.37



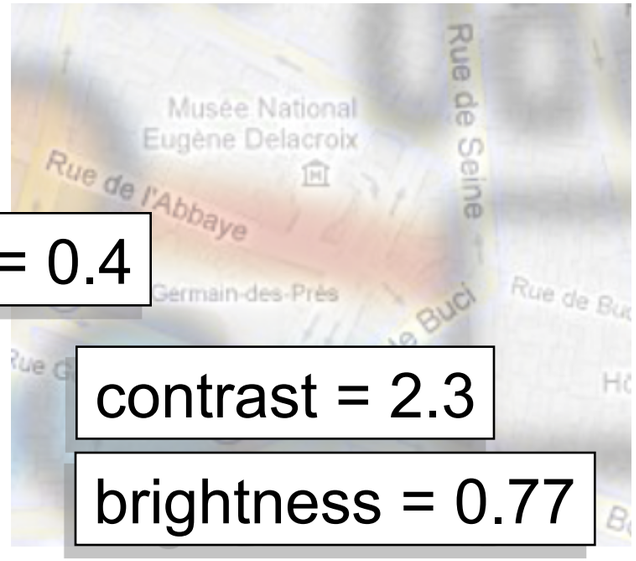
filter radius = 15 px

Lo-pass Filter



Alpha Blending
+ contrast

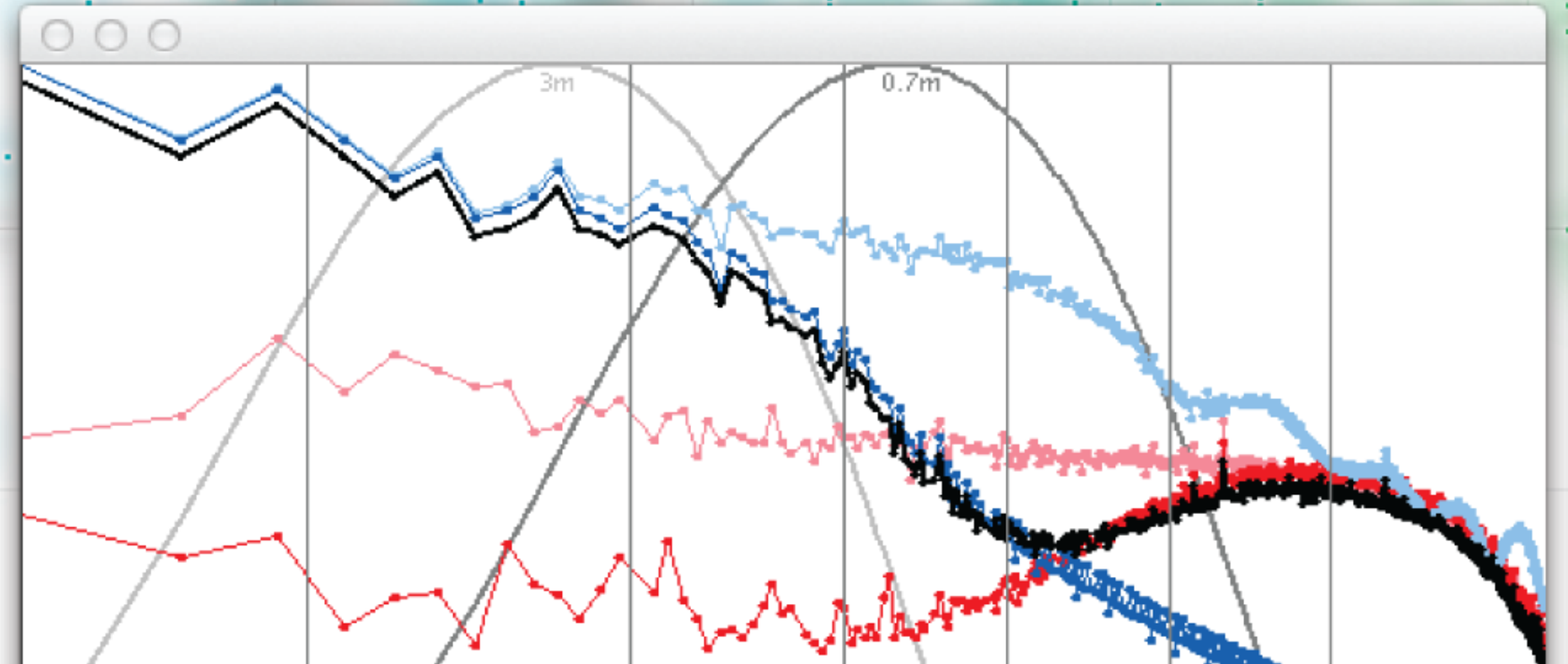
opacity = 0.4



contrast = 2.3

brightness = 0.77

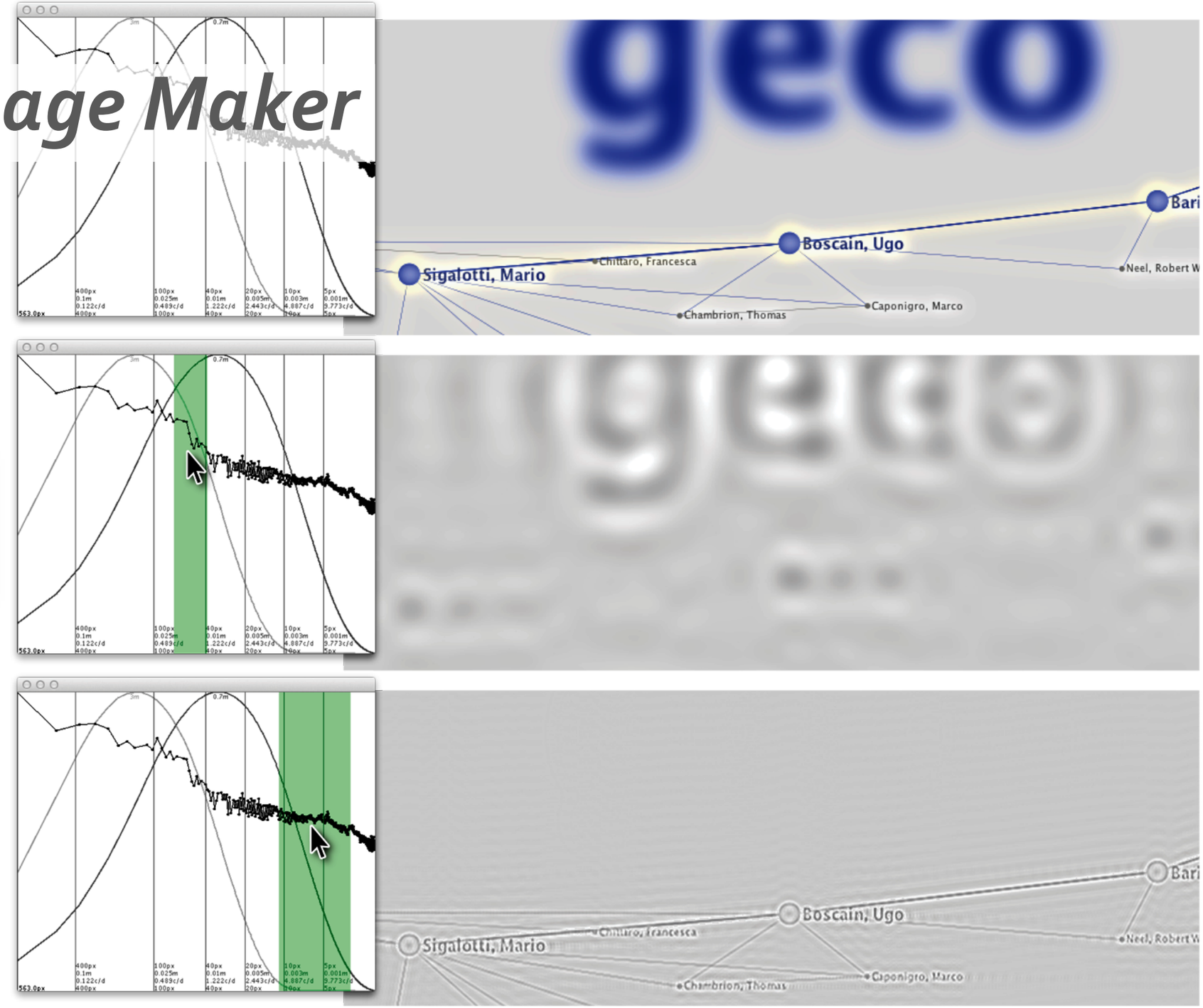
Hybrid Image Maker



Hipass radius	5
Transparent hipass	☐
Hipass contrast	1.5
Hipass brightness	1.5
Near image opacity	1
Draw far image	☑
Blur radius	30
Far image opacity	0.5
Post contrast	2
Post brightness	0.8
Draw bezels	☑
Draw settings	☐

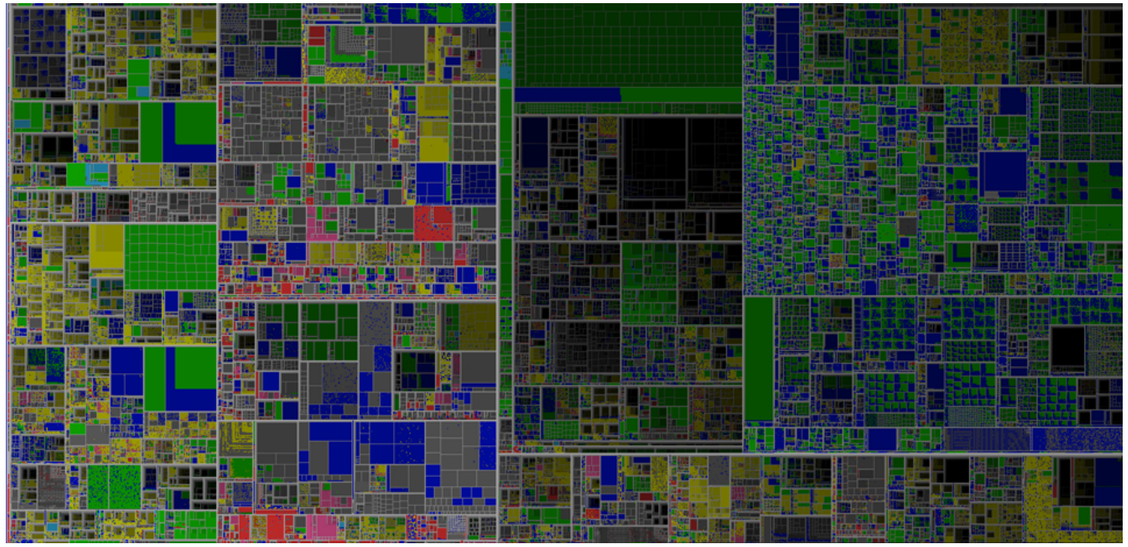
Hybrid Image Maker

Frequency highlighter



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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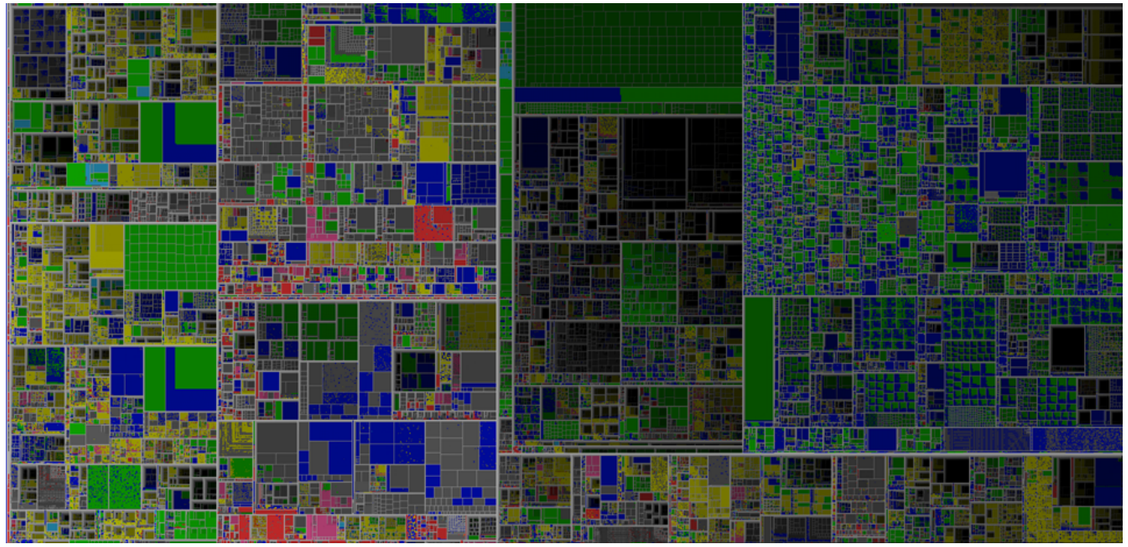
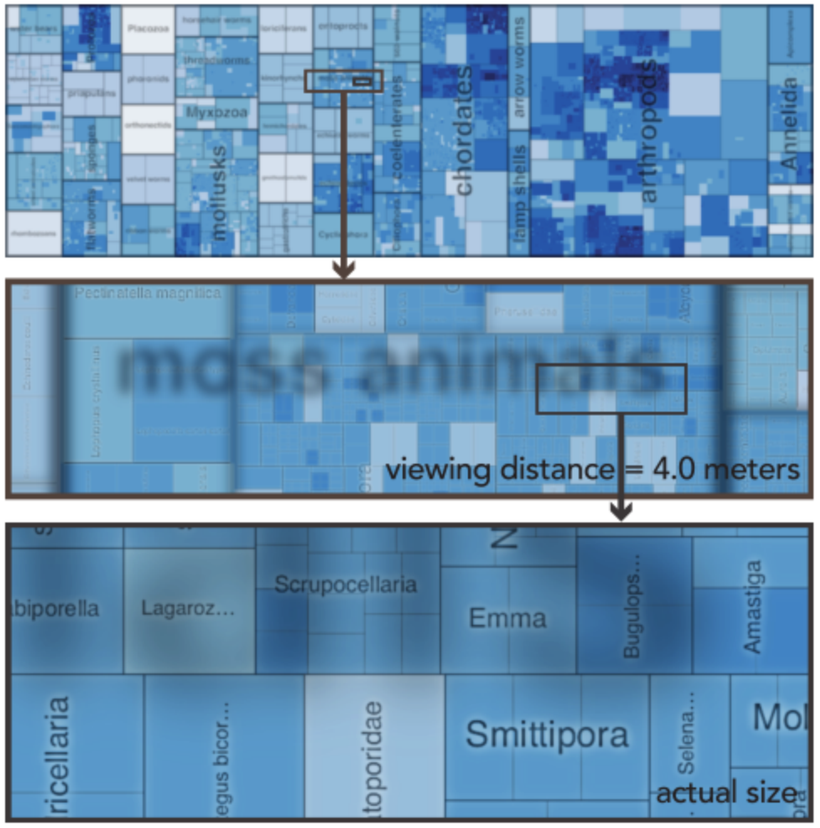
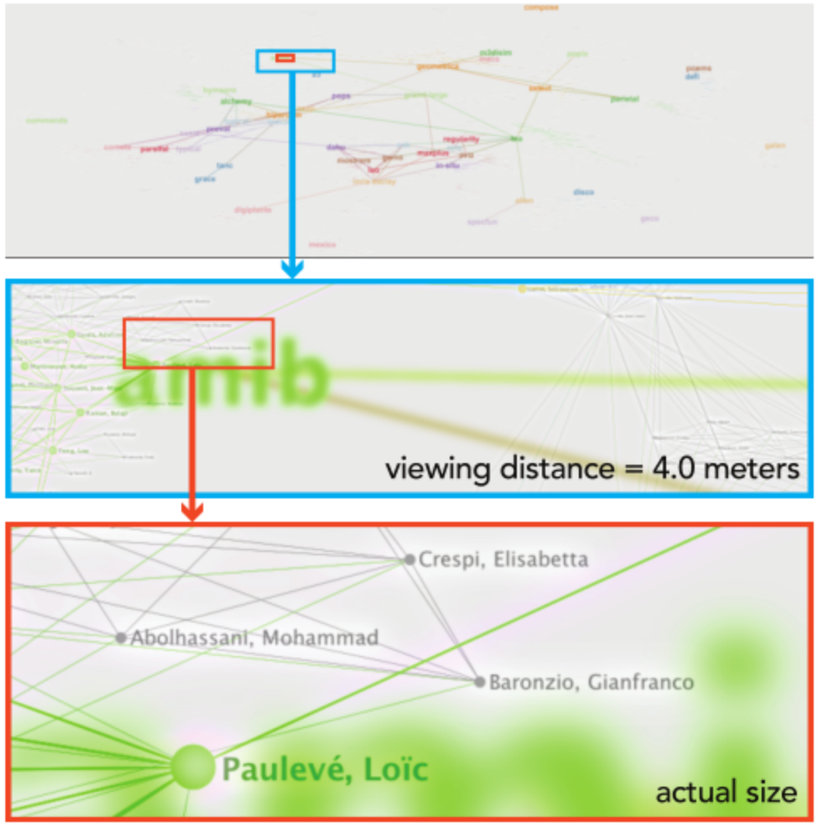


Examples

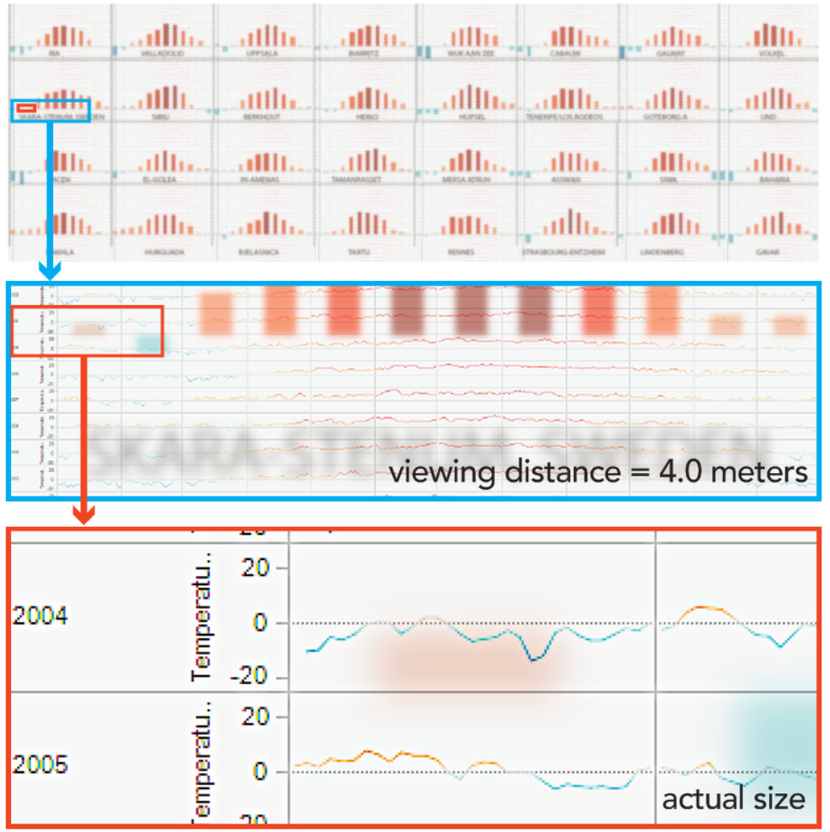
http://aviz.fr/hybridvis



Tree of Life Treemap



co-authorship network



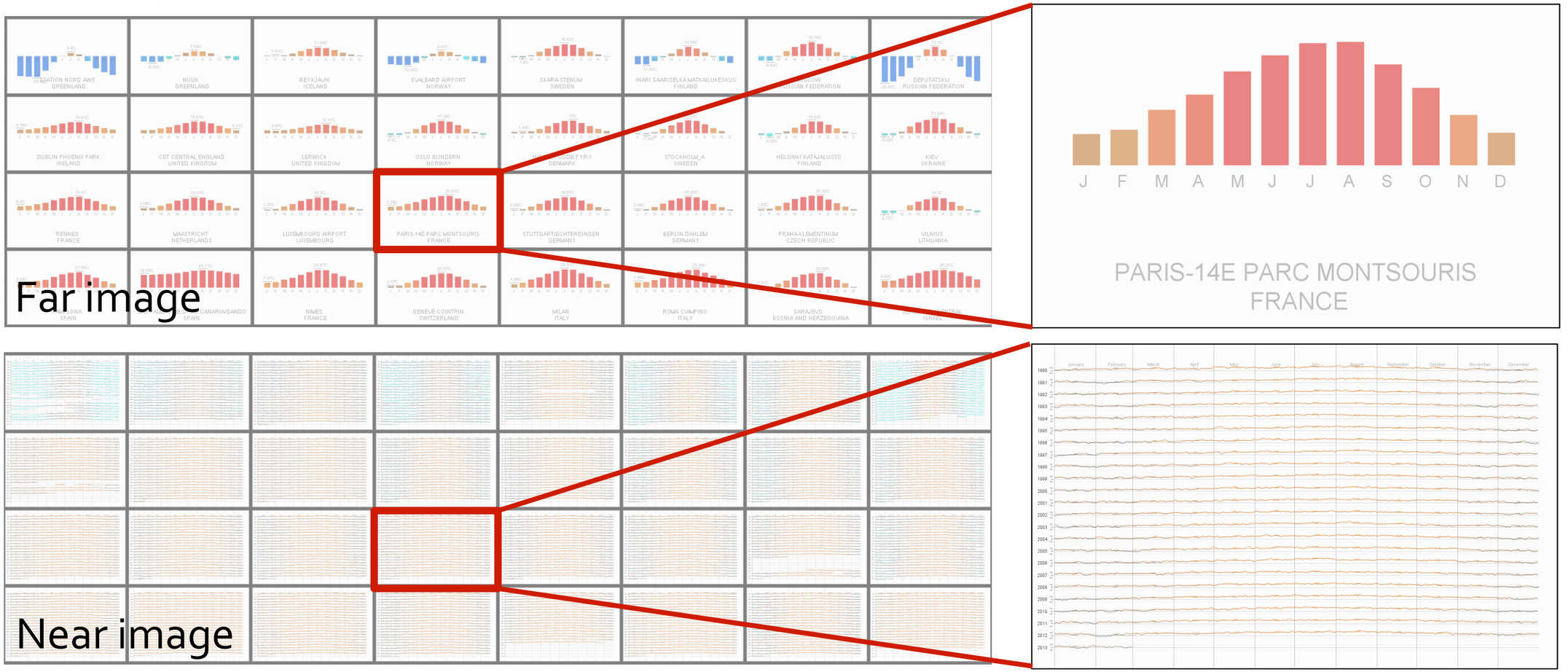
temperature data

...and more

http://aviz.fr/hybridvis

HI-Visualization Techniques

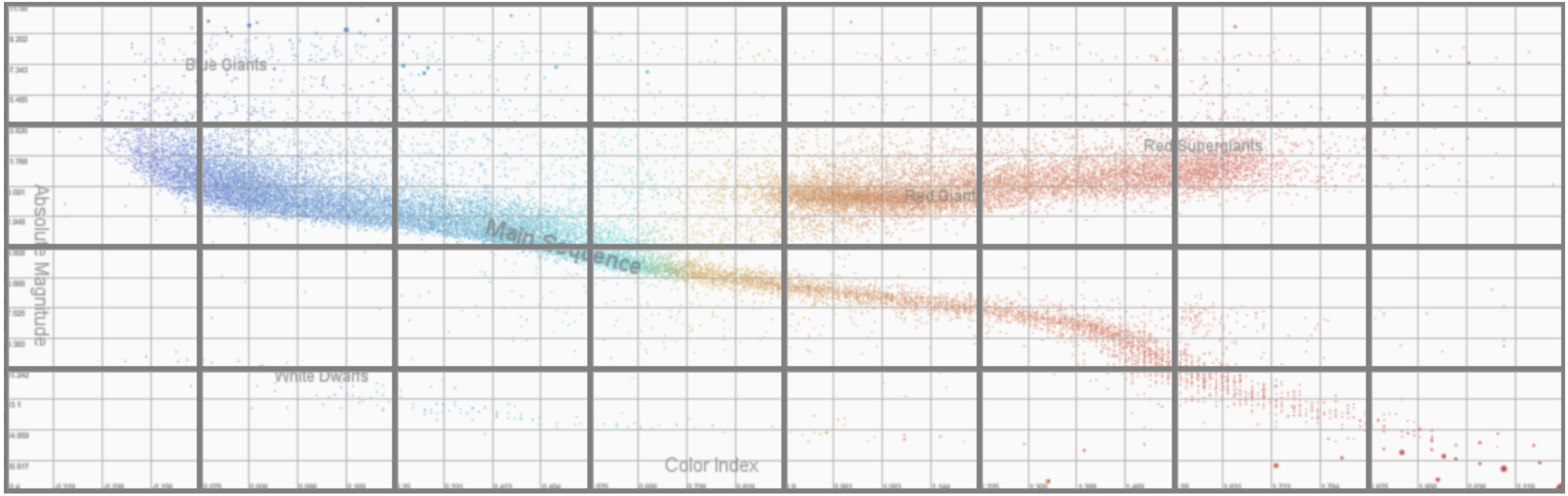
- Mixing multiple visualizations
- Navigation aids & summaries



http://aviz.fr/hybridvis

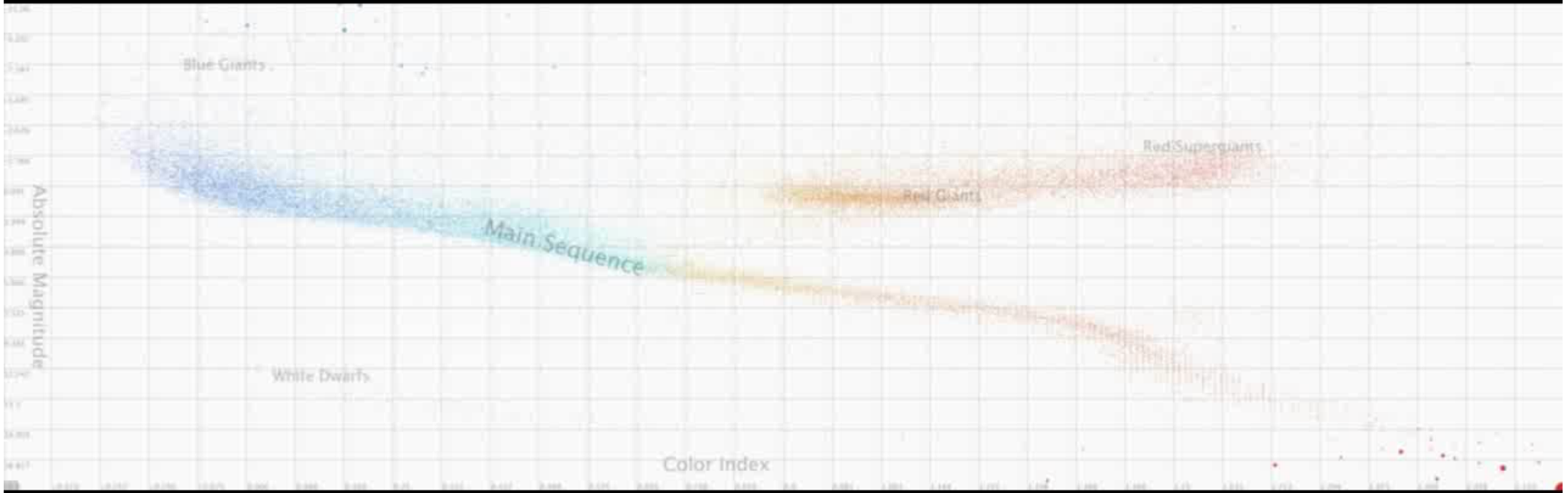
HI-Visualization Techniques

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

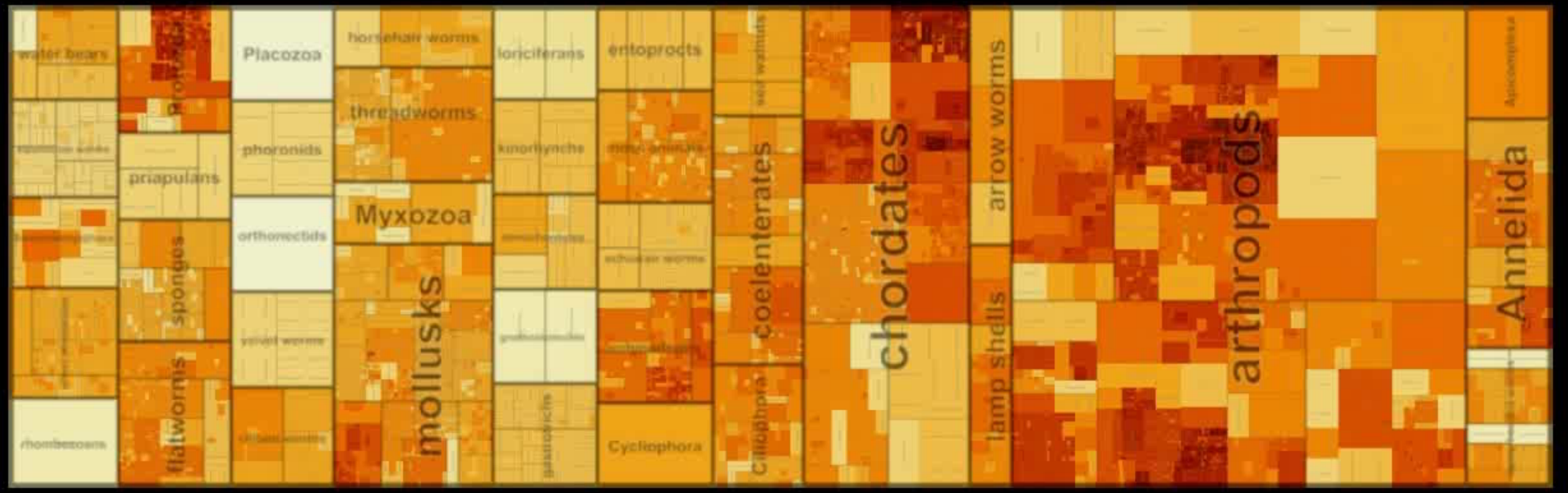


Hertzsprung-Russell diagram (think of this as a scatterplot)

www.fraps.com



www.fraps.com



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

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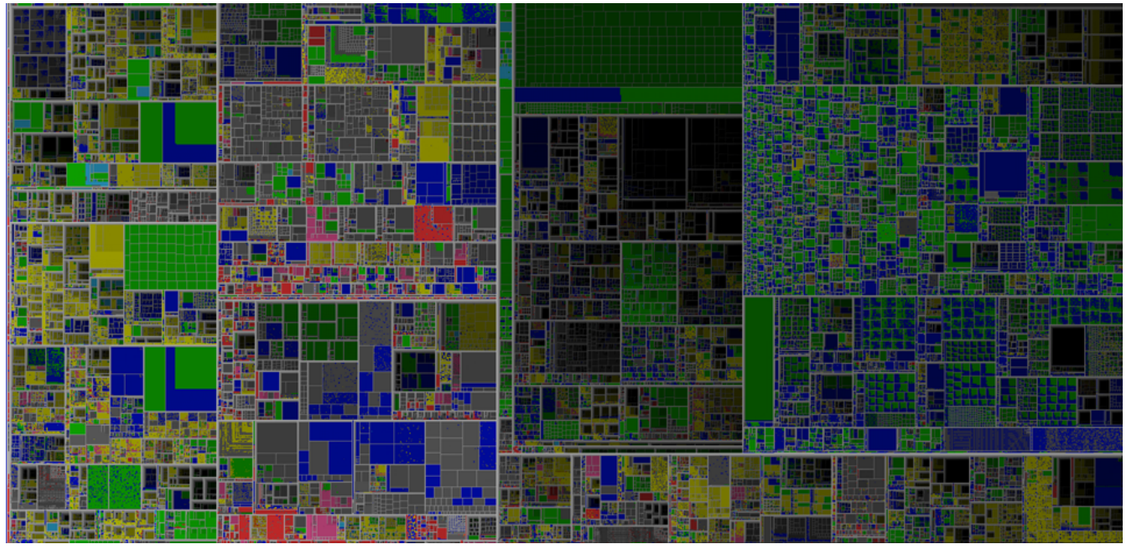

Aviz
Visual Analytics Project

Inria
informatics mathematics

LABORATOIRE DE RECHERCHE EN INFORMATIQUE

http:aviz.fr/hybridvis

Funded by: ANR-11-JS02-003