





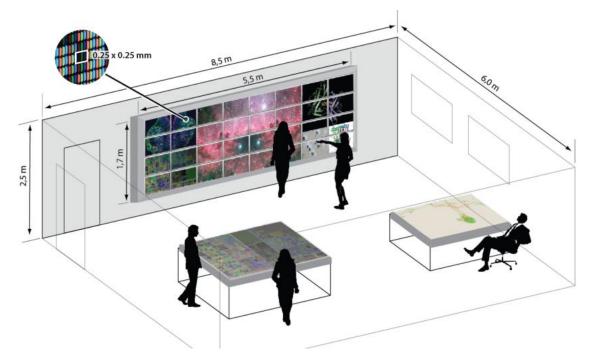


## Hybrid-Image Visualization for Large Viewing Environments

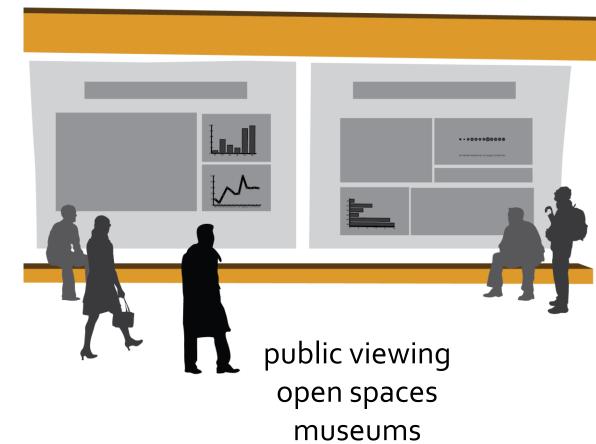
Petra Isenberg, Pierre Dragicevic,

Wesley Willett, Anastasia Bezerianos, Jean-Daniel Fekete

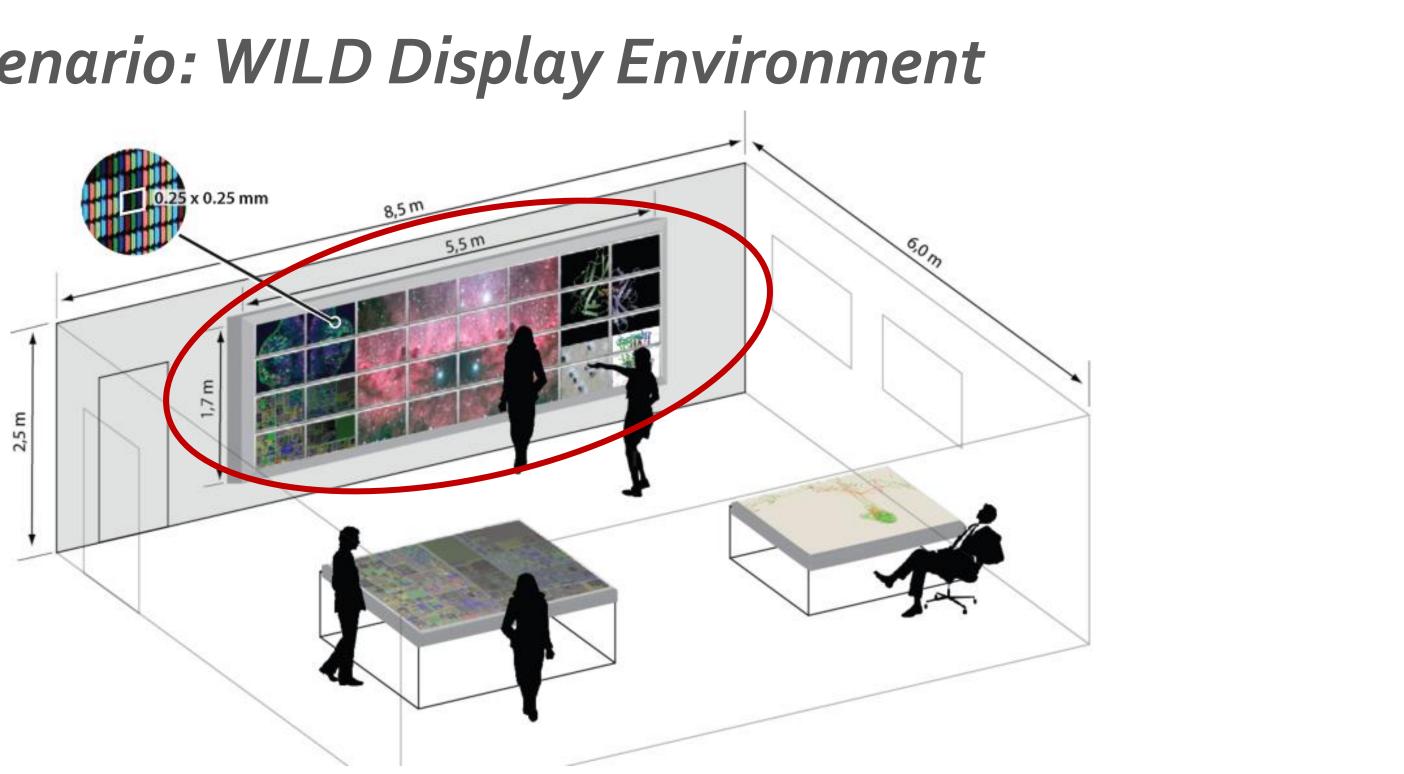
## Large Viewing Environments



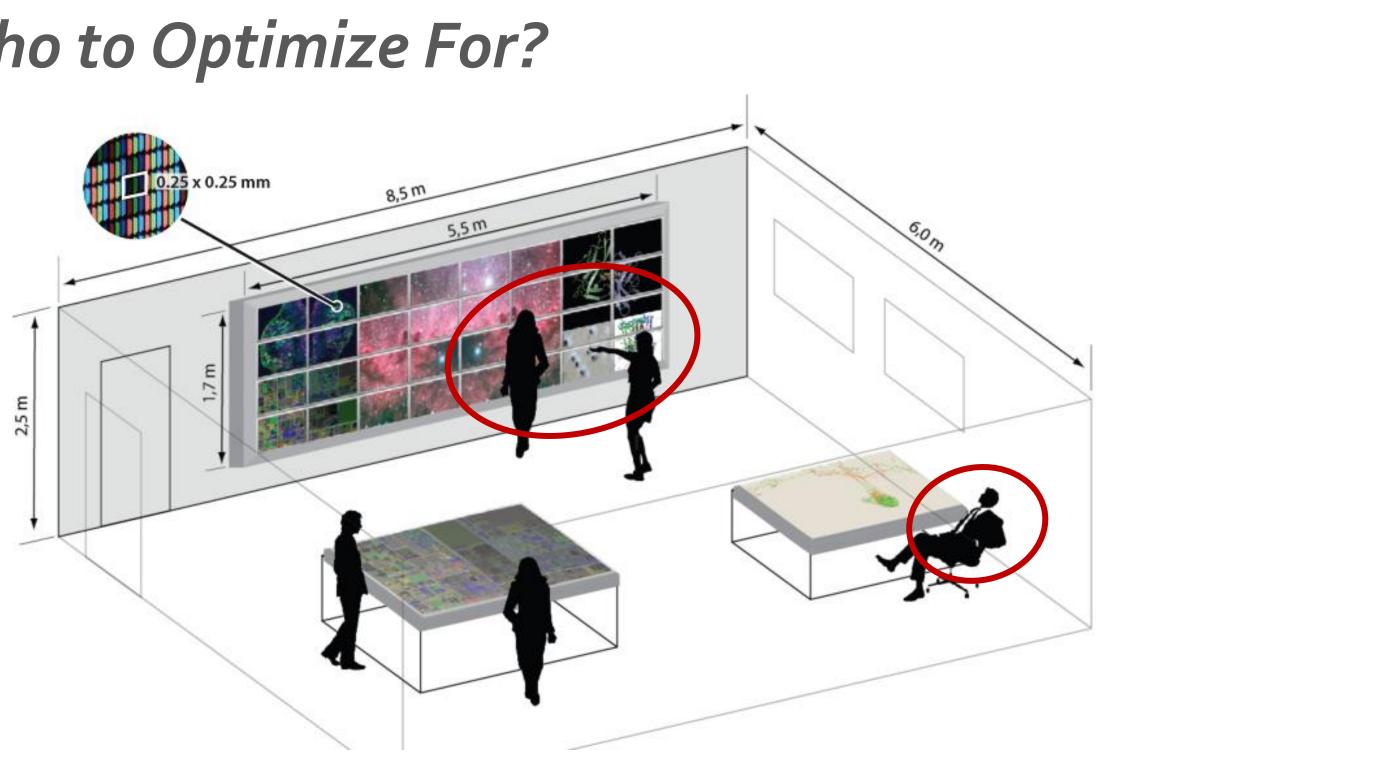
large displays meeting rooms / war rooms emergency response rooms



## Scenario: WILD Display Environment



Who to Optimize For?



#### Example Data

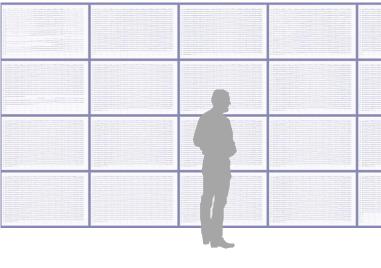
#### 23 years of daily temperatures for 32 cities

ation, Count:	ry, Statio	on ID,	SOUID,	Date,	Temper	ature	(decidegrees	Celsi	ius), 1	Cempei	cature	Quali	ty		
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RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-02,	-13,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-03,	-2,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-04,	-12,	0									
RLIN-DAHLEM,	GERMANY,	41,	133,1990	-01-05,	Ο,	0									l
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RLIN-DAHLEM,	GERMANY,	41,	133,1990	-01-07,	-40,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-08,	6,	0								Ī	
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-09,	35,	0									
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RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-11,	48,	0									
RLIN-DAHLEM,	GERMANY,	41,	133,1990	-01-12,	60,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-13,	22,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-14,	30,	0									
RLIN-DAHLEM,	GERMANY,	41,	133 <b>,</b> 1990	-01-15,	42,	0									

#### Naïve Approach

#### Optimize for one specific viewing distance

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	MANC NAME	LUXENBOURG ARPORT	PARIS-14E FARC MONTSOURIS				
	21.7% M A M J J A S O N D						
APLONA LAS PAI SPAIN	ALMAS DE GRAN CANARIA/GANDO SPAIN	NIMES FRANCE	GENEVE COINTRIN SWITZERLAND	MILAN ITALY	ROMA CIAMPINO ITALY	SARAJEVO BOSNIA AND HERZEGOVINA	JERU
		NINES FRANCE	SWITZERLAND		ITALY		JERU



detail from close

#### Problem: detailed information lost

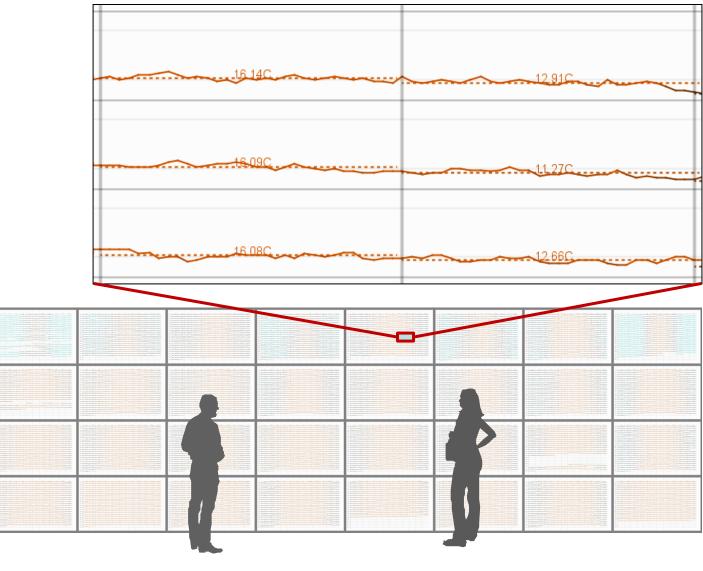
Problem: mental aggregation, comparison

6

### Naïve Approach

#### Optimize for one specific viewing distance

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detail from close

#### Problem: detailed information lost

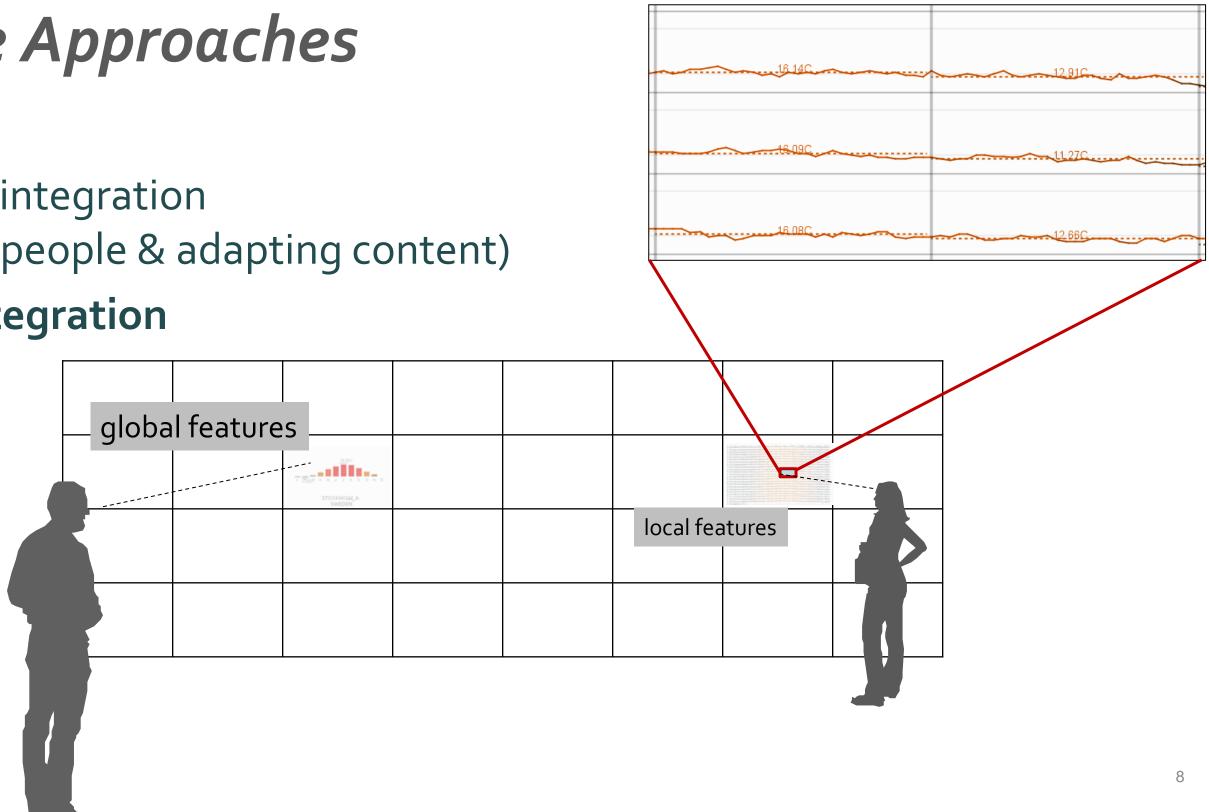
Problem: mental aggregation, comparison

7

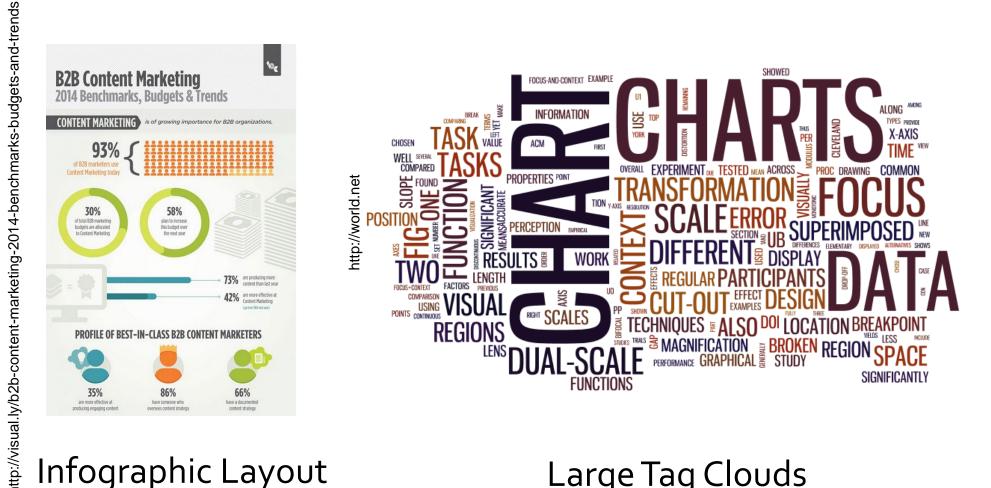
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## Possible Approaches

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



#### Juxtaposition: global & local features next to each other

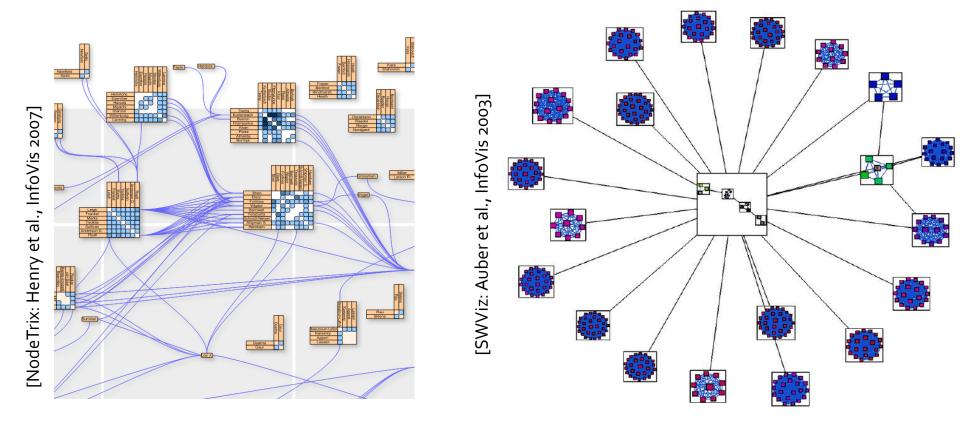


Infographic Layout

Large Tag Clouds

9

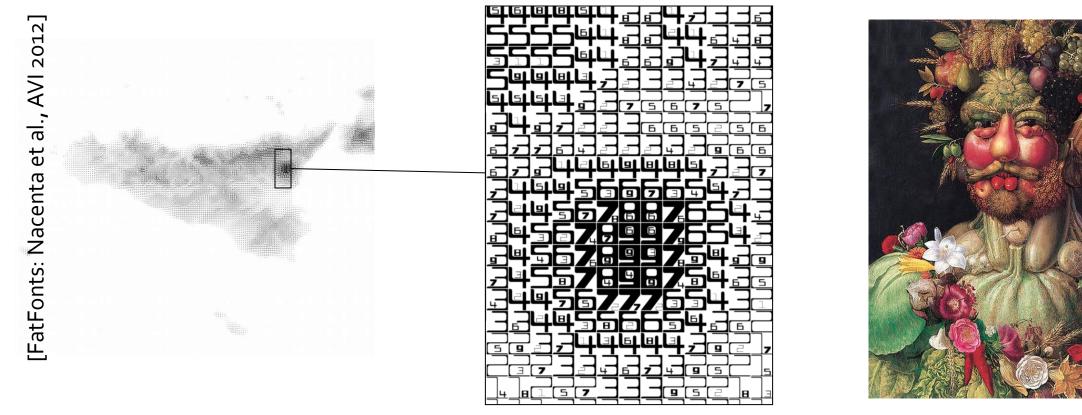
#### Nesting: local inside global features



NodeTrix

SWViz

#### Visual aggregation: local form global features



FatFonts

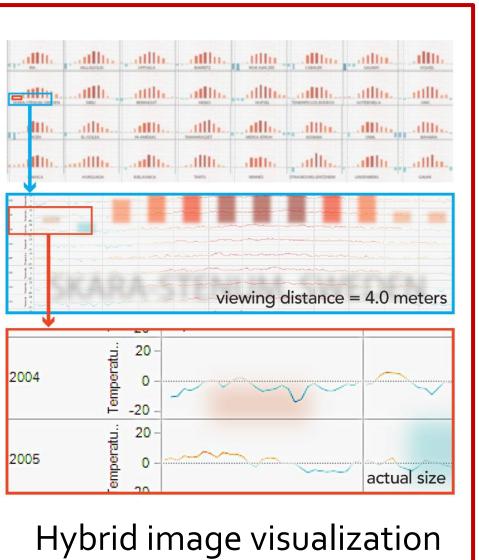
Arcimboldo Paintings, Calligrams

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#### **Blending**: local & global features overlap



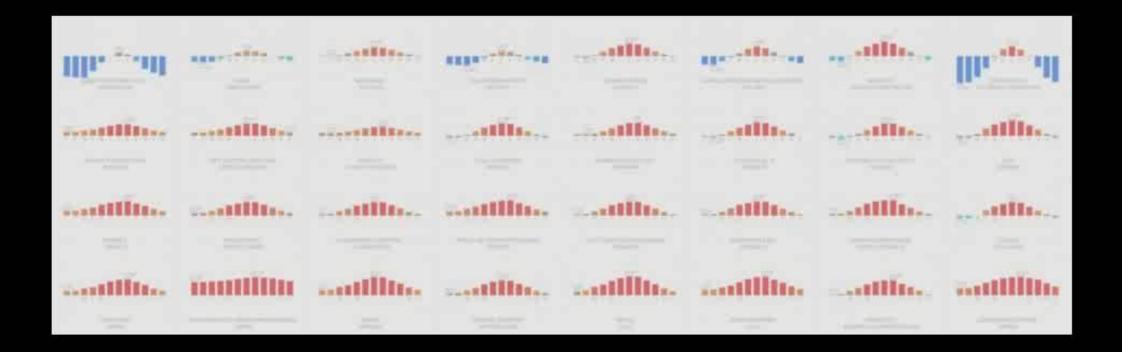
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	Sense About Gravity	Jakub Narębski 1,144 • 1 • 10	Jason Heine
674	Ames's Window Optical Illusion Will	Joel Coehoorn 39.9k • 6 • 71 • 1	FreeMemory
014	Blow Your Mind	Jason Heine <b>2,996</b> • 7 • 30	Mitch Wheat
552	A Harvard Psychiatrist Explains Zombie	James Hopkin 3,861 • 3 • 17	Michael Kohr
202	Neurobiology	Matthew Vines 1,373 • 1 • 10	Mehrdad 29
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438	Is Aging Optional?	Visage 2,551 • 1 • 12	akappa 1,09
		Brian Agnew 8,576 • 3 • 16	jrockway 4,9



Map regions over map detail

#### Label detail over bar chart

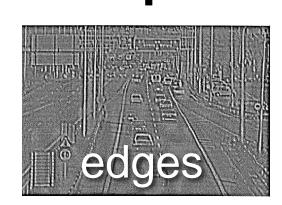
www.fraps.com



## Hybrid Images

• Schyns & Oliva, 1994



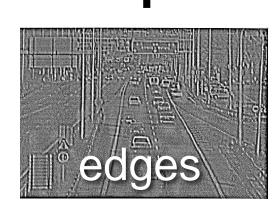




## Hybrid Images

• Oliva, Torralba & Schyns, 2006





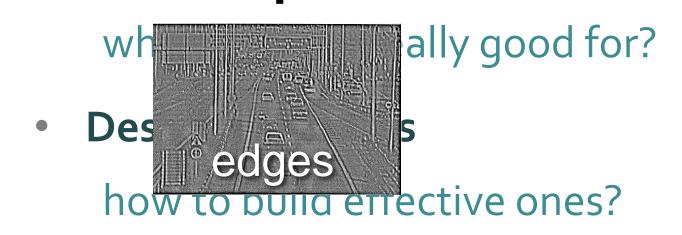
## **Our Contributions**

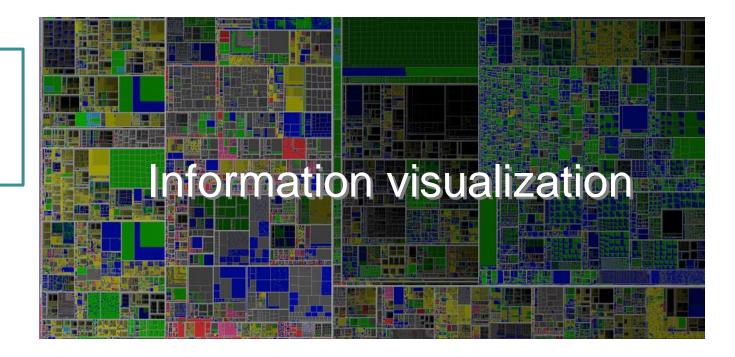
 Theoretical grounding why & when use hybrid images?

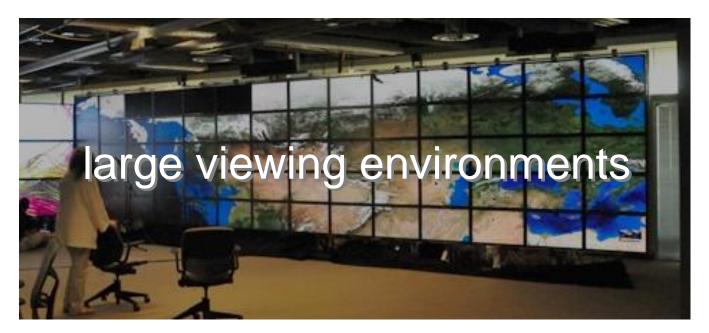
their creation?

Toc ho blurred

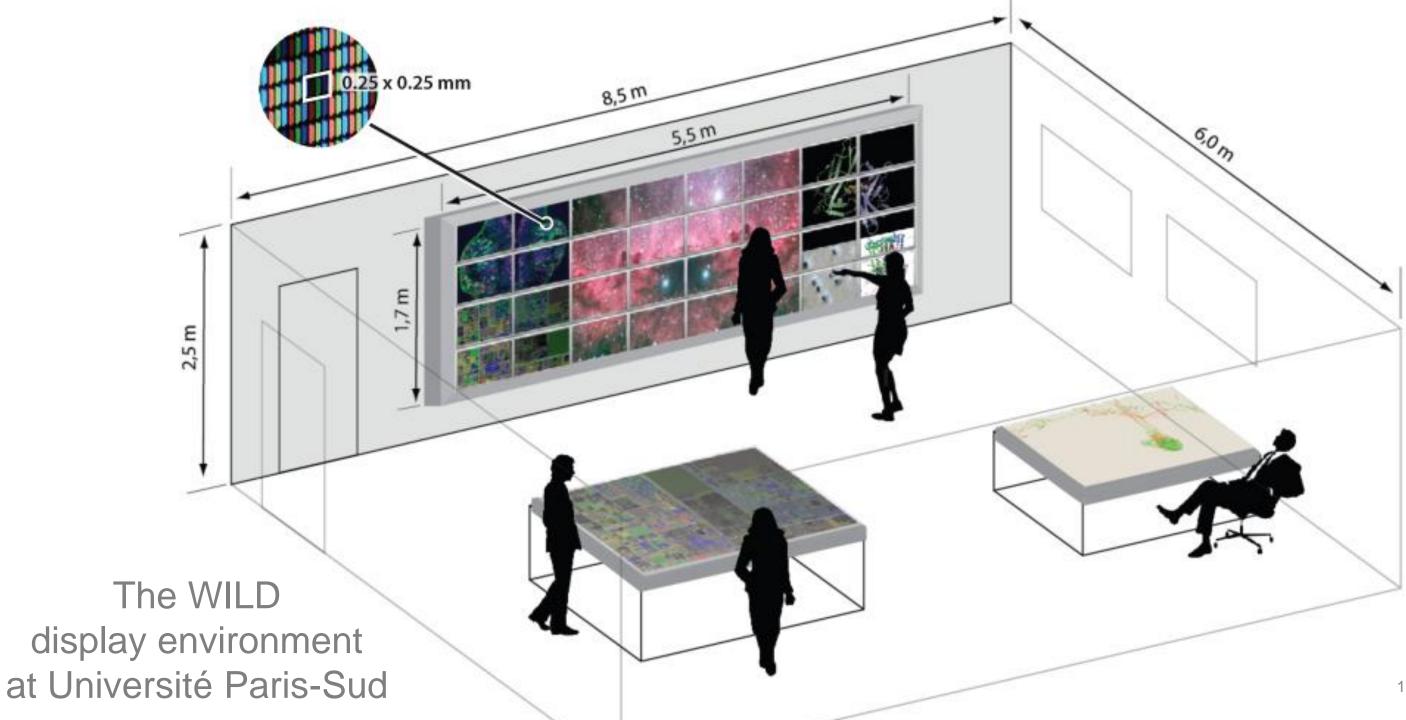
Examples





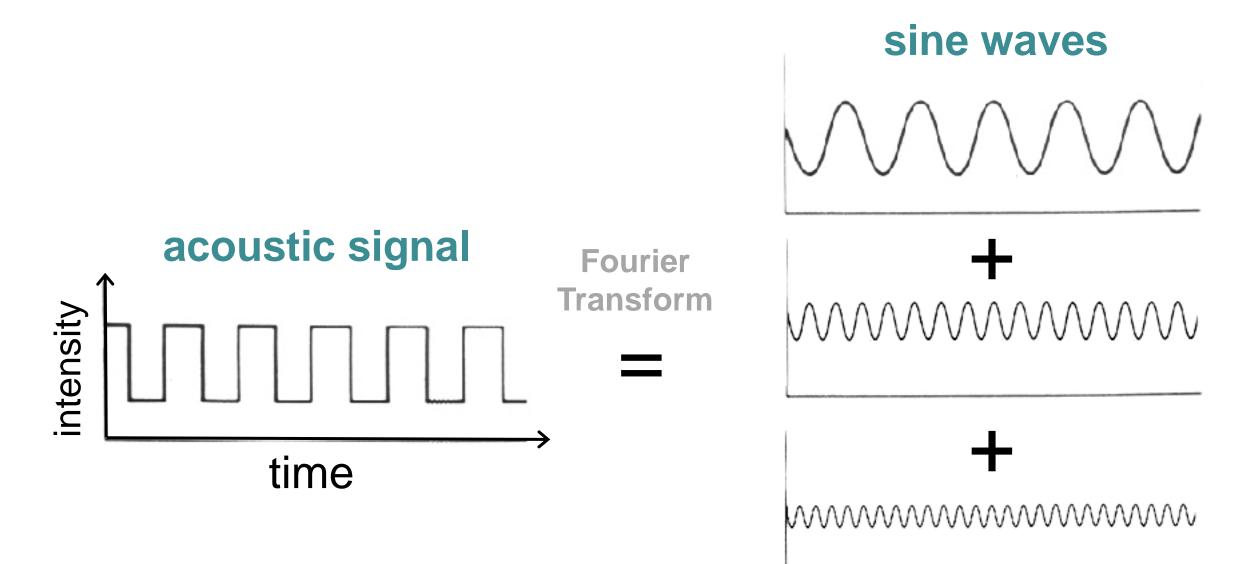


## Can they Convey More Visual Information?





## Frequency Domain Approach



#### frequencies in Hertz

## Frequency Domain Approach

#### sinusoidal gratings



# 

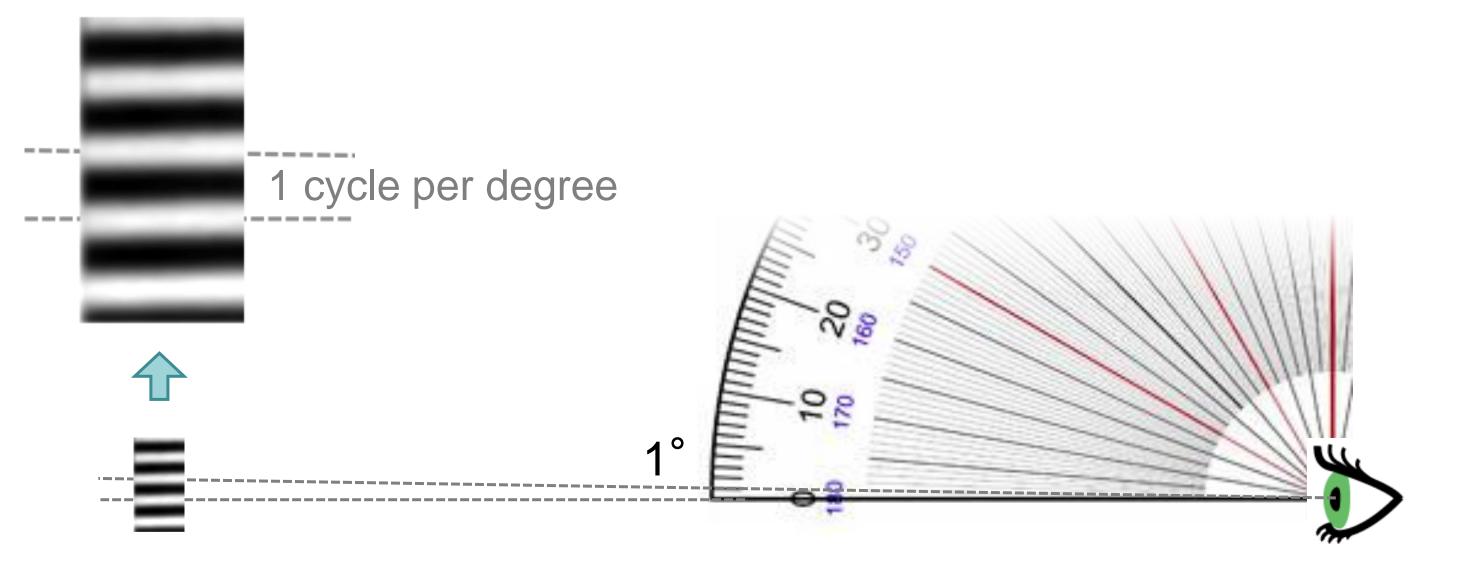
(1D) Fourier Transform



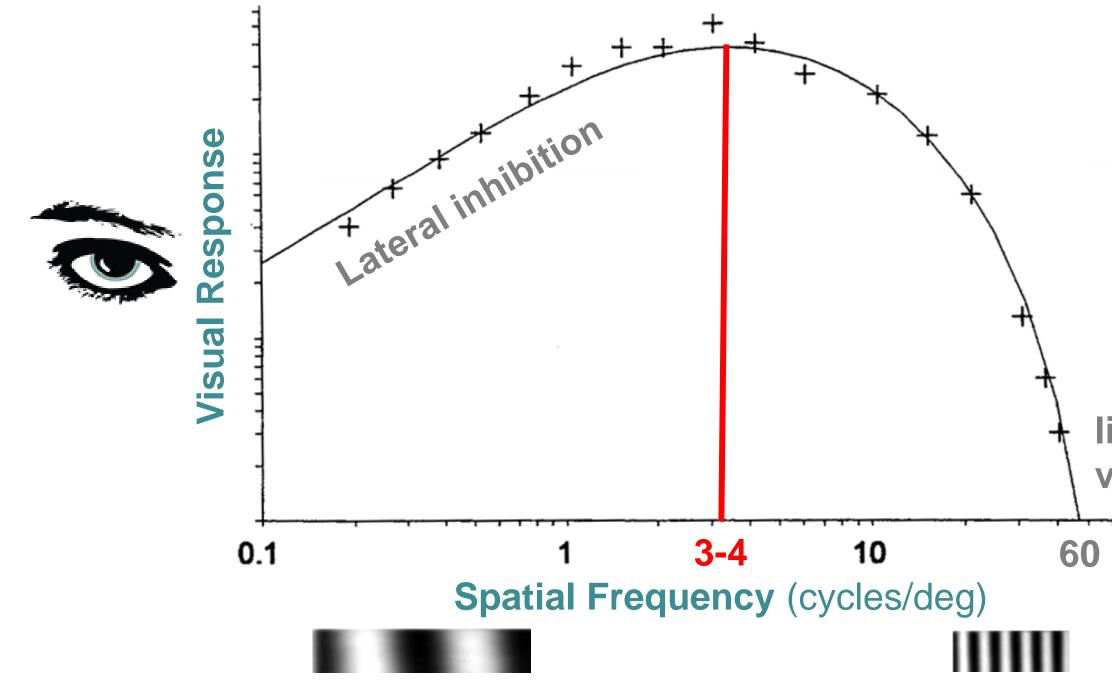


#### frequencies in cycles/degree of visual angle

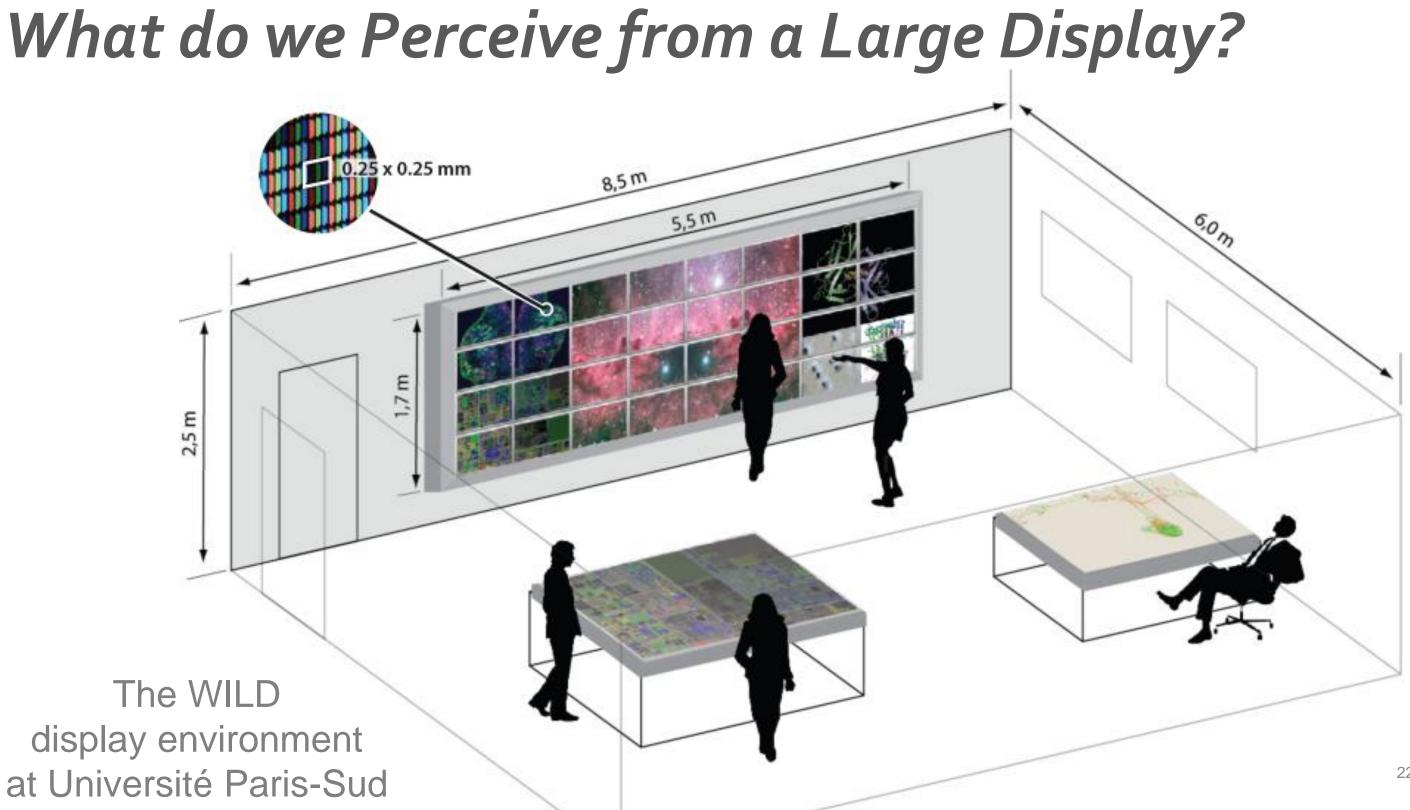
#### **Contrast Sensitivity Function**

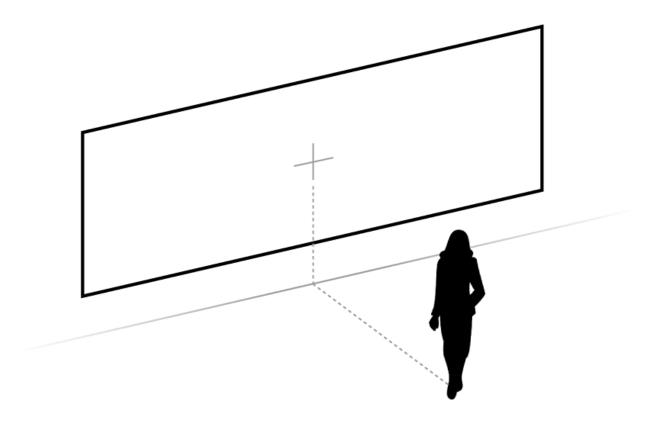


#### **Contrast Sensitivity Function**

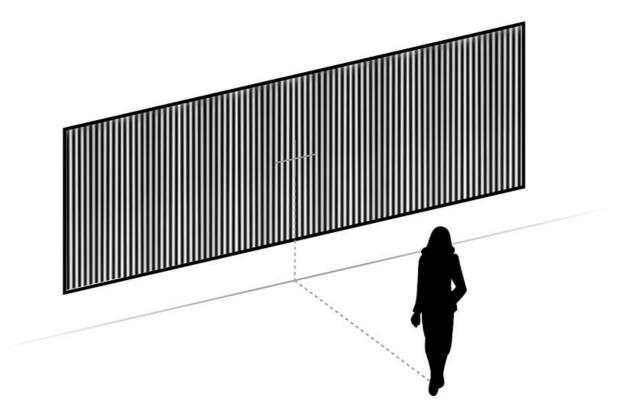


## limit of visual acuity

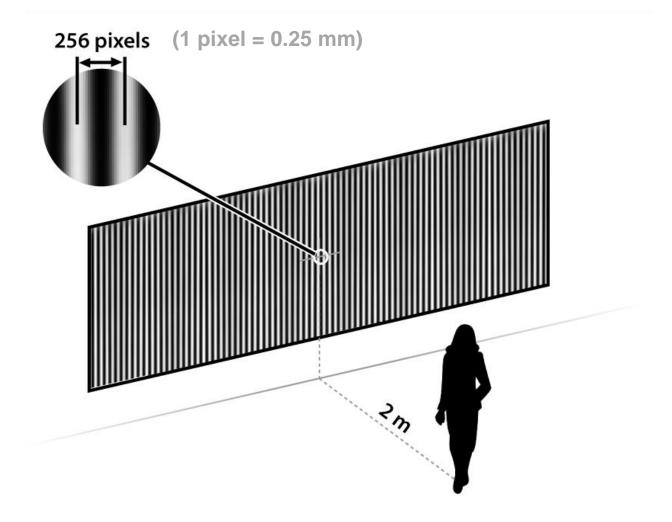




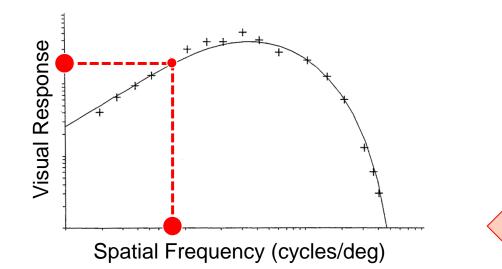


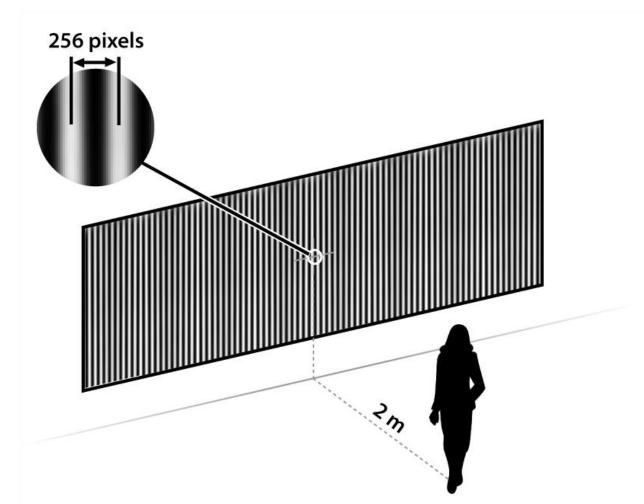




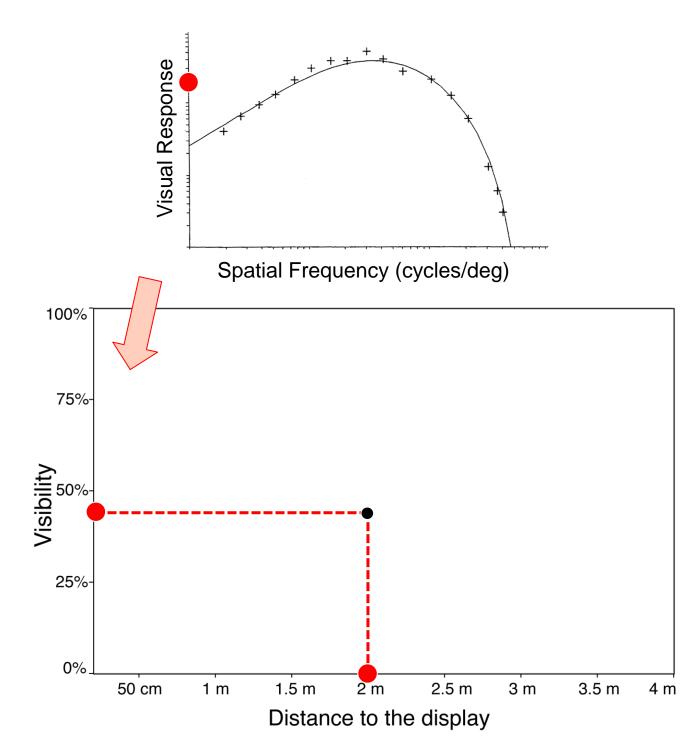


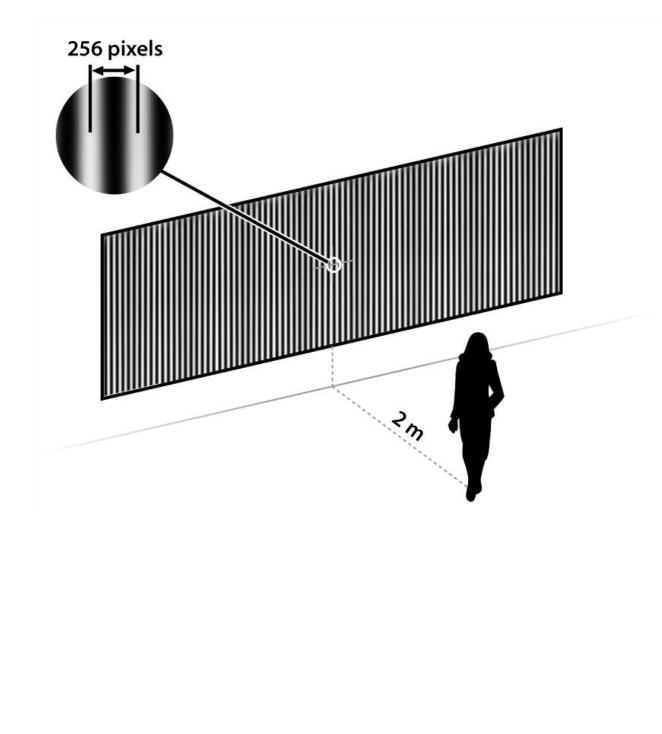




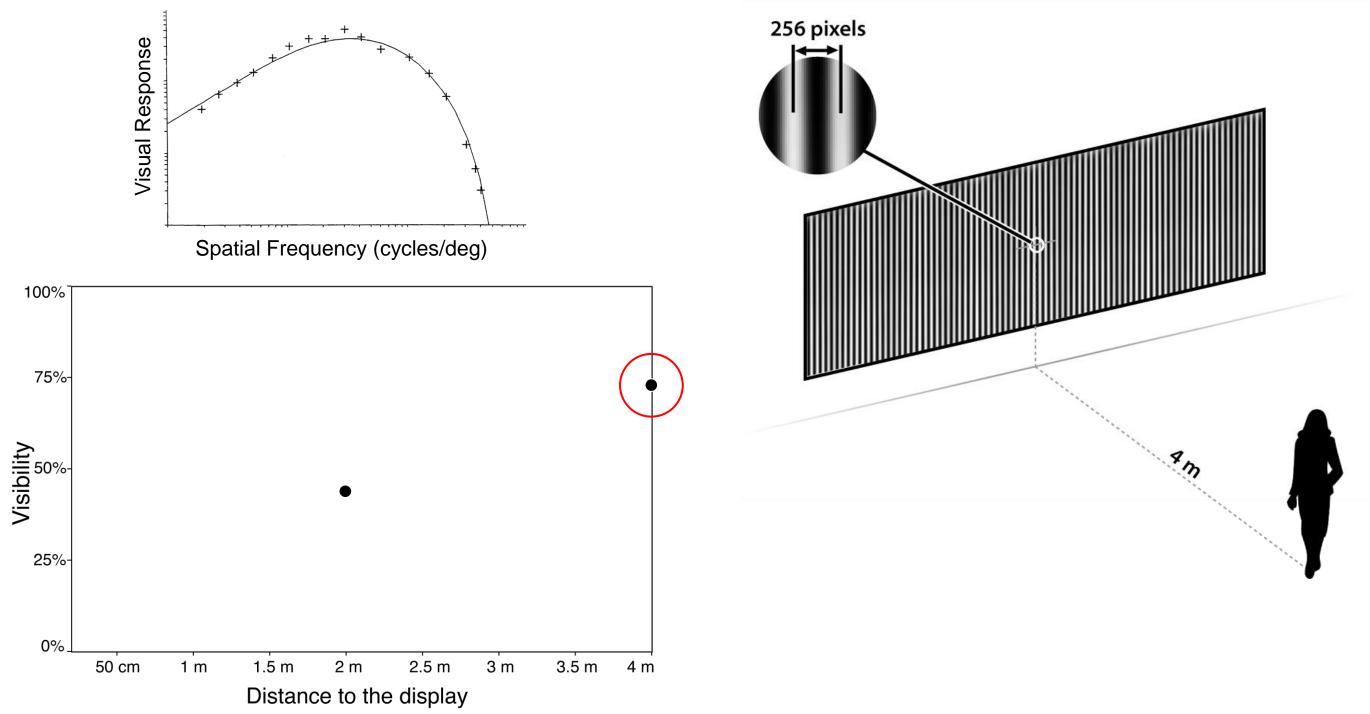




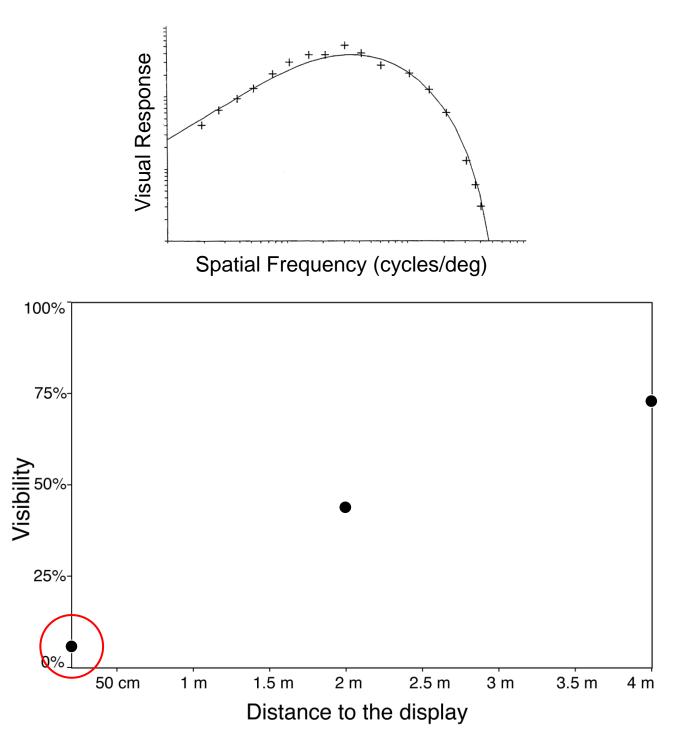


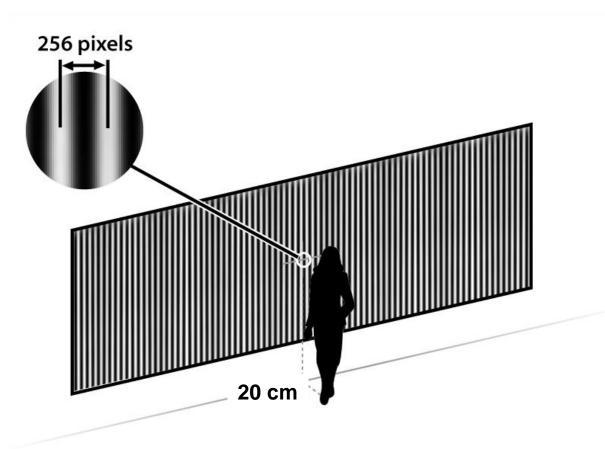




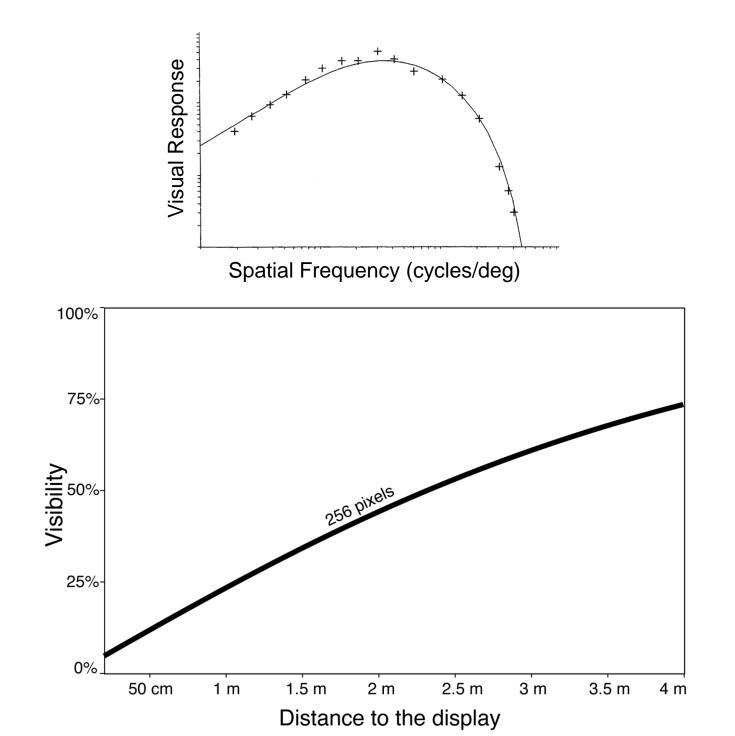


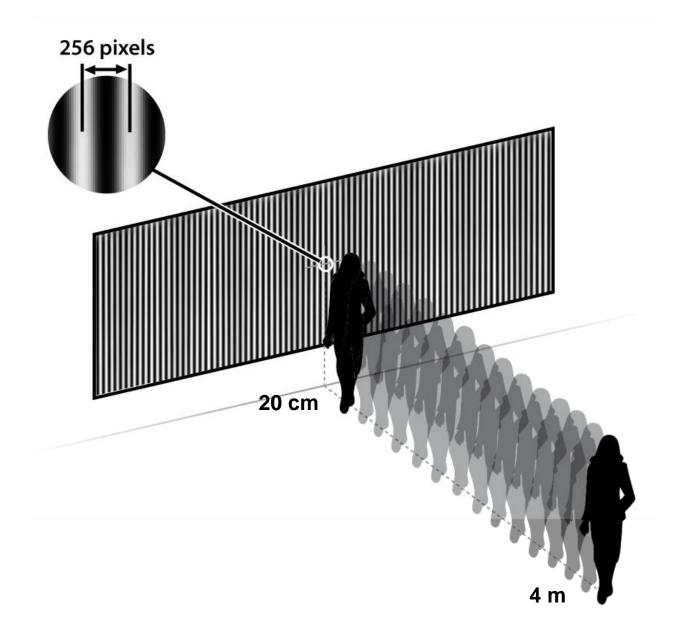




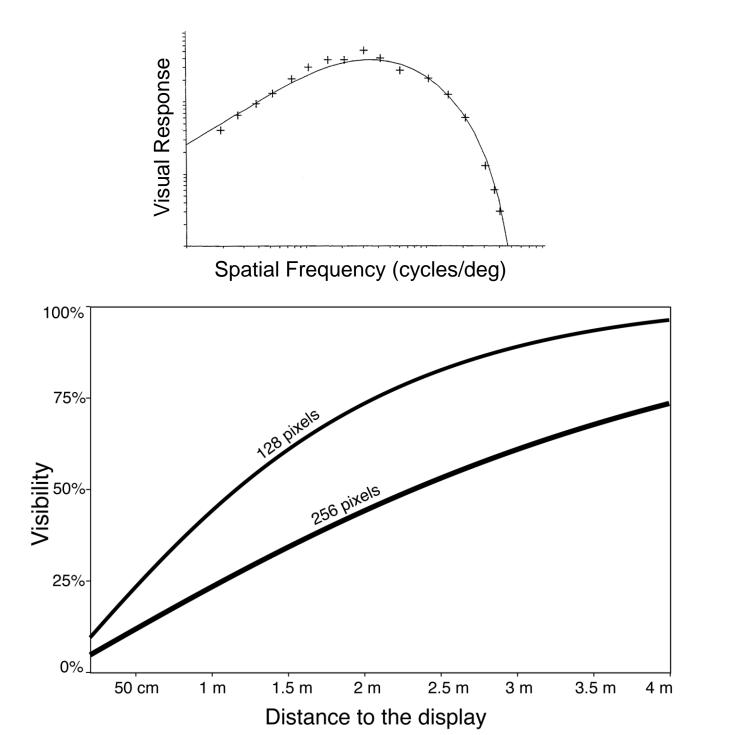


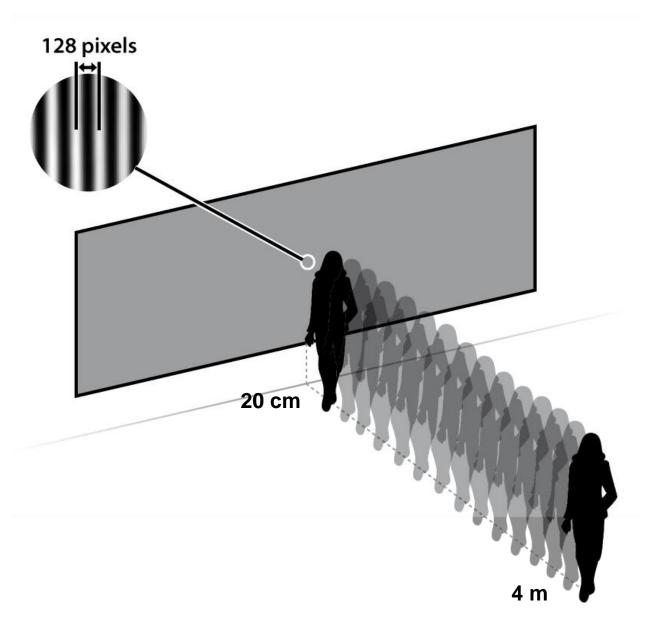




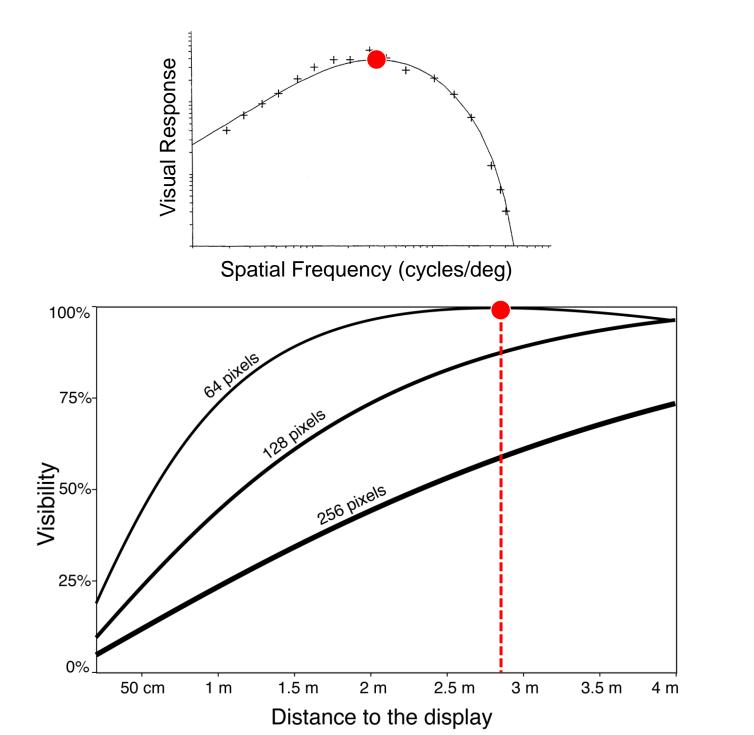


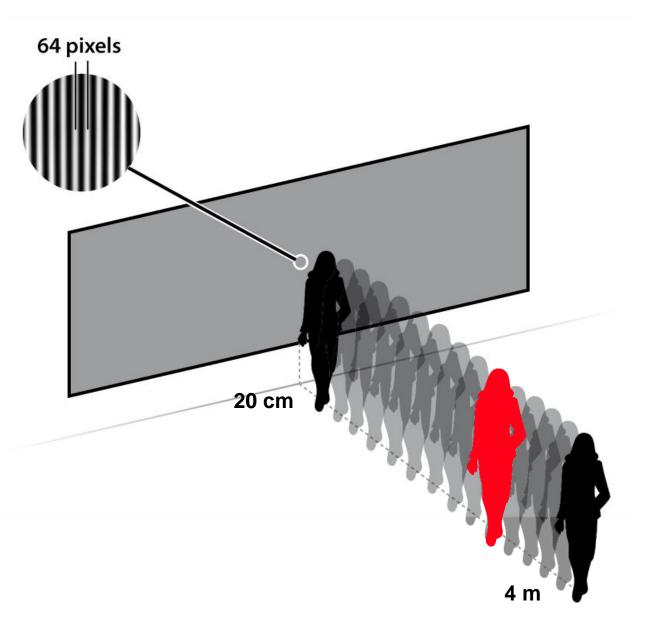




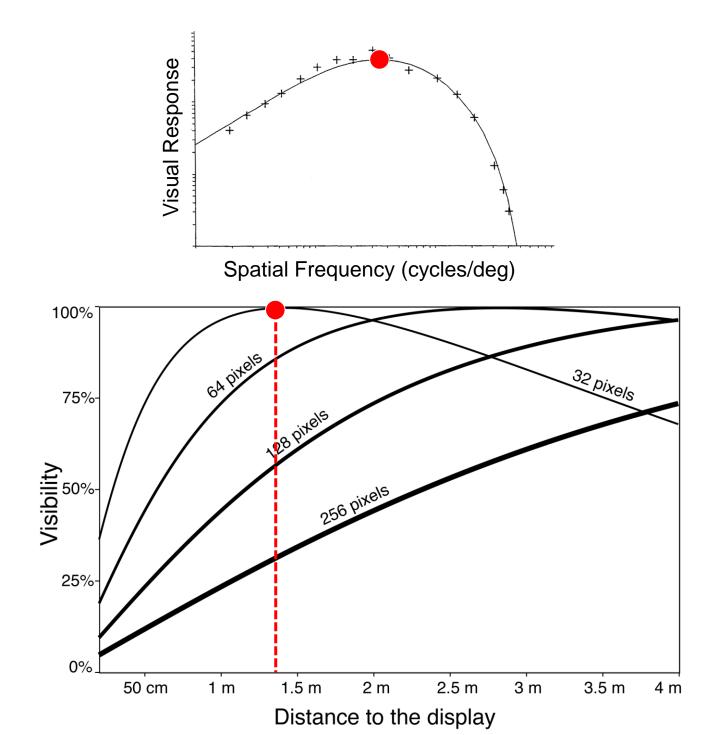


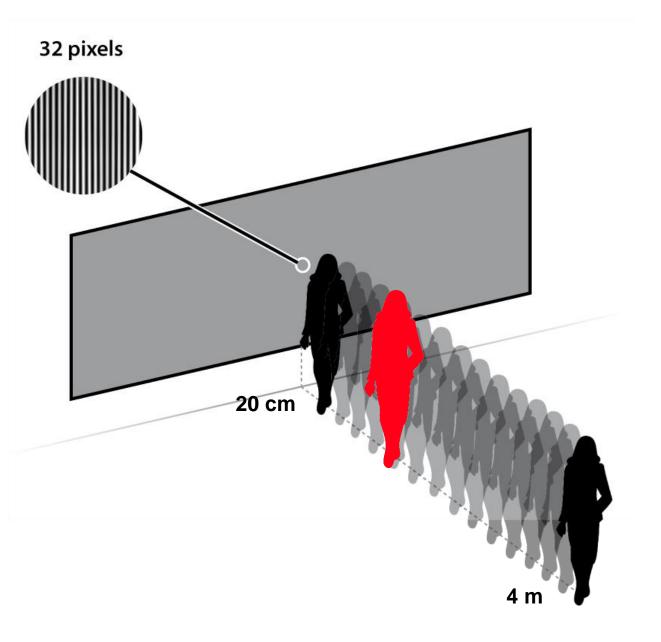




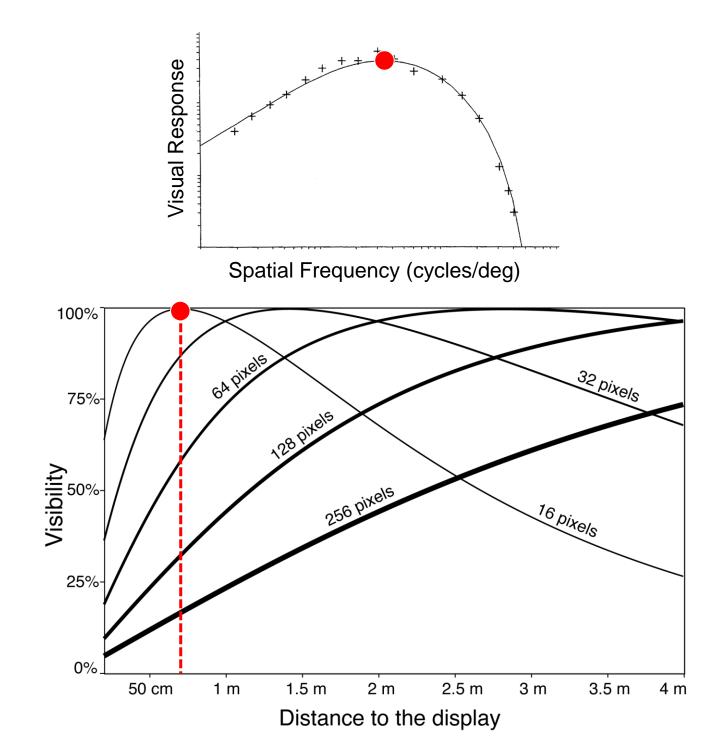


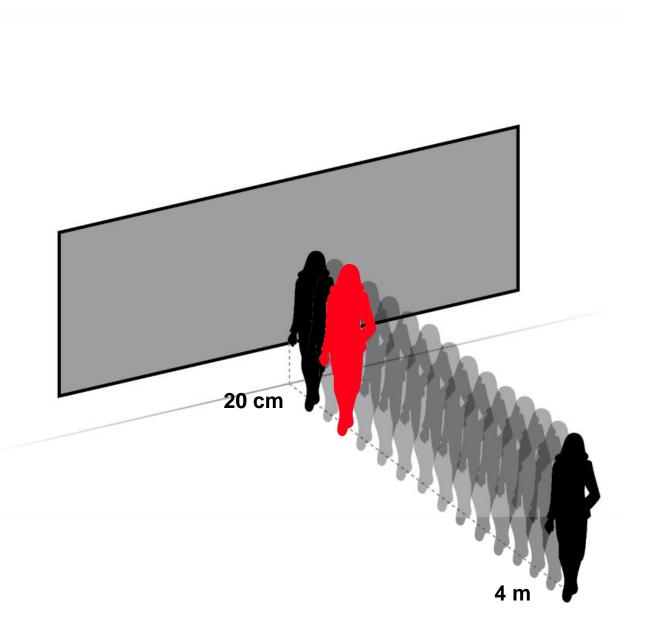




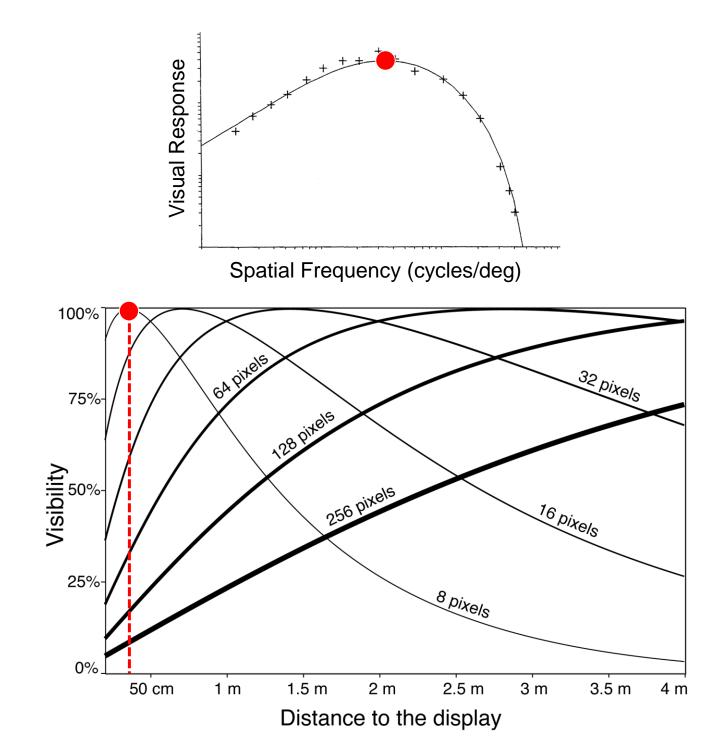


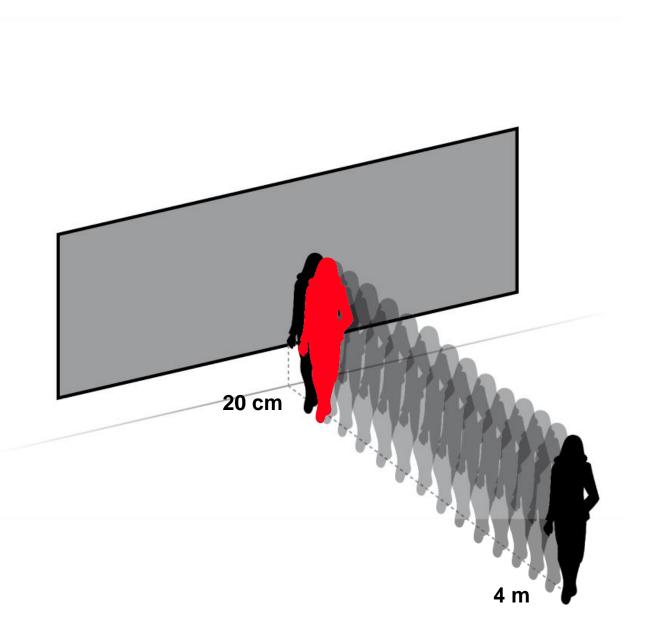




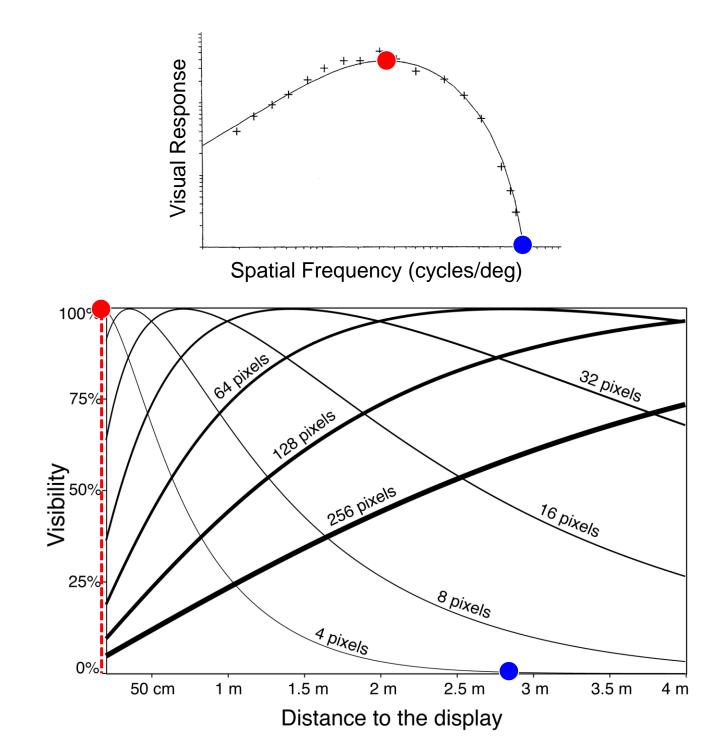


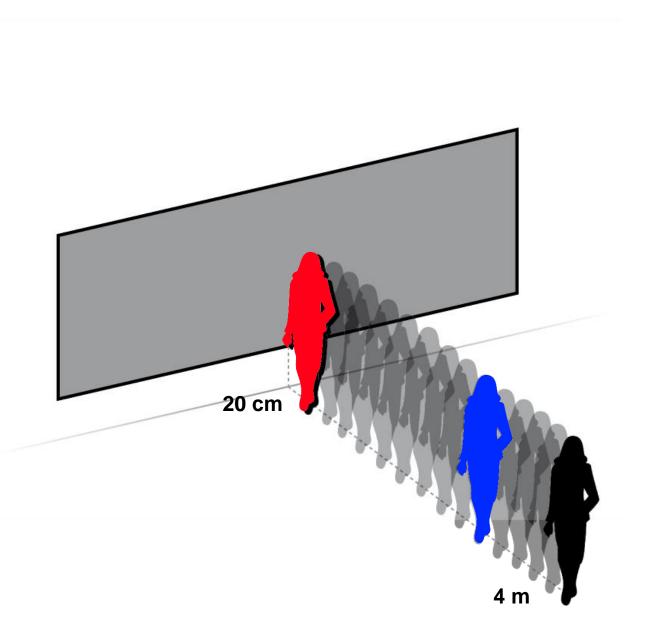






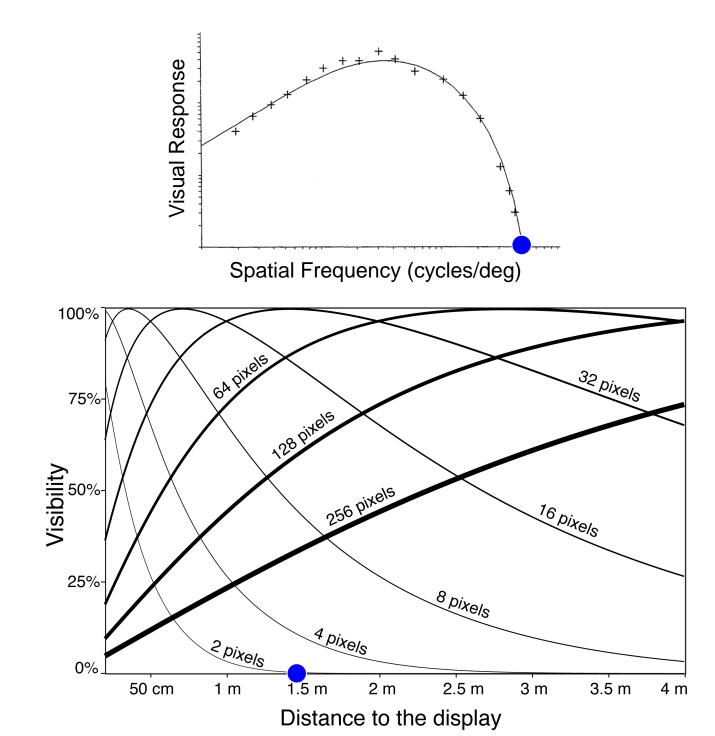


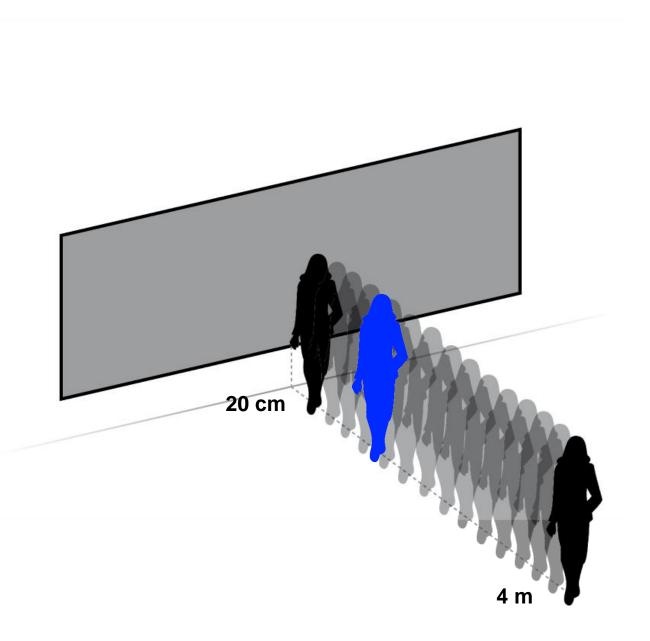






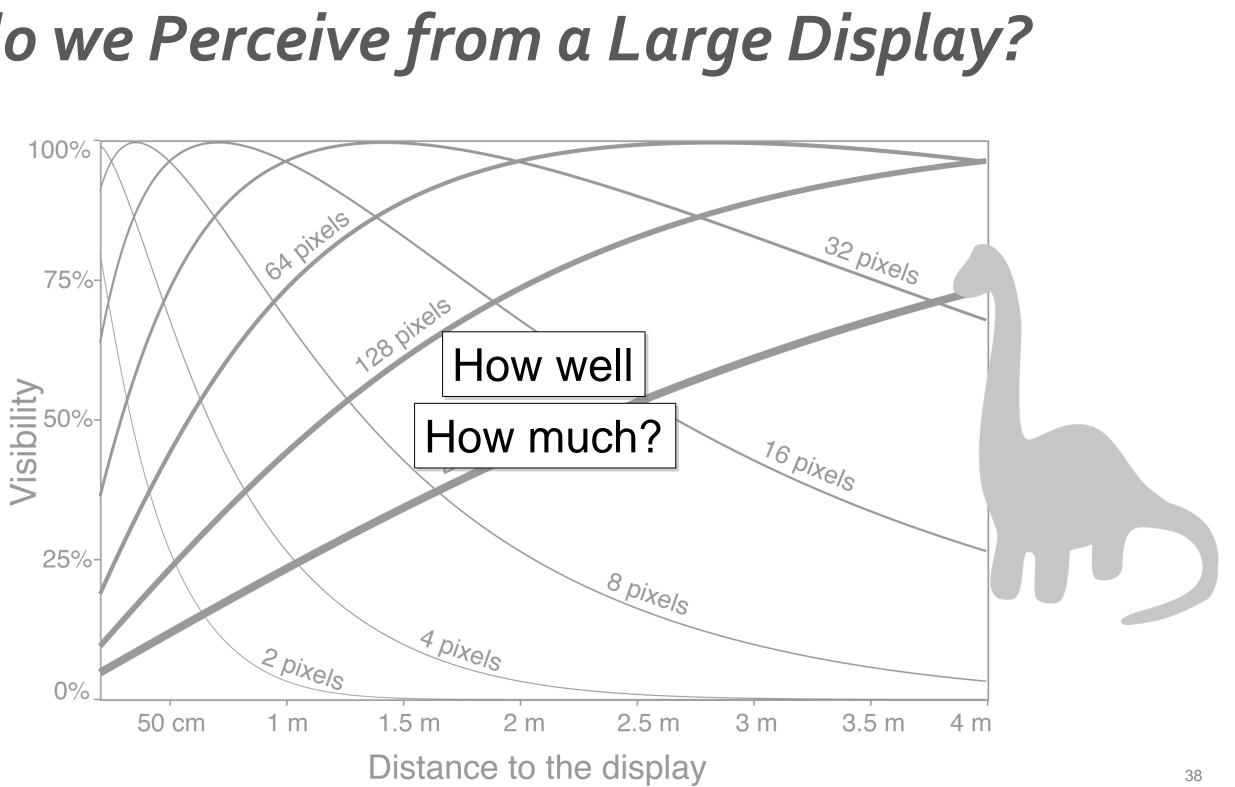
#### What do we Perceive from a Large Display?



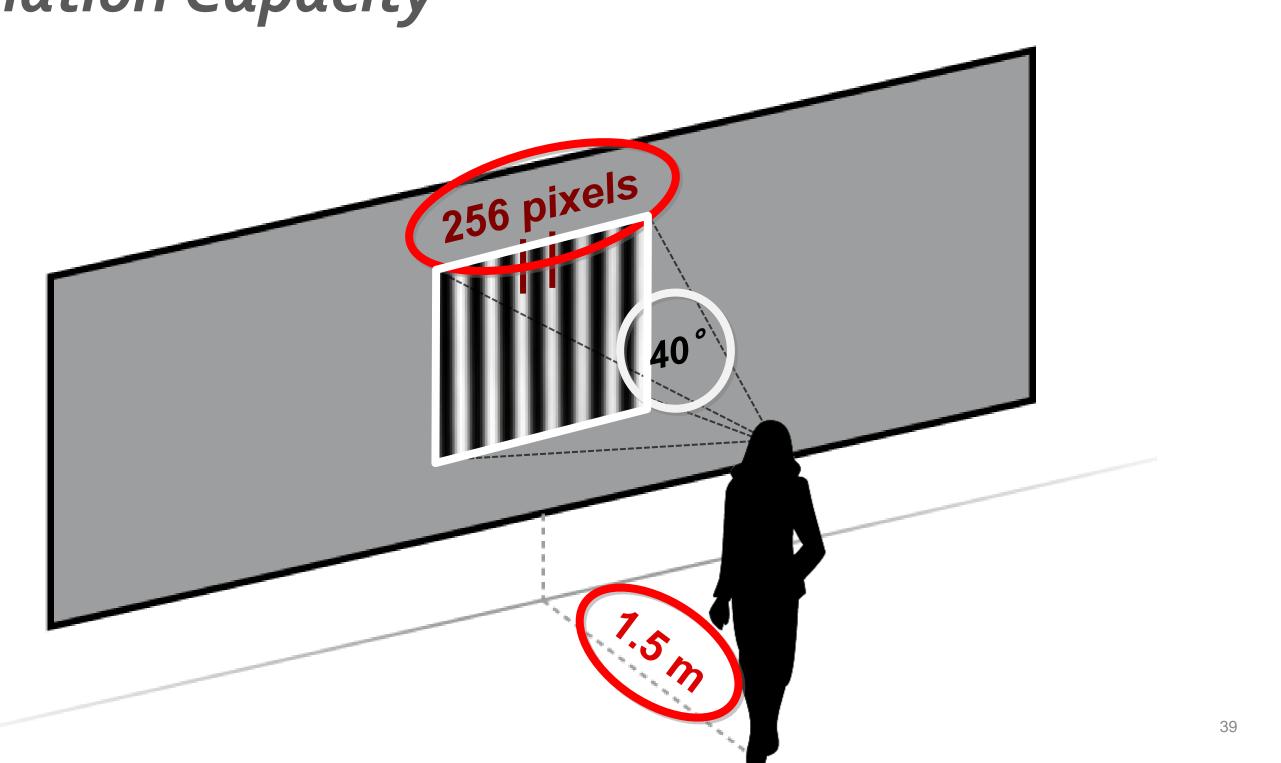




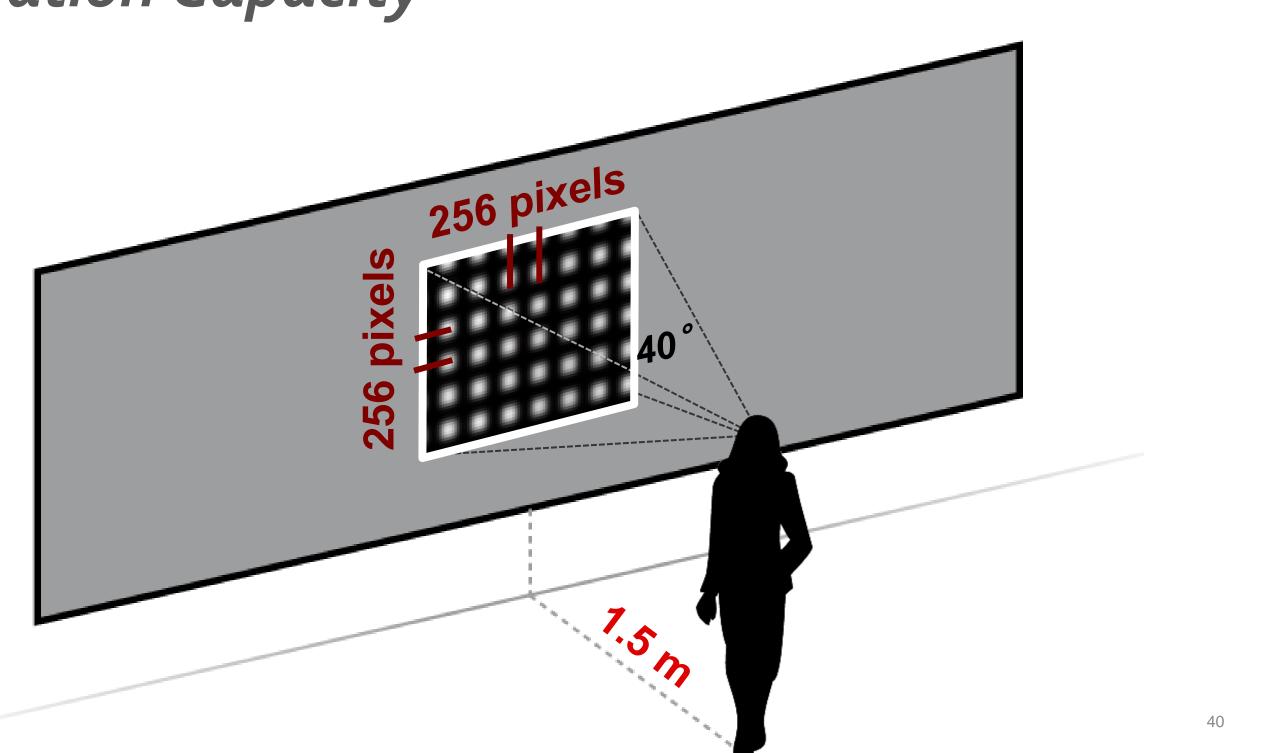
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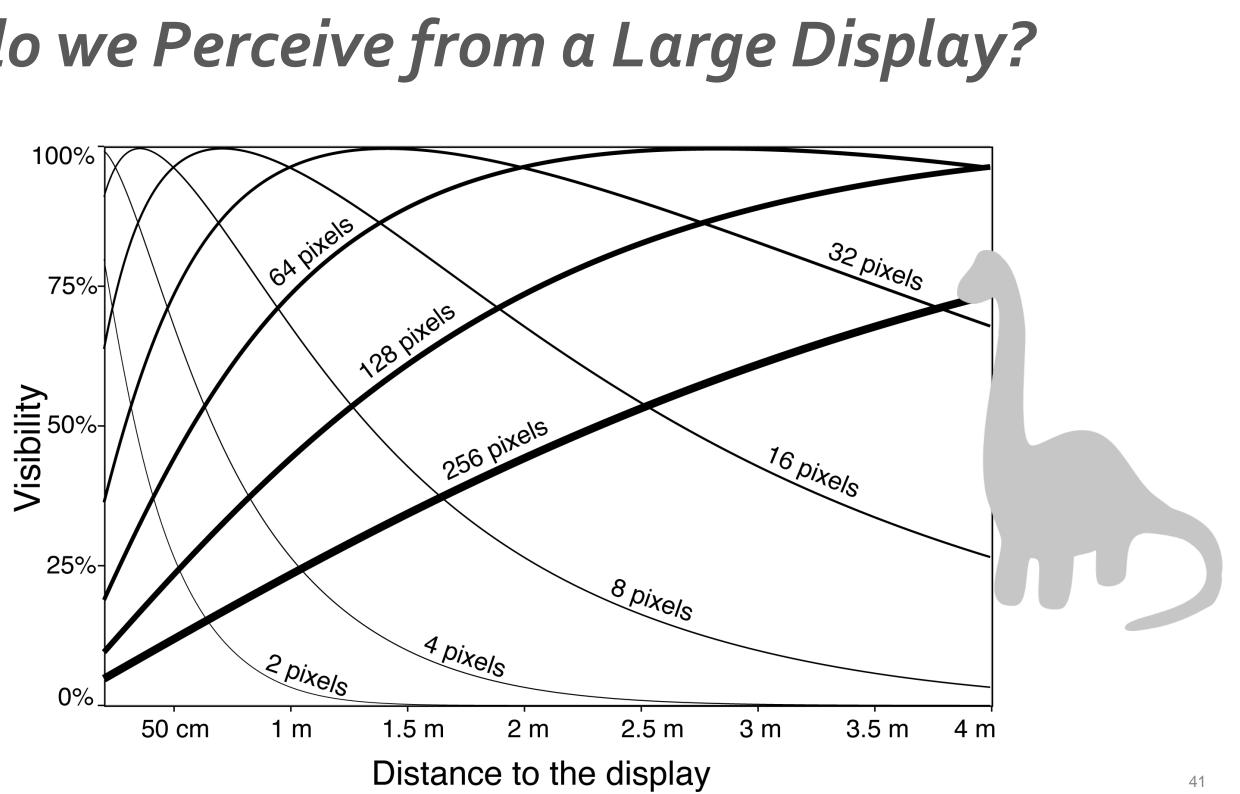
#### Information Capacity



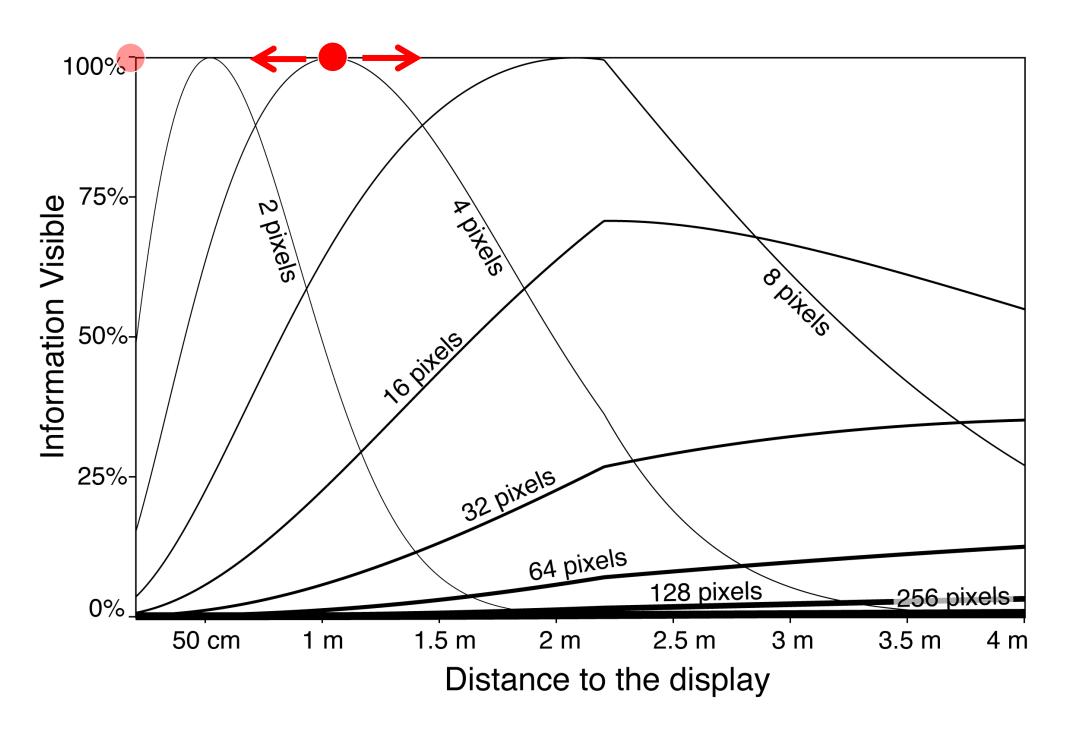
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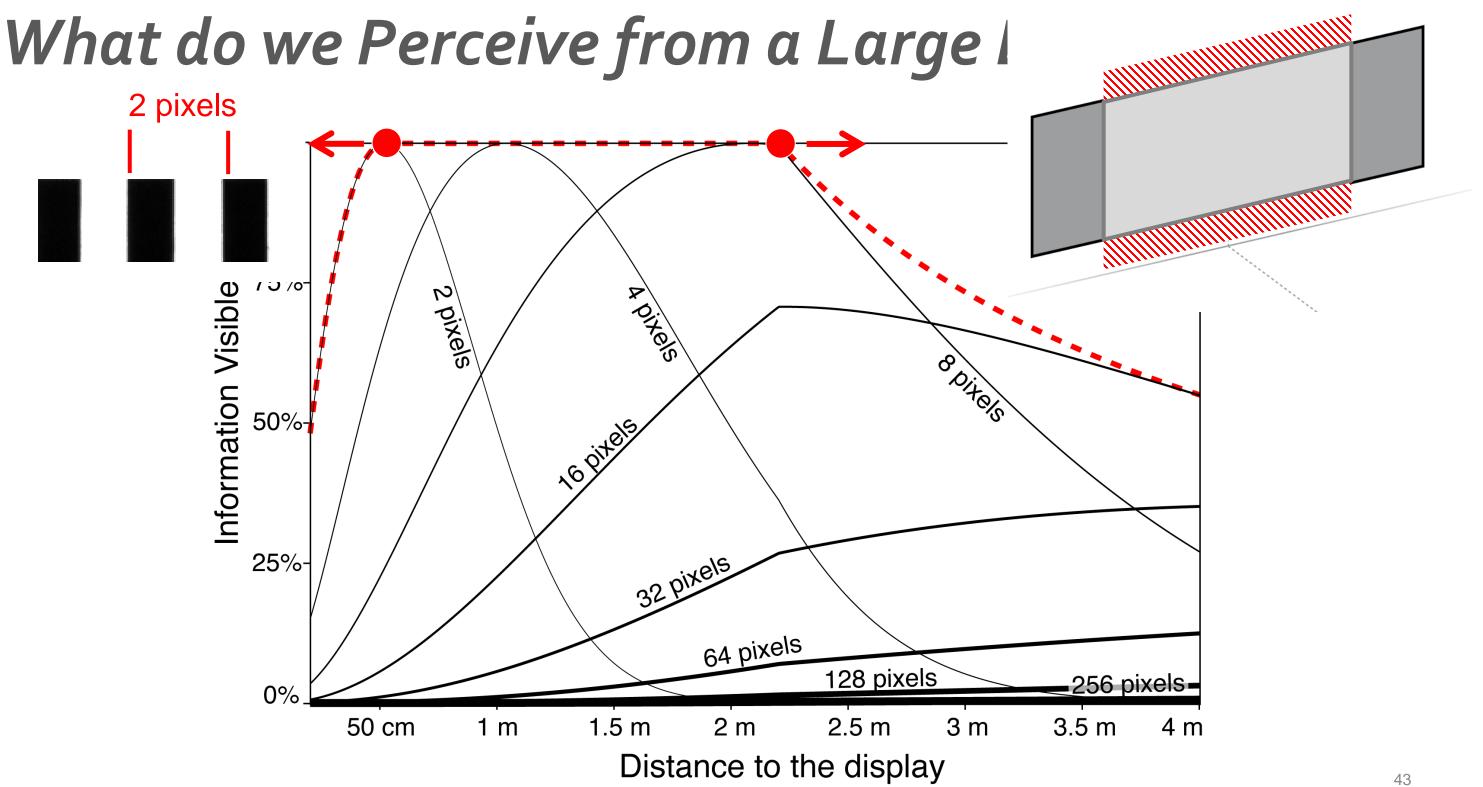
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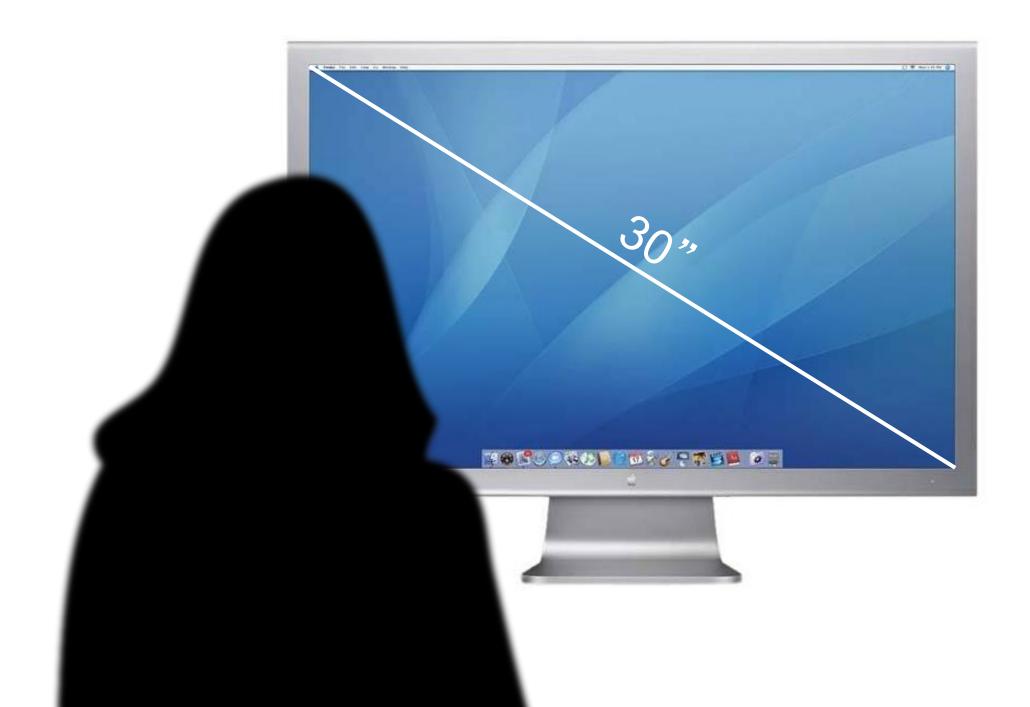
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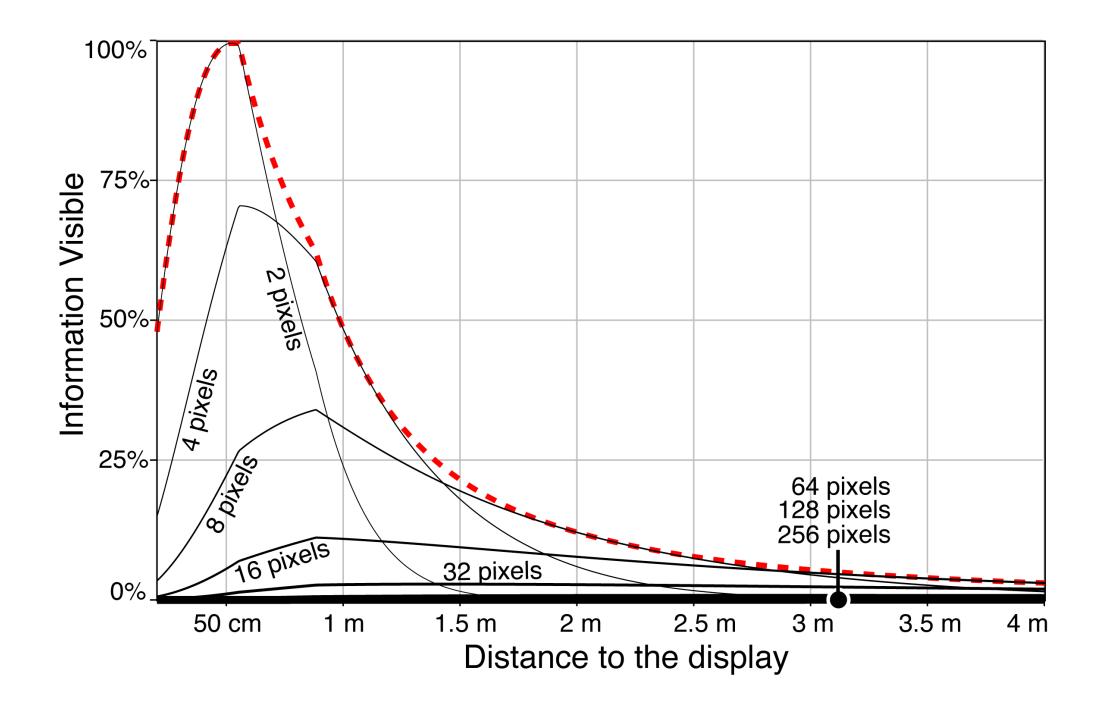




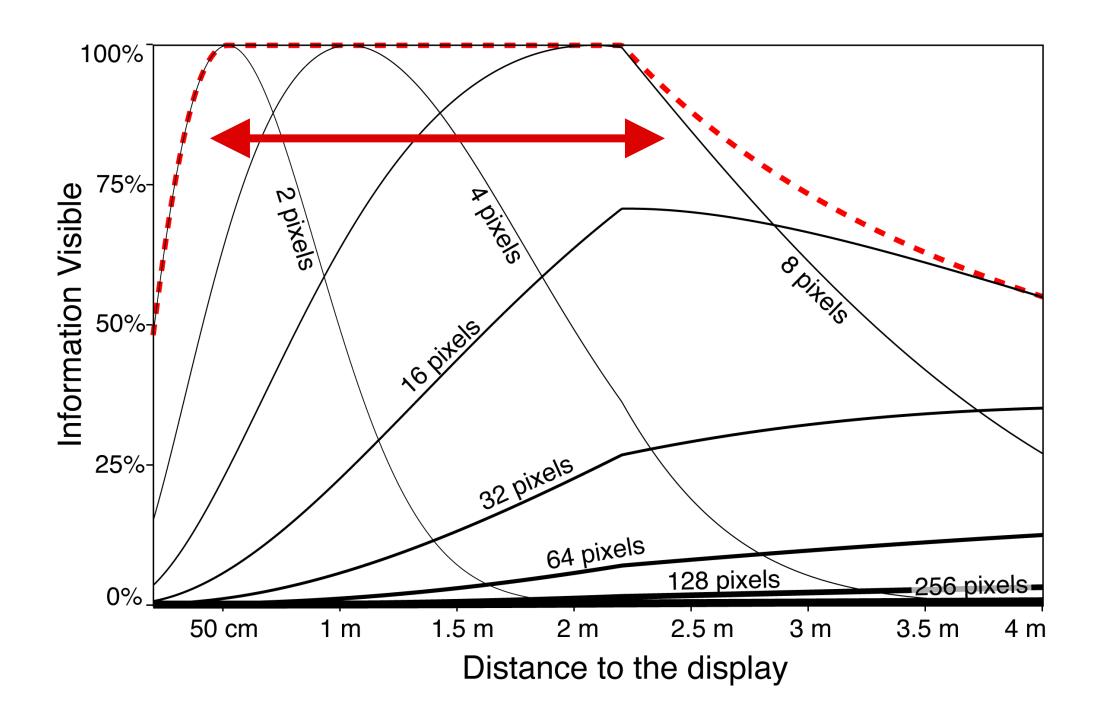
#### Comparison with a Desktop Display

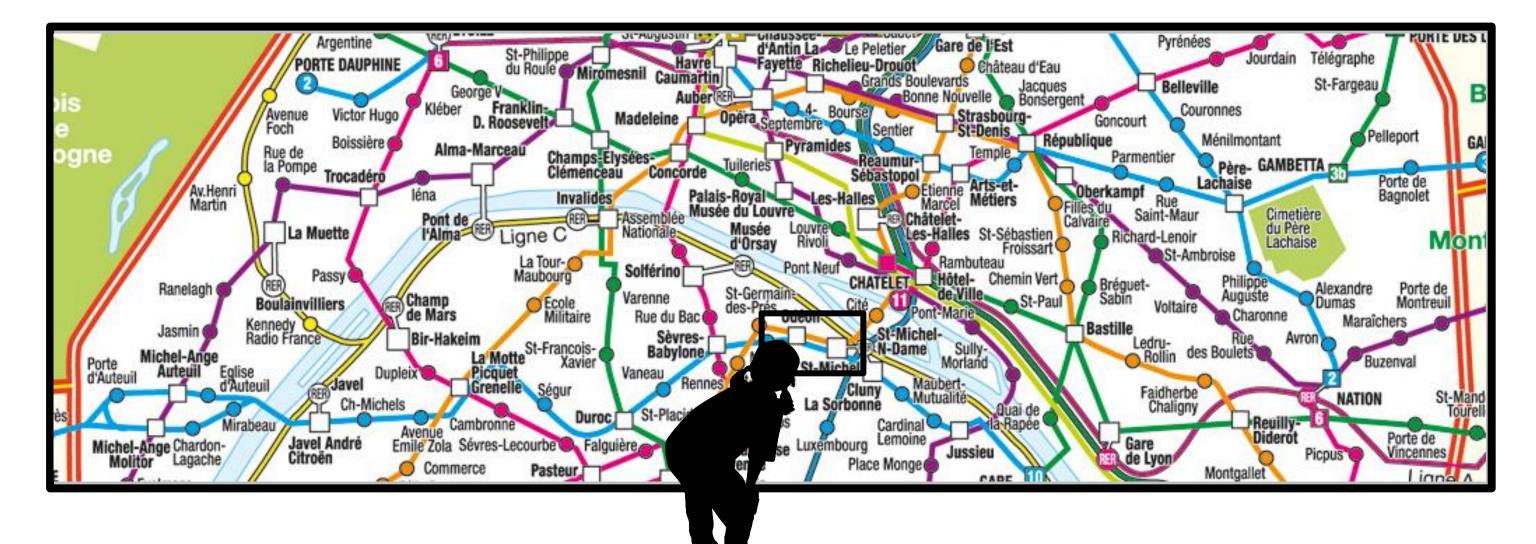


#### Comparison with a Desktop Display

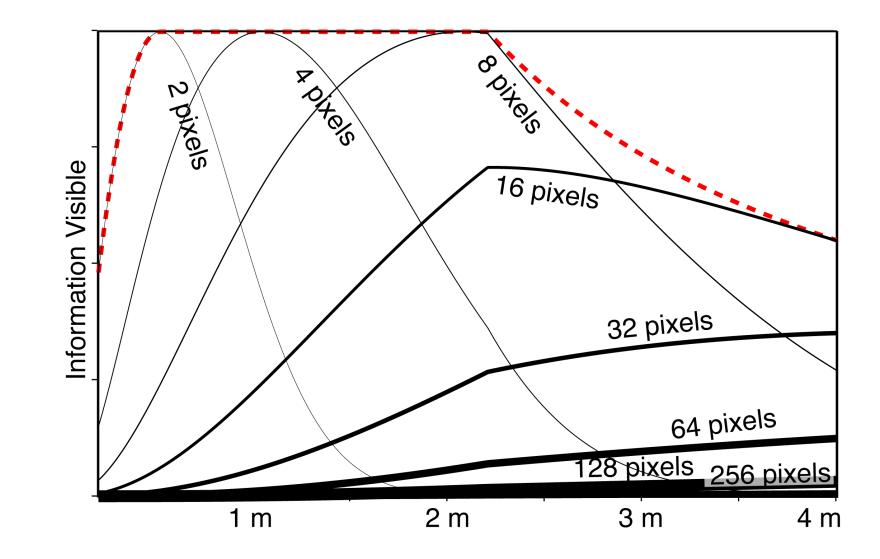


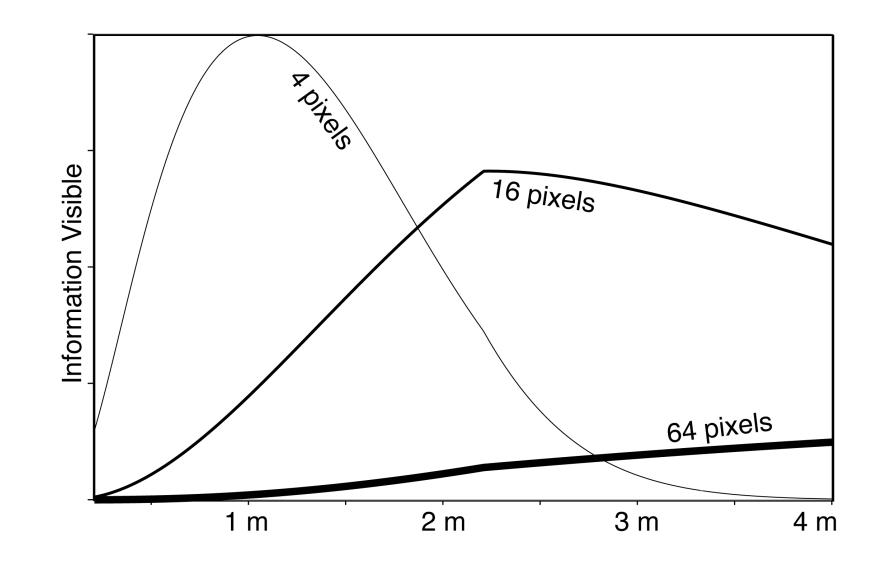
#### Leveraging Large Displays

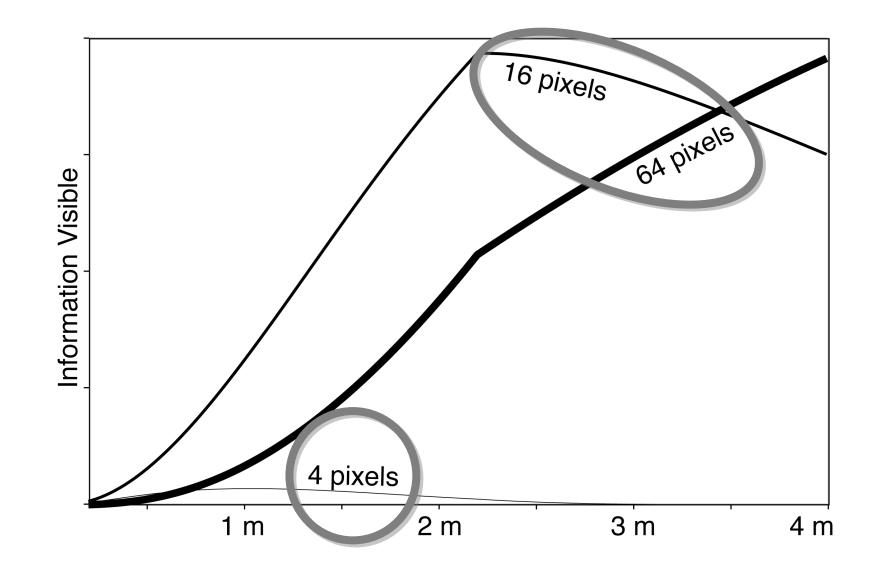


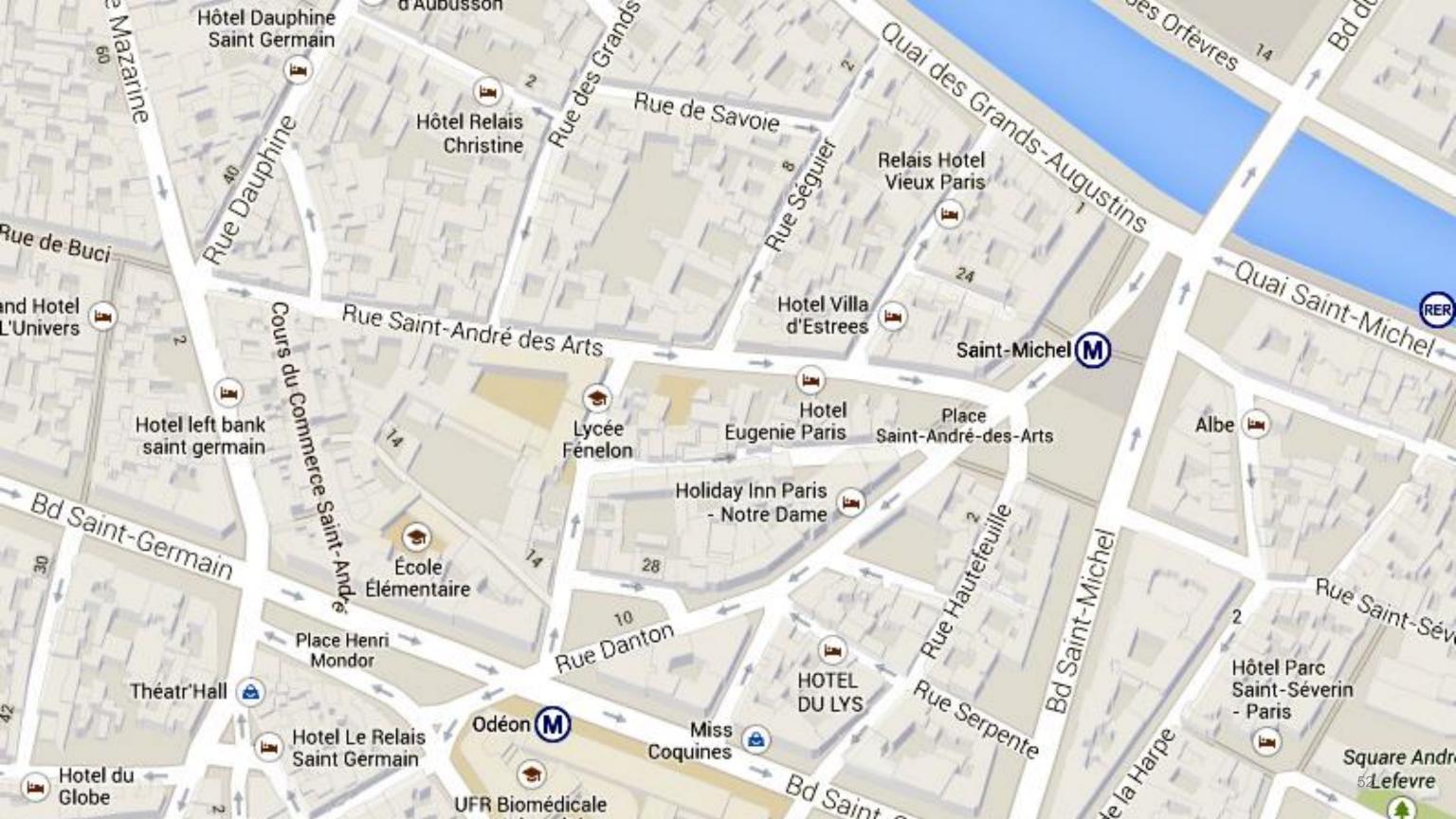


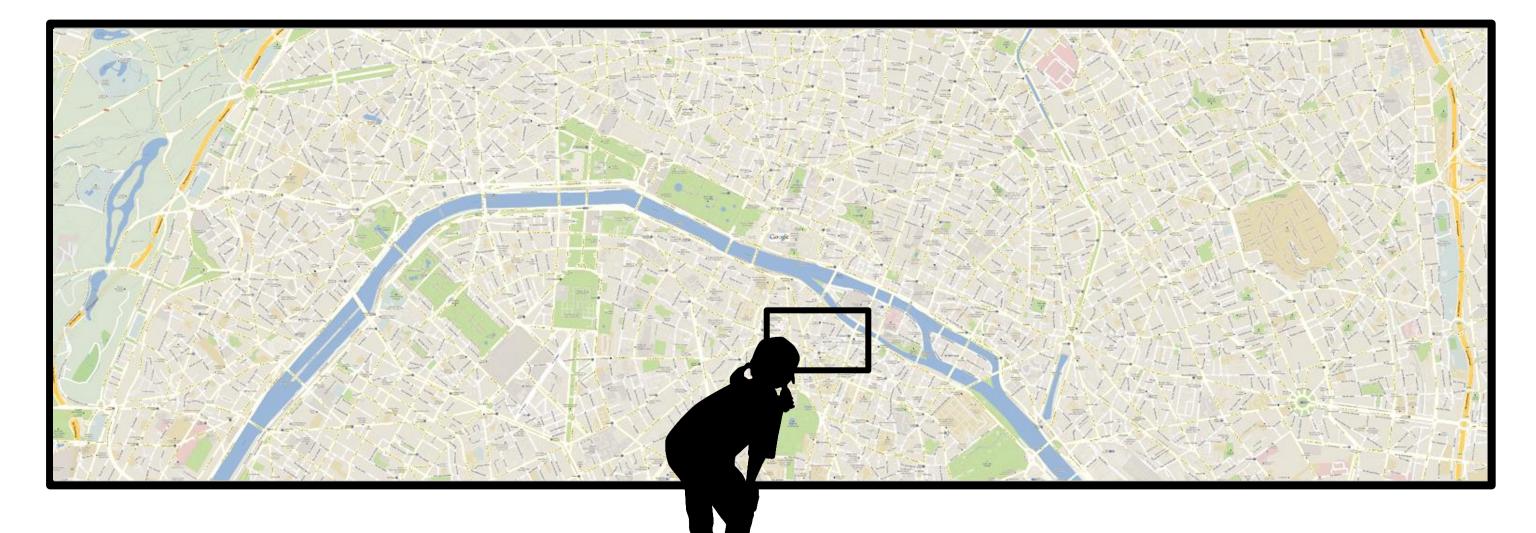


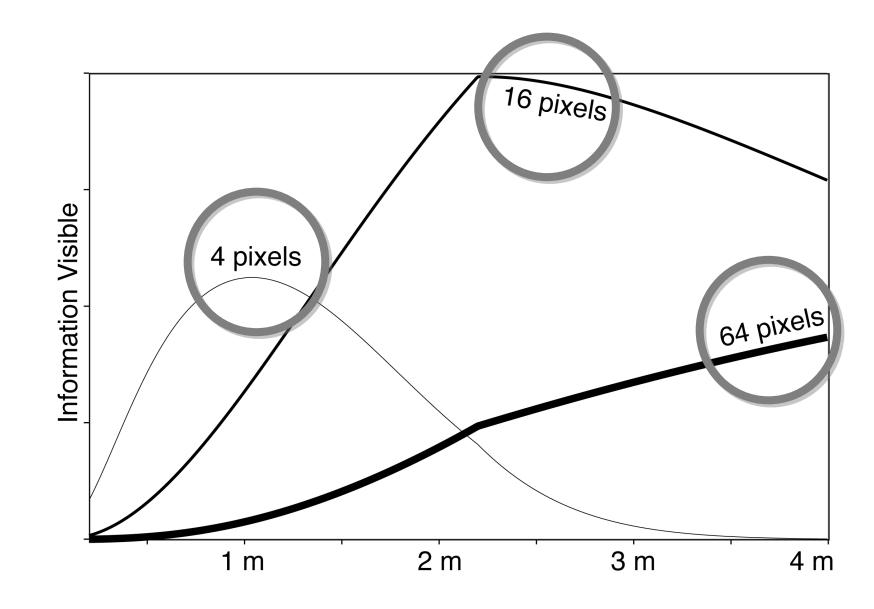


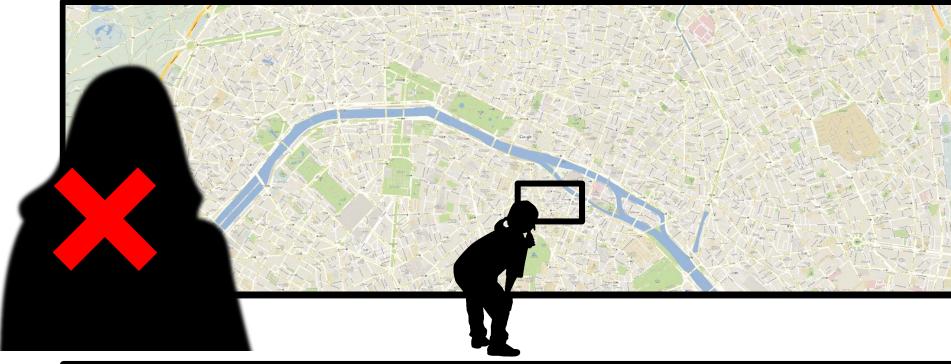


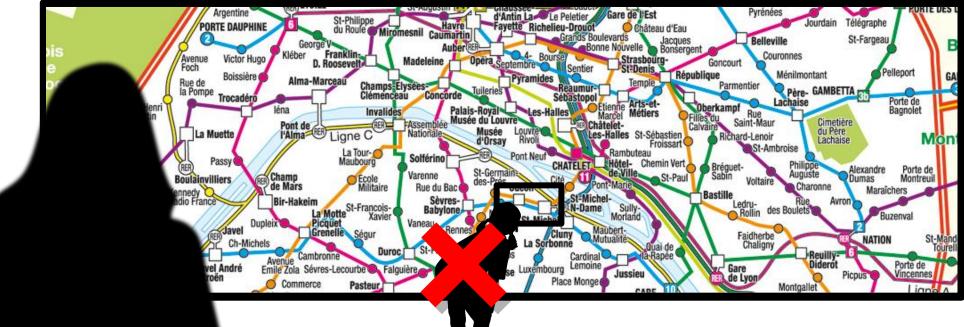




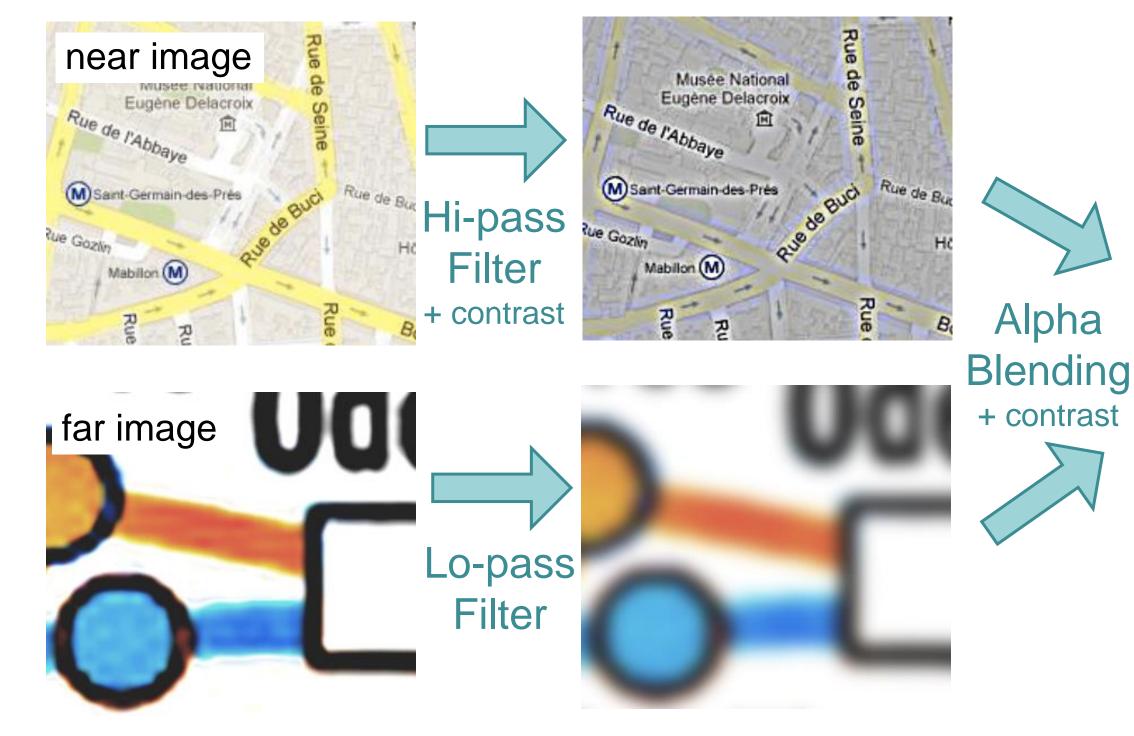


















#### Place Sant-André-des-Arts

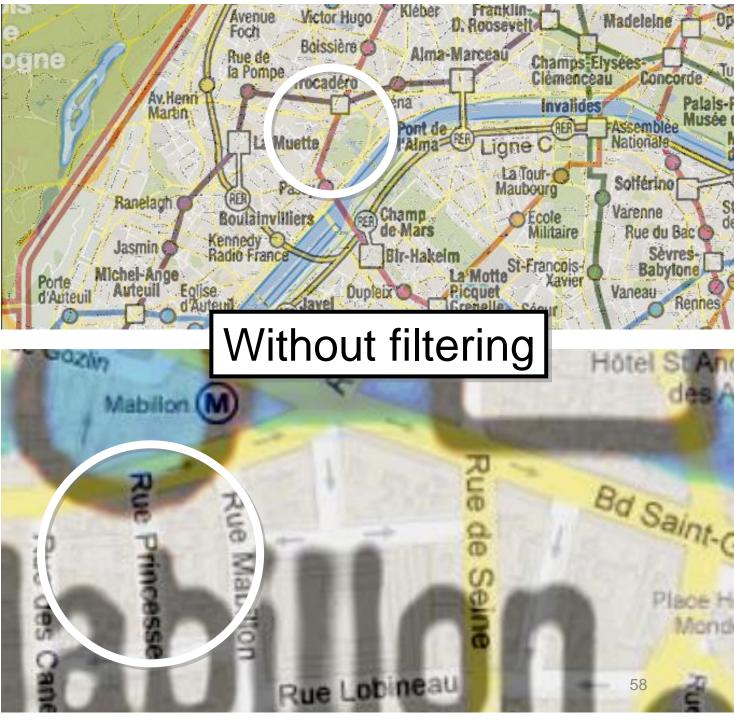
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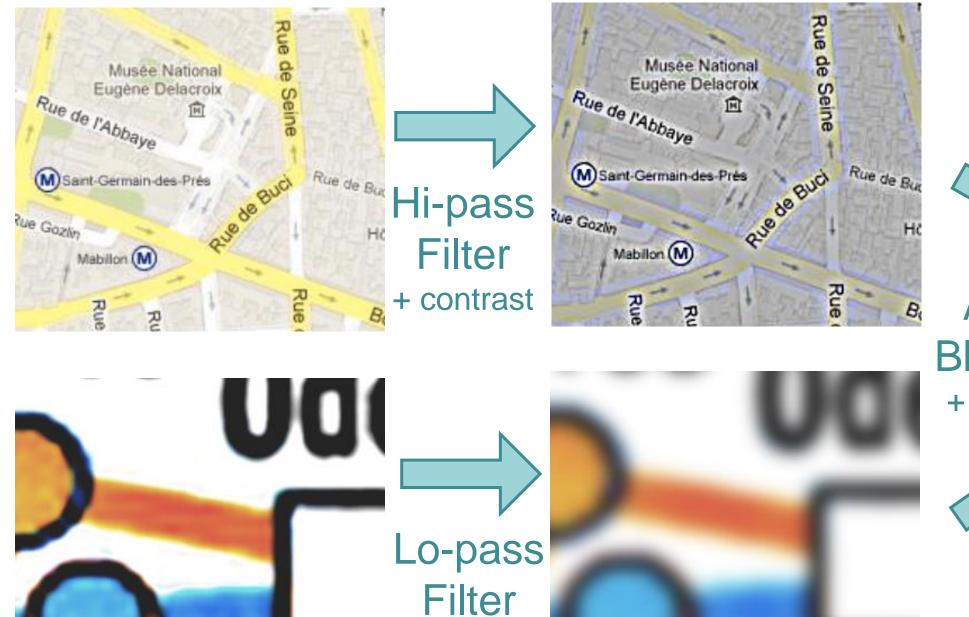
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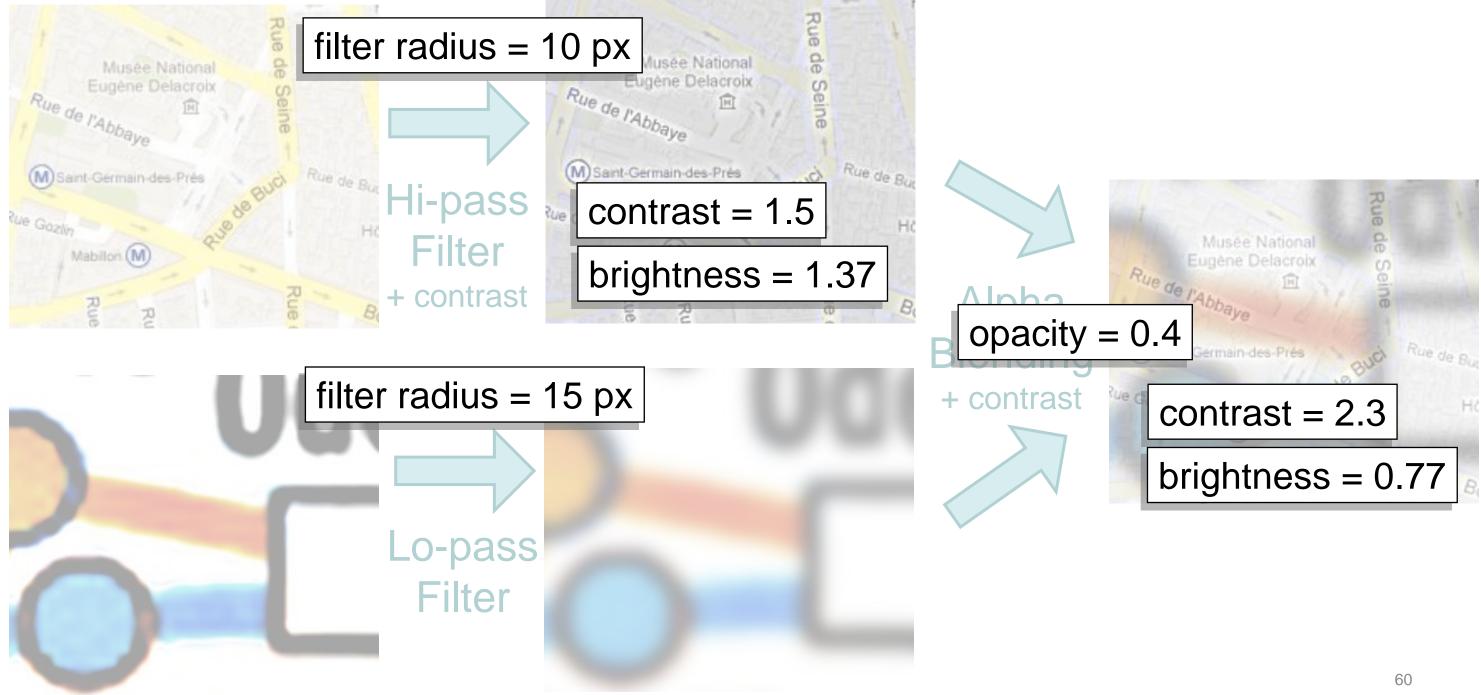




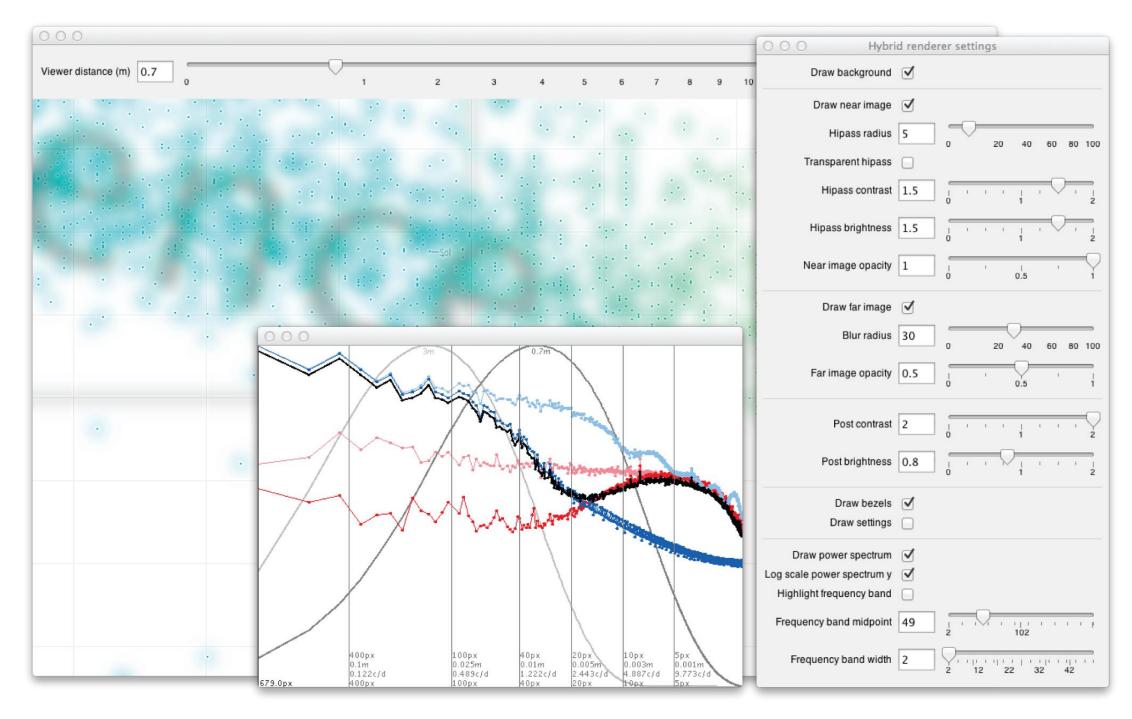








### Hybrid Image Maker



# Hybrid Images for Large-Scale Visualizations

 Theoretical grounding why & when use hybrid images?

Tools

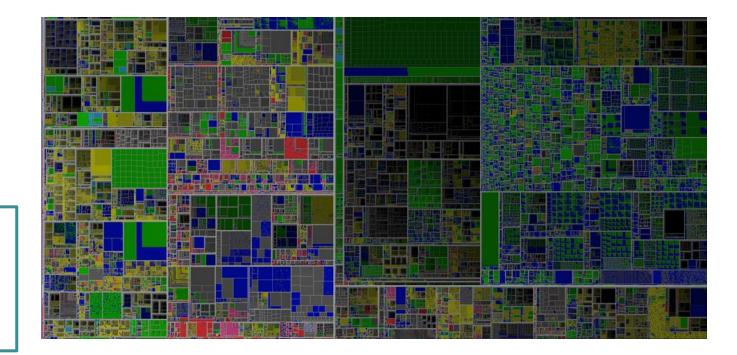
how to support their creation?

Examples

what are they really good for?

**Design principles** 

how to build effective ones?







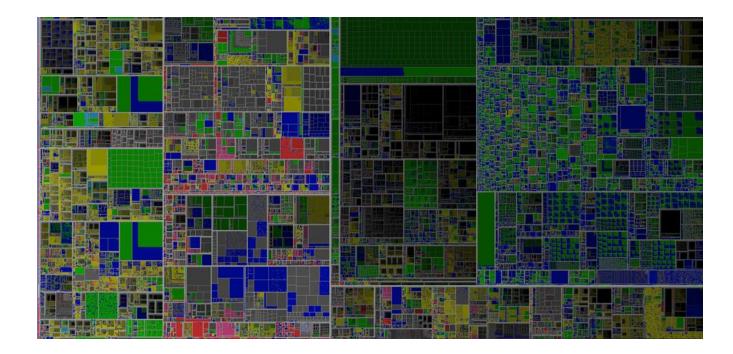
# Hybrid Images for Large-Scale Visualizations

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

what are they really good for?

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how to build effective ones?

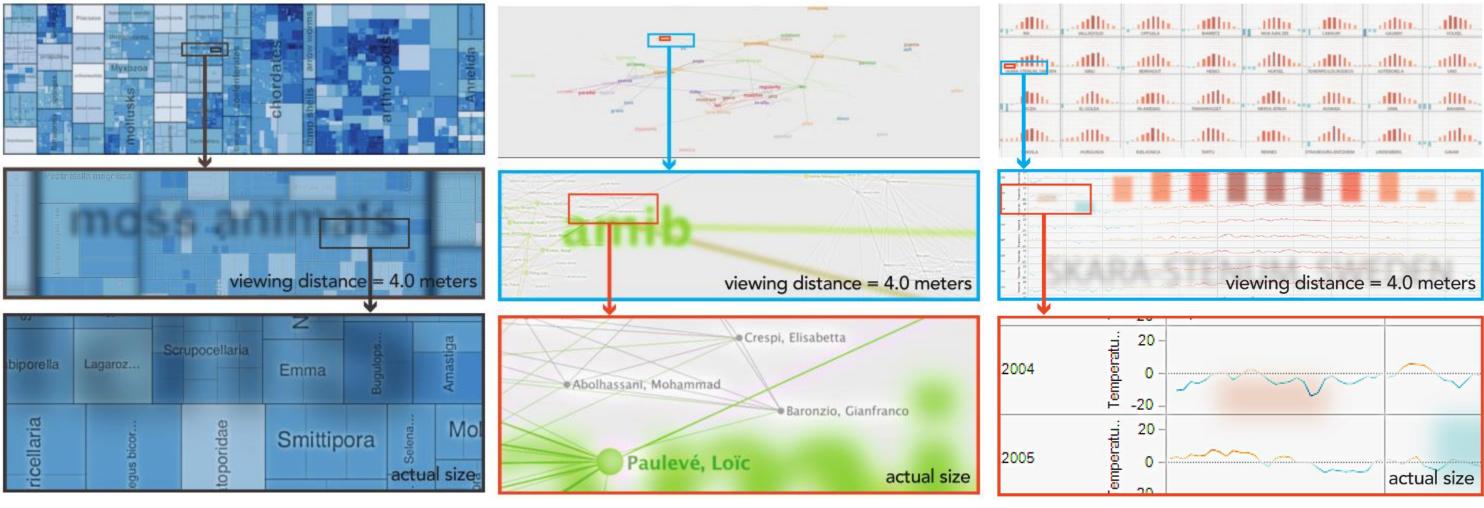






#### http://aviz.fr/hybridvis





Tree of Life Treemap

co-authorship network

...and more

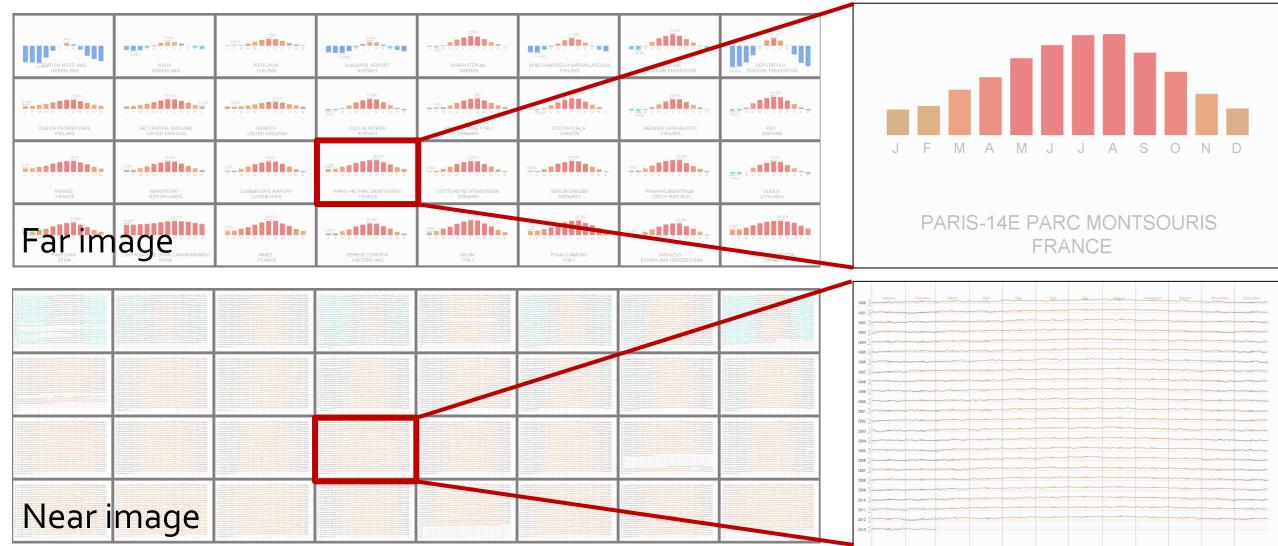


#### temperature data

#### http://aviz.fr/hybridvis

# **HI-Visualization Techniques**

- Mixing multiple visualizations
- Navigation aids & summaries





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#### http://aviz.fr/hybridvis

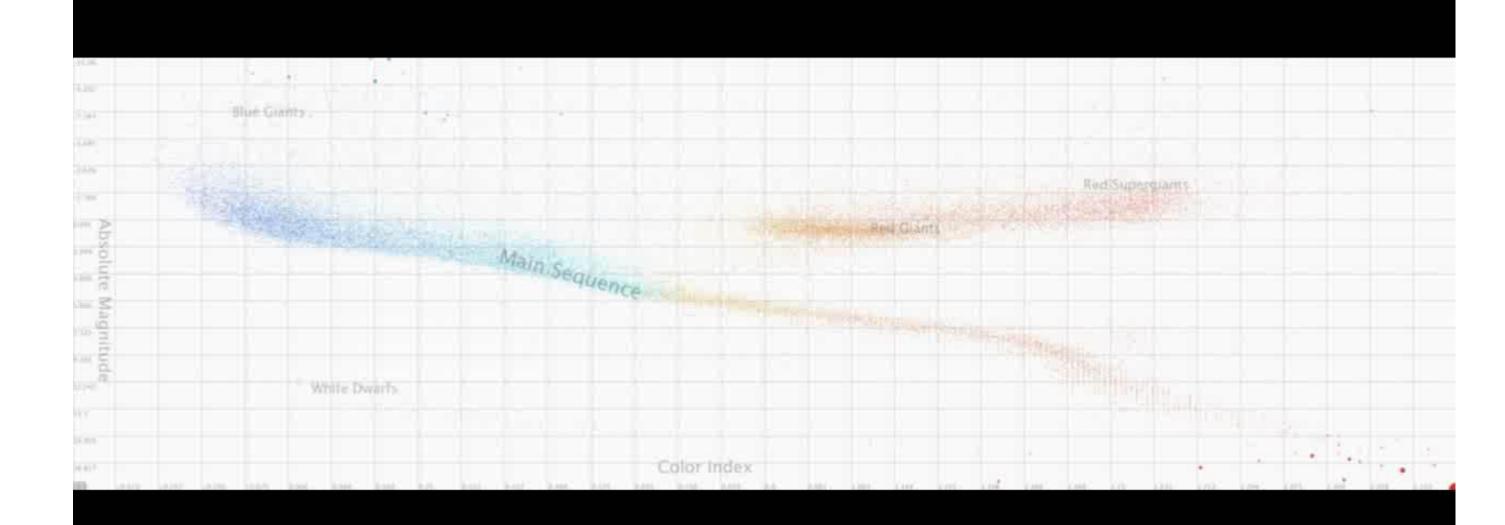
# **HI-Visualization Techniques**

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

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





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homehair worms. arrow worms entoprocts Piacozoa loriciterans . 1 threadworms (II) chordates coelenterates arthropod phoronida kinoritynche. priapulains Myxozoa orthorectids authors are recommended sponge mollusks shells the state of the s solution weather \_ flatworms. Cilibatora lamp

Cycliophora

r bears

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**STREET** 

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#### 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

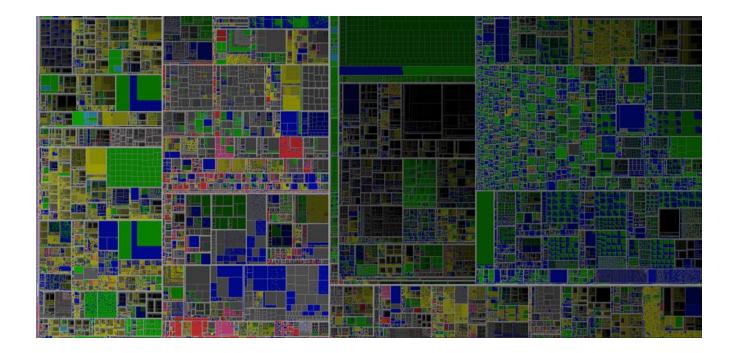
how to support their creation?

• Examples

what are they really good for?

• Design principles

how to build effective ones?













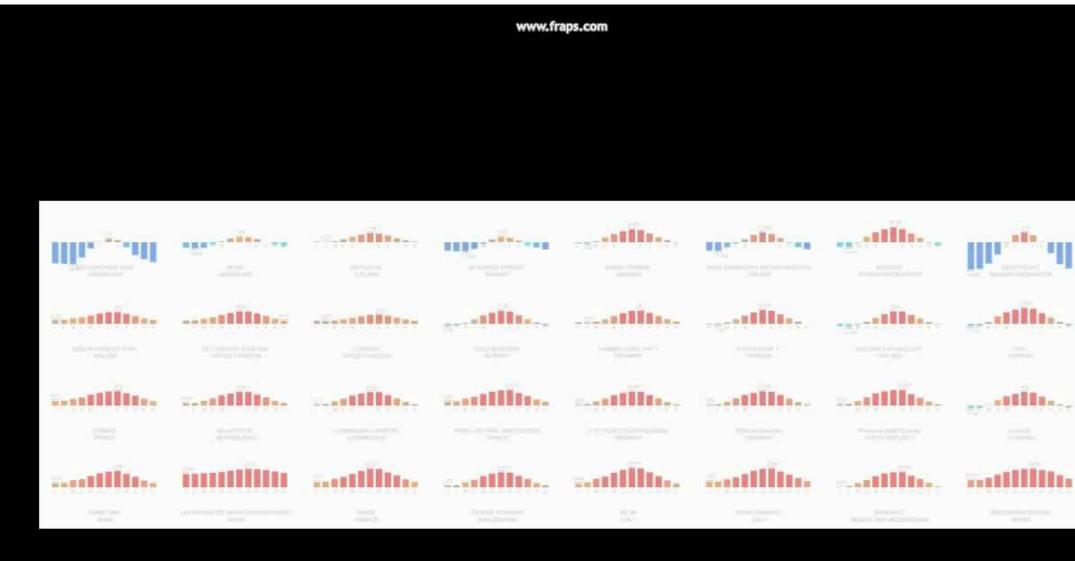
http:aviz.fr/hybridvis

Funded by: ANR-11-JS02-003

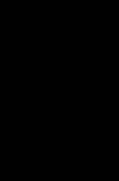


#### **Question Slides**

# Video: Information Loss When Walking Close





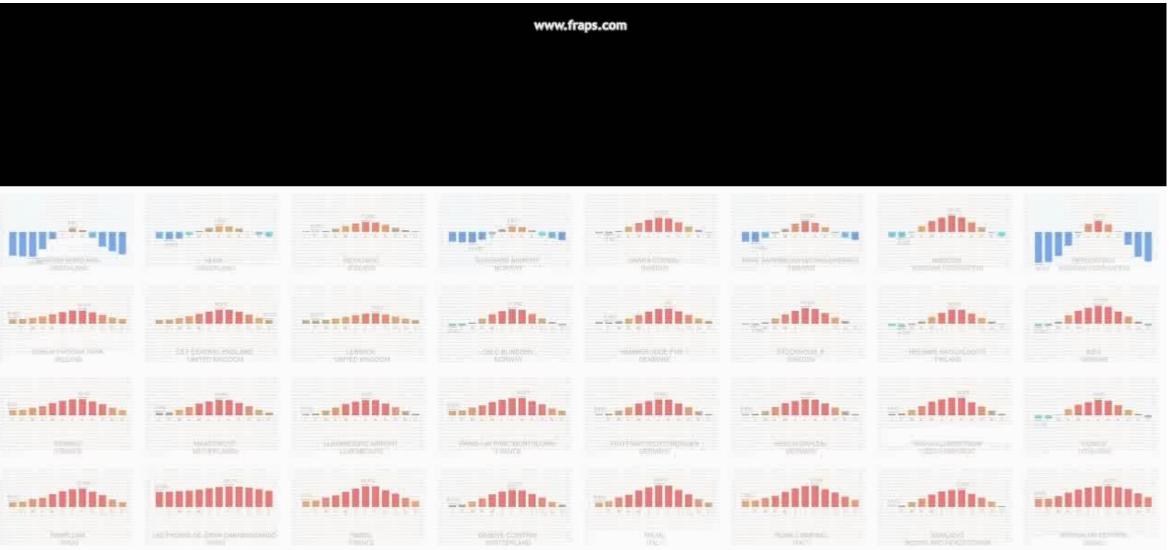




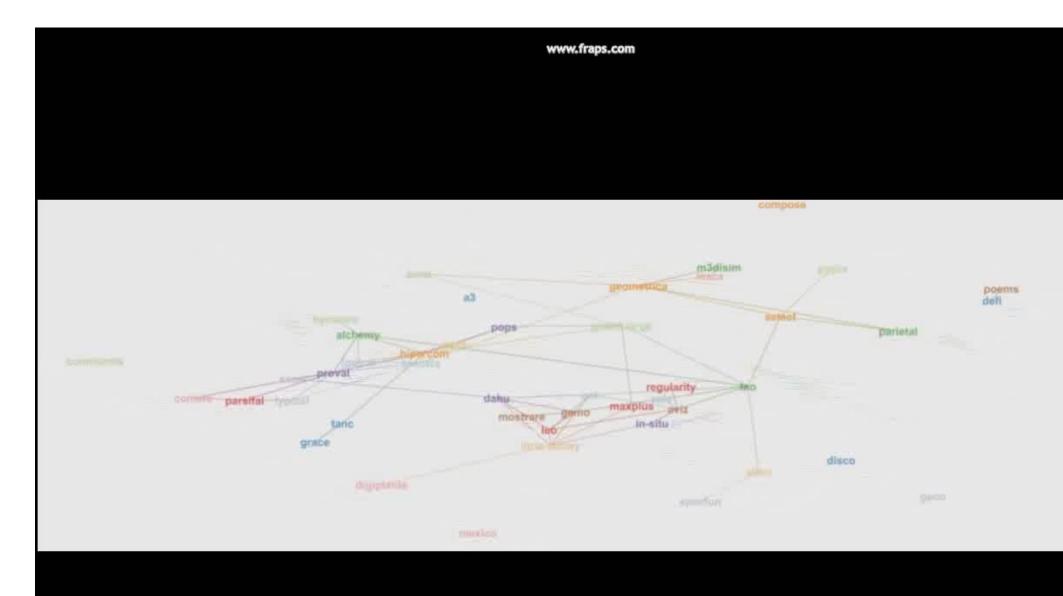
# Video: Mental Aggregation

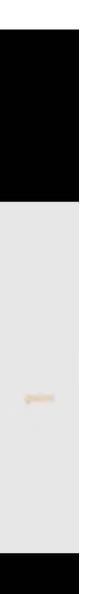
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Fabrany 730	March	April 10.530	May 17,150	18,518	July-	
February 5.689	March 9.690	Apiil 12.210	Mav 17.20	June 17756	July 21,780	
February 7,880	March 9.270	3pm 11.420	May 10,699	June 	400y-	~~~
February 6.530	March	Apiil 10,080	Mav 18,955	durre 18.120	July. 20.730	
February	March	April	May 140460	June 19:06C	Juny 19.810	

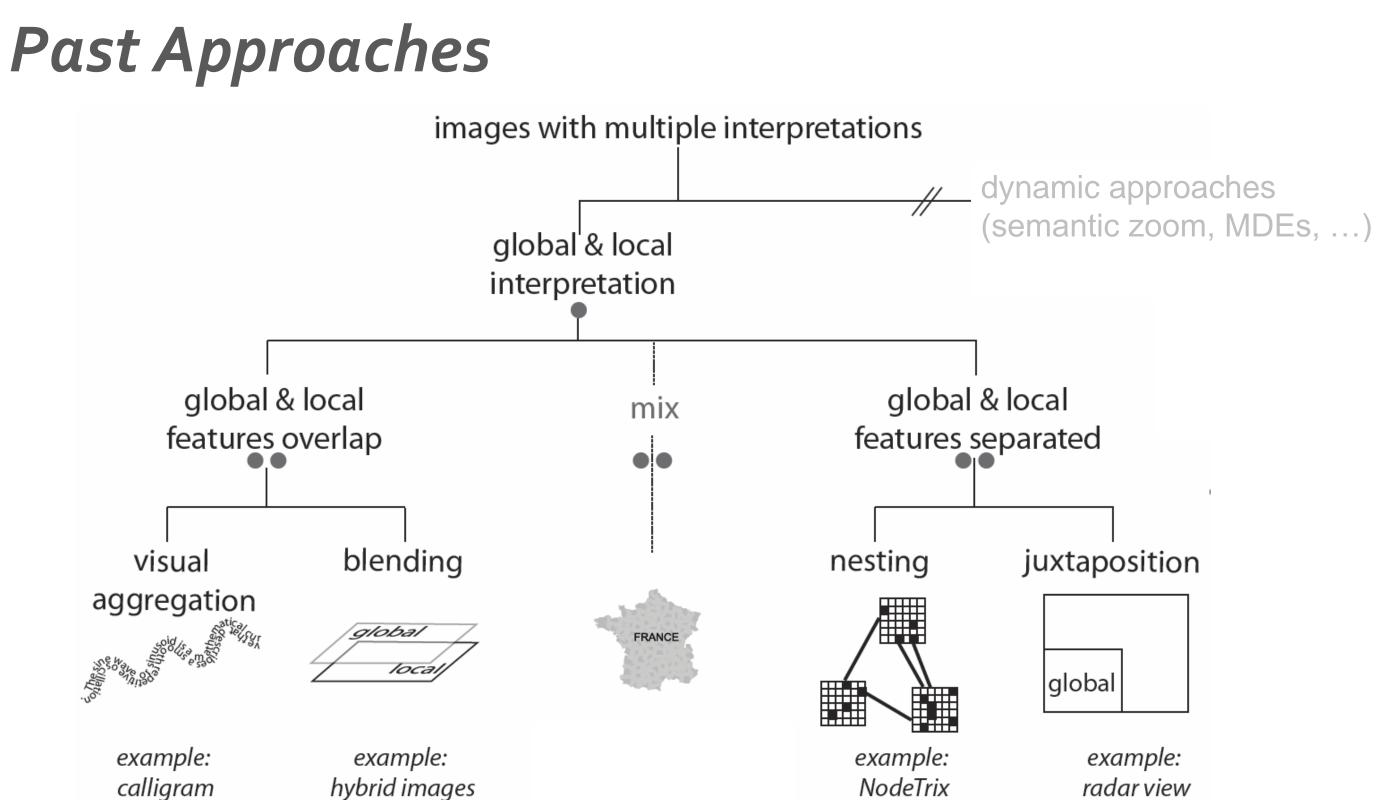
### Video: Alpha blending



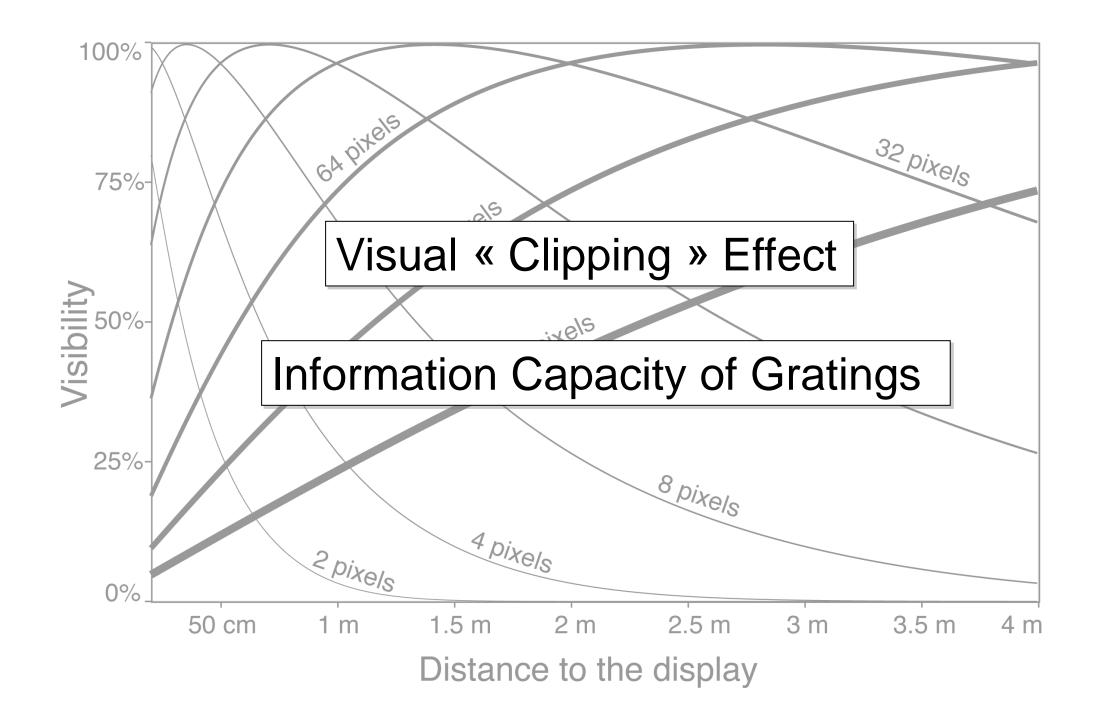
### Video: Graph vis



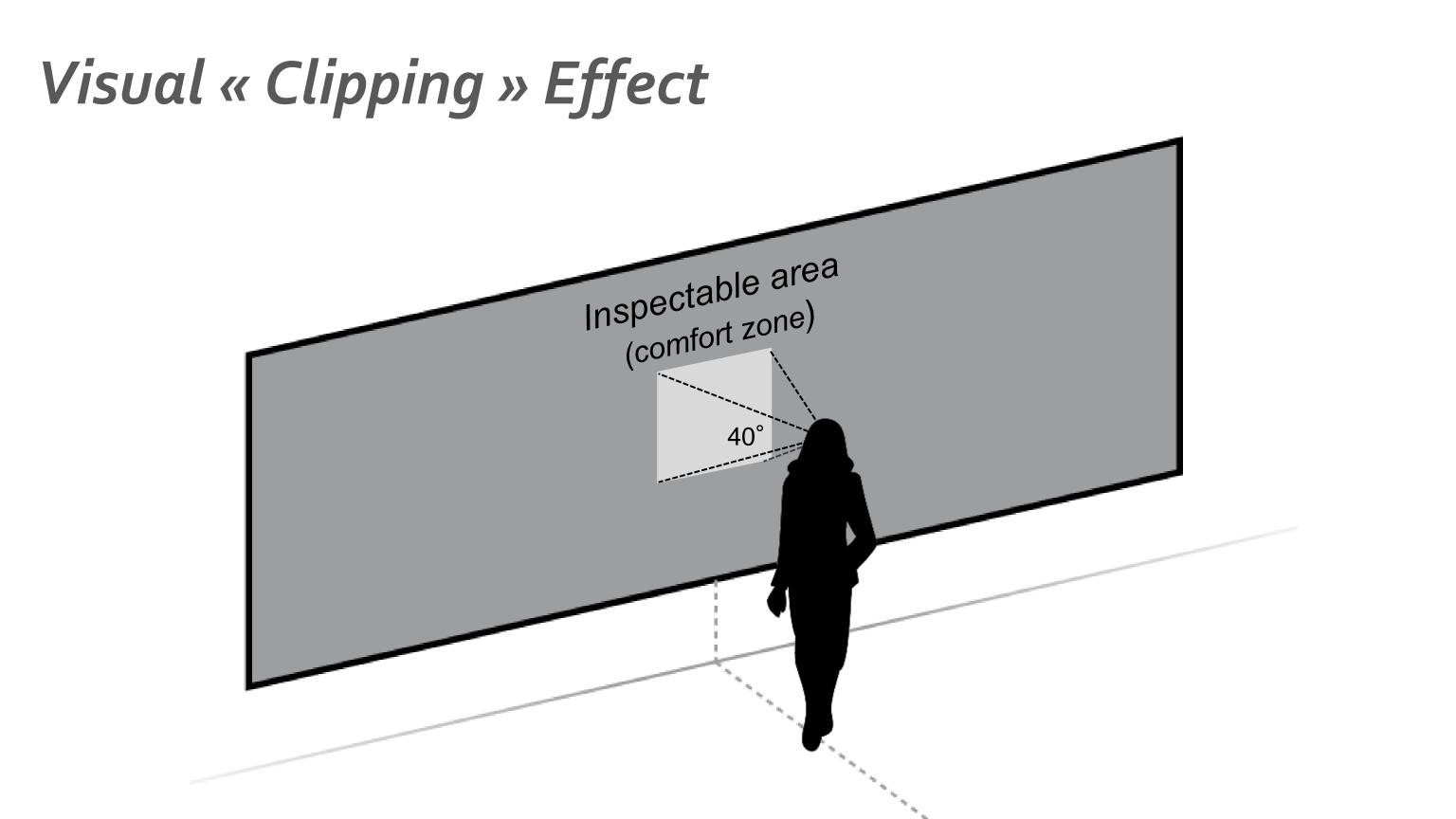




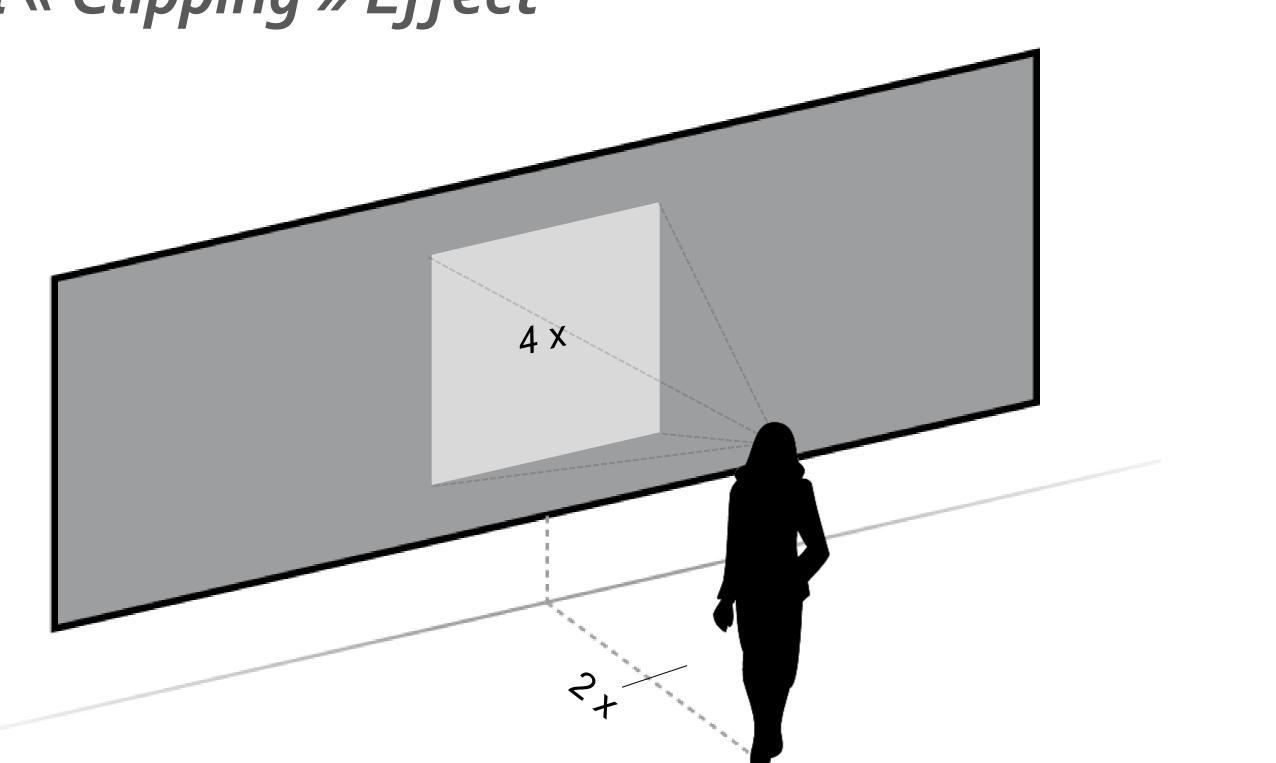
### What do we Perceive from a Large Display?

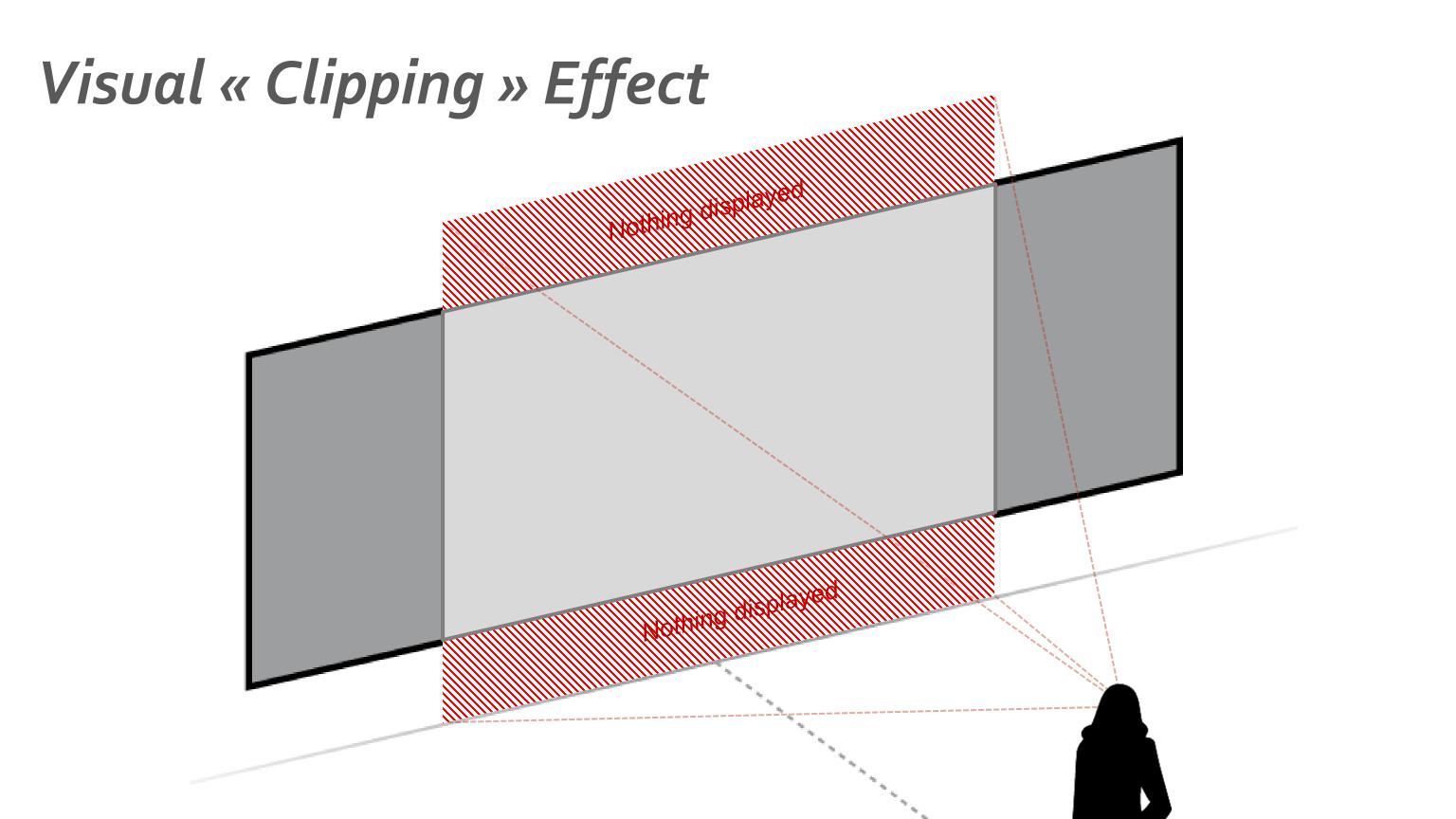






## Visual « Clipping » Effect





# Visual « Clipping » Effect

