Effects of Unsupervised Participation over the Internet on a Usability Study about Map Animation

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Abstract

The Internet has become a major platform for experimental research for several kinds of scientific and commercial questionnaires, polls, and surveys, including geovisualization and cartographic topics. At the same time, the volume of Internet use by an individual person has increased heavily, and maintaining focus on experimental tasks performed on the Internet can be questioned. Previous comparisons between supervised laboratory and unsupervised Internet conditions have prompted experimental studies over the Internet. This extended abstract compares supervised laboratory conditions with unsupervised conditions over the Internet in a geovisualization usability experiment on map animation. The same experimental procedure was run for experimental sessions in both conditions. The results show that reaction times are significantly affected by the experimental environment, as participants reacted remarkably faster to all tasks over the Internet than in the laboratory. However, quality of answers was affected only in two of ten cases. The results of the reaction times may be explained by a more relaxed and focused environment causing less self-control over the Internet. The results suggest that running experiments over the Internet is appropriate for human experimental research on geovisual tasks. We call for further studies on evaluating the Internet as an experimental research platform.

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1 Introduction

The Internet has become a major platform for various kinds of experimental studies in scientific and commercial research. Many experimental geovisualization and cartographic studies are also run over the Internet [3, 4]. However, adequacy of Internet-run experiments can be questioned because of the lack of supervision and control of participants and supposed threats for quality of the experimental sessions, such as participants’ multi-tasking, breaks, lack of focus, or weak motivation. In addition, suspicious can arise because of varying technical devices with which participants perform experiments over the Internet. Consequently, standards have been developed to ensure reliability of Internet studies [5]. Previous comparative studies on the adequacy of the Internet as an experimental platform have disproved most of the doubts, such as several psychological disciplines [2], clinical psychological paper-and-pencil questionnaires [6], and political sciences [1]. However, studying human geovisual processing over the Internet sets higher challenges as the visual experience...
of a participant may vary because of differences due to graphical reproduction devices, such as display size, resolution, and color gamut. Importantly, geovisual tasks require spatial thinking in two or three dimensions, which is essentially different from processing textual information that the majority of studies require.

In this extended abstract, we briefly present a comparison between supervised laboratory and unsupervised Internet results of a geovisualization usability experiment on a popular type of animation on maps, namely animated streamlets on vector fields. The geovisual purpose of the study was to investigate how changes of animation parameters of animated streamlets affect reading of the vector fields on the map. Additionally, however, conducting the study both in the laboratory and over the Internet allows for analysis of the effects related to experimental supervision.

2 Methods

2.1 Materials

We created experimental stimuli of map animations with the earth web software [7]; (see http://earth.nullschool.net) that is used to render speeds and directions of wind fields. The earth renders stable vector fields in a web browser on a web globe by partially transparent, gradually vanishing line particles, or animated streamlets [9]. We created 16 animation stimuli of stable wind vector fields with duration of 10 seconds and size of 350 x 350 pixels, each with low, medium, and high values of an animation parameter, and a colored stimuli (Figure 1). We also prepared a 30-second changing animation by programming the earth software to replace the animation at even intervals, according to real sequential data of a moving wind field. For the preference task, we extracted a single static frame from each video of map animation as in Figure 1.

The data for the stimuli was from the same sources that the earth software uses by default. We obtained the wind data for the vector field animations from the NOAA Global Forecast System and the coast line data from Natural Earth.

We selected the wind fields for the stimuli so that only one area of the animation would be easily identifiable for the correct answer. We acquired four wind fields for stable animation tasks and a separate sequence of fields for the changing animation task. With regard to our planned participants, we selected the most difficult regions to recognize to avoid the possibility that familiarity with the area would affect task performance. In addition, we rotated the stimuli for different tasks to prevent area recognition.

We built the experimental procedure using Tatool Web software [8]. We installed Tatool Web on a laptop for the laboratory condition and on an Internet server for the Internet condition. In the laboratory, an experimenter instructed and supervised the sessions. The experimenter remained in the room with the participants behind a room divider and gave only short answers to their questions after having given the first instructions. Participants used an external mouse. For the Internet participants, written instructions directed them to use only the external mouse and keyboard and not to use touch devices.

2.2 Procedure

The experimental session began with verbal instructions by the experimenter in the laboratory and by text over the Internet. The participants were first asked to respond to a background questionnaire with questions on gender, experience on wind fields, use of glasses, and personal vision disorders. The experiment consisted of four tasks:
Figure 1 Static frames of video stimuli that showed map animation. Four vector fields (over rows), each animated with three different values of an animation parameter, and one colored animation with medium parameter values (columns).
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- Animation task: each participant was to point to the area of highest strength of wind field on the animated map;
- Animation-background task: each participant was to point to the area of highest strength of wind field on the coast lines of the background map;
- Animation preference task: the participants were to select their preferred animation from the ones that were shown during the experiment (excluding colored animations); and
- Changing animation task: the participants were to point to the area of highest strength throughout the duration of the changing wind field animation.

The tasks were to be sequenced as follows:

1. Training of the animation task or animation-background task (3 stimuli);
2. Animation task or animation-background task (4 vector fields x 4 styles = 16 stimuli)
   - controlled random order: no same vector field twice in a row
   - differently mirrored stimuli of the 4 styles;
3. Steps 1 & 2 with the task that was not yet done; and
4. Changing animation task (1 stimulus)

The programming of the procedure randomized the order of the two search tasks evenly. Separate text instructions were given for each training and task set, highlighting differences from the other tasks and reminding participants to concentrate on the current task.

2.3 Participants

A total of 73 people participated in the experiment: 32 in the laboratory and 41 over the Internet. Laboratory participants were employees of the National Land Survey of Finland. We recruited Internet participants from email lists of visualization, cartographic, and geoinformatic research and development groups and associations. We consider participants reliable and skilled for performing this kind of digital experiment.

3 Results

3.1 Stable animations

3.1.1 Reaction times

Statistically significant differences in reaction times between the laboratory and over the Internet occurred for all four vector field stimuli in both animation and animation-background tasks ($p < 0.01$). Answers were 0.5–3.5 seconds faster over the Internet as shown in Figure 2.

3.1.2 Accuracy of answers

Statistically significant differences in accuracy of answers between laboratory and over the Internet were found in two of eight cases, with opposite effects:

- Vector field #3, animation task: all answers were correct only in the laboratory; and
- Vector field #4, animation-background task: there were 9 pp more correct answers over the Internet.
3.2 Changing animation

For changing animation, the median reaction times were 22.8 seconds shorter over the Internet than in the laboratory, which was clearly statistically significant ($p < 0.01$). Although contrary to instructions, 43.9% of Internet participants answered before seeing the end of the animation. In the laboratory, 21.9% answered before the end of the animation. Over the Internet, 9.8% of the participants watched the full animation two or more times, whereas in the laboratory, 34.4% did.

No differences were observed in the accuracy of answers between the Internet and laboratory conditions.

3.3 Animation preference

The preferred animation type was the one with long lifetime of animated streamlets; it was selected by 36.6% of the Internet and 40.6% of the laboratory participants. Also popular was the animation with wide streamlets: 22.0% over the Internet and 25.0% in the laboratory, as well as the medium-strength values of the animation parameters: 14.6% over the Internet and 25.0% in the laboratory. The most popular animation types are shown in Figure 3. Colored animations were not selectable. Participants selected their preferred animation 26.4 s faster over the Internet (median reaction time 15.8 s) than in the laboratory (42.2 s).

Interestingly, animations of Vector field #3 that had visible borders between intensity levels and that thus provided strongest visual cues for the tasks, were marginally preferred by the participants: over the Internet, only 12.2% of the participants selected these and in the laboratory, no one selected them.
Discussion and Conclusions

According to the results, both differences and similarities were observed in the different experimental platforms used in this study. For stable animations, differences occurred regularly in reaction times that were 0.5–3.5 seconds faster in median over the Internet than in the laboratory, which are remarkable time intervals in relation to the total median reaction times of 2.5–8.8 seconds. For the changing animation, difference was larger and many participants missed to watch the animation as long as required by the instructions. Selection of animation preference was also made much faster over the Internet. However, the accuracy of answers in the pointing tasks as well as preference of animation type differed only marginally between the experimental platforms.

Faster responses from the Internet can be explained by the more relaxed unsupervised environment versus the supervised and controlled laboratory environment. Although the laboratory environment was made as comfortable as possible by the experimenter and he was behind a room divider, participants may have felt the situation more demanding than over the Internet while being alone, using their familiar device, and staying in their preferred physical environment. The more relaxed environment over the Internet may have led to a more focused state of mind while performing the experiment, and thus produced faster responses. For the changing animation task, however, the Internet environment seems to have led to higher amount of ignorance of the instructions than the laboratory environment, which also suggests lower level of self-control over the Internet.

The results support a conclusion that the quality of answers in this kind of a geovisual experiment, that is, in accuracy of pointing tasks and a preference task, remain similar in both environments. Two statistically significant differences did were observed in the accuracy of answers but they were opposite: in one case, accuracy was higher in the laboratory, and in another, over the Internet. We are short of obvious explanations for these differences. More importantly, no differences were found between the correctness of answers in six cases of stable animations, nor in the changing animation task. That seems to be the prevalent state of the study, leading to a conclusion that accuracy of answers is reliable not only in laboratory but also over the Internet.

Animation preferences in the laboratory and over the Internet were similar for the three most preferred animations, with only slight differences in their percentages of popularity among participants.

To summarize, this study of geovisual search tasks found that supervised laboratory and unsupervised Internet conditions qualify similarly when looking at the quality of answers.
This accords with the results of previous studies in other disciplines \cite{2, 6, 1}. With regard to the response speed, answers over the Internet were clearly faster in all tasks of the study, possibly explained by more relaxed and focused participant performance. The study supports the conduct of geovisualization experiments over the Internet also in the future, although it also demands for additional comparisons between experimental results from the laboratory and the Internet. Particularly, effects of graphical reproduction, such as display size, resolution, and color resemblance, would be of interest for future research.

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