Remote Usability Testing in Cognitive Cartography: Evaluation of 3D Interactive (Geo)visualizations

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Outline

- Asynchronous (automated) remote testing
- Pilot study
  - Used testing tool
  - Experimental design & spatial task
  - Participants
  - Results
- Conclusions & future work
Remote usability testing

- method based on an insight platform to record test participants' activities when they interact with a given product in their natural environment (e.g., at home)
  - Frequently used in web design,
  - but only rarely for cartographic purposes.
  - It is considered as ‘potentially fruitful research opportunity’ (Roth et al., 2017)
- asynchronous (automated) remote testing
  - can record users’ interactions and collect users’ opinions even from large numbers of participants
  - It does not allow insight into the reasons for the user’s decisions.
Testing tool

- 3DmoveR 2.1
  - For desktop virtual reality – only monoscopic 3D
  - Web-based testing tool (HTML, JS, WebGL, PHP)
- Related methods
  - User logging + digital questionnaire + practical tasks
Testing tool

- You can try it …
Design & Tasks

Find the building of the specified category.

In this case, 'net-zero energy' (dark green)
Participants – What did they fill in the questionnaires?

- **30** respondents started the test, **23** completed it

- **Age**
  - Min: 16 years
  - Mean: 25.9 years
  - Median: 25 years
  - Max: 38 years

- **Gender**
  - Females: 10
  - Males: 19
  - No answer: 1

- **Expertise**
  - 'Geosciences': 26
  - Other: 3
  - No answer: 1

- **Work with computer**
  - Daily: 29
  - Regularly: 1

- **Work with maps**
  - Daily: 12
  - Regularly: 14
  - Occasionally: 3
  - Never: 1

- **Work with 3D models or visualizations**
  - Daily: 2
  - Regularly: 7
  - Occasionally: 12
  - Rarely: 7
  - Never: 2
Results – What can be detected automatically?

- **OS**
  - Windows 28x
  - Linux 1x
  - Mac 1x

- **Web browser**
  - Google Chrome 20x (89.0 4x and 90.0 16x)
  - Mozilla Firefox 5x (87.0 1x and 88.0 4x)
  - MS Edge 3x
  - Opera 1x
  - Safari 1x

- **Screen resolution**
  - 1920 x 1080 16x
  - 1536 x 864 11x
  - Probably two monitors 1x

- **Web browser window size**
  - Fullscreen 7x
  - Full 'width' of 3D scene 28x
    - with '3D' window height
      - 95-86% of screen height 14x
      - 85-76% of screen height 8x

<table>
<thead>
<tr>
<th></th>
<th>Successfully stored records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory questionnaire</td>
<td>30</td>
</tr>
<tr>
<td>Training task</td>
<td>27</td>
</tr>
<tr>
<td>1st task</td>
<td>25</td>
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<tr>
<td>2nd task</td>
<td>25</td>
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<td>3rd task</td>
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<td>4th task</td>
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<td>5th task</td>
<td>24</td>
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<tr>
<td>6th task</td>
<td>23</td>
</tr>
<tr>
<td>Closing questionnaire</td>
<td>23</td>
</tr>
</tbody>
</table>

All participants who completed the test, all passed it in the correct order – browser history has been recorded, too.
Results – user responses & interaction in spatial tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Number of correct answers</th>
<th>Relative correctness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>22</td>
<td>96%</td>
</tr>
<tr>
<td>B</td>
<td>21</td>
<td>91%</td>
</tr>
<tr>
<td>C</td>
<td>22</td>
<td>96%</td>
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<tr>
<td>D</td>
<td>20</td>
<td>87%</td>
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<tr>
<td>E</td>
<td>23</td>
<td>100%</td>
</tr>
<tr>
<td>F</td>
<td>23</td>
<td>100%</td>
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</table>
Results – errors & individual user strategies

- Visual searching?
- Virtual movement

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</thead>
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<tr>
<td>D</td>
<td>20</td>
<td>87%</td>
</tr>
</tbody>
</table>

DRAG / ROTATION: 53%
PAN: 34%
ZOOM: 13%
Conclusions – results of pilot test

- 30/23 participants within one week (22th April – 29th April 2021), then it became viral…
- Approximately of participants 20% must be excluded

- Tested colour scale seems to be not suitable for 3D visualization
  - especially the ‘green half’
- If the colour scale should be used in 3D visualization, it is better to use fewer classes with more significant colour distances.
Conclusions – basis for further testing

- **Technical solutions**
  - Disable some functions
    - *Pop-up menu in the browser,*
    - *Excluding some controls (e.g., keyboard)*
  - Record data related to intervening (nuisance) variables
    - *Examples on previous slides (e.g., screen resolution, colour depth)*

- **Non-technical issues – still open**
  - Motivations of users – 'gamification'
  - Integration with synchronous (moderated) remote usability testing
Future work – possible extensions of testing tool

- Sound recording (WebRTC, getUserMedia API, Web Audio API)
- Video recording (WebRTC, getUserMedia API)
- Screen capture (Screen Capture API)
- Eye-tracking integration (Webgazer.js)
- Adaptation for mobile devices
  - Responsive design (Bootstrap)
  - Integration with Geolocation API (GPS) and Orientation API (accelerometer)
- Integration with WebVR and available head-mounted displays, especially low-cost ones (A-Frame)
Additional information


Thank you for your attention