Geography and HCI

Mordechai (Muki) Haklay
UCL
Gower Street
m.haklay@ucl.ac.uk
+44 7679 2745

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. However, as computers started to emerge as powerful general purpose number-crunching 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. Thus, by the early 1960s, geographers promoted the use of computers for quantitative 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 keynote talk 'The Computer and the Geographer' from 1967, in which he concluded by stating that '[t]he fast developing data-processing technology can undoubtedly offer great potential aid to the geographer. In my opinion, we have to prepare ourselves for this… 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 the understanding of geographical information manipulation – geographical information science (GIScience) [2].

Yet, as the Hägerstrand citation demonstrates, the main focus remained on performing geographical analysis with computers, not the way that people interact with them or even the outputs that are produced by them. One of the pioneers of computer use in geography Ian McHarg reflected, in unsavoury language, that the quality of output from early GIS was: 'Absolutely terrible. I mean there wasn't a left-handed … technician who couldn't do better than the best computer.' [1]. The point was, after all, to prove that it was possible to carry out analysis with these machines. Interestingly, 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, indeed, Traynor and Williams were correct to identify these systems and their use 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 representation 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 capabilities of the latest generation of

CHI 2013 Workshop GeoHCI, April 27–28, 2013, Paris, France.

computers to manipulate oceanic geographical information [9]. Since then, HCI has played a role within the GIScience research agenda.

While it is beyond the scope of this paper to cover the full history of HCI research within GIScience (see [5] for detailed coverage), 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 where the primary focus was not on human factors. The 1990s, however, saw a strong international research interest, with four workshops that were held between 1990 and 1994 in the US and Europe explicitly focusing on HCI aspects in GIS, as well as at least two books [7, 8] on the topic. Since then, HCI has continued to be central to GIScience, appearing in a prominent position within conferences and, today, it is an integral part of the discipline [6].

HCI research in GIScience covers many research areas ranging from interface design to cognitive aspects of geographical information representation. Naturally, many of these research areas have parallels in the wider HCI literature. Thus, the development of Collaborative GIS work is linked to research in Computer Supported Collaborative Work (CSCW), and Geovisualisation is linked to general information visualisation and visual analytics. In some of these areas – most notably geovisualisation – the influence is not unidirectional from HCI to GIScience and innovations in GIScience have influenced researchers in 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 ease of use or on user-centred design. Any review of GIS packages, web-based GIS 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 in which the different websites were compared 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 new 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 increased popularity of social networking applications all contribute to the possibility of creating geographical applications and to their appeal.

The marked increase in interest in maps and geographical information can be seen in the interest of leading technology companies in mapping and geographical information (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 the utilisation of these new applications, which used the neologism 'neogeography' to differentiate themselves from GIScience [4]. Whilst the critique of naïve understanding of the power of maps, which in the past was aimed at the geographers and cartographers who promote computerised 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 and understandable geographical technologies. For example, in 2005 the International Cartographic Association (ICA) established a special interest group (commission) that is dedicated to use and user issues, and, within GIScience journals, there are papers reporting on usability studies.

Interaction between geographers and HCI experts can bring new and important insights. For example, under the auspices of the UK national mapping agency, the Ordnance Survey, a series of workshops dedicated to the usability of geographical information has been running since 2009 (see http://bit.ly/Pw4OGU). In these workshops, aspects of geographical information itself – as opposed to the applications that rely on it – are explored and discussed.

These workshops, the ICA events 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' mentioned above. These complex understandings of places can be used as an antidote to the reductionist (and unfortunately common in computer science) concept of a

place as a pair of coordinates, or as something that can be picked easily from a footprint of geotagged images.

Maybe more closely to the empirical worldview of many computing applications are the insights from spatial analysis experts who are developing universal methods that can be used across application domains, such as spatial statistical methods to identify patterns and assess the clustering of observations.

Another insight from geography can come from the understanding of geographical and spatial scales. While the same word is used to describe a computed scale of a map or the conceptual geographical understanding of a research participant, it has varied meaning within the discipline. Insight into the way different people, groups and processes work can be gained from engaging with these discussions.

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 the maps of OpenStreetMap demonstrate.

In addition, cartographers have developed a detailed understanding of 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 and understanding which can be rectified by using cartographic knowledge.

Finally, HCI knowledge and practices in studying interactions are important in understanding how technologies are being used. 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 such as exploratory data analysis applications, are highly valuable for those who are mostly interested in maps and geographical information.

CONCLUSION

The overview of this position paper demonstrates that, while interaction between HCI and geographical information technologies can be traced back 50 years, because of a plethora of technical, organisational and social reasons, we are only at the beginning of an era in which geographical information technologies are highly popular. The rapid growth in interest and use of geographical technologies has happened within the past seven years and, therefore, the interest in geographical aspects of HCI is timely and necessary. However, disciplinary knowledge is critical to developing this area successfully and benefiting from the accumulated knowledge that geographers, cartographers and HCI experts have developed over the years.

REFERENCES

1. GIS World. GIS World Interview – Ian McHarg Reflects on the Past, Present and Future of GIS. In *GIS World*, 8 (1995), 46-49.
2. Goodchild, M. F. Geographical Information Science. *International Journal of Geographical Information Systems* 6 (1992), 31-45.
3. Hägerstrand T. The Computer and the Geographer. In *Transactions of the Institute of British Geographers*, 42 (1967), 1-19.
4. Haklay, M., Singleton, A. and Parker, C. Web mapping 2.0: the Neogeography of the Geoweb, *Geography Compass*, 2, 6, 2008, 2011-2039.
5. Haklay, M. *Interacting with Geospatial Technologies*. Wiley, Chichester, UK, 2010.
6. Mark, D. M. Geographic Information Science: Defining the Field. In M. Duckham, M.F. Goodchild, and M.F. Worboys Eds. *Foundations of Geographic Information Science.* Taylor and Francis, London, 2003, 3-18.
7. Medyckyj-Scott, D. and Hearnshaw, H. M., Eds. *Human Factors in Geographical Information Systems*. Bellhaven Press. 1993.
8. Nyerges, T.L., Mark, D.M., Laurini, R. and Egenhofer, M.J., Eds. *Cognitive Aspects of Human-Computer Interaction for Geographic Information Systems*. Kluwer Academic Publishers. 1995.
9. Pivar, M., Fredkin, E. and Stommel, H. Computer-compiled oceano-graphic atlas: an experiment in man-machine interaction. *Proceeding of the National Academy of Sciences of the United States of America* 50, 2, 1963, 396-398.
10. Putz, S. Interactive information services using World-Wide Web hypertext. In *Selected Papers of the First Conference on World-Wide Web* (Geneva, Switzerland). Elsevier Science Publishers, 1994, 273-280.
11. Skarlatidou, A. and Haklay, M. Public Web Mapping: Preliminary Usability Evaluation. In *Proceedings of 14th Annual GIS Research UK Conference (GISRUK),* 2006.
12. Traynor, C. and Williams, M.G. Why Are Geographic Information Systems Hard to Use? In Katz, I., Mack, R. and Marks, L., (Eds) *Conference Companion on Human Factors in Computing Systems – CHI '95*, Denver, Colorado, ACM Press, USA, 1995, 288-28.