Towards Usable User Studies

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ABSTRACT
This paper presents a personal view on what we need to know to derive more usable knowledge from applying user research techniques when studying interactive maps and map use.

Author Keywords
Interactive cartography; map use; usability; user studies

INTERACTIVE CARTOGRAPHY & USER RESEARCH

In thinking about the "big question" in interactive cartography on which this position paper is focused ("*What is the usability of user research techniques and methods (longstanding and emerging) in the context of cartographic user research questions?"*), it occurs to me that it is important to first think about what constitutes interactive cartography. The cartography part is, perhaps, relatively clear. It involves maps, and perhaps other associated or linked information graphics. But what do we mean by interactive? The word implies that there is some capacity of the user to manipulate the map and effect a change in the display. But there is a wide range of kinds of manipulations that this could involve.

For example, if a user is using Google Maps to find directions between two locations, s/he can specify that s/he wants to avoid particular types of roads (highways, toll roads), or travel with a specific mode of transportation. S/he could also drag the proposed route to find out the details of an alternate route, in terms of whether it might take more time. These are all well-defined tasks for which it might be (relatively) easy to compare multiple modes of interacting with the map, or multiple ways of representing the result of this spatial query. Because way-finding is such a common task, there may be less variability in how map users use a product like Google Maps to find, examine and compare different route alternatives, when compare with other map use tasks cartographers might design for.

Equally, interactive cartography could imply the use of a map-centred system to explore aggregate patterns of movement through a city or potential drivers of increased crime rates in one part of a city compared with another. The types of tasks, and indeed the map user's thinking about these problems is much more likely to involve a larger range of types of maps, map interaction types, and tasks the map user wants to carry out with the system when compared with way-finding using Google Maps.

A comparison of these two extremes of types of interactive maps is illuminating. One product, Google Maps, is used by millions of people every day – testament to its high level of usefulness and usability for achieving the user's goals. The other type of interactive map, on the other hand, while many such systems have been designed, few, if any are in broad use, even considering the smaller population of potential users for such systems. Indeed, a number of authors have flagged the problem of low take-up of visualization systems among users [1, 2]. Several barriers to take-up have been proposed (overwhelming the user with the complexity of the system, inadequate capacity of the user to structure the decision problem, inability of the system to integrate with other work tasks, among others). While a survey of cartography journals will find many proposals for new visualization and representation methods, a large proportion of thematic maps that are made on the planet remain simple choropleth maps. Relatively few new visualization methods are studied among users to find out whether and how they work, and this remains true if one looks at the broader information visualization literature.

So, a key question remains: why is this take-up (on average) so low? This problem persists despite the increasing use of user-centred design methods that have been proposed and are employed by some visualization research groups (e.g., [3,4]). Moreover, we might stop to ask ourselves why some interactive maps are spectacularly successful and widely used while others, like the grey literature of government reports on bookshelves (or today, hard drives), languish on the computers of academics researchers. And furthermore, what is the benefit that an interactive map provides? Is it the map that results after the map interaction, or is it a mental benefit whereby the process of interaction (i.e., structuring the exploration or decision-making problem) is more important in informing the map-user's thinking than the resulting map? The answers to these questions, and the methods by which we might answer them may be very different for different maps. Hence, the usability of different user research methods for different map use contexts may vary greatly for different maps and map-based visualization systems.

TOWARDS USABLE USER STUDY RESULTS

While I cannot provide answers to all of the questions I posed in the previous section, I think there are some key

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questions that the community could work towards answering that would move us in the direction of being able to answer the question of what makes interactive maps both useful and usable.

- Is the representation useful? Does it help users to discover something new or needed from the map? In other words, is the representation effective, and how might we measure effectiveness for different map use context, users and tasks? Currently we are fairly good at this for well-defined tasks, and not so great at this for ill-defined tasks. This is a problem that Slocum et al [5] identified in 2001, but that I don't think is solved.
- *How* does the representation accomplish this? Understanding the *how* question may lead to generalizable design principles for interactive maps, which can then be applied to new map use and map user contexts.
- Can we separate the interface from the map? Is the interface usable? Can users effectively and efficiently achieve the manipulations they want to effect within the map? This form of effectiveness is distinct from that proposed for the representation itself. Cartwright et al [6] suggest that a user-centred design / usability engineering approach should be particularly fruitful for interface design questions. Typically evaluations do not distinguish between the map and the interface, although a few studies have done so [7-9].
- Do users get any pleasure or satisfaction from using the interface and representation? What is the role of aesthetic responses and interface design in providing users with a pleasurable or satisfying experience?
- What is the role of interactivity in accomplishing the map use task? To alter a visual characteristic of the display? To present different decision-making alternatives? To structure the exploration problem?

Answering these questions will require, as Slocum et al [5] noted, both theory-driven experiments and usability studies. The supposition is that better evidence from theory-driven experiments will reduce the need for usability studies, as more usable interactive maps will be produced from the get-go. However, user studies of all flavours take time, and generally, carefully controlled user studies are more time-consuming to conduct than formative usability studies. Moreover, every user study method has limitations. Using multiple methods typically provides more insight, providing different windows into map use and users, but it then takes more time to analyse and interpret the resulting data. Hence, a final key challenge is in deciding how much and what type of evaluation method(s) is needed to answer each of these questions for a given interactive map. As a community, where should we direct our limited resources? What are the 'cheapest' methods for answering a given question? Ultimately, finding answers to these questions will lead to more map users enjoying the benefits that interactive maps can provide.

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