

Proceedings of
the 8th Annual
Thompson Rivers University

Undergraduate Research and Innovation Conference

Kamloops, BC | April 2013



THOMPSON RIVERS
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Introduction

Thompson Rivers University Undergraduate Research and Innovation Conference and its annual proceedings continue to be a unique opportunity for young TRU undergraduate researchers. These students work on peer-reviewed and supervised projects, case studies, and research papers year-round covering a diverse range of topics of their choice.

In the following selected articles, presented at the 2013 Thompson Rivers University Undergraduate Conference, we witness the development of critical thinking and analytical skills from TRU undergraduate students that may change and affect our lives for the better. The articles represent for these young researchers the culmination of a long intellectual process. Having discovered and defined a topic of interest, researched that topic, written up results, presented their findings in an open forum, and revised and edited their papers for final consideration in this collection, these TRU students have thought deeply about their particular subject area. Most importantly, these articles demonstrate the enthusiasm and passion that our students have for research which can change our understanding of the world. The variety and the significance of the themes addressed may readily be seen in the brief description of each paper provided below.

Two of the articles in this collection raise questions about potential and direct impacts of industry on our environment and health. Alex Lapierre's research on a local lake, entitled Biodiversity Survey of Inks Lake, BC, Canada,

questions the claims made by a mining company that “Inks Lake is uninhabitable by fish and other aquatic life” as well as the claim that waterfowl do not breed there. Field data collected over an eight month period, with a primary focus on the diversity and abundance of vertebrates and aquatic invertebrates and the breeding activities of the bird species found on and around the lake showed otherwise. This study revealed that “[C]ontrary to previous descriptions of Inks Lake, a wide variety of vertebrates and aquatic invertebrates was found at the lake” and that “[I]f Inks Lake is altered or destroyed by the proposed Ajax Copper-Gold Project, a stopover site and breeding habitat and a food source for many species will be lost.”

The second paper by Christina Drescher, entitled Quantitative Analysis of Bisphenol A and Bisphenol F Leaching out of Baby Feeding Bottles Using Capillary Electrophoresis, evaluated a new method for determining the levels of three chemicals in plastic baby feeding bottles. Bisphenol A (BPA) and Bisphenol F (BPF) are endocrine disrupters that can easily leach out of plastic materials and which can have potentially harmful health effects due to their ability to mimic endocrine hormones. As Drescher notes, these detrimental compounds are of great interest to the plastics industry, especially when the safety of infants is involved. This research used capillary electrophoresis to analyze and quantify the amounts of BPA and BPF in multiple samples of baby feeding bottles. Drescher concludes by questioning whether “BPA Free” baby bottles marketed in Canada are truly “BPA Free,” and observing that “Sample variation provides a fascinating opportunity for future work. BPA is found in many consumer products, such as the white lining within tomato soup cans and water bottles. There is also a concern with plastic food packaging. Studying any of

these types of real world sample would be of great interest and research on them would be beneficial to the public.” As is apparent, the research findings of Lapierre and Drescher have important public policy implications for protecting our health and ensuring the continued diversity of our natural environment.

The other article examines the significance of long established social stereotype. In *Beauty in the Eye of the Beholder- Vancouver's Downtown Eastside*, Jennifer Ju uses a reader-response theory to challenge the assumption that this renowned area of Vancouver is simply run-down and impoverished. Rather, the works of Marie Clements, George Ryga and Evelyn Lau's, and the author's own experience with the Downtown Eastside, reveals a dichotomy of ugliness and beauty. Having grown up in this area Ju wants us to realize the positivity within this area, which is not often recognized due to the heavy stigma in which it is depicted as solely undesirable. As she observes, crime “statistics reveal the Central Business District, one of Vancouver's wealthiest neighbourhoods, comprised of many small businesses, franchises, employment opportunities and skyscrapers with panoramic views of the entire city, as what I would deem a more ‘dangerous’ area” versus the Downtown Eastside. However, the Central Business District is considered by modern Vancouverites as the most desirable place to live.” Despite seen as “undesirable, feared and neglected” Ju anticipates “that some people will continue to perceive the Downtown Eastside as simply as skid row...but I also foresee others deciding to embrace the DTES as a complex, integrated dichotomy of both a derelict slum as well as a place beautified by people who are constantly trying to understand it and helping to make it better.” Both of these articles compel us to reexamine our own lives and assumptions regarding issues as

varied as child rearing and urban areas confronted by multiple social challenges.

Technology and professionalization were the themes of the final two articles of our collection. These themes have been addressed from radically different perspectives. In *Military Ideology in 17th Century England: Departure From, or Continuation of Tradition?* Preston Arens explores the nature of military ideology in 17th century England, specifically whether the English Civil Wars or technological advances had any impact on those ideologies. Using primary sources from throughout the 17th century, it becomes clear that by the end of the 17th century English military thought was shifting to political, rather than religious affiliations. The latter were becoming increasingly incompatible with the nature of the modern military. As Arens concludes “the new organization of the army ... reinforced by new technologies ... promoting the rise of the professional soldier, as opposed to the reluctant warrior...these changes in turn promoted the emergence of a new image of the ideal soldier based on the cavalier. This ideal soldier, though he was a religious man, emphasized loyalty to king and country over religious principles in terms of his position as a soldier.”

Khalid Abdullah Alomar’s research project is entitled *Crime Data Visualization Using GIS and Augmented Reality: A Mobile Application*. A smartphone application is developed to visualize crime data with geographical information system (GIS) and its augmented reality. While police and reinforcement agencies are patrolling in a certain area they can point their smartphones (iPhones or Android phones) to nearby buildings to determine if those buildings are related to any past crimes where the crime data are superimposed on the buildings in the smartphone screen. As

Alomar notes “these technologies can help police and reinforcement agencies to quickly access and discover the appropriate crime data in the timely manner” and “the proposed mobile app will be useful for police and law enforcement agencies in their daily duty.” These two articles reveal how technology and the professionalization of security and law enforcement agencies alter the world we live in, changing not just our allegiances but also our understanding of our own urban environment.

In these articles our undergraduate researchers have drawn attention to threats to our environment and our health, stereotypes and stigmatization, and the role of technology and professionalization in changing our past and our future. Having had the opportunity to not only organize this conference and supervise research projects, but to view many students’ presentations and evaluate research poster displays, we can attest to the incredible pride, enthusiasm and knowledge demonstrated by all the students who participated in this conference. Further recognition must be given to the faculty attended the conference and/or served as session chairs, administrators, other support staffs including TRU librarians. They all contributed to another successful round of undergraduate research outcomes at TRU. In particular, without the help of the dedicated and committed faculty supervisors, these research papers would not be getting this chance for dissemination. We are pleased that with the support of these faculty members, TRU continues to be proud of promoting undergraduate research in Canada.

Finally, in addition to the contributions of these articles to our current understating of our communities, the environment, and the world, this conference and the selected articles are a testament to the critical insights of our students

which may protect and improve the lives of many in the future.

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Animal Biodiversity Survey of Inks Lake, BC, Canada

Alex R. Lapierre

Biological Sciences
Supervisor: Dr. Nancy Flood

Abstract

The goal of this study was to assess the diversity of animal species associated with Inks Lake, a small, shallow, slightly alkaline body of water that has been described by some sources as being devoid of aquatic life. Although the focus of this biodiversity survey was on vertebrates, mainly birds, water samples were also taken to obtain a snapshot of the diversity of aquatic invertebrates in the lake. Field data were collected from the beginning of May to December 2012 through weekly monitoring sessions. These sessions consisted of hour-long visits in which we identified and recorded the number of vertebrate species present at the lake. We also recorded the total abundance of ducks during each visit, and we noted any behaviours such as copulation, nesting, and raising young. A wide variety of bird species and aquatic invertebrate taxa was found at Inks Lake. Almost all of the bird species were observed feeding on the aquatic invertebrates and/or plants. The lake appears to be a stopover site for many migratory bird species, and several bird species were observed copulating and raising young. Inks Lake's habitat quality and food resources are sufficient to support a diversity of species.

Introduction

Inks Lake (Fig. 1) is a small, shallow, slightly alkaline body of water located south of Kamloops, BC in the interior grasslands. The lake is at an elevation of approximately 850 m above sea level and its shores are partially covered with salt deposits, as is typical of saline wetlands. The algae that grow at the edges of Inks Lake over the summer provide food for the aquatic invertebrates in the lake. Although the occurrence of fish and amphibians in alkaline lakes is usually very limited, these lakes typically have an abundance of aquatic invertebrates that are a food source for many resident and migrating birds (Boros, 2003). Inks Lake has been described by KGHM Ajax Mining as being “uninhabitable by fish and other aquatic life” (Ajax Copper-Gold Project Fact Booklet, 2011). It has also been stated that waterfowl do not breed there (Dueck, 2012). The purpose of this study was to assess the animal diversity of Inks Lake by monitoring the lake over time and taking detailed observations. This study primarily focused on the diversity and abundance of vertebrates and aquatic invertebrates, and the breeding activities of the bird species found on and around the lake.



Figure 1: Photo of Inks Lake in early summer (July, 2012) showing algal growth at its edges.

Methods

This study took place from May to December 2012. Field data were obtained during observation sessions that occurred approximately once a week. During each session, two observers spent 15 minutes at each of three observation stations positioned around the periphery of Inks Lake (Fig. 2). During this time these two observers identified and recorded the number of vertebrate species directly on, flying over, or on the shores of the lake, and noted any foraging and breeding behaviours. Species were identified visually using binoculars and spotting scopes or by sign, such as foot prints left on the shore.



Figure 2: Inks Lake study area showing the three observation stations (stations A, B, and C).

During each of the three 15-minute periods (one at each of the stations shown in Fig. 2) which comprised a weekly observation session, the two observers counted and recorded the total number of ducks on Inks Lake, and the maximum count for each session was used to plot the variation in duck abundance over the duration of the study. This was done in order to determine if there were a difference in duck abundance during migratory (spring and fall) and non-migratory (summer) periods. For this study the seasons were defined based on the maximum duck counts from the observation sessions. Spring was defined as those days on which the maximum duck count was higher than the average for the entire study; summer was defined as those days which had average or lower-than-average duck counts, and fall was defined as those days when the duck count again exceeded the average.

Although the focus of this biodiversity survey was on vertebrates, water samples were also taken at each of the observation stations at the beginning of August to obtain a snapshot of the diversity of aquatic invertebrates in Inks Lake. Benthic (lake bottom) and pelagic (open water) samples were taken using a petite ponar grab sampler and a D-frame sampling net (both available from Wildco Wildlife Supply Company). Aquatic invertebrates were identified in the lab using microscopes and an identification key. A ranking (with 3 levels: low, moderate, and high) of the density of each aquatic invertebrate taxon in the water samples was obtained by counting and comparing the number of individuals of each taxon. Three water samples (one at each of the three observation stations) were also taken on two occasions (a week apart) in October to measure the pH of the lake. The pH was measured in a lab using a Beckman Φ 350 Temp-pH Meter (available from Fisher Scientific).

An index of bird species diversity was calculated for each observation session of the study using the Shannon-Wiener diversity index: $H' = -\sum(p_i \ln p_i)$ where p_i is the proportion of the number of individuals of all species made up by one species (Pielou, 1975). The indices from each day out of the summer and fall seasons were averaged to give indices for the entire seasons. In the spring there was only one day with a higher-than-average duck count, and the index calculated for this day was used to represent the spring season. The purpose of averaging the Shannon-Wiener diversity indexes for entire seasons was to compare the diversity of bird species during the spring and fall periods of migration to the diversity of bird species during the non-migratory summer period

Results

We identified 59 vertebrate species at Inks Lake, 58 of which were birds (scientific names of all bird species given in Appendix, Table 1). These included 8 species of shorebirds (order *Charadriiformes*), 18 species of waterfowl (family *Anatidae*), and 23 species of passerines (order *Passeriformes*) (Appendix, Table 1). Other aquatic bird species on the lake were the Common Loon and Horned Grebe. Dabbling and diving ducks actively foraged on and in the lake, and fishing birds such as the Common Loon and Hooded Merganser were seen diving. Several bird species were observed courting, copulating, and raising young at Inks Lake. Two broods of Mallard ducklings were observed in July; Barrow's Goldeneye young were seen in June, Blue-winged Teal were observed raising young in August, and multiple families of Spotted Sandpiper and Killdeer were observed raising young in May and June. Cinnamon Teal, Lesser Scaup, Bufflehead, and Hooded Merganser were observed courting and copulating on the lake in May and June. Trumpeter Swans were seen flying near the lake in the fall, and swan tracks along with Great Blue Heron tracks were visible on the shores of the lake during some of the observation sessions in the later part of the study.

The maximum number of ducks observed during each observation session varied widely, ranging from zero to 190 ducks. The average duck count for each observation session was approximately 56. Over the duration of the study, peak numbers were observed in the spring and fall during migration periods (Fig. 3).

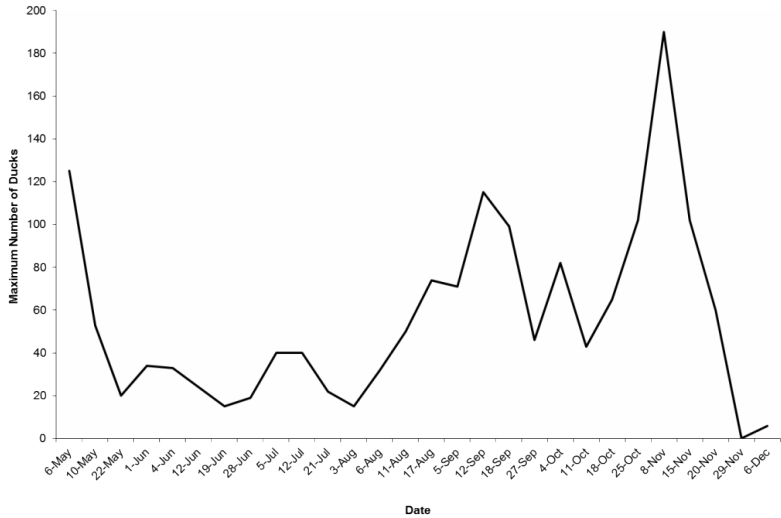


Figure 3: The abundance of ducks at Inks Lake during each observation session.

Calculating average Shannon-Wiener diversity indexes for the spring, summer, and fall seasons showed that the highest diversity of bird species at Inks Lake occurred during the summer ($H' = 2.298676 \pm 0.328677$) followed by the fall ($H' = 2.093167 \pm 0.056535$) with the lowest diversity ($H' = 1.42865$) found in the spring (Fig. 4).

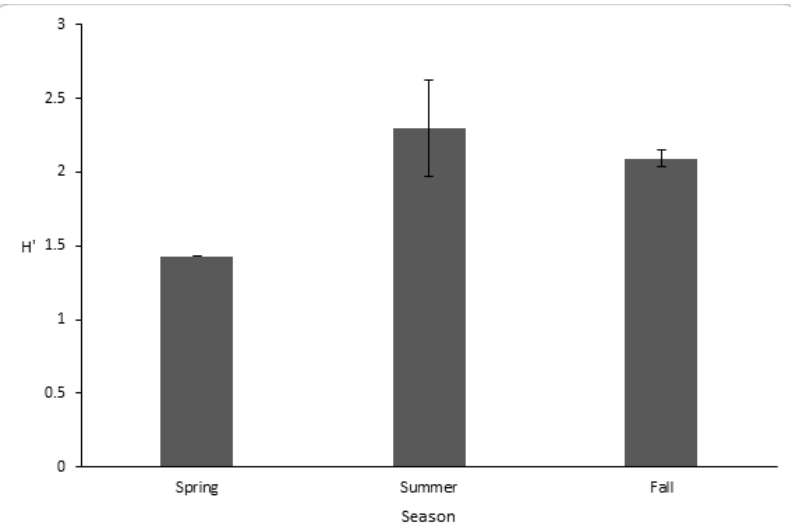


Figure 4: Average Shannon-Wiener diversity indexes (H') for each of the spring, summer, and fall seasons.

A muskrat (*Ondatra zibethicus*) family was observed foraging and burrowing into the lake’s banks during several observation sessions. During water sampling in August an unidentified tadpole was seen swimming near station C (Fig. 2). Ten aquatic invertebrate taxa were identified from the water samples taken in August (Table 1). In the pelagic samples fly larvae (family *Chironomidae*), daphnia (genus *Daphnia*), amphipods (genus *Hyaella*), and damselfly larvae (families *Coenagrionidae* and *Protoneuridae*) were the most abundant. Water boatmen (family *Corixidae*) were also present in the pelagic samples, and aquatic snails were present in the benthic samples. However, these snails were too decomposed at the time the water samples were analyzed to key out. After averaging the pH of the water samples taken in October it was confirmed that Inks Lake is slightly alkaline, with an average pH of 8.7.

Table 1: Aquatic invertebrate taxa found in Inks Lake. Note: relative density is based on the numbers of individuals recorded in the samples and has three rankings: low, moderate, and high.

Taxon	Relative Density
Fly larva, family <i>Chironomidae</i>	High
Amphipod, genus <i>Hyaletta</i>	High
Daphnia, genus <i>Daphnia</i>	High
Damselfly larva, family <i>Protoneuridae</i>	Moderate
Damselfly larva, family <i>Coenagrionidae</i>	Moderate
Fly larva, family <i>Stratiomyidae</i>	Low
Springtail, family <i>Isotomidae</i>	Low
Water boatman, family <i>Corixidae</i>	Low
Snail, species unknown	Low
Caddisfly larva, order <i>Trichoptera</i>	Low

Discussion

Contrary to previous descriptions of Inks Lake, which stated that it is uninhabitable by aquatic life (Ajax Copper-Gold Project Fact Booklet, 2011) and not a breeding grounds for waterfowl (Dueck, 2012), a wide variety of vertebrates and aquatic invertebrates was found at the lake. Several bird species and muskrats mate and raise young at Inks Lake. The young that were observed on (for ducks) or around (shorebirds) the lake appeared to be hatched within the

previous day or two of the observations, indicating that they were hatched from nests at Inks Lake as opposed to being brought in from elsewhere. Nearly all the vertebrate species observed at the lake actively forage in, on, or around it. Inks Lake also appears to serve as a stopover site for several species of migrating shorebirds and waterfowl.

The Shannon-Wiener diversity index was highest in the summer and not during migration periods, indicating a more even distribution and higher diversity of bird species during non-migratory periods. This may be because the arrival of large flocks of migrating birds at Inks Lake during the spring and summer skew the species distribution towards a small number of species. Also food resources provided by the lake are probably maximized during the summer as this is when there are abundant flies and algae on the lake's edge.

The dabbling and diving ducks likely feed on the abundant aquatic invertebrates in Inks Lake, and the fly larvae and amphipods are likely a food source for the shorebirds (Arzel et al. 2006). The muskrats probably feed on aquatic vegetation and possibly on the snails (Eder, 2001). More rigorous water sampling is required to better quantify the abundances and diversity of aquatic invertebrates in Inks Lake in order to obtain a better picture of what the vertebrate species at the lake are feeding on. Also, an analysis of the aquatic vegetation in the lake should be performed in order to better assess the food source that the lake provides. Although we were unable to obtain permits to sample for the presence of fish, the behaviour of the fish-eating birds observed on the lake suggests the presence of fish. Further sampling is required to determine what it is that these fish-eating birds are eating in Inks Lake. In years of high water, fish have been known to travel from the adjacent Jacko Lake into Inks Lake

(Steve Maricle, pers. comm.). Inks Lake is alkaline but, not the pH is well within the survival range of fish (e.g., Howell et al. 2006).

No species of concern were identified at Inks Lake during this study, with the exception of what was likely a western toad tadpole (*Anaxyrus boreas*) as indicated by this species' distribution and ecology (Pearson and Healey, 2012) and personal observations of local Kamloops area naturalists. This species is listed as being under special concern by the Committee on the Status of Endangered Wildlife in Canada, and in B.C., it has blue-listed status (Pearson and Healey, 2012). For birds, breeding is costly, and the breeding success observed at Inks Lake indicates that the habitat provided by the lake is of sufficient quality to serve as the breeding grounds for several species, including migratory birds. If Inks Lake is altered or destroyed by the proposed Ajax Copper-Gold Project, a stopover site and breeding habitat and a food source for many species will be lost

References

- Ajax Copper-Gold Project Fact Booklet. KGHM Ajax Mining. 330 Seymour Street, Kamloops, BC. 2011.
- Arzel, C., J. Elmberg, and M. Guillemain. 2006. Ecology of spring-migrating *Anatidae*: a review. *Journal of Ornithology* 147: 167-184
- Boros, Emil. 2003. Alkaline lakes. Authority for Nature Conservation, Ministry of Environment and Water.
- Eder, Tamara. 2001. Mammals of British Columbia. Lone Pine Publishing, Edmonton, AB, Canada
- L.R. Duek. Waiting Patiently for Environmental Assessment. Letter to Kamloops Daily News Oct. 30, 2012.

- Howells, G.D., D.J.A. Brown and K. Sadler. 2006. Effects of acidity, calcium, and aluminium on fish survival and productivity—a review. *J. Sci. Food Agric.* 34: 559-570.
- Pearson, Mike and Healey, M.C. 2012. *Species at Risk and Local Government: a Primer for BC*. Stewardship Centre of British Columbia, Courtenay BC.
- Pielou, E.C. 1975. *Ecological Diversity*. John Wiley & Sons Inc., Toronto. 165 pp.

Appendix

Table 1: Bird species observed at Inks Lake and observed behaviours and location of observations. Note: All birds flew over the lake, but only the bird species that were observed flying over the lake but not landing during the observation have "flying over (did not land)" in the last column.

Species	Observed foraging in, on surface, or on shores of lake	Observed copulating	Observed young	Where species was observed in relation to lake
American Coot (<i>Fulica americana</i>)	Yes			On
American Crow (<i>Corvus brachyrhynchos</i>)				Around
American Green-winged Teal (<i>Anas c. carolinensis</i>)	Yes			On
American Pipit (<i>Anthus rubescens</i>)	Yes			On shore
American Robin (<i>Turdus migratorius</i>)				Around
American Tree Sparrow (<i>Spizella arborea</i>)				Around
American Wigeon (<i>Anas americana</i>)	Yes			On
Bald Eagle (<i>Haliaeetus leucocephalus</i>)				Flying over (did not land)
Barn Swallow (<i>Hirundo rustica</i>)				Flying over (did not land)
Barrow's Goldeneye (<i>Bucephala islandica</i>)	Yes	Yes	Yes	On
Black-billed Magpie (<i>Pica hudsonia</i>)				Around
Blue-winged Teal (<i>Anas discors</i>)	Yes	Yes	Yes	On
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	Yes			Around
Bufflehead (<i>Bucephala albeola</i>)	Yes	Yes		On
Canada Goose (<i>Branta canadensis</i>)	Yes			On

Cedar Waxwing (<i>Bombus ciliatus cedrorum</i>)			Around
Chipping Sparrow (<i>Spizella passerina</i>)			Around
Cinnamon Teal (<i>Anas cyanoptera</i>)	Yes	Yes	On
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)			Flying over (did not land)
Common Goldeneye (<i>Bucephala clangula</i>)	Yes		On
Common Loon (<i>Gavia immer</i>)	Yes		On
Common Nighthawk (<i>Chordeiles minor</i>)			Flying over (did not land)
Common Raven (<i>Corvus corax</i>)			Around
Dark-eyed Junco (<i>Junco hyemalis</i>)			Around
European Starling (<i>Sturnus vulgaris</i>)			Around
Gadwall (<i>Anas strepera</i>)	Yes		On
Golden Eagle (<i>Aquila chrysaetos</i>)			Flying over (did not land)
Great Blue Heron (<i>Ardea herodias</i>)			On shore (tracks)
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	Yes		On shore
Hooded Merganser (<i>Lophodytes cucullatus</i>)	Yes	Yes	On
Horned Grebe (<i>Podiceps auritus</i>)	Yes		On
Killdeer (<i>Charadrius vociferans</i>)	Yes	Yes	On shore
Least Sandpiper (<i>Calidris minutilla</i>)	Yes		On shore
Lesser Scaup (<i>Aythya affinis</i>)	Yes	Yes	On

Long-billed Dowitcher (<i>Limnodromus scolopaceus</i>)	Yes			On shore
Mallard (<i>Anas platyrhynchos</i>)	Yes	Yes	Yes	On
Northern Flicker (<i>Colaptes auratus</i>)				Around
Northern Pintail (<i>Anas acuta</i>)	Yes			On
Northern Rough-winged Swallow (<i>Stelgidopteryx serripennis</i>)				Flying over (did not land)
Northern Shoveler (<i>Anas chrysaetos</i>)	Yes			On
Peregrine Falcon (<i>Falco peregrinus</i>)	Yes (observed attacking ducks)			Flying over (did not land)
Redhead (<i>Aythya Americana</i>)	Yes			On
Ring-necked Duck (<i>Aythya collaris</i>)	Yes			On
Ruddy Duck (<i>Oxyura jamaicensis</i>)	Yes			On
Savannah Sparrow (<i>Passerculus sandwichensis</i>)				Around
Semipalmated Plover (<i>Charadrius semipalmatus</i>)	Yes			On shore
Solitary Sandpiper (<i>Tringa solitaria</i>)	Yes			On shore
Spotted Sandpiper (<i>Actitis macularia</i>)	Yes	Yes	Yes	On shore
Tree Swallow (<i>Ichthyophaga bicolor</i>)				Flying over (did not land)
Trumpeter Swan (<i>Cygnus buccinator</i>)				On shore (tracks)
Turkey Vulture (<i>Caracara aura</i>)				Flying over (did not land)
Vesper Sparrow (<i>Pooecetes gramineus</i>)				Around

Violet-green Swallow (<i>Tachycineta thalassina</i>)	Yes	Flying over (did not land)
Western Meadowlark (<i>Sturnella neglecta</i>)		Around
Western Wood Pee-wee (<i>Contopus sordidulus</i>)		Around
Wilson's Snipe (<i>Gallinago delicata</i>)	Yes	On shore
Yellow-headed Blackbird (<i>Xanthocephalus xanthocephalus</i>)	Yes	On shore
Yellow-rumped Warbler (<i>Setophaga coronata</i>)	Yes	On shore

Military Ideology in 17th Century England: Departure From, or Continuation of Tradition?

Preston Arens

History

Supervisor: Dr. Annie St. John-Stark

Abstract

This paper explores the nature of Military Ideology in 17th century England, specifically whether the English Civil Wars or technological advances had any impact on those ideologies. This project uses primary sources from throughout the 17th century, mostly in the form of pamphlets published for soldiers, and analyses them for changes in light of the events and advances of the 1600s. Through this analysis, it becomes clear that by the end of the 17th century, English military thought was shifting to political, rather than religious affiliations which were becoming increasingly incompatible with the nature of the modern military.

In spite of technological advances and changes in how wars were fought, military ideology in England did not significantly change during the late middle ages and early renaissance. With this historical consistency in mind, it would seem reasonable to assume that while massive changes occurred in how war was conducted in 17th century England, the ideology behind warfare still remained essentially the same in spite of any technological or tactical advances; but

did it? Military forces at the beginning of the 17th century hardly resembled those at the end. New technologies, new organizational structures, tactics, and the rise of permanent standing armies fundamentally altered the English armies of the day. The question this essay will explore is whether those sweeping changes impacted, or reinforced the prevailing ideologies of war, and if so, how? To begin, we must first look at the ideology of warfare as it was in England at the beginning of the 17th century.

Military ideology at the start of the seventeenth century was essentially the same as it had been for several hundred years.¹ The concept of the Christian Soldier and Just War theory remained essential to military ideology, even becoming romanticised after the crusades. The 17th century society requirement everyone be Christian greatly influenced the structure of these ideologies. Furthermore, violence was much more a part of 17th century society than today, and given that many of these concepts had been developed in the middle ages, an even more violent time by most standards, the central ideological structure became that of reconciling warfare with Christianity. It is well known that the Ten Commandments expressly prohibit murder as well as stealing (plunder was a key part of period warfare) so it is easy to see how the concepts of a Christian Soldier in a Just War quickly became problematic, especially in times when men were actually called to war. Though England had had several military scares and minor engagements in the early 17th century, the first major use of land armies made up of English troops was the Civil War in the 1640s. This period of upheaval and subsequent involvement of many more troops meant that the need for the reconciliation process to produce a

convincing ideology for soldiers to rally behind became more important than ever. That urgent need resulted in an abundance of literature from both the Parliamentary and Royalist sides of the conflict providing their justifications for going to war, while still remaining a good Christian. However, this justification was not as simple as it once was. Before we investigate those difficulties, let us first look at the prevailing opinion on warfare as it was before the escalation of the civil wars, in other words, as it had been up to that point in the 17th century.

In his widely circulated 1636 pamphlet *Gods Three Arrowes: Plague, Famine, Sword*, the doctor of divinity and preacher William Gouge outlined the prevailing ideology of the time. In the first portion of the pamphlet, Gouge confirms the lawfulness of killing in a war according to the Bible. However, for the duration of the pamphlet, he outlines the evils of war, and that Christians should not take delight in participating, only doing so when: their hearts are “possessed with true charity,” only to carry out God’s judgement, and only as a last resort.² Gouge finishes his pamphlet with several passages celebrating the peace that England had enjoyed since Elizabeth’s reign.³ All in all, Gouge provides a fairly comprehensive look into the attitudes towards warfare in pre-civil war England. Clearly, men really shouldn’t want to go to war, must only do so as a last resort, and only with the right motivations; a simple, yet vague ideology.

The English civil wars and the resulting instability in England would be the catalyst to call into question these prevailing ideologies of warfare, but the question remains whether or not those changes were brought about by the changing nature of warfare, or by one or more of the many

other factors of change which existed during the war. In order to better understand the war itself, one must first look at the two opposing sides. Religious publications intended for the soldiers of both armies provide excellent insights into their differences.

For an example on the Parliamentary side, the 1645 publication *The Souldiers Catechisme, Composed for the Parliament's Army* serves well. The Catechisme, a basic description of the tenets of a system of belief,⁴ explores a variety of questions a soldier might have, and answers them according to the Parliamentary point of view. The first and most important sets of questions focus on whether or not it is lawful for a Christian to fight, followed by whether or not he may fight against his King. The argument follows that scripture does allow a Christian to fight, but not directly against his king. However, in this case it is permitted in order to rescue the king from “wicked Councells” and the “Popish Malignant Company” which have corrupted the king, and which hold him hostage with their power.⁵ The Royalist forces of Charles I produced their own catechisme later that year in rebuttal. This version proceeds with systematic responses to the Parliamentary questions and answers, with surprising similarity save for the first set of questions. In this case, the legality of fighting against one's king is firmly denied on account of the monarch being “absolute” and appointed by God.⁶ Considering that these are opposing sides in a civil war, the very slight difference of argument is surprising. This trend is confirmed in other documents as well. In 1643, the Parliamentary forces published a tract entitled *The Souldiers Pocket Bible*, “which doe shew the qualifications of his inner man, that is a fit Souldier to fight the Lord's Battel, both before the fight, in the fight, and after

the fight.”⁷ *The Souldier’s Pocket Bible* contains much more complicated than the pre-war rules governing the conduct of a soldier. In lieu of simple instructions on the lawfulness of a Christian going to war, this bible contains scriptures outlining how a Christian ought to behave in war, essentially providing a list of do’s and don’ts, as well as scriptural encouragements. Some 40 years later, after the monarchy had been abolished and restored again, the monarchy itself re-published *The Souldier’s Pocket Bible*, with some slight variations. The structure is somewhat improved with a numbering system and the consolidation of several lengthy points, but essentially the content remains the same, save for the addition of 3 extra points which highlight the soldier’s obligation to serve his King and country, obey his superiors, and behave justly and honourably.⁸ In both of these examples, the main difference between the two sides is just the question of loyalty to the King, suggesting little change in military ideology through the Civil War.

In his research, Keith Lindley found that “A corresponding line of continuity runs from early religious zealotry to subsequent dedicated parliamentarianism.”⁹ And conversely that: “correlation exists between the adoption of a conservative stance over religion...and varying degrees of royalism.”¹⁰ Based on Lindley’s findings, and what has been seen in contemporary documents, we can conclude that the older school of religion, that of a structured hierarchical form of Protestantism with the king at the top, faced off against less structured more radical forms of Protestantism, all the while sharing many of the same religious values. This was the backdrop of the military changes brought about in the English Civil War.

These slight religious differences in turn affected the development of their respective armies, especially that of the New Model Army on the Parliamentary side. Mary Coate described this new army by saying that it “constituted religious toleration, equality of opportunity, and severe discipline.”¹¹ She also described it as “keenly political, intensely religious, [and] thoroughly efficient.”¹² This image of a newly organized, disciplined, and religiously fervent army fighting for religious toleration and Parliamentary rule, starkly contrasts the image of the Royalist forces. Already we have heard of the association of the Royalists with religious conservatism, but this conservatism also extended into the social elements comprising the army. Roger B. Manning, in his study of command styles in 17th century English armies, states that while both sides faced the problem of “integrating gentlemen officers...to form one professional corps,”¹³ on the Royalist side “There was a longstanding prejudice against professional soldiers or soldiers of fortune.”¹⁴ The prejudice against soldiers of fortune could be seen as holding little importance, as “with the lure of pay and plunder, or with conscription, men could find themselves in...[the] army for reasons other than party conviction;”¹⁵ as has always been the case in warfare. What is of interest for this study is the prejudice against the professional soldier, a relatively new figure to emerge on the battlefield. The professional soldier was exactly that, a man whose profession was soldiering, as opposed to the intermittent duties of the pre-civil war militias, which were, as Coate says, “as a fighting force...negligible.”¹⁶ One would think that being an improved fighting force, the Royalists would be eager to embrace this new form of soldier, but as Manning has pointed out, this was not the case. To explain, we must recall the

firmly held conservatism of the Royalist side. In this highly hierarchical system, the aristocrats commanded the militias, and class, not military experience dictated who would be in command. The professional soldier, however, gained extensive experience in his military career, and would earn his rank based upon merit; a system which would easily challenge the placement of aristocrats in command over more experienced professional soldiers. Manning came to a like conclusion when he found that military progress on the side of the Royalists was delayed as aristocratic officers were “reluctant to accept the idea that military hierarchies had superseded social hierarchies.”¹⁷ The New Model Army, on the other hand, with equality of opportunity, embraced the new organization, and ultimately won the war by adapting to the “changing conditions of modern warfare.”¹⁸

While classes did play a role in the course of the war, Coate still posits that “the war was one of ideals, not of classes.”¹⁹ As we have seen so far, the main ideological conflict was not very drastic, being only conservative versus liberal Protestant views, with the most dispute being placed on the role of the King. To see the long-term impact of these differences, we must look to the events following the Civil War, in the latter half of the seventeenth century.

The military rule of the Parliamentary army immediately after the Civil War provides an interesting source of study. When the army took power it possessed its own liberal ideology. According to Donald Pennington:

The Army's Ideology had 3 elements: That all Englishmen had birthrights, freedoms, and liberties inherent to them; that the authority of civil

government resided in parliament, and that the chief principle of social relations was the advancement of public good over private interest.²⁰

He further states that: “The pledge to preserve the just rights and liberties of all Englishmen implanted a transcendent character to the Army’s ideology, and transformed a military body into a political force.”²¹ These two quotations give us many insights into the ideology of the period. Most of all we can see the politicisation of the army’s ideals. What started as a liberal interpretation of religiously oriented wartime ideals, transformed into a strictly religious, yet liberal set of governmental or political ideals. From this point onward, the new military became even more important in politics, a trend which transcended the change of regimes following the Restoration, so that by the time of the Glorious Revolution of 1689 “standing armies had been a long-standing political concern.”²² Under the new king, William of Orange, having already seen the change from amateur to professional, and from a tool of politics to a political force itself, military development took another turn. At this time, England faced external, rather than internal enemies, the Catholic kingdom of France in particular. As a large, permanent army seemed more and more necessary in the pursuit of war with France, the image of the ideal soldier changed. With such large scale international war, the latter half of the 17th century saw the size and scale of armies increase not only in England, but across Europe as a whole, as militaries developed into permanent standing armies with new rank structures like that of the New Model Army, professional soldiers in the ranks, and standardized equipment and uniforms for all.²³ If one recalls the ideology of the Christian Soldier from the first half of the century, the development of permanent armies

is quite problematic. Rather than a reluctant servant of God who fights as a last resort, and then only with the purest of motives, men are employed as soldiers and fight for pay. However, the ideology adapted to these changes, surprisingly by recalling the conservative stance of the Royalists, and applying it the new military. During the Civil War, there was a distinction between the conservative approach to religion of the Royalists, and the liberal interpretation of the Parliamentarians. After the Civil War, both of these positions had been in power, culminating with William of Orange's reign, which combined the hierarchical structure of the conservative camp, with a degree of toleration on the liberal side. The most important element of William's success in forging this compromise was both sides' hatred of Catholicism. With only slight religious differences separating the two sides of the Civil War, the introduction of a common enemy (in the form of Catholic France) easily united the two sides, in a Protestant versus Catholic frame of mind. Now that England was firmly united in their anti-Catholic cause, it became possible to revive some of the ideals of the conservative position lost in the Civil War, in order to patch the ideological holes of the modern military.

The solution came with the image of the cavalier. One of the key figures of the Royalist forces during the Civil War, the cavaliers were aristocratic warriors, or "patriotic gentlemen."²⁴ In her study of politics, patriotism, and gender, on the English stage after the Glorious Revolution, Hannah Smith offers this description of the cavalier, as portrayed in the popular culture of theatre: "The cavalier...presented as brave, tough, intelligent, ingenious, sexually attractive, and with a residual loyalty to the crown," a figure of masculine virtues, honour, and loyalty.²⁵ While this character would

indeed make a good soldier, the religious elements have all but disappeared. Manning describes this shift of the ideal soldier as “decayed military tradition revived.”²⁶ The aristocratic military leader of the conservative camp had been revived as the role model for the professional army, despite that army being founded on highly religious principles.

Having looked at the religious and organizational elements of military change thus far, let us briefly look at technological changes. The de-skilling of military equipment had been in existence for quite some time before the 17th century. The transition from longbow to crossbow in the twelfth century meant that anyone could use long-range weapons without years of training or the expensive armour for full contact fighting. The advent of the musket in the 1400s had only furthered this trend of easy to use, longer-range weapons gradually replacing hand-to hand armaments. This trend itself cannot be proven to be enough to change ideology on its own. However, it can be shown to support and reinforce the forces of change coming from other sectors. For example, while the growth of standing armies increased the number of professional soldiers, it was the new technologies that made it easier for men to become those professionals. In the middle ages, aristocratic knights were the highly trained soldiers, and although that tradition gradually deteriorated, the image of the trained warriors of the noble class did persist. On the other hand, the foot soldiers of the lower ranks were typically average men called up to join the militias. Armies raised from militias were more often than not, “worthless.”²⁷ New technologies such as the ever-improving rifle, allowed the class of men who once made up those worthless militias, to become professional soldiers as only nobility had been able to do before. Technology supported the rise of the professional

soldier and the standing army, which in turn, influenced the ideologies of the day.

Ideology before, during, and after the English Civil Wars, as well as structural and technological changes, return us to the question of their influence on the principles of warfare. Based on what we have seen thus far, one can make a strong case that the ideologies of warfare were indeed influenced by the events of the 17th century. As Mary Coate argues:

When the [16th] century ended, it left England with a larger colonial empire and enhanced prestige abroad, but with an intense desire for peace and a rooted dislike for military rule...if she had come into line with other powers in creating a standing army her national sentiment was unchanged.²⁸

This short passage provides a good summary of England at the turn of the 18th century, but also for military ideology at the time. First, the English populace had a strong desire for peace. This is natural after prolonged periods of conflict, but it also conforms to the pre-war reluctance to go to, and dislike for war. Second, they had a strong aversion for military rule. This illustrates that after a brief foray into the political sphere, the army was again relegated to being a tool of the state, not a political entity itself, but the ties between politics and the military had been strengthened. Given that the ideology of warfare was primarily religious at the beginning of the century, its increasing association with politics and the decreasing influence of religion shows some departure from the original ideology. Finally, despite the advent of the standing army, the population still held an ambiguous attitude

towards standing armies, and the increased importance of a strong military. Out of these three points, two lean favourably towards the maintenance of pre-civil war ideology. Regarding the new organization of the army, we have seen that, reinforced by new technologies, these changes supported divergence from the original ideology by promoting the rise of the professional soldier, as opposed to the reluctant warrior. Furthermore, these changes in turn promoted the emergence of a new image of the ideal soldier based on the cavalier. This ideal soldier, though he was a religious man, emphasized loyalty to king and country over religious principles in terms of his position as a soldier. Tallying all of these factors for or against ideological change, one finds that the factors promoting change are nearly doubled to those that oppose it, confirming that the English ideologies of warfare changed over the course of the 17th century. While there was still ambiguity and hesitation concerning these changes, the trend had been set of military ideology being increasingly associated with king, country and politics above its earlier religious association. Though this turn-around was not fully completed by 1700, the progression of change had been firmly established.

¹ Donald Wells, "How Much Can "The Just War" Justify?," The Journal of Philosophy Vol.66, No. 23 (Dec, 4 1969), 821.

² William Gouge, Gods Three Arrowes: Plague, Famine, Sword, in Three Treatises, Pamphlet, London: G. Miller for E. Brewster, 1636, University Microfilm International, [Microfilmed, 1985] STC 1, Unit 57, Reel 1878, Early English Books, 1475-1640, 12116.5.

³ Ibid.

⁴ Robert Thomas Fallon, The Christian Soldier: Religious

Tracts Published for Soldiers on Both Sides During and After the English Civil Wars, 1642-1648 (Tempe: Arizona Center for Medieval and Renaissance Studies, 2003), 44.

⁵ Robert Ram, *The Souldiers Catechisme: Composed for The Parliaments Army: Consisting of Two Parts: Wherin are Chiefly Taught*, 1 – The Justification, 2- the Qualification of our Souldiers, J.A. Cranford for J. Wright, 1645, In *The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648*, 56.

⁶ T.S. Wadlin, *The Soldiers Catechisme, Composed for the KING'S Armie; Wherin, His: 1 – Cause is justified and his enemies condemned, 2 – Soldier is instructed, and the Rebell reclaimed*, Oxford: Henry Hall, 1645, In *The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648*, 141.

⁷ *The Souldiers Pocket Bible*, London: G.B. and R.W. for G.C., 1643, In *The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648*, 7.

⁸ *The Christian Solider's Penny Bible*, London: R. Smith for Sam. Wade, 1693, In *The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648*, 24.

⁹ Keith Lindley, *Popular Politics and Religion in Civil War London* (Aldershot: Scolar Press, 1997), 224.

¹⁰ *Ibid*, 239.

¹¹ Mary Coate, *Social Life in Stuart England* (London: Methuen & Company, Ltd., 1924), 108.

¹² *Ibid*, 109.

¹³ Roger B. Manning, “Styles of Command in Seventeenth-

Century English Armies,” *The Journal of Military History* 71.3 (2007), 683.

¹⁴ Ibid, 671.

¹⁵ Lindley, *Popular Politics and Religion in Civil War London*, 233.

¹⁶ Coate, *Social Life in Stuart England*, 101.

¹⁷ Manning, “Styles of Command in Seventeenth-Century English Armies,” 670.

¹⁸ Ibid, 670.

¹⁹ Coate, *Social Life in Stuart England*, 104.

²⁰ Mark Kishlanksy, “Ideology and Politics in the Parliamentary Armies, 1645-9,” In *Reactions to the English Civil War*, ed. John Morrill (New York: St. Martin’s Press, 1982), 170.

²¹ Ibid, 172.

²² Hannah Smith, “Politics, Patriotism, and Gender: The Standing Army Debate on the English Stage, Circa 1689-1720,” *Journal of British Studies* Vol. 50, No. 1, (Jan. 2011): Accessed November 19, 2012, doi: 10.1086/656674.

²³ G.N. Clark, *The Seventeenth Century* (Oxford: Clarendon Press, 1931), 102, 105-6, 108, 109-10.

²⁴ Smith, “Politics, Patriotism and Gender.”

²⁵ Ibid

²⁶ Roger manning 684

²⁷ Coate, *Social Life in Stuart England*, 105.

²⁸ Ibid, 111.

References

- The Christian Solider's Penny Bible*. London: R. Smith for Sam. Wade, 1693. In The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648. Tempe: Arizona Center for Medieval and Renaissance Studies, 2003: 24-44.
- Clark, G.N. *The Seventeenth Century*. Oxford: Clarendon Press, 1931.
- Coate, Mary. *Social Life in Stuart England*. London: Methuen & Company, Ltd., 1924.
- Fallon, Robert Thomas. *The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars, 1642-1648*. Tempe: Arizona Center for Medieval and Renaissance Studies, 2003.
- Gouge, William. *Gods Three Arrowes: Plague, Famine, Sword, in Three Treatises*. London: G. Miller for E.
- Brewster, 1636. University Microfilm International. [Microfilmed, 1985] STC 1, Unit 57, Reel 1878, Early English Books, 1475-1640, 12116.5.
- Kishlanksy, Mark. "Ideology and Politics in the Parliamentary Armies, 1645-9." In *Reactions to the English Civil War*, edited by John Morrill, 163-185. New York: St. Martin's Press, 1982.
- Lindley, Keith. *Popular Politics and Religion in Civil War London*. Aldershot: Scolar Press, 1997.
- Manning, Roger B. "Styles of Command in Seventeenth-Century English Armies." *The Journal of Military History* 71.3 (2007): 671-699.
- Ram, Robert. *The Souldiers Catechisme: Composed for The Parliaments Army: Consisting of Two Parts: Wherin are Chiefly Taught, 1 – The Justification, 2- the Qualification of our Souldiers*. J.A. Cranford for J. Wright, 1645. In The Christian Soldier: Religious Tracts Published for Soldiers

- on Both Sides During and After the English Civil Wars 1642-1648. Tempe: Arizona Center for Medieval and Renaissance Studies, 2003: 56-136.
- Smith, Hannah. "Politics, Patriotism, and Gender: The Standing Army Debate on the English Stage, Circa 1689-1720." *Journal of British Studies* Vol. 50, No. 1, (Jan. 2011): Accessed November 19, 2012. doi: 10.1086/656674.
- The Souldiers Pocket Bible*, London: G.B. and R.W. for G.C., 1643. In The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648. Tempe: Arizona Center for Medieval and Renaissance Studies, 2003: 7-20.
- Wadlin, T.S. *The Soldiers Catechisme, Composed for the KING'S Armie; Wherin, His: 1 – Cause is justified and his enemies condemned, 2 – Soldier is instructed, and the Rebell reclaime*. Oxford: Henry Hall, 1645. In The Christian Soldier: Religious Tracts Published for Soldiers on Both Sides During and After the English Civil Wars 1642-1648. Tempe: Arizona Center for Medieval and Renaissance Studies, 2003: 141-153.
- Wells, Donald. "How Much Can "The Just War" Justify?." *The Journal of Philosophy* Vol.66, No. 23 (Dec, 4 1969): 819-829.

Quantitative Analysis of Bisphenol A and Bisphenol F Leaching Out of Baby Feeding Bottles Using Capillary Electrophoresis

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Abstract

Bisphenol A (BPA) and Bisphenol F (BPF) are endocrine disrupters that can easily leach out of plastic materials, including baby feeding bottles. Endocrine disrupters have harmful health effects due to their ability to mimic body hormones. These detrimental compounds are of great interest to the plastic industry, especially with respect to the safety of infants. This research uses a capillary electrophoresis method to analyze and quantify the amount of BPA and BPF in samples of baby feeding bottles. The experimental conditions permitted successful separation and quantification of BPA and BPF with good resolution and timely elution. The amount of BPA in baby feeding bottle samples from both China and Indonesia was quantified. The Indonesian 150-mL baby bottle contained 9.62 ± 0.97 ppb BPA. The Chinese 250-mL baby bottle was determined to contain 3.37 ± 0.61 ppb BPA. Although there has been some research on BPA and BPF in baby bottles, to the best of our knowledge, this is the first analysis done using capillary electrophoresis.

Introduction

Bisphenol A (BPA) and Bisphenol F (BPF) are dangerous endocrine disruptors that have been shown to leach out of many different forms of plastic used by consumers.³

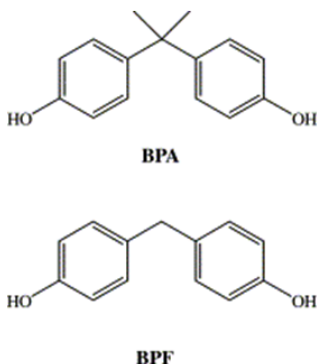


Figure 1: Structures of Bisphenol A (BPA) and Bisphenol F (BPF)

In addition to baby bottles, soft drink cans, the lining of cans containing tomato paste, and water bottles have been said to leach BPA. These are commonly used products.. Depending on the consumer, some of these products are used several times each day. All of this potential BPA exposure may have dangerous effects on the endocrine system. BPA and BPF can easily enter the body and begin to mimic the action of various hormones, interfering with the normal action of endocrine hormones in maintenance of homeostasis.¹ BPA has been the subject of many news reports over the past decade, and the public is becoming increasingly familiar with the issues associated with BPA. Avoiding heating of plastic food or drink containers in microwaves or in the sun for extended periods has been recommended in order to limit

leaching.¹ Because infants are considered to be at a higher risk from harmful contaminants in the milk and other foods that they consume daily, this research on baby bottles is of high priority.

The dangers of BPA, as well as the derivative compound, BPF¹, thus provided motivation for this research. Capillary electrophoresis (CE) is widely used method of analysis, because of its low detection limits and high precision. As BPA and BPF appear in only very small concentrations (in the 1-10 ppb range)¹, CE is an ideal separation technique for the detection of these harmful analytes. CE has been used to detect BPA and BPF in various circumstances, including in the leachate g from soft drinks cans¹. The same methods have been used and modified in this project, to detect BPA in baby bottles. Other methods used to detect BPA in baby bottles have included High Performance Liquid Chromatography (HPLC).⁴ In general, HPLC is less sensitive than CE. Another using CE and HPLC involved the quantitative analysis of BPA in human semen after the digestion of Proteinase K.³ The purpose of this study was to determine whether exposure to BPA has an any effect on human semen.³ Solid phase extraction, coupled with CE was used in another study that on quantified the amount of BPA in various substances, including tap water, wastewater, soil from the Yangtze River, shrimp, and human urine.⁵ Solid phase microextraction, paired with gas chromatography-mass spectrometry (SPME-GC-MS,) was used to determine the amount of BPA leaching from various household plastics.² Although CE has been used for the analysis of BPA in many substances to date, to the best of our knowledge, this is the first time it has been used to quantify the amount of this

chemical in baby bottles. Since the study of BPA is reasonably novel, this research is both exciting and necessary.

Experimental

Apparatus

A Beckman P/ACE MDQ system (Beckman Coulter, Fullerton, CA) equipped with an ultraviolet (UV) detector was used for all CE experiments conducted in this study. A fused-silica capillary (Polymicro Technologies, AZ, USA) was used, with an inner diameter of 50 μm and a total length of 50 cm (effective length of 40 cm). A 1mm polyimide coating on the outer surface of the capillary was burnt off to expose the transparent inner coating, forming the detection window. All experiments were performed at 25 °C and detected at 214 nm, which is the optimum absorbance for BPA and BPF. A Symphony SB90M5 pH meter with a standard deviation of ± 0.1 unit was used to determine the pH of all buffers prepared during the study.

Capillary Electrophoresis Conditions

The capillary was first conditioned by flushing 0.1 M NaOH for 30 min, 18 M Ω water for 30 min at high pressure (20 psi). At the start of each batch, the capillary was conditioned by flushing 0.1 M NaOH for 30 min, 18 M Ω water for 30 min and SDS/phosphate rinse buffer for 60 min at high pressure (20 psi). Before each trial, the capillary was rinsed with 0.1 NaOH for 35 min and 18 M Ω water for 2 min, and the SDS/phosphate rinse buffer for 5 min. Samples were injected at 0.5 psi over 15 s. The separation of the analytes occurred at 25 kV over 10 min with 0.17 ramp time using reverse polarity. All data analysis was completed using 32 Karat Software.

TABLE 1

Instrument Name	Beckman P/ACE MDQ Capillary Electrophoresis System
Capillary	Fused silica, 50 μm O.D. x 50 cm total length (40 cm to detector)
Operating Temperature	25°C
Detection	UV, 214 nm (indirect)
Rinse pressure	20 psi: 3.0 min (0.1 M NaOH), 2.0 min (Water), 5.0 min (Buffer)
Injection of Sample	Pressure, 0.5 psi for 15.0 s
Separation voltage	-25 kV
Separation time	10 min, 0.17 min ramp time

Table 1: Instrument Parameters

Materials and Reagents

BPA and BPF F standard compounds were purchased from Sigma-Aldrich Canada, Ltd., Ontario, Canada. Sodium Dodecyl Sulphate (SDS) and Sodium phosphate dibasic (Na_2HPO_4) was also obtained from Sigma-Aldrich. The phosphate buffer was prepared by first making two separate stock solutions of 500 mM SDS and 500 mM phosphate. The SDS stock was made by dissolving SDS solid in 18 M Ω water. The phosphate stock was made by dissolving sodium phosphate dibasic solid in 18 M Ω water. The pH of the phosphate stock was then adjusted to 2.5 by adding phosphoric acid. All reagents used were of analytical-grade, and all solutions were filtered using a 0.45- μm nylon filter before being used in the instrument in order to prevent clogging of the capillary.

Preparation of Standards and Samples

Standard 1000ppm BPA stock solution was prepared by dissolving corresponding masses of BPA powder first in ethanol, then in 18 M Ω water. All stock and standards were stored in glass vials at room temperature for one month. The standards for the neat calibration were made from a 1000-ppb stock solution, ranging from 200-900 ppb BPA. All standards were diluted using 18 M Ω water and each standard contained 50 μL of the dilution buffer (see 3.5)

The BPA was leached out of the sample baby bottles. Leachate samples were prepared according to the process shown in the flow chart (Figure 2).

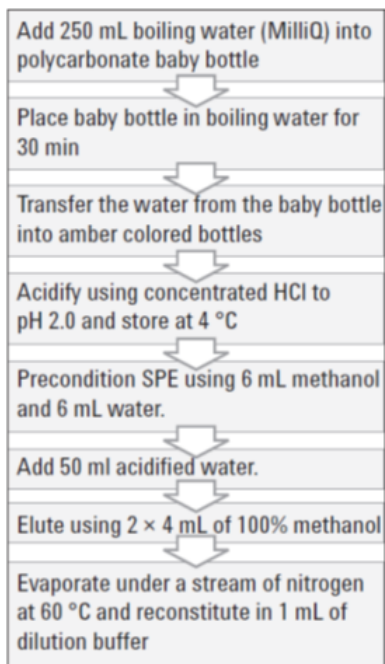


Figure 2: Baby bottle leaching and extraction method flow chart³

Depending on the volume of the bottles, 150-250 mL of water was brought to a boil. This water was then quickly transferred into the baby bottle, and capped. The bottles were then transferred into a shaker at 95 °C and shaken for 30 min to ensure full exposure of the bottles to the water. Still within the baby bottles, the water samples were cooled to room temperature, then tested for pH and adjusted to pH 2 for stability and extraction purposes. A solid phase extraction

apparatus was set up using C18 nonpolar columns. These columns were preconditioned with 6 mL of methanol followed by 6 mL of water. The columns were not allowed to run dry. From each bottle, a 50 mL sample was added to the column. After the 50 mL had finished passing through the column, 2 x 4 mL of methanol was used to elute the BPA from the column and into 10-mL labeled glass vials. These vials were capped and taken to a lab that had access to nitrogen gas. The vials were lowered into a 60°C hot water bath under nitrogen gas until the solvent was completely evaporated. The leached BPA was then reconstituted using 1 mL of the prepared dilution buffer. The total leaching and extraction procedure took approximately 6 h. The duplicate samples of bottles from the same geographical region were combined together for analysis. These samples were analyzed using standard addition. A 100- μ L aliquot of sample was added to each standard addition vial.

A total of 36 standard addition standards were prepared (3 real replicates for both China and Indonesia bottles). The known BPA concentration ranged from 0-500 ppb. Each standard also contained 50 μ L of dilution buffer, 100 μ L sample, and the remaining diluted with 18 M Ω H₂O.

Preparation of Buffers

All buffers were prepared from the aforementioned 500 mM stock solutions, and diluted using 18 M Ω water. The dilution and rinse/separation buffer concentrations are tabulated below (Table 2). The pH of the phosphate was consistently tested to ensure stability at 2.5. All solutions were filtered using 0.45- μ m nylon filters.

Buffer Component	Optimum Concentration (mM)	
	<i>mM, diluted with 18 MΩ H₂O</i>	
	<i>Separation/Rinse Buffer</i>	<i>Sample Dilution Buffer</i>
SDS	75	150
Phosphate Buffer (pH 2.5)	25	25

Table 2: Finalized buffer optimization conditions

Results and Discussion

Buffer Optimization

Development of the method for separating of BPA and BPF involved a process of buffer optimization. This optimization includes determining the optimum concentrations of SDS and phosphate within the buffer complex. To start, the initial parameters were from Gallart-Ayala et al: 1 25 mM phosphate and 200 mM SDS. This concentration mix was attempted first due to its successful use in previous studies. However, since separation did not occur, an optimization process was initiated, focusing on the SDS concentration.. The first round of optimization involved the range of 150 – 250 mM SDS, keeping phosphate constant at 25 mM. This optimization showed that although the lowest concentration, 150 mM SDS, was the most separated, it was still poorly resolved. Further optimization focused on working at a lower range of SDS concentrations. The next batch of buffers ranged from 25-125 mM SDS, again with phosphate constant at 25 mM. In the third buffer, with SDS at 75 mM, the two analyte peaks were clearly resolved, with even, sharp peaks (shown in Figure 3).

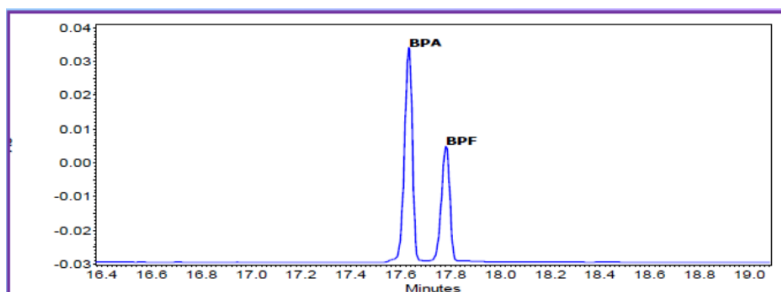


Figure 3: Electropherogram of 100 ppm BPA and 50 ppm BPF standard, 150 mM SDS and 25 mM phosphate dilution buffer run at 214 nm, -25 kV for 60 min, 0.17 min ramp

The dilution buffer within the standards run during this optimization was at an SDS concentration of 150 mM and a phosphate concentration of 25 mM. Optimization of the buffer was completed.

BPA BPF Separation – BPA Focus

Separation of BPA and BPF was completed, but as the research continued, and different CE instrumentation was used due to availability, the separation began to become inconsistent. As time was a constraint, and as BPF had not been detected in any other baby bottle research, BPF was then removed from the sample analysis. BPA calibration was continued, and BPF will perhaps be considered in future work.

Neat Calibration Results

The neat calibration of BPA was completed successfully. The optimized buffer conditions were employed. The calibration curve shown in Figure 4 was obtained.

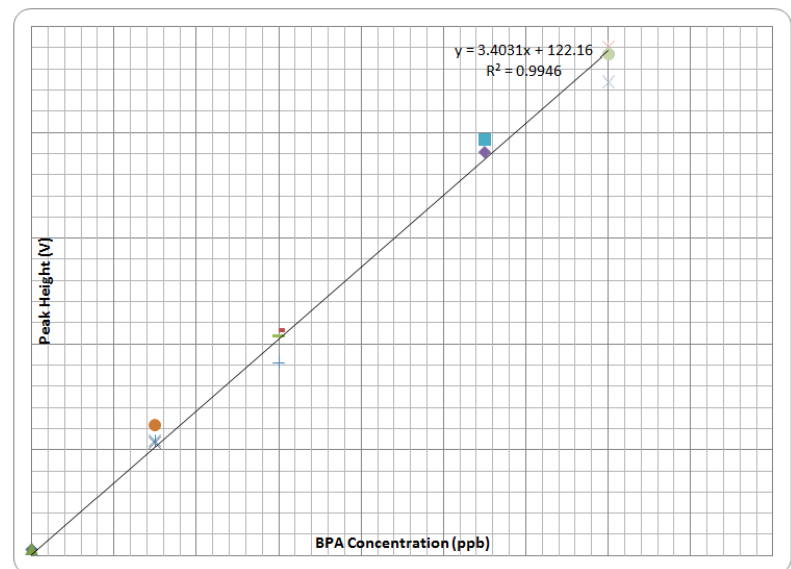


Figure 4: BPA Standard Calibration Curve: Peak Area Versus Concentration

The R^2 value for this calibration curve was 0.9948. This confirmed that calibration and detection of BPA accurately and precisely was possible. Originally, the approach was to use an external calibration curve to determine the amount of BPA in the samples. Due to the low levels of BPA in the samples, the LOD of the CE conditions would not allow for proper peak resolution within the sample complex. This led to the decision to move forward with a standard addition technique, allowing for a higher ppb range of calibration.

Standard Addition Results

Standard addition was the most advantageous form of analysis for BPA in baby bottles when looking for trace amounts at the low ppb range of 1-10 ppb. The range was followed as listed within the experimental section. The

standard addition was successful for detection of BPA within the samples. An electropherogram from the standard addition batch can be seen in Figure 5.

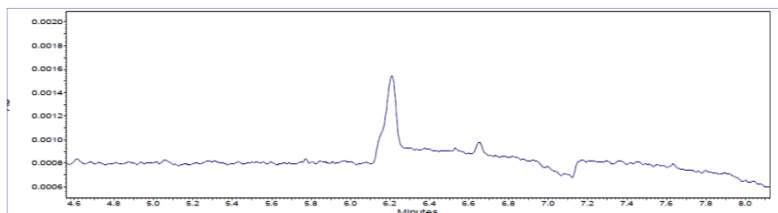


Figure 5: Electropherogram of 100 ppb BPA standard addition, 150 mM SDS and 25 mM phosphate dilution buffer run at 214 nm, -25 kV for 10 min, 0.17 min ramp

The data from the standard addition was analyzed and used to form the following standard addition curves (Figures 6 and 7).

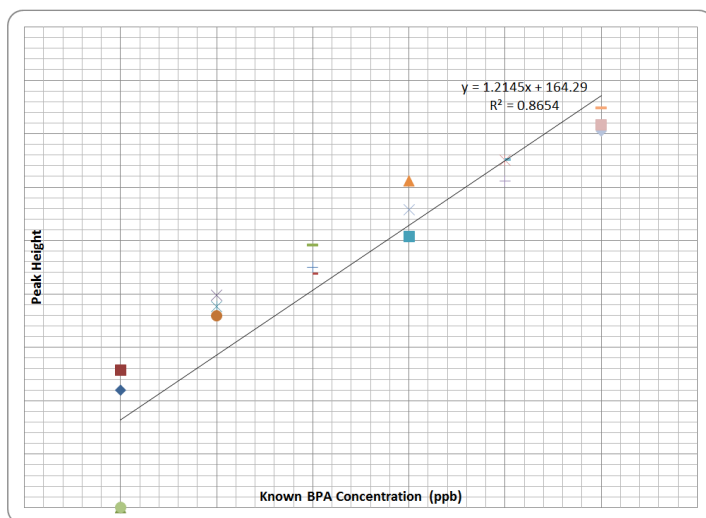


Figure 6: Standard Addition Curve for Indonesian Baby Bottle Samples Using Peak Height versus Known BPA Concentration

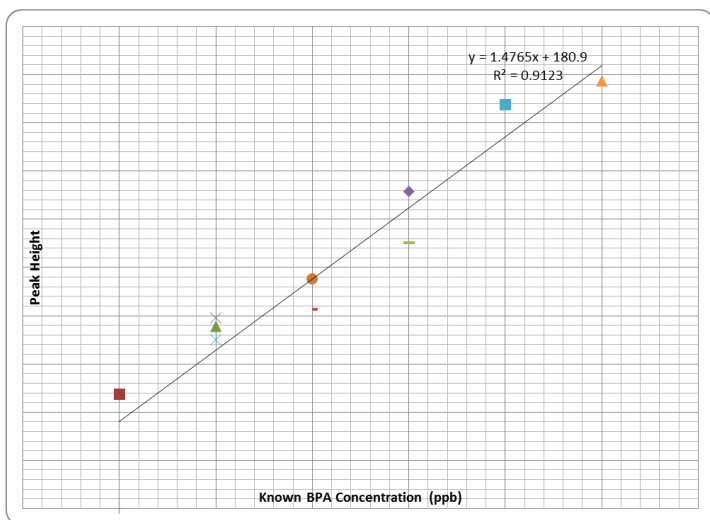


Figure 7: Standard Addition Curve for Chinese Baby Bottle Samples Using Peak Height versus Known BPA Concentration

For both samples, the R^2 values were 0.9, confirming the validity and precision of the method. The data from these standard addition curves was analyzed and the amounts of BPA leached from each type of baby bottle were determined as well as the uncertainty of each value. The uncertainties were calculated using the least squares method. The Indonesian 150- mL baby bottle was determined to contain 9.62 ± 0.97 ppb BPA. The Chinese 250-mL baby bottle was determined to contain 3.37 ± 0.61 ppb BPA. Although obviously different, the results are not completely comparable due to the difference in the sizes bottles examined. Although the Indonesian sample had a smaller volume capacity, and a smaller water sample was used, it was found to have almost three times the amount of BPA than the larger Chinese baby bottle sample. This suggests that Indonesian plastic has a higher BPA concentration. Continued work on this would be beneficial.

Results with Respect to Infant Safety and Health Canada

The main focus of this research is the safety of infants and the bottles they are using to drink from. Infants drink from a bottle 5-10 times a day; and the bottle is re-heated each time it is used, either in warm water or in a microwave. This gives more and more chance for the BPA to leach from the plastic into the infant's milk. According to Health Canada, the average human can consume up to 50 ppb BPA per day, but this is not specific to infants. There is much controversy regarding the amount of BPA an infant can handle. Considering the average body weight of a 1 year old infant, each time a child this age drank milk from an Indonesian bottle he or she would be consuming 0.145 ppb BPA.² Over a day, this amount would continue to increase. From the Chinese bottle, an infant would be consuming 0.084 ppb BPA. Although Health Canada researchers suggest that BPA could pose a risk for infants, safe limits have not been established and are still being debated.² According to these results, it is safe to assume that at the very least, the Indonesian baby bottles may be posing a high risk to these infants depending on the number of times the bottle is being reheated and at what temperature. It should be an extremely high priority to have continued research on the possibility of BPA leaching from these bottles and the harm it can cause to infants. Especially in countries other than Canada, such research could inform regulatory decisions on the use of potentially harmful bottles.

Future Work

This project has great potential for continued study. Future work could range from an exploration of sample variation to confirmation of previous results. Replication of this method would be a good idea, order to confirm the

validity of the results obtained found from this first attempt. There was not enough time in this study to retrieve multiple consistent batches, but doing so would be both ideal and very feasible.

Although BPA and BPF were separated with this method, the method was inconsistent with respect to finding a separate BPF peak. Thus, continued work on optimizing this method and possibly finding samples that contain amounts of both BPA and BPF would be a good idea.

Sample variation provides a fascinating opportunity for future work. BPA is found in many consumer products, such as the white lining of tomato soup cans and water bottles there is also a concern with plastic food packaging. Studying any of these types of real world samples would be of great interest and research on them would be beneficial to the public.

It is interesting to note that that only “BPA-free” baby bottles are being marketed in Canada. Are these “BPA Free” bottles truly as advertised? It would be interesting to add some Canadian products to a future study in order to answer this question. Can Canadians trust domestic producers of baby bottles with their babies’ lives?

Conclusion

A method for the separation, detection and quantification of BPA and BPF using capillary electrophoresis was successfully established, with good resolution and timely elution. The separation buffer was optimized. The amount of BPA in baby bottle samples from China and Indonesia was quantified using capillary electrophoresis and a standard addition process. BPA was found in leachate from both

bottles.. The Indonesian 150-mL baby bottle was found to contain 9.62 ± 0.97 ppb BPA. The Chinese 250-mL baby bottle was determined to contain 3.37 ± 0.61 ppb BPA. Although there has been some research on Bisphenol A and F in baby bottles, to the best of our knowledge, this is the first analysis done using capillary electrophoresis. Continued research to confirm the results obtained by using this method is needed.

Acknowledgements

I would like to thank my supervisor, Dr. Kingsley Donkor, for making this research possible and for his guidance and support throughout this challenging process. I would also like to thank Laiel Soliman for her encouragement and for sharing her capillary electrophoresis wisdom with me constantly throughout my research method development. We also thank Zhi Chao Guo for providing the Chinese bottles and Bob Stanley for providing the Indonesian bottles. This research is supported by the Thompson Rivers University Department of Chemistry, Science Faculty.

References

- Gallart-Ayala, H.; Nunez, O.; Moyano, E.; Galceran, M.T.; *Electrophoresis* **2010**, 31, 1550-1559
- Health Canada; *Food and Nutrition*, **2012**, http://www.hc-sc.gc.ca/fn-an/securit/packag-emball/bpa/bpa_hra-ers-2012-09-eng.php
- Johnson, B.O.; Burke, F. M.; Harrison, R.; and Burdette, S.; *J. Chem. Educ.* **2012**, 89, 1555-1560
- Katayama, M.; Matsuda, Y.; Shimokawa K.; Ishikawa, H.; and Satoru Kaneko, S.; *Analytical Letters* **2011**, 36 (12), 2659-2667
- Lateef, S.S.; *Agilent Application Solutions* **2011**, 1-11

Mei, S.; Wu, D.; Jiang, M.; Lu, B.; Lim, J.M.; Zhou, Y.K.;
Lee, Y.I.; *Microchemical Journal* **2011**, 98, 150-155M

Beauty in the Eye of the Beholder

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English

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Abstract

*This article justifies the DTES as a dichotomy of two worlds; bringing to readers' attention the opportunity, liberation, and helpful, active, individuals that exist in this area rather than the adversity, suffering and downtrodden, destitute, individuals that it's more commonly known for. By utilizing a reader-response approach to George Ryga's *The Ecstasy of Rita Joe*, Marie Clements' *The Unnatural and Accidental Women*, and Evelyn Lau's *Runaway*, this paper delivers a more "holistic" account of Vancouver's DTES (as the author describes it), to others in an attempt to stand up for home town and allow others to identify with who she is through her perspective of the DTES.*

When I bring Vancouver's Downtown Eastside (DTES) up on GOOGLE, possibly the world's most popular search engine in the 21st century, I am hit with photographs of bodies strewn awkwardly in graffiti-littered alleys, drug-fiends lackadaisically feeding poison into their veins and distraught women with strained facial expression and forced smiles, attempting to feel 'clothed' in skimpy tatters. This negative imagery publicly connotes the idea that Vancouver's DTES is derelict, dangerous and hopeless and, thus, should be avoided. And not only is this negative imagery promoted

on the internet but in literary works as well, which tend to portray this particular area poor—or rather, incompletely. For instance, George Ryga’s play “The Ecstasy of Rita Joe”, initially premiered in 1967 then published in 1970, and Marie Clements’ “The Unnatural and Accidental Women”, published in 2001, draw focus to what many consider the “run-down” aspect of Vancouver’s DTES while failing to acknowledge the other, more uplifting side—beautiful, full of hope, selflessness and compassion. Having applied the reader-response theory by James Cahalan, an English professor at the Indiana University of Pennsylvania and author of “Teaching Hometown Literature: A Pedagogy of Place”, to Ryga and Clements works as well as Evelyn Lau’s *Runaway* memoir, I have “created a link between my own life experiences and the work, helping me to connect and continue to build upon that connection [through sharing with others]” (Cahalan) my disposition on why my home town deserves more than the run-down image it is frequently made out to be. I hope to “extend my strong sense [of Vancouver’s Downtown Eastside] outward to others” (Cahalan), painting it fairly and completely, as Lau has done in *Runaway*. And although we must take into account that Ryga’s work reflects a case in the 1960s, Lau’s ability to depict the DTES well-harmonized with both good and bad as a vulnerable, fourteen year-old child in 1985, indicates that even before her time on the street, social nets in the DTES were already in place. The DTES is multi-dimensional and complex—full of sorrow and emotional, social, and physical displacement—yet it is given life by people with big hearts and drive—and it is this latter component that I want to acknowledge to help readers gain a more holistic account of what the Vancouver DTES is.

I’ve chosen the DTES as a place worthy of exploration, obviously, due to my strong attachment to and

keen interest in the area. Having grown up in the DTES, I've experienced much of what this particular locale has to offer, both positively and negatively. Another reason why I chose the DTES is because I feel that it is an area heavily stigmatized by negativities, so much so that its inhabitants are suffering. I find myself constantly frustrated when coming across instances (even in literary works) where the DTES is depicted as solely undesirable and feel the need to stand up for it. And perhaps my frustrations are because of the social makeup of my person; as someone who has been nurtured by the DTES, I may have a very different and biased understanding of it.

By studying works such as Lau's *Runaway*, a memoir written by a person who has had much experience on the streets of the DTES, I can, as Cahalan encourages, "understand that social contexts naturally affect the production of literature"(Cahalan), giving authors reason to portray the DTES however they see fit to the moulding of their own social make-up. In addition, by using the reader-response theory to investigate literature about my home town, I "am able to better understand my own identity; [my perspectives, morals and values] because part of who [I am] is determined by where [I've come] from and where [I am] now" (Cahalan), as Cahalan states. By employing a reader-response approach to Ryga, Clements and Lau's works, like Richard Beach, author of *A Teacher's Introduction to Reader-Response Theories*, I can "engage, conceive, connect, explain, interpret, judge" and share with others my perspectives. "As I read Ryga, Clements and Lau, I "symbolize and replicate myself" (Tucker).

Ryga's "The Ecstasy of Rita Joe" depicts the DTES as an area that neglects and fails to protect the vulnerable. The

play seems to suggest that the DTES is a cesspool for rapists to victimize vulnerable aboriginal women. Taking place in Vancouver, the plot addresses the aboriginal population that does in fact exist predominantly in the DTES, and their struggles to seek justice or sympathy from authoritative institutions. Ryga's storyline is of protagonist Rita Joe, a young Shuswap woman, leaving her reserve in search for work in the city, who finds herself embarking on an odyssey through hell. She is raped countless times and attempts to regain her human dignity by going to court. However, because of the prejudiced mentality of the 1960s, her race, gender and social status factor into her verdict. Instead of being supported, Joe is ostracized; she is accused of prostitution and having a seductive, tempting nature by an unsympathetic magistrate. Eventually, due to a lack of compassion and security from authoritative institutions, Joe is murdered on skid row, an act that demonstrates the mistreatment of Indigenous people across Canada at this time.

Similarly, Clements' play also addresses the very issue of justice for aboriginal women who are raped, go missing or murdered. She specifically discusses real life women from 1968 – 1987 “seen in the company of Gilbert Paul Jordan, a local barber” in the DTES (Ratsoy, Hoffman). Jordan essentially paid these at-risk aboriginal women to have sexual intercourse with him (often raping and assaulting them) and then convinced them to drink heavily with him. When they “passed out”, Jordan would continue to pour alcohol down their throats, which would eventually kill them. These cases, although sharing similar high alcohol readings, were again dismissed by authorities due to social and racial stereotyping.

It is certainly admirable for Ryga and Clements to address aboriginal issues that from what I've observed do

exist in Vancouver's DTES today. However, by solely discussing the desolate event of murdered women that did not seek justice, Ryga and Clements succeed in painting a monochromatic picture of this area. Yes, there are certainly cases of rape, kidnapping and murders here as there are in any vulnerable or even non-vulnerable postal codes—but the DTES is certainly not limited to an ongoing victimizing of vulnerable aboriginal women. There is also a thriving (albeit frugal) community that exists there: DTES residents also wake up and see the same sky as every other Vancouverite. They go to work, bring their children to school, make trips to the supermarket or visit their friends. On top of this, (and I may be biased here, being from this area) there seems to be a greater sense of compassion and sensitivity in people from this area. Because this area is so heavily stigmatized, it's as if the community is forced to become more tightly-knit to have "each other's back" and stand up collectively for themselves and the "poor postal code" they've been dealt. More affluent middle class members of this area are often seen working tirelessly to help prevent cases like the Robert Pickton Trial from recurring. People are also often seen providing clothing, food and comfort to the homeless and needy. And although some unfortunate events have occurred in the DTES, failing to include the feeling of community, failing to acknowledge the efforts to better this locale, ignoring the fact that there is a "normal" population that exists here, is denying the fact that there is life in this area. Because Ryga and Clements illustrate the DTES as a one-dimensional area of drugs, poverty and danger, readers begin to see it as just that, an area not worthy of attention or an area that needs to be avoided. And it is these ignorant mentalities that force local Vancouverites like me to feel angered by the unjustified misrepresentation of the place I call home.

Again, the DTES is much more than that. The Carnegie Centre, for instance, located in the midst of the city's most infamously plagued streets, Hastings and Main, actively helps to reduce individuals' vulnerability by offering free food, low-cost goods, employment opportunities and exercise for the low or no-income population. Their goal is to help individuals "nurture their body, mind and spirit in a safe and welcoming environment" (Carnegie Community Centre). Carnegie Hall is a historical monument with high ceilings and an intricate design, like the inside of a Roman cathedral. Also in the parameters of the DTES are countless women's shelters, children's shelters, emergency shelters, centres for rape and abuse and psychiatric services, many of which were implemented in 2007 after "the declaration of a public health emergency" (Vancouver Coastal Health). Before then, in 2003, a supervised injection site (In Site) was erected and funded by Vancouver Coastal Health. In Site operates on a harm-reduction model, looking to prevent infection and disease in drug-users by offering sanitary injection equipment and supervision from a team of nurses and supporting staff in case of overdose. By implementing so many different forms of help, In Site has reduced HIV rates in the DTES from "8.1 per 100 people to .37 per 100 [and] DTES residents are living longer than before—from 71.4 years in 1997-2001 to 79.5 years in 2007-2011" (VCH), a total increase of 8.1 years to date. Since the opening of In Site in 2003, there have been no fatalities within the premise. And so, it is evident that the DTES is attentive and protective of their vulnerable population despite what Ryga and Clement's plays suggesting otherwise. The DTES also consists of many well-run businesses, quality schools and a history worth looking at. It is an area full of life, brimming with hopeful, compassionate people that care enough to fight for the homeless, drug users, mentally ill, prostitutes and even rapists, helping them to get

back on their feet as part of the beauty of the DTES is of giving everyone an equal chance despite their situations.

Many people want to help these destitute individuals not because they want to “clean up” Vancouver DTES’ filthy image, but rather because they are aware that most of the time becoming homeless, a drug user or prostitute is much more complicated than a choice. Before speaking with A, a DTES social worker (who wishes herself and the subjects we’ve discussed to remain anonymous), I myself, a Vancouverite for 23 years now, was amongst the dominant population in believing all homeless, drug users and prostitutes in the DTES to *want* help and a better life. I’d believed that with enough people to raise awareness, funds and support, residents of the DTES as a result can go through a Hollywood method of being put into rehab, treated, and then integrated back into society. After speaking with “A”, I’ve discovered that not everybody that “needs help” according to society’s standard, is willing to accept it. Put simply, they do not want help. A stated approximately 90% of the homeless people that walk into her institution have suffered tragic or traumatic events in their lives, costing them their homes, families and support. “It is a process.” she says, “Often [their demise] starts off with [their] being too proud or ashamed to get help. Our society is so quick to criticize others—so much so that people suffering from trauma or misfortune tend to avoid this criticism and instead, push others away. Others simply do not have anybody to turn to”.

A believes that, most of the time, newly vulnerable individuals go to the DTES because it is an area well-known for helping those that are in need. However, some do choose to go to the DTES in order to blend in with others of the same social status and some go to feed their drug addictions. Some

merely go there to die. It is a constant struggle for workers like A because, as she further explains, “when people finally go to seek help, their addictions may have taken over them, their trauma severely affected them or their minds are so set on ending their lives that they have to go through numerous psychological tests and assessments before we can begin to help them. We need to break down some barriers before we begin to rebuild the person’s life”. Even more shockingly, A talks about how difficult it is to undo the damage that has been done to an individual because of the “ongoing preying” that goes on in the DTES. She is referring to a manipulative course of action that homeless veterans implement to addict the newly homeless to drugs—new addictions would then supply the homeless veterans with income for their own needs.

All of these underlying issues in the DTES A mentions in our discussion—the psychological issues, homeless preying, damaged pride and desire for death—stem from a radical loss of support, and, they are all what makes the DTES and its residents so complex. Lau confirms that these issues were very real in her memoir *Runaway*, revealing the DTES to be much more than meets the eye.

At 14, Lau decidedly runs away from home onto the streets due to her parents’ extremely conservative and forceful ways: constantly forcing her to study, verbally and emotionally abusing her, and failing to acknowledge her dream to be a writer due to their own selfish desires for Lau to become a doctor. This chokehold treatment and lack of support caused Lau to have psychological issues like much of the destitute population in the DTES today. Desperately unhappy, she sees the streets as liberation from her parents and the DTES as more desirable than her own home. Lau

psychologically replaces the members of her family with drug users, fellow homeless and various men. Part of Lau's psychological issues stem from her parents' unconventional way of showing their love for her. Lau is unable to differentiate between someone who loves her and someone who simply wants to have sexual relations with her. This is particularly evident when Lau eventually falls prey to a man old enough to be her father, deeming him to be her lover while in reality he is her pimp, using her for sex and addicting her to crack.

Lau's addiction to crack forces her to prostitute herself regularly, damaging her pride. She often experiences moments where she feels shame in selling her body and attempts to become sober. However, she constantly relapses into drug use because of her overwhelming dependency on drugs to get through reality and the mentality of prostitution being inevitable: She feels she must sell herself to survive. Lau also finds performing sexual acts is more manageable when she is high. Therefore, Lau believes in order to gain a chance at life, she must let go of her pride.

Sometimes Lau feels this trade is a regrettable one. During her flashes of clarity and sobriety, she yearns for her dignity and to be seen as the highly intelligent, pretty and respectable young girl that she is, rather than the illogical, promiscuous and drugged, objectified being that she presents herself to be. However, due to suffering from the tireless haunt of her tyrannical parents, constant manipulation and sexual abuse from men and feeling like the only way to survive is by giving up her pride, Lau on numerous occasions tries to take her own life.

It is evident that these issues that Lau endured in 1985-1989 are still prevalent in the DTES today, as A mentioned. They are not generally visible issues and not something that many think about often, as people tend to see what is blatantly obvious or put in front of them. The DTES is proclaimed to be filled with drugs, prostitution, crime and threatening, but, according to The Vancouver Police Department in their January 2013 “Statistical Report By Neighbourhood”, the area most prevalent in crimes such as Assaults, Robbery, Theft of valuable goods over \$5000.00, Mischief, Prostitution and the use of offensive weaponry is the Central Business District, which is the combined Downtown Vancouver along with Chinatown and Gastown, not any of the seven DTES neighbourhoods. Out of the total 334 cases of assaults, the CBD had 135 cases with the next closest being 38 in the Strathcona neighbourhood. Out of 73 robberies, the CBD had 26 and Strathcona followed with 10. In the category of Breaking and Entering including both business and residential areas, then CBD had 68 cases with Fairview neighbourhood coming in at second with 49. These statistics reveal the Central Business District, one of Vancouver’s wealthiest neighbourhoods, comprised of many small businesses, franchises, employment opportunities and skyscrapers with panoramic views of the entire city, as what I would deem a more ‘dangerous’ area. However, the CBD is considered by modern Vancouverites as the most desirable place to live—speaking volumes as Vancouver contends with other places like Melbourne, Australia and Vienna, Austria as one of the world’s most livable cities (Johanson, IB Times). And so, we can see that the public has bought into the stigma that people have created for the DTES that causes it to be undesirable, feared and neglected, because in fact, it should be Vancouver’s Holy Grail: the CBD, that is avoided.

In truth, many are judging the DTES by what appears to be on its surface, labelling it undesirable by definitions of the conventional criterion of their social make-up. I feel it is my duty to help explain the DTES in the eyes of others because, as Cahalan mentions, “students [exploring hometown literature] are better prepared to extend their strong sense of [their home] outward to others”. Like me, Lau has attempted to do the same, with her memoir revealing our home place to be an amalgamation of ugliness, (through her continuous running away from home;) and beauty, having people care for her—providing shelter or social workers, psychiatrists or child services to cater to her needs. She captures another dimension of the DTES (along with its common run-down image) in *Runaway*, making it what I believe to be a more holistic depiction of the DTES than “The Ecstasy of Rita Joe” and “The Unnatural and Accidental Women”. By looking closely at Lau’s response and emotional reactions to the DTES, I am able to verify my opinions [about the DTES with her] and build a relationship [to connect] and clarify our similar attitudes.

I anticipate that some people will continue to perceive the DTES simply as skid row due to the nurturing of their own environments but I also foresee others deciding to embrace the DTES as a complex, integrated dichotomy of both a derelict slum as well as a place beautified by people who are constantly trying to understand it and helping to better it. I will continue to teach others that the modern day Vancouver’s DTES deserves to have its beauty acknowledged because like Cahalan says “[I am] committed to know and care for the place I’ve come [from and the] landscapes that gave shape to my love of the earth, help [ing] me [to] understand people, their lives, concerns and formative home places” (Cahalan, Teaching). By accepting the DTES and seeing it for the place

that it truly is, one will also internalize the values, morals, perspectives and teachings this area has to offer. Rather than seeing the DTES as defined as somewhat hellish, Lau is able to see in it Eden's garden, using herself as living proof of its healing powers—having remained sober and recovered from her journey through “hell”. For Lau and me, our literary works depicting the DTES not only aim to unmask its splendor but also to show others through reader-response theory that the DTES is not merely a place or even a home, but that it is, as Cahalan articulates nicely “the very ground of our being” (Cahalan, Teaching).

References

- Cahalan, James M. “Teaching Hometown Literature: A Pedagogy of Place.” *College English* 70.3 (2008): 249-73. Web.
- Clements, Marie. “Unnatural and Accidental Women.” *Playing the Pacific Province: An Anthology of British Columbia Plays, 1967 – 2000*. Ed. Ginny Ratsoy and James Hoffman. N.p.: n.p., n.d. N. pag. Print.
- Johanson, Mark. “World’s Most Livable Cities List in 2013 Dominated by Australia, Canada.” *International Business Times* 29 Aug. 2013: IBT Media Inc. Web. 6 January. 2014.
- Ryga, George. “Ecstasy of Rita Joe.” Ed. James Hoffman. *Playing the Pacific Province: An Anthology of British Columbia Plays, 1967 – 2000*. Ed. Ginny Ratsoy. N.p.: n.p., n.d. N. pag. Print.
- Tucker, L. P. 2000. *Liberating Students through Reader-Response Pedagogy in the Introductory Literature Course*. Urbana, Illinois: NCTE: TETYC vol.28, issue 2, 199-206.

Crime Data Visualization Using GIS and Augmented Reality

Khalid Alomar

Computing Science

Supervisor: Dr. Andrew Park

Abstract

Information visualization has been an important area since human visual perception can recognize patterns and flows of big datasets when they are properly visualized. Recent mobile device technologies have enabled users to access and visualize data on the go with many different sensor inputs, wireless Internet connection, and geographical positioning system (GPS) information. These technologies can help police and reinforcement agencies to quickly access and discover the appropriate crime data in the timely manner. In this research project, a smartphone application is developed to visualize crime data with geographical information system (GIS) and augmented reality. While police and reinforcement agencies are patrolling in a certain area, they can point the cameras of their smartphones (iPhones or Android phones) to nearby buildings. If those buildings are related to any past crimes, the crime data are superimposed on the buildings in the smartphone screen. This application is evaluated by criminologists and will be useful for police officers in their daily patrol and duty.

Introduction

Information visualization is a research area that uses visualization techniques to help people understand and analyze abstract data. When data are visualized in particular ways, unexpected emergent properties (trends and patterns) can be discovered. Visualization techniques have become more important because people carry their hand-held devices (smartphones and tablets) to access and view all kinds of information on the go including weather, stocks, maps, and calendar. Many of these devices have cameras, geographical positioning systems (GPS), wireless Internet access, and many different sensors such as an accelerometer and a proximity sensor. This paper describes a research project that developed a mobile application to visualize data from a camera, a GPS, and a database using the augmented reality technology. In particular, the application visualizes crime data on the camera view of the surrounding environment in real time. When the camera of an iPhone or an Android phone is pointed to a building that has a record of crime, the detailed crime information will be superimposed on the building in the camera view. The application has been reviewed by criminologists and researchers. This application will be particularly useful for police officers in their daily patrol and duty, focusing on vulnerable areas.

Augmented Reality

Augmented Reality (AR) is a live view of a physical, real-world environment enhanced and augmented by computer generated graphics, animation, video, GPS information, and/or text, Azuma (1997). Recently AR technology has received much attention since this technology can be naturally utilized in most smartphones that have cameras, GPS, and other sensors. Many researchers and

companies have developed applications using AR by combining the real-world camera view and meaningful content in our everyday life such as GPS information, traffic information, landmark/hotel/restaurant information, and navigational information. Google glass is a typical product that utilizes AR technology. The mobile application developed in this research project uses AR technology by incorporating crime information into the current camera view. In addition, GPS information is employed to display the information on the designated building.

Prototype Development

Using an iOS development environment, the prototype of the Crime Data Visualization application has been developed. Here are some of the tools and APIs/libraries used for the development of the prototype:

- Xcode 4.2 application by Apple, Apple (2003).
- Objective-C Language.
- Metaio SDK for the Augmented Reality, Metaio (2013).
- Google Maps SDK for iOS, Google (2013).



Figure 1: Structure of the AR application prototype.

Figure 1 shows the overview of the structure of the application prototype. The application gets crime record information and its location information from the database. This database was created with mock-up crime data and their GPS coordinates for the purpose of the project. However, the application can be easily connected to the real crime database (for example, the RCMP crime database) if police officers decide to use the application. When the application is open, it initializes a connection to the GPS and finds out the current latitude and longitude of the user. Then the application calculates the locations of past crimes and finds the crimes that are only within 5 kilometers from the current location of the user. Those crimes are displayed on the camera view with the correct direction. The development has been done

using the framework of Xcode which provides many helpful functions. The application also used the location-based AR feature of Metaio SDK

Main Features of the Application

First of all, the application has been developed specifically for mobile devices. The users of mobile devices are rapidly increasing, Golson (2013). And many AR applications are used outdoors and provide useful information about the surrounding environment. The presented application can be used on the go and provide crime information about the surrounding buildings within 5 kilometers. The application can be on either iOS or Android devices.

Another important aspect of the application was user experience (UX) and graphical user interface (GUI) design. When any product or service that requires user interaction, many factors need to be considered such as the graphical user interface, industrial design, interactions, and the manual. The development of the presented application followed the standard UX and GUI design guideline, so that users can use the application easily, efficiently, and enjoyably, Apple (2014).



Figure 2: Initial screen of the AR application prototype.

Figure 2 shows the initial screen of the application prototype. It displays the name of the application and two big buttons: one for starting to use the application and the other for learning how to use it (Figure 3).



Figure 3: Two buttons: one for opening the application and the other for how to use.

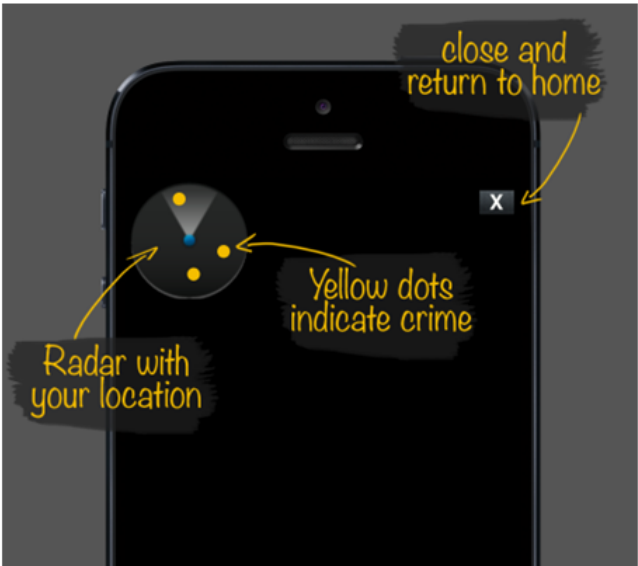


Figure 4: Radar view of crime locations.



Figure 5: Crime information superimposed on the buildings.

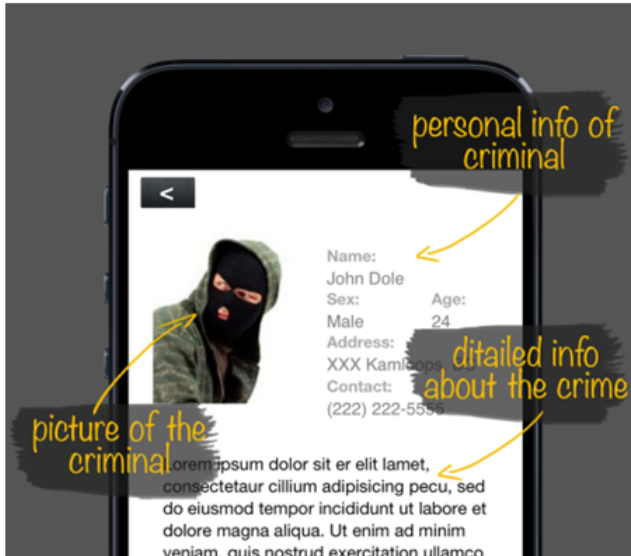


Figure 6: Details of crime information.

F displays a radar view of crime locations with yellow dots within 5 kilometers from the user's current location which is a blue dot at the centre (Figure 4). In the camera view, white dots are superimposed on some buildings if they have past crime records. If the user taps on one of the dots, it will show the brief crime information (Figure 5). When the user double-taps on the text bubble, it will display the details of the crime information (Figure 6).

Evaluation

It is important to conduct a usability test after developing any application or product. The presented application was reviewed and tested at the Institute for Canadian Urban Research Studies (ICURS) which is a well-

known crime study research institute. A few criminologists and researchers recognized the usefulness of the application for police and law enforcement agencies. Currently the prototype was tested with artificial crime data. Their suggestion was to test the prototype with real crime location data. General users that have had no experience about crime and AR applications tested the presented application. They said the application was useful and wanted to have it available for the public. However, they found that some functionalities were not clear. The “Learn More” button should provide a comprehensive explanation about all the functionalities of the application.

Conclusion and Future Plan

The proposed mobile application displays crime information about the surrounding buildings using AR technology and GPS information. The usability test shows the usefulness of the application with some future improvements. In particular, the application will be useful for police and law enforcement agencies in their daily patrol and duty. Currently, the application uses the Internet to fetch the updated database of crime data to show crime information on the map. But this may cause a delay depending on how fast the Internet/host servers are. There are several variables affecting the app such as high buildings affecting the accuracy of the GPS. The future research plan is improving the accurate display of crime location, testing the app with real crime data, and usability/UX test with police and law enforcement agencies.

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References

- Azuma, R. T. (1997). A survey of augmented reality. *Presence*, 6(4), 355-385.
- Apple (n.d.). *iOS Human Interface Guidelines*. Retrieved from <https://developer.apple.com/library/ios/documentation/userexperience/conceptual/mobilehig/MobileHIG.pdf>
- Apple (2013). Xcode (Version 4.2) [Software]. Available from <https://developer.apple.com/xcode/>
- Metaio (2013). The Metaio SDK (Version 5.0.2) [Software Development Kit]. Available from <http://www.metaio.com/SDK/>
- Google (2013). Google Maps SDK for iOS [Software Development Kit]. Available from <https://developers.google.com/maps/documentation/ios/>
- Golson, J. (2013, January 28). *Nearly 300 Million Devices Running IOS 6, 60% of All IOS Devices Ever.* - *Mac Rumors*. Retrieved from <http://www.macrumors.com/2013/01/28/nearly-300-million-devices-running-ios-6-60-of-all-ios-devices-ever/>