

# Effective Visual Scanning of Geographic Information

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# GI processing

- Problem
  - A huge amount of geographic data has to be visualised
  - To fulfil the principle of *one size fits all* on limited display sizes
  - To not overstrain the limited cognitive workload of users

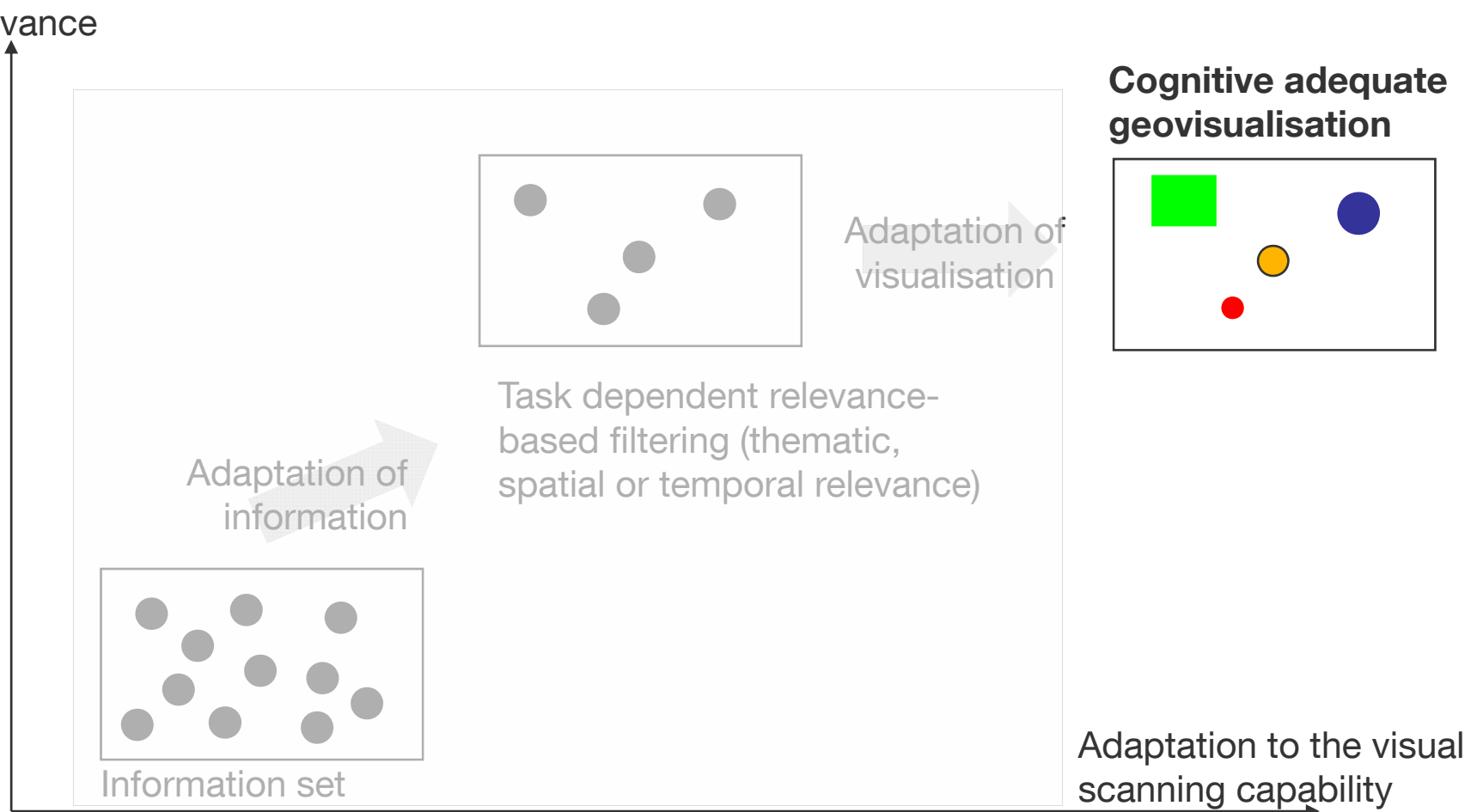


## GI processing

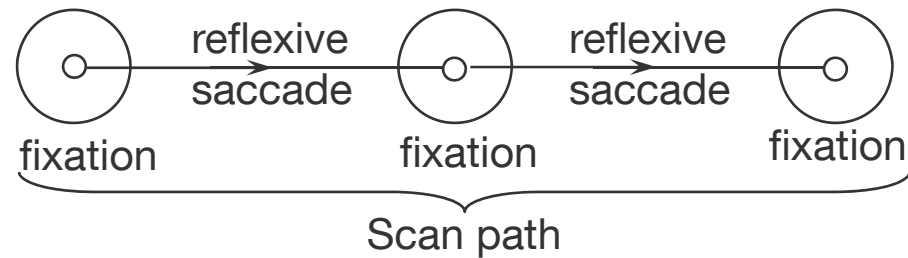
- Map design Challenges
  - To visualise as little as possible and as much as needed
  - To guide visual attention to the location of relevant geoinformation (where?)
  - To effectively code classes of relevant information (what?)
- Objectives
  - To support users in decision making
  - To facilitate the localisation of relevant information (where?)
  - To facilitate the decoding of relevance classes (what?)
  - To reduce information complexity

# Reducing displayed information complexity

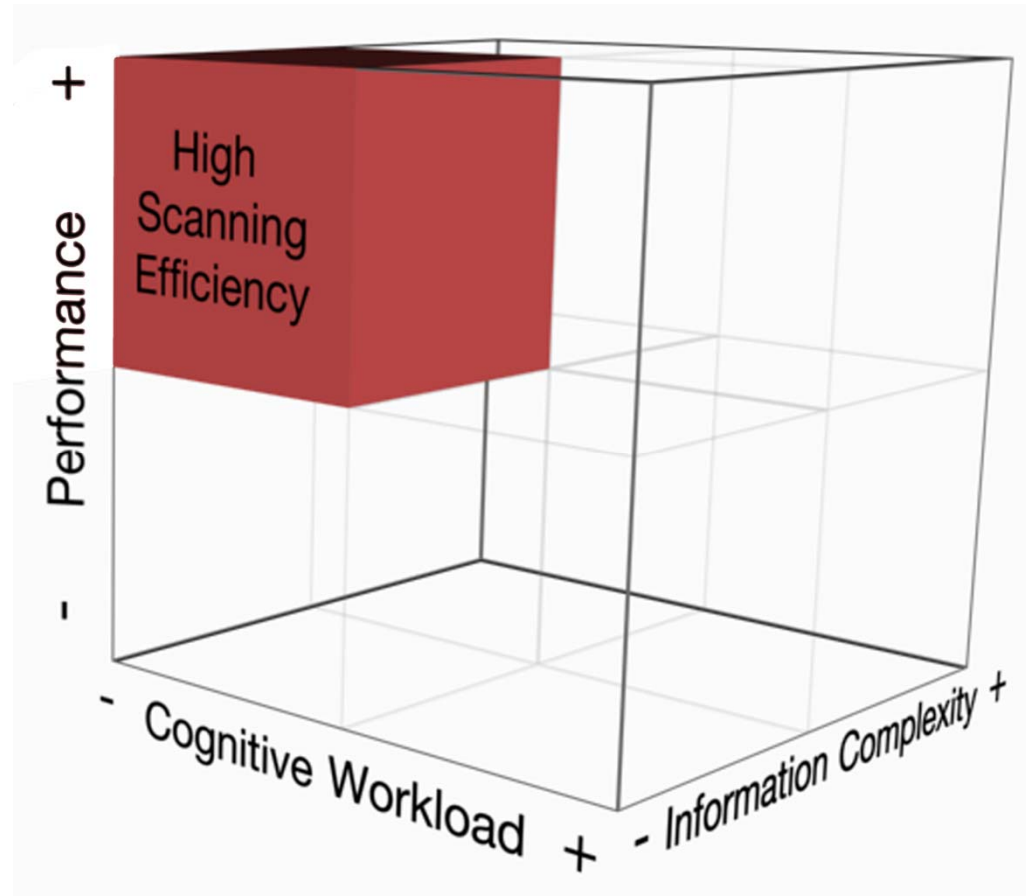
Relevance



# Visual scanning



# Visual scanning efficiency

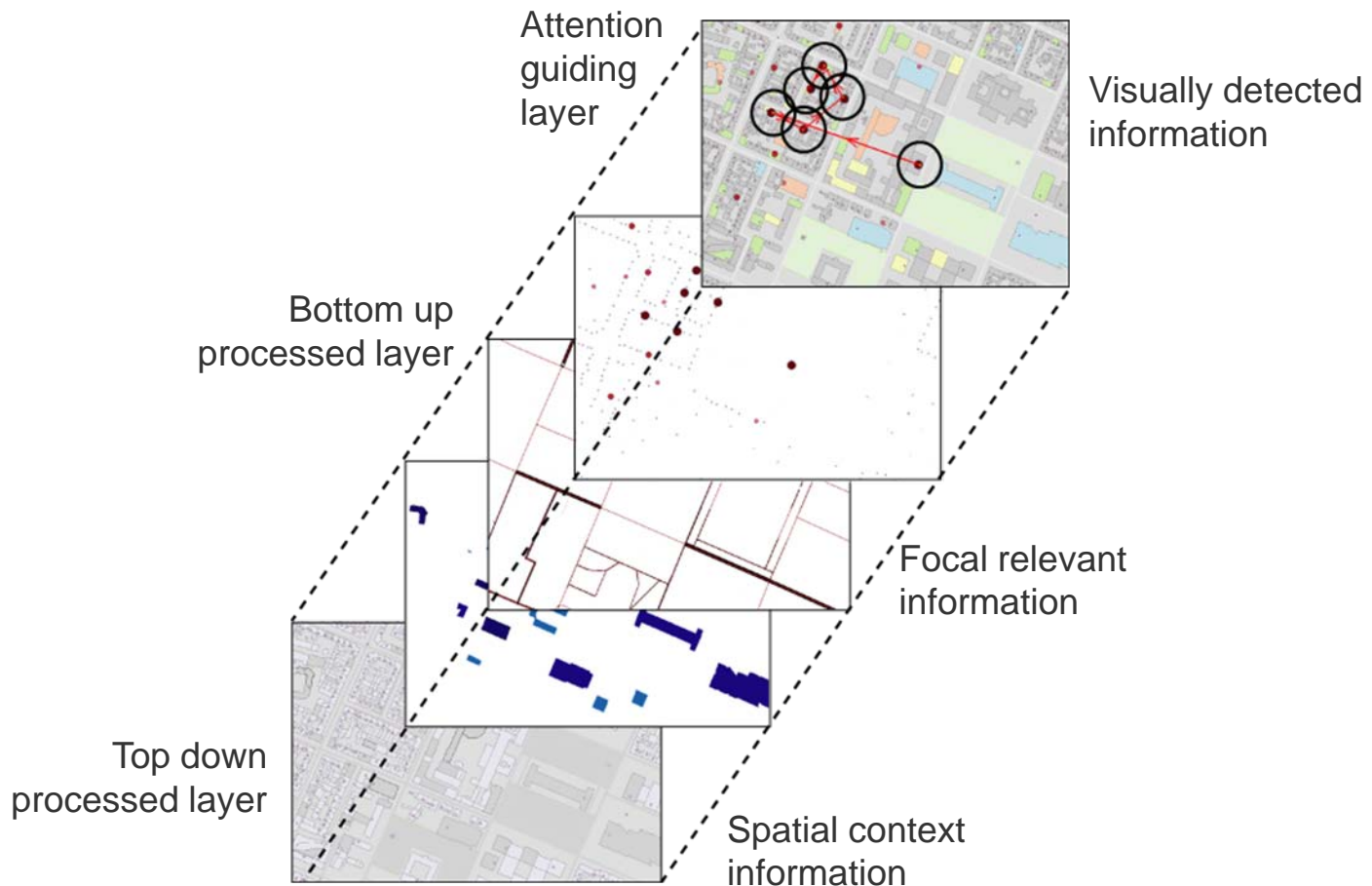


# Design principles

## Classical rules of thematic map design

- Simplicity:  
reducing visual complexity
- Visual hierarchies:  
organising and structuring the information into visual layers
- Conciseness:  
visualising relevant information in a salient way

# Design methodology



## Test cases



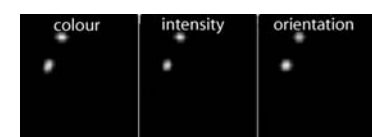
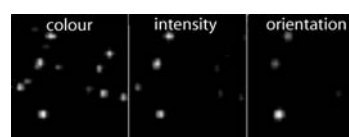
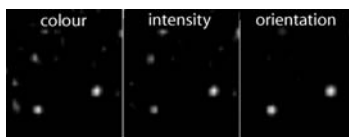
Unfiltered but  
cognitive adequate



Filtered but  
cognitive inadequate

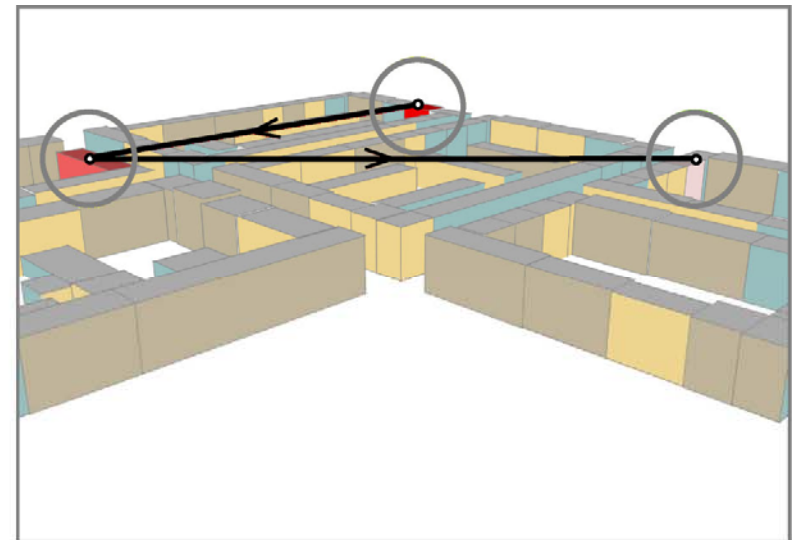
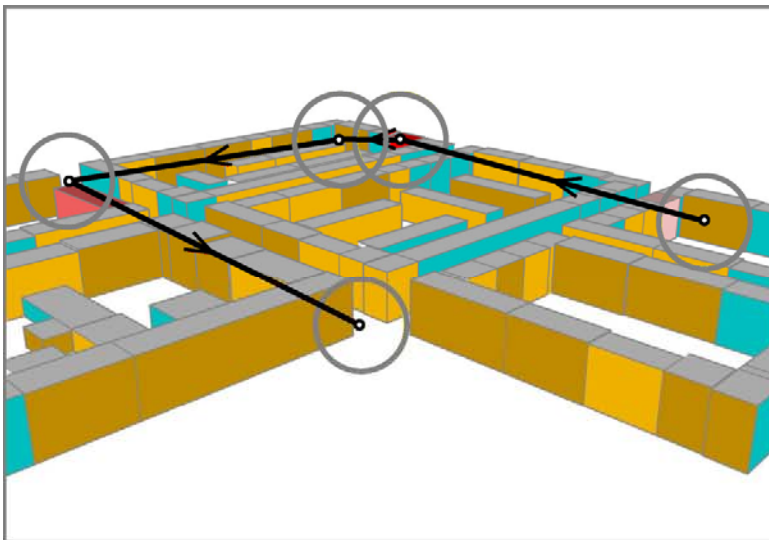


Unfiltered and  
cognitive adequate



# Computational attention model

- Saturation,  
left: case 2 (filtered but cognitively inadequate)  
right: case 3 (filtered and cognitively adequate)

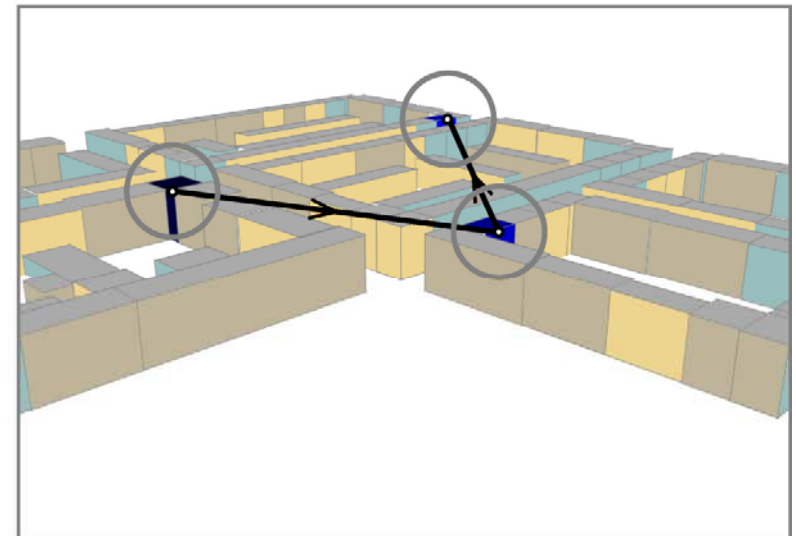
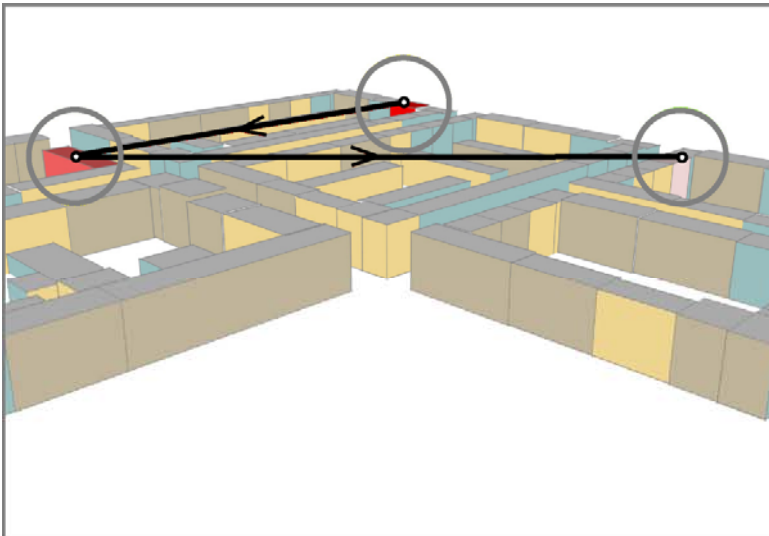


# Computational attention model

- Hue and Value

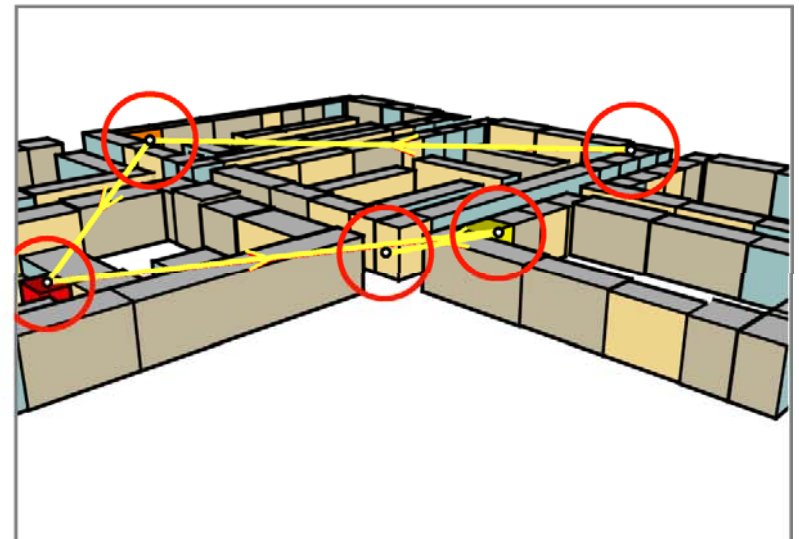
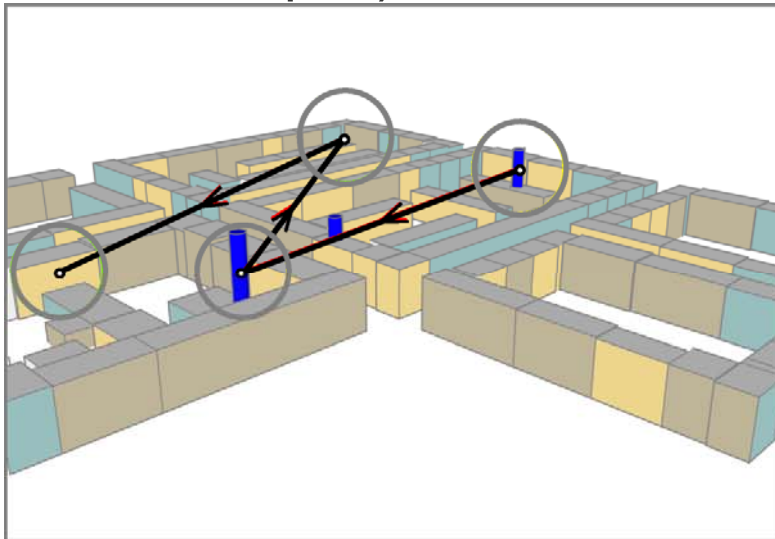
Left: hue, case 3 (filtered and cognitively adequate)

Right: value, case 3 (filtered and cognitively adequate)



# Computational attention model

- Bar charts and hue (contoured)
  - Left: bar charts/size case 3 (filtered and cognitively adequate)
  - Right: hue (contoured) case 3 (filtered and cognitively adequate)

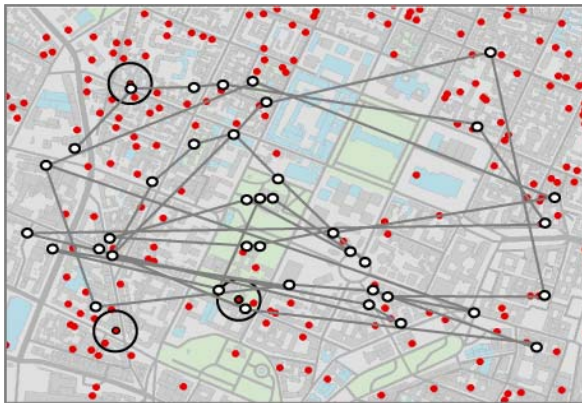


# Eye movement recording

	case 1	case 2	case 3	p
Time (sd)	5.49 (1.90)	3.01 (1.88)	1.95 (0.75)	<.001
Degree (sd)	77.75 (35.28)	32.77 (15.42)	21.51 (9.12)	<.001
Number of fixations (sd)	10.33 (5.50)	5.33 (2.89)	3.33 (1.40)	<.001
Repetition of fixations (sd)	1.33 (1.84)	0.33 (0.62)	0.00 (0.00)	.019
Duration of fixations (sd)	0.21 (0.04)	0.20 (0.04)	0.18 (0.02)	.031

## Contour

p = significance; sd = standard deviation



1



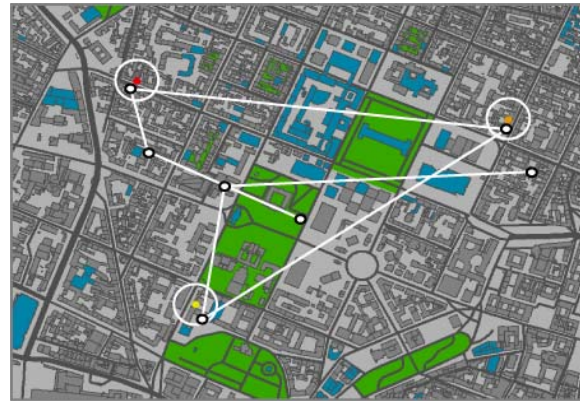
2



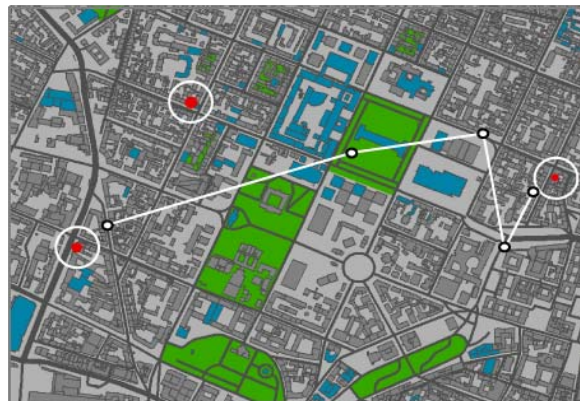
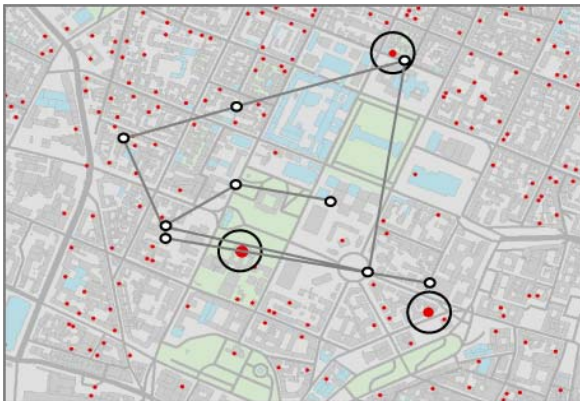
3

# Eye movement recording

Colour:

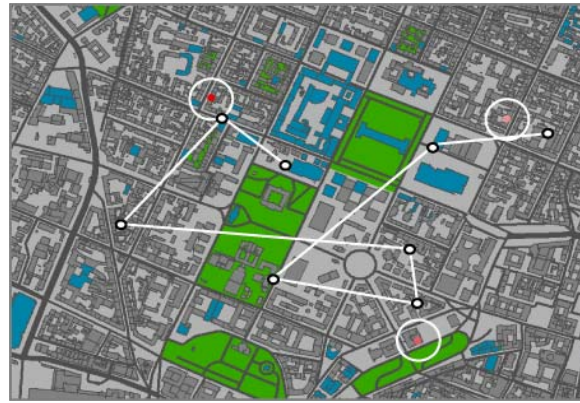
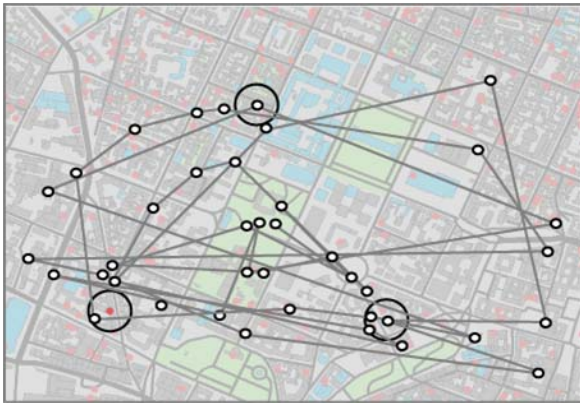


Size:

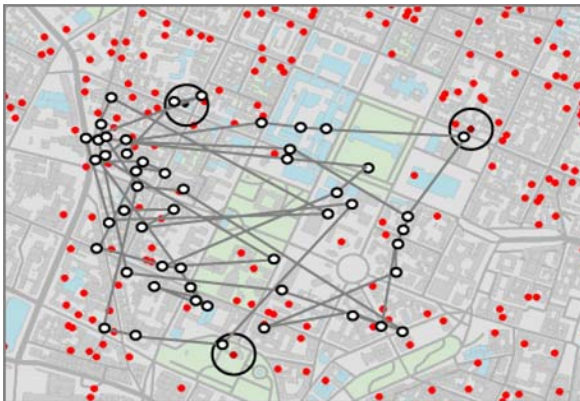


# Eye movement recording

Saturation:



Hue:



## Summary

- Conclusion
  - The concept of the design methodology optimises the visual scanning efficiency in detecting the location of GI (where?)
- Outlook
  - To intensify interdisciplinary user centred research
  - To evaluate NPR visualisations with the eye movement recording method
  - To intensify research in the field of semiotics to enhance the coding GI-meaning (what?)