





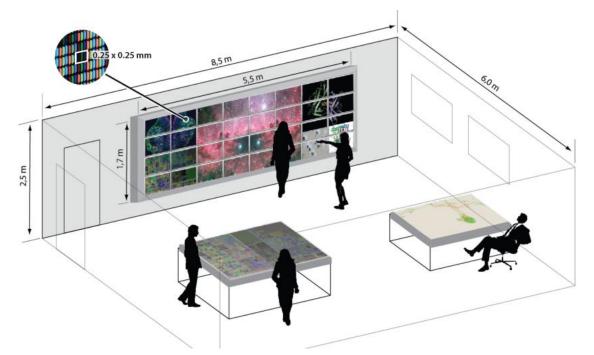


## Hybrid-Image Visualization for Large Viewing Environments

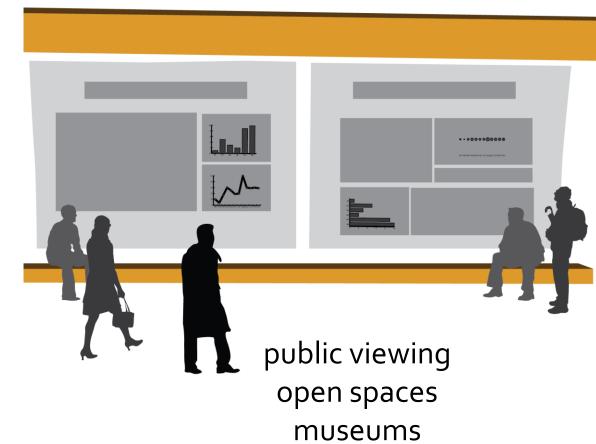
Petra Isenberg, Pierre Dragicevic,

Wesley Willett, Anastasia Bezerianos, Jean-Daniel Fekete

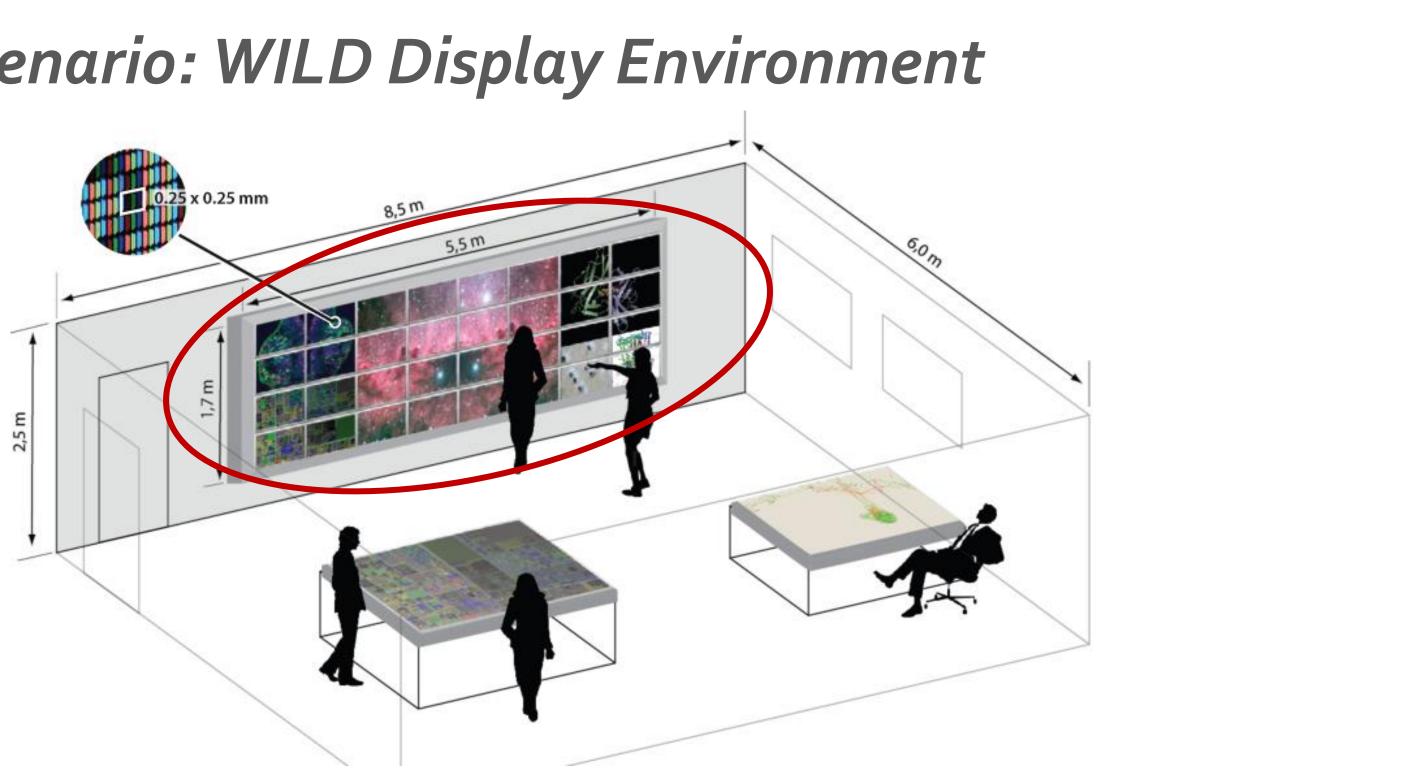
## Large Viewing Environments



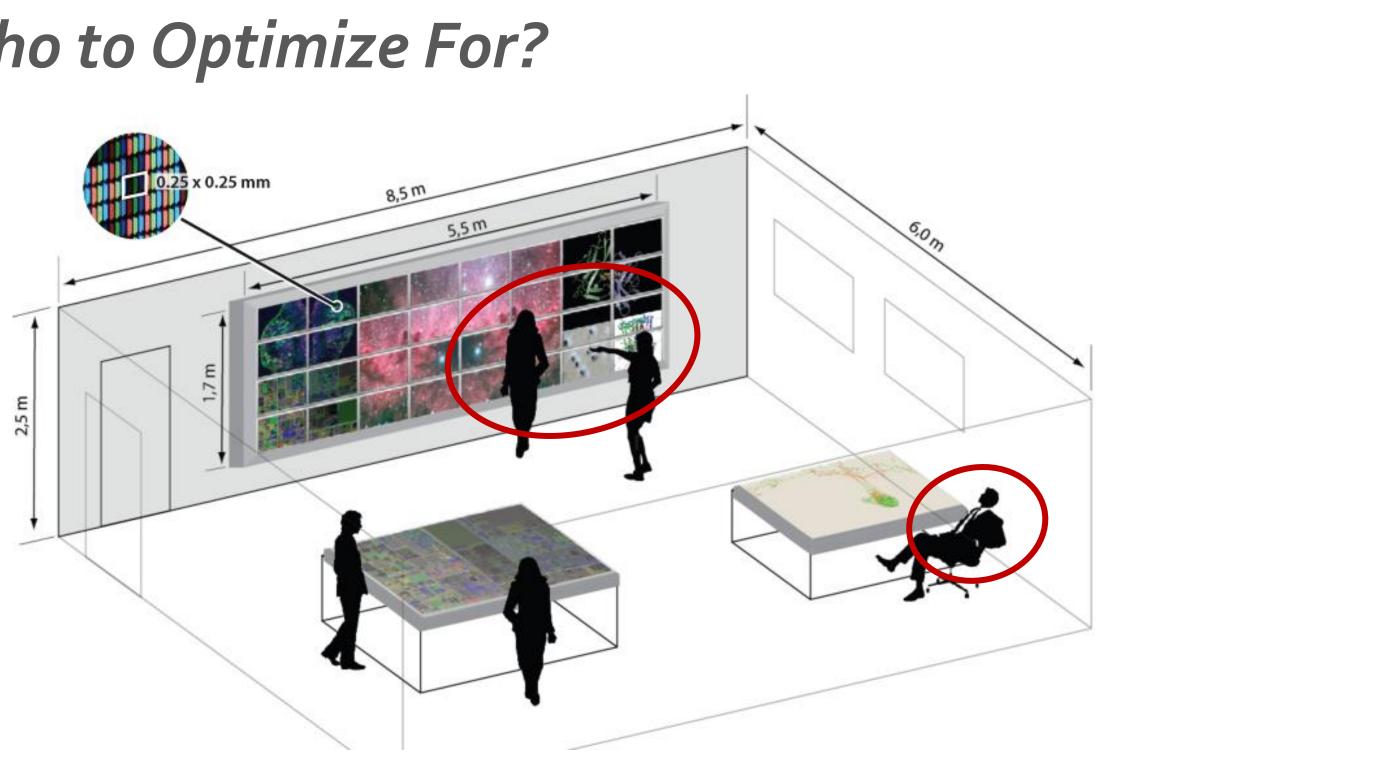
large displays meeting rooms / war rooms emergency response rooms



## Scenario: WILD Display Environment



Who to Optimize For?



#### Example Data

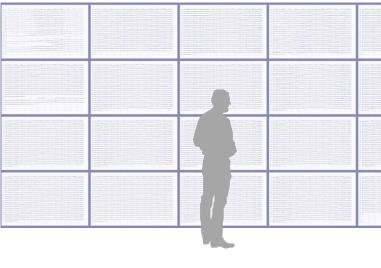
#### 23 years of daily temperatures for 32 cities

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	-01-04,	-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

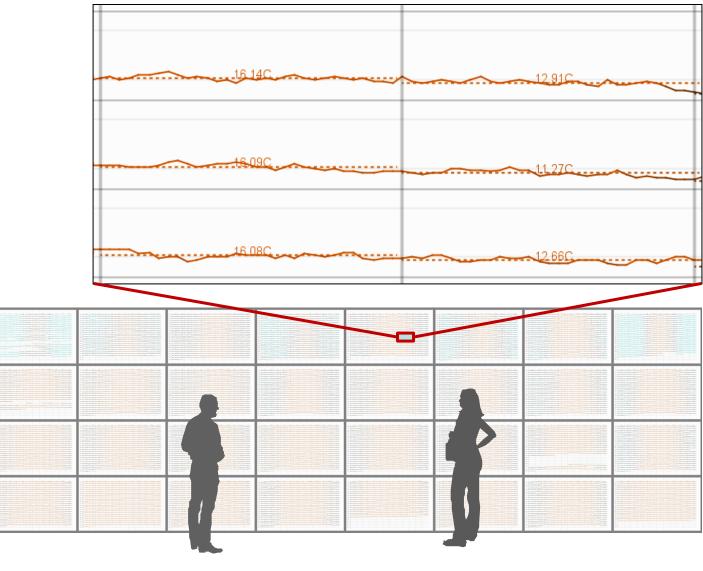
Problem: mental aggregation, comparison

6

### Naïve Approach

#### Optimize for one specific viewing distance

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21.90C							



detail from close

#### Problem: detailed information lost

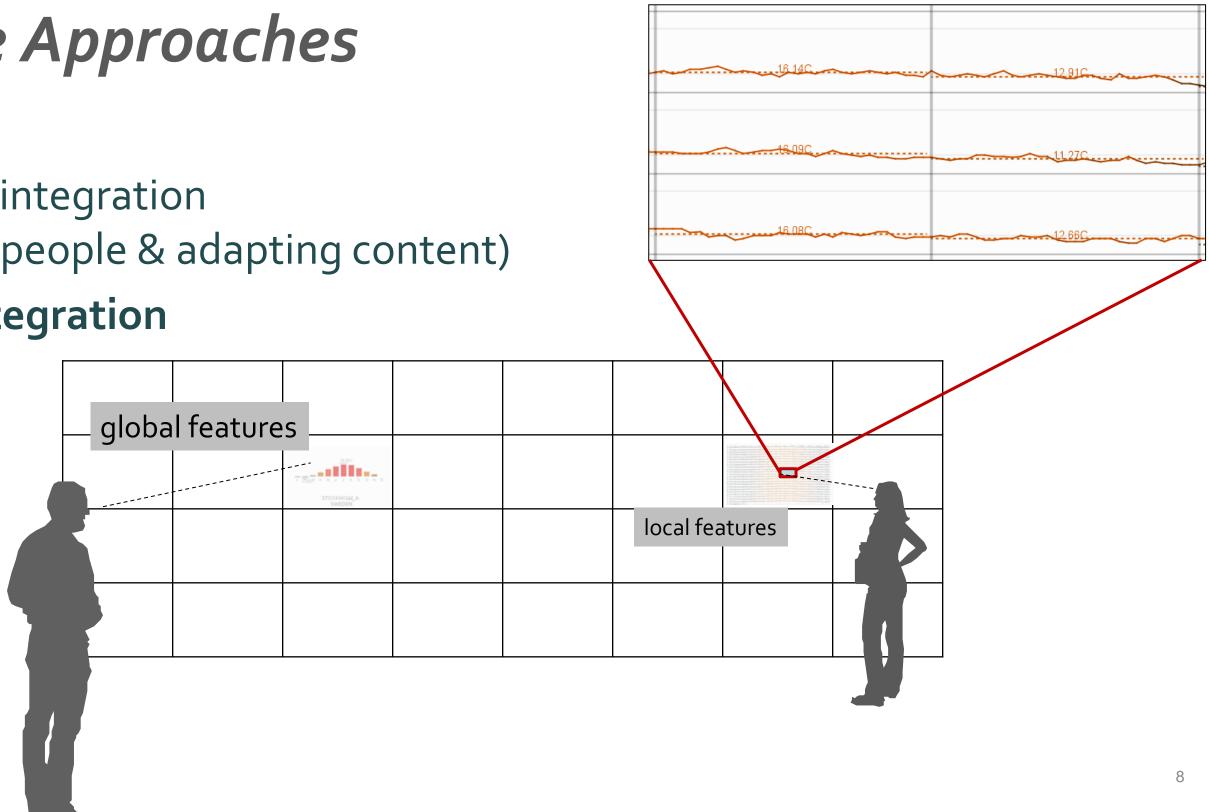
Problem: mental aggregation, comparison

7

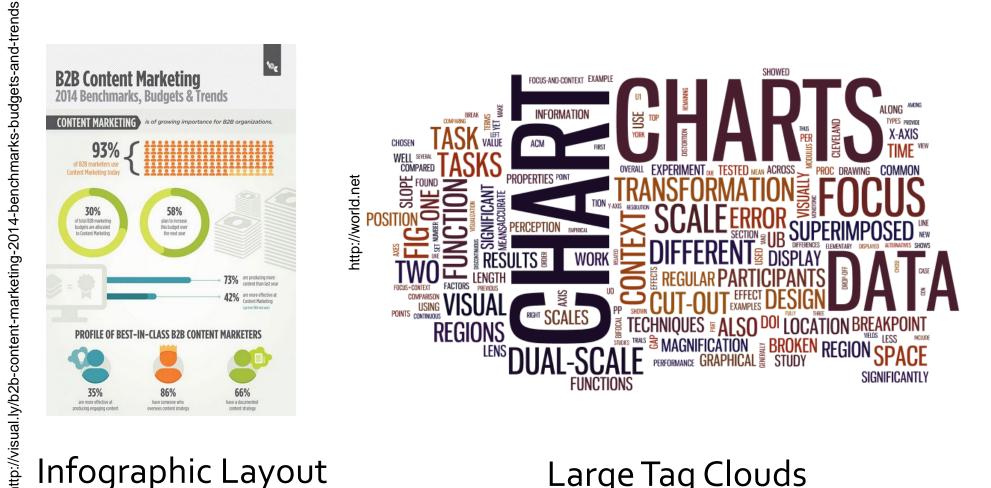
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## Possible Approaches

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



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

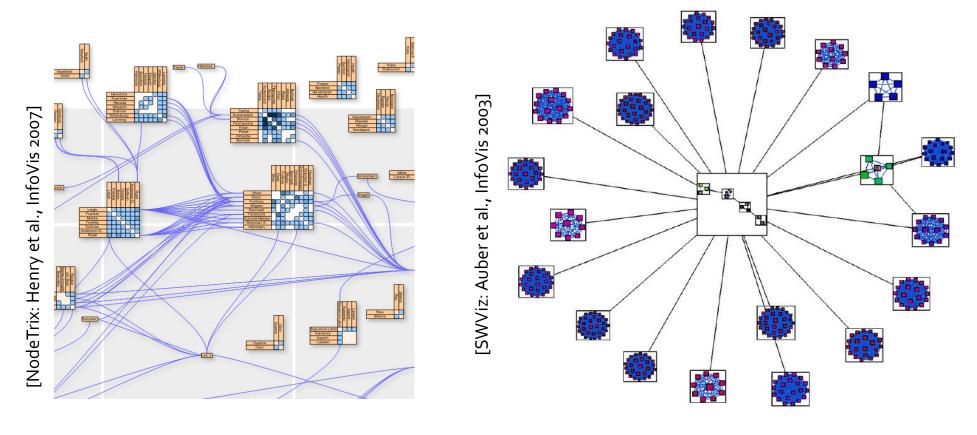


Infographic Layout

Large Tag Clouds

9

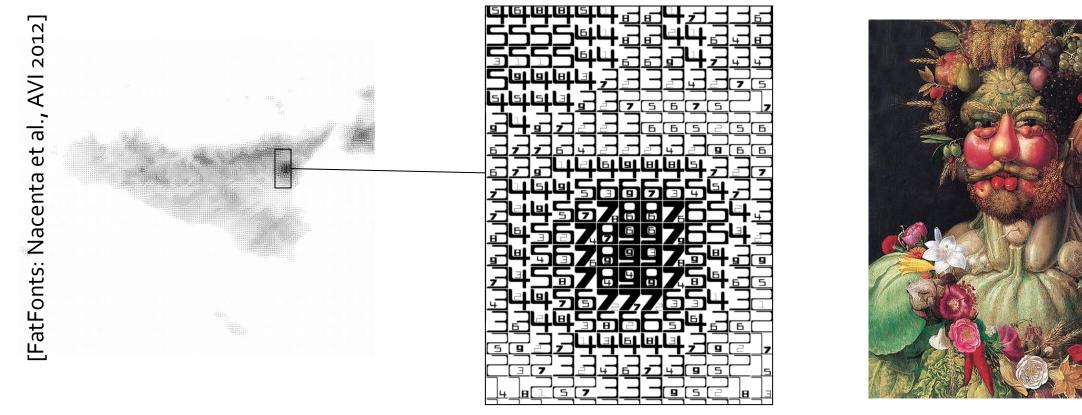
#### Nesting: local inside global features



NodeTrix

SWViz

#### Visual aggregation: local form global features

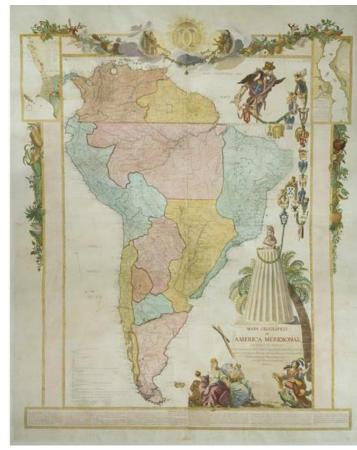


FatFonts

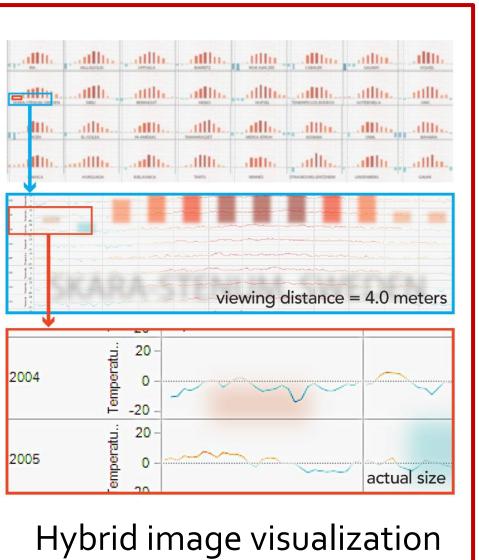
Arcimboldo Paintings, Calligrams

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LEM
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```

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



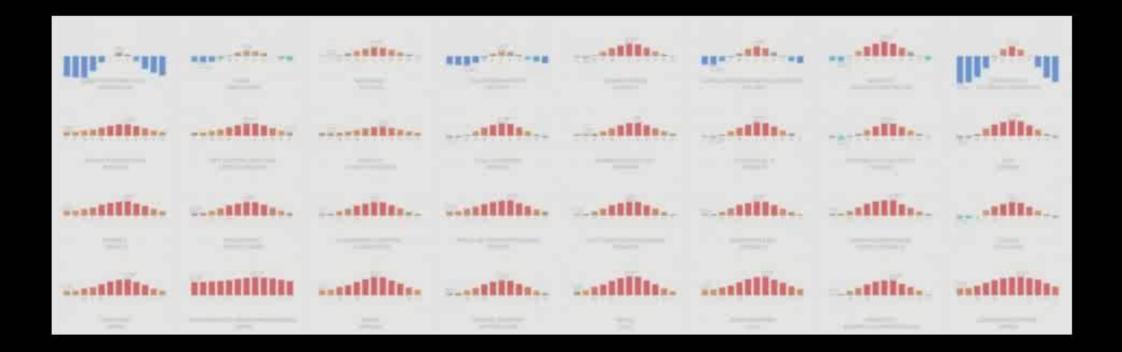
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674	Ames's Window Optical Illusion Will	Joel Coehoorn 39.9k • 6 • 71 • 1	FreeMemory
014	Blow Your Mind	Jason Heine <b>2,996</b> • 7 • 30	Mitch Wheat
552	A Harvard Psychiatrist Explains Zombie	James Hopkin 3,861 • 3 • 17	Michael Kohr
202	Neurobiology	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

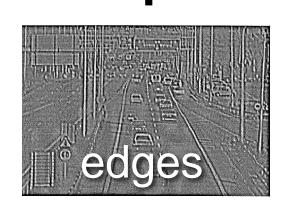
www.fraps.com



## Hybrid Images

• Schyns & Oliva, 1994



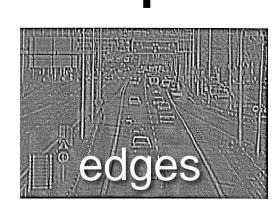




## Hybrid Images

• Oliva, Torralba & Schyns, 2006





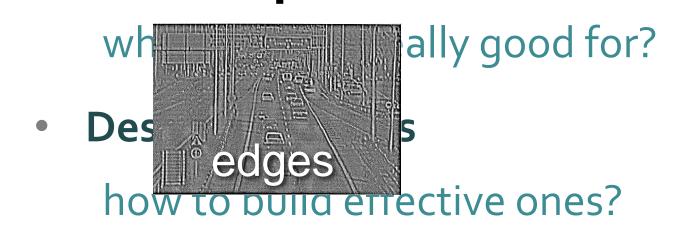
## **Our Contributions**

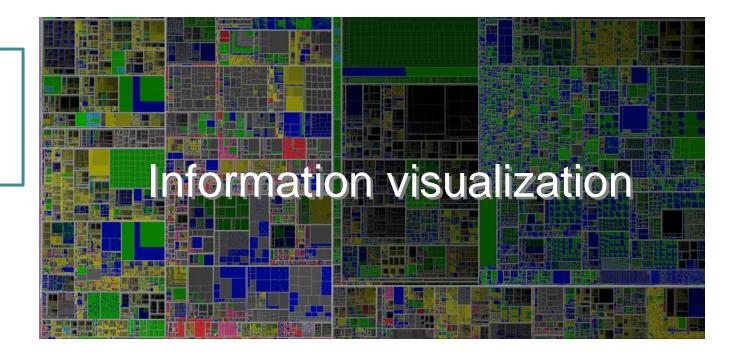
 Theoretical grounding why & when use hybrid images?

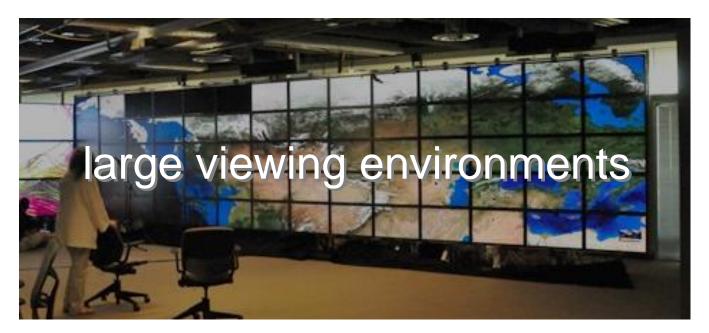
their creation?

Toc ho blurred

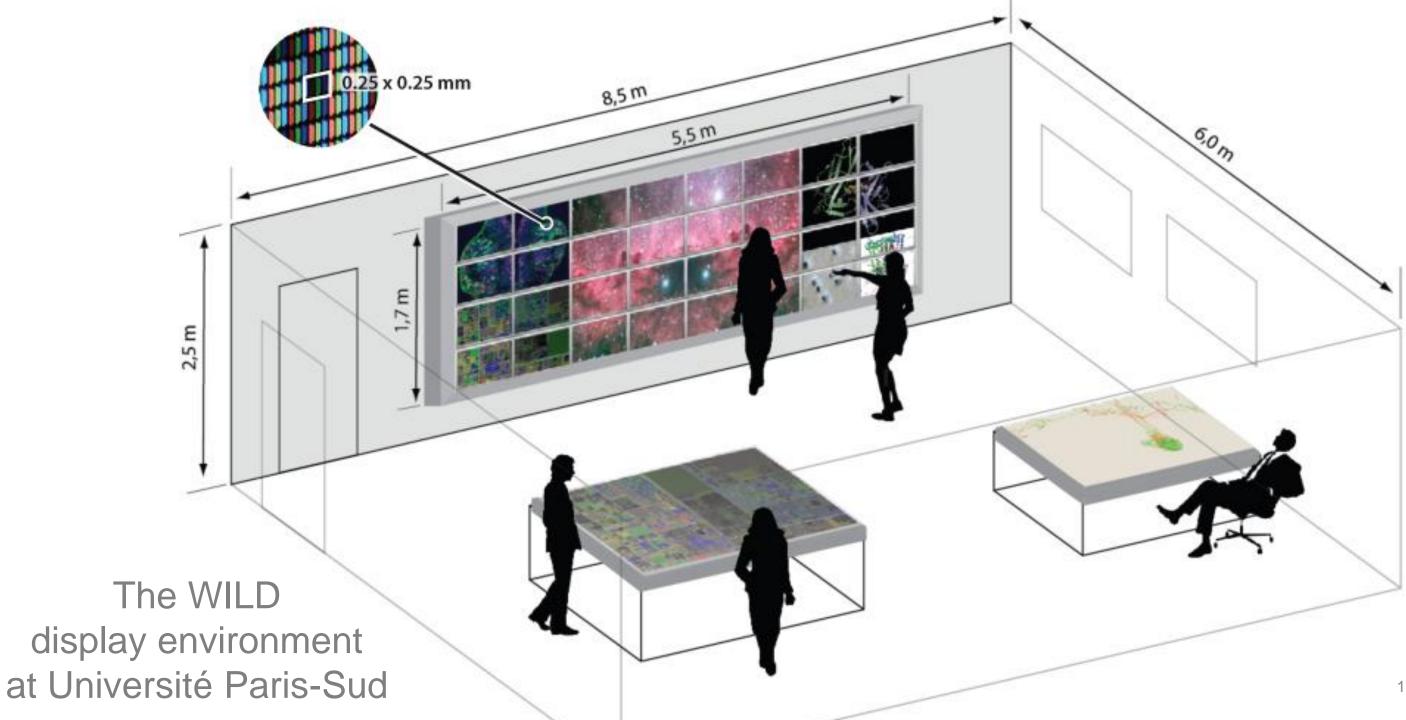
Examples





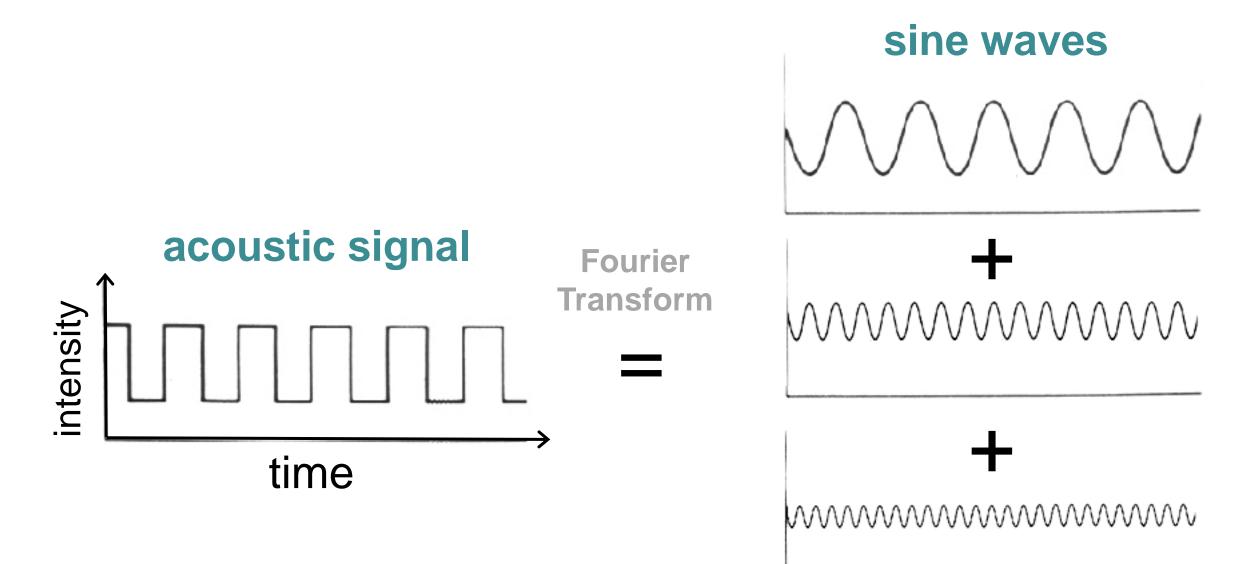


## Can they Convey More Visual Information?





## Frequency Domain Approach



#### frequencies in Hertz

## Frequency Domain Approach

#### sinusoidal gratings



# 

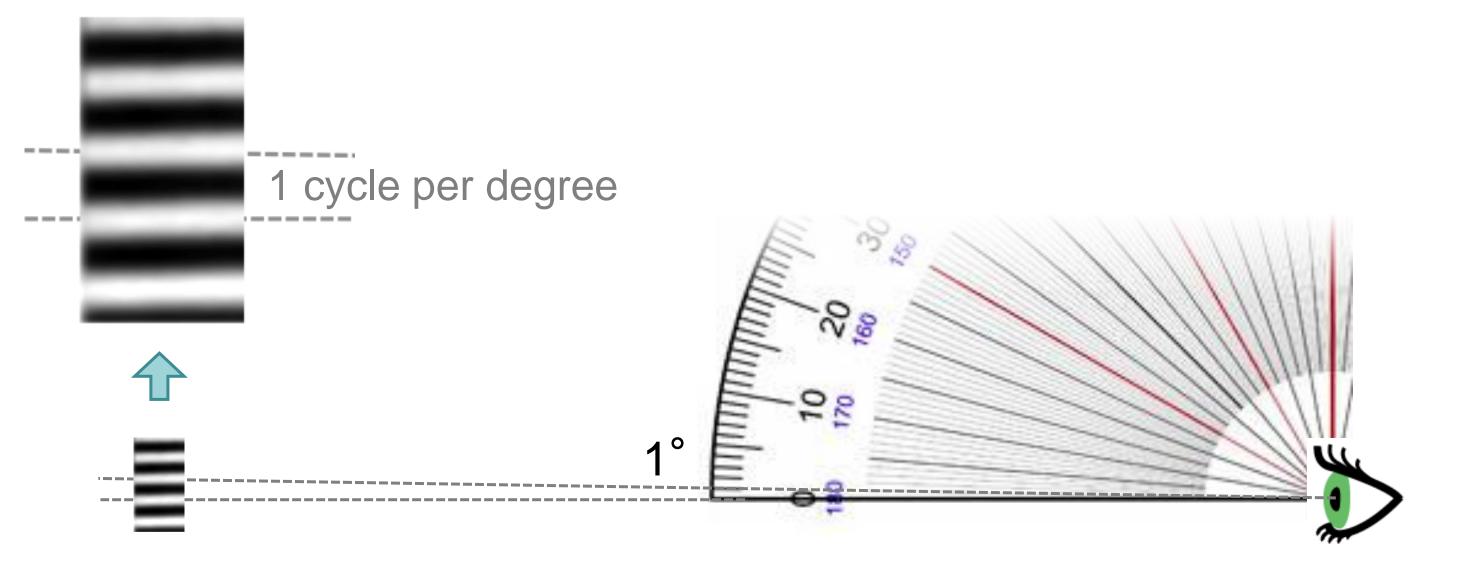
(1D) Fourier Transform



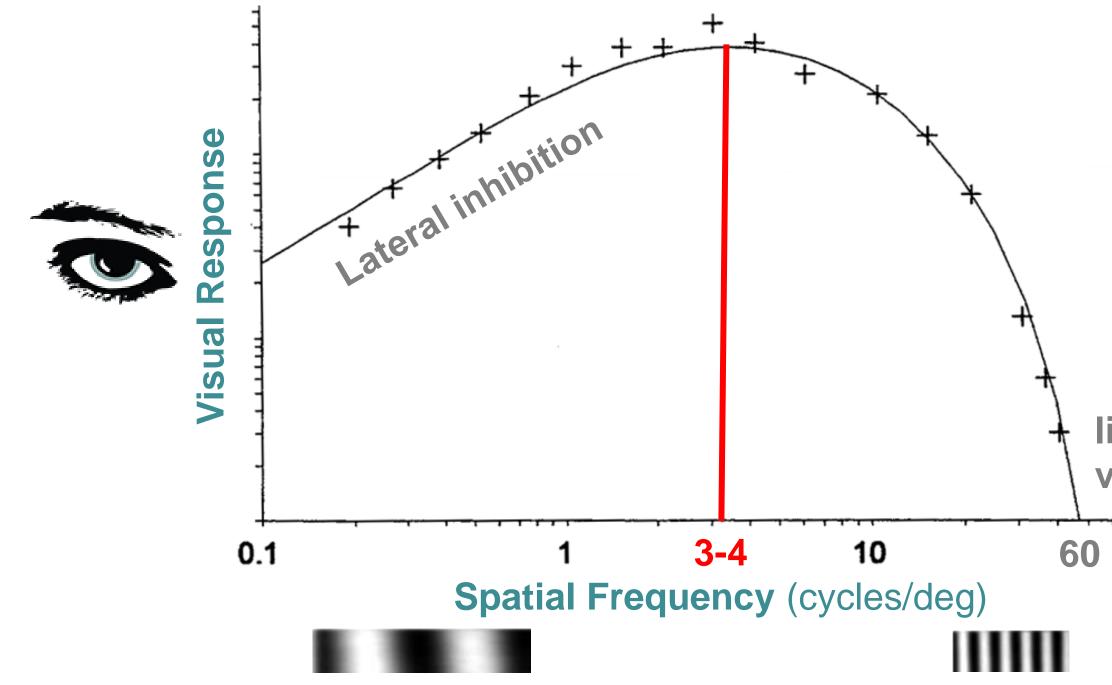


#### frequencies in cycles/degree of visual angle

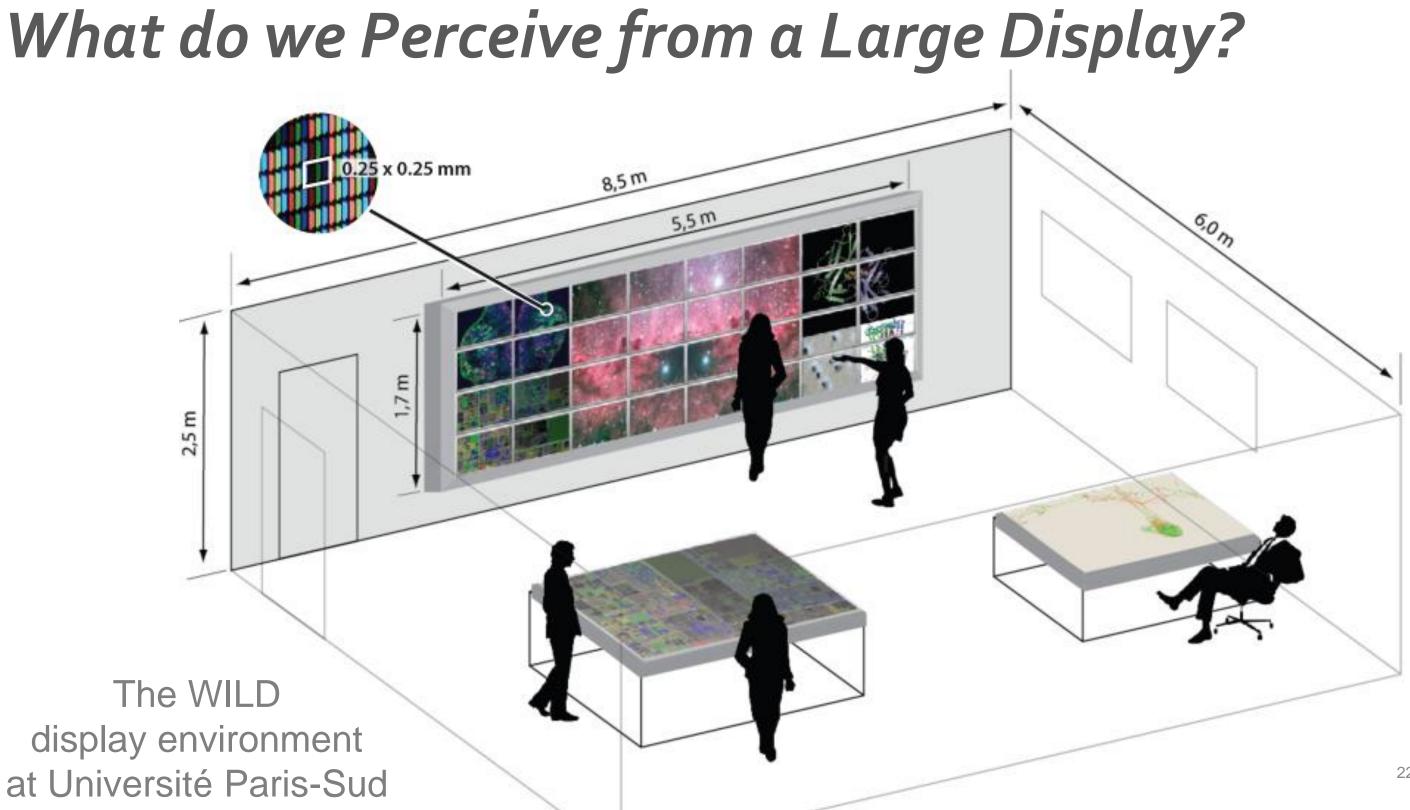
#### **Contrast Sensitivity Function**

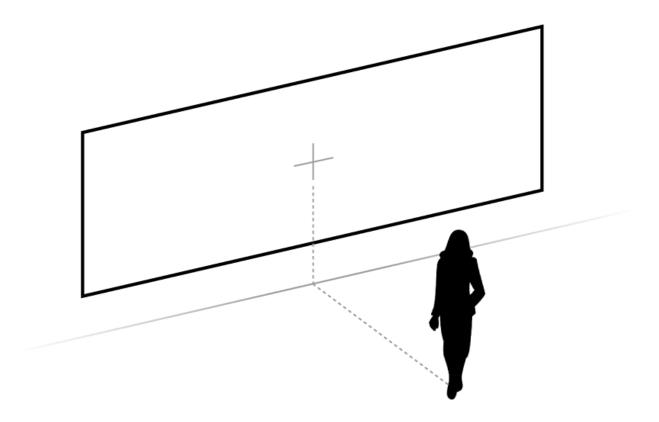


#### **Contrast Sensitivity Function**

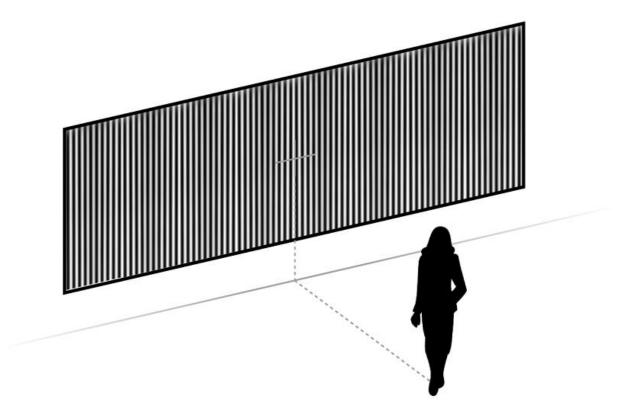


## limit of visual acuity

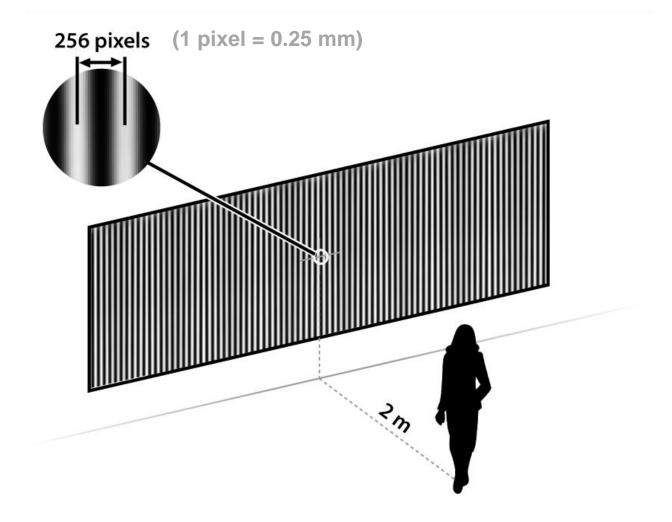




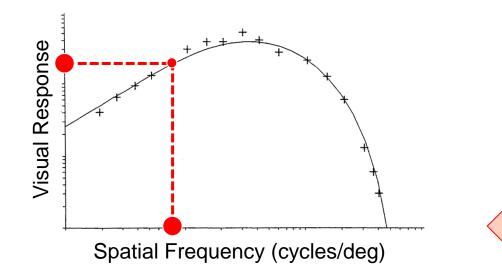


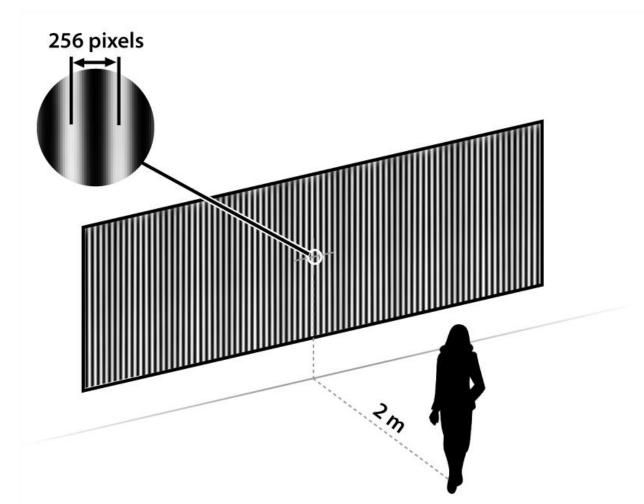




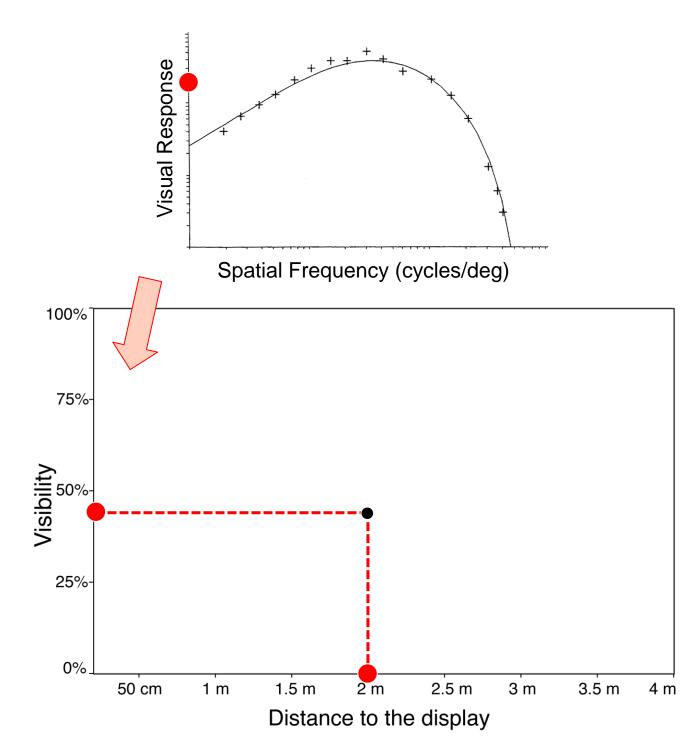


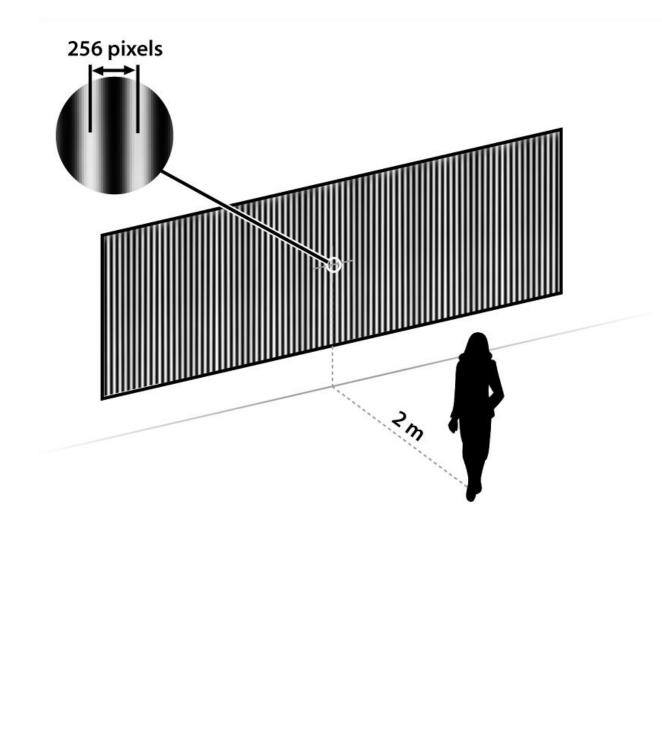




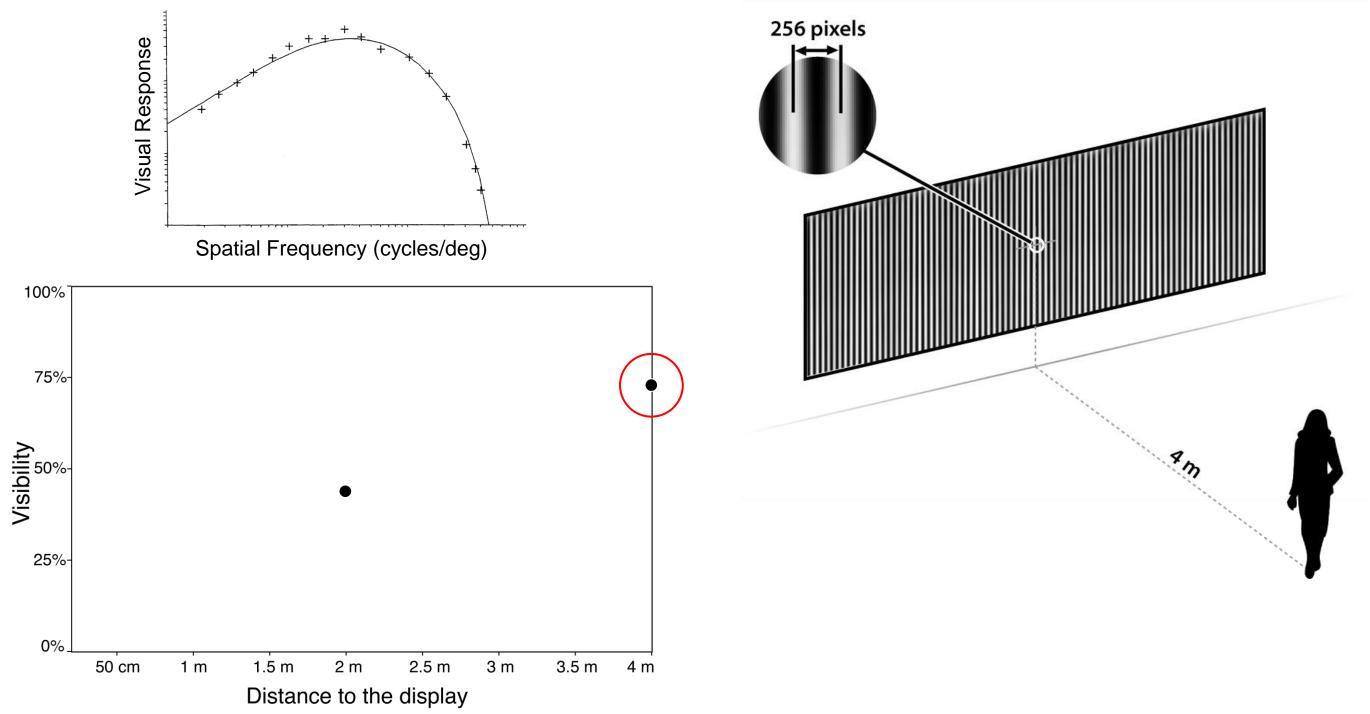




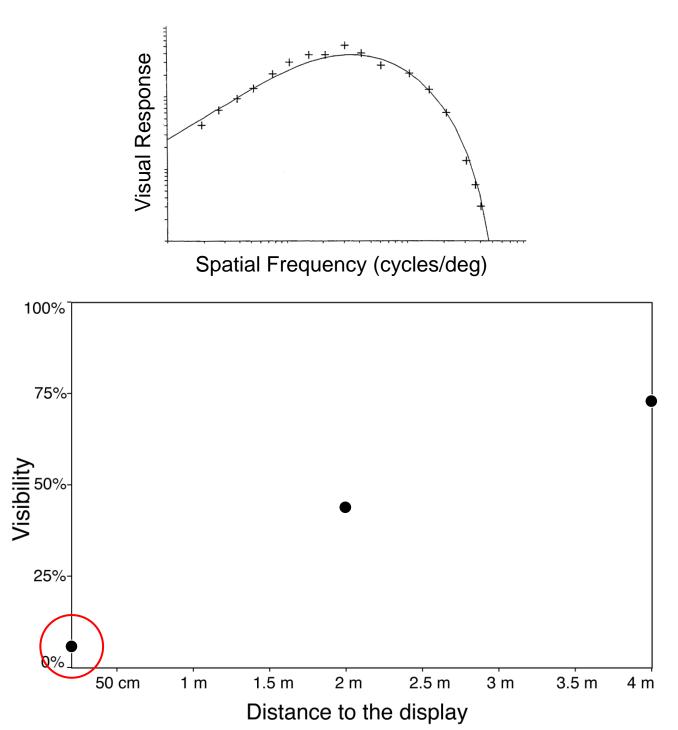


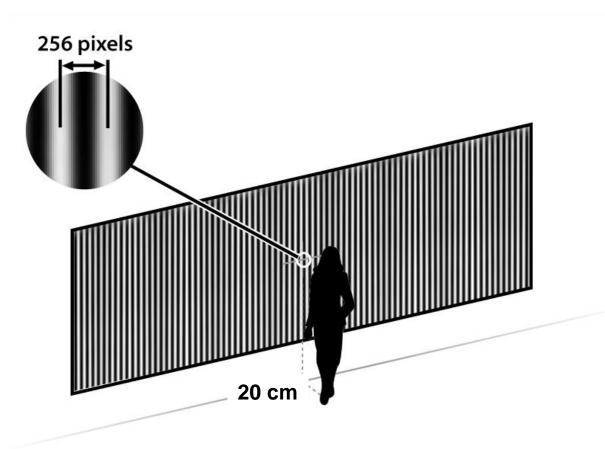




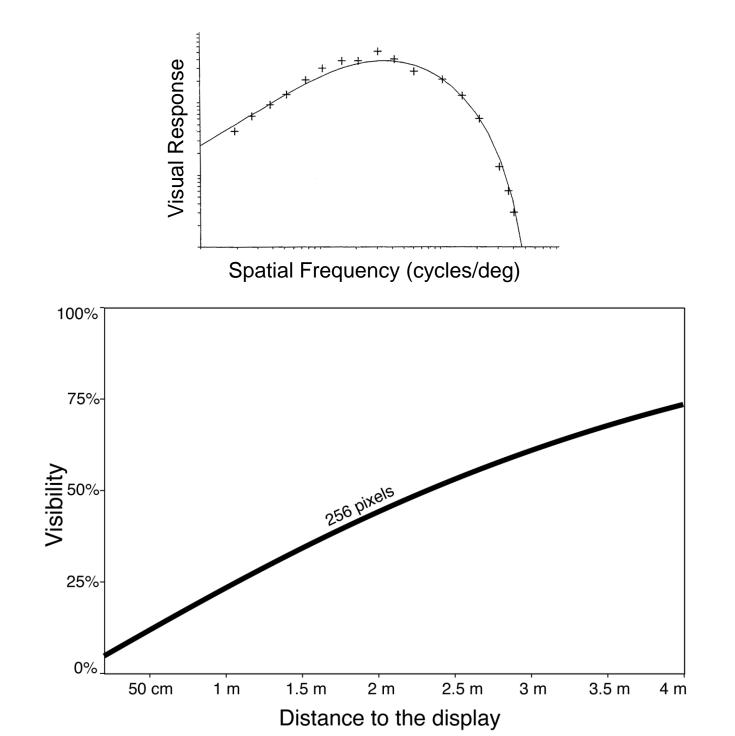


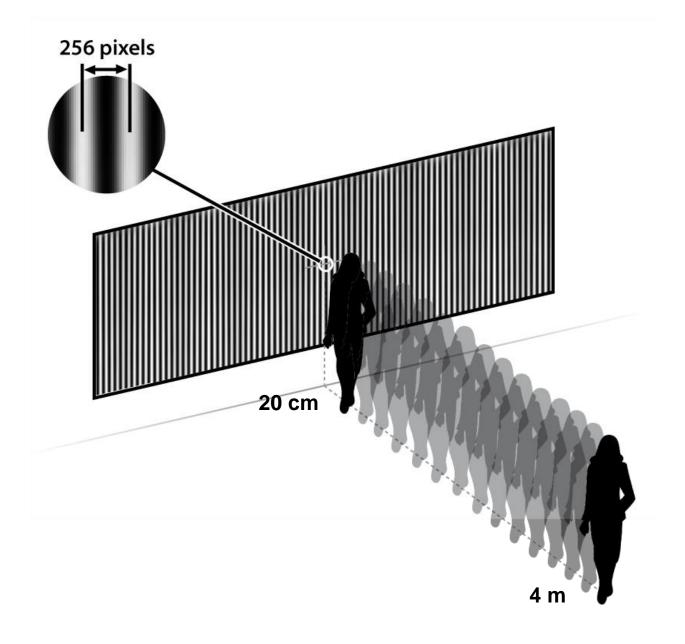




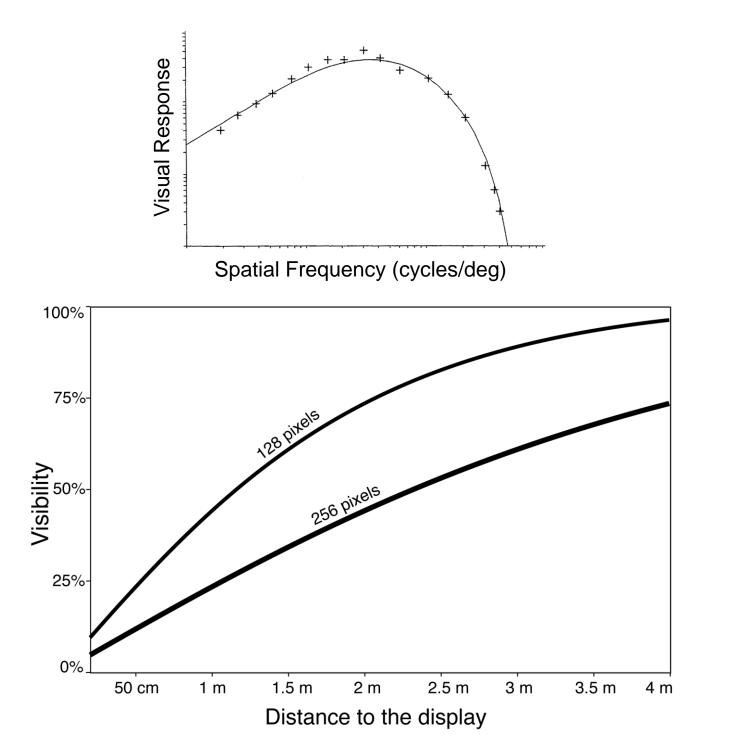


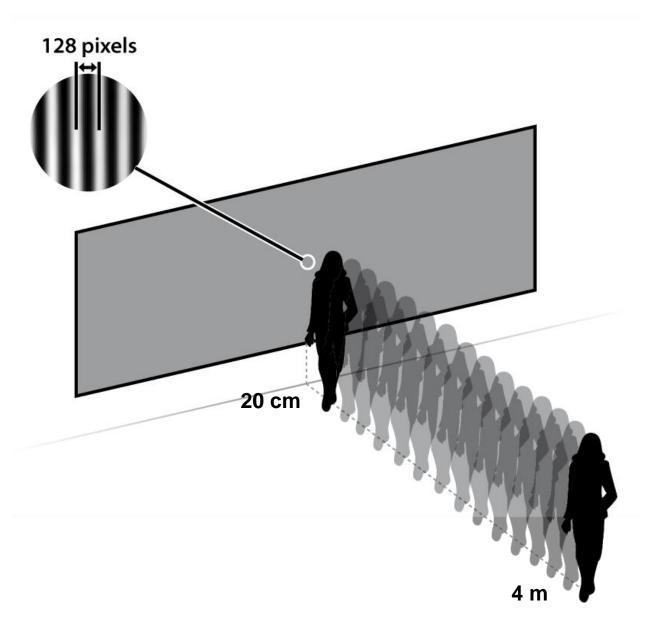




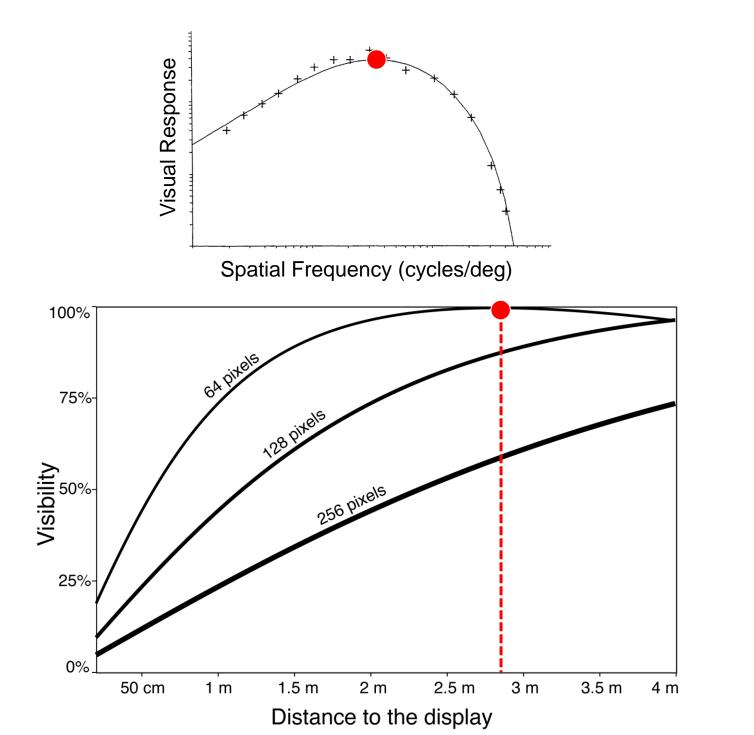


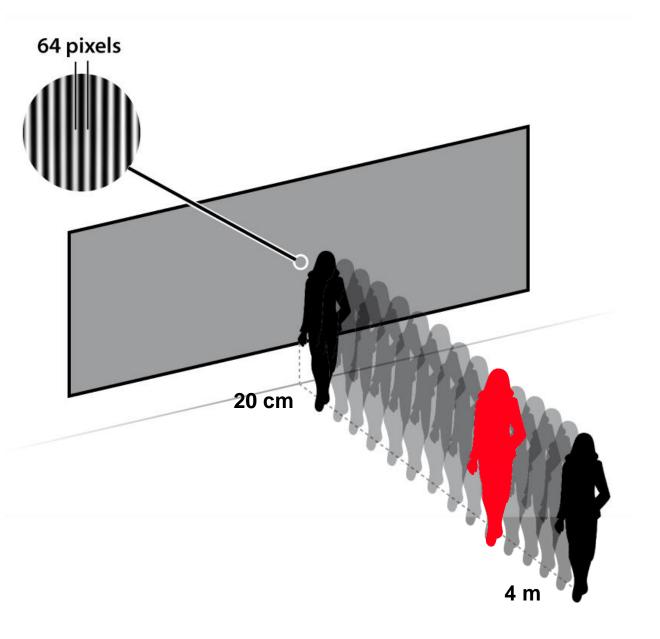




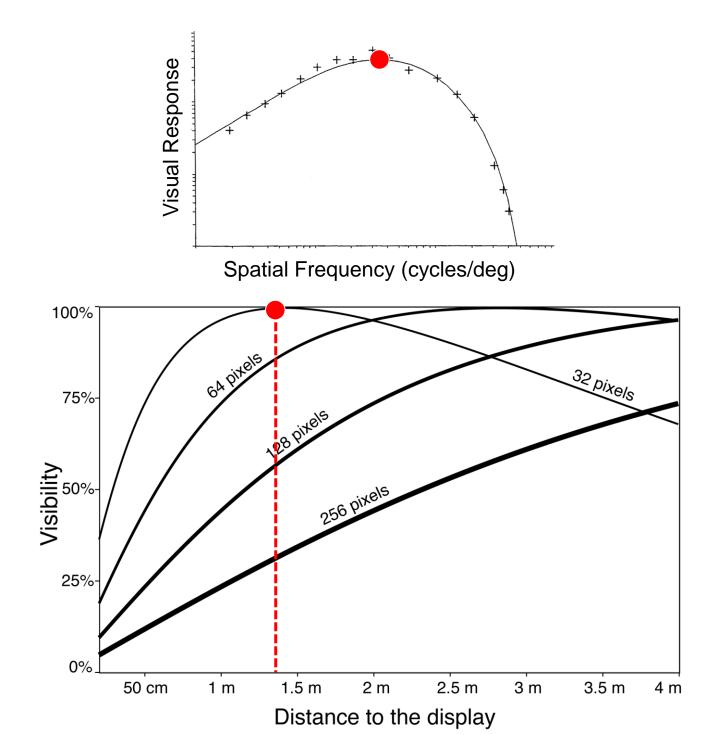


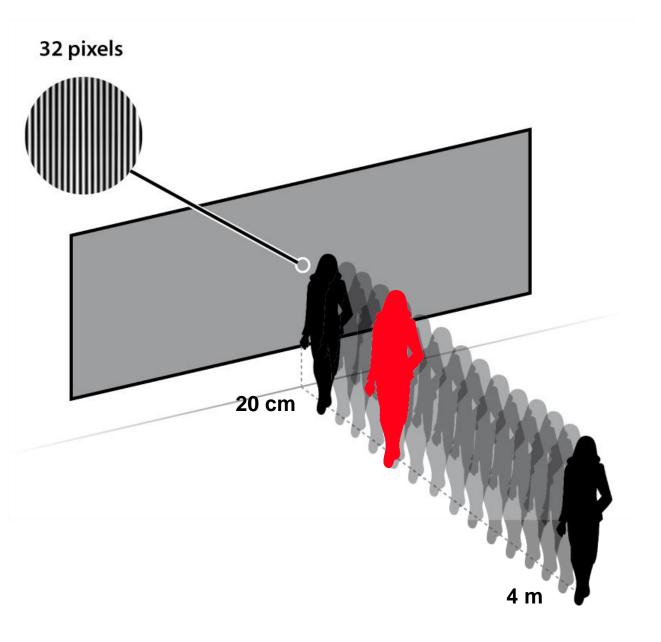




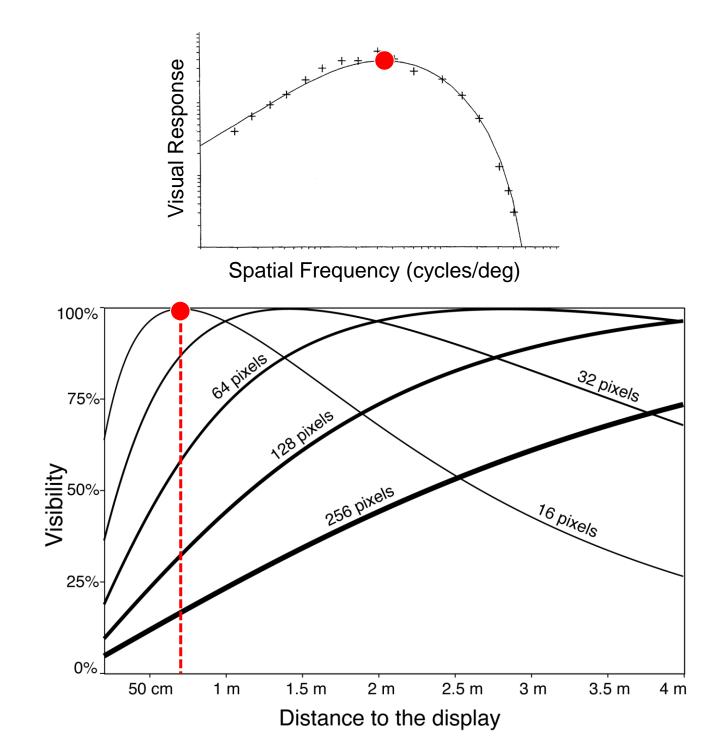


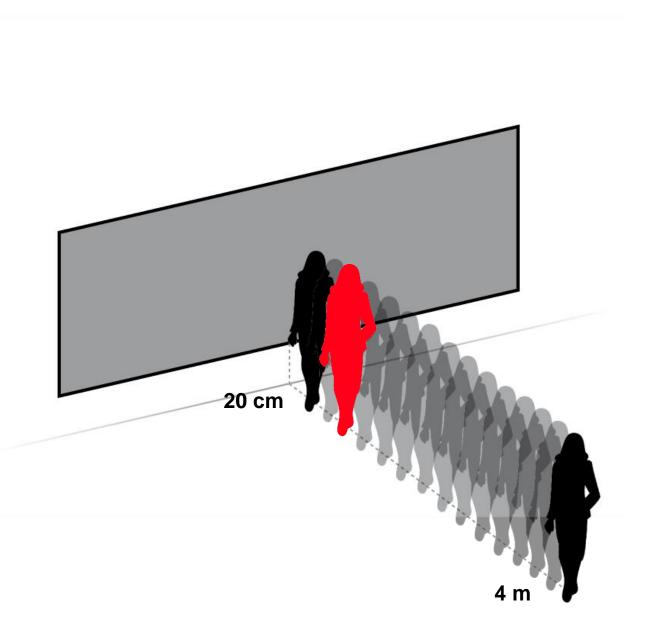




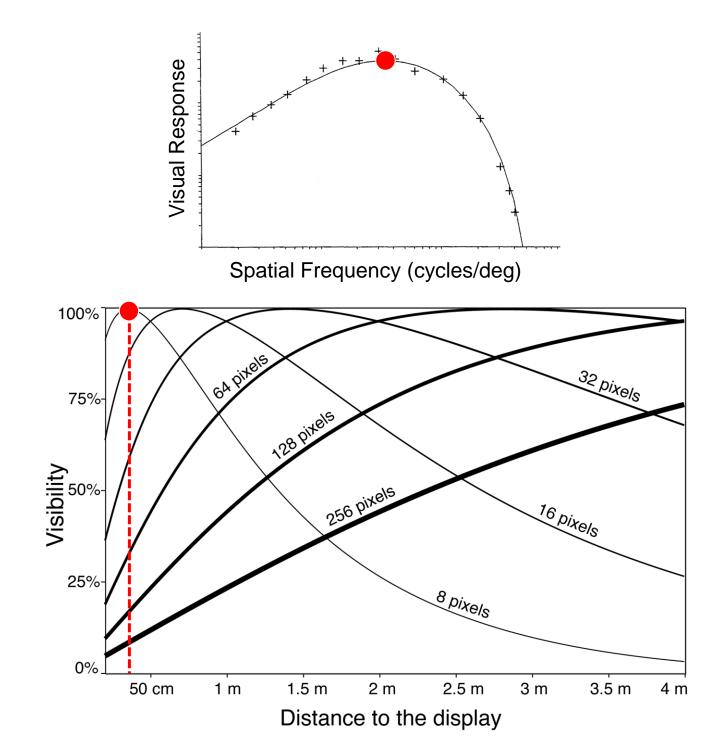


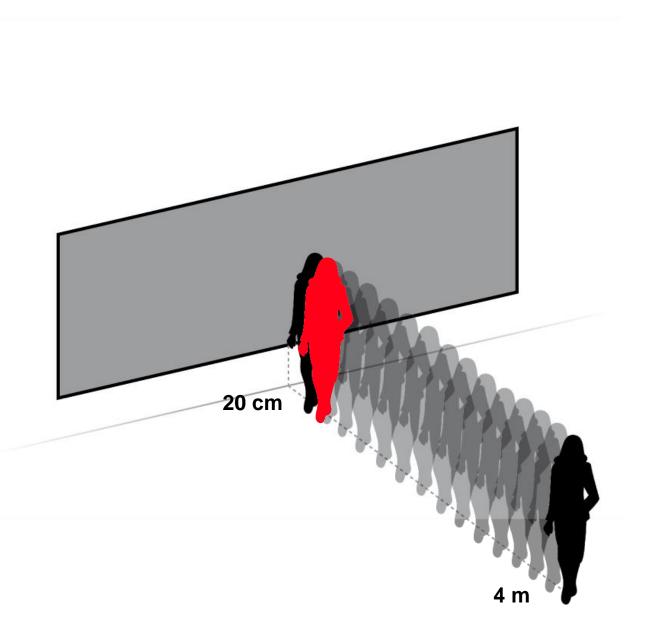




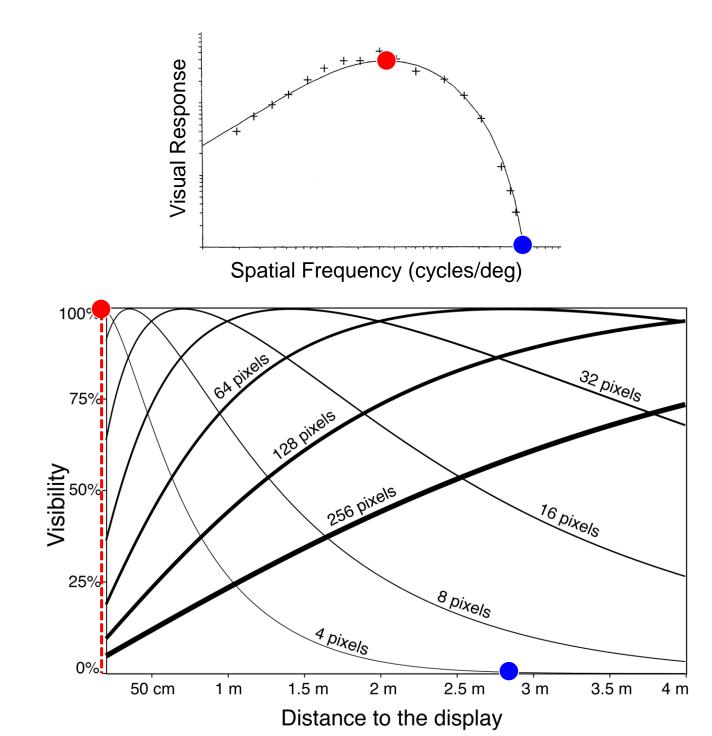


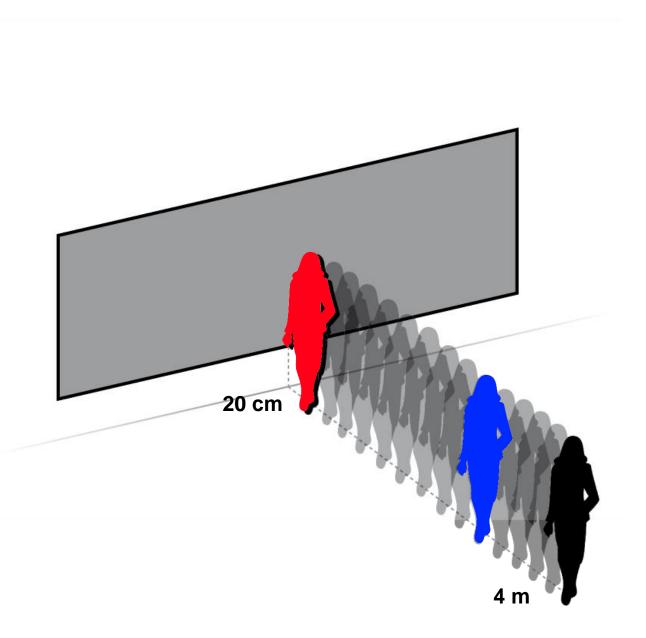






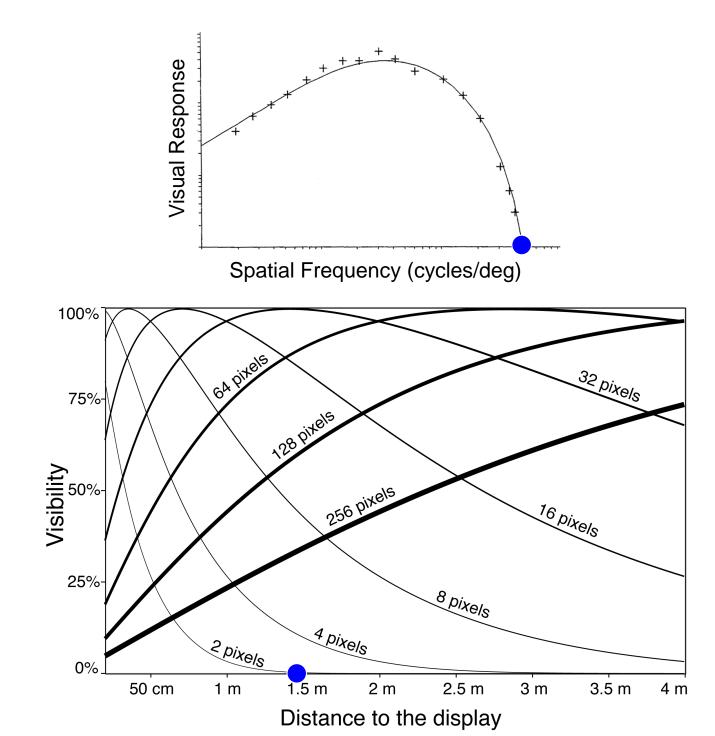


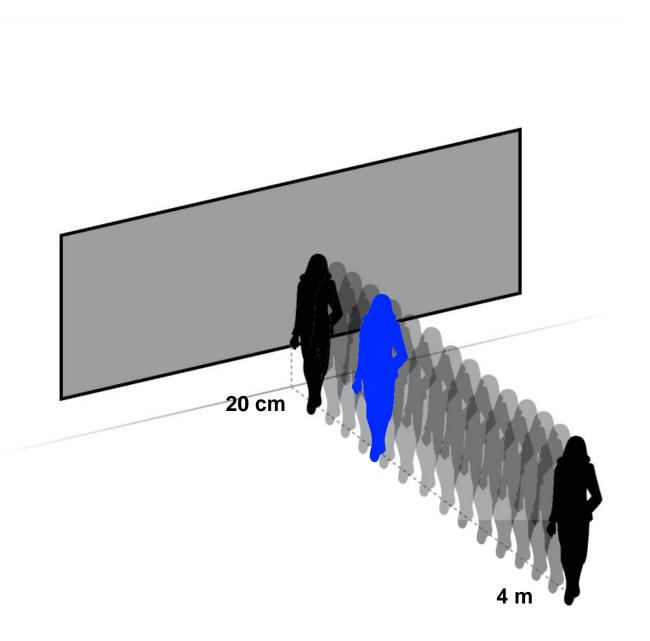






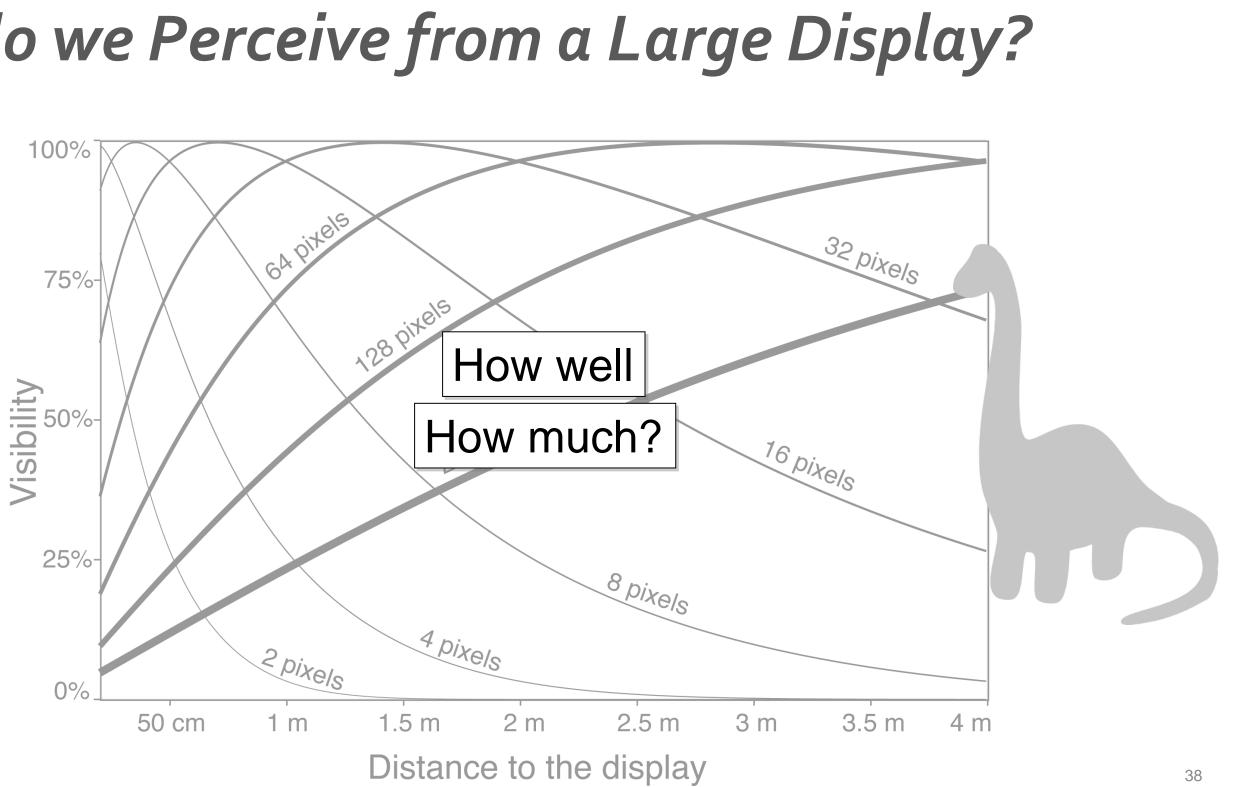
#### What do we Perceive from a Large Display?



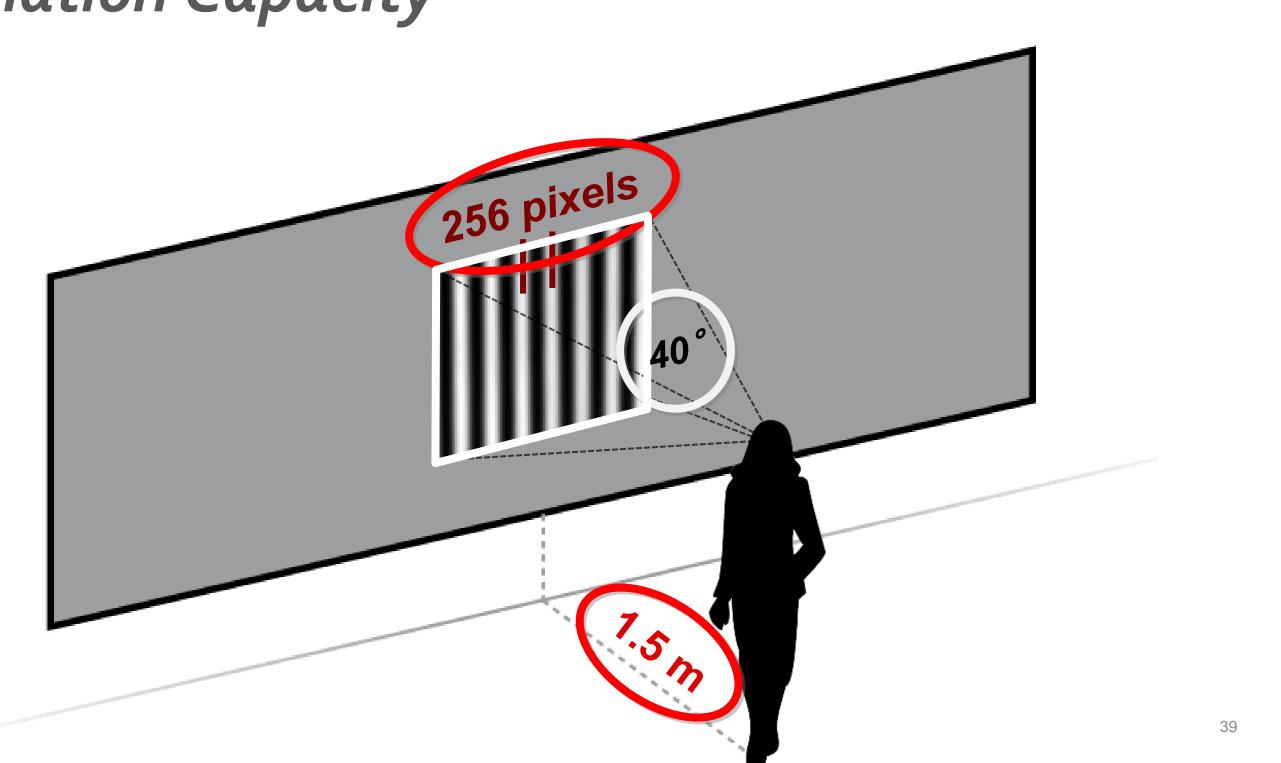




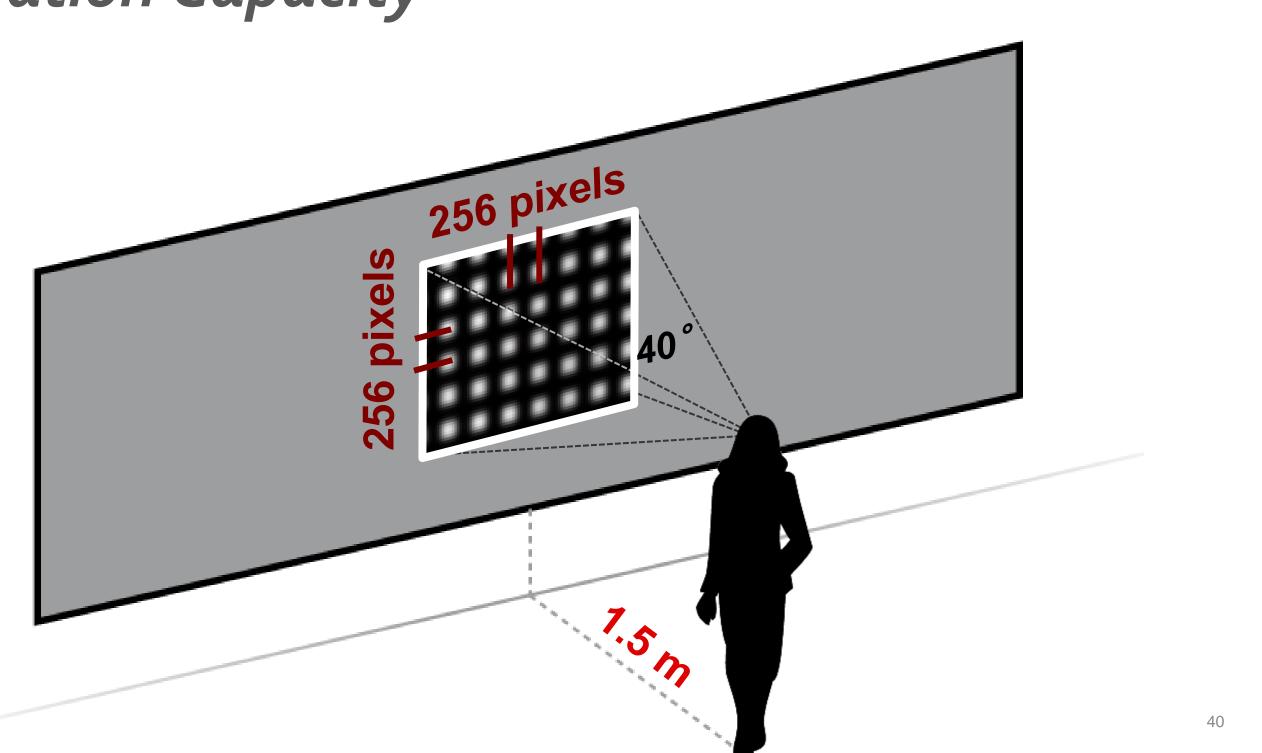
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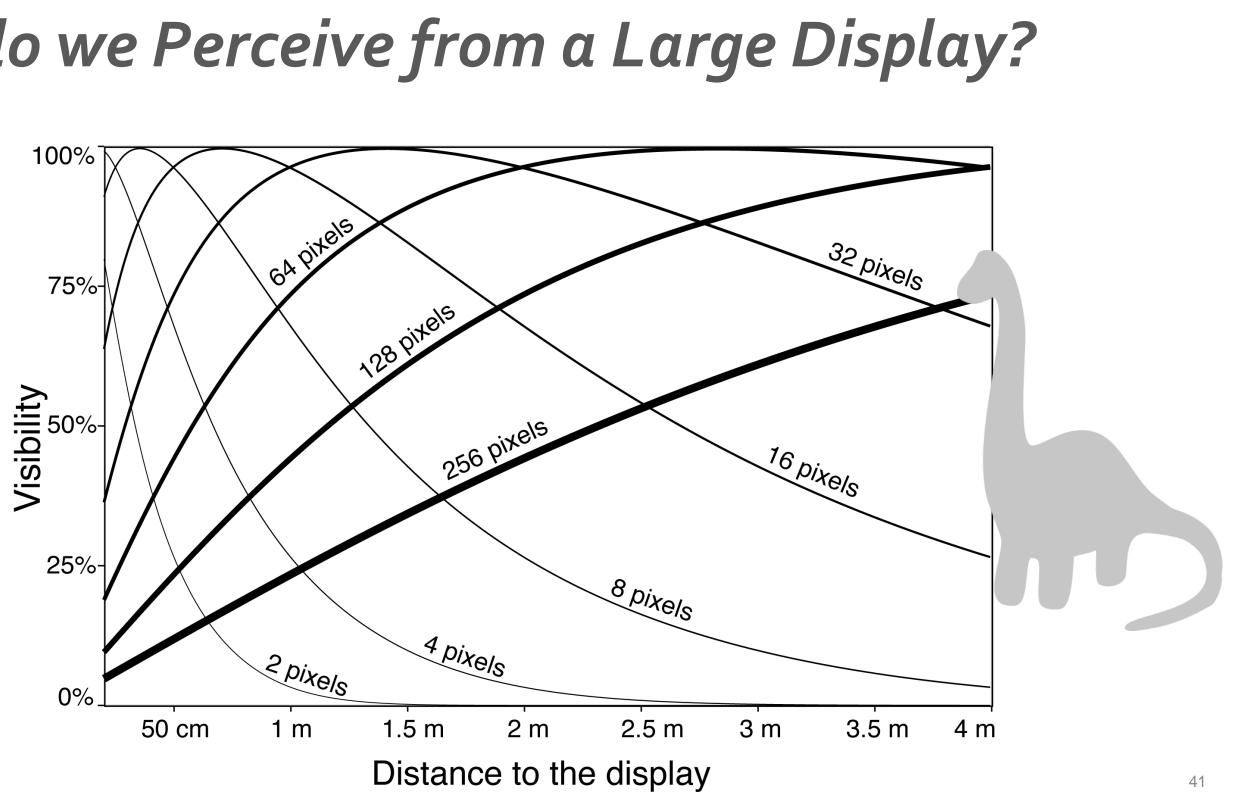
#### Information Capacity



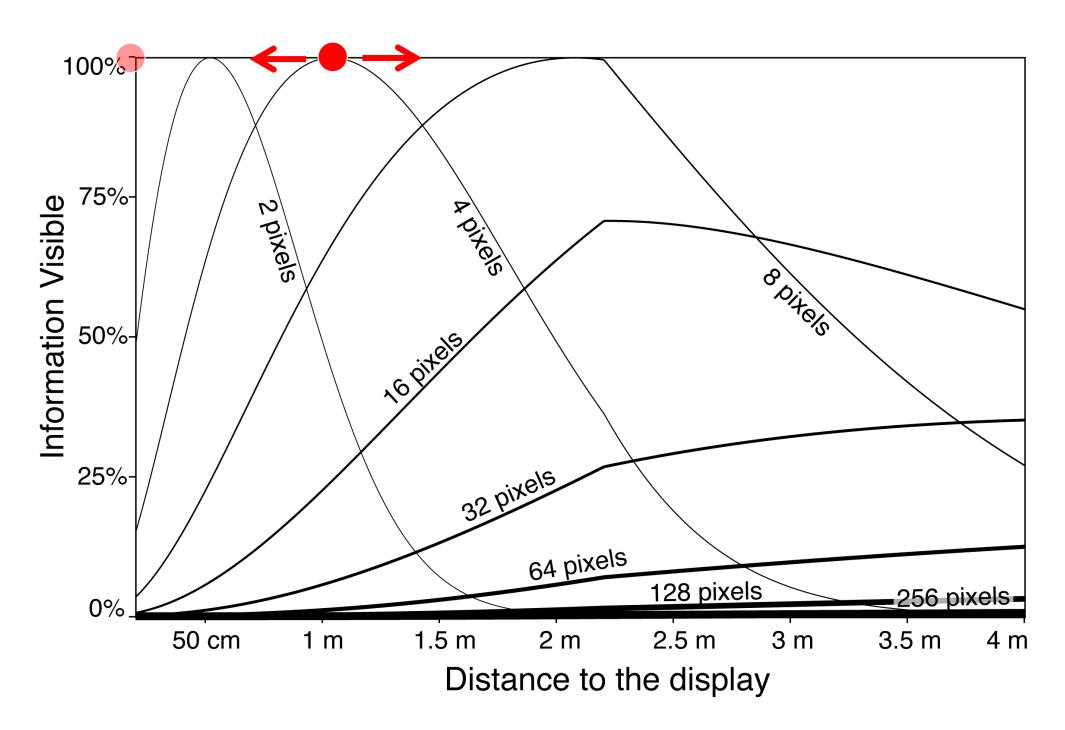
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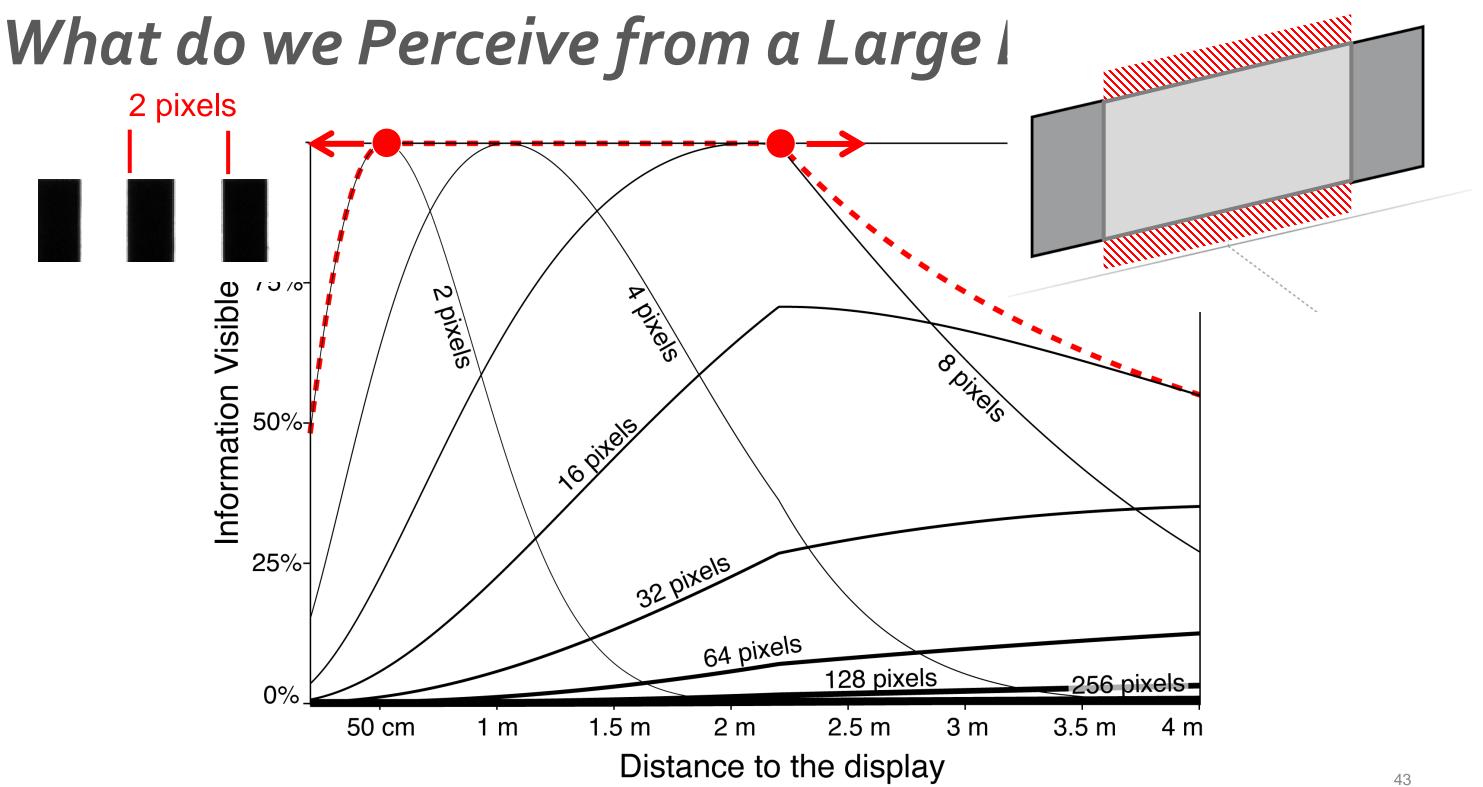
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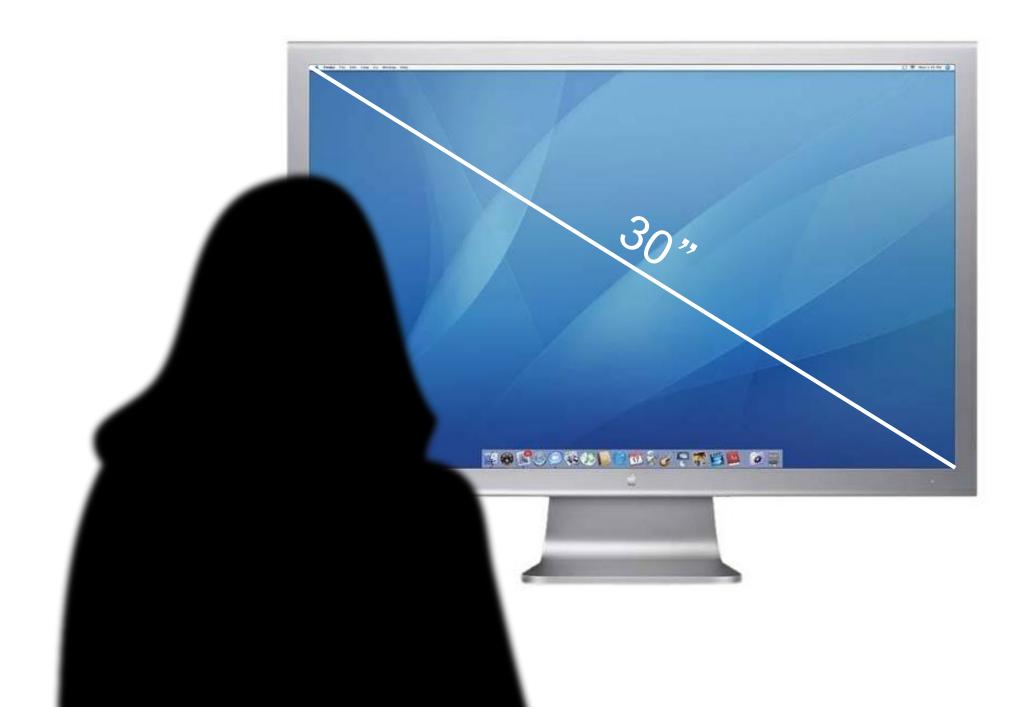
#### What do we Perceive from a Large Display?



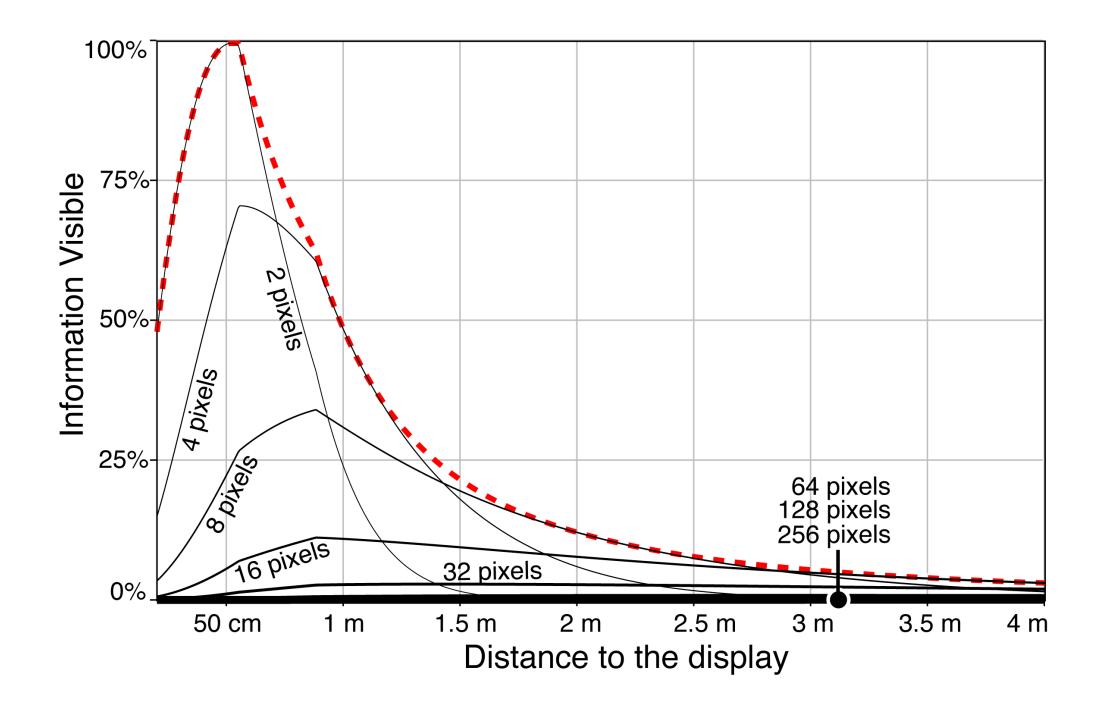




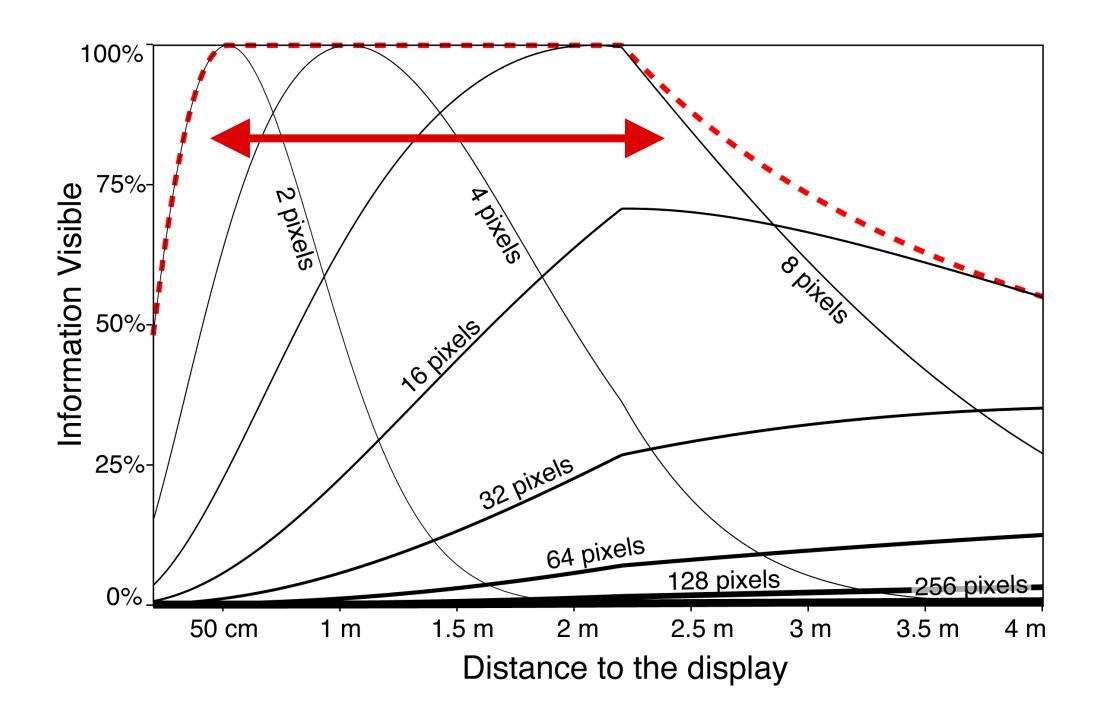
#### Comparison with a Desktop Display

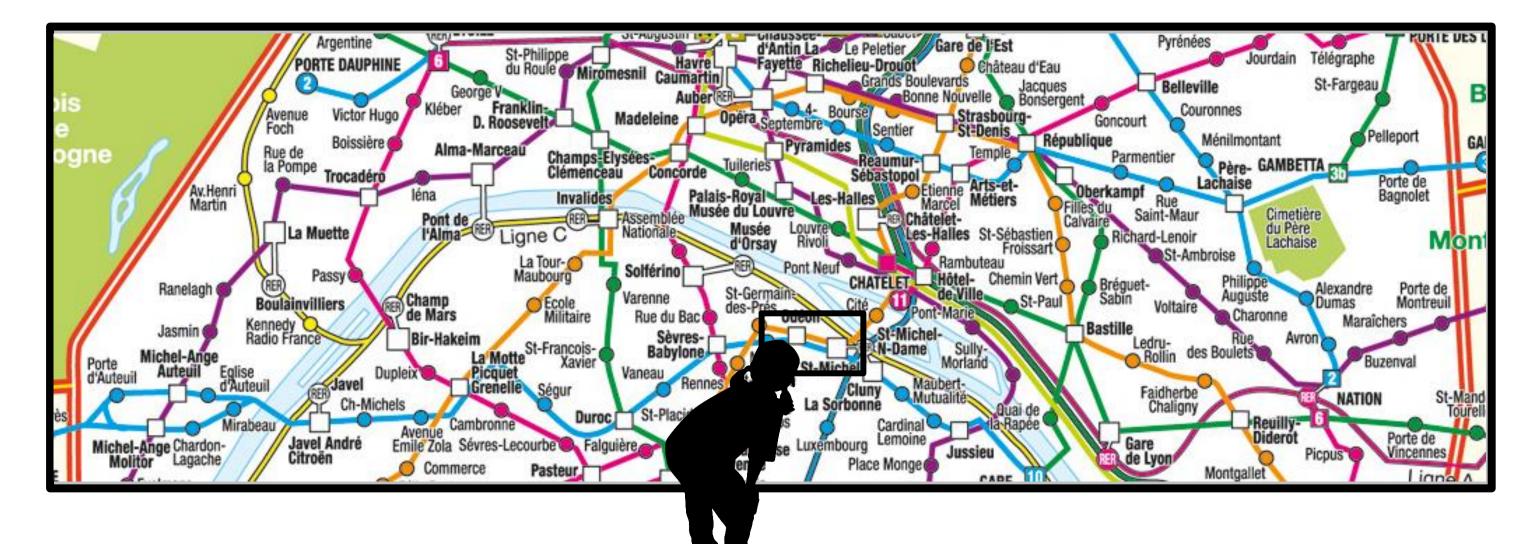


#### Comparison with a Desktop Display

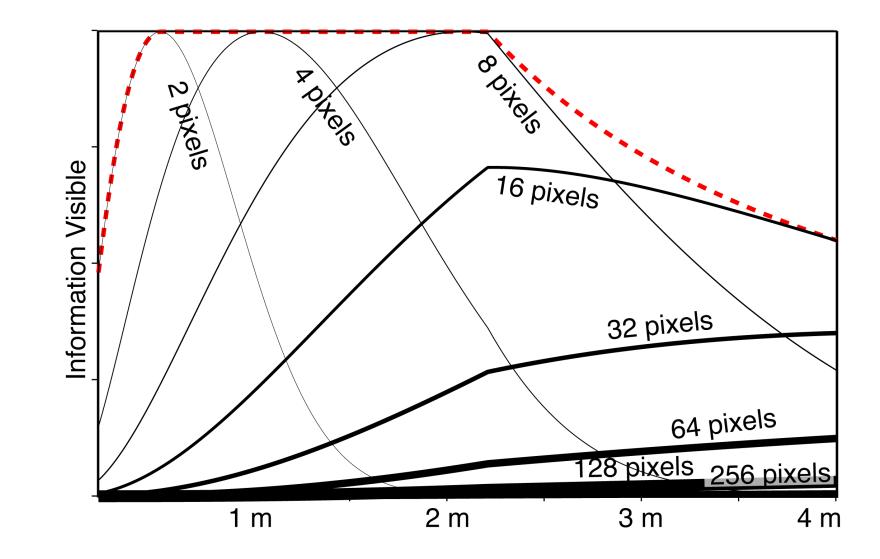


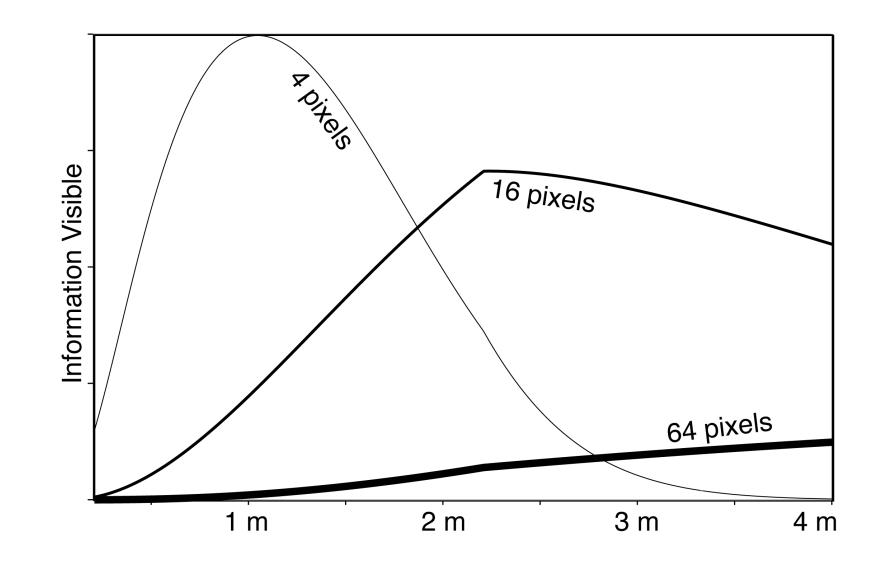
#### Leveraging Large Displays

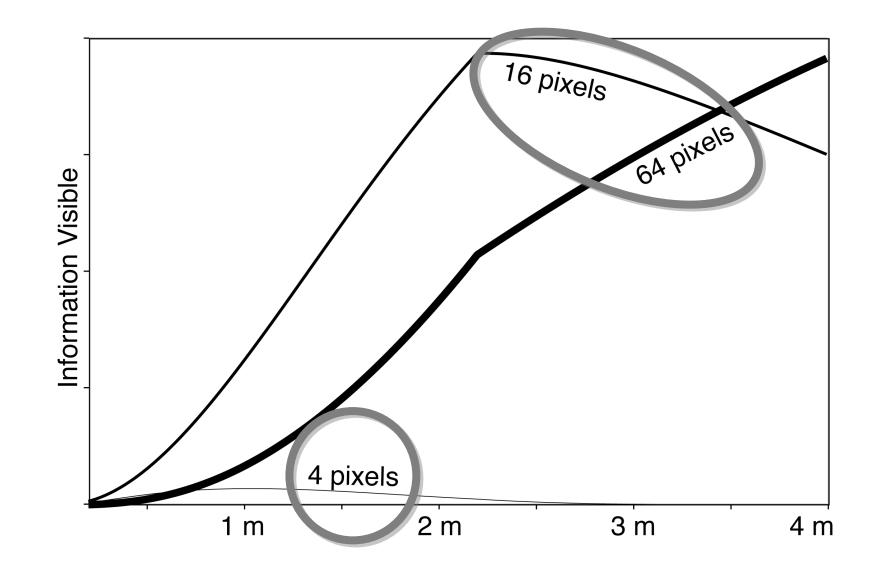


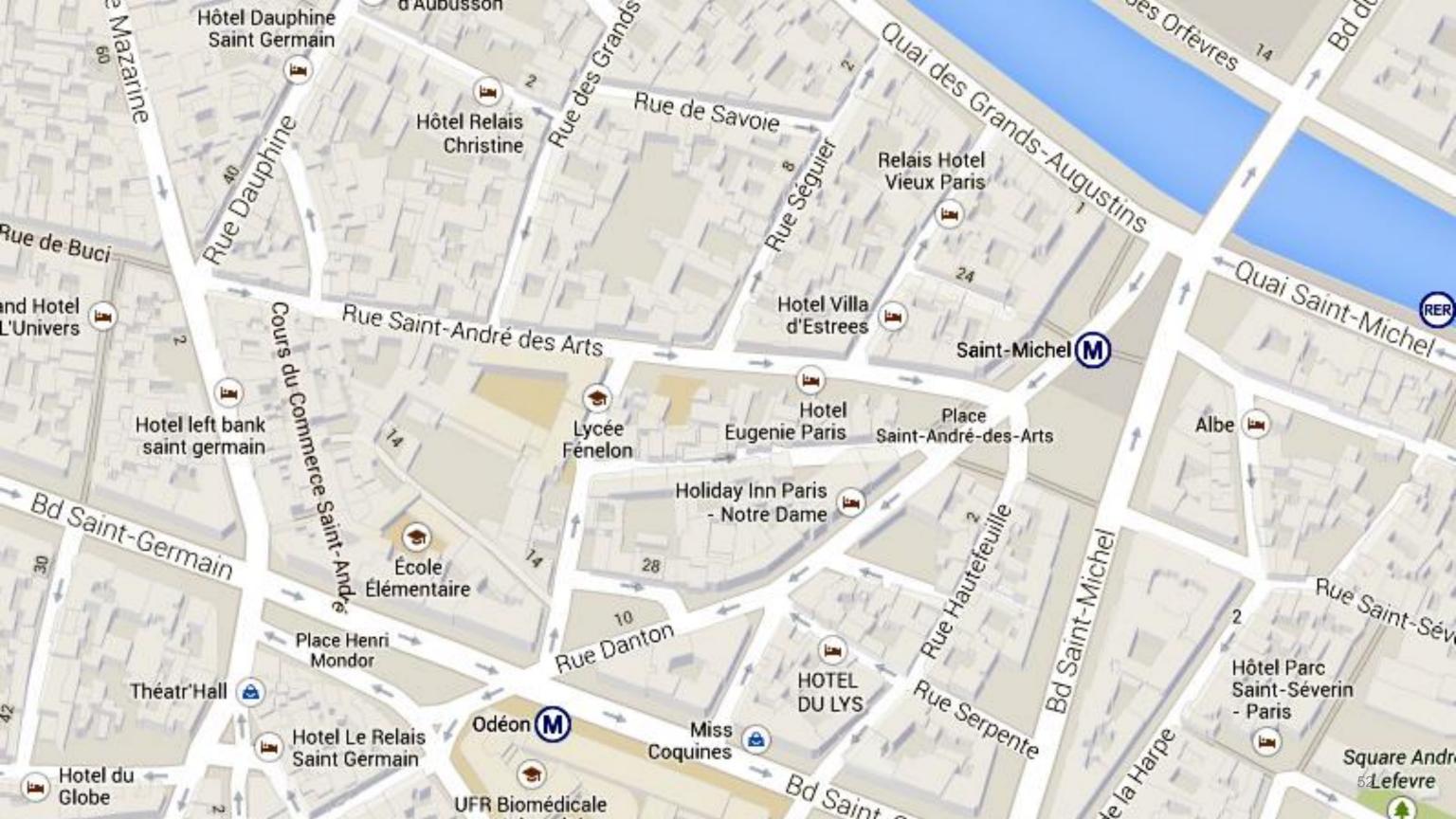


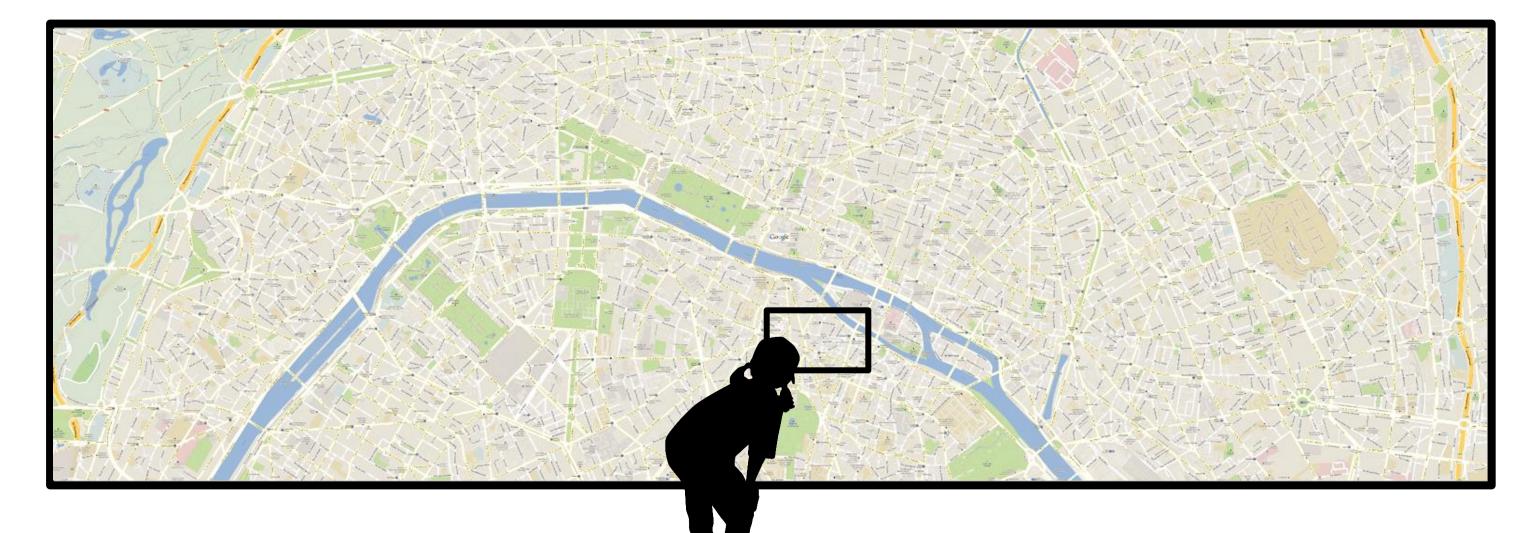


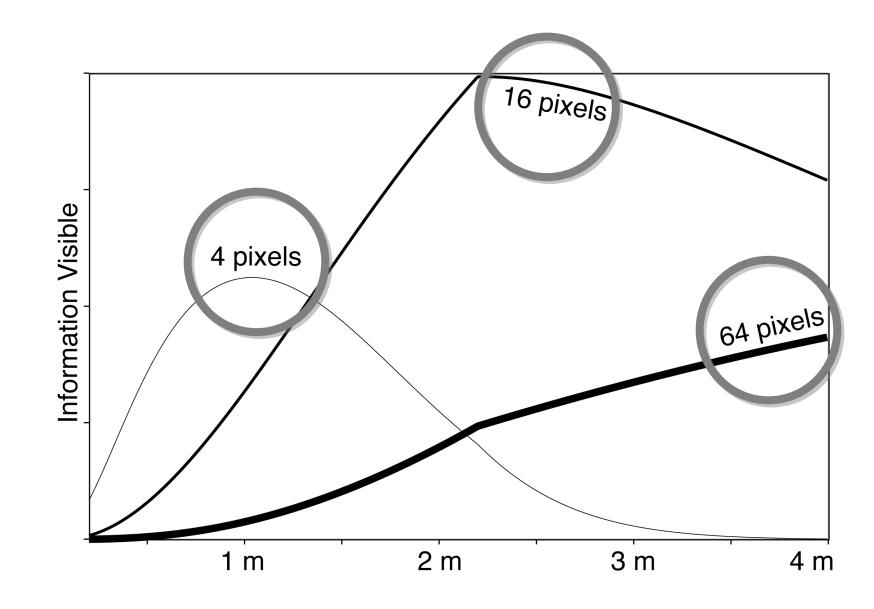




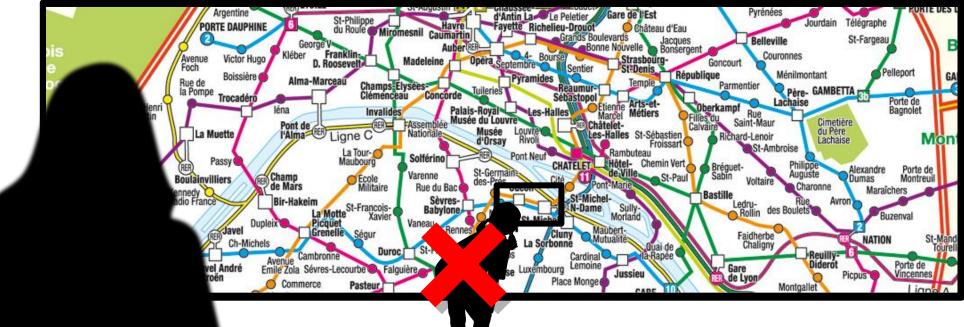




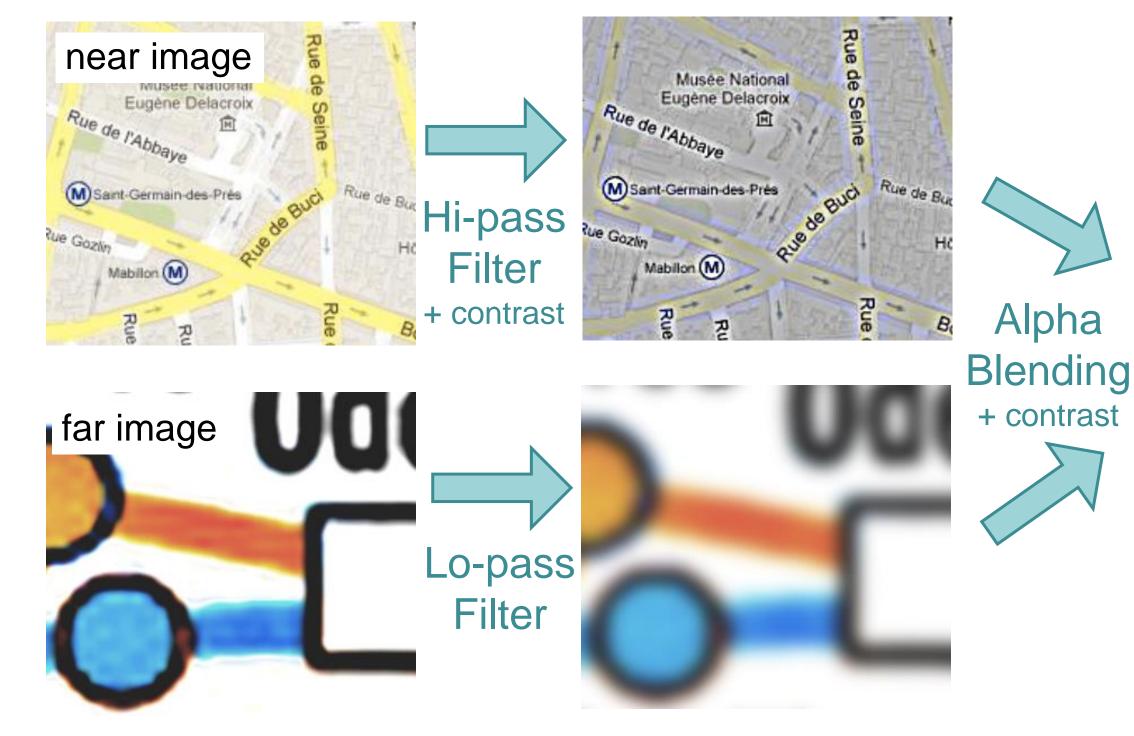


















#### Place Sant-André-des-Arts

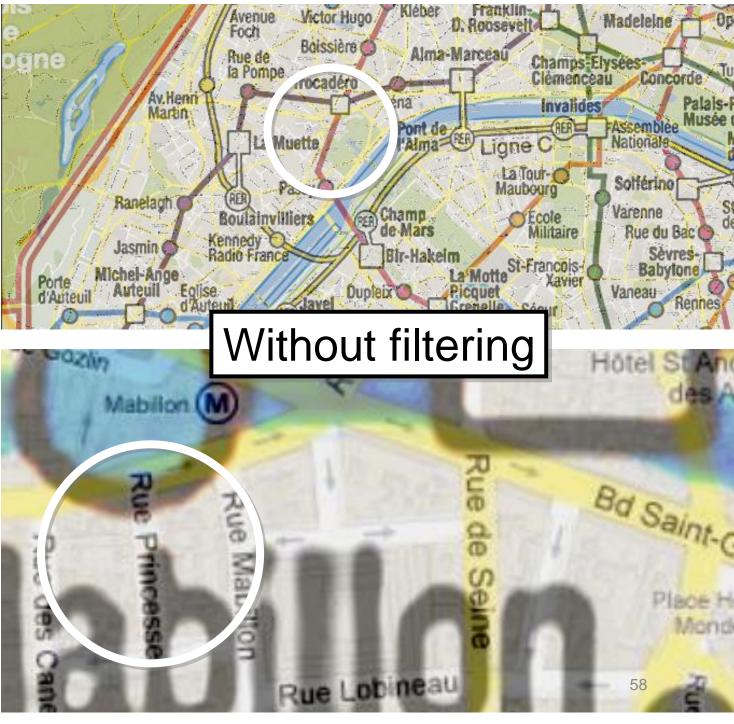
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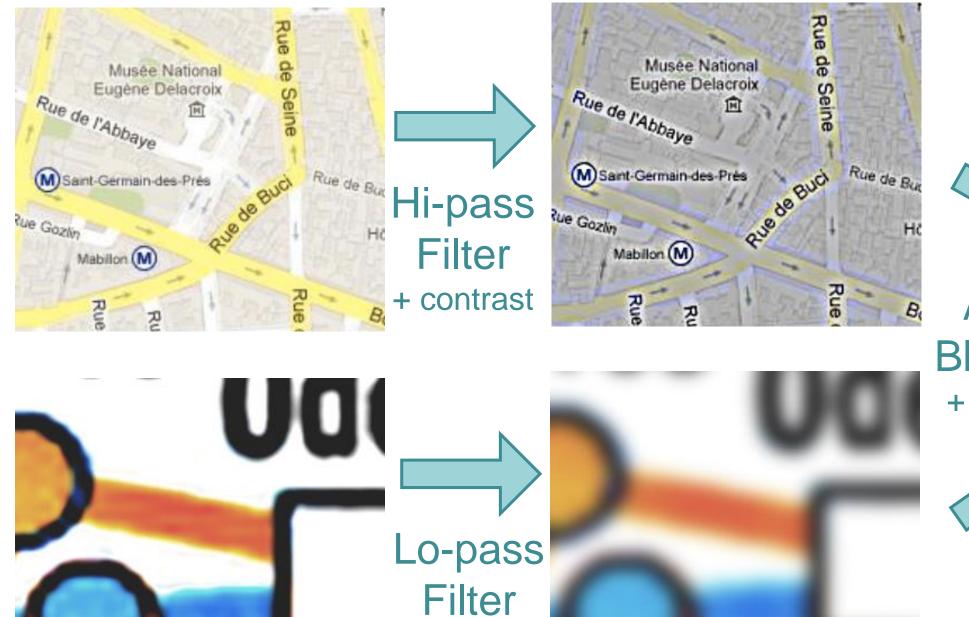
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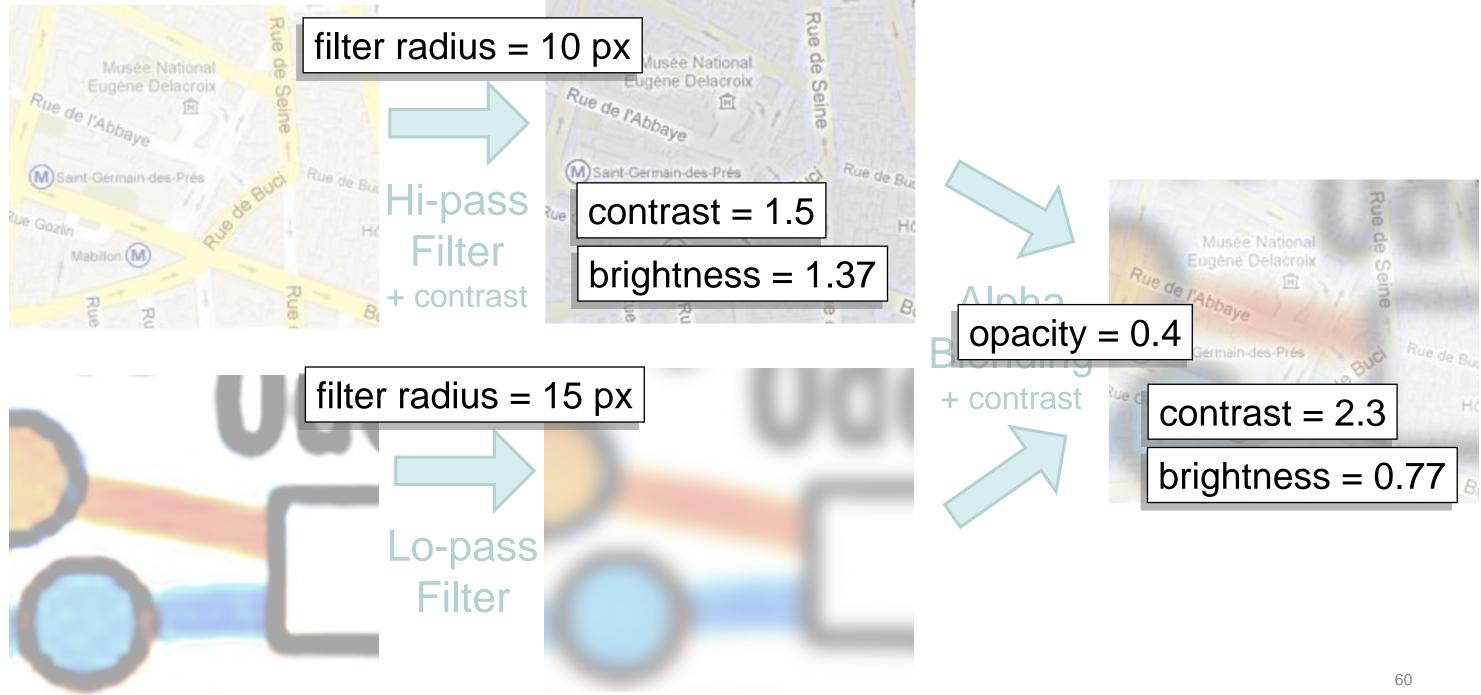




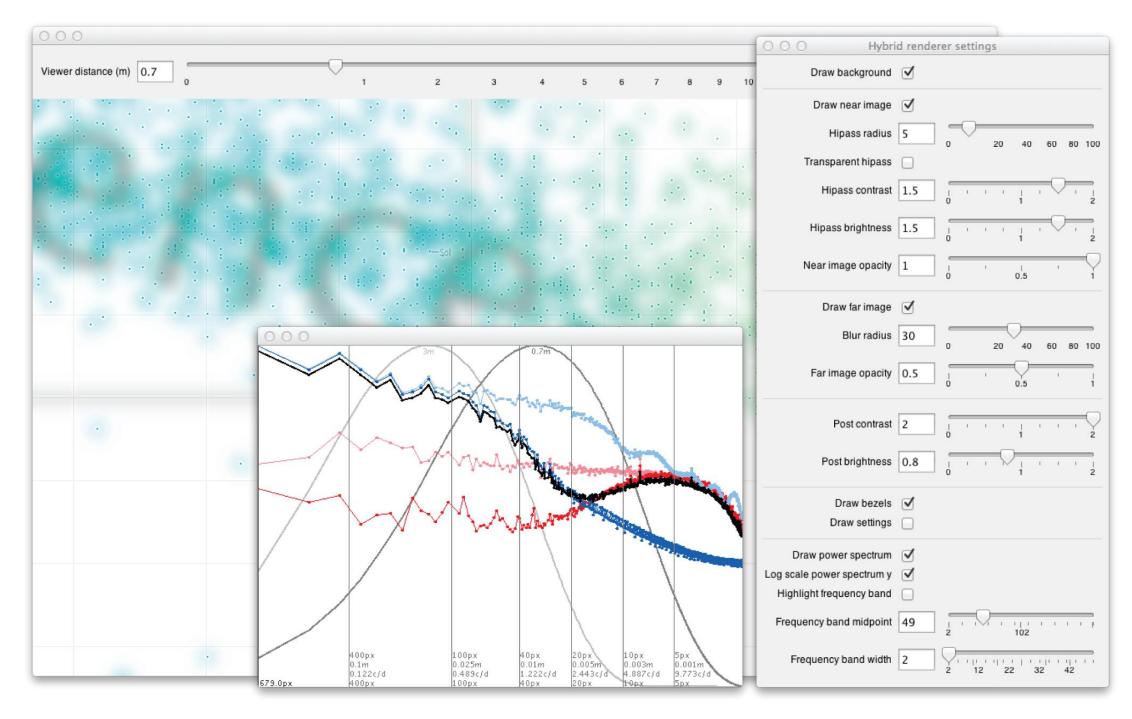








### Hybrid Image Maker



# Hybrid Images for Large-Scale Visualizations

 Theoretical grounding why & when use hybrid images?

Tools

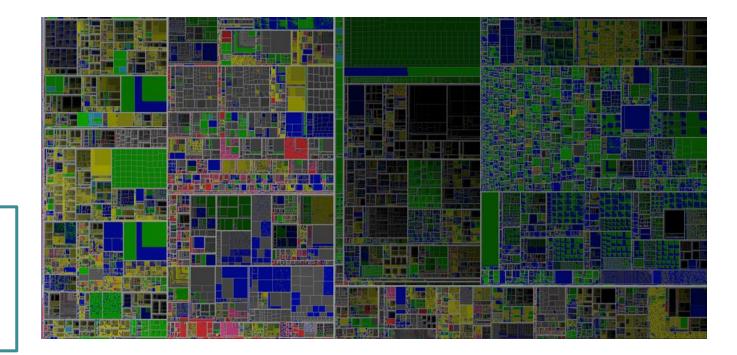
how to support their creation?

Examples

what are they really good for?

**Design principles** 

how to build effective ones?







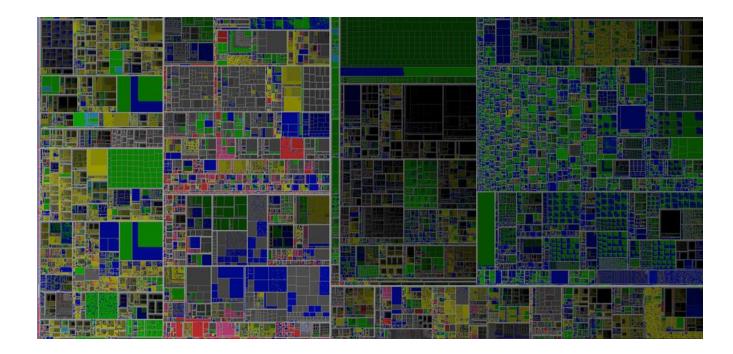
# Hybrid Images for Large-Scale Visualizations

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

what are they really good for?

**Design principles** 

how to build effective ones?

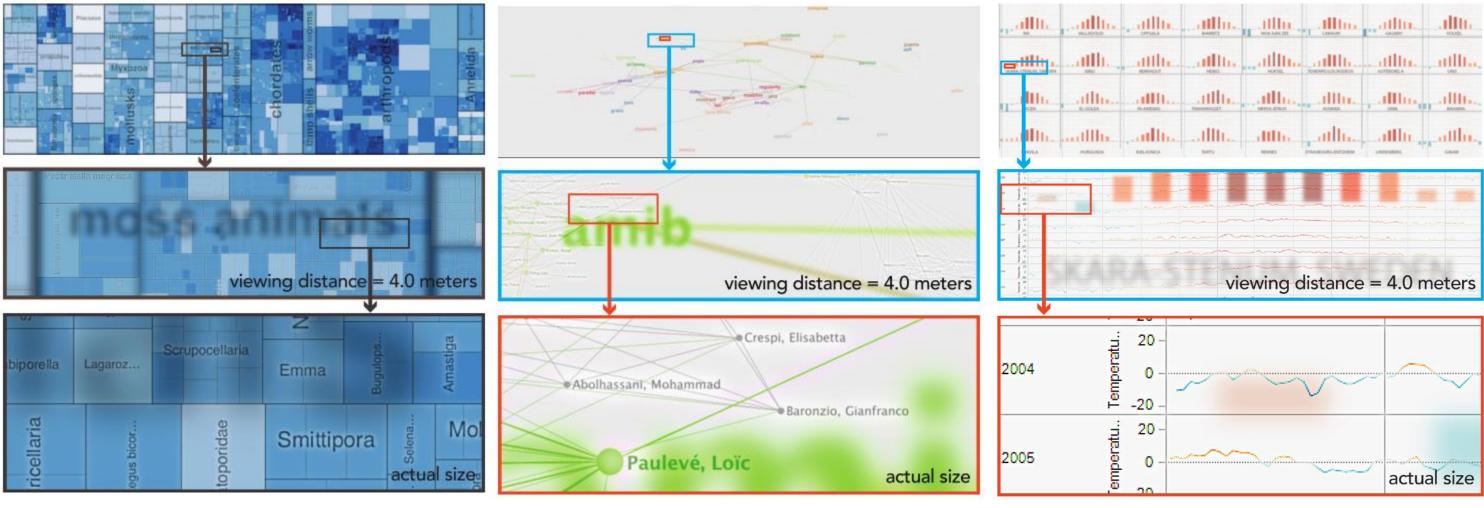






#### http://aviz.fr/hybridvis





Tree of Life Treemap

co-authorship network

...and more

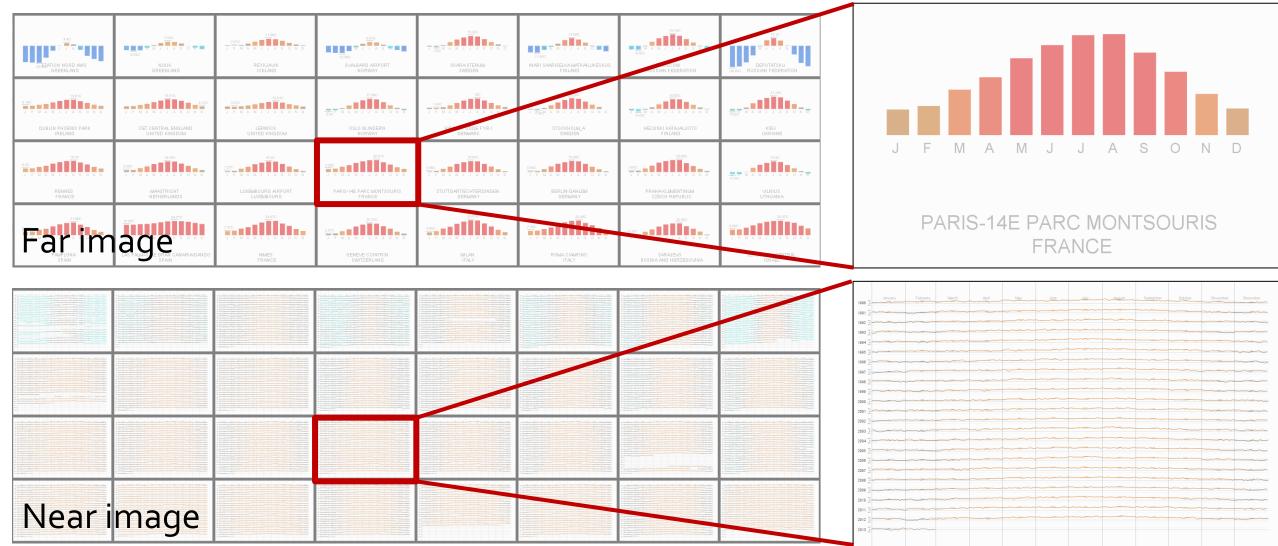


#### temperature data

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

# **HI-Visualization Techniques**

- Mixing multiple visualizations
- Navigation aids & summaries





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

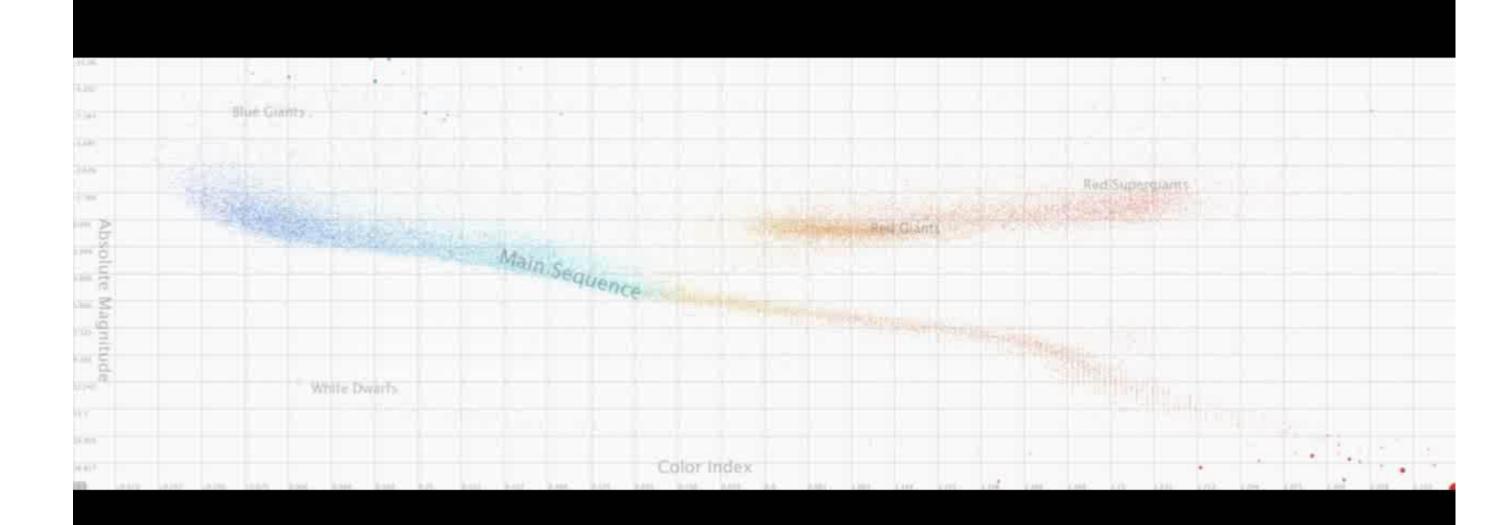
# **HI-Visualization Techniques**

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

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Absolute Magnitude						lain .		ence					en e		<b>1</b>						-	-	
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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

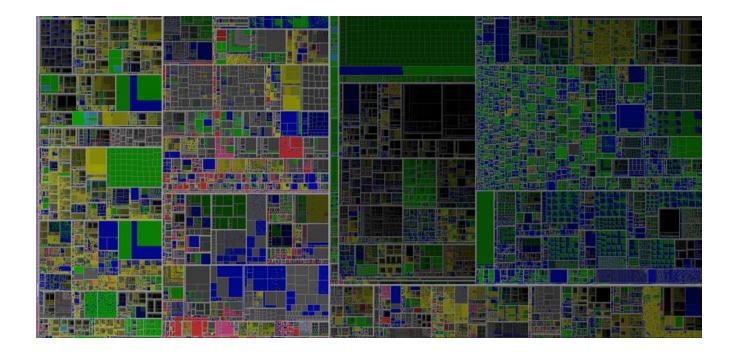
how to support their creation?

• Examples

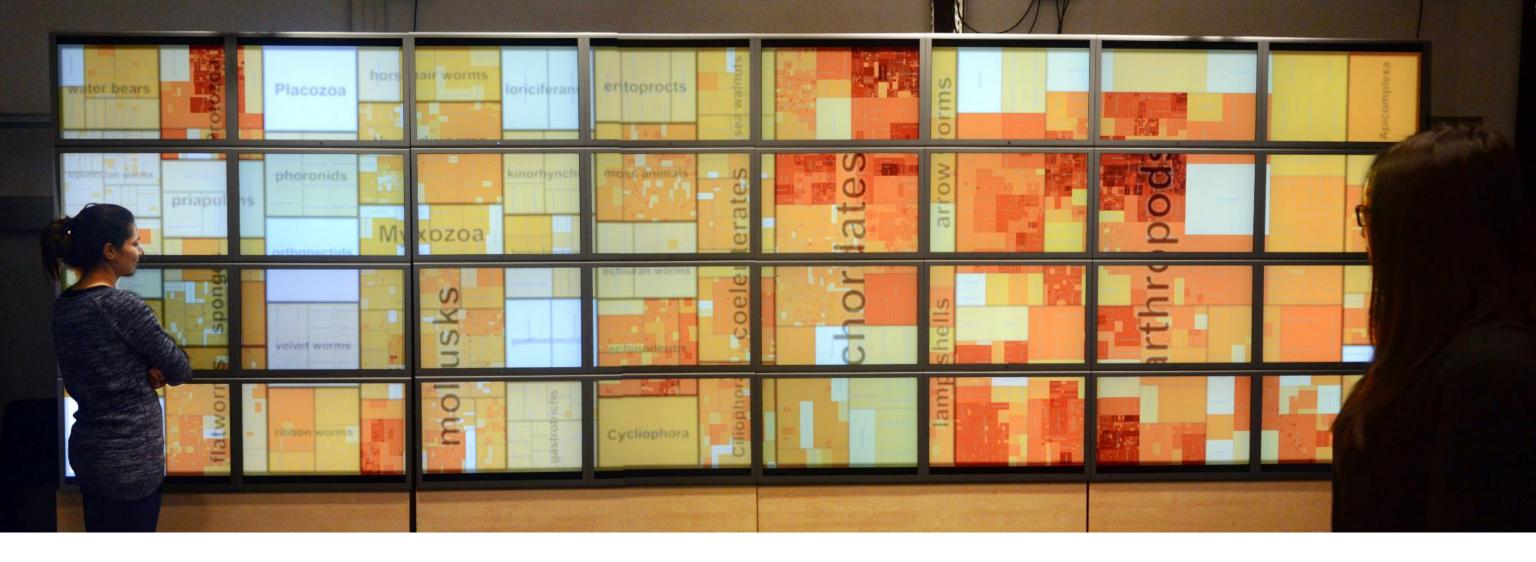
what are they really good for?

• Design principles

how to build effective ones?













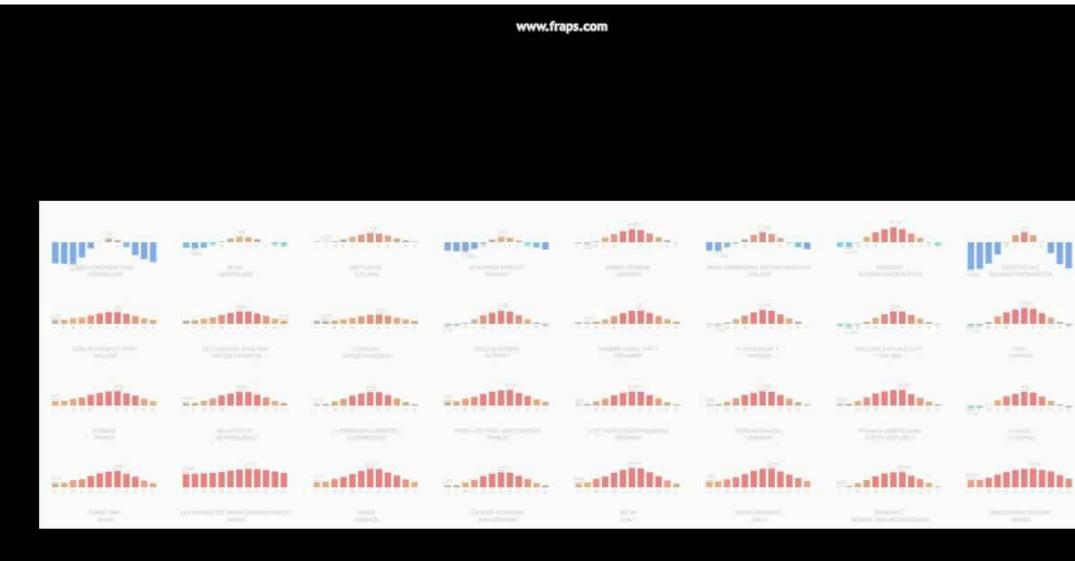
http:aviz.fr/hybridvis

Funded by: ANR-11-JS02-003

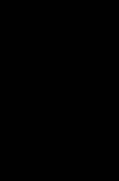


#### **Question Slides**

# Video: Information Loss When Walking Close





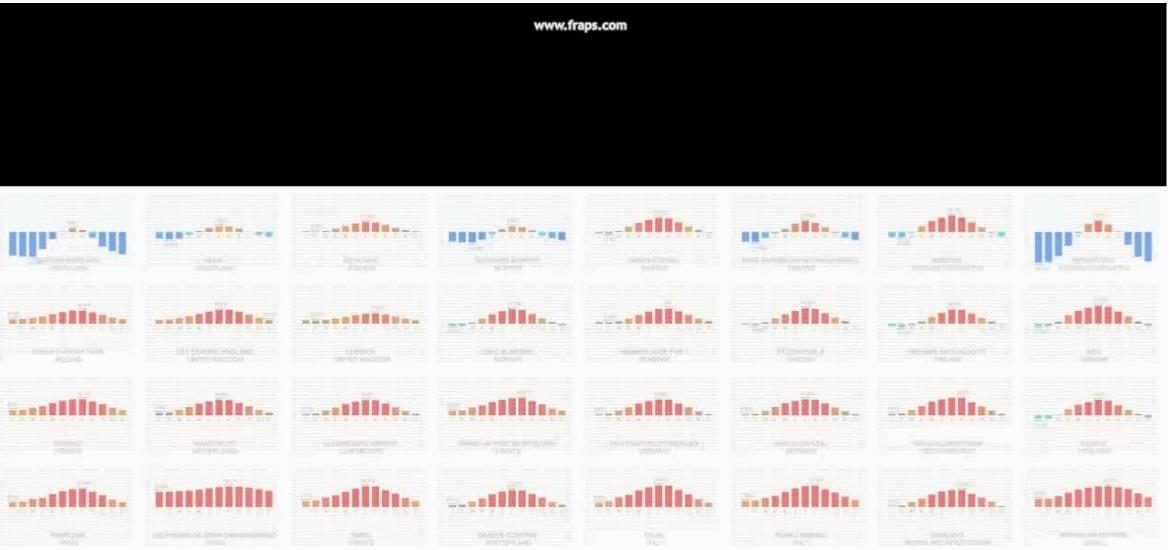




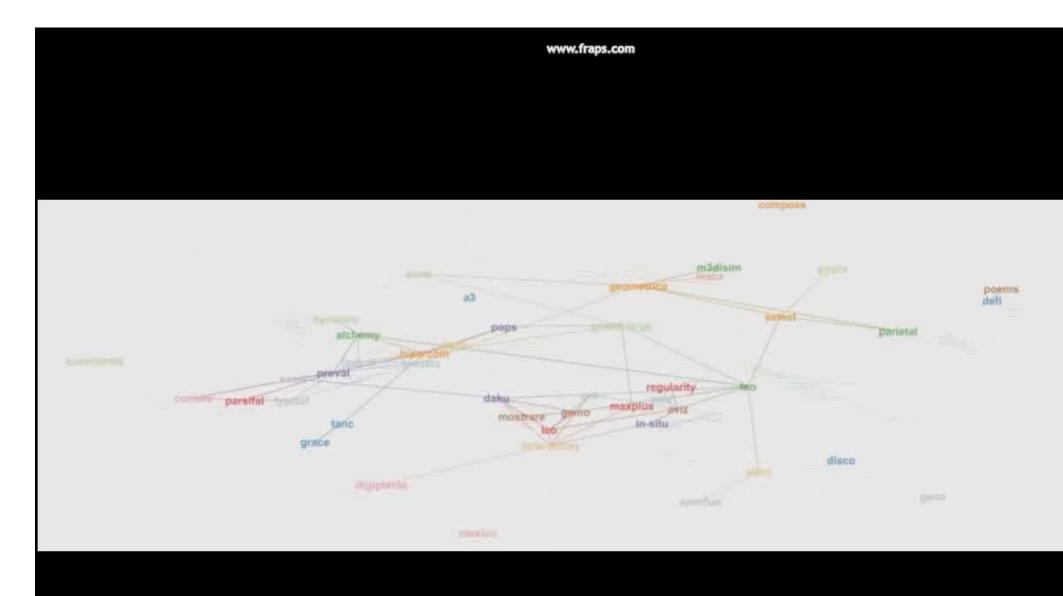
# Video: Mental Aggregation

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February 2.410	Match 10.059	April 10,810	Mav 12.870	15,350	30/γ. 20.380	
February R140	March 8 290	April 10,865	May 17,030	June	Juny 20.789	
February	March 8650	Apiil 12,80	Mav 15710	Јине 18.620	July	
February 5940	March 10.50	April 19.360	May.		23.05g	
5840 February 8760	March 7.800	Apili 19.750	Mey 15,319	June 17.188	July 22.856	
Felanaty	March	april 11.795	May 12,730	19.000	100y	
February 8280	March 11.040	Apiil 11.280	Mev 10:520	duite 17.785	July 19.70	
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	

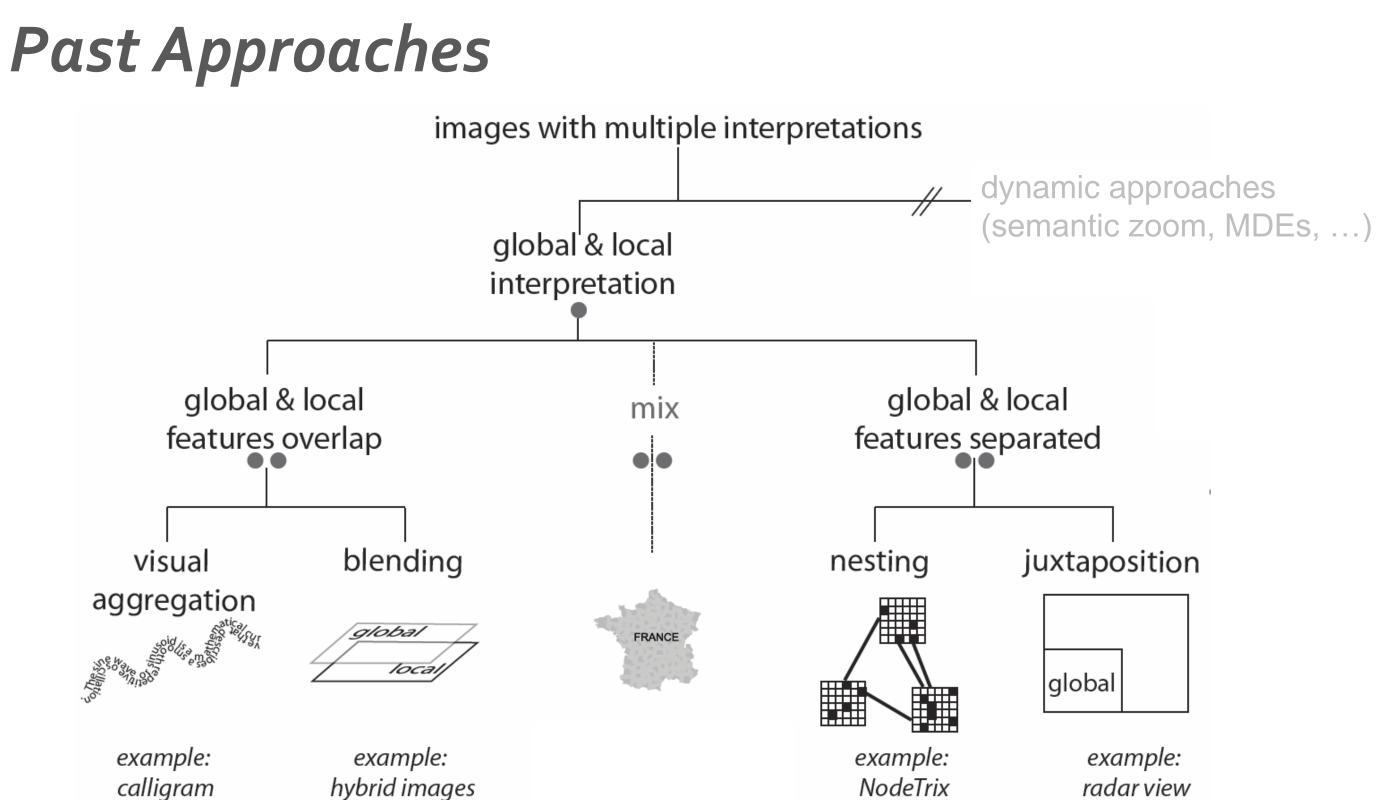
### Video: Alpha blending



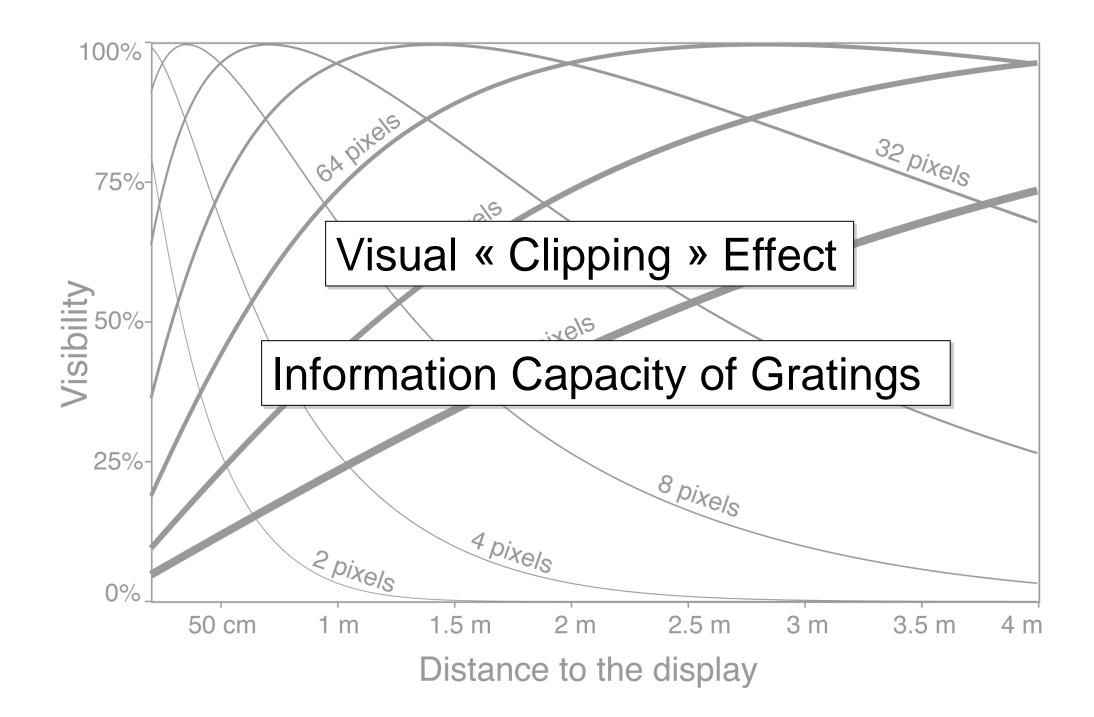
### Video: Graph vis



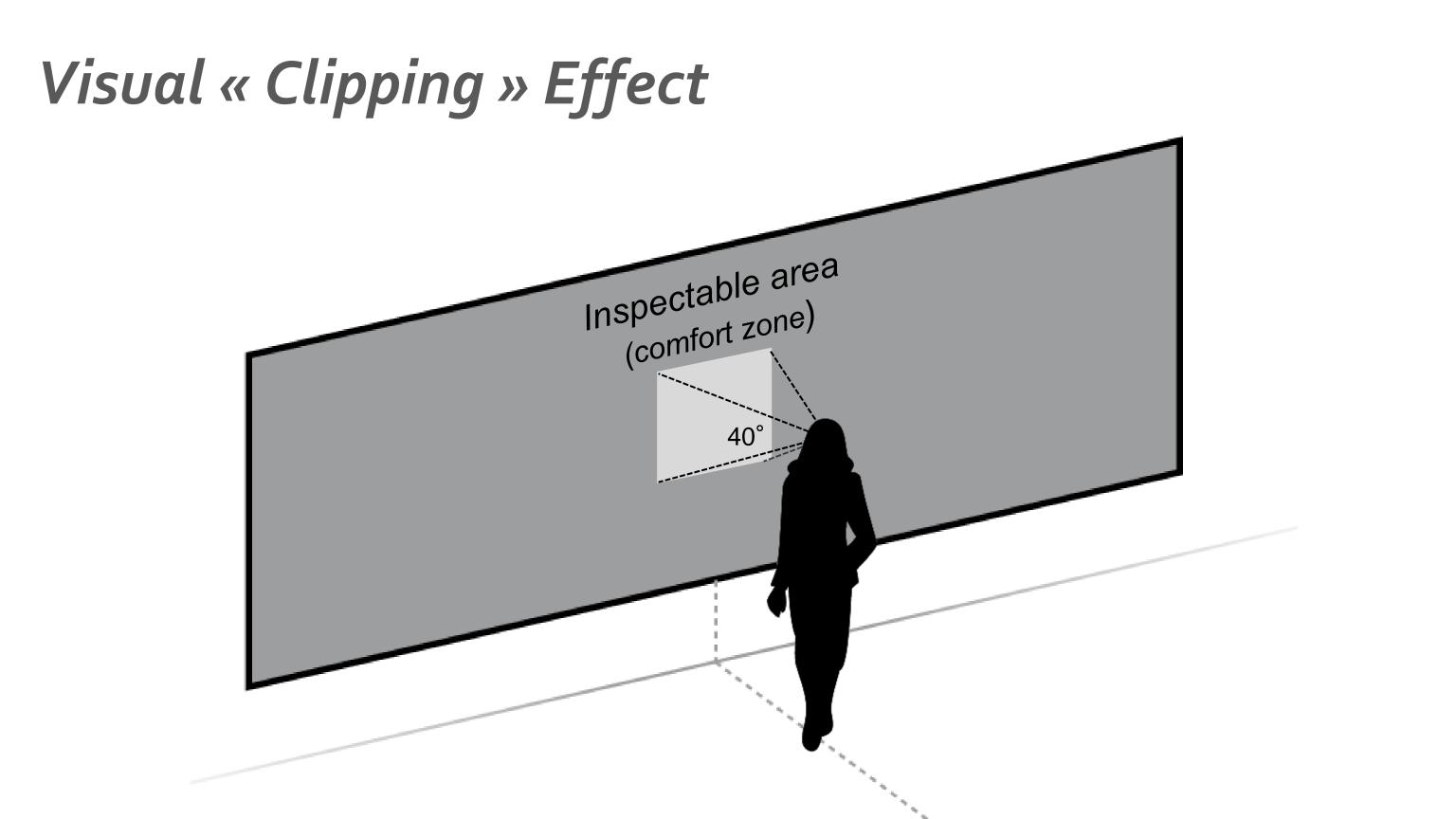




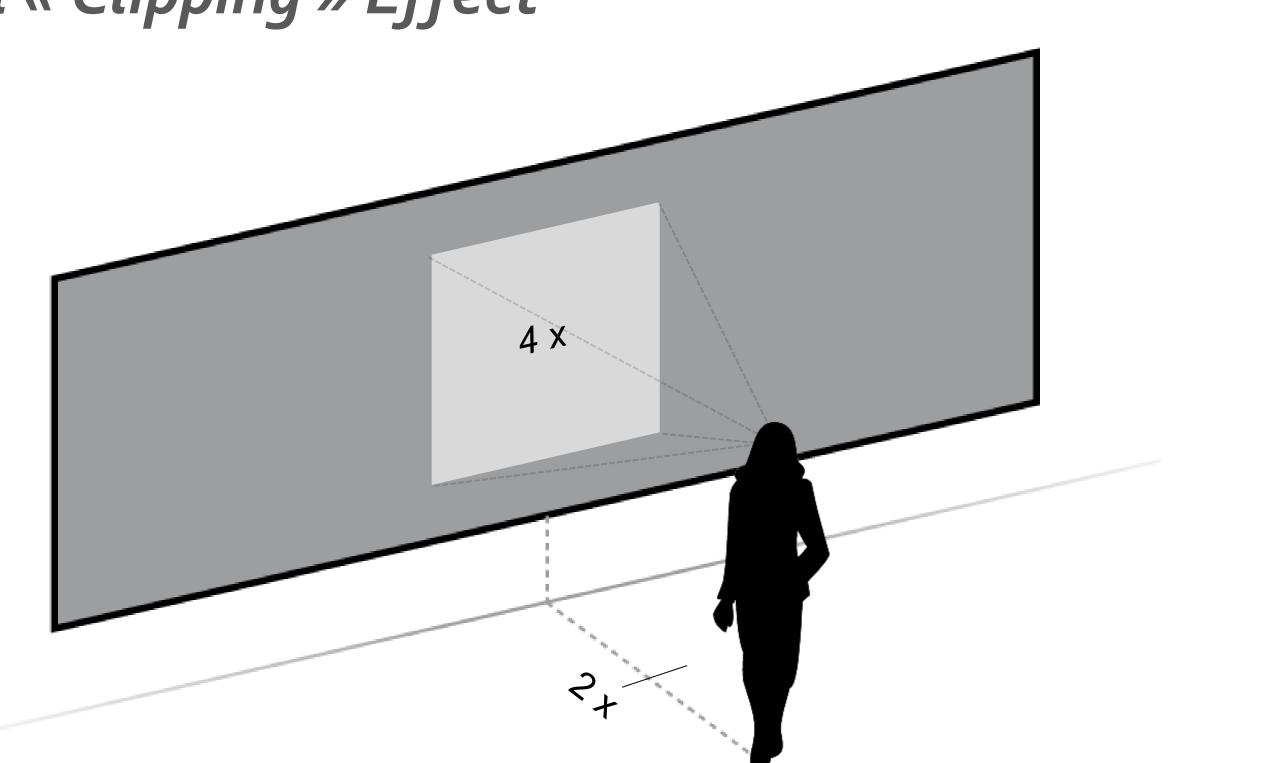
### What do we Perceive from a Large Display?

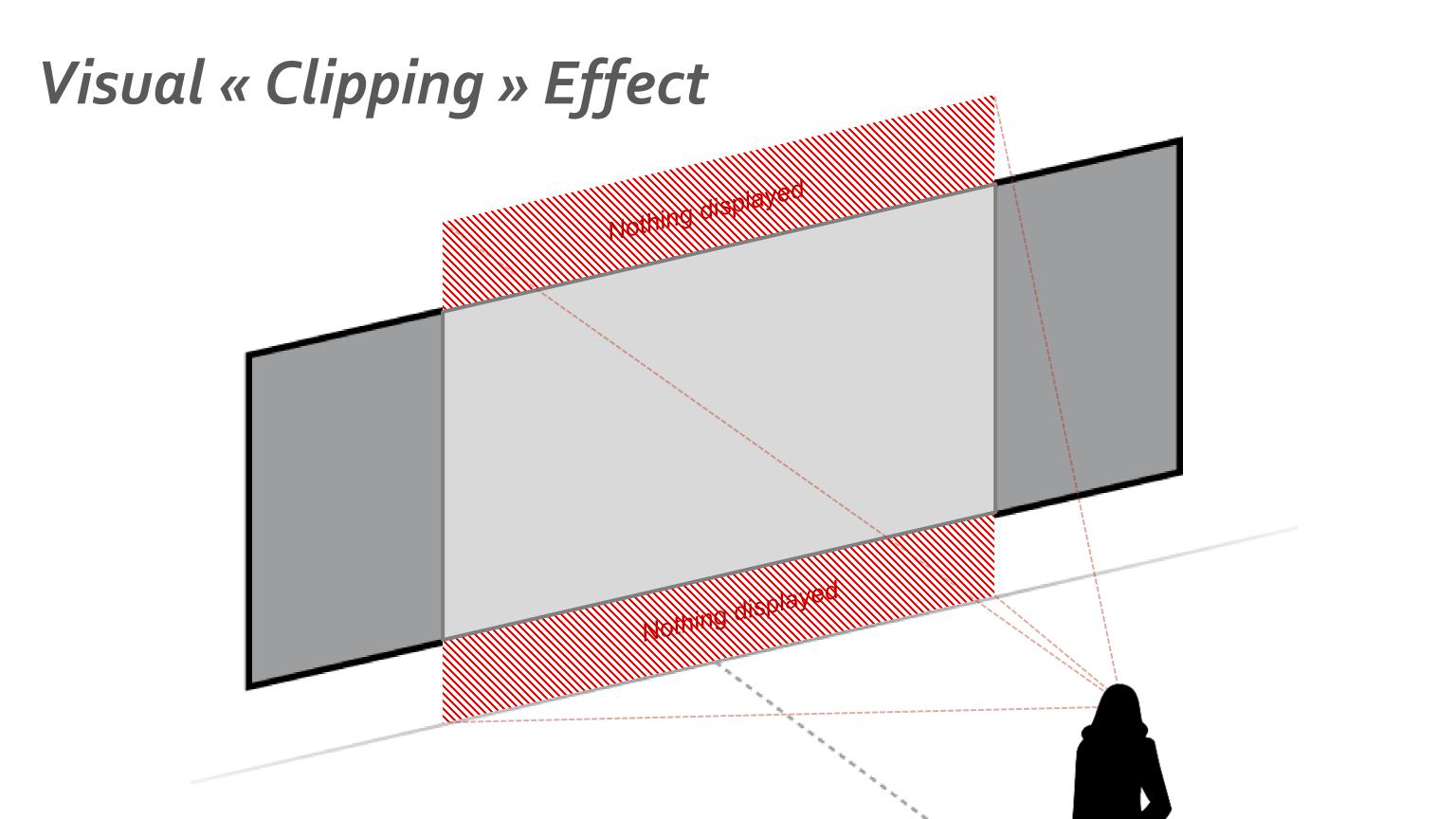






## Visual « Clipping » Effect





# Visual « Clipping » Effect

