University of Alberta

Crowdsourcing Edmonton's Ribbon of Green: A Case Study of Neogeography in Edmonton's River Valley

by

Matthew Edwin Dance

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Arts

Department of Earth and Atmospheric Sciences

Abstract

Public Participation Geographic Information Systems (PPGIS) has defined a process to support public expression of place-based knowledge. The central weakness of this approach stems from a lack of collaboration support for groups of citizens. Recent GeoWeb advances are challenging PPGIS in this regard. This research utilized a case study method centered on Edmonton's river valley. Data was collected via 17 semi-structured interviews centered on users' local knowledge, and their communication practices using mobile- and web-based GeoWeb technologies. Interview transcripts were analyzed thematically. In addition, a cluster analysis was conducted on 79 GeoWeb applications to assess their utility for citizen collaboration. It was found that the study cohort exhibits a nuanced understanding of place that cannot be fully captured by GeoWeb technologies. The cluster analysis corroborates this result - indicating that, in broad terms, the GeoWeb does not support collaboration, citizen-based power structures, or a variety of data types and sources.

Acknowledgements

It is a great pleasure to thank the many people who made this thesis possible, and I cannot over estimate the gratitude that I feel towards my team of supervisors, Drs. Arie Croitoru, Ofer Arazy and Damian Collins.

Drs. Croitoru and Arazy jointly agreed to take me on as a student, and offered every opportunity to learn from their vast and varied experience. Dr. Croitoru offered detailed GIS conversations in information systems, data mining, software development, and coffee. Dr. Arazy provided insight into information systems, on-line collaboration and the importance of building a grass roots network when developing a user centered software application.

Dr. Collins was frequently consulted in the early days of my research process with questions related to the research methodology. He assumed a greater role as an advisor in the last stages on my research by providing detailed edits (many edits) and discussion for each chapter of my thesis. Thank you.

I was also fortunate to be invited to write an essay for UCL researcher Fabian Neuhaus' (2011) Studies in Temporal Urbanism, which eventually formed the core of my literature review. In addition, as a geographer I had always dreamed to presenting at the Association of American Geographers conference.

That dream was realized in April 2010, and provided an opportunity to receive feedback from many researchers on the GeoWeb cluster analysis section of this thesis.

I am also indebted to my family. My parents, Rina and Ed Dance, and my in-laws, Rayna and Harvey Rabin, were always available with encouragement and support. My wife, Erica Rabin Dance has exhibited great patience and understanding. She and our children, Joseph and Mara, provided encouragement, support, and everything else.

Thank you.

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Chapter 1

Introduction

1.1 The Issue

It's Sunday morning and Edmonton's river valley trails are busy with runners. Each runner is equipped with the usual gear; running shoes, a hat, water bottle, etc. Many runners also sport a Global Positioning System (GPS) watch that assists them in keeping track of their training; it collects pertinent data such as running pace, heart rate, distance, and speed. While not common to every runner, GPS watches represent an evolving standard in personal data collection. But they are not the only location aware device: many modern smart phones are also able to detect their location via GPS, and by other means such as Wi-Fi and through internal sensors.

Edmonton's river valley may be central to a runners' experience of the city, and emerging location-based technology can play a role in how these runners understand and communicate their experiences of the river valley. Novel Internet and mobile based applications that combine web-based user interfaces with a location aware mobile component provide the basic infrastructure needed to gather detailed information about the locations visited. Once these data are gathered, it is a simple step to communicate that information to a larger social network found through web-sites that cater to runners (such as Garmin Connect) or even Facebook.

Castells (2004) describes a networked society as a social structure comprised of networks powered by micro-electronic based information and communication technologies. The GPS technology employed by many runners who use Edmonton's river valley trail networks exist within this structure and are used to describe their experience of this place. Furthermore, the technology can also influence the experience of place by, for instance, directing how and when a runner might go for a run. Yet, emerging technologies have not been looked at through a place-based lens. Devine-Wright and Lyons (1997) define place as being comprised of its physical characteristics, the activities that occur there, and the meanings derived through interactions between users, their activities, and those characteristics.

In addition, as more users define their understanding of place through these emerging technologies, and as these technologies structure the experience of place, it is possible to evaluate their role as members of the 'public' and as 'participants' within the context of spatial decision support systems (SDSS) (Simao et al., 2009), and public participation GIS (PPGIS) (Schlossberg and Shuford, 2005). As the notions of public and participation shift due to evolving technologies, motivations and privacy concerns associated with communicating location data to a network are also evolving.

In the past, motivation was the domain of sociology and was focussed on the motives of real-world volunteers (Clary et al., 1998). Current motivational models (e.g., Schroer and Hertel, 2009) evolved to glean understanding as to why people participate in Internet-based networks such as Wikipedia or open source software (OSS) development. This research extends this current understanding of motivation to the GeoWeb. Concern for privacy is a foil to a person's motivation; this research will also draw on the depth of understanding related to data and location privacy (Duckham et al., 2005) to explore how privacy concerns might limit the communication of location sensitive data to a social network.

While the literature provides a strong theoretical foundation for understanding place, and the role of the public in participating in place-based process such as SDSS and PPGIS, the following questions will seek to extend current understandings to emerging technologies in the Edmonton context. Specifically, (1) how do people understand location; (2) how do they communicate that understanding via emerging location-based tools; (3) why would they do this; (4) what are their privacy concerns; and finally (5) what is the larger context for this activity? These questions are formulated more formally in Section 1.2.

1.2 Research Questions and Objectives

This is a broad study located in Edmonton's river valley that is primarily concerned with how and why people communicate their understanding of location using emerging technology within a context of collaboration. Secondarily, it considers how the GeoWeb platform manages interactions around place. The relevant literature has suggested that there is a deep and historic understanding of place that is predicated on an intimate knowledge of location (Lynch, 1960).

The evolution of technology has created a shift in how public participation can be understood within the context of location. The literature related to location-based collaboration platforms, such as PPGIS (Sieber, 2006), suggests that there are research gaps (see Section 1.3) related to the emergence of novel locative technologies. Exploring the relationship between local knowledge production and the sharing of that knowledge via GeoWeb based tools might address these research gaps. To that end, the following questions, related to a population of regular users of Edmonton's river valley, were crafted to form the basis for this study:

RQ1a. How is knowledge of place and space expressed, and to what extent is a personal understanding of the local environment relevant to PPGIS?

RQ1b. Is a sense of place and space shared between people? To what extent?

RQ2a. How do people contribute geographic information to the GeoWeb? How do people collaborate with peers and with authorities via the GeoWeb?

RQ2b. What are the enablers and inhibitors to participation?

RQ3. What is the utility of current GeoWeb applications, and how do they manage issues of power, collaboration, data fidelity, and spatial understanding?

1.3 Significance of this research

This research was designed to address the following gaps in understanding as highlighted below and in Chapter 2:

1. While many authors have identified the range of place-based knowledge that people may possess, little has been written about this in the context of the GeoWeb.

2. Little research has been conducted to identify how this knowledge may be distinct from the information that individuals actually contribute to the GeoWeb.

3. Much has been written about volunteer motivation within the context of Wikipedia and other on-line applications, but little attention has been paid to the GeoWeb and volunteer motivation to contribute to applications like Open Street Map.

4. Similarly, data and location privacy implications have been discussed within the broad context of mobile application deployment such as Google Latitude as it would run on a mobile device such as an iPhone. This discussion has not been linked to its tempering effect on motivation, and specific actions that users would like to see to safeguard their privacy.

5. Finally, there is a significant gap in understanding in the utility of GeoWeb applications.

The specific case for this research is the generation, communication and consumption of geographic information by a population who use Edmonton's river valley trail network. The end result of this research process will be an improved understanding of how members of the public contribute geographic information to a suite of emerging GeoWeb mobile- and Internet-based applications.

1.3.1 Research Motivation

The GeoWeb, in conjunction with open data initiatives (where municipalities openly share key data sets with the citizenry) and emerging location-based technology, has the potential to fundamentally change how citizens interact with their physical environments and municipal governments. The issue of public participation can potentially be transformed from the current practice of a closed process conducted at a specific time and place, to include dynamic web-based process where citizens contribute a variety of media and spatial data to an Internet platform. Meaningful conversations shift from a physical space to include a virtual space where citizens are encouraged to map collectively the future of their cities.

This outcome is clearly a long way off, but there are some glimmers of potential with emerging technologies and innovative uses of those technologies. As such, this research is motivated by an interest in new ways of engaging with citizens through the GeoWeb and associated technologies.

1.3.2 Research Setting

Edmonton, Alberta, Canada is the capital of Alberta, and is located on the banks of the North Saskatchewan River (see Figure 1.1). Edmonton has an an estimated population of 1.1 million in its metropolitan census area (Statistics Canada, 2008), making it Canada's sixth largest urban area. Central to many residents' experience of Edmonton is the expansive green space adjacent to the North Saskatchewan River. This ribbon of green, the largest continuous urban green space in North America (City of Edmonton, 2011a), winds its way through the heart of Edmonton and hosts more than 160 kilometers of maintained multi-use trails, an estimated 450 kilometers of unimproved trails (City of Edmonton, 2011b), and is visited by approximately 10 million people per year (Ian Holster, personal communication, May 2009). While there are numerous parks and other green spaces encompassed within the river valley, such as golf courses and even two ski hills, particular attention is paid to five park areas in this research: Hawrelak Park, Kinsmen Park, Terwillager Park, Mill Creek Ravine and Gold Bar Park. These parks are located on a thematic map of Edmonton's river valley, Figure 1.1.

1.4 Structure of the thesis

The remainder of this thesis is structured as follows: Chapter 2 will review the pertinent literature, highlighting the themes of public participation within the context of emerging locative technologies and the GeoWeb. Central to this discussion will be notions of power, motivation and privacy relative to a user's contribution of personal data to GeoWeb platforms. Chapter 3 will outline the range of methods employed for this research. Specifically, the bulk of the data presented in this thesis was gathered via semi-structured interviews and through on-line primary sources. A cluster analysis of GeoWeb applications was also undertaken. Results are presented in Chapter 4, and take the form of quotes from interview transcripts accompanied by supporting numerical data such as the number of thematic mentions per physical location. The

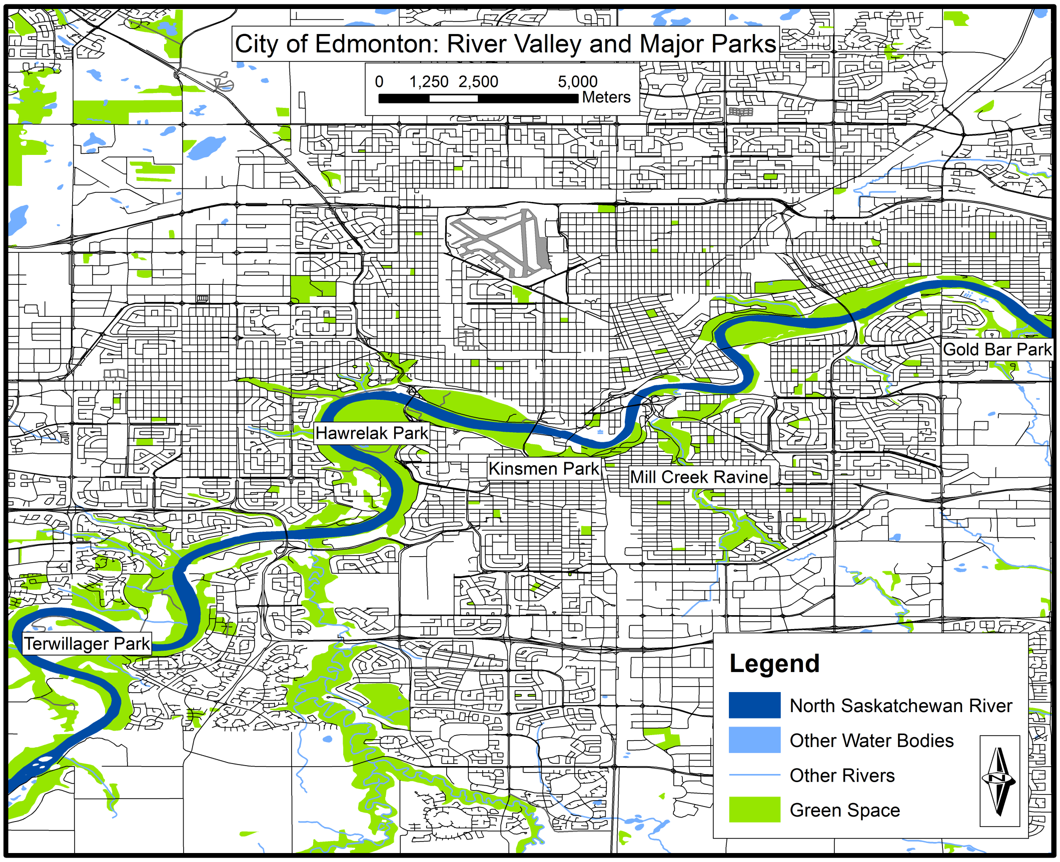


Figure 1.1: City of Edmonton: The river valley and major parks

cluster analysis is represented by a series of radar graphs. Finally, Chapter 5 will reflect on the findings, place them within the context of the literature and propose future research. Figure 1.2 provides a detailed thesis structure overview.

Research Questions	Chapter 1: Introduction	Chapter 2: Literature Review	Chapter 3: Research Methodology	Chapter 4: Results	Chapter 5: Discussion and Conclusion
RQ1a	Section 1.2	Section 2.2 Section 2.3	Section 3.2.3 Section 3.2.4 Section 3.3.2	Section 4.2	Section 5.2
RQ1b	Section 1.2	Section 2.3	Section 3.2.3 Section 3.2.4 Section 3.3.2	Section 4.3	Section 5.2
RQ2a	Section 1.2	Section 2.4 Section 2.5 Section 2.6 Section 2.7	Section 3.2.3 Section 3.2.4 Section 3.3.2	Section 4.3	Section 5.3
RQ2b	Section 1.2	Section 2.8	Section 3.2.3 Section 3.2.4 Section 3.3.2	Section 4.4	Section 5.4
RQ3	Section 1.2	Section 2.9	Section 3.4	Section 4.5	Section 5.5

Figure 1.2: Structure of the thesis

Chapter 2

Literature Review

2.1 Chapter Overview

The experiences of everyday living in a specific place inform how we think of- and what we know of- where we live. Everyday activities that people engage in, such as walking, running, driving and cycling create an awareness of a specific place and inform what we say about it.

This research pertains to (1) place based understanding; (2) communication of that understanding using emerging web-based technologies, and; (3) use of emerging technologies to collaborate on defining 'place' within social networks. The enablers and inhibitors of a person's participation in this process will also be explored, in addition to an assessment of the context of the Geographic World Wide Web.

This research is grounded in the literature explored in this chapter. Specifically, Section 2.2 provides an overview of place and space; Section 2.3 briefly reviews how place and space can be represented, in contrasting ways, through different cultural lenses via maps. Section 2.4 discusses the various iterations of spatial decision making that span the mainframe, personal computing and ubiquitous computing eras. A discussion of power in Section 2.5 highlights the tensions between an authority and a participant in a spatial decision process.

Sections 2.6 and 2.7 discuss the migration of place representation from desktop computers to the Internet via social computing and the Internet as a mapping platform. Section 2.8 provides an overview of the enablers and limiters that structure contributions to on-line forums via social computing. Finally, Section 2.9 places the above literature within the context of the GeoWeb and the utility that it may provide via the many applications that are available. This chapter concludes with Section 2.10 where the literature is briefly summarized.

2.2 Place and Space

The notion of 'place' is a common descriptor of the world, and is a central theme in the study of geography (Relph, 1976) and other social sciences such as sociology and psychology (Gieryn, 2000). These various disciplines characterize and describe place in a variety of ways (Harrison and Dourish, 1996); for the purpose of this study, place is defined as being comprised of three dimensions (after Relph, 1976):

1. Observable activities that occur in relation to the place
2. The meanings that are created by a person in that location, and;
3. The physical features that comprise the location's concrete or tangible attributes.

A place is comprised of its physical characteristics, the activities that occur there and the meanings derived thereof (Devine-Wright and Lyons, 1997).

Element	Definition
1. Paths	The streets, sidewalks, trails and other channels in which people travel.
2. Edges	Perceived boundaries between, for instance, districts such as walls, buildings or rivers.
3. Districts	Large sections of a city with a distinguishing character or identity.
4. Nodes	Foci that can be entered such as junctions or concentrations of interest points.
5. Landmarks	Identifiable objects which can serve as external reference points.

Table 2.1: Lynch's elements of place (1960).

The more familiar a person is with a place, through experience (for instance, through recreational or sporting activities), the greater the meaning that place is likely to have (Lynch et al., 1995).

Maps are a common metaphor used to describe place (Zook and Graham, 2007) where simple points on the map represent a much more complex reality. Lynch (1960) views place as a series of connected locations where individuals mentally organize their spatial environment in predictable ways around five elements (see table 2.1). Lynch's view of place implies that linkages exist between places based on a person's experience with those locations, creating a tapestry of meaning imposed upon an urban landscape. Similarly, Tuan (1977) differentiates place from space based on the familiarity a person might have of the former; as a space becomes more familiar, more intimately known, it is transformed into a place. 'If space is movement, then place is pause' (Tuan 1977, p.6).

Maps are one tangible way of conceptualizing and representing place and space. Other, less tangible conceptions or representations of place and space include **everyday space** as the space in which people live and move; **environmental space**, from inside building spaces to city-wide space; and **geographic space**, which includes formally bounded areas such as a provinces, countries, and continents (Freundschuh and Egenhofer, 1997). These conceptualizations are useful to distinguish the variety of scales that place and space occupy, they also distinguish the personal scale of everyday space from larger scales not pertinent to this research. For instance, it is the everyday space that Devine-Wright and Clayton (2010) discuss as being important to a person's self identity.

Places are immensely personal and when they are also natural landscapes, they often offer qualities that are unique within urban settings, and ofter suited to individual need (such as opportunities for solitude and/or social interaction) (Collins and Kearns, 2007). It is also worth noting that one person's place can constitute another person's location or space. Maps, as a means of place and space based communication, offer an incomplete and often misleading characterization of both (Monmonier, 1996). Maps can be dishonest, and there is a vocabulary to describe this dishonesty:

1. **Inaccuracy** refers to either an error of commission or omission. Errors of commission occur when features are included in the map that should not be there, or that are misrepresented (for example, a school in the physical world for a church on the map). Errors of omission occur when relevant elements from the real world are not represented on the map. For instance, a building might exist on the site deemed empty by the

map. Imprecision occurs when there is a lack of specificity or detail in an observation. (Worboys and Duckham, 2004).

2. **Vagueness** describes a borderline case for a feature or concept (Bennett, 2001). For instance, there are many locations that are considered within Edmonton's river valley (Hawrelak Park and Terwillager Park for example) and many locations that are not (e.g. Paris, London). There are also many locations where it is not clear if they are part of Edmonton‘s river valley, such as the neighbourhood of Cloverdale, or the Legislative Grounds. Both of these areas sit on the edge of the river valley, and are connected to it, but it can also be argued that they are on the top of the banks and, as such, not within the it.

Modern maps, such as atlas and road maps, are mass-produced for a consumer market, and are the result of painstaking work done by experts in the fields of cartography, air photo interpretation, statistics, and other disciplines. One of the goals of a modern map is to communicate an objective representation of place that is accurate, useful and that conveys a sense of that place (Taylor and Caquard, 2006). For instance, a map of a city may convey a sense of place by rendering a collection of place names (buildings, roads, plazas, etc) overlaid on a road network, on top of topographic features.

While a map-reader may get a sense of that place, via those representations, the map does not convey the deeper understanding of place that comes from everyday experience, meanings and associations that a resident may possess. In fact, maps may distort a local knowledge by misrepresenting the meaning of place as reflected by, for instance, place names (Frank, 2000). In this instance, expert knowledge of map-making is not enough to produce maps that convey an accurate sense of place. The missing ingredient is the experience of a place that can only be gleaned by visiting, or perhaps by interacting with someone who has intimate knowledge of it.

One outcome of this central and authoritative communication of place, via consumer maps, is that citizens are relegated to the role of consumers to be consulted by experts (i.e. urban planners, academics) in their quest to understand what a place means to people (Steinmann et al., 2005). Tools such as cognitive mapping (Kitchen, 1994) and mental maps (Lynch, 1960) are traditionally utilized to mine these location data from individuals. Tversky (1993) defines cognitive mapping as the process of mentally acquiring, storing, recalling, and decoding metric information relative to location. Mental mapping is the non-metric capture of spatial relations among elements, allowing reorientation, spatial inference and perspective taking (Downs and Stea, 1977). The importance of these concepts is that they rely on an individual's non-expert or lay, understanding of space. Indeed, the academic notion of Naïve Geography (Egenhofer and Mark, 1995) is predicated on a 'common sense' understanding of geography, where the focus is largely on the non-expert.

The descriptions of place gleaned from the cognitive, mental or naïve are the result of an individual process of understanding. While there are shared map elements between people (e.g. most people will recognize a 'cross' as being the location of a church on a map), these shared elements do not represent a shared experience or the basis of a common understanding within a community. Within this context, there are a variety of ways that an individual or community can understand place, maps being one.

2.3 A Brief History of Mapping

Traveling on foot and without modern navigation aids in the Canadian Arctic, a seemingly featureless land- and seascape, requires a sophisticated knowledge of subtle qualities: coastline shape, stone cairns, snowdrifts, wind direction, currents, animal movements, dreams, and other clues (Macdonald, 1998) that are read by individuals and shared within a community. While the Inuit, one of the aboriginal peoples of Canada's Arctic, report of hardships and challenging circumstances that may even lead to death, the idea of getting lost, until recently, is without a basis in experience (Aporta and Higgs, 2005). In fact, it is said amongst traditional Inuit people that 'A good hunter is someone who cannot get lost...' (Chris Fletcher, personal communication, December 2011).

The maps of traditional Inuit, and indeed many nomadic and aboriginal cultures, including Aboriginal Indigenous Australians (Dourish and Bell, 2011), are held in the collective imagination of that community (Greider and Garkovich, 1994). These maps connect several layers of understanding through a knowledge of the landscape where the physical, social, mythical, and cultural (Bell and Dourish, 2007) impact an individual's and community's understanding of place. Pervasive in the consciousness of an Inuit community, and consistent with our understanding of place and space, the landscape presents a network of interconnected places and symbols that are each significant and commonly understood. Features and items, from the largest river to the smallest bush and rock, are organized in a tapestry of nuance and meaning that derives from a world view rooted in experience, myth and landscape (Ingold, 1993). To navigate is to 'read' the landscape in a way that connects culturally meaningful stories to a series of locations along the path of travel.

In contrast, a Western understanding of location, mapping, and navigation is objective where the observation of natural phenomena was largely divorced from a collective and shared myth. This objective, scientific perspective informed the western approach to location, mapping and navigation problems. These mapping and navigation problems can very broadly be broken down by century (adopted from Friendly, 2009):

- 16th C: Mapping as scientific measurements of the physical world that stressed expert knowledge and the application of that knowledge to well defined problems.
- 17th C: A new growth of theory and practice that reflected the problems of navigation and map-making that grew out of the 16th C. Tools such as analytical geometry and statistics were developed.
- 18th and 19th C: A growth of statistics in social, medical and economic areas of research where one outcome from the 17C birth of statistics relates directly to a rise in tools of visualization, including maps.
- 20th C: At the beginning of the century, great emphasis was given to numbers, and little attention was paid to data visualizations beyond graphical representations of data. The development of the early GIS in the mid-1960s, which was itself an outcome of computer based data processing, re-introduced the map as a reflection of data.

These centuries of western thought were influenced by scientific enquiry, where expert knowledge was a highly valued. As a result, the contrast between aboriginal and western modes of thought is apparent. The aboriginal perspective is one of shared experience including a communal understanding of navigation tools and techniques; it is a perspective of inclusion where everyone is involved in the map making process. Western cultures, on the other hand, stressed the importance of knowledge; as such, maps represented a privileged perspective, not a common understanding, where a map is made by an expert and consumed by non-experts. As such the disconnect between map makers and consumers resulted in a 'splintered' understanding of place and space (Graham and Marvin, 2001), where local, non-expert knowledge is not valued and thus excluded from the 'official' representation of place via maps.

The tension between a shared experience perspective and an authority driven view of map making is explored in the following sections. Specifically, the technologies used to support group decisions ('decision', in this context, will be expanded upon in the following Section 2.4) within a spatial context will be explored through the three eras of computing: (1) the mainframe era; (2) the personal computing era, and; (3) the ubiquitous computing era (Weiser, 1991).

2.4 (Spatial) Decision Making

'Decision making' in this instance refers to an process which strives to reach agreement on complex problems with a variety of stakeholders and their range of perspectives. Stakeholders can be limited to colleagues within a business environment, or can be broadly defined by, for instance, citizens, politicians and business owners working on municipal issues. The process, as traditionally defined by an authority, is mediated through a networked computing system (Power, 2002).

Computer aided decision making has evolved in lock-step with computing technology. To understand this parallel evolution, it is important to define the three eras of computing as (from Weiser, 1991): The **mainframe era** (from the 1950's to the 1970's) was characterized by many people connected to a single computer which required an expert level of knowledge to use. This, combined with cost, limited mainframe computers to large businesses and research facilities. The **personal computing era** (from the 1980's to the 2000's) was characterized by a shift to many people owning their own computer, and those individual computers being connected via a closed network. The costs of computing were reduced as were the knowledge requirements. Finally, **ubiquitous computing** (ongoing from the 2000's) represents a shift from desktop personal computers to (1) hand help computers such as smart phones, and; (2) computing being integrated into common everyday items from refrigerators to busses. Ubiquitous systems are connected wirelessly through the Internet and can provide data feeds via sensors (either handheld or embedded) that are spread through a built environment.

The following sections (2.4.1 and 2.4.2) will explore decision support systems (DSS) and spatial decision support systems (SDSS), respectively, in relation to these eras of computing. In addition, Sections 2.4.4 and 2.4.5 will address group decision support systems (GDSS) and their spatially enabled counterparts, public participation geographic information systems (PPGIS).

2.4.1 Decision Support Systems

Decision Support Systems (DSS) are computer based information systems that manage and mediate decision making process, and are rooted in the 1950s mainframe computer revolution (Power, 2002). DSS origins can be traced to two significant contributions: (1) conceptual studies of organizational decision making completed at the Carnegie Institute of Technology in the late 1950's and early 60's, and; (2) Massachusetts Institute of Technology's interactive computer systems work of the 1960's, which strove to connect people to a decision making process (Power, 2002). During the 1970's DSS emerged as a research interest in its own right and was a precursor to the group decision support systems of the 1980's (Power, 2002).

At its core, DSS strives to enable a two-way exchange of information between a decision maker and those who have a stake in the outcome of the decision (Barton et al., 2005). For instance, Fjermestad and Hiltz (2000-2001) describe an 'old style' Fortune 500 company's use of a DSS to facilitate a strategic planning process between different business units and the executive within the company. The goal of the process was to generate and rank ideas from all the employees. These ideas, and their ranking, was seen as a vital step in defining the future of the company as the process would engage a broad group of stakeholders by giving them a voice and the power to recommend a direction for the company.

The evolution of DSS from the 1950's is a complex web of technologies and their associated acronyms. Because this research is specifically interested in spatial decision support, this Section 2.4 will focus on spatial decision support systems (SDSS) as they developed from the conceptual combination of DSS with geographic information systems (GIS). In this instance, DSS act as a conceptual precursor and bridge to the implementation of decision consultations within a GIS. Technical advances, such as the widespread advent of networked computers and spatial data warehousing in the 1990's, enabled GIS to move from a single-user desk-top system, to a network that supported multiple users who might be consulted in decisions (Fjermestad and Hiltz, 2000-2001).

2.4.2 Spatial Decision Support Systems

Spatial Decision Support Systems (SDSS) emerged from a combination of technologies that developed in parallel: (1) DSS and (2) Geographic Information Systems (GIS). Geographic Information Systems (GIS) represents the spatial tool that, when combined with a DSS, enables the spatial analytics within a SDSS. GIS can be defined as an esoteric, expert driven system of hardware and software used for the storage, retrieval, visualization, and analysis of geographic (spatial) data (Sieber, 2006). Historically, access to GIS has been limited to experts with specialized training in the use of specific software applications in combination with hardware and data (Sieber, 2000). SDSS can be illustrated by Figure 2.1 where multiple users can access background information through a map centered user interface via a desktop system implemented at an open house. The users can iteratively generate alternative solutions to a defined problem. For instance, if the problem was related to the expansion of a Light Rail Transit System, users could experiment with drawing different LRT routes on the map through their neighbourhood, and propose the route that they most like. The background information could include other route proposals, including technical information provided by the municipality. The mapping capability is provided by GIS.

As with DSS, developments in GIS track closely to the evolution of information systems infrastructure since the advent of mainframe computing. The

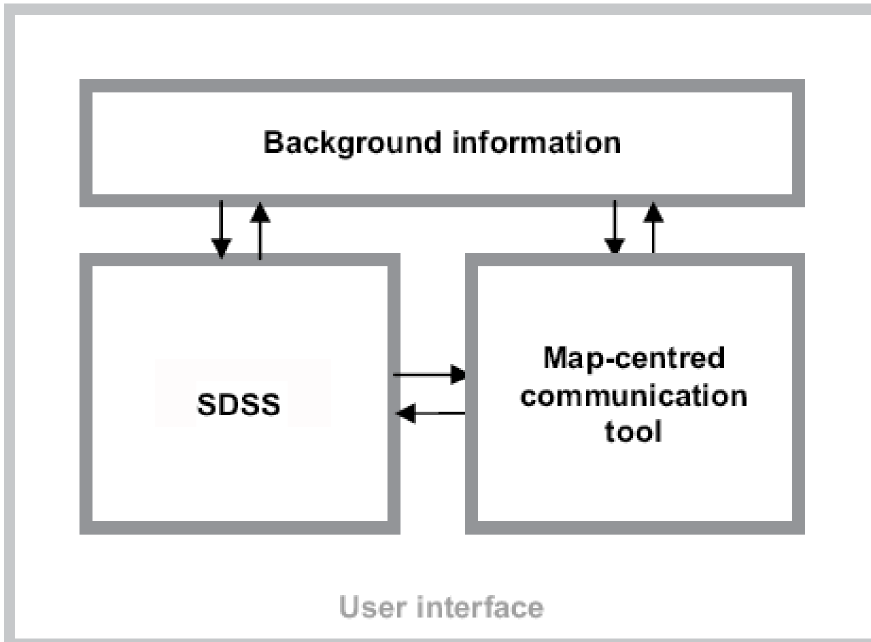


Figure 2.1: A conceptual framework of a spatial decision support system. Modified from: Simao, Densham and Haklay (2009)

PC, from the 1980s, saw the price of computing hardware fall and the development of affordable desk-top systems that brought GIS to a wider, less specialized, public (Longley, 2011). Desktop systems extended the range of GIS by making the previously unaffordable hardware, coupled with lower training requirements, more easily affordable. This heralded GIS's modern age via the introduction of relatively affordable and accessible software with ESRI Inc's launch of ArcInfo in 1981 (Longley, 2011). The ARC line of platforms has become an indispensable tool for spatial data analysis used by governments, researchers and even Non-Governmental Organizations (NGOs) (Sieber, 2000).

Finally, the ubiquitous computing era (Weiser, 1991) suggests that many location-aware hand held computational devices are embedded in the environment and connected via the Internet. Many hand held devices (e.g. mobile smart phones) now host basic GIS capabilities such as recording a route, finding a location and turn-by-turn navigation (Jones, 2011). Many more people have access, through smart phones, to a basic level of GIS that was formerly only available at great cost to professionals (Jones, 2011).

2.4.3 Spatio-Temporal Representation

In addition to mobile GIS, the Internet is enhancing data availability and the capabilities for visualization of spatial and temporal elements. For instance, Google Earth supports the traditional GIS spatial parameters of point, line, and polygon, but also three-dimensional (3D) objects such that users can visualize a 3D space. Through the Google Earth catalogue it is easy to find 3D renderings of thousands of buildings, even entire cities such as Hong Kong. Furthermore, time is also represented in many applications such as Google Earth, Second Life and World of Warcraft where 'players' move through space and time to accomplish complex goals (see Table 2.2).

While the point, line, polygon, 3D scale may be a logical progression that dates to Euclid's Elements (circa 300 BC), the notion of time as applied to GIS and the GeoWeb is a current, abstract problem. Croitoru (2008) defines time as a function of granularity where a granule can be composed of a single instant, a set of contiguous instants (for instance, a time interval), or even a set of non-contiguous instants. Granularity can also be described through a SNAP/SPAN (Grenon and Smith, 2004) framework where SNAP is a continuant and SPAN an occurrent. Continuants endure through time, occurrents do not, they happen and then are gone. For instance, roads, cities, and people are continuants; road construction, urban expansion and an individual's life are occurrent. Conversely, Frank (1998) offers a plain language definition of time as a tool for measuring a sequence of events on an ordinal scale.

Given that time can act independently of geometry, it is problematic when added to a spatial scale (see Table 2.2). For instance, a line connects and is comprised of points; a polygon is constructed from N lines, and a 3D object is constructed from N polygons. Each geometric component in the scale builds upon the previous component. Conversely, as per Grenon and Smith's framework, any geometry can either change with or extend through time (SNAP or SPAN). As such, time acts independently of geometry and is not a natural extension of a scale beyond the spatial. But, given that the use of time is integral to the GeoWeb, and that the complexities (and mathematical requirements) of time are beyond the scope of this research, a spatio-temporal scale will be applied to evaluating the GeoWeb while concurrently recognizing this scale's shortfalls. Frank's (1998) definition of time will be used, and the associated shortfalls of the spatio-temporal scale will be discussed in Section 5.6.

2.4.4 Group Decision Support Systems

Whereas DSS evolved from the mainframe era and allowed several users to connect via a mainframe computer, GDSS are the product of the PC era and allow a variety of users to connect via a closed network, or via the Internet post 1990. GDSS offered the innovation of enabling synchronous and/or asynchronous collaboration between a wider group of dispersed stakeholders, potentially including members of the public, in combination with experts or authorities like urban planners (Dragićević and Balram, 2004). It is significant to note that Balram and Dragićević (2006) included an initial and novel

Spatio-temporal Representation	Definition
1. Point	Elements that occupy a location but are size limited.
2. Line	Elements that connect two separate points.
3. Polygon	A planar feature that is limited by a boundary.
4. 3D	Objects are formed such that they provide a second (height) and third (width) dimension above that of a planar polygon (area) (de Smith et al., 2007).
5. Time	A tool of measurement used to observe event sequences on an ordinal scale (from Frank, 1998).

Table 2.2: Five levels of Spatio-Temporal representation found in GeoWeb applications.

diagram to explain their web-based spatial decision support system concept (see Figure 2.2).

Figure 2.2 represents an innovate approach for the time (the 1990's) based on three vital components: (1) a map layer such that the problem can be defined in a spatial context; (2) a facilitator to moderate and manage the discussion between stakeholders as they work towards consensus, and; (3) a sensemaking component integrated into the spatial collaboration process that enables a group of stakeholders to understand complex location based data.

It was at this point, in the 1990's, that the notion of a computer mediated decision tool migrated to the GIS domain via the proliferation of desktop computers.

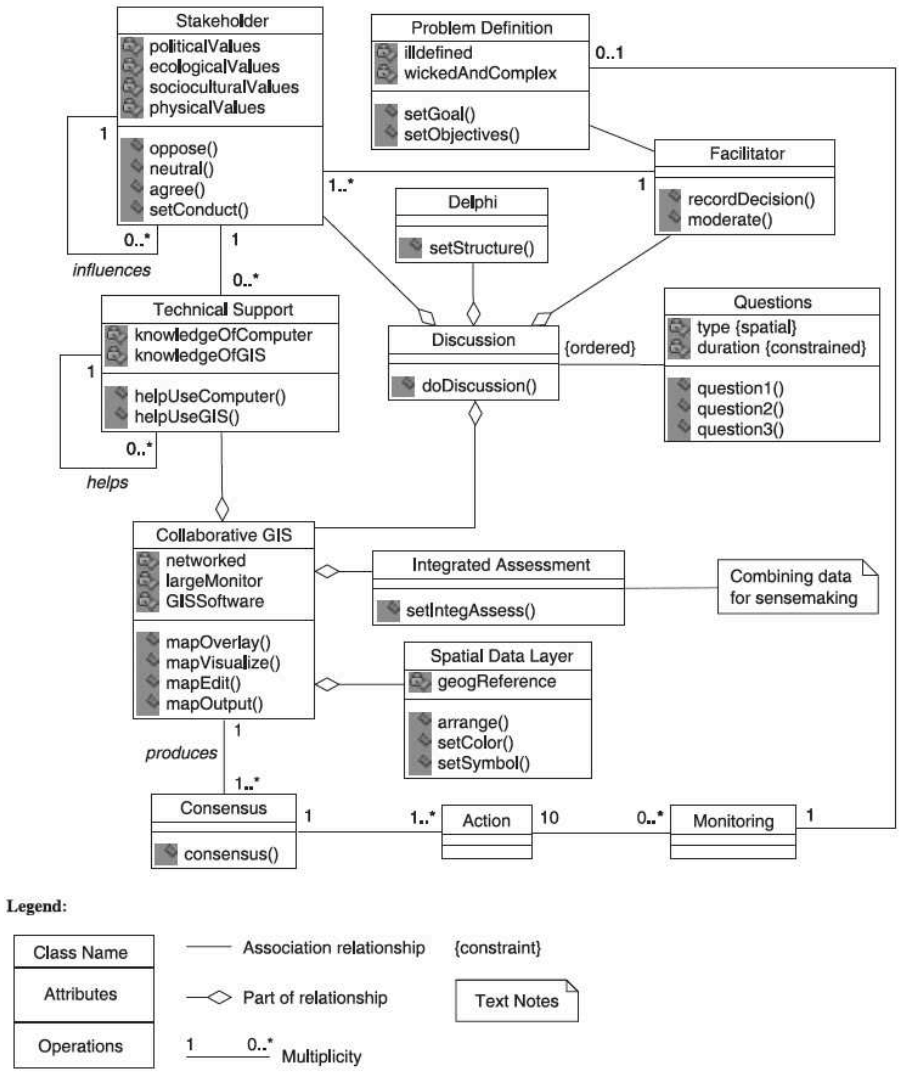


Figure 2.2: A 1990's UML diagram of a web-based spatial decision support system reproduced in Balram and Dragićević (2006)

2.4.5 Public Participation Geographic Information Systems

PPGIS defines a practice where GIS technology and methods are used in support of public participation and decision making in a number of domain applications (Sieber, 2000). These range from urban planning to public policy development by many varied practitioners (Sieber, 2006). The explicit desire of PPGIS is the empowerment of less privileged groups (relative to the authority; power will receive a more detailed treatment in Section 2.5) by including them in authority led decision making processes. This is achieved by improving transparency and access to the input stages of a policy, or similar processes (Schroeder, 1996). PPGIS's distinguishing feature is its desire for inclusion coupled with its implementation across many desk-top and Internet based platforms.

This desire for the empowerment of less privileged groups, coupled with 1990's desk-top computer technology, defines the PPGIS process as a top down process where a central authority (e.g. government, researcher) identifies a problem, the best way to address it, and who can be granted access to the process to achieve the desired outcomes (Carver, Evans, Kingston and Turton, 2001; Ghose, 2007). As such, PPGIS is a multi-dimensional entity whose core components include power, notions of public, participation and collaboration.

2.5 Power and (Spatial) Decision Making Systems

Power is central to PPGIS and the success of a PPGIS implementation is predicated on the quality of the communications between different power actors within networks of association (O'Sullivan, 2006; Ghose, 2007). In the case of SDSS, power operates by inclusion/exclusion (Castells, 2004), and has been defined by Castells (2004) as the structural capacity to impose ones will over another. Ghose (2007) suggests that excluded communities are the most marginalized and often sit at the bottom of a network hierarchy, and by virtue of exclusion, these marginalized communities are unable to communicate and participate effectively in a PPGIS process.

These findings are bolstered by Sieber (2000) who argues that for Environmental Non-Governmental Organizations (ENGOs) to be successful in their implementation of a GIS, they must become politicized and engaged with local governments as a means of gaining access to additional resources, data and knowledge. This process of engagement has the potential to (1) legitimize local issues within the concerns of a broader public and to integrate local knowledge into established decision making processes (Aitken, 2002), and; (2) potentially dilute the ENGO's concerns through assimilation. The risk of not becoming politically engaged, either through lack of literacy, access to technology, or lack of funding, may prevent privileged access to authority and the associated processes (Ghose, 2007).

While the monetary costs of GIS have been reduced as compared to a 1950's style mainframe GIS, it has been noted by O'Sullivan (2006) that cost is still a barrier for many organizations, and that those who can afford a GIS are likely already empowered. As such, despite 'lowered costs' and educational requirements, acquisition of the industry standard software is still a significant barrier to widespread engagement by marginalized groups.

Furthermore, those groups that are marginalized do not have access to the processes that have been established within the PPGIS by the authority or research group. PPGIS exemplifies the networked mentality of isolated thinking as PPGIS do not allow contributors to view or comment on other contributions; data aggregation and interpretation is left to an expert (Anderson et al., 2009). As such, PPGIS implementation supports broad contribution, but limits access to those contributions. This results in a process that does not support knowledge accumulation and insight amongst the contributors, and limits the learning that might otherwise occur (Tapscott and Williams, 2006). These barriers to a broader public participation within a PPGIS process calls for clarification to how ‘public and ‘participation are defined.

It is clear that notions of ‘public’ and ‘participation’, though closely tied to power, are poorly defined concepts within the PPGIS literature (Schlossberg and Shuford, 2005; Hansen and Prosperi, 2005). Schlossberg and Shuford (2005) cite four power continuums as a means of illustrating the role of power in defining ‘public’ and ‘participation’. These four continuums overlap and offer redundancy in their classification and understanding of power. In this instance, Arnstein’s (1969) Ladder of Citizen Participation (see Figure 2.3) can act as the power dimension collapsing various conceptions of power onto one scale.

Power can be defined by a person’s inclusion in a process (Castells, 2004). Those who are included can participate to varying degrees (see Figure 2.3), and can also act to exclude those citizens whose interests are not aligned with their goals and desired outcomes. Arnstein’s (1960) Ladder of Citizen Participation has been referenced as a power continuum (Hansen and Prosperi, 2005; Jankowski, 2009) and can be defined as a typology of eight levels of participation, where each level represents the extent of citizens’ power to influence the process and the outcome. Because there is redundancy in the eight levels, the Ladder of Citizen Participation presented in Table 2.3 has been collapsed to five levels in order to reduce redundancy and clarify the terminology.

Despite an understanding of power, and the different levels of engagement

Figure 2.3: Arnstein's (1960) Ladder of Citizen Control

that a citizen might have in a PPGIS, the definitions of public and participation are vague and poorly defined. Indeed, these definitions might be imbedded within the context of their use, and render broad definitions useless. For instance, 'public' might be defined within the context of a PPGIS, in a limited way, to those who are invited into a process. In contrast, 'public' may be defined more broadly within a social computing context to those who have access to the Internet and choose to participate in the process.

Similarly, 'participation' is also contextual. For instance, within the PPGIS context, the level of control or involvement that the public is granted on the process may define 'participation'. In contrast, 'participation', with social computing may be defined by the level of control that a pubic desires and takes for any given process or project, and speaks to the emerging collaborative technologies that are enabled by a social internet, or social computing (examined in Section 2.6)

Level of Power	Definition
1. Manipulation	A means of education and control, not of participation.
2. Informing	A means of enabling the 'have nots' with a voice.
3. Consulting	Citizens are heard and their ideas incorporated into the process
4. Partnership	Negotiation and trade offs between citizens and power holders
5. Citizen Control	Citizens are the power holders and decision makers

Table 2.3: Five levels from Arnstein's Ladder of Citizen Control. From Arnstein (1960)

2.6 Social Computing

Social computing exists in contrast to the closed networks of the PC era, and can be defined as the ability of users to create, interact with and manage an information space that is dynamic, socially collaborative, portable and location sensitive (Parameswaran and Whinston, 2007). Social computing is the technology that allows us to connect everything to everything (Hudson-Smith, Batty, Crooks and Milton, 2009) in a network whose utility to a user increases as its membership increases (Benkler, 2002; Hudson-Smith, Crooks, Gibin, Milton and Batty, 2009). As more members and devices connect to the network, the larger the information circle, and the more information any one individual has access to. This, coupled with enhanced communication predicated on mobile devices that can record and transmit spatially and socially relevant data, potentially challenges established power structures and traditional modes of citizen engagement with an authority driven process, such as PPGIS.

Social Computing not only empowers those with the means to connect to the Internet to access relevant data and information, but also the ability to contribute data, information, and knowledge. As Poore and Chrisman (2006) indicate, the data communicated through the model in Figure 2.4 represents a relation between those producing the data, and those consuming where the 'source' is the origin of the data, the 'channel' is the means of communication, and the 'recipient' is the consumer. Social Computing redefines this model, as represented in Figure 2.5, where the source, channel and recipient of the communication signal are potentially one-in-the-same. For instance, a user can edit a map in Open Street Map, save that edit, and then open and use the new edited information in their web browser. In this instance, the editor of the map, and the user of the map are one-in-the-same.

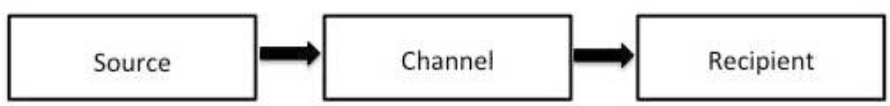


Figure 2.4: Traditional communication model that transfers information in one direction, from an expert to a consumer. From Poore and Chrisman (2006)

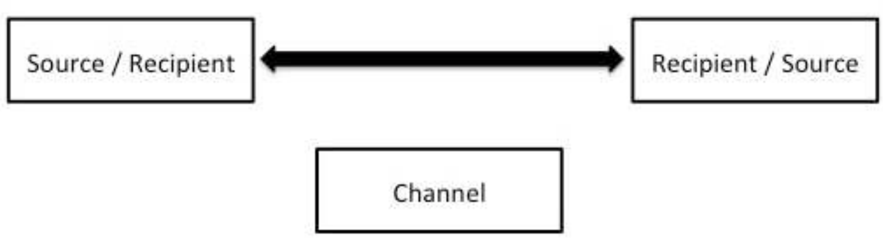


Figure 2.5: A new communication paradigm where the source and recipient of geographic information are potentially on-in-the-same, blurring the distinction between the creation, communication, and consumption of data.

Thus, the outcomes of Social Computing supports a shift from desktop based systems as epitomized by PPGIS to the GeoWeb and mobile-based systems where data are created through the connection of individuals, via a social Internet, to mobile devices, and autonomous sensors through the Internet. This connectivity (individual to an amorphous cloud of data, and back) speaks specifically to the limitations of a PPGIS collaboration paradigm where individuals work in isolation from maps produced by experts, and their individual contributions are then interpreted and made sense of by an expert.

Castells speaks of a networked society where '...key social structures and activities are organized around electronically processed information networks' (Castells, 2004 p.24), including location based services such as a mobile deployment of the GeoWeb (see Section 2.7 for a definition). Castells (2004) also notes, in keeping with Dourish and Bell (2007), that all networks are culture dependent, and technology is not used in a vacuum. Therefore, it is important to understand how spaces and cultures are impacted as GIS, and its associated proficiencies, shift through the continuum from mainframe, to desktop and finally to a social or ubiquitous platform. As technologies become more available to some people (i.e. those who are literate and wealthy), others who do not have access to those same technologies (those who are not literate or wealthy) might be impacted in unforeseen ways. The variables of people, culture and space are community dependent (Dourish and Bell, 2007), and, by extension, the details gleaned about GIS use within a community must be generalized cautiously.

2.6.1 Collaboration

Collaboration, meaning to work together for a common outcome (McConchie, 2008), is also community dependent. Given a traditional power structure where an expert or authority has the means to exclude participants from a process, collaboration is defined by those who can participate. As Ghose (2007) indicates, the missing voices and opinions are those of the most marginalized within a process hierarchy. Social computing has the potential to reduce some of the traditional barriers of access, such as the cost and application specific knowledge. As such the notions public and participation can be redefined, relative to a PPGIS, as those with access to the internet and a desire to participate. This is tempered by the limitations of (1) there still being a (smaller) cost to connecting to the Internet, (2) a need for literacy, and (3) the desire / motivation to engage with issues via the Internet.

The concept of 'shared goals' is central to understanding collaboration within this on-line location based context(Sheffield, 2009). For instance, our goals may be loosely shared, where we may collaborate in an informal or ad hoc manner, or tightly shared where we are working in a rigid and formal framework of collaboration (Shirky, 2008). Shirky (2008) offers a conceptualization that is helpful in expanding on the notion of shared goals and collaboration within a Social Computing context (see Table 2.4).

Social Computing comprises one layer in a complex system of data collection, communication, and consumption by a variety of individuals and networks. As described previously, ubiquitous computing is enabled through the dispersal of small, robust and networked devices and/or sensors throughout everyday life (Bell and Dourish, 2007) that are capable of collecting and com-

Collaboration	Definition
1. Sharing	The posting of information by a user and the consumption of information by others, such as in blogging; this process is one directional, requires almost no commitment from participants and does not involve interaction between users.
2. Responding	The next level of collaboration, describes a process where one user provides feedback on others postings, but the two are not collaborating to clarify or create a deeper understanding of the post; for example providing photography tips in response to a picture posted on Flickr.
3. Cooperation	A process where two or more people work together to create a product, such that there is a two-way interaction between people; for instance, in a discussion forum.
4. Collaboration	More than two people working in a process that has complex demands on both the originator of information and those responding, and it requires all parties to agree on goals, share norms, and identify with the product or the community.
5. Collective Action	The highest level of concentrated effort, where there are advanced communication tools supporting complex goals, outcomes, and the development of a group identity over and above individual identities; such tight relationships are typical of virtual games such as World of War Craft.

Table 2.4: Five levels of Collaboration; from Shirkey (2008)

municating data. These sensors can either be static (for instance, a traditional ambient air quality sensor) or mobile, and contribute to the complex interplay of data collection, communication and sense-making that occurs when the social and ubiquitous sensors interact via the Internet. In fact, as Goodchild (2008a) notes, sensors become social through citizens who use and connect through them to provide data about their local environment. The Internet, in turn, acts as a platform that can be accessed in a variety of ways providing an interactive venue where users cannot only connect with each other, but can also define the means and method of that connection.

If social and ubiquitous computing represents the current state of computing technology, then the GeoWeb, neogeography and Volunteered Geographic Information (VGI) describes how computing technology works as a mapping platform. The history of the GeoWeb and the recent emergence of neogeography and VGI are described in Section 2.7.

2.7 The GeoWeb

The use of the Internet as a mapping platform started shortly after its inception by Tim Berners-Lee in 1990 (Rinner, 2001). Specifically, Xerox introduced the PARC Map in 1993 (Putz, 1994); it was a rudimentary mapping platform that supported basic capabilities, including the presentation of the map (this was of technical significance at the time) as well as the ability to zoom to predefined levels. The PARC Map was limited to simple queries based on pre-loaded data and the user-side technology was equally limited in screen resolution, file size and associated bandwidth that made interactions with the map slow and clumsy.

From 1993 until 2005 the delivery of geospatial information and GIS capabilities over the Internet was possible but limited (Haklay et al., 2008) due to the complications that included a lack of qualified developers and the cost of base cartography on which the spatial data was overlaid (Haklay et al., 2008). These factors, coupled with the end user issues such as restricted bandwidth, limited the widespread deployment of Internet based maps and mapping applications.

Google Earth was launched in 2005 (Jones, 2011), marking a shift in how mapping technology was implemented from the advent of the first mainframe platforms in the 1950s. Specifically, GIS was made available at no cost to anyone with a computer. In 2005 the market leader in web-based mapping technologies in the UK (Multimap) attracted 7.3 million visitors and, in the USA, Mapquest was used by 47 million visitors (Haklay et al., 2008). By 2007 there were more that 50 000 websites that were mashed-up with Google Maps, and by 2010 Google Earth had seen more that a total of 800 million unique activations on a variety of platforms such as desktop, laptop, and smart-phone (Jones, 2011).

This growth of mapping applications, and users of mapping applications, required a new language to explain innovative technologies and the application of those technologies in an ever shifting landscape. Terms such as map mash-up, crowdsourcing, application programming interfaces (API), neogeography, and volunteered geographic information (VGI) Goodchild (2008a) were developed to describe new mapping capabilities that used the so-called Web 2(point)O (2.0).

Web 2.0 is commonly used to describe the growth of the Internet from a read only entity, to that of a platform that supported collaboration. Web 2.0, the term, was coined by Tim O'Reilly in 2005 at the first Web 2.0 conference. He later clarified his definition as:

> Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as platform, and an attempt to understand the rules for success on that new platform. (O'Reilly 2006)

Web 2.0 is the cornerstone of the Geospatial Web, or GeoWeb, that describes the merging of location-based information (geographical) with the other abstract information that is dominant on the Internet (Haklay et al., 2008). As noted previously by Shirkey (2008), these developments have had a profound impact on collaboration. Goodchild et al. (2007) concurs with Shirkey by noting:

> [T]he early Web was primarily one-directional, allowing a large number of users to view the contents of a comparatively small number of sites, the new Web 2.0 is a bi-directional collaboration in which users are able to interact with and provide information to central sites, and to see that information collated and made available to others. (p.27)

Two further developments in the GeoWeb enabled the explosive growth in mapping technologies from 2005 to the present:

1. Global Positioning Systems (GPS): In 2000 the restrictions on GPS signal availability were loosened, changing the signal resolution from 100 meters, to 6-10 meters (Haklay et al., 2008). GPS devices are now ubiquitous and can be found in watches (e.g. the Garmin Forunner Series) and smart phones (for instance, an Apple iPhone). The combination of GPS and mobility in turn enables a new suite of mapping applications that can gather and broadcast a trace of a route travelled (Reades et al., 2007).

2. Application Programming Interface (API): An API defines a 'door' by which a programmer's computer can access a stream of data. It is through an API that programmers have access to common pools of background geographic data that includes maps, satellite data, and street photography. These data can be housed by the data producers or, more recently, in open data catalogues. APIs make application development easier and support data visualization and the combination of data streams from a variety of sources in one application. The result is a far larger community of people who can create, share and mash up geographic information (Jankowski, 2009).

2.7.1 Neogeography

Many GeoWeb applications rely on non-expert geographers for their creation and development. For instance, the Open Street Map initiative (www.openstreetmap.com) is a map of the world that was created entirely by volunteers, many of them non-expert (or non-academic) geographers. This phenomena of non-expert geographers doing the work of experts is referred to as Neogeography. Jason Wilson and Di-Ann Eisnor, the co-founders of Platial: The People's Atlas, are attributed with coining this term (Haklay et al., 2008), and they describe it as a socially networked mapping platform which makes it easy to find, create, share, and publish maps. Furthermore, Turner (2006), in the Introduction to Neogeography (2006) describes its core concepts:

> Neogeography means new geography and consists of a set of techniques and tools that fall outside the realm of traditional GIS, Geographic Information Systems. Where historically a professional cartographer might use ArcGIS, talk of Mercator versus Mollweide projections, and resolve land area disputes, a neogeographer uses

> a mapping API like Google Maps, talks about GPX versus KML, and geotags his photos to make a map of his summer vacation. (p. 1)

Neogeography is a suite of tools that enable the collection, communication and consumption of geographic information by non-experts via the GeoWeb (Rana and Joliveau, 2009). For instance, the addition of GPS to mobile devices, enabled a sensor equipped person to contribute location specific volunteered geographic information (VGI) to a process, rendering this a key data construct within the virtual mapping environment (Goodchild, 2008b). Where neogeography describes the tools and platform, VGI describes the activity that occurs on that platform, and will be explored in greater detail in the Section 2.7.2.

A typical neogeography activity involves the creation of a geographic mashup where data that is not originally geo-located is layered on a map (such as a Google or Bing! map) and rendered spatial. For instance, www.emitter.ca took Environment Canada's National Pollution Release Inventory data set from MS Access, geo-located all of the emission sources in the data, and projected those data onto a Microsoft Bing! Map such that the data were searchable by location, for example a person's street address. Furthermore, GeoWeb applications that support multiple data feeds (such as www.openstreetmap.com) from citizens via VGI, and from an authority via an open data set, are able to combine these data feeds in complex and novel ways.

2.7.2 Volunteered Geographic Information

VGI is a specific geographic case to the more general crowdsourcing (Goodchild 2008) and refers to a range of activities where volunteers provide some geographically referenced object to the Internet. These objects can range from observational data, to geotagging a photograph or creating a GPS trace with a location aware mobile device. For instance: (1) observational data might simply be a location specific description of, for instance, an environmental problem that is uploaded to Eye on Earth (www.eyeonearth.com); (2) geotagging might occur where the user tags an object, like a photograph, with a location (see www.flickr.com for examples), or; (3) a runner might create a GPS trace of a running route and share that route with their community via Garmin Connect (http://connect.garmin.com/).

2.7.3 Data Fidelity

When combined with other data sources and types, VGI data can be a powerful tool to augment and even verify other, more authoritative, data sources (Flanagin and Metzger, 2008). The Dempster-Shafer Theory (Dempster, 1967; Shafer, 1976) provides some conceptual insight into how different and varied data sets can be combined to influence data reliability. It describes a series of evidence or data types, arriving from different sources, which can be used to evaluate the reliability or quality of information (see Table 2.5).

While the Dempster-Schafer Theory might explain how various data types, including VGI, can be combined, it does not address the 'why' of volunteerism in a digital context. Why would someone take the time to volunteer their geographic information? Section 2.8.1 will address the enablers (the whys) and Section 2.8.2 the limiters (the why nots) of collaboration on the GeoWeb.

Data Type	Definition
1. A single point	Represents a data source from either an individual or a sensor (or an individual with a sensor). Sensaris.com provides a compelling example where a person with a Sensaris air quality sensor can easily monitor a location's air quality, and publish that data on-line. As a single VGI data point, these data do not have a high fidelity.
2. Multiple points with equivalent reliability	Data from either autonomous sensors (i.e. a sensor network), individuals (e.g. an expert or citizen with a sensor) or in combination. For instance, Foursquare (https://foursquare.com/) provides the ability of multiple individuals to indicate their attendance at a specific location. It is possible to confirm the location of any one individual via another individual who has checked into that location. While each person has the same degree of reliability; their aggregated fidelity is greater than a single point.
3. Multiple points with various levels of reliability	The combination of data from many sources with various levels of reliability. For instance, Open Street Map includes data from 'authorized' mapping agencies as base data, but also supports citizen contributed data.
4. A sensor network superimposed over multiple points with various levels of reliability	Eye on Earth (www.eyeonearth.eu) is the European Union's environmental monitoring system interface that combines crowdsourced air and water quality data with sensors and authorized data from regulators.
5. Sophisticated model	A model (such as a climate model) consisting of many varied data sources (both crowd-sourced and sensor-sourced data would be represented) in conjunction with a human computer interface that draws on the strength of both to model complex problems. Ushahidi's Swift River is an example of a GeoWeb enabled system that seeks to manage and model various levels of data reliability.

Table 2.5: Levels of Data Fidelity. From Dempster (1967); Shafer (1976)

2.8 Enablers and Limiters to Collaboration

Motivation and privacy, the enablers and limiters to collaboration on the GeoWeb, represent deep and evolving research domains. These concepts are presented in this research as areas of exploration only. They are invoked to provide context for analyzing the neogeography contribution practices of informants. As such, a detailed review of these complex literatures is beyond the scope of this thesis.

2.8.1 Motivation

Motivation can be defined in terms of moved to do something (Deci & Ryan, 1985), and research into motivation is rooted in sociology. Initial attempts to characterize motivation stemmed from early research into volunteers who contributed to or provided help for a variety of causes in real world environments (Curtis et al., 1992). The phenomenon of volunteerism predates the Internet and, in 1993, accounted for a portion 89.2 million Americans' time (Clary et al., 1998). Despite the growth of the motivation literature in the virtual domain (Benkler, 2002; Nov, 2008) the motivations of those who provide VGI are poorly understood and not well represented in current geographic literature.

Benkler (2002) describes the volunteer efforts within on-line communities as a commons based peer production, and defines this as a new economic model of production where volunteers are coordinated within non-traditional (i.e. non-hierarchical) systems, via the Internet. A typical example of commons based peer production is the development of the Linux OS (Tapscott and Williams, 2006) as an Open Sourced Software (OSS) project.

OSS is generally produced via a loosely knit community of volunteer programmers who are spread across the world and connected via the Internet (Tapscott and Williams, 2006). Software developers have a long history of working for free in the organization, development, and deployment of OSS (Moon and Sproull, 2000). In addition to OSS development, commons based peer production has been observed and studied within the context of Wikipedia (Benkler, 2002), a web-based user created encyclopedia. Wikipedia is entirely peer produced by volunteers who have created more than 1.9 million articles in English (Schroer and Hertel, 2009). On the other hand, the motivations for volunteer contribution to geographic entities like Open Street Map, a web-based user created map, have not been studied.

In an effort to understand the incentives for volunteer contributions to Internet based projects like Wikipedia, OSS development and the GeoWeb, two motivational models were examined. Specifically, an extrinsic/intrinsic model (Deci & Ryan, 1985) and Clary's (1998) 'functional approach' motivation framework were compared and contrasted. Intrinsic motivation relates to internal incentives for an individual's desire to contribute (Schroer and Hertel, 2009), such as fun, intellectual stimulation, and reciprocity (Nov et al., 2011). Conversely, extrinsic motivation relates to external incentives such as reputation improvement, skills enhancement and career advancement (Lakhani and Wolf, 2004).

The functional approach to motivation offers an alternative to the intrinsic/extrinsic model. Nov (2008) implemented a variation of Clary's (1998) model in a study on the motivations of those who contribute to Wikipedia; Nov added two parameters (Fun and Ideology). Table 2.6 details the moti-

Motivation	Definition
Protective	This function serves to protect the volunteers ego from negative features of the self or to reduce guilt over being more fortunate that others.
Values	This relates to the importance that a volunteer may place on altruistic and humanitarian concerns, where others needs and well-being is valued.
Career	This relates to the career related benefits that may be obtained from participating in volunteer work.
Social	Volunteering may offer an opportunity for the volunteer to interact with their friends, or to gain some respect from important others.
Understanding	This can be expressed as a desire for the volunteer to learn something new or of value.
Enhancement	This relates to the volunteer receiving some personal growth, self-esteem and satisfaction from the volunteer activity.
Fun	This relates to the enjoyment of the activity.

Table 2.6: A Functional Approach to Motivation from Nov (2007)

vation scale used in this research as outlined by Clary (1998), and including Nov's (2008) addition of 'fun', but not 'ideology', as it was too specific to Wikipedia research.

Little research has been conducted on the motivations of individuals who engage in volunteer geographic information production. As such, the intrinsic/extrinsic approach to personal motivation was not appropriate to this research as it is a simple, binary approach. Rather that seek to understand the nuances of personal motivation, as Nov's (2007) approach does, the intrinsic/extrinsic model offers only two options, an internal motivation or an external motivation. Nov offers a more compelling motivational framework based on a nuanced classification of potential incentives relative to the binary intrinsic/extrinsic.

As noted earlier, to be motivated is to be moved to do something; the flip-side of motivation is inhibition. Inhibition is an inner impediment to action, where an individual does not feel comfortable participating in an activity. In this instance, privacy 'inhibition' is the concern that may constitute the foil to motivation.

2.8.2 Privacy

While there is the potential for a volunteer to gain personally from GeoWeb related volunteer activities (see Section 2.8), this domain is unique in its risks (Ludford et al., 2007). The very nature of the GeoWeb relates to location, and as such volunteers of geographic information are exposed to the risks of compromised location privacy through the sharing of specific location data.

Where motivations offer an incentive to volunteer, privacy concerns offer a disincentive. Malhotra et al. (2004) offer a privacy framework that provides insight into information privacy concerns within e-commerce. In this instance, information privacy concerns relate to an individual's subjective concerns relative to their sense of fairness within the context of information privacy. For example, Facebook often changes their privacy policies such that users must understand the implications of the new policy, and respond accordingly. That Facebook's privacy policies seem to change without warning or consultation can be seen as being unfair to the user. As such, three factors have been identified that are useful to this research:

- **Information (or data) collection** relates to the degree to which a person is concerned about the individual-specific data that is held by others relative to the value of benefits received.

- **Information (or data) control** relates to the amount of control that an individual has on their personal information and on the policies that define the uses imposed on their personal information.

- **Awareness of privacy practices** relates to the extent that an individual is aware of (1) the amount of control they have on their personal information, and (2) the data being collected, including when, where and how that data is being collected.

Location data can be defined as those data collected by a GPS enabled or otherwise connected mobile device that can communicate the specific location of that device. Negative effects of these data becoming available include location based spam, decreased personal safety, and intrusive inferences of individual preferences based on location (Duckham and Kulik, 2005).

2.9 The Utility of GeoWeb Applications

Utility can be defined as a measure of satisfaction (Daly and Cobb, 1989). The greater the utility of an object such as a consumer good or service, the greater the satisfaction the consumer has in using that object. For instance, a sharp knife is more useful and creates more satisfaction in a cook's hand than a dull knife. Therefore, the sharp knife has a greater utility. In the same way, information has utility in that it provides a service and in the process renders a level of satisfaction for the consumer. It makes sense, then, that useful information is more satisfying, has more utility than other, less useful, information.

At its most general, the GeoWeb seeks to marry geo-spatial information with other abstract information in such a way that more utility is created (Haklay, Singleton and Parker, 2008). For instance, it may be useful to know that the museum has a show on, but it is more useful (of greater utility) to know that the museum has a show on, and where the museum is. Map-mashups seek to create greater utility of non-spatial data by mashing (combining) the non-spatial with a relevant spatial component, or by making an embedded spatial component more easily readable. For instance, (to recycle a previous example) www.emitter.ca marries the non-spatial National Pollution Release Inventory with a location dataset and a searchable map. This mash-up renders the NPRI emissions searchable by address or city, and creates more utility in the emissions data by allowing, for instance, a home buyer to see the proximity of an emissions source to a potential new home.

As described previously, the GeoWeb exists largely within the context of applications, like Google Earth, or communities such as Flickr, that can be reached via stationary or mobile platforms. Each user of the GeoWeb has an interest in the quality and the utility of data presented. Current research has not explicitly addressed the notions of GeoWeb utility, user satisfaction or data quality. In this chapter, four orthogonal dimensions that describe different aspects of the GeoWeb have been presented: (1) Power as described by Arnstein (1960) in Section 2.5, and in Table 2.3; (2) Collaboration as described by Shirky (2008), found in Section 2.6.1, and in Table 2.4; (3) Data Fidelity as suggested by the Dempster-Schaefer Theory (Dempster, 1967; Shafer, 1976), found in Section 2.7.3, and Table 2.5, and; (4) Spatio-temporal representation as described in Section 2.4.2, and Table 2.2.

Each of these four orthogonal dimensions was selected because (1) as described in their respective sections, each provides a unique conceptual understanding of the GeoWeb; (2) there is no overlap between each scale's description of the GeoWeb, rendering these dimensions orthogonal, expanding in four dimensions, rather than overlapping in one dimension; (3) this combination of concepts has not previously been applied to understanding the GeoWeb, and; (4) the progression up the five point scale for each dimension describes an increase in information utility and, therefore, user satisfaction of the GeoWeb. It must be noted, however, that the user interface was not studied in this context, and as such the user experience of any particular GeoWeb application may detract from its utility.

2.10 Summary

This Chapter reviewed the literature pertinent to this research. Section 2.2 provided an overview of the place and space literature and highlighted Lynch's (1960) elements of place. Section 2.3 situated the place and space literature within the context of maps, and provided a brief historical overview of the major issues that mapping has addressed. Section 2.4 addressed spatial decision making tools, and Section 2.5 introduced the notion of power. The Social Computing and Collaboration literature were discussed in Section 2.6, and the GeoWeb literature, including neogeography and VGI, in Section 2.7. The motivations and privacy literature, relative to GeoWeb data contributions, were outlined in Section 2.8. Finally, Section 2.9 attempted to describe the utility of the GeoWeb by aggregating concepts described throughout this Chapter.

Chapter 3

Research Methodology

3.1 Chapter Overview

As detailed in Chapter 2, the emergence of the GeoWeb has empowered a generation of new (or neo) geographers to document how they move through and use various landscapes. Equipped with ever evolving mobile devices that incorporate, as core features, connectivity (cellular, broadband), photo, video and GPS data recording capability, neogeographers are empowered to collect data about their experiences of interacting with the world. As discussed in Section 1.2, interesting questions arise from these human-place interactions that are mediated by technology.

While it is a common practice to post a geotagged Facebook or Twitter update (Hollenstein and Purves, 2010) such that a social circle, or indeed the world, knows the specific location referenced in the update, little research has been conducted related to an individual's understanding of location and communication of that understanding in addition to motivations and privacy concerns (Section 1.2 describes the research gap and questions).

The task of data collection was broken down into a number of distinct phases that fell into two broad categories, (1) selecting the appropriate methods, and (2) implementing those methods. To select the appropriate method, it is important to garner a deeper appreciation for the range of research methods available for social science research generally, and human geography specifically. The objective of this phase was to select a method of inquiry that could accommodate a variety of data types while maintaining a focus on the interview as the main method of evidence collection. After exploring many options (see Section 3.2.3), the research process phase (see Section 3.3) defines, in detail, the process of data collection, analysis and presentation.

These methods were informed by the work of other human geographers and urbanists who explore place and space, and PPGIS. For instance, Kevin Lynch (1960) The Image of the City provided a process template as well as a number of interview questions related to capturing an informant's knowledge of place and space. Contemporary work from a number of authors (Sieber, 2000; Ghose, 2007; Rinner, 2001) also provided insight into the methods as each of these researchers has used a case study method to focus on the interactions between users, technology and place based knowledge within a PPGIS. For instance, Rinner's (2001) argumentation map explored how users interact with a geo-located on-line discussion forum, and Sieber (2000) used a case study method to study the interactions of a community of users through a PPGIS.

3.2 Qualitative Methodology

Qualitative inquiries provide a means of understanding the human experience and are commonly used within the domain of Public Participation GIS research (Carver 2001, Ghose 2007, Rinner 2001, 2007, Al-Kodmany 2001).

Winchester (2005) states that qualitative methods are used to answer questions related to two phenomena: social structures and individual experiences. As a broad methodology that seeks to understand the why and how, qualitative research guides the process from defining a set of research questions, through the specific evidence gathering techniques used to collect data, to the analysis and presentation of that data (Yin, 2003). There are three broad methods of collecting evidence as a means of gleaning insight into the phenomena being studied: oral, textual, and observational.

Oral methods describe a range of *talk-based* techniques that can be described as a continuum from biographies to surveys, where the focus of inquiry shifts from the individual (i.e. biography) to the group (i.e. survey). Textual methods are not limited to documents that contain text, but are more broadly applied to a suite of media that can include images and maps. Documentary sources include a wide range of documents, from official and non-official sources, such as newspapers and financial statements to postage stamps (and non-fiction texts). Observational methods, the third significant research type in human geography, place the researcher as an observer in the environment being researched. Observation tends to affect both the researcher and those being observed. As such there are significant issues related to the position of the researcher in relation to those being observed. For instance, research conducted in one's own community, or of life changing events such as disease afflicting the researcher, may alter the perceptions of the researcher due to how close the observer is to the observed. Such closeness may facilitate a deep understanding of the events creating insight into those life experiences.

3.2.1 Case Study Method

A case study method is specific to qualitative research that utilizes and combines several techniques such as interview, textual and observational methods to produce a variety of evidence. The case study method applies these evidence gathering techniques to an in-depth examination of a single case where there are many varied and complex interactions and where the variables are embedded within the context. As such, the variables are indistinguishable from surrounding events and processes (Yin, 2003) and the approach can be defined as 'an empirical inquiry that investigates a contemporary phenomenon within its real life context' (Yin, 2003 pp. 13). Furthermore, case study method provides an encompassing research strategy that helps to guide the research design, data collection, and data analysis; it provides a wide range of options for the gathering of evidence, and supports the combination of different evidence types in the presentation of results and ensuing discussion.

As Benbasat et al. (1987) state, case study method is appropriate for certain types of problems: those in which research and theory are in their formative stages, and for practical problems where the experiences of the actors, and the context of the action is important. There are three reasons why case study method is important for studying knowledge production and information technologies in a location-based context: (1) the researcher can study data production, communication and consumption of a specific group and location utilizing a variety of evidence gathering techniques, (2) it allows the researcher to address the 'how' and 'why' questions that are necessary for a deeper understanding of the processes taking place; (3) it is appropriate for undertaking research in an area where few previous studies have been conducted.

3.2.2 Case Study Method in Information Systems (IS) Research

The case study method has been used to study web-based collaboration (Crowston et. al. 2007, Gallivan 2001, O'Mahony 2003), as well as GIS and PPGIS (Carver 2001, Ghose 2007, Rinner 2001, 2007, Al-Kodmany 2001). It is well suited to the study of information systems because of its capacity to capture the knowledge and processes of practitioners, and subsequently developing frameworks and theories from that knowledge (Benbasat, Goldstein and Mead, 1987).

PPGIS and location-based research is typically characterized by one technique of data collection (e.g. Carver 2001). By contrast, this research will fully utilize the case study method and combine several data collection techniques in an effort to provide robust answers to the research questions. Specifically, location-based collaboration takes place in two overlapping spheres - on-line and in the real world. As such, informants interact with other people across this divide in the generation, communication and consumption of data. A case study method is qualified to address the information system (IS) processes that practitioners utilize to bridge the gap between the virtual and real worlds. This research combines semi-structured interviews, mental maps and on-line documentation to glean informants' experiences and knowledge of the real world and how they communicate that understanding and associated data in a virtual world. The advantages of case study method are outlined in 3.2.2.

1.	Phenomenon is examined in a natural setting.
2.	Data are collected by multiple means.
3.	One or few entities are examined.
4.	The complexity of the unit is studied intensively.
5.	No experimental controls or manipulation are involved.
6.	The results derived depend heavily on the integrative powers of the investigator
7.	Case research is useful in the study of 'why' and 'how' questions because these address operational links to be traced over time rather than with frequency or incidence.
8.	The focus is on contemporary events.

Table 3.1: Key Characteristics of Case Study Method (From: Benbasat et al., 1987)

3.2.3 Discourse Analysis

Discourse analysis is a technique for understanding passages of text and is based on the writings and philosophy of Michel Foucault. Within this context, discourse can be explained as: (1) all meaningful texts that have effects on the world; (2) a group of statements that appear to have a common theme that provides them with a unified effect; and (3) the rules and structures that underpin and govern the unified, coherent, and forceful statements that are produced (Waitt, 2005). From this, discourse analysis can be defined as the technique by which commonly themed statements are grouped in the exploration of the outcomes, perceptions and attitudes of informants.

Specific to this research, discourse analysis is the analytical tool that is used to understand the informant's statements as they pertain to his or her reported actions, perceptions and attitudes. Particular attention was given to the notions of place and space, and the themes of (1) place based knowledge, (2) activities and meanings of place, (3) motivation and (4) privacy, relative to the specific locations that were mentioned in each interview. The research questions outlined in Section 1.2 informed the identification of the initial themes of (1) place and space; (2) VGI, and; (3) motivation and privacy in the interview transcripts.

In contrast, additional emergent themes were also identified and explored (please see Appendix C for more details) in the transcribed interview text. As each interview was listened to a minimum of three times, and each transcript was read at least four times, common elements were identified between interviews. These common elements, or emergent themes, formed the basis for additional insight into the research questions. In one instance, the emergent themes of 'activities', 'meanings of place', and 'power' (see Section 2.2 for the data associated with these themes) were linked back to the literature. This technique also provides a model for integrating discourses provided by several informants into a narrative and argument that is defensible (Waitt, 2005).

An alternative to discourse analysis was considered. Content analysis is a means of coding the interview transcripts and provides a statistical output as a means of gaining insight into the text through the production of statistics based on the occurrence of words and/or phrases within the text (Cope, 2005). Content analysis was rejected as the primary analytical tool in this research because it does does not provide the depth of content understanding that discourse analysis provides and requires a level of statistical analysis that was not well situated to answering inherently qualitative questions.

Data Collection

The following five research tools were employed to gather data, and each tool will be explored in the following sections:

- Semi-structured interviews were conducted to provide the core data for analysis;
- Mental Maps were produced by each informant to provide a visual reference of their understanding of the geography of Edmonton's river valley;
- On-line Primary Sources such as Facebook and Garmin Connect were reviewed to demonstrate neogeography work flows;
- On-line Secondary sources such as technology blogs were read to gain a snap shot of the current state of technology deployment, and finally;
- Current GeoWeb applications were examined to provide insight into how people interact with these platforms.

3.2.4 Semi-Structured Interviews

A semi-structured interview is an oral method that is positioned in a continuum, from biographies to surveys. Where a biography focuses on the individual, a survey's focus is the group. For instance, a biography provides an in-depth account of individual experience where life's nuances are explored. Surveys, by contrast, do not provide the same degree of detailed information, but allow for the gathering of evidence from large groups of people. Interviews fall into the middle of this continuum and (may) provide an efficient way to gather evidence from a number of people without the depth and complexity of a biography, but with more nuance than a survey (Dunn, 2005).

Semi-structured interviews are bookended by unstructured and structured interviews where the structure of the interview is defined by the intent of the interviewer. Unstructured interviews require that the interview be conducted with no schedule, where the informant is granted autonomy to discuss the agreed upon topic area. Semi-structured interviews allow for an informal and flexible interview schedule where the informant is directed in a specific, but not limiting, direction. Finally, structured interviews are defined by a rigorous schedule where the set of questions is applied to all informants, without variation, exploration of thoughts and ideas, or tangents (Dunn, 2005).

Within the present research setting, the advantage of semi-structured interviews is threefold: (1) they provide a great deal of flexibility for the researcher to pursue a defined research agenda, while (2) allowing for the exploration of new ideas and thoughts presented by the informant, within (3) an open research framework that includes supplementary evidence gleaned from other research methods. A semi-structured interview technique was utilized in this research as a means of pursuing specific questions (please see Appendix A for the complete interview schedule) while concurrently exploring the research domain through the experience of the research informants. Unscripted follow-up questions based on the thoughts and opinions expressed by the research informants were necessary for this (Dunn, 2005).

Mental Maps

Mental maps have been used in human geography since Lynch (1960) utilized them as a research tool in his seminal work, The Image of the City (1960). A mental map represents the perceptions and knowledge a person has of an area. It is not meant to be accurate in a metric or topological sense, but rather reflect the specific understanding a person has of their local geography. During the interview process, informants were asked if they were comfortable drawing a mental map of a part of Edmonton's river valley that they were familiar with. All mental maps were rendered in PDF and Adobe EPS formats.

In the language of the case study method, a mental map is considered a physical artifact that allows the researcher to glean some insight into how its various elements are used individually and collectively to communicate understanding of a geographic space. Mental maps provide a relevant landmark to how people perceive and evaluate their spatial environment (Downs and Stea 1977, Tomko 2007, Lynch 1960) and how they ascribe meaning and attribute value to specific geographic elements (Kitchen 1994).

On-Line Data and Workflow Analysis

Like Mental Maps, on-line data are documentation and can be incorporated into case study method. In this instance, these data documented workflows for the collection and communication of geographic information and are reflected in a number of figures in Section 4.3. Because the object of study is the use of technology as a data collection and communication tool, on-line documentation of work flows provided great insight into how people collected and communicated geographic information using new and novel technologies (Peace and van Hoven, 2005; Yin, 2003). Each workflow was constructed based on a description provided by the informants during the interview process. Some additional supplementary images were used to demonstrate and exemplify specific workflows. These images were accessed from the internet with the permission of the informant and can be found in Section 4.3.

GeoWeb Applications

GeoWeb Applications are those platforms dedicated to displaying geospatial content and can be represented by Google Maps (maps.google.com). In brief, 79 GeoWeb Applications were examined and ranked on four orthogonal non-metric scales: (1) Power, (2) Collaboration, (3) Data Fidelity, and (4) Spatio-temporal Representation. The applications were ranked on each axis, and then a cluster analysis was applied to group similar applications (see Section 3.4 for more detail).

3.3 Research Process

Research is a process where the researcher defines the steps that must be completed for a desired outcome(s). In this instance, the desired outcome is to answer a set of research questions (see Section 1.2). As such, the first step was to review the relevant literature (see Chapter 2) and develop research questions in response to gaps in that literature. The research questions, in turn, suggest a research method (see Section 3.2) and specific data gathering techniques (see Section 3.2.3). The chosen techniques required that informants be interviewed which, in turn, required approval from the University of Alberta's

Arts, Science, and Law Research Ethics Board (see Section 3.3.1).

Once the research questions and methods were defined, and the appropriate approvals for the research were obtained, it was time to enter the research phase, which consisted of (1) reviewing 79 GeoWeb applications; (2) interviewing 17 informants (see Section 3.3.2); (3) organizing and verifying the transcriptions of those interviews (see Section 3.3.3), and; (4) preparing the collected data for analysis (see Section 3.3.4). This thesis represents the final stage of the research process.

3.3.1 Ethics

Research Ethics is concerned with the conduct of the researcher and his or her responsibility to those who are involved with the research process, specifically the informants. The process of collecting social information from individuals, whether in an on-line environment or with a more traditional face-to-face approach, requires personal interactions. These interactions can place the informant in a position of vulnerability for several reasons including: (1) real or perceived differences in power between the researcher and informant; (2) the revelation and subsequent discussion of details that are personal and, perhaps, sensitive; (3) the risk that the research process may harm the informant (Dowling, 2005). As such, this research was imagined and implemented in a manner that explicitly addressed these key issues, and an application for Ethics Approval was made to the University of Alberta's Arts, Science and Law Research Ethics Board (ASLREB). Ethics approval for this research was granted in April 2009.

All informants who participated in the research:

- Were provided with a written, plain language information statement about the study objectives;
- Understood that discrete sections of the information gathered could be published in a thesis, academic journal, conference, or on-line in a blog or similar post;
- Understood that the interviews were confidential, and that informant details, digital audio recordings and complete transcripts could only be viewed by the researcher and his immediate academic supervisors.
- Were provided with the means to contact the researcher and his supervisors by telephone, mail or email after completion of the interview. In addition, all questions that the informants had about the researcher were answered either at the time when they were first approached to participate, or at the beginning of the interview.
- Signed a written consent form (see Appendix B). Prior to signing the consent form, the issues of participation, withdrawal of consent to participate without penalty, and privacy/confidentiality were discussed. If consent was withdrawn within 2 months of an interview being conducted, the digital recording and transcription would be destroyed.

No minors participated in this research, and no inducements were offered.

3.3.2 Interviews

Seventeen interviews were conducted from May through September 2009 in Edmonton, Alberta. The informants were obtained through one of three circles of influence (please see Figure 3.1). Four informants were obtained from the inner-most circle, consisting of a small number of City of Edmonton employees who work within or influence the policy for Edmonton's River Valley. Two of these informants acted as gate-keepers and provided access to two City of Edmonton citizen policy committees that represented a broad range of river valley user groups. Five individuals from this committee consented to being interviewed, and they represented the cycling (mountain biking and commuting), walking and running communities. These five provided access (the 'snow balling technique' of informant recruitment) to a further seven individuals in the largest 'user' circle. One informant was found through the Open Street Map user list.

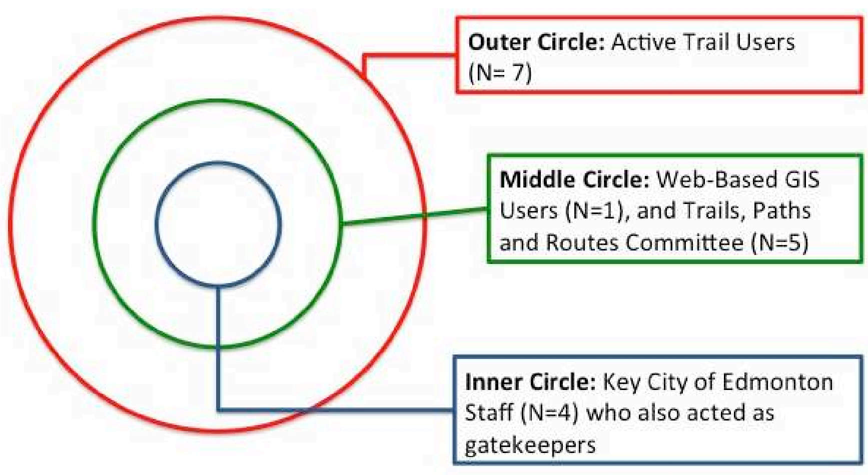


Figure 3.1: Three circles of influence.

The interview process consisted of four blocks of related questions, each block pertaining to one of the research areas. These question blocks were: (1) place based knowledge and mental maps, (2) contribution of relevant information to location based systems, and (3) motivation, and (4) privacy.

The place based knowledge section of the interview was based on the theory presented in Lynch (1960). Lynch introduces the mental map to the participants as follows: ‘We would like you to make a quick map of... Make it just as if you were making a rapid description of the city to a stranger, covering all the main features. We don’t expect an accurate drawing - just a rough sketch’ (Lynch 1960, p.141). The instructions to draw a mental map are simple and the focus lies on the content and not the cartographic quality or aesthetics of the sketch. There is no right or wrong. The key is that the sketch is not copied from a map or image but rather drawn from memory. This sketch formed the basis for a broader discussion pertaining to the informants’ use and knowledge of Edmonton’s river valley.

The contribution of relevant information section looked at how people gathered and contributed data to location-based applications by first examining a number of existing applications. Several screen captures of these applications were created to use as a means of demonstrating to participants the range of functionality of existing applications (see Figure 3.2 for an example). The questions followed a schedule as a guideline that was semi-structured, like the rest of the interview process. This section of the interview was not based on any particular theory, but was focused on the data that people collected as well as how they collected and communicated that information using new mobile or on-line tools such as a GPS enabled mobile device or Facebook.

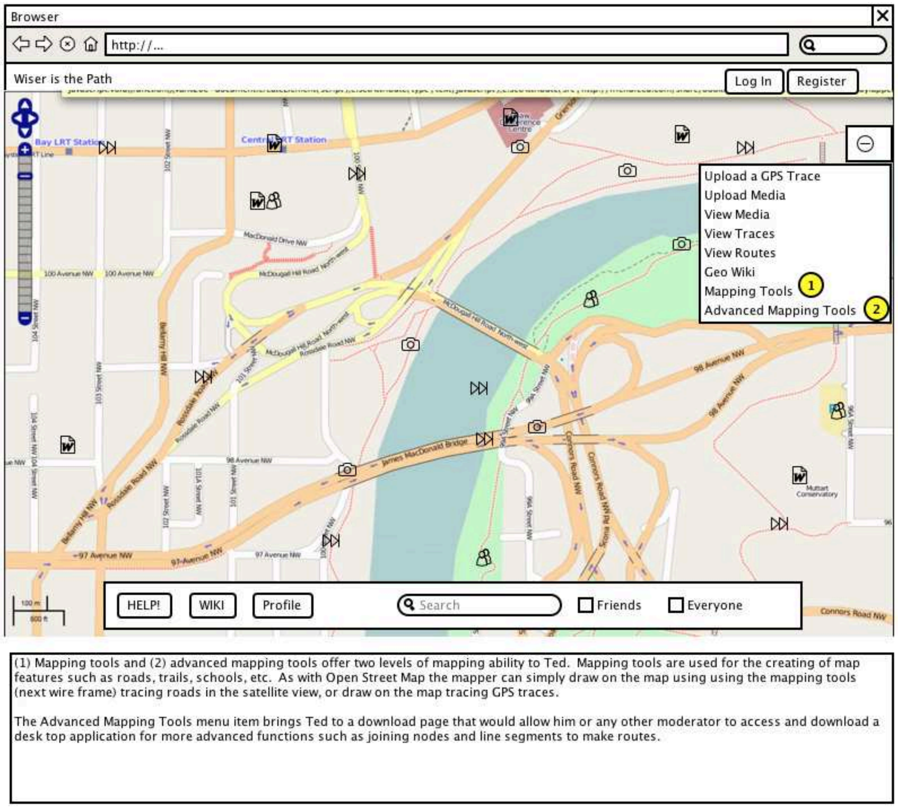


Figure 3.2: A mock-up of a GeoWeb application used as an illustrative example during the interview process

3.3.3 Transcription and Validation

Each interview was digitally recorded using Sony IC Recorder (ICD-SX700). The recording was then uploaded to TranscriptionHelp.com via a secure FTP client hosted by Transcription Help. Each interview was transcribed within two weeks by Transcription Help, and the resulting transcript was transferred back to the researcher via a secure FTP site. The transcript was then validated and corrected by the researcher. The validation process consisted of the researcher reading the transcript while listening to the recorded interview. Corrections were made on the transcript if there was a discrepancy between the written word as compared to the digital recording.

The validated transcripts were then loaded into NVivo 9.0 by QSR International, a computer-assisted qualitative data analysis software (CAQDAS). CAQDAS, in general, and specifically NVivo are accepted tools to manage and conduct text based evaluations (Peace and van Hoven, 2005).

3.3.4 Analysis

As described above, discourse analysis is a process of gaining insight into media through a detailed and in-depth examination of what is communicated in that media. The application of discourse analysis in this research setting supported the classification of the interview transcripts based on imposed and emergent themes. Rather than code only at the word, sentence or paragraph level, variably sized sections of each interview were identified and linked when they addressed a consistent theme or message.

The analysis of the informants' transcripts was an iterative process that occurred over several months. As described in Section 3.3.3, after transcription, each transcript was loaded into QSR NVivo 9.0 and checked for accuracy against the audio interview. Each interview was then coded according to the major themes as defined by the research questions, as follows: (1) place based knowledge, (2) activities and meanings of place, (3) motivation and (4) privacy. These four major thematic areas defined a structure for each interview transcript.

Within each major thematic section, common 'threads' of discourse between the transcripts began to emerge as each transcript was read and re-read. These emergent themes were identified and defined within NVivo and applied to all transcripts to see if each identified theme was common to all transcripts. The resulting coding framework (see Appendix C) thus emerged as a result of several detailed readings and application of the framework to the transcripts. Each theme was then evaluated to determine if it was (1) ubiquitous to all transcripts, (2) could be linked to the research questions, and (3) previous research provided an understanding conceptual understanding of the theme. If these criteria were met, then that theme was represented in the results section of this thesis.

3.4 Clustering of the GeoWeb

As described in Section 2.7, the GeoWeb is a general term used to characterize a wide range of Internet based mapping applications. An examination of these applications is vital to understanding the range of functions and limitations imposed on an informant's collection and communication of location-based data. These applications represent a wide range of functions that have been classified along 4 orthogonal axes as summarized in Section 2.9.

Each of the 79 GeoWeb applications analyzed was selected during the winter of 2009 as this domain was initially being explored. These applications were chosen to represent the widest range of utility available on-line at the time, which met the criteria of possessing 3 of the 4 axes described above. For example, a ranking of zero on more than one axis would disqualify that application from this analysis. Each application was examined and used for several days to assess its relative ranking on a scale of five for each of the four axes. Each individual application was ranked on 4 separate occasions; on each occasion all applications were ranked at one sitting. A fifth and final ranking produced the results that were analyzed through clustering.

The goal of a cluster analysis is to identify and classify patterns of similarity where the objects in each cluster are more similar to each other (in some sense) than those objects in other clusters (Narasimha and Devi, 2011). Pattern identification is based on distinguishing features found within a set of descriptors (for instance, the axes ranking, as described above, defines a set of descriptors for each of the four axes) that relate discrete objects (i.e. individual GeoWeb applications) to each other. This is accomplished by grouping a set of patterns through the creation of a partition between those patterns that are dissimilar (please see Figure 3.3). In this instance, the input patterns were defined by the GeoWeb application classification as per the four axes (from above). The clustering is accomplished by 'running' the classified GeoWeb applications through a Squared Euclidean Distance algorithm (described next).

Figure 3.3: The input-output behavior of a clustering algorithm

The squared euclidean distance algorithm is based on Pythagorus' Theorem, and is a measure of the 'closeness' between two objects within a pattern set (Narasimha and Devi, 2011). Those objects that share common characteristics are clustered based on those characteristics, and are graphically displayed in a hierarchical dendrogram. The results from this analysis can be found in Section 4.5. The squared euclidean distance algorithm can be described as follows (from Narasimha and Devi 2011):

$$D\left(P,Q\right) = \left(p_1 - q_1\right)^2 + \left(p_2 - q_2\right)^2 + ... + \left(p_i - q_i\right)^2 + ... + \left(p_n - q_n\right)^2 \quad (3.1)$$

Figure 3.4: Squared Euclidean Distance Algorithm

Clustering is important in situations where, for example, pattern identification and classification is useful in generating a deeper understanding of a process or case. As this research seeks to understand how an informant can collect and communicate location-based information, it is also vital to understand the functions and limitations of the tools available for these tasks. By classifying GeoWeb applications (the tools of neogeography), insight can be gleaned into their limitations and, thus, into the technology limitations faced by neogeographers.

3.5 Chapter Summary

A qualitative methodology is appropriate for gleaning insight into individual experiences, and the case study method is suited to research that is focused on an in-depth examination where there are many and varied complex interactions. Case study method is an accepted qualitative method in human geography, and information technology research. Within this context, the research process was designed to explore the four themes set out in Section 3.3.4.

These data were then validated and analyzed using NVivo 9.0 and ArcGIS 9.3/10 running on an Apple iMac via Bootcamp and Windows 7. Microsoft Word Mac:2011 was used to view the transcripts initially; the final results and this thesis were written in TextMate Version 1.5.10 on an Apple iMac and MacBook Pro.

Chapter 4

Results

4.1 Chapter Overview

Interview transcripts are quoted throughout this chapter in an effort to glean insight into the depth and extent of place based knowledge that the interview subjects posses. All names mentioned are pseudonyms created to protect the privacy of the interview informants. The mental maps presented represent drawings from memory that the informants produced in response to a question about their use of Edmonton's river valley (see Section 4.2 for a detailed treatment of place, space and mental maps). A complete catalogue of the mental maps produced during the interview sessions can be found in Appendix D.

4.2 Place and Space

4.2.1 Data Overview

Place and space data were gathered from informants during the semi-structured interviews. Several themes identified during the interview process will be explored in the following Section 4.2.2 and will be used to answer RQ1a: 'How is knowledge of place and space expressed, and to what extent is a personal understanding of the local relevant to PPGIS?'

The location data identified during the interview process allows for some insight into RQ1b: 'Is a sense of place and space shared between people? To what extent?' These data will be explored in Section 4.2.3.

4.2.2 Themes Relating to Space and Place

The themes identified for each of the top five most mentioned locations will be explored in detail in the following sections (see Section 4.2.2 for more detail), with supporting quotes provided. Table 4.1 describes the number of mentions each of the top eight themes received relative to the five most mentioned locations; Figure 4.1 provides a map of these locations. The themes, rather than location, are the primary means of exploring this data in an effort to be succinct and focussed; these themes can generally be broken down into three clusters related to place, as identified in Section 2.2: (1) activities; (2) functions or meanings, and; (3) physical features. One additional cluster, power, was also identified. Activities and functions or meanings data will be presented in the following Sections 4.2.2 and 4.2.2 respectively. Physical feature data will be presented in Section 4.2.3 though the mental map data. Power data will be presented in 2.5, and GeoWeb data are presented in a separate Section 4.3.

Theme	Hawrelak Park	Kinsmen Park	Terwillager Park	Mill Creek Park	Gold Bar Park	All Other Locations	Totals
Sports Activity	20	8	0	10	10	14	62
Recreational Activities	4	1	9	0	0	6	20
Activity Routes	15	18	0	6	5	15	59
Impressions	7	0	3	3	4	4	21
Memories	0	0	0	0	5	5	10
Special Place	0	2	4	0	0	1	6
Power	0	0	5	6	4	2	17
GeoWeb	2	2	3	5	0	12	24
Total Mentions	48	31	24	30	28	59	220

Table 4.1: Count of themes mentioned relative to river valley locations.

Locations Mentioned

Figure 4.1 presents a map of Edmonton with a topography of locations overlaid. This map was constructed by geolocating each of the locations mentioned in the interview process. Those locations that were too vague, such as the 'City of Edmonton' or 'river valley', or not within the study area, such as 'Paris', were not included. The elevation, or 'Z' coordinate, is derived from the number of mentions for each mapped location, and was added to the coordinates (X,Y or latitude, longitude) for each location. For instance Hawrelak Park, with 55 mentions, received a 'Z' value of 55. These location data were imported into ArcGIS 10 as a raster layer, and rendered onto a City of Edmonton base-map. An Inverse Distance Weighting (IDW) analysis (de Smith et al., 2007) was conducted on the location raster layer, and rendered as contour lines and as a colour gradient, as seen in Figure 4.1.

The points on the topography layer indicate the 80 relevant locations that were mentioned, and thus provide the focus for the thematic discussion of place. These 'peaks' present a natural break in the topography, and thus provide the focus for a thematic discussion of place. Of the 80 locations, five were mentioned more that 30 times and 68 were mentioned less than ten times.

The most mentioned location, Hawrelak Park, was mentioned 55 times (see Table 4.2). The average number of locations mentioned for each interview was 6.7. A complete list of locations mentioned during the interview process can be found in Appendix E.

Location	Mentions	Number of Interviews
Hawrelak Park	55	12
Kinsmen Park	37	10
Terwillager Park	36	7
Mill Creek	32	11
Gold Bar Park	30	7

Table 4.2: Locations mentioned most frequently by informants.

Activities

Activities relate to a wide range of movements within the study area, and are defined in Section 2.2. The use of Edmonton's river valley for activity is variable, some use it locally for only one activity, while others use the river valley quite extensively, for a variety of activities. Table 4.3 references the number of times a variety of activities were mentioned during the interviews, and by how many informants. The 'activities' mentioned are for that activity and all related iterations of that word. For instance, jog, run, running, ran, runs, are all represented by 'run'.

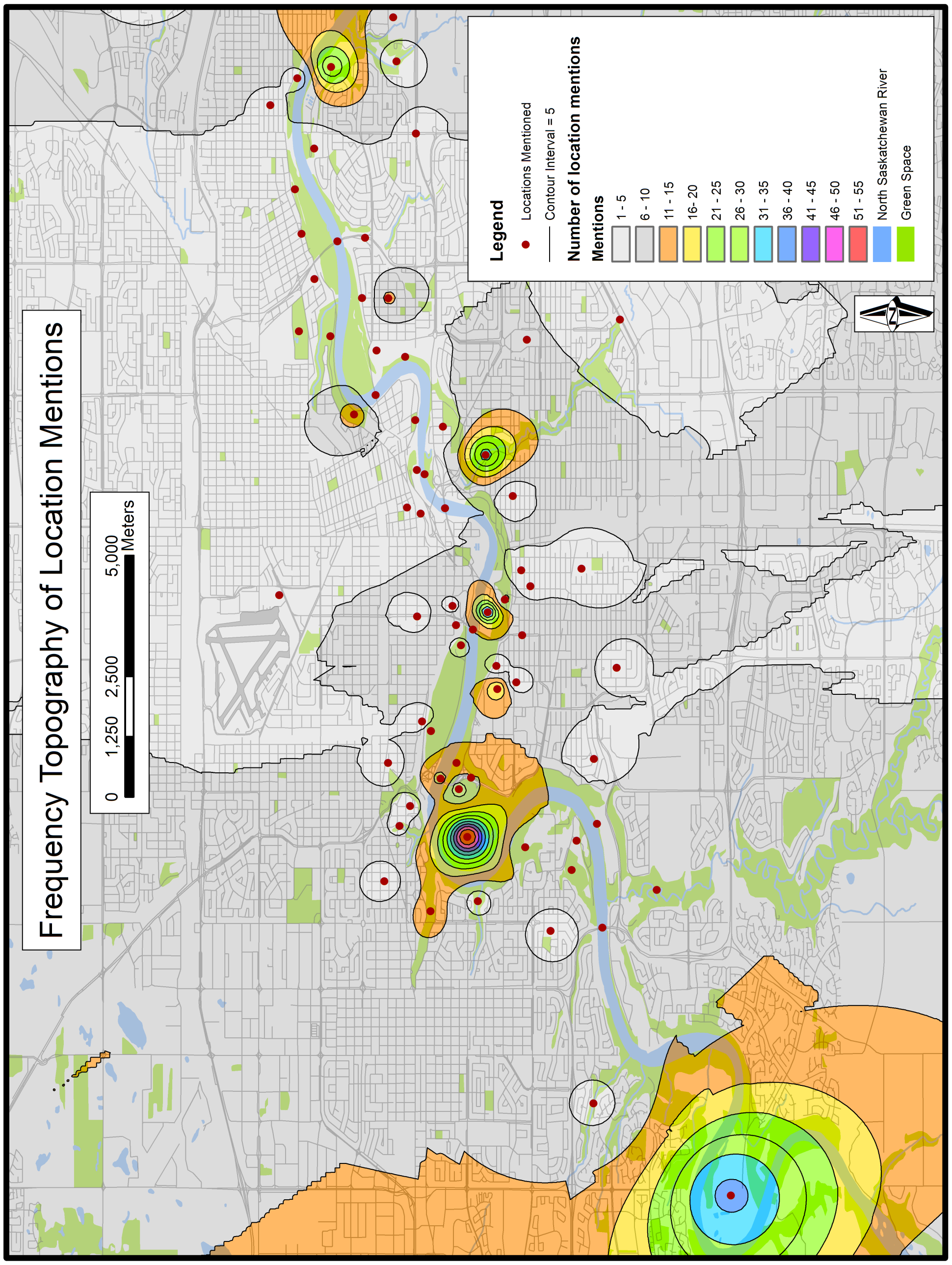


Figure 4.1: City of Edmonton: Locations mentioned by informants during the interviews.

Activity (or related word)	Total Number of Mentions	Mentions by Informants (N=17)
Trail	810	17
Run	538	17
Bike	487	17
Route	386	17
Walk	152	16
Activity	150	17
Ski (nordic)	65	10
Hike	49	7
Recreation	48	7
Orienteer	11	2
Playing	9	2
Playground	4	1
Wander	4	4
Canoe	3	1
Kayak	2	1
Play (Theatre)	2	1
Skate	1	1
Skijor	1	1

Table 4.3: Number of times an activity (or related word) was mentioned.

Sport Activities The theme of Sport Activities is defined as self propelled motion such as running or cycling that the informant engages in either individually or with a group where exercise is the primary goal of the activity. As indicated in Table 4.1, the theme of sports activities was mentioned in association with Hawrelak Park (N=20), Mill Creek Park (N=10) and Gold Bar Park (N=10) most frequently.

Three examples:

1. Mya, a student at the University of Alberta, is a runner who runs on the river valley trails close to the University and home. Here she expresses the value of running in the river valley as a function of the isolation.

> We have some great running loops by the Kinsmen as well as on River Valley Road that are very well used. When I run along the river trails a lot of the time, I'm in the trees which limits views of seeing the city. Also, being isolated,depending on where you are in the trails, limits you from seeing just you know, lots of other people too. You can be further away from other people as well and I just really appreciate that feeling of being a little bit more isolated and feeling that connection to nature.

2. Conversely, Nate is a coach for the University of Alberta's Triathlon Club, cycles with a local mountain bike club, and commutes through the river valley to the University. He is active in the river valley in each of these roles, in the summer and winter pursuing a variety of sports activities:

> So, yeah, I guess our primary use of River Valley is for cycling, with Hard Core Bikes and we do club riding with them. So, a couple of nights a week, we lead or participate in group rides, mountain bike rides. So, we do a lot of running and training. Personally, me and my wife and I use the River Valley for long runs, you know, out of the city. I would say on both shores, and that's by the way 90% of our time we spend in there. We spend a lot of time in the portion of the valley around Gold Bar in the winter time.

3. Seth belongs to a popular running group, the Hash House Harriers (www.eh3.org/). He explains the structure of the group run, including the associated social activities.

> Each run ranges from usually about 45 minutes on average, so it's not lots of hours. The way that the main group is structured is that we circle up first and have announcements and such and do a run, and there's usually some kind of stop towards the end where we have a quick little beverage and then go back to the start location and then the 'religious adviser' dispenses various types of rewards and punishments. There is lot of social activity. So the run may be short but once you count in all the other activities and then you go to a pub somewhere or a picnic in the summer time with the smaller groups, that will be pretty much taken in the evening or in the afternoon.

Recreational Activities The theme of Recreational Activities is distinct from sports activities in that the unit of participation is a family or selection of family or friends and does not involve exercise as the primary goal. Recreational activities can include playing at a playground, going to a theatre performance, or a sports activity where the main objective is recreation, not exercise.

Edmonton's river valley parks support a variety of recreational activities. As described in Section 1.3.2, the recreational activities range from dog walking in Terwillager Park to Symphony Under the Sky in Hawrelak Park. Terwillager Park was mentioned nine times, and Hawrelak Park was mentioned four times, in the context of recreation (from Table 4.1).

Three examples:

1. Terwillager Park is unimproved (see Section 1.3.2), yet still offers recreational activities. As Nolan states:

> Terwillegar as a great example of a multi-use area that is amazing with an off-leash area, and also opportunities for skijoring and other activities.

2. Chris references the variety of activities at Hawrelak Park that are family friendly:

> We attend Hawrelak Park to take advantage with kids of a number of the special events, such as Heritage Days and the Shakespeare in the Park are wonderful family events.

3. Emily discusses her recreational activities through Edmonton's equestrian center, located in the river valley.

> Another amenity is the equestrian center where they have a number of trails that are open for use at different times of the year - winter

> use, summer use, etc. The equestrian center is a great place to go because you get to interact with the horses, ride them and groom them. It allows you to get away from the day-to-day stuff and to connect with some friends.

Activity Routes Activity Routes are defined as a list of locations that outline a path from point 'A' to 'B' or from point 'A' to 'A' via a closed loop. As indicated in Table 4.1, Kinsmen Park (N=18) and Hawrelak Park (N=15) were mentioned the most frequently in relation to this theme.

Three examples:

1. John indicates that meeting at the Kinsmen is akin to meeting at a local coffee shop, and acts as (1) a meeting place and (2) a central location to launch on an activity:

> You know, meet at a coffee shop or meet in front of the Kinsmen or meet at the McKinney Park by the Chinese Garden area or, yeah something like that. Then me and my friends would go for a run.

2. As a location on an activity route, Hawrelak Park can act as an anchor to one end of the activity route that is close to other amenities or in proximity to an informant's home or place of work (as in Sport Activity above).

As Nate relates (see also Figure 4.2):

> Oh golly, we start somewhere around Hawrelak, so, we'll throw that in right about here [a starting point for a route on Nate's mental map, Figure 4.2], and I would definitely add an 'X' here for the Sugar Bowl, because that's where you want to end up.

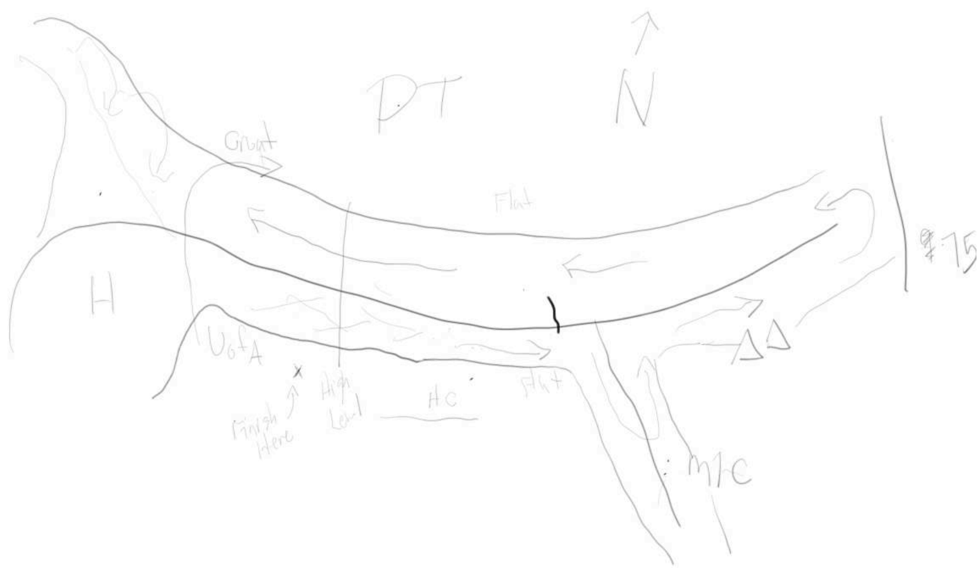


Figure 4.2: Nate's mental map.

3. Sarah, in contrast to Nate and John, gets her exercise by commuting to work from her residence in Old Strathcona. Sarah describes her activity route as follows (see also Figure 4.3):

> I only have to go a few blocks and I'm into the river valley. I go down through Queen Elizabeth Park and then from there I go over the 5th Street Bridge [105 Street or Walter Dale Bridge] and then I go left and onto the River Valley Road, and the Kinsmen is here, and I just keep going along, under the High Level Bridge, and then eventually, you get to Groat Road Bridge here, and keep going. I go past Government Park Hill which is here and then I go up, and I think it's Ramsey, and once I'm into Ramsey, and I go into 142nd Street and then it's all side streets all the way up to work. Within two minutes I'm in the River Valley and then maybe on 10 minutes on side roads.

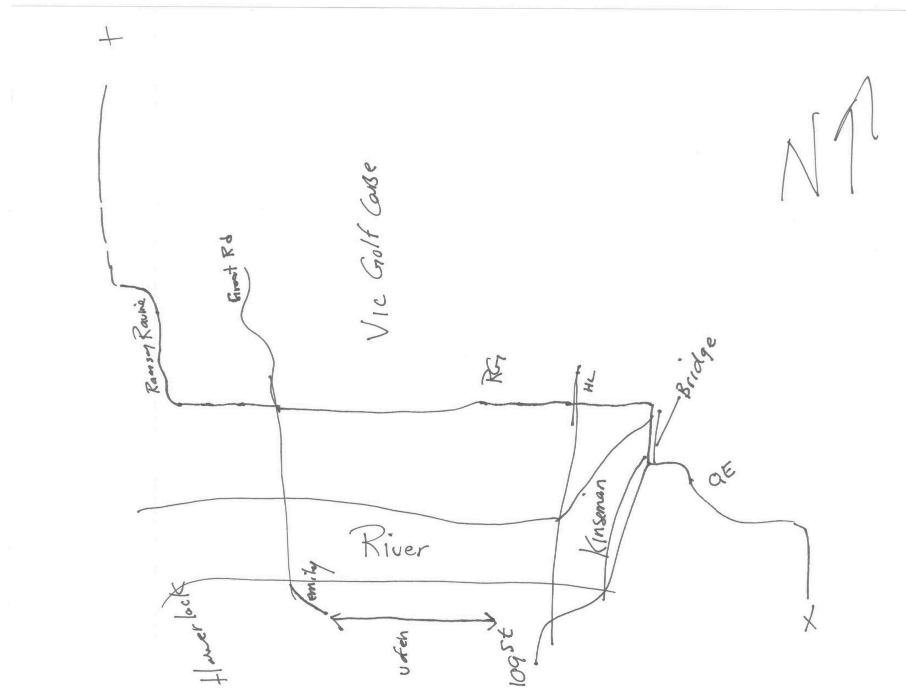


Figure 4.3: Map of Sarah's route from home to work. Drawn by Sarah.

Meanings of Place

Place meanings, discussed in Section 2.2, refers to the meanings that an informant has for a location within Edmonton's river valley, and was explored by the informants through three related themes: (1) impressions; (2) memories, and; (3) special places. Table 4.4 references the number of times specific words related to 'special places' where mentioned, where all derivations of a specific word are represented by their root. For instance, memories and memory are represented by 'memory'. All mentions in this table are in relation to a place.

Impressions The theme of Impressions describe feelings or ideas that informants currently have about a place, and sit in contrast to memories, which are impressions regarding past events. Impressions were mentioned in

Place (or related word/phrase)	Total Number of Mentions	Mentions by Informants (N=17)
Historic	21	14
Landmark	11	9
Impression	11	8
Memory (remember)	10	8
Special Place	7	7
Love	6	4
Religious	1	1
Uplifting	1	1
Unique	1	1

Table 4.4: Number of times 'meaning of place' (or related word/phrase) was referenced, and the corresponding words.

relation to Hawrelak Park (N=7) and Gold Bar (N=4).

Three examples:

1. Evan indicated that certain locations leave an impression on a visitor; Hawrelak Park was one such location, based on easy access to the park, and the breadth of activities that are available to people, and more importantly the beauty inherent in the park.

> If you want highlights for people to see, I would say Hawrelak Park or Mayfair Park [Mayfair Park was renamed Hawrelak Park in 1976] would be definitely one that people should spend some time and depending on what their intent or where they are located in the city you can have a very consistent experience throughout.

2. Gold Bar Park leaves an impression for a very different reason. As Chris related in describing Gold Bar Park:

> Now back in here, there's a hill, and then up here are oil refineries and back up in here. So, that's kind of ominous actually because you have these beautiful trees and everything, and then the backdrop you have these oil refineries, you know.

3. Jack seeks out old or other unusual places, where there is a desire to create a memory of a location due to a dearth of visitors to that location.

> I participate in mystery; mystery rides as we call them. You get a bunch of good people together at night and you kind of take a bike ride and it's sort of supposed to be like a bit of an adventure like you go to strange, unusual places, go to graveyards, you go see industrial areas, you go to the places that most people typically wouldn't go biking and to be able to kind of visit and identify some of those locations I think is interesting.

Memories Memories describe a theme made up of distinct personal recollections that informants have of a place that are easily and clearly described. Memories were mentioned in relation to Gold Bar Park five times (see Table 4.1). For example:

Two examples:

1. Chris grew up on the north shore of the North Saskatchewan River near Rundel Park, across from Gold Bar Park. He recalled when the pedestrian bridge was installed across the river and into Gold Bar; this was a new frontier that offered the opportunity for exploration and adventure:

> I think it was brilliant when they they put those [pedestrian bridge] in the 1970s. And when they did, immediately, you know us kids, could get across the river. There was a path in the woods there, and we call that Moonies run because our teacher, Mr. Moonie, lived right there. My friend played guitar and I played guitar, and we used to take our amps, carry our amps across back and forth across the river. At this point here right in the middle of the bridge was we deemed that as perfectly half way, so we would say, 'Okay, I'll meet you on the bridge'. But yeah, I spent a lot of time down there, in Gold Bar.

2. Andrew, a City Planner, has some distinct memories from when he initially moved to Edmonton, that emerged while drawing his mental map (please see Figure 4.4):

The McKinnon Ravine has an interesting history. When I first moved to the city, you know, they had plans to put a freeway down it. In fact they had plans to put freeways down the Mill Creek and McKinnon ravines. It was the old MED's plan Metropolitan Edmonton Transportation System in the 60s and they actually approved the McKinnon ravine freeway out to the west end and they had, when I moved to the city in 1982 they had the catch basins and the manhole covers and they stood out like big anthills, and then there was a group called 'Sparrow' that argued against it and counseled on the third reading of the bylaws, defeated it. So then years later a parks manager filled the head of the ravine and filled the rest of the ravine then and sort of undermined the opportunity for a freeway but occasionally some counselors come back with the bright idea of putting freeway through the McKinnon ravine.

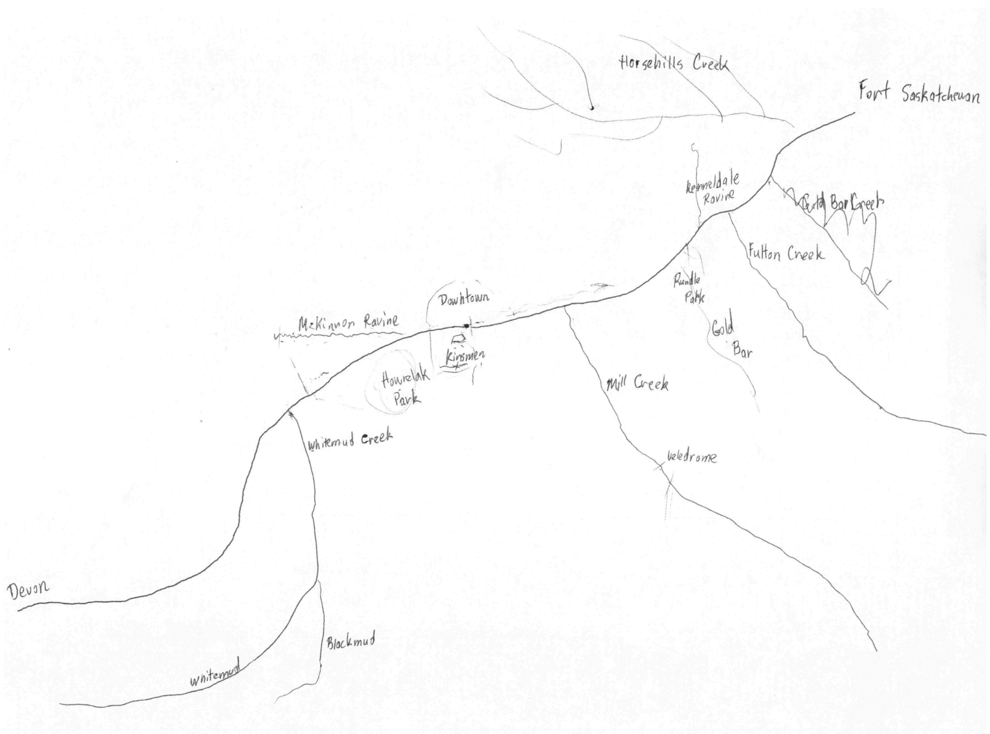


Figure 4.4: Andrew's mental map.

Special Place Special Places are those locations that are identified by an informant as being somehow unique or unusual to Edmonton's river valley. Terwillager Park (N=4), and Kinsmen Park (N=2) were both mentioned as special places (see Table 4.1).

Two examples: 1. Evan, was quite adamant about Terwillager Park being a natural park, and therefore unique in the river valley:

> Terwillegar Park and I know this is a... it's a wonderful park. It's one of Edmonton's natural parks and it's certainly under a lot of development issues right now, but I look at it as an interesting park both for mountain biking and for running. There's a great single-track opportunity is up on the bench of Terwillegar Park, you can plan to spend 30 to 40 minutes exploring. You know, and certainly when you phrase a lot of this, I love the word 'explore'. You know, because again it is challenging with trails because they are always changing and conditions change so the same one trail is here this year maybe it's not there next year or next month.

2. Megan, when discussing Ewok Village, was concerned about this special place being mapped. Ewok Village is a small network of raised wooden cycling paths that are intermittently build by avid 'north shore' of Vancouver style mountain bikers (who ride on elevated platforms) in Edmonton; when built it is situated in the river valley below Forest Heights.

> There's some areas that can't be mapped, like Ewok Village, you're not supposed to be in there. But it is such a unique and fun place to ride, and to learn how to do different things on your bike like they do in Vancouver!

Power

Power can be defined as the inclusion or exclusion of citizens in a process, and is discussed in Section 2.5. In this instance, power relates to the process that the City of Edmonton has for including citizen views in the development of city parks. For the purposes of this research, development is defined as an informant's understanding of the changes that have occurred to a location based on improvement, conversion or other changes to parks land. There was am impassioned discussion with 6 of 17 informants regarding the development of Edmonton's river valley trail and park network. As per Table 4.1, development at Terwillager Park was mentioned five times, at Mill Creek Park was mentioned six times, and at Gold Bar Park four times.

Three examples:

1. The conversation about development issues with Evan took place within the context of the GeoWeb. Evan feels that there is the potential of applying GeoWeb technologies to Edmonton's development issues. As he states:

> [The GeoWeb is] interesting because it has the opportunity to engage citizens and the reason I say that is because often when people feel like they want to do something it's because they have seen something that has been impacted. So, it usually involves a location and an experience. If you can capture those things and then be able to move that information and communicate it into a democratic process, that's really powerful. There's plenty of city infrastructure whether they are paved trails or not that fall behind maintenance schedules and then you see that development philosophy playing under the place like Terwillager Park and think that this is not a sustainable maintenance development model for the River Valley.

In this instance, Evan is referring to his sense that the development of trails within Terwillager is occurring without an inclusive process.

2. In contrast Andrew, who works within the City of Edmonton Planning Department, has a particular take on planning within the parks system:

> So it's a challenge to try and set reasonable expectations of what's possible within the context and scope of any particular park, and that's one of our challenges that the City has, in order to make

> the work we do manageable, we have to draw little boxes around stuff and say 'This is what's in and and what's out', in terms of what we're looking at as part of this particular project. So a good example was Terwillegar - they had money to do the connector trail right from, whatever, east or north of Terwillegar to south of Terwillegar. It came down to the river there. And the fate of Terwillegar Park wasn't part of that. It basically had some, you know, grant money to make that connection. People were freaking out that all of a sudden there was part of an evil plot to redevelop Terwillegar Park. And essentially, you know, really what was happening was, we knew this was going to be planned. All they wanted to do was design this trail as a connector, right?

3. James, who has worked in the past as a River Valley Ranger, for the City of Edmonton, has these observations with regard to power:

> I think one of the weaknesses right now is there's a disconnect between the city's development plans for its trail network and what the end users ultimately want. So from the city's point of view, it's driven by safety and access and often that translates into widening trails, leveling trails and making it accessible to move vehicles in and out. I think a lot of users consistently feel threatened by what could happen to certain trails and so if there's an opportunity for citizens to able to engage before different maintenance plans happen or different activities happen, that would be greatly appreciated, you know something that people could apply to if they wanted to be notified. I think the city really needs to figure out what it's doing when it attempts to do that because any attempt at trail closure that I have witnessed is it's always circumvented by users. They'll knock the fence down that will go around the barrier. So the city is attempting to close an area or show that they're closing an area obviously to reduce litigation risk. However, I think there's a kind of a philosophical gap in terms of how they are going about this.

4.2.3 Physical Features

Mental maps provide insight into the spatial knowledge that individuals deem as relevant or important. Sixteen of the seventeen informants who were asked to provide a mental map did so, one informant expressed some discomfort based on his or her inability to express spatial relations from memory and did not consent to drawing a mental map.

The mental maps found in Figure 4.5 represent two general classes of spatial knowledge: (a) fifteen mental maps were drawn with points of reference in addition to the specific route being discussed. In this instance the North Saskatchewan River was drawn first as an initial spatial reference, with addition features such as paths and routes added subsequently, with further details provided (such as the refinery 'circles' in the top right of the image) as a means of illustrating a point; (b) this mental map that was drawn with no spatial reference other than a line representing the route being discussed. The description of the route was limited to the trail and the features on or immediately adjacent to the trail. For instance, the grade of the trail, distinctive curves and water fountains were noted.

There are also a range of views expressed though the mental maps. As discussed earlier, Nate and Sarah (see Figures 4.2 & 4.3, respectively) each offered a detailed view of a specific region of the river valley that they regularly used. In contrast, Evan (see Figure 4.6) offers a more extensive and less detailed view of Edmonton's river valley starting in the south west with Terwillager Park and ending in the north east with Hermitage Park and the industrial plants. Each bridge that crosses the North Saskatchewan River in Edmonton is represented.

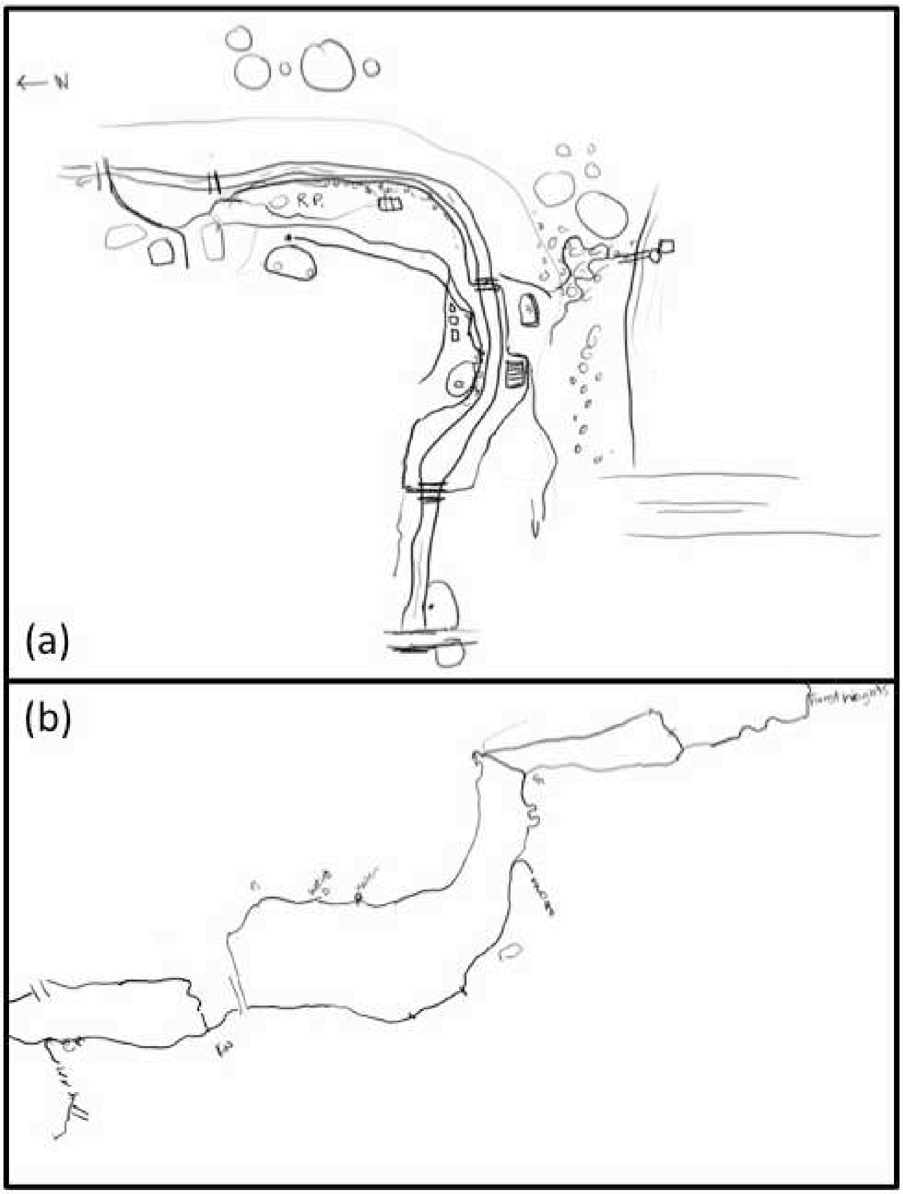


Figure 4.5: Mental map representations of space: (a) spatial features referenced, and (b) spatial features not referenced

Figure 4.6: Evan's mental map spans the entire river valley as it runs through Edmonton.

4.3 The GeoWeb

This section will present data related to the 'how' of data and information communication raised by RQ2a: 'How do people contribute geographic information to the GeoWeb? How do people collaborate with peers and with authorities via the GeoWeb?' This question is predicated on the neogeography notion that data contribution is part of a three mode process of data generation, communication and consumption. The research data presented in this section derive from the interviews and are organized based on neogeography behaviors. Section 4.3.2 refers to the informant's practices at generating spatial data, Section 4.3.3 communication practices, and Section 4.3.4 address data consumption behaviors.

4.3.1 Data Overview

Neogeography can be defined as the generation, communication and/or consumption of spatial data via the GeoWeb (Rana and Joliveau, 2009). Within this context, informants were asked questions related to their neogeography practices in Edmonton's river valley, and these results are displayed in Table 4.5.

Data Activity	Interviews	References
Data Generation	16	48
Data Consumption	16	76
Data Communication	16	123

Table 4.5: Neogeography practices in Edmonton's River Valley

As outlined in Table 4.5, 16 of the 17 informants demonstrated some neogeography practices. A closer look at these data (please see Table 4.5) reveal that of the 16 informants who reported some form of data generation, consumption or communication practice, that data communication was by far the most frequently mentioned activity at 123 references as compared to 76 for data consumption and 48 for data generation. These numbers and the corresponding practices will be explored in the next three sections.

4.3.2 Data Generation

The activity of data generation, for the purpose of this research, was focused on the mode and practice of data generation and the informants' corresponding attitudes towards this activity. As noted, 16 of 17 informants reported that they used the tools of neogeography (see Section 2.7.1) to support the creation of data for personal consumption or communication purposes. Table 4.6 reports on the data generation practices (technology and web applications used) of five informants who generated the most data of those in the interview cohort.

Two examples of data generation:

1. Isabel likes to run with friends and will work collaboratively with them at mapping a running route that they all agree to:

> My running friends and I, we'll put out a map either MapMyRun or Google maps are two of the ones we use the most of the time. I will create a map that I think we should run on, say Sunday, and then they'll send the KML file and they will just download it and we'll take a look at what they think and we can make adjustments based on ideas or if we know there's going to be construction in a certain area and not to run on that direction.

2. Megan collects a more complicated data set to create fly through visualizations in Google Earth, as follows:

> The way that I collect data, the work flow that I go through is I waypoint, I start a track on my iPhone or Garmin, and then I take a picture, and then I go on take my iPhone out, and the I go and correlate the picture and waypoint number together because there's no way to do it on either of my two devices. And I will do this for a number of locations. Then I go home and load the photos into panoramio.com and then input the waypoints, and I can then load all of this into Google Earth.

Counter to the attitudes of the top five data contributors (who are active GPS users), Andrew, an avid runner, characterizes the use of GPS devices as:

> It's not up to a GPS to decide where you want to go, but you. I think because I am a runner, I am a more serious runner, I sort of look down upon the Gucci runners who have to have a cellphone and a Garmin watch and all the other accoutrements. I am just going out there unencumbered and I usually know where I am going, and most people can follow the trails quite easily.

Informant (# of references)	Web Application(s)	Mobile Device	Data Types Generated
Evan (11)	Garmin Connect, Facebook	Garmin Forerunner	GPS trace, heart rate, pace, time, distance, elevation. Social network status updates
Megan (5)	Google Earth	Garmin eTrex, iPhone, Camera (stills and video), Panoramamio.com	GPS trace, video, photo, fly through visualization
Isabel (5)	Google Earth, MapMyRun.com	Garmin Forerunner	GPS trace, time, distance
Chris (5)	Runningmap.com	Garmin Forerunner	GPS trace, time, distance
John (5)	OpenStreetMap.com	Garmin eTrex	GPS trace, line, polygons

Table 4.6: Data generated by informations during activities in the river valley.

4.3.3 Data Communication

Table 4.5 indicates that data communication was the most discussed activity in the neogeography section of the interview. Overall, 16 of the 17 informants indicated that they did have a neogeography (see Section 2.7.1) communication practice to support the communication of data that they accessed or created for personal consumption or communication purposes. Table 4.7 reports on the data communication practices (technology and web applications used) of five informants who communicated the most data among those in the interview cohort.

Informant (# of references)	Communication Practice
Isabel (20)	MapMyRun.com, Google Earth (KML), Email
Evan (19)	Garmin Connect, Facebook
Megan (17)	Google Earth fly through
Ian (12)	BikeMap.com, email
Mya (11)	RunningMap.com, email

Table 4.7: Data communication practices by informants who plan trips prior to the activity in the river valley.

Two examples of data communication:

1. Evan communicates his his data via a number of communication channels to promote his trail running race series:

> I use Garmin Connect to record or to house and analyze my activity data and from there I also use it to communicate it to people through a Facebook group and then to email people that I might have actually done an activity with directly. It's also a marketing tool. It's part of my activity with the Five Peaks series, I have a vested interest in promoting the natural areas in Edmonton for people to go in and trail running.

2. Megan, as previously noted, likes to generate data. Once the data is generated:

> And so I geotagged of the entry and exit points. The obstacles were way-pointed and photographed, and I completed a trace of the cycling route. From these data - the waypoints, the geotagged photos, the GPS trace, I actually did a video up from Google earth. It's like showing all the web points for the data. I exaggerated the elevation because you can do that in Google earth and made it look like you were going through a fly-through. I shared this video with my friends who like to ride that trail.

There is some interesting detail in the interview transcripts regarding work flows where five informants had workflows that shared the elements of:

1. A desire to communicate route selection to a group of friends;
2. A desire to include a broader social network in their activity, and;
3. A early adopter attitude towards technology; they all owned at least one mobile GPS (for instance, a smart phone or Garmin device)

An Example of a GeoWeb Workflow

Evan is prominent in the Edmonton running community, and has a number of followers on Facebook who act as support and training partners as he trains for ultra-marathons. As such, Evan is often looking for running partners, or organizing group runs, using a combination of technologies. Garmin Connect allows him to display proposed running routes in a map format, and Facebook supports the communication of this map to Evan's social network. His workflow is as follows:

1. Evan posted a Facebook status update asking for runners from his social circle to go on a training run on a route that Evan called Trans-Edmonton. Evan provided a link in the Facebook update to the Garmin Connect web-based application where the proposed running route is mapped.

2. People respond to the request, and the details of the run are made clear and agreed upon. Those details include, time, place, route, distance and pace. Because this was a long run, Evan detailed some run requirements, such as food and energy drinks.

3. The run is completed.

4. Evan's Garmin Forerunner data are uploaded to Garmin Connect (see Figure 4.7), and is link to this data is provided in a follow-up Facebook update (see Figure 4.8).

4.3.4 Data Consumption

In the neogeography sense, data consumption relates to a user's consumption of geographic information via the GeoWeb. Within this context there were 76 references to data consumption within the neogeography section of the interviews across 16 of the 17 informants (please see Table 4.5).

Three examples of data consumption:

Isabel has a typical data consumption behaviour where she is interested in access activity routes that other people are running in the river valley:

> MapMyRun is nice to see where other people are running and to scope out other running locations, like Mill Creek Ravine, that I

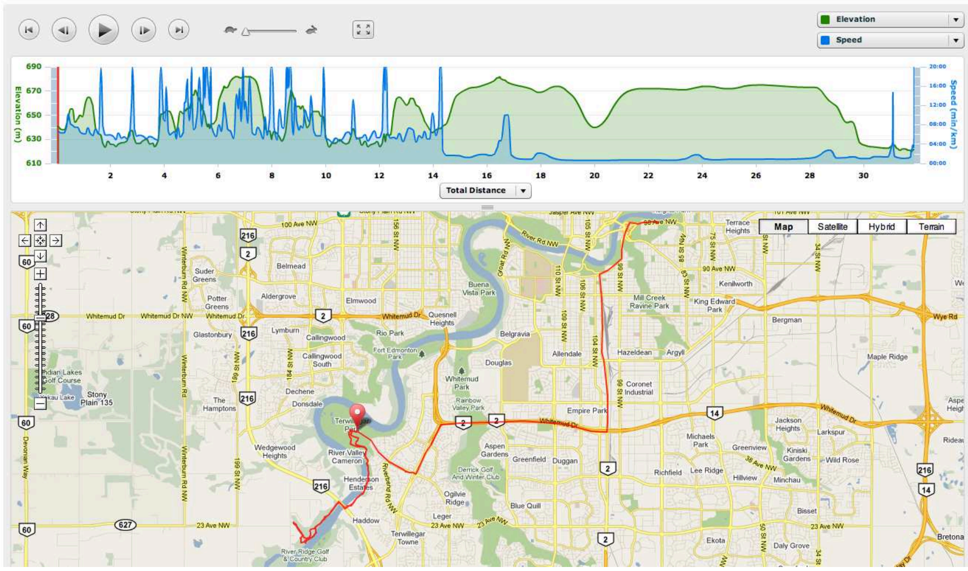
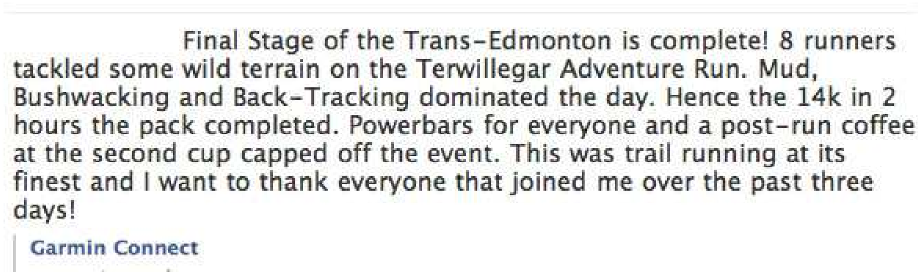


Figure 4.7: Evan's route map and additional data (speed, elevation) from Garmin Connect


Final Stage of the Trans-Edmonton is complete! 8 runners tackled some wild terrain on the Terwillegar Adventure Run. Mud, Bushwacking and Back-Tracking dominated the day. Hence the 14k in 2 hours the pack completed. Powerbars for everyone and a post-run coffee at the second cup capped off the event. This was trail running at its finest and I want to thank everyone that joined me over the past three days!

Garmin Connect

Figure 4.8: Evan's Facebook post thanking those who ran with him.

> don't necessarily use a lot. So I guess for getting the information also for races that are coming up, downloading the race route and being able to trace it. The Running Room often sends out their running routes with different groups as well though Garmin to where you can just download it on to your Garmin application.

John has an interest in maps, has contributed to the Open Street Map project and in this quote is contrasting the usefulness of a GPS to a paper map.

> Ever since I was a little kid, I've always like using maps. I am fairly good with navigating and I've always just enjoy it as an activity and will see how using GPS you know, if it's better or worse or what. The thing about paper map is that whatever you're looking at it's old and it represents the interest of the people who published the map. So like most maps of Edmonton don't really have the trail system on it and so they're not really not useful for it, you know.

James offers a counter trope to the use of the GeoWeb as a tool for data consumption.

> I'm an outdoor educator by training, so I grew up in a world of paper maps, and using those, you know, to get around. So I'm very comfortable with maps in terms of way-finding. I use to orienteer extensively; I was a ski guy, a canoe guy. I'm the kind of person that if I have a map, I know that I can orient myself and know where I'm going. So I never did sort of make that transition to any of the portable devices, and you know, I'm still getting used to carrying a cellphone.

4.4 Limiters and Enablers of Contributing to the GeoWeb

The data presented in this Section 4.4 are derived from a small portion of each interview, and are intended as an exploration of the themes of motivation and privacy. It is not within the bounds of this research study to investigate these two themes in great depth.

4.4.1 Risk

Privacy was defined by four classes of privacy concern: location data, data collection, data control, and data use. The informants in the interview process identified three main privacy concerns (see Table 4.8): (1) six identified location data; (2) eight identified data control, and; (3) two identified data use.

Informant	Dominant Privacy Concerns	Percent of Interview Coded (Total)
Jack	Data Control, Location Data	20 & 6 (26)
Sarah	Data Control, Data Use	15 & 11 (26)
Nolan	Location Data, Data Control	18 & 5 (23)
John	Location Data, Data Use	12 & 10 (22)
Emily	Data Control, Data Use	14 & 7 (21)
Nate	Location Data, Data Control	15 & 5 (20)
Isabel	Data Control, Location Data	12 & 7 (19)
Eric	Location Data, Data Use	12 & 3 (15)
Evan	Location Data, Data Control	9 & 5 (14)
Chris	Data Use, Data Control	7 & 5 (13)
Megan	Location Data, Data Control	8 & 1 (9)
Miya	Data Control	(7)
Michael	Location Data	(6)
Henry	Data Control	(6)
Andrew	Location Data	(4)
James	Data Control	(2)
Seth	Data Use	(1)

Table 4.8: Privacy concerns coded as a percent of total interview time

Location data

There was a range of answers related to the theme of Location Data. For instance, Nate indicated that she would have no issue with other users of a GeoWeb application seeing his location information:

> I'm fairly conscientious about online privacy but only in terms of like giving out my personal information like my address, my phone number, all that crap. I don't really have any issues with other people seeing where I am riding or you know, how fast I was going or this and that. I don't care about that stuff. So my privacy concerns would only be related to things like identity theft. So the usual Internet privacy issues. I don't care if my real name and location is up there. I don't really have a problem with it but I am, you know, a fairly fit male. I would probably wonder if my wife was posting off her routes and she is doing the same run on the same day every day, you know, just more of an announcement of where she is going to be every Wednesday afternoon kind of thing.

In contrast, many GeoWeb users were not comfortable with their specific real-time location information being available. Megan used PayPal analogy to describe how she imagined location information being safeguarded:

> So I'm thinking like PayPal, like the PayPal mechanism. You don't get to see the other person's banking information. That's kind of the same way because then, then applications act as an intermediary between two people - then their location isn't known to me and they don't know my location.

John, who works on the OSM project, has a specific concern related to location-based information:

> I am a gay man. I grew up in Oregon, Washington in the States at the time where there was actually anti-homosexuality laws, having sex as a gay man is actually punishable by life imprisonment. Okay. I developed a real sense of privacy about that and I think it sort of gone through my - many parts of my life...That you know, just living your life that way, you know, you keep so much of it private.

> The whole thing becomes very private other than your friends, and although I am more open about it now, I still keep most of my life private; I saw a friend go a jail for it, and there's a totally different life back then.

Data control

Data control relates to the amount of control the user has over the data that is being posted to the GeoWeb.

Chris, a GeoWeb software developer, is open to his location data being made available on-line, but would prefer to have control over who can access his data:

> But I think that people are scared of it because they think that they're going to be stalked, but if you can put the controls into it in the case of RunningMap.com, for example, if you want to put in your location-data....If you want to broadcast it and if you want to control who you broadcast it to, we'll allow that so that someone can watch where you are when you're running a big race.

Evan also likes to control his data, but rather than manage it through an on-line application, he uses another strategy:

> One thing that I do however is I don't start my routes from my house. If I'm going to publish them I'll start them from a common landmark or something like that. So I will start them from a local caf or a recreation facility or parking lot or something like that. I won't terminate it at my house.

Data use

In addition to control, Chris is also concerned about the future use of location data that is being made freely available now:

> I mean there's still a lot you don't know, the Internet is the Wild West right? There's a lot of things we don't know about Geo applications in that sense. You know, what are people going to use it [data made available now] for future malicious purposes and so

> forth. That's on my mind quite a bit. It is on mind about where we can you know the more you sort of push this and put data on there how is this going to be used in a malicious way, right?

The Open Street Map project is reliant, in part, on government base-map data, such as road infrastructure. John spoke to the issue of government collecting spatial data, and not always releasing it for public use:

> Well, you know there is a whole ton of tax money spent on creating this spatial data. I don't see any reason why government should hang on to it and keep it a secret. So yeah, I think it should be released. I mean, they are maybe some national secrets in there but, you know, the secret military base used to keep the aliens but other than that, why not let us use it.

4.4.2 Benefits

Of seven possible motivations as outlined by Nov (2007), the informants identified only two motivations as being their primary motivation (see Table 4.9); (1) eight identified enhancement; (2) four identified values, and; (3) five did not identify a motivation at all.

Informant	Dominant Motivations	Percent of Interview Coded (Total)
Miya	Enhancement, Values	12 & 6 (18)
Eric	Enhancement, Fun	10 & 5 (15)
Megan	Values, Fun	6 & 3 (9)
Henry	Values	(7)
John	Enhancement, Social	5 & 1 (6)
Chris	Enhancement	(6)
Isabel	Enhancement	(4)
Seth	Values, Enhancement	3 & 1 (4)
Jack	Values	(3)
Nolan	Values	(2)
Sarah	Enhancement	(1)
Emily	Enhancement	(0)
Andrew	N/A	(0)
Evan	N/A	(0)
James	N/A	(0)
Michael	N/A	(0)
Nate	N/A	(0)

Table 4.9: Motivations coded as a percent of total interview time

Enhancement

Section 2.8.1 of the Literature Review discussed Motivation and defined Enhancement as receiving some personal growth or satisfaction from the volunteer activity.

In this instance, John is discussing his participation in the Open Street Map project.

> This is one way you can collaboratively have your own map. You know, it's sort of a joy of ownership in a way, and be able actually have a hand in making one, that's interesting to me.

John personally gains satisfaction in working with other people on the project, feels and sense of ownership and pride in the making of the map.

Furthermore, Seth also feels a sense of community in that he is working collaboratively with his running group to create a running experience.

> It is sort of the aspect and the opportunity to have something like this interactive, collaborative thing that we do. We are a drinking club with a running problem; we like the nature, we like the environment. We have a name for it - we call it shiggy, which is non-roads, non-maintained trails so it's just going into the bush. That's the point of it.

Values

Values were also defined in Section 2.8.1, as the importance that a volunteer may place on altruistic and humanitarian concerns where the needs of others and their wellbeing is valued.

Seth discussed the importance of 'giving back' or contributing to the City of Edmonton.

> I feel that I can contribute something meaningful [information that could go onto the GeoWeb] instead of just sitting on a committee to listen and do nothing. If you want the city to be a good city then we need to contribute to it when we can.

Megan also feels that it is important to 'pay it forward'.

> I've been helped by other people; I have an interest in a huge array of subjects and everybody puts stuff on-line for other people to read. And if I can contribute to something that I know a lot about and something that I'm interested about, somebody might learn something and just paying it forward.

4.5 GeoWeb Cluster Analysis

As discussed in Section 2.9, the GeoWeb represents a diversity of mapping applications. While many individual applications, such as Open Street Map, have been studied (Haklay 2008), there has been no systematic analysis of the utility of applications. This cluster analysis represents an initial attempt at grouping the utility of GeoWeb applications based on the following:

1. Power as described by Arnstein (1960) in Section 2.5, and in Table 2.3;
2. Collaboration as described by Shirky (2008), found in Section 2.6.1, and in Table 2.4;
3. Data Fidelity as suggested by the Dempster-Schaefer Theory (Dempster, 1967; Shafer, 1976), found in Section 2.7.3, and Table 2.5, and;
4. Spatio-temporal representation as described in Section 2.4.2, and Table 2.2.

Figures 4.9 to 4.14 represent the clustering analysis of 71 GeoWeb applications on the four axes. The scale on each axis corresponds to a whole number between one and five, with the centre of each diagram being (0,0). The red polygon in each graph represents the average ranking of that cluster.

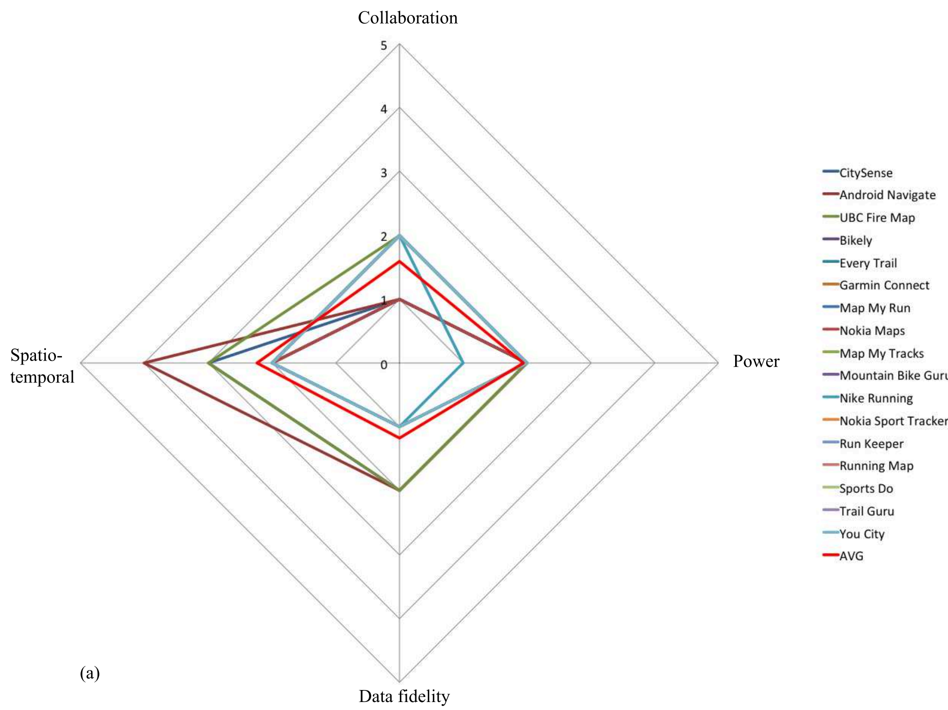


Figure 4.9: Cluster analysis: Weak spatio-temporal trend.

Figure 4.9 represents 17 applications that tend to cluster at the lower end of all four scales, with a slight leaning towards the spatio-temporal scale. The average ranking for the four axes are: collaboration = 1.6, power = 1.9, data fidelity = 1.2, and spatio-temporal = 2.2.

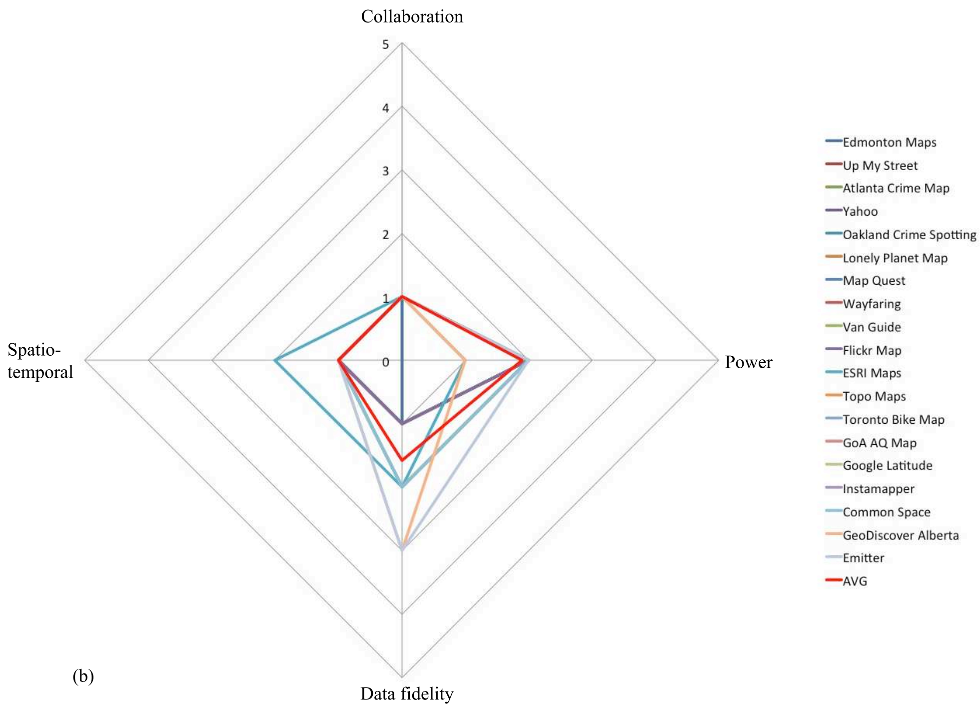


Figure 4.10: Cluster analysis: Weak data fidelity trend

Figure 4.10 represents 19 applications that tend towards the data reliability axis. Emitter.ca ranks highest with a score of 1 on the collaboration scale, 2 on the power scale, 3 on the data reliability scale, and 1 on the spatio-temporal scale. The average ranking for the four axes are: collaboration = 1.0, power = 1.9, data fidelity = 1.6, and spatio-temporal = 1.0.

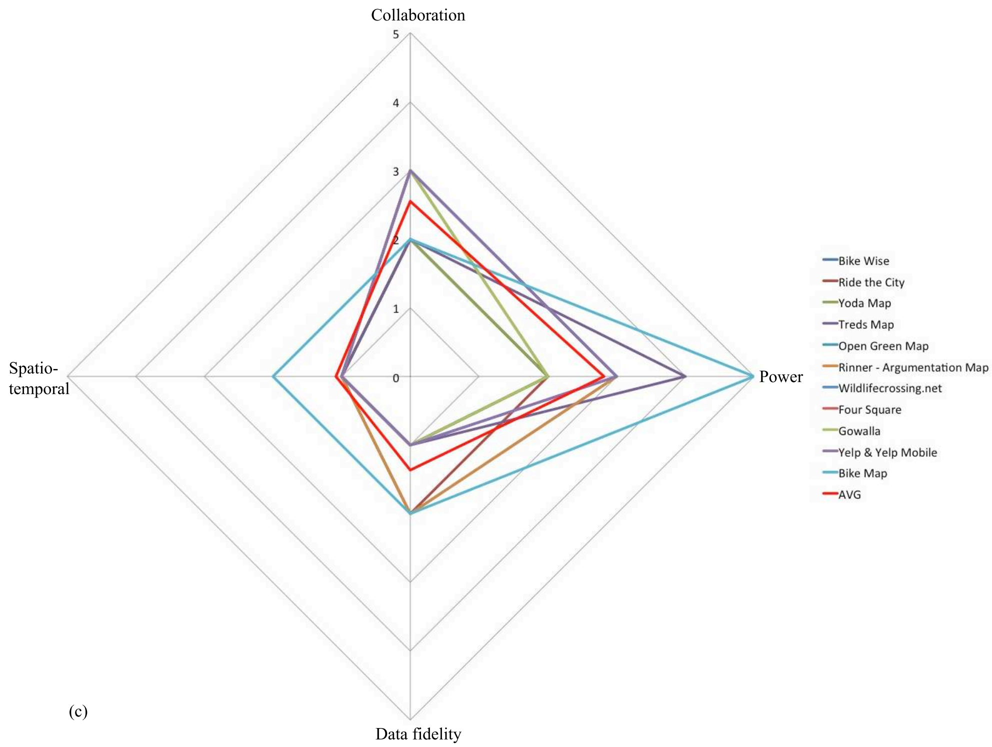


Figure 4.11: Cluster analysis: Strong power trend

Figure 4.11 represents 11 applications that tend toward the power axis, where Bike Map ranks highest on power (5 out of 5). The average ranking for the four axes are: collaboration = 2.5, power = 2.8, data fidelity = 1.4, and spatio-temporal = 1.1.

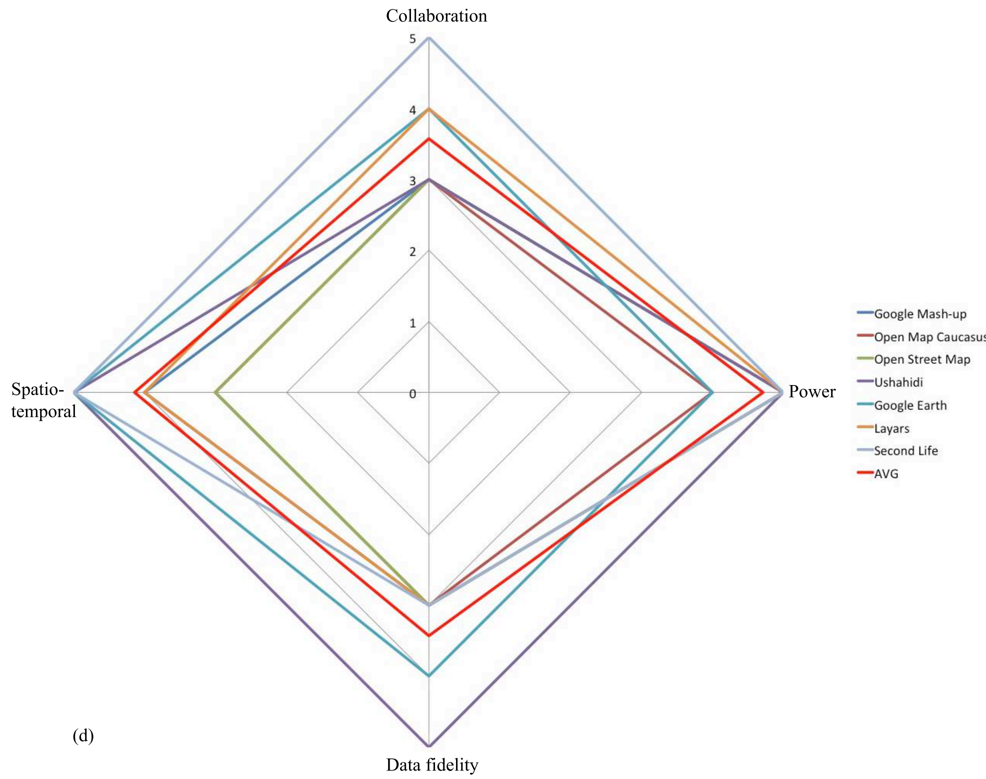


Figure 4.12: Cluster analysis: Strong collaboration, power, data fidelity and spatio-temporal trends

Figure 4.12 represents seven applications that tend to cluster at high end of the scale for all four axes. These applications, though few in number, tend to some of the best known of the GeoWeb and include Google Earth, Open Street Map and Ushahidi. Google Earth scores 4 (out of 5) for data fidelity and spatio-temporal (Second Life and Ushahidi also scored 5 (out of 5) for spatio-temporal); Second Life scores a 5 (out of 5) on the collaboration scale; Layers scores a 5 (out of 5) on the power scale (as do Second Life and Google Mash-up). The average ranking for the four axes are: collaboration = 3.6, power = 4.7, data fidelity = 3.4, and spatio-temporal = 4.1.

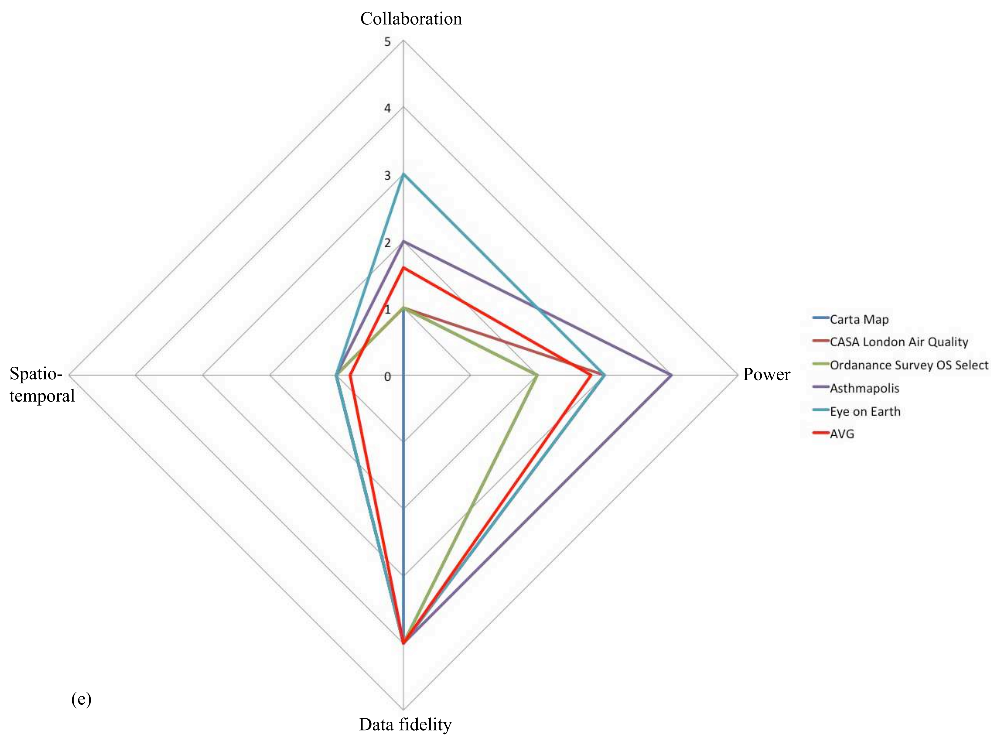


Figure 4.13: Cluster analysis: Strong data fidelity and power trends

Figure 4.13 represents 5 applications that show a strong trend towards data reliability and power, and low rankings for spatio-temporal and collaboration. Asthmapolis ranks a 4 (out of 5) for the power and data fidelity scales. Average rankings for the four axis are: collaboration = 1.6, power = 2.8, data fidelity = 3.8, and spatio-temporal = 0.8.

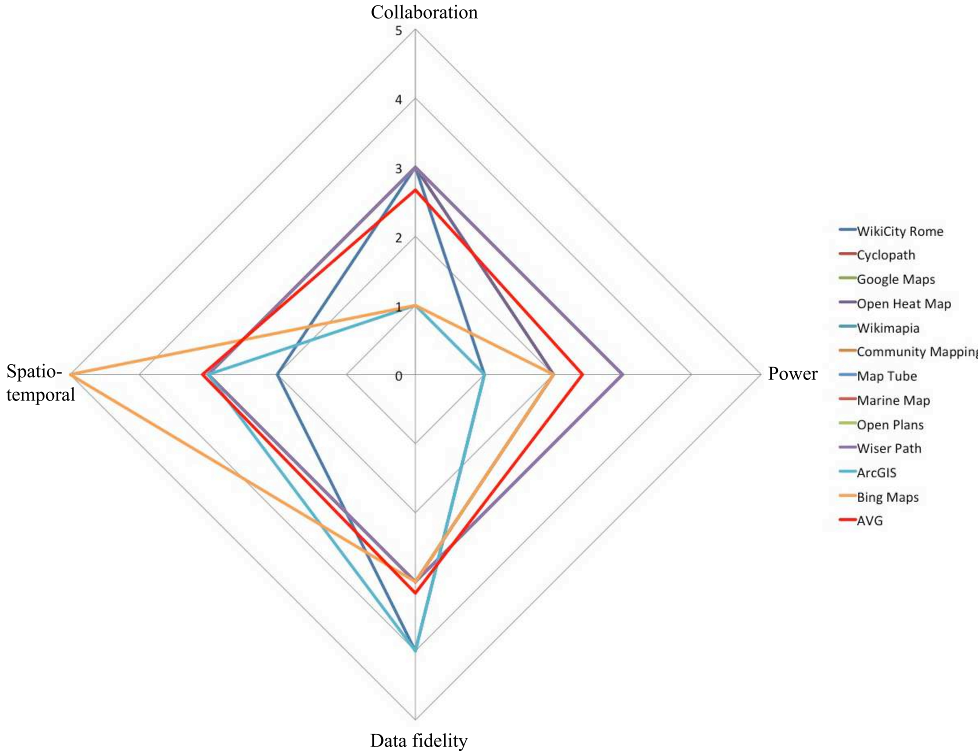


Figure 4.14: Cluster analysis: Strong spatio-temporal and data fidelity trends

Figure 4.14 represents 12 applications that show a strong trend towards the spatio-temporal and data fidelity axes with Bing Maps ranking at a 5 on 5 for on the spatio-temporal axis. Average rankings for the four axes are: collaboration = 2.7 power = 2.4, data fidelity = 3.1, and spatio-temporal = 3.1.

The six clusters developed in this section are an initial attempt to understand the current range of utility available from GeoWeb applications. The following Table 4.10 characterizes each cluster by its average ranking (portrayed in each figure in red) on the four scales.

The most striking finding from this analysis is that there are indeed substantial differences between clusters of applications, and this conceptualization is well suited for distinguishing the various types of GeoWeb systems. As can be seen in Figures 4.9 to 4.14, there are distinct patterns for each of these clusters, and for each individual application. Applications that were indistinguishable when using existing PPGIS conceptualizations (e.g., Google Latitude and Open Street Map) show very different patterns with our framework; Google Latitude can be seen in Figure 4.10 in light green, and Open Street Map can be found in Figure 4.12, also in light green.

Figure (# of apps.)	Spatio-temporal	Collabor-ation	Power	Data Fidelity
4.9 (17)	2.2	1.6	1.9	1.2
4.10 (19)	1.0	1.0	1.9	1.6
4.11 (11)	1.1	2.5	2.8	1.4
4.12 (7)	4.1	3.6	4.7	3.4
4.13 (5)	1.8	1.6	2.8	3.8
4.14 (12)	3.1	2.7	2.4	3.1

Table 4.10: Cluster analysis overview of 71 GeoWeb applications: average ranking across four scales (by cluster).

4.6 Chapter Summary

This Chapter detailed the results of this research in four broad sections: Section 4.2 addressed the place and space results. These results consisted of interview transcripts, mental maps and a map of locations mentioned during the interviews. Section 4.3 presented the data generation, communication, and consumption results; Section 4.4 provided the motivation and privacy results, and Section 4.5 detailed the results on a cluster analysis of the GeoWeb.

Chapter 5

Discussion and Conclusion

5.1 Chapter Overview

The intent of this chapter is to analyze and discuses the results so as to answer the research questions defined in Section 1.2. These questions are specific to the research population, a group of citizens active in Edmonton's river valley. Inferences will be drawn as a means of defining the wider applications of the results. Each section of this chapter will begin with a brief review of the pertinent literature and results, and then provide a detailed discussion of the results in light of the research question being addressed. Each section will end with a specific answer to that question. In addition, Section 5.6 will highlight future research needs, and Section 5.7 will conclude this thesis.

5.2 Place and Space

This research sought to glean insight into how people (1) express knowledge of place and space, (2) the relevance of that expression to PPGIS, and (3) the extent to which a sense of space and place is shared between people (RQ1a &

RQ1b). These results can be found in Section 4.2; Table 4.1 displays the most mentioned themes, Table 4.3 the most mentioned activities, and Table 4.4 the most mentioned meanings of place. Figure 4.1 and Table 4.2 display the locations mentioned on a map, and a table of the most mentioned locations, respectively. The mental maps presented in Figure 4.5 are also relevant.

Relph (1976) defined place as the meanings that are created at the confluence of location and activity. Lynch (1960) describes the elements of place based on their location within an urban environment, function and associated physical attributes as: (1) paths; (2) edges; (3) districts; (4) nodes, and; (5) landmarks (see Table 2.1). Thus, it is through these elements at a location and in combination with activities and people, that meanings of place are created.

The research reveals that local knowledge is gleaned through the sports and recreational activities that take informants to specific locations within the river valley. Those activities include, predominately, running (810 mentions), biking (487 mentions), and walking (152 mentions); from Table 4.3. The most mentioned locations are Hawrelak Park (55 mentions), Kinsmen Park (37 mentions), Terwillager Park (36 mentions), Mill Creek Ravine and Gold Bar Park (32 and 30 mentions respectively). Thus the expression of place based knowledge is dependent on activity at a location. The sport activities provide access to the benefits (see the quotes on pp. 76-77) of isolation, a variety of activities, and a real-world social network. Recreational activities also reflect a range of uses within the river valley. For instance, Nolan notes that range of activities available in Terwillager Park; Chris describes the family programming offered in Hawrelak Park, and Emily describes horse-back riding at the equestrian center (see pp. 78 for the relevant quotes).

5.2.1 Activities

Lynch (1960) defines a node as a foci such as a junction or a concentration of interest points. The five most mentioned locations can be considered nodes in that all of these locations concurrently act as junctions and concentrations of interest points. As junctions, these parks offer access to a trail network that spans the entire river valley, most of which is 'space', interspersed with nodes that are culturally and/or personally significant. As Mya notes, in reference to the Kinsmen Park (see pp. 76-77), or Hawrelak Park as discussed by Nate (see p. 71), there are a variety of running or cycling loops that originate in or transect these park areas (nodes), and that travel extensively through the river valley (a district, discussed on pp. 116-117).

There is a sense of remoteness and isolation that can be achieved by running or cycling on these trails that Mya likes (on p. 76). And yet, Seth (on p. 77) who runs with the Hash House Harriers, states that there are opportunities to socialize while participating in group sporting activities on the river valley trails. As such, Seth is able to connect with his real-world social network. Both Mya and Seth use the same trails and yet receive a different experience depending on their individual need. As the common elements in both circumstances are activity and location, there must be something satisfying in the movement through an 'isolated' part of the city and feeling a connection to nature. Indeed, many of the most isolated sections of the river valley require self-propelled activity to reach them. And people, including the informants, do seek these locations out.

In contrast to the trail network, park spaces such as Hawrelak and Terwillager offer concentrations of interest points through structured and unstructured recreational activities which act as draws to those places. Nolan (in reference to Terwillager on p. 78) talks about the range of activities available in this multi-use space from dog walking to skijoring. Chris (on p. 78) indicates that Hawrelak has great recreational activities including cultural and theatre events. These park spaces (the foci of the river valley) offer social and cultural events that are geared towards family, friends and organized activities such as horseback riding. These foci are structured to bring people together within a natural environment and to offer a diversity of events. The purpose of parks can be seen, generally, as a refuge from typical day-to-day routine by offering a range of activities. The river valley offers a break from our daily activities and an opportunity to play in isolation or within a social environment.

Where nodes represent discrete places within the river valley, the river valley as a whole can be seen as a district (from Lynch, see Table 2.1). This large space (in contrast to a foci, a place), is also transacted by a trail network which offers the opportunity for movement. Nate indicates (p. 79) that he often starts a runs at a node (in this case, Hawrelak Park), proceeds with his activity through the river valley, and ends up at a coffee shop. This illustrates a common theme amongst the informants, where an activity route originates at a 'place', travels through the space of the river valley and ends at a place. In this context, the river valley represents a space with a distinct character within Edmonton that reflects its size, ease of access via the trail network, diversity of activity, and connectedness to a variety places.

Collins and Kearns (2007) found similar results when examining the therapeutic qualities of landscapes. Specifically, the beaches of New Zealand were studied and found to have four qualities that overlap with the informants' experience of the river valley. These places (New Zealand beaches, Edmonton's river valley) provide: (1) a physical and psychological escape from day-to-day routines; (2) access to a natural environment; (3) opportunities for isolation or social interaction depending on individual preference, and; (4) routine interactions with a green space or natural environment that '...may shape individual and ultimately collective identity' (Collins and Kearns 2007, p. 16). This similarity in findings could be generalized to large recreational spaces in or adjacent to urban areas, such as Stanley Park in Vancouver, or Mount Royal in Montreal.

5.2.2 Meanings of Place

Table 4.4 lists the nine concepts mentioned related to the 'meaning of place'; impressions, memories and special places were discussed as themes in the Chapter 4. Impressions represent current feelings or ideas; memories are, in a sense, old impressions that have lasted through time, and; special places are understood as being, somehow, unique or unusual.

Chris reports (on p. 82) that Gold Bar Park leaves a striking impression on park users as there is a contrast between the '...beautiful trees...and then a backdrop [of] oil refineries...'. Hawrelak Park leaves an impression for a very different reason. As Evan states, Hawrelak is known as providing a good and consistent user experience, referring to the variety of cultural and sporting events that the park hosts throughout the year. Jack seeks out old and unused places in the river valley through 'mystery rides' (from p. 82) that provide a sense of adventure. For Jack, it is the combination of exploration and unusual places that leaves an impression.

Memories are impressions of places that have lasted. Chris' vivid memory is of his childhood when a bridge was installed across the North Saskatchewan River from Rundle Park to Gold Bar Park, and how this impacted his experience of that place. It allowed Chris the freedom to roam, to cross the river and access a new environment and his friends who lived on the south side. It is clear that this left an lasting impression on Chris as he was able to draw a detailed mental map, accompanied by a narrative of that time and place.

Andrew recalled the City of Edmonton's Metropolitan Edmonton Transportation System's (1960) plan to install a freeway in the McKinnon Ravine. This was remembered by Andrew as a result of two or more factors; his interest in Urban Planning, and his use of Edmonton's ravine system for running. In both instances, Chris and Andrew, the mental maps offered a gateway into the informants' memory of location and the associated activities and feelings that specific locations might evoke. This indicates that recollection is an important characteristic in describing place, and that there is a connection between remembered geography, emotion, and place.

Special places were identified by Evan and Megan as those places that are somehow unique or unusual within Edmonton's river valley. Evan discussed Terwillager as being a 'natural park' that offered the opportunity for exploration, that offers something other parks within the river valley do not. In this instance, that something is access to the unknown. Similarly, Megan is also interested in the exploring 'forbidden' destinations like Ewok Village (from p. 84). In both examples, Evan and Megan, there is a draw to the isolated or prohibited, those places in the river valley where people do not usually go, or where they are not supposed to go. It may be that there is an excitement at the isolation or in breaking the rules.

The examples provided by the informants, in conjunction with their activities, indicates that the informants have a deep, nuanced and varied understanding of the river valley. Deep understanding suggests that the informants know places(s) (i.e. attach meaning to places) within the river valley, understand the physical characteristics of those places, how they can be used, and can connect one place to another via a route or path. Their nuanced understanding of place is demonstrated by their preference for certain experiences at specific places, for instance: (1) Megan for mountain biking at Ewok Village, and; (2) Nate for running from Hawrelak Park on a route that will end at the Sugar Bowl Cafe.

5.2.3 Shared Place and Space

Some places mean more to an individual than other places; and some places mean more to the research population as a group than other places. It can be argued, from this varied representation of 'place', that individuals define a place, but a population defines a node or district (in Lynch's sense of those words). In the context of this research, nodes are those five most mentioned locations, and places are all the other 76 locations mentioned by the informants (see Figure 4.1). These five locations, which represent a concentration of activity and access to the rest of the river valley, were discussed previously in relation to activities and meaning of place. In contrast to the five, there are 68 locations that were mentioned less than 10 times, that are located on or adjacent to paths (again, from Lynch 1960) that radiate from and connect the most mentioned locations.

Indeed, there is a density of points between Hawrelak Park to the West, and Gold Bar Park to the East (see Figure 4.1) that seem to indicate some travel between these locations by the study population. This is expected due to the number of times trail (N=810), run (N=538), and bike (N=487) were mentioned. Those places that are more important both individually and within a group are mentioned more frequently. It is the aggregation of individual places mentioned that defined the extent of the river valley as a feature within the collective imagination of the study population.

The 68 locations mentioned less than 10 times represent places that lack a depth of meaning within the larger group of 17 informants. But within the personal narrative of a specific informant, a location such as Ezio Farone Park (8 mentions), might rank highly for deeply personal reasons. As such, it would still contribute to the overall sense of place within the river valley as a district.

The notion of the river valley as being a special space for activities was commonly held within the study cohort; activities define the experience common to all of those interviewed. In contrast, as discussed in Section 2.3, other cultures such as the Inuit (Greider and Garkovich, 1994) and Aboriginal Indigenous Australians (Dourish and Bell, 2011), view landscapes through a lens of history and myth. Past events colour the landscape with meaning, and location is determined through the aggregation of physical elements with a detailed mental map that spans time and myth, creating a shifting historical perspective that spans generations. Physical elements that hint at location include features that are not often encountered or recognized by many urbanites, such as coastline shape, snowdrifts, wind direction, and other clues (Macdonald, 1998).

The remembered historic context of Edmonton's river valley is not as complex or as deep as the Aboriginal experience of place. The informants generally did not speak to the history of either the river valley as a district, or places within it. There were several mentions of historic events, such as Andrew's reflection on the averted plan for the City of Edmonton to develop a road network within the river valley through the Metropolitan Edmonton Transportation System (METS), from the 1960's. But, strictly speaking, this is an individual's memory, not a recollection of a shared common history.

It can be concluded that there are shared contemporary experiences within the river valley that define the commonly used places, such as Hawrelak Park, Mill Creek Ravine, etc. But, experience is not the same thing as a historical context, and potentially splinters (Graham and Marvin, 2001) impressions of the river valley based on specific groups of users, limiting the collective imagination.

5.2.4 The Expression of Place

From mental maps that characterized a non-metric, detailed understanding of place to an extensive catalogue of how these places are used accompanied by an explanation of what the places mean, each informant was able to paint a picture with a depth of emotion and meaning. Taken as a whole, a complete data set, the research population has expressed a nuanced appreciation for their 'ribbon of green' that encompasses the entirety of Edmonton's river valley, and many of the adjacent ravines.

Knowledge has been demonstrated (see Section 5.2) to include a detailed understanding of the local environment, how the river valley is used, and personal memories. The informants have defined for themselves special places, and why those places are special. As (Devine-Wright and Lyons, 1997) argues, it is these characteristics that impart a relationship between a citizen and the world around them, and influence a personal narrative. As such an informant's local knowledge is relevant to PPGIS, but PPGIS is not relevant to the informant.

Because PPGIS is concerned with a public's expression of local knowledge as a means of informing expert processes, such as public consultation pertaining to specific urban planning initiatives, local knowledge is relevant as a means of understanding how a place is used, why it is important, and what it means. But, as the GeoWeb enables (1) a broader definition of public to include anyone with an interest (who is literate and with access to the Internet), and; (2) citizen deployment of a GeoWeb platform such as Ushahidi, PPGIS is less relevant. This is because citizens gain a greater suite of options to express local knowledge.

In this research process, the act of drawing mental maps, and questions and dialogue between the researcher and informant acted as a gateway to the expression of experience of place and space within the river valley. It was the act of engaging in a discussion that drew out the most pertinent details from interested informants. As such, the range and depth of views collectively expressed by the research population are beyond the capacity of a traditional PPGIS to collect. As a stand alone technology, PPGIS does not facilitate meaningful interactions. These static interfaces allow individual users to input point, line and polygon information, with limited associated 'meta data' in the form of use, experience, meaning. PPGIS does not support a welcoming environment through collaboration; there are no interactions between contributors to a PPGIS. Individual contributions are not linked to other contributions, or even visible to other users.

The expression of local knowledge, explored in the previous sections, is unique in that it has not been documented in the literature for Edmonton. It is not surprising, though, that the informants were able to draw mental maps identifying Lynch's elements of place (Table 2.1); describe what a place means to them, and link those places to activities, functions and physical features. It is also not surprising the depth of meaning expressed, whether it be personal, historic or otherwise (see Table 4.4). It is interesting to consider the limitation of PPGIS within the context of trying to illicit a deep understanding of place from an informant.

5.2.5 Power

As discussed in Section 2.5, power is directly relevant to the implementation of PPGIS through the inclusion of actors in a process; the actors being the 'public' and the process being one of 'participation'. Those excluded are often marginalized populations whose opinions are not valued. As discussed above, PPGIS exists in tension with emerging GeoWeb technologies expressed through mobile- and web-based applications relative to who the public are, and how they can participate. As such, PPGIS is relevant as a means of understanding the context of power relative to the avenues that the 'public' have for expressing local knowledge. The results (from Section 4.2.2), document a brief narrative of trail development in Edmonton's river valley.

The conversations about power took place within the context of development issues faced by many of Edmonton's parks. Contrasting views where highlighted in the results in Section 4.2.2. James (on p. 85-86) discusses the 'disconnect between the city's development plans for its trail network and what the end users ultimately want', Andrew defines the geographic and project based 'box' (p. 85) within which City Planners place specific projects. Finally, Evan discussed the use of the GeoWeb as a tool of citizen engagement within Edmonton.

James alluded to the difficulty citizens, including active users of the river valley trail network, have in engaging with the City of Edmonton in a meaningful way. This view is bolstered by both Andrew and Evan. Andrew explained that the re-development or improvement of a park is considered through a 'box' that segregates the improvement area from the rest of the river valley. In effect, Andrew (a City Planner) was describing a reductionist approach to river valley park redevelopment, expressing a lack of interest in the concerns citizens might express for landscape elements that fall outside of the redevelopment 'box'. Evan suggested that the GeoWeb, in this instance, can act as a gateway between citizens and planners by allowing citizens to express their experiences at a location, demonstrating how that place is used and the meanings derived from that use.

Those who use the river valley may be at odds with how the river valley parks are developing. As James indicates, some users feel threatened by the closure of trails that may present hazards. Those who want to use the hazardous trail, for mountain biking or trail running, will do so despite the fencing and warning signs erected by the authority. Similarly, if maintenance or improvements are being considered for a park, those who are familiar with the park and who may have an emotional connection to that place, could feel threatened and powerless to stop the development, or even contribute to the dialogue. Yet for many, there may not be a problem.

In this instance, there is a real or perceived exclusion of a group from the process that will define the 'problem' with the park area, and how to 'improve' it. As such, conflict may exist between the authority and those users users who enjoy the park area. To date, PPGIS did not offer a compelling method for bridging the power divide. Section 5.3 will discuss alternatives to a PPGIS.

RQ1a: How is knowledge of place and space expressed, and to what extent is a personal understanding of the local relevant to PPGIS?

To address RQ1a it is necessary to highlight a few points:

1. The informants possess detailed knowledge of the routes they travel to complete their specific sport activities, and the places they visit to participate in their recreational activities. Appendix D contains all of the mental maps that have not yet been discussed.

2. Their understanding includes non-metric representation of the places they visit on a regular basis. For some, this knowledge was limited to nodes within the river valley, others were able to describe larger geographic areas (the river valley as a district), and the spaces between nodes. In addition, there was a range of detail presented in the mental maps, from Chris' rendition of Gold Bar Park in Figure 4.5, to Evan's less detailed but expansive drawing of Edmonton's entire river valley in 4.6.

3. The informants' understanding also captured a range of meanings associated with place that encompassed the themes of impressions, memories and special places. Some were also able to address issues of power in relation to park development within the river valley.

Knowledge of place is deeply personal and can be difficult for a researcher, or other 'authority/expert', to access within the context of a research project. Persistent, open questions are required, coupled with a willingness to listen and probe for details. The resulting answers are nuanced and capture a range of knowledge from the obvious activities that an informant pursues, to the spatio-temporal and deeply personal experiences of places. The results, when combined and understood as a complete data set, reveal desires, such as 'dangerous' places to mountain bike, where the cyclist will receive a thrill, and fears that park development will remove the ability to 'explore' areas.

Knowledge of place and space can be expressed via mental maps and intimate discussions with informants, but these conversations do not happen in a way that is broadly accessible. A more pertinent question might ask to consider the tools, in light of the GeoWeb, which might better facilitate an urban based spatial consultation with citizens. This question will be considered in Section 5.7.

RQ1b: Is a sense of place and space shared between people? To what extent?

In the Edmonton river valley context, Lynch's nodes are the five most mentioned locations. These park spaces act as gateways to an extensive river valley trail network, junctions along activity routes that attract visitation from those seeking recreational activities or other respite from the city. Of the five locations, Hawrelak Park was the most mentioned and, thus, the most shared. Figure 4.1 provides a contour map all of the mentioned locations within Edmonton. Given that the research population was accessed through City of Edmonton and University of Alberta networks, the extent of geographic references away from the core of Edmonton is surprising. There is a relative lack of references to locations (except Hawrelak Park) in the core of Edmonton adjacent to the University and downtown.

5.3 Contributing to the GeoWeb

This section addressed the question of data generation, communication and consumption (RQ2a) in two parts; Section 5.3.1 will discuss the generation, communication and consumption of geographic information to the GeoWeb, and Section 5.3.2 will consider how people collaborate with peers and authorities via the GeoWeb.

Neogeography and volunteered geographic information were discussed in the Section 2.7, and provide insight into RQ2a pertaining to the contribution of geographic information and collaboration via the GeoWeb. Neogeography has been defined by Rana and Joliveau (2009) as a suite of tools that enables the collection, communication and consumption of geographic information by non-experts. In contrast, VGI refers more specifically to the object or content being contributed, whether it is a geo-tagged photograph or a detailed description of a place (Goodchild 2008). Results Section 4.3 provides the relevant data by outlining the informants' data generation (48 references), consumption (76 references), and communication (123 references) practices (see Table 4.5).

5.3.1 Volunteered Geographic Information

As previously discussed, Section 2.2 provides some insight into the breadth of information that may be available for an individual to contribute. Within this context, the 'contribution' of information or data to the GeoWeb can be difficult to isolate from the act of communication or consumption; when does the contribution of data end and its consumption begin (see Figure 2.4 and 2.5)?

The generation of geographic data (see Table 4.6) most commonly occurs through a GPS enabled mobile device (e.g. a smartphone or GPS watch), or through a combination of mobile devices such as a hand held GPS with a digital camera. Mobile devices are usually used to capture a current experience; it reflects an immediacy and intimacy with the location in which activity is occurring. The data that is collected via a mobile device, though, reflects a small portion of information that is available from the user. For instance, a GPX file that contains route data is a smaller (and perhaps less relevant) cross section of information when compared to a description of the experience at a location or series of locations. As Section 5.2 demonstrates, the informants in this research possess a deep understanding of location. In contrast, a Garmin watch is only able to capture a small portion of total experience. In fact, a distinction can be made between the information (historical, personal, intuitive) that an informant possesses and the data that a device collects.

There are a some notable exceptions. For instance, as Table 4.7 indicates, it is possible to aggregate data in such a way to create a deeper understanding of place. Megan, for instance, created a Google Earth fly through by combining a route with geotagged still photographs and way-pointed obstacles in Google Earth. She used Google Earth specifically because of its Fly Through function which allows the user to create a moving visualization of a route showing the specified information. It is also worth noting Evan's experience with creating a GeoWeb 'mash-up', found in Section 5.3.2.

The consumption of geographic information by the study population tended to fall within two broad categories: (1) traditional and (2) electronic. Those who are not comfortable with the GeoWeb tended to rely on paper maps that they printed from the Internet. As James indicates (see pp. 97), he '...grew up in a world of paper maps...' and is more comfortable with them as compared to the GeoWeb in specific, and even with cell phones as a more general case.

5.3.2 Collaboration

There were two compelling examples of GeoWeb collaboration by Isabel and John. Isabel runs with a group of friends, and they use Google Earth to create a running route that they can all agree on. It is an onerous process where one of the group would map out a route in Google Earth, create a KML file and forward to the others. Suggestions for alternatives might come back via email, which would then be incorporated and then email out again.

John, on the other hand, works on the Open Street Map (OSM) project. OSM offers to create a free map of the world by crowdsouring location data from contributors via sophisticated editing tools and open geospatial data provided by specific jurisdictions. While it is impressive that OSM has created an accurate and ever evolving map, the collaboration is limited to lines on the virtual map, and the creation of the tools to complete this task more efficiently.

Collaboration will be addressed in more detail in Section 5.5.

RQ2a: How do people contribute geographic information to the GeoWeb? How do people collaborate with peers and with authorities via the GeoWeb?

Several points can be expressed before an attempt is made to answer RQ2a:

1. Most (16 of 17) informants collect river valley data in some way or form.

2. Five informants regularly collect location (point), trail (line), and route (line or polygon) information in association with their activities via GPS enabled mobile devices.

3. Three of the informants took photographs that were either automatically geotagged (e.g. via an iPhone), or that were geotagged manually where the coordinates were marked with a hand held GPS.

4. One informant created a Google Earth fly through to demonstrate a mountain bike trail that contained located photographs, obstacles and a route.

5. One informant linked his Garmin Connect website to his Facebook page, another emails KML files containing running routes, and several informants input potential activity routes into applications like MapMyRun to map out activity routes.

6. One informant contributes to Open Street Map.

Those who collect data on a Wi-Fi or 3G enabled device are able to contribute that data directly to their activity site of choice. Wi-Fi devices are not able to load live data unless the users activity is occurring within a Wi-Fi zone, those with 3G devices can send live data to the Internet. Photographs are contributed to the GeoWeb either directly through Wi-Fi or 3G connected mobile devices, or uploaded via a portal like iPhoto or Flickr where these photographs can be geotagged.

Applications such as Google Earth and Open Street Map support the direct contribution of spatial data. Google Earth supports a users contributions of geotagged photographs, way points and routes. Open Street Map allows users to input points, lines and polygons, as well as other details such as the direction of one-way streets, stair cases, and any other feature that one would expect to find on a map.

One informant desired that place-based knowledge be linked to an activity route, and these data types be connected to his on-line social network. His GeoWeb application, Garmin Connect, allowed Evan to document several data types (see Figure 4.7), but not descriptions of the terrain, or experience of the run (see Figure 4.8). As such, Evan linked Garmin Connect to Facebook, which hosted his on-line social network, to communicate his running experience, including route data and experience commentary, to his friends. It is telling that Evan created a 'work around' that enabled him to link his running data to his Facebook social networking site. Garmin Connect did not have the capacity to manage complex social interactions within an extensive network. Actions such as planning an activity with a group of people, including directions to the activity and and what to bring, are not available. While Facebook excels at connecting to a social network, communicating with that network, it does not have the capacity to map out an activity route or to load GPS data. As such, because Evan required both sets of functions, he had to create an application mash-up to accomplish his goal.

Only one informant, John, collaborated with peers using the GeoWeb. No one collaborated with an authority. By contributing to the Open Street Map project, John connected with the OSM community in Edmonton to build an accurate map of Edmonton. While John is only able to document a small portion of the overall map data and edits needed, his data when combined with all other contributors, created a complete and accurate map. The contribution of geographic information, and collaboration, will be discussed further in Section 5.5.

5.4 Risks and Benefits

RQ2b pertains to the enablers and inhibitors to a person contributing data or information to the GeoWeb. As documented in the literature (Section 2.8.1), motivation can be an important factor when considering web-based volunteer process such as those epitomized by OSS like Linux or other forms of on-line collaboration like Wikipedia. Why are those who volunteer their time moved to do something? Nov (2008) offers a compelling framework which is presented in Table 2.6. The results, as presented in Section 4.4, indicate there for this research population there are two dominant motivations: (1) enhancement (N=8) and (2) values (N=4).

Enablers to participating in GeoWeb related activities are motivations for contributing data or information. Enhancement relates to receiving some personal growth or satisfaction in the process and can be summarized by John's statement (from p. 99) '...it's sort of a joy of ownership in a way...'. Values relate to altruistic concerns where the wellbeing of other is considered. As such, the sentiments of 'giving back', 'paying it forward', and 'contribute[ing] something meaningful' were significant factors in the informants defining their personal motivation.

In contrast, Malhotra et al. (2004) provides a useful model for understanding privacy concerns as being a moderating factor to a person's motivation to contribute data or information (see Section 2.8.2). In this instance, privacy is uniquely concerned with managing sensitive location data that may be communicated through the GeoWeb. Respondents identified three categories of concern: (1) data control (N=8); (2) location data (N=6), and; (3) data use (N=2). Data control pertains to the amount of control that an individual can exert over their data. For example, people post a lot of information to Facebook. Data control seeks to understand the extent of access and the power to influence or dictate how their information is used by Facebook. In the case of location data, Chris was advocating that GeoWeb applications allow the user to define who can see the location data. Conversely, it is possible to control data by not recording it. As Evan discussed, he will start to record his activities from a public location, not his residence. By not recording the data, he is controlling what people see, rather who can see the data.

Data control is a complex issue. Many applications allow an individual to check another person into a location. At one end of this spectrum it is possible for a Facebook friend to indicate that a specific person was seen at a specific place and time, and to 'check' that person in. At the other end of the spectrum, citizens act as an extension of the police by photographing or digital video recording (as in the Vancouver riots of 2011) illegal acts. While it is clear that these acts are taking place in public spaces, and that they are illegal, it is disconcerting to extend to role of the state (law enforcement and surveillance) to its citizenry. The confluence of mobile devices and social networks enable this citizen as sensor role.

There are a range of concerns for location data privacy, from no concern at all to an extreme level of discomfort. For instance, Nate, a fit athletic young man, is concerned with his on-line financial privacy and identity theft, but not with his current location data being broadcast. In contrast, John contributes trail data to the Open Street Map project, but is homosexual and grew up in a culture that supported anti-homosexual laws. As a result of his experience, John possess a well developed sense of privacy, and specifically location privacy.

RQ3: What are the enablers and inhibitors to participation?

This research population was motivated to contribute geographic information to the GeoWeb for two reasons: (1) enhancement which relates to personal growth and satisfaction, and; (2) values, to give back to a community in which they belong. There is some overlap between these two motivations that seem to satisfy their desire for improvement of either themselves or their community. It is expected that self improvement would be a major reason for individual contribution, and aligns with the OSS motivational research (Moon and Sproull, 2000).

It is interesting and surprising that four informants identified enough with their community to indicate that giving back was a major motivation. These findings could shed some light on the place and space findings. Those who belong to a small and tight community, for instance a cycling or running club, might share a common understanding of place that would help motivate the mapping of place. If this were true then interviewing homogeneous groups, specific cycling or running clubs, or even broader communities such as religious groups, might reveal greater sharing of place knowledge and history.

The inhibitors to participation relate to the reluctance of people to share their control of data, and their location. It can be argued that control of data stems from concerns that have been expressed in the press regarding identity or credit card theft. In a GeoWeb sense, data control can link to location data via the preferences that can be set within any given application. For instance, with Open Street Map, it is common to post under an assumed name, and receive communication only through the OSM application. In this way no one is able to link a real user with a location. Data is controlled though misinformation (an assumed name) or vague data (a general location, Edmonton) within the settings of the application.

In other instances, and as discussed prior, data can be controlled by virtue of not collecting it. If a user is uncomfortable with their location being known, not collecting GPS data limits who can 'see' you at that location to those who are there or those who learn about it after the event. For instance, both Evan and Sarah noted that they do not collect location data at personal or private places, such as home or work. In contrast, Evan publicly posts his running routes to Garmin Connect, and actively shares this information within the running community.

The themes of motivation and privacy were presented in this thesis for context and as areas of exploration with respect to the neogeography data generation and contribution practices of the informants. These themes represent a broader and evolving research domain important to the GeoWeb. As such, they are avenues for future research, as noted in Section 5.6.

5.5 Utility of the GeoWeb

Finally, RQ3 pertains to the utility of the GeoWeb. The GeoWeb was addressed in the literature review (Section 2.9) through the construction of four orthogonal axes that highlight relevant and common attributes of GeoWeb applications. Those four axes are power, collaboration, data fidelity, and spatio-temporal. Section 4.5 provides a cluster analysis of 71 applications that were grouped into six categories using a squared euclidean distance algorithm (see Methods Section 3.4 for details). The intent of this analysis is to explore the current utility of the GeoWeb.

It is clear that the current iteration of the GeoWeb offers utility and a level of satisfaction to users. Otherwise Google Earth would not have been activated 800 million times, applications such as Ushahidi would not see continued demand, and the ideas of the GeoWeb would not be ubiquitous. From in-car navigation, to checking in with Foursquare, the GeoWeb is everywhere. But, can its utility be increased?

There are a range of applications for urban areas that can utilize improved analytics of big or open data. For instance, there is a constant stream of social media data that people make available via a range of applications like Twitter and Facebook. One specific application that can be imagined is the deployment of a toolset by an authority that empowers citizens to provide feedback about their urban areas in a collaborative environment that welcomes nuanced place-based knowledge. That toolset, similar to a mashup between Wikipedia and a PPGIS, would support a 'collective action' level of collaboration in that all participants help define and buy into the broad goals of the project.

RQ3: What is the utility of current GeoWeb applications, and how do they manage issues of power, collaboration, data fidelity, and spatial understanding?

The GeoWeb encompasses an emerging class of applications that seek, to varying degrees, to combine elements of the spatio-temporal with collaboration tools, and robust data/algorithm models while understanding the power dynamic between an authority and participants. As discussed previously, the GeoWeb exists such that volunteers collectively create geospatial information repositories. In recent years numerous such applications have evolved from the initial Google Earth (launched in 2005), and the potential of these systems to be used as a tool for public consultation in, for instance, urban planning is substantial. Still, the GeoWeb is not well understood or studied.

Contributing to this confusion is the large number of applications that are often seen as one, yet have some fundamental differences as shown by the cluster analysis. Prior conceptualizations of computer based mapping applications, from the field of PPGIS, are not well suited for capturing the richness of interaction in GeoWeb systems. These conceptualizations, for instance from Schlossberg and Shuford (2005), are one dimensional and only consider 'power' as a axis of concern. This highlights the need to develop a new conceptualization of this emerging field.

In general, most clusters score low on spatio-temporal reasoning scale, with exception of Figures 4.12 and 4.14. This indicates that most of these applications manage point, line and perhaps polygon data, few delve into 3D representations and time. Notable exceptions include Google Earth as a pioneer in 3D representation, and Ushahidi which manages time. Although gaming systems, such as World of Warcraft, were not considered in this conceptualization, they can integrate time into their 3D spatial systems in a compelling way.

Collaboration also, generally, scored low in this analysis with the exception of Figure 4.12. As such, most of the applications support the sharing of information, or a basic level interaction by allowing the users to provide feedback or respond in some other way. Second Life provides a compelling example of a highly collaborative environment where the communication tools support a community of users who develop complex goals and outcomes in tandem with a group identity.

Power tends to rank in the middle of the scale (again, this is an average number for all clusters), with a low of 1.9 and a high of 4.7. The cluster shown in Figure 4.12, has the highest rankings of 5 for Layers, Ushahidi and Google Earth. Each of these applications are powered by citizen initiative, where the authority takes a back seat in defining a process, including problem and outcome. Ushahidi typically operates in crisis situations as an OSS platform that enables citizens to ‘tell their story’ via static or mobile platforms. As it is an OSS, anyone can deploy this application for any purpose that is technically supported, given the appropriate hardware and know-how.

Data fidelity represents the capacity of an application of combine varied and different data sources. In this instance, Figures 4.12, 4.13 and 4.14 represent clusters with high readings (3.4, 3.8 and 3.1 respectively) on this scale. Ushahidi represents the most sophisticated data fidelity model implemented amongst these applications.

5.6 Future Research

This study was focussed on place and space based knowledge acquisition and communication via the GeoWeb, several domains were explored that spanned social science and technology research areas. This highlighted the broad scope of enquiry necessary to address questions related to cognition, place and technology. As such, the areas of potential research, set out below, should be considered through the combined lens of social science (geography, sociology and cognitive psychology), humanities (digital humanities), and computer science (ubiquitous computing).

Furthermore, as the general domain of the GeoWeb is large, these future research directions will be focussed on the relationships between actors and processes that play out in urban environments. For instance, social media networks focussed on Edmonton have brought together urbanists in a loose collaboration addressing food security, downtown revitalization and local economies.

With this focus and setting in mind, this research process has highlighted a range of research opportunities that include:

1. The GeoWeb provides useful cartographic tools to citizens for the mapping of places and spaces using point, line and polygon. The GeoWeb does not provide for the communication of a deep, nuanced and varied understanding of place. How can this be accomplished? What is the role of the semantic web, social networks, and data visualization in this process?

2. Social networks offer a vibrant and real time data stream that reflect current events. Who are the actors who participate in social media?

How might their views and understanding of events differ from those who do not participate in social media?

3. The penetration of the GeoWeb into expert process, such as urban planning, is lacking. While the open data movement has allowed some governments to provide API enabled data sets on-line, the next step is to support citizen input into the processes that define, consult on, and attempt to resolve issues. For instance, allowing citizens to define what their issues are and how to address them would help empower and address citizen led issues. What are the barriers to a broad adoption of web-based public collaboration processes by municipal governments?

4. There is much room for social science research on the organization and management of location-related communities, including research on motivation and privacy. While this research touched on these themes, there is still much work to be done. For instance, while there has been substantial research on these topics in the context of social networks and online collaboration (e.g. Wikipedia, open source software development), the spatial dimension will have some unique implications (e.g. in terms of users' privacy concerns). As such, motivational research should address the tempering effect of sharing location based information.

5. Obfuscation, a privacy protecting technique described by Duckham (2005), was not used by any of the informants as a method of masking location based information. Yet, obfuscation is a recognized technique, within the literature, for managing privacy. Is obfuscation an appropriate technique for GeoWeb users to manage location privacy? Might obfuscation,

or other technology related privacy protecting techniques, act in conjunction with specific motivations to enable more participation on the GeoWeb?

6. As noted in Section 2.4.2, and in Table 2.2, the conceptualization of time as a component of a spatio-temporal scale is problematic. How can time be better conceptualized within the domain of the GeoWeb, within a spatio-temporal scale?

5.7 Conclusion

This study began in the summer of 2008, when there were a handful of GeoWeb applications that offered limited utility. Over the past four years, the GeoWeb has grown at a remarkable rate, fueled by an almost obsessive desire for people to communicate a variety of location information. Sadly, one of the foci of GeoWeb development has been ways to make money from consumer engagement, rather than explore opportunities for, as an example, citizen-authority collaboration.

There are a few exceptions to this rule, that include the Open311, open data and Gov2.0 communities. Leading research institutions such as MIT's Sensible City Lab, and UCL's Center for Advanced Spatial Analysis research group, also envision the utility of the GeoWeb through an altruistic lens. The broad intent of these initiatives is to help create more livable, healthier cities, where citizens are fully engaged with their elected municipal governments and bureaucracies such that spatial decision processes benefit from citizen input. While significant strides have been gained, they are a long way from their goal.

This study was motived by an interest in how citizens could potentially interact with their physical environments and municipal governments.
The GeoWeb, in conjunction with open data initiatives (where municipalities openly share key data sets with the citizenry) and emerging location-based technology, has the potential to change these interactions fundamentally through better data, data availability, and collaboration. Meaningful conversations shift from a physical space to include a virtual space where citizens are encouraged to map the future of their cities collectively.

While the scope of this study was small, the research questions (from Section 1.2) were designed to glean insight into how the research population understands location and communicates that understanding via the GeoWeb. Its secondary concern was to identify motivations and privacy inhibitors to contributing location-based information. The results have demonstrated that this research cohort possess a deep, nuanced and varied understanding of their local environment, but that the processes currently used by experts (e.g. urban planners) are not adequate to access this information in a manner that directly influences the policy development process of urban areas. In fact, the scope of place-based knowledge that the informants possess is not adequately captured by the tools of neogeography, the GeoWeb, or PPGIS. Where the informants demonstrated nuance and depth, the technology mediated tools can only capture point, line and polygon.

There are several 3D environment platforms that seek to engage a group of users with a set of common goals and objectives. The most noted of these environments is World of Warcraft (WoW), a multiplayer on-line game that supports the interactions between a very large number of players who self organize into teams. The interface supports the development of an avatar and voice based communication via a headset. While WoW is esoteric and unsuitable as a tool for urban collaboration, it does offer some valuable lessons on how to build a dynamic 3D interface that appeals to their audience and that supports community development and objective setting.

Related to WoW, IBM recently launched their IBM City One (www.ibm.cityone.com), and on-line 3D city building simulation game that challenges players to take on many of the problems facing real cities today from urban sprawl, infrastructure, economy, and design smarter cities that can sustain and encourage the growth. While City One does not support multiple players, goal setting, and in fact does not represent a real city, it provides a foundation for imagining a mash-up between the GeoWeb, 3D and gaming technologies.

The future of the GeoWeb could very well include a suite of 3D immersive web-browser powered games that:

1. Represent real cities such as Edmonton;

2. Gather realtime data feeds of key city variables such as budget, land use, pollution, economy, population, etc.;

3. Support multiple players in a collaborative environment, and;

4. Present a series of problems as a starting point.

The basis for this game would be to define several paths a city could take given the same base-line data. It would then be possible to compare, in a crude way, the real path taken with the virtual, and analyze how to improve the city's performance. In effect, this game would define a crowdsourced model for urban improvement using a sophisticated collaboration tool.

Several issues would still remain relative to the inclusion of the most marginalized into a costly and potentially meaningless process; privacy concerns where we become a surveillance state due to the ubiquity of Internet connected mobile devices gathering data; and a potential lack of deep and varied content based on a technocratic view of knowledge. While the future of computing is uncertain, it is vital to understand that computing technology should be applied evenly to all citizens. There is a real chance to marginalize the knowledge and concerns of our most vulnerable citizens, but also an opportunity to include then in a larger discussion.

5.7.1 A Reflection on the Methods Used and their Limitations

This research utilized a case study method as an approach to address five questions. Data were gathered from a number of sources; interviews, mental maps, and primary on-line sources such as Facebook and Garmin Connect. Data were also collected through examining GeoWeb applications, and by subjectively ranking each application on four scales. The strength of the case method lies in its capacity to manage and combine multiple data types to address 'how' and 'why' questions (see Table 3.2.2).

A wider range of data sources could have been considered for this study. In addition to those data gathered, GeoWeb application providers may have been willing to share those data that they gather during their day-to-day operations. For instance, OSM may keep detailed location records of who contributes data to their project, and what type of data is contributed. The same request could have been made of Google Earth, or any other application that accepts crowdsourced data. This information could have provided insight into broad patters of data contribution to the GeoWeb including demographics and location. Of course, this may of expanded the scope of the study beyond Edmonton.

Another source of data could have been gleaned via surveys distributed through social media, GeoWeb user lists, and through advertising in the river valley. These surveys could have asked a range of questions pertaining to river valley use and to the respondents' data collection, consumption and communication practices. Within this context, the literature indicates that surveys are commonly used in on-line privacy and motivation research (Malhotra et. al. 2004, Nov 2007). As such, this approach would have provided robust data that was potentially comparable to other studies. However, by their nature, surveys provide a broad but shallow understanding of respondents' attitudes and concerns. In contrast, the interview technique applied to this research provided a depth of insight that would not be available though a survey technique.

The 17 informants to this research were all active, to varying degrees, in the river valley and most were also comfortable with the GeoWeb technology under investigation. As such, this study could have been more robust had a greater number, and variety of informants been interviewed. For instance, it would be interesting to interview homeless people for their perspective on the river valley as a place, or conversely, those who are not at all comfortable with GeoWeb technology in an attempt at understanding how technology might influence perception of place.

Finally, a greater number of GeoWeb applications could have been examined and ranked in a more robust manner. Those applications chosen date from 2008-2009, the start of this research process. If more applications were chosen from a broader time period it would be possible to track how individual applications evolve, and how clusters shift over time as a result. In addition, rather than have a single researcher rank the applications, a team of researchers could develop and implement a ranking protocol that would would provide more objectivity to the ranking process. However, this approach is beyond the scope of this research project, and the process implemented does provide some interesting insights into the current state of the GeoWeb, and areas of future research.

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Appendix A

Interview Questions

A.1 Local Knowledge

RQ: What local knowledge do people have, and what do they deem as important (relevant), that could be used in location-based mass collaboration systems? What types of information are people likely to contribute?

1. Do you use the Edmonton River Valley trails? How? For walking, cycling, dog walking, etc? What activities do you participate in within the River Valley?

2. How much time do they spend per week doing these activities in the River Valley? (Ask them to describe their trip from home to the River Valley?)

3. How would you describe Edmontons river valley trails in a physical sense, to someone who is not familiar with the city?

4. I would like you to make a quick map of Edmontons river valley, focused on areas of the river valley that you frequent or use. Draw it just as you were giving a rapid description of the river valley to a stranger, covering

just the important features. Please do not worry about creating an accurate drawing, just a rough sketch.

5. Could you please locate where [i.e.Terwillager Park, Fort Edmonton, the High Level Bridge] is? Could you please show me on your map the direction north?

6. What local knowledge do you think is relevant for people visiting or using Edmontons River Valley Trail Network?

A.2 GeoWeb Applications

RQ: How do people contribute (i.e. what is the mode of contribution, GPS upload, photographs, etc.) data, information, and knowledge to existing location-based mass collaboration systems?

I will use these screen shots to describe different modes of user interaction and I would like you to provide your initial impressions of the ways in which you can interact with the application.

1. Do you currently use a web-based GIS application? How do you use it? For what activities? What data do you record when you participate in your activities?

2. Would you like to view [ACTIVITY] routes in Edmonton? How on-line? On your mobile phone? On a GPS device? Printouts of maps?

3. Would you [DO YOU] like to view the trails and routes that your friends use? Would you like your friends to view the trails and routes you use?

How would you like to communicate these? Would you feel comfortable with strangers seeing the routes you use?

4. When looking at the map interface, do you want to select what types of activities you can view, or would you rather see all activities. For instance, running, cycling, mountain biking, walking routes?

5. Would you like to upload the routes that you record with you GPS device for other people to see? Would you like to define who could see your routes? How? Would you like people to see your location in real time, as broadcast from a mobile device?

6. Would you use this application to plan activities with your friends, or solo activities?

7. Do you record pictures or video of your activities within the river valley? Would you upload other data, for instance photographs of video of your routes / activities? If that media could be viewed within the route, would that provide incentive?

8. Would you provide a description of your uploaded routes in the river valley for other people to see? Would you like to see other descriptions? Trail ratings? Current trail conditions (wet, muddy, blocked, dry, good conditions)?

9. Would you provide descriptions of areas within the river valley? For instance, would you write your impressions of [Terwillager Park]? Would you edit incorrect information? Provide trail ratings? Would you do this within a wiki? Do you see any benefit to having collaboration around

trails with other trail users? Would you recommend such a system to your peers?

10. Some systems use super users or moderators to help mange appropriate content in the application. Is this something that you might consider doing? What if your group of friends asked you to? If you were rewarded for you time?

11. Would you feel comfortable moderating a discussion that occurs on-line around an Edmonton location? What sort of process would you like to see in place to support moderation? How comfortable would you feel banning someone from a site for inappropriate behavior?

12. Would you use this type of application during your normal workday? Would it offer something of value to your work? How would you use it?

13. Would you be interested in viewing city plans (e.g. trail maintenance)? Would you report to the city on issues related to trail condition? Would they be interested in participating in trail-related decision-making processes (e.g. which new trails to develop)?

14. Would you like to see the application that we are developing linked to other applications? For instance, would you like to be able to move data from one format to another? For instance, to import into Google Earth or the Garmin mapping application?

A.3 Motivation and Privacy

1. Would you provide information to an online map regarding your use of Edmonton's River Valley? Would you provide other people information on how you use the river valley? Would having the information aggregated and personal identifiers to the data were removed? If you could choose who saw your data?

2. What information would you provide? Would you provide real time location information? What are your privacy concerns? Would you censor the information that you provided on-line?

3. What if the information was not in real time? If there was a time lag between youre use and the data being posted? How long of a time lag? Would you like to control the data pertaining to specific locations? Which locations? Is there activity related data that you would not like to share? Your favorite bike route? How would you define who can see your data?

4. If you were to provide information, can you speculate why you might want to do that? Do you trust on-line applications with private information such as email, your home address? Are you concerned about keeping your personal information private? What information? What kind of control measures would you deem as appropriate to safeguard your privacy? Do you trust that on-line companies will protect your information? Is there a potential of loss associated with providing personal information? Would you provide information if your friends did? If your running / cycling / riding groups were? If it would help the City

of Edmonton plan within the River Valley?

5. What would be a barrier to you contributing data? Do you have secret trails that you would not want to share data about? What would motivate you to contribute data? How would you like to be compensated? What would be a good reward?

6. What control do you want to exercise over access to your data / information? Under what circumstances are you not concerned about privacy? Do you trust, at a fundamental level, the Internet site that is collecting the data (why or why not, what elements do they trust, not trust)? Will they provide real time data to an authority to help with decision-making processes?

Appendix B

Consent Form

Consent Form

Researcher: Matthew Dance
Department of Earth and Atmospheric Sciences
Earth Science Building 1-26
University of Alberta, T6G2E3
Email: mdance@ualberta.ca
Phone: 780.554.9222

	Yes	No
Do you understand that you have been asked to be in a research study?	☐	☐
Have you been informed about the research project?	☐	☐
Have you had the opportunity to ask questions and discuss this study?	☐	☐
Do you understand that you can choose not to participate in this study at any time, without having to provide a reason and without penalty?	☐	☐
Has the issue of confidentiality been explained to you?	☐	☐
Do you understand who will have access to what you say?	☐	☐
Do you give permission for the researcher in this project to use what you say for academic purposes (publications, conferences, lectures)?	☐	☐
Do you consent to being audio-recorded?	☐	☐
I agree to take part in this study:	☐	☐

Printed name of research participant:

____

Signature of participant:______________________________Date:__________

Signature of researcher:______________________________Date:__________

Figure B.1: Consent form presented to informants prior to their interview.

Appendix C

Coding Framework

Code	Definition
Officially named places	Places that have been officially named.
Locally named places	Places that possess a local name.
Neogeography	Blurring the traditional roles or subject, producer, communicator and consumer of Geographical Information.
Data Source, medium The medium of data capture.	For instance photos, video and GPS traces, paper maps.
Communication Channel	The technology used to communicate the data source.
Consumer	Those who look at and use the communicated data.
Motivation	The reason or reasons one has for acting or behaving in a particular way.
Values	Related to altruistic concerns for others.
Social	A chance to interact with friends.
Understanding	A chance to learn new things and exercise their knowledge.
Career	Job related benefits.
Protective	Reducing guilt, addressing ones own personal problems.
Enhancement	Adds some joy or fun.
Information (data sharing) Privacy	This is from the user perspective in the collection and transmitting of data.
Data Collection	When, how and what data is collected.
Data Control	Wether or not data is communicated, and the control measures that the communicator requires prior to communicating the data.
Data Use Awareness	Level of awareness of the control measures in place within an application.
Location Privacy	The tools or behaviors used to maintain location privacy within an application.

Table C.1: Tier one codes within the coding framework used to organize and classify each transcript.

Appendix D

Mental Maps

The following represent the mental maps drawn by informant during the interview process. Each mental map is labelled with the alias of the informant who produced the drawing.

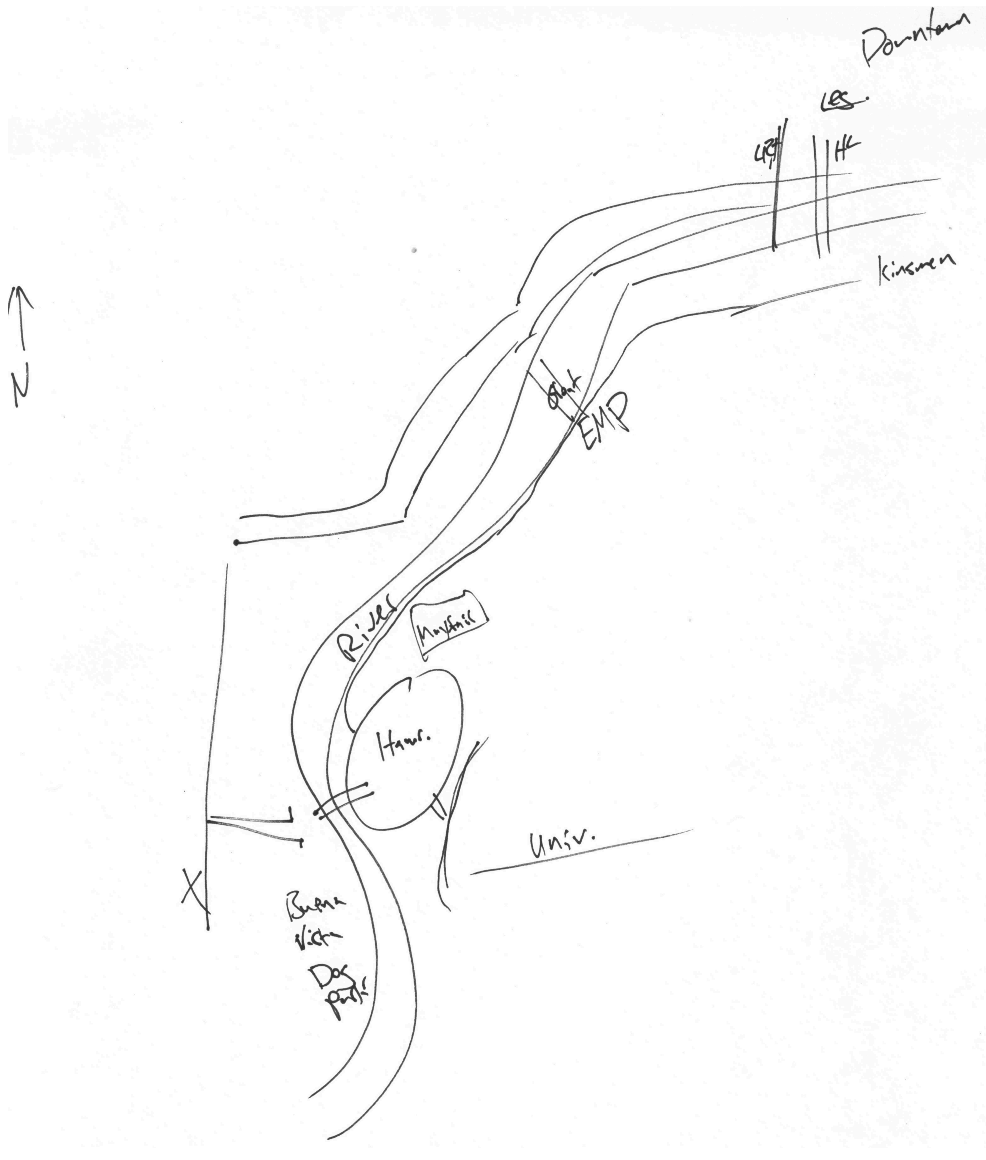

Figure D.1: Jack's mental map.

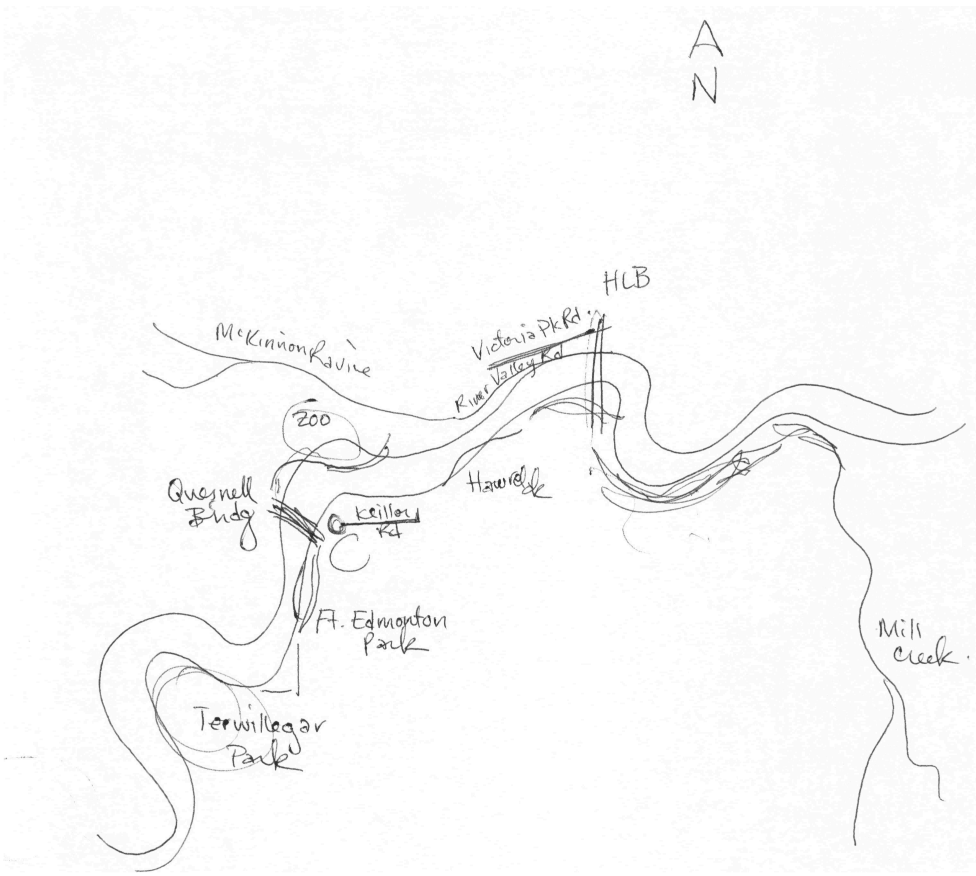

Figure D.2: Emily's mental map.

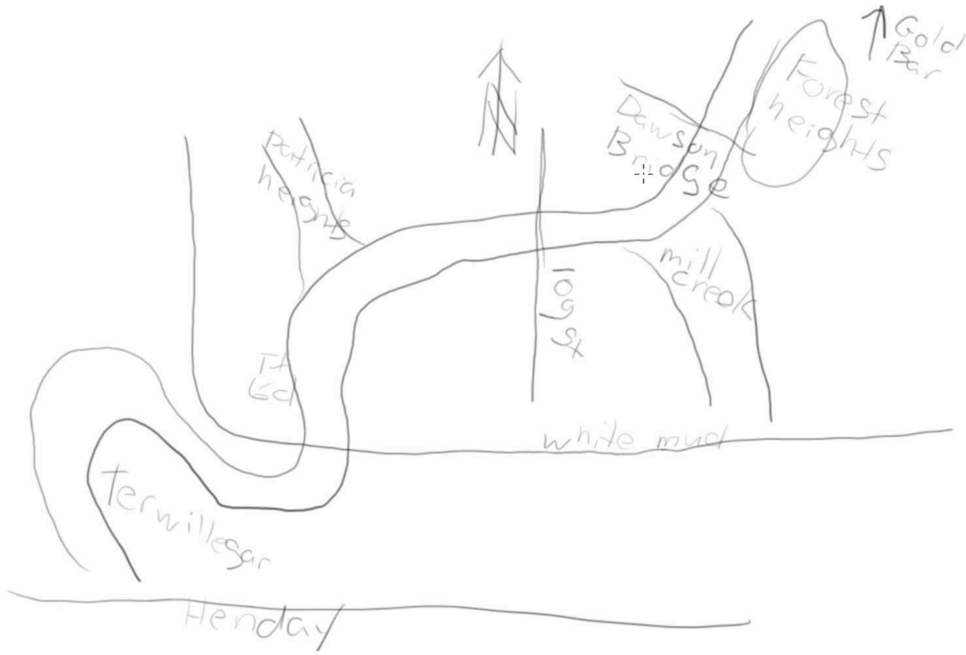

Figure D.3: Nolan's mental map.

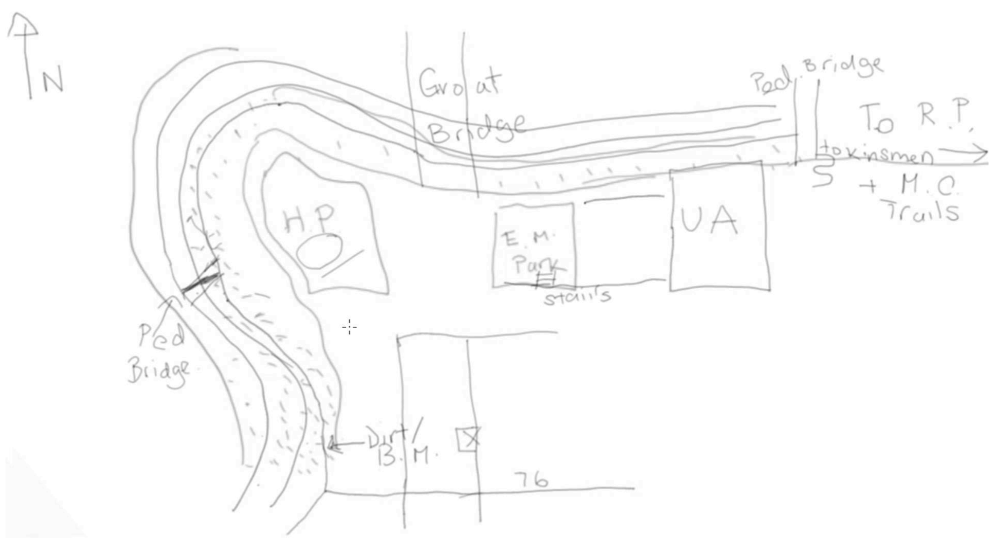

Figure D.4: Mya's mental map.

Figure D.5: Seth's mental map.

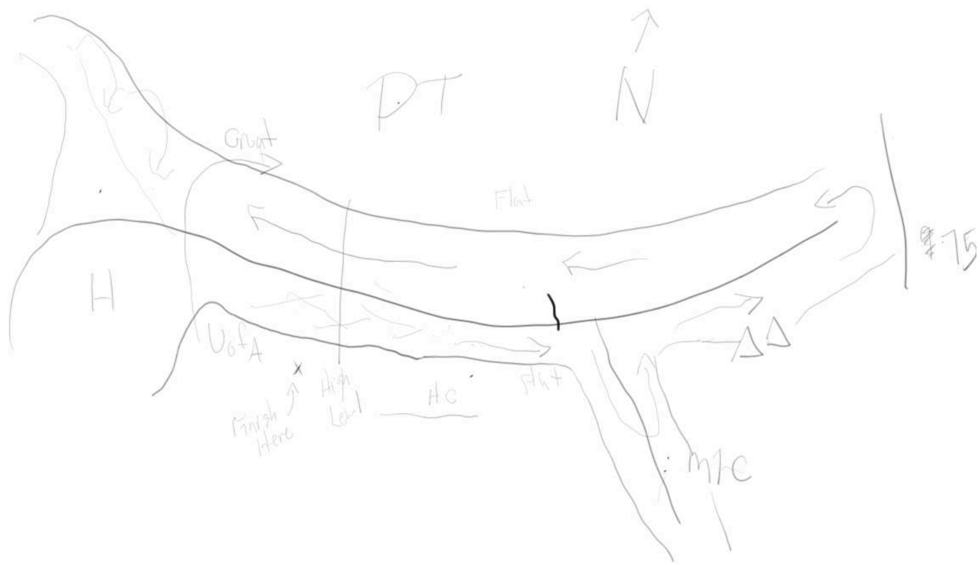

Figure D.6: Nate's mental map.

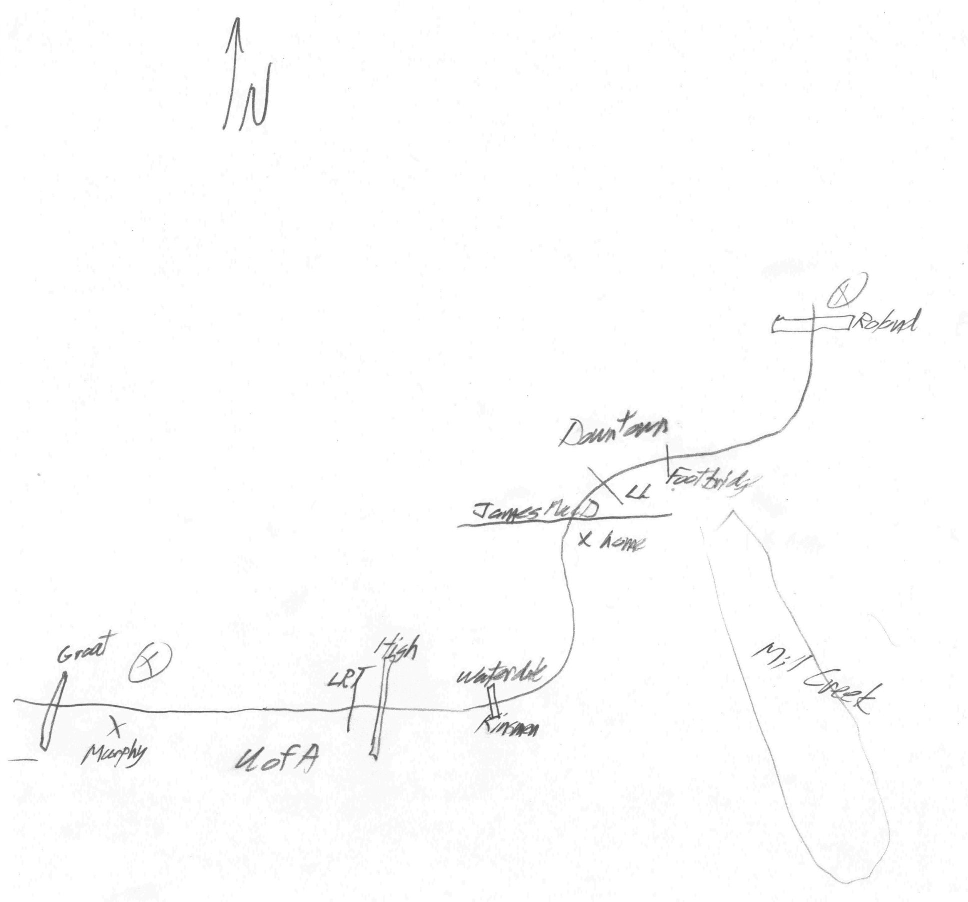

Figure D.7: John's mental map.

Figure D.8: Megan's mental map.

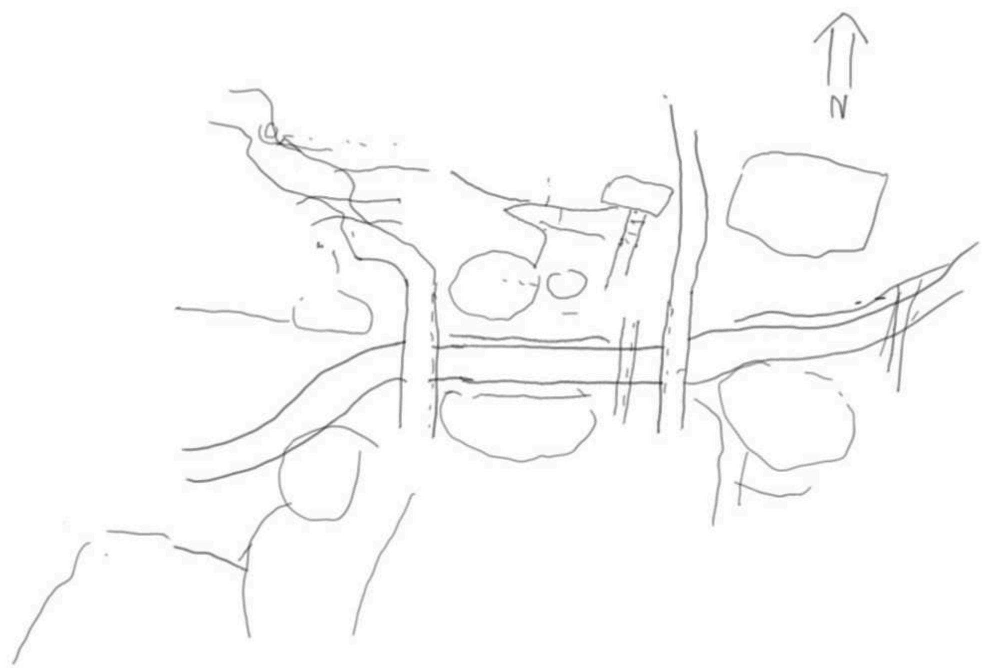

Figure D.9: Michael's mental map.

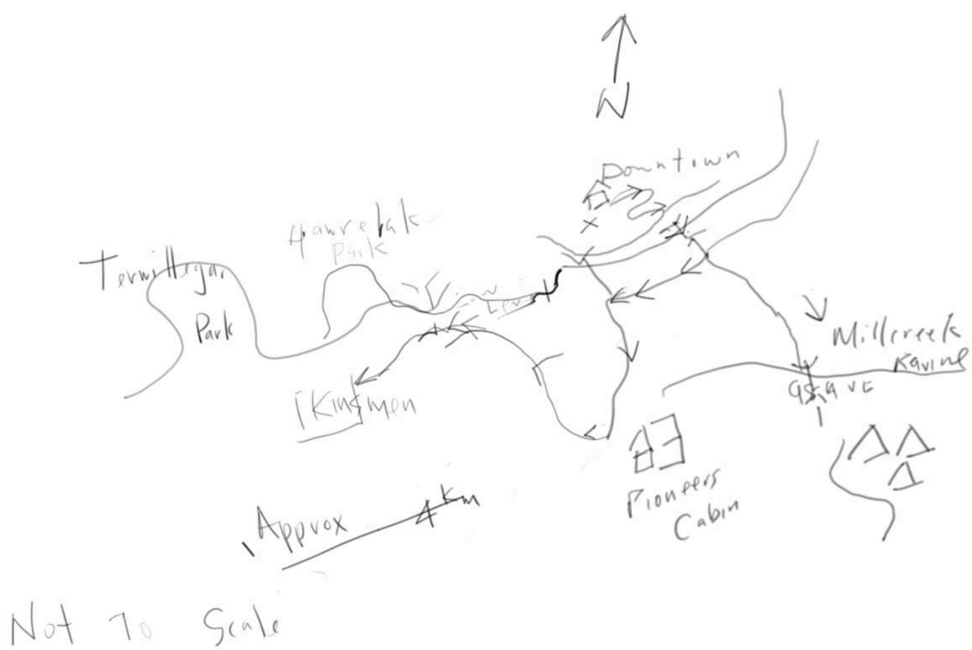

Figure D.10: Henry's mental map.

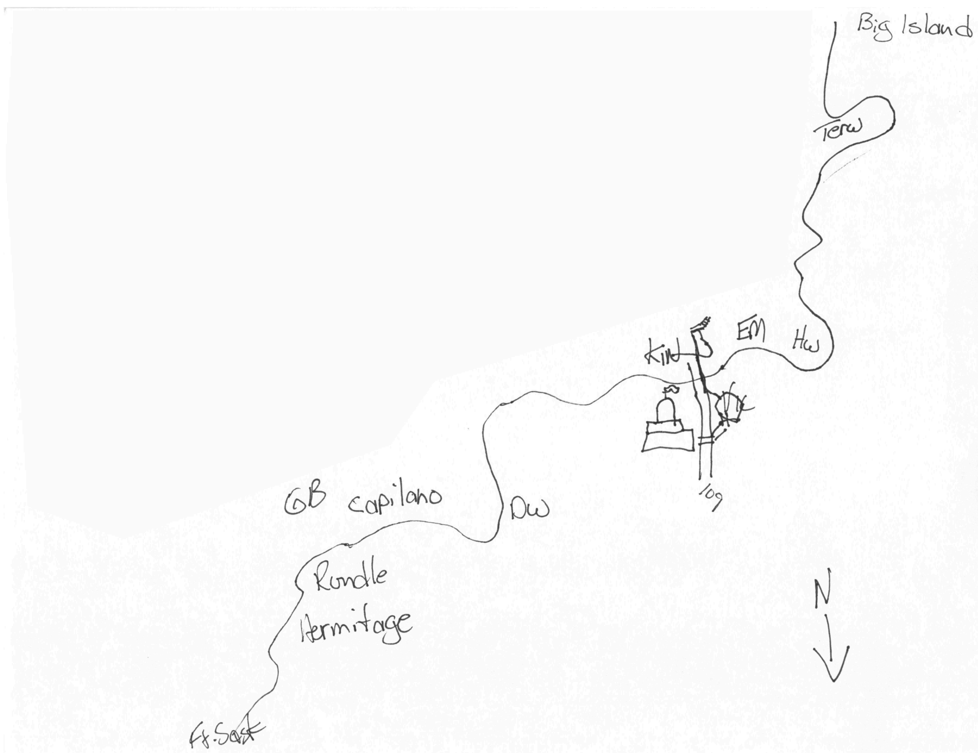

Figure D.11: James' mental map.

Appendix E

Locations Mentioned During the Interviews

Location	Longitude	Latitude	Mentions
109th Street	-113.5120608	53.52134979	7
111th Street	-113.5177859	53.52616888	1
112th Street	-113.5208613	53.52245831	1
124th Street	-113.5358876	53.54636544	1
50th Street	-113.4185689	53.54114575	4
99th Street	-113.4861348	53.52311061	2
Ada BLVD	-113.4372623	53.56245897	1
Argyll Road	-113.453245	53.50316588	1
Belgravia	-113.5351228	53.50802337	2
Beverly Heights Park	-113.4133153	53.56828654	4
Big Island	-113.6397689	53.44273077	2
Borden Park	-113.455448	53.56295962	2
Buena Vista Park	-113.5516005	53.52080008	5
Capilano	-113.4570117	53.52050373	5
Capilano Bridge	-113.4386854	53.55575977	2
Capilano Park	-113.4213892	53.56008337	2
Citadel Theatre	-113.4882857	53.54279321	1
Cloverdale	-113.4732155	53.53613301	2
Concordia University	-113.4457072	53.56004019	2
Dawson Bridge	-113.4689729	53.54910789	1
Dawson Park	-113.4689729	53.54910789	13
Edmonton Queen	-113.4820576	53.5395207	2
Emily Murphy Park	-113.5356535	53.53464022	13
EWOK	-113.4602077	53.54315136	3
Ezio Farone Park	-113.5101752	53.53369732	8
Floden Park	-113.4082669	53.5632558	3
Forest Heights	-113.4492972	53.54630806	11

Table E.1: Locations mentioned, their coordinated and number of times mentioned (Table 1 of 3).

Location	Longitude	Latitude	Mentions
Glenora Park	-113.5579088	53.54704073	2
Goldbar	-113.4073994	53.54447239	30
Goldstick Park	-113.4051344	53.54475453	2
Groat Bridge	-113.5363503	53.53349779	17
Groat Road	-113.5386373	53.53089066	10
Hawrelak Park	-113.5446872	53.52828838	55
Hermitage Park	-113.3744055	53.58141482	3
High Level Bridge	-113.511017	53.53052737	10
Highlands	-113.42899	53.56366159	4
Horse Hills	-113.3422268	53.65658811	1
Hotel MacDonald	-113.4893849	53.54025477	1
James McDonald Bridge	-113.4884066	53.53575038	3
Jasper	-113.5086008	53.54092774	3
Keillor Road	-113.5472057	53.50742418	8
Kennedale Ravine	-113.3878788	53.58792285	3
Kinnard Park	-113.456359	53.55710431	1
Kinsmen Park	-113.5078099	53.52780937	37
Kinsmen Sports Complex	-113.4999636	53.52154132	2
Laurier Heights	-113.5671739	53.51610318	2
Laurier Park	-113.5503563	53.51124895	9
Legislature Grounds	-113.5066025	53.53433921	3
Louise Mckinney Park	-113.4812968	53.54097024	2
Mayfair Golf Course	-113.5407653	53.53316623	1
Mayfair Park	-113.5446871	53.52828839	2
McKinnon Ravine	-113.563493	53.53846224	11
McNally	-113.4590323	53.54847108	2
Melton Ravine	-113.5616503	53.52964019	3
Mill Creek	-113.4828514	53.51992155	32
Mill Woods	-113.4160576	53.46991957	6

Table E.2: Locations mentioned, their coordinated and number of times mentioned (Table 2 of 3).

Location	Longitude	Latitude	Mentions
Museum	-113.5438951	53.54224945	2
NAIT	-113.5046068	53.56662319	3
Parkallen	-113.5181485	53.50375871	4
Patricia	-113.5993304	53.50808918	4
Quesnell Bridge	-113.566572	53.50644693	5
Ramsey Ravine	-113.5476101	53.54420415	4
Refinery	-113.3969025	53.54537278	5
Riverdale	-113.4720069	53.54128669	2
Rowland Road	-113.4492532	53.55118815	1
Royal Glenora	-113.5139355	53.53277142	2
Rundle Park	-113.3904769	53.55249985	21
Scona	-113.4996579	53.51029924	1
Strathcona	-113.5029432	53.51982246	3
Terwillager	-113.5958004	53.4769919	36
University	-113.5221126	53.52598763	20
Valley Zoo	-113.5558262	53.51213437	6
Victoria Golf Course	-113.5299117	53.53837418	8
Victoria Park	-113.5299117	53.53837418	7
Victoria Promenade	-113.5281214	53.54000349	2
Walterdale	-113.505452	53.52461304	4
Wayne Gretzky Drive	-113.4380165	53.55063689	3
Whitemud Creek	-113.5595516	53.4962954	10

Table E.3: Locations mentioned, their coordinated and number of times mentioned (Table 3 of 3).