Geography and HCI

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ABSTRACT
In this contribution, the linkage between the fields of HCI and geography is outlined and explored mostly from a geographer's perspective. In particular, the linkage between the areas of geographical information science and cartography on the one hand and HCI and usability engineering on the other shows that, while some attention is being paid to insights from both sides, there is a disciplinary gap that makes more integrated interactions challenging. In the places where there are sustained interactions, benefits occur to both sides. The paper ends with identification of some of the contributions that each side can make to the field of Geographical HCI (GeoHCI).

Author Keywords
Geography, Geographic Information Science, GIS, Cartography, Human-Computer Interaction, Usability Engineering.

ACM Classification Keywords
H.1.2 Human factors
H.2.8 Spatial databases and GIS
H.5.m. Information interfaces and presentation (e.g. HCI): Miscellaneous.

General Terms
Human Factors; Design; Measurement.

GEOGRAPHY AND COMPUTERS

The very early use of digital computers, as part of code breaking efforts during World War II, was to identify geographical information – information about the movement of military forces or the location of submarines. Yet the use of computers was not to manipulate or handle geographical information but to deal with deciphering codes into meaningful messages. As computers started to emerge as powerful general purpose machines, the field of geography started to pay attention to them. Geography, with its interest in the detail of places, population and patterns, was attracted to the promise of manipulating ever-larger datasets that came from censuses of populations, automatic instruments and growing sets of observations. By the early 1960s, geographers promoted the use of computers for geographical studies. Torsten Hägerstrand, [3] a famous Swedish geographer and one of the proponents of quantitative geography, captured the spirit of the period in his 'The Computer and the Geographer' (1967), in which he concluded that '… we have to develop sophisticated and efficient geographical techniques which fully match the new standards of observation and computation.' (p.19). Since then, geographers have been developing geographical information systems (GIS) and, by the early 1990s, had defined a new sub-discipline dedicated to geographical information manipulation – geographical information science (GIScience) [2].

Yet, the main focus remained on performing geographical analysis with computers, not the way that people interact with them or their outputs. One of the pioneers of computer use in geography Ian McHarg reflected that the quality of output from early GIS was: 'Absolutely terrible. … there wasn't a left-handed … technician who couldn't do better than the best computer.' [1]. In 1995, the same year in which McHarg reflected on early attempts, the first CHI paper to address GIS asked 'Why Are Geographic Information Systems Hard to Use?' [12] and Traynor and Williams identify these systems as complex and confusing. Not only were GIS hard to use, GIScience experts were also fighting for their place within the discipline. As a response to the 'quantitative revolution' of the 1960s, together with other disciplines in social science, geography went through a 'cultural turn' during the 1980s. This period is marked by a more humanistic and philosophical approach to the study of human geography, combined with a critique of positivist approaches. One of the results of these changes was a reduction of interest in maps and, in some quarters, disdain of GIS and related technologies due to their origins as military technologies and their use for assertion of power and control.

HCI IN GISCIENCE

HCI research in GIS can be traced back to 1963, when researchers of 'Man-Machine Interaction' at MIT were utilising the display of the latest generation of computers to manipulate oceanic geographical information [9].

While the full history of HCI research within GIScience is covered elsewhere [5], it is worth noting that interest rose significantly during the late 1980s, when cognitive aspects of HCI for GIS were discussed at workshops of larger conferences or as sections of books on GIS. The 1990s, however, saw a strong international research interest, with four workshops in the US and Europe explicitly focusing on

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HCI aspects in GIS, as well as two books [7, 8], and the Conference on Spatial Information Theory (COSIT) series which continue to this day. Since then, HCI has continued to be central to GIScience [6].

HCI research in GIScience covers many research areas ranging from interface design to cognitive aspects of geographical information representation. Naturally, many of these areas have parallels in the wider HCI literature. Thus, the development of Collaborative GIS work is related to Computer Supported Collaborative Work (CSCW), and Geovisualisation is linked to information visualisation and visual analytics. In some of these areas – most notably geovisualisation – the influence is not unidirectional and innovations in GIScience have influenced HCI.

Even so, GIS and the use of geographical information remained, until after the turn of the millennium, the preserve of expert users who used it for specific applications with emphasis on functionality and not on user-centred design. Any review of GIS packages or even public mapping websites revealed a plethora of usability problems. Thus, while mapping websites have been in existence since 1994 [10], Skarlatidou and Haklay's [11] study in 2005 was one of the first published academic studies to compare these sites in terms of their performance with users who are GIS novices.

MOBILITY AND GEOGRAPHY

Following the emergence of Web 2.0 around 2005, the situation changed dramatically, heralding an era of Web Mapping 2.0 [4]. A combination of factors came together to allow for a new generation of much more usable geographic applications. The changes in the availability of Global Navigation Satellite Systems (GNSS) coverage and the reduction in the cost of devices that are location enabled; the development of technologies for the delivery of graphical information over the web and the ability to deliver maps that support direct manipulation; the proliferation of smartphones and, finally, the growth of social networking applications all contribute to the possibility of creating novel geographical applications. The marked increase in interest in maps and geographical information can be seen in the interest of leading technology companies (e.g. Google, Apple or Nokia), as well as the proliferation and success of applications that combine the abilities that are noted above (e.g. Waze, OpenStreetMap or FourSquare). This transition also influences geography itself, with a marked interest in these new applications [4]. Whilst the critique of naïve understanding of the power of maps is now directed towards technology companies, geography itself is going through a revival of interest in maps and geographical technologies.

INTERDISCIPLINARY INSIGHTS FOR GEOHCI

The new wave of geographical technologies renews the interest within HCI in geographical applications, and the impact of usability engineering methods can be noticed in the applications that are being developed and used. There is even a noticeable influence on traditional GIS vendors, who, through osmosis from the wider technology community, are integrating features and interactions that emerge from usability and HCI studies. In GIScience and cartography, there is also a new interest in the importance of usable geographical technologies. Interaction between geographers and HCI experts can bring new and important insights. For example, the series of workshops dedicated to the usability of geographical information explores aspects of geographical information itself – as opposed to the applications that use it. These workshops and other encounters demonstrate the importance of interactions between geography, cartography and HCI. In what follows, several examples of contributions are discussed.

Geography brings to these discussions the multitude ways of understanding space and place, especially with the wide-ranging theories that emerged from the 'cultural turn'. These complex understandings of places should be used as an antidote to the reductionist (and unfortunately common in computer science) concept of a place as a pair of coordinates or the footprint of geotagged images. More closely to the empirical worldview are the insights from spatial analysis with its universal methods, such as spatial statistical methods to identify patterns and assess the clustering of observations. Another insight can come from the understanding of geographical and spatial scales. The same word is used to describe a computed scale of a map or the conceptual geographical understanding of a research participant, and hold varied meaning within the discipline.

Cartography, has much to contribute through the accumulated knowledge on mapping and the creation of geographical representations for different media – not all of them in the form of maps. Understanding of generalisation – the process of reducing visual clutter of a map – is an area in which cartographers excel, and the interaction between cartographers and computer experts already shown to be fruitful, as OpenStreetMap demonstrate. In addition, cartographers understand the appropriate representation of thematic information, and in many web and mobile applications it is all too easy to notice cartographical mistakes that can lead to wrong inferences which can be rectified by using cartographic knowledge.

Finally, over the past two decades, geographers and cartographers have studied methods that are widely used in HCI and usability engineering, and then tested them with geographical information technologies. Questions about the uniqueness of geographical information, and the ability to find parallels and insights from other specialised systems are highly valuable for those who are mostly interested in maps and geographical information.

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