

# **The Graphical Attractiveness and Perceived Effectiveness of Cartographic Presentations of Spatio-temporal Accessibility**

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- **Objective of the research**
- **Cartographic presentation methods in research**
- **Experiment**
- **Results**
- **Conclusions**

# Objective of the research

- Determining users' perceived effectiveness and their subjective evaluation of the graphical attractiveness of the mapping techniques used to convey information about spatio-temporal accessibility.






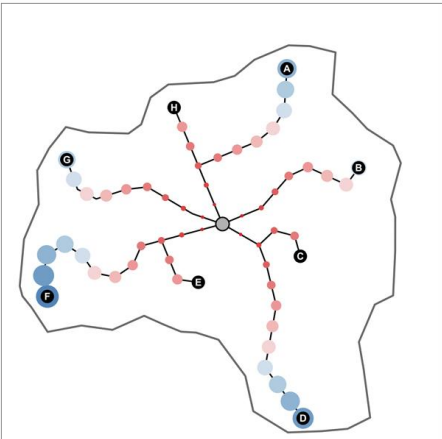
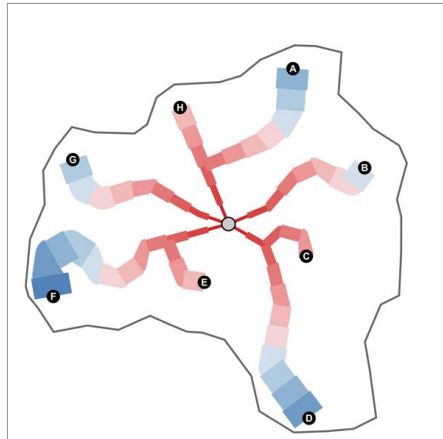
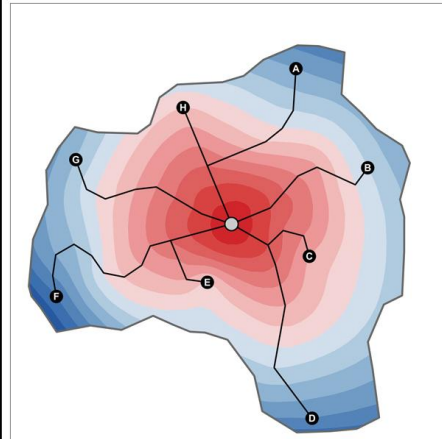

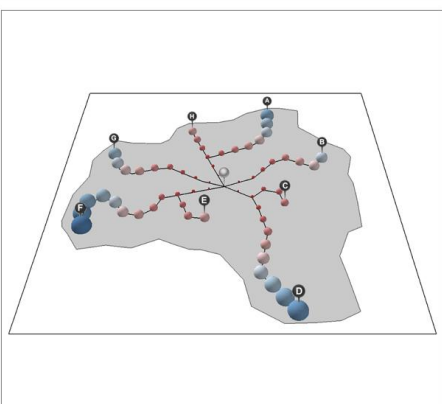
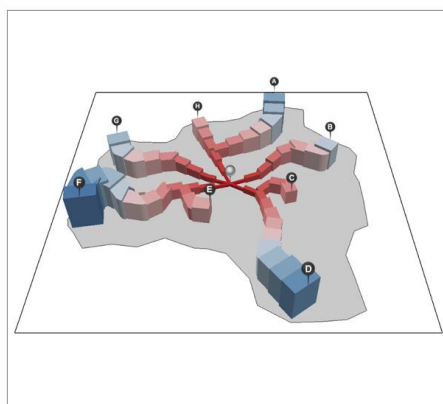
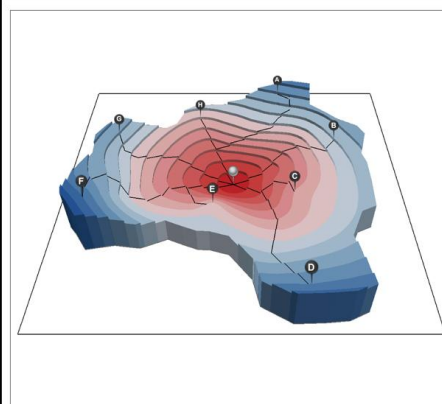
- Answers to the following questions:

*Which mapping technique is perceived as the best to read distance from map?*

*Which mapping technique is the most graphically attractive?*

*Which colour scale variant is preferred by users?*

# Cartographic presentation methods in research

|  |   |   |  |   |
|--|---|---|--|---|
| <p>Bipolar colour scale</p>                              |    |                                  |                     |                                      |
| <p>Theme of cartographic visualisation:</p>              |    |  <p>Graduated symbol map 2D</p>  |  <p>Flow map 2D</p>  |  <p>Equidistances</p>                |
| <p>Studied criterion:</p> <p>Perceived effectiveness</p> |  |  <p>Graduated symbol map 3D</p> |  <p>Flow map 3D</p> |  <p>Stepped statistical surface</p> |

# Cartographic presentation methods in research

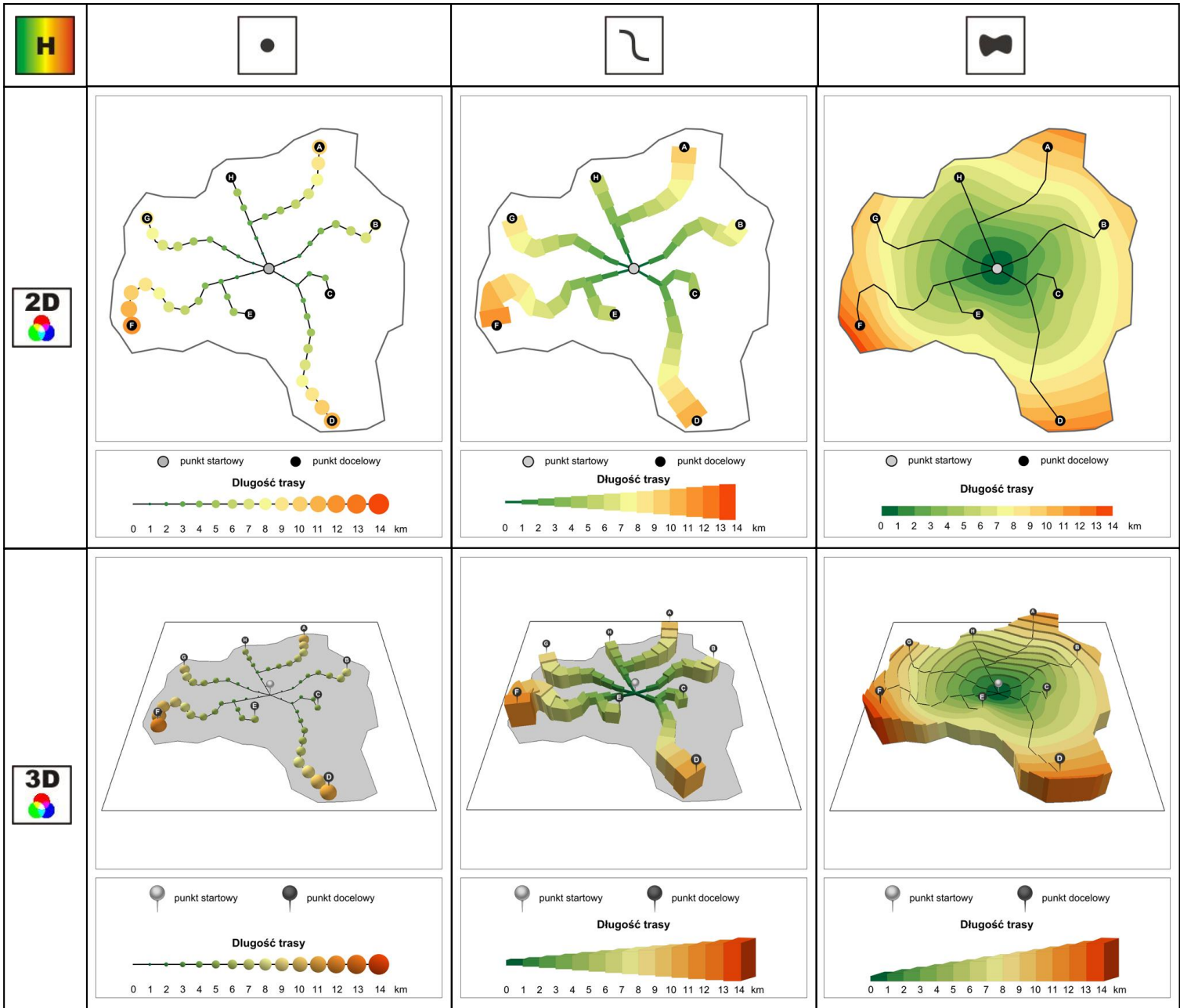
Hypsometric  
colour scale

Theme of  
cartographic  
visualisation:

Road  
distance

Studied  
criterion:

Perceived  
effectiveness



# Cartographic presentation methods in research

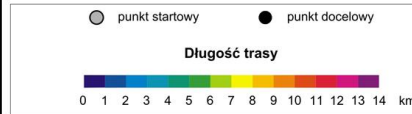
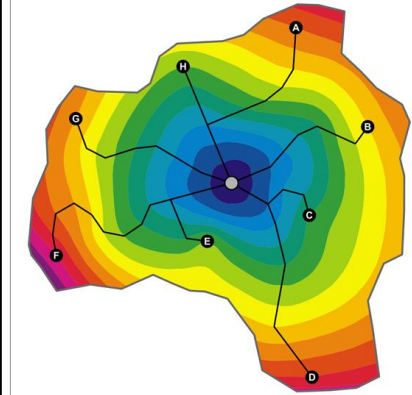
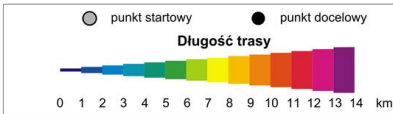
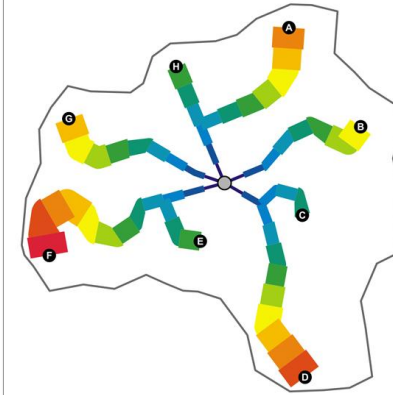
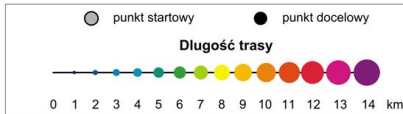
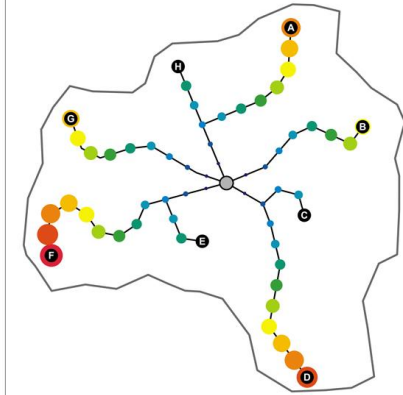
Spectral  
colour scale



Theme of  
cartographic  
visualisation:

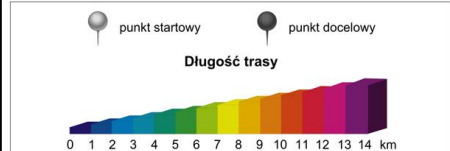
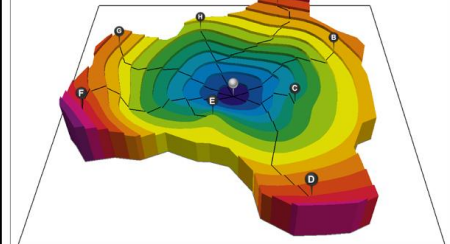
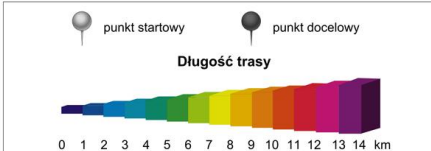
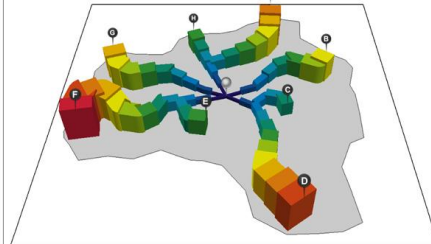
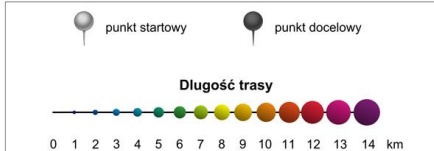
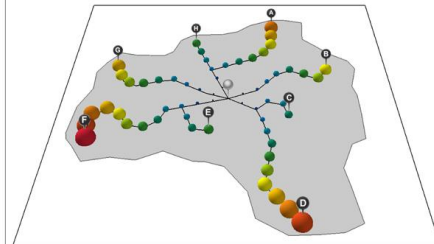


Road  
distance



Studied  
criterion:

Perceived  
effectiveness





# Cartographic presentation methods in research

|                                      |  |                           |               |                             |
|--------------------------------------|--|---------------------------|---------------|-----------------------------|
| Bipolar colour scale                 |  |                           |               |                             |
| Theme of cartographic visualisation: |  |                           |               |                             |
| Temporal distance                    |  | Graduated symbol map 2D   | Flow map 2D   | Isochrones                  |
| Studied criterion:                   |  |                           |               |                             |
| Graphical attractiveness             |  | Graduated symbol map 2.5D | Flow map 2.5D | Stepped statistical surface |
|                                      |  |                           |               |                             |

# Cartographic presentation methods in research

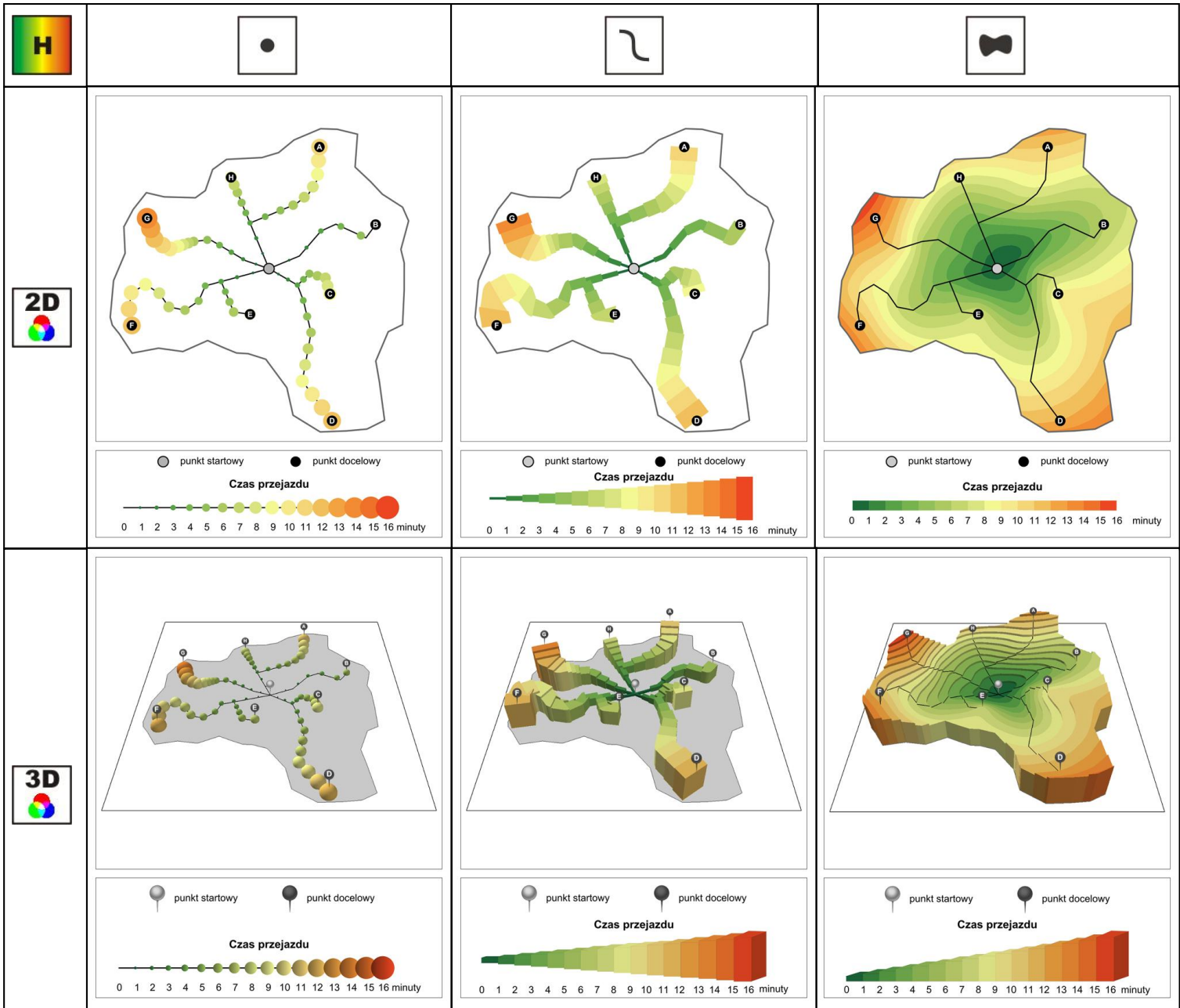
Hypsometric  
colour scale

Theme of  
cartographic  
visualisation:

Temporal  
distance

Studied  
criterion:

Graphical  
attractiveness





# Cartographic presentation methods in research

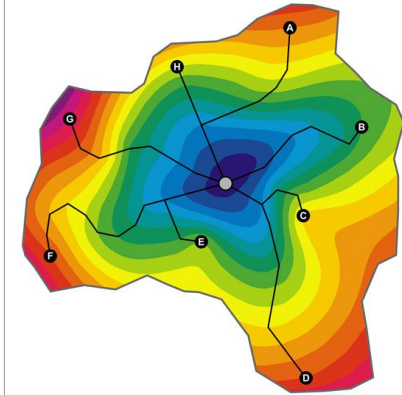
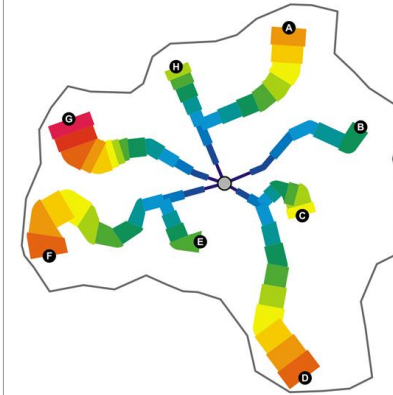
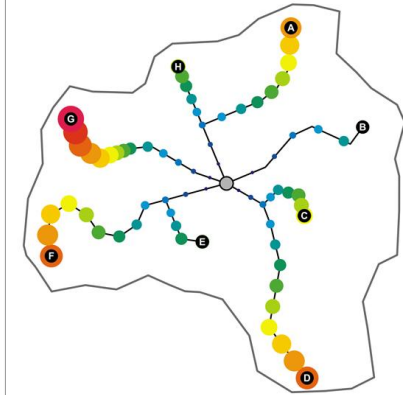
Spectral  
colour scale



Theme of  
cartographic  
visualisation:

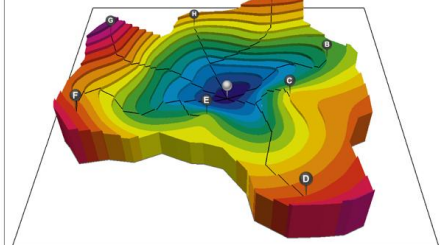
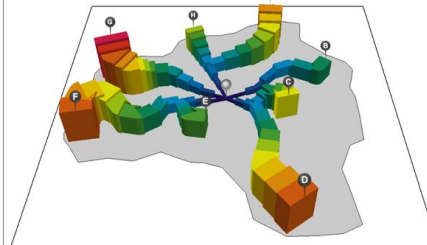
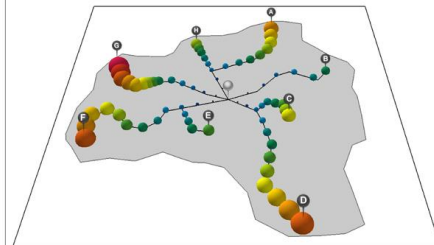


Temporal  
distance



Studied  
criterion:

Graphical  
attractiveness



# Course of experiment

**Two subjective criteria:**

- **perceived effectiveness**
- **graphical attractiveness**

**• 6 mapping techniques of spatial and temporal accessibility**

- **3 colour scales: bipolar, hypsometric, spectral**

- **Internet survey**

- **180 experiment participants**

**(60 person for each colour scale variant)**

**I stage**

**Real effectiveness**

**II stage**

**Perceived effectiveness  
and graphical attractiveness**

# Course of experiment : Internet survey

Perceived  
effectiveness



**Task 1:** Choose one cartographic visualisation of spatial accessibility (A-F), which in your opinion is **the best for estimating distance (in kilometers)**.

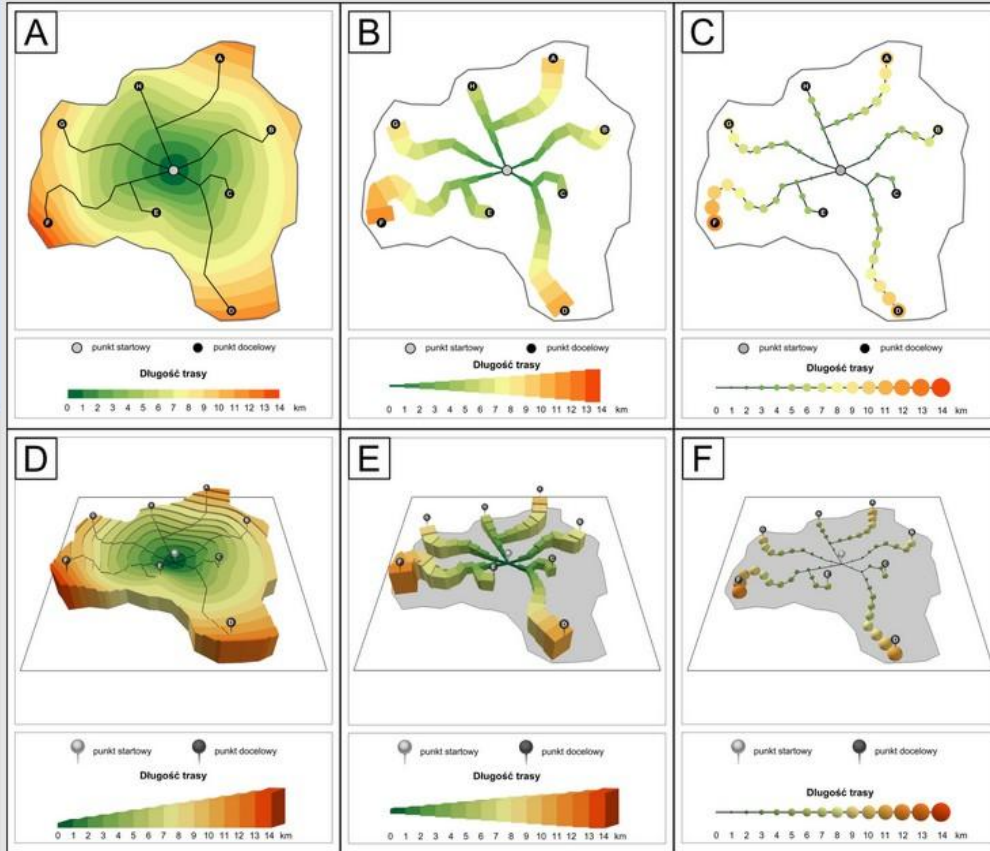
Ankieta IA - Badanie efektywności i atrakcyjności graficznej metod prezentacji kartograficznej dostępności przestrzennej

Pytanie nr 19

Z sześciu wizualizacji wskaż **najlepszą** do szacowania odległości drogowej w kilometrach

Proszę wybrać jedną odpowiedź:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ F



0% 100%

Dalej >>

**Task 2:** *Choose one cartographic visualisation of spatial accessibility (A-F), which in your opinion is **the worst for estimating distance** (in kilometers).*

Ankieta IA - Badanie efektywności i atrakcyjności graficznej metod prezentacji kartograficznej dostępności przestrzennej

Pytanie nr 20

Z sześciu wizualizacji wskaż **najgorszą** do szacowania odległości drogowej w kilometrach

Proszę wybrać jedną odpowiedź:

A

B

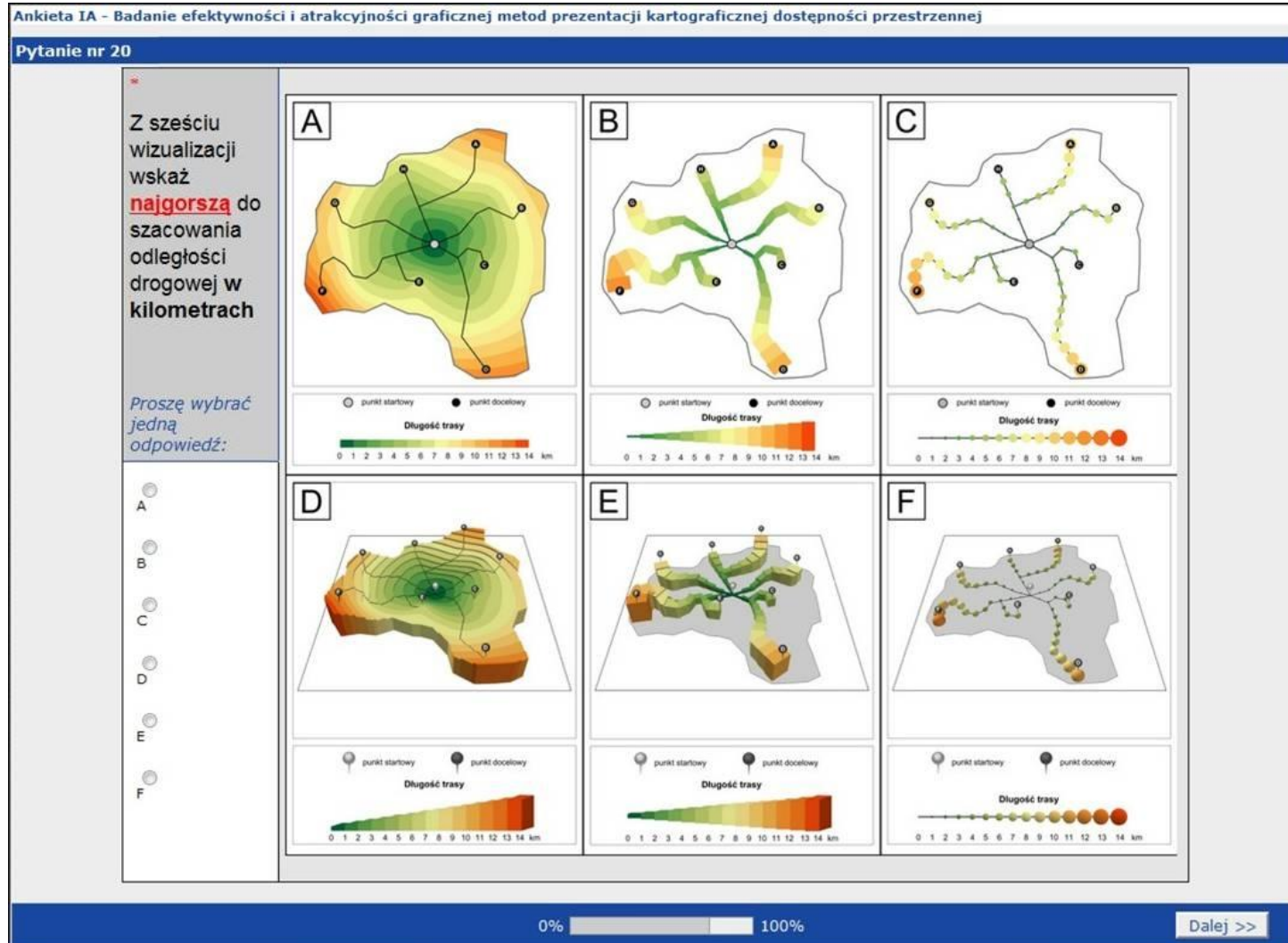
C

D

E

F

0% 100% Dalej >>



The survey interface displays six cartographic visualizations (A-F) for evaluation. Each visualization shows a network of roads and points, with a color scale indicating distance. The visualizations are arranged in a 2x3 grid. Below each visualization is a legend and a scale bar. The legend indicates 'punkt startowy' (start point) and 'punkt docelowy' (end point). The scale bar is labeled 'Długość trasy' (Route length) and ranges from 0 to 14 km. The visualizations are: A: 2D map with a central point and radiating lines; B: 2D map with a central point and radiating lines; C: 2D map with a central point and radiating lines; D: 3D map with a central point and radiating lines; E: 3D map with a central point and radiating lines; F: 2D map with a central point and radiating lines.



**Task 3:** Choose one cartographic visualisation of temporal accessibility (A-F), which in your opinion is **the most graphically attractive**.

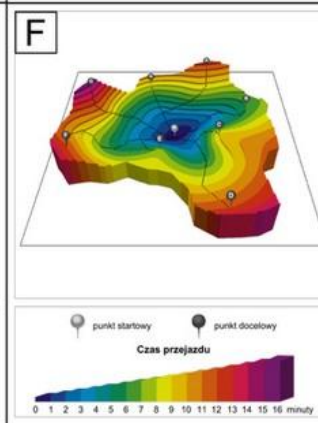
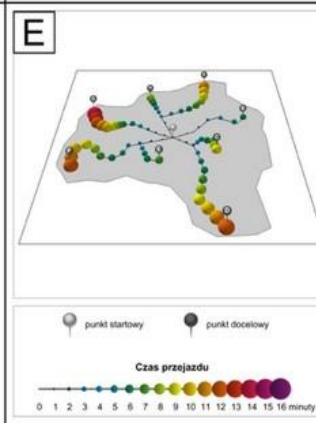
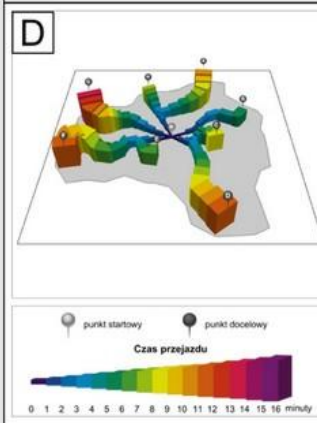
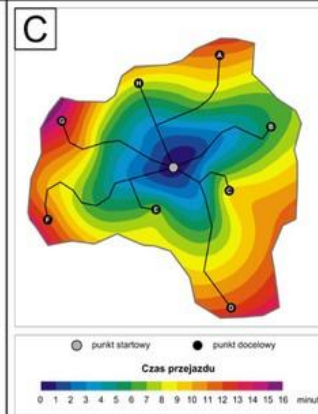
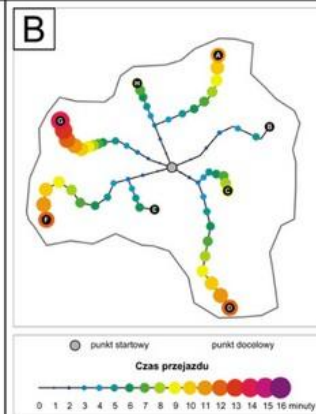
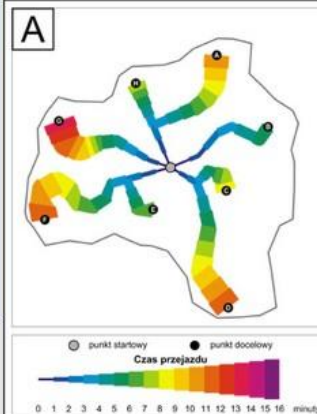
Ankieta IA - Badanie efektywności i atrakcyjności graficznej metod prezentacji kartograficznej dostępności przestrzennej

Pytanie nr 21

Z sześciu wizualizacji odległości czasowej wskaż **najbardziej atrakcyjną** graficznie/wizualnie

Proszę wybrać jedną odpowiedź:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ F



0%  100%

Dalej >>



**Task 4:** Choose one cartographic visualisation of temporal accessibility (A-F), which in your opinion is **the least graphically attractive**.

Ankieta IA - Badanie efektywności i atrakcyjności graficznej metod prezentacji kartograficznej dostępności przestrzennej

Pytanie nr 22

Z sześciu wizualizacji odległości czasowej wskaż **najmniej atrakcyjną** graficznie/wizualnie

Proszę wybrać jedną odpowiedź:

☐ A  
☐ B  
☐ C  
☐ D  
☐ E  
☐ F

**A**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

**B**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

**C**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

**D**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

**E**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

**F**

● punkt startowy ● punkt docelowy

Czas przejazdu

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 minuty

0%  100%

Dalej >>



# Course of experiment: Internet survey

Task 5: Choose one colour scale variant, which in your opinion is *the best for visualisation of distance* (A, B or C).

Ankieta IA - Badanie efektywności i atrakcyjności graficznej metod prezentacji kartograficznej dostępności przestrzennej

Pytanie nr 23

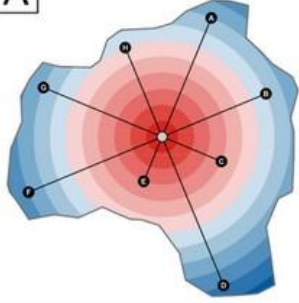
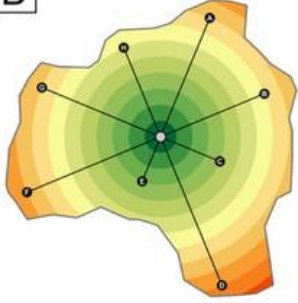
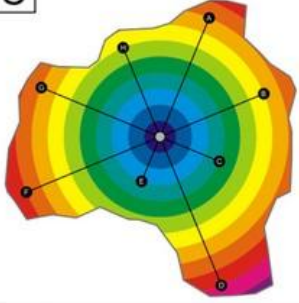
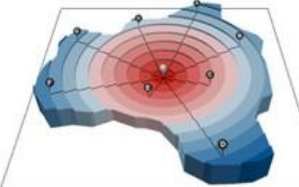
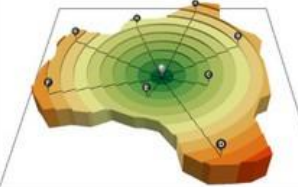
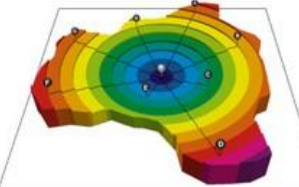
Która skala barw najbardziej nadaje się do wizualizacji odległości?

Proszę wybrać jedną odpowiedź:

☐ A

☐ B

☐ C

| A   | B  | C   |
|---|--|---|
|  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p>  |  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p>  |  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p>  |
|  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p> |  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p> |  <p>0 1 2 3 4 5 6 7 8 9 10 11 12 km</p> |

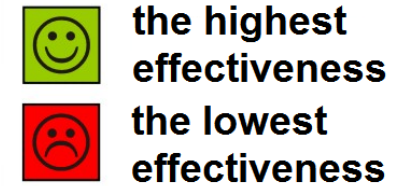
0% 100%

Dalej >>

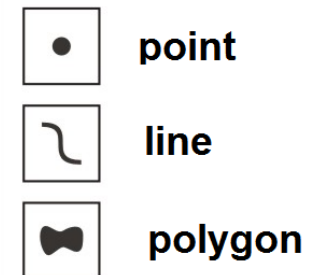
# Experiment results



Perceived effectiveness



Geometry type



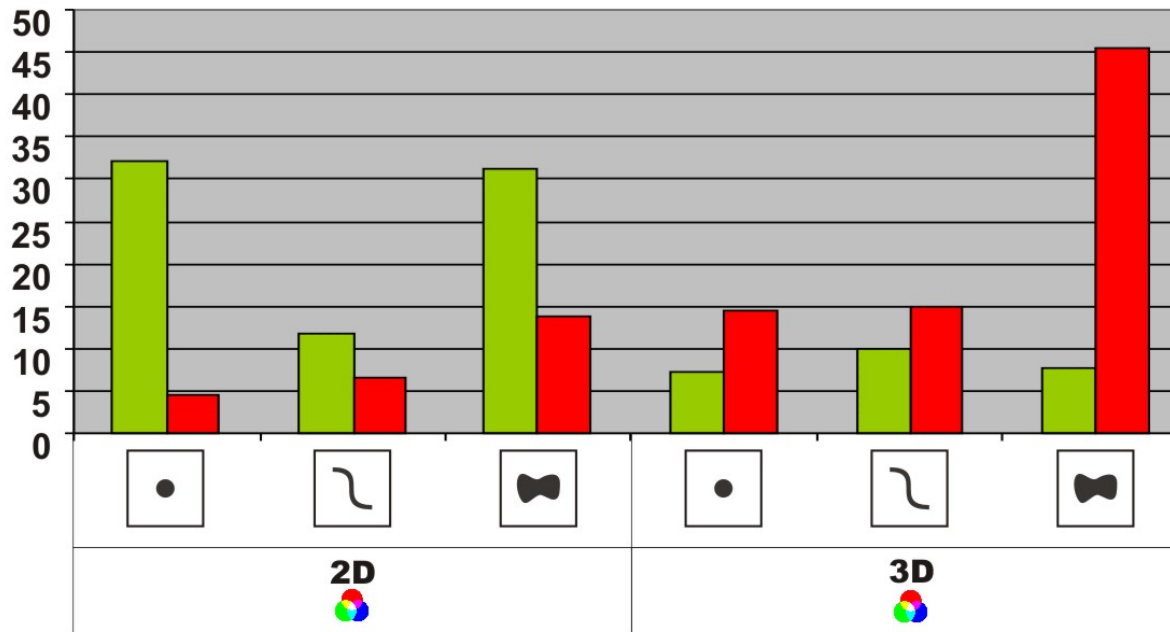
Spatial dimension



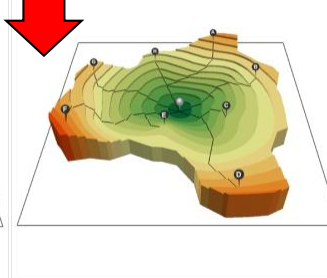
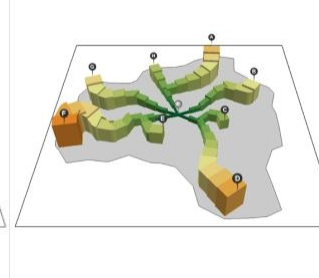
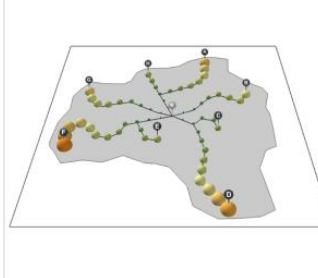
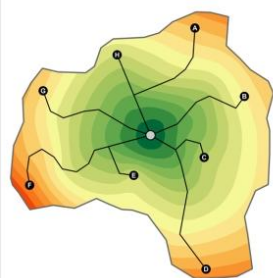
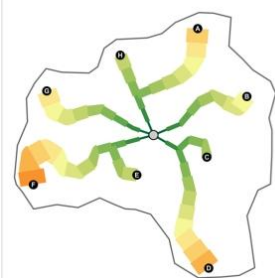
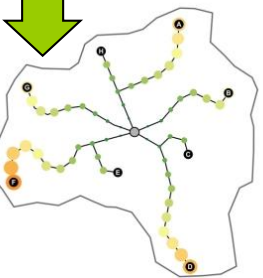
Answers - percentage share (%)



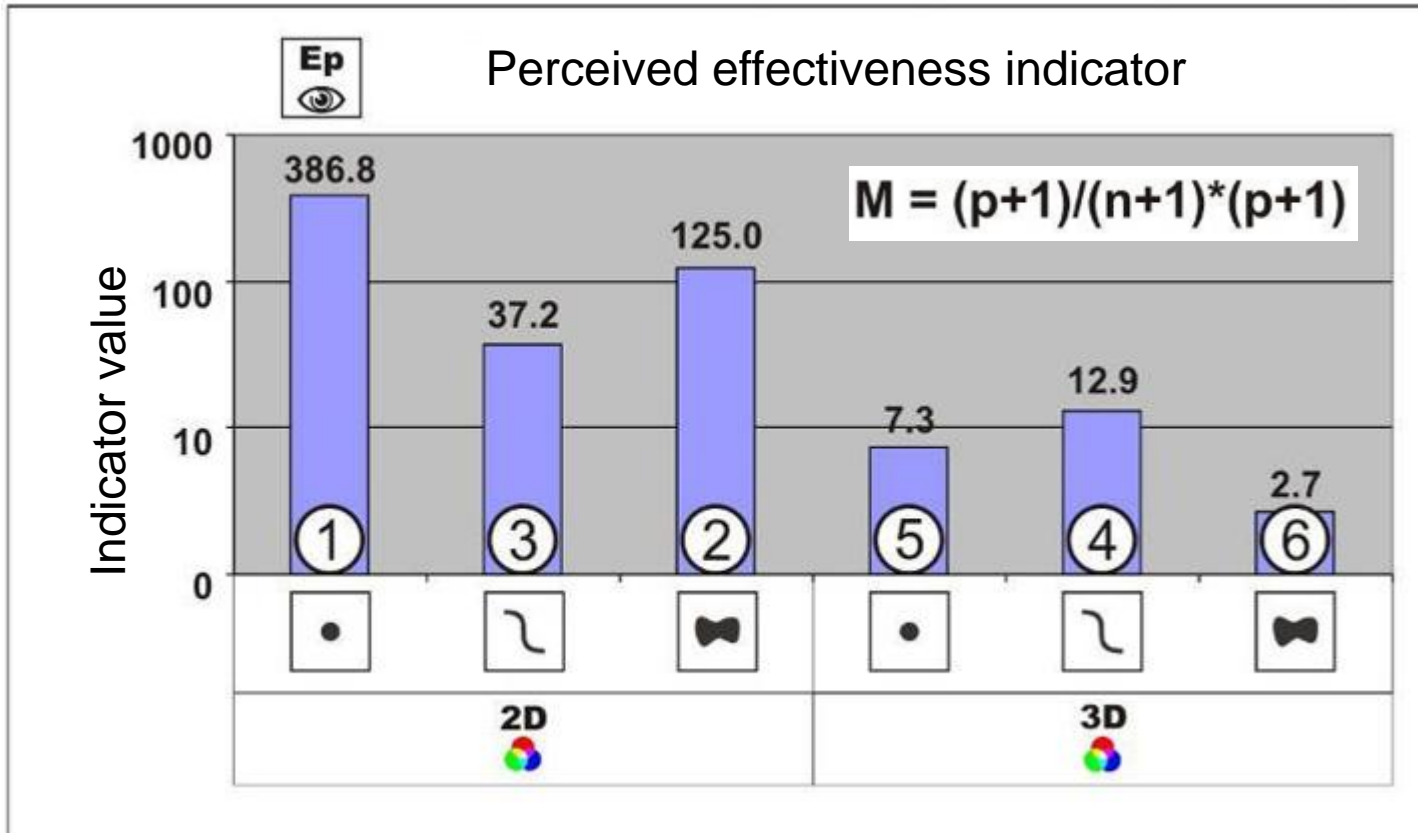
Perceived effectiveness  
(replies of respondents)



Graphically complex cartographic presentation method



# Experiment results

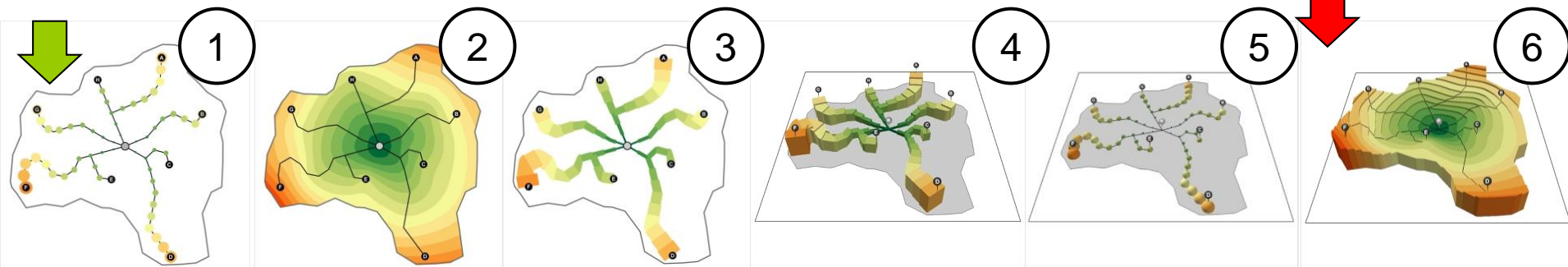


M – perceived effectiveness indicator

p – positive votes



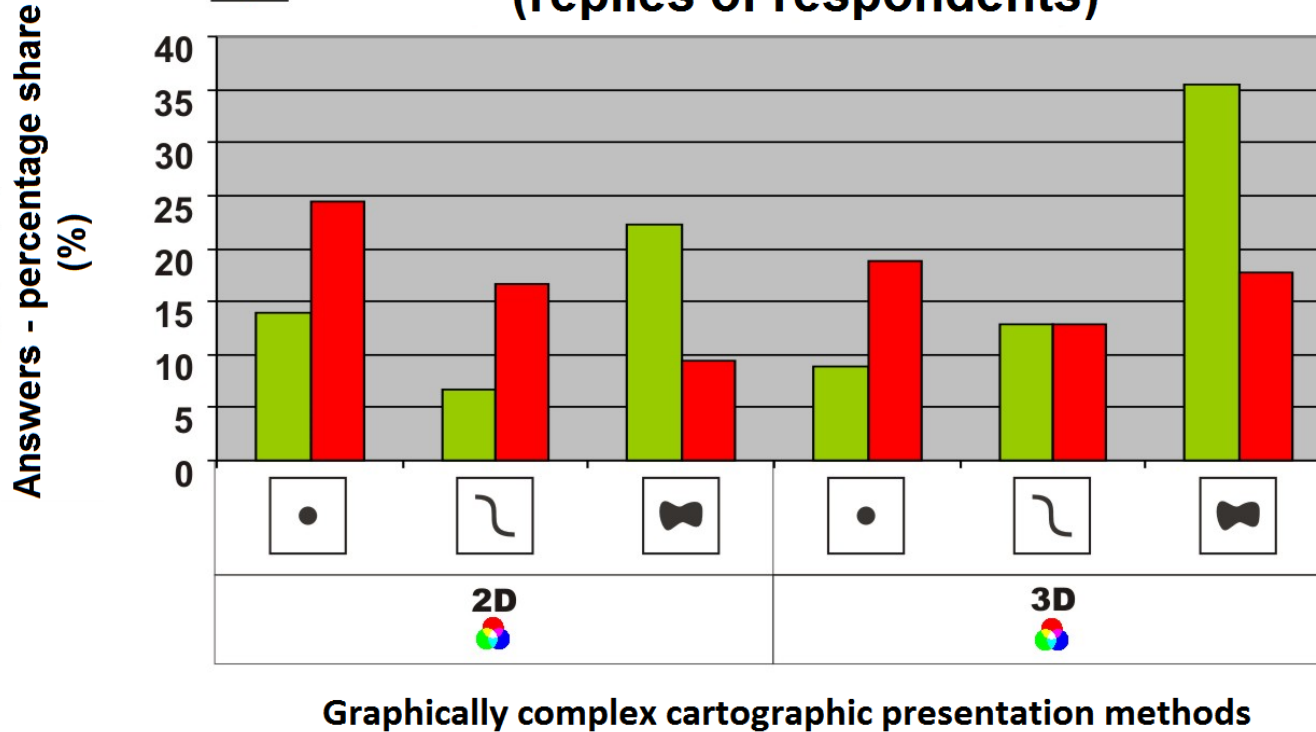
n – negative votes



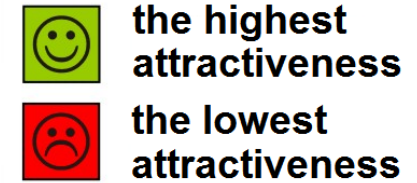
# Experiment results



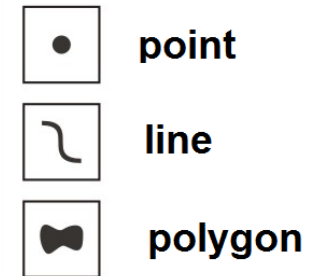
## Graphical attractiveness (replies of respondents)



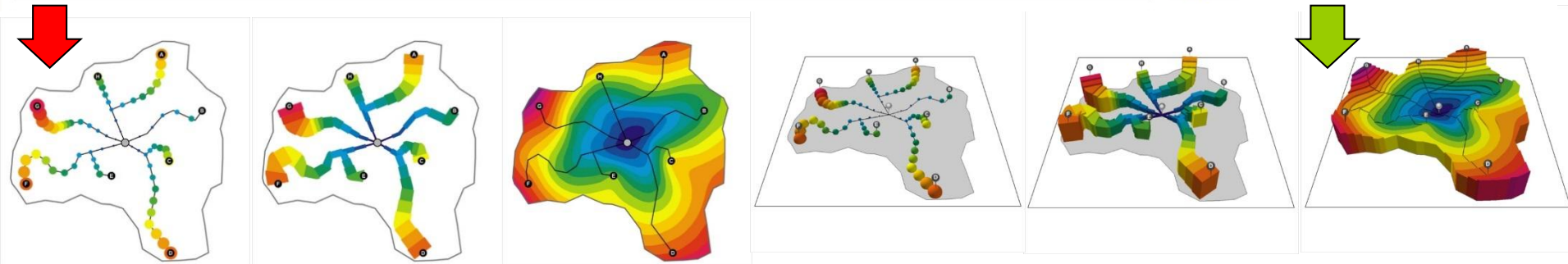
## Graphical attractiveness



## Geometry type



## Spatial dimension





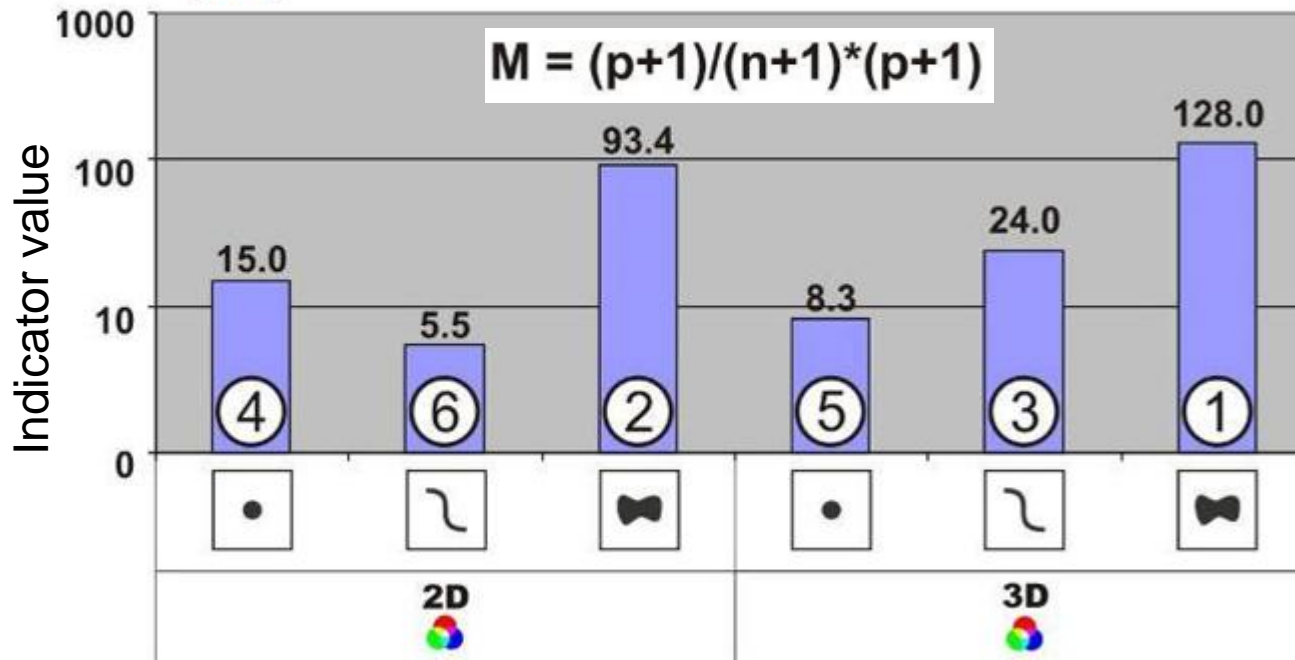
# Experiment results



Ag  
❤️

Graphical attractiveness indicator

$$M = (p+1)/(n+1)*(p+1)$$

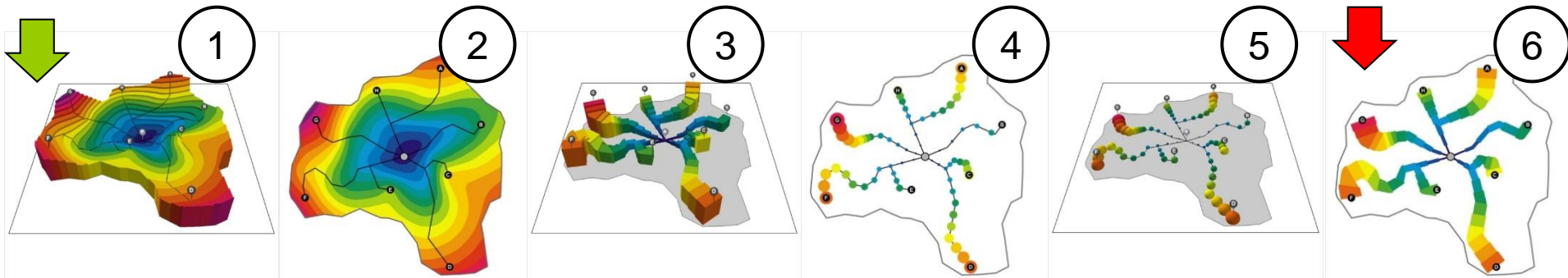


M – graphical attractiveness indicator

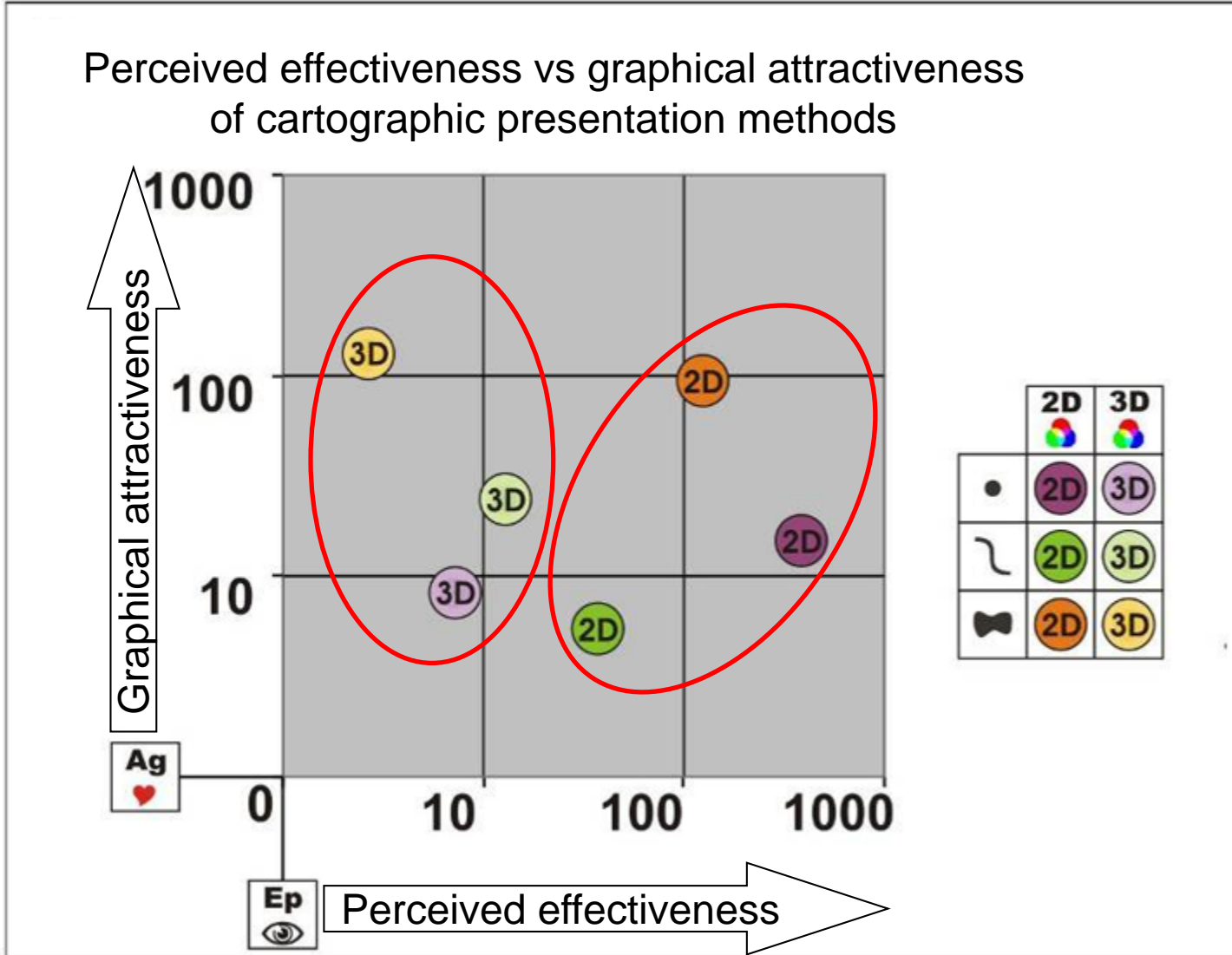
p – positive votes



n – negative votes



# Experiment results



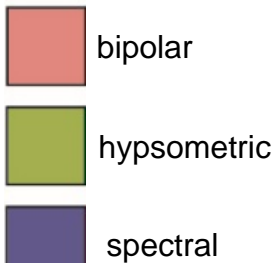


# Experiment results

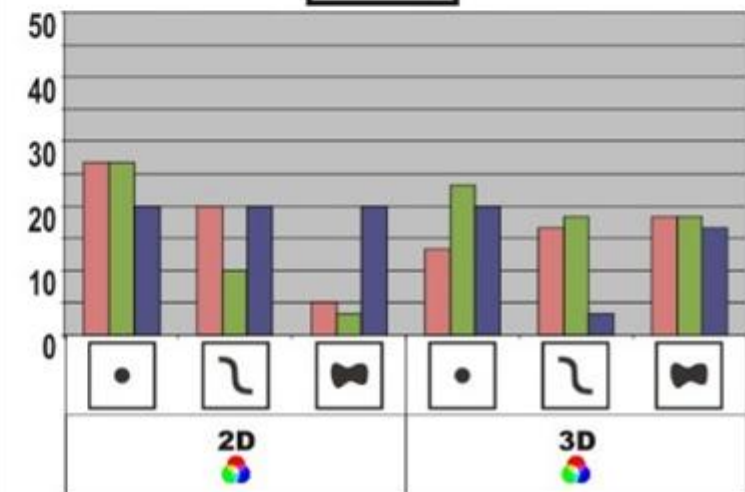
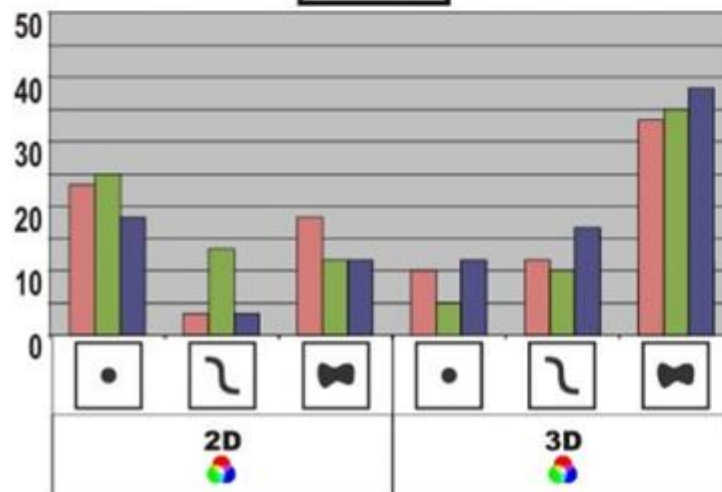
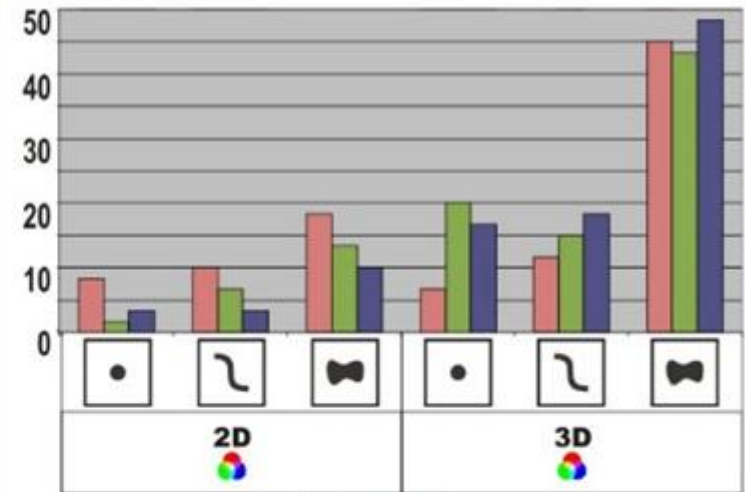
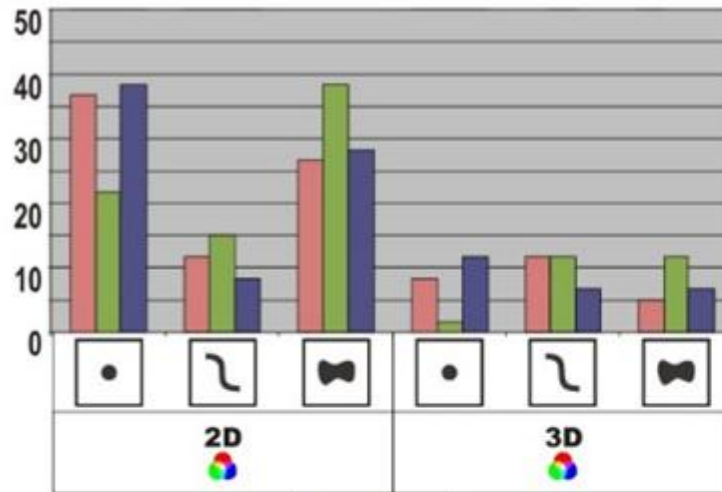
Perceived effectiveness



Colour scale

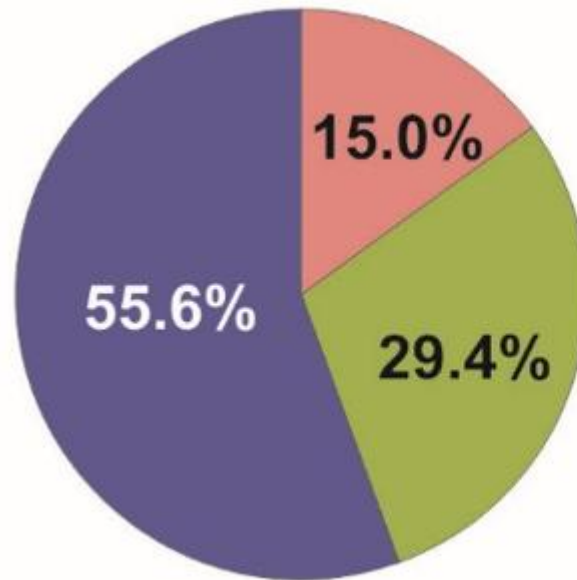


Graphical attractiveness



# Experiment results

Colour scales chosen  
by experiment participants  
(percent of total)



Colour scale



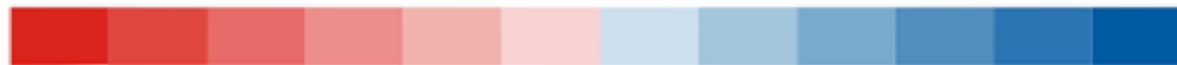
bipolar



hypsothetic



spectral



bipolar



hypsothetic



spectral

# Conclusions

## The most interesting conclusions:

- users of spatio-temporal accessibility maps perceive three-dimensional methods as less effective than their two-dimensional equivalents;
- the stepped statistical surface method is considered as one of the most attractive graphically and the least effective in the conveyance of information;
- according to users, the scale of spectral colours is superior to the hypsometric and bipolar scales.

***Thank you for your  
attention!***