# Table of Contents

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Message from the Department of Knowledge Integration</strong></td>
<td>3</td>
</tr>
<tr>
<td>Kristopher Barber</td>
<td>Making the Medical System a Little More Human: Prognosis</td>
</tr>
<tr>
<td>James Butler</td>
<td>Dialogues Across Difference</td>
</tr>
<tr>
<td>Keira Chadwick</td>
<td>Understanding Data Privacy: A Resource to Help Canadians Take Control of their Online Personal Information</td>
</tr>
<tr>
<td>Claire DesRosiers</td>
<td>The Story of Columbia Lake: An Exploration of Land and People</td>
</tr>
<tr>
<td>Deanna Di Vito</td>
<td>Helping Demystify Knowledge Integration's (KI) Learning Experience by Matching Future Students with KI Students</td>
</tr>
<tr>
<td>Alex Esser</td>
<td>PSYCH 292 Tutorial TA Guidebook</td>
</tr>
<tr>
<td>Nathan Flach</td>
<td>Conceptually Designing a Mobile Experience to Help Student-Athletes Develop Mental Resilience During Competition</td>
</tr>
<tr>
<td>Meagan Flus</td>
<td>Findings on a designated project manager in student capstone project teams</td>
</tr>
<tr>
<td>Hannah Gardiner</td>
<td>The Women in the Willows: Exploring the Willow Tree Cross-Culturally</td>
</tr>
<tr>
<td>Kat Jacobs</td>
<td>Leveling Up Our Mental Health</td>
</tr>
<tr>
<td>Hannah James</td>
<td>Implementation of Video Consultations: A Systematic Review of the Challenges to Scale-up, Spread, and Subsequent Sustainability</td>
</tr>
<tr>
<td>Saffiya Kherraji</td>
<td>Out with the old and in with the new: Redefining the American Dream home</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Jordan Klassen</td>
<td>There’s More To Life Than Being Right: Voice Assistants Need to Consider Delivery Nuances</td>
</tr>
<tr>
<td>Jason Kurian</td>
<td>The Creative Processes behind “Pocket Blues”</td>
</tr>
<tr>
<td>Lexi Layne</td>
<td>No Borders: A Revival of Toronto’s Underground Music Culture through a Business Lens</td>
</tr>
<tr>
<td>Greg Litster</td>
<td>Remembering Knowledge Integration (KI): An online resource for KI students</td>
</tr>
<tr>
<td>Christina McArthur</td>
<td>Facilitating meaningful climate centred conversation: Lobby displays, priming audiences and systems of economy</td>
</tr>
<tr>
<td>Tarunima Mittal</td>
<td>Bringing Restorative Justice into the Classroom: Exploring a Restorative Approach to Teaching and Curriculum Design</td>
</tr>
<tr>
<td>Devaney Moraes</td>
<td>Effects of academics on student well-being</td>
</tr>
<tr>
<td>Kaitlin Ollivier-Gooch</td>
<td>Testing a New Method for Extracting DNA from Dental Calculus</td>
</tr>
<tr>
<td>Samir Reynolds</td>
<td>Curating Medieval Pilgrim Badges: Exploring Technological and Narrative Means of Display</td>
</tr>
<tr>
<td>Kyla Sedore</td>
<td>Do gamers just want to have fun? How the study of gaming can reveal ways to motivate students experiencing symptoms of burnout</td>
</tr>
<tr>
<td>Kienna Shaw</td>
<td>Dungeons &amp; Dragons and Livestreaming: Audience as Narrative Collaborator</td>
</tr>
<tr>
<td>Brendan Wigram</td>
<td>Bringing Choice into Identity</td>
</tr>
</tbody>
</table>
A Message from the Department of Knowledge Integration

Welcome to the Knowledge Integration Senior Research Symposium Proceedings! In the pages that follow, you will find a collection of papers representing the breadth and depth of scholarship of the Class of 2019 during their 4th year Senior Research Project courses.

The Senior Research Project is the two-term culmination of the Knowledge Integration undergraduate program. It provides our students the opportunity to demonstrate the ability to make connections across disciplines and to engage in integrative research that addresses a topic drawn from their particular areas of concentration. Students identify a topic and faculty supervisor early in their final year of studies. We are grateful to the many individuals from across campus, as well as from outside the university, who have generously offered to supervise these students.

A scan through the table of contents will give you a sense of the rich diversity of interests of our students. As you’ll see, these projects enhance our understanding of real-world issues (and in some cases how we might address them). Students have accomplished this by analyzing existing knowledge, generating new and useful data, developing evidence-based recommendations, and creating new tools that others can use.

Just as impressive as the breadth of scholarship represented here is the depth you will find as you read these short summaries of their eight-month senior projects. You are welcome to contact the authors if you wish to further explore their projects by reading their full theses, reports, or manuscripts. Whether you choose to dig deeper into one or more of these extraordinary projects, or content yourself with a perusal of the abstracts, I am sure you will come to understand why we in Knowledge Integration are comfortable asserting that what makes KI students special is that they make connections that others often don’t, and see solutions that others often can’t.

Finally, on behalf of everyone in the Department of Knowledge Integration, I extend my heartfelt congratulations to the Knowledge Integrators of 2019. You have done yourselves, your friends and family, and your program proud! We wish you the very best in your future endeavors.

Dr. John McLevey
Assistant Professor, Knowledge Integration, University of Waterloo
Making the Medical System a Little More Human: Prognosis

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Abstract – Healthcare in much of the world is under an intense strain, as most systems rely on face to face communication with physicians, which is unscalable to current population levels. Patients feel ignored, rushed, or confused, and physicians feel callous and worn out. The introduction of the internet and the proliferation of online health resources has proven to alleviate some of this strain, however this information is decentralized, and current social media platforms were not built to deal with health issues. To that end this project attempts to build an app that can serve as the go-to platform for social media health discussion. The app will be organized into communities that connect patients, family, friends, and medical professionals. A number of features have been completed already, and more are planned.

I. Introduction & Framing the Problem

Technology has had a tremendous impact on the medical field and is poised to continue making an impact. Innovations such as wearable technology and AI are common topics of discussion in medical circles.

One of the big problems that is not being addressed is the personal side of healthcare. Simply put, doctors are strained for time, and it comes across to the patients. In the US, nearly a quarter of patients reported feeling rushed by their doctor, and 15% were confused by the instructions they were given for treatment (Strauss, 2017). This strain is also felt by the doctors, with 46% of physicians feeling burnout, and more calloused towards others (Peckham, 2015). In this way, the healthcare system puts a social strain on both the physicians and the patients. The concept of face to face meetings with physicians is not scalable to the size of the population.

So how can we alleviate this stress while still getting patients the information that they need? For starters, the internet provides a scalable method of providing general health care information. Already, more than half of Americans with internet access use the web to get health information (Rainie & Fox, 2000). Furthermore, 37% of U.S. adults have engaged in health-related social media, (Pew Research Center, 2009). Of those that looked for health information online, 16% searched for others with the same concerns and 26% watched or read someone else’s health experience (Pew Research Center, 2013). Currently, no one platform stands out, so people are using a variety of websites including Wikipedia, Facebook, Twitter, personal blogs, and Myspace. None of those sites however were designed with healthcare in mind, nor are they designed to help connect users with other users based on health issues.

To phrase the problem simply, people are looking for health care solutions that are online, accessible, and personal.
II. Goals & Solution

This project was to create an app that could serve as the “go-to” social media health app.

The working title of the app is “Prognosis”. A diagnosis is the description of what disease or ailment a patient has. A prognosis is the forecast of how the diagnosis will impact the patient’s life. It is an estimation of future quality of life, physical and mental condition, and in some cases, how long a patient has left. A patient has very little control over a diagnosis, but they can always improve their prognosis, even if it’s just an improvement in how they see the future, or how happy they are with what time they have left. The app hopes to accomplish 3 main goals:

1. Reduce the social fallout that accompanies diagnosis and/or hospitalization

After a diagnosis, people’s lives are turned upside down. Their routines are broken, and their lifestyle must change. If they are bed-ridden or house-bound it means significantly less socializing. This app aims to connect users both in-person, and online.

2. Make healthcare information more available and reduce stigma around disease

Most diagnoses often have accompanying stigma. Patients with HIV might be physically avoided, patients with diabetes might be assumed to be unathletic or have poor eating habits. This app aims to provide a friendly environment where learning can occur, and where patients, friends, family, and health professionals can come together to show support.

3. Improve patient compliance

Compliance is a measure of how well a patient follows a treatment plan. Compliance can generally be improved with external support and accountability. For example, having a gym buddy that provides emotional support and encouragement has been shown to increase someone compliance to a fitness regimen (Rackow, Scholz, & Hornung, 2015). This app aims to provide a community to patients that encourages them and provides emotional support.

To achieve these goals, the app will create communities that connect patients, family/friends, and medical professionals. These communities will be focused on a particular disease or condition and will allow members to commiserate and provide meaningful support for each other.

III. Requirements

The first step in designing a piece of software is to understand what the requirements are.

Requirements were determined by focusing on “Extreme Users” - the people that would struggle with the product the most or have a unique experience with it.

In this case, the extreme users were people who suffer from chronic or long-term disease. The internet is generally inaccessible to them, so they rely more heavily on direct contact with health professionals (Fox & Purcell, 2010). However, those who do use the internet are much more likely to contribute to online health discussion, blogging, or group forums, if they can access them (Fox & Purcell, 2010). Long term disease is statistically associated with being older, poorer and less educated (Fox & Purcell, 2010).
With an idea of the target demographic in mind, requirements were focused on a few key areas:

1. **Accessibility** – the need for content that is perceivable, operable, understandable, and robust (W3C, 2018)

2. **Privacy** – the need for users to have control over what they want to share and who they want to share it with

3. **User Experience** – the need for users to feel comfortable in the app.

IV. **Process**

The process for creating the app can be broken up into two parts: aesthetics and features.

For designing the aesthetics, input from classmates was relied on. Quick mock-ups of various elements were made, and feedback was requested; often by showing two or three options at a time and asking which one was preferred. To maintain proper internet standardization, accessibility guidelines from W3C (W3C, 2018) and design guidelines from Material.io were followed where applicable (Google, 2019).

Features were designed by focusing on the goals of the app and the needs of the users. Some features, such as moderator impeachment, were a product of the author’s own frustrations with other apps.

V. **Current Features**

The app has custom branding, including an icon, app name, fonts, and colour scheme.

Registration and sign-in features are functional (Figure 1). Users can sign up for an account using an email address and password. All user input is sanitized. Text entry constraints are in place, so emails must be of the form ***@***.com, passwords must be between 8 and 30 characters, etc. Terms of Service checkbox and popup link are working. After registration, an Email is sent to verification the user’s email address. Password recovery is set up. Users can also sign-in using a Google account. All registration information is sent back over the internet to a centralized server. Passwords are hashed, and securely stored.

Live access to the database is operational. Once authenticated, data can be retrieved from the database to the local device or sent from the local device to the database over the internet.

The navigation menu is functional, although incomplete as not all the pages have been created. Users can access the menu by either clicking the “hamburger” icon at the top or by dragging the menu from the side of the screen.

![Figure 1 – A screenshot of part of the registration page](image)

VI. **Upcoming Features**

Due to the nature of this project, and its potential commercial existence, the author
intends to continue working on it after graduation. As such, most of the features are still in development but have been designed and need to be implemented. Class diagrams and workflows have been created.

The upcoming features include:

**Communities**
Communities are focused on a specific condition or disease, and act as a “safe space” for people to share their experiences and provide support. Users will be able to post information, schedule events, and otherwise socialize.

Communities will be managed by a group of moderators, who can be impeached if they fail to do their job.

**Messaging**
Users will be able to curate a “friends list” and send messages to each other. Group conversations will be possible. Image messages and other media will be shown inline, so the user doesn’t need to switch to another app.

**Geolocation**
While this app will help connect people online, it will also leverage face to face socialization. As such, if the user feels comfortable, they’ll be able to make their location publicly visible.

### VII. References


Dialogues Across Difference

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Abstract - In this project, Dialogues Across Difference, we ask “How might we have more and better dialogues across difference?” Knowing how to have good dialogue across our differences is a skill, one that is both increasingly and fundamentally necessary to solving complex problems, a skill that we are under aware of. We rely on our ability to grow shared understanding across differences between disciplines, between cultures, and between our experiences to address complex global problems, to share resources and to exist in community. The problem this project seeks to address is though we engage in dialogues across difference all the time we don’t think intentionally about how to do it well.

This project is aiming at growing our awareness of this problem by creating a handout and a podcast on how to have good dialogues across difference aimed at a general audience and based on an ongoing series of paired interviews with people who think and communicate differently. In each interview two participants from different communities, be they disciplines, professions or communities, meet to discuss how to communicate across their differences and difference in general. During the interview, they are guided by questions about their experience to discuss how dialogue exists in their communities, how their communities address different perspectives and how might we communicate across our differences. Ultimately we’re working with our participants towards asking “What makes for good dialogue across difference?”.

We aim to build an idea of what good dialogue across difference is, establish a set of practices for good dialogue across difference, and express these practices as a useful, accessible and interesting guide to begin having good dialogues across difference in the form of a handout and a podcast. This project is actively transdisciplinary, aiming to engage, with and above, the disciplinary or paradigmatic level. It is an applied epistemology project interested in how people communicate ideas across differences in methods of communication and understanding.

I. Introduction

Overview

This project pursues the research question “How might we have more and better dialogues across difference?” This project is an accessible exploration of what good dialogue across difference is, and how to have it, intended ultimately to help people have more good dialogues. There’s a dualism in the project, which seeks to produce a concrete and approachable artifact, the handout and its accompanying podcast, while simultaneously engaging in the pursuit of a broader academic question; “What is a good dialogue?” The extremely broad nature of the research question is tempered by our engagement with participants from a wide range of disciplines and professions who bring to bear their particular dialogical expertise and unique experience.

To pursue this research question we’ve conducted six paired semi structured qualitative interviews. In each interview our participants discussed together how dialogue exists in their respective areas of expertise, how they might have a good dialogue across their differences and what makes for good dialogue across difference in general.

Aim

The aim of this study is to prompt and enable a general audience to build their intentionality of how to have good dialogues across difference grounded in a thematic analysis of paired interviews between people from communities with different norms of communication.
Objectives

1. Create a one page approachable and actionable handout which defines good dialogue across difference and provides guidelines on how to have it. Showing that good dialogue across difference is important, what good dialogue across difference is, and how to have good dialogue across difference.
2. Create an overview podcast with a transcript that accessibly introduces the project, its aims and objectives, briefly grounds the dialogical guidelines and provides teasers for the paired interview podcasts.
3. Publicly advertise and host the podcast and the handout in a way which could reasonably attract attention, generate interest, point to actionable engagement and motivate a call to action.

II. Methods

Overview

Methodologically, this project is a short series of paired qualitative semi-structured interviews. Each interview is about 90 minutes long. There is a finite set of questions that I, as the researcher ask, but participants also ask each other questions as the conversation develops. The conversation begins with specific experiences of the participants in their areas of expertise. I ask “What was the last interesting conversation you had in [your community]?” and progress to more general questions about their experience like “What are some common differences that you need to address with [your community]?” to broader cross-boundary questions like “How do you explain perspectives in [your community] to those outside it?” The participants are also asked questions that actively build a dialogue between them. This eventually broadens into a discussion of what makes good dialogue in general based on the experiences the participants have shared. The participants as the interview closes are given direct input on my analysis and space for reflection. I ask them “How could this interview have been better?” and “What would you want to see on the dialogue guideline sheet?”

Academic Background

There still exists a lack of awareness and struggles communicating across difference. We’re working with and inspired by Eigenbrode’s “Employing Philosophical Dialogue In Collaborative Science” (2007) which posits a toolkit for interdisciplinary collaboration and Helen Longino’s “Science As Social Knowledge” (1990) which lays out principles for effective epistemic community and tequila sovereign’s “Indigenous Feminist Killjoy” (2015) which couples issues of inclusion and community with trauma and power dynamics. This foundation impacts how we value epistemic difference in our project and what that looks like in community. Disciplinarily, this project can be framed as an applied social epistemology project in philosophy and as a transdisciplinary project that draws firmly on knowledge integration as an applied practice.

Participation Requirements

Possible participants have been included in the project on the basis of three things. First, their participation, as a practitioner, in some paradigm with its own dialogical norms, be it disciplinary, professional or cultural. This will most likely restrict the participants on the basis of higher education. Second, their differentiation on the basis of dialogical paradigm from other participants. Participants from similar paradigms will be placed in different paired interviews. Each participant will possess in some way their own dialogical paradigm. Third, their availability for interview, as limited by their availability, the availability of other focus group participants and the availability of the interviewer with respect to time and place. A reasonable effort has been made to recruit participants such that the study is not substantially homogeneous in any way except for geographical location and education. This will diversify the kinds of differences there are between the participants. The study is being conducted locally with participants likely possessing an undergraduate degree or more advanced qualifications.

Interview Components

The interviews were semi-structured and qualitative focusing on participant’s personal
experience with dialogue in their fields and in life more broadly. The interview had a defined question set, with unspecified prompts. In each interview some of the questions were skipped in the interest of time or to better build on the input of participants. Some questions were asked of each participant in turn and some were asked of both participants together. Participants were encouraged to ask questions of their own throughout the process and to actively question the assumptions of the project. They did this by asking questions like “What is the value of dialogue?” “What does ‘dialogue’ even mean?” “Is finding common ground necessary for good dialogue?”. They also helped to clarify and refine the perspectives of the other participants. As each interview progressed it becomes less structured, more conversation than interrogation. It becomes a dialogue.

Participant Risk & Limited Confidentiality

The interviews were audio recorded. These audio recordings serve to inform the analysis which will produce the guidelines and the handout. They also are the substance which grounds the podcast. Some of the audio recorded during the interviews will thus become public. There’s some recognized risk to the participants associated with speaking publicly about more problematic elements of communication norms associated with their professions, disciplines and communities. To limit this risk participants sign an information and consent form in which they promise to keep the comments that the other participant makes confidential until such a time as they are released as part of the podcast. During or following the interviews for a period of two weeks participants retain the right to retract any of their statements for any reason. This allows participants to be candid during the interview.

Analysis Method

Having completed the paired interviews I’ve now begun the analysis process. This involves listening to the audio of each interview and taking notes on it to identify significant themes, both those that are specified by the participants as they collaborate towards a shared understanding of what good dialogue is and those things which emerge in the dialogue of the participants themselves.

III. Results

I’ve conducted 6 paired interviews all took take place in Kitchener-Waterloo in February and March of 2019, with local guests, many of them take place in local libraries and at the University of Waterloo, most notably the Conrad Grebel Library whose generous and accessible study rooms have been a significant asset. Most of my interviews are still covered under the two week retraction period which means I can’t formalize my analysis or publicize it in any way.

IV. References

Understanding Data Privacy: A Resource to Help Canadian’s Take Control of their Online Personal Information

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Abstract - The Internet is a pivotal component of our lives today and will continue to be tomorrow. The purpose of this research is to explore how to balance a person’s right to privacy and the public’s right to access information in this data-driven age of social media. At the heart of the issue of data privacy, is an individual.

For this research project, data privacy policies, laws, and the academic literature were reviewed, and a gap in information was identified. Materials on how data privacy impacts the individual, on how to stay informed on different regulations, on the advantages of information, and on the landscape of data privacy from various perspectives are not readily available to the public. The intersection between social media, publicly available information, and data privacy is complicated and hard to navigate.

To address this, I have developed “Understanding Data Privacy: A Guide to Help Canadian’s Take Control of their Online Personal Information.” The goal of this project is to empower Canadians to understand the landscape of data privacy, and to encourage them to take control of their information.

I. Motivation and Background
The landscape of data and information privacy is complicated. In an age where information is bountiful, we are more connected than ever before. Privacy is an important personal interest, and there are certain expectations of the private and public sectors to protect the public’s information. Over 90% of Canadians are concerned at some level about the protection of their personal privacy, and the majority lack confidence in how organizations collect and used their personal information online.¹

Information is very powerful. Digital sources enable organizations to collect information, generate insights, and draw conclusions about human behaviour.²

There is no international standard for ethical or regulatory practices for collecting and using data from digital sources, specifically social media networking sites. Different countries have reached different conclusions and have chosen different policies and means for protecting their public’s information. Furthermore, norms have not been established in the private sector, especially in regard to advancing the insights of the private sector. Inconsistencies in both the public and private sectors, complicated policies, and technical barriers, result in complications for an individual to easily take ownership over their online personal information.

The motivation for this project was to identify how to enhance an individual’s ability to understand data privacy and the importance of their online personal information.

The scope of this research can be distilled into four major components; information privacy, consent, accountability, and the importance of information.

Information privacy refers to the concept of controlling how one’s personal information is acquired and used.³ Concerns about information privacy are related to the improper use of personal information, disclosure of information to external parties, and the unauthorized secondary use of personal information without the person’s consent.⁴ Personal information is data about an individual that is deemed as identifiable.⁵
Consent in the realm of data privacy enables the use and processing of personal information. It is specified to be what would be reasonable for someone to understand the nature, purpose, and consequences of the collection, use, or disclosure of their personal information. Consent is an important concept that allows us to exercise control over our information, and decide when, how, and with whom we share the information.

Accountability and the importance of information are concepts which are more abstract in nature. They prompt important questions surrounding who is accountable for the protection of information, and why information is so powerful.

II. Research and Insights

To understand the data and information privacy landscape I studied of the literature in the space, evaluated relevant legislation, and reviewed various industry policies. The reviewed literature informed the scope of my project and provided me with sufficient background information to engage in the space. Conclusions of the reviewed literature highlighted a gap in research that addressed publicly available information and personal information on social networking websites. The study of literature informed my understanding of concepts that were fundamental to this project; information privacy, consent, accountability, and importance of information.

I then transitioned into an evaluation of relevant legislation. There is no international standard for ethical or regulatory practices for collecting and using data from digital sources, specifically social media networking sites. The purpose of this research was to analyze the different approaches pertaining to legislation surrounding data privacy of publicly available information. The included subjects were Canada, the United States of America, and the European Union. The subjects were chosen due to their similarity in structure of government, and their variance in approach of governance surrounding data and information privacy. The pieces of legislation that were evaluated include; Canada’s Personal Information Protection and Electronic Documents Act, Privacy Act, and role of the Privacy Commissioner, The United States of America’s sectoral laws, and the Federal Trade Commission Act 15 U.S.C. §§ 41-58, and the European Union’s General Data Protection Regulation.

To understand the norms surrounding the data privacy policies of social media platforms where publicly available information is housed, I compared the policies of three prominent and heavily used platforms. These platforms have distinct differences in the content that is shared (i.e., photo, video, and text), but have commonalities surrounding their purpose and intent. The platforms of analysis were: Twitter, Inc, Youtube, LLC, and Facebook, Inc. The bases of comparison of these platforms will be privacy of user’s information, and a user’s meaningful consent and understanding of the policies in place.

The culmination of this research identified two distinct and common gaps.

The first gap was the in the accessibility of content that exits to inform the public on data and information privacy. The academic literature included complicated concepts and jargon that may alienate a person without a significant amount of background knowledge in the space. Both the policies and legislation were comprehensive, also included jargon, and amounted to hundreds of pages in length. The information was incredibly detailed, but it would not be reasonable to expect a person to read these extensive documents to understand what is being done and can be done with their information. Let alone, be able to easily conclude what they can do protect their information.

The second gap that was discovered was the lack of available information. The context in which personal social media information is considered publicly available is not defined and is situation dependent. The ambiguous nature of this makes it complicated for a reasonable person to clearly understand whether what they share is available to be collected, shared, and used, or not.

III. Project Implementation
The initial intention of this project was to create a journal article to contribute to the literature surrounding data and information privacy. Through reflection, it became apparent that this would further inaccessibility and ambiguity of the information that exists in the space. This resulted in a decision to develop a solution to address this gap.

The solution, “Understanding Data Privacy: A Resource to Help Canadian’s Take Control of their Online Personal Information.” utilizes my research to better inform the public on their rights to their information, and the impacts that their information has.

Fig 1. This is a capture of the homepage of the website. It articulates the purpose of the project to the user.

To implement the project, I chose to create a website to share the information that I developed. The content that is explored in the project includes a distillation of fundamental concepts that were necessary to engage in the space, concepts that appeared in various phases of my research, the results of my research, and engaging elements to contextualize the work.

The focus of my work in the latter part of this project transitioned into accurately distilling the information into a form that allowed it to be easily understood by wide audience. The aggregation of the content allows for a user to choose the level of engagement that they would like to have, and easily access more information if needed. Furthermore, the interactive design is less intimidating than what currently exists.

IV. Conclusions and Future Potential

The scope of the project was limited due to the timeframe of this research project. However, I believe that there is future potential to elaborate on this work.

Moving forward, I would conduct an extensive amount of user-testing. This testing would answer questions that would iterate and improve on the content that has been curated and allow the project to thoroughly address gaps in the information.

Furthermore, there is space to extend this work into other forms of science communication for technological advancement. Accessible information is crucial as we advance in science. It is important to engage diverse perspectives and enable understanding as these advancements will impact everyone.

V. References

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The Story of Columbia Lake: An Exploration of Land and People

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Abstract- Understanding the interdependencies between land and people is a vital step in educating the public in environmental practices. The goal of this project is to use a case study to explore how People and Land can impact each other both negatively and positively. Focusing on Columbia Lake, I hope to create a work of historical fiction that shows the reader how Columbia Lake has changed from the first Mennonite settlements, to present day. Combining history, ecology and story the reader will learn about different ecological processes and facets of Columbia Lake and the human history of the area. The chapters build on each other showing how the ecological facets of Columbia Lake impact the people and how the people in turn have shaped Columbia Lake. My own interactions with the land have been included as a way to show how these past histories, decisions, and facets are still making an impact on current day people. The overall goal of this project is to make people deeply consider the important role land plays in our lives, and explore how everything from our homes, farms, and recreation depends upon it, and impacts it.

I. Introduction

Our planet is faced with a climate crisis. We have created a culture of pollution and environmental degradation. If you have ever talked to a climate change denier, or frankly most people, and try to tell them that we need to change our culture of use and waste they very often respond with “why should I care”. This leaves us faced with trying to undo generations of ingrained not caring.

But how do we fight apathy? The problem is that pure education of the facts doesn’t seem to be working and can often be overwhelming, leading to more of a doomsday mentality then a desire to save the planet. So how do we educate and instill care into people without scaring them? My answer is the same way we teach children complex issues like manners, morals, and empathy: Story.

Stories, since the beginning of language, have been a powerful tool, used to captivate and elicit emotion from audiences. Stories are engrained with lessons wrapped up in a pretty packages that sweep you up into the narrative. You don’t even realise you are learning that you should always act with compassion, you just enjoy the magic. Stories allows us to connect and care about things, and help us find new ways to look at the world.

This I believe is our solution. We must learn to teach the stories of the Earth in order to rekindle care for the environment in society. This is why I have chosen to write a collection of short stories and narrative essays for my project that explore the interdependencies between people and land. The hope is to create a work that allows us to learn about the environment, history, and hopefully ourselves.
If I miss on that last one you will at least learn a lot about me in the reading process as I have decided to share my own stories with you. I have chosen to do this because I decided to scope this project by focusing my stories on a place I care about deeply: Columbia Lake. Columbia Lake is a park owned by the University of Waterloo located at the intersection of Columbia street and Westmount road, in Waterloo, Ontario (that’s in Canada just FYI). The work aims to do a deep-dive into the history of Columbia Lake, and the people who have depended upon it for hundreds of years. I compiled the human and ecological history of the area as best I could and have woven them together into a story that will hopefully be educational and entertaining. The plan is to peel back the layers on something that at face value looks like a park but in reality, is so much more.

II. Methods

In order to achieve these goals, I started by looking for inspiration, reading texts that did something similar to what I wanted to create. The Meadow by James Galvin¹ was used as an example of place as character, and place through time. Teaching a Stone to Talk by Annie Dillard² is a perfect example of complex essays that bring people, place and culture into conversation with each other. A River Runs Through It by Norman Mclean³ was a beautiful example of showing truth through story, and exploring the interconnectedness of people and land.

Fueled by this I went forward trying to pick a location. I wanted somewhere important to me, somewhere I could visit while I was writing, and somewhere that had a story. In time I narrowed it down to Columbia Lake and Waterloo Park. Waterloo Park was a place I didn’t know very well personally, but I knew was full of history. Columbia Lake was the exact opposite: a place I personally knew very well but didn’t know if it had any history. Based on the fact that I have stories about Columbia lake, the fact the Waterloo University Ecology Lab works there, and some sheer gut instincts I decided to choose Columbia Lake.

From this, the research began. I spent much of the rest of fall term at the Waterloo Library in the Ellis Little Local History Room going through books, newspaper articles and reports searching for anything and everything I could about Columbia Lake. I discovered the Brubacher museum and the curator there graciously gave me information on Columbia Lake, The Brubacher House and the families that had lived there. I also went through the archives of the University of Waterloo’s Daily Bulletin and gathered all the information they had on Columbia Lake and all the events that had taken place there.

From all this I created a time line that mapped out the ecological and historical information I had gathered. This dates from the formation of the rocks in the area 430-395 million years ago⁴, to a snippet from 2012 in the Daily bulletin about a Canada Goose having been shot⁵. From this timeline I create my chapters layout.

I started the chapter design by going through my timeline and writing down all of the things that could potentially be a story. From there I decided to try and group them based on theme. The first chapter in a section would be an ecological facet that would dictate the theme for the section. Then would be either a historical or recent story (sometimes one of each) that reflected the theme set up by the first chapter. This would be followed by a personal story told by me to illustrate how the theme set up is present in current day.

These sections were then arranged to build on each other, and call back to one another so that a person can see how every moment is impactful and leaves marks on the people and/or the land.

III. Results

The ecological sections ended up being: Water, Rock, Trees, Land, Wildlife, Lake 1, and Lake 2. These were paired with information on the Haldimand Tract⁶, the German Mennonite Settlement of the area, the Brubacher family history⁷, and different newspaper articles about events at Columbia Lake⁸. Then my own interactions ranging from my first-time visiting
Columbia Lake and my discovery of The Brubacher Museum, to an awkward first date I had there, and my friend and my’s discovery that Columbia Lake has fire flies.

The more I got to know Columbia Lake the more I started to see its history written all over it. Things that happened 200 years ago still were present on the land and in the memory of the land. The Brubacher House made from stones pulled from the land it now stands on, the apple trees spotted around the property, the lake created as storm water management, and the tree burnt by some tragic accident. I could also see how the land had impacted the people. The people who had made this place their home, the people who fought for the Brubacher House to be preserved, the people who designated this place as a park, and the students that work to preserve it.

The result of all of this is what I call the Story of Columbia Lake, comprised from pieces put together to create as much of a complete story as I could.

VI. Discussion

“Stories are among our most potent tools for restoring the land as well as our relationship to land. We need to unearth the old stories that live in a place and begin to create new ones, for we are storytellers, not just story tellers. All stories are connected, new ones woven from the threads of the old.” – Robin Wall Kimmerer, *Braiding Sweet Grass* ⁹

I recently worried I didn’t have consistent character development in my story, because that is often what is most compelling to a reader, watching something change. Then I realised that maybe no person has significant character development, but Columbia Lake sure does. Columbia Lake unfolds and develops through this book changing drastically time after time, and turning into the beautiful place I know and love. I wouldn’t ever have seen this if I hadn’t payed attention, if I hadn’t taken the time to examine its story.

So, it is time we start paying attention to the land we interact with and depend upon. We must shift mindsets from land as a thing we can use to Land as a living changing entity. We must shift this system that is causing so much harm to our world and work towards fixing the destruction we have caused. Fostering respect, and taking the time to understand the stories of our land is a vital step in this process.

Learning about land and becoming more intimate with land allows for greater connection to a place, and therefore more respect for a place. Building these connections is work, and effort, but the payoff is greatly worth it. Feeling like you are a part of a place’s story, allows you to feel a connectedness, and sense of place that you otherwise would not. Having done this project I know feel like Columbia Lake is a part of me and that I am a part of it’s story. I may not have physically shaped it, but it has definitely shaped me.

We must cherish the stories of the land, strive to create new stories and respect all we find. Our Earth is our home and without it we would not be alive. I have created a story for you to hopefully get you started on your journey. It’s here to remind you how complex the interdependencies are, and to encourage you to look at land differently. So please give it a read. Hopefully you will come out if it with a slightly changed perception, or at least a desire to look at our relationship with land more closely.

V. References

1. *The Meadow*, James Galvin
2. *Teaching a Stone to Talk*, Annie Dillard
3. *A River Runs Through It*, Norman Mclean
4. The Grand River Conservation Authority
5. The Waterloo University Bulletin
7. The Brubacher House Museum
8. The Ellis Little Local History Room - Waterloo Public Library
9. *Braiding Sweetgrass*, Robin Wall Kimmerer
Helping Demystify Knowledge Integration’s (KI) Learning Experience by Matching Future Students with KI Students

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Abstract – Knowledge Integration’s (KI) unique program offering is attractive to many people – students, parents, and employers. However, it struggles with communicating its value and the benefit of having diverse experiences to parents and high school students. I propose the creation of a new tool that would help to demystify the Knowledge Integration learning experience for these groups of users by providing a way for future students and their parents to view the current life paths of students from KI. The term ‘life path’ describes the path that KI students took throughout their degree, including various jobs or volunteer experiences they’ve had, their degree specialization, words of wisdom, and the answer to the famous question, ‘What happens after KI?’ Through a web application, future students fill in details about their favourite subjects and hobbies and are matched with three students from KI. When matched, future students will be able to view the life paths of the students already enrolled in the KI program. This application enables students and their parents to see that KI students can take different paths through post-secondary education based on their diverse interests. In doing so, they create a unique degree that will serve them well in the future. The application helps to decrease that ambiguity of the program and helps future students articulate what their life in KI might look like.

1. Introduction

Knowledge Integration (KI) is an interdisciplinary arts and science program at the University of Waterloo (UW).¹ It lets you design your own degree and curate relevant experiences, meaning each student graduates with a unique degree. This experience is highly personalized, and KI encourages students to build a meaningful life using the opportunities around them.

The value of KI, while immediately apparent to anyone who is in the program, can be less identifiable to those outside the program, like future students, parents, or employers. The thesis project of one KI alumni, Robbie Abrams, focused on how KI can improve its communications with future students, to improve how KI demonstrates and communicates its values.² Abrams’ research centered on the best way to recruit students to university programs. He wrote in his report that stories are an easy way to show why the program is the right choice for a certain student.² In addition, other best practices suggest that interacting with future students in a way that encourages further engagement in the future helps future students stay involved in the experience.²

The findings from Abrams’ research project demonstrated the strengths of KI. The ability to design your education and be flexible within your degree, allowing your diverse interests to flourish, is one such reason.² KI also helps to create an engaged learning experience inside and outside the classroom.²

Communicating an engaged learning experience to future students and parents is challenging. It can be difficult to show in traditional marketing brochures and materials, as they are not well adapted to show how the learning experience in KI, or demonstrate KI’s unique classroom environment.² Abrams suggested that it would be beneficial to display this through testimonials of user experience, showcased through traditional mediums or through a different medium.²

This was the inspiration for my project idea. I imagined a way to share stories, create connections,
and demonstrate what an ‘engaged learning experience’ can look like, because it can be different for every student. The diverse student body in KI leads to a vast range of interests and unique degrees, and this kind of choice can be overwhelming to a future student who is used to having a relatively structured life. KI encourages its students to build their degree to fit their life, and add in career and volunteering opportunities that help to round out their experiences within the program. The overall goal of KI is to have a meaningful life with which you contribute to and feel a sense of belonging in.

Thus, I propose the creation of a web application that matches future students (students who are interested in the university; prospective students) with KI students based on subject interests and hobbies. It will show the future student potential life paths, and allow them to visualize what their own life might look like in KI. A life path is a term used to describe the path that KI students took throughout their degree, including various jobs or volunteer experiences, their degree specializations, words of wisdom, and the answer to the famous question, ‘What happens after KI?’ This web application will help future students visualize themselves in KI and help them begin to articulate what post-secondary experience they want for themselves.

The obvious benefit to the KI program is that it will help to entice more students to either apply or accept the program offer; it will help KI reach a broader audience; and it will show, through stories and personal experiences, the engaged learning experience that KI provides for its students.

II. Process

I planned this project with two main steps in mind: the first step was creating a database with information from Knowledge Integration students, and the second step consisted of the design process of coding the web application that would match the future students with the current students. I reached out to the Knowledge Integration department and spoke with Rob Gorbet, the Chair of the Knowledge Integration program; Kim Boucher, the Outreach and Administrative Manager; and Paul McKone, the Senior Design Instructor. I discussed the premise of the idea with Rob and Kim to gain their insights, feedback, and to see what potential they saw in the project. Next, I spoke with Paul about how to create the database and where I might host the web application. I also met with Michael Tjendra, the Web Designer and Administrator for the Mapping, Analysis, & Design (MAD) Lab in the Faculty of Environment at UW. He shared with me some thoughts around accessibility, hosting, and privacy restrictions. All the meetings were helpful in fleshing out my project idea and project plan.

Throughout the first term, I focused on creating a survey that would collect data from the Knowledge Integration students. I thought about the data I wanted from KI students to help properly visualize and articulate their life paths. I aimed to gather meaningful data that would be relevant to future students while helping to paint a complete picture of the Knowledge Integration learning experience. I tested the survey with a small group of students to gain feedback about the flow, design, and content. Google Forms was an ideal choice because of its ease of editing and integration with other Google suites, such as Google Sheets and Google Script. After creating the final form, I posted in on the Knowledge Integration Student Society (KISS) pages on Facebook: KISS and KISS for Current Students. After getting some responses, I attempted to use Google Script and Google Sheets to pull the responses from the forms and code a database.

Throughout the second term, I worked on creating a web application. After doing some research into how to use Django, an open source web framework, and Python to create a web application, I worked my way through tutorials and wrote some of my own code. The task proved more complicated than I thought. I pivoted about halfway through the term to a more design-oriented focus and spent some time identifying my goals, users, and core functionalities. I also created detailed wireframes and user flows, changing the user experience from what I previously imagined. For the final project, I plan to use a prototyping software like Adobe XD to create a clickable prototype of the web application.

III. Next Steps

I created a project plan for the web application as part of this project. The next steps for this is to find someone who can actually code and create it. The next stages of the web application are researching solutions, building the application, and launching it for use. Researching solutions is important to help evaluate when to use pre-made libraries versus building a function from scratch. For the building of the app, the creation of a database (ideally using SQL, Structured Query Language) is necessary both
to gather information from the survey and from participants in the quiz. A development environment, server, and hosting location would need to be decided upon as well. Lastly, AODA (Accessibility for Ontarians with Disabilities Act) standards would need to be implemented to ensure that the application is accessible for all.

IV. Beyond KI

This project is beneficial in applications beyond Knowledge Integration. Its ability to help students visualize and articulate their plans for their post-secondary educational experience would be useful in any post-secondary program. Using your experiences to create a meaningful and value-aligned life is something that all institutions should strive to communicate through their programs.

Other programs in the Faculty of Environment, or across the University of Waterloo as a whole, can use this web application. In similar programs, typically with less structure and many electives, this application can help to communicate the variety of paths students can take within their degree. It allows students to visualize potential pathways for themselves, and opens their eyes to potential experiences they might want to try. Having concrete examples of the experiences of actual students helps prospective students dream about what their own experience might be.

Regardless of how narrow or broad a program is, the web application will help future students see that there are many different pathways through the same program, and that they have the chance to take different opportunities and have the flexibility to design their degree the way that they want.

Overall, it helps future students see if the program they are interested in is actually a good fit for them. This can have a positive effect on first year attrition rates within post-secondary education because future students will be choosing programs that are more well-suited for them. This also would help to increase student satisfaction within their program and within their post-secondary institution.

This application would also be a useful replacement for students that live too far away from Waterloo to come visit during open house days (e.g., across Canada or internationally). The web application would help them hear relevant stories and form connections with the program without leaving their own home, once again helping them see if the program and UW is right for them.

Lastly, the creation of this web application would allow UW to collect data on the actions and accomplishments of its current students and alumni, allowing them to communicate the outcomes and avenues of various programs with more certainty.

I strongly believe in the creation of this web application, not only for the benefit of Knowledge Integration, but also for the benefit of all the programs across the University of Waterloo.

V. References

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PSYCH 292 Tutorial TA Guidebook

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Abstract – In the past, TAs that led the PSYCH 292 (Introduction to Statistics for Psychology Students) tutorials were not given much direction about how to run it. The lack of a standardized plan led to TAs running tutorials run inconsistently between sections. This inconsistency was problematic for students, especially those who struggled with statistics, because tutorials are designed to be a built-in, easily accessible, useful resource for students to better understand course material. However, the PSYCH 292 tutorial’s inconsistency between sections and overall lack of organization rendered it significantly less useful for students than it was intended to be.

To address this problem, Dr. Wehr suggested that I create a guidebook for the TAs. The guidebook contains 10 detailed lesson plans designed to be easy to follow during tutorials and include a section for notes to the TAs indicating important information to point out to students. The guidebook was designed to make it significantly easier for TAs to prepare for and lead future tutorials, and to make them standardized across sections. The TAs’ use of the guidebook should make the tutorial a more useful resource for future students.

I. Background
Students in Psychology at UW are required to take an introduction to statistics course called PSYCH 292. In general, students in psychology don’t particularly love statistics, and many of them struggle in this course (that is required for the major). PSYCH 292 has a tutorial lead by TAs. In the past, TAs were given little instruction as to how to lead the tutorial. This resulted in tutorials being run differently and certain concepts being explained differently depending on the TA running it. This inconsistency and overall lack of organization between tutorial sections made it difficult for students to use the tutorial as a viable resource to reinforce learning from the lecture. Given that many students already struggled with this course, it was unfortunate and that the tutorials weren’t a helpful resource. To address this problem, Dr. Wehr, the professor teaching the course, decided to create standardized lesson plans for the TAs to follow during the tutorials. My role would be to make these lesson plans more graphically appealing and as visually clear as possible.

II. Methods
Most of the first semester was dedicated to figuring out the logistics of this project. I decided that I should ask previous TAs about their experience with the tutorial, and what things they would have liked to be included in a guidebook had they been given one. After consulting with 3 previous TAs, and Dr. Wehr, I decided that an appropriate final deliverable would be a comprehensive guidebook for the TAs which would include the following:
- An overview of effective teaching/communication practices in the PSYCH 292 tutorial
- Information explaining how to access pre-made Kahoot! quizzes intended to be used at the beginning of each tutorial to engage the students and reinforce concepts relevant to the tutorial
- Pre-learning material intended to be understood by both the TA and the student prior to each tutorial to remind them of important concepts that will be relevant in the tutorial
- A section for notes to the TAs pertaining to confusing parts of questions covered in the tutorial
- A table of contents to help TAs quickly find the tutorial they are looking for

Once I decided what I wanted to include in the guidebook I had to find a software to turn my dreams into a reality. I decided a graphic design software would be more helpful for this project than a book-writing software because it was more important that I could easily move things around to improve clarity and legibility, and less important that it had functions to help my product resemble a book. I decided to use Canva, a free online graphic design software, to create both the lesson plans and the guidebook itself.

We decided that every week Dr. Wehr would send me a preliminary version of the tutorial lesson plan. I would create a more visually appealing and clear version of it in Canva and send it to the TAs a preliminary version of each tutorial. I would ask them if anything was erroneous, visually unclear or difficult to follow. If anything was identified as problematic, they would tell me, and I would fix it and send them an updated version to the lesson plan, and it would be used in the tutorial.

III. Results
Through a combination of soliciting TA feedback and trial and error, the lesson plans got fewer critiques over time and presumably became more clear and helpful resources for the TAs. The TAs expressed gratitude to both me and Dr. Wehr for our combined effort to improve the tutorial for both them and their students. Both Dr. Wehr and the TAs agree that this semester’s tutorials were overall a better, more helpful resource for students than in the past. These comments suggest that our efforts were appreciated and that my project was helpful for both TAs and students this semester and for semesters to come.

IV. Discussion
As an instructor, is important to be cognizant of the quality of your tutorial, and to make sure it achieves the learning objectives you seek to achieve. Tutorials have the potential to be an excellent resource for students if they are given thorough care and attention by those who design them. However, if tutorials are an instructor’s after-thought they have the potential to be a waste of opportunity for TAs, and a waste of time for students (who demonstrate their distaste with their absence). Students deserve to have a tutorial that is given as much thought as the lecture component accompanying it. I am happy that my project will live on and help future students and TAs.
Conceptually Designing a Mobile Experience to Help Student-Athletes Develop Mental Resilience in Preparation for Competition

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Abstract - The purpose of this 4th year Knowledge Integration senior design project was to use existing research in the field of sport psychology to create a mobile application. Currently, there is a lack of free and simple resources for student-athletes to use that will help prepare them for competition. As opposed to traditional text, mobile apps are accessible, easy to use, and engaging. This application (which includes daily/monthly habit tracking aids and tools such as imagery techniques) serves as a one-stop training tool to help student-athletes continuously improve positive mental habits in order to succeed in competition. There are few apps offered that have simple consistent mental training for student-athletes; this application will provide an easy-to-use interface where athletes can form habits to help their training. It’s important to note that this app is not fully coded - it is a detailed prototype with mock data that users can still interact with. The creation of the app started with ideation by means of the Jobs-To-Be-Done framework to establish core mental resilience techniques such as weekly journals, imagery, and goal setting. Through an iterative process with user needs at its focus, hand-drawn wireframes were transformed into digital mockups using prototyping software Figma and Invision. To further improve the simplicity and ease of use, several usability sessions were conducted. Participants would walk-through the app with prompting questions and the feedback given would be used to iteratively revise the app. New sessions with additional participants are still ongoing.

I. Introduction

Elite Athletes dedicate hours of their day over years of their life to the grueling physical demands of sport; student-athletes, like the ones at the University of Waterloo, are no different. The physical aspect of competing in sport, however, is only half the battle that athletes face. On the surface, it may seem that competition pits two opposing teams/individuals against another, but an overlooked fact is that many athletes struggle to play against their biggest opponent: themselves. We often place importance on the need to train our bodies to face the rigors of sport, seldom do we take time to train the most important muscle that manages pain, fatigue, and your ability to stop or go - the brain.

The issue of mental health is especially prevalent in student-athletes. With less experience in the world (compared to matured adult athletes) coupled with stress from school, relationships, and finances – a poor state of mental health is not uncommon. In fact, there has been a decreasing state of mental health wellness in student-athletes in the past few years (NCAA Sports Science Institute, 2016). Professional athletes have support networks that oversee and educate them whether it’s on weight-lifting, conditioning, skill sharpening, or mental health excellence. Unfortunately, even though there has been a push for mental advocacy, especially on campus, there are few simple and applicable resources that student-athletes can use (UWaterloo Mental Health Progress Dashboard, 2018).

There is a plethora of research in the sports psychology field; what happens in the mind of an athlete during competition and techniques to combat those limiting thoughts has already been wildly established. Since it would be redundant to perform any research in this field, the goal of
This senior design project was to take this knowledge and solve the how. How might student athletes consistently train themselves to be mentally stronger in a simple and consistent way? The result of this was to design an app that aids the athlete through their pre-season and season to consistently train their mind to handle and adapt to fatigue-inducing stressors during competition using mindfulness and sports psychology techniques. Most student-athletes have access to a smartphone, so the medium of mobile applications was decided as they are an extremely accessible way to provide an educational and interactive experience as opposed to traditional paper methods.

**Competitor applications**

A big concern that was held at the beginning of this project was if there were existing apps that achieved the same goal as this project, especially since apps like Lucid: Mental training and Ahead Sport Mind Training pop up in app stores upon searching for “mental training apps for athletes” (Ahead in the Game Inc., 2015). Although it may seem then that an app to train athletes’ mental game is commonplace, further exploration yields the opposite. These apps, including others, are generally complex to navigate, require subscriptions (the previous two examples cost $89.99/year and $11.99 respectively; heavy prices for a typical student), they ask too much of the user (voice recording or require filling out tedious forms), are time-consuming, and don’t have a complete collection of features aimed specifically at the student demographic.

An app that simplifies mental resilience strategies should not be overwhelming or time consuming, yet most of the current apps on the market are just so. For this project, the goal was to help student-athletes in a way that pre-existing apps could not: enable simple and quick techniques that could consistently help users prepare themselves for their important competitions.

**II. Product Design**

To create a well-designed mobile application, efficiency, feedback, and quick iterative cycles are of the upmost importance (Knapp, 2016). To build a simple, useable, creative, and great looking app, a goal for this project was to use these best possible practices of modern day product design. The project was setup so that every week a new “sprint” was created; each sprint had a clear list of tasks that was currently being worked on, what has been completed thus far, and what work was needed ahead on the roadmap. The product development tool *Airtable* was used to help plan weeks, complete deliverables, and update how tasks are managed through their lifecycle.

After setting a list of tasks and completing the necessary sports psychology background research, a list of features needed to be completed. To do so, a use case document was created to flesh out each idea for the app. Having a use case document further ironed out each feature by explaining what it entails, how the user interacts with it, the motivation behind it, and its capacity. It’s a very clever way to plan what each feature encompasses so that during development/design all necessary components are idealized. To help with creating use cases, each feature was with a “Jobs to Be Done” (JTBD) framework rather than a typical persona. A persona aims to create user profiles; however, personal biases are often included and without a large dataset of existing users an accurate portrayal of a one is difficult (Ulwick, 2016). JTBD statements follow a when [situation] I want to [motivation] so I can [outcome] format which is a great way to truly understand the motivation behind both a user’s problem and solution.

To implement the use case features, hand-drawn sketches and wireframes were created to illustrate rough prototypes of the app screens and a user’s journey when interacting with it. From there, they were translated into digital mockups using tools *Figma* and *Invision*.

Finally, a continuous cycle of creation and design critiques was initiated in the latter stages of the project. Usability testing sessions were conducted with student-athletes to test how easy and logical the app was to use. Usability testing is for iteration only, simple comments and surveys as a “design-critique” rather than accumulation of data points.
III. Discussion

The app has a list of features that targets consistent and positive habit forming, building a routine, hitting personal goals, and optimizing mental health wellness using a variety of sport psychology techniques. A gamification aspect was originally conceived, however, the authors decided that that would create an unhealthy motivation and pressure for users. The following features have been implemented in the app.

First, the app will include a monthly calendar that will be used to plan goals and build a routine. Built around the user’s class schedule, the calendar will be a place where daily checklists, pre-competition routines, and competition schedules can be easily found. Users will use the calendar to form a routine by visually laying out their process goals, tasks, and preparation efforts. A green circle represents a day with all goals completed, red means incomplete, and yellow is a competition day. Furthermore, a daily reflection will be available for users to use to become cognizant of the emotions they felt during that day. For example, after each practice the user should write down “3 things I did well after practice” to be aware of how they felt during and to build confidence in their abilities.

The second aspect of the app is a personal bullet journal which allows daily tasks to be viewed and checked off. Users can easily see a monthly overview to track how well they’re developing positive habits.

Finally, the app will have a toolkit that uses well-established sports psychology methods that can improve performance. Having a mantra is crucial to help build confidence and counter negativity, therefore, the user will create their own content (with some guiding) to develop “I am” statements that can reframe irrational beliefs. This will help get users to improve self-talk by emphasizing positive reinforcement in and outside of competition. These, along with inspirational quotes/phrases, will be shown during launch/splash/loading screens. Another aspect of the toolkit will be the breathing section. Practicing deep breathing exercises will help with concentration, relaxation, and will alleviate tension, stress, and high arousal. By honing breathing skills, users will be able to cut out distractions and will easily reach a focused state of mind during competition. The breathing exercises will have visual prompts ranging in complexity, but audio will not be included as the complexity is far too high. The final aspect of the toolkit is imagery. Using each of their senses, users will perform short exercises to visualize themselves performing and succeeding. This can be helpful in both calming them or “amping” them up before a competition (Wilson, 2017).

To help with a higher user retention rate, the calendar will have a notification system that will remind users to go through their pre-competition routine x amount of days before they compete.

Further iterations of the app may include a tracker that can show the frequency of completed activities, favorite activities, and progression throughout the year.

IV. References

Findings on a designated project manager in student capstone project teams

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Abstract - The University of Waterloo is encouraging more collaborative projects. Upper year students, specifically those in engineering, are tasked with working on 8 month capstone projects that involve conceptualizing and designing a project in their discipline. Students often face challenges and may struggle to succeed. Research has shown that educating students on project management techniques prior to beginning their capstone projects helps students succeed. While the Faculty of Engineering does lecture students on project management, the student groups decide if and how they wish to designate a peer project manager. This research attempts to analyze how a designated peer project manager emerges, why the group designated a project manager, and the overall effects of a project manager on the success of the student teams. Areas of research include management processes, student collaborative patterns, and student perceptions of group success.

The research includes two studies to gain qualitative and quantitative insights. The first study was a cohort study in the Department of Knowledge Integration. Third year students completing their capstone design project were interviewed five times over the course of the 7 months they were working on their projects. The second study was an attempt to confirm the interview findings and determine if they hold in the Faculty of Engineering. Fourth year engineering students were surveyed upon the completion of their capstone design projects. The research will contribute to the literature on student capstone group dynamics. Ultimately, the results are another insight into how groups may be more likely to succeed if they designate a peer project manager.

I. Introduction

In order for students participating in capstone projects to be successful, they must receive proper guidance and training.¹ One of the most impactful pieces of training for high-performance teamwork is project management.² Designating a project manager in a student group ensures that at least one student is using the taught skills and that the group will benefit from the actions of the project manager. Studies have shown that student use of project management techniques can nearly guarantee success.³ Despite these findings, when given the choice, students do not always use a designated project manager. Instead, students may choose to use project management tools or delegate the project management tasks among the entire project team. This research will attempt to answer the questions of how and why a project manager emerges in student teams and whether the project manager has a different perception of group success.

In this study, we will attempt to identify the reasons students use designated project managers in their capstone project teams. An investigation into how students designate a peer project manager will also address why the project manager was needed. This study will qualitatively evaluate the Knowledge Integration cohort currently enrolled in the INTEG 320/321: The Museum Course sequence. Interviews will outline project management models, students’ perception of overall experience and success, and shape the questions given to engineering students. Engineering students completing their capstone design project will be asked to complete a survey.
in order to gather empirical evidence. Together, these studies should describe how and why project managers emerged. Measures of perceived group success will also be taken; where group success is operationalized to include the elements: high group satisfaction, low group stress, meeting deadlines, and meeting a budget. The purpose of measuring group success will be to determine if the designated project manager (PM) reports a different perception of group success than the rest of the group.

II. Background and Motivation

Research on project management techniques in a capstone project concluded that the students who understood project management tools and principles are able to complete their projects in a more timely and cost-effective manner.4 Other research findings conclude that the successful adaptation of project management techniques enhances students’ abilities to complete their projects efficiently.5

This leads to the motivation of this study. Research will attempt to answer; why does a peer project manager emerge?

Investigations on the advantages of designating a peer PM found that student groups with peer PMs reported high group success. This research compared 3 cohorts of students: Cohort A that had no PM model, Cohort B of students who were given the option to designate a PM, and Cohort C who were required to designate a PM. Groups with a designated peer PM had higher levels of reported group success, fewer slackers, higher grades, higher peer evaluations of performance, and higher project quality than groups without a PM.6 The research does not address why the students chose to designate a peer PM and what the process entailed.

In unpublished research at the University of Waterloo, it was revealed that some Management Engineering Capstone Design Groups from the 2016-2017 academic year had a designated PM (43%), others had PMs on a rotating schedule (30%), and still others had no designated PM at all (27%). A closer analysis on the correlation between PM style and group satisfaction was completed with sufficient evidence to support a positive correlation.7

Another study empirically explored how PMs emerge. PMs who were interviewed identified that they were completing project management tasks and acting as a PM without knowing that they were the PM.8 If industry practice is to have informal selections of PMs, do student PMs also fall into the role?

This supports an additional research question: how does a peer PM emerge? Is it self-driven or a conscious group decision?

Naturally, PMs and project teams have different goals. Research has found that PMs experience higher stress during the planning and concluding phases of a project, whereas the project team does not. Instead, they experience higher stress in the middle.9

This study investigates the differences of perceived group success depending on the role a student has in their capstone project team. In other words, another research question is; how does the perceived group success differ between group members depending on their role in the project team?

At the University of Waterloo, when engineering students complete their capstone design project, they are instructed on project management tools which has increased their success rate since implementation.10,11 In this study, groups who designate a peer PM will be studied to identify why they designated a peer PM, how the peer was designated, and compared to groups without a peer PM.

III. Methodology

To investigate how PMs emerge in student capstone projects, a longitudinal study was conducted over seven months. This analyzed the process of the collaborative experience rather than simply a cumulative reflection. The longitudinal study culminates into a one-shot comprehensive survey. The two studies are outlined below;

Study 1: Longitudinal Interviews. A cohort study with students from the Knowledge Integration community who were currently enrolled in the INTEG 320/321 Museum Course sequence was conducted. This study began with preliminary conversations after groups originally formed. Five cycles of semi-structured interviews, once a month, with different representatives from each group gathered qualitative data. The purpose of these interviews...
was to follow the groups as they designate a peer PM in order to understand how the PM emerged and why. These interviews informed the questions for study 2.

**Study 2: One-Shot End Survey.** All engineering students at the University of Waterloo participate in a symposium mid-March to display their final project. All members of the project team were encouraged to complete a survey. Group answers will be compared with other groups to learn how peer PMs tend to emerge. Answers within the group will be compared to identify any discrepancies between the PMs and the rest of the group members. The purpose of this survey is to gather quantitative data on how peer PMs were chosen, why, and the impact on group success.

**IV. Results and Discussion**

**I. Study 1**

The study population was all students enrolled in the INTEG 320/321 Museum Course sequence during the time of the study. Their capstone design project was to build a museum. Knowledge Integration students enrolled in the course sequence were divided into 5 groups of size 5-6. Their deliverables included a detailed implementation plan outlining timelines and budgets. Students received a lecture on project management techniques at the end of November.

All five groups were included in Study 1. In this report, there is a mention of semesters: September – December (Term 1), and January – March (Term 2). I classify project management into 4 models: no PM, an unofficial/unrecognized PM, rotating PMs, one PM.

The focus of the project during Term 1 was planning. During this time, students reported that they would work on the deliverables as an entire team and all group members were consulted for decision making. It was during the first term that students reported the most amount of conflict. There was a discovered trend in the correlation between group conflict and the emergence of a PM. When groups were experiencing conflict, a group member tended to step into a project manager role. When this would happen, the PM emerged naturally and informally. The group would typically recognize that member as performing project management tasks, but not as the formal project manager. Depending on the team, this experience was recorded as a rotating or informal PM. One group was an exception. This group decided to designate a peer PM at the beginning of the project. They remained consistent and reported minimal conflict.

Groups began building and implementing their project during Term 2. Every group designated a peer PM. The same PM stayed in the position for the remainder of the project. There was a consensus among all team that the presence of a PM contributed to the success of the group.

One group reported disagreement in the perception of the degree to which the PM contributed to success. While the PM reported a good group experience, this was not agreed upon by all members. This suggests a disagreement in the perceptions between different group roles. It may be that PMs have different values and criteria of success than the rest of the group; therefore, their final perceptions do not align with those of their group members.

**II. Study 2**

The purpose of study 2 was to confirm the findings of study 1 and test if they hold in the Faculty of Engineering. Fourth-year engineering students participate in an 8-month capstone design project in groups of an average size of 4.

At the time of submitting this conference paper, a survey was sent out to all fourth years enrolled in the capstone projects in Mechanical Engineering, Management Engineering, Systems Design Engineering, Mechatronics Engineering, Civil Engineering, Chemical Engineering, and Nanotechnology Engineering. Surveys will continue to be sent out to increase response rate.

Due to the timing of this deliverable, no data has been formally analyzed yet. Therefore, there are no concrete conclusions at the time of writing.

There are some preliminary findings from the data already collected. A major limitation of these
findings is they have not been cleaned or aggregated based on groups. Therefore, these numbers may be slightly skewed depending on the number of individual responses from the same project team.

From the preliminary findings 20.8% of respondents did not have a project manager, 26.7% of respondents had a rotating PM, 49.5% of respondents had one project manager, and 3.0% of respondents claimed to use a PM model not included in the survey. Since study 1 captured transitions between PM models, this was also captured in study 2. In the first study, 4 out of the 5 groups changed PM models throughout the project. Based on the current study 2 survey responses, only 11.9% of the respondent’s groups changed PM models.

In order to answer the research questions of this research study, there have to be 3 analyses. First, an analysis on how the PM emerged. 63.8% of the project managers naturally emerged, 31.2% of the PMs were decided upon by the group, and the remainder of the respondents chose “Other”. These findings suggest the group will recognize members more inclined to the PM role. Second, the main reported reason a PM emerged in the engineering projects was because teams needed organizational management (64). The least common reason was due to group conflict (2).

A hypothesis test was done on the preliminary data to test if the difference between mean responses from group success survey questions are significantly different between PMs and non-PMs ($H_0: \mu_{PM} = \mu_{non-PM}$). None of the p-values were smaller than 0.05, indicating that there was no significant difference. Since this was just done on the preliminary data, the sample size was very small. No conclusions from the findings will be drawn until all data is collected.

V. Conclusion

Both studies in this research study conclude the importance of a peer project manager in student capstone projects. In both studies, a majority of the groups used a peer PM. There are different reasons why a group will choose to designate a peer PM, but primarily there is a recognized need by the team and an acknowledgement of the skillset of one of their team members to fulfill the need. Further analysis can lead to conclusions about perceived group success and team aggregations of the results.

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Leveling Up Our Mental Health

Mental health is becoming a more prominent issue in public awareness and health policy. This is especially the case for youth who may start to develop mental health difficulties as early as 13 years old. Recently, there is growing attention to this issue in the relevant research literature (Polanczyak & Salum, 2015). Growing attention on helping individuals improve their mental health and develop self-regulating skills has been especially prominent. Studies have identified tasks and changes in lifestyle that have led to statistically and clinically significant improvements on many measures of wellbeing (Kobau & Seligman, 2011). For example, these actions include improving one’s overall outlook on life, one’s attitude toward others, motivation to treat one’s self well, and even coping mechanisms for specific disorders such as Generalized Anxiety Disorder (Lyubomirsky, 2013). However, while much of this research supports the development of these beneficial techniques, mental health issues are still prevalent for youth. This is in part because many of the people who would benefit from using these approaches are either unaware of their existence or unmotivated to give them a chance because they seem ingenuine (McConigal, 2012). For example, it is well established that slow breathing can help a person to calm down; however, it is unlikely the average teenager will seek out a slow breathing exercise when stressed or anxious. (Lyubomirsky, 2013)

How might such an issue be addressed? The core of the solution may involve ensuring different mental wellness strategies are presented in accessible, motivating, and age-appropriate ways. One supported approach is the application of gamification techniques, which are techniques used primarily in the design of video games to motivate players to complete unnecessary or challenging tasks. This approach could make looking after one’s own mental health more enjoyable and immediately rewarding than it is currently perceived to be. Gamification techniques are often successfully used to motivate players to complete otherwise undesirable activities (consider various learn-to-type games) as part of a game instead of as tedious work. These techniques have also successfully implemented for self-improvement for physical health as well (see, for example, Couch to 5K). This study examines the effectiveness of a gamification technique for youth in a specific mental health context. This design thesis created a prototype to test whether gamification techniques can be used to motivate players aged 13-20 to complete short tasks known to improve their mental health. Specifically, the prototype explores the practicality of gamifying the coaching of slow breathing as a self-moderation strategy.

For the creation of this prototype, previous research was reviewed on relevant topics from a variety of disciplines. These included the efficacy of various gamification techniques, previous gamification efforts for public health initiatives, positive psychology research focusing on mental health improvement techniques, self-help research, research into effective game design, and potential game engines.

The main challenge was to develop a motivation for the player to engage with the mental health improvement tasks presented. This problem was approached through the use of narrative progression and standard gamification techniques such as experience bars.
Experience bars refer to a common graphic monitor found in video games that tracks the player’s progress in attaining goals set by the game. As the player completes more of these presented mental health tasks, their progress is reflected visually in the experience bar. As the bar fills up, the player unlocks further events to enable the game’s story to progress. In this prototype, the game focuses upon helping a young student deal with anxiety and self-esteem issues. The goal is to develop a mentor relationship between the player and this character. Giving individuals responsibilities and putting them in care-focused positions can help develop a more positive self-image (Karcher, 2009).

The non-playable character (NPC)’s design is a younger individual with clear and exaggerated facial expressions that are not overly childish in style. All of the animations in the game were also designed to emphasize the character's expressions and body language. This was to make reactions and expressions more meaningful to a wide range of individuals as well as helping individuals identify the meaning behind subtler body language. The character was developed to be a friendly but timid young boy with anxiety issues who loves reading spy novels but is awkward in social situations. This profile was designed to help flesh the character out beyond their relevant mental health issues and build them into a realistic individual the player can interact with and feel more connected to. By choosing problems such as anxiety and social difficulties (that are experienced by all youth regardless of diagnosis) the non-playable character has a higher chance of being more relatable to the player. The character is designed as a friendly and personable child to help motivate the player to mentor them in positive mental health techniques. This character wants to make friends with his peers but finds he says the wrong things or is too anxious to talk. This is a common experience for all youth regardless of diagnosis and therefore more relatable for a diverse audience. In this way, most players can project themselves into a mentoring role on this issue.

The actual activities chosen for this prototype were narrowed down from a curated list of positive coping strategies and mental health techniques with well-documented effectiveness (Kobau & Seligman, 2011). The two main tasks chosen were prioritized due to their wide applicability, general usefulness for the non-clinical population, and ease to implement in a short timeline. A slow breathing exercise and an act of kindness exercise were selected as tasks. The slow breathing exercise in particular was chosen because it is a simple and well-supported strategy for helping one calm down when stressed or anxious. Slow breathing exercises are one of the most diversely applicable short tasks to help improve their mental health with quick effects. Despite this common knowledge, many people don't regularly participate in slow breathing exercises either because they are unmotivated to do so or because they are unwilling due to a perceived ineffectiveness (Lyubomirsky, 2013). The act of kindness activity is based on research that shows that by making others feel happier and smile elevates one’s own current mood (Laird & Bresler, 1990). This is especially a useful technique because research also shows that being on the receiving end of such actions also helps to improve one’s mood. This exercise also helps motivate players to partake in even the smallest social interactions such as holding the door.
for others or complimenting someone's outfit. This pushes the player in more low stress social interactions with high chances of positive social interactions.

When deciding the prototype’s format, many different factors were taken into account. These included accessibility, graphics, affordability for complex or subtle animations, ease of use, and aesthetic attractiveness to the average player. Many different formats were considered, including the use of a facerig to capture more realistic expressions. A facerig is software that can capture a face by webcam and transform facial features or expressions onto an animated face. However, for the sake of approachability and ease of use, the final format chosen was a much simpler one. The software chosen was a well-known game engine called Ren'Py (Rothamel, 2018), which specializes in programming visual novels. Visual novels are a form of video game that play primarily as interactive stories in which the reader can choose their own adventure through interactive sequences and visuals. Some famous examples of successful visual novels include games about solving murder mysteries from the perspective of a lawyer known as the Ace Attorney Franchise, a romantic sci-fi mystery called Steins;Gate, and a time-travel murder mystery titled Life is Strange. Using this game engine in conjunction with a Japanese animation software called Live2D (Nakajo, 2019) allowed a prototype to be created in which the player can interact with expressive characters in a story driven format. The Live2D software facilitates the use of 2D graphics in a fluid pseudo-3D format to create precise and expressive animations. Integrating these two programs enabled other the prototype to be a more expressive and relatable experience.

The prototype was created to gauge the relatability and effectiveness of this format to motivate potential players to complete tasks proven to help them. The format was designed for a target audience of youths from 13 to 20 years old identified as being at risk for or already suffering from poor mental health. The prototype specifically targeted problems with self-esteem and anxiety because they are both serious and common problems known to affect this age range of individuals. The hope is that this prototype can motivate individuals in this at-risk population to complete activities known to lower their psychosocial risk factors and help with the development of healthy coping mechanisms. If developed into a full game, the focus would be on the effectiveness of the activities and the overall approachability of the game. For this reason, it would be very important to ensure the game is accessible to individuals regardless of economic status.

At the completion of this design thesis, a game dialogue with multitude of dialogue interactions and 5 different outcomes was developed and tested with peers. The prototype includes meeting the game character, developing a conversation and discovery of the character's social anxiety issue, and an interaction that leads to coaching the character through one of two anxiety-reducing exercises. In this design challenge, the dialogue was easily developed, once a context and scenario were developed. Those were considered important, as they had to be both realistic and engaging. A more significant challenge was implementing the animation software to provide expressions with sufficient verisimilitude and engagement for players to immerse themselves in the dialogue.
If the prototype were to be further developed, the focus on positive self-esteem would be emphasized. Along with this, additional research supported mental health tasks would be identified and added. These would include tasks focusing on positive self-reflection, self-love, gratitude, increasing awareness of the body’s needs (e.g., eating and sleeping healthy amounts), practicing self-care, reflecting and making peace with traumatic events through reflective writing, structured positive distractions, facilitating more positive social interactions, and encouraging the player to reflect on their strengths. These tasks would be designed with gamified elements focusing on increasing motivation, making failure more acceptable, creating experiences that increase the player’s happiness, visually tracking and rewarding progress, and encouraging the player to become more connected in the world around them both socially and through increased comfortableness with themselves. To help motivate players right off the bat, the prototype’s story would be developed into a deeper and more relatable experience in which the player must help the NPC character to become more comfortable with himself both in social interactions and in his own self-view. Different parts of the story would focus on developing additional skills. The player would be able to enter a mode in which they can solely focus on using any of the relevant tasks as needed throughout the day. The NPC would go through difficult social situations and come to the player both for support and advice on how to move forward. As the player completes more tasks and further develops their skills, the NPC character would progress through these social situations and learn how to more effectively deal with them.

Prior to developing the game more fully, some additional aspects of involvement should be explored to ensure it is both effective and accessible for a diverse range of individuals. It is important to take additional criteria beyond a player’s age and mental health risks into account. The potential player’s culture, economic status, and reading level are all also important factors that should be taken into consideration. In addition to this, it will be important to run experiments on the design’s effectiveness over a period of time to ensure the tasks have a lasting effect on the individual and assist with overall improvement in mental health. Finally, the accessibility of the design must also be taken into account. These could include scalable text size & voice-overs for those with visual impairments or reading disorders, varied colour options for those with different forms of colour blindness, or even low light options for individuals with sensitivity to bright screens.

Overall, the implementation of this design is to gauge the effectiveness of using gamification techniques to address a lack in motivation for self-care. Through the use of gamification techniques and game studies research on emotion, creating relatable characters, and motivating players this prototype can help to further demonstrate the capabilities of gamification as tool a tool which may serve to assist in developing and reinforcing healthy strategies to promote a mental health perspective. By motivating players to partake in tasks beneficial to their mental health, they can lower their risk factors for developing relevant disorders and develop positive coping mechanisms to deal with them.
Bibliography


Out with the old and in with the new: Redefining the American Dream home

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Abstract - Redefining the American Dream home as a whole concentrates on examining the modern North American housing landscape, addressing its impact on class divisions and mental health, as well as housing stigmas, and exploring the opportunities presented by modular and adaptive communities. This portion in this work explores particularly the shift if definition of the American Dream. It considers how the changing definition might be more attainable through the trimming the fat in housing gluttony. After providing background to the redefining and the emphasis on personal prosperity instead of monetary prosperity, this portion of Redefining the American Dream home examines the median size home in the United States, its elements that are useful and necessary as well as those that are wasteful. This aids in gaining an understanding of what exists at the core of a home. These elements are then reassembled in a contrasting tiny home, an extreme to show what is possible without compromising lifestyle. The extreme case presented in this work acts as a base piece in the modular and adaptive communities that bend, flex, and morph to the needs of its current inhabitants through propagation of the same units as well as the manipulation of components to enlarge or shrink a unit.

I. Introduction

The American Dream has long been a standard for which many people strive and sacrifice: a white picket fence surrounding a single family detached house – a picturesque and thriving existence. However, not only is this not sustainable financially, environmentally, or emotionally for a large portion of the population, recent surveys suggest a shift in what is considered the American Dream. Though the staples of freedom and housing stability through homeownership still remain, recent surveys suggest an increasing emphasis on financial freedom and being debt-free, and flexibility to pursue our passions (1, 2). Another emphasis was a good family life (3).

Massachusetts Mutual Life Insurance commissioned a survey carried out in the beginning of 2018, which found that 64% of respondents had a mortgage and 33% of respondents said they felt that financial stability is unattainable because of their debt, with many respondents claiming not to have financial security regardless of whether they felt that the American Dream was attainable or not (2). The median home size built in the United States in 2017 is approximately 2,426 sq. ft. (very close to the median size of homes sold in 2017, 2,457 sq. ft.), and the average sale price from 2017 was $384,900 USD (just under $515,000 CAD). The median household income in 2017 was approximately $57,652 USD (just over $77,000 CAD) (4). Considering these last statistics, the new American Dream is a lot more achievable if we allow ourselves to abandon the old American
Dream, if we allow ourselves to abandon the “having it all, and having it bigger and better than our parents” lifestyle.

Though housing alone is not enough to achieve this new American Dream, it can have a dramatic impact. The Federal Housing Association suggests that most Americans can afford to spend up to 30% of their income on housing (5). Reducing housing expenses allows individuals to reallocate a significant portion of their income towards achieving their American Dream sooner and more aggressively. This can be done through lower square footage, resulting in both a lower acquisition price as well as lower utility usage. This is not meant to force compromise now to have comfort in the future.

Below is an exploration on how this sort of housing change is might be achieved. Considered first is the usage of single detached houses, then the components of a traditional home, and, finally, how the components can be reimagined in an uncompromising small home. This last point serves to illustrate an extreme, not a universal ideal.

II. How do we use our American Dream?

The house shown in figure 1 has approximately the same square footage as the median house completed in the United States in 2017. The colour-coding explores the usage of each room, keeping in mind that the average number of people per household in that same year in the United States is approximately 2.63. Though this diagram is an estimation and likely somewhat tinted with personal experience, it still illustrates how little is actually used frequently in the old Dream-worthy home. Were the old Dream home to half in size, there would still be some low-use sections.

III. What component make our Dream home?

Accepting that the old Dream home could be trimmed at least by half, why not consider how much can be trimmed while still retaining references to the old Dream home comfort; let’s go tiny without compromise. There are two main considerations for beginning to design: what are components of a home and what are the volumetric constraints of a tiny house?
Examining the old Dream home, the following are high-use, important areas become apparent:

- Bedroom and storage/closet space
- Bathroom
- Kitchen
- Somewhere to eat
- Somewhere to lounge/relax

While creating the above list, additional elements that differentiate the old Dream home from commonly advertised elements of a tiny house, not captured in figure 1, come to mind:

- An old Dream home provides space division, accessed by circulation spaces
- An old Dream home provides space to get dressed standing up, without having to leave the bedroom
- An old Dream home does not require meticulous reorganization of a space to complete a regular daily task

In order to be a successful suggestion of an alternative, this tiny home must contain these spaces and avoid these compromises. These stipulations must fit within the volumetric constraints of a tiny house: 13.5 ft tall, 8.5 ft wide, and 40 ft long. These dimensions are often met with the question that those dimensions are practically that of an apartment or a condo – what’s difference? The simple difference is that homes on wheels do not need to abide by the same building codes as houses, apartments, and condos. This applies in particular to the bathroom size and layout. The tiny house provides a maximum to demand responsible use of square footage as well as opportunity to reimagine formulaic components of our housing.

IV. What could the new Dream home look like?

figure 2 | diagrams of floor plan iterations; starting with crude colour blocking in the top left, the middle interrupted by bathroom layout explorations, finishing with the final iteration in the bottom right corner
After the 17 iterations (not including washroom iterations) laid out in figure 2, a reasonable new Dream home suggestion has been achieved. Pushing close to the volumetric limits, this plan accounts for all the useful and usable home criteria, the different space needs outlined in the diagram in figure 3. It does not require compromise. This space comfortably houses two people, with the couch in the living room folding out to become a double bed to accommodate two extra (likely temporary) inhabitants. From left to right, the floor plan shifts from public to private, with a semi-private buffer in the middle (the washroom). This reduces the need for doors, which can not only take up precious space (especially if they are swing doors) but also create visual ends that make the space feel smaller. Though it is obvious that the bedroom is a private space without the physical boundary of a door, a person can easily see the entire length of the unit form the living room. This layout also leverages furniture as opposed to built-ins so that the eye can see more floor space, again avoiding making the space feel smaller than it is. It also makes it feel more like the old Dream home because those sorts of home typically favour furniture over built-ins. Combining all the public spaces in the open left half of the unit echoes current open-concept trends and allows inhabitants to visually and physically “borrow space” from the other public spaces, subtly making rooms bigger and smaller as daily needs dictate.
V. The drawing set of the new Dream home
This proposal is not meant to be taken as the version of homeownership and the American Dream towards which everyone should strive; it is an extreme. That being said, the contrast between old Dream layouts and new Dream layouts aims to promote self reflection, particularly in how an individual might reduce their square footage preferences (even simply by 1 sq.ft.), and how that might improve their financial stability and their pursuit of the new Dream.

VI. References


Abstract

Modern voice assistants are bringing reality and sci-fi closer together. Products like Alexa, Google Assistant and Siri that enable us to interact with technology using our voices are improving very quickly, and becoming a staple in many lives. Now, more than ever, companies are competing to make sure that their product gets as many users as possible -- because the quality of their product depends on the amount of data they can accumulate, and because people are unlikely to switch once they’ve gotten used to one. Right now, the competitors focus on the technical aspects of voice assistants. Metrics like accuracy of results and percentage of questions answered drive the development of these products. There is a blatant lack of progress towards the less measurable, and more human, improvements that these products need. Being right isn’t worth much if you’re not understood. Social nuances like changing your speed or volume to match the person you’re speaking to, recognizing the context of a question, and adapting the complexity of a response to suit a question are things humans do instinctively. These features of human conversation are important to feeling like your question has been understood and valued. My project focuses on the ways these basic conversational concepts can improve comfort when conversing with an AI, and how humans will better receive information if it’s communicated well. People know not to respond to a whisper with a shout, so why should a machine do any differently?

Measurement and Purpose

You get what you measure. The idea behind this conventional wisdom is that we define success based on certain metrics, and then the best solution becomes the one that most meets the metric. Since voice assistants are currently assessed on the percentage of questions they can answer correctly, they focus only on being as correct as possible. This is certainly a good feature to have, but a technically correct assistant is not the only important consideration.

I believe that the purpose of a voice-based assistant (VBA) is to support our decision-making and to carry out actions on our behalf. So in order to do this, they don’t just need to be correct. They need to communicate the information in a way that we best understand, and in a way that most supports our retention of information. This is the basis of my project: to identify and assess ways in which we can optimize the assistant experience in order to be more useful.

Weather: The Testing Ground

For the purpose of my project, I’ve created prototype versions of a voice weather app in Google Assistant. I chose weather because it is a very complex and challenging concept that we are used to interacting with in a simple, abstract way.
For example, we hear “there’s a 50% chance of rain” when the actual truth is a complex and imperfectly understood system of interactions between moisture in the air, barometric pressure and many other variables. Even though my prototypes focus on weather, I think that these ideas can also apply to other use cases, complex and simple; like calendar or basic information requests.

Although I haven’t done any formal user research or studies, I have been able to interview some people about their use habits with VBAs, and have them interact with my prototypes. I’ve shared the notable and general reactions with each test as it is described below.

The Tests

Test 1: Adjust Speed and Volume Appropriately

My first concept is adjusting volume and speed of an answer to match the way in which a question is asked. If a user asks a question quickly, quietly or loudly, the response should match the question and the environment. Since the current model is based on a volume setting on the device, it fails to adjust to changing needs. In unusual circumstances, such as when the user is hurried, in another room or if it’s night, the default volume or speed is inappropriate. In these cases, the answer could be too late, too quiet to be heard or very loud and jarring. It should be simple to do a basic analysis of voice volume in relation to ambient volume, and voice tone in order to determine if the user is shouting or whispering.

In feedback so far, this has been a more dividing concept than I’d expected. It seems some people only use smart speakers for one setting, such as a living room, in which case they are entirely content with setting the appropriate volume level and leaving it be. For users who have smart speakers in the bedroom or in multiple settings, however, this feature seems to be a natural and welcome improvement to the status quo.

Test 2: Support Users In Making Their Own Decisions

My second concept focuses on giving users the support they need to face problems, instead of trying to make judgements or decisions for them. A good example of this is the question “what should I wear today?” Current answers (mostly third-party apps) to this question are either not helpful, or take it at face value. I believe that a user who asks this question isn’t looking for fashion advice or a judgement call, but is really trying to figure out what to expect from the day, and how to be prepared for it. When we put on clothes in the morning, we’re considering weather conditions, plans for the day, and more personal things like fashion or mood. VBAs can’t possibly take the personal conditions into account, but they can let you know about some factors that support good decision-making. For the specific question of “what should I wear today,” I believe that the most universal factors are basic weather (temperature, along with rain and wind if they are significant for that day), and abnormalities in the calendar.

In testing, this feature was the most impactful and delightfully surprising to users. It turns out that most people agree: we don’t usually care about technical details as much as we care about how to prepare for the day. We don’t usually need specific information, but we need to somehow figure out how to be best prepared, and how to
adjust our clothing and activities to suit the conditions.

**Test 3: Let Users Ask Questions**

One of the earlier improvements that helped make VBAs a useable tool is the ability to retain information from a query, so that follow-up queries can be made. For example, you could ask “what’s four plus four?” and then “divide that by two” and it would give an answer. This is a really useful feature that is fully implemented in VBA architecture, but is not very well-used or widely supported. In the case of weather, being able to ask for the information we need, or asking for more detail in certain areas can be very useful. In my prototype, I’ve demonstrated this by putting users in a situation where they need the weather in a specific place over a specific period. They begin a ‘conversation’ which allows them to slowly ask for relevant information, and develop their understanding as it most benefits them.

When I’ve had people try this, the common response is positive. People like to be able to ask for the information they need, and build up their understanding in a way that suits their own pattern of thought. It’s especially helpful that my implementation allows them to ask questions in a conversational flow, without the need to repeatedly say a cue word (‘Hey Google!’). The tricky thing with this one is the need for extremely concise responses -- nobody wants to hear a robotic voice drawl on slowly, and a longer conversation really emphasizes this.

**Test 4: Simplify When Asked**

Sometimes, we need an extra-simple abstract response. Maybe you’re tired, or you don’t care very much about specifics. Whatever the reason, the need for an extra-simple response is not a complex concept. For this test, my prototype responds to a request for ‘simple weather’ with what I thought to be a very simplified response. Feedback on this one has been extremely positive, except for one thing. Most people seem to want even *more simple* responses than I thought. In this case, a simple answer like “it’s cold” or “it’s hot and dry” fits the bill. It’s worth noting that this conflicts with reactions to test 2, where people prefer that the machine doesn’t make any judgements on their behalf. I believe this is because we care more about certain decisions than others: deciding what qualifies as cold is not important to most people, but deciding on an outfit is a task best left to human interpretation.

**Test 5: Use Context To Support Understanding**

It can be difficult to put numbers into context. Understanding exactly how a number like -4 or 12 is going to impact your day can be challenging, especially with so many other factors to consider. A sunny 0 and a windy 0 are very different days, as are a dry 30 and a humid 30. Usually, we try to understand the weather by knowing all of the factors that stand out: whether there will be precipitation, excessive wind, lots of clouds, etc. Historically, this has been the best way to communicate weather information, but not anymore. With modern data collection, a VBA can usually know where the user has been and how familiar they are with the current conditions. This allows us to give weather by comparing it to yesterday’s experience. For example, we can tell someone that today they can expect a similar experience to yesterday, but with some exceptions. Since *yesterday* is always
a recent experience, we have a solid basis on which to form expectations for today.

I expected this to be the most impactful and useful of my tests, but I was surprised to find that most people liked it -- not blown away, and nobody disliked it. I suspect that this might have been because it is more useful in real life than in a test environment. Comparing a fictional today to a fictional yesterday isn’t very useful, because a fictional yesterday isn’t a recent and well-understood experience; thus, the concept isn’t going to be very useful outside of everyday usage.

**General Lessons About Voice Interaction**

After all of this work with VBAs (and after having spoken with a lot of people about their usage habits and relationships), I’ve learned a few things about voice interfaces and how they differ from graphical interfaces. Listed below are a few important things to remember when working in the vocal interaction space.

I. **Consistency is not always good.** With a graphical interface, users depend on certain features being in certain orders. With voice, people tend to tune out anything that is repetitive or boring. Thus, changing the order and layout of conversations is important to retaining attention.

II. **Be as concise as possible.** People are really good at tuning out sound. If a message is too long-winded, people get bored and annoyed really quickly -- and then they tune it out. When this happens, people won’t gain or retain any information.

III. **Voice interfaces can reduce our dependency on visual interaction,** especially where accessibility is considered.

IV. **Voice interfaces can’t replace graphical interfaces for some tasks, but they can supplement them.** Information is best received by sight, but audio is well-suited for many use cases (such as when the eyes or hands are occupied).
The Creative Processes behind “Pocket Blues”

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Abstract
After a major pivot from the original plan for my Knowledge Integration Senior Research project that was leveraging my software and data science interests, I decided to tap my love of music and 20 years of experience piano and over 10 years of performance to seriously enter the world of music production. This meant that the last part of the term would be spent writing and producing an original song. At this point in the production process, the song will be purely instrumental and potentially some interactive elements where those visiting who are inclined may be able to contribute to it and make it entirely unique.

The theories of creativity involved in my production include: creativity as a primary process & as an output of work, creativity made possible by tool chains, creativity as a product of incubation (subconscious process), and as a product of intuition (conscious process).

I also leveraged techniques that included writing “morning pages” / music memos and embracing mistakes from initiating work. These techniques and theories as they apply to creative thinking and the process for my music production were based on Kevin Ashton’s How to Fly a Horse. In this book he describes his understanding of creative thinking and the process behind creativity that makes it accessible rather than a mystic art. With these tools and the resources at my disposal (on a very modest budget), I set about writing a song and this paper outlines the processes behind it.
1. Background

In *How to Fly a Horse*, Kevin Ashton outlines several of the following theories and techniques in the process of creativity. He argues that creativity is not some magical stroke of genius in the middle of the night, but a constant process one works towards at all time, regardless of starting skill. Obviously for something like this a little bit of prior experience did help me, but, I did find myself working through the processes intentionally to produce what I am nearly happy with.

2. Theories of Creativity at work

a) Creativity as a primary process & as an output of work

I think this is Ashton’s main message - it’s another way of saying ‘to win the game you must be playing and be able to build on what has been done before’. I observed some successful electronic music producers through their content on YouTube. This was enlightening especially during the parts where they were just being themselves and caught moments of filming while they were “in the flow” (rather than a YouTube content creator) and I could get a glimpse into how they think, problem solve, and work through a given situation. I also had the opportunity to work with local friends who are successful producers in their own right, and that collaboration and in-person experience is a large part of what I built upon for creating new ideas for my song.

b) Creativity made possible by tool chains

In the past, popular songs have been created almost by accident, as admitted by the creator of “Like A G6” who had the (in)famous lead line recorded in a different voice. In working with a new client one day he accidentally dropped that lead line into a different chain of effects than he intended and created the iconic intro and main loop for the song. I am open to experimenting with as much as possible since I am totally new to the Ableton Live software suite. Ableton and my recording setup also allow for some potential for interactivity in my song so that it is not entirely a static finished product.

c) Creativity as a product of incubation

Over the course of the term (since I am a full-time student) I had many moments where I was not actively working on my song, but, my subconscious mind was engaged with whatever I was working on last in the song (e.g. percussion). I also found the age old “just sleep on it” helped me solve a lot of problems & creative blocks. Subconscious processes are relatively hard to describe in detail because of their abstract nature so instead I will say that achieving a balance of focused time and time to rest was what I was ultimately going for and what I think would have brought me the most success.

d) Creativity as a product of intuition

When actively creating I found myself leaning on my existing music education and especially music theory knowledge to build
the structural patterns (i.e. chord progressions and melodies in the intro/verse/chorus and the transitions between them) of my song. One of my teachers told me many years ago “once you know the rules well enough, that’s when you are allowed to break them”, and I found that to ring true in music production as well.

3. Techniques Used
   a) Morning pages & music memos
      The process of writing out ~750 words in the morning to capture my immediate thoughts and even what I may have dreamed of the night before was certainly an adjustment. However this practice did eventually pay off when I found myself recording basic music memos that were the starting point for the main chord progression in my song when I woke up. Tapping into the creative energy as soon as I woke up turned out to be very productive.

   b) Embracing mistakes from initiating work
      I would say that in my existing musical career I have been doing this a lot - incorporating mistakes in my performance to create an entirely new art. Whether or not people agree was never entirely my concern so it was fun to leverage this in my production. It was also evident when I was collaborating with my friends, as we were editing piano rolls to try and find melodies or bass lines, that our mistakes were guiding us more than some form of divine inspiration.

4. Music Production Plan
   The equipment I have in hand includes my brand new Korg GS1-73 Grandstage keyboard, with 6 sound engines providing over 500 unique voices. It has 4 built-in reverb settings and 4 different delays with customizable depth. I also have purchased an Arturia miniLab mk2 MIDI controller, bundled with their Analog Lab Lite synthesizer library, providing another large set of synths, sequencers, pads, and digital percussive instruments to choose from. The miniLab came with Ableton Live 10 Lite, which gives me access to some of Ableton's built in instruments, and letting me record up to 8 scenes * 8 tracks parts (verses/chorus etc as clips) for a total of 64 clips that I could come up with and use. Even though 64 sounds like a large number, it's actually quite the limitation that I want to be using to my advantage to avoid the “paradox of choice”. Of course the disadvantage here is the flexibility that will not be available to me in terms of layering several sounds together - electronic music producers that I have talked to and learned from can use up to a couple hundred tracks (ie. instrument inputs) in a single song.
   All in all I think my venture into music production has been very rewarding and the final product hopefully reflects the hard work, practice, several takes, and process behind it all. I hope you enjoy my “Pocket Blues.”
No Borders: A Revival of Toronto’s Underground Music Culture through a Business Lens

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Abstract - Underground music culture - a diminishing aspect of Toronto’s culture- which in the past has enabled individuals to experience different music types because of two primary motivations: inability to access mainstream music, due to financial limitations; or mere preference to niche music genres. The introduction of technology has made underground music in particular, more accessible. However, it has simultaneously removed the motivations for most underground event attendees. Technology, combined with Toronto’s noise by-laws and condo developments have enabled the mainstream nightlife industry in Toronto to thrive. Leaving underground music venues and events failing. As a result, there is less variety in the events offered. A segment of Toronto’s residents and visitors recognize that Toronto’s nightlife music scene has become redundant. The city council of Toronto has discussed that more resources will be provided to the culture sector to help ensure Toronto remains rich in culture and diversity. The potential changes in politics surrounding Toronto music culture have created less barrier to entry for businesses. There is now an opportunity and a need to introduce a new nightlife experience. This is explored through a business venture, called No Borders. It offers events, where consumers attend to celebrate niche music genres, dance, and human interaction.

1. Underground Club Culture

In the past, individuals from different parts of the world would gather together to celebrate unconventional music genres- niche music genres. These celebrations were a means for attendees to react against, what was during that time, socially accepted and highly commercialized- they were referred to as the Underground. Individuals at an underground music event were exposed to a variety of niche art forms, ranging from house music, to hip hop, to indie pop. The term originated in the 1960s in Britain, where many artists and their audiences did not want to conform to the sound that was being produced by mass media¹. Many of the individuals who attended an underground music event were unable to access mainstream music due to their socio-economic status. They were forced to explore other avenues that were more affordable. Other individuals, were motivated by their inherent affinity to underground club culture and music. As a result, they sought out underground music events because of their preference to different niche music genres.

Within Western societies, such as Toronto’s, technology has provided users immediate access to different types of information. However, it has been a detriment, as well¹. The culture of immediacy that society is currently engulfed in, has given the ‘seekers’ of the music showcased in the underground music scene, a more accessible medium to listen. In the past main stream music was very accessible to society through multiple forms of distribution, such as, radio, records, CDs, and concerts. Most niche music did not have access to the same distribution channels. Currently, due to advancements in technology the gap between consumer and underground music genres has become more minimal. Digital music publishing platforms,
such as, Spotify and Youtube have enabled individuals to access any type of music from anywhere. The need to attend underground music events to experience niche music became less apparent with the introduction of digital music publishers.

2. Toronto’s Music Landscape

Presently, many people associate Toronto with being culturally diverse. However, Toronto’s underground music scene has diminished, as a result of technological advancements, noise regulations and condo developments. This paper explores this problem through a business oriented lens.

In 2009, Toronto implemented noise by-laws that significantly restricted the ability for music venues, such as, nightclubs and bars to function as they normally would. Chapter 591 of the Toronto Municipal Code states that “The operation of any electronic device or a group of connected electronic devices incorporating one or more loudspeakers or other electro-mechanical transducers, and intended for the production, reproduction or amplification of sound…” is only permitted between the hours of 11 p.m. one day to 7 a.m. the next day2. Considering the nature of the nightclub and bar industry, amplified noise between about 10:30 p.m. and 3 a.m. is a large aspect of the experience offered. The noise by-laws have favoured residential inhabitants over culture in Toronto. Individuals that have a complaint are now able to more easily inform city services by calling 311 information service. Music event venues are suffering as a result of fines averaging between $3000 to $50003. The noise by-laws have created a culture of fear amongst the music event venues. As a result, venues are hosting less music events, causing a decrease in consumer attendance and in some cases failure of the business.

Condo developments within Toronto contribute to the failure of music event venues as well. Most often music event venue owners are renters of the property, and because there is no rent control for businesses, if the rent increases significantly the business will fail. Therefore, making it is relatively easy for building developers to purchase the land6.

Toronto’s favouritism toward residential development, has caused music culture to suffer. Amongst the 44 music event venues that had opened since the 1980s, only one remains4. Music event venues, particularly nightclubs - which tend to offer a larger venue space, where consumers attend to dance, socialize and consume alcohol - in Toronto, that are currently thriving, continue to offer relatively the same experience.

Allison Tierney, a reporter for Vice states that “[T]he clubs in this district tend to look and feel similar.” The Toronto nightclub industry tends to offer mainstream music, also known as “Top40”, and is often considered within society places to meet romantic prospects. Individuals within Toronto’s underground club culture have become increasingly frustrated because the city of Toronto and some of it’s residents do not understand that richness in culture does not suddenly appear. Part of music culture starts at underground music events, where new music genres are introduced, and new artists are given a platform to share their art. There is a lot of concern from artists, and underground club culture enthusiasts that Toronto is morphing into a city with a very homogenous culture, where the arts community will become suffocated, due to the current legal and political structure in Toronto6.

3. Opportunity

Toronto city council has recognized the concerns of the music community and is attempting to combat the issue by increasing funding to Toronto’s culture sector. The current priorities for Toronto’s culture sector include7:

- “[Improvement of]Toronto’s competitiveness by investing at least $2 million in annual culture funding.
• The establishment of a new program to support mid-sized festivals and events that draw 100,000 to 500,000 attendees…”

From the year of 2018, Toronto city council has expressed that they consider the culture sector valuable, not only for the economic benefits, but also for the opportunity it presents residents and visitors, to contribute, engage and experience a variety of cultures in Toronto.

The introduction of increased funding to Toronto’s culture sector provides less barrier to entry for potential businesses. The Toronto Music Advisory Council are also recommending that city council take steps in protecting music venues.

The compilation of the current perspectives on Toronto’s nightlife scene, by some individuals, as well as, potential legal amendments and funding directed to the culture sector (to be implemented between now and 2022) highlights the current needs in Toronto. Individuals still want to attend nightlife events for a fun and social experience, however, they want more variety in the music events offered.

4. The Method

The response to this problem and need in Toronto, is a business venture. It is an event series, called No Borders. Each event will be held once a month, at a secret location in Toronto. No Borders is an event organization that aims to produce events that promote inclusion and diversity of both the music offered, as well as it’s consumers. Consumers will be able to experience underground club culture and its ability to bridge the gap between people. Unlike many of the thriving nightclubs in Toronto, the focus of No Borders’ events is on producing an experience where individuals can experience new music, dance and interact with people, in an unpretentious environment. Each event will be live streamed on Youtube, as a means of remaining authentic in the vision of truly bridging gaps and allowing anyone to have access to the underground music culture in Toronto.

Events will be targeting individuals 21-30 years old, who are young professionals, that enjoy nightlife events; they are also open to experiencing different things. Majority of individuals are single, with a moderate to low amount of disposable income due to debt accumulation. However, disposable income growth for Canadians is projected to accelerate by about 1.5% per year, until 2024.

5. Building Brand Awareness

Approximately 14% of Toronto’s population is within this age demographic. About 37% of Canadians use Instagram. Considering a social media post has been made, it is assumed that only 1% will see it and that an additional 1% will be interested or at least intrigued about underground club culture in Toronto, resulting in a potential market of about 3071 people.

In an effort to reach as many potential consumers there are four key elements that have been prioritized:

• Logo Design
The criteria for the logo was that it be simple, yet symbolic and relatively obvious in how it relates to the concept of the company. The lines form the letters “N” and “B”, which are intersected by the lines of a circle, which represents union and crossing barriers. The typography used also represents this, as it spells out the brand No Borders but has a line crossing through it.

• Word of Mouth and Networking
Informing individuals within my network of the brand and what it represents, whether it be in person or via social media, can at least establish more followers on social media platforms: Facebook, Instagram and Twitter.

• Frequent Social Media Posts (Figure 1)
Consumers are attracted to eye catching posts. Each post must convey the vision of the event
to the consumer. Frequency is important as it ensures that the brand leaves a lasting impression on the observer, which can possibly lead to them sharing it with others.

- Promotion Video
The video will be shared via social media, and will be used to give potential consumers a more visual representation of what the brand and it’s associated events have to offer.

6. Limitations and Future work
Currently the most limiting factor is capital. The budget for the event is estimated to be approximately $4750. Going forward this budget is not feasible, as tickets will not be sold for more than $15. Sponsorships are a potential financial resource. However, considering the fact that the business has not made any revenue yet, I assume it would be a deterrent for the sponsor. Despite this, future efforts will be put on marketing strategy and developing brand awareness, as this may encourage sponsorships in the future. In conclusion, despite lack of capital, Toronto city council is establishing new programs and funding the culture sector, creating a large opportunity for potential businesses to enter the nightlife market with an idea that offers a different experience than that of popular culture.


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Remembering Knowledge Integration (KI): An online resource for KI students

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Abstract - Knowledge Integration (KI) instructors have observed that upper year KI students often forget critical information from their early KI courses.¹ This is problematic for KI students because many of their projects build on the best practices and methods learned in their introductory courses (INTEG 120/121/220/221). Students are engaged with the material initially but may lose sight of where this knowledge can be applied in future projects.

To address this problem, I developed the question: how might we help students remember the core concepts from introductory KI courses so they can use them to solve complex problems presented in upper year KI courses and beyond their Bachelor of Knowledge Integration? As a solution to this problem I have designed an online resource for students that will be hosted on the KI website. Students wishing to engage with the material will now have the access to easily interact with foundational concepts. This will help them remember key information and further develop their skills, as they take on new projects.

This solution was designed with the students in mind. I recognized that as a KI student myself, I could not just design a resource that was helpful for me but something that would be beneficial to the students, alumni, faculty, and staff of the department. In order to take their insights into consideration, I investigated what students and alumni were able to remember and what they found valuable from their introductory courses using a series of focus groups. Key concepts, best practices and skills became the emphasise of our conversations, which informed design decisions when shaping the project. Students now have the opportunity to reconnect with the design thinking process, tips on collaboration and key concepts in an efficient way.

I. Background

The introductory courses taken by KI students are foundational, and these courses scaffold knowledge and skills for future learning. As KI students’ progress through their degree, they are required to use the knowledge and skills they acquired in early courses and apply them to solve complex problems. As stated in the 7-year review report of the Knowledge Integration program, “cross-cutting skills like group work, peer assessment, reflection, and writing, are intentionally scaffolded from first to fourth year, but every core course from first to third year has some measure of each.”²

Instructors in the faculty have seen that students forget the essential knowledge from their early courses.¹ This creates a huge problem when they enter into their third- and fourth-year courses when they encouraged to use this knowledge in order to be successful.

Course content is available to students for the duration of time they are enrolled in the course (on LEARN) but is then removed. If students do not take the opportunity to save course notes or material, it may be difficult for them to have access to it in the future.
Another layer of this problem is the exposure students get. For example, INTEG 121: Collaboration, Design Thinking and Problem Solving, a first-year course commonly taken in a KI student’s 1B term, is an important introduction to the processes and best practices used throughout the degree. Students typically move on to take the second-year core courses INTEG 220/221 where they engage with the social and scientific nature of knowledge. This means that students are not directly exposed to the design thinking process for almost an entire year, right before they take on an 8-month design project in the museum courses.

This becomes a problem for both students and instructors. Students must put in their own effort to review old material, which they may not have access to, while instructors must dedicate valuable course time to re-teaching old material. With this problem in mind, I began to think about a solution. I started with the question: how might we help students remember the core concepts from KI introductory courses so they can use them to solve complex problems presented in upper year KI courses and beyond their BKI? The solution: design an online resource for students to reconnect with old material.

II. Methods

In order to understand this problem, and address my crafted problem statement, I needed to first define who my audience was. Current first- and second-year KI students would be the primary users of the resource, as they would be the first students to use the resource in their upper year KI courses. As much as their input was necessary, they lacked the relevant knowledge of potential topics for the resource because they have not completed the introductory courses. It was also essential to align the resource content with the KI program’s learning objectives. Finally, the resource could benefit alumni, which meant it needed to reflect their experience as KI students. Thus, upper year students, alumni and faculty became the primary audience I needed to engage with.

I began my research by having informal conversations with the faculty members of the department. I was initially interested in what they thought of the idea of an online resource, but quickly realized the magnitude of information that could be included in a resource of this nature. I needed to address the scope of my project.

In order to understand what was important from the courses, I wanted to talk to the students. I began creating questions that would be used in a series of focus groups. I had two goals in mind for the focus groups. The first was to learn what students and alumni found informative from their introductory courses and how they were applying it. The second was to see what they were unable to recall or are not using. Initially the focus groups were separated based on their current academic year (third-, fourth-year students and alumni) because they have completed all the introductory courses but would likely be applying the knowledge in different ways. I later learned that blending the focus groups could provide useful dialogue between cohorts. A total of four focus groups were conducted, recorded, transcribed and analyzed to inform design decisions.

III. Results

Participants of the focus group were able to reflect and remember what knowledge they often draw on and how they apply the content from introductory courses. With an analysis of the transcripts I classified four categories of the most common themes of our discussions: concepts, skills, frameworks, and best practices. The results of the focus groups were consistent with what I believed students were going to be using and applying, based on my own experience and knowledge of the program. Students and alumni, when asked what they remember most from their courses, were able to reiterate many of the key terms. One student
commented on design thinking; a framework frequently used by KI students:

“Design thinking, it's a way of thinking to solve problems and about making things better. [...] [You] can apply it to small things in your life [to answer questions like] ‘I don't know what courses to take or plan things’ to ‘How do I want to tackle this project on climate change?’ It's really scalable.” (Participant 4.4)6

The most interesting result from the focus groups was that participants mainly focused on skills they developed, rather than concepts or frameworks. One student commented on the two skills that were developed in the INTEG 120 course: writing and collaboration.

“When you have to write as a group you can't just [divide the sections] and you have to go through it, everyone has to edit it over and over to make it sound cohesive. I think that's probably one of the biggest takeaways [...].” (Participant 3.1)6

Many other skills were discussed including brainstorming, reflection, collaboration and observation. As much as students and alumni were able to recall this information, there were many instances where they were unable to remember a specific topic, or it do not make use of a particular best practice.

IV. Discussion

An interesting insight from the alumni focus group was that they believed much of the program content came together after they graduated. After reflection, some alumni were able to see connections between courses that current students may not see until after graduation. For example, some alumni felt that the connections between INTEG 121 and INTEG 220/221 were influential in how they currently work.6 The online resource might help make those connections more explicit among students earlier.

The focus groups met my expectations. The information was extremely influential in learning what was most important for students to have access to once they were finished with a course. After analyzing the transcripts, I learned that what would be most beneficial for students would be brief summaries of the course concepts. Specifically, students expressed interest in having a series of one-page documents outlining specific course content and a detailed set of reading summaries from the second-year courses. This would become the main focus for the duration of my project: creating and curating a series of one-page documents, developing reading notes, and compiling a list of readings. I have also spent time soliciting feedback from the KI community to ensure that the resource meets their needs. By the end of the Winter 2019 term, the first version of content will be available on the KI website.

V. References

Testing a New Method for Extracting DNA from Dental Calculus

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Abstract – In the past decade or so, dental calculus (dental plaque that has mineralized) has been used as an important source of ancient DNA (aDNA) for biological anthropologists wishing to gain insight into the lives of individuals who lived thousands of years ago. This technique has been used to reconstruct ancient diet, identify pathologies, and recover mitochondrial DNA (mDNA) from individuals as far back as the Neandertals. As this is still an emerging field, this project provided the opportunity for collaboration between anthropology and microbiology in utilizing a new method for DNA extraction that Dr. Josh Neufeld pioneered on ancient dental calculus. Using protocols adapted from existing literature, this paper provides a proof of concept for using Dr. Neufeld’s method on human aDNA. Sixteen samples of dental calculus were taken from thirteen individuals from four different sites from ancient Nubia in Sudan and Medieval France. With six samples from the same three individuals, the aim of this study was to test the method and our protocol for removal and preparation for extraction along with extraction and analysis itself. The results of this paper will inform the use of this method in the future on dental calculus and will hopefully lead to further work on aDNA at the University of Waterloo. The DNA will also be sequenced though this is out of the scope of the timeframe of this project.

I. Introduction

The human oral microbiome—that is the community of microorganisms that are found on or in the human oral cavity—is made up of 770 common species of microorganisms that are currently known to researchers¹. The oral cavity is unique because it is a major gateway into the body, with food and air both passing through the oral cavity on the way through the body, which allows bacteria, viruses, pollution, food, and DNA to pass through this one microbiome.

The focus of this study is on the microorganisms that become trapped in the dental calculus of an individual during life. Dental calculus (also known as simply ‘calculus’) is the mineralized form of dental plaque. It mineralizes over time to become structurally stronger and more durable. This means that, in the absence of modern, Western dentistry, any microorganisms that get trapped in the matrix of the calculus stay trapped to the individual’s tooth forever. This is useful in the emerging field of research in anthropology that is using calculus from ancient individuals to determine aspects of their life, from their diet to their diseases to their DNA.

Dental calculus is prevalent in the archaeological record due to the lack of dental hygiene. It is also believed to be highly resistant to contamination and degradation² which makes it a great source for DNA analysis. Calculus has also been proven on many occasions to be useful specifically because a small sample of it can be used to extract an entire human mitogenome³. One of the most appealing aspects to the analysis of dental calculus is that it is a non-invasive, minimally destructive sample that can be directly related to an individual, meaning that any results can be tied directly to the life of that individual without a doubt.
This project is a proof of concept for a new method that Dr. Josh Neufeld, a microbiologist at the University of Waterloo, developed for analysing soil. It was proposed that it might be possible to use the same methods to extract and analyze DNA from dental calculus. Therefore, this project aimed to test whether or not that method would work on dental calculus, and particularly on ancient DNA.

Figure 1. Right upper first molar from individual GU1. The image on the left shows the tooth with dental calculus on it, and the image on the right shows the same tooth with half of the dental calculus removed.

II. Materials

The samples of dental calculus that were utilized in this study came from two sites and four different time periods. The two sites are Wadi Halfa in Sudan and Gurat in France. Wadi Halfa is an area of the Nile in northern Sudan, close to Egypt. This is one of the most arid regions on the planet, which, over the past thousands of years, has caused many individuals from different cultural periods to be naturally, extremely well preserved. There are three different cultural periods from Wadi Halfa that represent three different time periods: the Meroitic, which spanned from 350 B.C. to 350 A.D.; the X-Group, which spanned from 350 to 550 A.D.; and the Christian Group, which spanned from 550 to 1300 A.D. Gurat is a small village in southwestern France, in the Charente department. The individuals were found in a cemetery that was adjacent to a monastery that existed in these rock-cut cave churches. The site was first used by humans around 1237 to 1286 and last used between 1655 to 1701. The individuals from this site represent the 14th century in France, as was determined with radiocarbon dating techniques of charcoal fragments and pottery. The sites themselves were not excavated with modern techniques, Wadi Halfa was dug in the early 1960s and Gurat was uncovered in the late 1960s and early 1970s. This means that the methods for recovery and the research that was (or was not) done on the remains reflects the knowledge in the field at the time.

There were sixteen samples of dental calculus taken for the purpose of this study. Thirteen individuals are represented in the study and three individuals had two samples taken.
from them to not be decontaminated to check the methods. As it was a proof of concept there was no need to have enough of a sample size to prove conclusions that were drawn. It was also more desirable to save dental calculus from the collection to use in future studies once it was proven that this method worked for dental calculus.

III. Methods

For this project a protocol for the removal of dental calculus from the teeth, decontamination, and pulverization was developed from the literature. The calculus was removed from the teeth with sterilized dental tools, caught on aluminum foil to make sure the entire sample was captured, and then placed in sterile 2 mL tubes. From there the samples were decontaminated with UV irradiation UV-C 100-280 nm for 15 minutes on each side. Following this the samples were placed in 5% dilution bleach for three minutes then 80% dilution ethanol for 1 minute. Finally, to pulverize the samples, modified glass robs were used to crush the dried samples into fine powder in sterilized containers. After this the powdered dental calculus was transferred to Beadbeating tubes to begin the extraction process.

The DNA extraction followed the manufacturer’s instructions for the DNeasy PowerSoil Kit (Qiagen) with a few modifications. After the lysis buffer was added to the samples, they were incubated at 70°C for 10 minutes. Beadbeating was conducted in the FastPrep-24 Instrument (MP Biomedicals, OH, USA) at 5.5 m/s for 45 seconds. DNA was eluted in 50 µl elution buffer. Total DNA (5 µl sample volume) was quantified using a Qubit dsDNA High Sensitivity Assay Kit (Invitrogen). Aliquots were frozen at −20°C until PCR analysis. A control extraction (kit control) without any sample was carried out in parallel to determine contaminations from kit reagents.

16S rRNA gene PCR analysis and sequencing data processing will follow, with the results of the PCR as part of the scope of this project. The timeline of this project will not allow for the results of the DNA sequencing to be included in the final results, though they will be sequenced this summer and will contribute to work moving forward.

IV. Results

At this point, DNA has been extracted, but nothing beyond that has been done. The results of the DNA extractions are shown in Figure 2. The results expected from PCR amplicons will give more details on what DNA has been found in the samples and will hopefully provide more information about the samples that extracted DNA that was below the detectable level (BDL).
V. Discussion

There is little pattern to the success of the DNA extractions. They do not seem to be more successful with more dental calculus, though the technique does seem to be more successful with the samples that are from more recently. Additionally, there will be more details about the success of this project with the PCR amplicons that are being done.

This project explored a novel method for extracting DNA from dental calculus, providing a proof of concept for Dr. Josh Neufeld’s method with the assistance of himself and his research associate Katja Engel. Moving forward, the information gathered here will provide a stepping off point for any future research done on dental calculus in collaboration between the Department of Anthropology and the Department of Biology. The results will inform improvements or changes that need to be made in the methods. Hopefully moving forward this project will lead to exploring ancient diet and diseases and will allow researchers to explore the DNA of ancient populations.
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Curating Medieval Pilgrim Badges: Exploring Technological and Narrative Means of Display

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Abstract
This project explores medieval pilgrim badges and their display in museum exhibits. Badges are historically and culturally important objects, but because they are small and often corroded, tarnished, and damaged, they can be difficult to exhibit in ways that are engaging. This project explores and proposes innovative means of displaying these badges in museum exhibits, aiming to make them more interesting and accessible to visitors. First, it explores technological means of display such as contemporary 3D scanning and 3D printing technologies. The scanning technologies explored are photomapping and optical scanning, as used in additive manufacturing. The printing technology explored was stereolithography, with different layer thicknesses and sizes of objects being looked at. The conclusions from this section are that the optical scanners used in additive manufacturing are more powerful than necessary for the project and the data produced requires considerable knowledge of point cloud datafiles to be useful. Although promising, photomapping is equally complex technologically and requires a great deal of expertise to be used for these purposes. Second, the project explores the use of narratives and interactive storytelling in communicating information to and engaging the visitor. A text-based story app called Twine was used to communicate information about badges through the story of a medieval German pilgrim. Based on anecdotal evidence from individuals who played the game, this section concludes that creating a narrative around the badges makes them more interesting, potentially because it contextualises their role in medieval life, suggesting that badges can provide a potentially engaging gateway for educating modern museum visitors about the complexities and challenges of life in the late Middle Ages and for challenging modern preconceptions and stereotypes about life in the Middle Ages.

Introduction
There were several types of badges commonly worn in medieval times, and they are historically and culturally important for several reasons. They were some of the first mass-produced objects, they give great insight into visual expressions of identity in medieval times, and they are a rare insight into the lives of common people during this era. Badges that were collected by people at sites of pilgrimage to demonstrate their piety
are called pilgrim badges and are the focus of this work. This work is also part of a larger and more comprehensive project that includes a wide variety of scholarly work about all types of medieval badges.

The design problem being addressed in this work is that presenting the badges in traditional museum settings comes with unique challenges. The badges are small, often faded and corroded, typically lack engaging context, and put plainly, can be boring for visitors to interact with. This challenge presents the opportunity for new and innovative means of presenting pilgrim badges in museums. Museums are the chosen medium for presenting the badges for several reasons. First, most existing badges reside in museum collections. Additionally, museums offer a unique environment for teaching and learning that advantages object-centric learning experiences\textsuperscript{2,3}. The inherent informality of museums presents many opportunities for educating visitors not present in conventional, more formalized learning environments\textsuperscript{2,4}.

This work had multiple design constraints that were taken into consideration. The stakeholders contacted early in the planning stages of the project expressed interest in exploring technological means of displaying the badges as new technology presents opportunities for innovative ideas previously not possible or feasible in a museum context. Additionally, all work undertaken had to be completed in six months and the researcher had no prior experience working with any of the software or technology required, further limiting the possible scope of the project. Finally, all means of presenting the badges were intended to be – in their final forms – engaging, interactive, and understandable to non-experts. In addition to these design constraints, it is understood that the project is exploratory, intended to produce proof-of-concept prototypes for presentation to museum curators. Further development cycles would follow to move towards implementation, but are outside the scope of this work.

The rest of this paper is divided into three sections. The first of these outlines the technological means of display, including methods and results. The second explores the narrative means of display, again including methods and results. The final section presents discussion and conclusions drawn from the project, including calls for further research.

Technological Means of Display

Implementing technology into museum exhibits can greatly aid the educational ability of the exhibits if done effectively\textsuperscript{4}. The specific technological aspects explored in this work are augmented reality (AR) and 3D printing technologies. AR has been shown to increase interactivity within museum exhibits and has been used to supplement traditional object-centric learning\textsuperscript{5,6}. 3D printing technology can be used to create touch objects, such as badge replicas, which are valuable educational tools in museums and especially useful in the context of this project as the badges are old, fragile, and cannot be handled by the public\textsuperscript{4}.

This part of the project focused on 3D scanning technologies, but briefly
explored some possibilities for 3D printing. The 3D scanning technologies explored include photomapping software Autodesk and Autodesk ReCap as well as the less powerful mobile phone applications Trnio and Qlone. Also, an AICON SmartScan optical scanner housed at the Multi-Scale Additive Manufacturing lab at the University of Waterloo was used to create a 3D scan of the object. Another software that was initially explored as a potential way to map images onto 3D objects but later discarded was Unity, a game design software. Concerning 3D printing, the printer used to prototype was the Form 2 from Formlabs, a stereolithographic printer printing layers between 25 and 100 microns thick. The badge that all the scans were taken of was a replica of a pilgrim badge from Wilsnack in Germany (Figure 1).

Looking at the photomapping software, Trnio and Qlone were effective at creating workable 3D objects, but do not have the power to capture the intricate detail of the badges. Autodesk and Autodesk ReCap are designed for architectural and geographical uses, which are on a considerably larger scale than the badges. The software requires significant experience to use in the context of the badges, putting it beyond the scope of this project. The optical scanner did produce a workable point cloud file, but many issues arose from this process. The first issue, which was common amongst all the scanning technologies, was that the replica badge being used was reflective, making it difficult for the scanners to function. This issue was solved for the optical scanner by placing a thin (~5 microns) layer of resin on it so the scanner could function. The other issues encountered when using the optical scanner were that it has a cost of over $1000 CAD for a single scan and the data produced was inaccessible without significant experience with that specific scanner. To see the point cloud from half of the replica badge, see Figure 2. As there was not a workable scan created, it was not possible to 3D print a replica. The approximation that was printed was based off a scan that did not include much detail, so it does not provide much insight into printing the badges in full detail.

Narrative Means

Human beings often operate under what is referred to as a narrative paradigm as part of their socialization. Particularly when it comes to education, narratives have a special spot in human cognition, being understood more thoroughly and recalled more easily than alternative methods of education. This translates well into museum exhibits as they present a unique manner of presenting narratives and telling stories to visitors. In museums, narratives act as a case study from which visitors can generalize the concepts being taught.

The criteria for this aspect of the project considered both that the presentation of the story be engaging and that it be able to accurately represent the journey and life of a medieval pilgrim. The former of these was addressed by looking at the constraints in place for this project. As this project is not tied to a specific museum, it was not feasible to design an exhibit that would incorporate the badges as much of exhibit design is location- and collection-specific. Instead, a supplementary text-based choose-your-own-adventure (CYOA) story was created, in which the user follows the fictional story of a medieval pilgrim and his journey through various sites in modern-day Germany. The story was based off wills from Lübeck gathered by Webb that instruct
beneficiaries to go on pilgrimages to receive their inheritance\textsuperscript{10}. The story is divided up into three possible pilgrimage routes, one to the Rhineland, one through Lower Saxony, and one through Brandenburg. The sites of pilgrimage and associated badges are all taken from current badge research\textsuperscript{11,12}.

From this, a storyboard for the game was created using a text-based CYOA software called Twine (see Figure 3 for a visual of the storyboard). The story created for this project includes text, images, and some basic conditional narrative behaviours: the user must collect at least three badges at three different pilgrimage sites to receive their inheritance. Twine has many features and more could be incorporated into future iterations of the story, including integrating augmented reality to tie the game back to badges in possession of the museum. Six people who had no experience with medieval badges participated and all said they were more interested in the pilgrim badges after, suggesting the use of a story can help increase interest in the badges.

Discussion/Further Research

This project is largely exploratory and is primarily intended to act as a starting point for museum curators and designers when looking at potential means of displaying medieval badges to make them more interesting and accessible. There is much to be explored regarding implementing both the 3D scanning and 3D printing technologies into museums. Going forward with exploring 3D scanning, optical scanners like the AICON Smartscan are available, but may not feasible with current technology because of cost and computational complexity. Photomapping technology has much lower overhead costs, as the only required materials are the software and a high-quality camera. Additionally, there are some 3D scanning techniques used in anthropological research to recreate finds, which may be the most comparable use of 3D scanning technology, including image restoration techniques\textsuperscript{13}. With 3D printing, the technology for viable replica badges exists, but the materials available to print with are mostly plastic- or resin-based, which could detract from the...
metallic nature of the pewter badges. Additionally, as the badges are small, creating larger-scale replicas could be beneficial for highlighting their intricacies and making the detail accessible to a larger subset of the population.

Moving forward with narratives, there is much potential for the idea of a story to be worked into an exhibit. Specifically, the format of a CYOA story addition could be implemented into a museum either on a screen in-house or as an app to supplement the experience. A potential next iteration of the story could include more information about what medieval pilgrimage was actually like, for example making the character encounter some of the hazards along the way. It could also be paired with augmented reality software (Layar, for example) so visitors could scan the badge with their phone and have the story of that badge pop up on the screen. This could be combined with a 3D scan of the badge so a digital version could be manipulated and details on the badge highlighted. Moving forward, there is much potential for presenting the badges, but some means are more feasible at the current time with the technology currently available.

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Do gamers just want to have fun?
How the study of gaming can reveal ways to motivate students experiencing symptoms of burnout.

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\textbf{Abstract}
The ongoing rise of the gaming entertainment industry has made many educators question how gaming relates to the classroom, especially with dropout rates in post-secondary institutions as high as 50\% in Canada. This project considers how students who are suffering from burnout, but who spend a lot of time gaming, are overlooking the hard work and cognitive effort they put into gaming when trying to determine why they are struggling so much with their education. In this project, I provide an overview of research on burnout, including more recent work on burnout in education. I then consider why students who suffer from burnout, and subsequently drop out of school, remain engaged in gaming despite needing a break from the cognitive effort required for their studies. As I discuss, many people see gaming as “fun”; however, as Jane McGonigal argues in her book, \textit{Reality is Broken}, gaming can also require serious cognitive effort, making games “hard fun.” Building on McGonigal’s work, I argue that one of the key aspects of gaming that makes it so engaging for students is the element of choice. Many educators have already started to incorporate gaming into the classroom in an attempt to engage students; however, those educators often focus on the “fun” aspect of gaming, while neglecting the important element of choice. By paying closer attention to what makes gaming so appealing to students, and shifting their focus to choice, educators can more effectively gamify their classroom. In this project, I lay out the research on choice, burnout, and engagement of students, how educators can use choice in the structure of their classrooms, and how to develop efficient resources for students in post-secondary education who are struggling with burnout.

\textbf{Introduction}
In many games, there is a main storyline and the player is given a series of quests in order to move the story along. This often involves the player levelling up and discovering new areas of the game. Within the main storyline, there are often many little adventures that help the player understand the story better and look at different parts of the world. These adventures, or side quests, don’t move the plot forward, but help to give the game more depth. In popular video games like Assassin’s Creed, for example, you frequently see these kinds of side quests. The comparison between reality and games can be made in educational domains as well. Think of a student in post-secondary education. They have a clear main goal (a very expensive one in most cases), which is to complete their education and collect their reward: a degree. There are many small quests, such as completing particular courses, that contribute to the final achievement. The student may also undertake a few side quests along the way: clubs, student politics, social outings, relationships, and gaming.

In this project, I examine a particular type of side quest -- namely, gaming -- in order to shed light on student engagement and motivation with respect to students’ main goal.
of completing their education. According to the Entertainment Software Association of Canada’s annual study of game players (2017), 52% of all Canadians play games (18,868,917 Canadians), and the average age of a Canadian gamer is 36 (which means that half of the 52% of Canadians who game are under 36). Since gaming is widely accepted as a hobby or “side quest”, this project asks how gaming as a side quest influences the main quest. In particular, it asks what role gaming plays when a player starts to give up, or disengage from, their main quest - their education.

Interestingly, although gaming often demands the same levels of cognitive effort required to complete a degree, some students find gaming engaging in a way that their formal educational experiences are not. Looking at Jane McGonigal’s understanding of games as hard work, rather than mere passive entertainment like television, helps to inform the understanding of games as engaging activities (McGonigal 2011). Educators need to look more deeply at games in order to effectively gamify the classroom. Characterizing students who play games as lazy is not productive; rather, educators should consider why students are willing to spend cognitive effort on gaming than they are on their studies. As I argue in this paper, one of the key elements of gaming that draws students in is choice. By increasing choice in the classroom, educators can engage students and possibly even prevent them from becoming disengaged in the first place.

**Burnout**

Students are under a lot of stress in upper-secondary and post-secondary education. This stress can lead to burnout. With dropout rates in Canadian universities ranging from 15 to 50% of students, an investigation into student engagement is intensifying (Macleans 2018). One of the main characteristics of burnout is the loss of interest in a particular domain (Pines 2005). In some cases, students can disengage from their studies and experience burnout related to their education. Social psychologists such as Christina Maslach have been studying burnout for a long time, but have just recently started to examine burnout among students. Researchers have found that students who are burned out experience emotional exhaustion, cynicism, and inefficacy when facing their studies (Schaufeli et al. 2002). It is important to note the difference between stress and burnout, as these two are often mistakenly understood to be the same. Put simply, stress builds up as too many tasks that you are invested in take your energy away, while burnout involves a lack of interest in the task, (Pines 2005). Although researchers do not explicitly discuss whether burnout can be considered domain-specific, research suggests that it is since students can still be engaged by other domains (or side-quests) in their life, despite feeling burnt out towards their education (Pines 2005). Though education is cognitively demanding, if a student still considers it to be their main quest, encouraging them to seek out resources available at their institution is key. It is difficult to overcome the cynicism and exhaustion present in burnout, but acknowledging the cognitive effort required for gaming helps to reduce the inefficacy the student feels. Having engaging classrooms and resources for personalizing the learning curriculum are two examples of how to help overcome the cynicism and exhaustion aspects of burnout (Schaufeli et al. 2002).

**Gaming**

While students are engaged in their education, they can also spend a significant amount of time gaming. Some students who game also participate in gaming communities in many ways other than playing the game itself. Some popular examples include doing research and writing for walkthroughs and guides, designing and creating costumes based on characters in games, writing fanfiction, writing and programming mods, and recording videos. Part of the reason why games are so engaging is that they involve doing voluntary hard work – i.e., they involve choice. In her book *Reality is Broken*, Jane McGonigal investigates how the hard work of gaming plays a role in a student’s education. The key understanding of
gaming that is missing in the general discussions of gaming is the fact that “playing a game is the voluntary attempt to overcome unnecessary obstacles” (Suits 1978). The word 'voluntary' in this definition helps to explain why, despite Jane McGonigal’s insistence that games require hard work, students are so engaged in the games and the gaming communities: in short, they include choice. Gamers make the decisions as to which side quests they want to pursue and take responsibility for their successes and failures, and as a result, they are more engaged.

**Implications for Education**

The questions asked at the start of this project have led me to identify choice as a key element of gaming that players find so motivating. Students that find themselves engaged in gaming and not education are not just having more fun gaming; they also feel more powerful when gaming. They can make decisions and take responsibility for their successes. This concept of power and responsibility over choices is known as the internal locus of control (Duhigg 2016). It is also related to the idea of a growth mindset, where individuals believe abilities are not innate, but can be developed with hard work (Dweck 2006). Students who disengage from school may lack a growth mindset when they approach their education; they may see their failures as inevitable and become more and more detached and cynical, possibly leading to burnout. Gaming, however, highlights and encourages this mindset. Thus, I suggest that educators work choices into their classroom in order to engage students who are used to the power they have when gaming. Educators are already looking towards gaming as a solution to waning student engagement, but unfortunately, many just see games as “fun”, overlooking the cognitive effort they often require. Instead, by designing games that have an element of choice, educators can engage students in the classroom.

**Conclusion**

From this exploration of burnout, gaming, and choice in education, I am hoping more resources will be developed to help students engage in their classrooms. Instead of assuming that the side quests have distracted the student into just having fun, acknowledging that gaming requires hard work will help students return to their main quest, especially if educators are implementing choice in their classrooms. Providing more effective and accessible resources for students dealing with burnout is a good next step as well, as many resources are limited to the workplace, or have a misconception about the relationship between stress and burnout. My main hope is to help students understand that their current situation is something they can overcome, and that educators are working to help them.

**Footnotes**

1Further examples available in full paper by the same title.

**References**


Neurodesign: Measuring the Impact of Social Proof in Landing Page Design

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Abstract - Studies in social psychology have been demonstrating for many years that an individual’s judgements and behaviours can be influenced by those of their peers.1,2 The term “social proof” is used to denote this phenomenon, and it is leveraged often by digital designers to captivate potential customers. The conclusions of studies surrounding social proof, however, are commonly adopted into mainstream design heuristics – coined “neurodesign” principles – with the assumption that social proof used in new contexts, such as website and landing page design, will mimic the behavioural influence documented in controlled, laboratory studies. The goal of my research is to challenge this assumption and offer more direct substantiation for the impact of social proof in landing page design. A review of the neurodesign field reveals that nearly all discussion of neurodesign exists in industry-driven blogs and articles. In this environment, practitioners advocate for the use of social proof and other neurodesign principles to attract potential customers, however, provide little or no evidence of this effect. Moreover, when evidence is provided, it is extrapolated from studies far removed from the context of real-world design. This project also offers a method of experimentation using eye tracking designed to determine whether the application of social proof in landing page design truly influences an individual’s behaviour.

I. Problem Introduction

Human behaviour is as fascinating as it is eluding. While we can’t predict with certainty how one will behave, we do know, thanks to the work of social psychologists such as Asch and Bandura1,2 of ways behaviour can be shaped by extrinsic factors such as social influence. The term “social proof” can be used to describe the act of referencing the behaviours of others to guide our own.3

There are few more motivated to understand social proof and other behavioural influences than those who design artifacts meant to elicit specific behaviours. Digital marketers, web and user experience (UX) designers are amongst
those driven to understand these influences. These professionals employ strategic design decisions to craft compelling landing pages that might make potential customers act in favour of a call-to-action: “sign up now!” for example. However, many traditional methods of informing design decisions don’t offer insight into patterns that help behaviour to be anticipated. User interviews and surveys, for example, capture only what can be articulated. Thus, insight into subconsciously driven behaviour is inaccessible. Other methods, such as A/B testing, may demonstrate patterns of behaviour but do not offer insight into why these patterns exist, making it difficult to apply findings in other contexts and leverage the potential of the testing.

In response to this need is a growing field referred to as “neurodesign”. This field aims to leverage neuroscientific research and methodology in order to equip designers with principles that allow for them to make inferences about how a user may respond to a call-to-action, for example, in the presence of social proof. The intention is that these principles shed light on subconscious user behaviours and preferences, informing design decisions that may increase engagement and ultimately, profitability.

What remains unexplored is whether the principles popular in the neurodesign field have a true effect on the designs they are applied to. The descriptions of these principles and their applications exist in the practitioner space, for example, in blogs and articles, and as a result are not documented with the same thoroughness as academic journals. This may be the case as much of the research that informs neurodesign principles is done commercially by companies for their own use. These companies typically lack the time and inclination to publish their findings and may also refrain from doing so to maintain competitive advantage.

The purpose of this research is to survey a sample of the neurodesign field in order to determine the level of evidence supporting the impact of neurodesign principles when applied to real design contexts. This research also explores social proof, one of the most frequently used neurodesign principles, in order offer a method of measuring the impact it truly has on influencing potential customers to follow a landing page’s call-to-action. While it may not be possible to entirely fill the gap that separates the neurodesign field from evidence of its impact, this project aims to more coherently address it by strengthening the connection between research and practice.

II. Surveying the Neurodesign Field

A survey was preformed on 103 neurodesign principles from 23 practitioner level articles with applications to UX, web design and digital marketing. In this research, any material outside of academic journals was considered “practitioner level”. There were no neurodesign articles found in academic journals. The articles were typically composed of a list of neurodesign principles, most commonly 5-10 items long with an explanation varying in scope to describe the grounds of the principle and how it may be applied to the relevant design
context in order to achieve a result. Most often, the anticipated result was some form of design optimization, for example, an increase in user engagement.

The goal of this survey was to determine if any of the content pieces produced in the neurodesign field offered first-hand evidence of the impact of the principles in question. “First-hand evidence” in this instance was described as original empirical data, demonstrating the effects of the principle in the context of application outlined by the author. If no such data was collected, the method of substantiation for each principle was recorded. If the substantiation was a citation, also recorded was the number of sources it was away from the original data collection. The original data did not need to originate from an academic journal to qualify, any experimentation with empirical evidence was counted. If more than one citation was provided for a single principle, the number of sources removed was averaged between the sources. If there was no explicit citation provided, the method of substantiation was listed as “Experience/Intuition”.

Of the articles surveyed, none provided direct, original data to demonstrate the effectiveness of the principles. Nearly half (46.6%) of the principles had only the author’s own experience/intuition as substantiation. Of the principles that did receive substantiation in the form of a citation, it was most common for them to be 2 sources removed from the original data, with the average number of sources removed being 1.764. There were also no instances where the practitioner’s area of application matched that of the original source. For example, principles with intended applications for web design referenced studies where participants were not interacting with a web interface, but instead reacting to stimuli in a lab environment. For example, one article defined the concept of using emotion in web design to maximize engagement through a reference to a study where participants performed recognition tasks in an fMRI.

III. Experimental Design

Clearly there is a level of disconnect to be found between the stated impact of applying neurodesign principles and the evidence offered of their impact. Oftentimes, there is no evidence at all. This research aims to address this gap. The following is the procedure being carried out to better test the impact of applying social proof to landing page design.

Procedure

Experimental sessions are conducted with one participant at a time. Participants are only informed of the purpose of the study in the debriefing letter once the session is complete. On arrival, once consent is provided, the participant is seated in front of a laptop loaded with 27 landing page mock-ups. Each portrays an offer with a simulated “sign up” button, representing the call-to-action, and a “next” button. This deck contains three iterations of 9 distinct landing page designs. The iterations include a page with no social proof, with social proof, and with a substitute element occupying the same area on the page as the social proof.

The participant is then asked to put on eye tracking glasses. Eye tracking is used to confirm that, firstly, the social proof element
is being noticed, and secondly, to compare how long the participant’s gaze fixes on the social proof. It is hypothesized that the gaze will linger longer when participants are internalizing a social stimulus.

Once the glasses are calibrated, the participant is instructed to view each landing page at their own pace and either select the call-to-action if the landing page presents an offer they are interested in, or the “next” button to proceed to the next landing page.

When the participant completes the deck of landing pages, the researcher asks them to remove the glasses. The researcher thanks them, provides a debriefing letter as well as a verbal explanation of the debriefing letter and offers an opportunity for them to ask questions.

IV. Continuing Research

Recruitment and data collection are ongoing. Due to time constraints, we do not expect to collect enough data to make a definitive claim on the effectiveness of social proof in landing page design. Oftentimes, for reliable patterns to emerge using eye tracking, upwards of 30 participants are required. Instead, the goal of this component of the research is to provide a commentary on the effectiveness of the proposed method for responding to the research question. This commentary will be supported by a small number of trial data collection sessions. In order to reinforce the notion that social proof can be used as a tool to persuade a potential customer into following a call-to-action, we are looking for landing pages which use social proof to elicit a significantly greater number of sign-ups.

V. References


Dungeons & Dragons and Livestreaming: Audience as Narrative Collaborator

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Abstract - Over the past 5 years, tabletop games have transitioned from basements and kitchen tables to the “Wild West” of online livestreaming platforms. Where before you would play tabletop roleplaying games like Dungeons & Dragons (D&D) solely with your friends, you can now share the collaborative stories in real-time with an audience on platforms like Twitch. Furthermore, the structure of Twitch facilitates real-time audience interaction with the livestream through a live text-based chat and donations. But how exactly does audience interaction impact the story being created, and what role does audience play in the collaborative narration process? My project explores how real-time interactions between D&D livestreamers and their audiences on Twitch profoundly impact both the game narrative and the storytelling relationship. Considering the great extent and variety of D&D Twitch livestreams available, I approached a selection of 5 different shows, each with their own approach of audience interaction. I conducted a series of interviews with people involved in these livestreams, ranging from producers to cast members to audience, and observed the games to see how the audience impacted the narrative and the collaboration process. Through the lens of interactive performance and narrative, social rules within collaborative storytelling games, and participatory culture, I have found that audience profoundly impacts the narrative in both direct and indirect ways. While there is no singular way to designate the role that the audience plays in the collaborative narration process, it is key to purposefully design that role and what capacity they have to influence the story in a way that facilitates collaboration.

I. Introduction

Dungeons & Dragons (D&D) is a collaborative storytelling tabletop roleplaying game, where a group of players take on the role of characters and roleplay through a story facilitated by a Dungeon Master (DM). The players and DM use dice to make the outcomes of scenarios have an element of chance, and to facilitate the improvising element of collaborative storytelling.

Twitch, the livestreaming platform, is home to a variety of livestream shows. Livestreaming on Twitch involves someone (a livestreamer) broadcasting a real-time live online video to an audience, who can then interact in real-time with the livestreamer and the show using the built-in chat. Audience members can support a livestream show and a livestreamer by following, becoming a monthly subscriber, or making one-time donations. D&D livestreams focus on people playing their D&D games, and sharing their games live in real-time with an audience.

The presence of audience members and their interactions has the potential to change the story being told in the game. However, there is little academic work or foundational community understanding on how audience interaction impacts the collaborative story being told. Therefore, this project explores how audience interaction impacts the collaborative narration process, and therefore what role the audience plays in that process.

II. Process

Going through a list of D&D and tabletop roleplaying game Twitch livestreams, I selected a group of five shows as my focus groups. These shows were chosen due to their variance in audience interaction models, community sizes, and content.

From each focus group I conducted one-on-one...
interviews with a collection of producers, cast members, and audience members. This highlighted a variety of experiences within each focus group in order to gather a more holistic understanding of the different observations and perspectives around audience interaction. Interview questions included the following:

i. What do you like and don’t like about audience interaction?

ii. Do you think audience interactions impact the story? How?

iii. What role do you think the audience plays in the collaborative storytelling of D&D games? Are they passive viewers, collaborators, or something else?

Alongside these interviews I watched the shows live, observing not only the game but also the chat and how audience interacted with the story. I also observed how production and players acknowledged, presented, and engaged with the audience and their interactions.

III. Results
Throughout the conversations and observations, there were a handful of themes that stood out.

Almost unanimously there was the agreement that no matter how much or what kind of interaction there was, audience impacted the narrative being told. There are indirect ways that audience impact the narrative. Examples include:

i. The presence of the audience changing the way that the DM and cast play and present the story to be more performative/entertaining

ii. Audience giving energy and feedback that guided the direction of the story similarly to a theatre group adjusting story beats in response to the audience applauding or laughing

iii. Audience commenting on and observing things within the story that DMs or players can use to guide story beats or actions

There are also direct ways that audience impact the narrative. Examples include:

i. Giving the players and player characters resources that impact the chance of succeeding at certain story moments

ii. Adding story and world elements such as non-player characters (NPCs), locations, items, background lore, and monsters

iii. Voting on or unlocking events and story elements presented by the DM that would shape future events in the narrative

These audience interactions all guide and adjust the story in ways that the DM or players didn’t think about, allowing the audience to have a say in the direction of the story.

While most of the perspectives on audience interaction is positive, it’s also clear that there are times that audience impacts are negative rather than positive. This includes interruptions or derailment to the story, drastic and unwanted shifts in tone, and the removal of autonomy from the DM and the players to tell and impact the story themselves.

All of the interviews emphasized the idea that there is no right or wrong way to approach audience interaction in D&D livestreams, but rather that different approaches worked better for different kinds of stories and content. Generally speaking, more high-energy and chaotic comedy games had more audience interactions that were direct and had immediate impact, while more serious and narrative-heavy games had more audience interactions that were less immediate and had long-term effects.

Similarly, all of the interviews highlighted that there is no singularly agreed upon role that audience plays in the storytelling process. The perspectives range audience being a theatrical audience to being another player to being somewhere between a DM and a player.

IV. Discussion
Audiences want to engage with the stories they enjoy. As seen in participatory culture, fans generally want to participate in some aspect to add to the world and story in the context of their own lives [1]. For Twitch streams, this can be done with interactions.

As with any form of interactive performance or narrative, the interface has to be designed to allow for and facilitate interactions at varying levels [2]. A major consideration in the design is setting up guidelines and expectations (whether explicit or not) that outlines what is acceptable and unacceptable for interactions, as this helps to guide the interaction in a way that contributes positively to the collaborative storytelling process.

In order to set up those guidelines and expectations in a way that is synchronized with the collaborative narrative process, it’s recommended to construct a role for the audience similar to the way
that the DM and the players have a role in the process, and to therefore extend the rules and guidelines that the DM and players follow to the audience in some capacity.

For example, in order for the game to run and for the world and narrative to be cohesive, the DMs and players have to adhere to the endogenous, exogenous, and diegetic rules of the game. Endogenous rules belong to the game frame, are defined by the game’s structure, and are enacted by the players [3]. These are mechanics and the rules written in whatever game you're playing, what we usually call "rules". Exogenous rules belong to the social frame, are defined by the players and DM, and are enacted by the players [4]. These are the social rules and the social contract between the players, and what role each person has as a player at the table. Diegetic rules belong to the in-game frame, are defined by the fiction of the game, and are enacted by the characters [5]. These are the rules in the world such as laws, science and magic, etc. that are then followed (or purposefully not followed) by the characters.

Similarly, for the collaborative narration process to work in a way that facilitates audience interaction, the audience also has to adhere to the three rules. Otherwise, they risk interrupting rather than contributing to the story.

So while there may be no singular way to designate the role the audience plays in the collaborative narration process, we should consider that they still have a role similar to the way that the DM and the players have roles in the collaborative narration process. This role should be designed to fit within the endogenous, exogenous, and diegetic frameworks of the game.

V. References
Breaking Social Identities

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Abstract - Human beings take on social roles in the social systems we inhabit. Social identity evolved in human groups during our early evolution and serve to specialise individuals in different roles in the group. As a result, each member of the group gains access to the benefits that role provides without having to fill that role themselves. In human ancestors, it was efficient to break those roles down by sex, with females taking care of children and males gathering resources and defending the group. While those sex based roles are no longer helpful or necessary in modern society, we have not evolved past them, and the expectations based on those roles can still be felt today in gender inequality and gender norms. Evolutionary pressures that formed those roles have since been replaced by social pressures, and the roles that they support can be harmful to those who are forced to fill them. Despite this outward conformity, however, people do not always conform internally, and research has shown that even simple interventions can allow people to adjust their behaviour to be more in line with how they actually feel. In my literature review of social identity and gender roles, I am seeking to explore what has continued to push these types of roles, as well as develop a framework for designing interventions to help break people out of the roles that they have been assigned.

I. Introduction

Human beings are social animals, and in order to function in a social structure a person needs to know who they are and where they fit in that structure. For this to occur, humans use our social identities, schemas or mental models that people have that allow them to quickly appraise themselves and others in a social context. These identities function as social roles and serve to diversify human groups while at the same time ensuring that the groups needs are filled¹. While these social roles can help human groups operate efficiently, they are not without flaw, as these social identities can harm those in them if there is a disconnect between the person and that social identity. While not all social identities are harmful, a lack of choice in one’s identity can cause harm, as a combination of social pressures and cognitive dissonance can keep one in a role without realising how uncomfortable conforming to it has become.

For this reason, we must identify ways in which these roles can be broken down when they are no longer healthy for the individuals in them. While research has identified ways in which specific social identities can be broken down, little has been done looking at social identities as a whole. I am designing a framework on which we can build future interventions to harmful social identities. As I design this framework, I hope to empower people to break out of the social identities that no longer work for them, potentially allowing people to live more authentically.

II. Evolution of Social Identities

In order to understand how social identities can be broken down and changed it is important to understand where they come from. Social identity evolved naturally in human ancestors in order to improve the survival of a group¹. By taking on a specific role, such as making tools, the individual in the role becomes more and more proficient at it but would not have time to practice other skills needed for individual survival, such as gathering food. As humans naturally live in social groups these differences in skill can be accommodated for by other group members with complimentary skill sets. As societies grow, these roles develop into full social identities, resulting in various features that
others can use to predict qualities of the individual and how they fit into the society at large\textsuperscript{1}.

In human ancestors, groups were not particularly large, so the evolution of social roles and identities began with a small number of roles which tended to follow sex lines. Differences between sexes arose from sexual reproduction, and necessitated differences in role\textsuperscript{2}. The female’s role is to carry and feed the infant whereas the male’s role is fertilisation. In many non human species the female invests immeasurably more resources in their offspring than the male, but in humans there is more equity in investment due to social groups. Because males cannot produce milk for their infant offspring they must support in other ways, namely gathering resources and defending their family. The loss of a father while he defends his family is less detrimental to the infant than the loss of the mother early on, as without her the infant starves, and this difference acted as an evolutionary pressure for development of gender based social identities.

Evolution is, however, a slow process, and despite the fact that most modern humans live in vastly different environments to our ancestors we have not evolved much since our inception\textsuperscript{3}. As such the social identities that humans form now still broadly resembles those formed by our ancestors.

III. Traditional Social Identities and Gender
While ancestral human environments showed mostly men gathering resources to support their family, modern workplaces show ever increasing numbers of women\textsuperscript{4}. That being said, there is not always equal treatment or expectation of women in the workplace, due in no small part to the fact that the sex based social identities of our ancestors are to some degree still present in us despite their current lack of benefit. Women in the workplace are still expected to show the communal traits that evolved to help them care for their young, such as empathy and emotional intelligence, despite the fact that those traits are not always advantageous when trying to be competitive at work\textsuperscript{4}. Men on the other hand are expected to show agentic traits, like assertiveness and logic, which often benefits them in the workplace\textsuperscript{4}. Further, women are often penalised for showing agentic traits, whereas men are either penalised less for showing communal traits or actively encouraged to do so depending on context\textsuperscript{4}, possibly due to the fact that there is more leeway in how one can show their social identity in a congruent role than an incongruent role\textsuperscript{5}.

The differences in ability based on gender cannot be fully explained by biological differences or genetic differences between males and females\textsuperscript{5}. This leaves society and social identities as possible explanations to the differences in. Interestingly, gender differences between men and women have shown some degree of difference in chosen academic fields, where women in the top 0.01% of math scores also tend to have other comparable skills that they choose to pursue instead of STEM fields\textsuperscript{5}, but choice does not always predict all career differences between men and women. Research by Holman, Stuart-Fox, and Hauser predicts that the gender differences in many fields could continue to be present for decades to come\textsuperscript{6}.

IV. Evidence of Social Identity Breakdown
While differences between sexes and genders do persist today, they are generally small and do not predict reliable differences in ability\textsuperscript{5}. As evolutionary pressure for the continued use of social identities following sex and gender lines has disappeared in modern environments, their continued prevalence and historic resistance to change suggests that society continues to support their use. In fact, non conformity to social identity norms often leads those not conforming with negative or diminished expectations put on them. This often leads to stereotyping, resulting in both diminished ability through stereotype threat and social ostracization\textsuperscript{7}. These harmful social identities seem to be supported by a mixture of cognitive dissonance in the individual in question as well as environmental factors outside from society at large.

Fortunately, research into specific social identities shows that changes can be made to social identity with the correct intervention strategies, and these changes can result in either adjustment of the social identity in question or changes in social identity all together.

The cognitive dissonance of these social identities can be leveraged to modify them in a number of ways. In highly agentic ‘manly men’, empathy and concern for other men is often inhibited and not shown. If one is exposed to a simple subliminal prime that rephrases caring as being a trait of strong men, levels of reported empathic concern shift noticeably, despite the fact that the individual does not consciously register the
prime\(^8\). Alternatively, if men are forced by circumstances to take on gender atypical roles like that of a house husband, they initially show resistance to their new role. Over time however they grow to appreciate and enjoy their role while not viewing themselves as any less manly\(^9\). This effect was also seen in their opinions of other men in similar roles and their opinions of women in traditionally male roles\(^9\).

Modifications to the social environment are also shown to have similar effects on social identity. Despite stereotypes and expectations that women are worse at mathematics, research shows that there are negligible differences in actual mathematics skill\(^5\). Stereotype threat can cause such differences to appear, but removing threat cues from the environment or reminders of other social identities with counter stereotypical traits can mitigate or remove these effects\(^10\). Other large scale societal interventions, like programs promoting fathers to take child care leave like mothers do resulting in a perception of acceptance of the different role by society, often show improvements in quality of life for mothers, fathers, and children\(^11\).

V. Proposed Direction for New Framework

These are just some of the interventions that have shown to be successful in breaking down harmful barriers in changing social identity, with others targeting social identities with a wide variety of sources other than evolved sex differences. The problem I find with their approach is that they often look at individual social identities only, with little consideration for how social identities come about in the first place and how different social identities relate to one another.

My objective is to develop a framework that we can use to develop future intervention into sex and gender based social identities and beyond, by identifying what common aspects are sustaining the harmful identity and pulling from previous interventions that were designed for identities with similar supports. It is my hope that by looking at social identities as a whole, an effective framework for intervention structure can be developed, to make intervening easier and allowing people to live more authentically to how they want to.

References