

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
 - Not to overstrain the limited cognitive workload of users

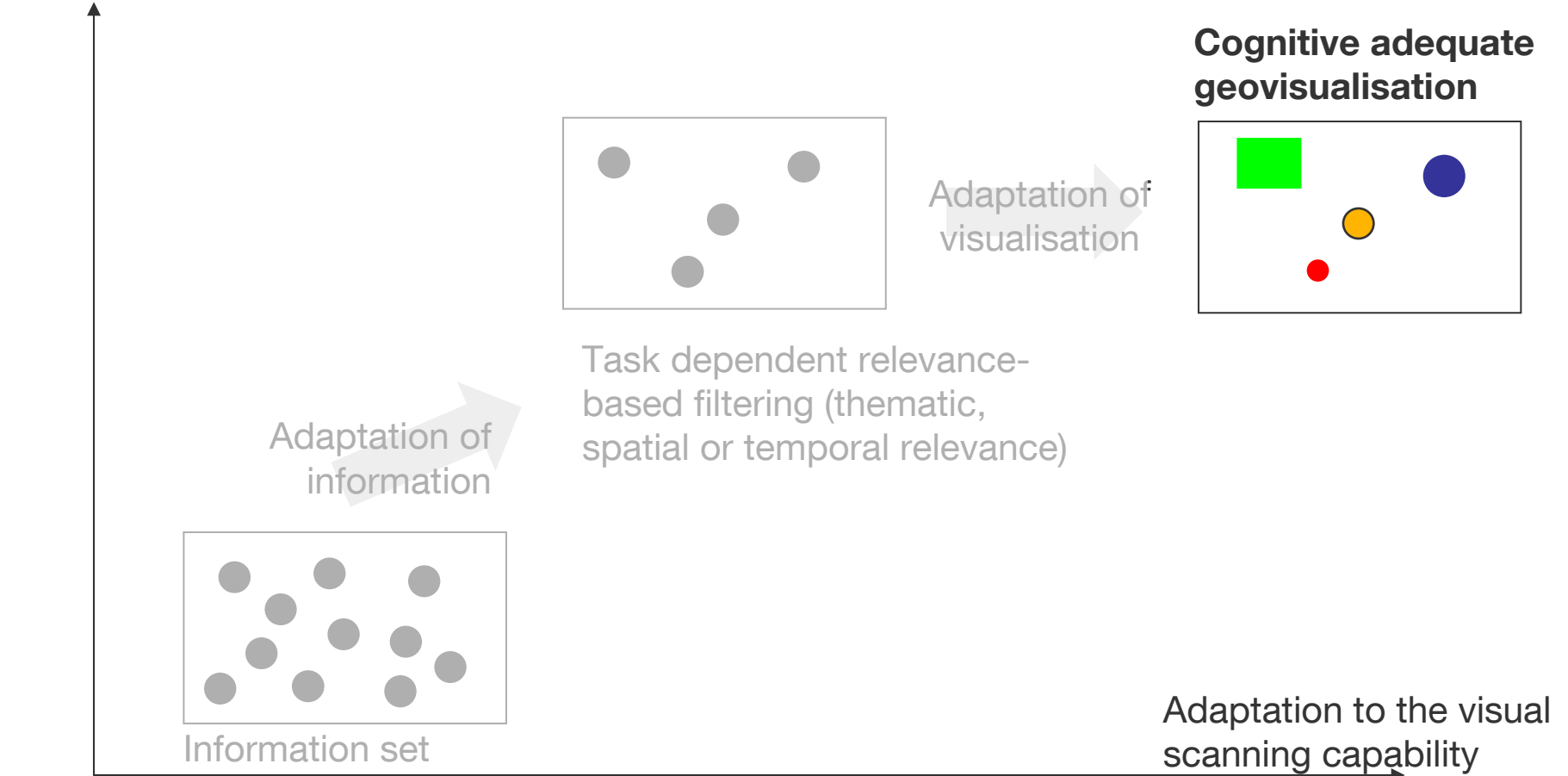


GI processing

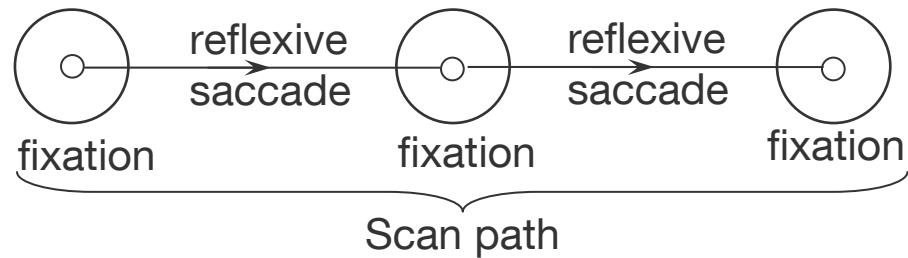
- Map design challenges
 - To visualise as little as possible and as much as needed
 - To guide visual attention to the location of relevant geoinformation (where?)
 - To effectively code classes of relevant information (what?)
- Objectives
 - To support users in decision making
 - To facilitate the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

Reducing displayed information complexity

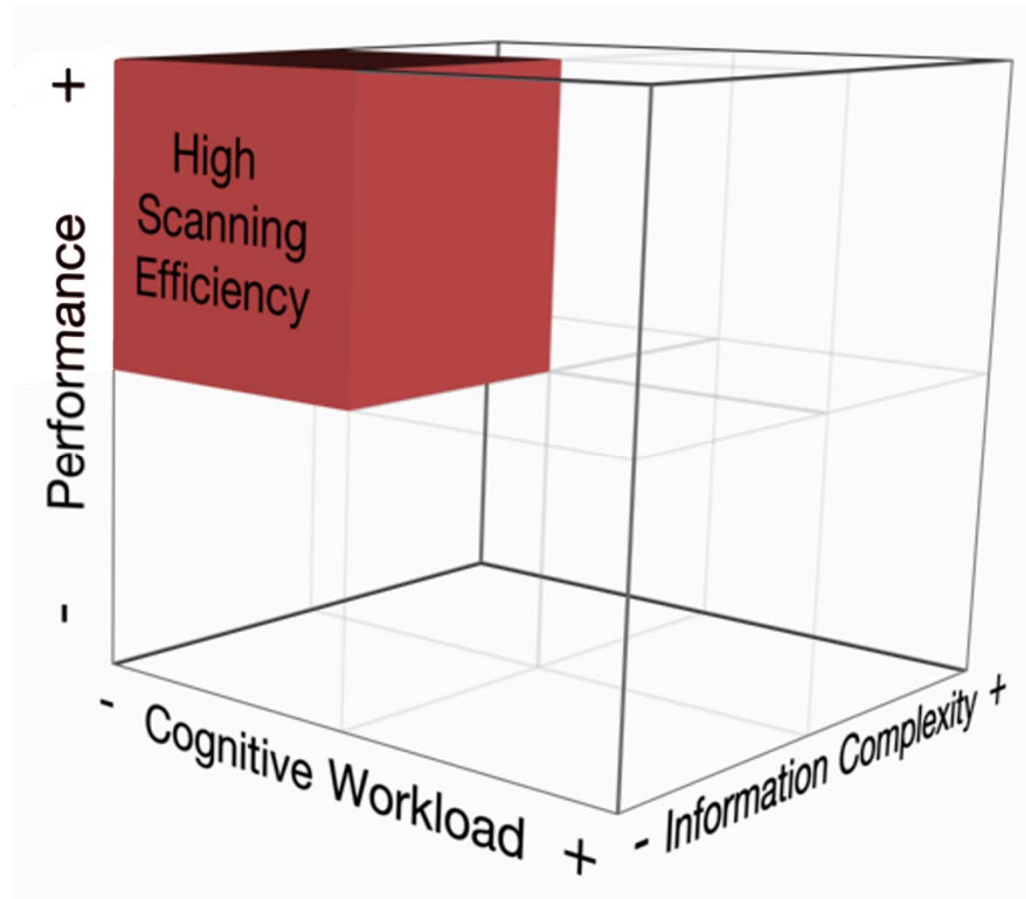
Relevance



Visual scanning



Visual scanning efficiency

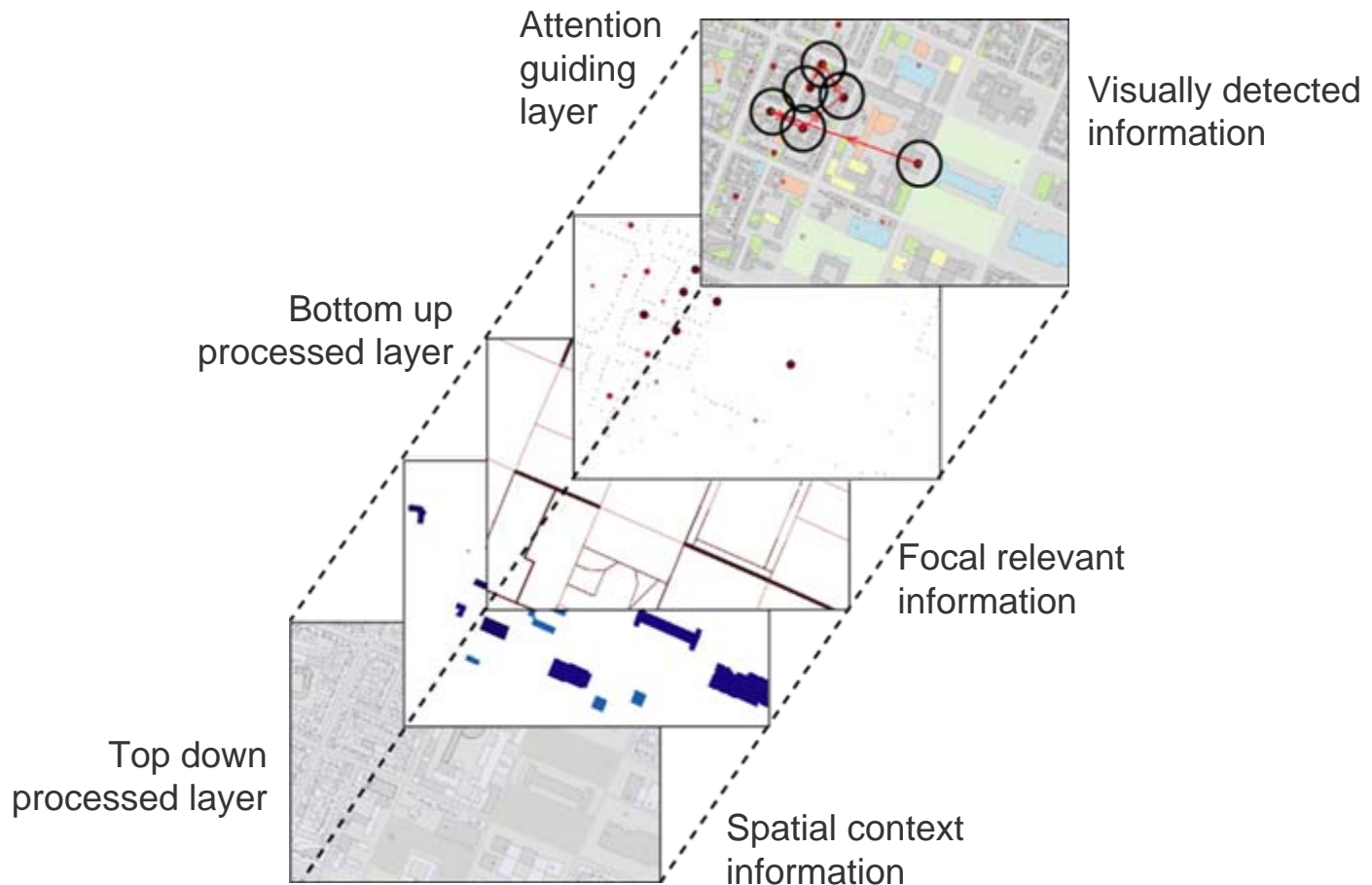


Design principles

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



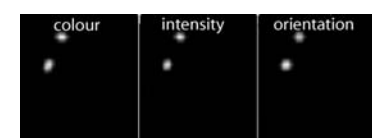
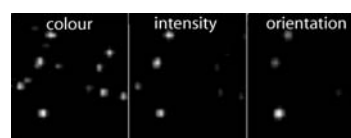
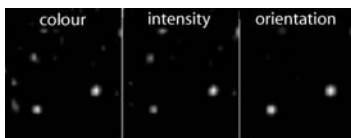
Unfiltered but
cognitive adequate



Filtered but
cognitive inadequate

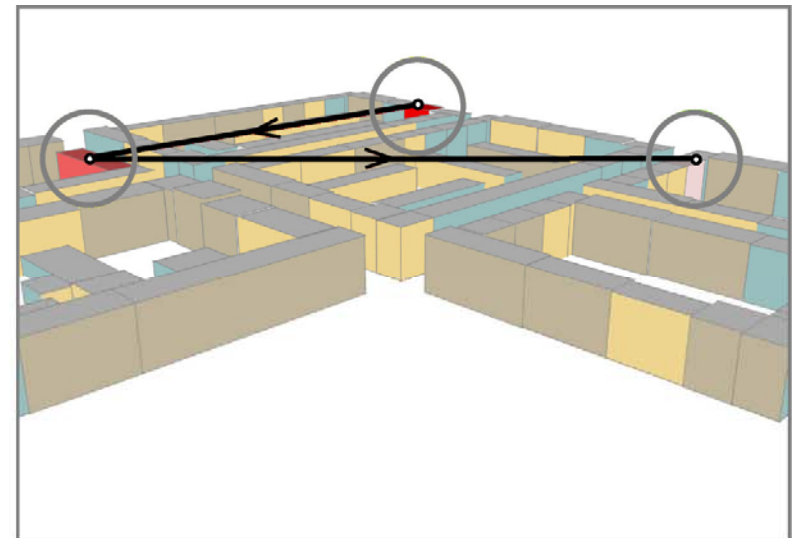
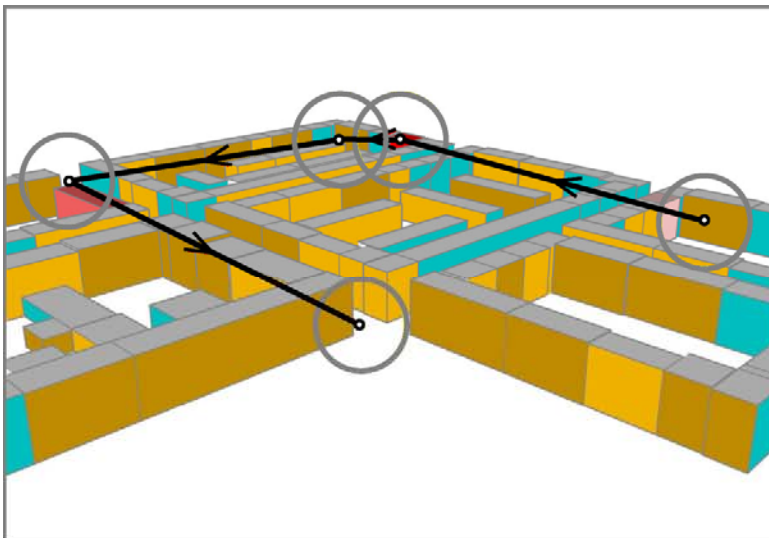


Filtered and
cognitive adequate



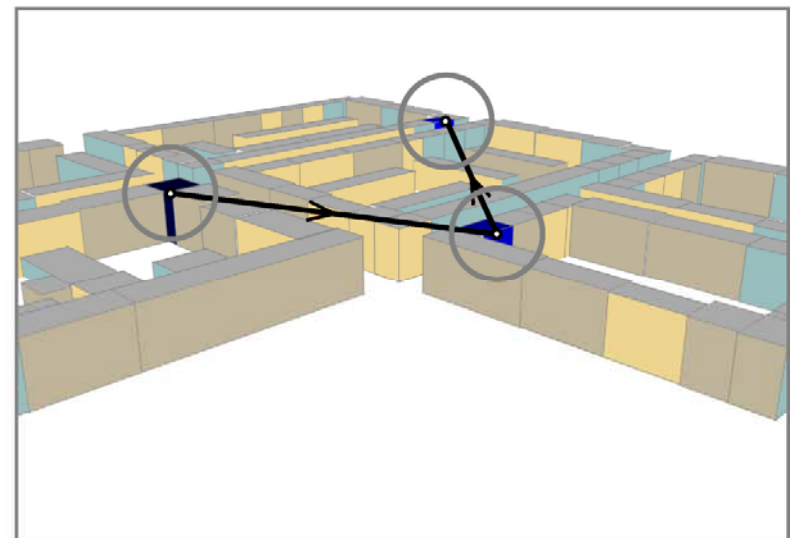
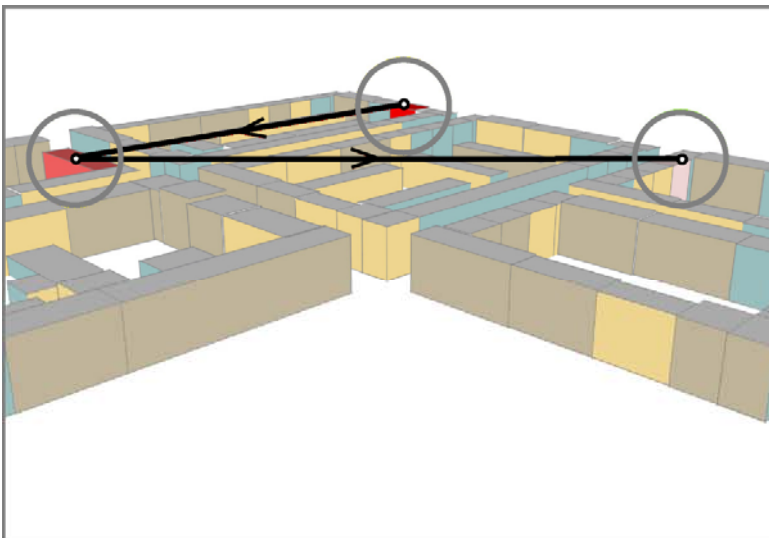
Computational attention model

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



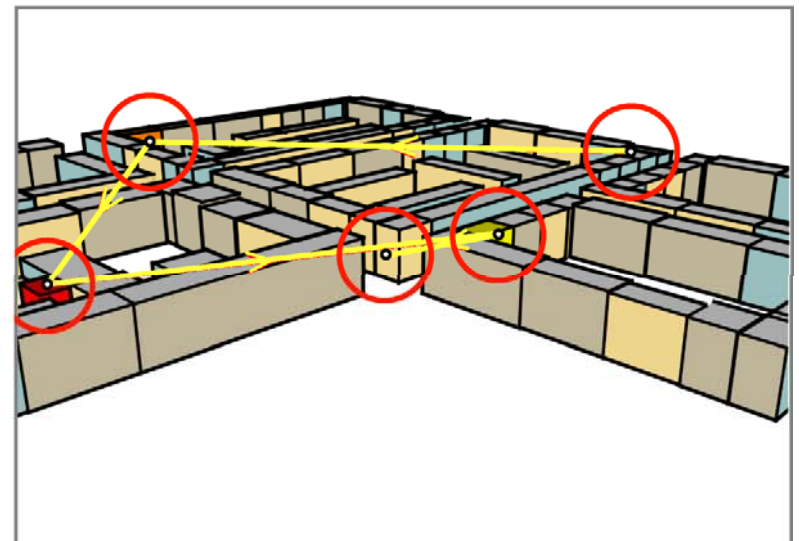
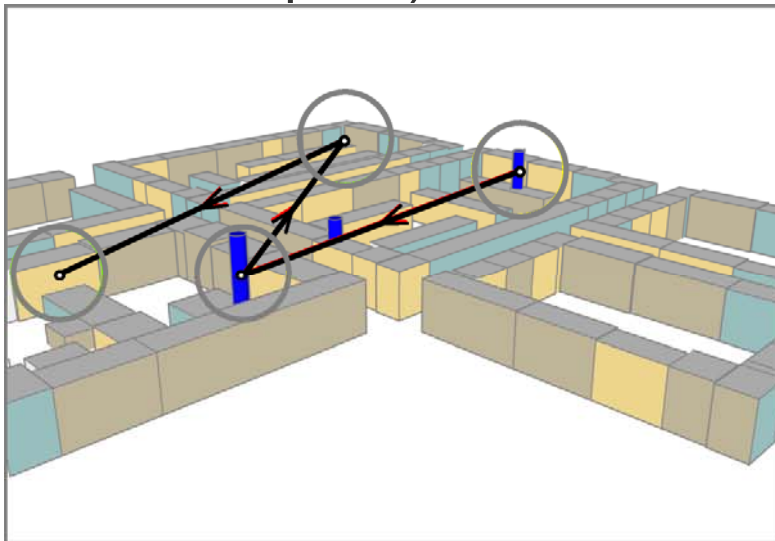
Computational attention model

- 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)

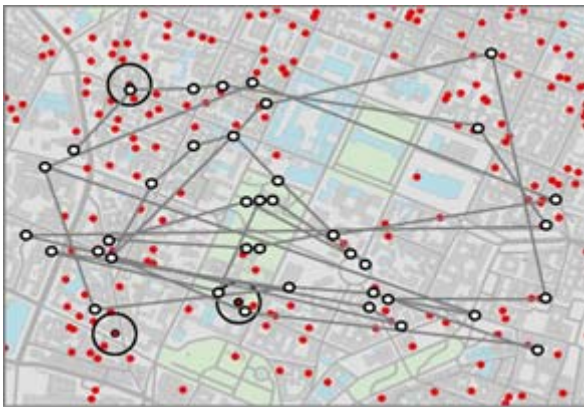


Eye movement recording

	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



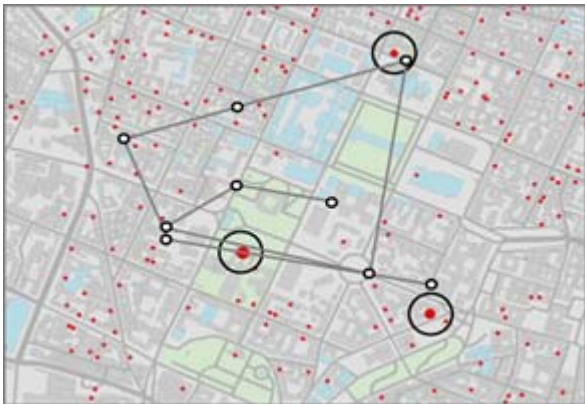
3

Eye movement recording

Colour:

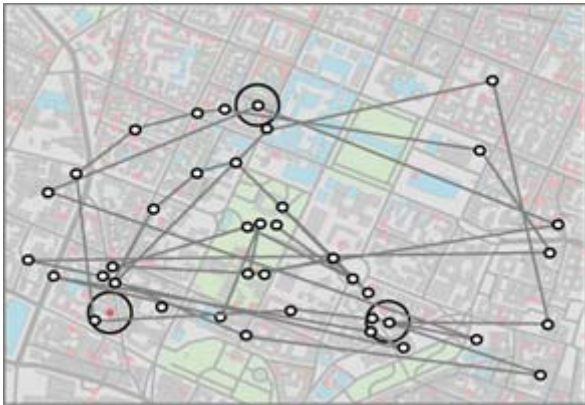


Size:

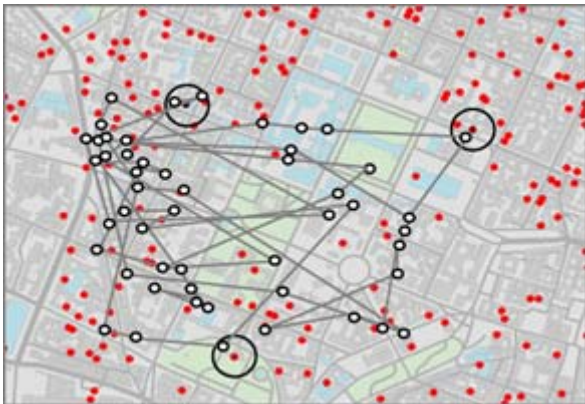


Eye movement recording

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 of GI-meaning (what?)