A CREATIVE EXPLORATION OF THE USE OF INTELLIGENT AGENTS IN SPATIAL NARRATIVE STRUCTURES.

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ABSTRACT

This thesis is an interdisciplinary study of authoring tools for creating spatial narrative structures– exposing the relationship between artists, the tools they use, and the experiences they create. It is a research-creation enterprise resulting in the creation of a new authoring tool. A prototype collaborative tool for authoring spatial narratives used at the Land|Slide: Possible Futures *public art exhibit in Markham, Ontario 2013 is described. Using narrative analysis of biographical information a cultural context for authoring and experiencing spatial narrative structures is discussed. The biographical information of artists using digital technologies is posited as a context framing for usability design heuristics. The intersection of intelligent agents and spatial narrative structures provide a future scenario by which to assess the suitability of the approach outlined in this study.*

DEDICATION

For Dave...

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Chapter 1
Introduction

It is often said that "we change our tools and our tools change us" (Culkin, 1967). This quote, often misattributed to Marshall McLuhan, echoes laments from Plato to Nietzsche and recently popularized by Carr that we incidentally shape our behaviours with the instruments we use to share our thoughts (Carr, 2010; Kittler, 1999; Plato & Fowler, 1925). It implies that our relationship to our environment is cyclical. By creating tools, we change our environment and as a result we change our behaviours. To better understand this relationship between culture, stories, and the tools we use, I have developed a novel authoring system for use in a large-scale public art project and an accompanying research-creation methodology for examining the cultural context in which tools are developed. This study challenges the message inherent in many of our tools that they "are beyond our understanding" (Turkle, 2004). By investigating the intersection of technologies, such as augmented reality and artificial intelligence, we see how the tools we create today affect the nature of the experiences we can create in the future.

I Thesis Objectives

The primary contribution of this thesis is a novel authoring environment for creating spatial narratives with an accompanying analytical method for future development of these tools. Spatial narratives are a method of storytelling in which the

author encourages their audience, often with a locative device, to traverse a physical space to comprehend a story. This thesis also proposes a conceptual model for understanding the cyclical nature of tool design and experience authoring. A series of technobiographical interviews with artists who used the authoring tool or work with intelligent agents illustrate how the context of use for software can be drawn from biographical information. I will propose a design heuristic for creating and evaluating spatial narrative experiences in context. Finally, future work on a software environment is described based on the data gathered from users.

II Research Questions

I am primarily using an inductive method to make connections between authoring tools, their users, the projects they are used to create, and the cultural contexts in which they are used. This study is designed to open a space for the inclusion of intelligent agents as expert systems in tools for creating spatial narratives[1]. Among the questions

[1] Note: This is not a discussion of prefabricated Intelligent Agents, nor are new agents for authoring produced in this phase of the research; however, an overview of expert systems is used to guide the construction of this system so that future iterations of the tool can include the intelligent agents either as characters, guides, or tools to facilitate narrative structures through content selection. This is a discussion of how tools may be created for the inclusion of such agents and how, through a new conceptual model, we can understand the usability of such tools and the projects they are used to produce. This

that inform this study are: Do the technological tools we create inform the choices we make in the creation of stories? In what way do the constraints of a particular technology change the process of storytelling? How does the inclusion of intelligent agents help to realize complex, dynamic narratives? How does the use of humans in place of intelligent agents allow us to evaluate the effectiveness of future technologies?

I am particularly interested in trying to elicit the following information: what do artists perceive to be the affordances or limitations of the technology they are using? Have they changed or altered their project from its inception to suit the technology that will be used? Are there problems they anticipate which may lead them to further adapt their method of development? Do limitations exist that they feel could be addressed with a technological solution? What do they imagine these technological solutions to be? If we change our tools and our tools change us, it stands to reason that the answers to many of these questions fall within the cycle of production and distribution and would influence the design of future tools. It is not an investigation of the implementation of intelligent agents at this stage but is an identification of the preconditions in which intelligent agents may be incorporated in the near future.

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is only the first step towards a much more complex research project but given of the successful creation and use of a unique authoring tool it is also the most significant one.

III Hypotheses

I argue that technology changes the way we tell stories and that those stories change the cultures we are part of. Is it then possible that these changes in culture impact the design of the tools we use? If so, there may be empirical evidence that the methods used in software design could be influenced by cultural factors. The problem arises when there is indirect interaction between the software designers and the authors who use the tools. In a simple production model, software is developed using and internal production testing cycle, and if often deployed to users to provide feedback in a staged deployment model (alpha, beta, golden master, release). User feedback is analyzed and the product is refined.

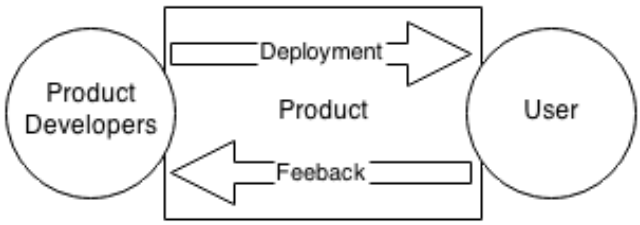

Figure 1 Simple Product Development/Deployment Cycle

The above model assumes there is a direct connection between the user and developer. It also masks the epistemological decision making behind information used for production and testing. In particular it masks the context in which the software is used and the goals it is being used to achieve. To investigate this cycle more thoroughly, I pose the following hypotheses which are further refined throughout this thesis:

1. The *testing* criteria influence the design of a *tool*.

2. The *properties* of a tool influence the creation of a *project*.
3. The outcome of a project, based on its *goals*, becomes part of an author or *user's* experience.
4. *Information* about the author's experiences becomes the basis of a *context* from which tools are assessed and developed.

I postulate that the type of product, which in the case of an authoring tool includes the experiences it is used to create, has an influence on the cultural context in which it is used. If this is the case, technologies used to tell stories could be particularly responsive to and influential on cultural contexts.

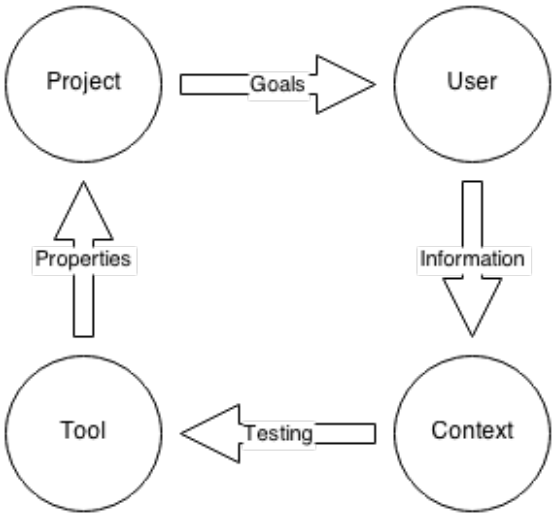

Figure 2 Expanded Product Development/Deployment Cycle

From these hypotheses, the proposed model can be used to describe a cyclical development/deployment model with relevant contextual data about how a tool is used, and does not necessarily assume a direct connection between the user and the developer of the tools (Figure 2).

IV Methodology

While this thesis predominantly uses research-creation methodologies, it is also a conceptual model for future interdisciplinary inquiry. This work is influenced by software studies as model for understanding "the role of software in contemporary culture, and the cultural and social forces that are shaping the development of software itself" (Manovich, 2013). I aim to understand the impact of cultural context on the production of authoring tools and their use. I map the cultural context for software development based on the assumption that "autobiographical narratives are the point at which the individual and culture intersect" (Fivush, Habermas, Waters, & Zaman, 2011).

This thesis is designed to function as one iteration of an ongoing iterative cycle. As a research-creation endeavor the tools developed in this study are intended to provoke "user-responses to help build the project in question, as well as future initiatives" (Chapman & Sawchuk, 2012). The authoring tool is developed from an extensive examination of existing tools but have also taken shape while reflexively addressing the concerns and needs of stakeholders such as the invited artists of *Land|Slide*. The data collected from interviews will inform future development of the tool.

Narrative is both a subject and method of analysis in this study. The possiblity of authoring spatial narrative strutures draws into question the role of the author and the diversity of methodologies at play in the study and creation of interactive stories (Barros & Musse, 2005; Dow, Lee, & Oezbek, 2005; Grasbon & Braun, 2001; J. T. Murray, 2012; Ursu et al., 2009). My intent is not to priviledge formalist or structuralist concepts

of narrative, nor is it to suggest narrative analysis should operate in service to positivist design pursuits.

Future studies are proposed and I encourage an ongoing, rigorous analysis of these methods to determine consistencies between the methodologies outlined here – particularly between the narrative and qualitative analysis of interviews. To the best of my ability, I will relay data collection methods, the selection of quotes, and subject follow up in line with the principles of rigour in the qualitative social sciences (Baxter, 1997). In particular I have validated the interviews presented in this thesis by requesting feedback and corrections from the participants to ensure they feel they have been represented fairly.

V Interdisciplinarity

This interdisciplinary study draws from computer science, communications, cultural studies, and media studies. In order to understand the cultural relevance of the context of use of software "it is necessary to bring a variety of narrowly disciplinary insights, each of which grows out of a more specific question, appropriate to, and approachable by a single discipline" (Newell & Green, 1982). Manovich observes that "paradoxically, while social scientists, philosophers, cultural critics, and media and new media theorists seem by now to cover all aspects of IT revolution […] software[…] has received comparatively little attention" (Manovich, 2013). It is predominantly interdisciplinary, multidisciplinary, and transdisciplinary scholars who continue to expand the field (Fuller, 2008). Usability inspection methods from computer science

inform my understanding of software design and development, communication and cultural studies inform my use of biographical narratives and context, while both communication and media studies play a role in understanding narrative as a subject and method of study.

Chapter 2
Related Work

This section outlines contemporary work in usability inspection, narrative, and spatial navigation of story worlds relevant to this study. Contemporary work in intelligent agent design and authoring tools are also discussed towards identifying novel intersections.

I Usability Inspection Methods

This study is primarily interested in the use of software for creating experiences; therefore we will draw much of the necessary vocabulary from usability inspection methods. Software usability testing, or usability inspection, is an assortment of methods adopted as commercial standards for the purpose of refining software interfaces (Jakob Nielsen, Blatt, Bradford, & Brooks, 1994). *Empirical* and *heuristic* are two of those most commonly practiced user-testing methods.

A Heuristic Usability Inspection

Heuristic testing is performed by a small number of experts who evaluate usability according to an established criteria. It is widely considered to be the most economic form of user testing and is compatible with rapid iterative development (J Nielsen & Molich, 1990). However, purely heuristic usability inspection methods are notorious for overlooking contextual information. For example, language that de-

emphasizes contextual information, such as “natural”, “average”, and “common sense”, is commonly used in heuristic studies (J Nielsen & Molich, 1990).

B Empirical Usability Inspection

Empirical usability inspection methods define *context of use* as the super-category from which the user, task, equipment and environment data are evaluated. The environment data is intended to account for “relevant standards, attributes of the wider technical environment, the physical, ambient, legislative and the social and cultural environment” (Jokela, Iivari, Matero, & Karukka, 2003).

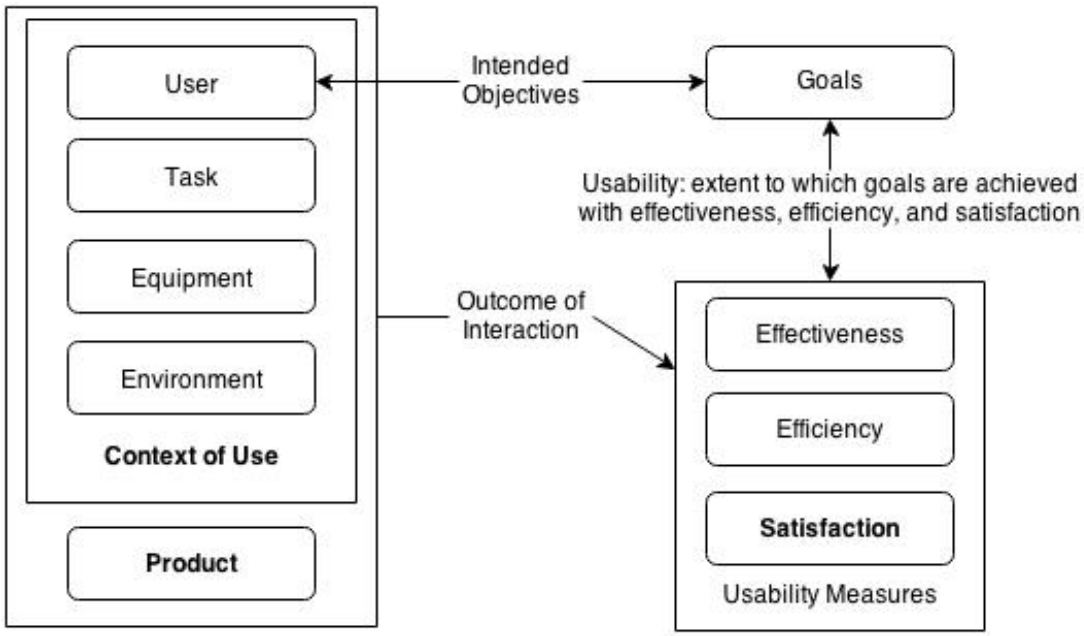

Figure 3 Usability Framework (Bevan, 1995)– Emphasis Added

I examine the ISO 9241-11 standard for “Guidance on Usability” for its widespread adoption in a variety of inspection methodologies (Abran, Khelifi, Suryn, &

Seffah, 2003; Federoff, 2002; Green & Pearson, 2006; Jokela et al., 2003; Jokela & Iivari, 2004). The outcome of these studies is primarily to produce a tool that can be used efficiently, effectively and satisfactorily. Of particular interest to this study are the following aspects of the ISO usability testing guidelines (Figure 3):

1. The *context of use* of a product.
2. The *product* itself (previously referred to as a *tool*) in this case an authoring environment.
3. The *satisfaction* variable in the study's usability measurements.

There are problems with assuming that formal usability testing is inherently beneficial. The expense of usability studies is well documented spawning a debate over the ideal number of testers to minimize costs (J Nielsen & Molich, 1990). It can and can be difficult to conduct in circumstances that do not have obvious "stakeholders" (Maguire, 2001). These economic concerns risk overshadowing aesthetic, cultural, or community priorities.

1 Context of Use

While not all empirical usability testing methods use the same language to describe their expected outcomes, *context* in particular is a reoccurring variable across standards (Lindgaard, 2007; Pinelle & Gutwin, 2002). The ISO 9241-11 document also provides a common vocabulary by which to discuss these variables that are used in this study. According to the ISO standard the context of use consists of the user, the task, the equipment, and the environment (Jokela et al., 2003). Usability studies are qualitative, involving time-consuming transcriptions of interviews, and coding of questionnaires

customized to each new context of use. Because of the context's significant impact on usability measures tools such as DRUM have been developed to standardize its definition (Macleod & Rengger, 1993). Context is also one of the defining differences between an empirical user study and a heuristic study. Its been reported that heuristic studies are nearly devoid of context so hybrid models have been developed to compensate (Po, Howard, Vetere, & Skov, 2004).

2 Product

Usability studies are costly and as a result the priority of these standards has been to create a "practical and cost-beneficial tool" (Macleod & Rengger, 1993). Some of these concerns are also reflected in the design of interactive story systems "in order to ground design decisions and future technology developments on solid perspectives for user acceptance and market success." (Vermeulen, Roth, Vorderer, & Klimmt, 2010). These priorities remain contested by some communities of developers or researchers but are unarguably a driving concern behind the funding and generation of software as a *product*. It is important to unpack the assumptions usability inspection methods carry with them. Judgements as to the usability of a tool are seldom objective, empirical, or neutral. Inexpensive or informal heuristic testing can be advantageous for rapid development but the size of the testing group makes decisions based on a very narrow mandate that is shown to differ between cultural contexts (Shen, Woolley, & Prior, 2006). It has been suggested that the only way to avoid the apparent cultural elitism that results from small expert groups making decisions about software behind closed doors is

to include users in the development process. This is not a new argument and has been reported as a social justice issue for over 20 years (Lawrence & Low, 1993).

3 Satisfaction

The ISO standard defines satisfaction (as a usability measure) as: "the comfort and acceptability of the work system to its users and other people affected by its use" ("ISO 9241-11", 1998). This creates a difficultly in the creation of authoring tools. The *product*, in this case an authoring tool, would be measured in part by its comfort and acceptability in producing a *project*, the end user experience. It would also then been judged in based on the comfort and acceptability of that end user experience. This may seem self evident when discussing software tools such as Maya, Flash, or Unity 3D (Adobe, n.d.; Autodesk, 2014; Unity Technologies, 2014). But does their commercial value depend on the satisfaction of the end user with an experience created with them? If so, by what criteria is satisfaction measured? One may argue intuitively that the satisfaction of the user with the story of a film has nothing to do with editing software; however, the non-destructive digital editing techniques of software only usurped traditional methods of editing by being satisfactorily equivalent. Importantly, it is also difficult to determine satisfaction without an in depth cognitive analysis of the attitudes of the end users.

II Research-Creation

The term Research-Creation describes a variety of methods used to create or to understand the creation of products that inform and are informed by ongoing research. It is difficult to define a research-creation project in familiar terms because "the theoretical, technical, and creative aspects of a research project are pursued in tandem, and quite often, scholarly form and decorum are broached and breeched in the name of experimentation" (Chapman & Sawchuk, 2012). Foundational to this thesis is the research-creation on authoring tools being done at research labs such as the Augmented Environments Lab (AEL) at Georgia Tech, USA and the Human-Interface Technology Lab in New Zealand (M. Coleman, 2012; Kato & Billinghurst, 1999). The development and release of a tool into the hands of new users allows for new questions and new methods to emerge.

This thesis, according to a taxonomy of research-creation subcategories, is *creation-as-research* in that it "involves the elaboration of projects where creation is required in order for research to emerge" (Chapman & Sawchuk, 2012). While numerous tools exist for authoring spatial narratives, the artists or curators deemed none of these tools suitable for the exhibit. In order to be able to explore the authoring of spatial narratives during this exhibit a new tool had to be constructed. It is because of the creation of this tool and the methods used that the biographical information is now available for future research.

III Narrative

Because narrative is of methodological concern and also the intended output of the tools in this study, it is important to develop a working definition. There are no definitive boundaries between narratives and stories. There is an incomparable body of literature that attempts to define narrative, to distinguish narrative from storytelling, and to establishing narrative as a method of analysis (Barthes & Duisit, 2013; Labov, 1997; McGuire, 1985; Polkinghorne, 2006; Sandelowski, 1991). Because this study involves narrative as both a method and subject of study it is important to provide distinct yet compatible definitions. Narrative is an organizing principle used, for example, as a "discourse composition that draws together diverse events, happenings, and actions of human lives into thematically unified goal-directed processes" (Polkinghorne, 2006). Narratives are therefore not a structure themselves but contain multiple structures or "processes".

As a method of analysis, I am primarily interested in what events, such as interactions with technology, have "entered into the biography of the speaker" (Labov, 1997). If we apply this definition to a single speaker (the subject of this study) it is compatible with Polkinghorne's definition of narrative. The use of autobiographical narratives as qualitative data is discussed in P. VI (*Technobiographies)* and the roles of narrative in storytelling practices are discussed in Sections A (*Narrative Structures and Interactive Storytelling*) & B (*Spatial Narratives*).

In addition, there are references in this thesis to the level at which critical discourse operates as a superstructure of the individual narrative structures within works. Gee's theory of "situated meanings" and "cultural models" for contextualizing discourse has been applied to online gaming communities and may be an appropriate model for understanding the various "Discourses" in the *Land|Slide* exhibition (Gee, 1999; Steinkuehler, 2006); however, an in-depth critical discourse analysis is beyond the scope of this thesis.

A Narrative Structures and Interactive Storytelling

The formalist and structuralist theorists, or narratologists, considered the presence of organizing structures to be the overriding characteristic of a narrative (Barthes & Duisit, 2013; Propp, 2009). Discussions of non-linear narratives and interactive storytelling predominantly address user agency within the navigation of complex story structures (Aarseth, 1997; Bates, 1989; Hosale, 2008; Thabet, 2011; Ursu et al., 2009). There are many popular conceptual models for merging interactivity and storytelling with few examples of working systems (Gilroy, Porteous, Charles, & Cavazza, 2012; J. H. Murray, 1997; J. T. Murray, 2012; J. Murray, 2005; Ryan, 2001). Some theorists maintain that the merging of user agency with traditional narrative forms is a "myth" based on the "notion that the narrative impact of film could be grafted to the networked nonlinearity of the digital" (Lunenfeld, 2004). This has done little to dissuade researchers from proposing and building new interactive systems, often integrating the formalist structures proposed by early narratologists (Cavazza & Pizzi, 2006; Grasbon &

Braun, 2001). While there are still some divisions between conceptual models of storytelling and simulation as interactive experiences, the body of practice utilizing a pragmatic, hybridized approach continues to increase (Adams, 2013; Cavazza, Pizzi, & Charles, 2009; Gilroy et al., 2012; C. Roth et al., 2012). This study is therefore informed by the nuanced discussion of how user agency affects narrative coherence but holds these dichotomous ideas in constant tension.

B Spatial Narratives

There are a growing number of studies and projects described as spatial narratives. Practices such as locative media (Rieser, 2005), mobile media (Møller-Jensen, 2008), guided historical tours (Azaryahu & Foote, 2008; Dow, Lee, et al., 2005), urban geography (Elwood, 2006), experience design (Hellström, 2007), have all identified work as spatial narratives. Apelab describes their digital work IDNA as a "spatial storytelling prototype" (Tappolet, 2013). Borrowing from Linde and Labov, De Certeau uses the metaphor of the "map" and the "tour" to describe the qualities of "spatial stories" (De Certeau, 1984; Linde & Labov, 1975). Proposed elsewhere is the neologism "terratives" (Waal, 2009).

In film, narrative structures are built by a "process of reintegrating disparate elements, spaces and timescales to create a perception of meaning in the audience" (Rieser 11). Space and time of any measure can be traversed in the span of two consecutive frames. Conversely a spatial narrative prioritizes "the coherent three-dimensional flow of space along a path" (Rieser, 2005). The characteristics of a spatial

narrative that emerge from these texts are that they are possible to map, contain at least one structure (plot, setting, etc.), and rely on real time user input (walking, looking around, causing an avatar to move) to traverse a space (Figure 4). These spatial arrangements allow for both linear and non-linear *spatial narrative structures*.

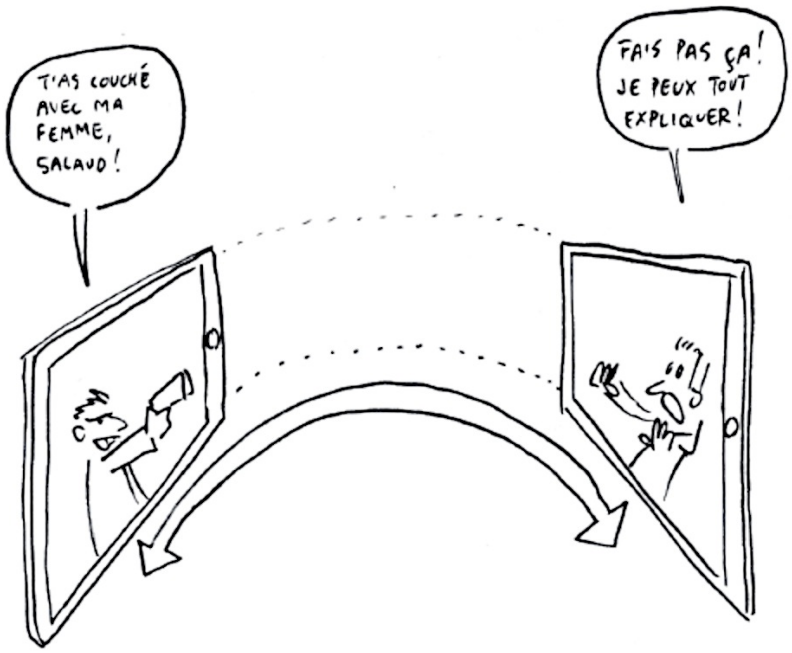

Figure 4 Apelab, IDNA Storyboard Sketch (Tappolet, 2013)

IV Authoring Tools

A Product

For the purpose of this thesis I define authoring tools as software environments that can produce self contained programs or experiences. This study focuses primarily on authoring environments as the tools or *product* of the usability tests we refer to in 2.1. In

this study, the *product* (Figure 1) is assumed to be an authoring environment for developing spatial narratives. There are a number of tools out there that support the authoring of large scale augmented reality experiences ("Junaio," 2009, "Layar," 2009, "Wikitude," 2008; Blair MacIntyre, Hill, Rouzati, Gandy, & Davidson, 2011). TOTEM and ARIS have recently emerged as toolkits for mobile games and storytelling using locative and AR technology ("ARIS: Augmented Reality and Interactive Storytelling," 2011, "Totem Games," 2010).

B Project

The "standalone" programs produced by authoring tools, also called apps, binaries, bundles, or projectors, could be considered products themselves, but for the purpose of simplicity, we are considering the *standalone experience, a spatial narrative, to be part of or the entire Project,* rather than the Product (Figure 2). In keeping with our definition of spatial narrative structures, this project can be made up of many spatial narrative structures to form a larger narrative experience. Examples of spatial narrative structures are outlined in Ch. 4 P. IV (Spatial Narrative Structures).

V Intelligent Agents

Employing AI techniques in location-based media, such as augmented reality, for the purpose of creating tours and historical re-enactments is an emerging area thanks in part to the commercialization of new mobile and heads up display technologies. AI techniques have been used in interactive storytelling to create characters (Cavazza,

Charles, & Mead, 2002; Cavazza, Lugrin, Pizzi, & Charles, 2007; Pizzi, Charles, Lugrin, & Cavazza, 2007; Vuono, 2008), responsive environments (J.-L. Lugrin & Cavazza, 2006), and to modify and generate story structures (Grasbon & Braun, 2001; Mcintyre & Lapata, 2010). AI searches have been used to demonstrate consumer preferences in points of interest based on localization (Husain & Dih, 2012; Kofod-Petersen & Langseth, 2010; Zheng, Zheng, Xie, & Yang, 2012). AI pathfinding techniques have been proposed for producing automated tours in a completely virtual environment (Li, Lien, Chiu, & Yu, n.d.; Poschmann & Donner, 2012). There have also been investigations into the creation of intelligent agents, both physical (robots) and virtual (augmented reality), as guides in museum tours (Lim & Aylett, 2007; Poschmann & Donner, 2012; Richards, 2012; Skjermol & Stokes, 2010). While AI techniques are covered generally in this paper, the Intelligent or Rational agent approach to AI is useful because it relies on formalized introspection methods to evaluate intelligence as a usability measure (Russell & Norvig, 2003). The determinations of 'rational' and 'satisfactorily usable' both depend primarily on the context of deployment but are useful, quantifiable measures nonetheless.

VI Technobiographies

Information about users, their tasks, their environment, and the equipment can be elicited using a variety of techniques. I am particularly interested in the application of biograhical infromation into the software production cycle. Biographies reveal an intimate relationship to cultural contexts as "cultures inform individual narrative

identities and individual narrative identities inform cultural forms" (Fivush et al., 2011). Exploring the relationship of identity and technology in Cyberculture through biographical analysis, Kennedy develops a loose "technobiographical methodology" (Kennedy, 2003). While her initial study focused on identities in Cyberculture, the methodology has been repurposed for studying "stories of learning" in youth (Brushwood-Rose, 2006) and educators (Ching & Vigdor, 2005a). These inquries are consistent with Kennedy's insistance that the goal of any particular study "should not be to universalize and subsequently simplify, but to specify and then render complex" (Kennedy, 2003). Because of this approach the "subject-in-society" becomes the "isolated actor who experiences and narrates as a matter of private and priviledged experience" (Atkinson, 1997).

VII Affordances and Constraints

I postulate that the tools we use impact the work we create based on their inherent properties. These properties, commonly referred to as "affordances" and "constraints" or limitations, have informed the design of narrative experiences in augmented reality for over a decade (B. MacIntyre, Bolter, Moreno, & Hannigan, 2001; Norman, 2002). The expanded conceptual model in Figure 2 begins to describe how "new technology will develop into one or more particular forms within a particular historical and cultural setting" (B. MacIntyre et al., 2001). User feedback is one of many forces that shape the development of tools. While it often makes good business sense to please a large number of users by accommodating popular requests, a carefully considered context of use

evaluated by professionals (including the environment and equipment) impacts design decisions because of specific technology ecologies.

Chapter 3
Problem Identification and Study Design

At the *Land|Slide: Possible Futures* exhibition in Markham, Ontario thirty artists were invited to install site-specific installtion art at the Markham Museum for a period of a month (Marchessault, 2013). In addition to technically advanced projects at the site, the exhibtion currators and artists requested an mobile app that could enable the artists to produce locative media walks, vitural installations, augmented reality art works, and provide contextual information about each exhibit. Many of the artists seemed keen to engage with augmented reality in particular and so an evaluation of existing tools was performed (A. C. Roth, 2013). To aide in the rapid development of a mobile app (a *project*), I constructed a web-based authoring tool (the *product*). Formal usability studies were deemed unfeasible given the inavailabilty of the artists as subjects. Design decisions were developed to produce interfaces usable in interactive narrative experiences with the assumption that "technological drivers can have a relevant impact on [interactive storytelling] entertainment experiences" (C. Roth et al., 2012).

I Problem Identification and Hypotheses

Based on current research, we can broadly identify the following problem areas:

P 1. How is the experience that the artist creates with an authoring tool evaluated in order to further develop the tools used to create it?
P 2. What is the user's relationship to the authoring tools they use?
P 3. What impact does this relationship have on the tools?

P 4. How does the culture of a user impact the project they seek to create?

Applying the vocabulary of the ISO usability testing guidelines (Figure 3), Norman's affordances, and Kennedy's technobiographies to a spatial narrative experience, we can restate the hypothesis as follows:

H 1. The *usability measures*, including *satisfaction*, influence the design of a *product*.
H 2. The *affordances and constraints* of a *product* influence the creation of a *project*.
H 3. The outcome of a *project*, based on its *goals* enters into the *user's technobiography*.
H 4. The user's *technobiography* provides a *context of use* against which *usability measures* are evaluated.

Despite the straightforward nature of these hypotheses, there are some problems that make it difficult to design an experimental situation to test the validity of these claims. We can group these issues into the following categories, around which I base my preliminary investigations. How do we determine if a user's interaction with technology has entered into their biography? Do cultural factors within a context of use affect the outcome of a usability study? How can satisfaction with an authoring tool be measured if, to date, there are few tools with which to conduct studies and even fewer interactive story experiences that can be described as satisfactory? If no authoring tools are publically available that allow the creation of intelligent agents in spatial narrative structures, where should this development cycle begin? Allying myself with a large-scale

public art exhibit, I proposed this study by which to both create and investigate the use of a novel authoring system.

II Study Design

Initially, this thesis was designed with a three stage investigation of the *software production* and *project authoring* model outlined above through a questionnaire and interviews. Additional interviews with artists not involved with the *Land|Slide* project are conducted to compare themes. This section addresses design process for the authoring tool (*product*) followed by the *context of use* and *satisfaction* measures through *interviews*. Due to a low response rate, the results of the questionnaire are omitted from the remainder of this study (Appendix II).

A Product - Authoring Tool

I stated previously that authoring tools are used for authoring standalone projects. Because of the ecology of mobile app development, it is undesirable for a multitude of artists at an exhibition to publish their own apps. For *We AR in MOMA*, Manifest.AR asked artists to contribute to an artistic intervention using AR browsers that result in multiple channels or layers in a single app called a browser (Freeman, 2012). Many of the browsers and tools outlined in Ch. 2 P. IV (*Authoring Tools*) are not easily extensible and the end project would be encapsulated in a browser app. Aesthetic concerns from the event organizers (the desire for a single dedicated app rather than a browser) made the creation of a new, custom tool necessary.

Compiling many individual projects into a single app was logistically complex. Through iterative, bottom-up design, I developed a distributed, web-based authoring tool for spatial narratives that would permit artists to incorporate their own intelligent agents. Given that most current systems using intelligent agents for interactive storytelling are expert systems requiring custom development this was deemed to be a reasonable solution.

1 Bottom-Up Design

The *LandslideAR* app was constructed using the *Unity* 3D game engine and Qualcomm's Vuforia, an augmented-reality computer vision library (Qualcomm, 2014; Unity Technologies, 2014). To encourage experimentation, the artists were presented with three options for creating their own augmented reality content. They could either make it themselves with a web interface, they could build a scene under the tutelage of student volunteers with some experience in Unity and AR storytelling, or they could choose from a set of existing templates that would load their content. To leverage all three possibilities a bottom-up approach to the software design became necessary.

Unity organizes its projects into groups of scenes that contain instances of assets. These scenes remain isolated from each other. When a new scene is loaded any asset from the old scene not specially protected is unloaded. To emulate the functionality of existing AR web browsers such as Layar and Argon, I constructed several prototype

scenes[2]. These scenes displayed a single media asset such as a panorama still or a floating movie clip that can be explored using the gyroscopic sensor. Since many of the necessary functions between prototypes overlapped it was trivial to create a variety of experiences. Rather than determine the necessary design criteria for every artist and building the necessary data structures, the data structure emerged from building several prototypes and finding common sets of attributes. These attributes were loaded into an XML format and parsed on start-up into a constructor that was preserved between scene transitions.

Selection from List	Media Asset Type	File Extension
Movie	QuickTime Video	.m4v
Audio	Audio File	.mp3, .aiff
Model	Filmbox Model	.fbx
Panorama	QuickTime Video or Still Image	.m4v or .jpg
Website	URL for a webpage	http:// (Prefix)
Walk	QuickTime Video, Audio File	.aiff, .mp3, or .m4v
Scene	Unity Scene	.unitypackage

Table 1 Point of Interest (POI) Types

Once a proof of concept had been developed, I used the XML template to determine what attributes needed to be made accessible to the author. The web builder was constructed assuming that the GPS and Frame Marker POIs are used independently of each other: one for indoor experiences, one for outdoor. Loading a video into a GPS based POI creates a floating video plane at a location the user searches for by moving

[2] Allowing these users to duplicate and modify prototypes scenes for their own purposes is meant to

their phone whereas a video on a Frame Marker POIs would overlay the video directly on the marker. Authors indicate the type of experience to trigger at any POI from a drop down list (Table 1). For audio/video walks, the XML file is parsed for all POIs labelled "walk" so they can be presented on a map. Videos and audio are only loaded individually to preserve performance.

Figure 5 *LandslideAR* Map (left), David Han's The Rust in the Furrow Audio Walk (right)

By retaining the modularity of the scenes, I could import and integrate custom Unity scenes in the final build with little effort. To augment his physical installation *Homunculus Agora (h.*a*)*, Mark-David Hosale exported virtual representations of his 3D

printed sculptures and collaborated with two York University Digital Media students to import them into a Unity scene. This customized scene contained 42 instances of five textured and animated models superimposed over the installation space the gyroscopic sensor.

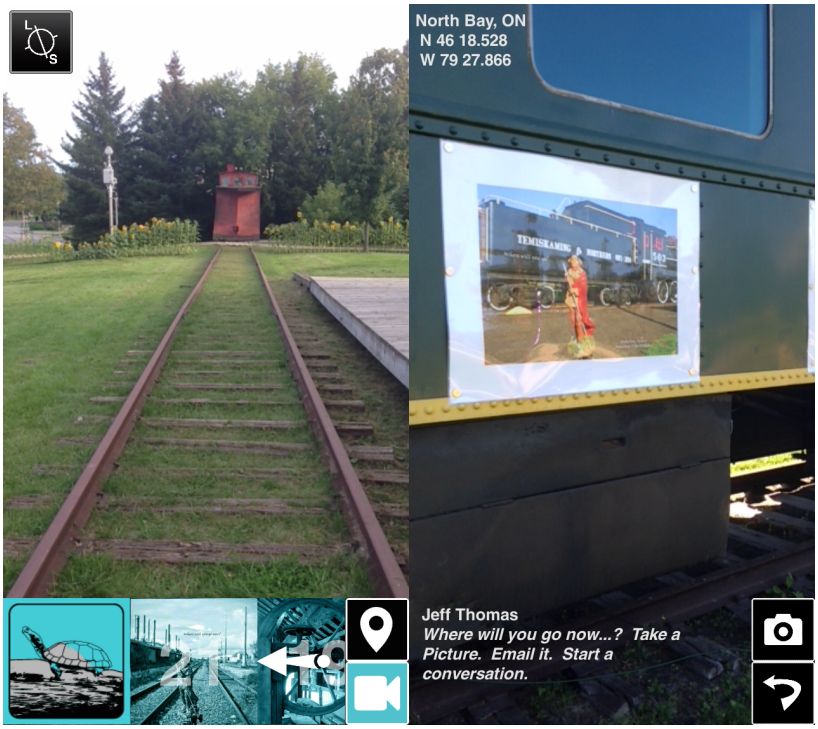

Figure 6 Camera View with Icons (left), Jeff Thomas's *Where Do We Go From Here?* with AR Annotations (right)

The app that visitors download has an intentionally minimal interface. The main screen or *index* (Figure 5 left) has a button in the bottom right to switch between the camera and map. The icon buttons in the bottom left representing each artist appear as you approach an artist's exhibit. If more artist icons appear than can fit on the screen the user can scroll the list of icons left and right. When an icon is tapped, the app loads the

artist's experience. All artist experiences are programmed with a back button to return to the index screen when the visitor has finished with the artist experience. This allows visitors to either experience an entire *walk* independent from the other exhibits. Similarly when a user points the camera at a black and white marker, such as those designed into the brochure, the list of artist icons would populate.

2 Distributed Authoring

The scope and nature of the project was simple in premise and technically difficult: any of the 30 artists who wanted to contribute content to the app could. To encourage creative and iterative engagement I created a custom web-based authoring tool. Based on the bottom-up, prototype model outlined above authors create simple experiences by assigning a prototype to either an outdoor (GPS) or an indoor (marker) based point of interest (POI). Authors upload videos, panoramas, audio (with visualizer), or an exported Unity scene (.unitypackage extension).

The content management prototype is set up for a single project and is moderated by a single administrator responsible for the final build. Each user creates a personalized password-protected account that allows them to create one or more POIs containing multimedia elements. An administrator has access to the encrypted system databases and their own control panel allowing them to download XML playlists generated for each artist account. POIs are associated with the user account name therefore every artist requires their own account. Information in the database is encrypted and sanitized to prevent MySQL injection. The site is written in PHP, JQuery, and JavaScript. Ajax is

used for asynchronous communication to the server so the form data can be saved without refreshing the page.

To create a GPS based POI, artists choose a GPS coordinate by clicking on a Google Map iFrame. Geo-fences of a programmable radius (default of 15m) exist around the coordinate. When the museum visitor with a GPS enabled mobile device enters the geofence, the POI is added to a C# List of active zones. The default screen or *index* displays a scrollable list of all active zones the visitor is within with every authors experience indicated by an avatar. *Land|Slide* artists were dispersed throughout the Markham museum site, but multiple POIs still appear due to overlapping geo-fences. The resulting app contained 116 points of interest ranging from websites, videos, audio tours, virtual models, and panoramic stills.

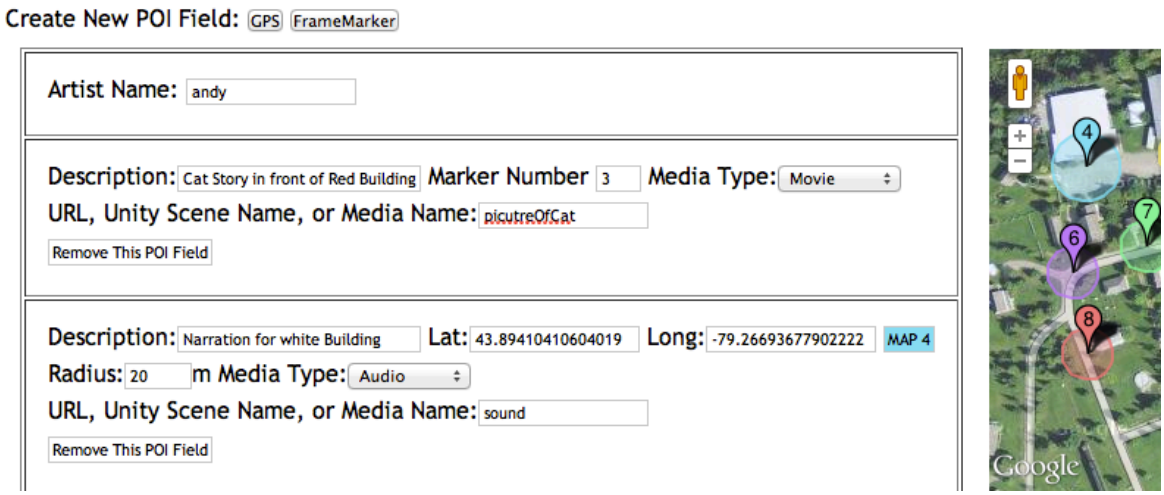

Figure 7 Web Authoring Tool with 2 Example POIs

In addition to GPS based POIs the app supports AR target recognition and tracking for use indoors. Black and white frame markers are used to reduce the processing demands on the device, but these frames have a limit of 512 distinct markers. I scripted an auto-release pool in PHP to ensure markers are assigned and freed as required while allowing artists to download the markers they would need to print and install. A button on the main interface allows the visitor to change between the outdoor map and an AR camera.

3 Spatial Narrative Structures

Several artists requested an app that would support narrative structures resembling both maps and tours. As a result of the iterative design process, those with specific concerns about functionality were consulted with about how they wanted the app to perform. Investigations into locative media storytelling apps were acutely influential. During a production residency at the Banff Centre in 2008, I developed a near-future science fiction AR experience called the Gremlin-infested Positioning System. The experience used geo-fencing but a computer generated tour guide filled the paths between story events with a narrative from a script. Drawing from this idea, I created simple geo-fences that could serve both to populate the list of artist experiences at a location and trigger media assets from within an artists experience. In this draft the author had no control over the playback of the clip, which was deemed a necessary constraint simplifying the amount of programming involved. Where artists requested complex

technological solutions that exceeded time constraints analogue work-arounds were implemented.

4 Spatial Narratives as Interactive Storytelling

In interactive storytelling (IS), the line between the effectiveness of the technology and the satisfaction of the end user in viewing the experience is blurred. Many theorists openly doubt the feasibility of effectively combining authorship with user agency to produce a satisfying narrative (Aarseth 1997; Lunenfeld 2004). Meanwhile the field of interactive storytelling is crystalizing around expert systems and conceptual models with varying degrees of user agency (Cavazza et al., 2002; J. Lugrin, Cavazza, & Pizzi, 1995; Lynch, n.d.; Seif El-Nasr, Milam, & Maygoli, 2013; Szilas, 2003). System designers discuss feasibility using terms such as "coherence" and "believability" (Riedl & Stern, 2006). Essentially these are discussions of the user's satisfaction with the experience and the story. Interactive experiences are meant, in general, to react to a user's feedback or input. But the implicit argument is that the interactive technologies should be in service to, or at least not prohibitive to, a coherent, believable, or satisfying story. Perhaps, as some researchers suggest, interactive stories can be programmed to react more intuitively by developing "elicitation techniques to help construct models of [user] satisfaction and/or behaviour" (Roberts, Riedl, & Isbell, n.d.).

The problem of satisfaction is addressed two-fold in the design of an authoring tool, albeit in limited ways. One way is through a conceptual restraint. Problems of internal consistency in interactive stories require premeditated "decisions about such

details as the plot structure and the technologies that will implement the experience" (Adams, 2013). Authors and myself discussed the programming challenges of interactive story design because "offering to participate interactively in the story events, expectations towards how the system should respond to inputs are necessarily put relatively high compared to a fully linear stimulus" (Vermeulen et al., 2010). While spatial narratives afford user agency in the navigation of a story space, we encouraged authors to supplement the narrative structures non-programmatically, creating relatively linear experiences using maps and tours. The second design decision is outlined below.

5 Intelligent Agents

Because at this stage it is not possible, nor desirable, to create all-purpose, prefabricated intelligent agents, the goal of these tools is to allow the greatest amount of flexibility that works with artists' current practices using intelligent agents. In this preliminary iteration, the tools are designed with spaces to incorporate autonomous programs by allowing direct access to the Unity editor, including scripting. Server-based autonomous programs (such as Apple's Siri) or Wizard of Oz techniques are permitted through networking from Unity using .NET sockets in C#.

Though many AI techniques are considered for use in interactive storytelling, intelligent agents provide a popular model for a system. The advantage to the rational agent approach is that agents are expected to behave to optimize their performance measure. This approach makes it easier to evaluate an implementation for indicators of success. The trade off is that there are no simple answers to what constitutes a *successful*

story, only perhaps a *satisfying* experience. In a widely influential text, the definition of an intelligent agent rests entirely on expected utility measures:

> "For each possible precept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built in knowledge the agent has." (Russell & Norvig, 2003)

This definition permits a practical approach to building intelligent agents including the simple, state-based, search and reasoning agents commonly referred to as game AI (Millington & Funge, 2009). Intelligent agents can also refer to the use of human proxies in place of complex programs to test the suitability of a system. This is known as the "Wizard of Oz" technique (Dow, Macintyre, et al., 2005; Kelley, 1983; Maulsby, Greenberg, & Mander, 1993; Poschmann & Donner, 2012). While the end user experience may be identical to interacting with an intelligent agent the system design for supporting input from a human proxy is often significantly different.

Three options for the authoring tool based on commonly implemented examples were considered:

1. The use of intelligent agents as characters in a narrative space (Dautenhahn, n.d.; Mateas & Stern, 2002; Rank, Hoffmann, Spierling, & Petta, 2012; Vuono, 2008).
2. The use of intelligent agents as a guide through a spatial narrative (Abowd et al., 1997; Lim & Aylett, 2007; Richards, 2012).
3. The use of human proxies in place of intelligent agents (Dow, Lee, et al., 2005; Maulsby et al., 1993).

Because the current implementation of intelligent agents as characters has largely been in the form of expert systems that are not at the time of writing widely available on multiple platforms, option 1 was discarded. Given the number of possible instances of using intelligent agents and the idiosyncratic nature of many expert systems the decision not to focus on prefabricated intelligent agents saved valuable time and resources. Rather than incorporating intelligent agents into the mobile app or using Wizard of Oz techniques to guide their users through a narrative or provide characters to interact with, the artists instead gravitated towards relative constraint of narrative. The lack of agents used in the mobile app at *Land|Slide* is not unexpected. Designing the tools to incorporate intelligent agents lead to the construction of more advanced experiences and paved the way for future iterations to incorporate systems that fall within the three categories outlined above.

B Interviews

This section outlines how users were chosen for the study, and the structure of the questionnaire and the interviews. Rather than conducting usability inspection methods at in a controlled environment, I tested whether it was methodologically practical to determine a context of use and satisfaction measures for future heuristic tests using survey data and biographical information. I present the technobiographical data from five interviewees[3] in an abbreviated format to outline the subjects' personal stories about

[3] Pseudonyms are used to preserve anonymity.

working with storytelling technology. In accordance with the technobiographical methodology, I state my own position and relationship to the interviewee to "highlight the partiality and locatedness of the researcher's point of view" (Kennedy, 2003). This is compatible with the methods of rigour stated in Ch. 1 P. IV (*Methodology*).

The technobiographical methodology outlined by Kennedy is largely an autobiographical exercise and recent adaptations of this method have turned to interviews for collecting phenomenological data. I therefore relay long portions of interview text in order to let the interviewee "speak for themselves as much as possible" (Maykut & Morehouse, 1994). Interviewees requested their natural hesitations and pauses removed from the included text.

The interviews were performed in two parts: interviews with *Land|Slide* artists and interviews with artists and researchers working with artificial intelligence and authoring tools for creation spatial narrative structures. The intention is to compare the answers of *Land|Slide* artists using the tools provided with the strategies, behaviours, and workflows of researchers who used advanced tools for creating interactive narratives. Because of time constraints, the interviews with the more experienced sample started before the interviews with *Land|Slide* artists.

1 Participant Selection

Participants were recruited in three stages. Artists exhibiting works at *Land|Slide: Possible Futures* were asked to participate in this study. Many of the 30 artists showed an interest in working with augmented reality technology early in the process and about

15 artists contributed points of interest to the app. Artists were then emailed three times after the exhibition using an online survey tool asked to fill out a questionnaire. Artists who filled out this questionnaire were asked if they would consent to a follow up interview. Those artists were then interviewed either in person or through video teleconference. Finally, the last group I hoped to contact consisted of artists and scientists who previously published artistic or scientific works that include artificial intelligence and/or narrative structures. They would be contacted and asked to participate in an interview.

The interviewees were all known to myself in advance and had been engaged, as colleagues and peers, in discussions about technology over the last seven years. They were unaware of the subject matter of this research project. There are no financial ties between the interviewees and myself. I do not intend to draw wide reaching conclusions from the data collected.

2 Interview Outline

The interviews were unstructured and were intended to encourage the participants to speak freely. The preamble was consistent between interviews:

> "This is a conversation about your interests and workflow. If you have particular insights about the tools and techniques you use, I might ask you to expand on those areas as much or as little as you like."

A checklist was used to guide the study with time codes recorded during user responses, though the interviewer incorporated few of the words from the outline in the

questions. To avoid accidently priming the interviewee, the questions began as non-specific and began with cursory identification of the relationship between the myself and the subject. I deliberately avoided technical jargon and proper names until the artist instantiated them in the conversation. Artists in *Land|Slide* were asked about their involvement in the exhibition. The professional was asked "how this conversation sort of got started in the first place". The "conversation" refers to his interest in the work at the Augmented Reality Lab at York University to inform his own practice. Having identified himself as someone who had experience with storytelling and intelligent agents, I asked if he would freely consent to an interview.

3 Context of Use

I assumed technobiographical methodology would be straightforward to use a thematic analysis to determine whether or not artists felt their interaction with technology had entered into their own biography. I believed I could conduct before and after interviews with artists who would be engaged with an authoring tool for a period of time. This plan was rejected because given the uncertain sample (artists deciding at the last minute whether or not they had time to add to the app), conducting interviews on every member of the population was deemed unfeasible. This approach was also made redundant by the need for a proprietary app for *Land|Slide* project. Since the tool I would need to build did not yet exist it could not possibly be part of the intended users biography. A follow up questionnaire was sent to indicate if the authoring tool had entered into the users personal narrative.

- ***Interview Guide***

By comparing contexts, we can both produce qualitative usability testing guidelines as well as unique individual contexts of use that permit "a greater understanding of how socio-technical structures are experienced" (Kennedy, 2003). Checklists for *context of use* are outlined in (Bevan & Macleod, 1994) in accordance with Figure 3. The following checklist was used for the long form interviews to aid thematic analysis:

> User Data - history, background, interests, experience level, existing techniques
> Task - Outcome, goals, hopes, ambitions, specific areas of application, future technologies.
> Equipment - Hardware, software, current tools, hardware setups, imagined end user interfaces
> Environment - "Who do you work with normally?", "How would you describe that relationship?", "Any external revenue sources for funding projects?", The current workflows and obstacles that might describe environment they work in, "Any groups or professional affiliations you belong to that you discuss your work with?"

The questions outlined here were not often asked directly as the interviewees were open to sharing about their own work and practices. Drawing from technobiographical studies, the method emulates an ethnobiographical study by "beginning the interview with an open-ended question [...] then following up with probes about topics like specific tools, practices, and contexts" (Ching & Vigdor, 2005b). Time codes were recorded by theme as topics were mentioned.

Chapter 4
Results

I attempt to ascertain whether the technobiographical method can reveal personal details useful in developing heuristic models of usability studies that account for highly specific contexts. In this section I provide large excerpts from the interviews to provide biographical information relevant to their interest in the software or to the use of intelligent agents. I then provide a thematic analysis in order to illustrate commonalities between interviewees for the purpose of creating context specific heuristic testing methods.

I Interviews as Technobiographies

The technobiographical method used here outlines a broad range of ideas about the use of the authoring tools and the artists' own workflows. This data provides a broad range of perspectives about technology, the authoring process, and the interplay between user agency and narrative structures. While the use of technobiographies allow for a wider breadth of data it should be cautioned that the data is only being used here as guidance towards small incremental changes in the design of the system. Because the opinions and topics discussed can vary widely, the collection of biographical data here is only a first step towards future tools for refining the development process.

A "Stephen"– Artist, Filmmaker, Technician

"Stephen" is an artist who works predominantly in the medium of cinematic projections and installation art. He was interested in building a locative storytelling experience for *Land|Slide*. I have known "Stephen" for seven years and he inquired early in the development process as to the capabilities of the tools:

> *Stephen*: I think that part of my interest in working with the technology was thinking about the way in which the site itself as a museum, and how museums in general, incorporate these kinds of technologies and the way that they deliver their content to their customers. The public. You think about the museum audio guide, which is the form I used for my project. I was interested in using their technology to mimic that pre-existing form. And one of the things I was interested in– of the technology and the formal quality the technology was this idea that the technology in itself, this app that's on your phone, that's this high tech piece of software, lends a sort of authenticity to the content, regardless of what the content is. It's almost like if you deliver it in the right way, the formal qualities of the technology itself lend an authenticity to the content. And so I was really interested in that concept. So that was one of the reasons I gravitated towards audio only and this specific technology.

He investigated other locative projects and inquired about the technology used in building the *LandslideAR* app. Prior to that he approached me for consultation in the field of locative media. Some of these early conversations inspired some of the features of the mobile app, so by gleaning information about his ideas, the app started to take a particular shape:

> *Stephen*: I consulted with you, I sat down with you, I picked your brain, about what was feasible, because I knew that you personally had a lot of experience working with these technologies. So, it was more like, "what platforms should I investigate?" and I went off and investigated them on my own, what was out there in terms of what you were building for the actual exhibit and how it actually worked. I think we had a conversation

> sometime over the summer, where you kind of sat me down and said this is what I'm building and this is how it works. After that conversation when I had a pretty clear understanding of exactly what you were building, specifically the tool you were building, then it all kind of fell in place in terms of what my project was going to end up being. So in a lot of ways if you think about the process, I had this general idea what I wanted to do, kind of generally knowing what technologies I wanted to incorporate but then when the tool was presented to make it I kind of tailored the project to fit the delivery method, basically– the technology that I would be using.

As an artist working with the authoring tool, I asked "Stephen" for some cursory feedback about its perceived usability and the usability of the app:

> *Stephen*: I found it super easy to use, everything was sort of right there for you, and I think there was only one time I ran into a little bit of an issue and I remember you and I were like chatting online and you were walking me through the process in terms of getting the media online, and attaching the GPS locations and kind of explaining what was happening on the backend, so I could have a better idea of how to use the front end. I was very impressed by just how easy it was to use, how the front end was presented to me, and was very user friendly. [It] allowed me to upload my media, as long as it sort of fit within the constraints of the larger project, so we had that discussion about file sizes and optimization, which is a conversation which *I'm* comfortable having, and once I had an understanding of that, the larger picture of that application and the deadlines, I was able to very quickly and easily put my media on. I was really impressed by the fact that 3 days later I could get the app, and *use* it. It was pretty amazing if you think about the complexity. I know at least a little bit of what the complexity is in the back end. There were a few things that I probably would have changed, I think I mentioned them right at the beginning of the exhibit–
> *Researcher*: You can feel free to mention those again.
> *Stephen*: I think it's worth going over. I was completely complicit in why it was the way it was, mainly because I put my media up a week before the exhibition opened or two weeks or three weeks or whatever it was. One of the things in terms of the audio walk, just in terms of the way the interface took you through, at least from my perspective, once you were in my audio walk the screen stayed on my audio walk, which I liked. What I didn't like was that it would start playing the file as soon as you were within the range. Because what ended up happening was,

> just because of the nature of the walk and how I needed the walk to work conceptually, was that often you would be passing through other zones, on the way to the next stop and you kind of had to do my walk in order. You didn't *have* to, and it wasn't necessary, but it was really best experienced– it was really designed to be experienced in this linear way which I realize is probably in retrospect not the best way to approach a locative media project, because obviously as people move through the city, or any space for that matter, they're going to move through that space in any which way they're going to want to. Whereas, you remember what I said, this was designed to mimic the museum audio guide, which is a very specific path through a museum and a museum exhibit is physically designed to make visitors pass through it in a very specific way.

This statement reveals a potential conflict between the two conceptual models of simplicity and user agency that are mentioned by other interviewees. It indicates a need for understanding the collaborative context of the app and the technical requirements for file compression and management (which could be automated in future iterations).

B "Susan"– Artist, Instructor

"Susan" has a varied arts-based practice including sculpture, print making, and digital storytelling. Her work at *Land|Slide* began as a film and emerged into a number of related projects that spoke to the exhibitions theme and location:

> *Susan*: So originally it was a much smaller scope, but the sort of core kernel of it was that I wanted to reflect on, since my narratives and my understanding and my memories of spaces had changed my practice so much, I wanted to open that up and bring in the narrative of other community members. What happened when I then opened up to looking at how things change over a generation, what that would bring into the process. I interviewed people with the original intent to make hand printed maps that we could create walks through the sites that people remembered engaging, playing with as children, those who grew up in the area, so we had I think 25-30 participants. They all grew up in the area, some still live there some had moved away. [...] The original intent

> was that from the interviews I would make maps and allow people who came to the exhibition to pick up the maps find a way to access going to the suburbs, with finding these green spaces, being able to reference notes on the stories or the memories that people had of them and almost trying to recapture that whimsy that people had when drawn to these sites. But someway along the process we decided to digitally record all the interviews of all the people we got to tell their stories, and at the end of that we had so much footage we ended up making an hour and half feature length documentary out of it. Which I thought was interesting because it brought in a perspective about really how the land use had changed, because by simply asking people across different generations how they remember the landscape as children, you realize the drastic changes that have happened. The oldest man talked about "Oh, I didn't go out and play outside, I worked on the farm, my experience was agricultural". You'd ask someone in their 50's and they'd talk about the big open field they used to play in and they used to be farms. And then you have an 18 year old who then shows us pictures of the area that she used to play in that was actually a construction site which hadn't been developed for years but now is gone, but she flipped though pictures on her iPhone to show us the memory of the places she played. And so of course she had the totally mediated relationship to it. [...] So at the exhibition, I had the documentary playing on a loop that people could come into and access wherever they came, the maps they could pick up, there was also a Korsakov interactive version of the documentary and that was really a way people could kind of customize their experience with the content while still being onsite, so almost reproduce what would happen when they picked up the maps. The content of the map wasn't so much about the sites themselves though it was– and so I think that would connect more to people who were unfamiliar with the area at that point, it was more like "this was a big tree I played in" and "this is a big body of water". The three different formats allowed to mimic how you could maybe connect through different forms of mediation through these sites or maybe how different peoples' memories kind of compartmentalize these differently.

She incorporated the videos from her work into the mobile app to create an "open-ended" experience which she hopes to develop into its own application in the future.

C "James"– Researcher, Artist, Assistant Professor

"James" is an artist with a work exhibited at *Land|Slide* but did not produce content for the mobile application. His work included an intelligent agent that referenced the museum hosting the exhibition thematically. He is included as an expert designer of intelligent agents as well as a *Land|Slide* artist. The system at *Land|Slide* employed:

> *James*: An artificial agent, so it's kind of a non-player operated agent, or NPC they call them, non-player character I think is the actual term that they use for them, and that's more applicable to games, like World of Warcraft. In a virtual world setting probably it's more appropriate to call it an agent, because they are not necessarily game characters. So myself and [name omitted], a research assistant that I hired from my program in multimedia at [organization omitted], we started to develop these artificial agents which would have multi-purpose [sic] in an art and science group so people could use them for anything, from artistic works to pedagogical purposes, even say for a canned kind of research interview project so you always have consistency of action and questioning, etc. So they act as guides or interlocutors in some way. So this particular bot–so these are called 'bots' then, it's another term– it's a character that has the ability to respond to queries or conversation, and we have a couple versions. The one that was installed at *Land|Slide* is a text communication bot, so you type instant messages to the bot and the bot hunts for keywords in your question and then matches that to certain conversation threads, and it will then match your key terms. If one of your questions has the word "who" and then it has "Roth" in it, it will assume, "Who is Andrew Roth?" and it would provide information about the artist Andrew Roth based on the biography that was supplied to the exhibit.

"James" is primarily interested in the performative elements of AI in particular intelligent agents such as simulated "bots" and physical robots because:

> *James*: True AI– you know I don't think we're anywhere near that anywhere in the world. But we're getting much, much better at the performance of AI. And the performance of AI would be something that I would be hoping to improve upon. And improving upon that you know from an artworks point of view one related robotics project that we've

> been working with is [project name omitted] which is a robotic art critic, so it tours around galleries and photographs the works and captions text onto still frames of the works and then tweets those. And one of the interesting things that we're trying to do with that is take these great critical art manifestos from the past and rework them into word salad. So the [project name omitted] right now has the futurist manifesto, and it uses a mathematical algorithm, it's called the Markov chain algorithm, to look for frequency of word combinations and depending on how many nodes in the chain, or how many links in the chain you set, you get more or less grammatically viable sentences although completely nonsensical. [...] So what you have is this very kind of passionate, didactic, but insane art critic, making really bold statements about the death of the museums and "glory to the machines" and stuff like that.

I asked whether he considers narrative or storytelling as important to these works and his response was affirmative:

> *Researcher*: Would you say that narrative or storytelling has any part in your own research or your own artworks?
> *James*: Definitely. Conversation, dialogue, I see it as a narrative. It may not be distilled narrative but it certainly is the raw ingredients of narrative. And I would say these works, say with the manifestos incorporated, instantiate a narrative. For example, with [project name omitted], one of the things– because it was somewhat randomized image capture with the bot– it's basically on a floor sweeper just you know kind of lolling around the gallery– and people were saying, "Well, how does it know what's an artwork in a gallery?" And they'd say "What if it just took a picture of a light socket or a white wall?" Of course you're laughing because that's immediately summoned the narrative of "What is art?" and you probably know of at least a couple of instances where the white wall or the light socket have actually been the artwork.

He identifies several technical requirements for a system that bring into question the boundaries between a completed *project* and the *goals* of the author or *user* (Figure 2). When asked about a graphical user interface built into his work at *Land|Slide* to allow refinement on the fly, he replied:

> *James*: I like the idea a lot, because to me it says the work can be dynamic and unfinished and hopefully unfinished in a good way. That you could carry on tweaking it even in an exhibition setting. I think that'd probably be the main advantage there. [...] And there's a history to that too. I forget which painter used to go into a gallery and touch up his paintings. [...] I can think of a really good example. With the bot there are some times where we could log in and we could actually– and this is just by coincidence– we just happened to be in there when people were interacting with it. I think I was having a conversation, I think I was showing somebody the work, and I began in real time to do the you know Wizard of Oz kind scenario, where I took over and was texting to the person, so suddenly the thing got really– well, *more* intelligent, than the actual program.

Given this anecdotal evidence in the context of a larger body of literature the substitution of key processes by a user by means of the "Wizard of Oz" technique would seem to be an essential part of any prototype system. In evaluating the distribution platform for a spatial narrative experience, a lack of ad hoc software compilation or file browser might be a key limitation of using a mobile device for experimental software.

D "Jacques"– Musician, PhD Student, Composer

"Jacques" was both a member of the AR Team for assisting artists with their projects and he also collaborated on a *Land|slide* installation. He identifies a possible use case for user interaction, possibly with the aid of an intelligent agent, discussed in early project designs:

> *Jacques*: This whole experience with AR and [course name omitted] has really got me interested in the area of experience design, and made me really think about all of that from a lot of perspectives. From an entertainment perspective, from a marketing perspective, from an educational perspective, and so the whole time thinking about the app I'm trying to think about the end user experiences and what I know about this technology from other settings, particularly art settings. I see these

> sort of apps used, they often seemed under-utilized. Like there are so many things that could have been done but they've just scratched the surface with it and my hope was with this app it could have gone beyond scratching the surface and done a lot of cool things. There were a lot of hopes for things that I wanted to do that we just didn't get around to, like, what you and I had talked about, about micro-curating, where people pop in a couple of things that they are interested in and then based on the words that they choose, a micro-curated experience would be spelled out for them. So the path would be there, telling them the different artists that they'd be going to see, and it would give them a sampling of a lot of what they want and a little bit of what they need.

He was influential in the design of the web builder and app interfaces, offering feedback and testing its usability in his spare time as part of his role in mentoring artists:

> *Jacques*: I tried to find– I can't remember any specific strategies. I was constantly trying to dig around and download other apps that – that I could look at and say, "okay, this worked well" and this is why and "this I don't think works well and this is why". But there didn't seem to be a lot of it that I could actually use, right there, without going to the Guggenheim or the MOMA and actually walking around with it, but then just remembering some experiences, like years ago when I was at the MOMA, they could – the WiFi was set up, so that– and at the time I just had an iPod Touch, where it could connect the WiFi and there would be mini bits [sic] of information here and there. And try to think about I felt about that and was it useful, was it not useful, was it engaging, and um– and I was always trying to think about how this app, it would be an add-on, it wouldn't be a distraction, it wouldn't be kitchy, not a gimmicky thing, and it would add a little bit of a fractal experience to all this stuff where if people visited an arts installation and they wanted to go deeper, and the artist wanted to present and provide the uh– the content or material to allow the user to go deeper then they would be able to do that, but if they didn't, nothing lost.
> *Researcher*: Right, so you mentioned simplicity though, is something that you–
> *Jacques*: Simplicity in terms of the interface that it would be intuitive. That's what I mean. Well, elegant simplicity in what it– in being the [company omitted], well, the old [company omitted], elegance in the user experience, so that there would be no question as to what you'd do next. You know always try to strip things away and go back and say "is it

> simple enough" and try to simplify it more if you can, uh– the fewest steps possible, all of that sort of thing.

Jacques and the rest of the team provided informal heuristic usability feedback about the online authoring tool to improve the usability of the interface.

E "Mark"– Filmmaker, Videographer, Producer

"Mark" was not involved in the *Land|Slide* project but because of his background in interactive storytelling was asked to participate in an interview. "Mark" has been interested in interactive storytelling (IS) and collaborative script making for close to 36 years.

> *Mark*: Historically I think it was CoEvolution Quarterly in 1977 or eight, came out with a thing on Dungeons & Dragons and immediately it popped into my head and I thought, 'well, this is a way of developing open-ended stories'.

His first experience with a system of intelligent agents used for storytelling came in 1996, after a friend told him about software from New York he'd seen at SIGGRAPH:

> *Mark*: It stripped out subject-verb-object elements and then used those to either direct action or to point to the characters by name that would then act. So you could ask someone to go over to the bar and get you a glass of beer and they would come back and bring it to you. And I went, "Oh wow." In terms of interactive cinema that's a major thing because it's happening in real time and it's interactive, right?

"Mark" is still looking to build or repurpose a system that can enhance "collaborative script making" for performing "cultural simulations" and creating fictional works. While discussing his early strategies for working with the community theatre

group on social issues, he identifies a possible use case, and challenges, for an IS authoring system:

> *Mark*: The whole thing behind it originally was if you could do cultural simulations and you could run stories, then it's also a learning tool and it's a tool for developing strategies for acting in the real world. So that's basically it. So how do you get the input to drive–to build the simulation and drive it, without having to sit in the back room and do it?

Early experiments also indicated a preferred workflow that compliments, rather than fully replaces, the writing process:

> *Mark*: I came across a guy in Sweden who was programming around linguistics and he said "well, yes there's one person who's written a story engine that can do what you want it to do" which is to feed the material in that would direct the actors, which was Chris Crawford who had built, what I think was called the Erasmatron, then. So I got in touch with him and arranged to get access to his C code that he'd written for the engine, and bought a second hand Mac."

His investigations of IS technologies, particularly in contrast with the work of other artists in *Land|Slide*, help to illustrate some affordances and constraints of the *LandslideAR* mobile app and web authoring tool in Ch. 5 P. I (*Discussion – Developing Design Heuristics*).

II Thematic Analysis of Interviews

A Context of Use

A thematic analysis is conducted to illustrate commonalities between the artists and how they can be used to build a context of use for context sensitive usability design

and testing. “Mark” prefers to be able to “tinker” and incorporate systems and code form other sources:

> *Mark*: I think that that’s important, just in terms of keeping your steam up and actually being able to try things out, bits of things out, as you build them. Try them out. See if they– see how people use them, and whether they are usable or off the wall or whatever.

This hands on approach is mentioned less explicitly by “Jacques”:

> *Jacques*: There’s a lot of drag and drop to work in a basic way with it, obviously it’s the user– the design experience is really scalable and I was just scratching the surface all the way through, and I learned a lot a long the way. A lot of the issues I did have I would constantly turn to you to set me straight, point out simple little things, that were simple things, but I was overlooking and overlooking that one little step just would just make none of it work. So prior to Unity I’ve done video editing and done a lot of recording, audio recording using pro tools and logic, and a variety of software programs and plugins and all sorts of things so I had some experience with things like that but translating it to the visual experience was very different but very enjoyable and very, very satisfying.

“Stephen” was less explicit about his own desire to work hands on with technology:

> *Stephen*: I wasn’t too intimidated by tackling new technology.

Susan was appreciative of her colleagues expertise but, despite her own technical competence, felt that it was more important to collaborate:

> *Susan*: Am I probably going to seek out further education to do these things? [laughs] Probably not. I find it more interesting when working with people who think of things in certain ways, who are more native to these technologies, or have a line to more with thinking with the capabilities within them, and then finding where the ways of thinking come together. So am I more familiar with them, maybe slightly, but I came to be more familiar with the possibilities, not necessarily how to do it on my own.

Four of the interviewees discuss the social processes of refining idea into a work:

> *Mark*: Improvisation [...] sort of pairs in what I did in '84 and also in 2000 - 2001 in terms of improvising around the Dungeons and Dragons, in inverted commas, script generation model. But also we hosted the [theatre group name omitted] in [country omitted], who came out to workshop with [community omitted] there and that's a tool for building scripts around community issues, and positing solutions to them, by starting by getting audience feedback. It'd start by doing a still pose of a particular situation and so, some guys drunk and is about to beat his wife up or something like that, right? So they posed it as a still and then from that they build out into the story and that's the current situation. They build on flow from that to a possible solution. So that's like collaborative script making.

> *Susan*: It's not that I don't want to learn how to do them myself I think I'm just sort of realistic that I probably won't figure it out. Because even when I do– like if I do a screen print it's so easy to do it all in Illustrator, to layout your images, but I'll do it in Illustrator for a little bit and then I'll press print and then I, for some reason, have to go over it with a pen and then I have to scan it in. So I have this way of working, that I need to make it tactile in the process. So I think it works really well to collaborate with other people who, sort of these, I don't know if you would call them coding environments, you know, kind of can visualize them in a different way [sic]. And I think it's also surprisingly easy discussing things with you, or speaking with [name omitted] who I worked on with Korsakow, it's not like we were speaking totally different languages, it was like really seeing where these intersections are, which was exciting because you don't want to have an idea for a project and be discouraged that "oh, I just don't have the skills to do it" right? And you don't want to just be like, "hey, you, you have the skills. Do this for me." You really want to see where that conversation can take things to build something new.

> *Stephen*: I always have lots of discussions with people around work that I'm working on, whether it's conceptually or on a technical level.

> *James*: This process of refining the artwork is social and it depends on conversations and feedback with my peers

"Jacques" describes a formalized collaboration method for works he calls "intercurrent". Visuals and music are composed in reaction to each other at various stages of refinement. Because all five have identified an interpersonal process of refinement as a part of the development process, it is worth studying the effect of being involved in the creative development of software as part of a community increases user engagement.

Each interviewee indicates some of their originally anticipated goals for working the technologies they identify:

> *Jacques*: I just created these immersive walks that referred to some literature some film some different experiences that I'd had and just tried to juxtapose things and that kind of immersion was very interesting and attractive to me. And also to be able to use *sound and music and compose original soundscapes uh to it and voice overs and layering of audio helped to create that immersive experience*, I think– I hope.
>
> *Mark*: So, I got a job as an artist in residence for a year, and didn't get it done then, but ended up in [country omitted] and got funding to do a short experimental thing based on Dungeons and Dragons roughly, but what I realized was that Dungeons and Dragons is epic, and has lots of characters in it, right? [...] So to make it more manageable and more filmic it would be better to adapt it so that you had fewer characters and it was more character based. I did that by finding it–when I worked in [city omitted] as the artist in residence I spent probably 8 months shooting *a documentary using role playing techniques* inside a prison and using volunteer actors and it was really hard to schedule anything and took forever to do.
>
> *Stephen*: So *then the choice to incorporate physical artifacts into the project along side the audio* really made a lot of sense in terms of the site, so the buildings are these physical artifacts of the past and they have a story just by existing, by being there brought together in this specific configuration. And so the physical artifacts kind of mirrored that, the physical artifacts stood as physical manifestations of a story. And so I

> tell this story of this character, this person that existed through these physical artifacts.
>
> *Susan*: I really like to see when we brought in the content of the maps into the app, that to me it mirrored itself so well because it was very much like an illustration of *that mediation of the experience that probably so many people experience*. Like that teenage girl flipping through her phones [sic], to show me uh, you know, the lot that she used to hang out in when she was younger.
>
> *James*: They do kind of hold up half of the conversational bargain by *continuing the performance of conversation*. So that's an important feature.

These passages (emphasis added) outline key project goals in past or existing systems. These statements also indicate the context of use of a project to which the goals and usability measures, such as satisfaction, would be influenced by.

B The Use of the Authoring Tool

A cursory analysis of the interviews reveals a varying amount of feedback on the performance of the authoring tools themselves:

> *Jacques*: It was intuitive, it was simple, once we worked around and tried to streamline and simplify little things– simple things like placing things in a certain order, on the left or the right, and the colour coding, these little things that we didn't think about at all. All these little things, they made a huge difference. [...] And I think the artists that I talked to, their experience was pretty simple too. None of them had any questions about functionality and usability at all.

The absence of feedback from authors/artists cannot currently be explained but there were reports of inconsistent communication between the AR Team and authors/artists in the weeks leading up to the apps release date. "Stephen" provided

candid feedback about how he felt the authoring tools met his own usability requirements:

> *Stephen*: I think, I found it super easy to use, I mean [laughs] it was like, everything was sort of right there for you, and I think there was only one time I ran into a little bit of an issue and I remember you and I were like chatting online and you were walking me through the process, and in terms of getting the media online, and attaching the GPS locations, and explaining what was happening on the backend, so I could have a better idea of how to use the front end. I was very impressed by just how easy it was to use and how quickly, basically how the front end was presented to me and was very user friendly, and allowed me to upload my media, as long as it fit within the constraints of the larger project, so we had that discussion about you know file sizes and optimization and that kind of thing– which is a conversation which I'm comfortable having. Once I had an understanding of that, the larger picture of that application and sort of the deadlines and all that kind of thing, I was able to very quickly and easily put my media on. And I was really impressed by the fact that literally 3 days later I could get the app and use it. And it was pretty amazing if you think about the complexity– I know at least a little bit of what the complexity is going on in the back end. There were a few things that I found that I probably would have changed. I think I mentioned them to you right at the beginning of the exhibit–
> *Researcher*: You can feel free to re-mention those again.
> *Stephen*: I think it's worth going over, just because there were things that I would have changed but I realized I was completely complicit in why it was the way it was, mainly because I put my media up right a week before the exhibition opened or two weeks or three weeks or whatever it was. One of the things in terms of the audio walk, just in terms of the way the interface took you through, at least from my perspective, once you were in my audio walk the screen stayed on my audio walk, which I liked, but what I didn't like was that it would start playing the file as soon as you were within the range. Because what ended up happening was just because of the nature of the walk and how I needed the walk to work conceptually was that often if you did the walk, you would be passing through other zones, on the way to the next stop and you kinda had to do my walk in order. You didn't have to, and it wasn't necessary, but it was really best experienced, it was really designed to be experienced in this linear way which I realize is probably in retrospect not the best way to approach a locative media project, because obviously as people move through the city, or any space for that matter, they're

> going to move through that space in any which way they're going to want to. Whereas, you remember what I said, this was designed to mimic the museum audio guide, which is a very specific path through a museum, and a museum exhibit is physically designed to make visitors pass through it in a very specific way. I guess that those two things kind of came head-to-head and what ended up happening, as you went through the audio walk, you'd be triggering sounds before you'd really want to hear them– or how I'd like people to hear them. The other part was– the idea was that the audio was attached to these physical objects, and so, I wanted people to walk up to the display cases and then walk up to the audio, not just have the audio triggered when they're just kind of near it, and I realize I could have adjusted the radius, but then the problem with that is that it became very hard to trigger it, and also, depending on the sort of range, it's not down to the inch, in terms of the GPS coordinate, so there's a little too much range,

"Jacques" provided anecdotal evidence to regarding the usability of the *project* on older hardware:

> *Researcher*: Did you end up using the app yourself?
> *Jacques*: I did, yep.
> *Researcher*: What did you think? What were your impressions of that?
> *Jacques*: Well, part of it was that I have an iPhone 4, and it wasn't very effective on the iPhone 4, so I tried it a few times but I just had to give up, because it was optimized for the 5, right? Or even the 4s. And the 4 was clunky because it was an older, you know old device. So I didn't have the experience I wanted to have unfortunately and I just couldn't bring myself to go out and buy a new phone.

"Susan" framed her relationship to the web builder interface in terms of how it facilitated collaboration:

> *Susan*: And then of course with the app that you were working on, I actually found it really user friendly when you sent us that page of "upload these things" because it made me think of the first version of Facebook where you had to upload each photo individually. So I understood that, I could get to that, but I actually found it a confidence booster, that it's like "oh wow, I can actually work with other people who are doing these things and these ideas translate and its really a

> collaboration of skills to kind of bring these projects together." So, yeah, I found it like empowering to be able to realize projects in that sense.

The *LandslideAR* app was launched with 116 points of interest to augment their installations, which included several spatial narratives that could only be experienced on mobile devices. The large number of points of interest worked well for the prototype application but illustrate a problem of scale with the systems handling of collaborative elements.

III Summary of Technobiographical Results

The technobiographical method was originally developed to describe the breadth and complexity of relationships between users and technology. The five biographies presented here can be presented as stakeholders in the authoring tools with differing positionality. "Stephen" had a deeply invested interest in building a spatial narrative with the authoring tool for one particular project. "Susan" expressed a desire to use the interface for authoring a spatial narrative and has since proposed repurposing the project she built with the tool into a standalone application. "Jacques" was integral to developing the tool and has plans for its further development. "James" expressed an interest in tools that support the performative aspects of intelligent agents. "Mark" has an interest in using narrative authoring tools with intelligent agents for generative script making and cultural simulations. It is reasonable to suggest "Mark" and "James" are stakeholders as the development of the tools could impact them directly if they are further developed and released as planned. Each interview also describes cultural influences on

the context in which they develop their work. "James" describes the "pedagogical" and artistic provocations of his work. "Jacques" points out experience design as a focal point for his investigations, attempting a multitude of perspectives from education to marketing. "Stephen" points out he power dynamic at play between the museum, its "customers" and the technology that mediates that relationship. "Susan" delineates the relationships of the people she's documented according to generational identifiers. "Mark" describes ways he helped facilitate "cultural simulations" around community identified social issues using improvisational theatre techniques. This influenced his investigation of generative script making for collaborative, interactive storytelling. Each distinct cultural context exposes many possible vantage points from which to understand technology and authoring tools– from the artist, to the end user, to the subject of their own inquiries.

The thematic analysis, in emulation of the more recent adaptations to the technobiographical method outlined in Ch. 2 P. VI (*Technobiographies*), reveals common uses and expectations that can inform future development of the authoring tools. From these interviews with stakeholders we can see similarities between the contexts of use as well as direct feedback about the authoring interface that can be used for future development. The feedback and in particular the commonalities, such as the ease with which the tools can incorporate existing code, can be used as guidelines or heuristics for future testing.

IV Spatial Narrative Structures

Within the *Land|Slide* exhibition there were five notable examples of experiences that contained spatial narrative structures. Each spatial narrative consists of points of interest that are arranged sequentially so that they are not overlapping. A user must traverse from point-to-point to assemble the story and in each case (except one) the user is guided along a path in a unique way. The app permits multiple, overlapping points of interest therefore a user can choose to continue in one artists spatial narrative continuously or experience multiple narratives converging on a single location. Each narrative structure is organized by different themes.

David Han's *The Rust in the Furrow: A (mis)guided tour* and Jennie Suddick's *Stomping Ground* both tie media clips to specific points of interest on a map. Han's work is a single linear narrative tied to points of interest (artifacts housed in plinths) throughout the site. Suddick distributed analogue postcard tours grouping the 30 POIs into tours consisting of 5 or 6. Patricio Davila and Dave Colangelo's *The Line* is a two part installation consisting of a sculpture and an outdoor projection mapped on a barn. Camille Turner's *Time Warp* is a video walk in which the user is expected to follow, with their smart phone, the point of view and path of a recorded narrator.

Each work is an example of a spatial narrative. The structure of Han's work is explicitly linear with a definite beginning and end built into the narration. Though the user can enter into the tour at any location from within the app, Han set up a video introduction using a monitor from which visitors were meant to start their journey. The

narrative builds a fictitious biography and a tantalizing mystery using fabricated evidence and pushes the believability of the story as the tour progresses. His work is organized thematically and chronologically, giving the impression of a linear story that builds around the presentation of each new artefact to the visitor. Each artefact is tied to biographical information, a fragment of a larger story, about a fictional Chinese-Canadian man.

Suddick's work is a series of autobiographical interviews from residents of Markham. Postcards distributed at the exhibition indicated walking tours grouping 30 videos into sets of 5 or 6. The biographies are connected geographically with stories touching on nostalgia, memory, familial and cultural relationships, and community. Each postcard provides a path for the user to traverse and so the tours maintain a linear form; however, the videos are short stories in themselves and so can be viewed in any order while maintaining coherence.

Camille Turner's *Time Warp*, an Afro-futurist re-interpretation of the exhibition site, takes the form of a tour. Rather than using geo-fences or automating the interaction the video on the device provides a linear narration. Reminiscent of works such as Cardiff's *Alter Bahnhof,* the visitor is guided around the site but must interpret what they are seeing in order to follow the narrator's direction (Cardiff & Miller, 2012). The work is strictly linear and presents a story about the narrator following visitors from another time around the site of the Markham Museum. Users are asked at the end of the video to share their interpretations of the story with the artist and other visitors via social media.

Davila and Colangelo's *The Line* uses the mobile app to supplement their installations with contextual narrative at two separate locations. Users are presented with concept images and audio information in the artists' own words. *The Line* is an example of how artists used the app to contribute to the narrative discourse of the exhibition as a whole, rather than to a specific story within their work. Davila and Colangelo construct a snowfence and film it in various locations around Markham. As a meditation on urban planning they posit that "the lines that define us become a focal point for more critical and careful consideration" (Colangelo & Davila, 2013). The audio component augments their existing film with the genesis of their idea and connects more explicitly the relationship between the snow fence installation and the film that is projection mapped on to the Kinnee Barn.

Mark-David Hosale similarly uses *Homunculus Agora (h.*a*)* to engage the larger narrative discourse of the exhibition. The 3D printed homunculi mimic the shape of the Ontario Greenbelt– a contested agricultural preservation site that suburban Markham infrastructure development puts at risk. These sculptures, along with their virtual counterparts are representative of humankind's relationship to the technology it creates. While visibly mechanized and artificial they are also shaped as organic objects. Their positioning emulates a constructed barrier between rural and urban development. The installation reflects curatorial remarks included in the exhibition guide by addressing "some of the most pressing issue facing us today: the balance between ecology and economy, development and preservation, and diversity and history" (Marchessault,

2013). The standalone version of the *Homunculus Agora (h.*a*)* app, developed in collaboration with Rohan Likhite and Ursula Sarracini[4], was awarded 3rd place at the Canadian University Software Engineering Conference 2014 in Montreal, QC.

One of the foremost constraints of a spatial narrative, particularly augmented reality experiences, is that the user is expected to traverse a space in real time under their own locomotion. This high degree of agency often works against the coherence of a narrative that must be experienced linearly. Providing narrative coherence while trying to work with the user's high degree of agency is often considered the essential challenge of interactive storytelling that is mediated by technology. Because each experience at *Land|Slide* contains its own narrative structure, authors offer their users a preferred way to proceed along a path either through guided tours or by providing digital and analog maps.

[4] Additional credits to Jeff Tuxworth, and Susana Navarete.

Chapter 5
Discussion, Conclusions, and Future Work

I Discussion – Developing Design Heuristics

As outlined in Ch. 1 P. III (*Hypotheses*), the hypotheses that inform the new conceptual model of this study are observable. We can re-shape our methodology and re-evaluate the model based on the observations from this study. We can also make outline some points of concern that may be important for future usability studies for spatial narrative structures allowing for intelligent agents. As with other heuristics, these are not meant to be universal but instead should apply to mobile experiences such as locative media and augmented reality, that are built to support spatial narrative structures.

A Usability measures, including satisfaction, influence the design of a product

Usability testing is important to the economic viability and user adoption of software. This would indicate that regardless of the type of software, user satisfaction of the experience is necessarily improved by usability inspection. It has also been suggested that usability affects the readability of interactive narrative works (Pope, 2010). The following observations include considerations for future usability studies. The interface did not provide a clear overview of how the material was to be incorporated into the final product ("Stephen"). The authoring tool was unable to respond to a changing environmental context after the deployment of final product ("Stephan"). A primitive authoring interface may enhance usability and therefore satisfaction if it allows users to

draw from memories of existing tools ("Susan"). The app could not be fully used without guidance or instructions ("Stephen").

B The affordances of a product influence the creation of a project

This hypothesis is difficult to refute but has also proven extremely difficult to test. Narrative analysis indicates that the affordances of a technology influence some artists' projects. "Stephen" explicitly allowed the design of the app to shape his project. "Susan" implied that the interface was "empowering" and encouraged a collaborative approach to design. Unfortunately, it is difficult to determine the exact extent of this influence. The failure of the online questionnaire to return a usable sample size indicates a new strategy for empirical evaluation is necessary.

Some artists used a very open ended, (partially) nonlinear experience, while others tried to create an overtly linear experience. Mobile technologies afford locative media permit structures that are "maps", "tours", or a combination of both. The system afforded modularity and permitted tinkering by the other artists. The system allowed users to construct low-level experiences uploaded from Unity, which provides a space for incorporating existing code ("Mark", "James"). A continuously networked interface can enable a human proxy for an intelligent agents or "Wizard of Oz" technique ("James"). The system allows different narrative structures in the final app but the physical layout of the space may work against the implicit structure of the narrative ("Stephen"). This reveals a relationship between the environmental context of an experience and the inherent affordances of the technology that needs to be further explored.

C The outcome of a project enters into the user's technobiography

The interviews focused mainly on the artists/authors relationship to technology on in a broader context but do provide evidence that projects authors have used and experienced enter into their biography. Every interviewee conveyed a sense of how they felt their projects functioned, ultimately were received, or played a role in shaping their ongoing practice. This is probably the most suitable hypothesis to test using the technobiographical method and would benefit form continued testing with an in-depth narrative inquiry. Worth noting are the few formal systems of feedback for apps beyond ratings and comments in app stores and reviews from tech pundits. Of the 24 art reviews uncovered for *Land|Slide*, few show and none explicitly mention the experiences that were built specifically for the app. The *Land|Slide* mobile app was downloaded exactly 200 times on Google Play and iTunes between Sept. 18th and Oct. 24th, 2014 but received no comments or ratings. It is likely artists would have benefitted from some metrics of feedback such as the length of engagement with a project.

D The user's technobiography provides a context of use

As "Stephen" indicates, the context of use of the app changed after the publication of the app. Many of the anticipated weaknesses of the app, often due to time constraints, were exacerbated by a lack of supporting instructions. While the app was fairly easy to use in some respects, the scale of the exhibition and location gave users little time to explore the app as was intended. Instead of providing instructions for use, it was assumed early in the development process that volunteers at the exhibition would be

available to show users how it worked and troubleshoot any problems. There were less volunteers then anticipated at the exhibit so there were fewer people available specifically to help users with the app:

> *Stephen*: It was my understanding there'd be volunteers staffing it, and I built the project based on that assumption and, as it turned out that the volunteer situation turned out to not really panned out the way they expected, and as a result there weren't really any staff members staffing the project, and as a result I think the project in a lot of ways was not experienced by the – by many people. I don't really know, 'cause I wasn't there everyday and I didn't really receive any feedback so I can only assume that the lack of feedback– I don't really–or the project was just terrible and no one wanted to say anything because it was really bad [laughing]. But no, I'm inclined to believe– From the days that I was there, and I was there quite often, that there just weren't a lot of people aware of what was going on. And they'd see these sort of display cases scattered around on the grounds, but there was no way to connect it all together without the actual piece of technology, and no, some people thought "Oh, what is that?" and the way that it was set up visually at least is that it kind of looked like a museum display. There was nothing to indicate that this was like part of an artist project that was part of the larger exhibit. I guess if you kind of looked closely you could tell but the only way that I think you really experienced it was if you were actually going through the actual audio walk itself. And I think that judging from how often, at least talking to the front door staff– we had loaner devices– how often they went out– I don't think it was used all that often. So in terms of success I'd say that it wasn't as successful as I would have liked or would have hoped but I think that was largely because of a staffing issue.

A notable deficiency of the design of the web builder is the lack of responsiveness of the changes in the project. This is the key advantage of an AR Web Browser such as Layar, Junaio, or Argon over this design. This does raise an interesting concern about the feasibility of incorporating intelligent agents for guidance. The context of use for a tour with personnel is radically different from one, which visitors download on to their own

phones exclusively. While usability problems in this design were largely due to time constraints, the assumption that personnel on site would replace the need for instructions could be an ongoing concern in other similar contexts of use.

II Methodological Concerns

Given the low response rate, it is possible that a web-based survey is not appropriate for the targeted population, that project technical support was an insufficient compensation, or that technical issues prevented the completion of the survey. Investigations into the use of authoring tools in future will require an alternate or complimentary approach. Face to face interaction with the authors/artists was a challenge, but the AR Team could perhaps have been asked to conduct a series short questions by email, phone, or video conference before, during and after the creation of their work. There is a confidentiality concern in that an artist's creative process is often deeply personal and changes in concept, technical problems, financial issues, political, and interpersonal issues may require a methodology that works with, rather than against, and artists own workflow and objectives.

III Conclusions

Because the sample is relatively small and self-selected the data is not meant to be widely generalizable but can serve as a basis for future studies. An analysis of the interviews does provide insight into the different motivations and indicators for evaluating satisfaction and usability in an authoring tool for creating spatial narratives.

The conceptual model provides a useful map with areas to focus future efforts. It is reasonable, based on the interviews, to conclude that the interface was not seen as an impediment to creating spatial narratives. The following heuristics can be used to assess the usability of future iterations of this system:

1. The software provides a clear overview of the system (such as a target application size) to assist collaboration.
2. The authoring tool allows the author to respond to changes in the physical environment.
3. The app includes instructions of use so it can be used without supervision.
4. The system allows authors to incorporate existing code.
5. A networked interface allows a human proxy to stand in for an intelligent agent.
6. The app provides mechanisms for interaction logging and feedback to the author.

Each of these broad categories can be narrowed down into more descriptive heuristic measures of usability but serve as a guide for designing and improving systems for creating spatial narratives and using intelligent agents.

IV Project Future

To continue this research, ideally the tools should continue to be debugged and made publically available as soon as possible; however, it may be a long while before this is possible. This project was made possible by prototyping in Unity; however, there are user license restrictions that could prevent distribution of the source code for the iPhone app. An iPhone client could be constructed using less restrictive software, but the workflow for creating and combining scenes may be prohibitively complex without additional programmers. The current version of the system still requires automated

compilation (such as building from the command line) to reduce the time demands on the system administrator. An upgraded authoring tool is being developed to generate xml files compatible with an open source locative media app for iOS made in the Augmented Reality Lab at York University. Investigations are also underway to generate KARML files that would be compatible with the Argon AR Browser.

A Intelligent Agents

Towards implementing multi-purpose intelligent agents in the future, I conducted an investigation into AI techniques for spatial narratives. Comparing the Enhanced Profitable Tour Program, the O3 approach, and Genetic and Ant Colony algorithms I postulated that a program using a genetic algorithm treating a dynamic map as a micro-world travelling salesperson problem (TSP) could feasibly guide an intelligent agent (D. M. Coleman & Wunderlich, 2008; Dorigo & Gambardella, 1997; Joest & Stille, 2002; Moon, Kim, Choi, & Seo, 2002). Using a top-down approach in which a simple map is known to the system, an agent would act as a guide along the path determined by the genetic algorithm and augmented by an A* or D* search algorithm to dynamically correct the path according to user or sensory input (Tovey, Greenberg, & Koenig, 2003). The system would use asset recombination to playback two video, audio clips or animations: a narrative containing site-specific information and a clip that plays back part of an overarching, sequential narrative that unfolds throughout the course of the tour (Piacenza et al., 2011). This approach uses narrative coherence to promote satisfaction

by favouring relative constraint over complete user agency. The criteria for evaluating its performance derives from its adherence to a path set by the genetic algorithm.

A prototype using a genetic algorithm adapted for C# to solve the TSP between points on a map is in development (LaLena, 2013). The adaptation successfully draws points between cities on the first pass of the algorithm but still requires correctly implemented parallelization to function properly (Figure 8). The plan to "micro-curate" the site as described by "Jacques" is a feasible goal for future projects.

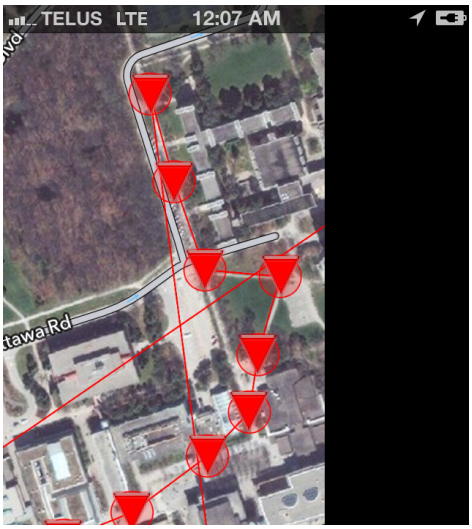

Figure 8 Travelling Salesperson Problem C#

B Usability

Usability features indicated by this research are an enhancement of the collaborative capabilities of the tools. It should be clear to all users what the target size of the shared application in real time and who has specific space needs and requirements. This would make it possible for teams to collaborate on a single project in real time.

The development of intelligent agents is also an important future goal for this system. For now a networked application that a human proxy can connect with to control the behaviour of an agent is sufficient for testing.

While it is difficult to draw wide reaching conclusions from an analysis of the data, the usability of the app can be improved based on the feedback from artists and these points have been refined into usability heuristics for spatial narrative structures. These heuristics demand continual critical reflection and the methods outlined for using biographical information would be an effective way to administer such reflection. The conceptual model provides a framework by which to challenge any assumption that the cycle by which we change our tools is deterministic or simply beyond our understanding.

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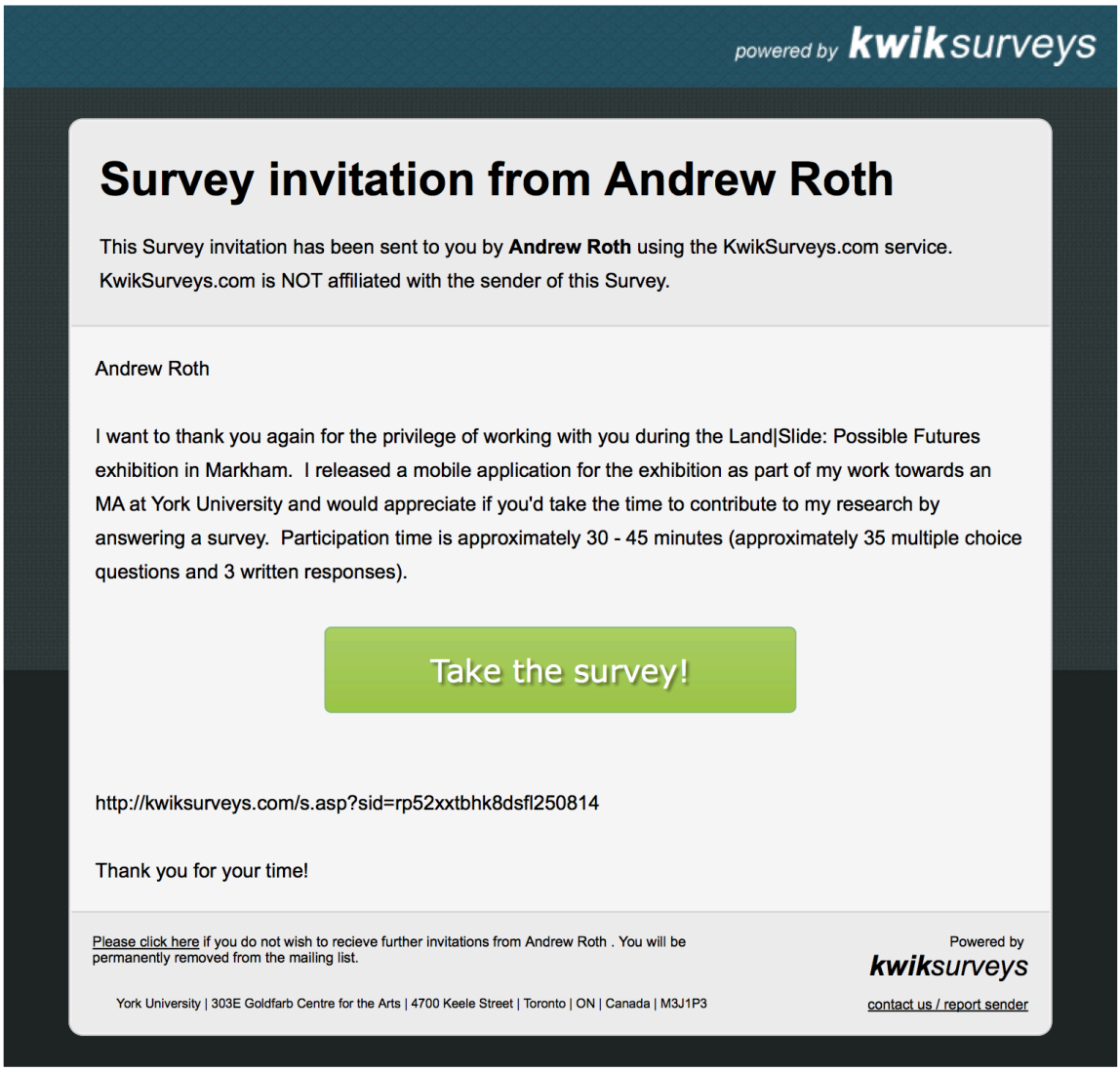
APPENDIX I. Questionnaire Email Invitation



APPENDIX II. Questionnaire

Q3 Did you personally use the LandslideAR Authoring page to build anything for the Land|SlideAR mobile app?

1. Yes
2. I don't remember if I did or not
3. No
4. I don't know

Q4 Did you view the resources at http://futurestories.ca/landslide-AR-blog?

H1) Yes
H2) I don't remember if I did or not
H3) No
H4) I don't know

Q5 Did you use the resources at http://futurestories.ca/landslide-AR-blog to assist you?

1) Yes
2) I don't remember if I did or not
3) No
4) I don't know

Q6 Did you receive assistance from one of the AR Team leaders (Andrew, Adonay, Tony, or Sara)?

1. Yes
2. I don't remember if I did or not
3. No
4. I don't know

Q7-1 To what extent do you agree with the following statements?: The AR Web Builder was easy to use: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q7-2 I successfully completed an AR project for Land|slide using the AR Web Builder: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q7-3 The AR Web Builder was difficult to use: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q7-4 There were technical issues with the website that prevented me from completing an AR project for Land|Slide: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q7-5 There were other issues that prevented me from completing an AR project for Land|slide. (Please elaborate in comments): (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q8-1 Before working with the Land|Slide AR Web builder and the AR Team: I wanted to build an augmented reality project: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q8-2 I felt that I understood what augmented reality is: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q8-3 I felt that I understood the potential benefits to using augmented reality in my work

Q8-4 I felt I understood the potential limitations of using augmented reality in my work: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q8-5 I did not want to build an augmented reality project: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q9-1 Now: I feel I know more about Augmented Reality than I did before I was contacted by the AR team.: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q9-2 I want to build an augmented reality project now or in the future: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q9-3 I am less interested in augmented reality than I was before I was contacted by the AR team: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q9-4 I would avoid building an augmented reality project in the future: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree).

Q10-1 How experienced do you consider yourself at the following practices: Augmented Reality

Q10-2 Virtual Reality (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don’t know)

Q10-3 Mixed Reality (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don’t know)

Q10-4 Artificial Intelligence (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-5 Locative Media (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-6 Mobile Media (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-7 Site Specific Installation Art (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-8 Film or Video (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-9 Writing (Literature, Poetry, hypertext, hypermedia, etc…) (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-9-other

Q10-10 Performance (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-11 Sculpture (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-11-other (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q10-12 Other (write in comments)

Q11-1 I would consider the following to be advantages of using Augmented Reality technologies: Using digital elements (sound, video, animations) in a physical space: (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q11-2 Placing multiple, simultaneous narratives in a single space (channels or layers): (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q11-3 Combining physical and virtual objects(1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q11-4 Replacing screens (TV screens, projections) with virtual screens (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q11-5 Other (please enter in comments section) (1: Strongly Disagree, 2: Somewhat Disagree, 3: Neutral, 4: Somewhat Agree, 5: Strongly Agree, 6: I don't know)

Q12-1 Do you consider the following important to your work (Check any that apply): Guiding the user towards objectives

Q12-2 Creating paths for the user to explore (checkbox)

Q12-3 Creating spaces for the user to explore (checkbox)

Q12-4 Facilitating interaction between the user and characters in the work (checkbox)

Q12-5 Allowing the user to construct his or her own interpretations (checkbox)

Q12-6 Providing user with intelligible information about their surroundings (checkbox)

Q12-7 Constructing coherent interactions from large data sets (checkbox)

Q12-8 Creating generative or procedural content (checkbox)

Q12-9 Facilitating interaction between multiple player characters (checkbox)

Q12-10 Other (checkbox)

Q13 Do you consider yourself a storyteller? Why or why not? (text response)

Q14 Do you enjoy working with digital technology? Why or why not? (text response)

Q15 What is your current relationship to Artificial Intelligence technology? (1. I work with AI technology 2. I do not work with AI technology 3. I don't know if I do work with AI technology)

Q16 If you answered "I work with AI Technology" in question 14 (above), please describe the way in which you work with AI (including Intelligent Agents, applied or game AI such as pathfinding, or reasoning engines). (text response)

APPENDIX III. Interview Checklist and Time Recording Sheet

[Start recording screen, Start Audio]
Preamble: "This is a conversation about your interests and workflow. If you have particular insights about the tools and techniques you use, I might ask you to expand on those areas as much or as little as you like."
User
- History,
- background,
- interests,
- experience level,
- existing techniques
- Where did the interest in narrative come from?

Task
- Outcome,
- goals,
- hopes
- ambitions,
- specific areas of application,
- future techniques.

Equipment
- Hardware,
- software,
- current tools,
- hardware setups,
- imagined end user interfaces

Environment
- Who do you work with normally? How would you describe that relationship?
- Any external revenue sources for funding projects?
- Current workflow and obstacles that might describe the environment they work in?
- Any groups or professional affiliations you belong to that you discuss your work with?

~~Satisfaction~~
- ~~What would you consider "successful" use of a tool that helped you author the kind of experience you create?~~
- ~~Does your satisfaction with an authoring tool come from the end users satisfaction with the experience you've created?~~ [Omitted From Interviews]

Anything else you'd like to say or add?
[Turn off screen cap, Turn off audio]

APPENDIX IV. *LandslideAR* App Download Record

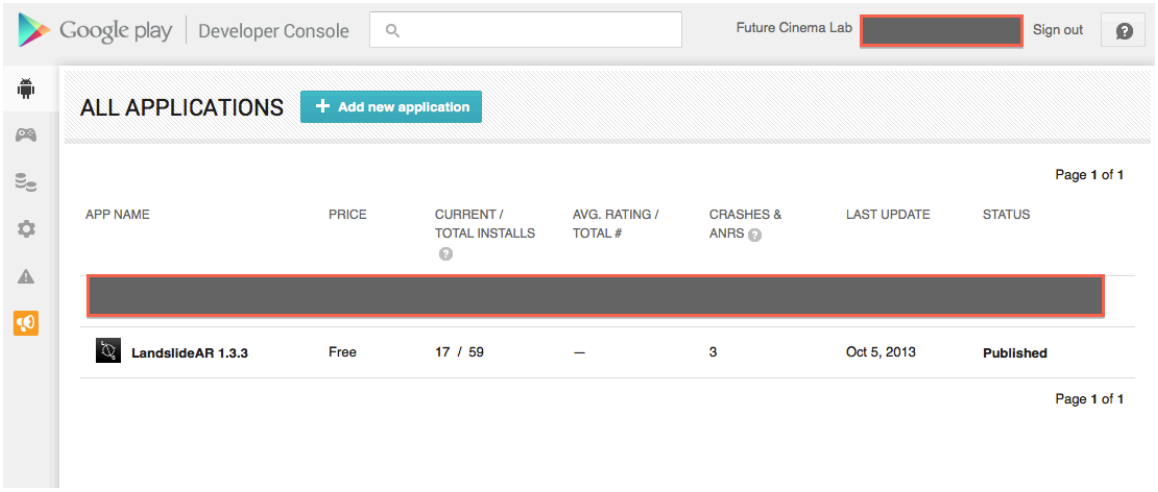


Figure 9 Google Play Store Downloads

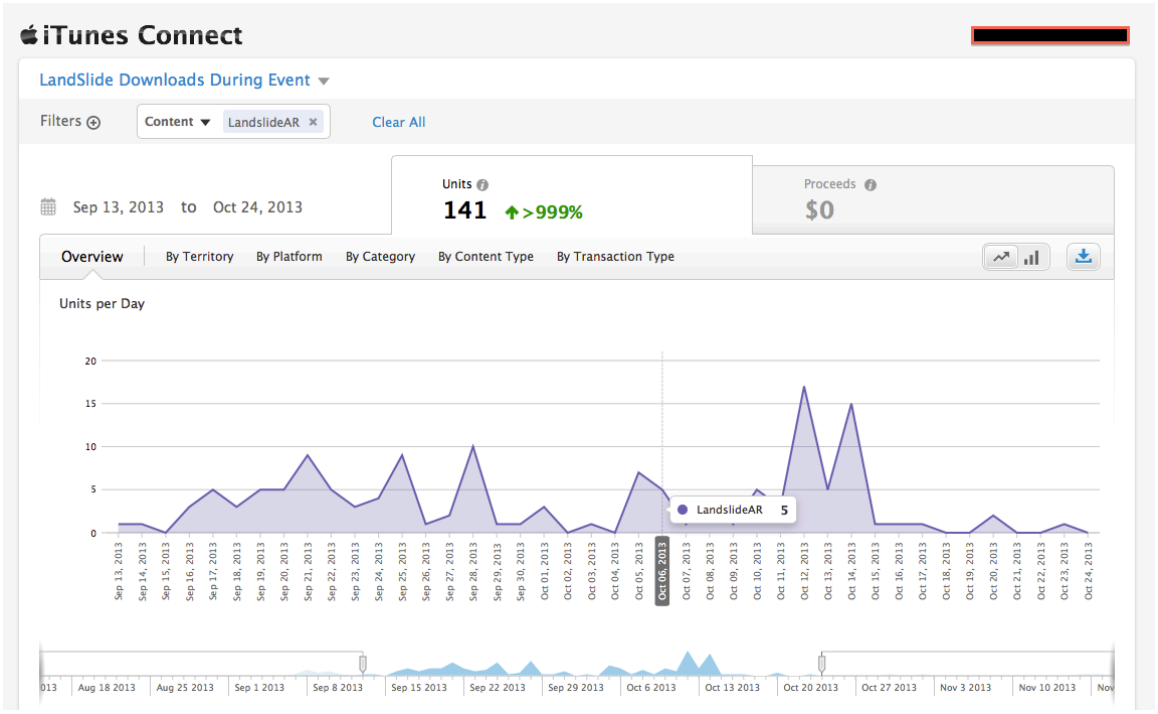


Figure 10 iTunes Store Downloads