THE EFFECTS OF AUGMENTED REALITY COMPUTING ON MICROGENETIC PLACE DEVELOPMENTS IN UNFAMILIAR SPACES

THE EFFECTS OF AUGMENTED REALITY COMPUTING ON MICROGENETIC PLACE DEVELOPMENTS IN UNFAMILIAR SPACES

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ABSTRACT

Modern virtually mobile technologies, largely facilitated by the Internet, have changed communication modes, methods, and even daily-lived experiences within the past 20 years. The most prevalent medium of virtual mobility, virtual reality (VR) manages information through the creation of analogies of the physical world. Recently, a new mode of computing called augmented reality (AR) has become increasingly ubiquitous through the proliferation of modern mobile handsets. AR utilizes augmentation of the physical realm rather than simulation as a guiding principle, binding together the physical and virtual realms. Through the use of context-aware features such as landmark identification, geodetic data, etc., AR is able to superimpose virtual information onto real-time displays of physical landscapes. It is in this way that AR is the first mode of computing that truly transcends the boundaries of the virtual and physical realms, demonstrating the concept of *dual presence*. The effects of this new medium of computing on navigation, wayfinding, and especially the developments involved in the creation of sense of place are largely unstudied. A phenomenological exploratory research design is carried out to seek to identify the effects AR facilitation has on respondents' cognitive developments, including developments in wayfinding and the creation of social representations of place.

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Chapter One

Introduction and Background

1.1 Research Context

Modern virtually mobile technologies, enabled by the Internet, have profoundly changed the way people learn, communicate, and experience the world. Never have information and communication technologies (ICTs) been as pervasive as they are now; they are regularly utilized by many people and influence a multitude of facets of everyday life (Vilhemson and Thulin, 2008). Although ICTs have been studied extensively throughout various disciplines, many of these technologies are still in their infancy. It is important to engage in and maintain an ongoing academic discourse that focuses on new technologies in order to better understand their implications on the ways we experience and create understandings of the world. Since there is an ever-increasing necessity of ICTs in the everyday lives of many people, it is especially important to understand how new implementations of ICTs can change, alter, or influence human experiences (Vilhelmson and Thulin, 2008).

Much of the information available to us from ICTs is presented through a platform called virtual reality (VR), a mode of computing that engages users through the use of simulated representations of the real world, providing information and communication services in a format that embraces analogy rather than actuality. Since VR has been the most dominant mode of computing, its effects on cognitive developments in space and place have been studied extensively (for example, Darken, 1998; Takeyama, 2001; Nicola, 2002; Thulin and Vilhelmson, 2004; Kesselring, 2006), however little attention has been directed towards studying ICTs that utilize a platform other than VR. Within the last decade, a new mode of computing called augmented reality (AR) that utilizes augmentation of the real world rather than simulation as a guiding principle has become increasingly ubiquitous due to advancements in mobile computing hardware and the

proliferation of modern mobile handsets (i.e. smart phones). The sophisticated hardware that is now standard in most mobile devices allows AR computing to overcome the inherent disengagement between the realms of the virtual and physical that exists with VR computing. The purpose of this thesis is to begin a discourse of inquiry that seeks to better understand the implications of dual presence, the merging of virtual information with reality, which is the defining characteristic of AR computing (Takeyama, 2001). Specifically, this study seeks to understand the effects of AR on people's cognitive developments and understandings of the physical world from a spatial perspective. Studies of sense of place have been integral to the focus of social geography within recent years however these studies have yet to focus on the effects that novel ICTs have on cognitive developments in humans, such as sense of place. In this study, respondents utilize a facilitative AR iPhone application which acts as a tour guide during a first exposure to a new and unfamiliar space. Utilizing transcendental phenomenology as its principal methodology, this study examines and compares the effects of AR facilitation on the cognitive and spatial developments that inform the microgenesis[1] of place, experienced between eight users, in an attempt to express, in a detailed and accurate manner, any implications that AR facilitation may have upon these developments.

1.2 Research Objectives

To date, only a fraction of the geographic research on AR has focused beyond the realm of the natural sciences. Since it is a technology still in its infancy, current AR research is focused upon discovering its pragmatic uses; few studies observe AR from a social, essentialist perspective. For instance, in the medical sphere, AR has been applied and evaluated as a facilitator of certain

[1] "Microgenesis" refers to the early development of "a percept, a thought, an object of imagination, or an expression. It defines the occurrence of immediate experience as [dynamically] unfolding...in which the 'germ' of the final experience [i.e. sense of place] is already embodied in the early stages of its development." (Rosenthal, 2004)

surgical procedures (see Shekhar et. al., 2010). The usefulness of AR implemented into navigation technologies, in both military and civilian facets, has also been studied and evaluated to an extensive degree (for example, Narzt et al., 2006; Goldiez et al., 2007). In the field of geography, AR studies almost exclusively focused within the fields GIS and navigation. For instance, a study by Biocca et al. (2007) addresses the benefits of AR-facilitation by observing how AR implemented within mobile devices "can provide unique human factors benefits…[such as] improved task performance, decreased error rates, and decreased mental workload," when used as a navigational aid. A study by Shen et al. (2001) evaluates AR as a means of visual assessment in urban planning which utilizes AR to overlay projections of built structures onto physical landscapes to more accurately and realistically perceive the outcome. Scott-Young (2003) describes another practical implementation of AR that uses the technology in automobiles to highlight the physical boundaries of roads in low-visibility conditions, such as in a storm or dense fog.

Few studies exist that address the effects of AR on processes and developments in people from a humanistic, essentialist perspective and from these, none were found that explicitly addressed the effects and implications of AR computing on the development of sense of place. A search querying various academic journal databases (including GEOBASE, psycINFO, and Google Scholar, among others) using the terms "augmented reality", "place", and "sense of place" in various combinations found no published, peer-review academic literature studying the effects and implications of AR facilitation on the development of sense of place. Due to the lack of research focusing on AR and its potential effects on the development of this phenomenon, this study seeks to observe how AR influences people's understanding of the world around them and in which ways it inhibits or facilitates the microgenesis of place between two respondent group: those facilitated by AR computing and those facilitated only be their senses.

The objective of this study is to accurately express, compare, and contrast the experiences of individual participants (aggregated as members of their groups) in order to develop a better understanding of the effects AR facilitation has on the microgenesis of sense of place in unfamiliar spaces. This study is framed upon the following four research objectives:

1. To observe how AR-facilitation affects the microgenesis of place in unfamiliar spaces by focusing on spatial aspects of wayfinding that are utilized by both AR and non-AR respondents.

2. To observe how the facilitation of AR affects the microgenesis of place in unfamiliar spaces by focusing on respondents' cognitive (i.e. beliefs and perceptions) and affective (i.e. emotions and feelings) developments.

3. To observe the effects of AR on the development of respondents' social representations of an environment, namely through the creation of positive and negative assessments (i.e. polar assessments).

4. To evaluate whether the use of AR as a facilitator in new and unfamiliar spaces is cognitively ergonomic[2] or debilitating.

1.3 Background Literature

[2] "Cognitively ergonomic" refers to the ability of a technology to make any cognitive human experience more comfortable, convenient, and efficient, demonstrating a true form of facilitation.

This section reviews the body of scholarly literature which focuses on virtual mobility, VR, AR, sense of place, wayfinding, and the social representation of place. The research gap in the existing literature will be identified and the context of this study will be set forward.

1.3.1 Virtual Mobility

Modern ICTs possess the capabilities to converge space and time, making information, people, and places accessible to a user easily and conveniently at any moment. These technologies have radically changed communication modes, methods, and everyday experiences within the past fifteen years. Virtual mobility refers to a device's ability to transcend space and time, making "everyday activity patterns—the location, duration, and sequence of work; shopping, learning, information seeking, social contacts, and entertainment—more flexible in time and less rooted, as well as more extended, in space" (Thulin and Vilhelmson, 2008). In terms of space, virtual mobility makes proximity less significant since it reduces the friction of distance. Virtually mobile devices have not only changed the ways in which people learn, communicate, and share information, they have also affected spatial patterns. For instance, research has shown that the use of virtually mobile ICTs has affected people's mobility in the forms of commuting and shopping behaviours (Kesselring, 2005; Schwanen and Kwan, 2008). Schwanen and Kwan (2008) also suggest that due to the proliferation of virtually mobile handheld devices such as smart phones, people are now less likely to use their homes as central locations of planning social activities. Instead, people are becoming more likely to rely upon more iterative methods, using their mobile devices to negotiate and communicate to plan activities. Virtual mobility even has an effect on modern urban planning; South Korea's U-City program (short for Ubiquitous City) is in the process of constructing virtual mobility right into the infrastructure of some of its cities, effectively embedding interactive and synchronized ICTs into urban landscapes to allow people to receive and share information (Shin,

2009). There is no doubt that the world is changing due to the prevalence of some of these new implementations of ICTs. Some proponents of this virtual mobility transition, such as Blum (2009), believe that ICTs have even become *necessary* for people to cope with the sprawling landscapes of modernity and globalization that exist in the 21st century; he believes that modernity brings with it human dependencies upon these types of technologies. These dependencies have most accurately been demonstrated by the exponential increase in the use of ICTs, especially handheld devices, since the turn of the century (Thulin and Vilhelmson, 2004; Vilhelmson and Thulin, 2008).

1.3.2 Modes of Computing: Virtual Reality and Augmented Reality

The most prevalent mode of virtual mobility is called virtual reality (VR). VR utilizes "simulation (replication and separation) as [its] guiding principle" (Viseau, 2003). VR utilizes a framework of analogy to present information. For instance, Google Maps, Google Earth, and the popular Google Street View function that is available on both of the aforementioned platforms are commonly used examples of VR. These instances of VR allow users to view accurate and detailed virtual representations of the real world through the screen of a computer or a handheld device. Figure 1.1 shows an example of a fairly detailed VR rendering of McMaster University derived from Google Earth; the image is a simulated replication, a virtual form of the campus, as it exists in actuality. The Google Street View function takes interactivity and capability to a different capacity by providing users with access to virtual, 360 degree panoramic images of streets in various cities around the world, allowing them to change positionality and location, allowing users to virtually walk down any location in the world archived in Google's databases (Google, 2012). A less explicit example of VR includes computer operating systems (e.g. Windows 7, OS X, Linux, and others). They exemplify VR through their graphical user interfaces (GUIs) which recreate a simulated version of a real world utilizing a virtual framework. From a computer's operating

system, enabled by the Internet, a user can access media, information, people, and places, viewed through “windows” or “panes”, which virtually bridge a user with any sought after content. Video games are more fantastical demonstrations of VR. They utilize graphical rendering to create large-scale life-like virtual environments that people are able to explore Tan and Yee, 2010). In cases, developers are able to recreate virtual representations of the real world with immense precision, detail, and accuracy, however the disadvantage of VR is the inherent disembodiment that exists between a created virtual simulation and the world as it exists actuality. Even in the most optimal simulation, an obvious rift between the real and the virtual is evident (Vilhemson and Thulin, 2008).

Figure 1.1 A three dimensional VR rendering of the McMaster University campus in Hamilton, Ontario (Source: Google Earth, 2012)

Recently, another mode of computing called augmented reality (AR) has become increasingly ubiquitous due to advancements in virtually mobile ICTs and the proliferation of handheld devices. Rather than representing information through simulation like VR, AR utilizes augmentation of the physical world as a guiding principle. Until recently, implementations of AR were limited to those who possessed expensive, cumbersome devices—many early implementations of AR were used in military facets. For instance, the heads-up-displays (HUDs) in fighter jets utilize AR overlays to provide a pilot with information in his or her normal field of vision, minimizing distraction and inattention (Regenbrecht et al., 2002). Today, AR computing is available in a much more mobile and intuitive format to anyone who owns a handheld device, such as a smart phone, that utilizes hardware and features such as camera tracking, voice recognition, stereoscopic sensors, accelerometers, GPS receivers, compasses etc. (Gotsis, 2009; Frohlich et al., 2011).

The sophistication of hardware in modern smart phones allows AR to operate through two fundamental capacities: spatial sensing and georeferenced digital content (Frohlich et al., 2011). Spatial sensing refers to the "handheld's ability to sense its orientation toward its physical surroundings" (Frohlich et al., 2011). Spatial sensing in handhelds is enabled through four common technologies: geospatial calculation (i.e. through the use GPS receivers, accelerometers, compasses, etc.), visual detection (i.e. some AR devices are able to detect and process text, images, or features within physical landscapes), real-time feature tracking (i.e. the ability to track anchors in the real world and overlay them virtual augmentations in real-time), and image-based localization (i.e. the ability to pinpoint a user's location based on the identification of markers in a landscape rather than relying on built-in hardware) (Frohlich et al., 2011). These technologies are what enable AR to superimpose location-specific information onto real-time displays of physical landscapes, melding together virtual information with the real world (Viseau, 2003). By entangling these two realms, AR

effectively transcends boundaries of both the virtual and physical, allowing for their synchronous coexistence, being the first and only mode of computing to truly demonstrate Takeyama's (2001) concept of "dual presence". Papagiannakis et al., (2008) argue VR and AR as two mediums of virtual mobility at opposing ends of a continuum, however, in this study AR is considered to be an incrementally improved mode of computing above VR that utilizes virtual information while effectively diminishing the disembodiment between virtual information and reality. While VR simply creates a simulation of the real world, AR superimposes displays of real, physical spaces with virtual information, fusing "computer-generated information with our sensations of the natural world" (Viseu, 2003). Based on augmentation of the physical world rather than utilizing virtual representations, AR incorporates virtual information onto displays of physical landscapes, allowing for "context-aware information in [a] natural and built environment, on demand…as intended by content authors" (Gotsis, 2009). Figure 1.2 shows an example of an AR mobile phone application called GeoTravel, which demonstrates how AR utilizes superimpositions of virtual information overlaid onto displays of the real world. Although it was hypothesized that the use of AR-enabled ICTs in new and unfamiliar spaces might influence the process of familiarization and affect the experience of exploration, it was not clear to what degree, nor was it clear what effect the use of AR computing would have on developments of sense of place in these environments.

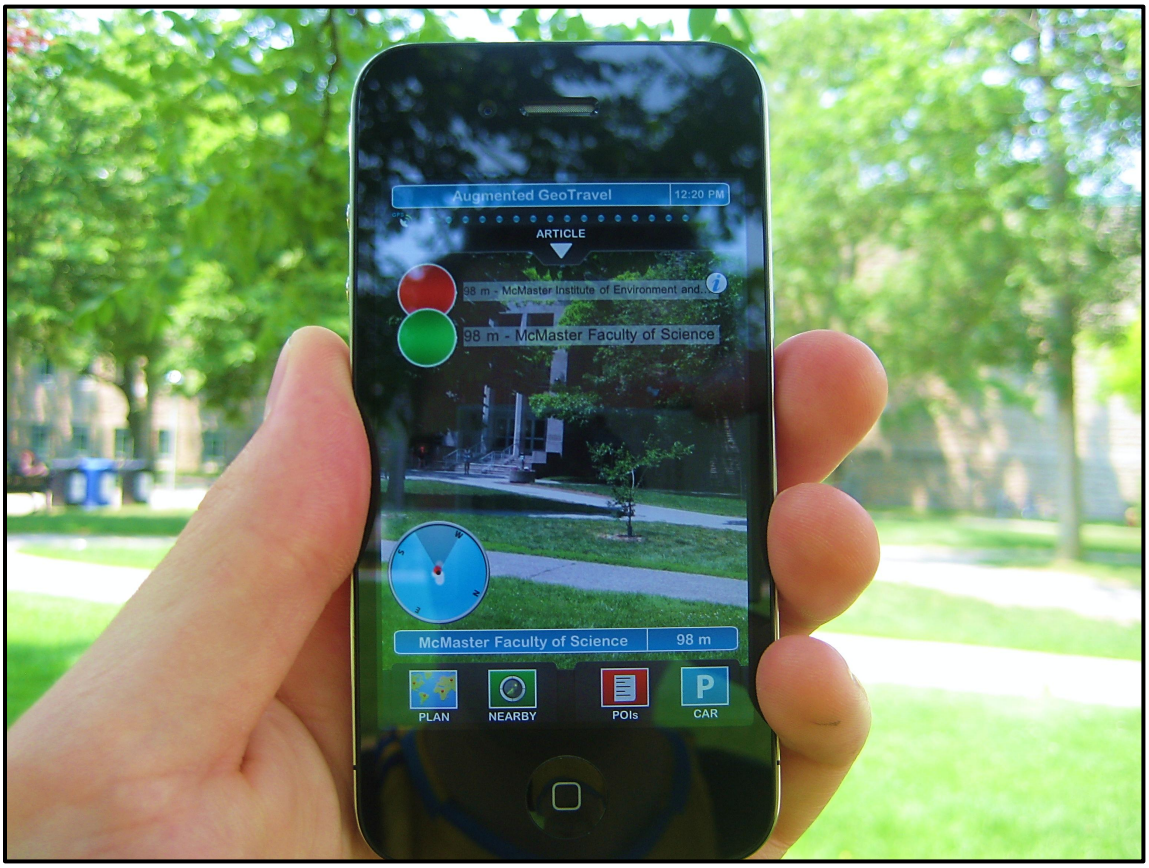

Figure 1.2 A user with an AR application called GeoTravel on an iPhone learning about proximate points of interest at McMaster University in Hamilton, Ontario

1.3.3 The Microgenesis of Sense of Place

Cresswell (2004) defines place as "an embodied relationship with the world…[resulting from] process and practices". Simply put, place is created in space by instilling it with meaning that is gained through experience. The phenomenon of sense of place is essential to life since existence is place-bound; a life without place would be "as unimaginable as a life without other people" (Relph, 2007). Relph (1986) describes sense of place as existing on a continuum of sorts, ranging from "possible awareness, from simple recognition for orientation, through the capacity to respond empathetically to the identities of different places, to a profound association with places as cornerstones of human existence and individual identity." The degree to which one holds an affinity for place depends largely on volume and frequency of exposure to a space. Most commonly,

people experience sense of place when they revisit the towns, neighbourhoods, or cities they live or grew up in, within which they created "memories, associations, and meanings" (Relph, 2007). The development of place, of course, is a highly subjective, egocentric process—it grows not only over time but also at an individual level, through daily-lived experiences thus, sense of place is made and remade every day. In the words of Cresswell (2004), "places are never 'finished' but always 'becoming'". The development of place is both sensory and extra-sensory, utilizing "senses, hearing, smell, movement, touch, memory, imagination, and anticipation" (Relph, 2007). Those who are exposed to unfamiliar environments for the first time will encounter a solely sensate experience. The developments that are constructed from these senses that influence will influence a person's beliefs, perceptions, emotions, and feelings within a space, leading to their subsequent development of a sense of place (Porteous, 1990).

Relph (1986; 2007) describes three essential components to place: the physical setting, the activities that occur there, and meanings developed within it. The physical setting refers to an environments landscape and physical characteristics. Relph (2007) believes that certain places have inherent features that may catalyze the developments of sense of place (he describes spaces with these types of accelerative features as rich with "spirit of place"). However, this is not to say that place can develop from design alone; a person's motivation and openness to learn and observe an environment in detail is what allows place to be created.

The second component that is essential to place is human activity. Places are the domains of human activities such as shopping, working, producing, exercise, commuting, exploring, etc. Places are partly endowed with meanings due to these activates which derive experiences from "living, working or visiting somewhere, appreciating its architecture, being familiar with its routines, knowing its people and having responsibilities towards it" (Relph, 2007). There is no question that the notion of place has changed due to the recent advancements in mobility, virtual mobility, and

communications; many people have a more broad and cosmopolitan view of the world leading to a generally less intense but more diverse and open sense of place (Relph, 2007).

Many researchers believe that a sense of place can exist in virtual environments, albeit much differently than sense of place in the real world (Cresswell, 2004; Cowan, 2005; Relph, 2007; Tan and Yee, 2010). There are several differences between place in the real world and place in VR. Primarily and most obviously, places that exist in VR are not fundamental to human existence like places in reality are (Cowan, 2005; Relph, 2007). Places in VR also exist without any geodetic bearings (i.e. without occupying space in the real world), thus they exist in a realm that is not under the constraints of time or space (Cresswell, 2004). Additionally, the activities that take place in VR, in comparison to reality are limited; Relph (2007) suggests that the only categories that exist in VR are "entertainment and games; the exchange of information; academic research; [and] technical training". Although not bound by the constraints of space and time, VR does have its limitations, primarily existing through a human aspect. At best, the extent of human involvement with virtual environments is limited to participation; no matter how accurate a simulated recreation of a real environment is, it will not allow for the intricate and necessary processes of placemaking because no human synesthetic experiences are able to occur in a VR construct due to the fact that sensory perceptions in a virtual realm are greatly limited (Relph, 2007).

AR is inherently different in form and function than VR; since it interactively and seamlessly combines the real and the virtual together, the disembodiment between the information provided and reality is minimized. Frohlich et al. (2011) describe AR computing as a "smart lens", a way of looking at the world through a device that is aware of context and location-specific digital content which is then superimposed onto a view of the real world; although AR is the first mode of computing to do so, its effects on the developments of sense of place have yet to be studied. This study seeks to acquire a greater understanding of AR and how using it as a facilitator can lead do

the development of sense of place in unfamiliar spaces. Since it was hypothesized that it would be unlikely for the use of AR facilitation in new spaces to lead to a profound association with place, this study observes only sense of place in its most nascent form, through its microgenesis. Within the microgenesis of place, wayfinding and navigation are central processes used to endow a space with meaning; since place is essentially space with meaning created through experiences, the microgenesis of place will be observed from the perspectives of wayfinding and navigation (Golledge, 1992).

1.3.4 Cognitive Developments in Space and Place

Although some equate navigation with wayfinding, they are notably different. Navigation, a component of wayfinding, refers to the cognitive processes that concern themselves with queries and understandings of locational and directional cues that allow users to orient or position themselves within a space. Wayfinding, an overarching process, refers to the cognitive developments that begin to endow new and unfamiliar spaces with meaning. In wayfinding, an observer divides and mentally organizes space into a hierarchy. The basic organizational principles of wayfinding, according to Darken and Sibert (1996) are: the division of a large-scale world into distinct small parts to preserve sense of place, the organization of the small parts under a simple organizational principle, and the provision of frequent directional cues—the last two processes are largely guided by navigation. Golledge (1992) explains wayfinding in further detail, suggesting that there are four different types of spatial knowledge that contribute to the understanding of wayfinding, essentially informing the development of an organizational hierarchy. These knowledge types are: declarative (i.e. the creation of an inventory of pieces of information and their containment in long-term memory), procedural (i.e. the linking of pieces of declarative knowledge into strings to create associations and relations between points, lines, and areas), configurational

(i.e. the creation of associations between and relative to places), and place knowledge (i.e. the creation of a list of perceived features and attributes, natural or built, that exist within an environment). The latter two types of knowledge are of particular importance. Configurational knowledge involves an awareness of an area's spatial characteristics that "are used to infuse meaning into an environment while experiencing it or while thinking about an experience" (Golledge, 1992). Configurational knowledge also relates closely to place knowledge which can be defined as an awareness of features or landmarks in a space where each feature or landmark has attached to it a string of perceived attributes such as "location, size or magnitude, identity, time, colour, uniqueness, function, and so on" (Golledge, 1992). This type of knowledge is used in wayfinding, not only to familiarize oneself with a space, but also to create initial sense of place through conventionalization (infusing meaning into environment). It is in this way that wayfinding presumes not only the spatial judgments that are ascribed with familiarization of an area (e.g. inter-point distance judgments, directional judgments, spatial sequencing, and spatial linkage), but also the formation of an internal, partly egocentric, social representation of an area. Thus, the fundamental difference between navigation and wayfinding lies in the fact that navigation involves a process of "choosing headings, defining the sets of angles, path segments, and speeds of movement…over a path," focusing on the task of guidance through a route while wayfinding relies on the representations an individual creates which lead to the subsequent formation of a sense of place (Golledge, 1992).

Moscovici's (2001) concept of social representation can be used to further understand how experiencing a space through wayfinding leads to the creation of a sense of place. At its basis, social representation seeks to prescriptively conventionalize objects, individuals, or events people encounter according to that individual person's socially learned dispositions that arise through dealings with everyday life—essentially what Bourdieu and Wacquant (1992) call *habitus*. For

instance, past representations, language, culture, religious beliefs, political beliefs, and anything else that derived from previous knowledge and experiences are used as templates in the course of social representation (Bourdieu and Wacquant, 1992). Social representation functions through two processes: anchoring and objectification. Anchoring is a process that identifies something foreign and "compares it to a paradigm of a category" that an individual thinks suits it (Moscovici, 2001). For instance, if due to past experiences one associates urban spaces with negative opinions, it is likely that any exposure to an unfamiliar urban space will lead to further negative representation ascribed through the anchoring process. Anchoring works by categorizing objects (as best as possible) into types. Anchoring also implies assessment and labeling thus neutrality is not possible; each object or being that becomes anchored is classified with a positive or negative value assessment. By particularizing an object, person, or place through anchoring, we also "maintain the distance and consider the object under scrutiny as a divergence from the prototype. At the same time, we try to detect what feature, motivation or attitude makes it distinct" (Moscovici, 2001). Anchoring recognizes each object being compared to a paradigm of category as distinctly unique, although still corresponding to a category.

The second process at work in social representation, the objectification of objects, people, or events, turns something unfamiliar into reality, making it familiar and obvious. Something that is objectified becomes conceptualized mentally—it becomes a realized physical object that is ascribed with value and meaning. Objectification is the process of cognitively materializing an abstraction into a reality.

In this study, the use of AR facilitation in new and unfamiliar environments was hypothesized to directly influence the anchoring process because its use presents a user with a reality that is altered through augmentation; quite simply, it was expected that one would view the world differently through the lens of an AR device. The extent to which AR changes perceptions of

reality and experiences within place are questions that are embraced by the research objectives of this study.

1.4 Chapter Outline

This thesis is organized into four chapters. The second chapter describes in detail methodology and methods used in the study, including the rationale behind choosing constructivism as a research paradigm, choosing transcendental phenomenology as a research approach, mentioning also how the data was analyzed and the measures that were taken to ensure rigour and reflexivity in the duration of the study. Chapter three presents the findings of the qualitative data collected which are based upon the thematic codes that were generated during the coding process. This chapter also discusses methodological limitations of the study. The final chapter concludes the thesis by presenting a summary of the findings and a discussion that addresses each of the four research objectives. The limitations of the study are elaborated upon and suggestions on futures avenues of research are provided.

Chapter Two

Methods

The purpose of this chapter is to present the methods and overarching methodology utilized in this research. First, the rationale behind the study's overarching research paradigm, constructivism, will be explained. The research approach, guided by Moustakas' (1994) version of transcendental phenomenology will then be described in detail, clarifying the philosophical perspectives and presuppositions that influenced the methods and methodology of this study. Once the framework of the research is established and its utility in answering the applicable research questions is validated, a detailed description of the rationale and methodological guidelines used behind determining sample size and recruitment, data collection, and data interpretation will be explained. Following this, an overview of the study's limitations, both methodological and technical, will be explained. Lastly, the measures used in this study, proposed by Baxter and Eyles (1997) to ensure rigour in qualitative research will be outlined.

2.1 Research Paradigm

In order to establish a set of research rules and guidelines to aid in the maintenance of a critically reflexive standpoint, it is important for every researcher to identify a study's fundamental paradigmatic perspective. A research paradigm can be described "as a set of *basic beliefs*...that defines, for its holder, the nature of the 'world,' the individual's place in it, and the range of possible relationships to that world and its parts..." (Guba and Lincoln, 1994). In other words, a research paradigm is a composition of assumptions that guide the researcher's ontological, epistemological, and methodological orientations when conducting a study.

In the context of qualitative research, ontology brings into question the nature of reality (i.e. "how things really are" and "how things really work"); epistemology questions the nature of the

relationship between the researcher and the knowledge that is being sought after, in order to maintain vigilance and objectivity (i.e. a study's epistemic bearing is what encourages a researcher to be aware, critical, and reflexive of his/her own role in the research process); and lastly, methodology which brings into question the methods used by the researcher to gain knowledge, guiding the researcher to choose a methodology that informs and supports the methods to effectively carry out the research objectives (Guba and Lincoln 1994; Cresswell 2006). Due to its ontological, epistemological, and methodological bearings, and because these bearings are applicable to all the research objectives under question in this study, constructivism was identified as the primary research paradigm for this study. It is important to justify the criteria of constructivism in relation to its applicability in this study; Guba and Lincoln (1994) provide a table listing the characteristics of social constructivism compared with other research paradigms (see Table 2.1).

Table 2.1. Basic beliefs of competing paradigms of inquiry in quantitative and qualitative research (from Guba and Lincoln, 1994)

Item	Positivism	Postpositivism	Critical Theory	Constructivism
Ontology	naïve realism--"real" reality but apprehendible	critical realism--"real" reality but only imperfectly and probabilistically apprehendible	historical realism--reality shaped by social, political, cultural, economic, ethnic, and gender values; crystallized over time	relativism--local and specific constructed realities
Epistemology	dualist/objectivist; findings true	modified dualist/objectivist; critical tradition/community; findings probably true	transactional/subjectivist; value-mediated findings	transactional/subjectivist; created findings
Methodology	experimental/manipulative; verification of hypotheses; chiefly quantitative methods	modified experimental/manipulative; critical multiplism; falsification of hypotheses; may include qualitative methods	dialogic/dialectical	hermeneutical/dialectical

The ontology of constructivism is relativistic, implying that the realities under observation exist as multiple, intangible mental constructions based on individual experiences. Relativism is ontologically appropriate for this study since the study seeks to understand the microgenesis of sense of place between facilitated (i.e. those who use AR) and non-facilitated respondents in their initial interactions with a new and unfamiliar environment. The microgenesis of place is dependent upon the subjective process undergone by each individual, thus every reality created is tailored by each respondent and their unique experiences. The epistemology of social constructivism is transactional and subjective, implying that any findings are hermeneutically and iteratively developed in the duration of the research process. This epistemic orientation is appropriate in this study context since this research is guided by phenomenology, a fundamentally iterative and hermeneutic methodology, implying that findings can only be developed and revealed if a mutual dialogue between the researcher and the participants (including all data they produce) exists. This methodology is very much a process of creation and crystallization rather than a simple agglomeration of facts and data. As Guba and Lincoln (1994) suggest, "the final aim [of this methodology] is to distill a consensus construction" that become the results of the research.

2.2 Research Approach: Transcendental Phenomenology

This study supports the ontological supposition that the structure of objective reality is not immediately known to an environment's inhabitants rather, the construction of reality is shaped by the individual differences that exist between people. Under this supposition, no two people will have the exact same cognitive construction of the same environment that they are both exposed to (Golledge and Spector, 1978). Golledge and Spector (1978) suggest that people who are exposed to the same environment only experience that space isomorphically, and only to a certain degree.

Perceptions which are cognitively structured at an individual level, influenced by various social factors (e.g. language, upbringing, education, culture, religion, political beliefs etc.) also play a significant role in the development of cognitive representations of space. Sense of place is the cognitive construction of an environment that exists beyond an isomorphic scale. Due to the egocentric processes involved in its development, even at a microgenetic scale, sense of place is a concept that is highly intangible, thus making it difficult to measure (Eyles, 1985). Some researchers advocate quantitative methodologies to measure sense of place (for example, Shamai and Ilatov 2004; Jorgensen and Stedman 2001; Jorgensen and Stedman 2006) however, due to the level of abstraction involved in understanding the microgenesis of sense of place, a quantitative methodology was deemed unable to provide an adequate understanding or representation of the intricacies of the development of place. Thus, this study utilizes phenomenology as a research approach since it best " [isolates] and [clarifies] that which we experience and how we experience it…[Additionally,] it involves the suspension of the presuppositions and methods of 'official science' in order to describe the world of intentionality and meaning" (Eyles 1985). More specifically, this study utilizes Moustakas' (1994) variety of transcendental phenomenology in order to uncover and understand the microgenetic developments of sense of place between two groups of respondents (those facilitated by AR and those facilitated only by their senses) who are exposed to a new and unfamiliar environment and are asked to explore the area along a prescribed tour route. This experimental approach was deemed most effective when considering the study's research objectives. Additionally, phenomenology was chosen as the most suitable approach since it is the only approach that is able to "reduce individual experiences with a phenomenon to a description of the universal essence" (Cresswell, 2006). The purpose of phenomenology is not solely to explain, it is meant to describe the essence of a certain phenomenon for the purpose of a more complete understanding.

Transcendental phenomenology is founded upon two concepts: *intentionality* and *intuition*. Intentionality describes the way in which something is perceived, valued, or judged by someone (Moustakas, 1994). Intentionality is based upon consciousness and thus is entirely subjective, differing between individual; it depends largely on previous disposition gained through past experiences. In the case of intentionality, "self and world are inseparable components of meaning" (Moustakas 1994). However, this is not to say that common denominators cannot be found between individuals who share the experience of a certain phenomenon. Moustakas suggests that intentionality is composed from a *noema* and a *noesis*. Noema refers to the perceived form of an object rather than it's objectified form. For instance, if a person were to look at Niagara Falls, that person's noema of the object, Niagara Falls, would come into existence based on the self-perceptions that are involved with recognizing the *appearance* of the falls and not the *actuality* of the falls themselves; the object under observation can exist in different perceived forms depending on the viewer and his or her previous dispositions, the angle at which the object is viewed, the time of day, and various other extraneous conditions. There can exist multiple *perceived* or interpreted forms of Niagara Falls but only one exists in *actuality*. In this way Husserl (1931) describes the noema as the "perceived as such" form of an object or experience.

The second component of intentionality, noesis, is an essential process that states that meaning is inherently derived from any experience; noesis is the process of bringing something into consciousness (Moustakas, 1994). As is such, noema and noesis are two mutually dependent components that are both required to develop intentionality. In sum, intentionality allows one to understand a phenomenon by explicating upon the correlation between noema and noesis, thus revealing the meaning and essence of an experience (Moustakas, 1994). Moscovici's (2001) theory of the development of social representations was also adapted to this thesis in order to better understand the phenomena of place microgenesis. Social representation (described in more detail in

section 3.5) is composed of processes that mirror noema and noesis called *anchoring* and *objectification*. Anchoring, similar to noema, is a process that compares an unfamiliar object to a category of a paradigm that a user deems most suitable for that object, based again on previous disposition derived from experience. Like noema, anchoring is a subjective and unique process that varies between individuals. Objectification is essentially terminologically interchangeable with noesis; it is the process of mentally materializing that which is unfamiliar, using anchoring to make it familiar. Intuition is the second key focus of transcendental phenomenology; it is described as the starting point in the derivation of knowledge "of human experience, free of everyday sense impression and the natural attitude" (Moustakas, 1994). Intuition helps to understand the essences of any phenomenon through extrapolating what an agent consciously experiences by stripping away of all a priori knowledge of the world, viewing the pure essence of the experience in isolation, embracing the adage, "Whatever presents itself, [is] whatever is actually given" (Moustakas, 1994).

To achieve a true and valid understanding of the intentionality and intuition of an experienced human phenomenon, Moustakas proposes three methodological criteria that this study adheres to. The first methodological criterion is for the researcher to remove his or her own experiences as much as possible, in order to be able to objectively describe the conscious, lived experiences of any lived phenomenon being observed; this is called *bracketing* (Moustakas, 1994; Cresswell, 2006). Bracketing requires the researcher to view things reflexively, setting aside past experiences, understandings, judgments, and knowledge of the world to view a phenomenon openly and naively (Moustakas, 1994). It is of course impossible to achieve perfect bracketing (i.e. to obtain a fully transcendental view of the world), however, it is the researchers duty to be as critically reflexive of his or her own role as an agent within the research process, from organization to interpretation and representation. In this study, as a researcher, I attempted to bracket myself from my own dispositions for the purpose of maintaining objectivity by providing an

autobiographical disclaimer, a bracketing statement, that conveys any relevant information or life experiences that I suspected might compromise the objective interpretation the data in this study (see Appendix A).

The second methodological goal proposed by Moustakas (1994) is to first focus on each experienced phenomenon as a singular entity, allowing it to be observed in its totality, and then move on to describe any commonalities shared between those who experienced the phenomenon; this is called *transcendental-phenomenological reduction*. This is an important task within the chosen research approach because it allows the phenomenon to be first viewed from the "vantage point of an open self" (Moustakas, 1994), only then being aggregated to represent the experiences of a group. In this study, each respondents interview transcripts were read and revisited continuously throughout every stage of the research process. Additionally, a summary of each respondent's experiences derived from their interview data, photographs, and mental maps was created in order to more easily be able to compare and contrast individual respondent experiences. Once the final interpretative codes were determined, these individual accounts were used to create a textural description of each individual experience aggregated as experiences of the AR and non-AR groups. To validate these interpretations, respondents were contacted via e-mail and each one provided with sample excerpts of interpretations derived from each type of data. During this member-checking process, each respondent was able to validate and provide commentary and the researchers interpretations of their experiences.

The final methodological criterion in transcendental phenomenology, called *imaginative variation*, calls for the utilization of "data of experience, data of perception, [and] the data of memory," from each respondent to allow for maximized understanding of the essences of the phenomena they experienced (Moustakas, 1994). In this study, imaginative variation was achieved by triangulating multiple data sources produced by respondents. Usually in phenomenological

studies, in-depth interviews from between 5-25 respondents are the primary source of information, but it is not uncommon for phenomenological researchers to triangulate between observations, journals, written responses, and various forms of art (e.g. poetry, music, paintings, drawings, etc.) (Cresswell, 2006). The data in this study is triangulated between interview transcripts, mental maps, respondent-taken photographs, and a researcher's journal used to maintain confirmability.

2.3 Study Area Context and Route Segment Delineation

The events of this study take place in the St. Lawrence neighborhood of downtown Toronto, Ontario, an area sometimes referred to as "Toronto Old Town" (Old Town Toronto, 2012). An urban environment was chosen as the location for this study because the spatial forms within these kinds of environments are "substantial, relatively stable, and composed of many different discrete things that obey [a set] of natural laws...[Additionally,] occurrences or phenomena that in total make up [urban environments] exist as facts in time and space and are independent of mind" (Golledge and Spector, 1978). Golledge and Spector suggest that urban environments have a strong and dynamic presence that exists in actuality and can also exist in perception. The specific area was chosen as the location for the prescribed tour route in this study since, during pilot tests, it was deemed to have a substantial amount of unique points of interest (POIs) in close proximity to one another within a relatively small area; the majority of POIs in the area were also recognized by the chosen AR vessel of this study, an iPhone application called GeoTravel. In short, the chosen area was deemed to allow an AR user to utilize the technology to its maximum facilitation. Finally, the sensory experiences encountered in this area during the study's pilot stages were very rich, allowing respondents to form a rich impression of the area within a relatively short period of time.

The area, founded in 1793, is both culturally and historically rich, as made evident through the areas physical landscape and ambience (Old Town Toronto, 2012). Bounded by Queen St. to

the north, Parliament St. to the east, Lakeshore Blvd. to the south, and Yonge St. to the west, the area is about 1.35 km^2 and is home to many interesting sites, both old and new. Located just east of Toronto's Financial District, the St. Lawrence Neighbourhood is home to mainly commercial establishments but some residential buildings (e.g. condominiums) can be seen in the vicinity. The area maintains a relatively flat, consistent plane and provides a variety of unique POIs; both of these characteristics can be used to aid in navigation. The area also has many road signs but they are usually small and inconspicuous. Again, both the POIs and the road signs allow orientation in the area to be fairly intuitive and easy, even on a first exposure. The area contains a substantial amount of pedestrian and vehicular activity, especially during regular work hours (e.g. 9:00 am-5:00 pm, weekdays), during which all respondents toured the area. This was found to be distracting and uncomfortable to those who were not used to urban environments.

The area also houses many salient features and characteristics. This study adapts the concept of imageability from Golledge's (1978) anchor-point theory, which attempts to explain how salient environmental characteristics are cognitively selected and organized, and states that any given urban environment has one or more anchor points (i.e. POIs), key elements that are considered to be the paramount features of that environment. According to Golledge, anchors and the associations between them create the framework for the human cognition of space. Couclelis et al. (1987) suggest that all environments, natural or built, possess landmarks with distinctive features (e.g. size, colour, shape, etc.) or symbolic meanings (e.g. religious or historical significance) that make them noticeable in a given environment. An area's characteristics, largely embodied by its POIs are communally and individually derived "cognitively salient cues in [an] environment" (Couclelis et al., 1987). Although the St. Lawrence Neighborhood has many POIs, all integral to the area's identity, some of the area's POIs have a larger, more important presence and can be considered definitive to the area; these POIs are recognized by both locals and visitors, and are thus defined as

communal anchors (Gale et al., 1990). In this study, as a collective, all eight respondents (through their interview responses and mental maps) defined the communal anchors of the St. Lawrence Neighborhood as: the King Edward Hotel, St. James Cathedral, St. Lawrence Hall, St. Lawrence Market, and the Gooderham Building. These five POIs, which exhibit a large presence in the area, are also scattered relatively equally along the tour route. Beyond the area's communal anchors there are a number of minor POIs such as small restaurants, shops, and businesses that are also important in defining the identity of the area.

Golledge et al. (1995) suggests that pathway shape is the most influential factor in increased error rates in the acquisition of spatial knowledge. The tour route chosen for this study is relatively simple, forming a "p-shape" that is composed of one long street (King St.) that makes up route segments A/B, and three shorter streets, Jarvis St., Front St., and Church St., which make up route segments C-E, respectively. During the tour, only right-hand turns were chosen to increase consistency and decrease errors during the mental map recollection phase. Additionally, each of these turns measures roughly 90 degrees, except when approaching and leaving route segment D (Front St.), which is angled slightly when compared to segments A/B.

The respondents from both the AR and non-AR groups were also able to collectively identify five different route segments that exist along the four major roads of the prescribed tour route. The segmentation of the route was based upon the differences that the respondents noticed within the physical landscape and the variance of perceived ambience among "regions" of the tour area. The route segments, labeled A through G, are identified in Appendix B.

2.3.1 Research Design, Methods, and Methodology

This study utilizes a constructionist approach (elaborated upon in section 2.1) to comparatively present and assess the experiences and microgenetic developments of two groups of

respondents—those who are facilitated by AR (referred to as the AR group) and those who are facilitated by only their senses (referred to as the non-AR group), using a transcendental phenomenological approach.

In this study, eight University of Toronto (U of T) students were recruited using selective quota sampling. Two males and two females were allocated into each of the two groups: the non-AR group (i.e. those who did not use any sort of facilitative technology to assist them along their tour route) and the AR group (i.e. those who were assisted by an augmented reality iPhone application called *GeoTravel*). The recruitment criteria required for each respondent to be a first-year student attending the St. George Campus at U of T, owning an iPhone or at least having some previous experience using a touch-screen mobile device with a similar interface. Each respondent was also required to be unfamiliar with the area where the tours took place, the St. Lawrence Neighborhood in downtown Toronto.

First year U of T students were chosen as respondents for this study since post-secondary students belong to the demographic group that is most exposed to information and communication technologies thus are more familiar and comfortable with these types of virtually mobile devices (Schwanen and Kwan, 2008). Additionally, undergraduate students, especially those who live on residence, rely on the capabilities of mobile technologies (e.g. text messaging) to maintain their existing social ties (Collins and Wellman, 2010). Many university students also own and utilize smart phones daily, thus exposing them to all of the functionalities of these devices. Furthermore, the use of ICTs (especially cellular phones) has recently become normalized within students' social lives, thus the respondents chosen were expected not to be hesitant or embarrassed to talk about the extent of their dependencies on virtually mobile devices (if such a dependence existed)—in other words, they were expected not to be affected by the social desirability bias, allowing them to provide honest and accurate answers when asked how and to what extent AR facilitated their

development of sense of place, increasing the dependability and confirmability of their results (Baxter and Eyles, 1997; Neuman and Robson, 2009).

Once approval to carry out the study was granted by the McMaster Research Ethics Board (MREB) in late August of 2011, respondents for this study began to be recruited in person starting in early September, 2011; recruitment concluded in late October 2011. After obtaining permission from the respective colleges at the St. George Campus of U of T, first year students were approached and, presented with the researcher's credentials, making clear the researcher's affiliation with McMaster University's School of Geography and Earth Sciences, and explaining, in lay-terms, the objective of the study and what the study sought to observe. Once the purpose of the study was made clear, an informational recruitment brochure was provided to each prospective respondent. Each brochure (see Appendix C) included information about the researcher's background (i.e. educational background and research interests), the objectives of the research, the prospective participant's role in the research, confidentiality measures, and researcher contact information. These informational brochures were handed out to prospective first-year students. From 167 flyers that were handed out, only five (3%) replied and agreed to participate in the study; the remaining three positions were filled using a snowball sampling technique that had the existing five participants recommend their peers for the study.

In the planning phases of this study, an in-person recruitment strategy was decided upon because it was expected to maximize response rates and allow respondents to be selectively chosen via e-mail once they had responded to the requests of the recruitment brochures. U of T's Frosh Week was chosen as an ideal time to start the recruitment process since it was discovered that all students who participate in the Frosh Week wear t-shirts that are colour-coordinated according to each college at U of T (e.g. during Frosh Week 2011/12, all first year students who belonged to Trinity College wore identical red t-shirts). This was expected to provide the researcher with an

obvious advantage since each first year student would be easily identifiable. However, Frosh Week also turned out to be an ideal opportunity for on-foot marketers who too used the opportunity of the event to hand out flyers. In retrospect, due to the amount of non-academic solicitors, Frosh Week became a non-ideal opportunity for recruitment since the prospective respondents were immediately skeptical when they received an informational brochure to participate in this study, many disposing of the brochures immediately. Beyond the presence of people soliciting flyers during Frosh Week, low response rates can also be explained by the stress many students experience during early weeks of university mainly due to acclimatization to the campus itself and to the workloads of their courses, rendering them too apprehensive to engage in any extra-curricular tasks.

Once the sample of eight first year students was selected, the respondents were allocated into their respective groups. Two males and two females who owned an iPhone were allocated into the AR group and the remaining two males and two females, who did not own an iPhone or did not have a data plan for their phones, were allocated into the non-AR group. For the AR group, the iPhone was chosen as the vessel for *GeoTravel*, the facilitative AR application. The iPhone was chosen because it is a popular smart phone, running on iOS, a mobile phone operating system developed and distributed by Apple Inc., which is at the time of this writing, the single most pervasive smart-phone operating system in the North America (Nielsen, 2012).

Once the two respondent groups were organized, the respondents were initially expected to meet with the researcher at a mutually agreeable date and time at Robarts Library, located on the St. George campus, U of T, in order to build a rapport with the researcher, receive further instructions/explanations, and decide when each individual tour experience would take place. However, the respondents made it clear early on that they preferred to meet only once instead of two separate occasions; only one respondent preferred to meet a week before her tour date while the remaining respondents met with the researcher about twenty minutes prior to their scheduled tours

in front of a coffee shop at the start of the tour route, at the intersection of Yonge St. and King St. in downtown Toronto. All tours were carried out on separate days between September and early November 2011, save for a pair of respondents who carried out their tours on the same days, two hours apart from one another. Before their individual tours, each respondent was given instructions on how to proceed with their tours; after the instructions were given, each respondent had the opportunity to ask any questions before their tours began. During this time, respondents were also asked to sign a form of informed consent, which they were also given a copy of (see Appendix D). This provision was to assure that each respondent understood the objectives of the study and what was expected of him or her, thus strengthening the dependability of the study. The respondents were also informed that their identities would be kept confidential and that any personal information they provided would only be made available to the researcher and his supervisor. This ethical measure also gave the researcher further opportunity to build rapport with each respondent.

During the meetings prior to each individual tour, each respondent was provided with a skeletal map of the tour route (see Appendix E) and given the same basic instructions; they were told to explore the area following the tour route outlined on their maps, using all their senses to attempt to obtain a full experience of the area. Each respondent was instructed to take a photograph of any salient aspect of the physical environment or simply anything interesting or unusual they encountered. The non-AR respondents were provided a digital camera to take photographs while AR respondents were instructed to take screenshots with their iPhones since they would be using AR as a guiding lens during their tours. As suggested by Beckley (2007), many people develop a sense of place without ever consciously reflecting upon the meaningful components within a space. Since these developments are largely unconscious, respondent-taken photographs were determined to be useful in allowing the researcher to observe the POIs that each respondent deemed salient,

allowing for a better understanding of the components of meaning that each respondent unconsciously noticed.

Immediately after each individual tour, the respondents were taken to a nearby, casual restaurant where a semi-structured in-depth, in-person interview took place. The interview site also served another purpose since the incentive provided for respondent to participate was a free meal at the restaurant. Prior to each interview, the respondents were asked to draw a *mental map* of how they experienced the tour area. Carreras (2008) describes the use of mental maps in qualitative research as an "ancient and useful technique…used as a way of knowing about the feelings (such as sense of place) that people have with relation to their places" (in Eyles and Williams, 2008). In this study, respondents from both groups were asked to draw mental maps highlighting the salient physical characteristics and points of interest they experienced during their tours. In addition to this the respondents were asked to recall visual, auditory, and olfactory stimuli they encountered along the route. Utilizing mental maps allowed the researcher to gain an unmediated, interpretable understating of respondents' cognitive developments, including developments in spatial knowledge and the microgenetic developments of place.

Interviews were recorded primarily with an audio-cancelling program called TapeDeck (v.1.3.2) on a MacBook Pro laptop computer, using the built-in microphone. Dunn (2010) suggests that a handheld audio recording device can act as a reminder of the formality of an interview situation, possibly compromising rapport and the natural flow of conversation in an interview. In this study, a laptop computer was chosen as the recording device in order to promote a more informal interview atmosphere. In addition to the audio recordings, the interviews were also corroborated with notes taken by the researcher in order to obtain a complete record of each interview. Specifically, each respondent's mannerisms, non-verbal behaviours, and any interesting or unusual responses they gave were noted in the researcher's journal. A semi-structured interview

format was chosen because, due to the standardized nature of the questions, it allowed for the maintenance of a rigid enough structure in order to uphold transferability and confirmability of results while also flexible enough to allow for the exploration of respondents' experiences through probing questions if needed (Dunn, 2010). The semi-structured interview format proved to be useful since a variety of important questions were iteratively added to the interview schedule.

The interviews were designed to explore respondents' development of social representation (Moscovici, 2001) and the two criteria of sense of place proposed by Jorgensen and Stedman (2006): the cognitive (i.e. beliefs and perceptions) and affective (i.e. emotions and feelings) aspects each respondent's tour (see Appendix F). A focus-group approach was ruled out for this study because of the concern that a group influence could threaten or manipulate the individualistic descriptions of microgenetic processes that this study sought to observe. Additionally, in-person interviews were expected to reveal important questions regarding the sense of place process, promoting iterative and hermeneutic discovery in terms of overarching themes or simply further interview questions to be asked of subsequent respondents.

2.3.2 Methods of Data Analysis

Once the audio recordings from each of the eight interviews were evaluated for quality, they were transcribed verbatim and then checked and rechecked for any errors. The interviews were transcribed to include descriptions of gestures wherever possible; the tone of each respondent during their interview was noted in the researcher's journal and referred to during coding and analysis through written annotations using NVivo 8, a qualitative analysis program (Dunn, 2010). Any unprompted and especially insightful or informative responses were annotated at this point.

In terms of analytical style, this study utilizes a qualitative method of analysis adapted from the guidelines proposed by Crabtree and Miller (1997). The five phases of this style are:

description, organization, connection, corroboration/legitimation, and representation of the account. The description phase is one that requires continuous reflexivity on the part of the researcher, demanding the researcher to question how his or her own position within the research process may influence the various stages in the study including the interpretation of the results, how the researcher's background, including previous dispositions, language, culture, and tradition maintained a role in shaping the research, how the researchers assumptions and expectations maintain a role in describing the results, etc. (Crabtree and Miller, 1997). To ensure reflexivity and to substantiate congruency between the study and the researcher, a biographically oriented bracketing statement has been included (see Appendix A). This statement describes the researcher's upbringing (including cultural and lingual background), interests, and any life experiences which could potentially influence the various stages of the study, from developing the questions in the interview schedule, to deducing the coding scheme, to interpreting, analyzing, and presenting the data. As a further measure of reflexivity, the researcher's supervisor, Dr. John Eyles, acted as an advisor during each stage of this study, checking interpretations, helping maintain the adherence of the study to the research paradigm, and contributing to the iterative, hermeneutic cycle that informed the entire research process.

The organization phase, where the actual analysis of data begins, starts with the choosing of an analytical style. The analytical style chosen for this study was one adapted from Crabtree and Miller (1997) called immersion/crystallization (I/C), a dialectic that is both hermeneutical and heuristic, described as an organizational framework where "the analyst immerses him-or herself into, and experiences the text, emerging after concerned reflection with intuitive crystallization, until reportable interpretations are reached". In the case of this study, the most important analytical tool when using this organizational style was the researcher himself; a researcher who is open to uncertainty and embraces anomalies, who suspends all presuppositions and maintains a reflexive

stance throughout the entire research process, and who realizes that experience is the focal point to understanding and explicating upon a phenomenon, is a vital component in this type of analytical style (Crabtree and Miller, 1997; Cresswell, 2006).

Before the coding process in this study, the interview transcriptions were read over multiple times in order to elucidate the phenomenon that each individual respondent experienced. During this phase, every statement made by a respondent that was deemed relevant to the research objectives was highlighted manually using a coloured marker. Moustakas (1994) calls this process of sorting out relevant data "horizonalization". From there, these horizonalized statements were coded using NVivo 8, the qualitative research software, as an organizational tool. It was important for the themes in the study to arise from the data collected and not from any presuppositions or expectations created by the researcher, thus the initial codes were checked for validity by referencing the codes back to the interview transcripts to ensure that the interpretation (i.e. the codes) corresponded with the raw data. The visual data used in this study (i.e. the mental maps and photographs) were of particular importance since they were deemed to potentially reveal any subconscious and indirect cognitive developments experienced by the respondents. The interpretation of visual data in this study adhered to the critical visual methodologies proposed primarily by Rose (2001) and, to a lesser extent, Barthes (1977), Beckley (2007), Kyle and Chick (2007), and Magee (2007). Following Rose's (2001) criteria of maintaining a critical visual methodology, each photograph and mental map was looked at carefully and then given a textural description (see Appendix G), ranging from one small paragraph to about a page in length. Each textural description identified the main subject of the photograph and made note of any salient features or characteristics in the background and foreground of the image. A strategy of photo elicitation through in-person interviews (see Beckley, 2007; Kyle and Chick, 2007) was considered for this study, but was deemed to be more harmful than beneficial. Each respondent's microgenesis

of place is often not consciously reflected upon; asking the respondents to describe their developments of meanings and attachments to place, as seen through pictures, could have led to biased results due to the possibility of leading questions (Beckley, 2007). Rather, to maintain validity, the researcher critically interpreted the microgenetic place developments from each respondent as they were presented through photos they took during their tours. One may argue that relying to such a degree on the researcher's interpretations could result in misleading or biased results since "ways of seeing are historically, geographically, culturally, and social specific...[thus, how a researcher views visual data] is not natural or innocent" (Rose, 2001). However, in order to minimize misinterpretation, the researcher attempted to view each piece of visual data naively and without, keeping a critically reflexive stance. To further ensure the validity of these interpretations, respondents were provided with excerpts of interpretations from each data source and were asked to verify them (i.e. via member-checking).

After immersion with the data, including the interview transcripts, mental maps, and photosets of each respondent, these initial codes were then further reduced into five major interpretive codes: wayfinding, area awareness, the role of technology, social representation, and navigation (see Appendix H for a complete list of codes used). Transcendental phenomenology requires that the phenomenon under study must be revealed through the experiences of the respondents, that it not be categorized according to any presuppositions or expectations that may exist on the researcher's behalf, thus the initial codes in this study were not determined prior to the data collection stage (Hay, 2010). This final reduction process was an ongoing, effectively engaging the researcher into the immersion phase of the I/C process in the final stages of analysis and interpretation. The coding process was iterative and cyclical—with increased exposure to the data, initial codes continued to be developed, reduced or expanded upon accordingly. All three data sources were revisited until a point of saturation had been reaching in terms of the development of

codes or themes. Additionally, all of the data sources, including the visual data, were coded following the same coding structure.

The connection phase is the penultimate stage of analysis described by Crabtree and Miller (1997). In a sense this phase does not exist chronologically after the organization phase, rather it is a continuous process that begins at the start of the research process, allowing for an "iterative spiral of organizing, connection, and corroborating/legitimating" throughout the entire research endeavor (Crabtree and Miller, 1997). However, creating connections in the data can only be achieved once all the data has been organized, most often from constant exposure and engagement with the data. This phase shares essentially the same criteria as Crabtree and Miller's (1997) concept of crystallization (which is part of the I/C process). In this study, after constant exposure and interpretation with the data, the overarching thematic links that made clear the similarities and differences between the experiences of each respondent and in turn, the AR and non-AR groups, were iteratively uncovered and crystalized. These themes, represented in Chapter 3, are:

i. Wayfinding and spatial knowledge
ii. Spatial awareness
iii. Social representation and the development of meaning
iv. Role of augmented reality

Following this, any themes discovered must be corroborated/legitimated in order to verify any claims made (Crabtree and Miller, 1997). Like the connection phase, corroboration/legitimation is an iterative process that is undergone throughout the entire research endeavor. In this study, each data source was reviewed after initial analysis and then again once thematic saturation was reached. A textural summary of each interview transcript, photo, and

mental map was created. Each respondent who participated in the study was e-mailed the summary of the interview transcript and also summaries of the two randomly chosen photographs from their photoset in order to verify the consistency of the interpretations made by the researcher and also to validate whether the researcher's interpretation was congruent with what each respondent experienced in actuality. This phase also involves the evaluation of the account of each individual who experienced the phenomenon under study. In this study, each respondent's microgenetic development of sense of place was compared to the experiences of members within their own groups and their AR or non-AR counterparts. Any anomalies that were found were closely scrutinized to see if any explanation could be determined from the existing data; if this could not be achieved, alternative explanations were sought after in pursuit of legitimation. Further measures of legitimation/corroboration in this study are described below (see section 2.5).

The final analytical phase described by Crabtree and Miller (1997) is representation of the account. This phase concerns itself with the presentation and dissemination of the final account of the research endeavor. Since this study was developed as a partial requirement in the completion of an M.A. degree, it is represented in the format of an academic thesis written for an academic audience. The primary challenge in the representation of this research was honouring the individual voice of each respondent (Crabtree and Miller, 1997). This challenge was addressed by first understanding each individual experience through the creation of a textural description derived from the respondents' raw data, iteratively immersing the researcher with textual and visual accounts of each experience. Once an understanding of the individual-level experiences was obtained, only then was the researcher able to move on to understanding the experiences at the aggregate level, within the AR and non-AR groups.

2.4 Rigour and Meaningful Inference

Rigour is crucial in qualitative research in order to maintain a study's integrity. The criteria for ensuring rigour in qualitative social research proposed by Baxter and Eyles (1997) were closely adhered to in this study. Baxter and Eyles (1997) list various strategies to help promote rigour within the credibility, dependability, confirmability, and transferability in qualitative research. The credibility of a study is directly related to how the researcher interprets, understands, simplifies, and presents a concept under study; essentially, credibility puts under scrutiny the authenticity of a representation (Baxter and Eyles, 1997). In this study, the concept of the microgenesis of sense of place is the phenomenon under observation. Measures to uphold credibility began with a random, purposeful sampling strategy used to recruit the respondents. Although the sample size used is not large enough to ensure generalizable results, it meets the needs of this experimental study by allowing for in-depth observations, analysis, and presentation of each respondent's experiences. To maintain credibility, staying vigilantly reflexive is of utmost importance in the organization, data collection, and interpretations phases of research. In this study, the researcher maintained a constant awareness of his position within the research and how his predispositions or mere presence could potentially affect the answers given by respondents or how they were interpreted and presented. To maintain this awareness, a bracketing statement was composed (see Appendix A) to make clear all of the researcher's relevant predispositions and background information; this statement acted as a constant reminder of the researcher's position within the grand scheme of the study. To maintain credibility during the interview stages, measures were taken to build rapport and trust between the respondents and the interviewer. For instance, the interviews were carried out in a restaurant in order to created an informal atmosphere for the respondent. Additionally, a laptop was chosen over a handheld recorder because it was perceived as a more informal recording device, emphasizing the casual nature of the interviews. To maintain credibility during the interpretation phase, member checking was used to verify the interpretations and representations of each

respondent's experience within the tour area. Triangulation of data sources, interpretation methods (especially in the interpretation phase of the study), and investigators (i.e. both the researcher and his supervisor, Dr. John Eyles, acted as primary investigators in this research) also ensured credibility.

Dependability refers to how qualitative research is able to manage and minimize "instability/idiosyncrasy and design-induced change" (Baxter and Eyles, 1997). In this study, the plausibility of the research design and the interpretations created from the data were upheld by clearly delineating the phenomenon under study (the microgenesis of sense of place) and the process involved with it—these elements directly influenced the creation of the research questions. Furthermore, the data was analyzed and interpreted until a point of saturation was reached. This allowed for a thick description of each respondent's experience to be accurately created, allowing for a dependable representation of the phenomenon under scrutiny.

Confirmability refers to the "notion of objectivity...[on the part of] the investigator and the interpretations" (Baxter and Eyles, 1997). The way to ensure confirmability is to make clear all of the biases, motivations, and interests on the part of the researcher, by keeping an audit trail of the data throughout the research process (Baxter and Eyles, 1997). Again the bracketing statement created by the researcher (Appendix A) allows for the researcher to be aware and vigilantly reflexive, separating all predispositions and background experiences that may potentially create incongruences within the research. Simply being aware of these predispositions and assumptions promotes the separation between the researcher as he exists as a person and the researcher as he exists as an investigator in the study. Additionally, a researcher journal was also utilized in this study to keep an audit trail of the data. The journal included notes taken during the interview process and ideas written down during the interpretation phase of this research.

Transferability refers to the external validity of a study or how well the findings apply to contexts outside of that study (Baxter and Eyles, 1997). Due to the exploratory nature of this research, it is difficult to assess the degree of generalizability that the results of this study support. Measures were taken to increase transferability, for instance, purposeful sampling and the provision of a textural description of each individual respondent's experience. The transferability of the findings in this study however, are questionable beyond the realms of first-year university students (Baxter and Eyles, 1997).

2.5 Limitations

Due to the exploratory nature of the research, there were several limitations encountered with this study design; for technological limitations of the AR application used in this study, see Section 3.6.2. A primary limitation of this study was the small sample size used. With only eight respondents (four male and four female), the results found are not generalizable or externally valid. However, due to the exploratory nature of the study, its phenomenological orientation, the phenomenon it sought to observe (i.e. the microgenesis of place), a sample of eight respondents proved to provide an abundance of interpretable data. As phenomenology relies greatly on the researcher as a research instrument, the data sources, once triangulated, allowed the researcher to develop an accurate and rich understanding of the respondent's tour experience and thus their microgenetic developments of place.

Another limitation encountered in this study is the fact that all respondents did not experience uniform conditions when exploring the St. Lawrence Neighbourhood. For instance, in terms of variations in weather, some respondents experienced strong rains or overcast conditions while others experienced only clear skies. These weather conditions may have influenced their developments of social representation in the tour area. A specific example of this was in the case of

Harry, an AR respondent who developed a generally negative representation of the area due to the Occupy Toronto protestors that he encountered along his tour (he was one of three respondents to experience these protests). In his interviews, Harry clearly expressed that the protests themselves contributed to his negative representation of the area—he was the only respondent who explicitly identified the protests as a negative feature of the area. Other residents, for instance Aaron, non-AR, who experienced extreme rain, developed a generally positive representation of the area, stating that he would return again to explore further and fulfill his curiosities.

Another previously mentioned limitation of this study was the recruitment strategy used. Although using U of T's annual Frosh Week as a window of opportunity for recruitment at first seemed beneficial, it was in retrospect an inopportune time since potential candidates were skeptical and hesitant to be approached let alone recruited for the study. Even those who agreed to participate were unwilling to meet on more than one occasion, making it difficult to build rapport between respondent and researcher. Additionally this unwillingness made it unfeasible to account for the historicity of each respondent (i.e. their backgrounds, previous dispositions, etc.), a vital component in the development of a subjective understanding of place. However, all the objectives of this study were still achieved because the observation of microgenetic place developments as experienced by the tour groups, using mode of facilitation as a point of comparison, did not require an understanding of historicity.

The final limitation experienced in this study was the non-AR groups unintended use of the cameras provided to them as a mode of visual facilitation. The cameras were provided to respondent strictly to document which POIs they deemed interesting or salient. Some respondents revealed that the use of the camera provided them with a second layer of exposure to certain POIs, allowing them to more easily remember them. Even though the camera acted as a type of facilitator

for some of the non-AR respondents, there was still an evident disparity between them and the AR group in terms of spatial developments and the cognitive developments of place they created.

Chapter Three

RESULTS

3.1 Introduction

The purpose of this chapter is to present the results from the data collected which was triangulated between transcripts from eight semi-structured and in-depth interviews, eight respondent-drawn mental maps, one hundred and two respondent-captured photographs, and one researcher journal in which observations about respondent behavior and opinion during the walking tours and the in-depth interviews were recorded. Results of the analysis will be outlined according to the scheme from which they were coded. The sections in this chapter are informed by the major thematic codes used in analysis (see Appendix H). The coding for this study is framed upon the following research set forward in Section 1.2.

First, the microgenesis of sense of place, determined through the observations of respondents' wayfinding developments is discussed. Next, area awareness, a component vital to navigation and wayfinding alike, will be analyzed and compared between both the AR and non-AR groups. Finally, respondents' cognitive and affective developments and their polar assessments (i.e. the identification of positive and negative characteristics) of the area's attributes and features will be presented. The role of AR and its influence on respondent experiences and developments will be mentioned in each section and in a summary at the end of the chapter, comparing and contrasting the experiences of the two groups.

3.2 Wayfinding

Respondents' developments in wayfinding, in particular their different utilizations of spatial knowledge types, appear to vary notably between the non-AR and AR groups. The following section presents all data coded in the "wayfinding" category comparatively between the two

respondent groups. In this section, data is triangulated between interview transcripts, photographs, mental maps, and the researcher's journal. The primary focus of this section is to compare and contrast respondents' utilizations and developments of each of the four types of spatial knowledge described by Golledge (1992) which are: declarative, procedural, configurational, and place knowledge.

3.2.1 Declarative Knowledge

Declarative knowledge refers to one's ability to inventory and memorize pieces of information that are extracted from a physical environment in order to aid in orientation, navigation, and wayfinding (Golledge, 1992). For instance, names of streets, points of interest (POIs), routes or route segments, and other components of a physical landscape are all partially processed through the use of declarative knowledge. This study utilizes interview and mental map data to examine developments in declarative knowledge through respondents' demonstrated abilities to memorize and inventory the locations and names of streets, various POIs, and communal anchors.

Overall, the data suggests that compared with the AR group, members of the non-AR group were likely to experience more difficulty inventorying and memorizing POIs. The non-AR group also demonstrated difficulty recalling the correct placements of certain POIs (both minor POIs and communal anchors) on their mental maps. For instance, when asked if she remembered the names of any buildings or landmarks, one non-AR subject replies:

> *I saw "St. Lawrence" on a couple [buildings] and, I don't remember the name of the church but a couple seconds from that was the weird Christmas store...and a weird place called "Rainbow Cinemas" and a place called "The Giant", a vodka and liquor store. There was a cleaners, there was a rug shop, there was that school supply [store], and "Hero Burger", this place [laughs]...I don't know, how many names do you need? (Elena, non-AR)*

Elena seems to demonstrate declarative knowledge for only the minor POIs in the area, paying no regard to surrounding communal anchors. However, her memory of these minor POIs is quite extensive. This is interesting because later in the interview, when asked what landmarks in the area she perceived most salient, she begins to list communal anchors:

> *The church is a pretty big one, a very different looking building...and I'd say the market is another big one...and there's that really tall building on the corner of Jarvis and Bay with like, the flag on top [referring to the Gooderham Building]...that was pretty memorable. (Elena, non-AR)*

Although Elena had considered the communal anchors to be the most salient POIs in the area, she was not able to recall the names of most of them. Elena's focus of attention on minor POIs in the area instead of the communal anchors is also demonstrated in her mental map (see Fig. 3.1 below). Although she denotes all the communal anchors in the area onto her map, aside from St. Lawrence Market (SLM), she does not label their names; instead, Elena declaratively recollects various shops, restaurants, and other minor landmarks. Interestingly, Elena explains that her use of the camera provided to her allowed her to better remember various POIs in the area:

> *Because you gave me a camera...[I realized] I could take pictures of landmarks and I would probably remember them even better so I think a lot of the stuff on my map is actually stuff I took picture of too. (Elena, non-AR)*

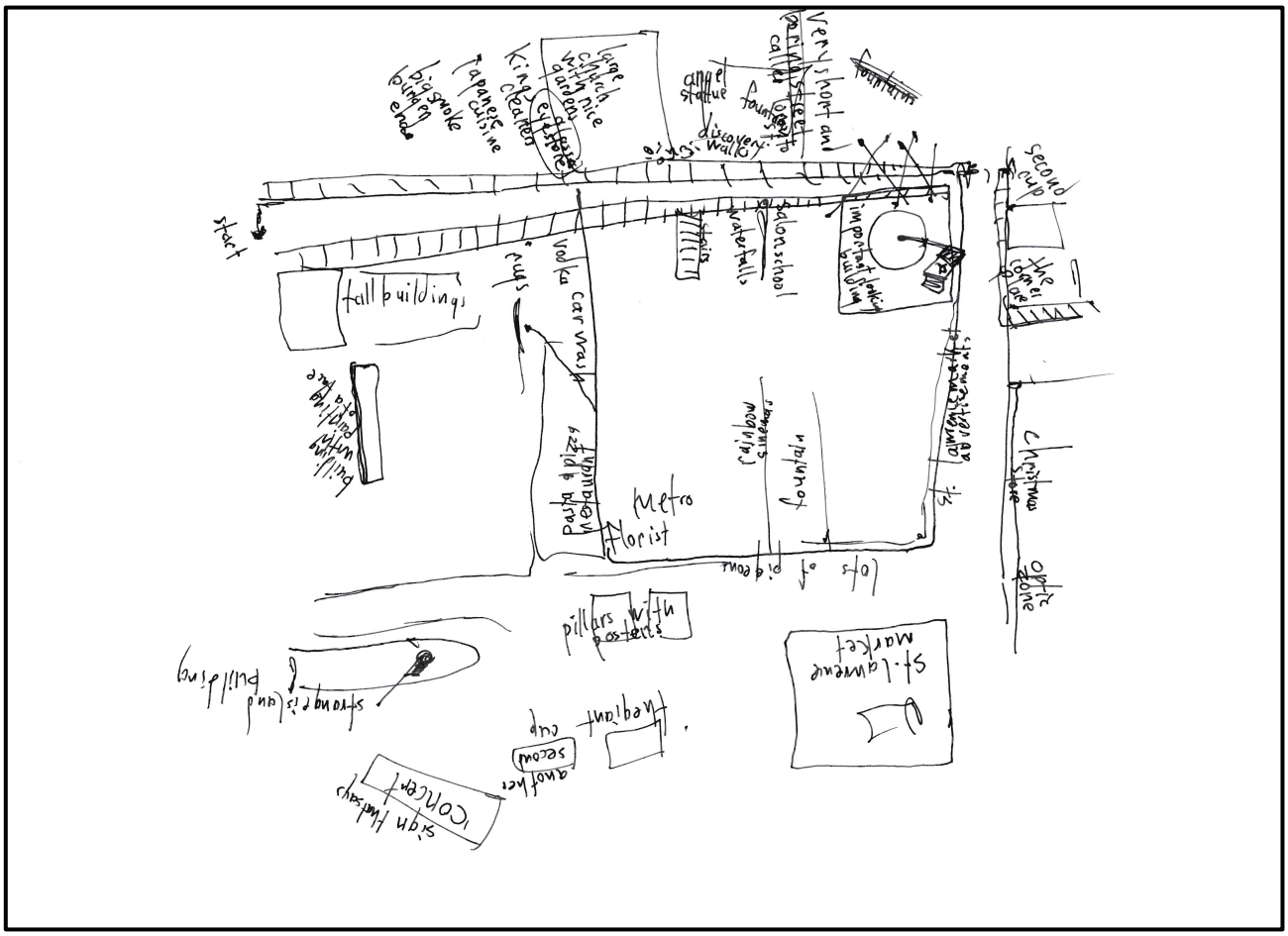

Figure 3.1. Mental map created by Elena (female, non-AR)

Elena suggests that the pictures she took facilitated the retention of some of the minor POIs in her memory. Elena also compares the benefits of using the camera to her perceptions of the facilitation provided by AR:

> *I would remember maybe more things [with AR]. I think I'm a big visual person so...probably...just like, more details. (Elena, non-AR)*

Elena suggests that her memory had been aided by using the camera and that it would have been further extended if she has used the GeoTravel application. This idea seems to be evidenced more

concretely through her photo set since most of the pictures she took focus on minor POIs, all of which she noted in her mental map (see Fig. 3.2 below).

Fig 3.2. A collage representing Elena's (non-AR) photoset. The majority of her photos focus on minor POIs she encountered along the tour route.

Fernando, another respondent in the non-AR group, showed a similar dissociation with declarative knowledge, also seen through his interview and mental map data. When asked to list memorable POIs he had encountered on his tour, he replies:

> *I remember the churches and the places but I didn't really see the name...Well near um...near Front and Church... do you know what building I am talking about [referring to the Gooderham Building]. I think that is all. (Fernando, non-AR)*

Like Elena, Fernando notices communal anchors along the tour route but fails to inventory or memorize them. Fernando's mental map (Fig. 3.3) corroborates this inattention to declarative detail. The map only makes note of five POIs, three of which are communal anchors; none of the POIs declared are labeled. In addition to this, not only are none of the streets labeled, the basic skeletal route structure of his map and the locations of most of the POIs of his map are drawn incorrectly. The orientation of the map is also noteworthy—the top of the map indicates the southern-most point of the route while the bottom of the map indicates the northern-most point (i.e. the map orientation is inversed on the *x* axis compared to all the other mental maps from the AR facilitated group). In regards to Fernando's photo data, his picture set focuses exclusively on the POIs noted on his mental map. A photo that he took of St. James Cathedral (SJC) (see Fig. 3.4) focuses on a bold, conspicuous sign located in front of the cathedral that indicates the name of the POI and hours of service, suggesting that the information was available to Fernando but went unnoticed or was simply not remembered.

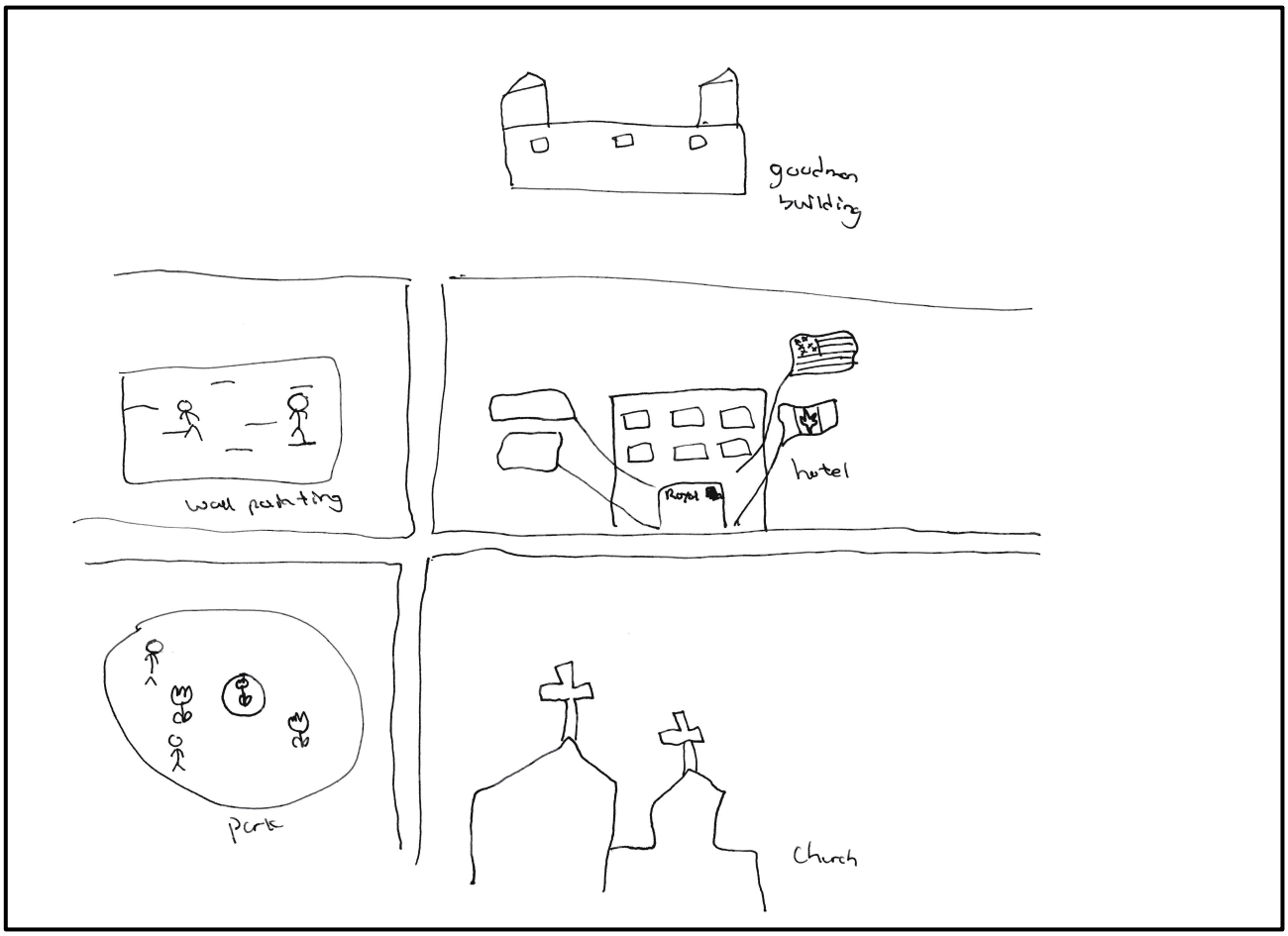

Figure 3.3. Mental map created by Fernando (male, non-AR)

Aaron, non-AR, demonstrates the highest capacity of declarative knowledge within his group but he fails to inventory/memorize the SJC, a definitive communal anchor in the tour area.

> *There was a big church right at King and Church St. I forget what it was called; I never saw the name actually. (Aaron, non-AR)*

Even though the sign indicating the POI's name and other information was visible and conspicuous, Aaron was not able to recall it. Aaron later comments on the utility of noting and remembering simply the names of POIs in an unfamiliar area:

> *I would say if I were to know even the exact names of some of these buildings…because right now, off the top of my head I can't remember…if I were to use that technology, I would definitely know the name of the place and for future reference of anything else I would need to know. This would definitely help to, um, identify where everything is and single out where you're trying to get. (Aaron, non-AR)*

Figure 3.4. Photo taken by Fernando, non-AR, of SJC. The sign in front provides all relevant declarative cues for the POI.

All non-AR respondents, prior to their tour experiences, were given a demonstration of the GeoTravel application. Because of this, Aaron was able to indicate perceived advantage of using the AR—the ability to triangulate one's position due to increased familiarity with one's surroundings.

He believes that simply knowing the names and details of landmarks in an area increases one's familiarity with that area.

Conversely, AR respondents showed a somewhat higher engagement and development of declarative knowledge. From the AR group, all but one respondent noted at least three communal anchors: St. James Cathedral, St. Lawrence Market, and the Gooderham Building. When asked which memorable landmarks in the area he could recall, Carl responded:

> *The Church of St. James...the Goodman—the Goodham Building? It was very interesting because it was like a triangle, very thin. Yeah, even on the app it said it was a landmark...The St. Lawrence Market, the sculpture pathway...and right away I noticed the hotel because it was a little bit different architecture...I'm not sure what it's called [referring to the King Edward Hotel]. (Carl, AR)*

Although exact phrasing of the names of the communal anchors Carl recalls is not entirely correct, he is able to demonstrate a more advanced development of declarative knowledge that the non-AR group. Carl's reliance on GeoTravel is apparent, suggesting that the application, through the provision of AR markers on the screen, had a strong influence in dictating what he deemed to be a salient POI. This may provide an explanation as to why three of the four AR respondents barely mentioned or drew any POIs other than communal anchors in their data.

Similarly, Gabrielle is a member of the AR group who also displays an increased capacity of configurational knowledge. When asked to recall memorable landmarks she encountered along her tour, Gabrielle responds:

> *The church, the St. Lawrence Market, the courthouse...I think there's a bridge. That's about it. (Gabrielle, AR)*

Gabrielle is only able to inventory communal anchors and only two of the multiple minor POIs in the area. In her mental map (see Fig. 3.5) Gabrielle indicates three communal anchors labeled

correctly: SJC, SLM, and the Gooderham Building. Apart from this, her mental map is devoid of much else. The overall route structure of her map is correct but she confuses two route segments: segment D (Church St.) with segment E (Front St.) (refer to Appendix B for route segment identification).

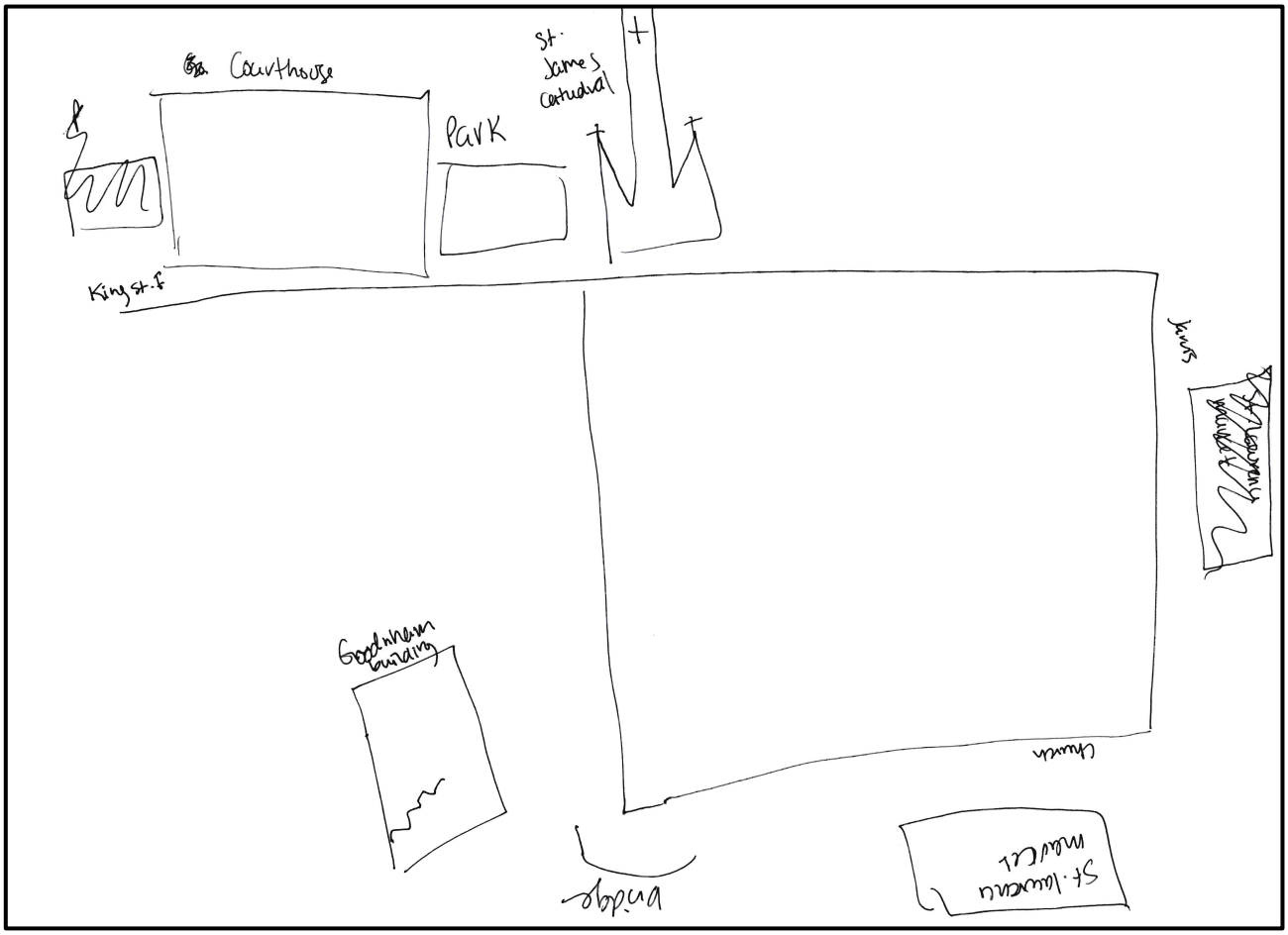

Figure 3.5. Mental map created by Gabrielle (female, AR)

Breanna is the only respondent in the AR group who provides a detailed map, noting both communal anchors and various minor POIs. During her interview, when asked what memorable landmarks she encountered along her tour, she provides and extensive and detailed response:

> *There was the sculpture…garden, I guess, off the side of the road which I found really interesting, to my right...There's obviously the cathedral which takes up a huge presence in this area. The cathedral gardens which were very noticeable… St. Lawrence Market obviously is famous through Toronto. There's a lot of people going by that and…there's also the Goodman, I think Goodman House [referring to the Gooderham Building] and I noticed an observatory on the top which I found was really interesting and I went through that article a bit [referring to her use of GeoTravel]. It's actually older than the similar building in Times Square which is also triangle-shaped, which I found interesting because I thought it would be the exact same age or if not, newer, which surprised me. Other landmarks in the area…by the St. Lawrence Market there was a walkway and it had a little fountain, that might be a landmark and…that's probably all that I can think of that would be a noticeable landmark. (Breanna, AR)*

Not only does Breanna denote communal anchors, as indicated in her mental map (Fig. 3.6), she denotes minor POIs in detail, along with detailed names of side streets.

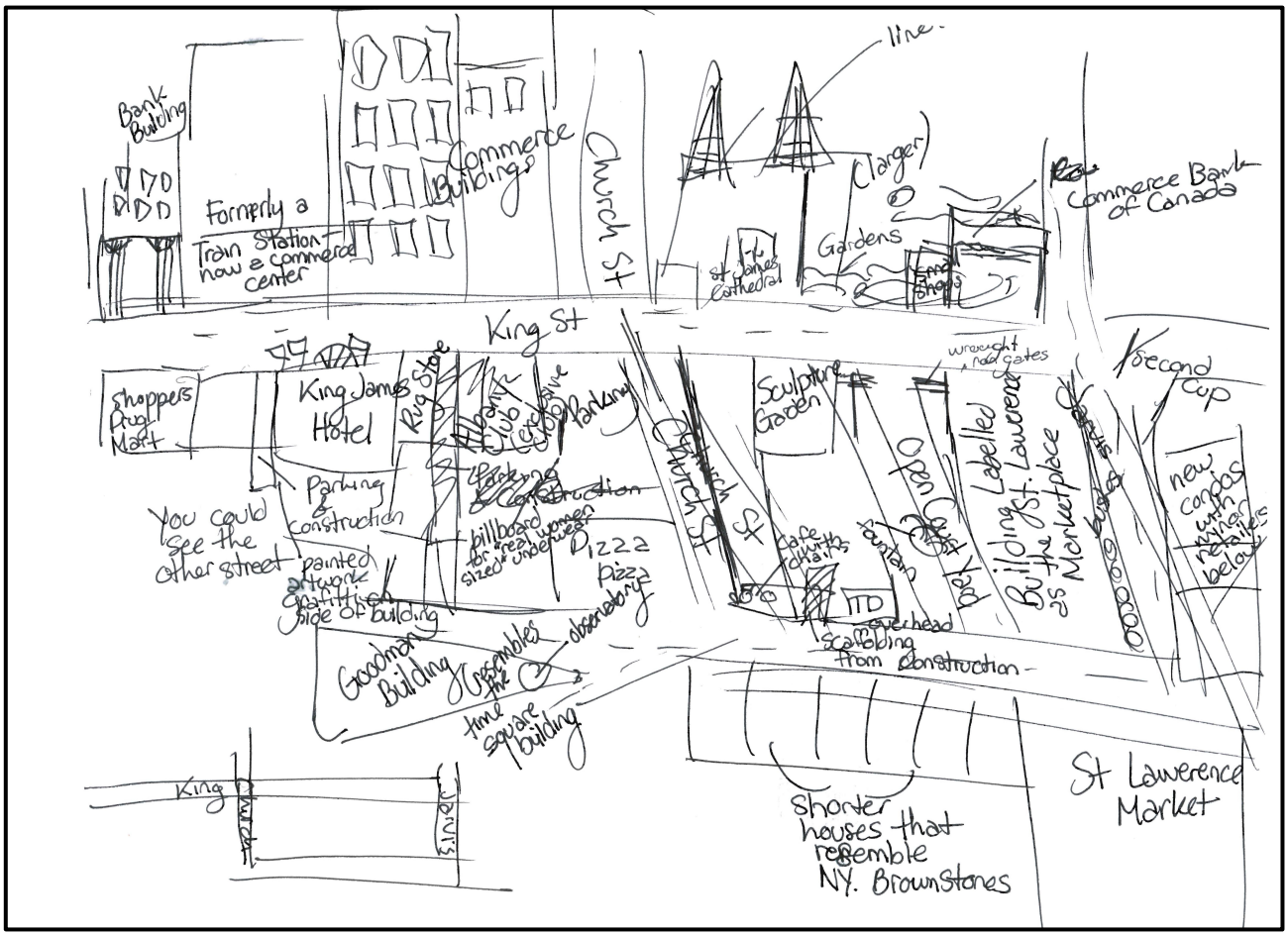

Figure 3.6. Mental map created by Breanna (female, AR)

The data suggests that AR users are more likely to become aware of communal anchors and possess a higher aptitude to inventory and memorize the most salient declarative information. Even though both respondent groups notice most communal anchors in the area, the AR respondents create a greater declarative understanding of these POIs. The only AR respondent who does not seem to notice as many communal anchors as her peers is Breanna. The explanation for Breanna's deviation lies within her photoset; it appears that, for most of the tour route, Breanna did not adhere to the virtual marker overlays on the map. Instead, she used her iPhone much like the non-AR respondents used the cameras provided to them. The markers in Breanna's pictures are not centered over the subject of the image, suggesting that she did not adhere to the POIs provided by GeoTravel

like the other AR respondents did (see Fig. 3.7). Additionally, the volume of her photoset and the numbers of pictures that diverge away from focusing exclusively on communal anchors match more of the results shown by the non-AR group than the AR group.

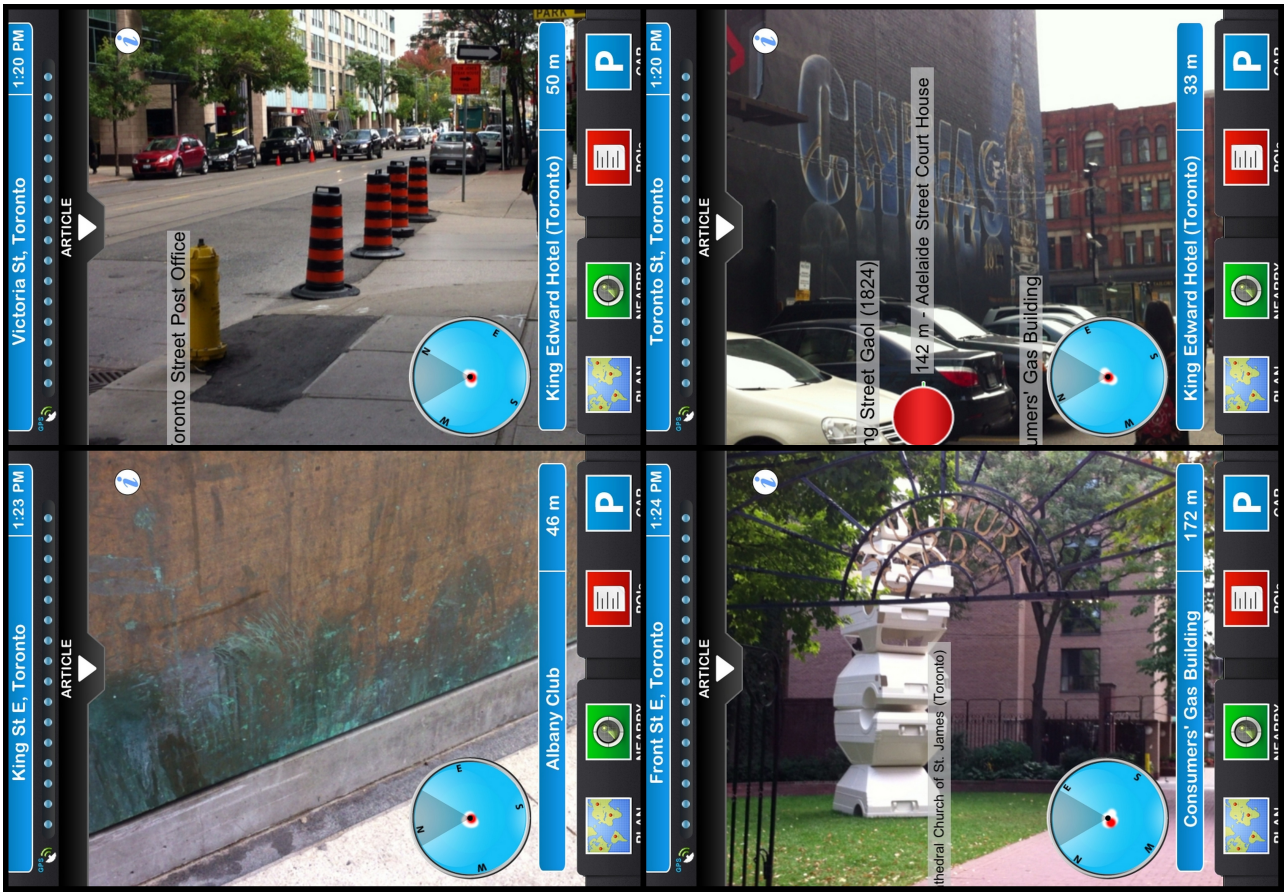

Figure 3.7. A collage representing screen captures from Breanna's (AR) tour experience. As indicated, the Breanna does not adhere to the AR markers suggested by GeoTravel.

3.2.2 Procedural Knowledge

Procedural knowledge refers to a one's ability to hierarchically organize an environment by defining rules for linking pieces of information into ordered strings (i.e. creating rules for wayfinding and navigation derived from sensate knowledge and experience) (Golledge, 1992). Those who demonstrate a higher capacity of procedural knowledge can easily define paths, link

together path segments (i.e. concatenation), and create associations between nodes, path segments, and areas. An awareness of spatial elements such as paths, edges, districts, nodes, and landmarks, is vital to procedural knowledge. This type of hierarchical organization is essential in navigation, wayfinding, and thus, the microgenesis of place.

The data collected seems to suggest that those in the non-AR group have a lower capacity of procedural knowledge than those who were facilitated by AR. Diana, a member of the non-AR group expresses the confusion she felt during her tour experience:

> *I didn't really know what all the buildings were and [if I had used AR] it would show me what it was and a brief history if I wanted to know about it. So I was kind of more confused I guess, not knowing where I was and what the buildings were. (Diana, non-AR)*

Diana believes that users facilitated by AR had a clear advantage over the non-AR group because they had access to an abundance of information provided by GeoTravel, allowing them to more easily familiarize themselves with the area. Diana adds:

> *[AR] would tell me more stuff. I just kind of assumed things, not knowing where to go. (Diana, non-AR)*

Diana expresses that, even though she was provided with a hard copy of a skeletal map of the route, she still felt as though it wasn't an adequate tool for familiarization. Instead, she had to base her familiarization process on assumptions and guesses that she made. Like the rest of the non-AR respondents, Diana was given a demonstration of the GeoTravel application and was shown that the only navigational cues it provided were distances to nearby POIs displayed as a measurement in feet and as a representation on a mini-map (which also included compass direction) and the street name occupied by the user at the current moment (see Fig. 3.8). She believes that these additional tools

would have allowed her to familiarize herself more with the area, granting her more information to be able to determine paths or links path segments together, giving her a better idea of where she was.

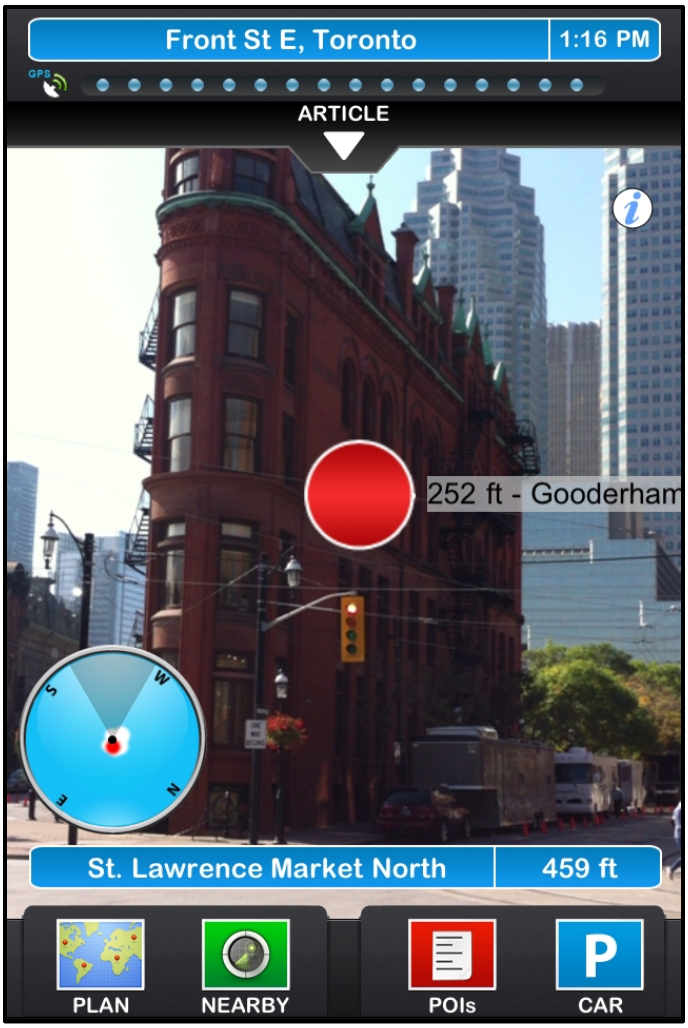

Figure 3.8. A screen capture of the GeoTravel application highlighting the directional cues it provides (e.g. mini-map, name of street occupied by user, distance and direction to selected POI, etc.)

Diana's mental map reaffirms her low capacity of procedural knowledge (see Fig. 3.9). The orientation of her map is rotated; the top of her map indicates an eastward direction and the bottom indicates a westward direction. The procedural organization of the map seems to makes sense

throughout route segments A and B (King St.), but loses clarity at segment C (Jarvis St.). It is clear that Diana expresses confusion when drawing segment C since she labels it as both Jarvis St. and Front St. Additionally, Diana locates SLM incorrectly on her mental map. When drawing segment D (Front St.), Diana leaves it unlabeled and seems to add in two additional route segments (i.e. ninety degree turns) that do not exist along the actual tour route. This convolution suggests confusion and a lack of wayfinding and navigational ability, both which are directed in this context by procedural knowledge.

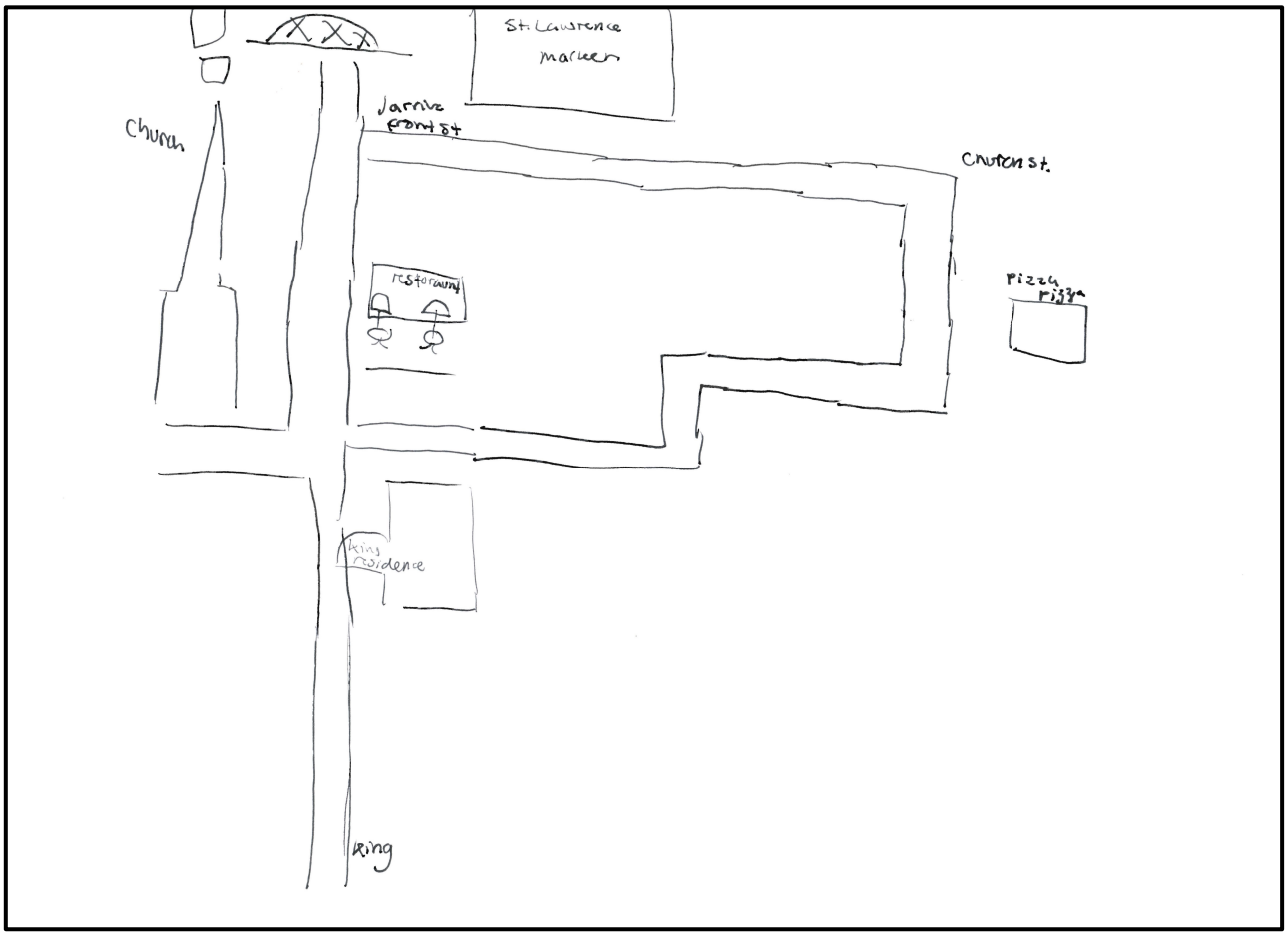

Figure 3.9. Mental map created by Diana (female, non-AR)

Fernando, another respondent in the non-AR group shows similar issues around procedural knowledge. When explaining how he drew his mental map, Fernando states:

> *So, I just basically drew what I saw in procedure…I was walking—that's why I drew this first [refers to the King Edward Hotel], because I saw it first…and then further on, the more things I saw, I drew. I'm pretty sure these are approximately where it is…I just tried to rethink about what I just saw—like visualize. (Fernando, non-AR)*

It is evident that Fernando attempts to utilize his procedural knowledge of the area and apply it to his mental map. He claims to have drawn things in chronological order, as he experienced them along the tour however, his map is indicative of a procedural convolution similar to Diana's. In Fernando's map (see Fig. 3.10), the map orientation is upside-down (the top of the map indicates south and the bottom of the map indicates north) and the route segments are unlabeled and denoted incorrectly. Instead of including the five major route segments with a single travel path, Fernando doesn't define any of the major segments. Furthermore, the way Fernando presents the skeletal route structure of the area is different that how it exits in actuality (i.e. his representation of the area does not denote the "p-shaped" route that was travelled).

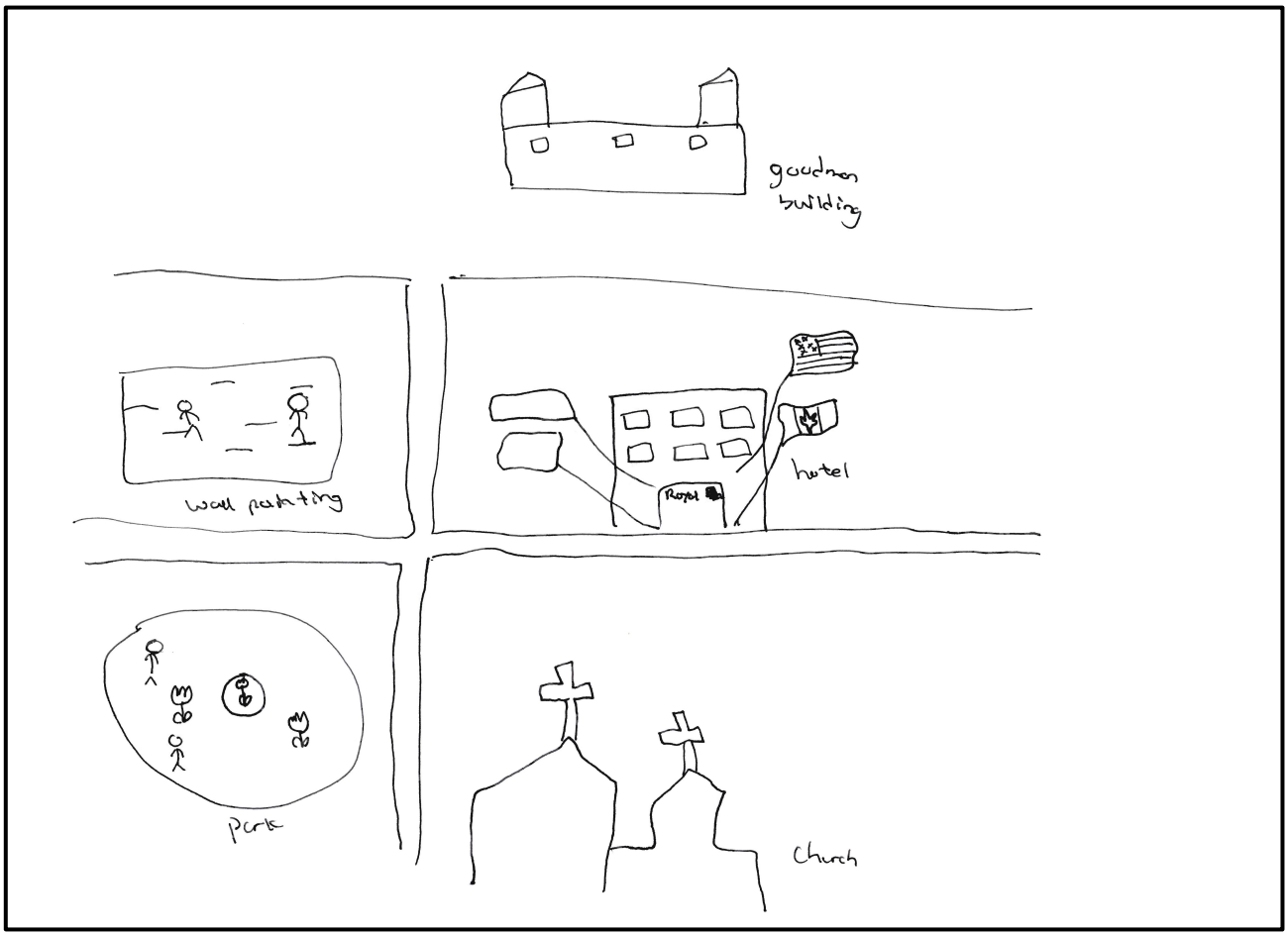

Figure 3.10. Mental map created by Fernando (male, non-AR)

Aaron is a member of the non-AR group who shows an increased capacity for procedural knowledge compared to his counterparts; he was the only member of his group to correctly draw and name the four streets that compose the tour route (see Fig. 3.11). Although he was not asked to comment about his mental map rationale during his interview, the attention to detail in Aaron's mental map is evident. The map shows that he correctly recalled the main route segments and their street names, even indicating minor side streets like Victoria St, Toronto St., and Wellington St. However, even though his map appears accurate, one important element is represented incorrectly—SLM is on the wrong side of the street (it should be on the west side of Jarvis St. and not on the east). Although this may seem like a minor detail, SLM was determined to be a

communal anchor by all respondents in this study. In his photoset, Aaron includes a picture of SLM taken right in front of the structure, indicating that he did notice the structure and that he found it salient enough to capture. This data seems to indicate that Aaron, like other non-AR members focused their attention more towards minor POIs, developing a general cognitive representation of the area that lacks depth.

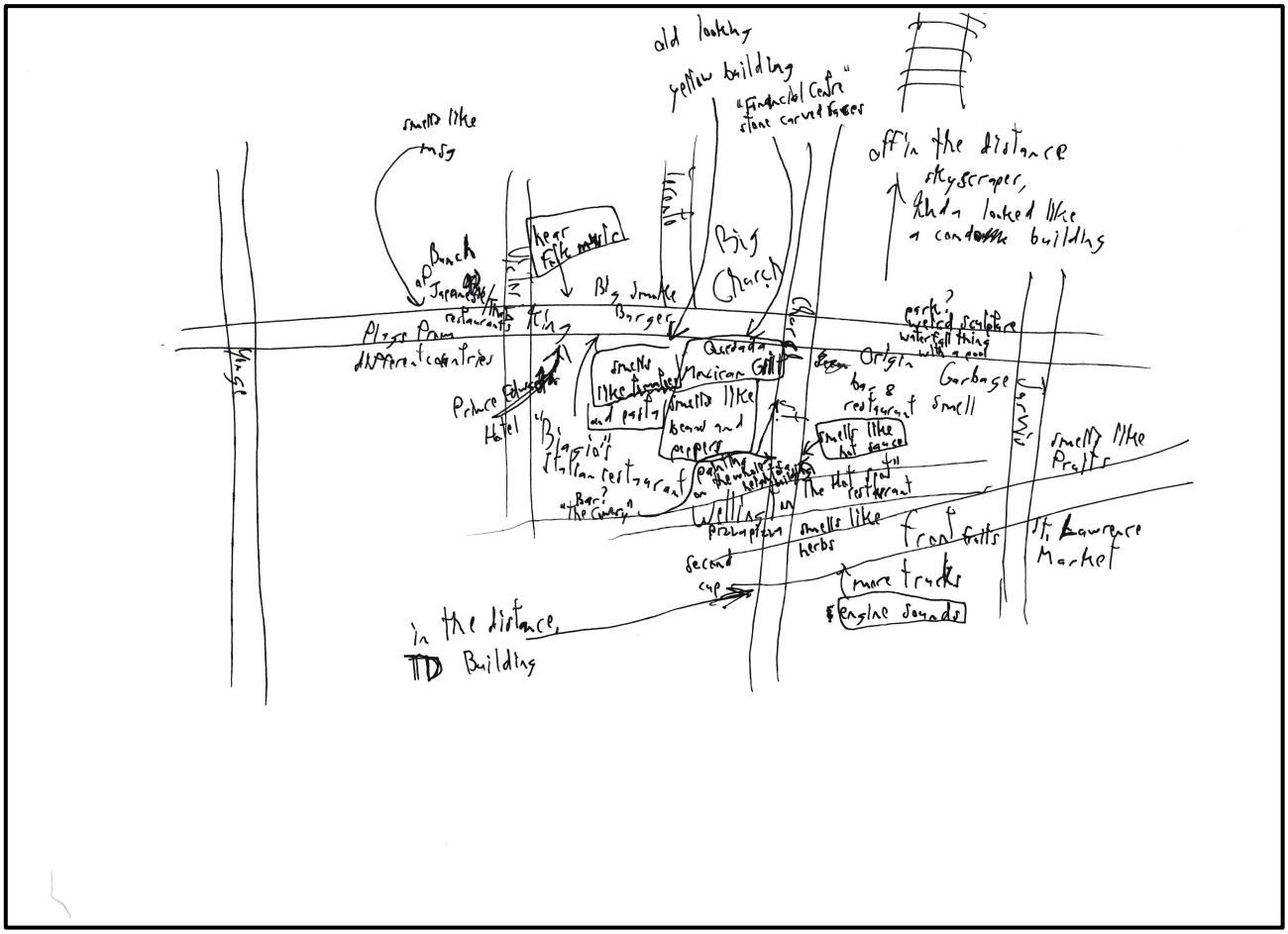

Figure 3.11. Mental map created by Aaron (male, non-AR)

The more developed demonstrations of procedural knowledge seen from respondents in the AR group suggest that there is an association with AR facilitation and this specific type of spatial knowledge. For instance, when asked to explain the rationale behind his mental map, Harry replies:

> *First step of the mental map was to create the streets, like that path that I was going and try to do it directly. So I started King and Jarvis and Church and Front St. in the shape that I generally walked. Next thing were like the biggest landmarks, so like the most iconic stuff, like the St. James is huge in the middle of King and Church. (Harry, AR)*

Much like Fernando, Harry expresses that when drawing his mental map, he denotes what he saw in order of procedure, starting with the basic skeletal structure (i.e. the four major streets: King, Jarvis, Church, and Front), followed by the communal anchors the minor POIs in the area. With regard to Harry's mental map, although it lacks detail, it demonstrates an adherence to the principles of procedural knowledge (see Fig. 3.11). One thing to make note of was that he did not include SLM into his mental map, arguably one of the most prominent POIs in the area. He explains this later on in his interview:

> *I remembered [St. Lawrence Market] after I drew the map. Like, I did notice it but I only remembered it after thinking it through. (Harry, AR)*

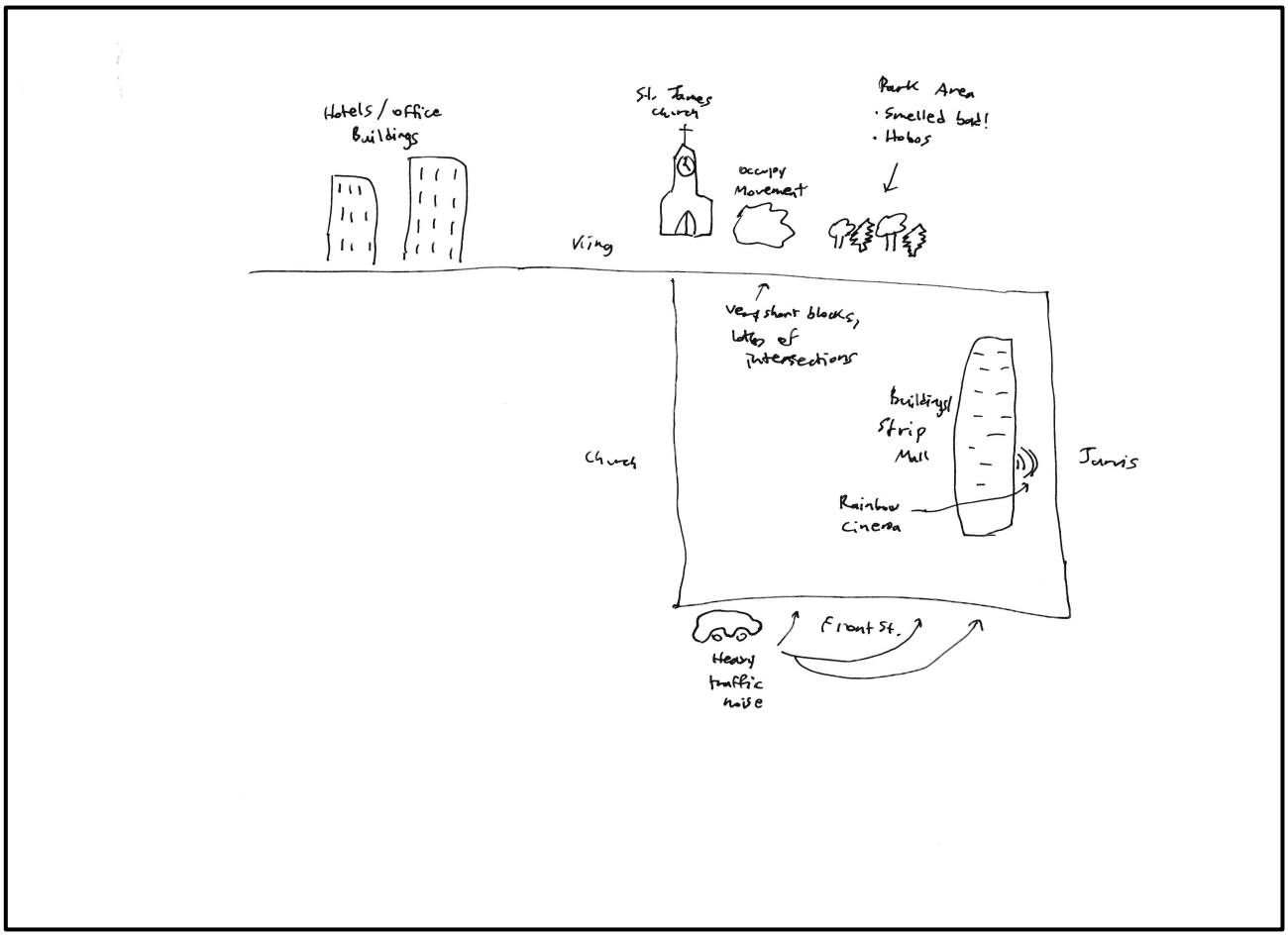

Figure 3.12. Mental map created by Harry (male, AR)

The clearest and most accurate recollection of any mental map was produced Carl, AR. Carl's map (see Fig. 3.13), although unremarkable in terms of recalling detail, demonstrates an in-depth capacity for procedural knowledge. In his map, Carl denotes and labels all route segments correctly. Additionally, all of the communal anchors he includes (e.g. King Edward Hotel, SJC, SLM, and the Gooderham Building) were in the right positions. These results are representative of the maps seen in the AR group, which are consistent and accurate in terms of orientation and the denotation of the basic skeletal route structure. All minor POIs included by the AR group, although few, were also indicated correctly on their mental maps, suggesting that the AR group demonstrates an acute level of hierarchical organization and catenation that procedural knowledge demands.

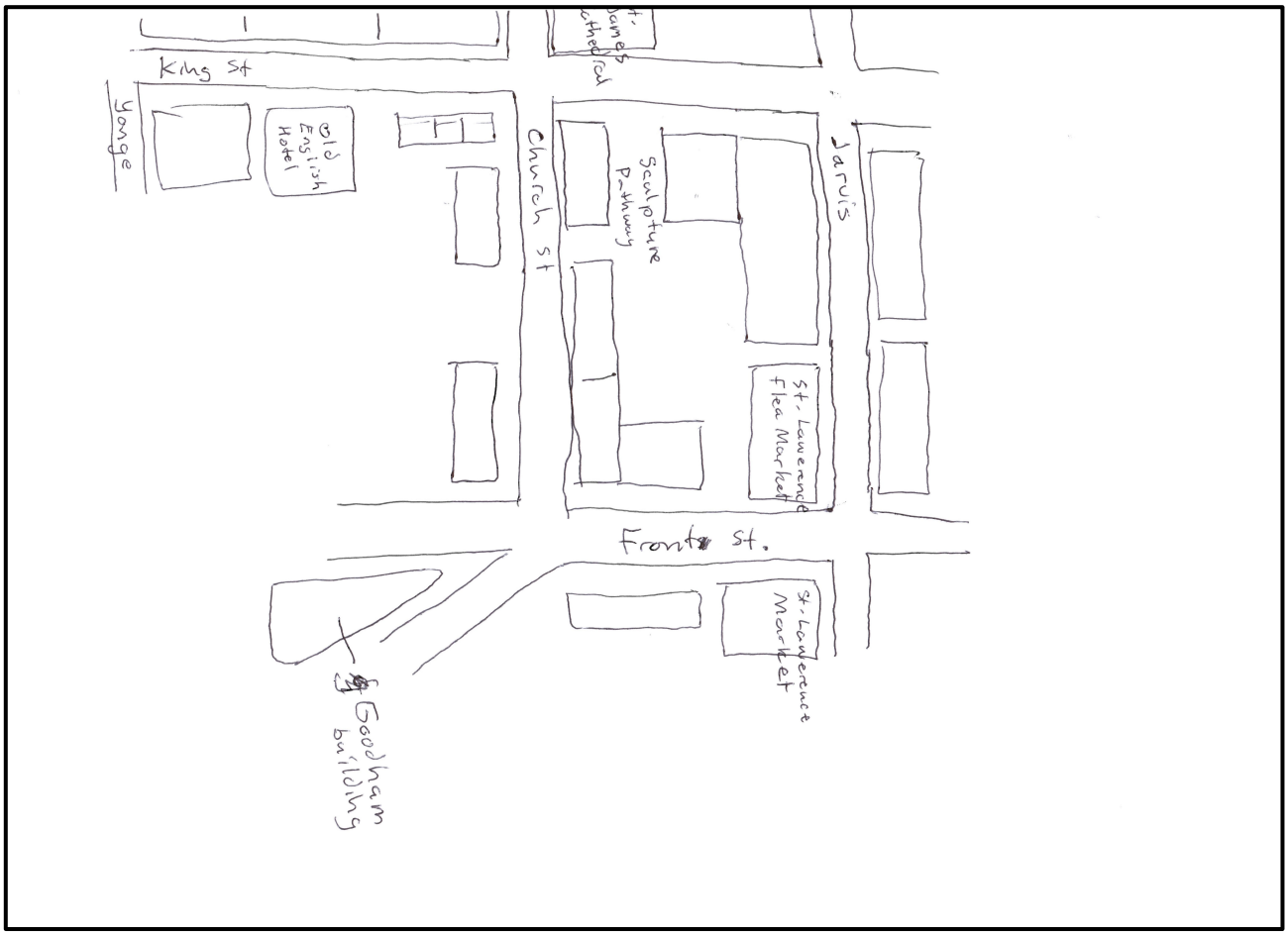

Figure 3.13. Mental map created by Carl (male, AR)

3.2.3 Configurational Knowledge

Somewhat similar to procedural knowledge, configurational knowledge refers to one's ability to link places together by creating associations between and relative to their locations (Golledge, 1992; Darken and Sibert, 1996). Where configurational knowledge differs from procedural knowledge is that it exists beyond the boundaries of the linear and the purely physical; it is an organic type knowledge that compartmentalizes sections of places and creates relationships between them based on a deeper understanding and not simply *prima facie* characteristics. Those with a heightened capacity of configurational knowledge are more likely to have a more clear and

familiar sense of the area and the POIs within, granting them the ability to create links and relations between nodes that are not necessarily in a linear, chronological, or proximate order. An understanding of nodes in an area is part of the development of meaning within that area which is a key component of configurational knowledge. Thus, configurational knowledge is inherently part of the microgenesis of place.

The data suggests that members of the non-AR group developed a more advanced application of configurational knowledge, indicated by their ability to connect POIs in the area in an organic fashion. The AR group, on the other hand does not demonstrate this kind of complex association with the area. For instance, when asked to explain the rationale behind the process of drawing her mental map, Elena, a member of the non-AR group says:

> *Basically I just put myself back exactly where I was, like from street-view in my head and I tried to remember as many places as possible and I found as soon as I remembered one building I could remember a building that came after it, or something that came a little bit after it. I also remember, ...[that] things are linked together—I remember seeing a place that sells glasses or does eyeglasses further along when I was drawing the map and then I remembered that I saw another one so I went back and put that one in. (Elena, non-AR)*

Elena's extent of procedural knowledge when drawing the mental maps goes beyond simply recalling the map in a linear, chronological procedure. Elena is able to link together segments and places along the tour route that didn't necessarily share an association based on proximity or chronology, instead, these associations existed from the relations that she created between them based on understanding.

Similarly, Fernando demonstrates a comparable level of procedural development. When explaining his initial reactions to the tour experience, Fernando states:

> *Just the way that…how buildings and things are like placed here…I feel like it's kind*

> *of unnatural…I was kind of surprised but then I started thinking that I could actually appreciate how things are built and the way…the buildings are there and why things are specifically that way…I feel like I'm kind of adapting myself to the environment. They say adaption is a necessary tool for survival and it kind of made me feel that…there should be a connection between the places themselves, when I was walking. (Fernando, non-AR)*

Fernando explains that his initial reaction was one of surprise due to the obvious contrasts he noticed within the physical landscape; his initial reaction then turned to one of understanding. Fernando describes that he experienced an "adaptation" (i.e. familiarization) to the tour environment, indicating that part of this process involved creating a connection between POIs along the tour route. This behavior is indicative of configurational knowledge because it suggests an understanding of place beyond simply the physical and the linear.

In comparison, members of the AR group do not demonstrate configurational knowledge to a high capacity. When asked to explain the rationale behind the process of drawing her mental map, Gabrielle, AR, states:

> *First I did the streets…. [Then] I kind of drew the landmarks that I used with the app. I used it here and here and here [points to three communal anchors on map] so I could read up on the buildings, so I knew those for sure and then I kind of remembered that there was a courthouse here somewhere and a park…I'm not exactly sure where. (Gabrielle, AR)*

The process that Gabrielle describes seems more mechanical and linear, driven largely by what she experiences through the lens of AR and not her senses, as Fernando had mentioned before her. The type of spatial knowledge she utilizes is more procedural than configurational due to her inability to demonstrate a creation of associations between and relevant to places. Gabrielle also demonstrated a reliance on AR; her choices of salient POIs in the area are influenced by the markers suggested by GeoTravel (see Fig. 3.14).

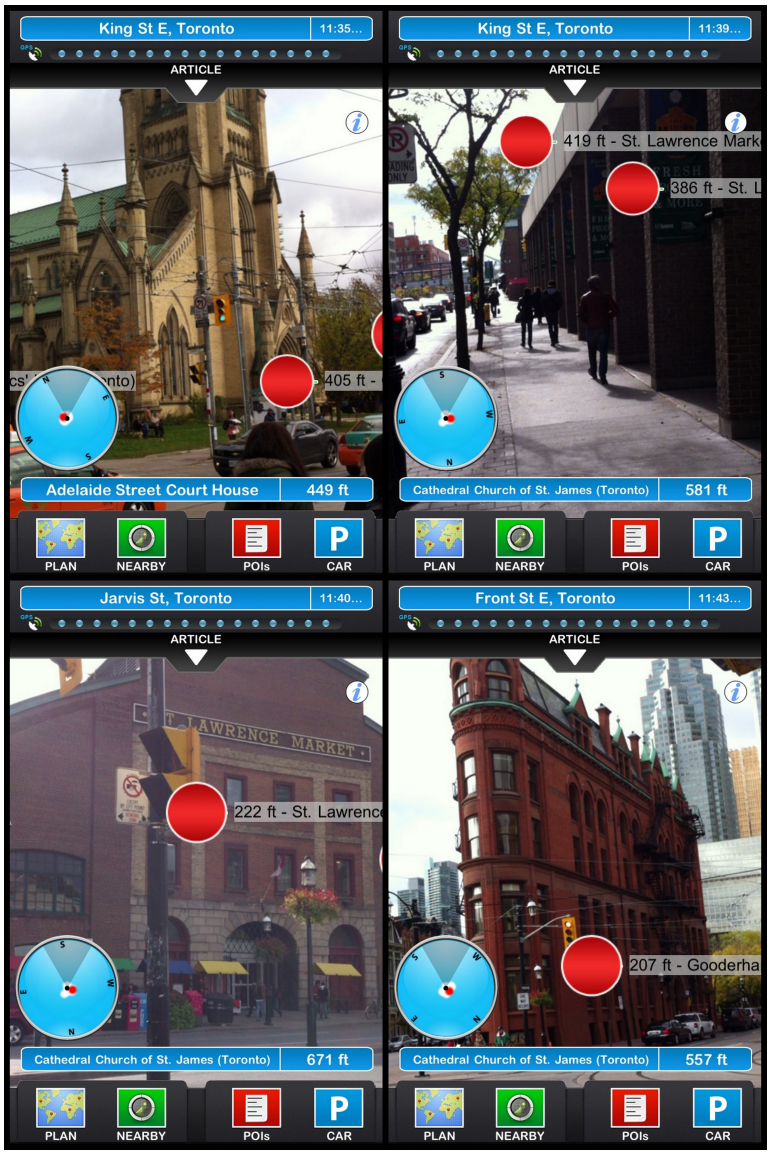

Figure 3.14. A collage of Gabrielle's, AR, photoset. This photoset indicates that Gabrielle choice of salient POIs were mostly recommended by GeoTravel due to the alignment between AR marker and the POI in actuality.

Harry, another AR respondent, displayed a similar lack of configurational knowledge. When asked to explain the process of drawing his mental map, Harry states:

> *I remember the Occupy Movement is right beside [the SJC]; it was like a contrast so I put that down. Then I tried to remember other things, like just the general feel of the area as opposed to the landmarks, so when I ran out of landmarks to think about, I started thinking about what the feel of the area was, was it just really characterized by the taller buildings or was it characterized by the low-rise or park area. I tried to*

mark that down, like the tall buildings vs. the strip-mall area. (Harry, AR)

Although Harry is able to notice contrast between different regions of the area, he does not create associations between places that are not linear or chronological. Thus, he does not demonstrate configurational knowledge because he is unable to create organic relationships between areas that exist along the tour route.

3.2.4 Place Knowledge

Place knowledge, also called "landmark knowledge" refers to one's ability to be able to create a list of perceived features or attributes that exist in natural and built environments; examples of these features can include "mountain, rivers, trees, beaches, buildings, roads, recreational areas, and so on" (Golledge 1992). To each feature are attached strings of attributes such as "location, size or magnitude, identity, time, colour, uniqueness, function, and so on" (Golledge 1992). Place knowledge is not simply an inventory of physical features that are attached to physical attributes; place knowledge also encompasses features that are internally developed by a user which are used to endow a space with meaning.

The data indicates that there are no discernible differences between the two respondent groups in terms of place knowledge developments. For instance, when asked to express his general impression of the area, Aaron, non-AR, provides detailed response:

> *Every block is covered with…tall buildings, unique windows, lots of…small restaurant places to eat…giving off a lot of smells…and like in between a lot of bars, things like that…There was on King St., one thing that took up plenty of space, which had a lot…had a lot of flags and different kinds of things. I don't remember if it was "Prince of King" but I remember the "Prince Edward Hotel" or something like that and this really old looking stone…stone or cement…[with] old ornate kind of designs on the windows and things like that…Not only were there significant looking like, different-kind-of looking buildings, there was actually a small—I don't know if it was as park but it was a little path, and on the left side, after you pass this kind of arch, there was a weird white sculpture, right? And beside it was a fountain-like thing*

> *where it was just a waterfall, like a marble kind of wall and you know, I guess it just reoccurred to me that [the water flows] into this pool. So I thought that was kind of cool, and like I mentioned earlier there was some kind of—it was definitely a bank but it was more significant, somehow more significant than that...and it had a lot of ornate carvings and stuff, with, right beside the sign of the place there was like, carved out faces and things like that. (Aaron, non-AR)*

Aaron's attention to detail is precise; he is effectively able to recall attributes and link features to most of them. The features he notices are both physical (e.g. size, magnitude, material, colour, etc.) and socially developed (i.e. the ability to tell whether a building is significant or not based on its appearance).

Similarly, Elena, non-AR, also exhibits an attention to physical and socially developed features linked with specific POI attributes. When describing a mural she saw during the tour (on the side of SLM), Elena states:

> *It adds colour, just cheers it up a bit because the buildings are really tall and, not necessarily intimidating but sort of…cold, almost. These ones not so much because there's not a lot of glass… I mean, they weren't that business looking before but all the murals makes it look nice…more comfortable. (Elena, non-AR)*

Elena not only notices the colour and vibrancy of the mural itself, she notices the contrast it creates within the area. Elena's use of place knowledge stimulates within her an emotional development which allows for the creation of socially derived features (i.e. a positive assessment) that she attaches to attributes (i.e. the mural). Similar developments can be seen when examining Elena's mental map (Fig. 3.1). Not only does she describe the features of attributes in the area (i.e. "large church with nice gardens", "waterfalls"), she creates assessments based on place knowledge (i.e. "very short and boring street called Toronto St.").

Not all members of the non-AR group showed this level of aptitude in their development of place knowledge. Diana, non-AR, explains what her favourite part of taking the tour was:

> *The difference in buildings—I really enjoyed looking…like, comparing something so old and something so new, it was nice. (Diana, non-AR)*

Although Diana expresses place knowledge by differentiating between old and new and realizing that contrast exists in the area, she does not express it to the same extent as her aforementioned peers. However, at another point in her interview, Diana also expresses the development of socially derived features of physical attributes:

> *I didn't see any bad graffiti, like, where I was I just saw the nice murals and, I didn't see any bad graffiti. (Diana, non-AR)*

She creates a positive assessment by attaching a socially derived feature (i.e. that the murals were "nice") to the attribute (i.e. the art that was located on the wall of the SLM).

Similarly, the AR group demonstrates place knowledge to a similar capacity as the non-AR group, demonstrating their ability to create and attach physical and social features to certain attributes. When Breanna, AR, was describing her general impressions of her tour experience, she was clearly able to link social features (e.g. status) to physical attribute (e.g. the physical environment and the physical features of the people that occupy it):

> *It was very interesting because [the start of the tour] was really high class. I could obviously tell that from the business people in the area, the amount of cars… There's also a fair bit of construction on the street and you've got places where it's really old but you can tell they've been trying to spruce it up and put new buildings over top of it so I found that really interesting…I don't know if that's any way to describe an area, just simply the fact it's a business area, everyone's looking very professional and into their job. (Breanna, AR)*

Carl, AR, displays also displays a similar level of development in terms of place knowledge when asked to describe anything interesting he encountered within the St. Lawrence Neighbourhood:

> *It was interesting that the church was, it was right at the beginning of, let's say, the end of the business district. Um, the Goodman…Goodham building [referring to the Gooderham Building]? It was very interesting because it was like a triangle, pretty much…very thin. Well for me, I kind of appreciated when I left the business area because it was more cultural so I saw like Toronto…I guess that's like a part of Toronto's history, like landmark-wise. (Carl, AR)*

Carl is able to identify a physical contrast in the area and indicate where one perceived region begins and another ends. The feature of the area he finds most interesting are ascribed through the attachments of features to attributes, thus demonstrating place knowledge.

Although there seems to be no clear differences between the non-AR and AR groups in terms of place knowledge, a discrepancy exists in the sheer volume of features and attributes the respondents in each group were able to retain—the non-AR group was able to identify and indicate a significantly higher volume of features and attributes, likely due to their higher capacity of declarative knowledge, as demonstrated below. Again, the non-AR group is able to create a more general understanding of the area than the AR group.

3.4 Spatial Awareness

The negotiation of spatial information is a fundamental process that people carry out on a daily basis. Spatial information, which acts as a foundation for the developments of sense of place, exists in two forms: through external representation (i.e. familiarization through sensory cues) and through internal representation (i.e. learning about places in ways beyond sensory cues) (Ishikawa et al. 2009). Spatial awareness is critical to navigation, wayfinding, and sense of place; it is something that develops with prolonged and increased exposure to an environment. External spatial awareness can be negotiated through the use of all human sensory perceptions but for the purposes of this experiment, only visual, olfactory, and auditory cues were considered when determining,

comparing, and contrasting levels of spatial awareness between respondents in the non-AR and AR groups.

3.4.1 External Cues

When dealing with spatial awareness, external cues are derived from sensory perceptions, namely visual, auditory, and olfactory information. A common external cue that respondents in both non-AR and AR groups processed was the existence of contrasts within the tour area, thus indicating an ability for the respondents to be able to divide the St. Lawrence Neighbourhood into various perceived regions. Respondents were able to delineate contrast between POIs, route segments, and different general areas of the St. Lawrence Neighborhood. In the non-AR group, Elena noted that a contrast of old versus new was evident:

> *Yeah, like, even the architecture—some buildings are really old and some of them look really new. (Elena, non-AR)*

Likewise, all members of the AR group noticed this obvious contrast as well. Harry states:

> *The modern buildings didn't always compare to the historical in the sense that like, the historical, a lot of them were over the top, like the church and stuff like that—over the top, really ornate whereas the modern stuff was just a run-of-the-mill strip mall and apartment buildings. (Harry, AR)*

In his case, Harry preferred the older detailing's of the attributes in the area because they broke the typical conventionality of the more modern buildings.

Interestingly, only members of the AR group could point out existing dualities in the area beyond the old versus new dichotomy. Some of the respondents, for instance Carl, AR, pointed out a duality of business vs. culture:

> *Well for me, I kind of appreciated when I left the business area because it was more cultural so I saw Toronto…I guess that's a part of Toronto's history. (Carl, AR)*

Carl highlights his appreciation for the historically and culturally rich part of the neighborhood that, according to a majority consensus between all respondents, began at route segments B (at the intersection of King St. and Church St.). Apart from this dichotomy, Harry, AR, is able to delineate a contrast of rich versus poor:

> *The difference from walking between, basically, King and Bay, the financial hub, through like Jarvis and Church was a lot poorer area. (Harry, AR)*

The contrast indicated by Harry exists between route segment A (which he identifies as "the financial hub") and all subsequent segments along the tour.

Breanna, AR, was able to identify a unique contrast within the area—she perceived some parts of the tour route to be more formal and others to be more informal:

> *The people seemed nice once you got closer to St. Lawrence Market. As you were in the core where we started, it basically became…it went from like snooty to more comfortable in a matter of minutes of walking. (Breanna, AR)*

Once again route segment A is referred to and is described as more formal or "snooty" and the successive segments, in comparison, are seen as more "comfortable".

Additionally, a different type of contrast identified in the area by both groups was the duality between natural and built features of the environment. This was evidenced to an extent in interview transcripts, but more so through respondent photo sets (see Fig. 3.15). This type of contrast was consistent within route segments B, C, and D.

Figure 3.15. The duality between natural vs. built features that existed within the tour area, as identified in the photos taken by multiple respondents.

The extent to which one notices physical detail through sensory perception is an elementary marker of one's development of spatial awareness through external cues. Respondents in both groups were aware of visual details in the area however, the non-AR group seemed to notice and retain more visual detail compared with the AR group. Nevertheless, there were exceptions to this postulation within both groups, suggesting that the extent of attention and the retention of visual cues seem to be dependent upon individual-level factors varying between each respondent. For instance from the non-AR group, Aaron, describes the Toronto Sculpture Garden (a minor POI) in detail (see Fig. 3.16):

> *There was actually like a small…I don't know if it was as park but it was a little path, and on the left side after you pass this kind of arch, there was a weird white*

sculpture, right? And beside it was like, a fountain-like thing where it was just like a waterfall, like a marble kind of wall and, you know I guess it just reoccurred to me that it just goes in this pool. (Aaron, non-AR)

Figure 3.16. A photo of the Toronto Sculpture Garden taken by Aaron, non-AR

Although his mental map depicted little visual detail (refer to Fig. 3.10), Fernando, non-AR, recalled some communal anchors that he considered memorable in detail:

Yeah, [the Gooderham Building] was kind of different. You don't see a building that has…that green colour. Those are usually for like large buildings, you know. It was kind of interesting even how it was positioned—it was kind of just in a row and it was really narrow. Usually those kinds of buildings are at the side of the street but usually not in the middle…Then I was just walking by, looking at the church and the old design and…I don't think I've ever seen a church like that these days just walking down the street. (Fernando, non-AR)

Fernando notices various features of the physical landscape—colour, size, organization, age, etc., but he fails to notice one of the most visually unique POIs in the area, the St. Lawrence Market

(SLM). When asked why he discusses the SLM during his interview or why he didn't draw it into his mental maps, he states:

> *I think I saw a market but I don't think I really paid much attention to that. (Fernando, non-AR)*

This suggests that the extent of the retention and awareness of visual cues in an area is dependent upon personal microgenetic sense of place development. Aside from Fernando, there was another non-AR respondent, Diana, who exhibited an unremarkable attention to visual detail in all of her data. For instance, when asked to recall all memorable landmarks that she remembered, Diana states:

> *[I remember] the St. Lawrence Market… [laughs] and like the big church…and at the St. Lawrence there was like, a wall painted. It was really nice…[I also] remember this one Pizza Pizza place because it kind of looked different from other places I've see…so I kind of remember that. (Diana, non-AR)*

Diana's lack of visual detail can also been seen in her mental map (see MAP); she is able to list and label only five POIs, providing a relatively barren map compared to other non-AR respondents. The duration of her tour was only 16 minutes, about 11 minutes less than the average tour duration of the entire non-AR group (see Table 3.1). This could suggest that interest and willingness to explore the area are correlated with length of tour.

Table 3.1. A comparison of the number of photos taken and the duration of tour experiences between the non-AR and AR respondents

Non-AR Respondent	Number of Photos Taken	Duration of Tour (in minutes)
Aaron	18	32
Diana	13	16
Elena	27	28
Fernando	7	35
TOTAL	65	111
AVERAGE	16.25	27.75

AR Respondent	Number of Photos Taken	Duration of Tour (in minutes)
Breanna	22	27
Carl	7	14
Gabrielle	6	16
Harry	6	22
TOTAL	41	79
AVERAGE	10.25	19.75

In the AR group, results are somewhat similar. Breanna's awareness of physical detail has already been demonstrated by her acute development of place knowledge (section 3.3.4). She further exemplifies her attention to physical detail when she lists the negative sights that she encountered along her tour experience:

> *Well, there's a lot of construction and scaffolding in the area which would be a negative sight, per se. I guess, another negative would be the orange pylons, they look hideous and they didn't really seem like they belonged even though there was, construction going on…There's a couple of run down area I noticed—on one of the corners there was a café, I'm just forgetting the name right now—it had a bunch of hedges and stuff and it looked wonderfully landscaped, I took a couple of pictures of them, but as you look down on the actual box holding the hedges, it was really run-down and the paint was torn off and stuff like that and there was a lot…and there's two big instances of large murals painted on the wall, like kind of a graffiti style and you can tell they commissioned an artist to actually paint on there and make it look nice and that just didn't appeal to me. There are graffiti tags on top of the artwork that they commissioned, I think—I don't know…Yeah, those were negative sights. (Breanna, AR)*

Most of what Breanna discusses demonstrates her visual awareness of minor details within her surroundings. Within the AR group, Breanna drew the most detailed mental map, listing various minor POIs and all of the communal anchors (see MAP). Breanna also spent the most time during her tour route (27 minutes; 7.25 minutes more than the average) and she took the most pictures (22; 11.75 photos more than the average) (see Table 3.1, above).

The other three AR respondents (Carl, Gabrielle, and Harry) all display poor attention and retention of visual detail, as seen in their mental maps. Although the general cartography of Carl's map is correct (i.e. structure, building layout, orientation, route concatenation, etc.), he demonstrates little evidence of awareness or retention of visual information in the tour environment (see Fig. 3.13). During his interview, after being prompted multiple times to express more visual detail, Carl replies:

> *Yeah. The sculpture garden…it had the sound of the waterfall which actually got my interest and it also had a nice patio restaurant there…There was the mural on the back of the St. Lawrence Market…and the Goodman building…[they were] unique. (Carl, AR)*

His demonstration of detail consists of only broad attributes; he is unable to mention specific features. Similarly, when Harry, AR, was asked to communicate his general impressions of the tour area, he replies:

> *It's really downtown...I don't know. The difference from walking between, basically, King and Bay, the financial hub, through like Jarvis and Church was a lot poorer area. (Harry, AR).*

Like Carl, Harry's visual awareness focuses on broad details, ignoring specific features and attributes that some of the other respondents were aware of. This lack of attention for visual detail

is reaffirmed in his mental maps. In his map (see Fig. 3.12), he lists few POIs, failing to give mention to SLM, an important communal anchor and includes some vague visual data such as, "very short blocks, lots of intersections".

Although visual perception is usually the primary mode of gaining spatial awareness in unfamiliar areas, auditory and olfactory perceptions are also vital (Cresswell, 2004; Relph, 2007). While visual cues create the framework upon which navigation is based, auditory and olfactory cues are just as important in ascribing meaning to an area, thus informing wayfinding and the microgenetic developments of sense of place. Although a noticeable discrepancy in terms of visual attention and retention didn't exist between the non-AR and AR groups, there were noticeable differences between the two groups regarding auditory and olfactory perceptions. The non-AR respondents seemed to notice auditory and olfactory cues to the same high capacity as they noticed visual content. In contrast, the AR group seemed to notice few auditory and olfactory cues.

For instance, Aaron, non-AR, showed a high aptitude in the awareness of non-visual cues. When asked to describe any non-visual sensory cues experiences, Aaron began describing smells in detail:

> *I smelled a lot of…foreign spices and things like that. Of course, it might have been something fake like MSG or something like that because there's lots of Thai and Japanese restaurants [in the area]. Then, after that, there was actually a really strong smell of beans and peppers… Along the way, at around Front and Jarvis, there's an overhanging smell [of garbage]…As you go farther along…it's like a little bit more gasoline, cause there's more trucks everywhere, but then eventually as I got closer to Church St., I actually tasted like some grassy herbs and things like that. Once I got to Front and Church, there were—I smelled two separate smells right beside each other, there was like Pizza Pizza on the left side, and on the right there was like this kind of um, there was like a really strong spicy smell, from some place called "The Hot Spot". (Aaron, non-AR)*

Later in his interview, Aaron also mentions memorable sounds he experienced in detail:

> *There were plenty of bars or like Italian restaurants where there was—not popular music but some kind of like…folk music… [the music] fit that restaurant or that bar. But then other than that, there wasn't any music outside playing or anything interesting out there...[Then] as I got around St. Lawrence Market, there were more engine kind-of-sounds and trucks. Then I saw some guy on, when I was coming back on Church St., just yelling to himself. (Aaron, non-AR)*

Aaron is able to associate specific smells and sounds relative to the locations where they were perceived along the tour route—this is a level of development in place knowledge that isn't demonstrated in the AR group. Aaron's ability to tie non-visual sensory cues (features) to places (attributes) is also demonstrated through his mental map (see Fig. 3.11). He clearly specifies the location of where he experienced each smell or sound, demonstrating not only acute levels of attention to, and retention of non-visual sensory detail, but also an ability to link those cues with specific location or POI.

Another non-AR respondent, Elena, shows a similar awareness of non-visual cues throughout the tour. She is able to recall both auditory and olfactory cues:

> *I heard cars…and I heard a couple instruments. There are a lot of people making deliveries, I noticed. So, you heard like, opening and closing car doors. [I also heard] a couple talking but most people were just walking somewhere, they weren't talking really. I could smell…flowers when I walked by that shop, that was great… and it smelled like…unusual when I walked by the Japanese restaurant. So I was like, "Ah!" Um, I didn't really smell that much, just lots of exhaust…and I didn't really taste anything [laughs]…except maybe exhaust [laughs]. I smelled a little bit [near St. Lawrence Market] but I don't think I was that close to it like, it was on the other side of the street…[but I] thought I could smell some…like bread. (Elena, non-AR)*

Elena is able to notice sounds and smells beyond those that are simply ambient and just as Aaron, she is able to link these non-visual sensory cues to certain places that she encountered, demonstrating place knowledge.

The attention to non-visual cues in the non-AR group is not an entirely homogenous occurrence. Fernando, non-AR, is a respondent who doesn't seem to be able to recall any non-visual cues from the tour. When asked to recall smells or sounds from his tour experience, Fernando replies:

> *I can't remember…All I heard was cars going and some guy in the street kind of stopped me and then he was like, trying to ask me questions. (Fernando, non-AR)*

This excerpt accurately represents the entirety of the non-visual sensate data Fernando was able to recall. This is unusual because Fernando did spend a considerable amount of time touring the area, more than anyone else in his group, suggesting that he had the most exposure to the space. However, Fernando also took the fewest pictures, suggesting that the cameras provided to respondents influenced their capacities of place knowledge (see Table 3.1).

In the AR group, the awareness of retention of non-visual cues was occasional and non-descript. None of the AR respondents were able to provide neither detailed features nor an ability to link features to POIs or specific areas like non-AR respondents could. Since sensory perception is linked closely with place knowledge (associating perceived features with attributes), it is to no surprise that the AR group performed more poorly than the non-AR group in this sphere. For instance, when asked to recall any smells or sounds from the tour, Gabrielle, AR, states:

> *I don't know, I think some people were talking French beside me, possibly…[and I] just smelled fresher foods. (Gabrielle, AR)*

Gabrielle demonstrates a vague and unsure account of smells and sounds in the area. Carl, AR, displays a similar level of awareness to non-visual cues:

> *The sculpture garden…it had the sound of the waterfall which actually got my interest and it also had a nice patio restaurant there and the smells coming out of it were good [laughs]. Um…oh the church! The bells went off. (Carl, AR)*

Both respondents appear to pay little attention to non-visual cues in these cases. Similarly, their mental maps also lack any information regarding smells and sounds (see Fig. 3.5; 3.13).

Breanna, AR, is one of the respondents in her group who had noticed both auditory and olfactory cues:

> *[Near St. James Cathedral] there were a lot of people just relaxing there and playing music and being mellow. Um, the [overall] smell is pretty clean…believe it or not, even though we're in an industrial town, I didn't really smell anything that would off-put me in any way, it just smelled like a normal city, which is good…[In terms of sounds], for the amount of construction I was actually surprised by the lack of sounds—I expected there to be jackhammers and everything going on and that would annoy the residents but I didn't hear anything considering there was a lot of construction in the area. (Breanna, AR)*

Although it may seem that Breanna had described non-visual cues in some detail, she actually describes what she expected to experience and didn't necessarily encounter. In this respect, her answer remains consistent with the respondents in the rest of the AR group.

3.4.2 Internal Cues

Internal spatial cues exist beyond simply the awareness and processing of sensory cues alone; internal cues arise from a deeper knowledge of the context of an environment, usually created through an active dialogue with an environment over prolonged and multiple exposures. The AR group had the advantage of being able to become passively informed about the tour area's internal cues through the use of the GeoTravel app. The application allowed the AR group to explore each POI in as much detail as they wished by integrating information about the POI drawn from a relevant Wikipedia article. Members in the AR group were able to read about each POI in as

much detail as they wished, giving them an advantage in terms of internal knowledge over the non-AR group who were only exposed to internal cues through signs and placards within the area. This facilitation of developing internal cues accelerates the familiarization process in unfamiliar spaces—essentially, those facilitated in this fashion are given an instantaneous guided AR tour of the area, provided by GeoTravel.

All respondents in the AR group utilized the external cues that GeoTravel offered to some extent, granting them an accelerated sense of familiarization. Breanna, AR, demonstrates this accelerated familiarization; when asked if she would have been able to tour the area without AR facilitation, she replies:

> *Yes, but I wouldn't have known more of the area. So I like I said, I pulled up the Wikipedia app, learned a bit about the church, learned a bit about…The Albany Club, for instance. I learned a lot about the King James Hotel and stuff like that. There's no way I could've went up to anyone at the King James Hotel and said, "Oh hey! When was this established?" Especially the Albany Club—according to the article, is super exclusive, so I wouldn't have known it was an exclusive club, I thought it was just another building, like a hotel residence or something and it turns out it's the only exclusive club in Toronto or something. (Breanna, AR)*

Breanna demonstrates that the facilitation of AR indeed increases internal knowledge within the area. The app provides information that can be accessed easily by the user, enabling the user to have an almost instantaneous familiarity with the area. Breanna was able to learn details about certain POIs that would have never been accessible to other users on a first introduction to the tour area without utilizing some of sort of facilitation. Without the app it would have probably taken her multiple exposures to learn about these features. She demonstrates her knowledge of internal cues further when she begins to discuss the St. James Cathedral:

> *The cathedral really stood out because it was just, it was old and you could tell it was old. I read an article; apparently it's one of the oldest that's survived because it*

> *was stone, not wood and didn't burn down [in the Great Toronto Fire] and there were a lot of fires in this area. (Breanna, AR)*

Breanna learns more about the histories of the cathedral and the area itself, while gaining a sense of the importance of the SJC and its footprint in the area.

Harry, AR, also demonstrates internal knowledge to a similar extent as Breanna. When asked if he thought his level of familiarity with the tour area would have been the same with the use of GeoTravel, he replies:

> *No, because when I saw the points-of-interest, I could not pull up the article. For one of the [POIs] it showed something about the Great Toronto Fire which I wouldn't have known was even there…so I could read up on the article, same with the St. James Church and stuff. When you're walking by that you see it's old but that's the only impression you'd get, whereas if you look at the app you'd see this year was for this type of thing...it's a lot more information readily and quickly available, right when you want it as opposed to trying to say, "I'm going to go home later and look it up."... I think I read up on like four or five [POIs]: St. James Church, some bookstore on King St, I forget what else. (Harry, AR)*

Without facilitation from the GeoTravel application, Harry claims he would not have known as much about the context of the tour area. The development of internal knowledge is normally an active process; one only gains internal knowledge of an area once one experiences it over time, through multiple exposures. As in the case of the other AR respondents, GeoTravel allowed Harry to learn about the historical background of the area and its POIs, thus giving him a deeper and richer understanding of the space he had walked through. All internal knowledge gained by AR respondents was done so passively. In comparison, the non-AR group had to rely solely on their senses and the limited information that they actively received from the area. Since all participants in this study were unfamiliar with the area prior to their tours, the non-AR group was left at a disadvantage regarding the awareness of internal cues since they had only experienced a single, brief exposure to the area as opposed to the "second exposure" that AR facilitation provided.

3.5 Social Representation and the Development of Meaning

An important component of sense of place, one that is essential in the microgenesis of sense of place and one that ties in with Moustakas' (1994) brand of transcendental phenomenology is *social representation*. Moscovici's (2001) concept of social representation can be used to better illustrate and understand how experiencing a space through wayfinding leads to the creation of a sense of place.

At its basis, social representation seeks to prescriptively conventionalize objects, persons, or events people encounter according to an agent's past representations, language, culture, and previous knowledge and experiences (i.e. all previous dispositions). Essentially, social representation seeks to "make something unfamiliar, or unfamiliarity itself, familiar" (Moscovici, 2001). Social representation exists through two processes: anchoring and objectification. Anchoring is the process of identifying something foreign and "[comparing] it to a paradigm of a category" determined by an agent. For instance, if one, due to past experience, associates urban spaces with negative connotations, it is likely that any exposure to an unfamiliar urban space will lead to further negative representation which is derived from anchoring. Anchoring works by categorizing objects as best as possible into types; it implies evaluation and labeling (i.e. determining if an object has a positive or negative assessment) thus, neutrality isn't possible in this process. Each object that becomes anchored is classified with a positive or negative assessment. The objective of anchoring is to "maintain the distance and consider the object under scrutiny as a divergence from the prototype. At the same time, [trying] to detect what feature, motivation or attitude makes it distinct" (Moscovici, 2001). In anchoring, even though an object is compared to its paradigm-category to create an assessment, it is still recognized as a unique object and not

simply a clone of its prototype.

The second process at work in social representation is objectification. The goal of objectification is to turn anything unfamiliar into reality, making it familiar (Moscovici, 2001). That which is objectified becomes conceptualized mentally; it becomes a realized physical object that is permeated with value and meaning. In other words, objectification is the process of materializing an abstraction into a reality. These two processes of social representation are fundamental in the microgenesis of sense of place because they initiate the crating of meaning within space.

In this section of the chapter, social representation will be first analyzed through respondents' assessments of the tour area (i.e. positive, negative, or neutral assessment) and their comparison of the area and its features to a paradigm of a category. Following this, the cognitive (i.e. beliefs and perception) and affective (i.e. emotions and feelings) developments of respondents will be compared between the non-AR and AR groups.

3.5.1 Paradigm-Category Comparisons: Positive Assessments

A central process in social representation, one that is at the root of familiarization with the unknown, is the ability to take something unfamiliar and compare it to a paradigm of category in an attempt to make it familiar (Moscovici, 2001). This process involves categorizing the unfamiliar into types to increase familiarity and assessing and labeling the types. The anchoring process presumes either a positive or negative assessment, thus neutrality and ambivalence are not possible.

The data suggests that the AR group seemed more receptive to the anchoring process, demonstrating a greater ability to clearly compare and valuate characteristics and details of the tour area in comparison to the non-AR group. For instance, Breanna, AR, explains why she found the initial area of the tour positive:

> *This may be more of a personal answer but I really liked the business buildings because I plan on eventually going into commerce and stuff like that, so that actually was what I liked most about the area because it had more of a personal connection to me. (Breanna, AR)*

Breanna associates with the area in a personal way, anchoring the physical area to her aspirations of becoming involved in a career in finance. This is an interesting development because when describing her initial reactions to the area, she described the initial tour area as more formal with a somewhat pretentious atmosphere:

> *As you were in the core of where we started, it basically became…it went from snooty to more comfortable in a matter of minutes of walking. (Breanna, AR)*

Although she felt somewhat uncomfortable in the area, Breanna associated the area with her aspirations of future success and this is why she created a positive association within the area. In another instance, Breanna anchors her experiences near the St. Lawrence Market, namely the sensory cues she noticed, to her previous experiences in New York City:

> *The smell is pretty clean. I was surprised because I've been to market places in New York and they smell like fish and they smell horrific. The St. Lawrence Market actually smelled really clean…I didn't really smell anything that would off-put me in any way, it just smelled like a normal city, which is good. (Breanna, AR)*

Breanna compares the smells she experienced near the SLM to a previous negative experience she encountered in New York City. She determines that during her AR-facilitated tour, her experience channeled through olfactory cues, was a positive one. Not all of Breanna's positive assessments were associated with explicit demonstrations of anchoring. For instance, when walking near SJC, Breanna creates a positive association with a musician playing a guitar:

> *I just hear it coming right off the garden that there was a guy playing guitar towards the middle of the park. He seemed pretty good and that was very comforting. (Breanna, AR)*

Although she didn't explicitly state the paradigm-category she was relating that experience to, she created a positive association with the experience, indicating anchoring, to some degree, must have taken place.

The other AR respondents weren't as explicit as Breanna when communicating the association between paradigm-category and physical attribute. Gabrielle, AR, lists features that she's perceived to be positive from her tour experience:

> *I like the market and how there was a whole patio outside for sitting and drinking coffee and stuff, that was cool...and I like the landmarks, the old ones... I guess just the sense of community, the feel. It's a nicer area and you don't really see that…It's, I feel, a safer area than many places in Toronto. (Gabrielle, AR)*

Gabrielle views the area in the vicinity of SLM in a positive light due to its informal, relaxed atmosphere and the communal spirit that comes along with it. She feels it is a unique area in Toronto and believes it to be a relatively safe environment. Although she doesn't overtly indicate the paradigm-category she had used as a prototype for the area (i.e. her personal anchoring process), it is clear that she came to the conclusion of a positive assessment in this area due to the comparative processes involved in anchoring. Similarly, when Harry, AR, was asked what he likes best about the area, he responds:

> *Some of the older buildings—I could read up on what the older stuff was. Other positive things were like, the histories behind some of the area. So like the Great Toronto Fire was a cool story to read about something that happened…It's a really old area with a lot of history that you can read about. [It's] just a general interest [of mine]. (Harry, AR)*

Harry was most intrigued by the history behind the area and its POIs. In this case, Harry's anchoring was passively facilitated by GeoTravel (i.e. based on internal cues) and based on his personal interest in history. The positive features of the area he identifies are grounded in the features area itself but advanced his subjective preferences.

The paradigm-category comparisons within the non-AR group were based solely on sensory data, thus no internal cues were used in the anchoring processes of these respondents. This dependence on sensory cues can be illustrated when Aaron, non-AR, suggests that one of the primary positive features he notices in the area is based on smell:

> *There was this kind of Italian restaurant that really smelled good…it was like "Giorgio's" or something like that, [it was inviting and so was] St. Lawrence Market…I would definitely like to come back there and check stuff out…They sell [things] that you wouldn't find in a grocery store. (Aaron, non-AR)*

Aaron's anchoring in this example is solely based on olfactory cues he has noticed during his tour, thus it is based on his subjective olfactory preferences. Another positive assessment Aaron makes is when he talks about the benefits of SLM:

> *I just think whoever is going in there is an informed, interested food consumer…someone who knows there's something interesting there that maybe you use for whatever meal you're cooking with. They just wanted something more interesting to eat because a lot of people don't really care [about food]…they just want to go through their cycle everyday eating, eating food…I just kind of think that once in a while exploring would be kind of interesting. (Aaron, non-AR)*

Aaron believes that patrons of the SLM are informed and educated about their food choices; they are perhaps people who put an emphasis on healthy and diverse produce. Aaron has an obvious admiration for this type of consumer and, indicating that his anchoring of SLM is based upon this perception.

Fernando is another non-AR respondent who determines a positive assessment of the tour area's characteristics from anchoring. At the start of his interview, Fernando describes that he felt as though during the entire tour experience he was "adapting [himself] to the environment". When describing positive associations he made with the area, he says:

> *[I like] the feelings I get, I guess…like seeing the things that I did not see before…like I said, some places look kind of abnormal and that really made me feel that that place really has its own style and characteristic…[Another positive thing is that] it makes you kind of experiment more. It further requires you to kind of, explore the area I guess. It makes you wonder about, "Oh yeah, what could that be? I don't know about it." (Fernando, non-AR)*

His positive associations with the area arise from the process of familiarization itself. He appears to enjoy being exposed to the area, allowing uncertainty to promote curiosity and exploration. It is this undertaking that influences Fernando's anchoring process and leads him to develop a positive assessment of the area.

3.5.2 Paradigm-Category Comparisons: Negative Assessments

Not all paradigm-category comparisons led to positive assessments of the area. Breanna, AR, explains how she negatively associates with certain attributes of the area which developed through anchoring:

> *This is probably yet another personal answer but I disliked the church and how it was the center of everything. I'm sorry, on record I'm an atheist so it didn't agree with me that everything in the area is named after the church and everything is related to the church. I understand that probably a couple years back…it was very prominent in the area just now I don't believe it should be as prominent…All the gardens were named after the church, all the little cafés had stuff about the church…I don't know, I kind of dislike that. (Breanna, AR)*

In this case, Breanna compares the area to a paradigm-category informed by her religious

orientation. Breanna associates the SJC with a negative assessment because she doesn't agree with its prominence and presence in the area. She believes that the church, although important in the past, should no longer be central to the neighbourhood's identity. Additionally, when asked if she felt safe enough to return to the area alone and at night, Breanna mentions another personal experience that compels her to create a negative assessment of the area:

> *I know a friend who got stabbed in Queen's Park…and he was in a group, so I still wouldn't feel safe just for personal reasons, especially near the gardens and St. Lawrence parkway. Maybe if I was closer…[to the] downtown area and if this area [was] busy during the night then I would [go alone], but not necessarily at night.*

Although most of the other respondents felt that the area was generally safe, and most were willing to return alone at night, Breanna's negative assessment of the area and its safety is based on her anchoring to a previous negative experience in a different area. Breanna was also able to create a negative assessment of the area based on visual cues:

> *There [were] two big instances of large murals painted on the wall, kind of a graffiti style and you can tell they commissioned an artist to actually paint on there and make it look nice and that just didn't appeal to me. There [are] graffiti tags on top of the artwork that they commissioned, I think, I don't know. Otherwise, the graffiti person has enough time to sit there and paint a nice mural...yeah, those were negative sights. (Breanna, AR)*

The respondents who noticed the murals all valued them positively except for Breanna. The murals (see Fig. 3.17) would not be considered illicit by normal standards, yet Breanna associated with them negatively, suggesting that she had anchored them to a previous negative experience or encounter.

Figure 3.17. An example of one of the commissioned murals within the St. Lawrence Neighbourhood

Another AR respondent who created negative assessments for certain areas within the tour route was Harry. Harry's associations arose mostly from the areas specifically the area near St. James Park (where the Occupy Movement was held in Toronto):

> *Near the Occupy Movement park and near some other shelters, it smelled pretty bad, like just a bad, putrid smell…[There were also] unclean areas, the dirty parts. Like, the garbage in some places…[It's] just a negative association with being dirty. (Harry, AR)*

Although lack of cleanliness usually creates connotations of negativity, Harry was the only one who

associated these areas with a negative assessment, suggesting that this was due to a subjective association he created.

The non-AR respondents show negative associations derived from anchoring in a similar scope as the AR group. Aaron, non-AR, is able to recall a previous negative association with another part of downtown Toronto:

> *One time…I don't know if this is relevant but one time I got off at Yonge and Dundas and went to Eaton Centre for a bit and then I wanted to go…a couple of blocks [north], just to see what's there. All of a sudden I see people with eyes twitching and things—drunks, walking across the street when you're not supposed to, a big strip club… It just seemed like bad news over there, you know? I felt like I didn't want to stick around there too long, right? So if something like that happened around here, which I don't think it is, [I wouldn't want to return]. (Aaron, non-AR)*

Aaron describes that he felt comfortable in the area and in comparing it to Yonge and Dundas Square in Toronto, he is relieved that the area is much different although he says that if the St. Lawrence neighbourhood ever began to share similarities with Yonge and Dundas Square, he would not prefer to return. Although he doesn't specifically create a negative assessment with the St. Lawrence Neighbourhood, Aaron compares the area to a negative category of another urban Toronto landscape. His final assessment of the area is positive, but it had been derived by comparison to a negatively valuated area. In this instance, Aaron does not utilize his negative perception to create an assessment for the tour area, however it is possible that he utilizes it when he goes on to specifically describe negative features he encountered when walking along the final route segment:

> *[There were] little sections of the blocks that had back alleys [on Church St.]. There [was] a lot of…garbage and…just the people that were coming out of there, I thought, even by the way they walked and things like that…the kind of demeanor of their face and things like that… it just felt really sketchy and off. [Like] they were up to something, you know? (Aaron, non-AR)*

Aaron was not alone in identifying this final area of the tour route as suspect; every respondent identified this specific area (in varying degrees) to be less safe. Seems to notice only unpleasant features of this certain route segment (see Fig. 3.18), possibly identifying with a previous negative experience.

Figure 3.18. A picture of Route Segment E (Church St.), an area of the tour route that many respondents found to be unsettling

Fernando, non-AR, was another respondent who was able to identify an overall negative quality in the area. He describes the confusion he felt during the tour due to the lack of order and organization among the buildings:

> *Often buildings [in the area] are unique. They might possibly bring some confusion to the people [who may ask], "Why is [that building] there?" [I got a] disoriented feeling, I guess… [In terms of cleanliness,] I think right beside the park there are a lot of tents and people camping. It kind of seemed a little bit disorganized in a way… I think [it's] important, how organized [an area] is. I don't think buildings [here] were as structured; some were standing out more than others and yeah—that's how I find something interesting—that could be a good thing and a bad thing because…[it could make people feel] disoriented or not in order. (Fernando, non-AR)*

To Fernando, the confusion he experienced from the lack of perceived organization in the area was the primary negative component of his tour experience. He places great emphasis on order and organization and he believes that these principles scarcely exist within the physical landscape along the tour route. It is possible that the emphasis Fernando places on order and his inhibitions with disorder exist through paradigm-categories that he had compared the area to. Although he didn't explicitly mention this process, it would explain why other respondents hadn't noticed this apparent lack of order.

3.5.3 Neutral and Ambivalent Respondents

Not all respondents were able to create positive or negative value judgements based on their tour experiences and thus, by definition, did not comply with the criteria of the anchoring process. Although neutral respondents existed in both groups, there were two respondents in the non-AR group, Elena and Diana, who gave neutral and/or ambivalent responses throughout their whole interviews. Conversely, respondents in the AR group were more easily able to determine a polar assessment regarding individual components and characteristics of the area or the overall area itself.

Elena, non-AR, exemplified these notions of neutral and ambivalent responses. When asked if she would even consider bringing a date to the area in the future, Elena responds:

> *I guess so…I don't really know what exactly [I think]. I haven't yet excluded anything about it because I haven't been around here enough. I noticed [a contrast*

in the area] because of myself but I would conclude that this area is mysterious. (Elena, non-AR)

This response suggests that Elena is still unsure of the area; this unfamiliarity is what prevents her from making an assessment of the area. She remains ambivalent, the area remaining "mysterious" to her. Elena further demonstrates her neutrality and ambivalence towards the area when asked to choose a one-word adjective to depict her experiences in the area:

Agreeable…Agreeable, does that make sense? I can't think of one word that's like, "Yeah, this is alright," so…yeah, it's pretty neutral [laughs]. (Elena, non-AR)

Additionally, during interviews, each respondent was asked to choose a single adjective to describe their overall impressions of the tour area (see Table 3.2). Compared to the respondents in the AR group, Elena's descriptor is unique and clearly indicates her neutrality and her lack of familiarity with the area; most of her responses follow this prototype.

Table 3.2. An inventory of one-word descriptors each respondent used to describe their general impressions of the tour area.

AR Respondent	Descriptor
Breanna	Professional
Carl	Curious
Gabrielle	New
Harry	Overwhelming

Non-AR Respondent	Descriptor
Aaron	Inviting
Diana	Normal
Elena	Agreeable
Fernando	Exotic

For instance, when asked when she would ideally return to the area and if she would return if there was a public event being held in the area she replies:

I can't really think that far…right now…I guess it depends. (Elena, non-AR)

Most other respondents gave a polar response (i.e. yes or no), indicating their reason behind their choices. Elena's uncertainty within the area is also demonstrated by various pictures from her photoset (see Fig. 3.19); unlike most other respondents, she takes many pictures that don't seem to be associated with the context of the tour route in any way (i.e. photos of advertisements, pigeons, a pile of corn husks, etc.). She diverges from taking pictures of POIs and takes seemingly random pictures within the tour area, indicating that she had trouble identifying features of the area that interested her. She divides her attention between a multitude of different features and characteristics in the area, not allowing her to make a judgemental assessment of anything.

Figure 3.19. This photo collage represents many of the seemingly randomly taken photos within Elena's photoset

Another non-AR respondent who shows disengagement with the tour area is Diana. When asked to describe her initial impressions of the tour, she responds:

> *It wasn't like a high emotional…whatever…It was different, coming from Etobicoke where stuff is kind of all the same. (Diana, non-AR)*

Her initial reaction lacks detail and specific references to locations along the tour route. Like Elena, Diana shows a neutrality and ambivalence towards the area. The only vague feature she is able to explicate is that the tour area is different than the suburb of Etobicoke in that there is more variation within the physical landscape. Later, when asked what she views as positive or negative in the area, Diana responds:

> *There's kind of like…there's really no positive or negative. There was just…neutral. (Diana, non-AR)*

Even after being prompted with probing questions several times more, Diana's response remained unchanged—she was not able to identify either positive or negative features of the tour area. Diana further demonstrates her uncertainty when she is asked if she would ever consider living in the tour area:

> *I don't think so. It's kind of far from what I'm used to, like where I usually know where to go and stuff. But, I guess if I was trying something totally different, I guess I would live here…but not really. (Diana, non-AR)*

Even in this response, Diana changes her answer twice until she finally determines that she would not prefer to live near the tour area because it is simply not what she is used to. Although this may seem like a negative assessment, it is more a testament to Diana's ambivalence, suggesting that she has not yet familiarized herself with the area. Diana noticed little detail, as indicated in her mental

map, and took few pictures; her level of awareness towards the area was too low, leaving her unable to create a polar assessment.

Elena and Diana, both non-AR, were the only respondents who were notably neutral or ambivalent in their opinions and assessments of the tour area. All the other respondents had no inhibitions in ascribing either a positive or negative assessments towards certain physical characteristics or the overall tour area.

It seems to be the case that passive facilitation from AR accelerates familiarization, allowing respondents in the AR group to be more likely to create polar assessments of the area or its characteristics when compared to the non-AR group who have no sort of facilitation and no internal cues.

3.5.4 Cognitive and Affective Developments

Cognitive (i.e. beliefs and perception) and affective (i.e. emotions and feelings) developments are not mutually exclusive; rather, they are two processes that inform one another through an ongoing discourse. In this section cognitive and affective developments will be examined together instead of being treated as separate entities. Although respondents only experienced one exposure to the area, Ishikawa and Montello (2006) posit that microgenesis in navigation occurs immediately from the start of a first exposure to an area; it is a continuous process that usually increases with multiple exposures over time. Since navigation is a critical component of wayfinding and thus, sense of place, similar principles apply to these concepts as well.

3.5.4.1 Levels of Interest and Curiosity

Respondents' levels of interest and curiosity of that area are derived from both cognitive (i.e. beliefs and perception) and affective (i.e. emotions and feelings) developments. Although

some of the non-AR respondents displayed notable interest for the area (mainly Aaron and Fernando), all the members of the AR group showed a general interest towards the tour area, the majority of them curious to explore it further.

In the non-AR group, Aaron demonstrates a notable interest for the tour area when he describes his initial feelings after walking the route and seeing its POIs:

> *I felt like I knew where had to go but also I kind of wanted to drop into some of these places…to see what they're like. (Aaron, non-AR)*

Aaron implies that although he was instructed to simply walk along the prescribed tour route, he was attracted to certain POIs and wanted to explore them further (i.e. actually explore inside the buildings).

Another non-AR respondent, Fernando, explains how the physical landscape of the tour area captured his interest:

> *I would say it makes you kind of experiment more. It further requires you to kind of, explore the area I guess. It makes you wonder about, "Oh yeah, what could that be? I don't know about it."...It's a new sense of exploration...because I didn't know about it before. But, after I've been through the area, I've gained new information. Somehow in the future it could be useful. Maybe I could go there and since I've been that place before it could be friendlier… [I would like to come back] to check out the church, inside...how it would look like…Next time I might just walk around this area to really explore the area to see what's here. (Fernando, non-AR)*

Fernando also expresses that he would like to explore POIs, namely the SJC, in more depth. He explains that the area elicits in him an impulse to explore further. The possibility of gaining new information about the area sustains Fernando's curiosity. He claims that when he returns to the area, he will take some time to explore it further. The rest of the non-AR group, Elena and Diana, were prone to neutrality and ambivalence in regards to their opinions and polar assessments of the

area (see section 3.5.3); as such, they did not provide any clear indications of curiosity or interest from their interviews. For instance, Diana demonstrates her lack of interest in the area when, after she is asked to choose a one-word descriptor for her experiences in the area, she responds:

> *Normal…Yeah, it was kind of just walking around—like I've never been around to this area so it was different… (Diana, non-AR)*

Although Diana has never been to the area before and finds it to be unfamiliar, she described the area as a normal, with everyday experiences; she found nothing of particular interest during her tour.

In comparison, respondents in the AR group were more likely to express curiosity and interest towards the area. For instance, when Breanna was asked when she would most likely see herself returning to the area she replies:

> *I think it would be more interesting to see what you notice after you don't have AR with you because then it's just walking through an area—you don't really notice as much…[I would most likely come back] if I [got] a job in the area or if I came here for sightseeing, maybe going further down into St. Lawrence Market. (Breanna, AR)*

Breanna explains that she would potentially return to the area for further sightseeing but if she were to do so, she would prefer to return without AR facilitation because she believes that this would alter her awareness; she posits that returning to the area without the AR would cause her to be less conscious of her surroundings. To recall, Breanna was the only AR respondent who included a high level of detail (i.e. declarative knowledge), thus it isn't surprising that she demonstrates an interest in the area.

Carl, an AR respondent who demonstrated little declarative knowledge, expressed a relatively high degree of curiosity and interest in the study area, similar to Breanna. When asked if and when he would return to the area to explore it further, Carl states:

> *Yes. Definitely…What most interested me was the architecture and the…little bit of history when [I read about it]…[I would return] just to further explore, maybe go beyond the boundaries of the area, maybe go read up a little bit more on the buildings. (Carl, AR)*

Carl indicates a clear interest in the tour area, stating that we would, without a doubt, return to the area to explore its features further. This is an interesting result since his photo and mental map data were not detailed. By the same token, Gabrielle was another AR respondent who, despite her lack of declarative knowledge and awareness during the tour, expressed a higher level of curiously and interest in the area. For example, when asked if she would ever return to the area on a date, she replies:

> *I think it might be really nice, especially like in the evening if there were lights up or something, it would be like a really nice place in Toronto to go…I think I'd [also return to] the St. Lawrence Market area…[If I wanted] to get something to eat or like, wanted to shop around for food, I would definitely come back here. (Gabrielle, AR)*

Gabrielle demonstrates an implicit curiosity and interest towards the area by expressing that she would return to the area in a social scenario. This suggests that Gabrielle, although she may not have been interested in all of the POIs, she was at least interested enough in some of the communal anchors (e.g. SLM), to merit a return to the area.

Harry, AR, was the only respondent who stated that he would not prefer to return to the study area. Compared with other respondents, both AR and non-AR, Harry's assessments of the

area very largely negative (see 3.5.2). However, even though Harry generally disliked the area, he stated that he might be interested to explore it further:

> *If I do [return] for the purpose of just reading about it, if I had somewhere to go and I was on this path and if I had the app with me, I'd definitely take a little bit more time and walk around a bit. (Harry, AR)*

Harry explains that if he were to pass through the area and had some time to spare, he would be interested in exploring the area further with the GeoTravel application. Although in this case Harry expresses curiosity and interest for further exploration, it could be misplaced—he may not be expressing genuine interest in the area itself, but rather at the novelty of using AR to facilitate his exploration.

3.5.4.2 Perceptions of Safety

Perceived safety is not only an important indicator of cognitive and affective developments but is also vital in determining a polar assessment in a new space (i.e. anchoring). All of the non-AR respondents found the area to be safe overall; many of them stated that they would even feel comfortable returning alone during the evening. For instance, Aaron, non-AR, stated that he felt generally safe in the area except when walking along the final route segment of the tour, going north on Church St. back to King St. When asked if he felt safe in the area during the tour, Aaron states:

> *That last stretch when I came back on Church, it starting to get a little bit sketchy…It was like, back alleys and things people were walking out of…and of course [a] guy yelling…[If I were to return] I would figure out some kind of route which I can pass [along] the best streets, right? [I would take] safe streets, but still I could get there as easily. (Aaron, non-AR)*

Aaron identifies this last route segment of the tour to be unlike the rest of the tour; he indicates that it is unsettling and if he were to travel through the area again, he would figure out a safe route to take, one that avoids any sort of potentially intimidating path. Diana, non-AR, also indicated that this route segment was unsettling to her; when asked if she felt safe in the area, Diana replies:

> *Yeah. There were a lot of people. I didn't see very many…homeless people…and there are a lot of business people walking around, so I felt kind of safe…The [last street] was kind of weird. It looked really old and I guess I wouldn't say it looked kind of sketchy, but there were other places that looked newer and like modern…so I felt more safe. I didn't really feel any discomfort…I saw garbage on the floor and you know, the back alleys were…I don't know, "There's something not right here," – kind of dirty (Diana, non-AR)*

Diana reveals that she felt generally safe in the area as well, mainly due to the amount of people, especially in the business area (i.e. near the start of the tour). However, even though she didn't feel in danger when walking along the final route segment, she indicates that she noticed something off-putting about that particular area, possibly the uncleanliness or the abundance of alleyways.

Respondents in the AR group also seemed to express results similar to the non-AR group; they all indicated impressions of personal overall safety but some excluded the final route segment from this appraisal. For instance, when asked if she felt safe during her tour, Gabrielle, AR, responds:

> *Yeah…everyone just looks so friendly and in the area, everyone was kind of chilled. I saw a lot of police officers in cars [too]…I think… [I felt less safe] walking down the last street—not that I felt unsafe, but here was more safe…There weren't many buildings or like, it was the back of buildings. (Gabrielle, AR)*

She indicates that she felt safe in the area, due to the generally friendly and relaxed nature of the people she encountered, also indicating that she felt less safe along the final route segments, failing

to specify why. Breanna, AR, expresses similar sentiments; when asked if she felt safe in the area, she replies:

> *[I felt safe] just because it's an upper class area and there's a lot of population nearby so if anything were to happen, its daylight, there's a lot of people around and it seems like a nice area to be in and not a lot of people would try to stab you outside a church, I'm pretty sure.…By the St. Lawrence Market, if I actually went down the street into the St. Lawrence Market, I probably wouldn't have felt as safe but I only passed by it so I felt relatively safe. (Breanna, AR)*

Breanna identifies the St. Lawrence Neighbourhood as a respectable, affluent area that left her with a general impression of safety. She also identified the SLM area as less safe, perhaps because it was a stark contrast from the route segments at the start of the tour (e.g. along King St.).

Somewhat of an anomaly in the AR group, Harry, indicates that he felt generally safe but he would have expected others to feel a lack of security in the area:

> *Personally I felt safe, but I could see that it was an area that some people probably wouldn't…I don't know if this is politically correct, but there are just a lot of homeless people. (Harry, AR)*

Although Harry felt personally safe, he imagined that others might have felt unsafe due to the amount of homeless people in the area perhaps due to a personal association of homeless people being dangerous. It is important to note that Harry is the only respondent to express an overall dislike of the area due to its perceived uncleanliness. Additionally, Harry was the only respondent who noticed any homeless people in the area while others (i.e. Breanna, Gabrielle) noted that they surprised not to have seen any homeless people within the St. Lawrence Neighbourhood.

3.5.4.3 Degree of Acceptance and Attachment

Creating an attachment to a place is vital in the development of sense of place; one cannot experience sense of place without feeling some degree of attachment and/or belonging to an area. Respondents in the non-AR group were more prone to feeling unwelcome or ignored during their tours. For instance, when asked if she felt welcome in the area, Diana, non-AR, replies:

> *No…everyone was kind of busy doing their own thing…Nobody was kind of looking at you or doing anything. I wouldn't say I was out of place, I kind of felt like I was more just…camouflaged or something. (Diana, non-AR)*

Diana states that she feels unwelcome during her tour, mostly due to being ignored by the other occupants of the area. She states that she felt as though she didn't receive any recognition from other occupants within the area, leaving her to feel "camouflaged", ignored by the masses. Elena, non-AR, stated that she didn't feel welcome or unwelcome in the area, only neutral but seemed to share Diana's impression of feeling ignored:

> *It seemed like—I don't mind if people smoke—but those people who did smoke were like…blank about it. They weren't considerate. I know some people really bothered by that. I kind of felt a blankness in the area. (Diana, non-AR)*

Aaron was the only respondent in the non-AR group who felt generally welcomed into the area; however, he did feel less welcome in certain parts of the study area:

> *I would say…[I felt less welcome] probably around…King [and Jarvis] and King up until, a little bit after Church, only because, I don't know…I only saw people trying to get where they are…they have work, like, they weren't pushing me out of the way, they were saying, "excuse me," and whatever. When I was crossing Church, some guy notice I had the map out and he acknowledged me in a kind voice or whatever [saying], "your map is getting wet." (Aaron, non-AR)*

Aaron explains that he felt more welcomed in the area starting at the second route segment (Jarvis St. and Church St.) because people in this area, described earlier as the more "cultural" area, were more welcoming and helpful (e.g. Aaron describes the person who offered to help him with directions). He contrasts this with the initial route segment (Yonge St. and King St.), which is described as more "commercial" or "business", as an area where people were preoccupied with their own business, inattentive to anything that did not concern them.

The AR group felt more accepted within the St. Lawrence Neighbourhood. For instance, Breanna discusses her general impressions of the area and the degree of acceptance she experienced:

> *[People in the area could tell] I was a bit lost or I was taking pictures and I was a tourist and [that] it doesn't really belong in this area. You can kind of tell but most people just ignored me…The people seemed nice once you got closer to St. Lawrence Market…it went from like snooty to more comfortable in a matter of minutes of walking…[But] I felt welcomed in a sense, especially by St. Lawrence Market, I felt more welcomed there. (Breanna, AR)*

Breanna described that the degree of acceptance she experienced changed along with the aforementioned contrast in study area; she felt less welcomed in the initial formal, commercial area and more welcomed in the less formal, more cultural area around SLM.

Carl, AR, shared a similar opinion regarding acceptance and belonging. When asked if he felt welcome in the area, Carl replies:

> *I think, yeah. After the business sector, I felt very welcomed. There are people…relaxing outside the church. St. Lawrence Market was just…I don't know—everybody looked pretty friendly… [I would] probably [return] to dine at the market or some of the restaurants I saw on the way. (Carl, AR)*

Carl's initial reply is one of uncertainty but he explicates upon his answer and states that he felt very welcome after the initial route segment, due to the overall relaxed nature of the area and the friendly demeanor of its occupants.

Gabrielle, AR, explains that she did not feel as though she was a part of the area since it was still very new to her but she also explained that she did feel welcomed. When asked to explain why, she responds:

> *I don't know, it wasn't like cold—it felt like it was a more community sense, like with the market there and all the people sitting on the patios, whatever...and like the food. It seemed more welcoming than just like...everyone busy, on their way. (Gabrielle, AR)*

Although Gabrielle does not overtly remark on the initial route segment, she implies that she prefers a part of the study area that she describes as existing along segments B, C, and D.

Harry is the only AR respondent to perceive an overall feeling of acceptance in the area. When asked if he felt welcome in the study area, he replies:

> *[I felt] a little bit unwelcomed then because not all the areas were particularly clean or well kept, especially like near the Occupy Movement (SJP)…[I felt more welcome] near the church, it was a lot cleaner. The grass was really well kept and nice. (Harry, AR)*

The two locations which Harry refers to are in close proximity to one another yet he creates a negative association of St. James Park and a positive association of the St. James Cathedral. Harry is unique is that he is the only respondent to create a negative association along route segment B.

3.6 The Role of Augmented Reality

It is evident that GeoTravel had some notable facilitative effects of navigation, wayfinding, and thus, the microgenetic developments of place, as can be observed from the respondents' data. It is important to note that the non-AR respondents were given a demonstration of the GeoTravel app before their tour experiences to allow them to be asked questions and to give evaluations regarding AR facilitation and GeoTravel. Any observation from non-AR respondents regarding GeoTravel is suppositional since they had not used the technology during their tour experiences. In light of this information, all but one respondent (Fernando, non-AR) in this study perceived AR to be a useful and cognitively ergonomic mode of computing when experiencing new and unfamiliar environments.

3.6.1 Benefits of GeoTravel

All participants in the study indicated that the use of AR had (or, in the case of the non-AR group, would have) facilitated their tour experiences. When Breanna, AR, was asked if she could have managed the tour route without the use of AR, she replies:

> *Yes, but I wouldn't have known more of the area…Like I said, I pulled up the Wikipedia app, learned a bit about the church, learned a bit about…The Albany Club, for instance, I learned a lot about the King James Hotel and stuff like that…There's no way I could've went up to anyone at the King James Hotel and said, "Oh hey! When was this established?"…I think [that the amount of information presented] was perfect because—based on Wikipedia, I could've just went through the article as much as I wanted. I could just read the little preface or I could go down to the section and go "History" or "Architecture" and find out more. (Breanna, AR)*

Breanna points out that the her use of GeoTravel increased her spatial awareness , mostly due to the passive collection of internal knowledge that helped her identify POIs that she would not have noticed if she had not been facilitated. She also mentions that information provided by the app was

accessible based on her own motivations; she was able discover more about each POIs to the capacity of her interests.

Gabrielle, AR, also points out the benefits she experienced from using the GeoTravel application:

> *It helped me to see the different buildings and read up on them. That was really cool, that you could read up on them. That was probably my favourite feature because not only do you get to see it but—there was one buildings that I thought was really cool, I took a picture of it but I didn't know what it was so now I know the name and everything. (Gabrielle, AR)*

Like Breanna, Gabrielle describes GeoTravel to be an application that increases spatial awareness through the passive collection of internal knowledge. Gabrielle confirms this when asked if she would have been less aware of the area if she had not used the application:

> *I don't know, it just made me feel like even when I was walking there were buildings I was passing that I didn't even pay attention to but then all of a sudden—for example, the courthouse one—I was like, "Oh, all of a sudden there's a courthouse here," so then I kind of read up a little on it and that was cool. But I would never have noticed it. (Gabrielle, AR)*

She describes an instance in which she would not have noticed a specific POI had it not been for the AR marker provided by GeoTravel.

In another example, Harry, AR, was also asked if he would have been just as familiar with the area if he had not used the GeoTravel application:

> *No, because when I saw the points-of-interest, I could not pull up the article. For one of the [POIs], it showed something about the Great Toronto Fire which I wouldn't have known was even there, so I could read up on the article; same with like, the St. James Church and stuff. When you're walking by that you see it's old but that's the only impression you'd get, whereas if you look at the app you'd see this year was for this type of thing...it's a lot more information readily and quickly*

> *available, right when you want it as opposed to trying to say, "I'm going to go home later and look it up." (Harry, AR)*

Harry also agrees that the application increased his familiarity with the area. Harry states:

> *[My knowledge of the tour area] definitely would not have been as high [without AR]…because the app gave direct links to Wikipedia to learn about it on the spot. As opposed to trying to read face plates everywhere, like historical plates and things. (Harry, AR)*

Harry believed that AR facilitation in his case was beneficial because it provided a substantial amount of information about specific POIs in an interactive and accessible manner, much faster and more efficiently than would occur in a non-facilitated context.

The responses of the non-AR group were almost identical to the AR group in terms of evaluating the usefulness of AR. For instance, when Diana, non-AR, is asked if she thought AR would make her tour experience easier:

> *Probably because I didn't really know what all the buildings were and it would show me what [each building] was and a brief history if I wanted to know about it, so I was kind of more confused I guess, not knowing where I was and what the buildings were. (Diana, non-AR)*

Diana expresses that she probably would not have been as confused as she was in the area if she had used GeoTravel because she believed that it would allow her to identify buildings more easily and learn about them in depth, allowing her to get a better sense of the area.

When asked if she thought the use of AR would have changed her tour experience, Elena, non-AR, replies:

> *Having a camera did so [AR] probably would change my experience…I would remember maybe more things. I think I'm a big visual person so…probably...just like more details. (Elena, non-AR)*

Elena expects that AR would facilitate in her attention and retention of external cues, specifically visual perceptions. As with a camera, Elena expects that GeoTravel would allow her to become aware of more details within the area.

Breanna, AR, felt that AR increased awareness and even appreciation in an environment. When asked if she would have been able to navigate the area without AR, she replies:

> *I would've been able to navigate it just fine but "navigate" is getting around, not exactly appreciating your environment… (Breanna, AR)*

Breanna believes that the role of GeoTravel hadn't been to help with directional or navigational cues; instead, it had helped her become more aware and perceptive of her surroundings.

There are other benefits of AR beyond increasing awareness, facilitating exploration, and making the overall tour experience convenient. Some respondents found a sense of reassurance from using GeoTravel. The following dialogue with Gabrielle, AR, reveals that using the application was reassuring to her:

> ***Int***.: *Did you feel at any time nervous during the tour?*
>
> ***Gab***.: *Nervous? At the beginning, a little…I always get lost…*
>
> ***Int***.: *Was that the only thing that made you nervous?*
>
> ***Gab***.: *Yeah.*
>
> ***Int***.: *What would've made you more comfortable?*
>
> ***Gab***.: *Probably to have someone with me.*
>
> ***Int***.: *What if you didn't have a map or if you didn't have the AR, would you be even*

more nervous?

***Gab**.: Yeah, definitely.*

Gabrielle expresses that both the map of the tour route provided to her and the GeoTravel application reassured her along her tour experience. Aaron, AR, also expressed a similar perception of reassurance from the application that was discussed earlier; he felt that GeoTravel allowed him to achieve a better sense of orientation in the area, possibly enabling him to avoid undesirable areas or determine different paths leading to a destination.

The respondents also expressed that fact that the use of AR increased their capacity for curiosity—it made them want to discover the area in more detail. The following dialogue with Carl, AR, demonstrates the role AR played in determining his capacity for curiosity:

***Int**.: If you could pick one word to describe how you felt during the tour, how to describe your feelings during the tour, what would it be?*

***Car**.: Does curious work? Curious.*

***Int**.: Do you think the technology had anything to do with that? The AR?*

***Car**.: Yeah, I think it did. After reading about the first building, then I was curious just to see what it had to say about the other ones.*

***Int**.: So you really appreciated the unique, sort of, historical buildings that the area had to offer. Would you ever return to this area?*

***Car**.: Yes. Definitely.*

***Int**.: Why?*

***Car**.: Just to further explore, maybe go beyond the boundaries of the area, and maybe go read up a little bit more on the buildings.*

Carl is interested in exploring the area further, specifically learning more about certain POIs by reading about them in the articles provided by the app. It is difficult to say if the novelty is generated by genuine curiosity or simply the novelty of using AR in the form of a tour guide.

Harry, AR, also expresses a curiosity founded upon the use of AR in the following dialogue:

> ***Int***.: *How much did you actually read? Did you read about each point-of-interest that stood out to your or did you kind of just pick a few of them?*
>
> ***Har***.: *I think I read up on like four or five.*
>
> ***Int***.: *So why would you choose to [return with] the app instead of just using your senses.*
>
> ***Har***.: *Probably because it would be on a very convenient medium…so it's easy to access, so it's not a problem...it doesn't limit you. The other side of it is like, you could use it to learn more about stuff, like if you see a point-of-interest, as opposed to not being able to identify it.*

Harry expresses that he would return to explore the area further with GeoTravel because it was generally convenient and that with it, one would be able to learn more about any POI that caught their attention.

3.6.2 Limitations of GeoTravel

Fernando, non-AR, was the only respondent of all who participated who thought that the use of AR in initial exposures to unfamiliar areas would be detrimental. Fernando gives an evolution of AR in the following dialogue with the interviewer:

Int.: *Do you think your journey would have been made easier if you had used augmented reality technology?*

Fer.: *Without [AR] it would have been easier. I feel like…if you depend on the app, you're not quite appreciating what's around the surroundings…Secondly, it is easier to remember in a sense because the second time you visit, you will be more sure…you will remember things, right?*

Int.: *Ok, do you mean without the app you would remember more things but with the app you would remember fewer things in more detail?*

Fer.: *Yeah… about that specific place like…what that place is about. It would be more general if you don't use the apps because you would have broader perspective.*

Int.: *So what do you think is better on a first walkthrough of the area? Do you think it's better to use the app or not?*

Fer.: *Well, because I haven't used the app, I can't really say how it feels like to be using it…but, I feel like…if you want to explore the specific location, using the app would be better but if you just want to kind of generalize the surrounding environment then not using the app would probably be better. It's kind of like how we use map vision to find places, right? If you go a second time you won't really remember because you were dependent on the app. So, in a sense, really I think people are losing their sense of direction in terms of where they want to go so they feel that they can't go by themselves. Like if you drive alone, then you might get lost between places.*

Fernando believes that using AR to facilitate a first exposure in an area is detrimental in two ways. According to his assessment, the use of AR allows a user to be generally less aware of his/her surrounding environment but deceivingly hides this fact with the passive provision of information that is POI-specific. Fernando suggests that this allows for increased familiarity with certain POIs but not a general area. Secondly, Fernando suggests that the use of AR during a first exposure in an unfamiliar space may be cognitively debilitating since the user will become largely dependent on the technology in the observation and retention of spatial data. If the user were to return to the area after an initial exposure facilitated by AR, Fernando believes that they would view the area as mostly foreign, being prone to losing their direction.

Another important detriment of AR was its level of social acceptability in everyday use. From the AR group, Breanna and Harry both noted that the use of AR on the iPhone is a somewhat awkward experience. For instance, Breanna, comments:

> *I got a couple of strange looks from business people, going around with a phone, trying to look only off my phone. (Breanna, AR)*

Harry expresses a similar view:

> *I had more feeling of humour because everyone was kind of looking at me walking by with a cell phone in my face. So I wasn't really nervous, I was actually kind of laughing because people were probably wondering, "What the hell is this kid doing?" (Harry, AR)*

Harry admits that he felt awkward using the AR in the area due to stigmatization from the local public, however he claims that it didn't bother him.

Aside from Fernando's opinion of GeoTravel, the social stigma that might be attached being overly reliant upon technological facilitation, the awkwardness of navigating the physical realm

through the use of an AR lens, and the sporadic technical problems experienced with GeoTravel, AR was, overall, deemed to be beneficial. Not only did it increase curiosity and interest, it provided some respondents with a perceived confidence and sense of safety in the area. Many of those who had used the application stated that they would prefer to return back to the area with it and the non-AR group, who had not used it, mostly said it would have proven useful during their initial exposure to the St. Lawrence Neighbourhood.

Chapter Four

Discussion and Conclusion

The purpose of this chapter is to recapitulate, discuss, and interpret the data collected by the AR and non-AR groups in a manner that addresses the four primary research objectives of this study, set forward in section 1.2. Above all, this chapter will present the fundamental differences between each experimental condition, determining whether or not, and to what degree, AR affected the development of the experiences of the respondents within each group. Additionally, this chapter will address the study's substantive, theoretical, and methodological contributions while also outlining possible limitations. Directions for future research will be suggested in the penultimate section. The chapter will conclude with an overview of expected developments for AR in the near future, discussing how these developments will potentially change the experience of AR facilitation in real-world scenarios.

4.1 Spatial Knowledge

4.1.1 Developments in Wayfinding

When experiencing the St. Lawrence Neighbourhood for the first time, the AR and non-AR group displayed notable differences in terms of their developments of the four principal types of spatial knowledge outlined by Golledge (1992) (i.e. declarative, procedural, configurational, and place knowledge). It is important to note that, due to the phenomenological design and the experimental nature of this study, the interpretations of these results are based solely on qualitative data and thus do not bear any statistical significance; the results of this research are exploratory and not confirmatory.

Regarding declarative knowledge developments, the data collected suggests that although the non-AR group was able to inventory and memorize minor points of interest (POIs) (i.e.

commercial buildings, restaurants, etc.), they demonstrated a lower capacity to correctly inventory and memorize the communal anchors of the area. Most non-AR respondents were able to identify at least some of the communal anchors within the tour area but failed to correctly label and, in some cases, situate them on their mental maps.

Two non-AR respondents, Elena and Aaron, who displayed the highest capacity for declarative knowledge in their group, were able to provide a detailed inventory of some of the area's minor POIs on their mental maps but both failed to inventory the communal anchors in the area. Although it would seem that the duration of time spend exploring the tour area would be associated with an increased demonstrated capacity of declarative knowledge, this did not appear to be the case. For instance, Elena and Aaron spent more time exploring the tour area than the other respondents in their group (Elena and Aaron spent 28 minutes and 32 minutes, respectively; the average exploration time for the non-AR group were was 27.75 minutes) and both were able to create fairly detailed and accurate mental maps. However, Fernando, who spent 35 minutes in the tour area, more than anyone else in the non-AR group, demonstrated an inability to correctly denote the key organizational elements of the area onto his mental map. Although the explanation to this anomaly is not certain, it is possible that the non-AR group's increased development of declarative knowledge may have been caused by the ways they utilized the cameras provided to them. Before their tours, each non-AR respondent was informed to use a camera simply to digitally document and archive which features/characteristics in the area they deemed salient. One non-AR respondent, Elena, revealed during her interviews that she perceived the camera as a visual aid, to help her memorize certain POIs. This supposition is reflected in Elena's photoset, the largest from her group, taking 27 photos compared with the non-AR photoset average of 16.25 photos. Aaron, although never explicitly mentioning his use of the camera as a form of visual facilitation, also produced a

photoset comparable to Elena's, suggesting that the use of cameras might have influenced various wayfinding developments.

In comparison to the active exploration of the non-AR group, the AR respondents passively explored the area under the guidance of GeoTravel which caused their attention to be focused mostly on the POIs highlighted by the application. Although the AR group's knowledge of the area did not match the breadth of the non-AR group, they had a more specific, in-depth knowledge of certain POIs in the area, namely the communal anchors. During their tours, members of the AR group, like the non-AR group, were able to utilize their senses. Both groups noticed most of the area's communal anchors likely due to their undisputable presence in the area, defined by the characteristics and features of each of these POIs. Where the AR group diverged from the non-AR group was in their ability to be exposed to certain POIs once again via the internal cues provided through GeoTravel. AR respondents utilized their facilitation to further inquire and learn about POIs, primarily communal anchors, essentially providing the AR group with a second exposure to these types of POIs and not the minor ones. Consequently, AR respondents demonstrated a higher capacity to inventory and memorize the communal anchors but showed an obvious inattention to the minor POIs in the area. From the AR group only Breanna was able to create a detailed mental map that includes communal anchors in addition to various minor POIs. Breanna's deviation from the rest of the AR group's results was due a discrepancy in the way she utilized AR compared with her peers. Breanna's photoset contained 27 photos while the average photoset in her group only contained an average of 10.25 photos. Additionally, many of the POIs that were the subjects of her photos were not aligned with the AR marker provided by GeoTravel. For example, one of Breanna's screen captures indicates an AR marker titled "Consumer's Gas Building" while the subject of the photo was the St. Lawrence Market, suggesting that she did not adhere to the information overlays provided by the application, utilizing the app more as a camera than as a AR

tour guide; the way she utilized the application was more closely related to the way the non-AR respondents utilized the cameras provided to them, likely developing their acute capacities for declarative knowledge. Unlike the rest of the AR group, Breanna did not allow her tour to be solely dictated by AR facilitation, allowing her to acutely develop her declarative knowledge of the tour area.

It appears that when used as intended, the use of AR promotes a partitioned understanding of the tour area, allowing users to learn about communal anchors or major POIs in detail while drawing attention away from other components of the environment. These results are in accordance with a study by Willis et al. (2009), who compare the developments in spatial knowledge between respondents who use traditional paper maps and those who use mobile maps (i.e. using digital maps viewed on a mobile device such as a GPS or smart phone). Their findings suggest that with the use of mobile maps, users develop a fragmented understanding of an environment. Mobile map users focused on creating strong associations between various closely clustered POIs within an area which led to a piecemeal cognitive representation rather than a fuller representation of an environment in its entirety. Although, according to Golledge's (1978) anchor-point theory, POIs and the associations created between them lay the groundwork for cognitive developments within an area, including spatial knowledge developments, they do not provide a complete representation of the area. Compared with the non-AR group, the AR group (save for Breanna) developed a piecemeal comprehension of the tour area based on communal anchors, due to the specific informational cues provided by GeoTravel. In contrast, the non-AR group was able to create a more static, in-depth representation of the area, allowing them to inventory and memorize a larger volume of POIs in less detail.

In terms of procedural knowledge, non-AR respondents displayed an inability to link together pieces of information gathered from the physical environment of the tour route into

hierarchically ordered strings. The non-AR group was also generally unable to create associations between POIs, path segments, and within the overall tour area. This is demonstrated by the convolution, simplification, and confusion in the representations of route segments and other cartographic features seen in their mental maps. Non-AR respondents like Diana and Fernando, who mislabeled and wrongly positioned route segments, produced disoriented and inaccurate maps. Even Aaron, a non-AR respondent who correctly denotes the basic skeletal route structure of the tour area, its four main intersection, and various other streets, fails to indicate the correct location of St. Lawrence Market (SLM) even though his photoset indicates that he spent some time focusing on that POI (i.e. he took multiple pictures of the SLM). In comparison, the AR group displayed more structurally accurate, albeit less detailed mental maps. Carl exemplified the AR group with his simplistic mental map, which accurately detailed the skeletal structure of the tour area. The mental maps of the AR group were uniform in orientation; unlike the maps created by the non-AR group, they adhered to the forward-up equivalence principle (Darken and Sibert, 1996). Additionally, the AR group included the correct route structure, route shape, and all of the area's communal anchors (save for Harry who did not denote SLM). A study by Willis et al. (2009) found users of mobile maps based (which utilized a VR platform) demonstrated a comparatively poorer development of procedural knowledge than traditional map users, specifically in orientation and distance estimation tasks. This was mainly due to the fact that the mobile map users in their study passively embraced and interacted with their surrounding environments, relying on the maps to provide information about positionality. The mobile maps users received a flow of fragmented information which did not allow them to create a single, static representation of an environment. In addition to this, Willis et al. found that the fragmentation of attention mobile maps users experienced affected their memory by dividing attention between their mobile devices and the surrounding environment, affecting their development of procedural knowledge. Although Willis et al. suggest that the use of

a mobile device as a facilitator creates a different procedural understanding of an area, the respondents in their study utilized a mobile device based on a platform of VR and not AR, two modes of computing that are inherently different. In this study, although the AR group arguably created a piecemeal representation of the St. Lawrence Neighbourhood, they consistently and accurately demonstrated a high capacity for procedural knowledge compared with the non-AR group, a result which is at odds with the findings of Willis et al. This is likely due to the fact that while being provided with an intermittent flow of virtual information which also included navigational cues, the AR user was also able to see the real world around them, in real time. In terms of procedural knowledge, the GeoTravel application acted as a kind of extension of the senses that allowed the AR respondents to be able to survey the area through GeoTravel while also naturally exploring it, an advantage that the non-AR group did not possess.

Configurational knowledge, somewhat related to procedural knowledge, involves the ability to create relationships between nodes within an area; it differs from procedural knowledge due to the fact that these ties are founded upon a deeper understanding of the area and its POIs and not simply physical characteristics. In the case of configurational knowledge, the non-AR group surpassed the performance of the AR group and was generally able to create more organic relationships between POIs which were based upon a developed understanding and not simply a linear, procedural understanding. Elena and Fernando provide an accurate representation of the non-AR group's capacity for configurational knowledge, demonstrating a more advanced familiarity and understanding of the area. For instance, Elena, when drawing her mental map, was able to create relationships between commercial POIs based on their names and the products they sold and not simply the order in which she encountered them. Additionally, Fernando also made it clear that, when carrying out his tour, he had to consciously adapt himself to the area in an attempt to familiarize himself with it. In comparison, the AR group demonstrates a more passive approach

to the development of configurational knowledge, relying largely on GeoTravel to guide them towards salient POIs. Gaunet et al. (2001) outline two cognitive strategies that are used when creating a cognitive representation of an area: the continuous updating of path integration during exploration or from a synthesis based on configurational knowledge after the exploration has ceased (Golledge et al., 1995; Gaunet et al., 2001). The AR group seems to utilize the former, creating a piecemeal cognitive representation of the area compared to the fuller representation demonstrated by the non-AR group. As such, the AR group expresses difficulty creating associations between and relative to places that exist along the tour route (Golledge, 1995).

With regard to developments of place knowledge, there seem to be no discernable differences between the two respondent groups in terms of the quality of being able to list socially and physically derived environmental attributes and features that existed within the tour area. Both respondent groups seemed to have fairly detailed notions of attributes within the area, evidence of the fact that the use of AR as a facilitator created no advantage towards the development of place knowledge. During their tours, both respondent groups were exposed to their environments in actuality (i.e. reality as opposed to a virtual simulation), thus their capacities of place knowledge are relatively equal. Additionally, both groups produced respondents who demonstrated both high and low capacities of place knowledge, suggesting that individual-level factors influenced the development of this type of spatial knowledge rather than the mode of facilitation. For instance, a study by Golledge et al. (1995) suggests that those who had had previous training in understanding spatial relations (e.g. geographers, surveyors, etc.) perform better in both navigation and wayfinding tasks. The study also goes on to suggest that "women do very well in understanding spatial relations when they have had geographic training and very poorly when they have not" (Golledge et al., 1995). Comprehension of spatial relations could be one explanation for the discrepancies that exist between place knowledge developments in respondents. For instance, Aaron, was able to

accurately estimate the total length of the tour route in meters, while other respondents such as Diana, had difficulty conceptualizing and envisioning distance, evidenced by her tour distance estimation of 100 meters (in reality the tour distance was 935 meters). Even though the quality of place knowledge between the groups was consistent, the volume of attributes and features mentioned by the non-AR group was greater—this was likely due to their increased capacity of declarative knowledge.

Overall, the non-AR group's experience was largely egocentric due to the fact that the respondents had complete freedom when choosing which POIs and attributes in the area they deemed salient. The AR group, although also having freedom to choose salient features within the area, was to a large degree influenced by the suggestions provided by GeoTravel, as can be seen in the aforementioned discrepancies between spatial knowledge development comparisons. A commonality shared between the respondent groups is that they were both able to experience the St. Lawrence Neighbourhood using all of their senses, something that would only be limitedly possible if VR facilitation had been used instead. AR respondents shared a similar tour experience as the non-AR group, save for the fact that they had accessibility to internal knowledge cues and minor navigational cues, however these differences created notable differences between their wayfinding developments.

A vital difference that existed between the tour experiences of the AR and non-AR groups was the provision of internal (i.e. learned experience, beyond sensory awareness) and external (i.e. sensate experience) spatial cues. Since the AR group used the GeoTravel application during their tours, they were provided with virtual information overlays, which acted as internal cues. In addition to this, they also experienced external cues using their senses. In comparison, the non-AR groups, utilizing only their senses, only had access to external cues from the surrounding environment. AR learning, somewhat similar to map-based learning, requires a synthesis of

knowledge from both one's surrounding environment and any information acquired from facilitation. In contrast, route-based learning, the type experienced by the non-AR group, requires full sensory exploration complied from the exploration of an environment and the integration of "knowledge gained from each path [within a route] into a web of environmental understanding" (Golledge et al., 1995). Regarding sensory information, the AR group was aware of mainly visual cues in some detail, while members of the non-AR group experienced, in detail, visual, olfactory, and auditory cues. Although this is not surprising due to the AR group's division of attention, focusing partly on the mobile application held in front of them and partly on their surrounding environment, it is surprising that the AR respondents were able to delineate various types of contrasts that existed within the St. Lawrence Neighborhood (e.g. business versus cultural, formal versus relaxed, etc.) while the non-AR group was only able to identify one (the duality of old versus new). This was not an expected finding since the AR group's cognitive representation was more fragmented and piecemeal compared to the fuller, more general representation that the non-AR respondents had developed. This result suggests that developing a piecemeal understanding of the area allowed users to be able to delineate the various regions that exist within that area. Since the communal anchors of the area are dispersed relatively evenly throughout the area, one existing along each route segment, it is likely that the AR group was able to regionalize the tour area based on the internal cues that they received from their facilitation.

4.1.2 Configurations of Exploration: Active vs. Passive

Many of the differences in spatial knowledge developments between the non-AR and AR respondents are likely explained by the different configurations of exploration they utilized during their tours, namely the differences in passive and active spatial exploration. A seminal study by Appleyard (1970) found that sketch maps of an urban area were more accurate when produced by

people who frequently drove their own cars through a city (i.e. those who actively explore the area) rather than those who rode on a bus through the same city (i.e. those who passively explored the area), suggesting that active knowledge development within an area leads to more acute developments in spatial knowledge (Gaunet et al., 2001). The results gathered from the AR and non-AR groups are at odds with Appleyard's conclusion—although the non-AR group surpassed the AR group in terms of the number of POIs inventoried and memorized, they performed more poorly in their demonstrations of procedural knowledge. This suggests that perhaps the AR experience is a hybrid combination of active and passive exploration, passive when intermittently receiving, interpreting, and processing informational cues and active at all other times (i.e. when not looking through the AR lens).

4.2 Social Representation and Development of Meaning

Due to the differences in the developments of social representation between the two respondent groups, that data suggests that facilitation AR may have altered, to some degree, respondents' development of meaning within the tour area and thus, their individual microgenetic developments of place. Using Moscovoci's (2001) framework, the data suggests that the AR group was more receptive to the process of anchoring (i.e. comparing something foreign to an individually determined paradigm category, essentially making unfamiliar elements of an environment familiar). Overall, the AR group was more easily able to create either a positive or negative valuation of unfamiliar components of the tour area. Although both groups were able to create paradigm-category comparisons based on individual level factors (i.e. their backgrounds and previous dispositions), the AR group had the advantage of being additionally informed by the intermittent prompts (i.e. internal cues) provided by GeoTravel while the non-AR group had to rely only on their senses, exclusively receiving external cues. It is likely that the internal cues provided by

GeoTravel may have had some bearing on the determination of polar assessment type (i.e. positive vs. negative); it was interesting to observe that overall, the AR group was able to create a polar assessment of parts of the tour area while the non-AR group was more likely to create a neutral or ambivalent assessment of the area and its components. Gale et al. (1990) argue that the development of spatial cognition requires a filtration process of sorts, suggesting that "a broad range of information is selectively filtered so not all...information reaches long term memory to be included in the knowledge base of any person...significance is attached to some items while others are discarded after cursory examination". As stated earlier, the use of AR as a facilitator in new and unfamiliar spaces provides various layers of exposure which are:

a) Sensory Interaction—both AR and non-AR respondents were able to freely utilize their senses when exploring the St. Lawrence Neighbourhood. Although AR respondents demonstrated a lower capacity of declarative knowledge and consequently aware of a lower amount of the area's attributes and features (via place knowledge), likely due to the division of attention created by the AR facilitation they utilized, they were still able to cognitively process and evaluate these cues to create a social representation of the area.

b) Spatial awareness—unlike the non-AR group, the AR group had the advantage of navigational cues provided by the compass and mini-map in the screen of the GeoTravel application, distance prompts (measures in meters) from user to selected POI (measured in meters), directional cues in the form of an arrow pointing to any selected POI (when the iPhone was held parallel to the ground), and the name of the street being occupied by the user.

c) Internal Cues—perhaps the greatest advantage of the AR group in terms of determining a social representation of the St. Lawrence Area was the fact that they had instant and interactive access to a flow of information about any POI in their proximity.

A combination of these three levels of exposure likely allowed the AR group to create a more definitive and clear social representation of the area. Consequently, with a single layer of exposure, the non-AR respondents were more likely to be unable to create an assessment of the area, maintaining an ambivalent or neutral stance.

4.2.1 Cognitive and Affective Developments

Cognitive (i.e. beliefs and perceptions) and affective (i.e. emotions and feelings) developments were evaluated based on a close analysis of interview responses. Overall these developments were reflective of much of the wayfinding progress mentioned in the previous sections. Three primary categories of respondents' cognitive and affective developments arose from the interview data: levels of interest and curiosity, perceptions of safety, and degree of attachment to the area.

Regarding respondents' levels of interest and curiosity, members of the non-AR group were found to be less curious about the St. Lawrence Neighbourhood, some of them ambivalent or neutral (like Elena and Diana). The non-AR respondents who showed a genuine interest in the area weren't specific about which POIs or locations piqued their curiosity, they simply claimed that they found the general area of the tour interesting. In comparison, all AR members, regardless of their polar assessments of the area, stated they would be interested to explore further, most of them stating specifically which POI they would like to explore further or which region of the tour area they would like to see more of. At this point there is uncertainty as to whether the use of an AR

facilitator genuinely increases learner motivation; there is the possibility that the use of a novel technology such as AR may generate a false interest in which the learner would be more intrigued by using the technology itself rather than actually learning or wanting to explore certain POIs.

Regarding respondents' perceptions of safety, all of the respondents felt generally safe in the area however, many non-AR respondents noted that they would have felt more at ease exploring the area if they had used the GeoTravel application. Everyone felt generally safe in the area however, most respondents noted that they found route segment E (Church St.) to be unsettling due to the lack of people walking in that area and due to the fact that they did not identify that route segment as clean or as inviting as other parts of the neighborhood. While the idea of using a mobile form of facilitation such as AR seems to be a reassuring thought for most of the participants, it is uncertain to what extent AR facilitation influences a user's confidence in exploring an unfamiliar environment.

Interestingly, in terms of degree of acceptance or belonging, the AR respondents generally experienced a higher degree of acceptance within the St. Lawrence Neighbourhood than the non-AR respondents. Non-AR respondents described their experience of attachment as more removed from the area, using adjectives such as "camouflaged", "ignored", and "blank". Aaron was the only non-AR member who felt generally welcome in the area, more so in the later route segments (e.g. near the SLM) than near the initial stages of the tour (e.g. near Yonge St. and King St.). Most of the respondents in the AR group shared Aaron's experience—they felt generally accepted within the tour area, focusing mostly on the region of closest proximity to the SLM, highlighting its sense of community, relaxed atmosphere, sense of culture, and cleanliness.

4.3 Evaluation of AR Facilitation in Unfamiliar Spaces

Evaluating cognitively ergonomic wayfinding and navigational aids are the topics of recent wayfinding research (Li, 2010). In the case of this study, the differences respondents in each group experienced, in terms of wayfinding and the development of social representation merit the fact that the AR application, GeoTravel, did in fact affect the AR group's spatial and social developments within the area.

Before their tours, each respondent, both AR and non-AR, was given a live demonstration of GeoTravel, enough to understand the extent of its facilitative capacity. Interestingly, all but one respondent interviewed after their tour experiences believed that AR was/would have been a valuable asset to have with them during their first exposure to the St. Lawrence Neighbourhood. However, since the AR respondents were the only ones who utilized GeoTravel in the tour area, their experiences are vital to understanding whether or not AR, in its present form, is cognitively ergonomic insofar as a facilitator of navigation, wayfinding, and thus, the microgenesis of place. Interestingly, most non-AR respondents perceived AR facilitation to be invaluable when exploring a new space for the first time, believing that GeoTravel provided an increased capacity for users to locate themselves within space and a passive stream of information that allowed them to easily navigate and create a better and more accurate cognitive representation of the tour area.

After being introduced to the application and having a chance to use it for the duration of their tours, the AR group deemed GeoTravel invaluable due to both the navigational data and internal cues it provided about POIs. One respondent even went so far as to say that without the use of GeoTravel, she would not have been able to truly experience the area. Others in the AR group embraced the internal cues provided by the application, reading about some POIs (mainly communal anchors), learning about their origins and their history, which, according to the respondents, gave them a better understanding of not only the features and attributes of the area, but the overall neighbourhood itself. AR respondents expressed that they would not have noticed some

of the POIs in the area, had it not been for the AR markers on the screen, indicating all proximate POIs to the user.

Although the AR group had various advantages when utilizing GeoTravel, the non-AR group also boasted advantages, based on their egocentric and fully sensate experiences; both groups experienced errors which manifested themselves in the forms of inventorying and memorization, visual recollection, orientation, and recreation of perspective (Golledge et al., 1995). The major advantage of the non-AR group was that their attention was focused solely on the task of exploration—it was not divided. In contrast, the AR respondents' attention was constantly being divided between their mobile devices and the environment around them. A study by Willis et al. (2009) found that mobile map user's developed conflicts of interest between "the attention paid to the features of the real environment and the interface". Rather than becoming a background process, the users of mobile maps became distracted by the devices facilitating them. These findings are consistent with those from the AR group in this study who had to consistently divide their attention between a sensate exploration of the tour area and managing the information provided by the AR interface.

4.4 Research Contributions

This thesis has made several contributions to existing literature. Substantively, it is the first study to attempt to observe the effects of AR computing on human interactions with space and place from an essentialist perspective, utilizing a constructivist framework. Furthermore, this research attempts to begin to understand the construction of sense of place at its microgenetic stages, a topic that is not only absent in AR and VR literature but in much of sense of place literature in general. Results also suggest that AR facilitation is perhaps more efficient and effective than VR computing in terms of spatial facilitation and wayfinding developments. However, in the current form studied

(i.e. the GeoTravel application), AR comes also with many disadvantages. Nevertheless, the guiding principle of AR, augmentation, inherently changes the way users are provided with information, apparently changing their experiences with space and place.

Theoretically, this study adapts Moscovici's (2001) concept of social representation with references to wayfinding and sense of place literature, in an effort to explain, at a microgenetic level, how the use of AR facilitation affects the development of sense when people are experiencing new and unfamiliar environments. The study attempts to better understand that sense of place exists on a continuum and that even at its microgenetic level, it is a highly complex and subjective process, one that can be influenced and manipulated based on configurations of exploration or types of facilitations used.

Methodologically, this study contributes to existing AR research by addressing the effects of AR on human spatial interactions under the guidance of transcendental phenomenology. The qualitative methods utilized in this study allow for a deeper understanding of the essence of each respondent's microgenesis of place experience, based upon their wayfinding developments, one that would not be attainable by solely utilizing quantitative methods. Utilizing phenomenology and triangulating between the various interpretable data sources used in this study, while maintaining rigour and reflexivity, have led to a more accurate and authentic conceptualization of the essence of each individual respondents exploration experience, aggregating them to represent the AR and non-AR groups.

4.5 The Future Horizons of Augmented Reality

As mentioned in the introductory chapter, AR technology, although it has existed for well over a decade, is still in its infancy. In many ways, the nascent state of AR was a major reason why AR was chosen as a subject of interest in this study. It is without a doubt that AR is the next

generation of modes of computing, one that will continue to develop and change the way we see and experience the world (Feiner, 2002). GeoTravel, the iPhone application used as an AR lens in this study is an example of an early generation of AR computing and, like many of its kind, has several drawbacks existing in the applications interface, limitations in the hardware, and how the application's encoding utilizes the hardware in the iPhone. A current major disadvantage of GeoTravel on the iPhone is that it greatly limits a user's field of vision when "looking through" the AR views. Additionally, few commercially available devices are dedicated or designed solely to operate on an AR platform. This means that the current generation of mobile devices, the iPhone for instance, do not support AR applications to their fullest potential. Some of the AR respondents in this study indicated that the AR markers did not immediately align overtop of the POI in actuality or if they did align, the marker would sometimes disappear and then reappear. This is likely a product of hardware or data network limitations of the iPhone and possibly a result of the "canyon effect" that is common in urban cores, diminishing the quality of a cellular signal due to surrounding large buildings disrupting the communication of the mobile device and the cellular tower. Additionally, although none of the AR respondents viewed the way GeoTravel presented internal cues as a limitation, these methods were deemed to be unintuitive and partly distracting. To learn more about a selected POI, the application directs a user to a Wikipedia article based on that POI, a process that disrupts the user from the wayfinding task at hand, requiring them to stop walking and dedicate a few moments to read. Likely due to his unnatural process, many of the AR users refrained from learning about more than the communal anchors in the St. Lawrence Neighbourhood.

Many of the limitations experienced from GeoTravel are now being addressed in new implementations of AR technologies. Perhaps the leader in current commercially AR technology Google Inc. has been developing a device called Google Glass (Fig 4.1), a new breed of wearable mobile computing that has been dubbed not only a post-PC device, but the first post-phone device

to become virtually mobile (Jackson, 2012). Google Glass, projected to be released commercially in 2013, is essentially an AR device that utilizes an adapted version of the Google Goggles software, is able to recognize images, places, text, barcodes, logos, books, and countless other visual cues, providing knowledge and information based on image being viewed by the user (Marshall, 2012) Currently in a prototype phase, the Google Glass will reportedly be able to provide a user with real-time information relevant to a user's context and location in space, more intuitively than ever before. For instance, if looking at a famous landmark such as the CN Tower, Google Glass could potentially provide information about the CN Tower in a way that does not obstruct a user's vision, perhaps dictated through a speaker or presented in text form in the peripherals of a user's field of view, allowing for the natural exploration of an environment, while in a way, acting as an extension of the senses. Additionally, a specific Google Glass marketing campaign suggests that a user wearing the device will be advised of such things as a Subway Station closures just before entering the stations. In these cases, the device will provide users with options of other operational subway stations and indicating the route to get there, all provided within a user's normal field of vision, in an unobstructed, almost instinctive fashion (Google Inc., 2012).

Additionally, and perhaps most importantly, Google Glass will be a hands-free device. To navigate through the prompts on the screen, a user simply tilts their head or gives voice commands (Marshall, 2012). AR users in the future will be able to focus their attention on what is in front of them, through their normal field of vision without having to divide their attention among various tasks in order to utilize AR facilitation. Future technologies dedicated to AR like Google Glass are certainly more advanced and functional than GeoTravel, likely possessing the capacity to change the way humans live their daily live if they become ubiquitous.

Fig. 4.1. The next generation of AR computing, a prototype wearable post-PC device called Google Glass. (Source: Time, 2012)

4.6 Directions For Future Research

This thesis was carried out in order to begin an explorative academic discourse into understanding the cognitive implications of utilizing AR facilitation and its effects on wayfinding and the social negotiation of place. While AR computing continues to rapidly advance, it is likely that future implementations of this type of technology will continue to change the way people experience the world in an ever-improving manner. Based on its operational principles of augmentation of the real world, the future of AR may create both advantages and disadvantages in the ways people interact with each other and the world around them. Like VR has already done, future iterations of AR technology will likely impact mobility, motility, social behaviours, the way

we learn, the way we communicate, and the way we share information. It is important to closely follow the advancements and continue to add to the body of knowledge, utilizing qualitative, quantitative, and mixed methods research to maintain an understanding of AR and ICTs in general and how they currently and may potentially affect people's daily lives.

Sense of place, although it exists on a continuum, is a process that is usually used throughout academic literature to mark a profound association with an environment. Although the associations respondents in this study created with the St. Lawrence Neighbourhood were by no means profound, associations between respondents in both groups and the tour area existed. As has already been suggested, the use of AR facilitation seems to have influenced the AR group's wayfinding and developments of social representation, both of which are microgenetic processes of place. Although AR facilitation in unfamiliar places seems to have contributed to forming initial developments of sense of place, its prolonged effects on the developments of sense of place were not addressed as objectives in this research. Future avenues of research should begin to focus on the effects of perpetual AR facilitation and how this may effect socio-spatial developments. The prolonged effects of AR should also be studied in both familiar and unfamiliar environments, observing what effects, if any, AR facilitation has on the alteration or manipulation of an individual's previously developed sense of place. Additionally, further qualitative exploration of the effects of AR using in-depth interviews with respondents of various demographic backgrounds and who explore different geographic areas is critical to be able to compartmentalize the individual-level factors such as culture and historicity from the effects of AR to better understanding the processes of exploration and human cognition of environments.

Future quantitative research can focus on evaluating the effects of AR specifically on wayfinding and navigational tasks, to allow for representable and externally valid results. These

types of studies would allow for results to be compared across varying demographic variable and spatial boundaries.

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Appendix A: Bracketing Statement

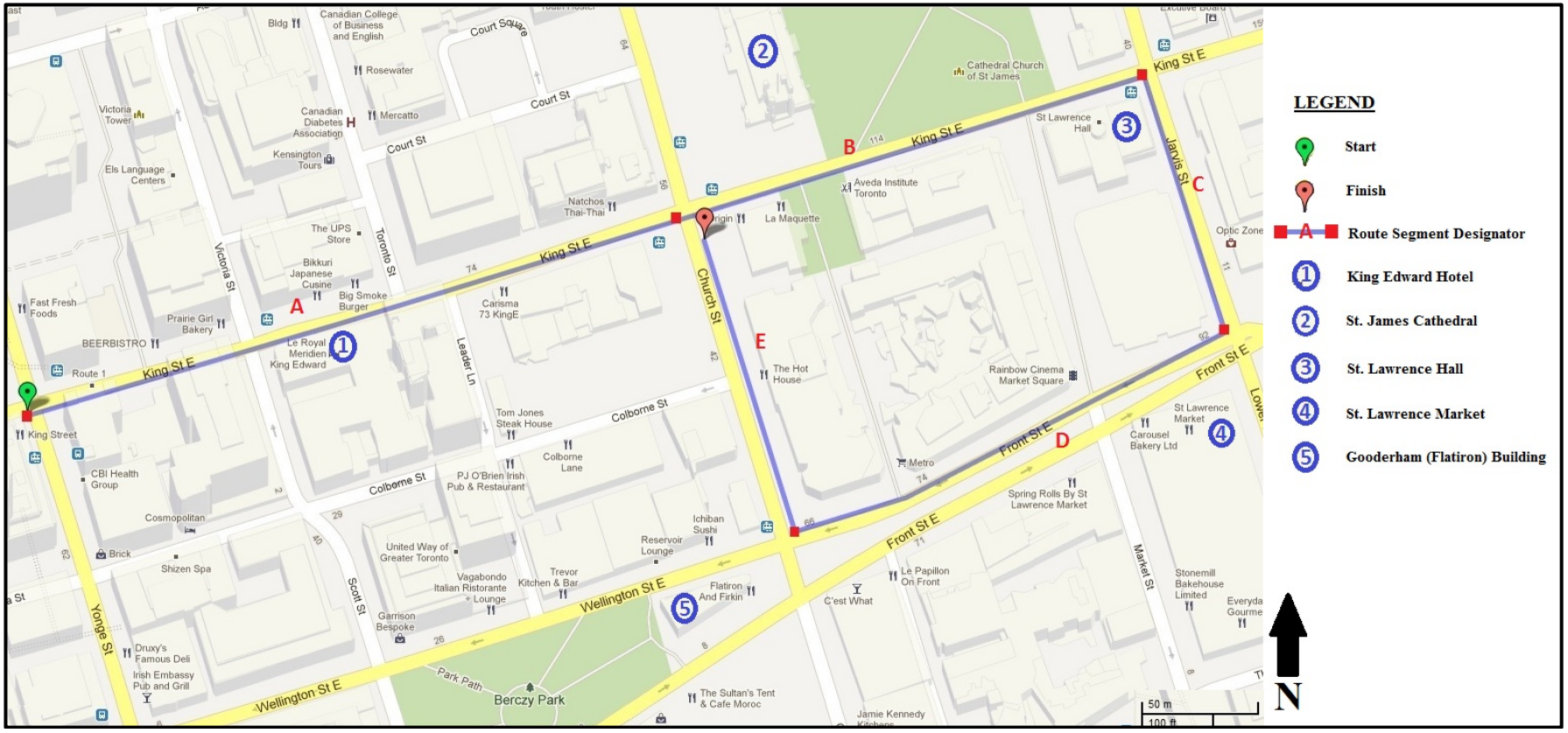
I was Born October 1, 1987 in Toronto, Ontario to my parents, John and Stefania Klisz, two Ukrainian immigrants who had moved to Canada only three years before my birth. Growing up in the suburbs of Toronto, I remember spending most of my childhood outdoors, exploring the neighbourhood with my friends who lived next door. However, when the time came to come indoors, I can always remember watching my father, an electrician, tinkering with various electronic devices such as TVs, VCRs, clocks, etc., in an attempt to repair them. I was always fascinated by his inquisitive nature, a characteristic that I most likely inherited from him over time.

Since I can remember, I have always been interested in technology, sometimes naively embracing new gadgets that promise to somehow make my life more convenient. Even now I find myself tinkering with various electronic devices, both hardware and software, trying to repurpose or modify thing to better suit my needs. However, I am aware that, while certain technologies can certainty improve or bring convenience to everyday life, all technologies have both facilitative and detrimental capacities. Before this study, I had only read about AR, never utilizing it myself. After using the GeoTravel app in the pilot stages of this research, I became aware of both the facilitative and detrimental properties but I made sure to only use the application briefly so that I could focus on how the participants of this study experienced the technology.

I was raised Ukrainian Catholic and was sent to a Catholic elementary and high school and I still consider myself a Catholic. Although I do not think that my religious beliefs would affect the development of this study, it is important that I be aware of them and the values that they have instilled within me during the interpretation and presentation of data.

In regards to post-secondary education, I studied English, Philosophy, and Geography and the University of Toronto where I graduated June 2010 with my B.A. (Hons.). My diverse academic background has further built upon my existing inquisitive nature and has taught me to become a critical and interpretive thinker. I have a proclivity to be overly analytical, a quality that could prove to be detrimental in the interpretive phases of this study. Measures such as data triangulation and member checking have been implemented in the context of this study to help maintain and objective stance during the interpretation and analysis of the data collected.

Appendix B: Map St. Lawrence Neighbourhood Identifying Tour Route Segements, Start and End Points, and Communal Anchors (Adapted from Google Maps, 2012)



About the Researcher

I am a first-year Geography MA student with research interests centered on the geography of everyday life, information and communication technology, and sense of place. I am hoping to extend the knowledge of the effects of new modes of computing, namely Augmented Reality (AR) on sense of place in unfamiliar places. I will be working alongside Dr. John Eyles, who has over 20 years of experience in the field of social geography.

Contact Information

If you would like to participate or ask any questions, please contact Adrian Klisz:

E-Mail - kliszaj@mcmaster.ca

Telephone – (647) 300-1315

The results of this study will be available in 2012. You can contact the researcher by email if you would like to receive a copy.

Appendix C:Informational Recruitment Brochure

This study has been reviewed and received ethics clearance from the McMaster Research Ethics Board.

If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact the McMaster Research Ethics Board Secretariat.
Phone:(905) 525-9140 Ext.23142
Email: ethicsoffice@mcmaster.ca
Mail :
c/o Office of Research Services
McMaster University
1280 Main St West
Hamilton, ON L8S 4L8

My faculty supervisor, Dr. John Eyles, can be reached at (905)

McMaster University

Participant Recruitment Brochure

The Effects of Augmented Reality Computing on Sense of Place in Unfamiliar Spaces

McMaster University
Inspiring Innovation and Discovery

Research Investigator
Adrian Klisz

Masters Student
School of Geography and Earth Sciences
McMaster University
Hamilton, ON

About this Project

In this project, I intend to explore how new a new mode of computing called Augmented Reality (AR) affects the development of people's sense of place and familiarity in new areas. Augmented Reality is the first mode of computing to effectively transcend the boundaries of the virtual and physical worlds. AR is becoming increasingly common due to the convenience and efficiency of overlaying virtual information over real-time displays of the physical world; the potential uses and applications of this technology, although still in their infancy, are vast.

To date, little research has been done on AR. I intended to shed light on some unanswered questions regarding the effects of AR when used to facilitate the exploration new spaces.

My research is qualitative and data will be triangulated between audio-recorded interviews, pictures, and respondent drawn mental maps.

Your Role

Individuals who agree to participate in this study will be reimbursed with a free meal in return for about 1.5 hours of participation. They asked to explore a predetermined tour route in the Yonge-King area of downtown Toronto. The tour will take approximately 15-20 minutes to walk. Participants will be divided into two groups: those facilitated by AR and those without facilitation. Each individual will walk tour alone, taking pictures along the way. After the tour, individuals will be interviewed about their experiences with the unfamiliar area and asked questions about their emotions, feelings, beliefs, and perceptions (sense of place) along with their overall impressions of the area. The interviews will be audio-recorded with a laptop computer during a free lunch, provided by the researcher. Interviews will be approximately 30-45 minutes in length and will follow a general guideline but will remain open to unscripted discussion if the possibility arises. In addition to the interviews, participants will also be asked to draw rudimentary mental maps (from memory) of the area.

Confidentiality

All records of my observations, audio recordings of individual interviews and conversations, and any other data will only be available to supervisor, my supervisory committee, and myself. All forms of data will be stored securely, encrypted by password and/or lock and key. No participant will be identified by name in this study, ensuring confidentiality.

If at any time respondents feel uncomfortable with my taking observations and notes, they are welcome to let me know and I will make every effort to respect their wishes. Participants have the freedom to withdraw at any time from the study. If a participant chooses to withdraw, data they provide along with any relevant information will be destroyed by default unless they give the researchers permission to utilize it.

If there are any questions that participants feel uncomfortable answering or that they would prefer not to answer they may skip over that section or stop the interview.

Appendix D: Letter of Informed Consent

DATE: _____

LETTER OF INFORMATION / CONSENT

A Study of the Effects of Augmented Reality Computing on Wayfinding and Sense of Place in Unfamiliar Spaces

Investigators:

Principal Investigator:
Dr. John Eyles
School of Geography
and Earth Sciences
McMaster University
Hamilton, Ontario, Canada
(905) 525-9140 ext. 23152
E-mail: eyles@mcmaster.ca

Student Investigator:
Adrian Klisz
School of Geography
and Earth Sciences
McMaster University
Hamilton, Ontario, Canada
(905) 525-9140 ext. 20440
E-mail: kliszaj@mcmaster.ca

Purpose of the Study

The most prevalent mode of computing is virtual reality (VR), which utilizes simulation (replication and separation) as a guiding principle. Recently, a new mode of computing has emerged called augmented reality (AR), which utilizes augmentation of the real world as a guiding principle. Rather than simulating the real world, AR combines virtual information with real-time displays of the physical world, creating a tangible interactivity between the virtual and the physical realms called "dual presence". Little research has been conducted on the AR implementations and their effects on social processes. Since AR technology could potentially become highly influential and ubiquitous in mobile devices, the intention of this study is to observe how augmented reality affects social processes; in particular, the development of sense of place when one encounters a new, unfamiliar space.

You are invited to take part in this study, which will be part of a thesis in the completion of an MA degree in human geography. With your help we intend to discover out what effects AR applications found in mobile devices have on developing sense of place when facilitating in the exploration of an unfamiliar area.

Procedures involved in the Research

If you choose to participate in this study, you will be asked to walk along a predetermined tour route in the Yonge-King area of downtown Toronto on your own (starting outside of King subway station) which will take about 15-20 minutes. You will either use AR facilitating during the tour (in the form of an iPhone app called *Geotravel*) or you will take the tour without any sort of facilitation, using only your senses. Along the tour you will be asked to take pictures with your iPhone of features, things, places, etc., that you encounter during your tour. Please not that you will be instructed ***not*** to photograph other people. When the tour is over, you will meet up with the student investigator and will then walk to a nearby restaurant where you will be treated to a free meal for your participation.

During the meal the student investigator will casually interview you; the interview will last about 30-45 minutes and, with your permission, it will be audio-recorded with a laptop microphone. During the interview, you will be asked

questions regarding your particular development of sense of place (i.e. your beliefs, feelings, and emotions of the area). You will also be asked some background questions such as your age and education. The pictures you took during the tour will be uploaded and stored onto this laptop as well. You will also be asked to draw a mental map of your tour, highlighting paths taken, distances travelled, and features, all from memory.

Before the day of the tour, you will be asked to meet with the student investigator in a mutually agreed upon location to received instruction on how the tour process will commence and other relevant information.

After data has been collected and analyzed by the researchers, you will be contacted over the telephone or e-mail to verify that the researchers' interpretations and analysis of the data match your personal experiences of the tour.

Potential Harms, Risks or Discomforts:

You should be aware that, although highly unlikely, there are potential risks in participating in this study. Since you will be walking along a predetermined tour route in the downtown Toronto area alone, there is a low risk of psychological or physical harm. For instance, you may possible feel uncomfortable, anxious, or uneasy exploring the area on your own. To accommodate you, the tour will be held in the early afternoons from Tuesday-Friday. If you even feel uncomfortable or encounter a situation that you would rather not face alone, the student investigator will be in the area during your tour and you will be given his phone number to contact him. In addition to this, you should use your cell phone to call 911 if you feel the need to.

To reiterate the risks that may be encountered during this walk will be no greater than those participants may encounter on an everyday basis.

In addition to this, you do not need to answer questions that you do not want to answer or that make you feel uncomfortable. You have the right to withdraw from the study at any time you wish. I describe below the steps I am taking to protect your privacy.

Potential Benefits

The research will not benefit you directly. However, we hope to learn more about the effects of increasingly common implementations of AR in mobile devices and their potential to allow users to explore new areas and their effects social processes related to this experience, namely forming a sense of place. Once this is known, future research could potentially inform implementations of mobile technologies, improving upon their convenience and efficiency.

Reimbursement

As stated earlier, for the time and effort of your participation in this study, you will receive a free lunch that will be served during the interview process.

Confidentiality

You are participating in this study confidentially; all of your information will be kept private and anonymous when published. All of the data collected (interview notes and audio recordings, mental maps, photos taken) will be stored securely. The digital data will be protected by encryption. The mental maps and researcher notes will be locked in a secure location. Names will be kept strictly confidential; each participant will be assigned a pseudonym will thus be referred to by this name from any papers that may arise from this research. Only the researchers will know the true identities of the participants.

Once the study has been completed, data will be stored up to one year; once it is no longer needed, it will be destroyed.

Participation and Withdrawal

Your participation in this study is completely voluntary and you have to right to stop (withdraw) at any time you wish, even after signing this consent form. If you decide to withdraw, there will be no consequences to you. In the case of withdrawal after data has already been collected, your data will be destroyed unless you give the researchers permission to use it. If, during the interview, you do not wish to answer certain questions, they may be skipped.

Information about the Study Results

The expected completion date of this study will be approximately April 2012. If you would like a brief summary of the results, please let me know how you would like it sent to you.

Questions about the Study

If you have questions or need more information about the study itself, please contact me at:

Adrian Klisz, M.A. Candidate
School of Geography & Earth Sciences
Office: Burke Science Building, Rm 339
Tel: (905) 525-9140 ext. 20440
Fax: (905) 546-0463
Email: kliszaj@mcmaster.ca

This study has been reviewed by the McMaster University Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Research Office for Administrative Development and Support
E-mail: ethicsoffice@mcmaster.ca

CONSENT

I have read the information presented in the information letter about a study being conducted by Dr. John Eyles and Adrian Klisz of McMaster University.
I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.
I understand that if I agree to participate in this study, I may withdraw from the study at any time. I have been given a copy of this form. I agree to participate in the study.

Signature: _____

Name of Participant (Printed) _____

E-mail _____

Telephone Number _____

1. I agree that the interview can be audio recorded.
Yes [ ]
No [ ]

2. Yes [ ], I would like to receive a summary of the study's results.
Please send them to this email address _____
or to this mailing address: _____
_____
_____

No [ ], I do not want to receive a summary of the study's results.

3. I agree to be contacted about a follow-up telephone interview, and understand that I can always decline the request.

Yes [ ].
No [ ].

Appendix E: Map Provided to Respondents to Indicate Tour Route

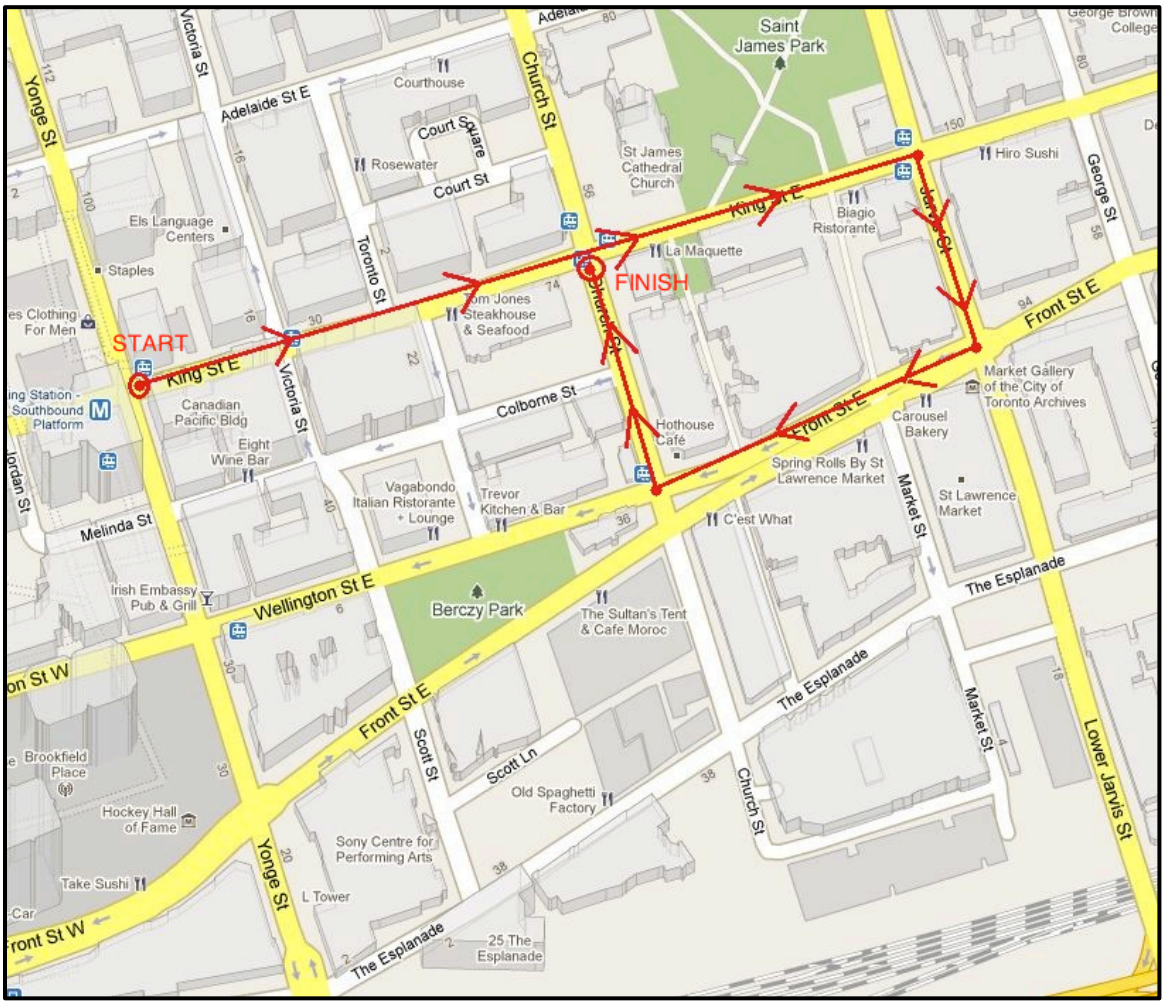


Fig 1. Map of tour route utilized by respodents in the study; tour starts at Yonge and King intersection and finishes at Church and King.

Appendix F: Interview Schedule

Date:
Time:
Respondent Name:

Introduction

While I prepare the interview, I would like you to draw for me a mental map of the area, following the instructions we discussed earlier.

- Can you tell me a little bit about your thought process when you were drawing your mental map?
- Did you remember the POIs you were going to include from the start or did they come to memory as you began drawing the map?

Before I ask you about your tour route and your perceptions of and experiences in the area, I would like to ask you a few questions about the (potential) role of augmented reality (AR) technology.

1. What are your impressions of the area in which you just walked?

- Did you notice a contrast in the area?
- If you noticed a contrast, where did you begin to notice this transition?
- Did you notice any order in the area?
- What stood out to you most about the area?
- How did the area make you feel?
- Were you nervous in the area? Why?
- How would you describe the atmosphere of the area?

Before I ask you more about the walk, I'd like to ask about the role of AR technology in your journey:

Augmented Reality Questions

2. (This question is for the **AR-facilitated** group only) Would you have been able to navigate this area without any sort of technology-facilitation?

- Do you think you would have known the area as well if you didn't use AR facilitation?
- Did the app at all contribute to the level of interest you had in the area?
- Did you ever worry about getting lost or losing your way in the area?
- Do you think the app provided to too much, too little, or just enough information?
- Did you feel more comfortable or less comfortable using the app during the tour?
- How many of the POIs did you actually read about? Can you tell me what you remember about them?

- Did you find it difficult or easy to navigate the area?
- What do you think is better for a first walkthrough of the area, using AR facilitation or just using your senses?

3. (This question is for the **AR-facilitated** group only) Would you return to this area without the facilitation of your cell phone? Why or why not?

- Can you point out any shortcomings of the app?
- Did you feel at all awkward using the app in public?
- Do you think that the AR app ultimately complicated the tour route or made it easier?

4. (This question is for the **non-facilitated** group only) Do you think your journey has been/would have been made easier through the facilitation of technology, like a smart phone?

- Would you be interested in reading articles about points-of-interest in the area if you had the app?
- Do you think that if you used the app I was telling you about your experience of the area would have changed? How?
- Do you think you would have remembered more points-of-interest if you had used the app?
- How do you think using the technology would have changed your experience?

Cognitive, Affective, and Tour-Area Familiarity Questions

5. What are some memorable landmarks that you encountered during your journey? Why do you think you noticed these more than others?

6. From your recollection, tell me about anything interesting you saw, smelled, or heard on your way to the restaurant. Were these pleasant? Why or why not?

- Do you think the smells/sounds weren't there or did you just not notice them?
- Were the sights/smells/sounds more pleasant in some areas than others?

7. How far do you think you walked during your tour? (This is just to get a sense of the perceptions of distances travelled among respondents in the two groups)

8. Did you feel safe in the area? Why or why not?

- What made you feel safe/unsafe about the area?
- Were there any areas where you felt more/less safe? Why?
- Did you find the area to be busy? What did you think of that?
- What role do you think the AR app would play/did play in terms of your feelings of safety in the area?

9. Did you at any time feel nervous in the area? Why or why not?

- What would have made you feel more at ease/comfortable?

10. Did you feel welcomed in the area? Why or why not?

- What would have made you feel more welcomed?
- Are there any places in particular where you felt more or less welcome?
- Would you say that you felt out of place?

11. What is one word to describe how you felt in the area?

- Why did you pick this word?

12. What are some positive things/features you encountered in the area? Please include sights, smells, and sounds.

- Why do you think these are positive features?
- Did you think the area was clean?

13. What are some negative things/feature you encountered in the area? Please include sights, smells, and sounds.

- Why do you think these are negative features?

14. What did you like most about the area? Why?

- What did you like most about the area after you had discovered it?

15. What did you dislike most about the area? Why?

16. Would you ever return to the area? Why or why not?

- Would you ever return to the area for the sole purpose of further exploration? If so would you come back with or without the AR app?
- If you were to come back, which POIs or general areas would you visit? Why would you come back to these areas?
- What if you were to come back with a group of people?

17. Would you return to this area at night? Why or why not?

18. Would you ever bring a date to this area? Why or why not?

- Do you think that this area offers a lot to do in terms of social activity? Why or why not?

19. Would you ever return to shop or dine in this area? Why or why not?

- What can you say about what the area offers in terms of places to eat?

20. Under what conditions would you most like to be in the area again? Why?

21. Under what conditions would you least like to be in the area again? Why?

22. Would you ever consider living in this area? Why or why not?

- Would you classify this area as busy?
- Did you like what this area had to offer

Classifying Questions

- How old are you?
- What year of studies are you in? What is your program?
- How would you rate you knowledge and capacity of technology on a five-point scale?
- How would you rate you knowledge of the tour area before the tour on a five-point scale?
- How would you rate you knowledge of the tour area after the tour on a five-point scale?
    - Do you think that the role of AR has/would have played a role in increasing your knowledge of the tour route? To what extent?

Appendix G: Examples of Interpretations Derived from Respondent-Taken Photographs

Fig 1. Photo of St. James Cathedral (Fernando, non-AR)

Suggested Interpretation - This photo takes place near the middle of the tour route. The weather seems to be somewhat unplesants (slightly overcast). The subject of the photo is St. James Catherdal, an old an ornate Catholic church that has a large presence in the area. It seems to stand out even from the condomimiums in the background of the picture. The landscaping of the area seems to be well maintained and the plaque in from of the church identifies it's names and times of mass. The photographer doesn't focus on the bell tower but rather the gothic architectural features (i.e. spires).

Fig 2. The Gooderham Building (Fernando, non-AR)

Suggested Interpretation - This photo takes place in the intersection of Church St. and Front St. Central to the photo is the Gooderham Building (Flatiron). It has unique architecture: old, copper/slate roofing, triangular in shape, etc. It stands out from the establishements around it and the modern, glass-panneled buildings in the background of the scenery. The intersection seems somewhat busy, filled with cars and a few people. The weather seems somewhat unpleaseant due to the slight overcast.

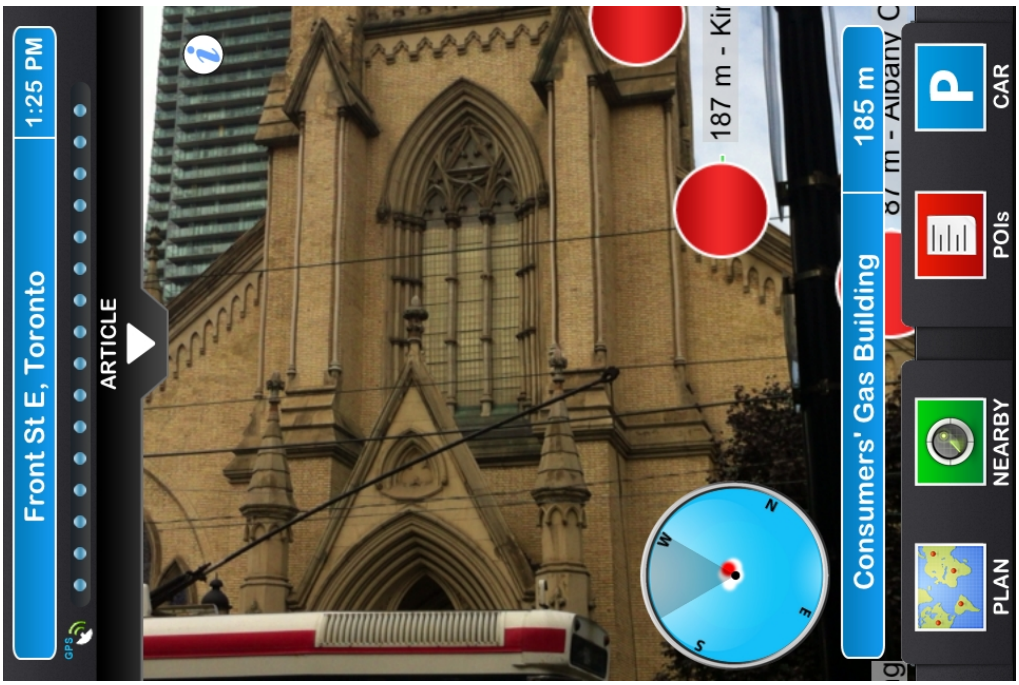


Fig 3. St. James Cathedral (Breanna, AR)

Suggested Interpretation - This photo takes place in from of the SJC. The photographer didn't adhere to the AR marker. Nevertheless, the grandeur of the building and its old, ornate architecture are clearly presented in the photo. The cathedral is contrasted with the modern, glass-paned high-rise in the background of the image. The top of a street car is visible in the bottom of the photo, suggesting that the area is busy.

Appendix H: Code List

- **Wayfinding**
  - Space Knowledge
    - Declarative (inventorying and memorizing)
      - Names of streets/POIs
      - Inventories major POIs
      - Inventories minor POIs
    - Procedural (linking places into ordered strings for wayfinding/navigation [hierarchical])
    - Configurational (creating associations between and relative to places)
    - Place (linking attributes to places
  - Recalls POI incorrectly
  - Recalls layout of area incorrectly

- **Area Awareness**
  - Contrast in Area
    - Duality
      - Old vs. New
      - Business vs. Retail
      - Business vs. Cultural
      - Formal vs. Relaxed
      - Human Construction vs. Natural
  - Physical Detail
    - Old architectural features
    - Modern architectural features
    - Surprising
    - Unique
    - Promoted curiosity and exploration
    - Significance
    - Overwhelming
    - Grandeur
    - History
    - Interesting
    - Layout
    - Well-maintained (i.e. tidy)
    - Not maintained (i.e. unclean)
    - Random/disorganized/confusing/unusual

        - Nature
        - Cultural aspects
        - Retail
        - Construction
        - Calming
        - Aware of little physical detail

    - Sensory Detail (Visual, Olfactory, and Auditory)
        - High Detail
        - Low Detail
        - Links sensory perception with landmark or POI
        - Area duality through senses (smell and sound)
        - Possibly distracted by AR
        - Adhered to AR marker
        - Ignored AR marker
        - Misled by AR

    - Activity in Area
        - Busy
        - Rushed
        - Interesting
        - Low Activity

- **Role of Technology (AR)**

    - Positive
        - Made tour easier (more convenient)
        - Facilitates familiarization (awareness)
        - Promotes curiosity (interest and exploration)
        - Connects user to area
        - Provides confidence and reassurance
        - Provides perception of safety
        - Provides abundance of information

    - Negative
        - Awkward
        - Not for casual use
        - Limits experience and appreciation of area
        - Limits awareness of surroundings
        - Technological limitations

- **Social Representation (Anchoring and Objectifying)**

    - Positive

- Landmarks
    - Anchoring
    - Unique
    - Patrons are informed and interested
    - Architecture
    - Exploration (seeing new things)
    - Contrast in landscape

- Restaurants or food
- 'Community' atmosphere
- 'Cultural' aspects
- Atmosphere
- Sensory perceptions
- Inviting
- Convenience
- Adaptation
- Evokes curiosity

- Negative
    - Landmark
        - Anchoring
        - Unsettling nature of area ("sketchiness")
        - Layout is confusing

    - Lack of nightlife
    - Not enough music
    - Feeling of 'blankness' in area
    - Busy
    - Rushed atmosphere
    - Unclean areas
    - Lack of security (due to lack of familiarity)
    - Sensory cues
    - Uninteresting

- Neutral (defies Anchoring)
    - Ambivalent
    - 'Average experience'
    - Indifferent
    - Lack of emotional response
    - Sensory cues

- Safe
    - Due to physical characteristics
    - Due to high volume of people and their demeanor
    - Safe in 'new' area
    - Safe in 'old' area
    - Safe during daytime
    - Anchoring

- Unsafe
  - Some areas were unnerving
  - Anchoring
  - Only unsafe at night

- Welcome
  - Area inviting to further exploration
  - Sensory perceptions
  - Likely to return to area
  - Atmosphere
  - People
  - Comfortable

- Unwelcome
  - Nervous and uneasy
  - Felt ignored, unacknowledged, like an 'outsider'
  - Unclean areas

- Reasons for return
  - Further exploration
  - To learn more about the area
  - Boredom
  - Events in area
  - Job in area
  - Restaurants/food

- Reasons for no return
  - No 'nightlife'
  - Not a 'destination'
  - Not eventful enough
  - Unclean areas
  - Weather

- Yes Date
  - Eventful area
  - Many POIs/sights
  - Unique
  - Inviting area

- No Date
  - Uneventful
  - Uninviting
  - Too busy

- Would live in area
  - Area is convenient
  - Area is active

        - Sense of community
        - Good experience
        - Proximity to other areas
        - Area has ‘a lot to offer’
        - Area is safe

    - Would not live in area
        - Uninviting
        - Does not prefer downtown
        - Too busy
        - Not a place for a home

- **Navigation**
    - Easy to navigate
    - Difficult to navigate
    - Accurate estimate of distance
    - Inaccurate estimate of distance