

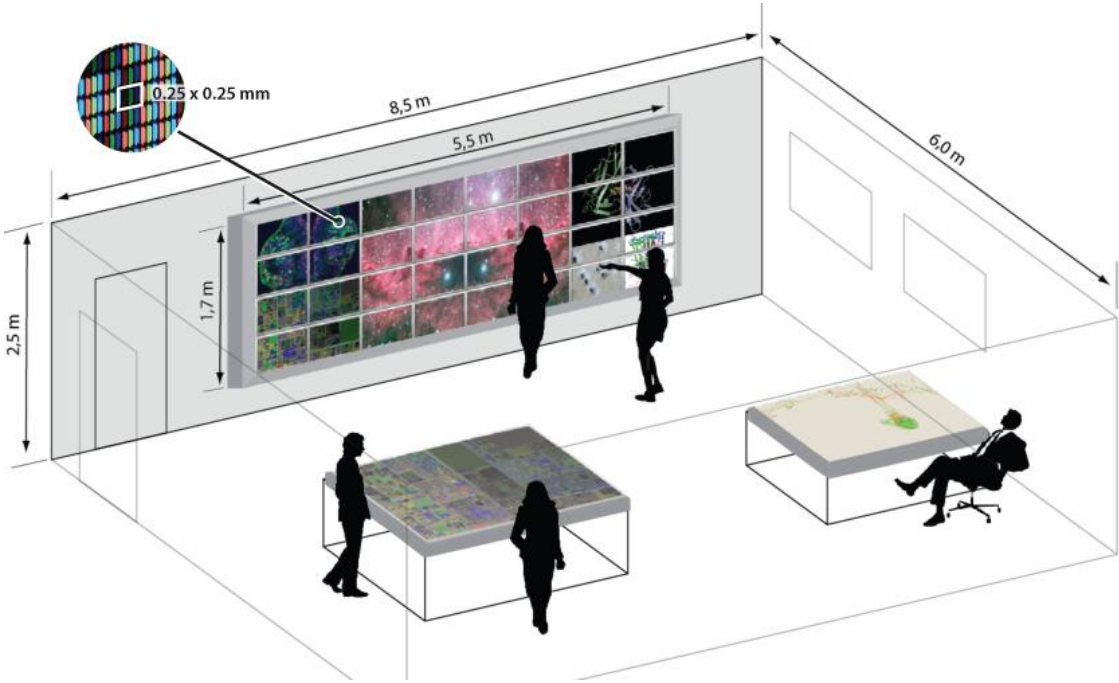


Hybrid-Image Visualization for Large Viewing Environments

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



Large Viewing Environments

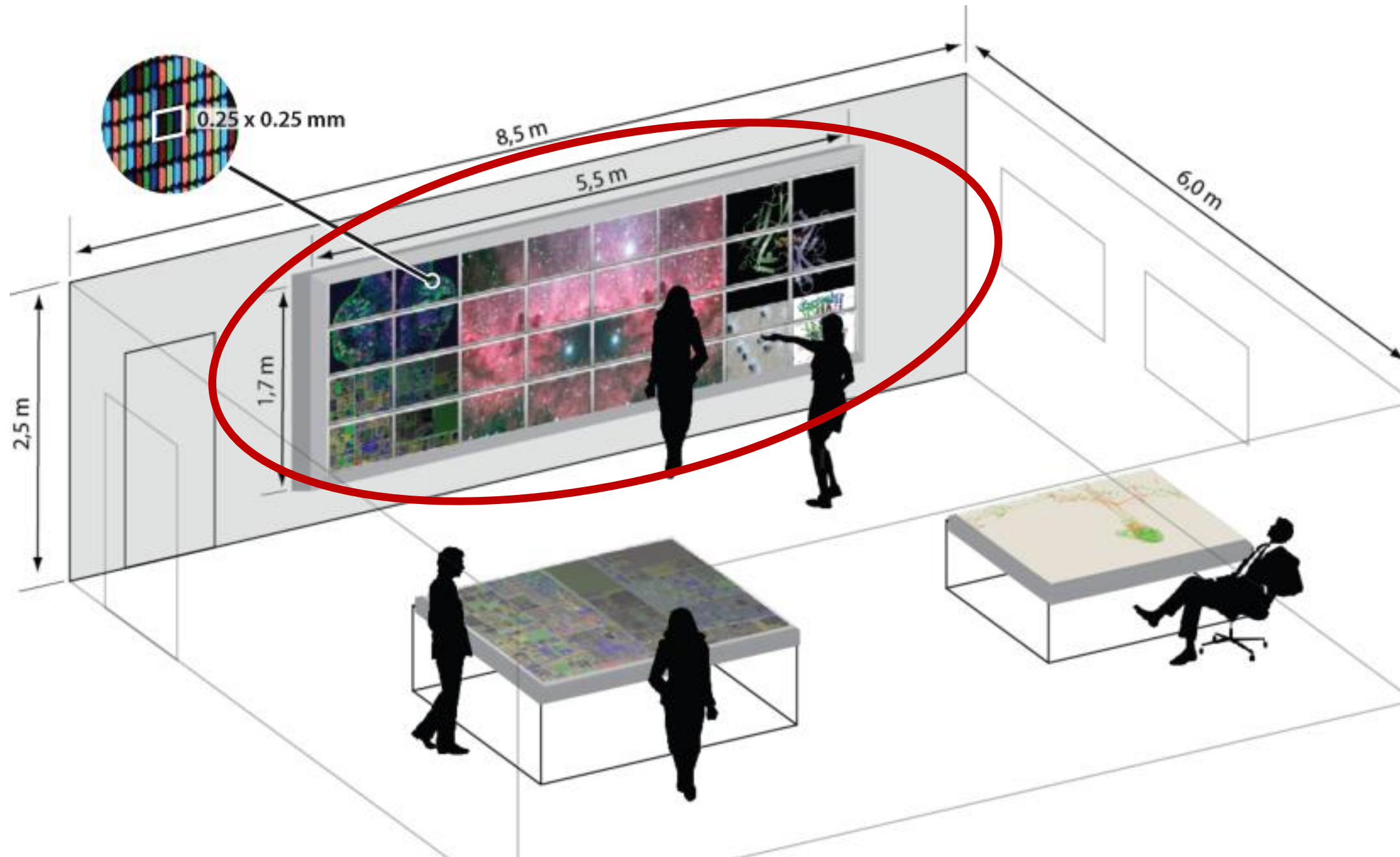


large displays
meeting rooms / war rooms
emergency response rooms

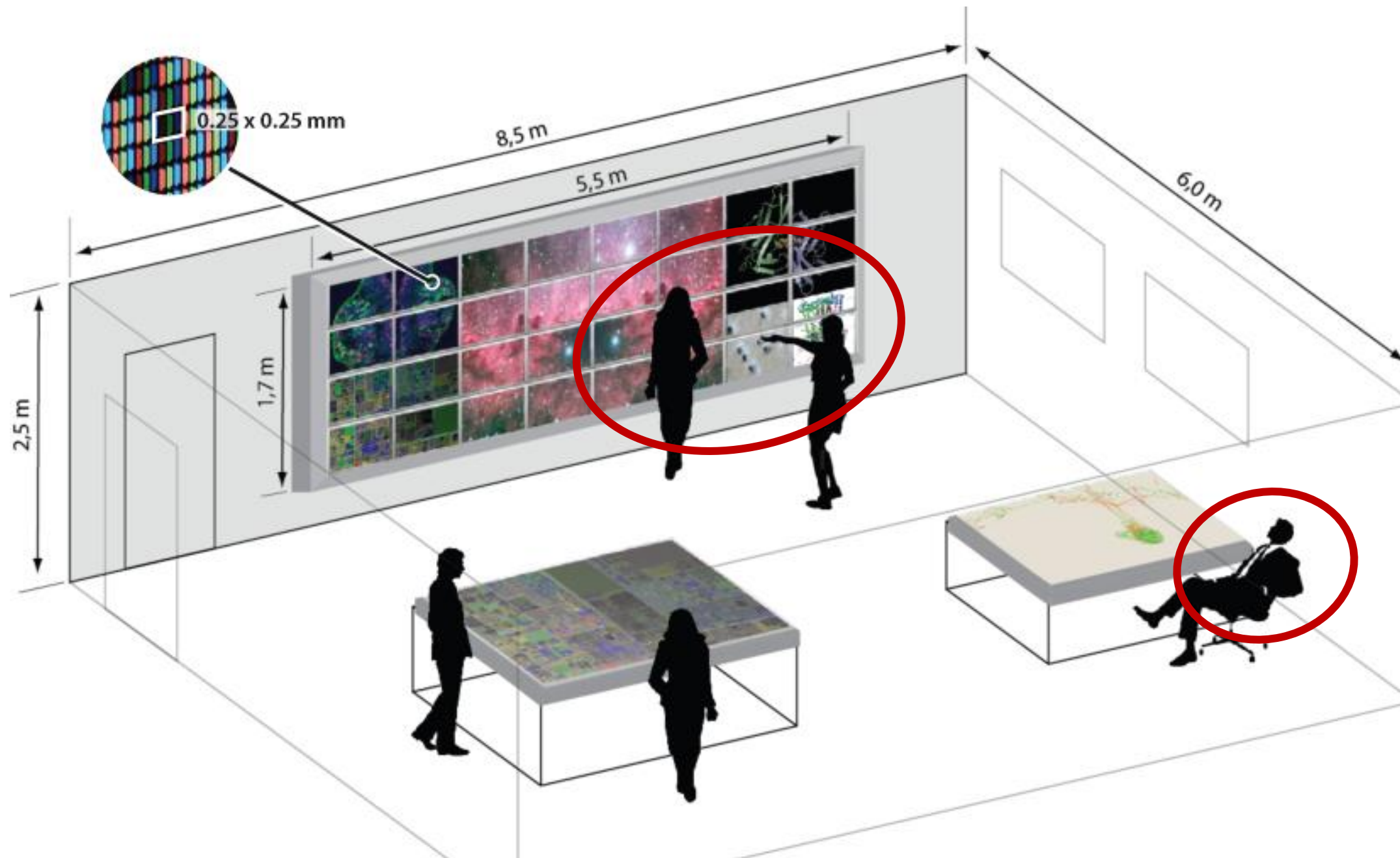


public viewing
open spaces
museums

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





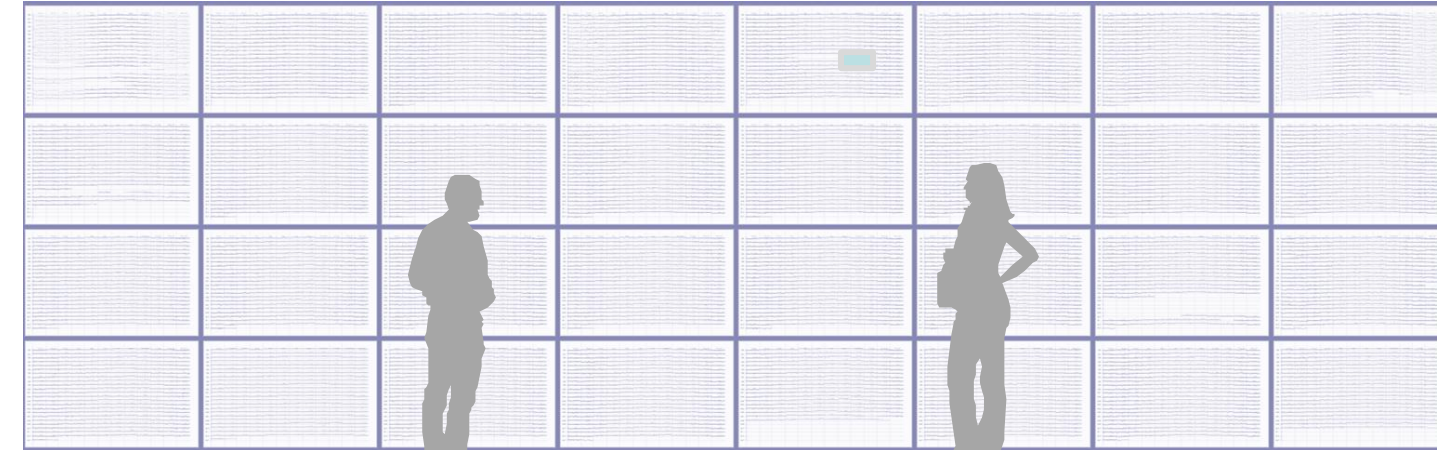
Naiïve Approach

Optimize for one specific viewing distance



overviews from far

Problem:
detailed information lost

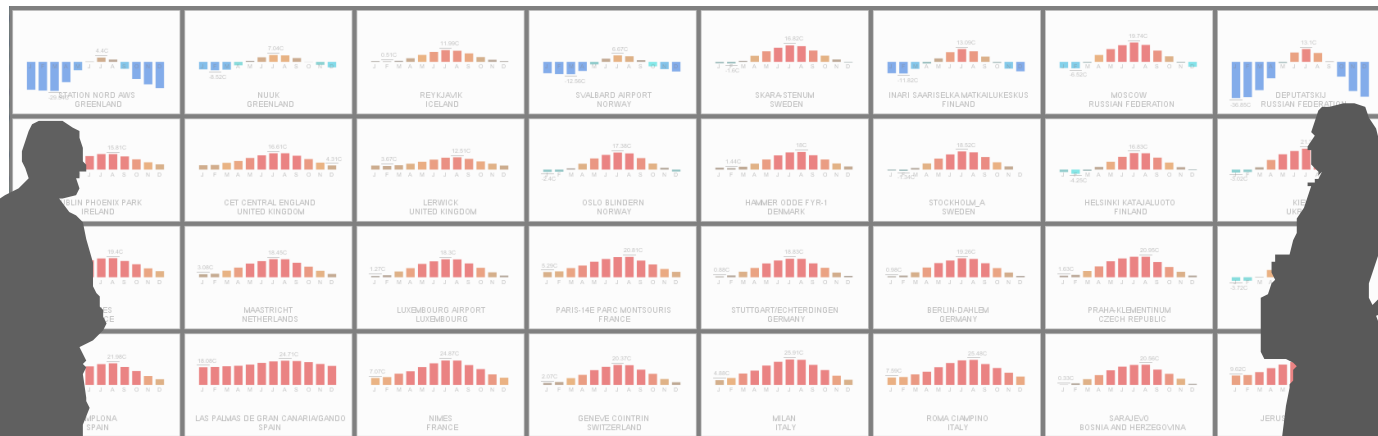


detail from close

Problem:
mental aggregation, comparison

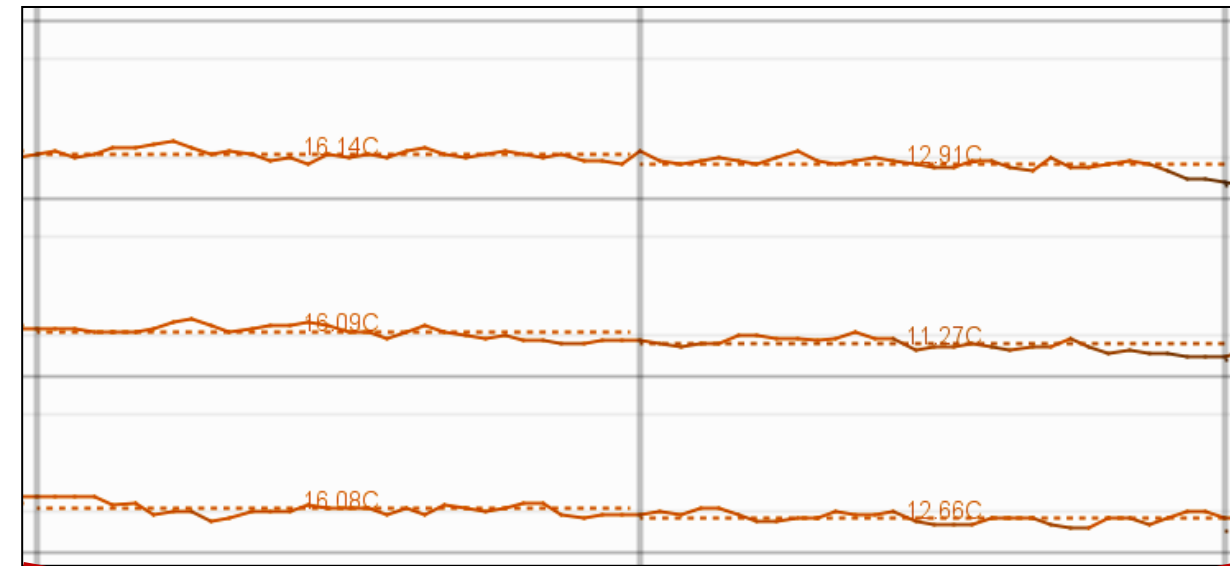
Naïve Approach

Optimize for one specific viewing distance



overviews from far

Problem:
detailed information lost

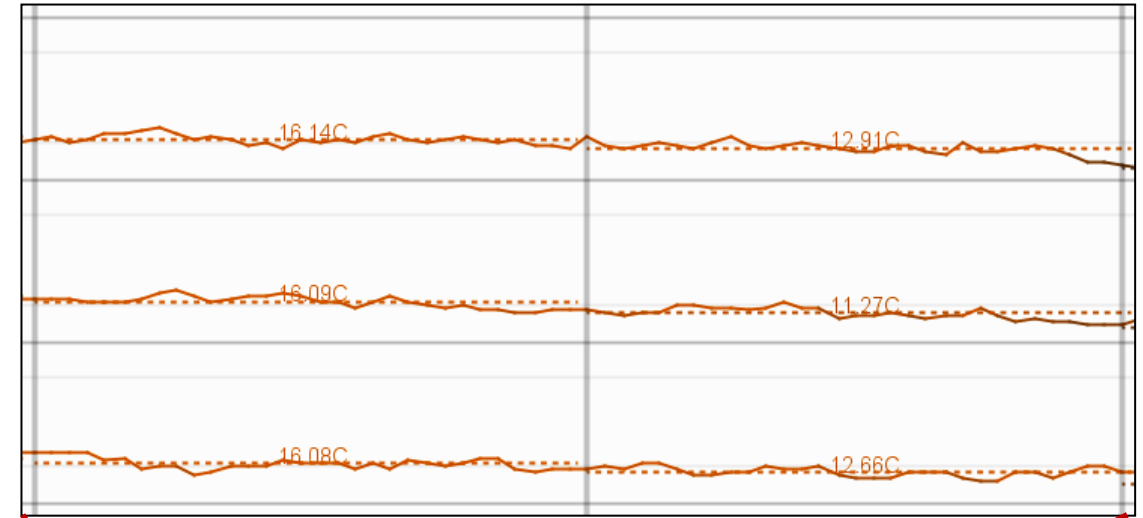
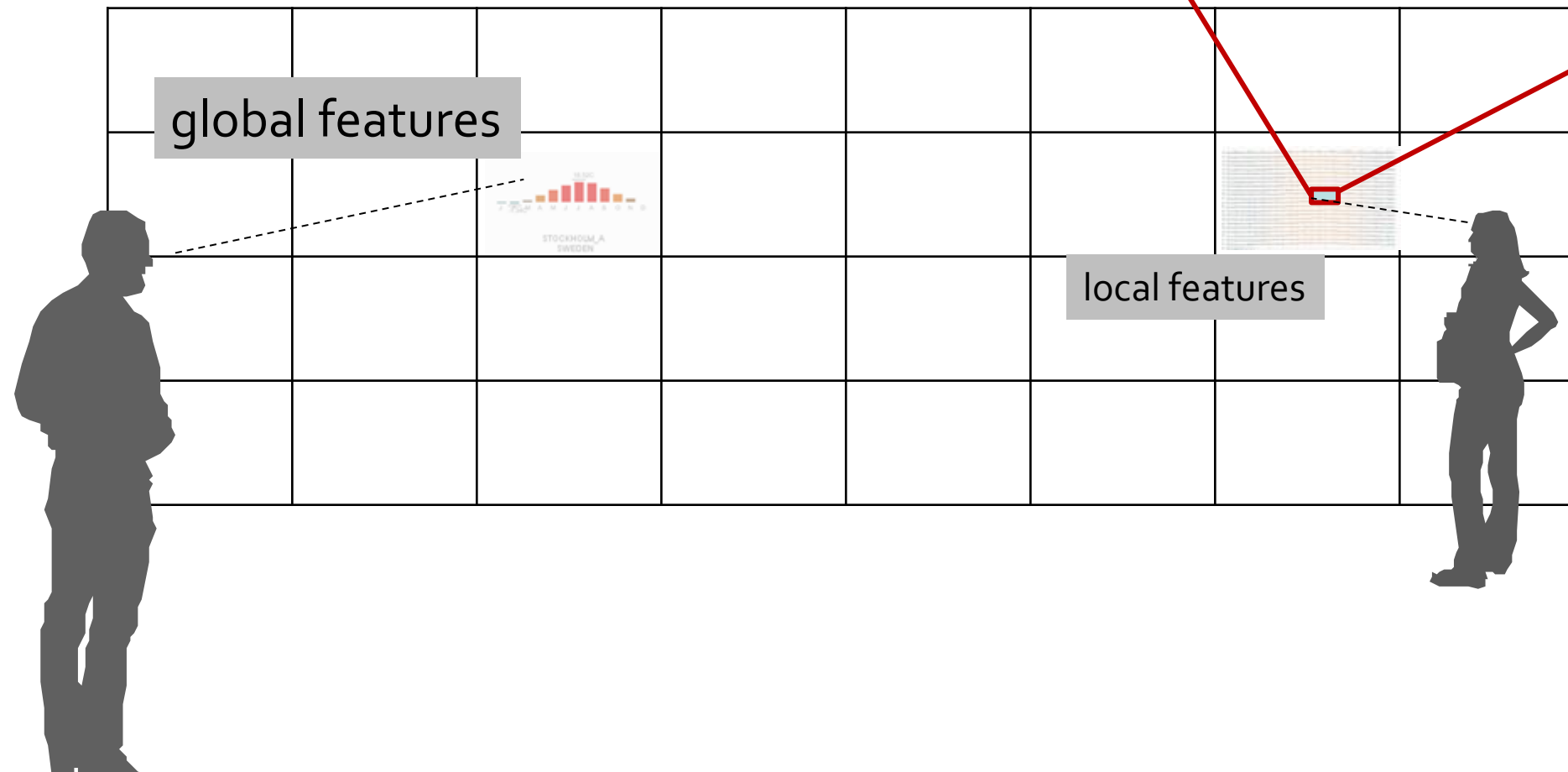


detail from close

Problem:
mental aggregation, comparison

Possible Approaches

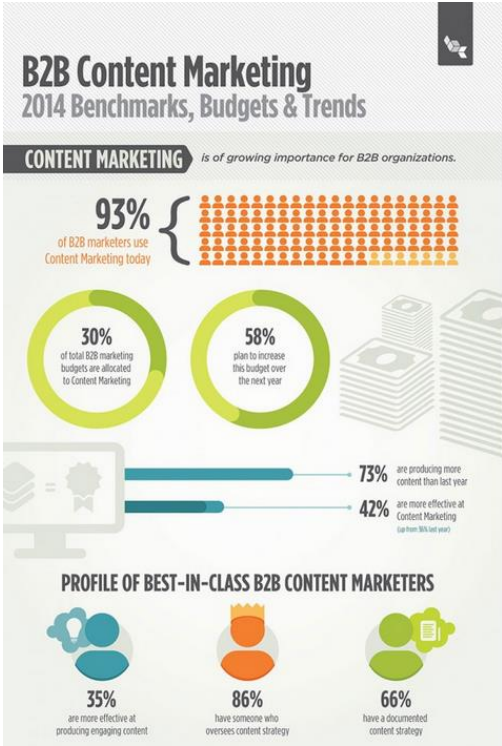
- Dynamic integration (tracking people & adapting content)
- **Static integration**



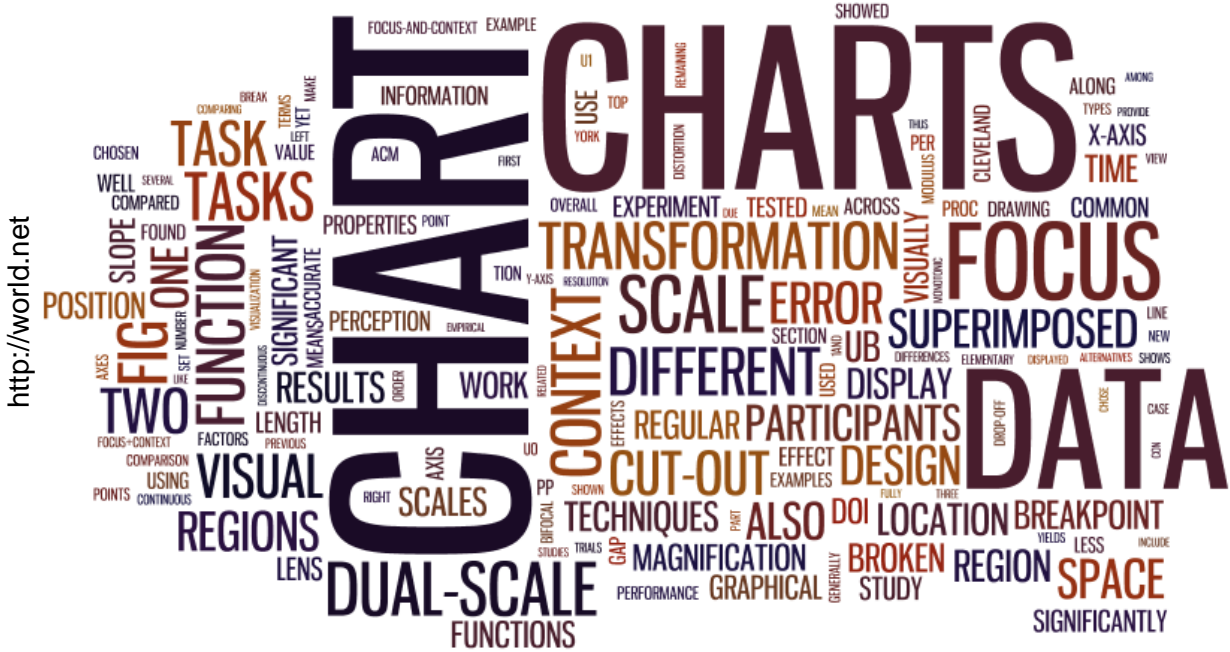
Static Approaches

Juxtaposition: global & local features next to each other

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



Infographic Layout

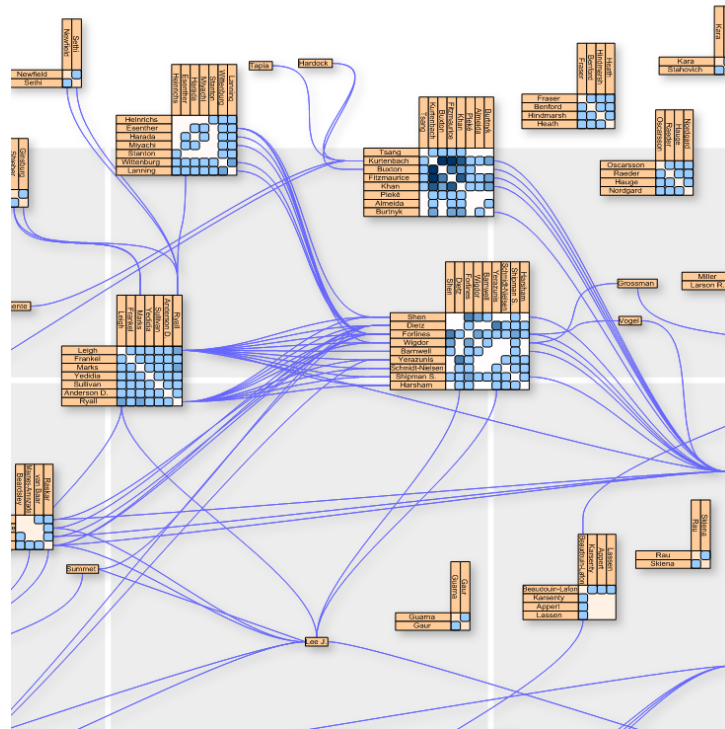


Large Tag Clouds

Static Approaches

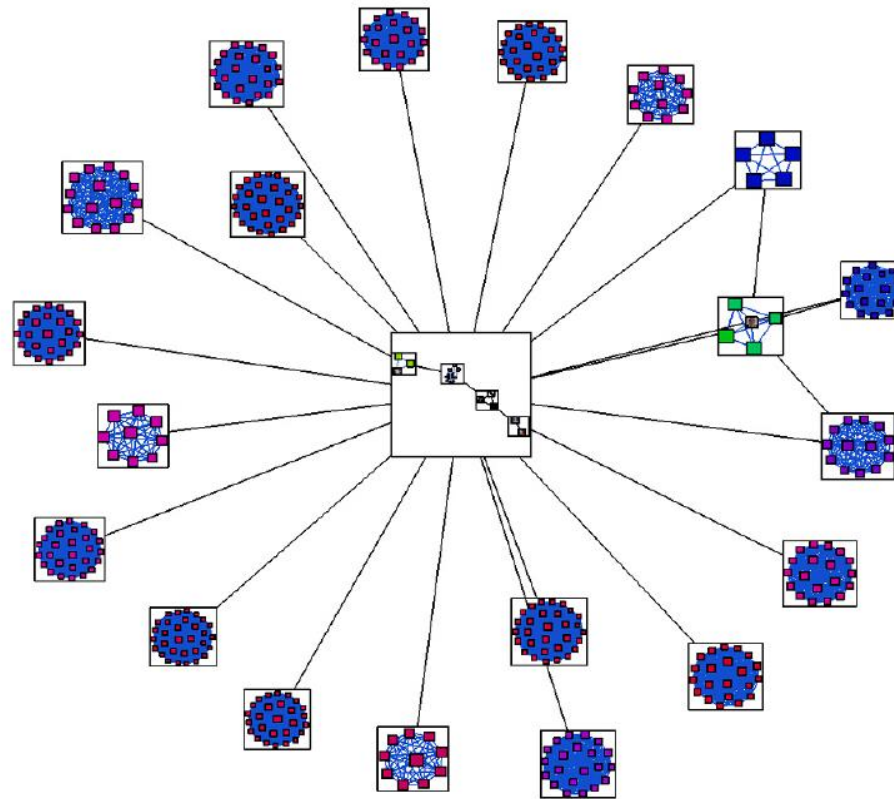
Nesting: local inside global features

[NodeTrix: Henry et al., InfoVis 2007]



NodeTrix

[SWViz: Auber et al., InfoVis 2003]

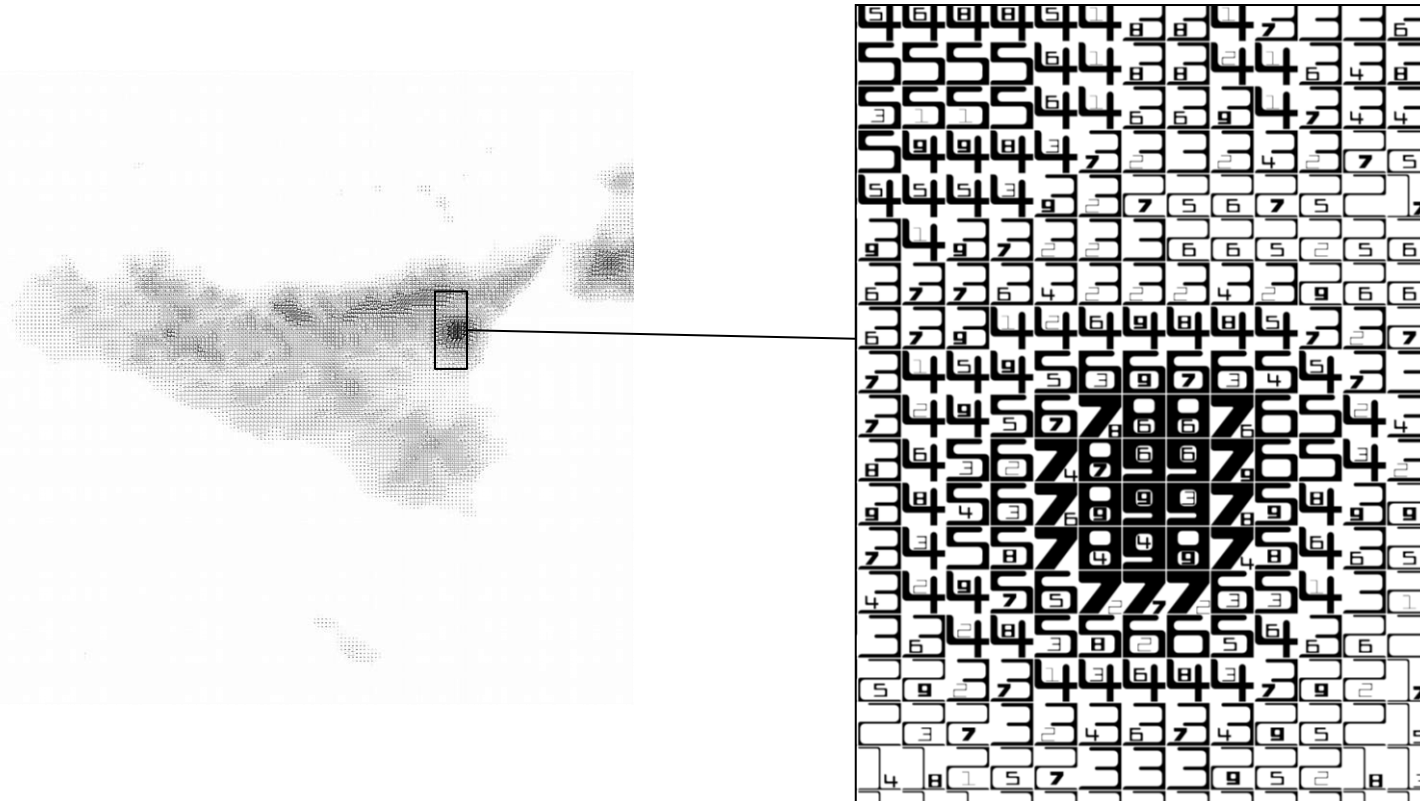


SWViz

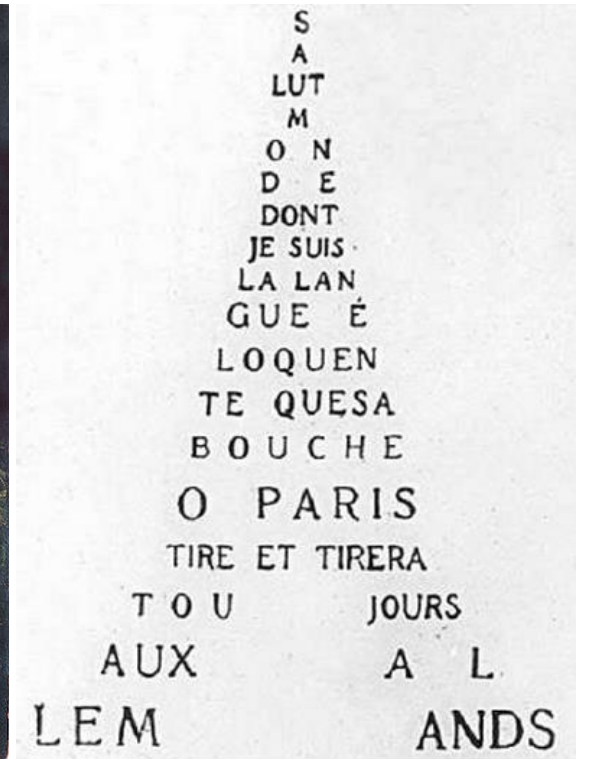
Static Approaches

Visual aggregation: local form global features

[FatFonts: Nacenta et al., AVI 2012]



FatFonts



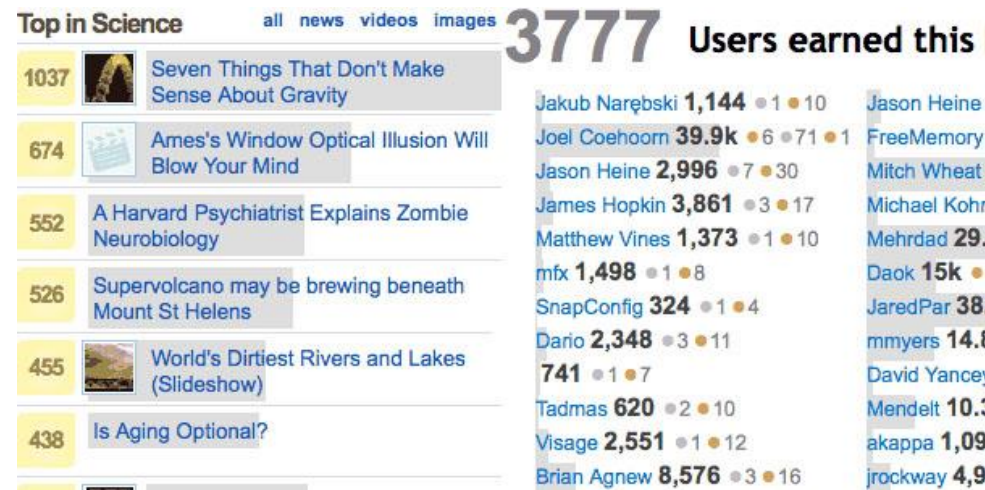
Arcimboldo Paintings, Calligrams

Static Approaches

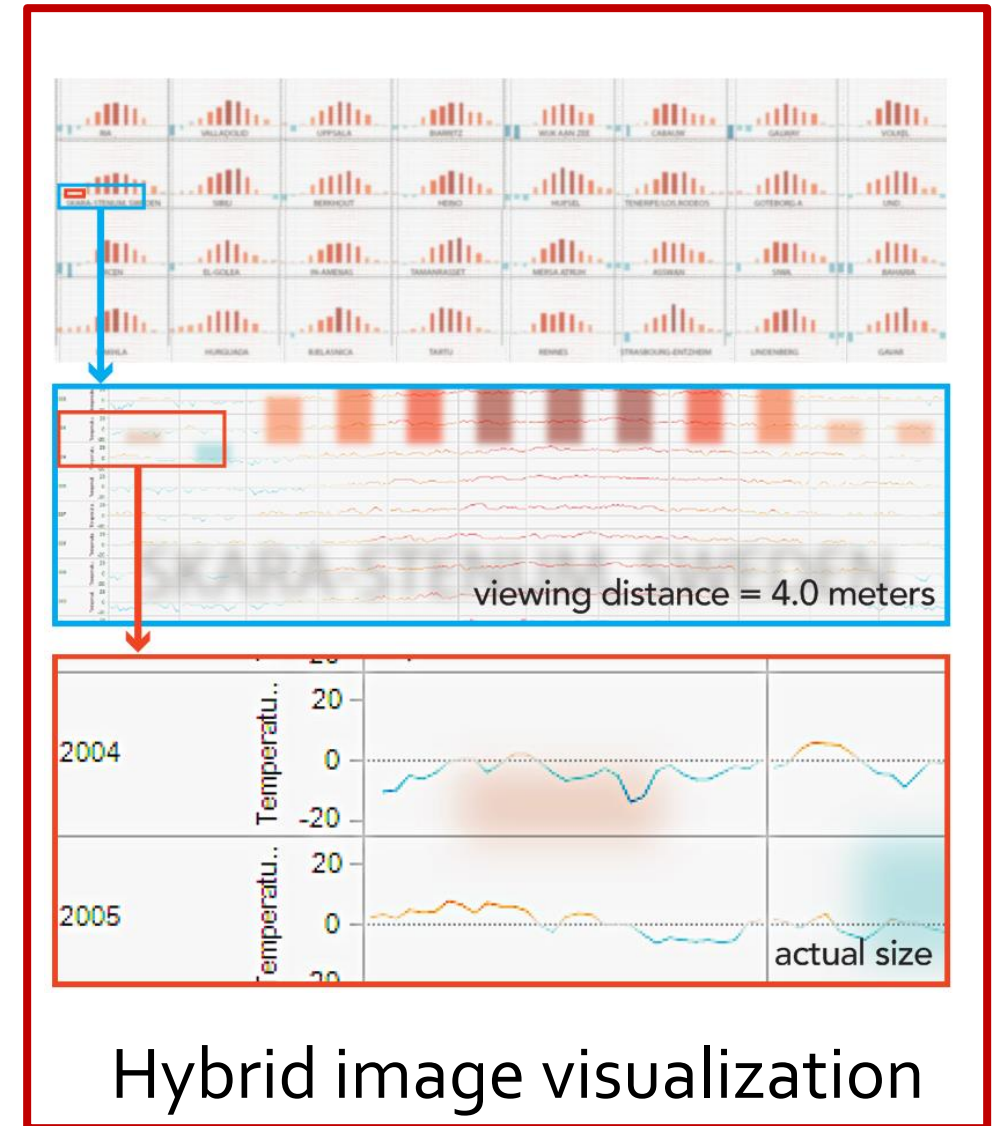
Blending: local & global features overlap



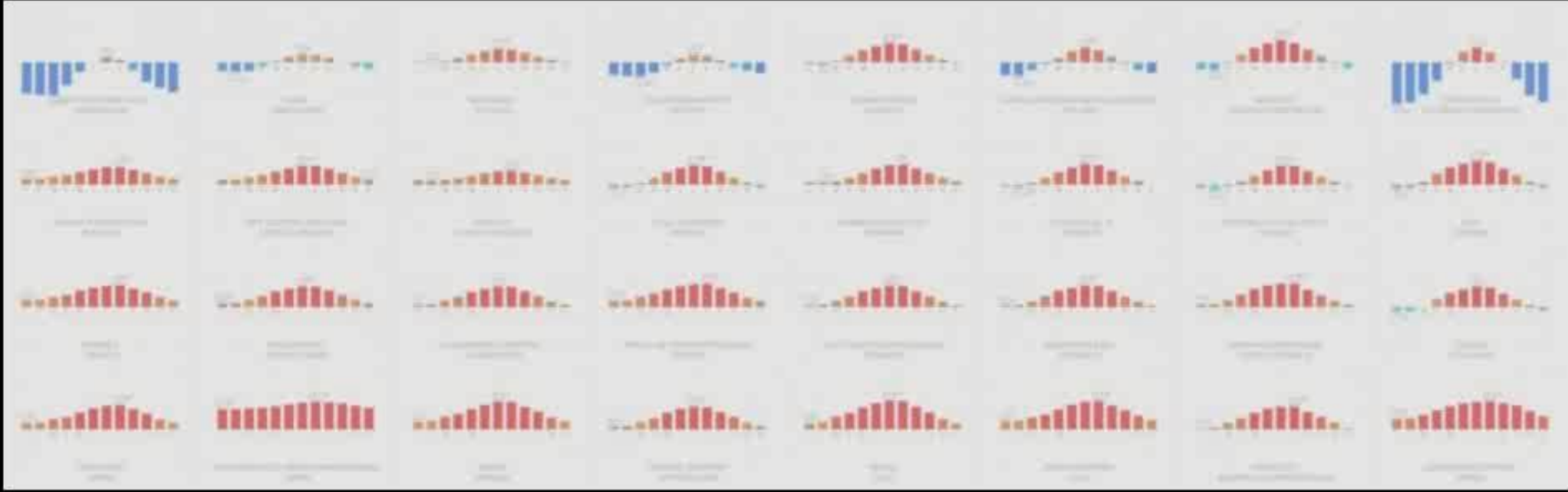
Map regions over map detail



Label detail over bar chart



Hybrid image visualization



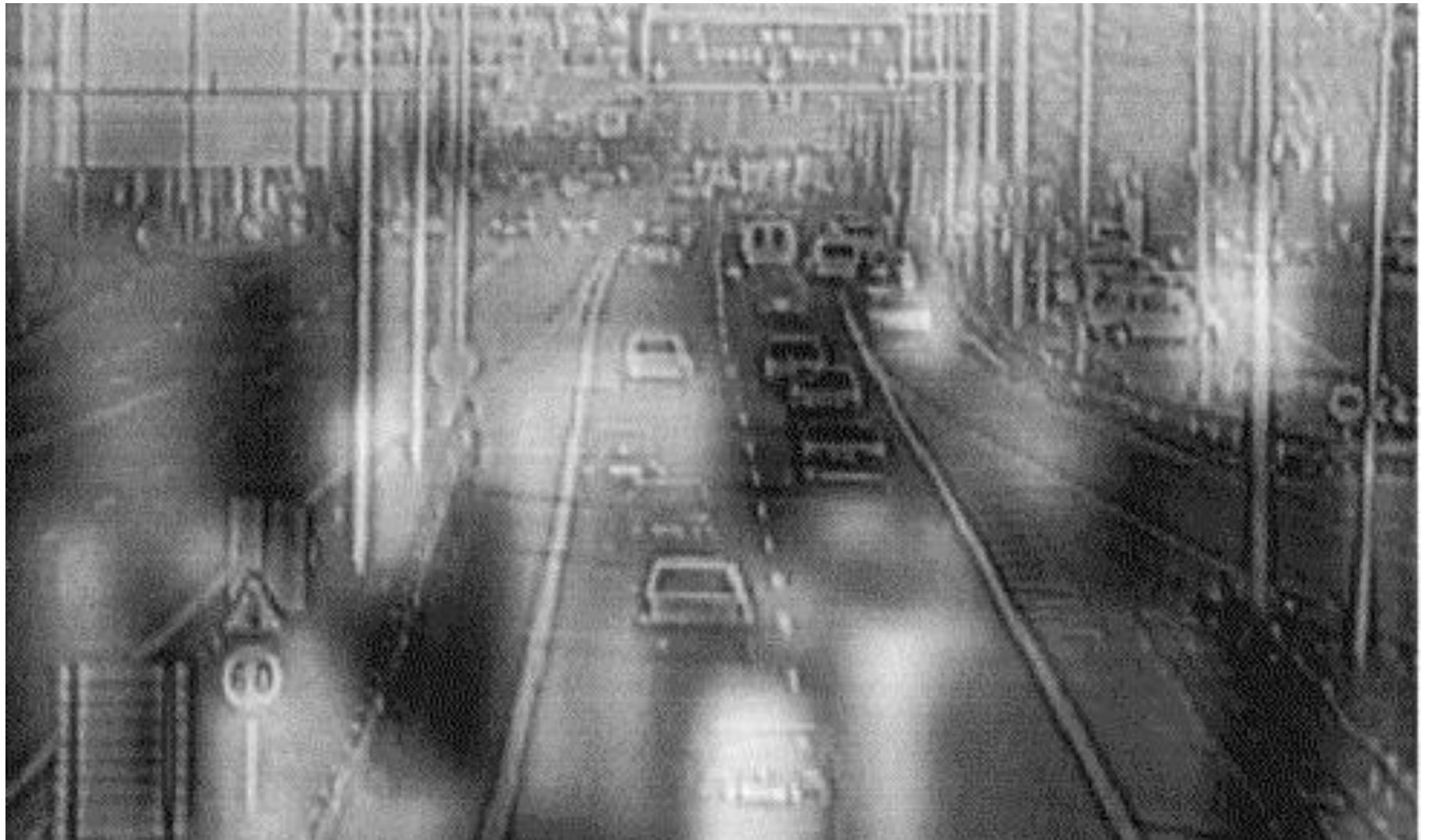
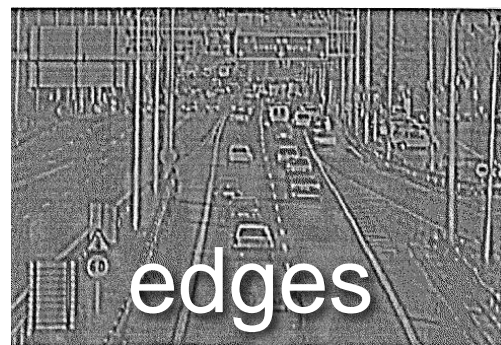
Hybrid Images

- Schyns & Oliva, 1994



+

=

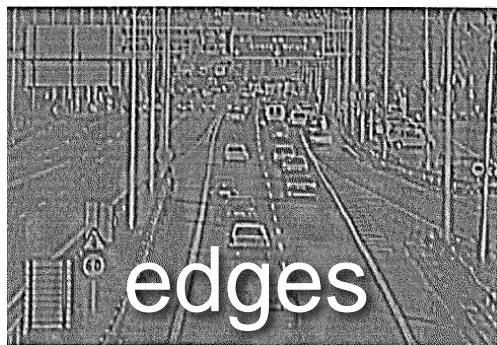


Hybrid Images

- Oliva, Torralba & Schyns, 2006



+



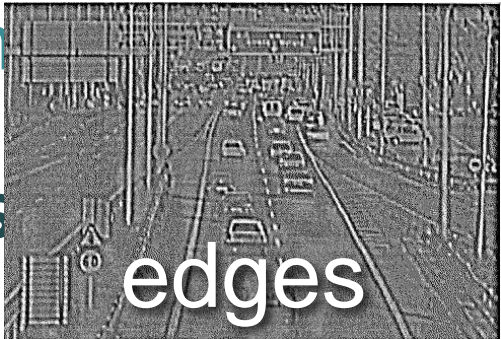
Our Contributions

- **Theoretical grounding**
why & when use hybrid images?

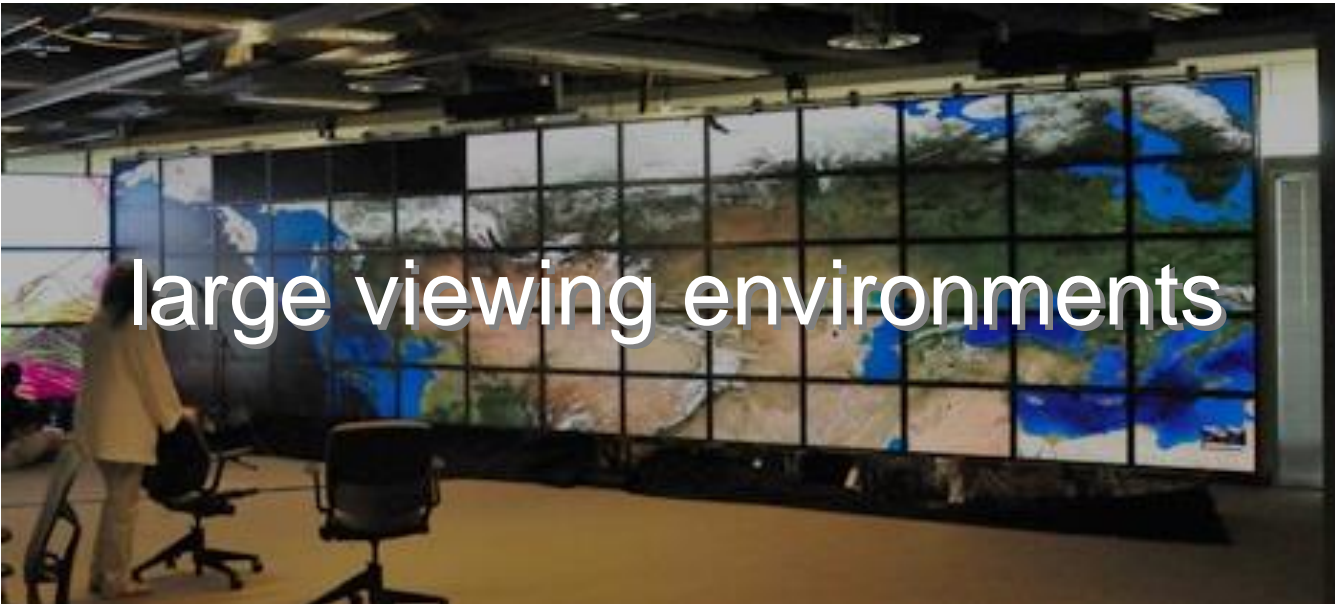
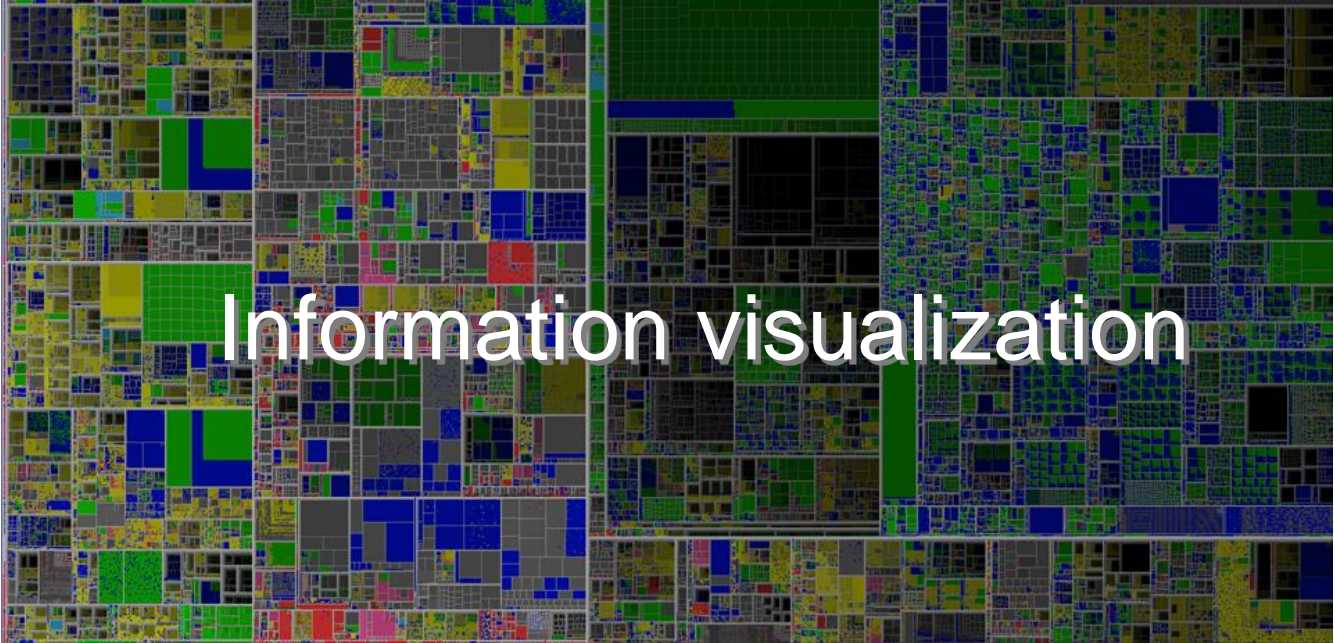


- **Tools**
how blurred their creation?

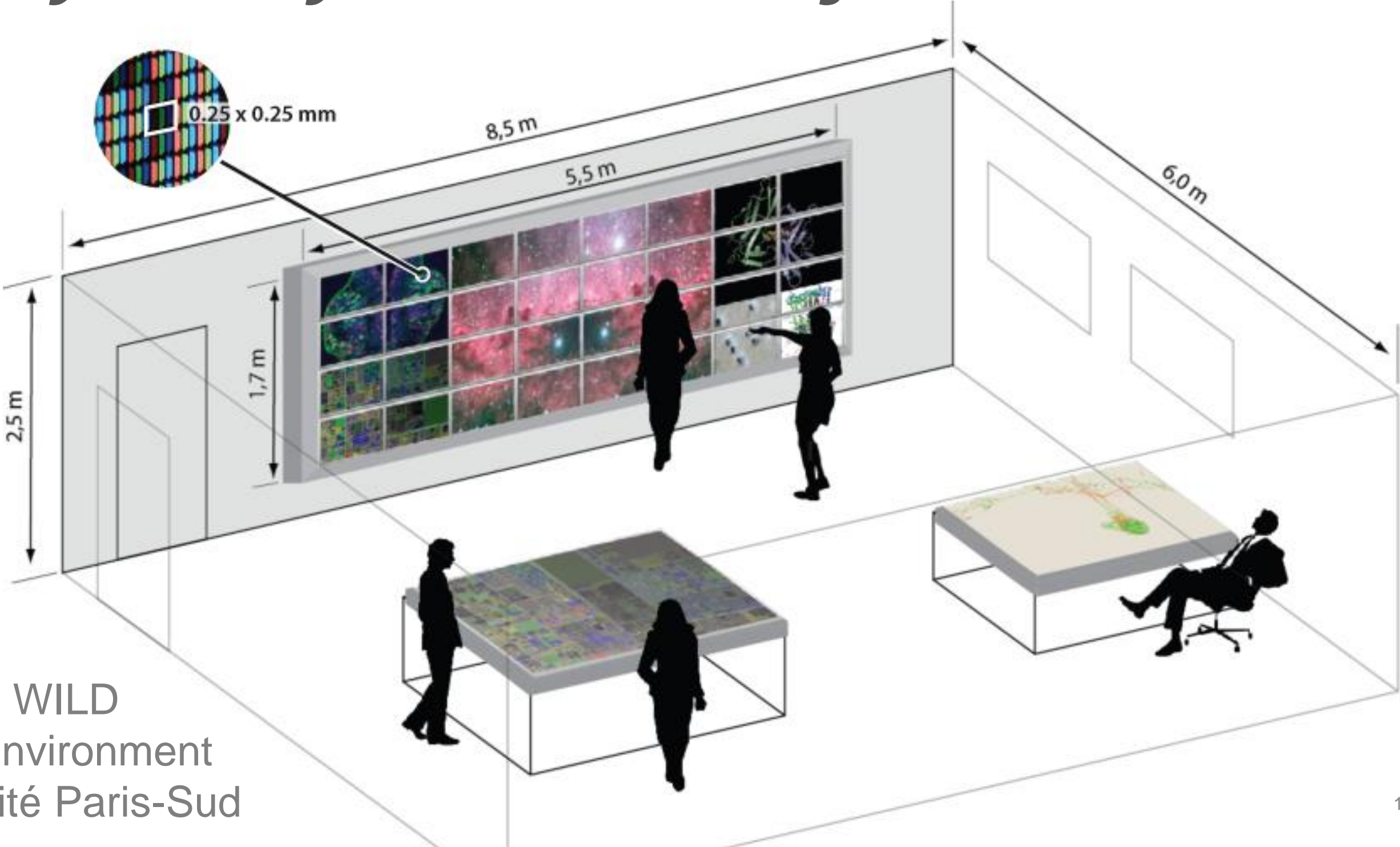
- **Examples**
why are they really good for?



- **Designs**
how to build effective ones?

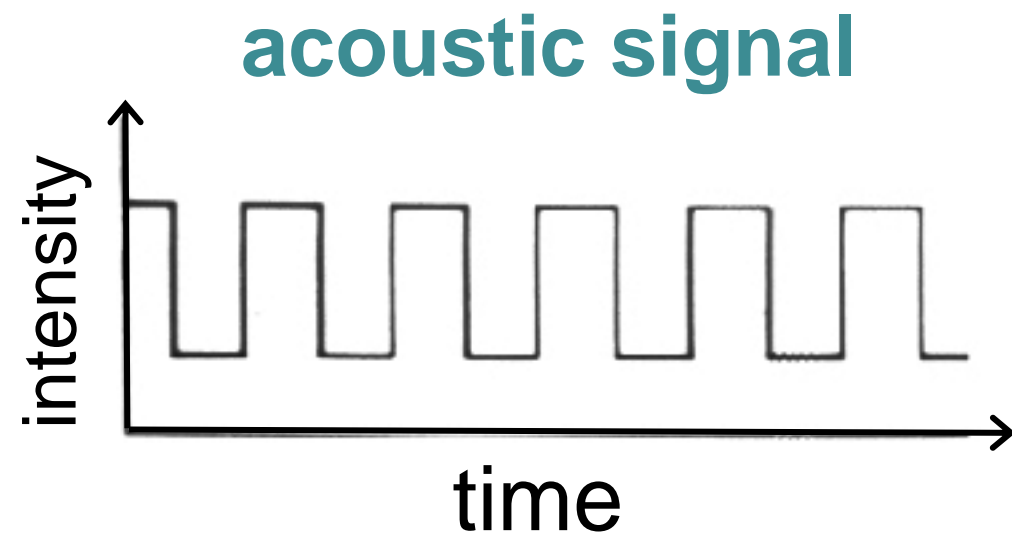


Can they Convey More Visual Information?



The WILD display environment at Université Paris-Sud

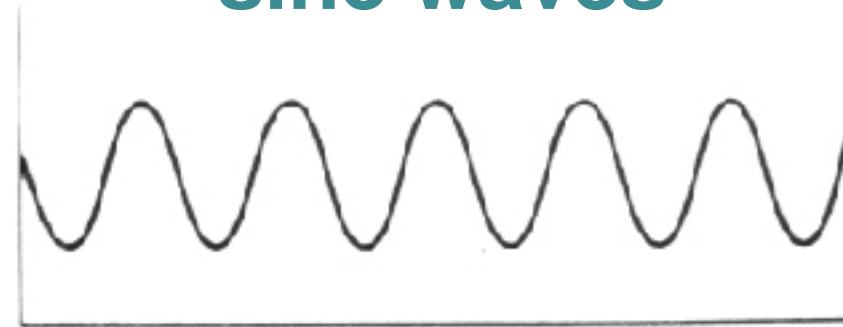
Frequency Domain Approach



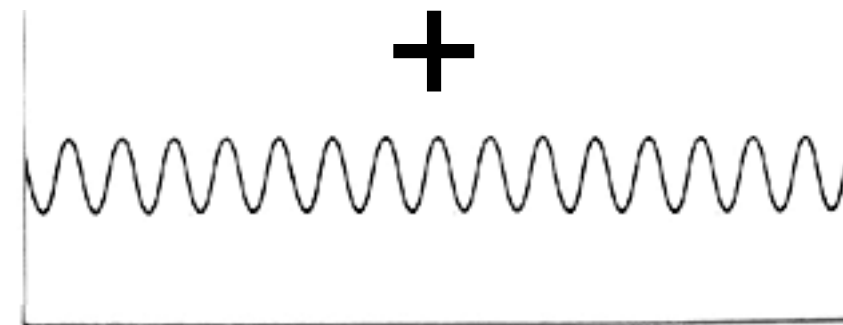
Fourier Transform

=

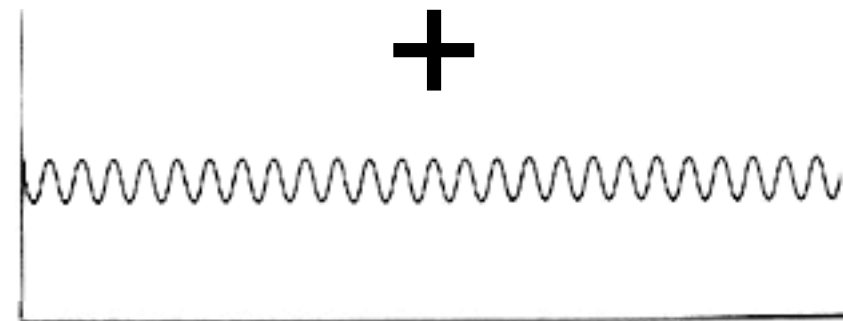
sine waves



+



+



+

...

frequencies in
Hertz

Frequency Domain Approach



(1D) Fourier Transform

=

sinusoidal gratings



+



+



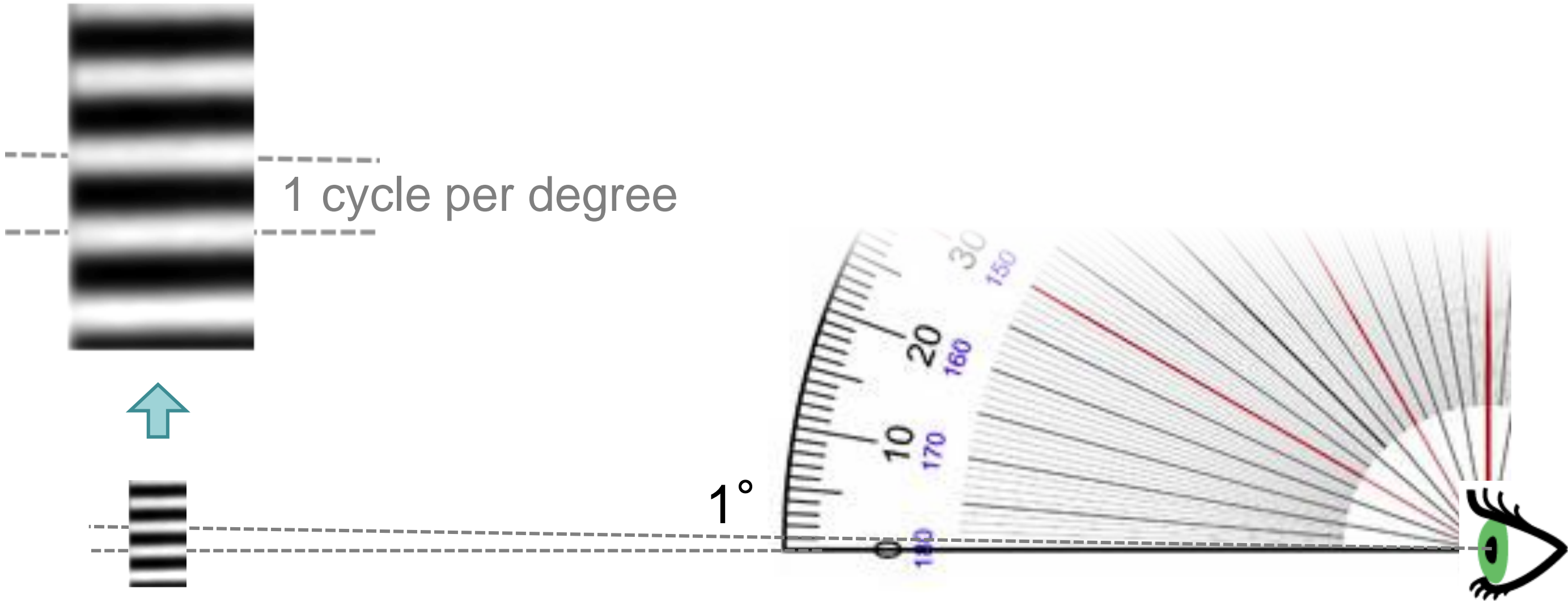
+

...

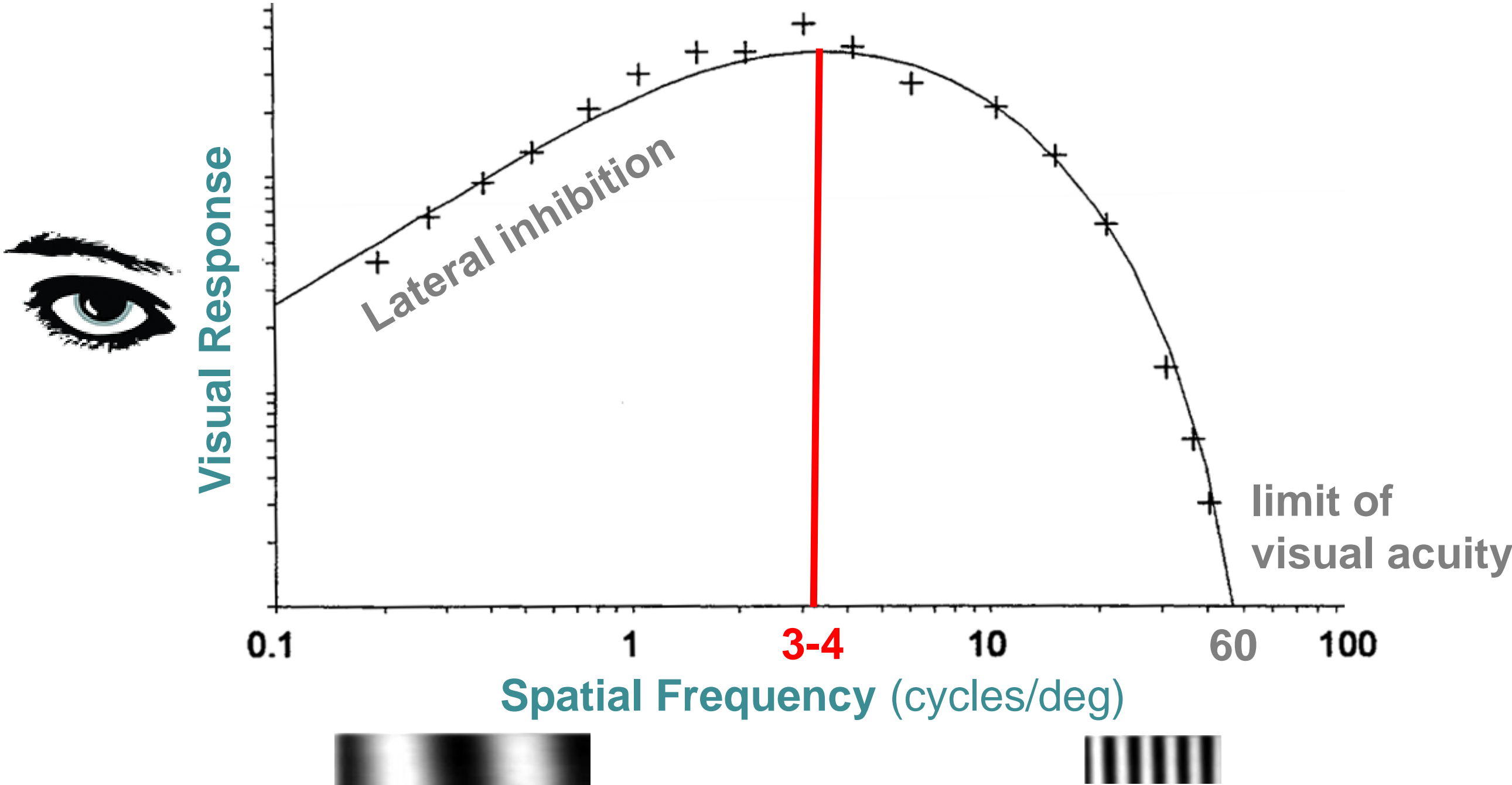
frequencies in

cycles/degree
of visual angle

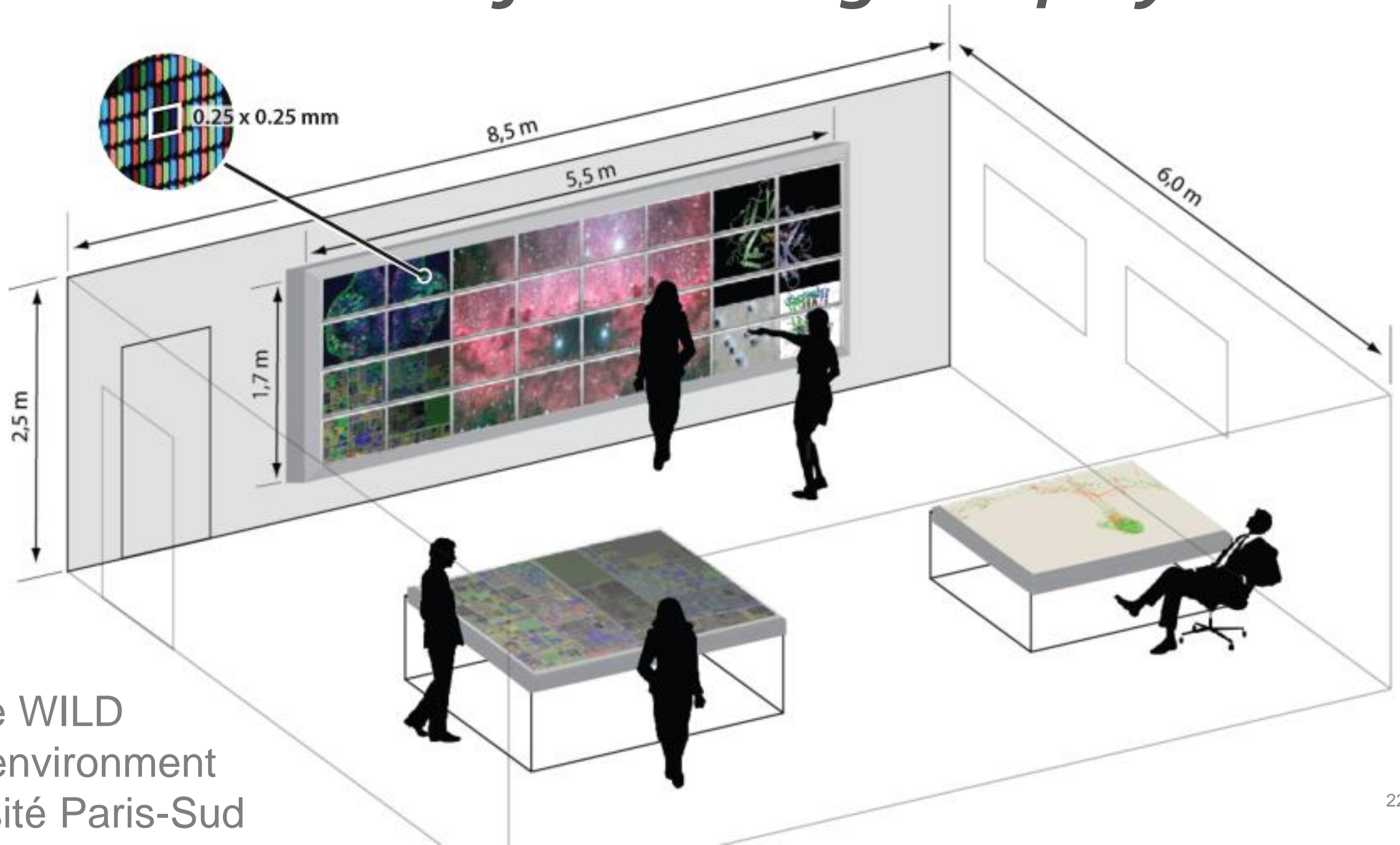
Contrast Sensitivity Function



Contrast Sensitivity Function

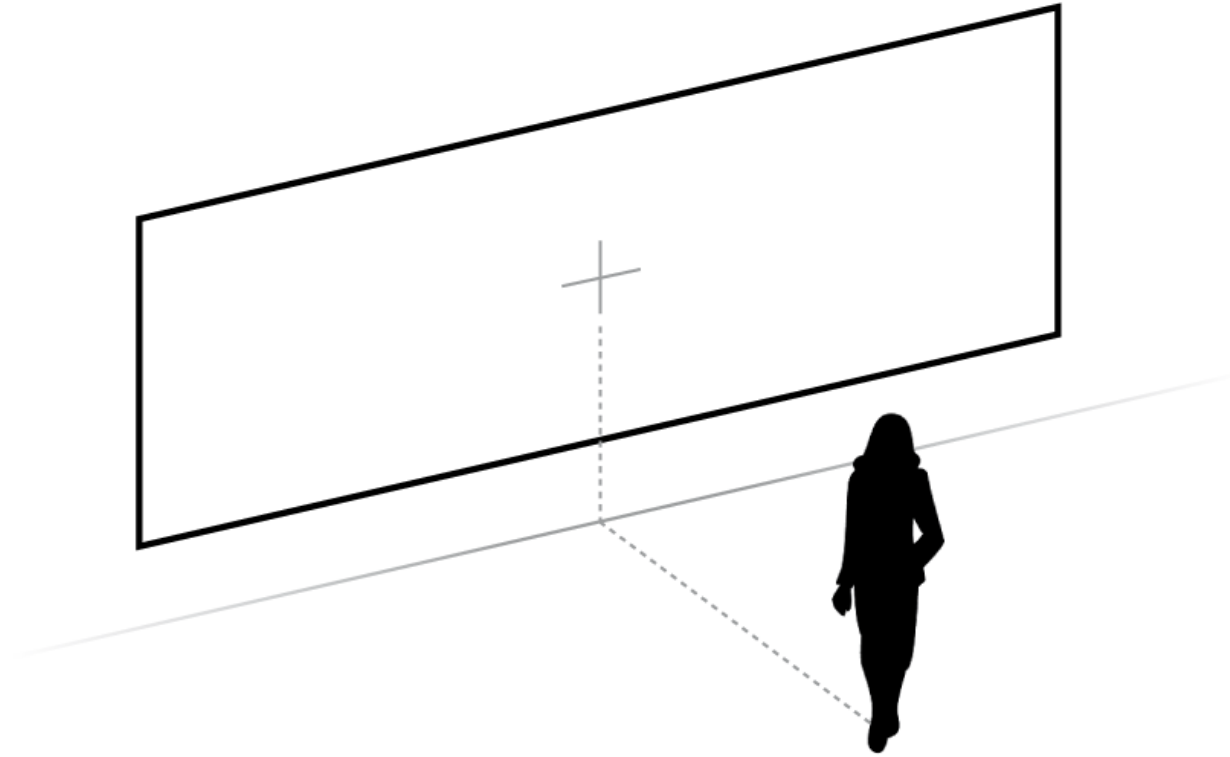


What do we Perceive from a Large Display?

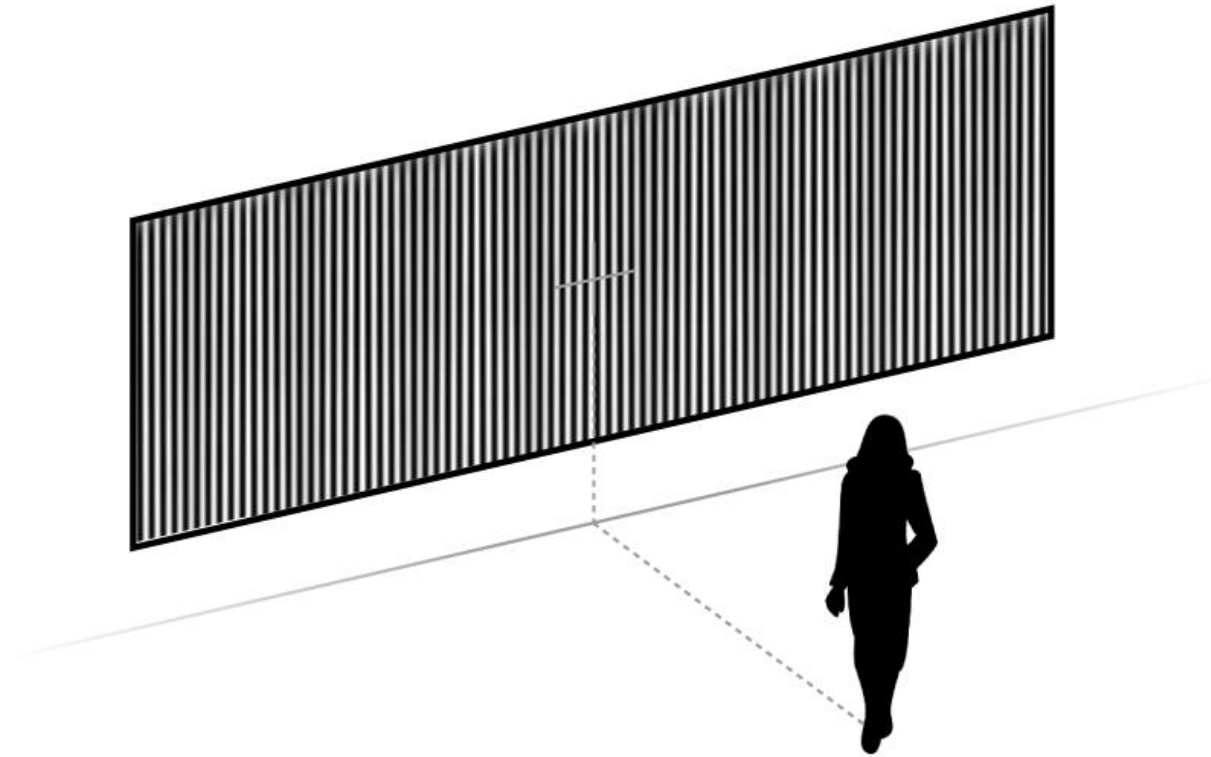


The WILD
display environment
at Université Paris-Sud

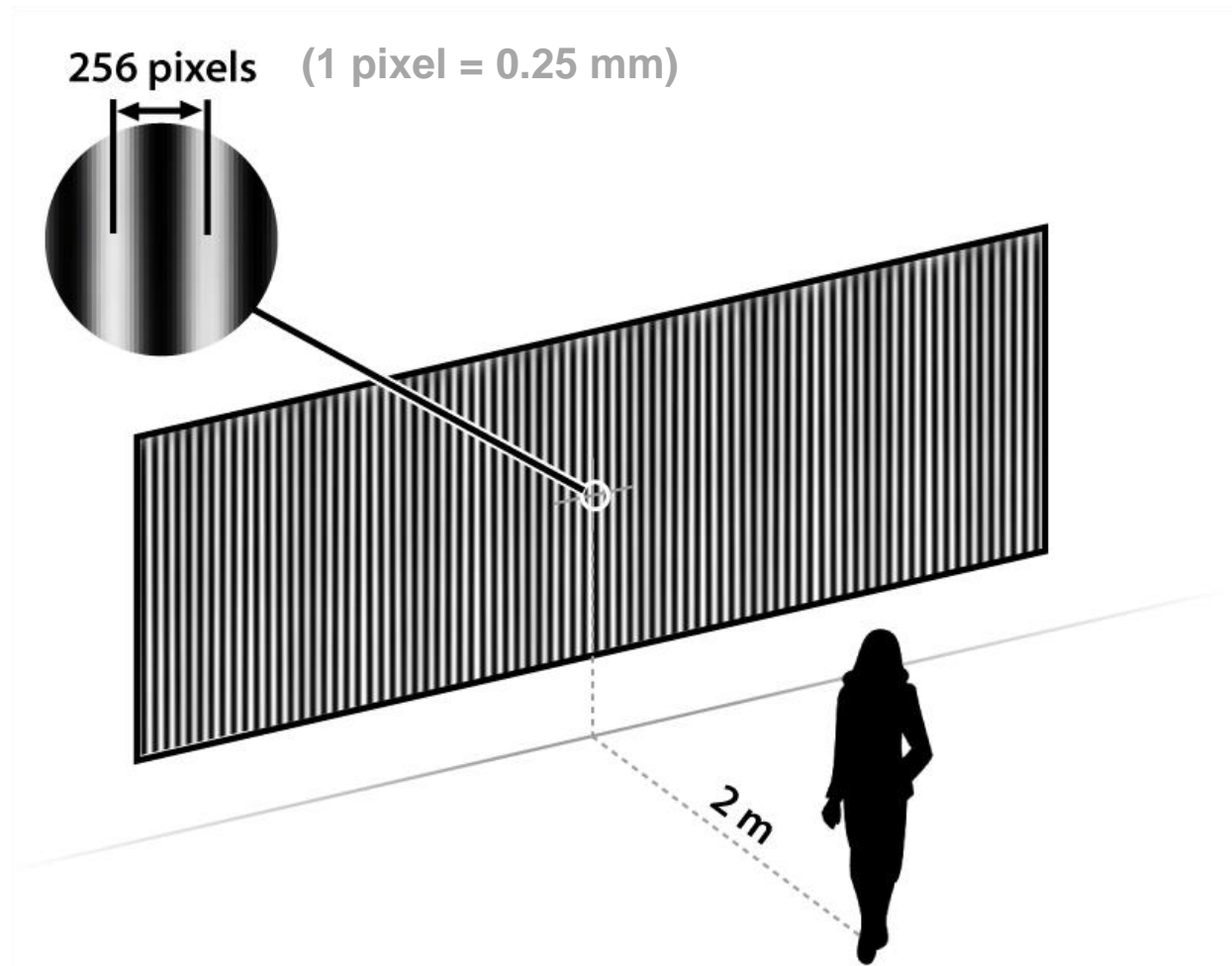
What do we Perceive from a Large Display?



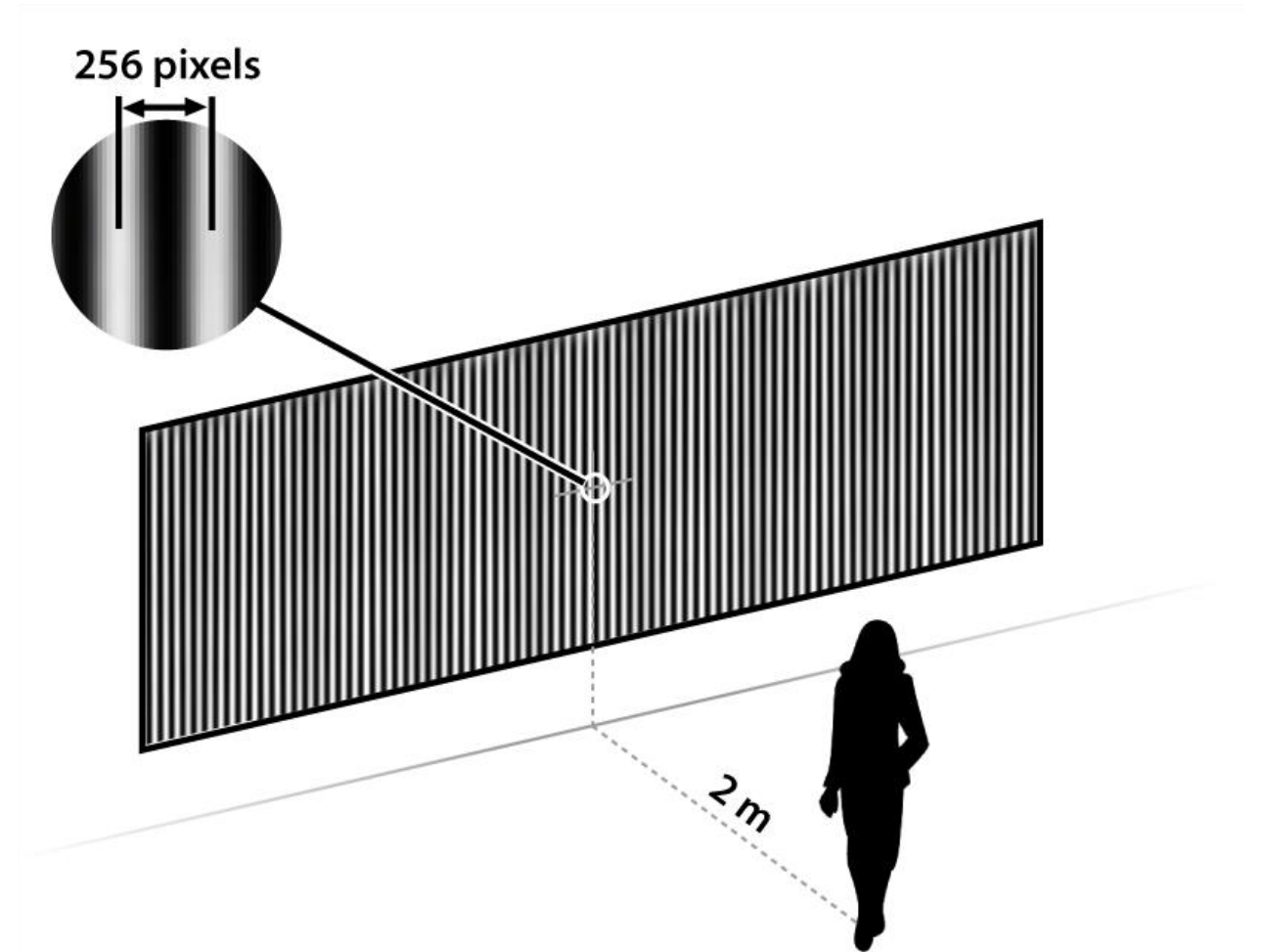
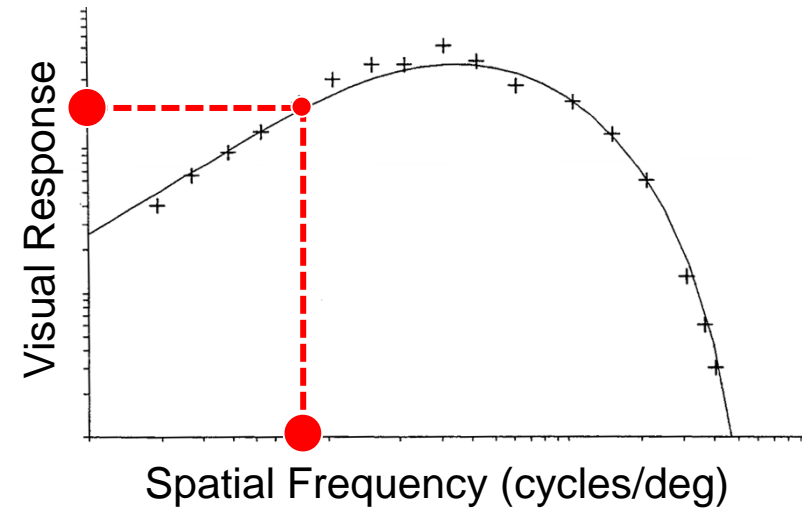
What do we Perceive from a Large Display?



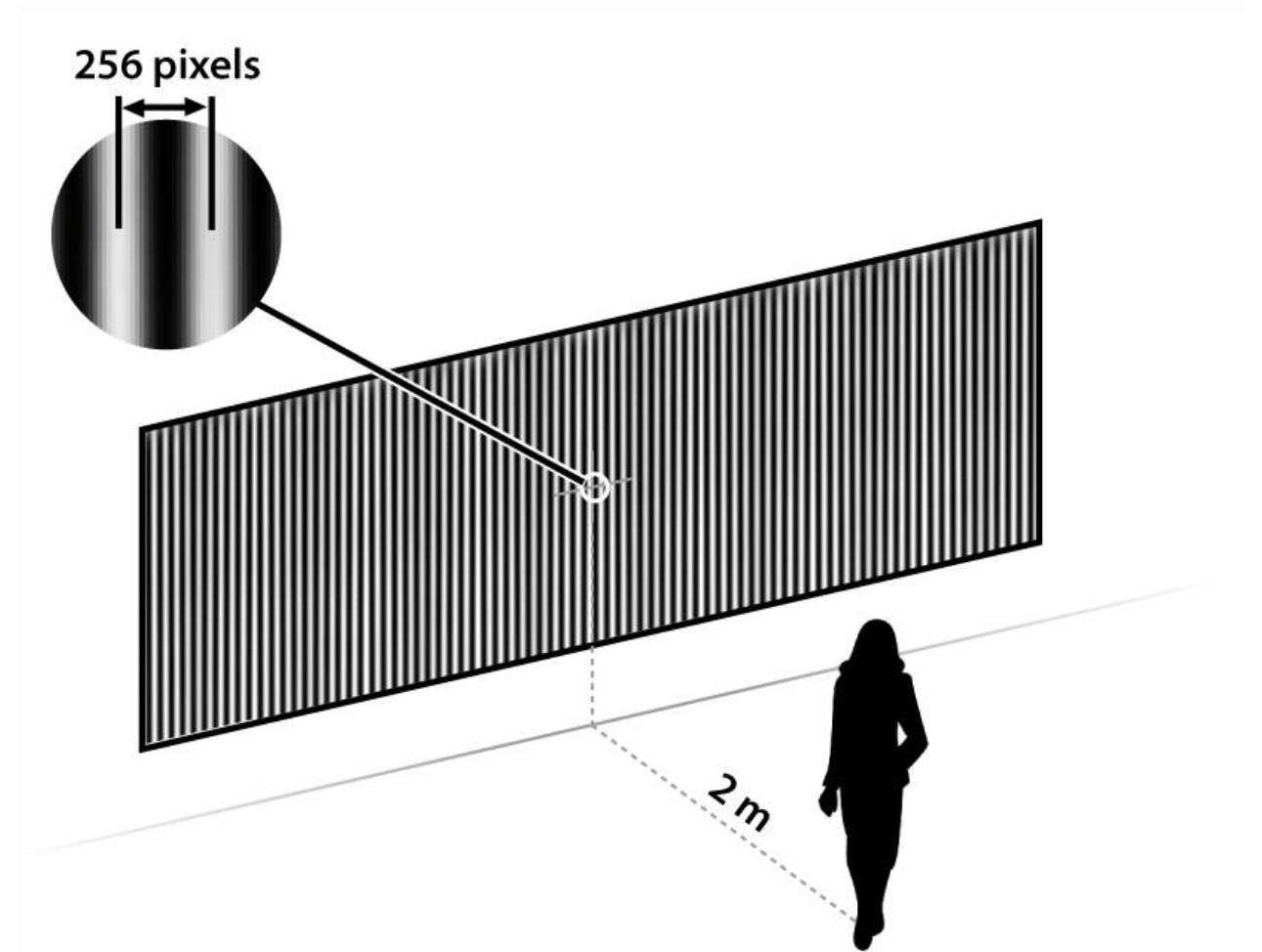
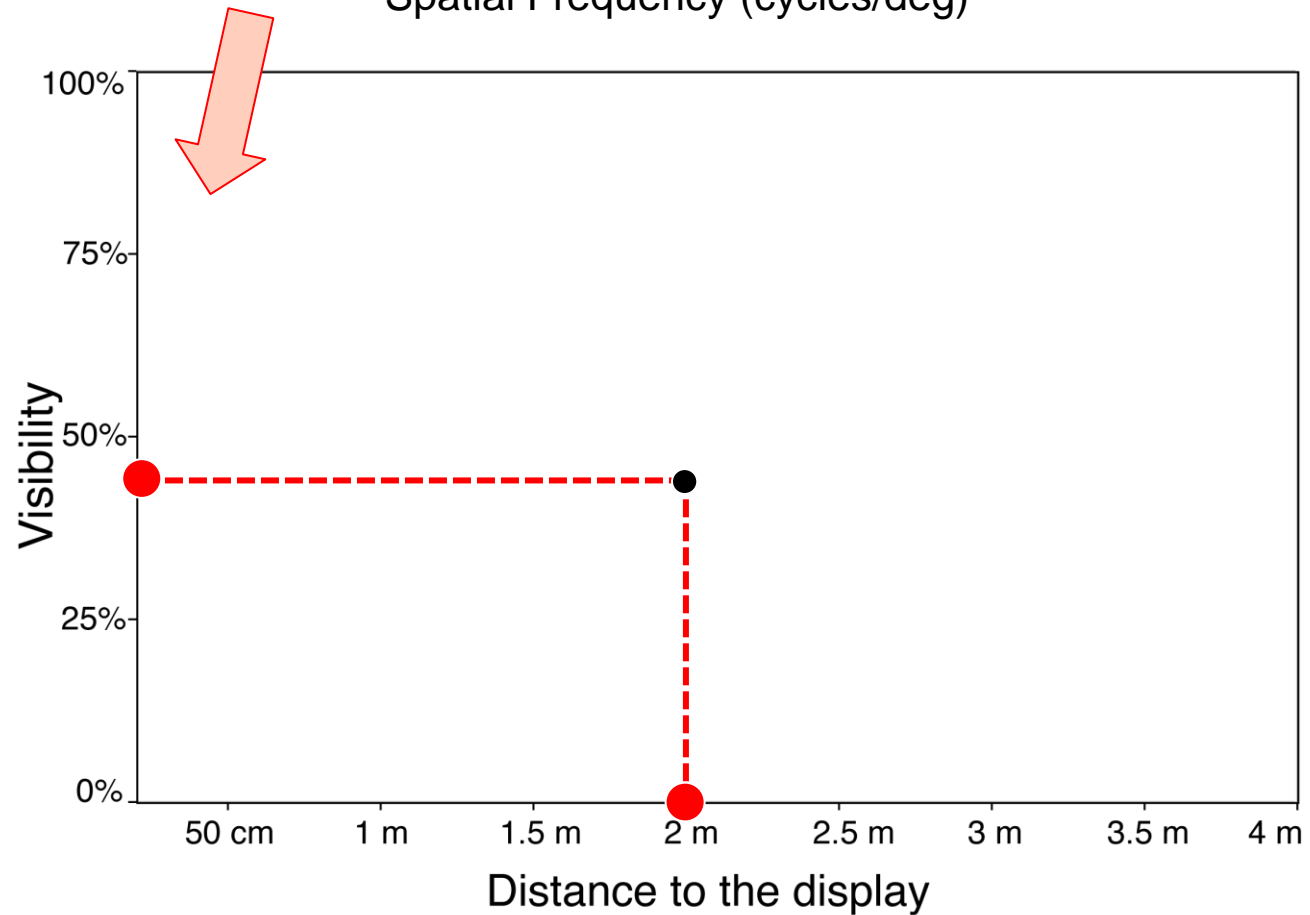
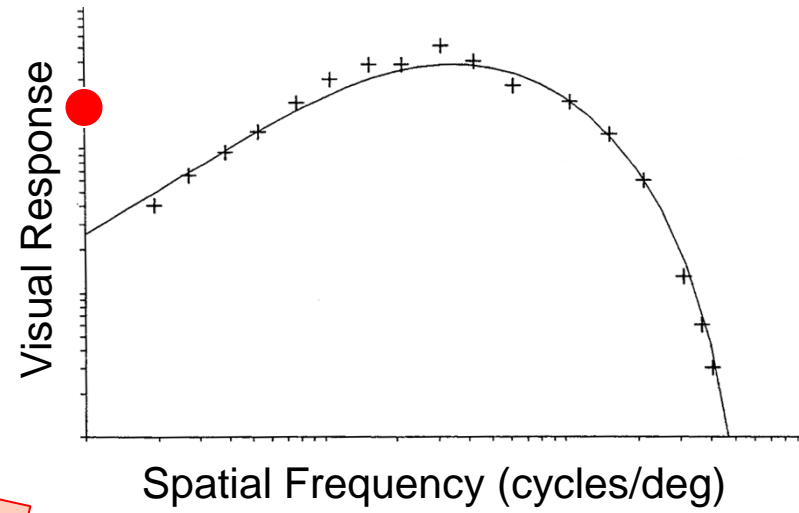
What do we Perceive from a Large Display?



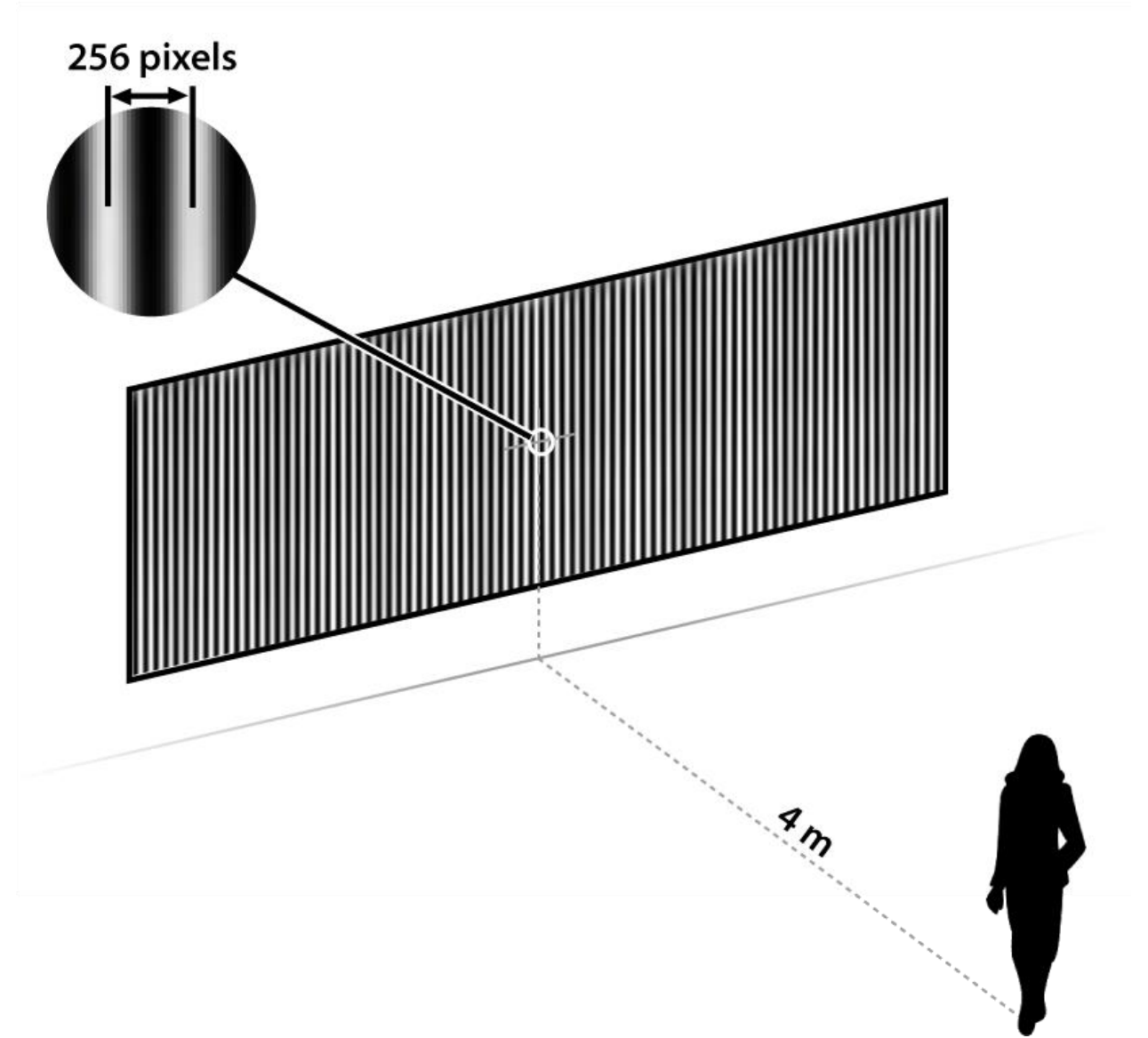
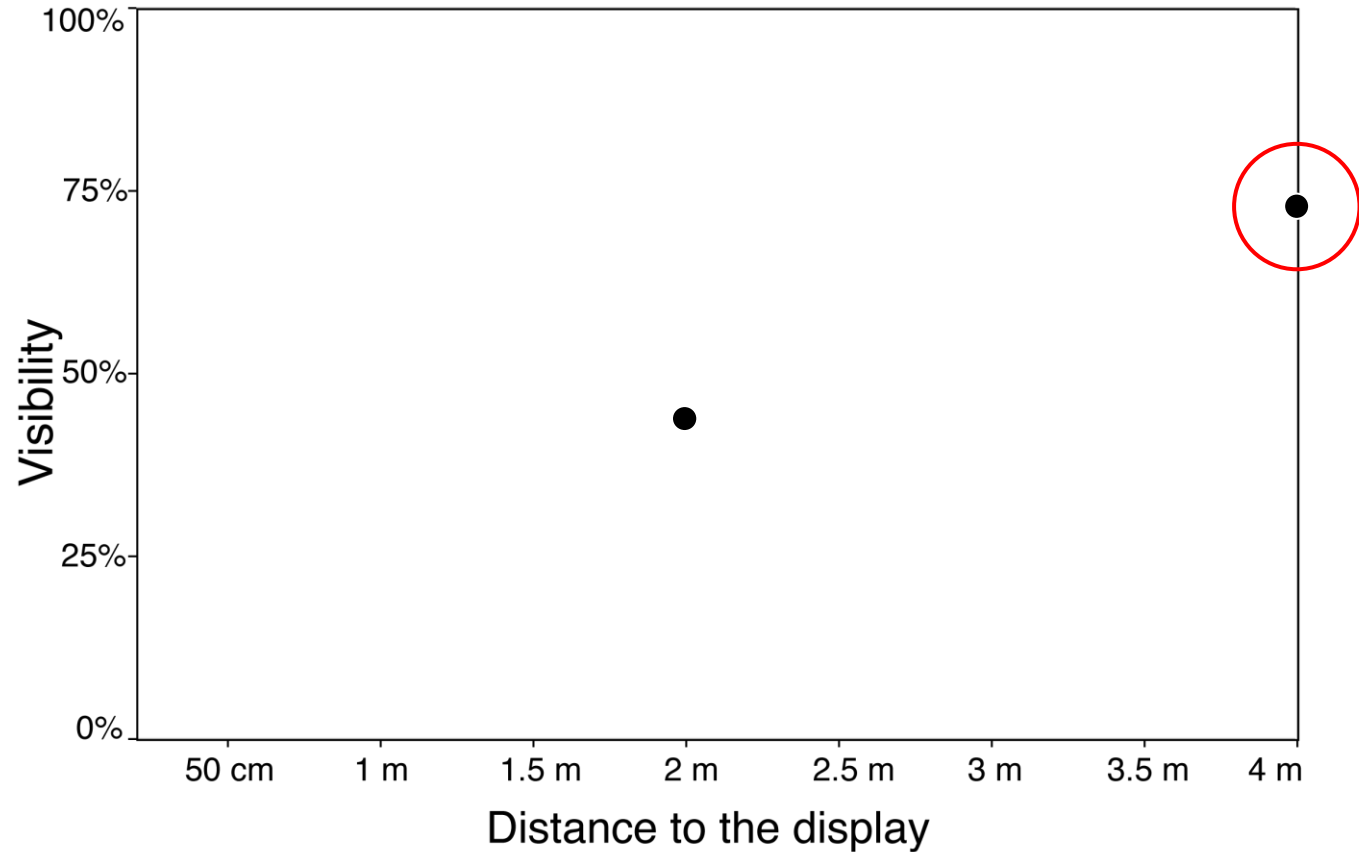
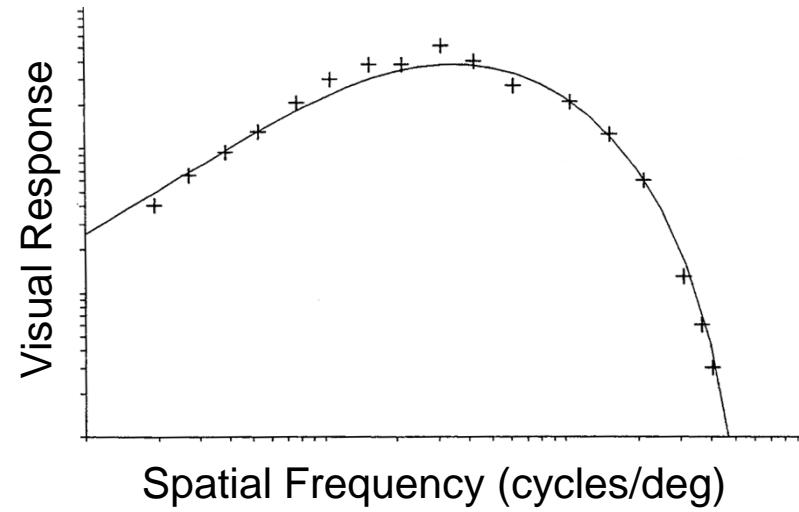
What do we Perceive from a Large Display?



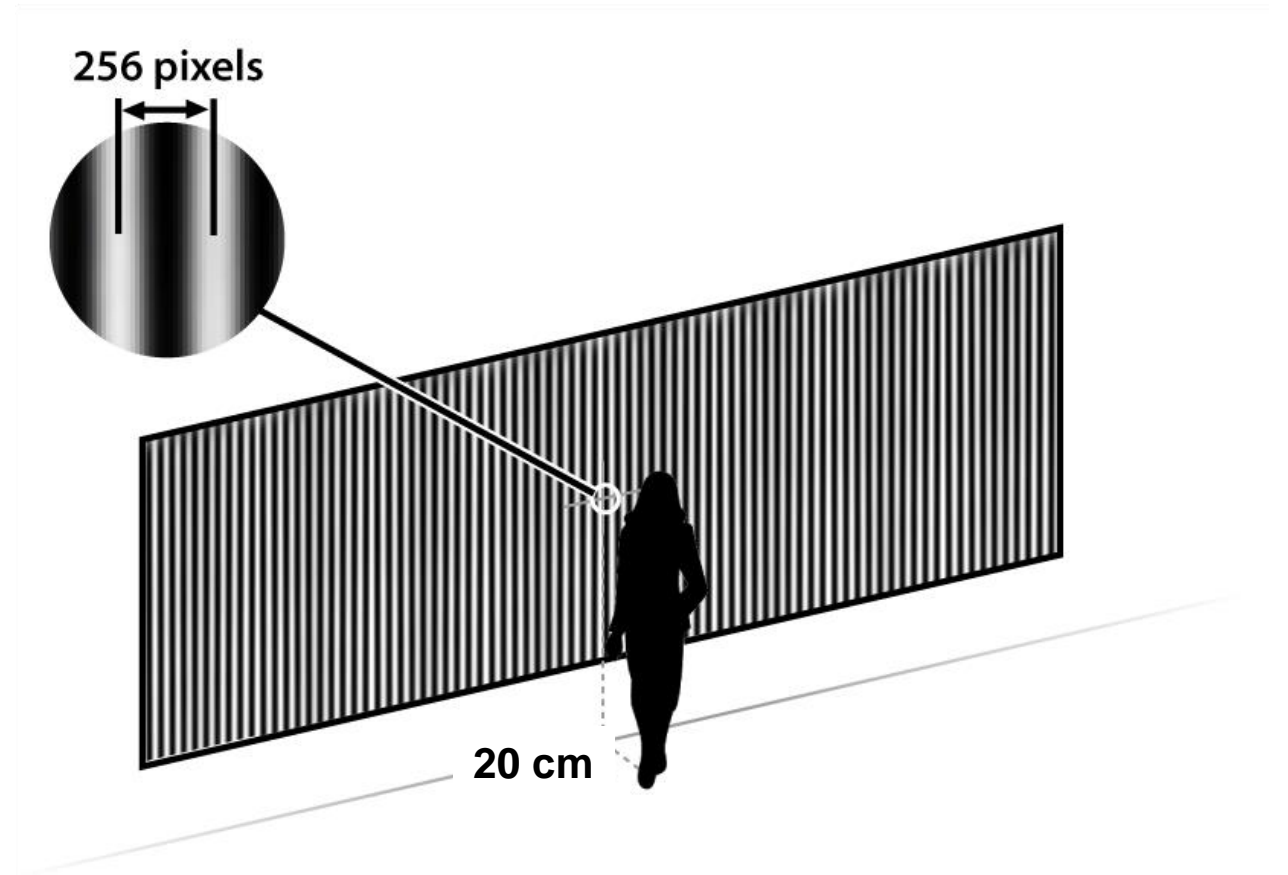
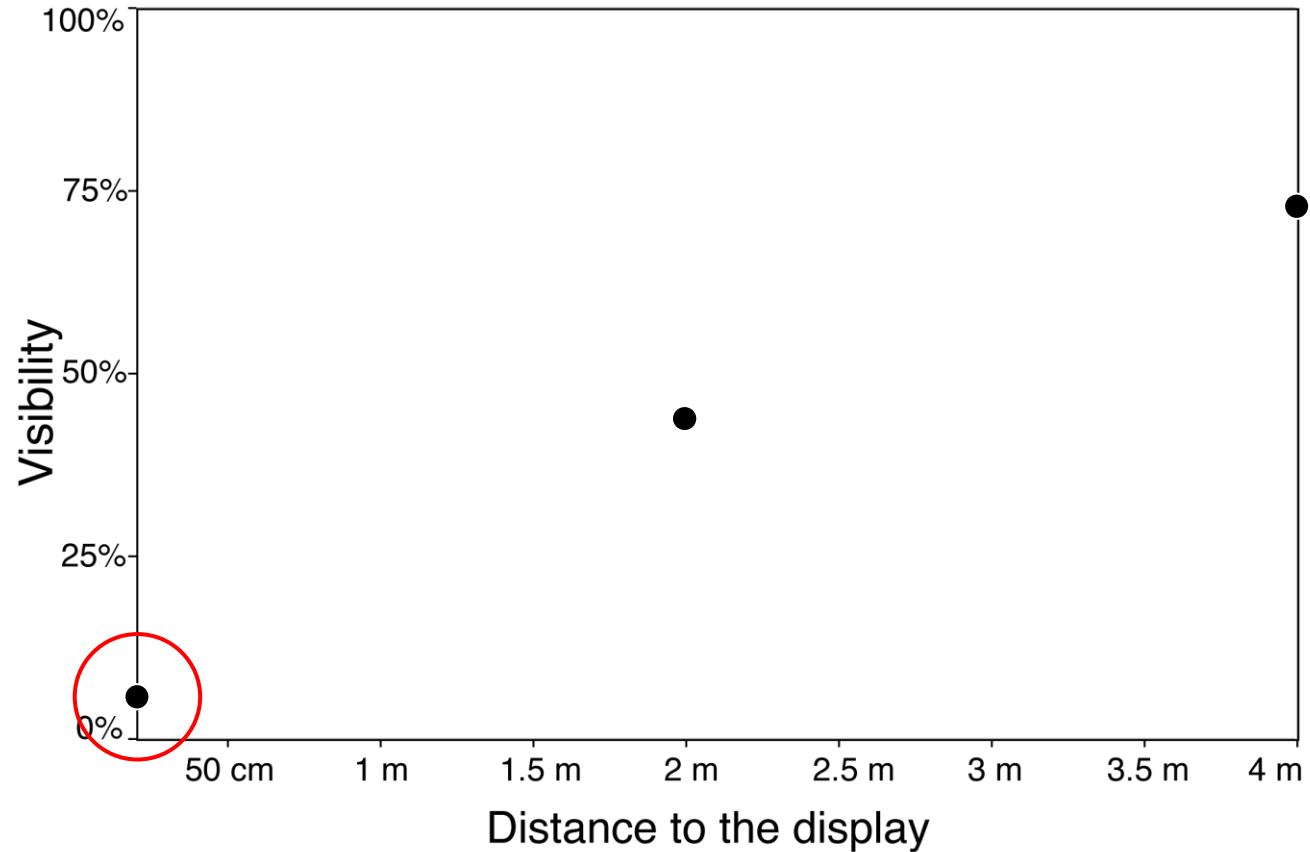
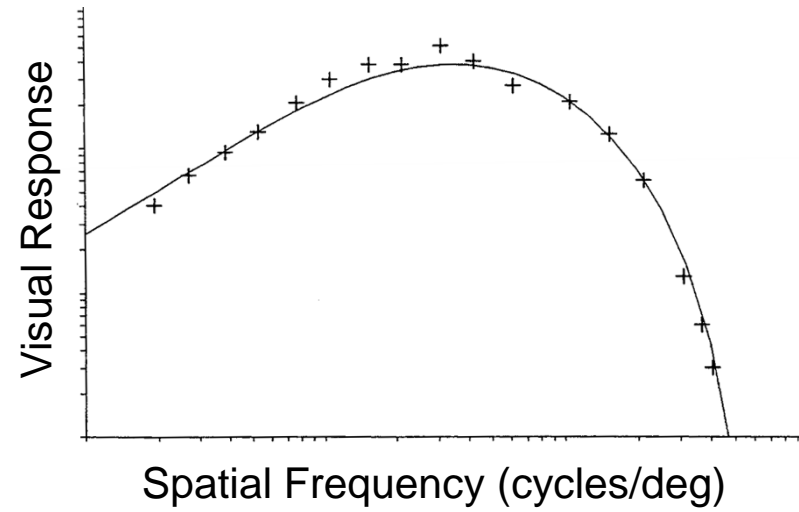
What do we Perceive from a Large Display?



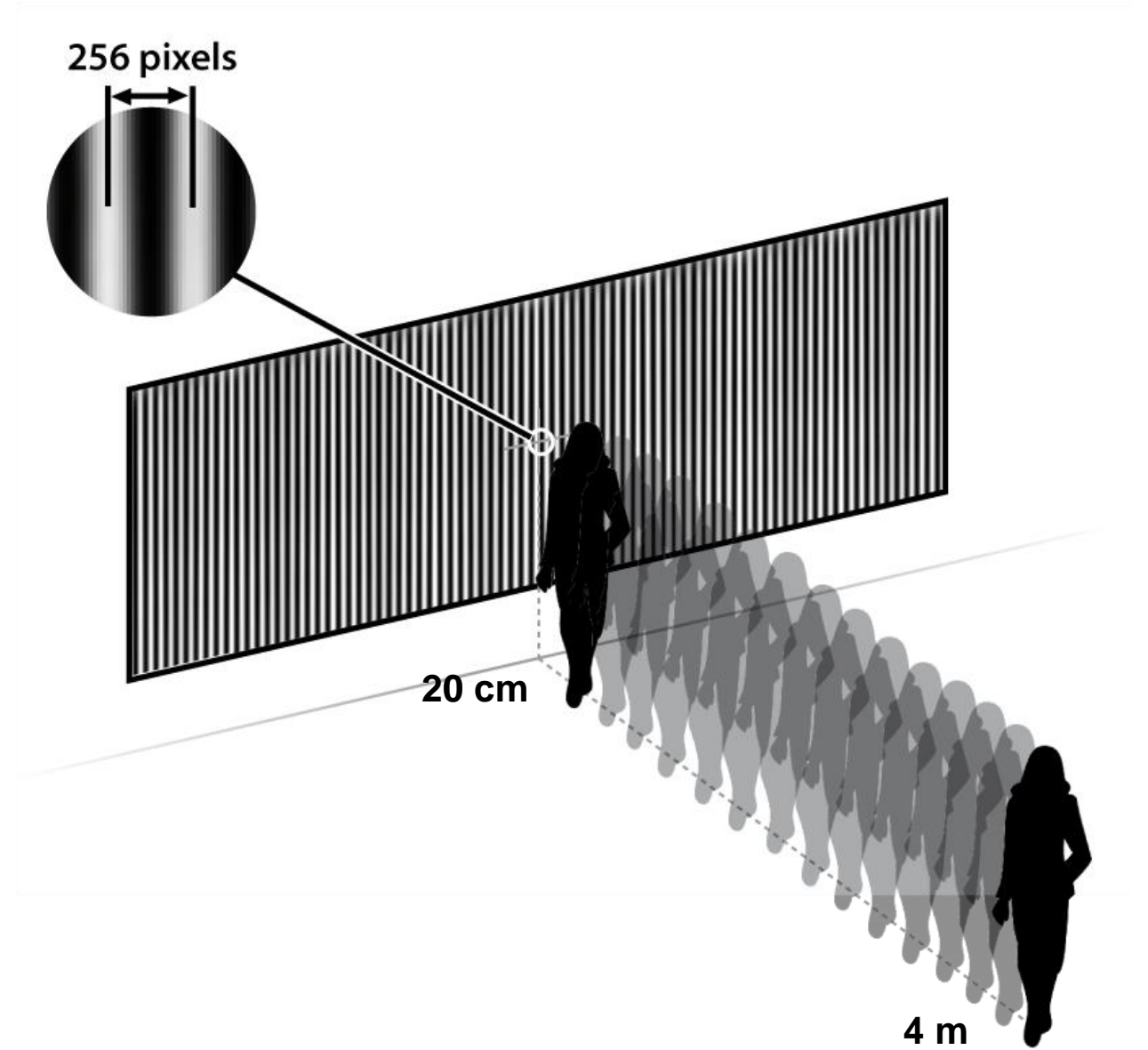
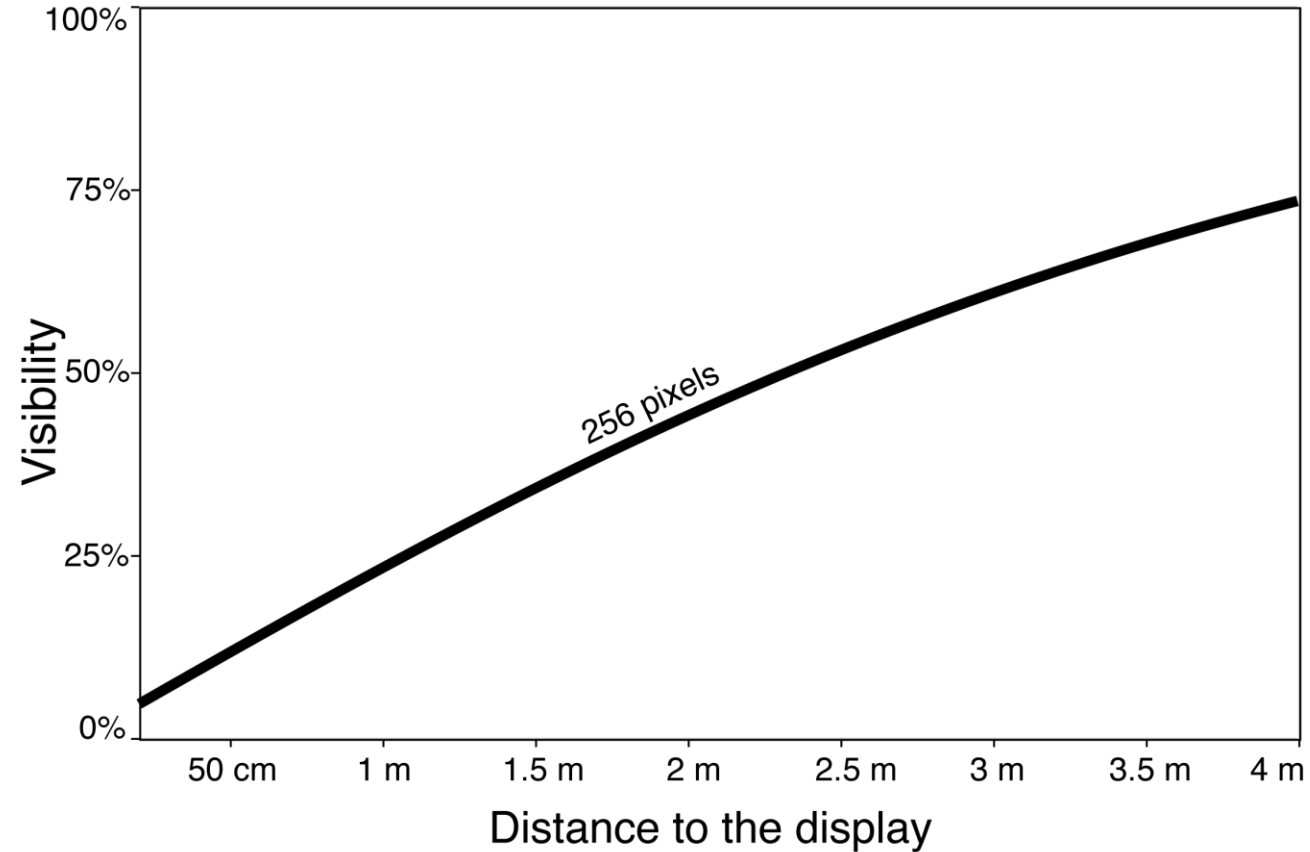
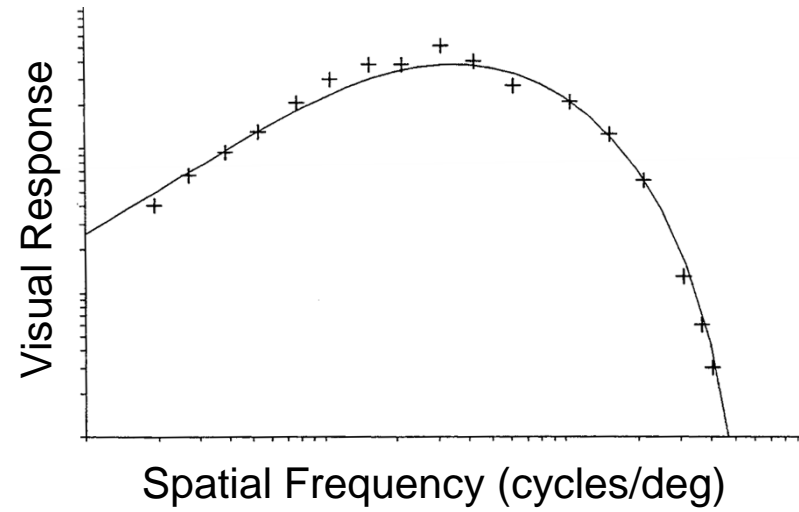
What do we Perceive from a Large Display?



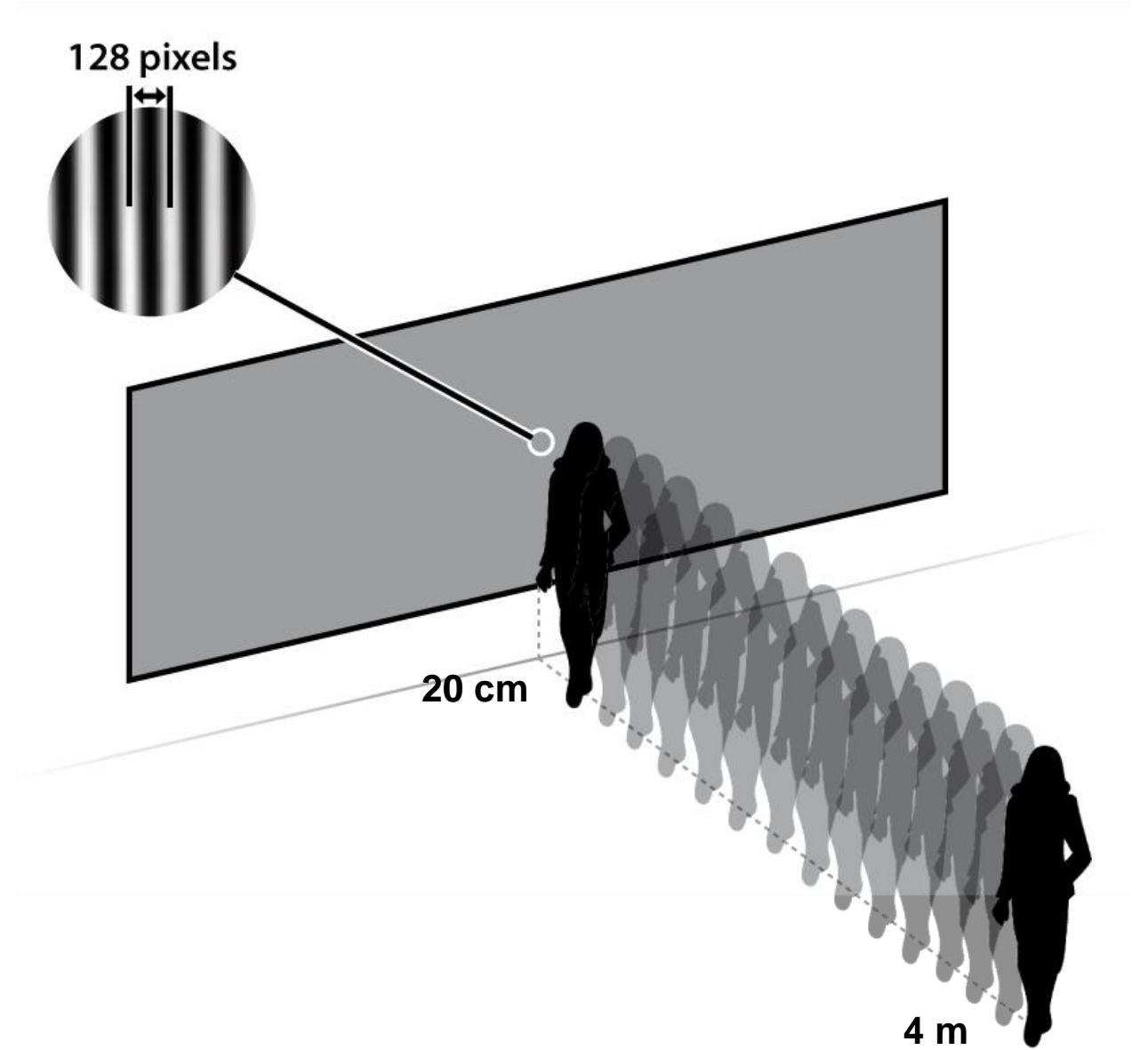
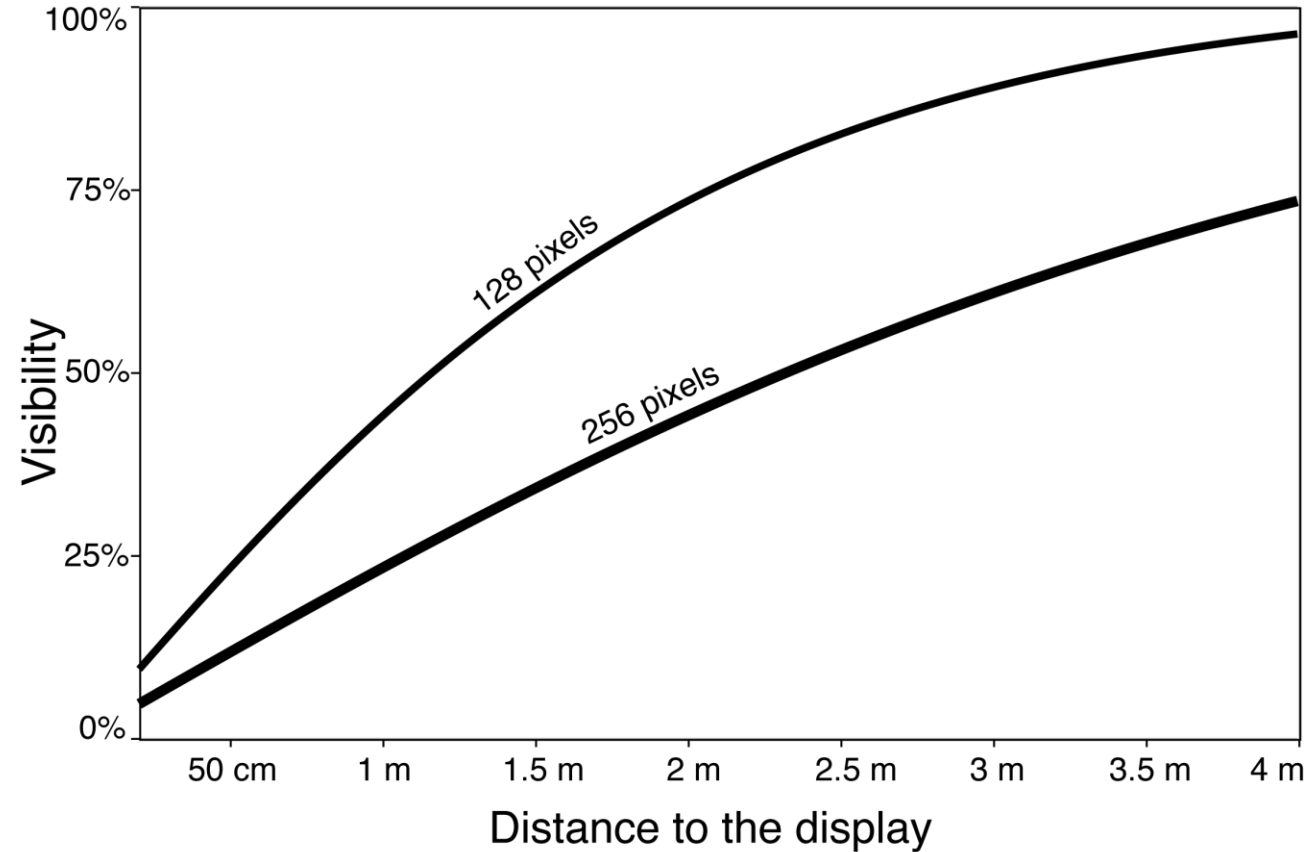
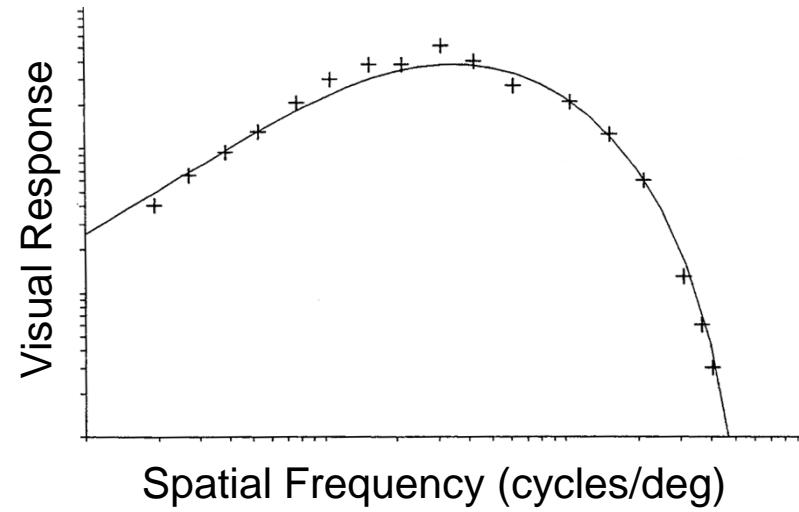
What do we Perceive from a Large Display?



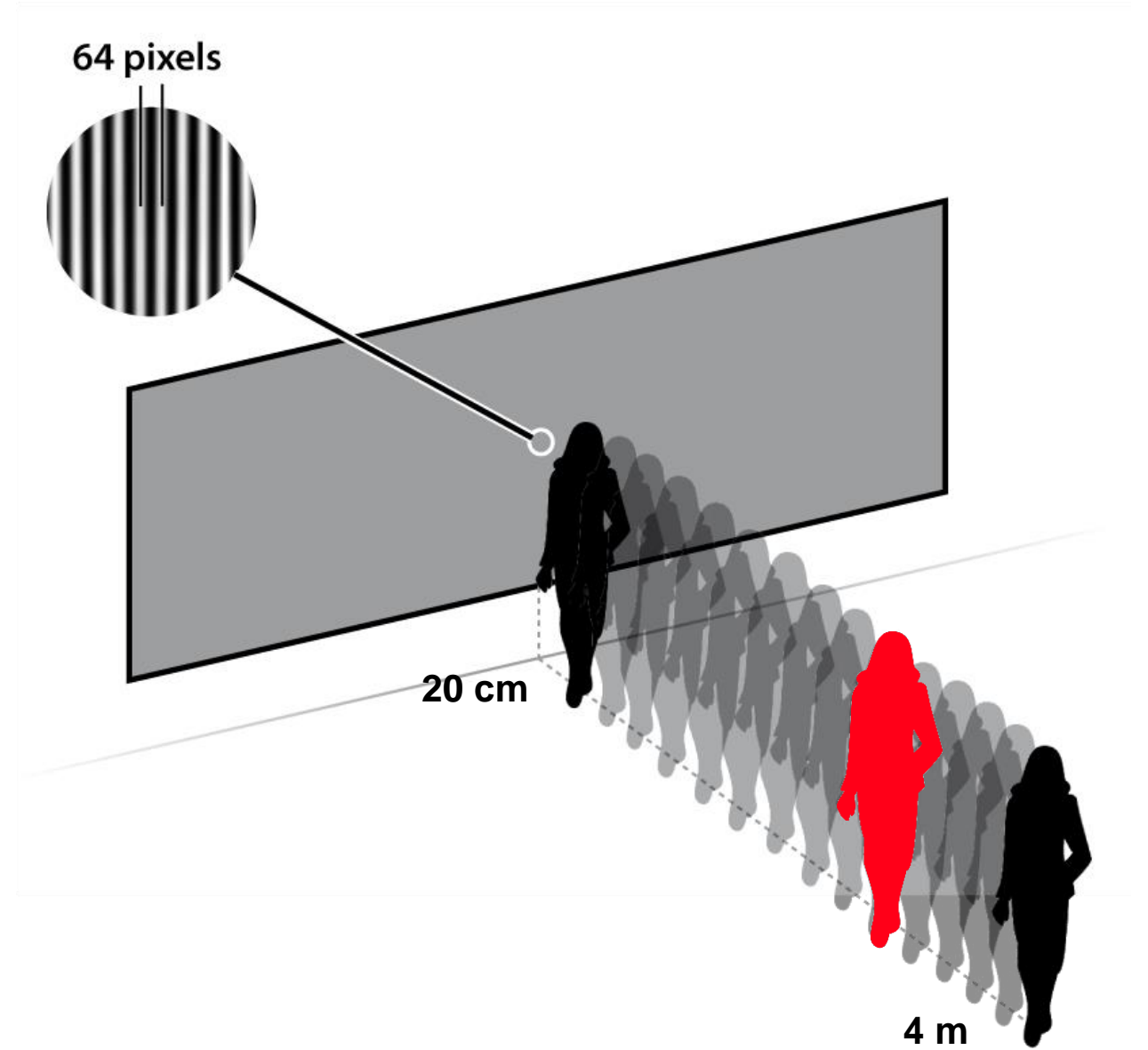
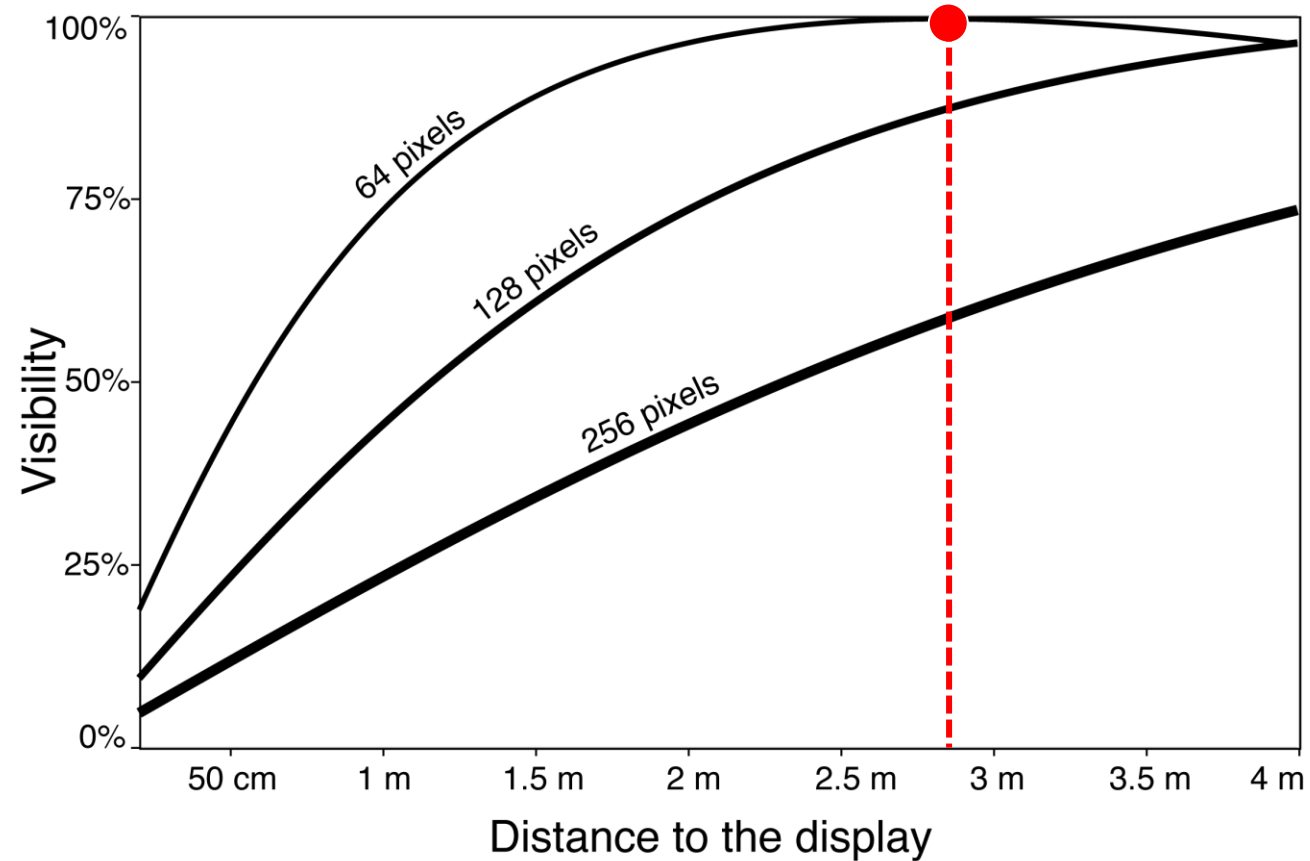
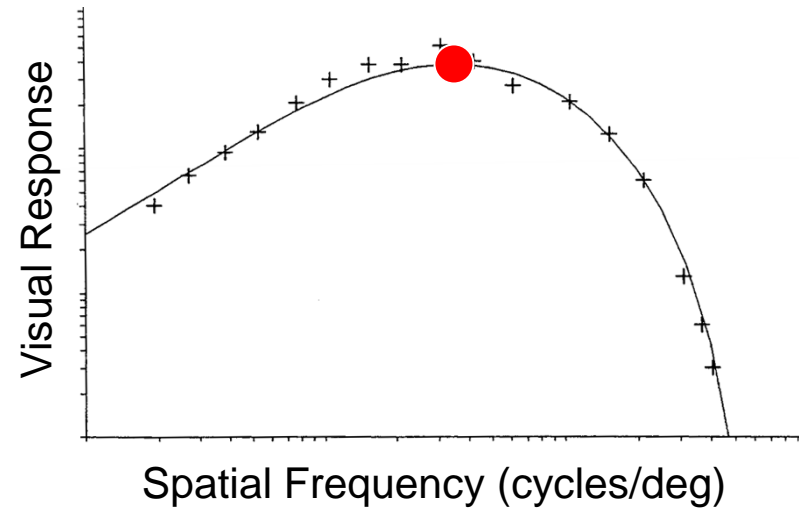
What do we Perceive from a Large Display?



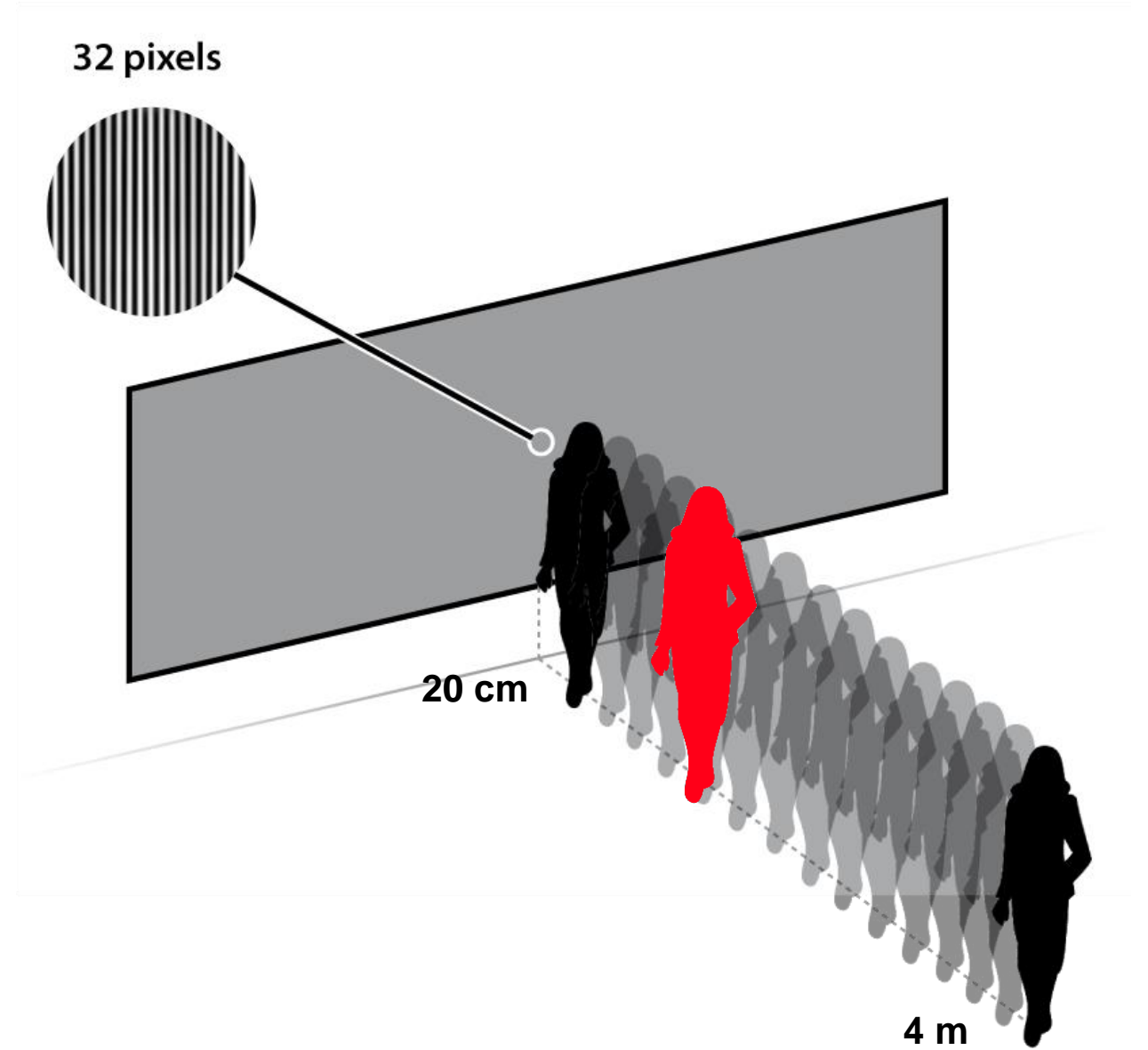
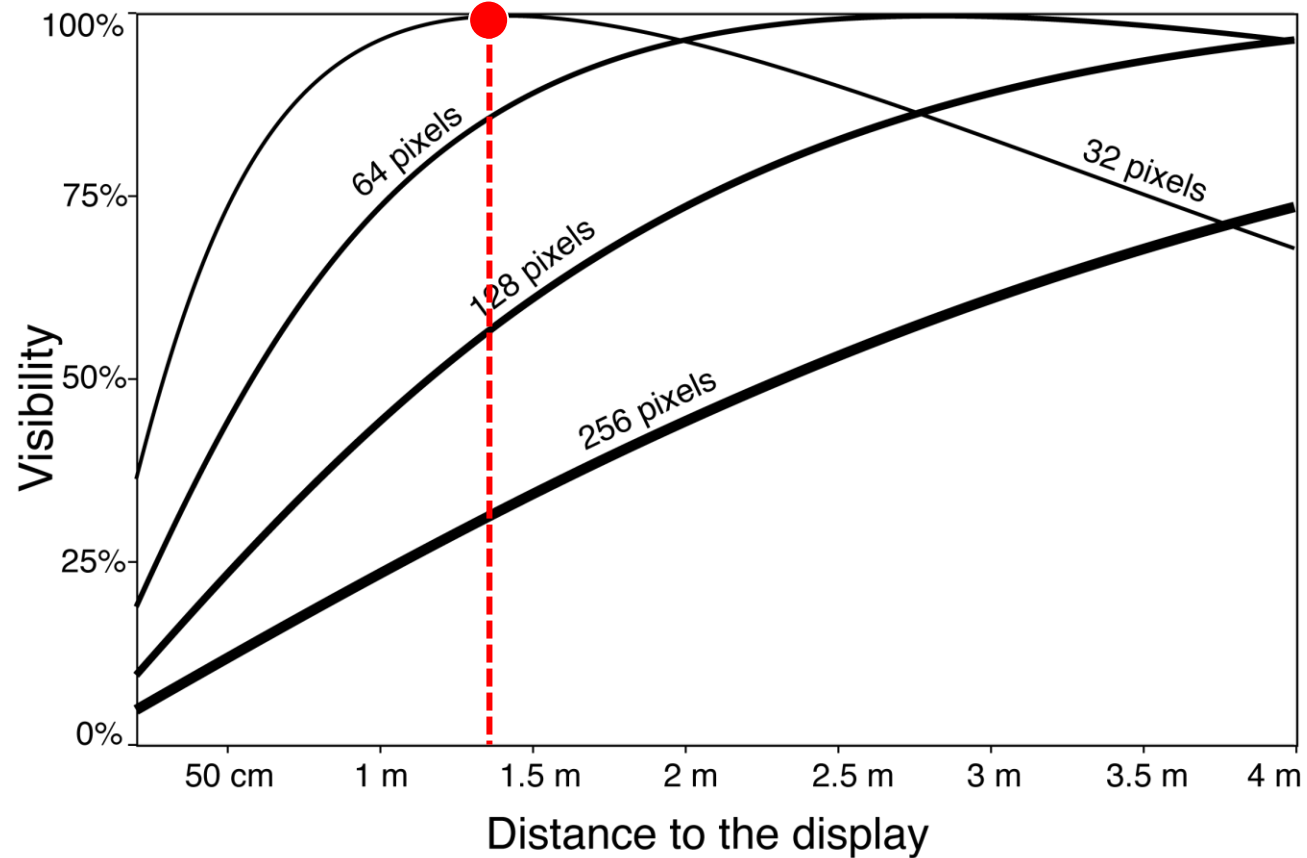
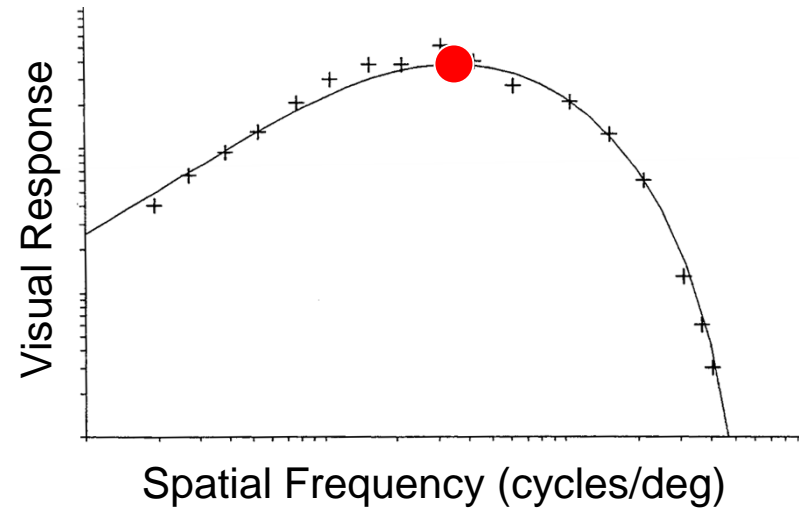
What do we Perceive from a Large Display?



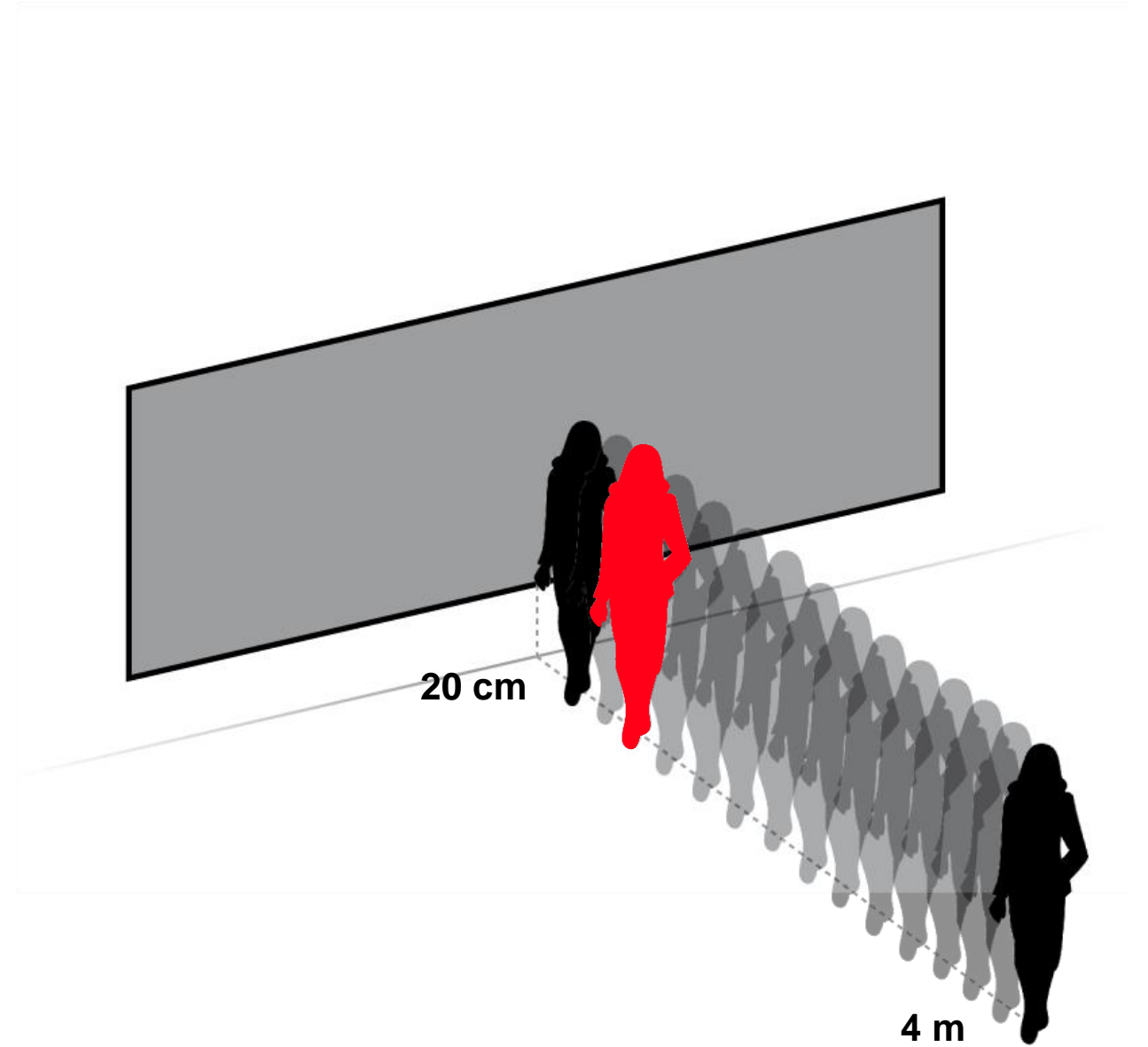
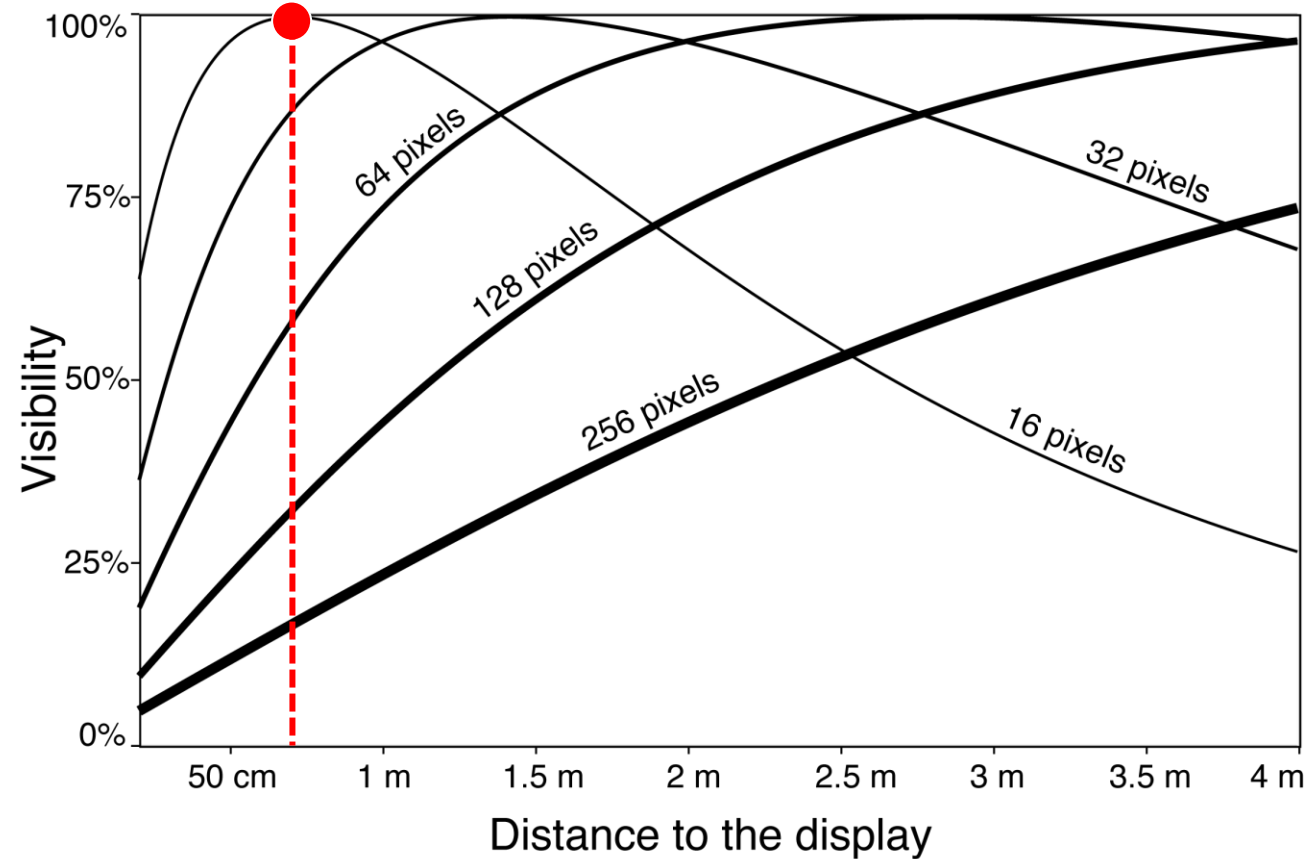
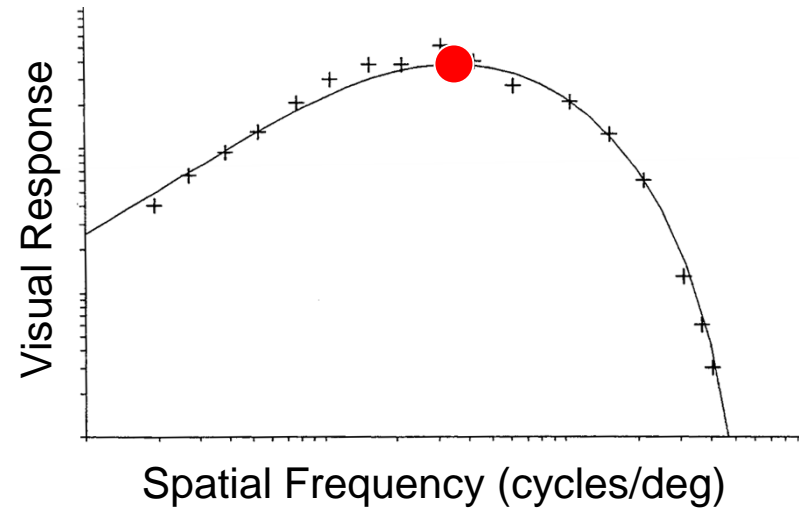
What do we Perceive from a Large Display?



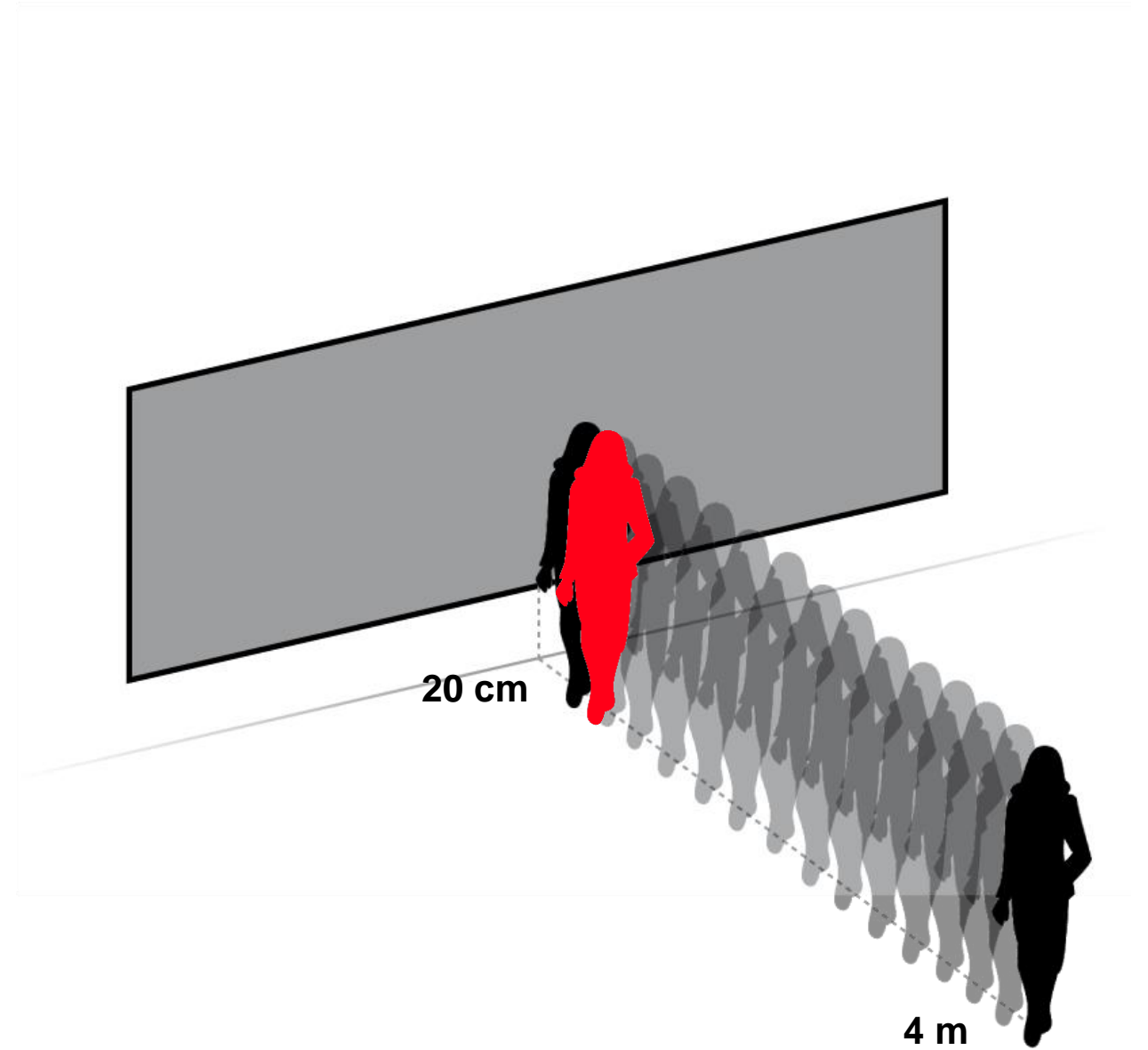
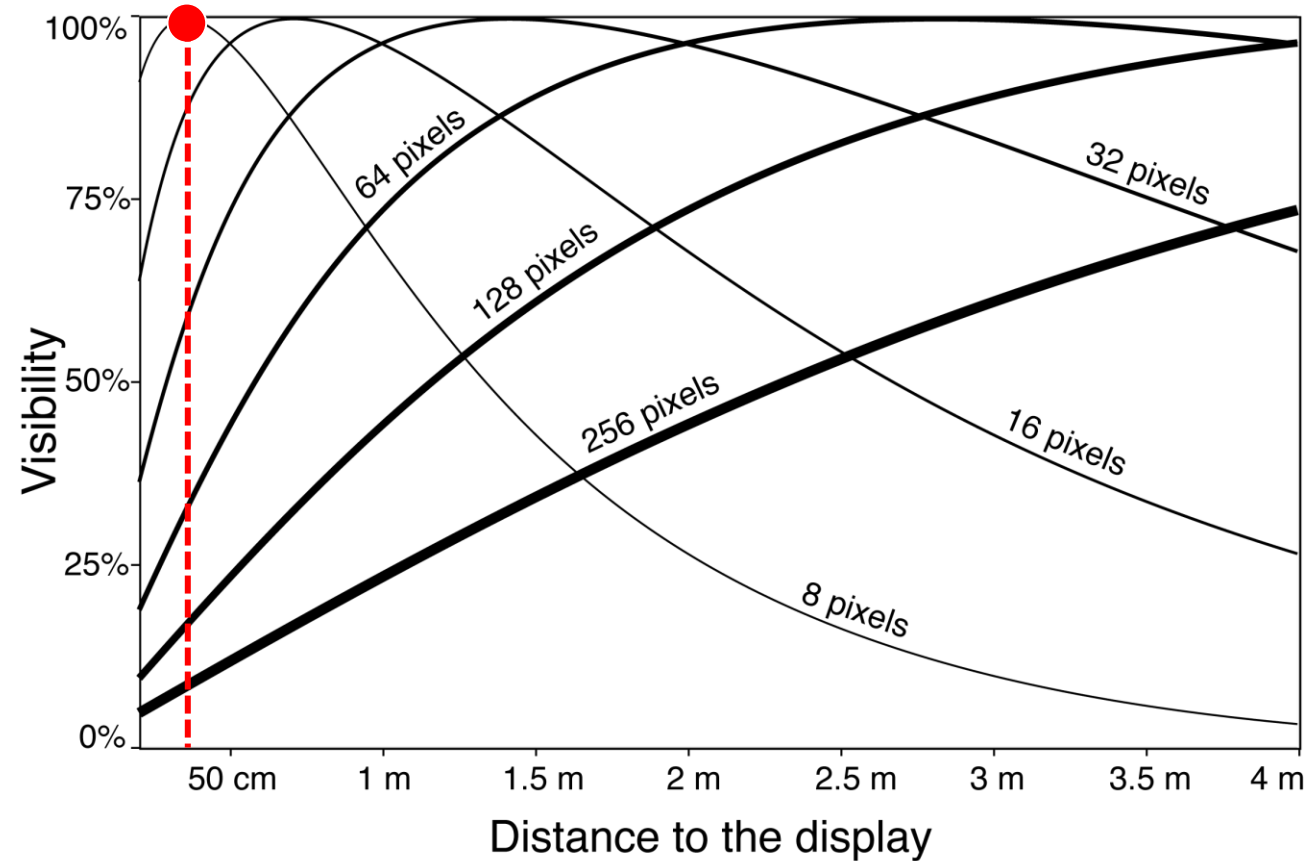
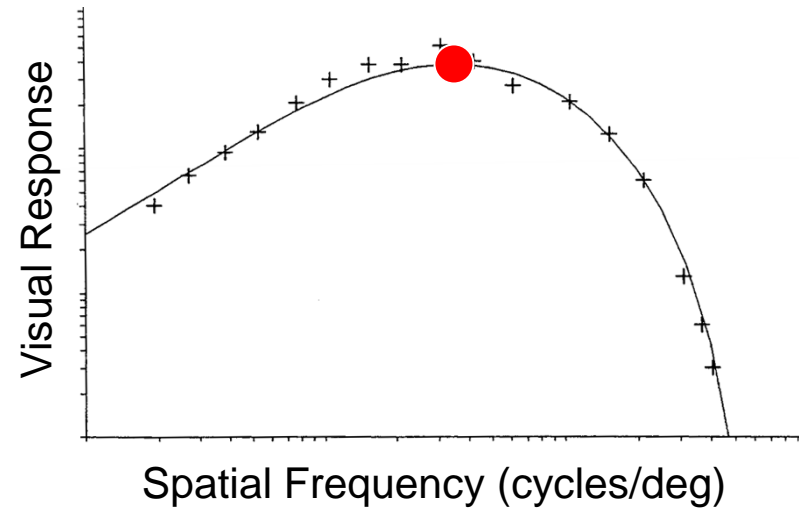
What do we Perceive from a Large Display?



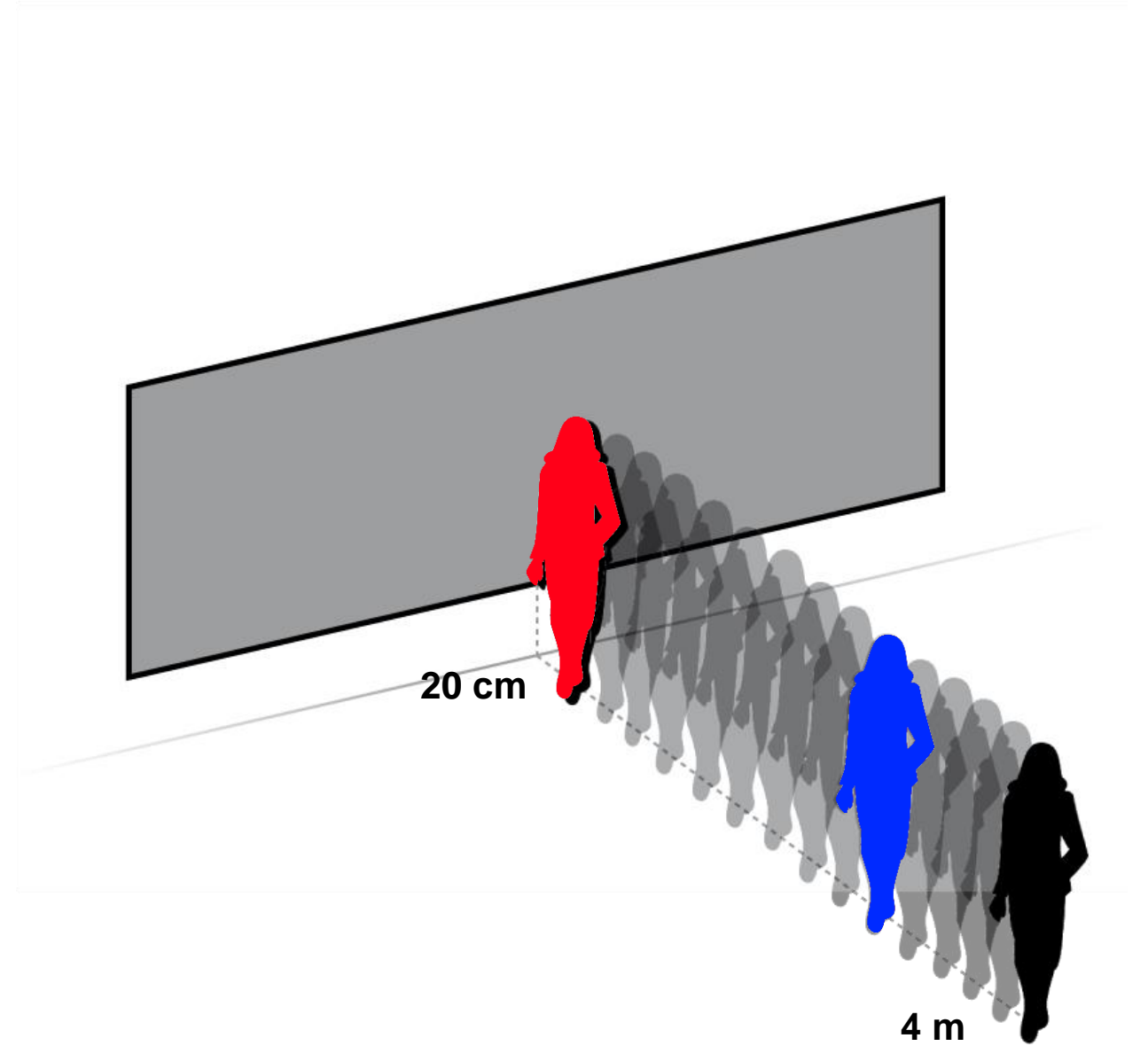
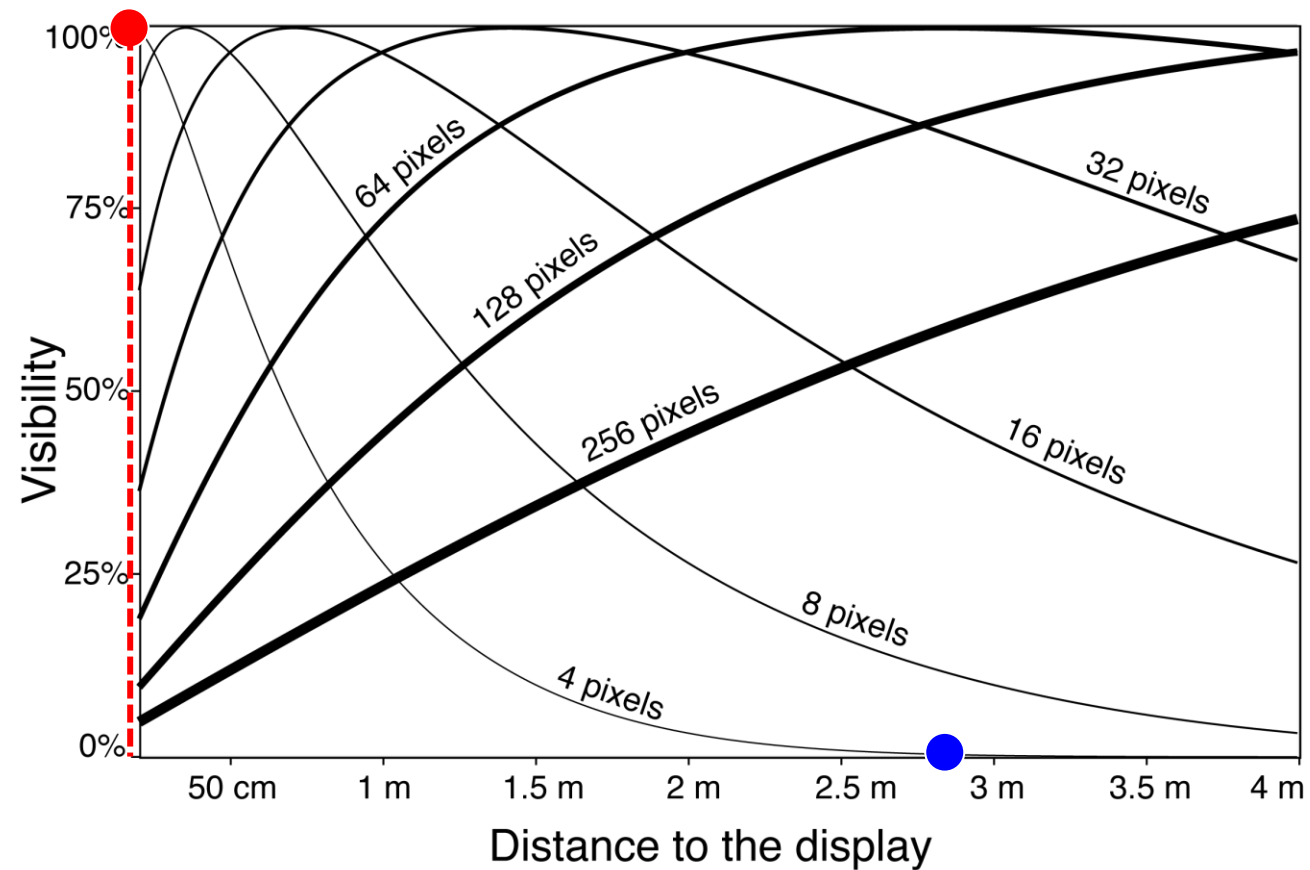
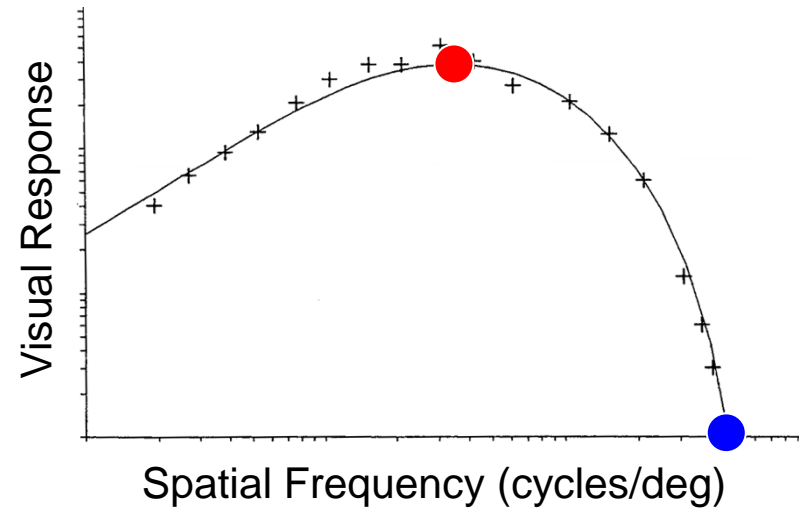
What do we Perceive from a Large Display?



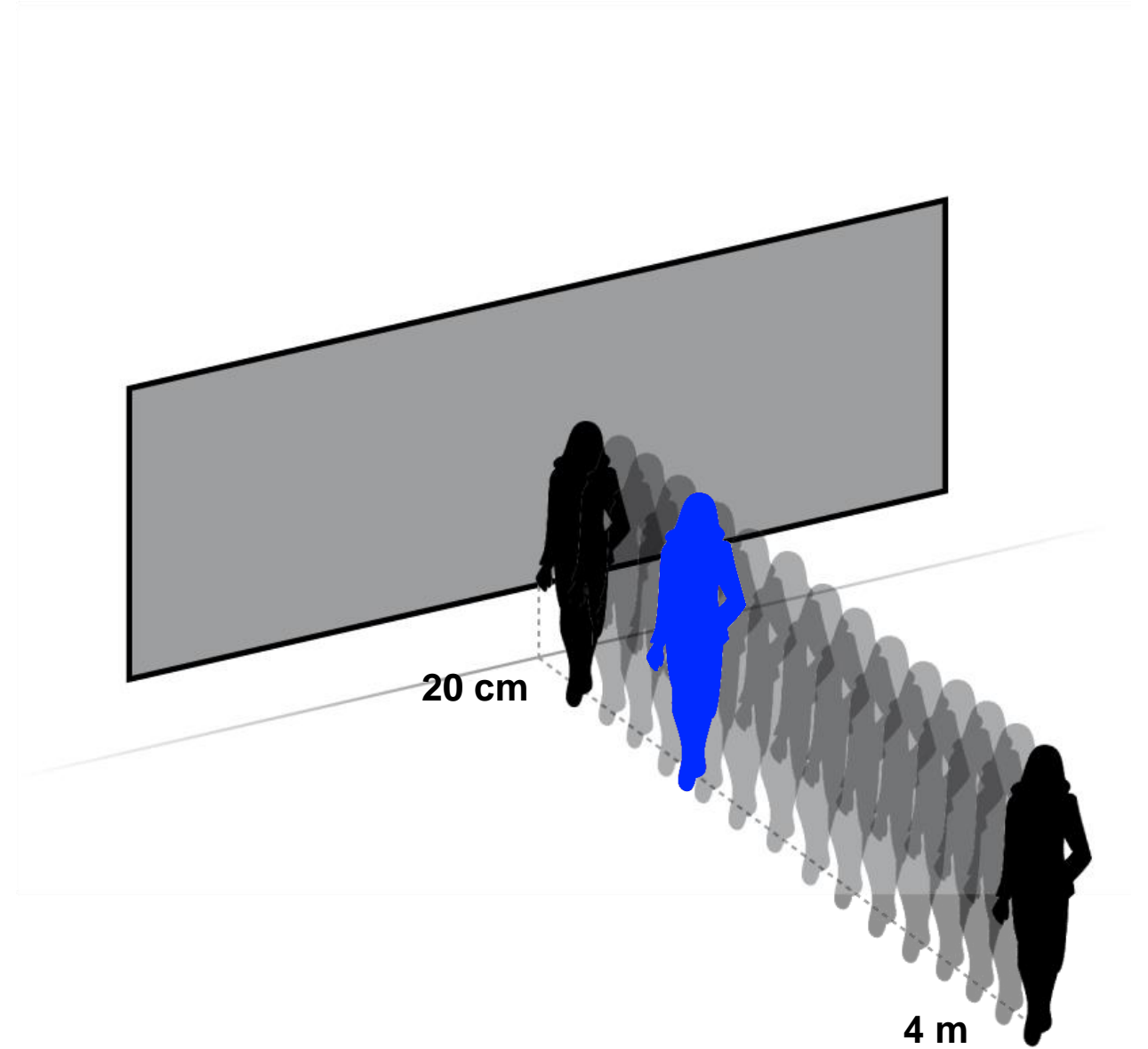
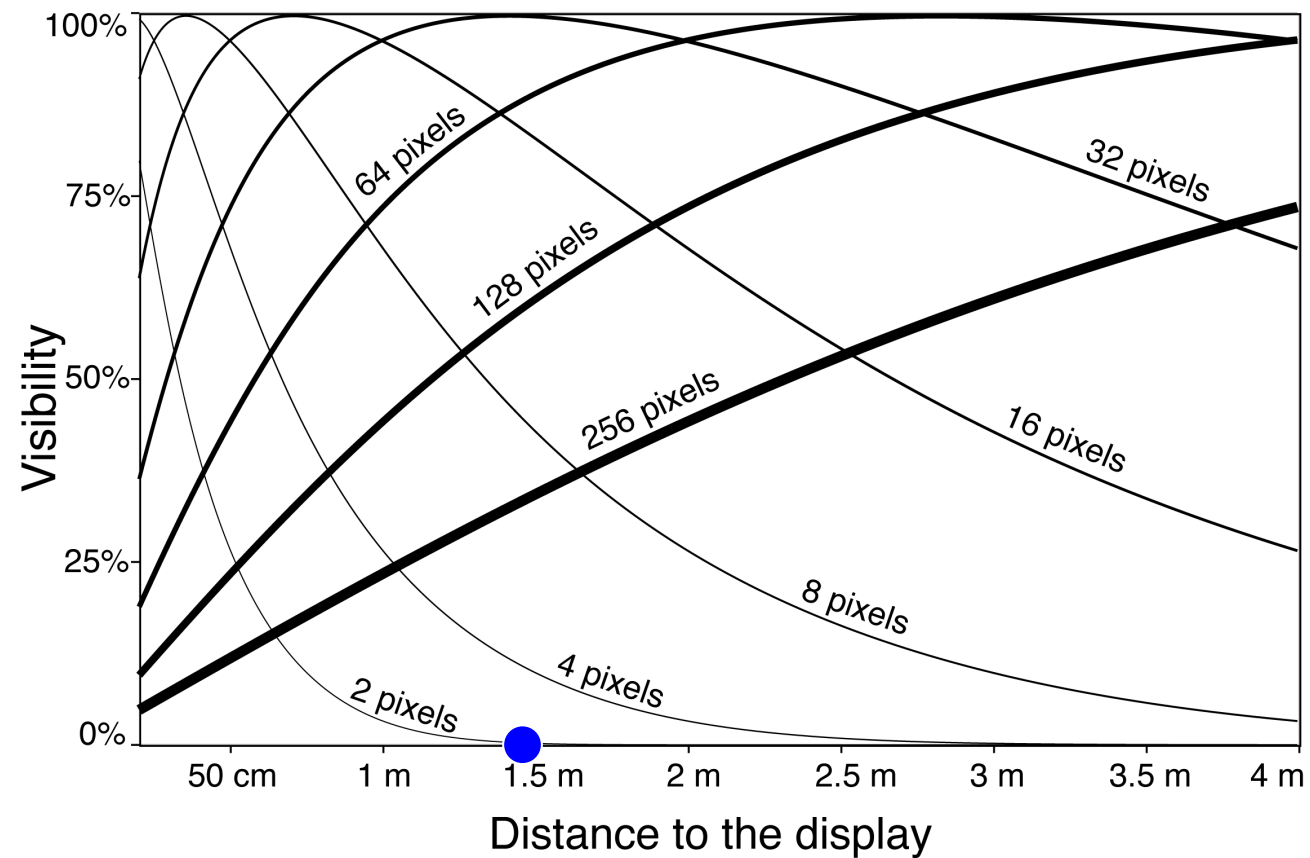
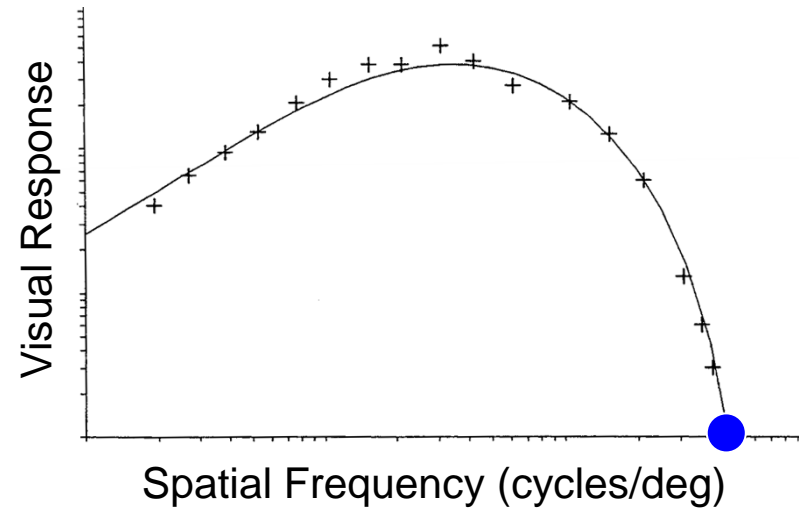
What do we Perceive from a Large Display?



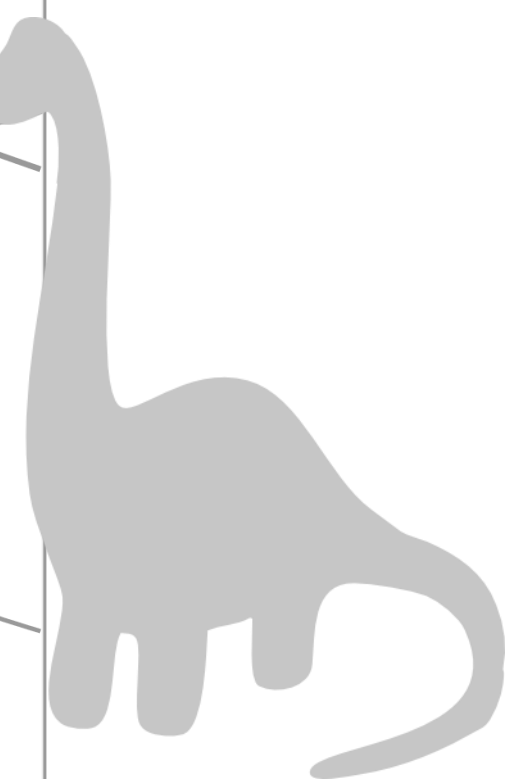
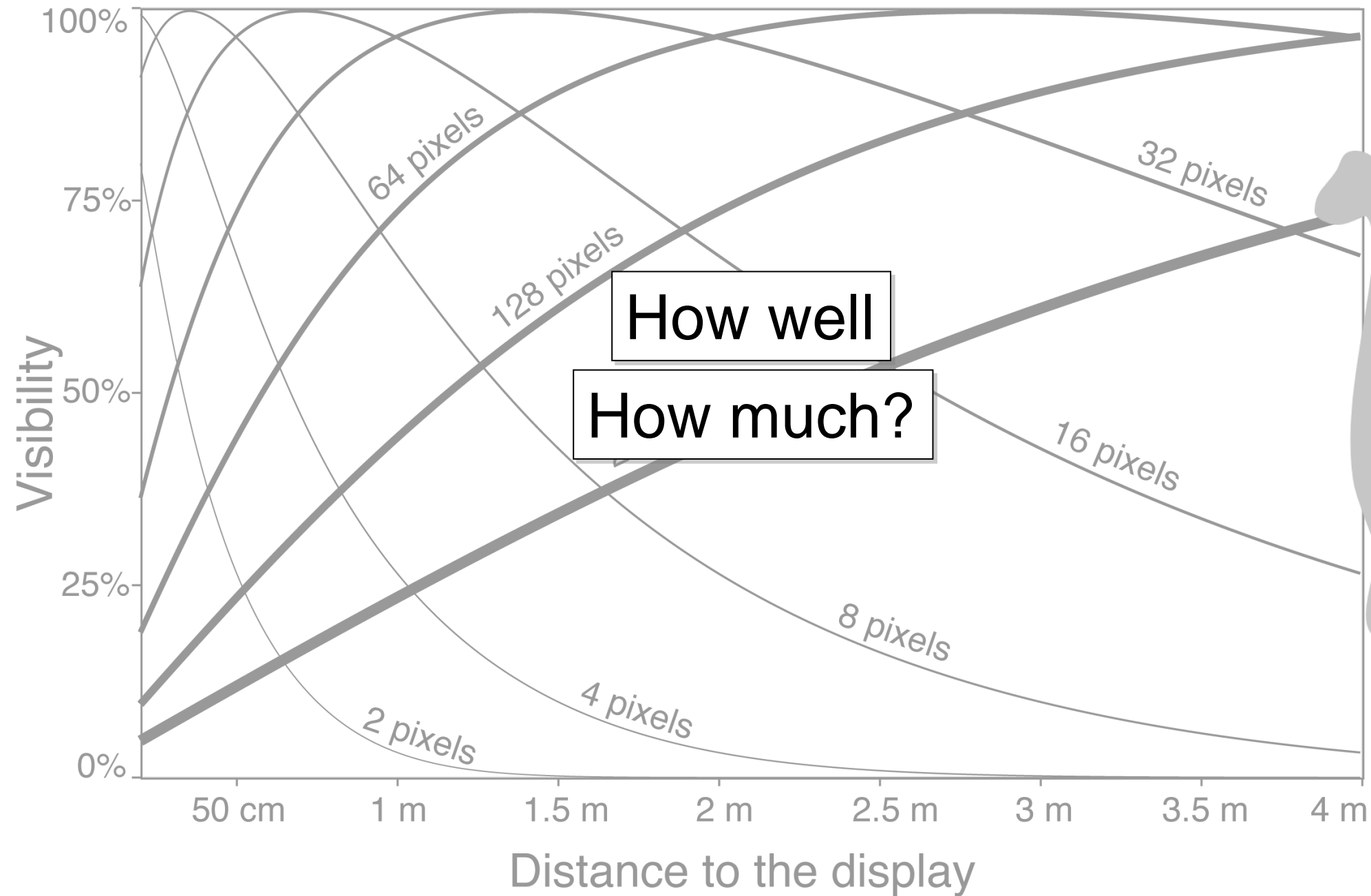
What do we Perceive from a Large Display?



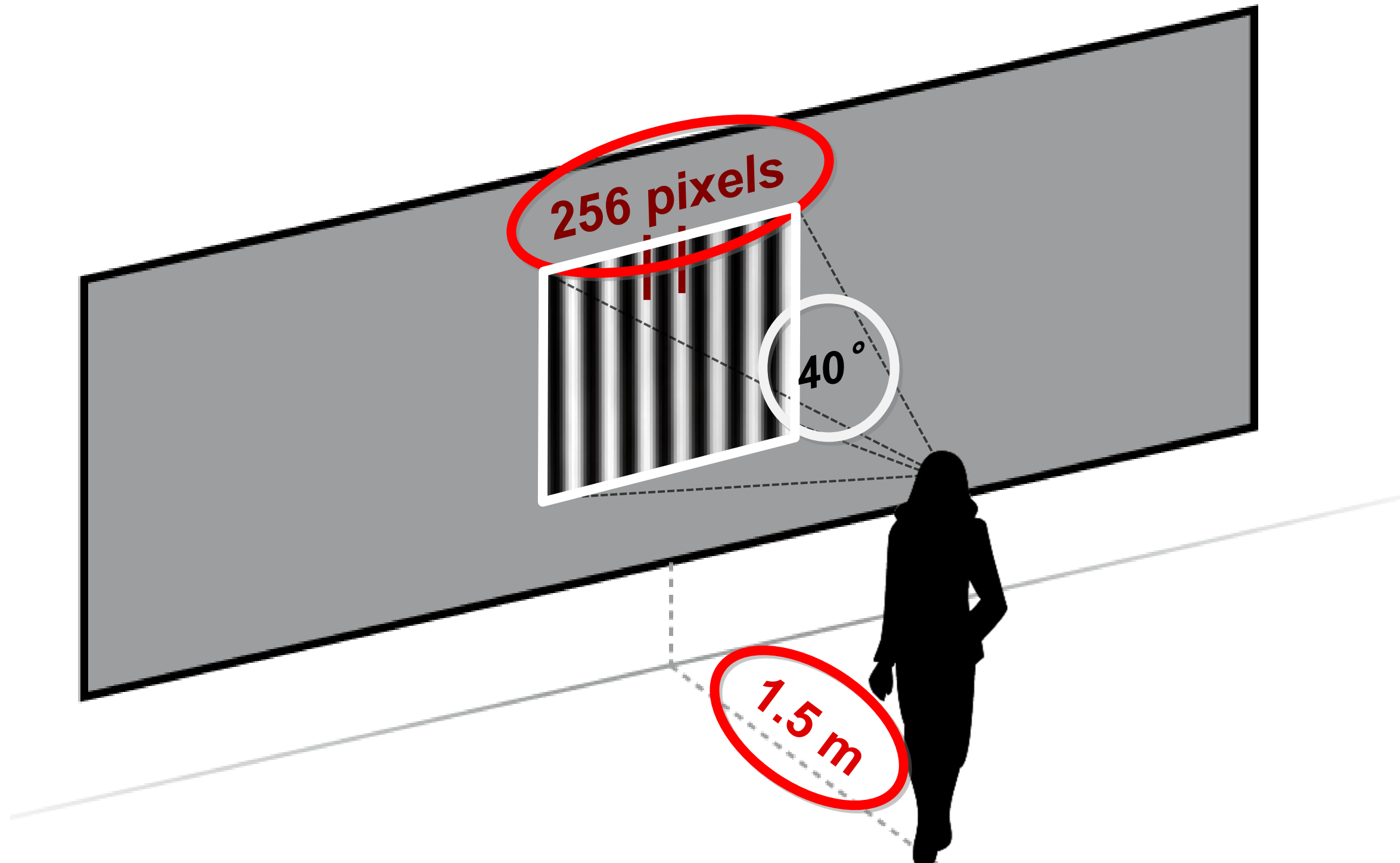
What do we Perceive from a Large Display?



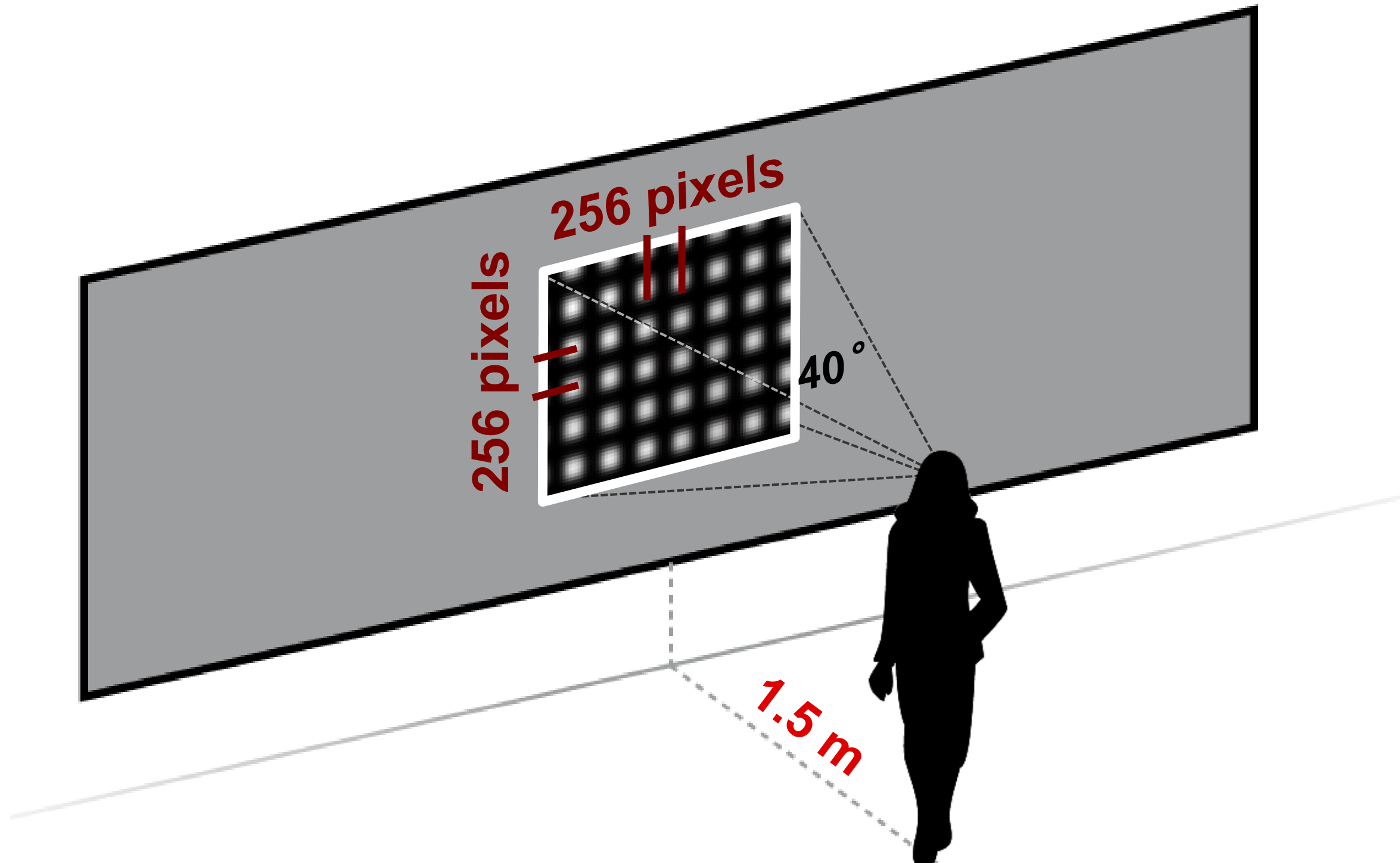
What do we Perceive from a Large Display?



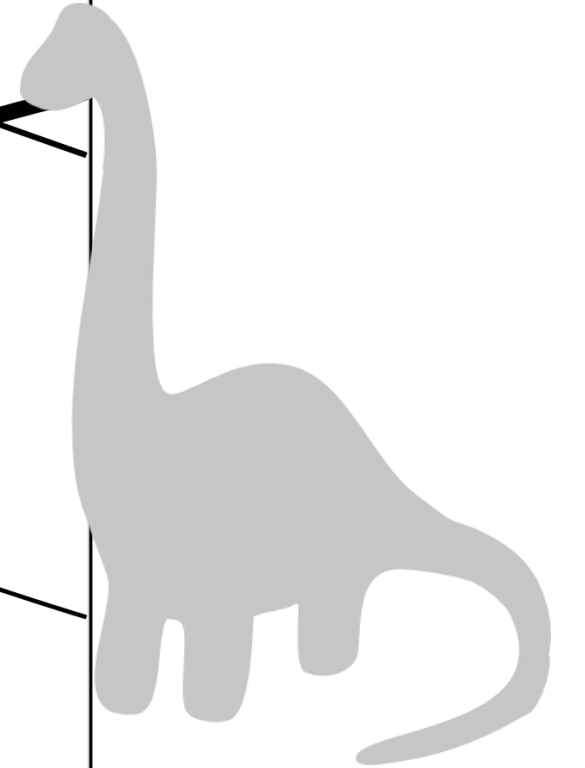
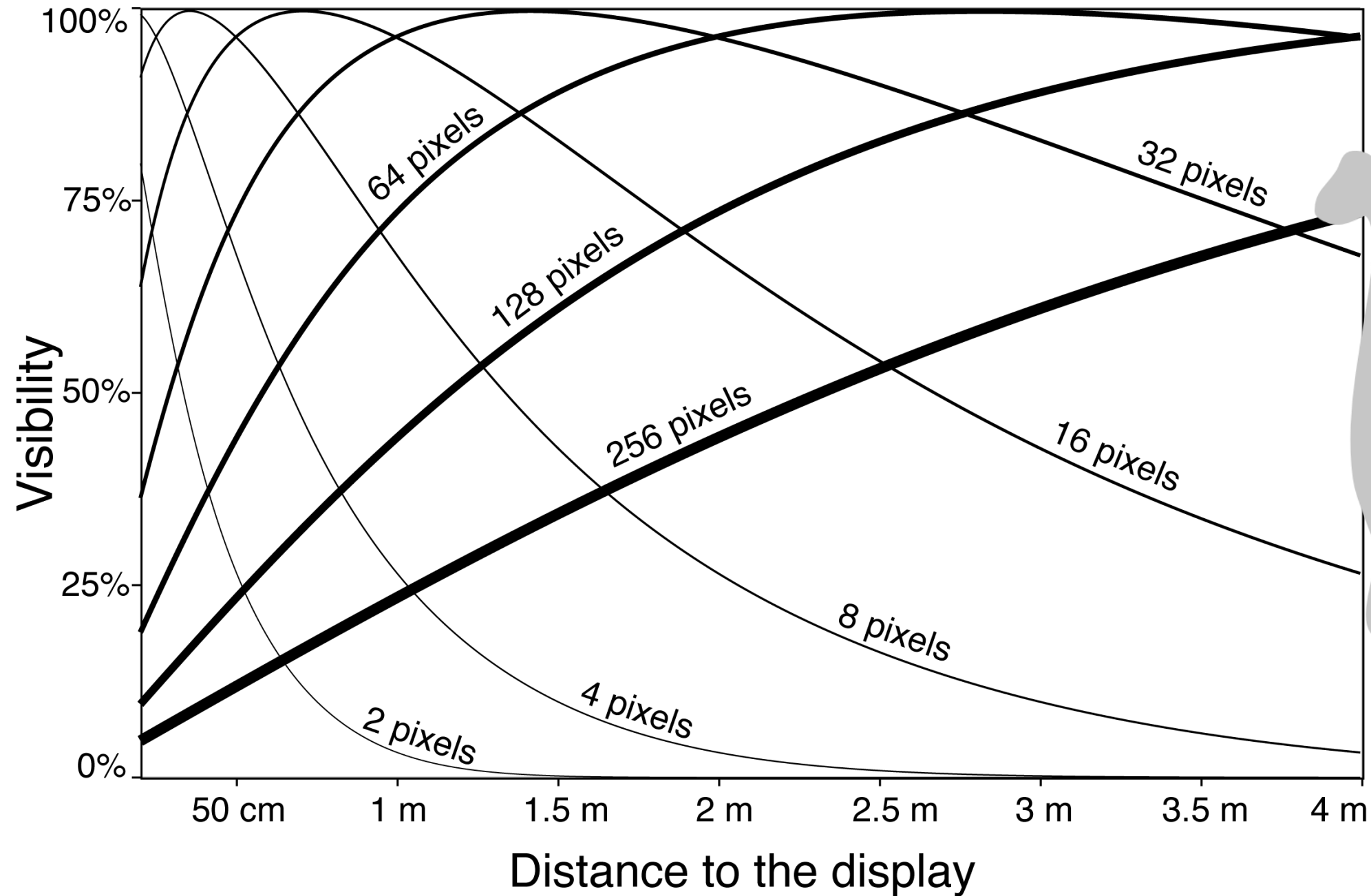
Information Capacity



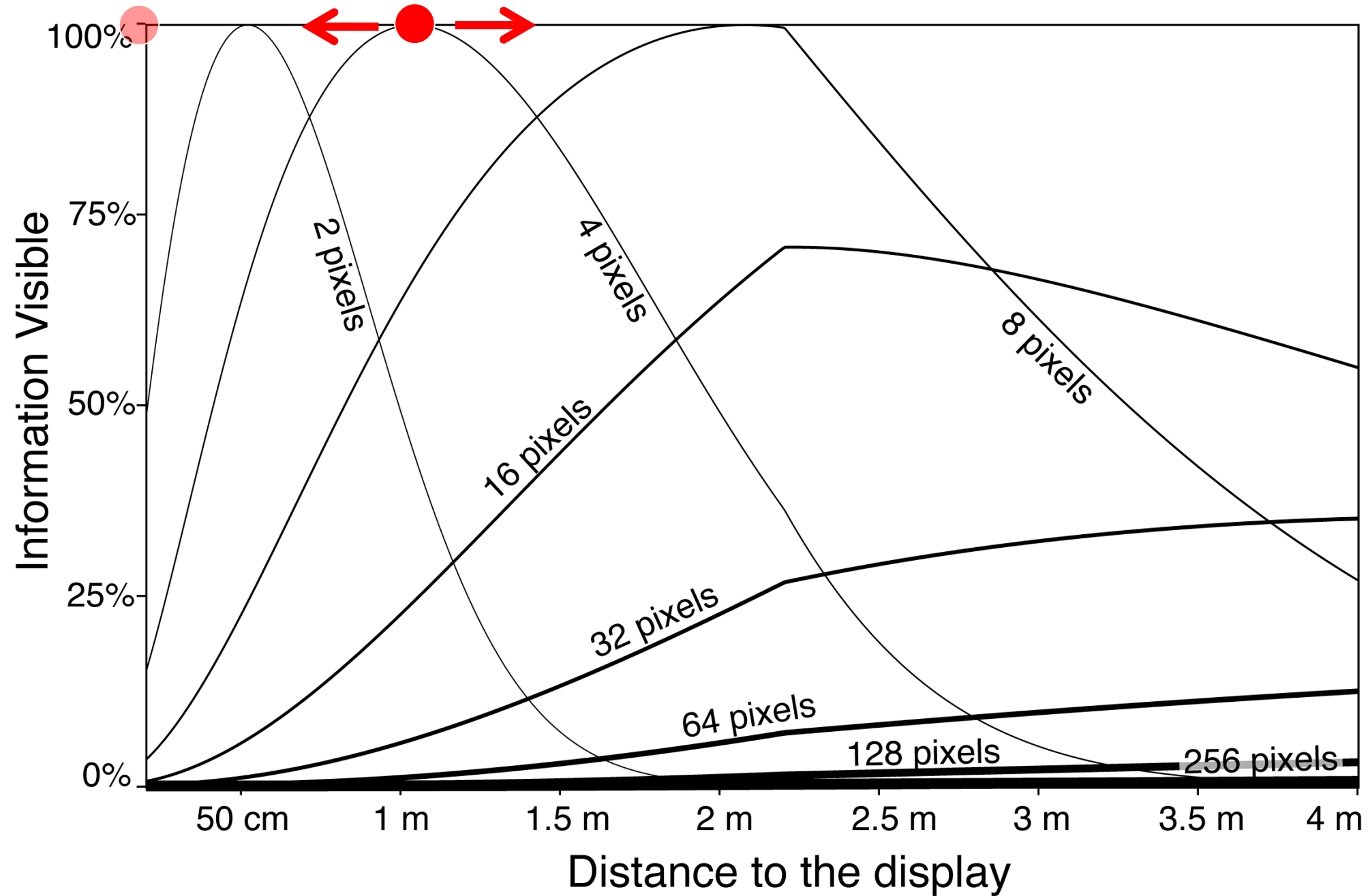
Information Capacity



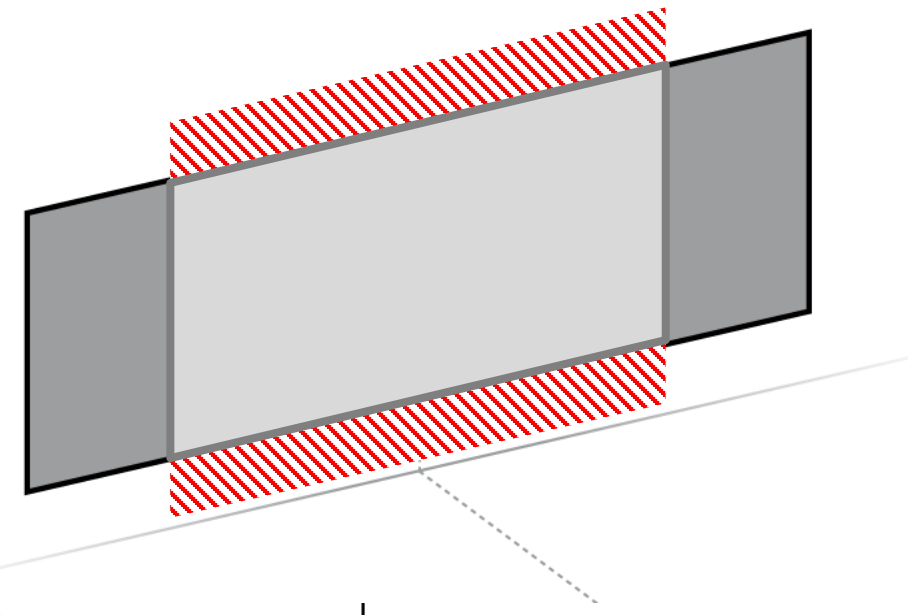
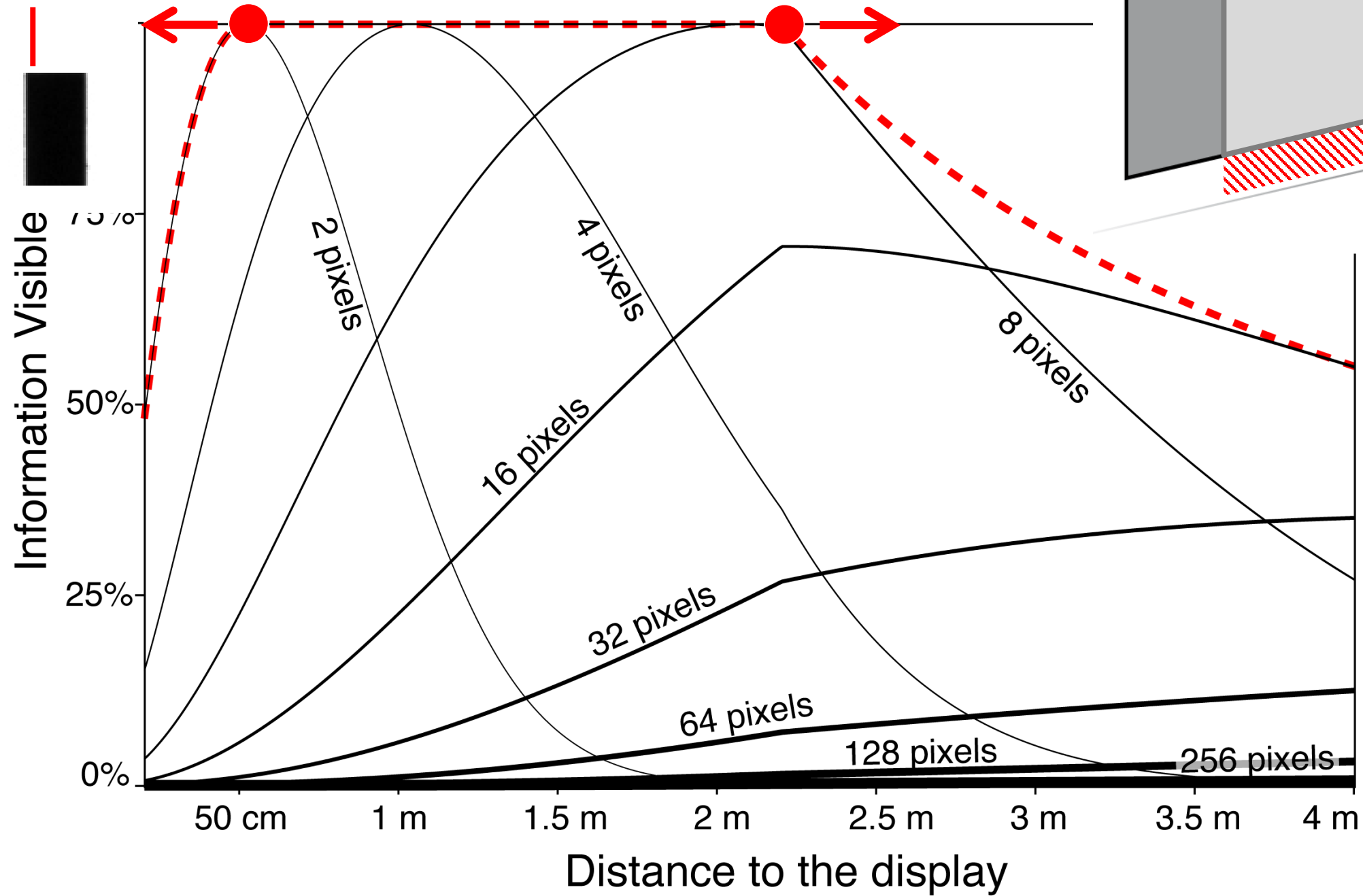
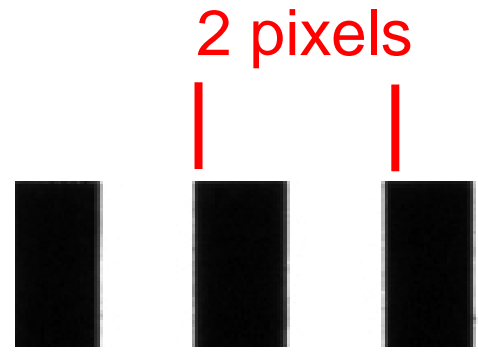
What do we Perceive from a Large Display?



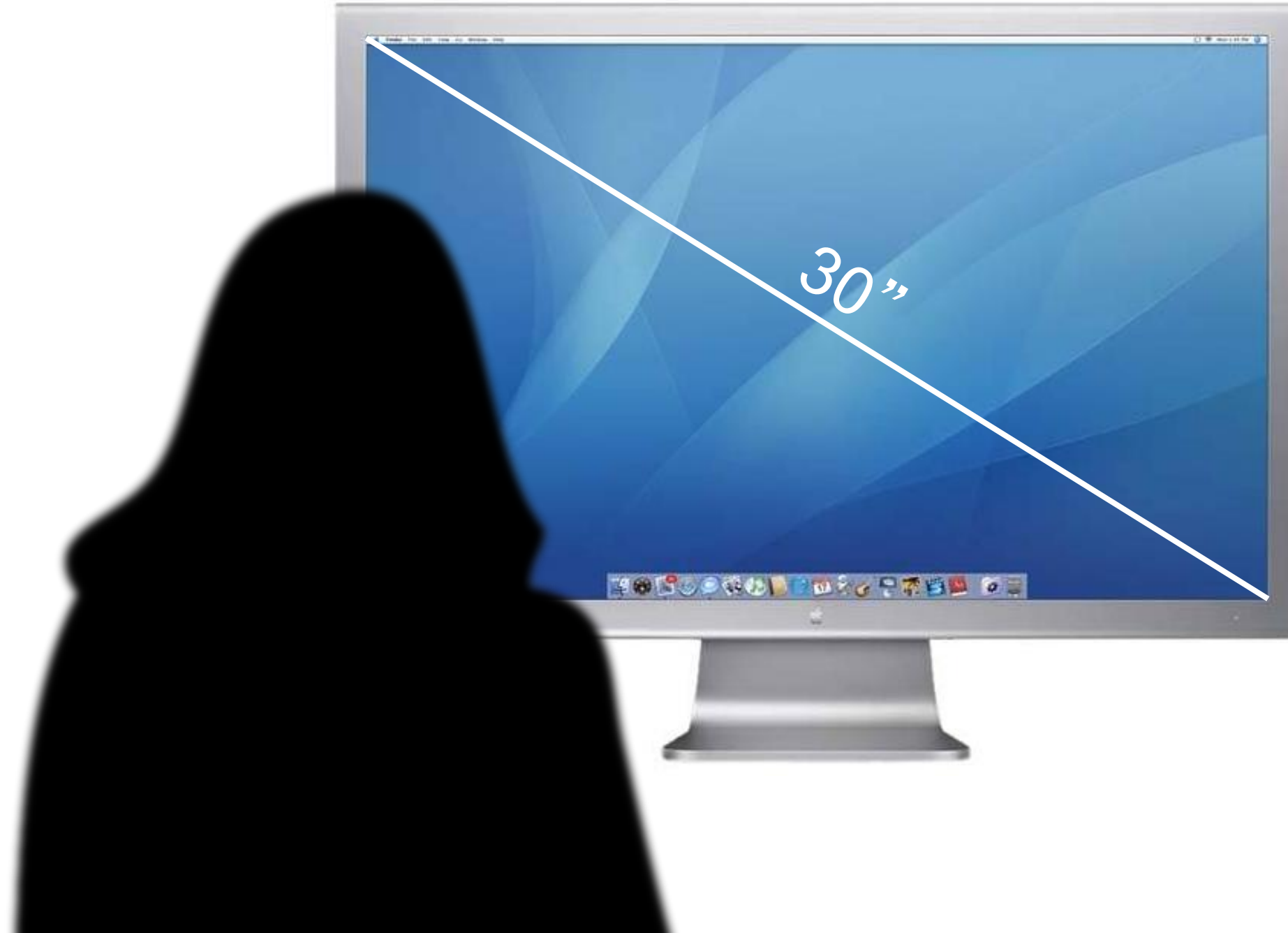
What do we Perceive from a Large Display?



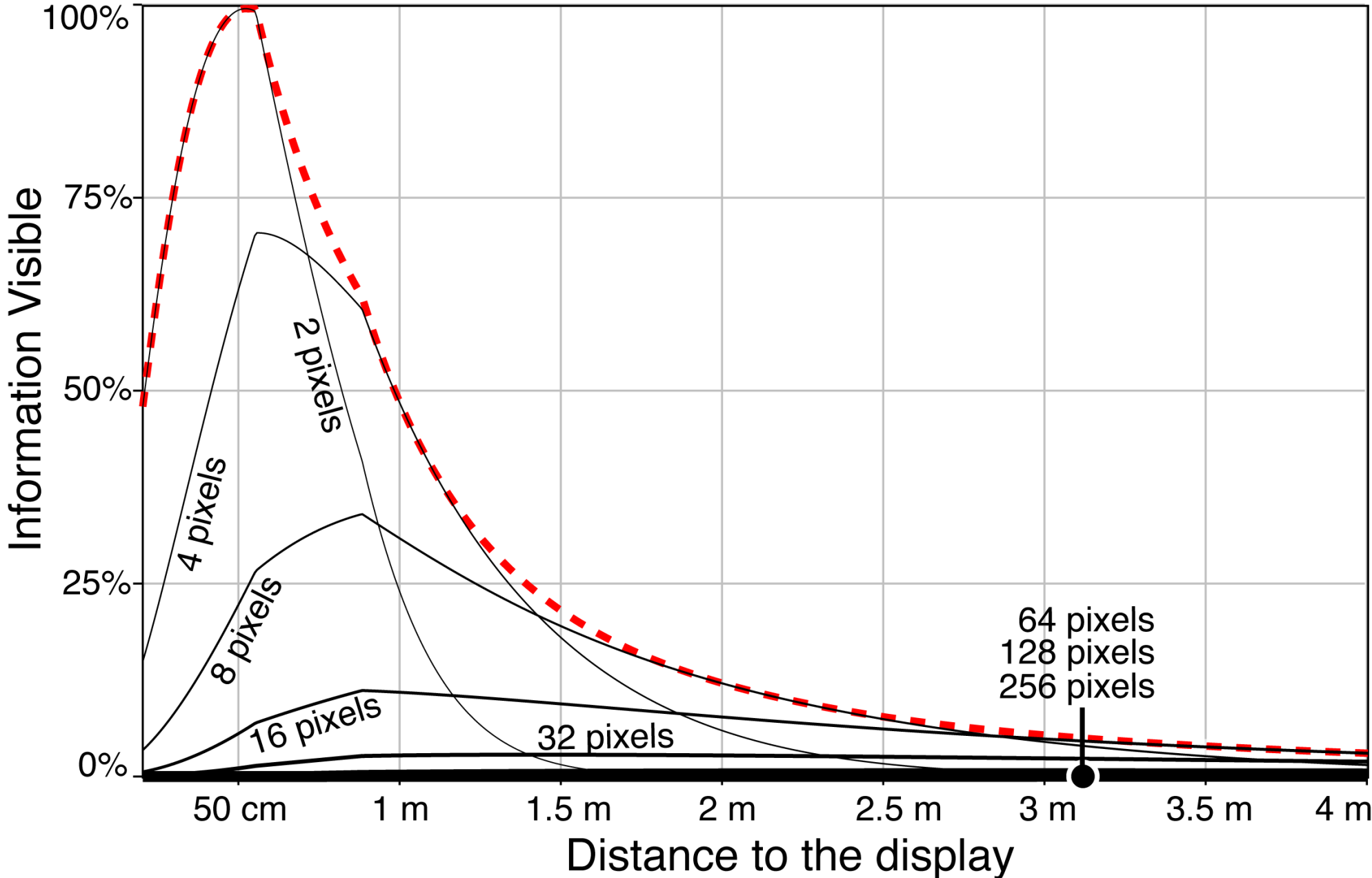
What do we Perceive from a Large I



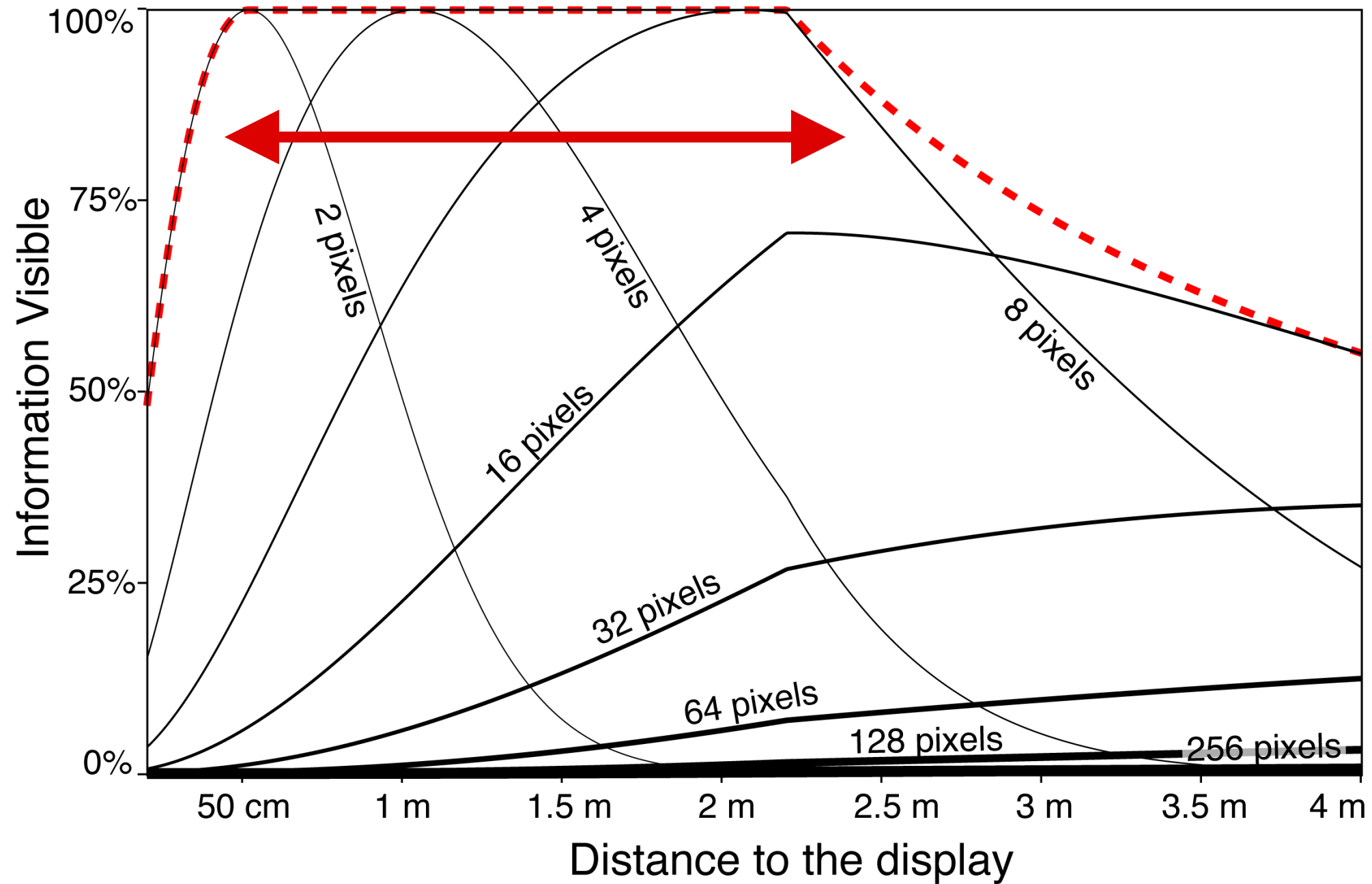
Comparison with a Desktop Display



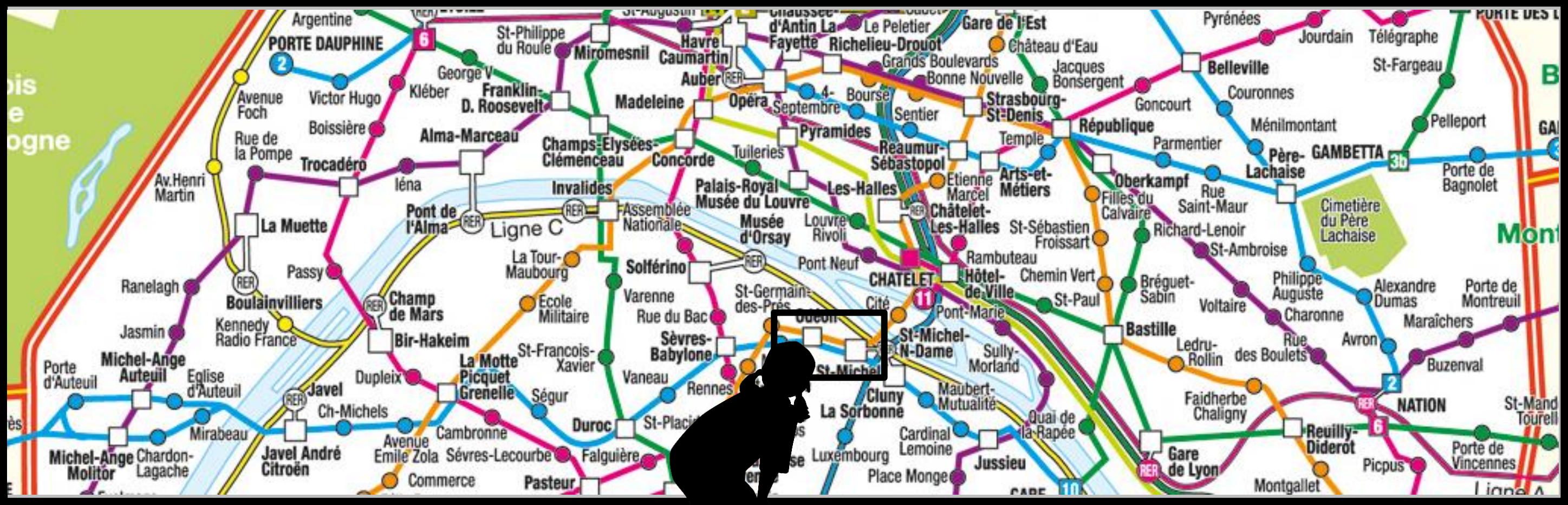
Comparison with a Desktop Display



Leveraging Large Displays



Ineffective Visualizations



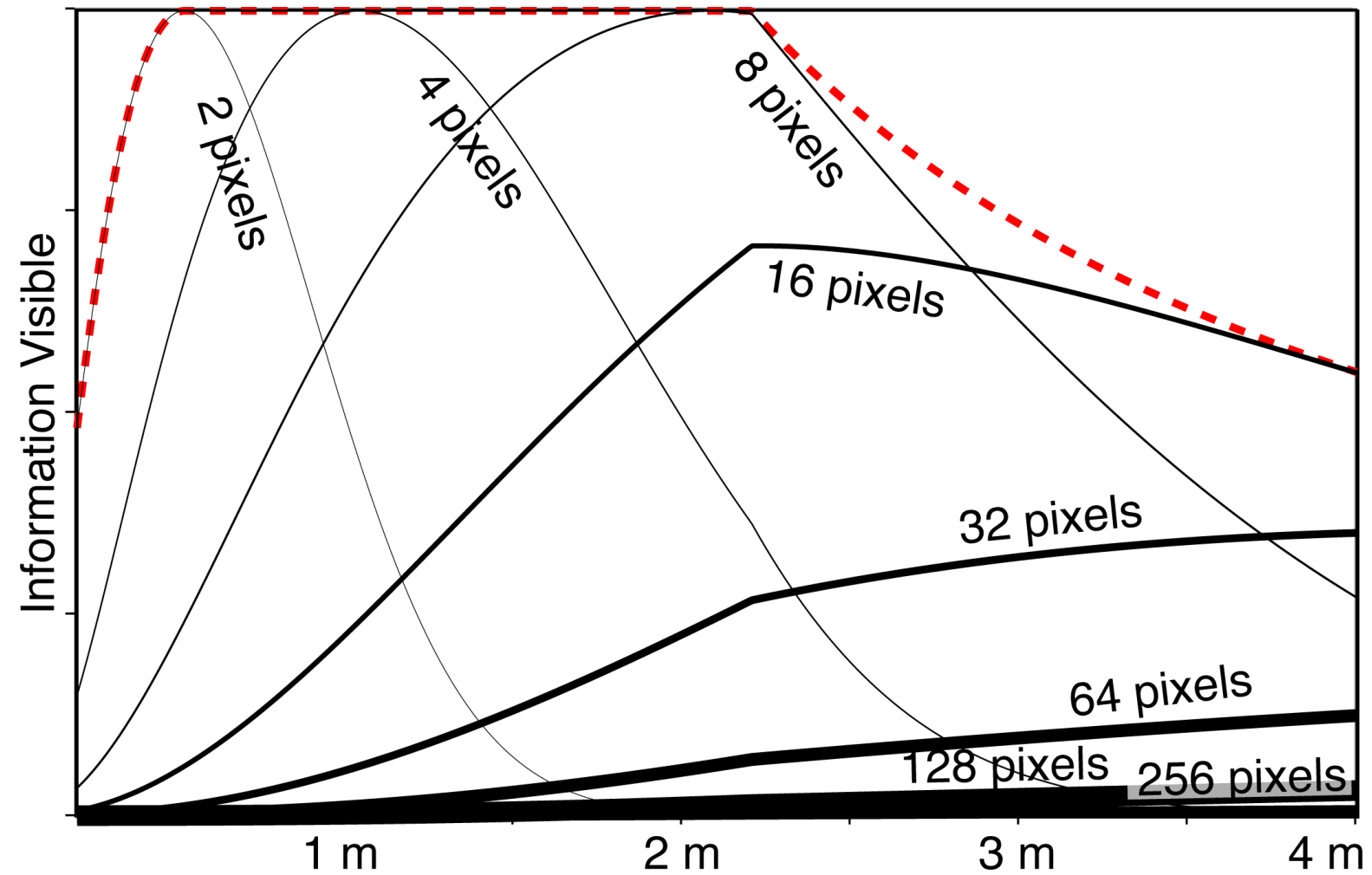
Udeon



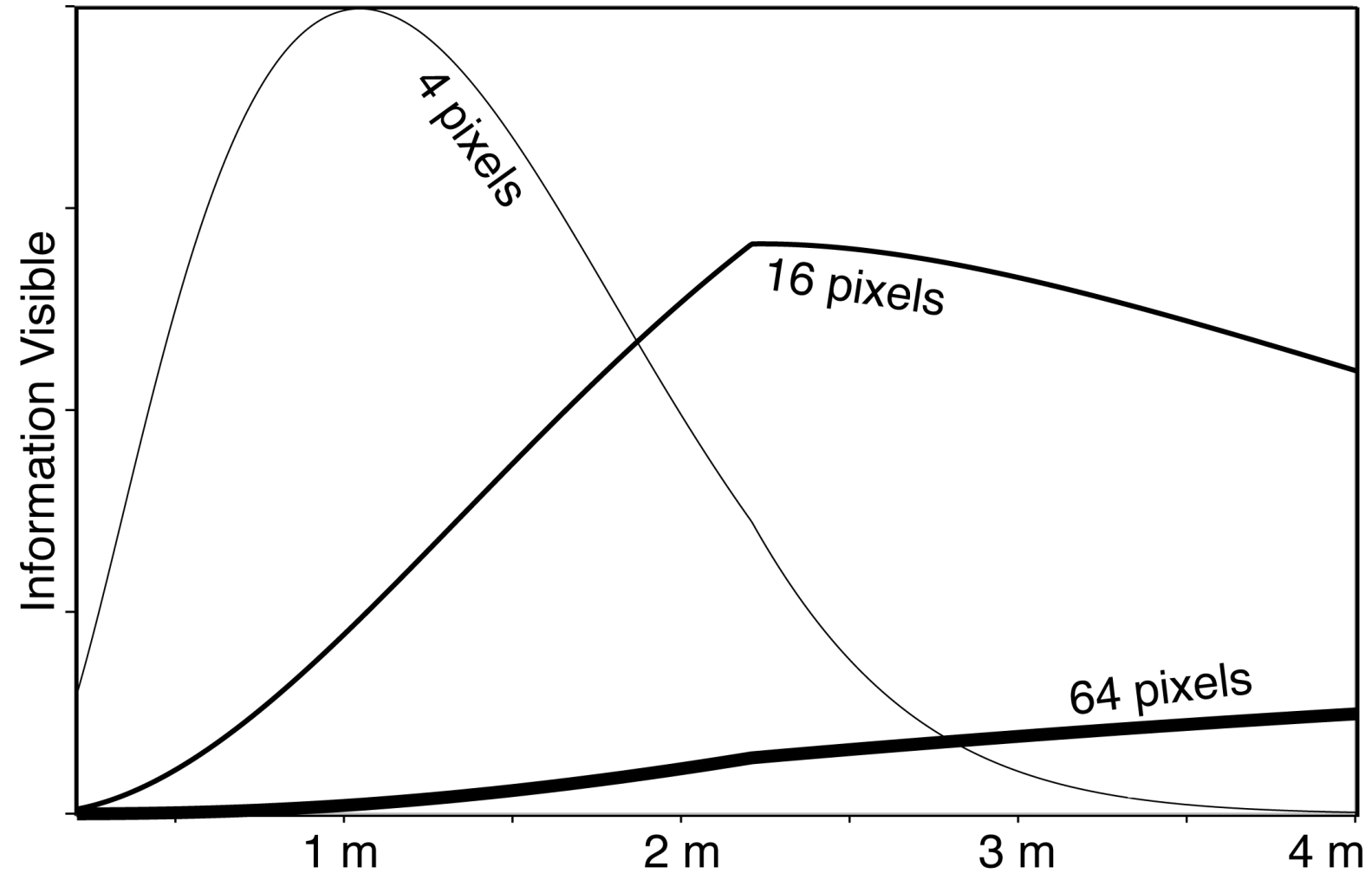
abillon

St-Michel

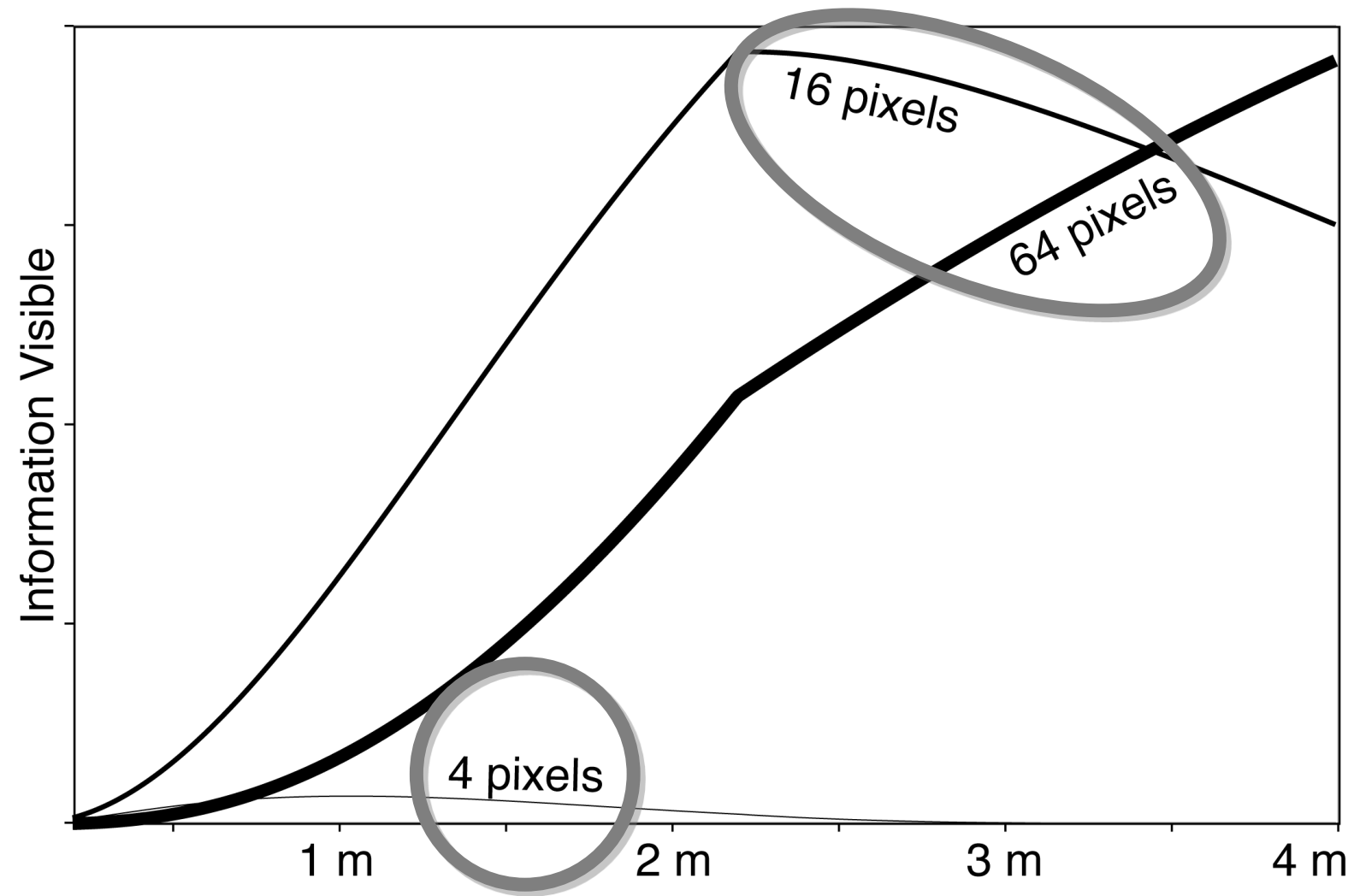
Ineffective Visualizations

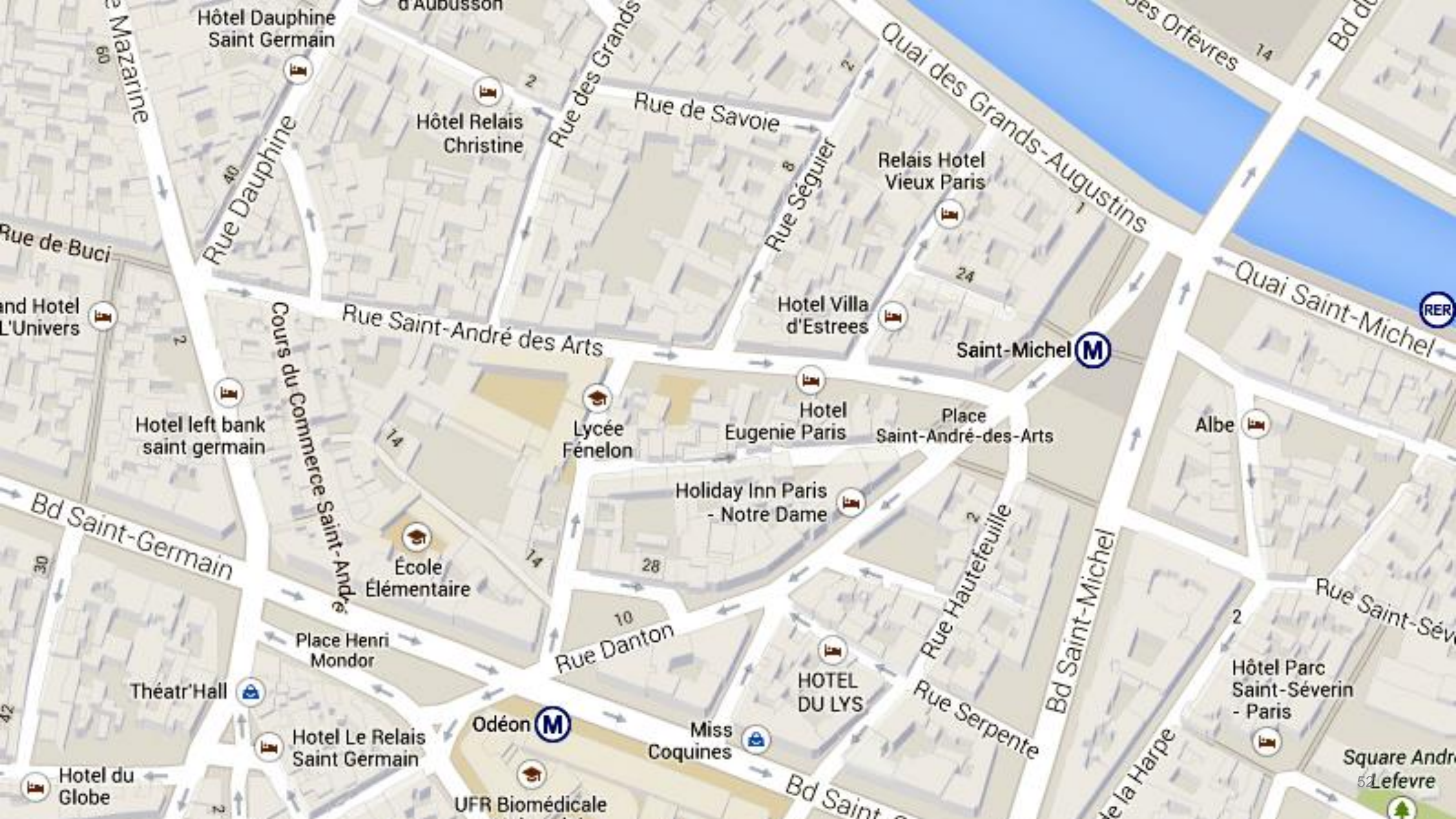


Ineffective Visualizations



Ineffective Visualizations





Hôtel Dauphine
Saint Germain

Hôtel Relais
Christine

Relais Hotel
Vieux Paris

Hotel Villa
d'Estrees

Saint-Michel **M**

Hotel left bank
saint germain

Lycée
Fénélon

Hotel
Eugenie Paris

Place
Saint-André-des-Arts

Albe

Holiday Inn Paris
- Notre Dame

École
Élémentaire

Bd Saint-Germain

Cours du Commerce
Saint-André

Place Henri
Mondor

Rue Danton

HOTEL
DU LYS

Rue Hautefeuille
Rue Serpente

Bd Saint-Michel

Théatr'Hall

Odéon **M**

Miss
Coquines

Hôtel Parc
Saint-Séverin
- Paris

Hotel du
Globe

Hotel Le Relais
Saint Germain

UFR Biomédicale

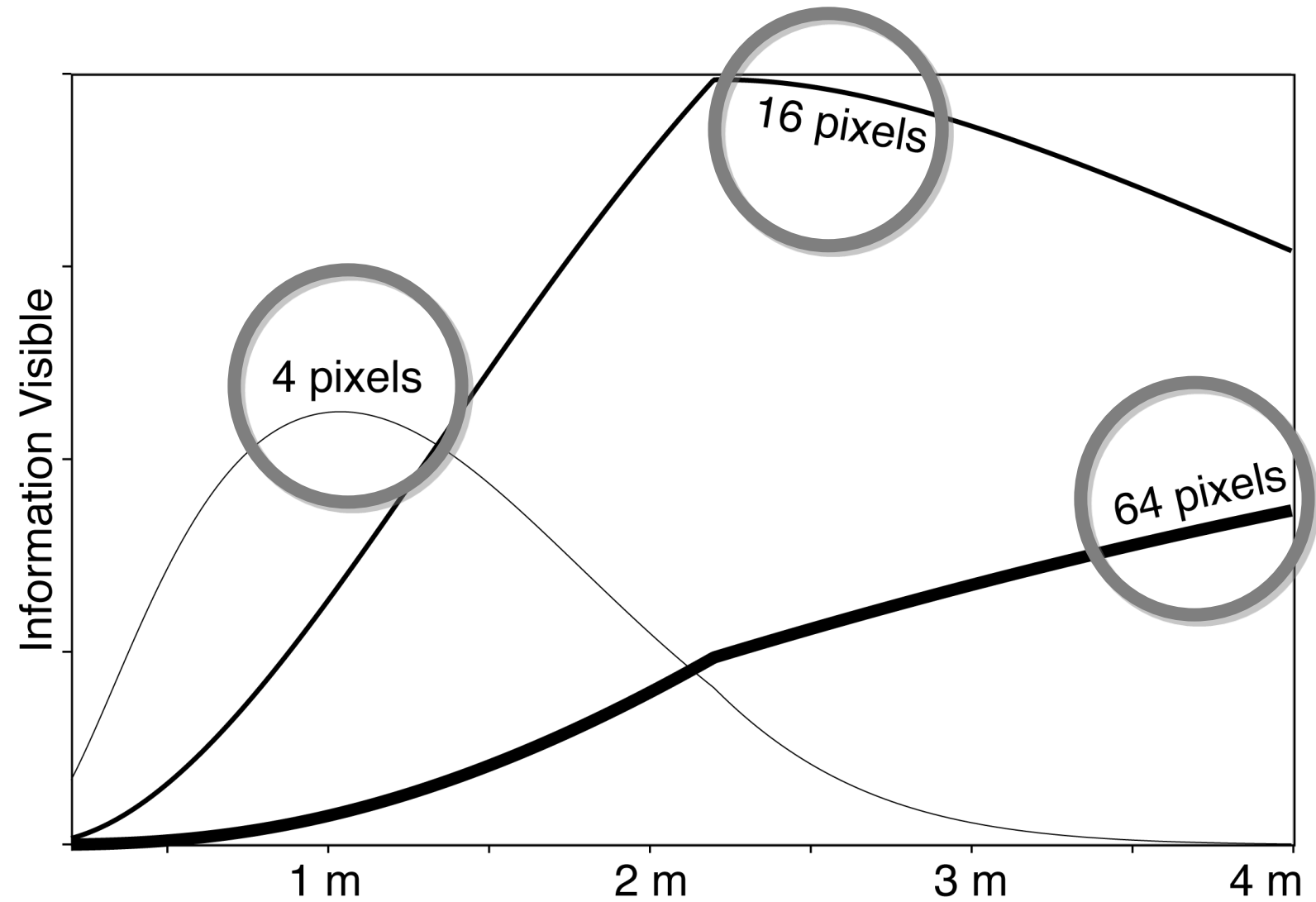
Bd Saint-Germain

Square André
Lefevre

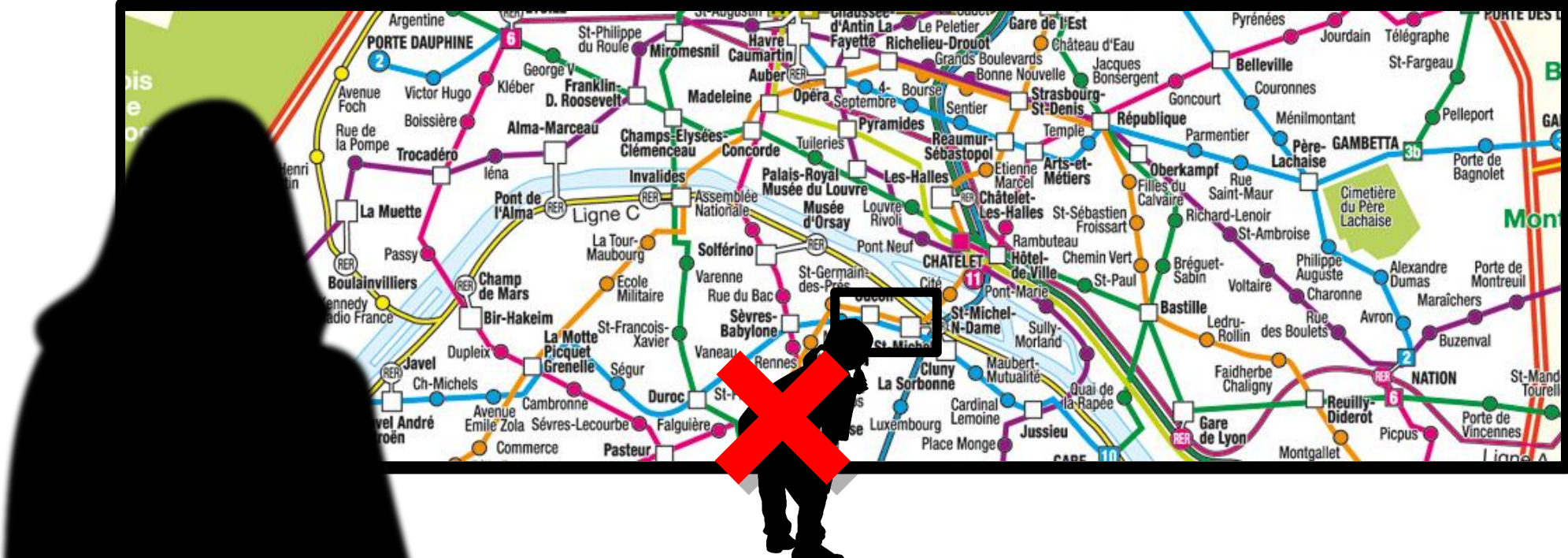
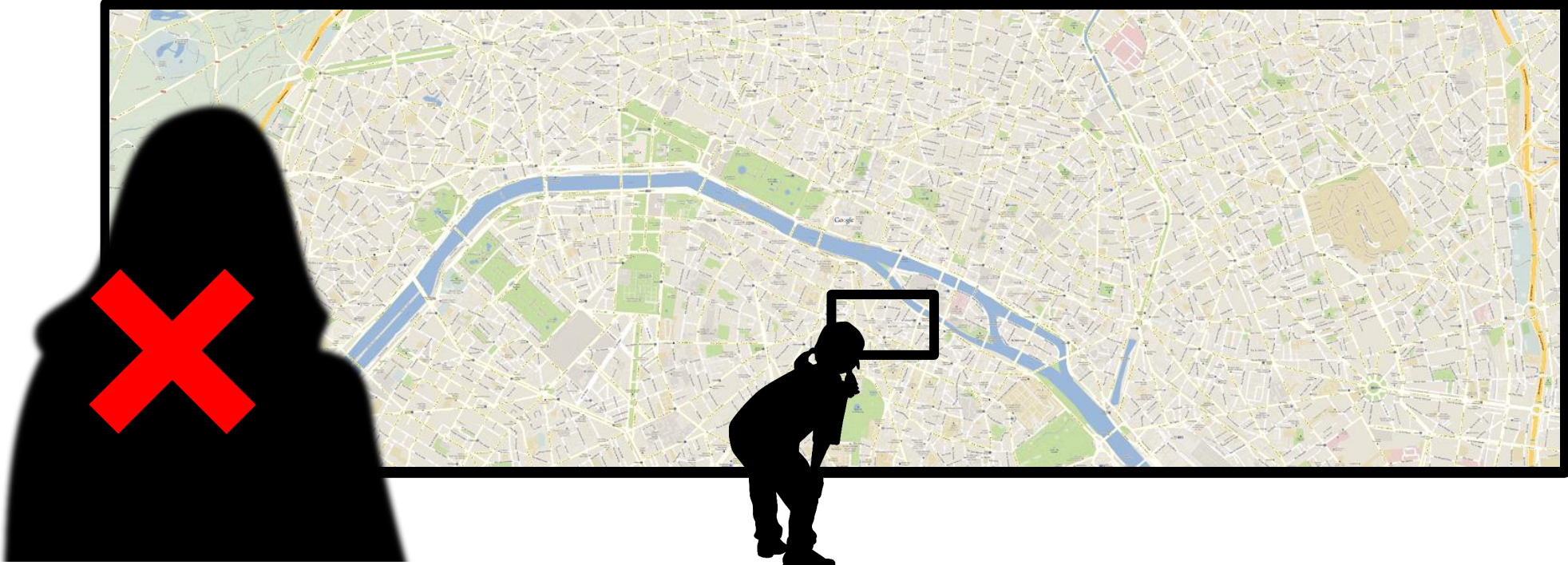
Ineffective Visualizations



Ineffective Visualizations



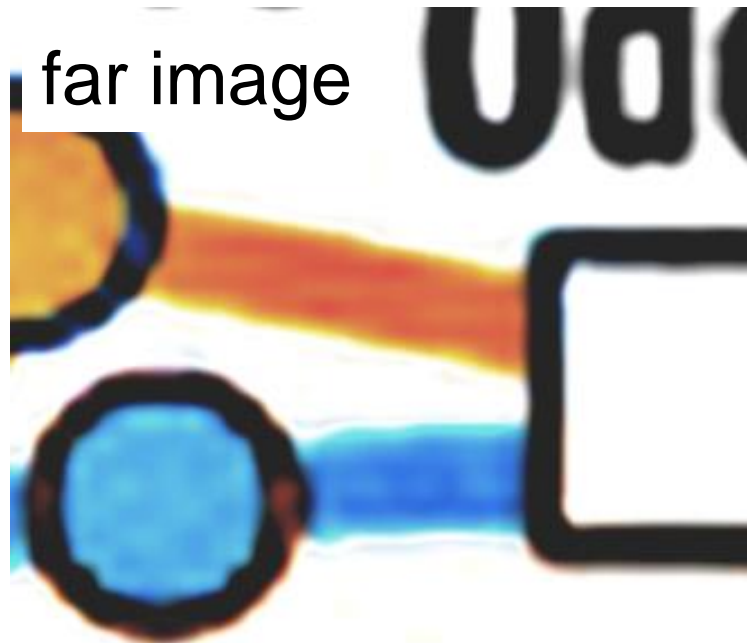
Ineffective Visualizations



Hybrid-Image Visualization



Hi-pass
Filter
+ contrast



Lo-pass
Filter



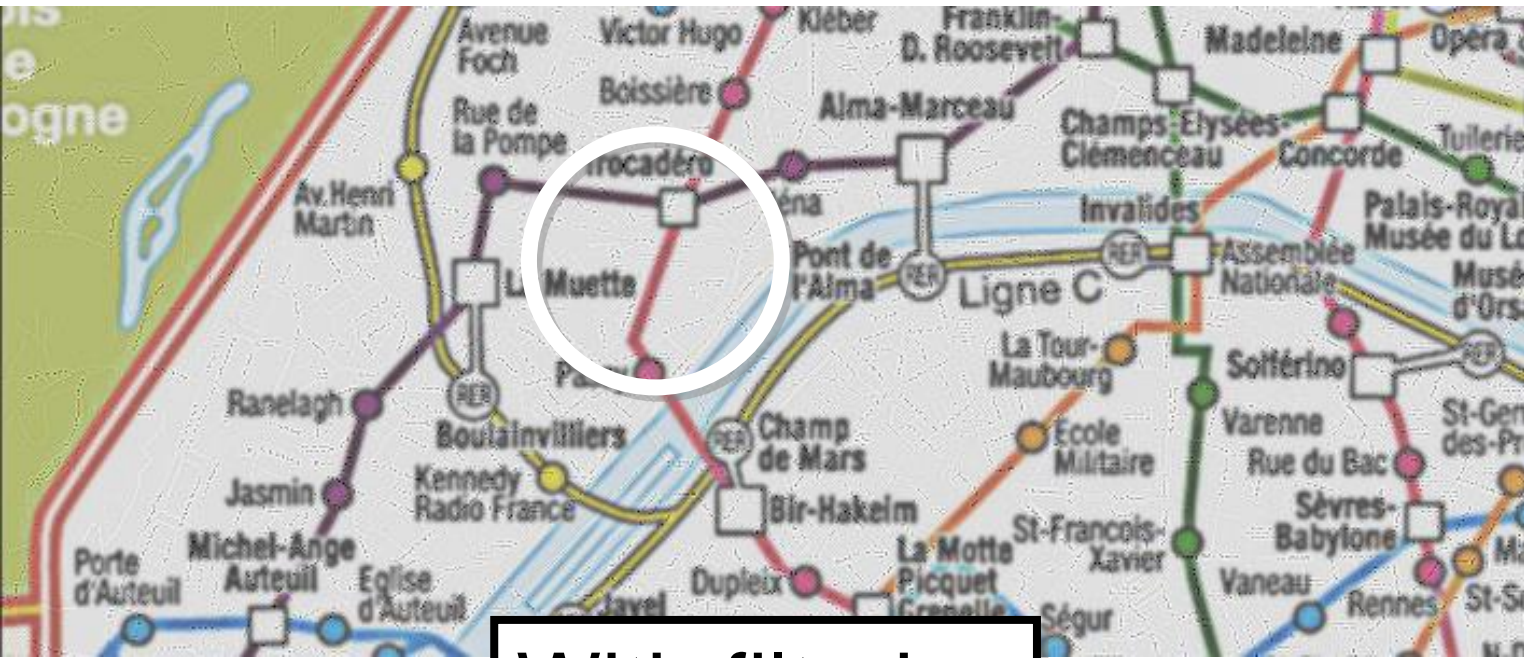
Alpha
Blending
+ contrast



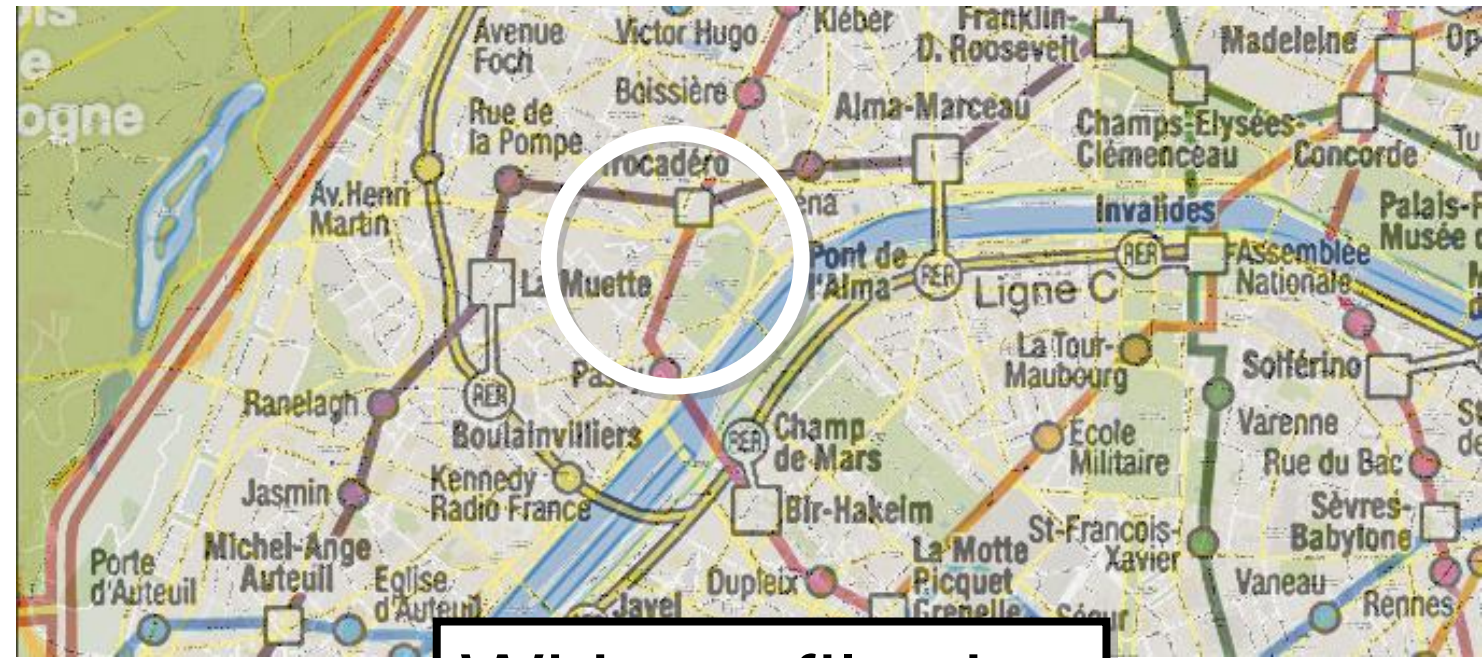
Hybrid-Image Visualization



Hybrid-Image Visualization



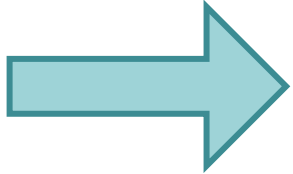
With filtering



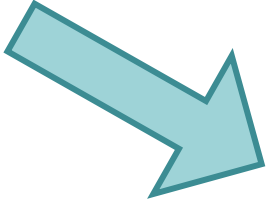
Without filtering



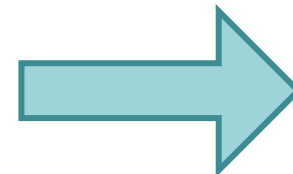
Hybrid-Image Visualization



Hi-pass
Filter
+ contrast



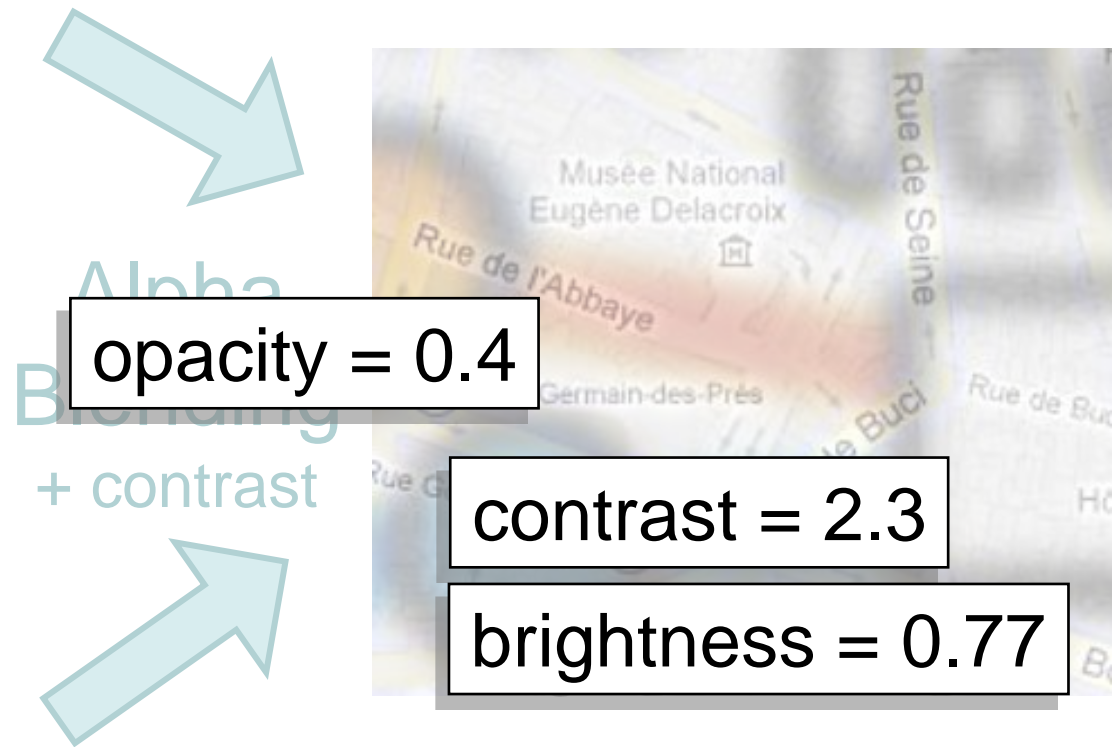
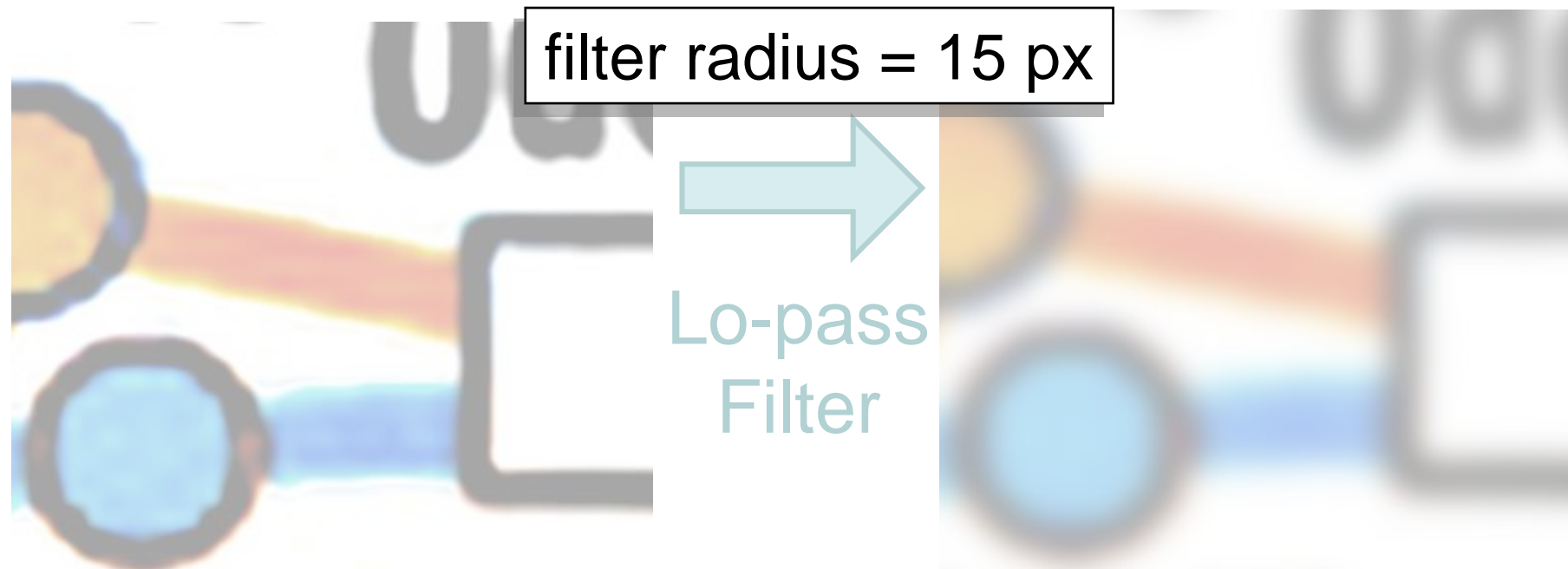
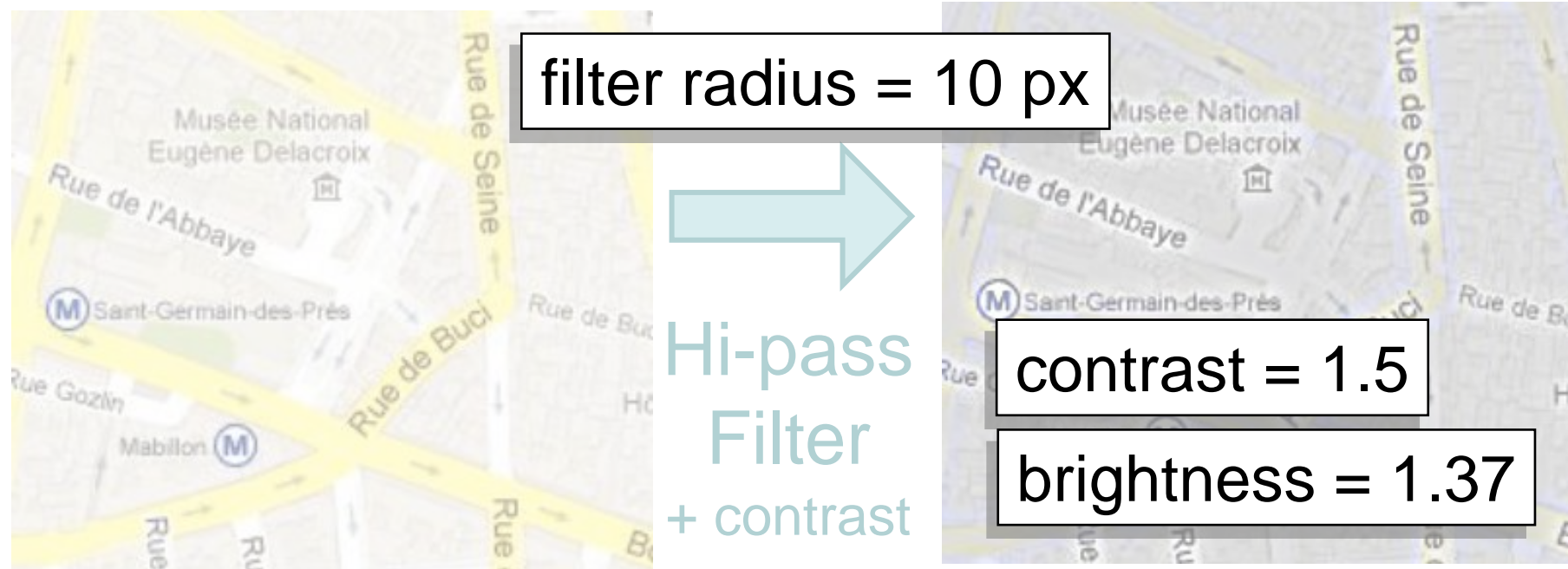
Alpha
Blending
+ contrast



Lo-pass
Filter



Hybrid-Image Visualization



Hybrid Image Maker

The image displays the Hybrid Image Maker software interface. It features a main 3D visualization window with a viewer distance slider set to 0.7m. A settings panel titled "Hybrid renderer settings" is open on the right, containing various controls for rendering options and parameters. A 2D plot window is overlaid on the bottom, showing a power spectrum plot with multiple data series and a grid of resolution and distance values.

Hybrid renderer settings

- Draw background
- Draw near image
 - 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
- Draw power spectrum
- Log scale power spectrum y
- Highlight frequency band
- Frequency band midpoint: 49
- Frequency band width: 2

2D Plot Data

Resolution	Distance	Value
679.0px	400px	0.1m
400px	100px	0.025m
100px	40px	0.01m
40px	20px	0.005m
20px	10px	0.003m
10px	5px	0.001m

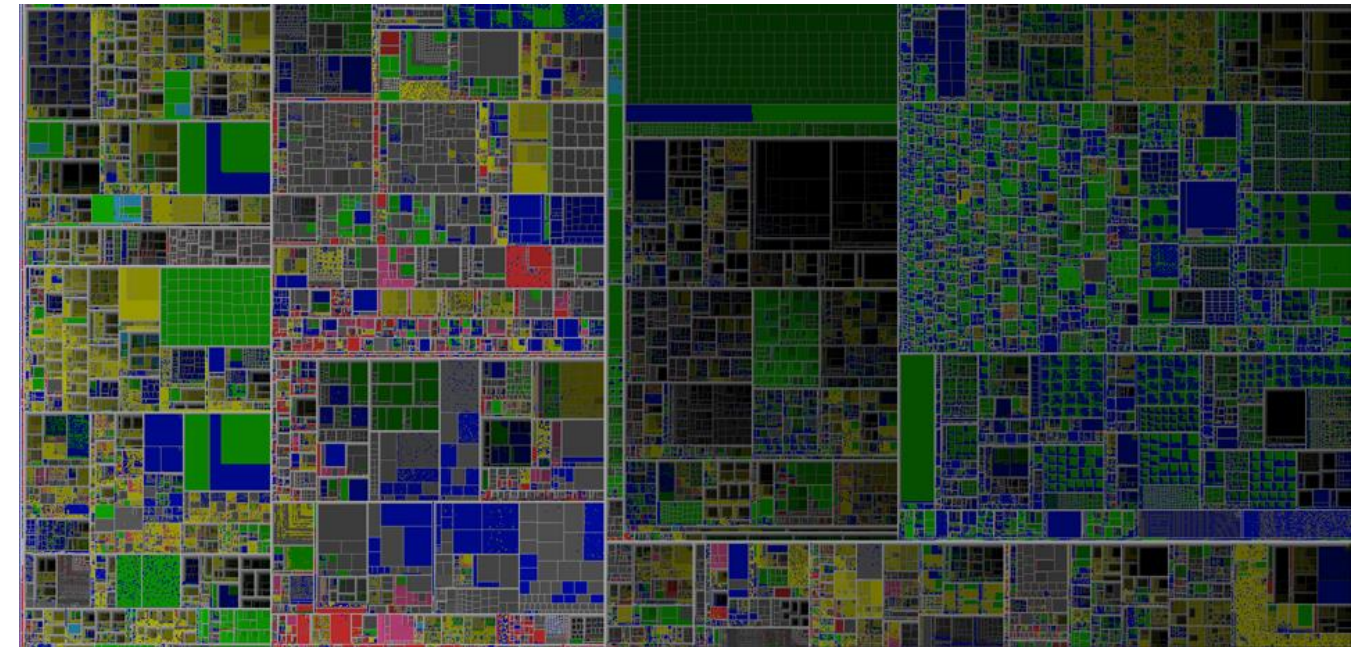
Hybrid Images for Large-Scale Visualizations

- **Theoretical grounding**
why & when use hybrid images?

- **Tools**
how to support their creation?

- **Examples**
what are they really good for?

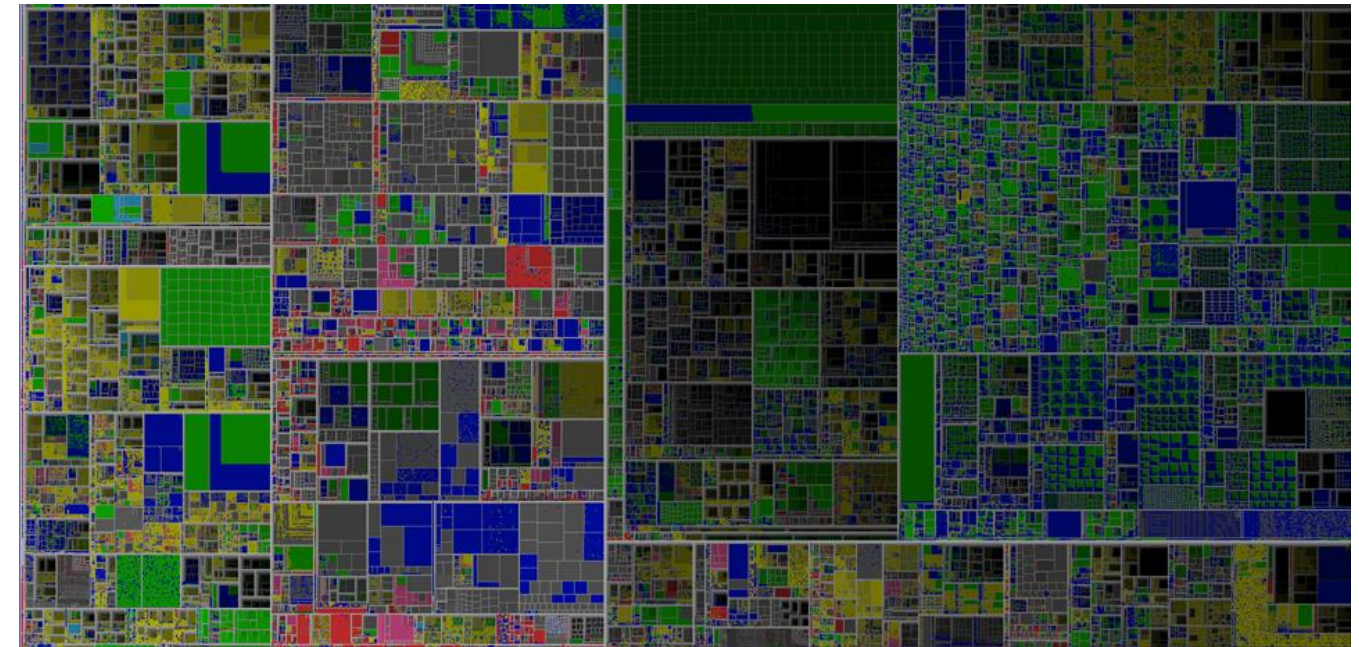
- **Design principles**
how to build effective ones?



Hybrid Images for Large-Scale Visualizations

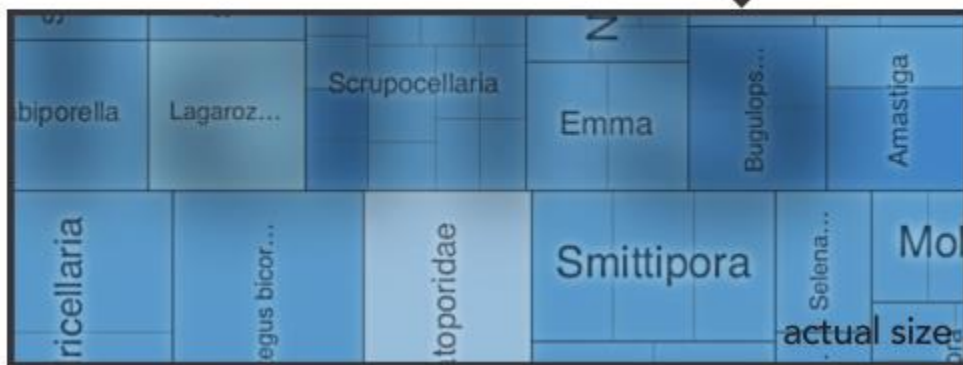
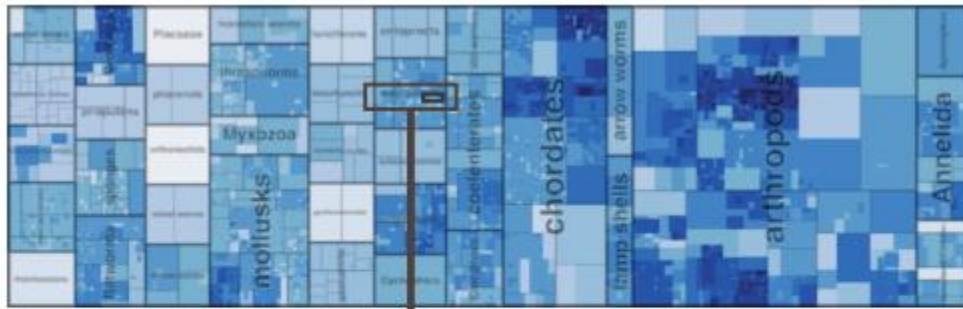
- **Theoretical grounding**
why & when use hybrid images?
- **Tools**
how to support their creation?

- **Examples**
what are they really good for?
- **Design principles**
how to build effective ones?



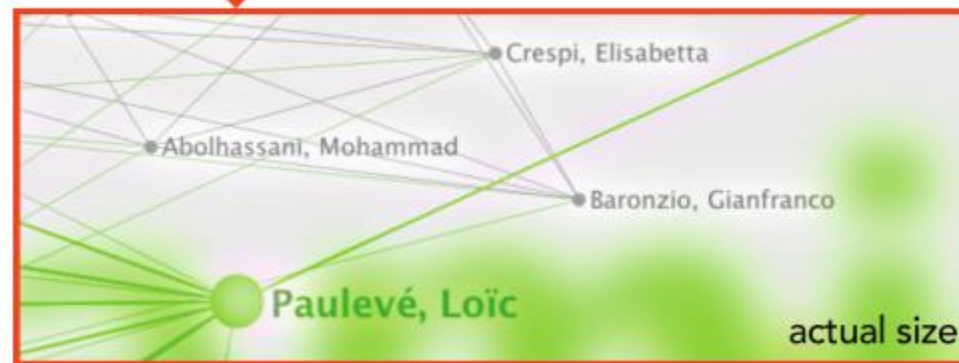


Examples

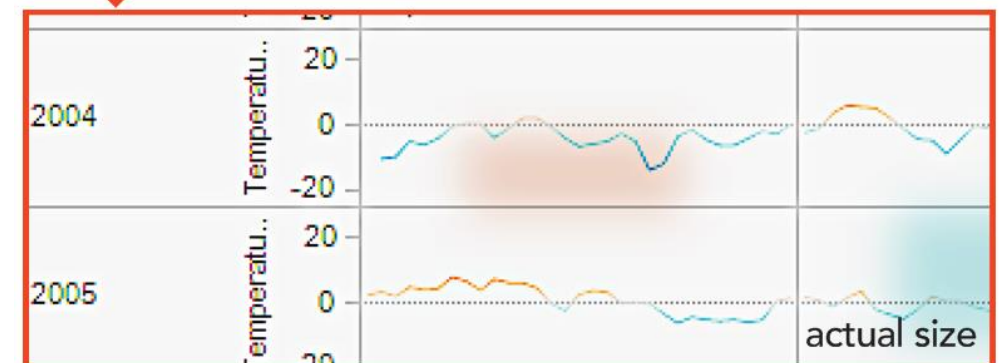
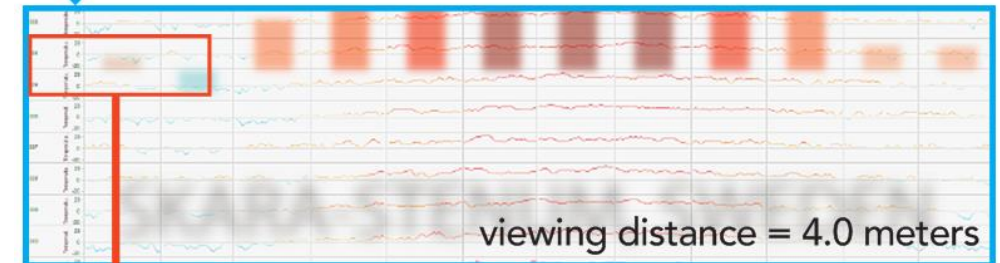
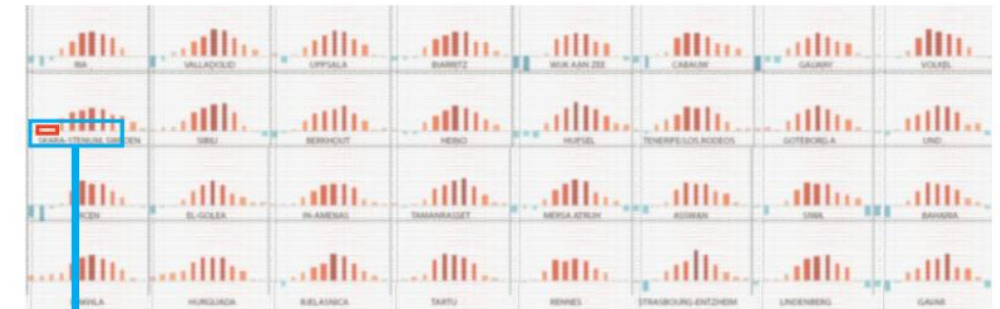


Tree of Life Treemap

...and more



co-authorship network



temperature data



HI-Visualization Techniques

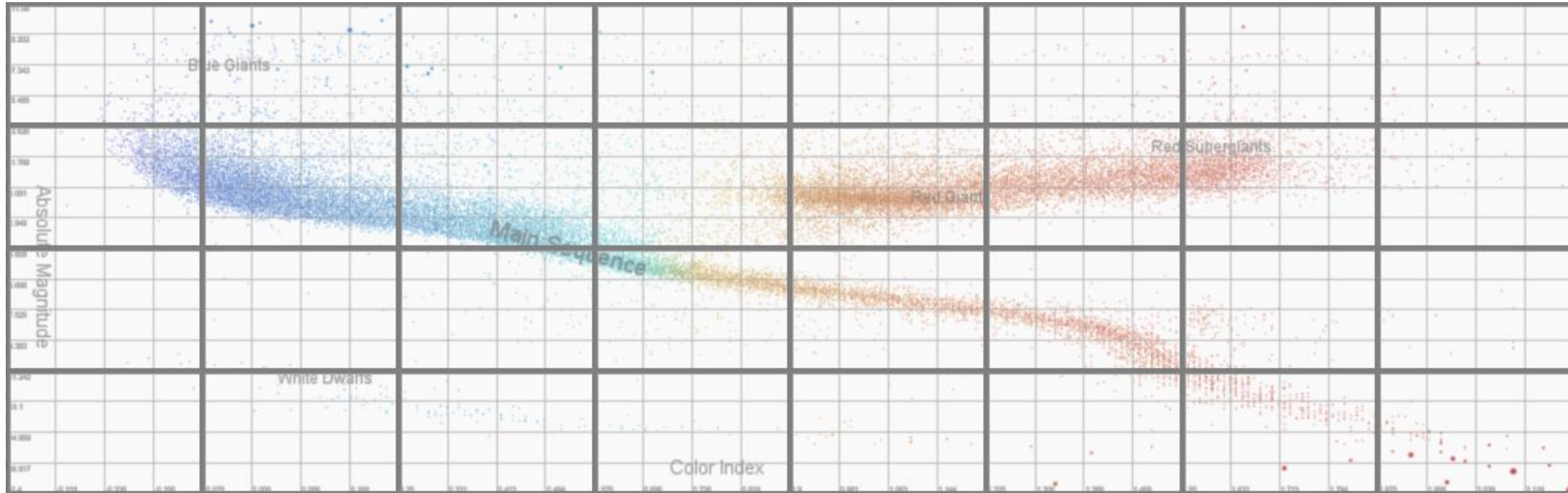
- Mixing multiple visualizations
- Navigation aids & summaries



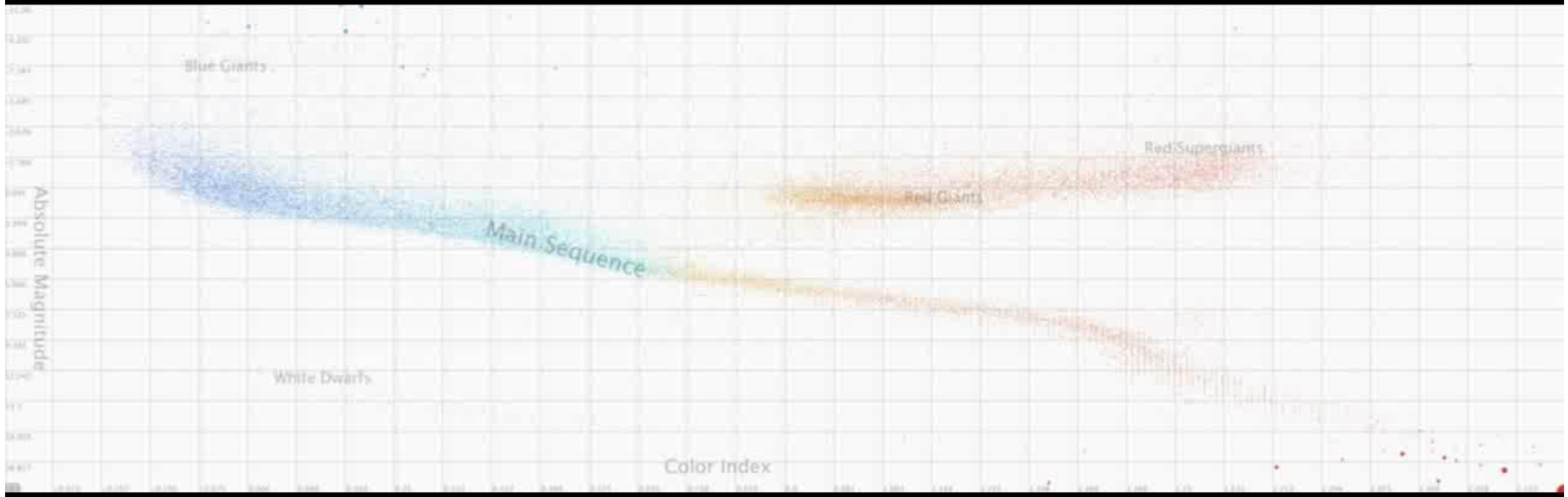


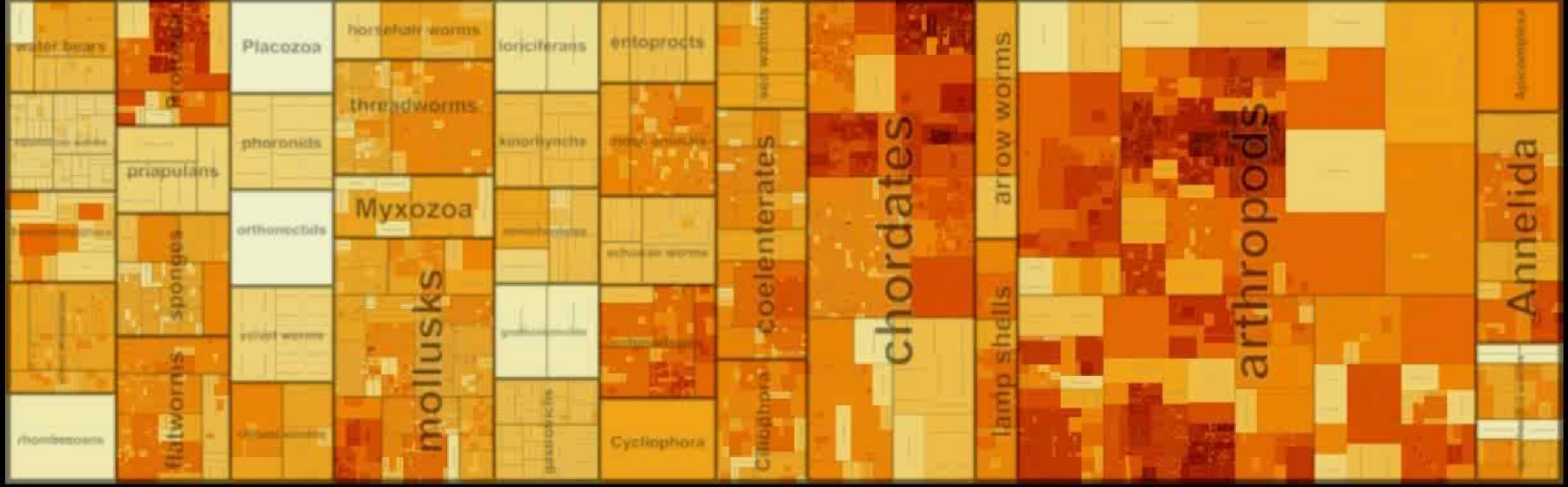
HI-Visualization Techniques

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



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



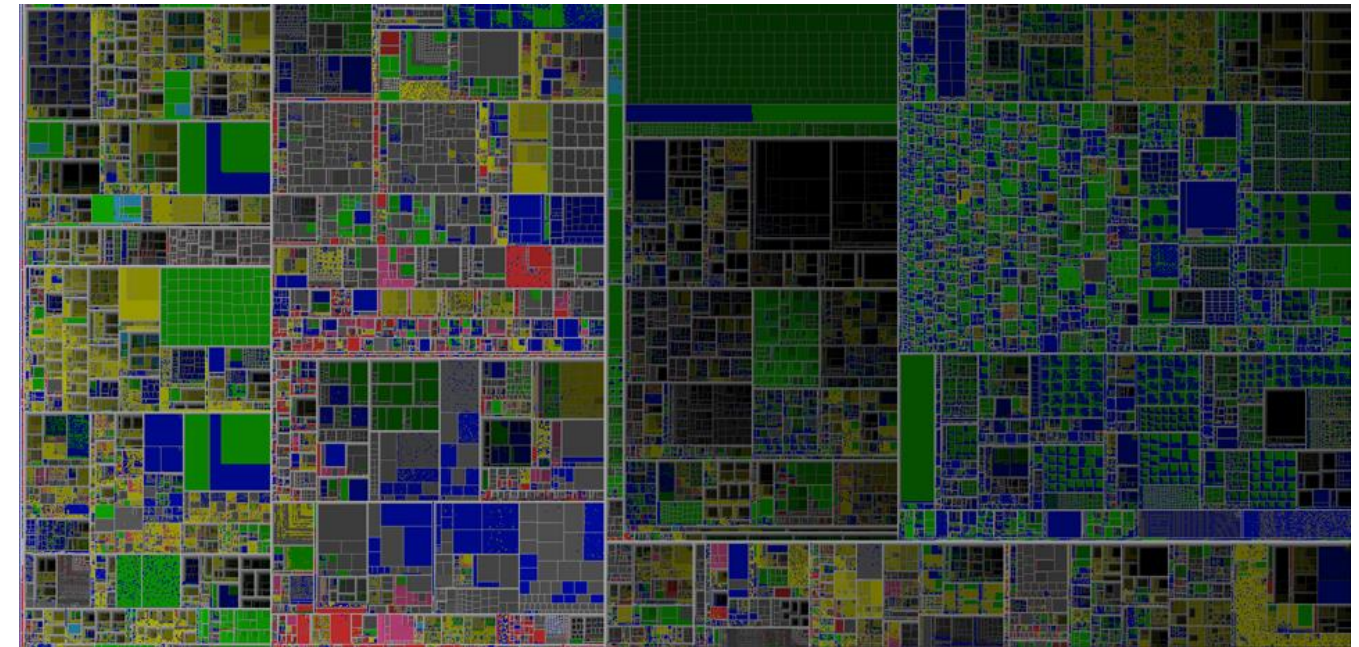


Limitations

- 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?





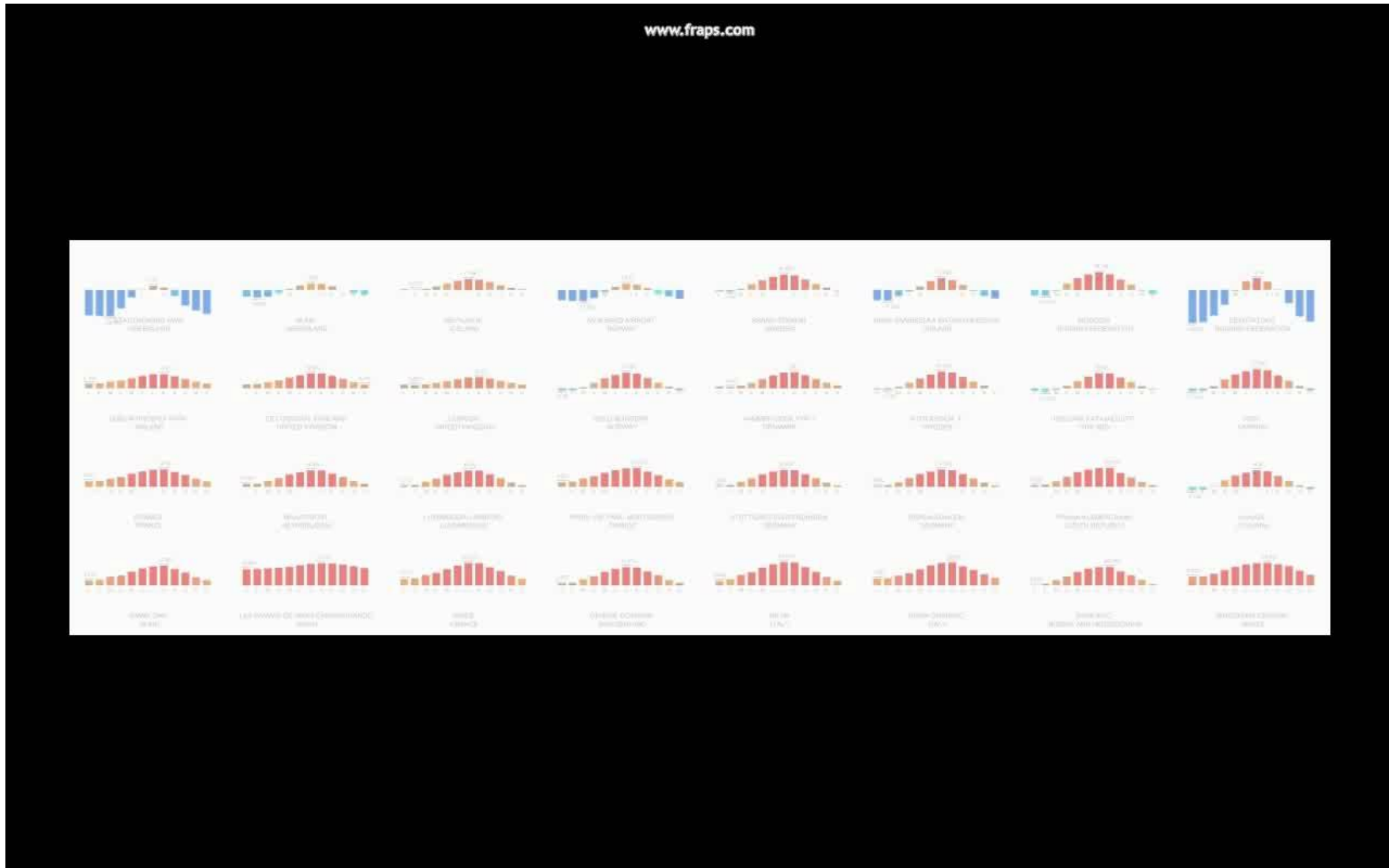
<http://aviz.fr/hybridvis>

Funded by: ANR-11-JSo2-003

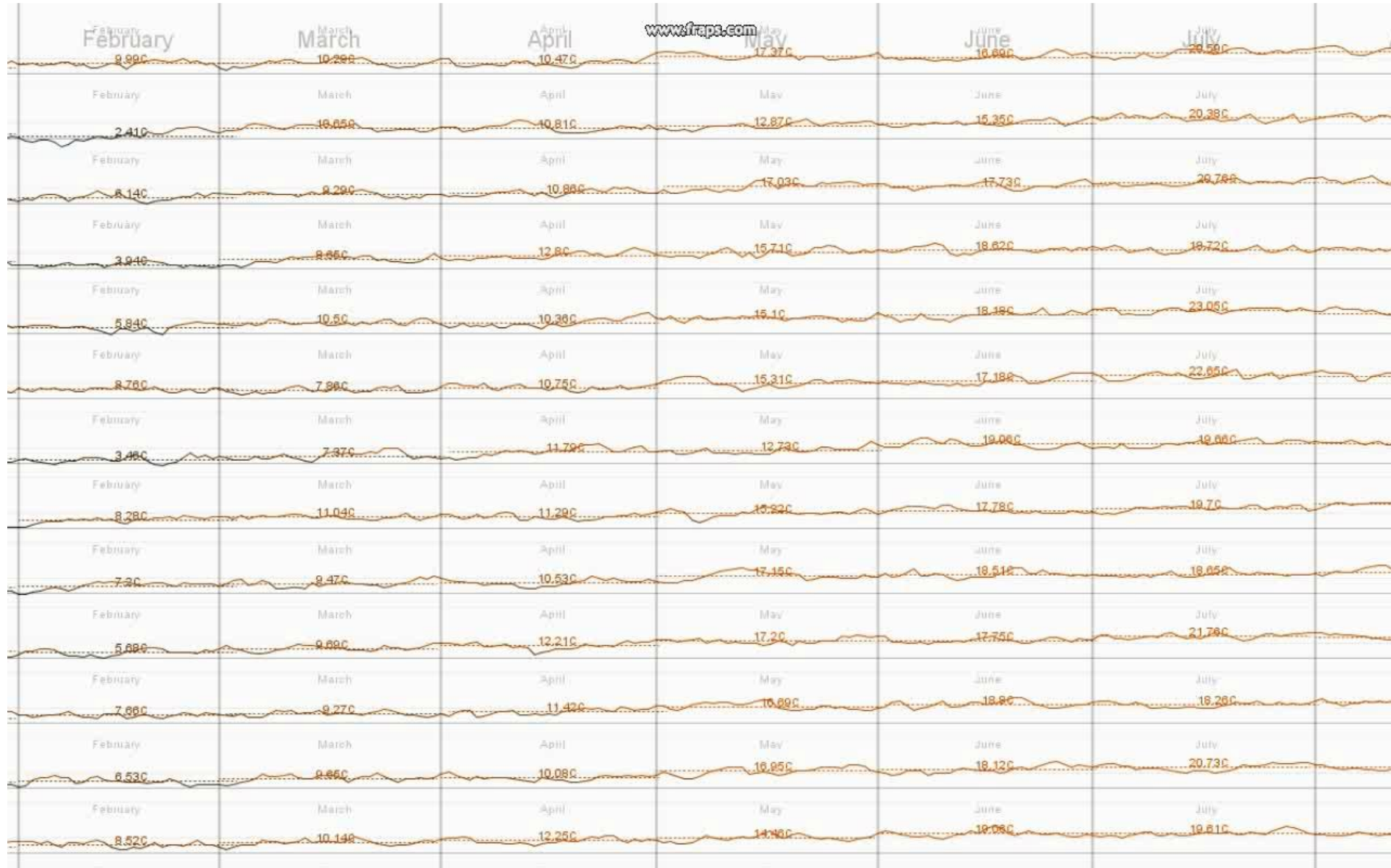


Question Slides

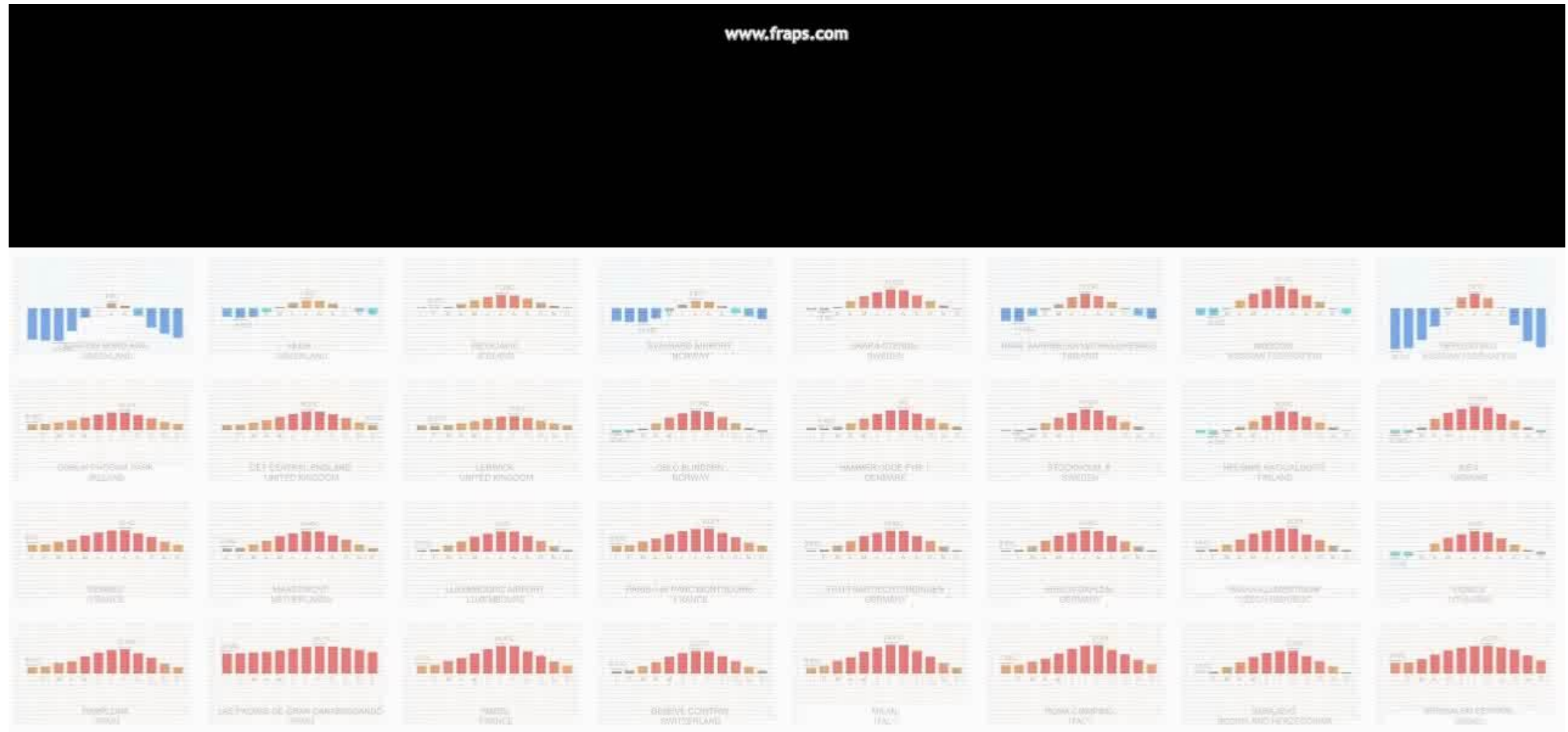
Video: Information Loss When Walking Close



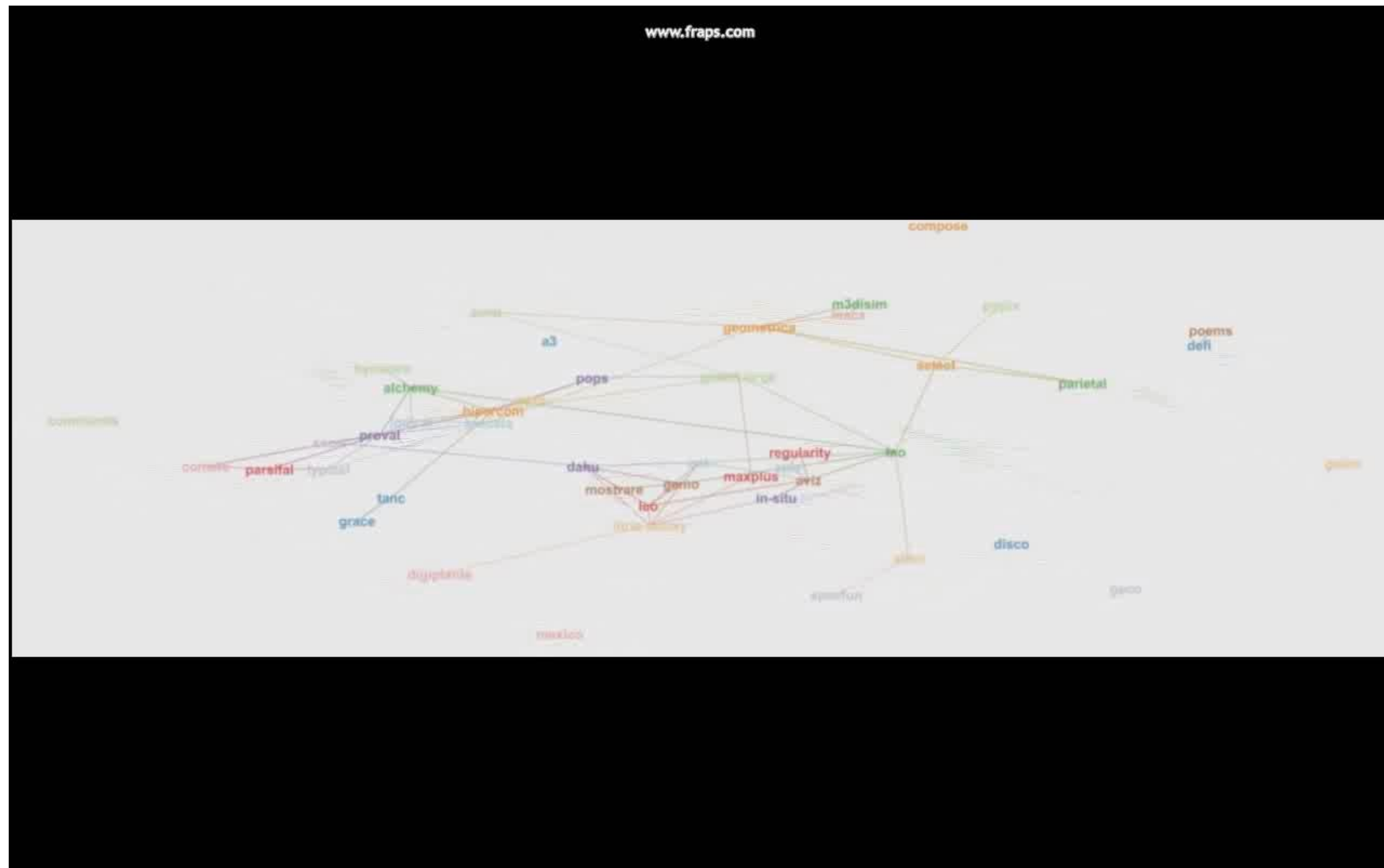
Video: Mental Aggregation



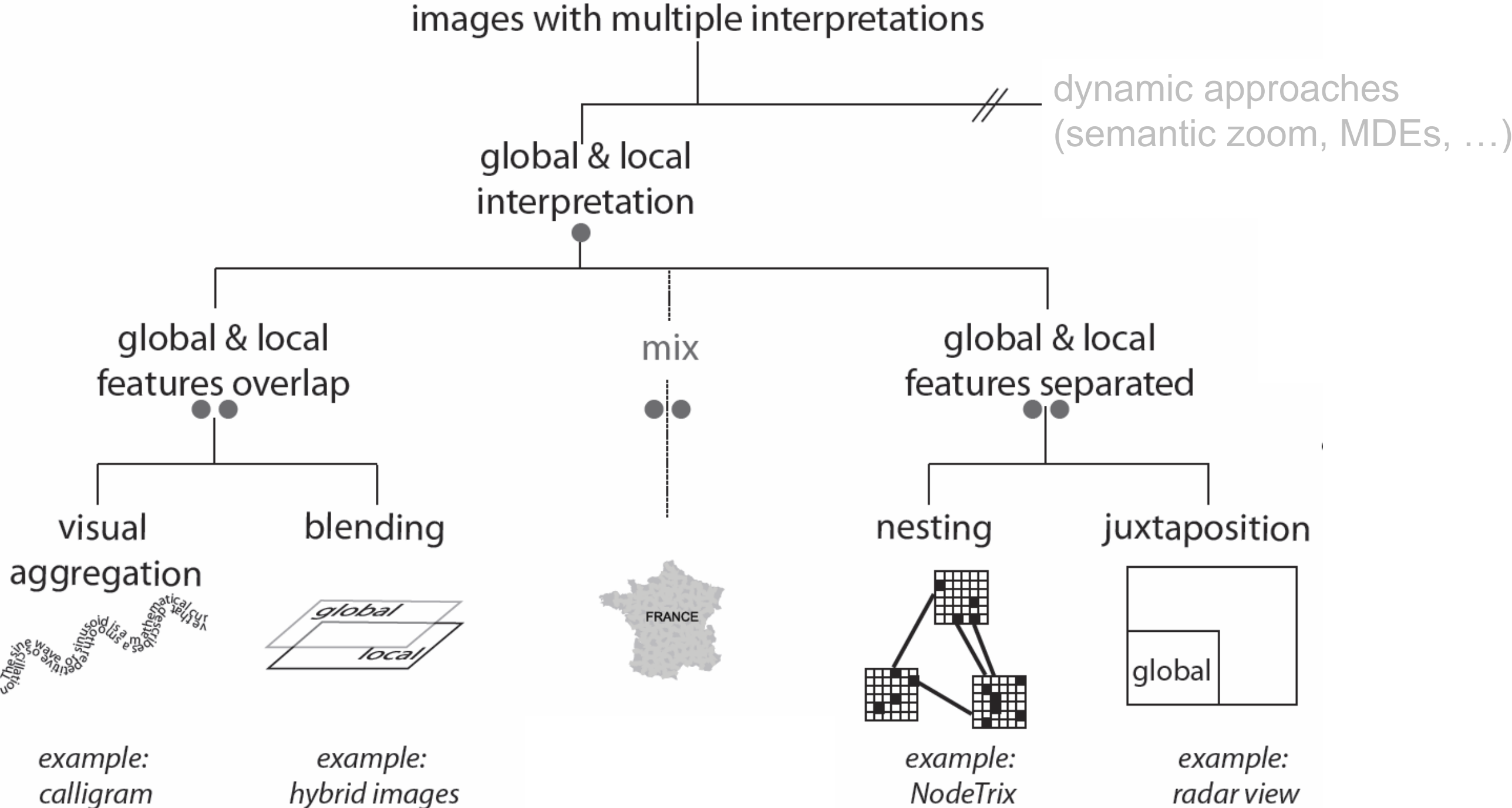
Video: Alpha blending



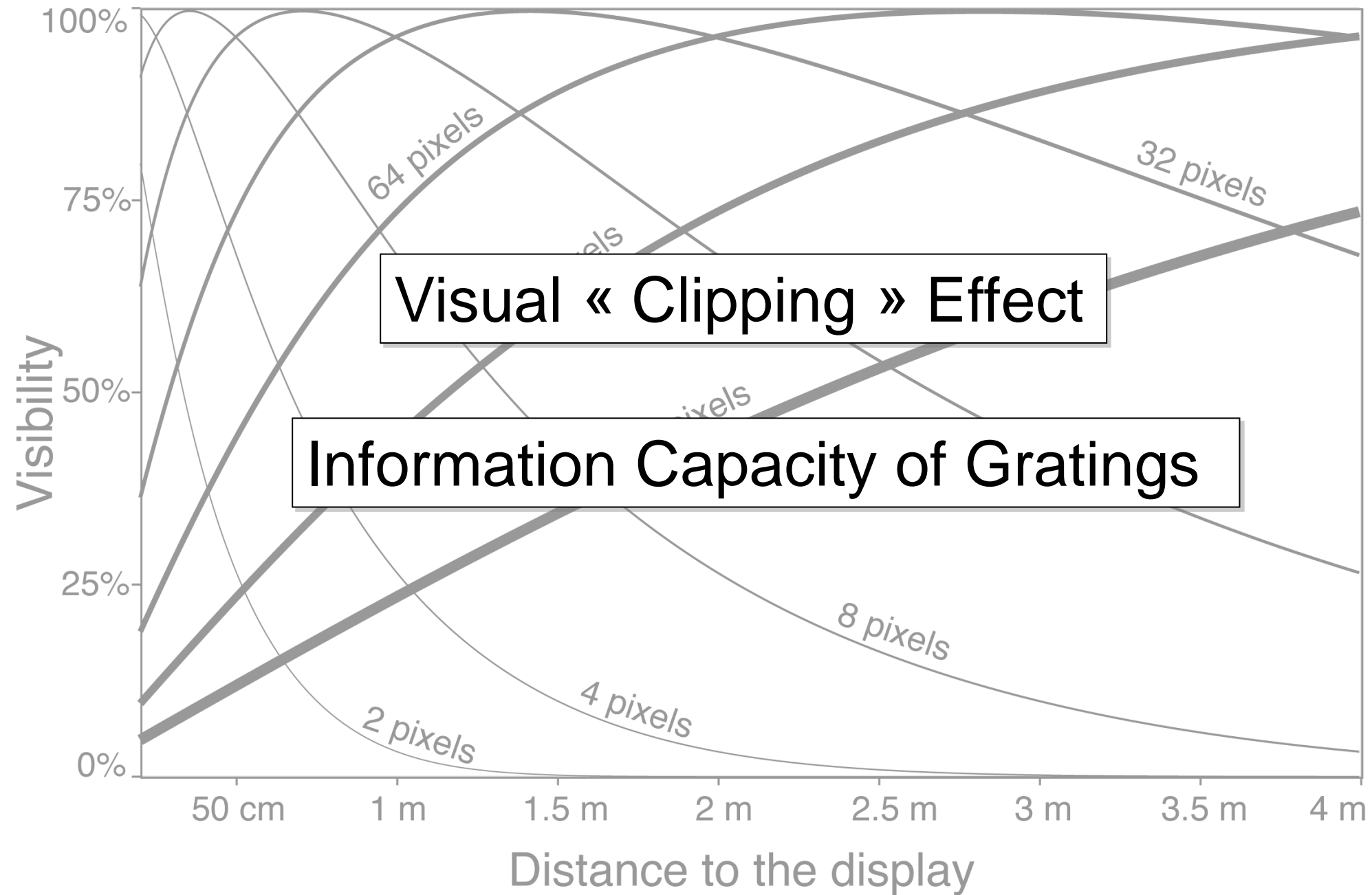
Video: Graph vis



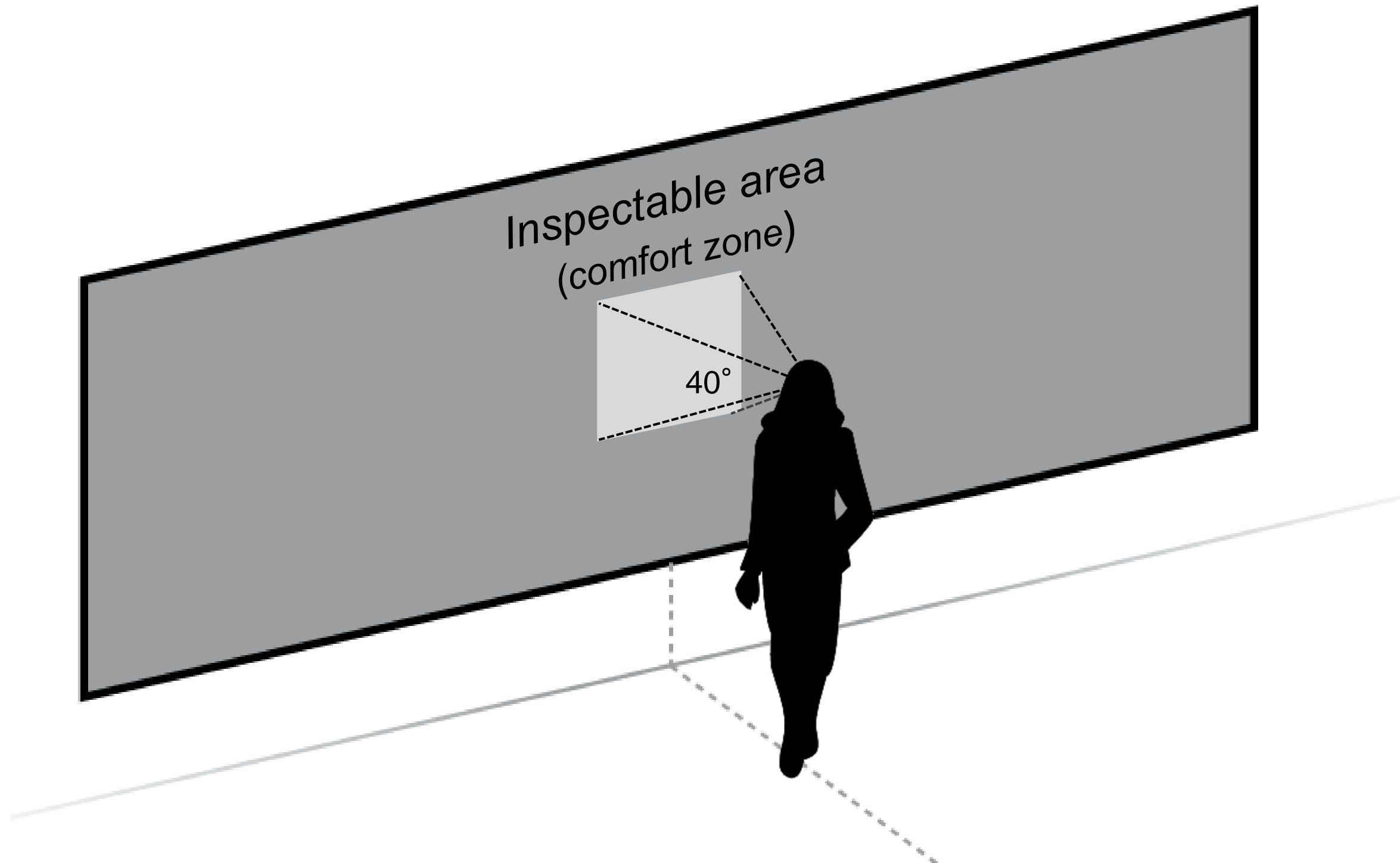
Past Approaches



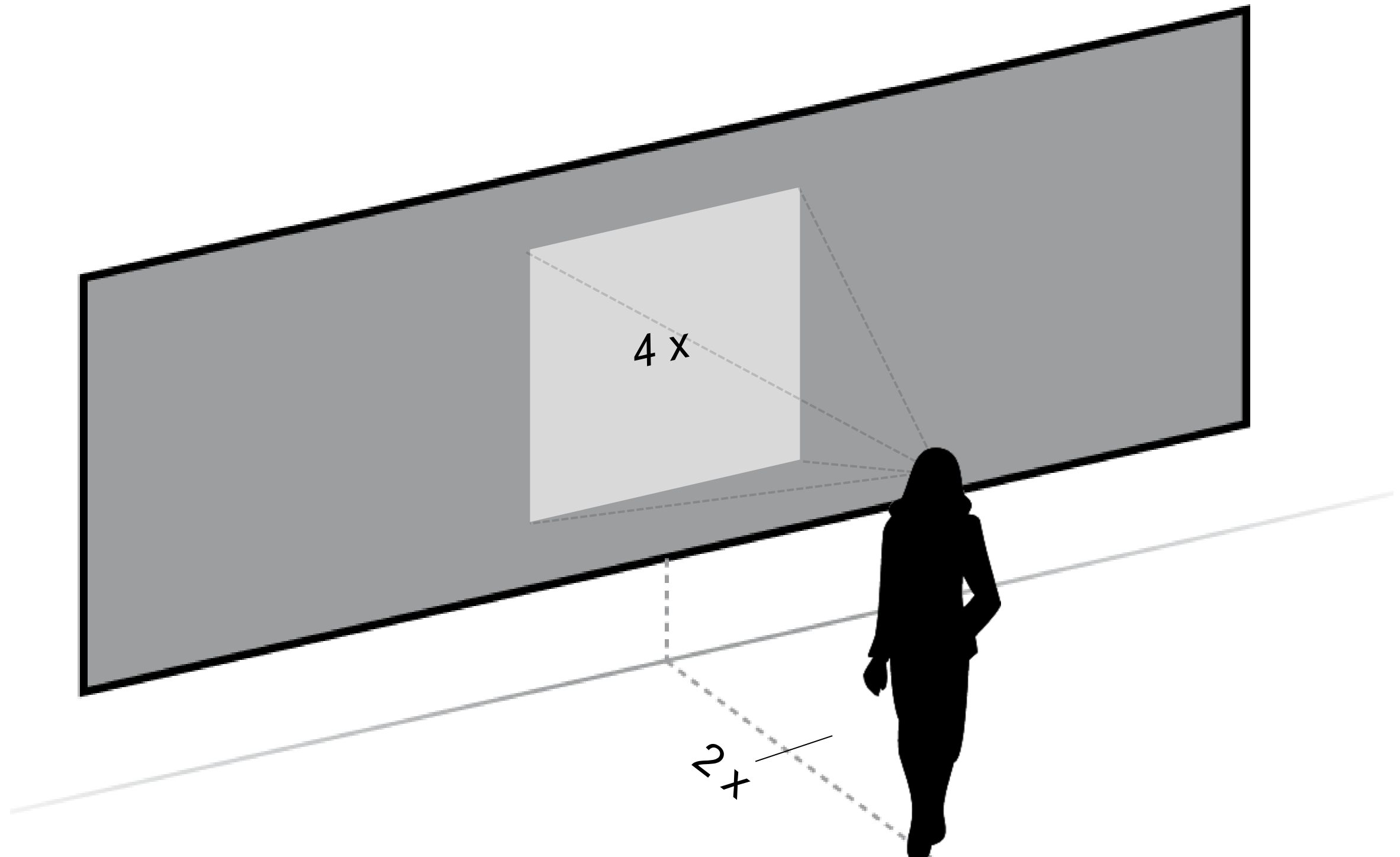
What do we Perceive from a Large Display?



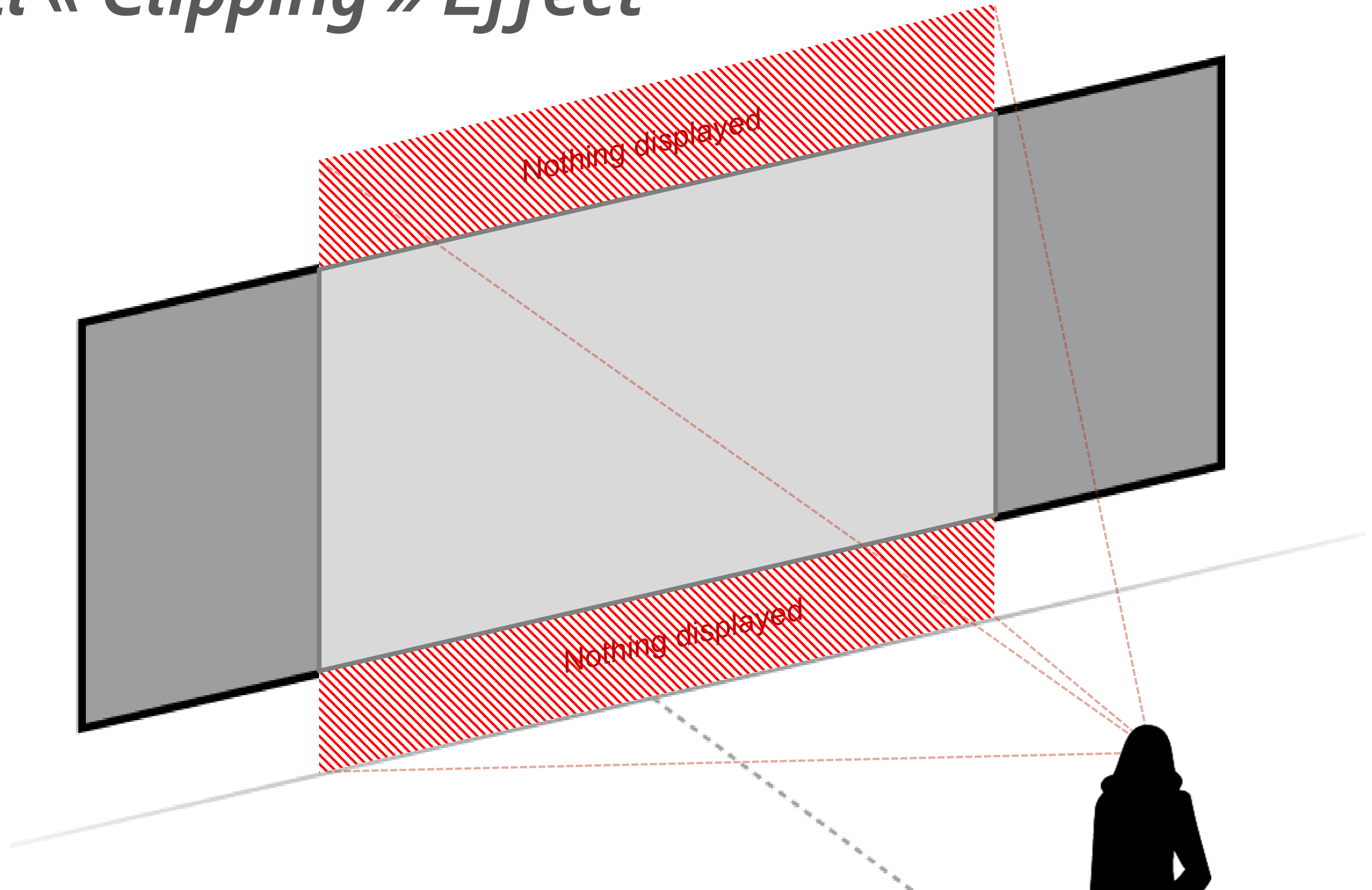
Visual « Clipping » Effect



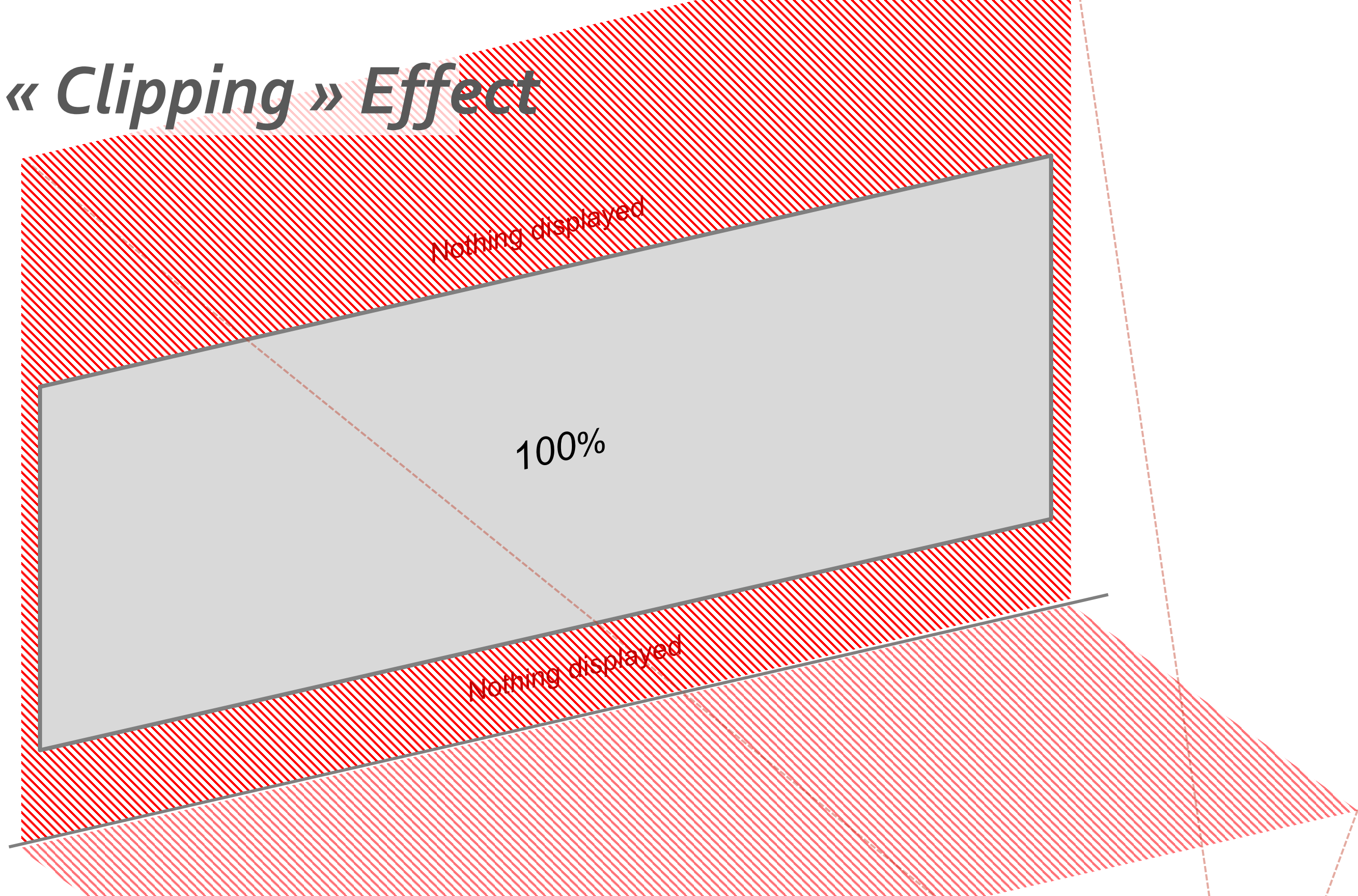
Visual « Clipping » Effect



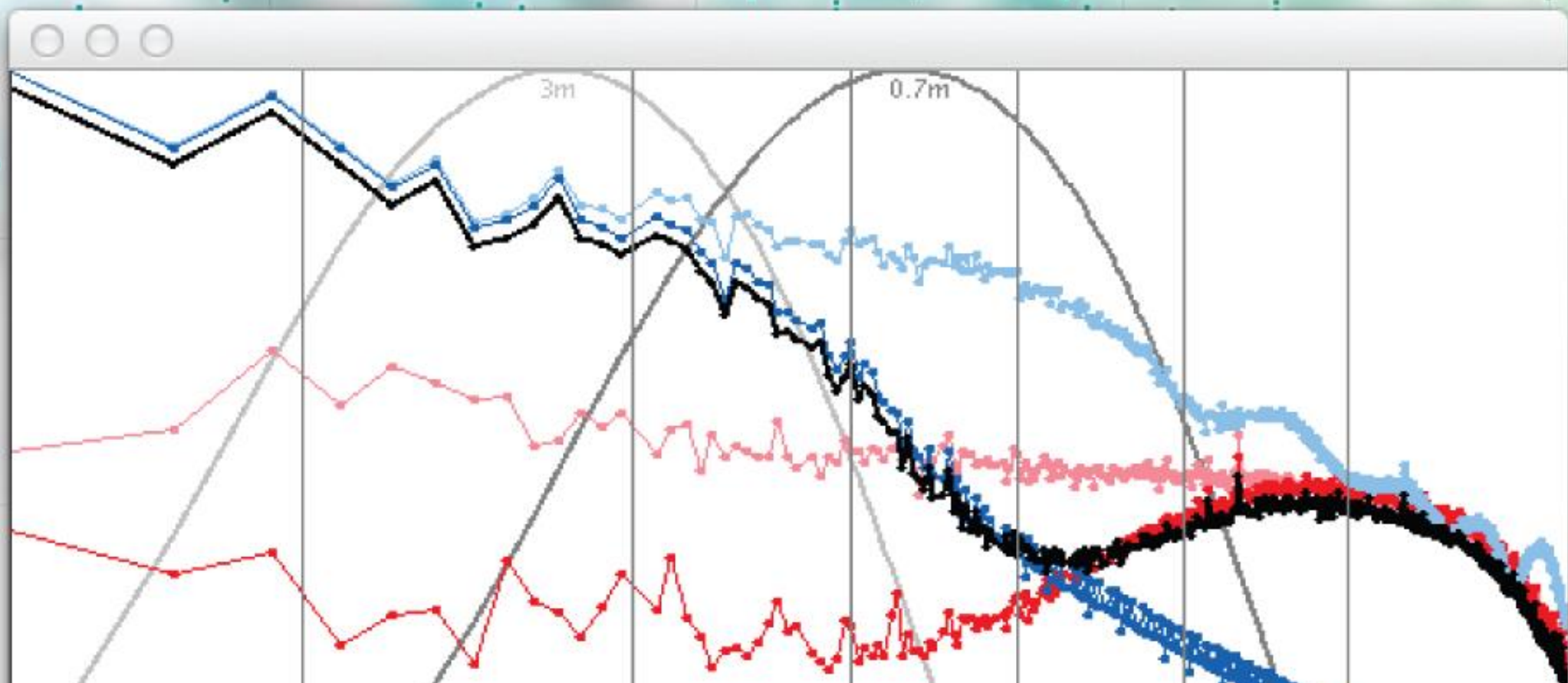
Visual « Clipping » Effect



Visual « Clipping » Effect



Hybrid Image Maker



Hipass radius	5
Transparent hipass	<input type="checkbox"/>
Hipass contrast	1.5
Hipass brightness	1.5
Near image opacity	1
Draw far image	<input checked="" type="checkbox"/>
Blur radius	30
Far image opacity	0.5
Post contrast	2
Post brightness	0.8
Draw bezels	<input checked="" type="checkbox"/>
Draw settings	<input type="checkbox"/>

Hybrid Image Maker



Frequency highlighter

