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University of Lethbridge April 2007

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PROCEEDINGS OF THE MULTIDISCIPLINARY GRADUATE STUDENT RESEARCH CONFERENCE

(PROCEEDINGS OF THE FIRST ANNUAL GSA CONFERENCE, HELD JULY 28, 2006)

UNIVERSITY OF LETHBRIDGE
April 2007

Focal Theme: Diversity of Research at the University of Lethbridge

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FOREWORD

Graduate school marks a transitional moment for students as they move from role of receivers of knowledge as undergraduate students to standing with their mentors and teachers as contributors of new knowledge. In July of 2006, graduate students of the University of Lethbridge marked this transition with the inaugural annual conference of the University Of Lethbridge Graduate Students Association's Multidisciplinary Graduate Research Conference.

Inspired by the success of the conference, the students quickly moved to have papers published in a peer reviewed collection. Moving beyond the proceedings themselves, they also invited papers from faculty from a range of disciplines to add to the range of topics and disciplines represented.

The proceedings capture all that is best about graduate studies: the students have embraced the challenges of research and writing, established scholars have volunteered their time and expertise as reviewers, and the volunteers on the editorial board have experienced and joys and challenges of academic service work.

The dedicated hard work of all involved, authors, presenters, reviewers and editors has culminated in these proceedings which stand both as a tribute to the work of the graduate students we can all share and as a wonderful memory book for the students in the years to come.

Fiat lux

Jo-Anne Fiske
March 9, 2007

Dean of Graduate Studies
University of Lethbridge

EDITORIAL

The Proceedings of the Multidisciplinary Graduate Student Research Conference, organized by the University of Lethbridge Graduate Students Association (U of L GSA), is the outcome of the research and organizational contributions of a large number of enthusiastic graduate students and faculty members from the University of Lethbridge. The Conference was held July 28, 2006, during the Summer semester, and was the first of its kind at the U of L. It brought together representatives of a diverse array of disciplines and interests, from Biology to Sociology and from gender issues to neuroscience. These Conference Proceedings thus showcase the diversity of research conducted at U of L.

The Proceedings have four major subsections: peer reviewed abstracts of the talks and of the posters presented at the Conference; peer-reviewed graduate student articles (12); and invited articles from faculty members from several different disciplines. Initially, the editors insisted on having all references formatted according to either APA or MLA style guidelines. However, due to differences in preferred citation styles among widely divergent fields, the editors have decided to allow multiple formats within this single document, to better showcase the beauty of different stylistic patterns used within modern academia. The contributors and their coauthors hail from a variety of institutes and universities within Canada and internationally. We are very happy to have them united under our GSA banner.

It has been a great pleasure and privilege for the GSA editorial board members to work with an extremely capable group of reviewers from across Canada and abroad. They were of great help in making these Proceedings a reality, and in improving the quality of the articles submitted. The GSA editorial board highly appreciates and thanks all of them for their encouragement, support and prompt responses throughout the process. The editorial board would also like to extend their gratitude to all contributors from the U of L and other institutions for their kind cooperation, patience and support; and to the executive council members of GSA, the offices of the President and Vice Presidents, and the School of Graduate Studies at the U of L for their continued encouragement and financial support for this initiative.

The Proceedings will be available in both hardcopy and electronic versions. We hope that this inaugral Conference will provide the model for many excellent gatherings to come.

Thanks sincerely,

GSA Editorial Board

ABSTRACTS FROM ORAL PRESENTATIONS (Peer-reviewed)

O1: ANDRES, K.J.[1] 2006. ARTECHNENCE: WORK BY CANADIAN WOMEN. Is it possible for an individual to excel at both art and science, or is just a passing familiarity with one adequate to influence the other? How do the arts contribute to scientific advancement? Where will recent scientific innovation lead the arts in the near future? This paper discusses Canadian women artists who have embraced an interdisciplinary approach to art production through applying scientific or advanced technological research to their practice. The paper describes the shift within the visual art field from a singular art practice, for example painting, photography, drawing, or sculpture, to research and artwork that is rapidly contributing to technological innovation through the crossing of science and art disciplines, such as in robotics, virtual reality, cloning or responsive materials. The paper outlines different strategies employed by women artists who have branched into the fields of science, engineering or computer programming through educational choice or collaboration with other technical specialists. The individuals highlighted are engaging with technology and art to create subversive and highly innovative works of art that engage technological tools such as computers and the internet. Two examples are: Jessica Field's work which primarily focuses on creating a parallel between the artificial intelligence (AI) of machines to that of human behavior when dealing with changing environments (robotics), and artist and theorist Nell Tenhaafs' research and creative work described as the exploration of the generationof self as a mutable entity shaped by science and the new technologies (Biology and AI).

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O2: BAKER, M.[1], KOTURBASH, I.[1], LOREE, J.[1] AND KOVALCHUK, O.[1] 2006. ROLE OF EPIGENETIC CHANGES IN RADIATION-INDUCED TRANSGENERATION CARCINOGENESIS. Radiation exposure poses a serious threat to the progeny of irradiated parents. It causes transgenerational genome instability which is linked to transgenerational carcinogenesis, yet the mechanisms by which it arises remain obscure. Epigenetic alterations may play a pivotal role in a predisposition to radiation leukemogenesis and lymphomogenesis in the progeny of exposed parents. DNA methylation is a crucial epigenetic mechanism safeguarding the cellular genome. Here we studied the levels of global DNA methylation in hematopoietic (spleen and thymus) tissue of the unexposed progeny upon maternal, paternal or both-parents exposure in a murine model. Significant DNA hypomethylation was found in the spleen and thymus of the progeny upon paternal and both-parents exposure. The loss of global DNA methylation was paralleled by a noticeable downregulation of the expression of cellular maintenance (DNMT1) and *de novo* (DNMT3a and 3b) methyltransferases and methyl-binding proteins MeCP2 and MBD2. We have also found significant local DNA methylation alterations in genetic elements such as

IAP-LTR and rDNA, both of which are implicated in increased cancer risk. In addition to altered DNA methylation, an elevation of DNA strand breaks occurred in thymus of the progeny of exposed parents. The observed changes indicate a significant epigenetic dysregulation in the offspring, which may serve as a mechanism for transgenerational carcinogenesis.

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O3: BASU, S.K.[1], ACHARYA, S.N.[2] AND THOMAS, J.E.[1] 2006. IMPROVEMENT IN SEED YIELD OF WESTERN CANADA GROWN FENUGREEK (*Trigonella foenum-graecum* L.). The first North American fenugreek forage legume cultivar "Tristar" was released for use in western Canada in 2004. However, Tristar suffers from lack of consistency in seed production due to an indeterminate growth habit. This cultivar takes about 120 days to produce mature seed in the temperate climate of the Canadian prairies where only ~100 frost free days are available for crop production. To develop new germplasm with early maturity, high seed yield and a determinate growth habit, a mutation breeding study was conducted using the Tristar cultivar and ethyl methane sulfonate as the mutagen. World accessions of fenugreek also were evaluated under rain-fed and irrigated conditions to select early maturing, high yielding lines with potential for use in western Canada. Lines with high seed yield and early maturity were identified for the Canadian prairies. This investigation will help to improve the economics of beef and dairy production in western Canada and will lead to more sustainable cropping practices.

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O4: BERLANDO, M.E.[1] 2006. EXPLORING MASCULINITIES IN TOMSON HIGHWAY'S DRY LIPS OUGHT TO MOVE TO KAPUSKASING AND DAVID HENRY HWANG'S M. BUTTERFLY I would like to present a paper related to my research on the work of playwrights Tomson Highway and David Henry Hwang. I have researched and lectured on the roles of gender and race in M.Butterfly and I have researched and written a paper for an independent study on 'femininity' and 'masculinity' in Dry Lips Oughta Move To Kapuskasing. Both works highlight how gender is used as a tool for colonizing and oppressing people. The works show how Western patriarchal ideology imposes the polarized gender binary of male/female onto cultures in order to assimilate them. These works highlight the dangers of the gender dichotomy and illustrate examples of extremely polarized 'masculinity' and 'femininity'. In both plays I look at examples of how the dominant ideology of 'masculinity' affects the characters in the plays and how this 'masculinity' can be looked at in terms of Western society. Both works illustrate extreme

'masculinity' or 'hyper masculinity' through certain characters in the plays. Both texts are able to offer commentaries as to why and how these characters have assumed these roles and what the roles embody. The texts are also able to warn their audiences of the dangers of assimilation and exaggerated 'masculinity'.

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O5: COOMBS, M.[1] 2006. A FIELD TEST OF SIMPLE DISPERSAL MODELS AS PREDICTORS OF MOVEMENT IN A COHORT OF LACUSTRINE BROOK CHARR. 1. Dispersal is a major determinant of the distribution and abundance of animals, as well as a key mechanism linking behaviour to population dynamics, but progress in understanding dispersal has been hampered by the lack of a general framework for modelling dispersal. 2. This study tested the capacity of simple dispersal models to summarise and predict the lake-wide dispersal of an emerging cohort of young-of-the-year brook charr *(Salvelinus fontinalis)*, over 12 surveys conducted during a two-month period. 3. The models are based on two types of dispersal kernel, the normal distribution from a simple diffusion process, and a Laplace distribution depicting exponential decay of the frequency of dispersers away from the point of origin. In all, four models were assessed: one-group diffusion (D1S) and exponential (E1S) models assuming homogeneous dispersal behaviour within the cohort, and two-group diffusion (D2S) and exponential (E2S) models accounting for intrapopulation differences in dispersal between sedentary and mobile individuals. 4. A rigorous cross-validation, based on calibrating the models to the distributions from the first two surveys only and then validating them on the remaining 10 distributions, was used to compare model predictions with observed values of five properties of the dispersal distributions: counts in individual shoreline sections; mean lateral displacement, variance and kurtosis of displacements; and the percentage of long-distance dispersers. 5. Substantial intra-population heterogeneity in dispersal behaviour was apparent: 83% of all individuals were estimated to be sedentary and the remainder mobile. Remarkably, the two-group exponential model E2S, calibrated to data from only two surveys conducted 3.5 and 8.5 days after the beginning of emergence, predicted reasonably well all properties of the spatial distribution of the cohort until the end of the study, seven weeks later. 6. Standardised measures of mobility derived from simple models may lead to better understanding of population dynamics and improved management. Specifically, the ability to accurately predict long-distance dispersal may be critical to assessing population persistence and cohort strength whenever key habitats, such as thermal refugia or productive areas supporting a large proportion of the cohort, are sparsely distributed or distant from the spawning site.

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O6: DAHL, R.[1], SPENCER, L.[1] AND QUEREL, R.[1] 2006. CHARACTERIZATION AND OPTIMIZATION OF A DUAL PHASE PROPULSION SYSTEM: AN EXPLORATION. This work explores various configurations of pressure-based propulsion systems. Key variables such as air pressure, inflation mechanism, propulsion gas, and mechanical configuration are studied with the ultimate goal of optimization. Observables are compared to theoretical and empirical models where applicable. A study of pressure increase versus altitude attained was conducted. Optimal air to liquid volume ratio is also explored. Standard atmospheric composition (78% N_2, 21% O_2, 1% Ar) gas is compared with pressurized CO_2 as the fluid propellant. We investigate means of obtaining launch pressures, namely mechanical and chemical, and provide comparison. Theoretical modeling includes conservations of energy and inertia, gas-liquid phase equilibrium, and gas thermodynamics. Efficiencies and effective power output are compared to theoretical limits. Potential explanations are cited where large deviations from expected results occurred. The results presented are based on experiments conducted on campus. This presentation includes pre-recorded demonstrations of the experimental apparatus.

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O7: DESHPANDE, S.[1] 2006. BETA ANALYSIS OF MICROSOFT® WINDOWS VISTA™. Microsoft® Windows Vista™ (Ultimate Edition Beta 2 Build 5384.4) is a totally new, resource hungry, operating system with a very different graphic user interface. It needs a fast processor, very high RAM and large hard drive space to run. Sidebar is a new useful feature. This version comes bundled with few gadgets and as new versions of Vista™ are being released, the number of gadgets is increasing. Some of the useful gadgets are CPU Meter, Stop Watch, Analog Clock and Number Puzzle. Internet Explorer 7 is much better than its predecessors as it has tabbed browsing function. Windows Media Player 11 is another new feature but it is not compatible with some of the file formats and does not download and install codecs automatically from the server. Reading Pane or Preview Pane is another new addition that gives a preview of the file/folder that one needs to open. Windows Sound Recorder has fewer functions than its predecessors. Due to added security in Vista™, it asks for the user's permission every time it runs a program. It does not even allow the Microsoft® programs such as msconfig and rundll32 to run without the user's permission. A novice user may find it a bit difficult to adjust to Vista™.

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O8: FRANKS, C.[1], PEARCE, D.[1], HONTELA, A.[1] AND ROOD, S.[1] 2006. VEGETATION ON VALIUM: PHYTOREMEDIATION OF TRACE LEVELS OF PHARMACEUTICALS WITH SANDBAR WILLOW (*Salix exigua*). There is growing concern following the discovery of pharmaceuticals and personal care products in wastewater and surface waters at sufficient levels to induce effects in fish (particularly vitellogenin production in males) and amphibians (developmental deformities particularly of limbs). Vegetation that thrives in riparian environments is a natural consideration for removing such contaminants from surface and ground waters. Riparian willow species are distributed throughout the Northern Hemisphere and are underappreciated for their ecological role and phytoremediation potential. This project examines the ability of sandbar willow to remove 3 pharmaceuticals from solution, including the synthetic hormone 17α-ethynylestradiol (commonly used in birth control pills), the antihypertensive diltiazem (a calcium-channel blocker), and the anticonvulsant diazepam (commonly known as Valium®). Atrazine, one of the most widely used herbicides in the world, is included as a positive control. Willow cuttings were grown in a hydroponic system and allowed to remove radiolabeled tracer compounds and cold compounds from solution. The solution was sampled at 0, 2, 4, 8 and 24 hours to determine removal of radioactivity (plant uptake). At 24 hours, the percentage removal ranged from 34 to 88%, demonstrating sandbar willow's potential for phytoremediation of pharmaceuticals.

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O9: FRANZ, D.[1] 2006. TURING PATTERNS IN SYSTEMS WITH LINEAR CHEMICAL REACTIONS COUPLED WITH NONLINEAR CROSS DIFFUSION. Typically when one joins together chemical reactions (i.e. A + B form C) with diffusion (the flow of chemicals from areas of high concentration to low concentration, like food coloring in a cup of water), the result is a solution of uniform concentration. However, in certain cases, the mixing of chemical reactions and diffusion will spontaneously form areas of higher and lower concentration, in the shape of dots, spirals, or other such patterns. These patterns, generally known as Turing patterns, were first postulated in 1952 and were found experimentally in a chemical system in 1990. One of the main motivations for research into these patterns is that they are seen as a possible mechanism for biological pattern formation (ranging from embryonic development to zebra stripes). The systems usually used to explain or model Turing patterns have a complicated chemical reaction network with a simple diffusion mechanism. Our system exhibits Turing patterns with only two chemicals interacting by very simple reactions and a form of cross diffusion (where the diffusion of one component is dependent on another component).

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O10: GERGEL, B.[1], CHENG, H.[1], NIELSEN, C.[2], AND LI, X.[2] 2006. GRAPH-THEORETIC FRAMEWORK FOR IMAGE SET COMPRESSION. As the availability and use of digital images increases, the efficient storage of images is becoming an important area of research. Traditionally, research has focused on the compression of individual images, but there has been little research on the problem of compressing sets of images. There is a need for such compression schemes where applications store large numbers of similar images, such as medical and satellite image databases. A number of schemes have been proposed that remove inter-image redundancies between pairs of images, but are often only effective on sets that contain specific properties. We present a unified graph-theoretic framework that includes all such previous schemes. By computing the minimum spanning tree from a graph constructed from the image set, we obtain the optimal lossless scheme automatically without *a priori* knowledge of the image set. However, the same method does not necessarily give the optimal result for lossy compression. Instead, we can provide a performance guarantee relative to the optimal scheme. Our experimental results demonstrate that our framework provides favorable results for lossless compression, but our schemes are not always the best for lossy compression. This suggests the need for further research to find a better method for choosing edge weights that predict accurate compression performance.

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O11: GILL, K.M.[1] AND ROOD, S.B.[1] 2006. INSTREAM FLOWS FOR COTTONWOOD SAPLINGS ALONG THE DEGRADED LOWER ST. MARY RIVER. Environmental impacts from damming have been especially dramatic along the St. Mary River, which supplies Canada's largest irrigation project. Since completion of the St. Mary Dam, at least 68% of downstream riparian cottonwoods have died, likely due to drought. Recruitment of new seedlings was also prevented, further endangering the population. Concern following this collapse led to changes in dam operation to promote restoration, which involved more natural flow declines following flood peaks (ramping flows) and a three-fold increase in minimum flow. Ramping flows following the flood of 1995 promoted seedling recruitment, however, have the changes allowed for seedling survival and growth to reproductive maturity? Is restoration occurring along this degraded river? An initial study revealed that saplings are present, but seem smaller than those along other river reaches suggesting that flows are survivable but not sufficient. Therefore, the objective of the present study is to assess the longer term effects of the changes in dam operation by linking the response of cottonwood saplings to flow variables and comparing the response to other regional reaches. This research will also increase understanding of instream flow needs in a region where there is an ever present human demand for increased water use.

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Email of the corresponding author: karen.gill@uleth.ca

O12: HAMILTON, S.[1] 2006. WHAT IS ROMAN ORNITHOMANCY? Roman ornithomancy refers to a specific form of divination interpreted from the flight and cries of birds. Historical interpretation of any aspect of the ancient world is problematic due to the limited nature of primary source evidence, which characterizes the practice of Roman ornithomancy. Ancient historical interpreters are increasingly looking to methodologies from a variety of disciplines, hoping that with careful application of appropriate elements uncertain hypotheses might be further considered. My paper, "What is Roman Ornithomancy?" applies methodologies derived from history, anthropology, and religious studies to assess the historical relevance of the divinatory practice of Roman ornithomancy. It was a ritual, and should be considered as such. Anthropologists have theorized about the complex nature of ritual for the last century, making this field a logical choice from which to seek out appropriate methodological frameworks. The result is a bi-partite study of Roman ornithomancy, consisting of compositional and functional analyses of the ritual. Analysis of the compositional elements of Roman ornithomancy demanded a consideration of the who, what, where, and when aspects of the ritual; while a functional analysis of the ritual begins consideration of why the practice of Roman ornithomancy originated and continued to be employed. Roman ornithomancy was conducted before a military campaign or political appointment could legitimately proceed, and was associated with the politically powerful College of Augurs, a major priesthood at Rome. This suggests that Roman ornithomancy was both religiously and politically significant in the turbulent Late Republican and Early Imperial periods of Roman history, necessitating an historical interpretation asking, "What is Roman Ornithomancy?"

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O13: INGRAHAM, L.[1] 2006. SEEING STARS: EXPLORING CONSTELLATION NETWORK TYPES RELATIVE TO INDUSTRY ATTRACTIVENESS. Even though strategic alliances have about a 50% success rate, industries and firms continue to believe they are the best way to gain competitive advantage within industries. One of these large mega-alliances is called a "constellation alliance". Several industries have adopted this strategy to compete against monopolistic industries that have the power to control competition. Michael Porter describes five forces used to make an analysis of the attractiveness (value) of an industry structure. This model is often used in business to strategize how to develop an edge over rival firms. A sixth force, developed by Nicholas Carr, discusses the Public Interest as an additional force, which will be the focus of this paper. It is posited that constellations could be a new strategy level to counter the forces. A typology of six constellations is developed and secondary data will be used to examine 120 industries to determine constellation membership. Predictions as to which industries should join a particular constellation will be discussed.

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O14: LUONG, E.L.[1] 2006. HOW TEACHER ASSISTANTS ENHANCE THE ONLINE LEARNING ENVIRONMENT. Teacher Assistants (TA) serve a valuable role in the classroom but how do their services transfer into an online learning environment? E-learning theory can be used to provide a framework for how TAs are instrumental in building an online community. Based on E-learning theory, a TA manual has been created for the CAAP community to use within their evolving TA program. The manual is based on the findings of the literature review with an integration of the presenter's two years as a TA in the CAAP program. This presentation will involve a detailed preview of the TA training manual.

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O15: MILLER, L. L.[1] 2006.THE EFFECT OF SELENIUM ON THE PHYSIOLOGICAL STRESS RESPONSE AND OXIDATIVE STRESS BIOMARKERS IN JUVENILE RAINBOW TROUT.
Selenium (Se), an essential element, can bioaccumulate and become toxic. In fish, most research has focused on reproduction, while other toxic effects have received little attention. The physiological stress response (PSR) enables fish to respond appropriately to stressors. Oxidative stress biomarkers indicate cellular damage and provide insight into a chemical stressor's toxicity mechanisms. The objective of this study was to determine Se's effect on the PSR and oxidative stress biomarkers in rainbow trout (RT). Juvenile Rainbow Trout (RT) were exposed to waterborne sodium selenite for 96 hours (acute) and 30 days (sub-chronic). Indicators of PSR (plasma cortisol, glucose, and thyroid hormones T3/T4, gill Na+/K+ ATPase, and the ability of head kidney to secrete cortisol) and hepatic oxidative stress biomarkers (lipid peroxidation, catalase, glutathione peroxidase, and reduced glutathione) were measured. Se activated the PSR in RT (Se increased plasma cortisol); however, fish appeared to acclimate to Se as the PSR was not exhausted or impaired (Se did not change the ability of the head kidney to secrete cortisol). Hepatic glutathione decreased during the acute exposure; however, no other biomarkers were altered. This is the first evidence that Se activates the PSR in rainbow trout and that fish may use GSH to inactivate Se.

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O16: MISHRA, S.[1], CLARK, A.P.[2] AND DALY, M.[3] 2006. WHY WOMEN SHOULD HATE FLIRTS: VIEWING PROCEPTIVE WOMEN AFFECTS MEN'S EVALUATIONS OF THEIR PARTNERS. Previous studies have demonstrated that men exposed to photographs of highly attractive women evaluate more typical women and their own romantic partners as less appealing, through so called "contrast effects". We attempted to replicate these previous findings with only partial success; contrary to previous findings, men did not rate their relationship partners as less attractive after seeing photographs of highly attractive women. Similar effects were induced, however, when men were exposed to mock videotaped interviews of a female actor behaving proceptively. Mated men's ratings of their current partners and unattached men's ratings of other women were both lower if the videotaped interviewee smiled and acted warmly than if she seemed bored and disinterested. Women were not affected by either exposure to photographs of highly attractive men or videotaped interviews of proceptive men. Results are discussed within an evolutionary psychology framework.

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O17: NESBITT, J.[1] 2006. THE CONTINUOUS EFFECTS OF FORMALLY BATTERED WOMEN. Every day one in four Canadian women are physically, emotionally, sexually, financially, and psychologically abused by their martial or common law partner, with 60% experiencing abuse more than once (Statistics Canada, 2003). The abuse typically includes more than one domain of violence, often alternating or simultaneously employing several forms of controlling behaviour. It is not surprising that many research studies have found empirical evidence linking abuse received by women in violent relationships with trauma endured. Trauma is commonly expressed in disorders such as depression, anxiety, and posttraumatic stress disorder (PTSD), presenting during inflicted trauma and after the abusive relationship ends. Prevalence of PTSD, depression, and anxiety have been distinguished as one of the strongest factors identifying abused women from non-abused women in terms of higher rates of diagnostic labelling (Koss & Herrera, 2003). Many abused women face barriers accessing professional psychological aid, with the health care system often treating the physical wounds of battery over the psychological trauma. In conclusion, it is necessary for the academic community to address the outcomes of women who have experienced domestic abuse in terms of trauma expression in mental disorders such as depression and PTSD. Research is needed to collect information about long-term outcomes of women who have experienced battery, so that progress may be made in addressing their specific mental health needs.

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O18: NIEBOER, J.[1] 2006. PRODUCTION AND SYNTHESIS OF RHENIUM SULFIDE FLUORIDES. Rhenium compounds with the rhenium in high oxidation states can be formed with fluorine and sulfur bonded to the metal. Such compounds are only stable in the absence of water and their reactivity requires preparative techniques, such as the use of a dry box and vacuum lines. Stable, yet highly reactive, materials are obtained and characterized at low temperature.

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O19: PAHARI, S.[1] AND BIMB, H.P.[2] 2006. ASSESSMENT OF GENETIC DIVERSITY OF *Citrus reticulata* Blanco AND *Citrus limon* (L.) Burm. F. OF NEPAL THROUGH ISOZYME ANALYSIS. Nineteen populations of two *Citrus* species of Nepal were selected for the diversity study. These populations included 10 populations of *Citrus limon* and nine populations of *Citrus reticulata* for isozyme diversity analysis. Four enzyme systems namely Peroxidase (PRX), Malate Dehydrogenase (MDH), Shikimate Dehydrogenase (SKD) and Malic Enzyme (ME) were evaluated for isozyme diversity using starch gel electrophoresis. PRX revealed seven phenotypes in all 19 populations followed by ME with five phenotypes only in 8 populations of *Citrus reticulata*. MDH revealed four phenotypes and SDH three phenotypes. The result indicated diversity within and among populations. Altogether fourteen different phenotypes identified in the present study suggest that citrus population in Nepal possess considerable genetic diversity. As revealed by the DICE coefficient and UPGMA cluster analysis (NTSYS), populations of *Citrus limon* clustered in one group and the populations of *Citrus reticulata* scattered at various levels of similarity ranging from 95-100%.

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O20: PHELAN, C.A.[1], PEARCE, D.W.[1], AND ROOD, S.B.[1] 2006. WATER FLUX OF COTTONWOODS IN A RIPARIAN ZONE ALONG THE OLDMAN RIVER, ALBERTA. The Oldman River, which originates in the Rocky Mountains and flows through southern Alberta, is a losing system. The associated riparian vegetation, including cottonwood trees, relies on river water that infiltrates into the groundwater reserves for its primary water source and availability determines survival. The proposed study aims to monitor water use of cottonwoods at a riparian zone along the Oldman River and link use to the levels of this regulated river. Overall, we hope to gain an understanding of the whole river-groundwater-soil-tree-atmosphere system that influences cottonwood water flux, and how this relates to their growth and survival. Water use will be estimated by measuring sap flow on a diurnal and seasonal basis, using thermal dissipation probes and dynagages. The

measurement of sap flow will be related to influential environmental factors including air temperature, light levels, wind speeds, and humidity which will be measured by a nearby weather station. Sap measurements will also be related to soil moisture, water table depth, and tree growth using soil moisture probes, pressure transducers, and dendrometers, respectively.

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O21: QUINN, A.L.[1], RASMUSSEN, J.B.[1] AND HONTELA, A.[1] 2006. COMPARISON OF THE PHYSIOLOGICAL STRESS RESPONSE AND ACETYLCHOLINESTERASE INHIBITION IN COLD- AND COOL-WATER FISH IN THE OLDMAN RIVER, ALBERTA. Fish are exposed to multiple stressors in their environment. The interactive effects of pesticide exposure, increased water temperature and changes in water flow rates on physiological fitness were investigated in this comparative field study with cold-water (whitefish *Prosopium williamsoni*) and cool-water (sucker *Catostomus* sp.) fish species from the Oldman River, Alberta. Primary (plasma cortisol), secondary (plasma glucose, liver glycogen) and tertiary (condition) stress responses were measured, and exposure to pesticides was evaluated using acetylcholinesterase inhibition. Relationships between sites and species were investigated to better understand the mechanisms that underlie species-dependent differences in vulnerability to stressors.

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O22: ROBERT, S.[1] 2006. CANADIAN ABORIGINAL TREATY LAW: THE CANONS OF CONSTRUCTION FOR TREATY INTERPRETATION. Provincial and federal government officials and the Canadian public know very little about First Nations treaty rights and Canadian treaty law. If established Canadian treaty law and the exercise of First Nations treaty rights are to endure, extensive efforts must be made to inform and educate the Canadian public on these issues. The canons of construction for treaty interpretation as established by the Supreme Court of Canada, provide the Canadian judiciary with guidelines for interpreting aboriginal treaties. This paper elaborates on each canon and also explores the origins and evolution of each canon.

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O23: SLINGERLAND, M. J.[1] 2006. A BIOCHEMICAL KINETIC MODEL FOR AUXIN ACTION IN PLANT LEAF CELLS. Auxin is a plant hormone involved in nearly all developmental processes. One striking result of auxin action is the generation of vein patterns in leaves. These patterns are dynamically generated *de novo* in each leaf, and are strongly dependent on auxin signalling and transport. Many of the enzymes and other proteins involved in auxin action have recently been identified and characterized. The auxin system contains multiple interacting levels of positive and negative feedback, whereby auxin can control its own transport and signalling pathways. A unique aspect of auxin action is that it is actively transported between cells; controlling the direction of this transport is an important target for regulation. We have constructed a kinetic model that incorporates known biochemical interactions involved in auxin regulation. Simulation results show that our model is sufficient to capture the experimentally observed polarization of auxin transport in a single cell.

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O24: SUN, H.[1] 2006. POWER ESTIMATION USING AUTOCORRELATION COEFFICIENTS. Power dissipation is an important aspect in the continued development of micro-electronic technologies. The dominant component of it in CMOS circuits is caused by switching activity. The presentation describes research on low power design for estimating switching activities by using transition probabilities and autocorrelation coefficients. The focus point is trying to understand the relationship between the transition correlation coefficients and the autocorrelation coefficient of the transition correlation coefficients. The transition probabilities of signal lines in a circuit can be collected and then used for calculating the switching activities. The autocorrelation coefficients of the transition correlation coefficients of signal lines also are calculated. The transition correlation coefficients between different signal lines are considered for the estimation of switching activities. Computing the transition correlation coefficients is a method to capture the spatial correlation between signal lines which affect the power dissipation in a circuit. Ordered binary decision diagrams are used to efficiently represent the circuit, allowing manipulation of its structure primarily by reordering the variables, or primary input signal lines. Using this structure the minimum switching activities of signal lines can be obtained by analyzing the autocorrelation coefficients of the transition correlation coefficients.

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O25: SUSCHINSKY, K. D.[1] 2006. LET'S TALK ABOUT SEX: A BRIEF HISTORY OF MEASURES OF SEXUAL AROUSAL. The study of sex does not have an extensive history. Less than 150 years ago, early researchers began to acknowledge the importance of sexuality and its impact on human behavior. More recently, the emphasis of research has shifted to understanding sexual behavior and arousal. Today, the study of sex has been enhanced by sexual psychophysiology, a distinct branch of sex research that employs a variety of tools to assess sexual arousal and response patterns. A variety of these tools, including both genital and extra-genital tools, will be reviewed and compared.

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O26: VENKATRAMANAN, A.[1] 2006. MANAGING THE COSTS OF DIABETES CLIENT EDUCATION: A STRATEGIC MODEL COMBINING THE BALANCED SCORECARD WITH ACTIVITY-BASED COSTING. Despite the widespread acceptance of the importance of patient education programs and vast amounts of resources invested in them, research into the costs of providing client education is sparse, especially in the chronic disease area. Healthcare organisations provide these complex services to a wide range of stakeholders, and could benefit from a strategic cost management model that links specific activities and their costs to general objectives such as quality service and widespread reach. Development of such a model to estimate the cost of a diabetes client education program, using activity-based costing (ABC) and the balanced scorecard (BSC) framework, is the primary purpose of this study. ABC provides information that is useful in decision making at various levels of business operation. However, there exists no framework for the collection and organisation of the vast amounts of complex activity and cost driver data that are collected in the process. Using a modified BSC approach, this model provides a framework for activity information collection, and then clearly organises the data collected, showing how activities are linked to an overall strategy and to each other. Four BSC dimensions – client, learning & growth, internal process, and financial – are used for this purpose.

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ABSTRACTS FROM POSTER PRESENTATIONS (Peer-reviewed)

P1: BASU, S.K.[1], ACHARYA, S.N.[2] AND THOMAS, J.E.[1] 2006. COLCHICINE TREATMENT PRODUCES GENETIC IMPROVEMENT IN FENUGREEK SEED SIZE AND YIELD. Most fenugreek (*Trigonella foenum-graecum* L.) genotypes are diploids (2*n*=16). Artificial increase in ploidy levels via use of colchicine often result in improved plant vigor, seed size and yield. In fenugreek larger seeds contained a higher percent oil compared to smaller seeds. The objective of the present study was to increase seed size and yield of Tristar fenugreek using colchicine treatment. Germinated seeds with 2-4 cm long roots were treated with 0.05, 0.1 and 0.2 % colchicine mixed with dimethyl sulfoxide (DMSO). Sets of 50 germinated seedlings were treated for 15, 30, 45 and 60 minutes in the above concentrations. The treated seedlings were then grown under greenhouse conditions at Lethbridge. After 10 weeks growth the treated and untreated plant root tips were observed for chromosome doubling (4*n* = 32). The lowest concentration and time produced the most chromosome doubling in this experiment. Survival rate of the untreated control was 100% (all had 2*n*=16 chromosomes) but only 4 to 16 % in the treated plants. The tetraploid plants (4*n*=32) showed a wide variation in morphometric and reproductive parameters providing an opportunity for selection of improved seed size, yield and consequent increase in seed oil content.

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P2: BASU, S.K.[1], ACHARYA, S.N.[2] AND THOMAS, J.E.[1] 2006. FOLIAR SPRAY TO IMPROVE FENUGREEK SEED YIELD AND REDUCE MATURITY DURATION. Fenugreek (*Trigonella foenum-graecum* L.) is a new annual legume crop for Canada. The first forage cultivar of this crop “Tristar” developed for forage production in western Canada does not produce high seed yield consistently. This is because of its indeterminate growth habit and long maturity duration. In two separate experiments the effect of foliar application of gibberrelic acid at five different concentration and ferrous sulphate, calcium chloride, cupric sulphate, magnesium sulphate, ammonium sulphate and ammonium molybdate at one concentration (10 mM) were applied at four different growth stages of the crop to determine their impact on seed production. Under greenhouse conditions all the main effects and the interactions of the GA_3 test were significant ($p < 0.01$). Foliar spraying after the post-pod emergence stage appeared to be the most effective stage in increasing seed and forage yield while inducing early maturity. Other chemicals with the exception of ammonium molybdate (1.7 g) had a significant effect on seed yield of fenugreek (2.8-5.6 g) compared to their untreated control (2.3 g). These results need to be verified in the field before any spay recommendations are made to fenugreek producers.

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P3: DIGWEED, S.M.[1], AND RENDALL, D.[1] 2006. TO FLEE OR NOT TO FLEE: DIVERSITY AND PREDATOR SPECIFICITY IN THE ANTI-PREDATOR RESPONSES OF RED SQUIRRELS, *Tamiasciurus hudsonicus.*

Many animals produce conspicuous signals when they detect a potential predator. Signals, such as alarm calls, can function to alert conspecifics to the predatory danger, as well as communicate to the predator itself that it has been detected. In some cases, the escape response appropriate to one predator type (aerial threat) is different from the response appropriate to another type (terrestrial threat). As a result, different alarm calls are produced for different predator types faced and are thus thought to function referentially in that these calls 'refer' to a particular predator class and associated escape response. My research focuses on North American red squirrels. Preliminary reports suggest that these solitary mammals may produce referential alarm calls in response to the different predators they encounter (e.g. raptors, coyotes). My specific focus is in determining the referential specificity of this species alarm calls by recording vocal and behavioural responses to predatory threats. My research was conducted at R.B. Miller Field Station in Sheep River Provincial Park, Kananaskis, Alberta. Field predator presentation experiments were conducted on 30 individually identified and marked squirrels to test the specificity of vocal and behavioural responses to three different predator types (coyote, marten and owl). Initial results indicate some evidence for distinct behavioral responses to the different predator types. In addition, call use appears far more mixed than previously suggested with some evidence to suggest that squirrels are more vocal to some predators (coyote) than others (owl).

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P4: DIONNE, D.[1] 2006. HEALING PRACTICES USED BY SURVIVORS OF RESIDENTIAL SCHOOL IN THEIR RECOVERY PROCESS. Since the inception of residential schools, First Nations people were absorbed into the governing culture, forced to relinquish their dominant cultural beliefs and practices and failed to be socialized in their everyday activities. In their quest for wholeness, reminiscences of residential school experiences preoccupy the minds of many First Nations men and women, attendees and aftermath survivors alike, rendering them unable to move beyond their past. Simultaneously, many of these former residential school residents, and subsequently, their children, have experienced significant rates of substance abuse (Claes & Clifton, 1998). Chronic addictions are part of the legacy of residential school

impacting those living with its consequences. Morrissette (1994) connects residential school abuse with many of today's First Nations peoples' spiritual need to unite to their culture and traditions by interfacing traditional and non-traditional healing practices. Using a hermeneutic phenomenological approach, I will interview three to five First Nations people who currently live with the after effects of family members' residential school experiences and I will investigate how healing practices are used by these survivors in their recovery process. The interviews will provide an avenue to understand the lived experiences of those individuals, whose parents, grandparents, and other family members, attended residential school.

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P5: EDWARDS, L.[1] AND LIDBERG, H.[2] 2006. EXPERIMENTAL DOCUMENTARY, WHAT IS IT AND WHAT MIGHT IT LOOK LIKE: A VIDEOZINE EXPLORATION (10 MIN). This 10 minute video poster presentation will explore the genre of experimental documentary and why I have chosen this genre, as well as my written thesis, to present my research on feminist, cultural activist art collectives working on the prairies, 1980-2005. Experimentation in film and video has been used with the goal of cultural change since the 1960's, and art historians and writers have described the films of filmmakers such as Trinh T. Minh-ha and Matt McCormick as experimental documentaries because they use the form of documentary to critique and subvert dominant discourses found in typical documentary, and in Mihn-ha's case ethnographic documentary in particular. In the 1920's John Grierson described documentary as a 'way to convey social truth'. Experimental documentary takes one step further with the intent to not only convey social truth, but to create social/cultural change. Experimental documentary often includes more artistic expression while at the same time theoretically and critically examining film and video making. This form of documentary often uses impressionistic reenactments, layered with archival materials, old film footage, footage shot off of televisions, etc. I will employ the techniques used in experimental documentary while at the same time combining it with the popular mode of zine. The second author on this presentation, Heather Lidberg, is my production/editing assistant and an undergraduate BFA student at the University of Lethbridge. We have been working together on this research project. She coined the word videozine that will be used in this presentation and my experimental documentary.

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P6: FORBES, K.[1] 2006. STREAMFLOW SIMULATION IN A SOUTHERN ALBERTA CATCHMENT. Surface water supply in southern Alberta is threatened by the changing Prairie climate. Changes to hydroclimatic conditions on the Prairies have the potential to upset the regional water balance which will have severe repercussions on the southern Albertan agriculture, a primary driver of the economy. Effective simulation of the water balance can foster an understanding of the magnitude of climate change and its effects on surface water supply. The Agricultural Catchments Research Unit (ACRU) is an agrohydrologic model designed to simulate the hydrological processes within an agricultural catchment. The Beaver Creek watershed is a gauged catchment with a substantial streamflow and climate record necessary for simulation of the historical record. Beaver Creek is an ideal location of such simulation as it is part of the headwaters to the Oldman River Basin. Preliminary results suggest that the model is sensitive to perturbations in land use change though a sensitivity analysis of streamflow to varied leaf area index. This research is the first application of ACRU to a Canadian watershed and its successful implementation and simulation of the historical record will provide a basis for future hydroclimatic predictions, namely a simulation of forecasted climate change.

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P7: GERGEL, B.[1] AND RICE, J.[1] 2006. SEQUENTIAL REVERSIBLE LOGIC SYNTHESIS: A BEGINNING. Digital devices such as cell phones and portable music players are becoming physically smaller but increasingly powerful, and the management of their ever-increasing power consumption is a problem. Using reversible logic for the design of these circuits offers a potential solution to drastically reduce power consumption. However, reversible computing currently suffers two main concerns. First, a lack of physical implementations of reversible circuits impedes development. Secondly, research on how to build practical implementations is still in its infancy. Recent research to address the second concern has focused on reversible combinatorial logic, while there has been little work done on reversible sequential logic. Storage elements, such as memory, are an integral component of most digital devices, and therefore make reversible sequential logic an integral part of any reversible logic solution. Recent research has proposed memory elements such as reversible latches and reversible flip-flops, and this poster presents an example of how to integrate the proposed elements into a logic synthesis process utilizing the existing reversible combinatorial logic research. Ongoing research is exploring both how to determine optimal implementations of the basic sequential elements, and how to automate synthesis incorporating such elements.

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P8: INKSTER, D.[1] 2006. DOCUMENTARY FILM'S POTENTIAL FOR THE CULTIVATION OF KNOWLEDGE. Motivation: Knowledge is a social wealth without which no society can function. It is a resource that generates strengths and skills among individuals, groups and communities, which in turn function as tools facilitating the attainment of goals. It is important to examine if and how pedagogical tools contribute to the cultivation of knowledge. Problem: Toward this end I present two questions: 1. Do a filmmaker's creative choices have any bearing on the potential of his or her documentary to cultivate knowledge? 2. How do documentary films, as pedagogical tools, contribute to the cultivation of knowledge? Approach: In order to carry out this analysis, documentary films as pedagogical tools must be considered on a title-by-title basis; hence the goals whose attainment they facilitate must be considered not only first but also contextually. Phase I Conclusions: **What information gets in? What information is left out?** The production of *Brooks, AB* a National Film Board of Canada documentary directed by Dana Inkster provides insight into the process of creative choice and decision-making as it pertains to the completion of documentary film that will ultimately find national distribution on the Canadian Broadcasting Corporation and in Canadian secondary and post-secondary schools.

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P9: JADAVJI, N.M.[1], KOLB, B.[1] AND METZ, G.A.[1] 2006. TO BE ENRICHED OR NOT TO BE? Enriched environment (EE) provides animals with additional sensory and motor stimulation when compared to standard laboratory housing conditions. Previous work has shown that EE can effectively facilitate recovery from various brain injuries. Parkinson's disease (PD) is a neurodegenerative disorder associated with aging. Given the large variability in symptoms and pathology in the population that develops PD, it has been suggested that environmental and lifestyle factors may alter the course of PD. A recent study from our lab has shown that in the animal model of PD exposure EE significantly increases animals' ability to perform motor tasks, such as the skilled reaching task. Here we investigated the benefit of EE prior to versus after a 6 -hydroxydopamine lesion (6-OHDA), an animal model of PD. Adult female Long-Evans rats were tested daily. One group of rats was placed in an EE while one group was housed in standard conditions and then conditions were reversed after the lesion. The animals remained in the two housing conditions for six weeks prior to receiving unilateral infusion of the neurotoxin 6-OHDA into nigrostriatal bundle. Daily behavioral testing continued up to three weeks after lesion. The observations from our previous study and current study showed that animals housed in EE continuously both before and after the lesion developed a significantly higher reaching success during the pre-lesion and post-lesion testing period when compared to rats housed in the standard condition. The results indicate that EE only improves skilled motor function when both pre- and post-lesion EE are combined. These data will be discussed in relation to possible mechanisms of experience-dependent modulation of the pathology of PD and in relation to implications for rehabilitation programs in patients with PD.

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P10: KATHIRIA, P.[1], BOYKO, A.[1], ZEMP, F.[1] AND KOVALCHUK, I.[1] 2006. SYSTEMIC CHANGES IN THE PROGENY OF PLANTS INFECTED WITH COMPATIBLE PATHOGEN. Pathogens are one of the prevalent stresses to plants. Infection with incompatible pathogens results in *R* gene mediated hypersensitive response, while infection with compatible pathogen leads to systemic spread of pathogen. During such a compatible interaction there is generation of systemic recombination signal (SRS) that is capable of spreading faster than virus and promoting changes in the frequency of somatic and meiotic recombination. This signal can have a role in the induction of various plant mechanisms against pathogen infection. To understand the transgenerational effect of the SRS more clearly, the progeny of pathogen-infected plants were analyzed. These plants showed a significant delay in symptom development and a delay in the progression of the virus in the plants. Methylation analysis revealed that the genomes of these plants were hypermethylated, with a sequence specific pattern of hypomethylation at *R* gene-like loci. The control loci, actin, RENT, and 5.8S ribosomal RNA, were either significantly hypermethylated or not changed. Changes in methylation were coupled with an increased frequency of rearrangements in *R* gene-like loci when compared to the control loci. It is hypothesized that the global genome hypermethylation is part of a plant mechanism to protect the genome, while the increased rate of rearrangements at specific loci due to the selective hypomethylation serves a role in increasing sequence variability. Such variation could result in production of novel *R* gene specificities that can recognize pathogens and lead to resistance response. Hence, the SRS can play a key role in the evolution of *R* genes against virulent pathogens and the increased tolerance.

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P11: KATHIRIA, P.[1], YAO, Y.[1] AND KOVALCHUK, I.[1] 2006. EFFECTS OF BIOTIC AND ABIOTIC STRESSES ON N GENE. Plant *R* genes play very important roles in resistance against many viral, fungal and bacterial pathogens. Interaction between TMV and the N protein from tobacco is one of the most widely used models to understand various aspects of this resistance. The transcription activity as governed by N gene promoter is one of the least understood elements of the model. In this study, the N gene promoter was cloned and fused with two different reporter genes, β-glucuronidase (N::GUS) and luciferase (N::LUC). Tobacco and *Arabidopsis* plants with stable integration of the N-reporter construct were screened for homozygosity and stable expression. Expression analysis using N::GUS tobacco plants revealed that the

expression is organ specific and developmentally regulated. During early stages of growth, GUS expression was limited to midveins, with no root expression. As the plant matured, expression spread into the leaf lamella. Using N::LUC tobacco plants, experiments to analyze the effect of various biotic and abiotic factors on the reporter gene activity were carried out. Results indicate that there is an up regulation of LUC activity following TMV infection. Also, an initial induction and then subsequent down regulation in reporter gene activity was noted when plants are subjected to high and low temperatures. At the same time, the SA didn't show any significant increase or decrease in the LUC activity.

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P12: LARSON, R.[1] 2006. INTEGRATING REMOTE SENSING AND GIS TO CONSTRUCT A SNOW ACCUMULATION-MELT MODEL APPLIED TO THE SAINT MARY RIVER HEADWATERS, MONTANA. A distributed snow model was developed to test the effect of hydro meteorological variables on Snow Water Equivalent (SWE) in the alpine headwaters of a semi-arid basin of southern Alberta. The model's function was to address concerns of climate variability and change on the basin's future water supply. A two-phase snow accumulation-melt model was constructed and run on a weekly timescale over the course of the November 1999-June 2000 winter season. Snowfall inputs, obtained from a weather station located in the Saint Mary area valley underwent land cover interception and wind redistribution. Snow cover at the end of each accumulation week was then added to the iteration of the next week's snowfall. The snow melt phase, beginning April 1st, was forced by a temperature-radiation model, which incorporated the use of relative radiance surfaces, and constants for atmospheric transmissivity, albedo, and attenuation effects. SWE at the end of a melt week was subtracted from the initial week's snow depth, to obtain the following week's snow depth. Maximum snow accumulation estimated in the region was 7.65m. Total estimated SWE was 243.83 million cubic meters, with maximum release occurring during the third week of May.

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P13: MCKNIGHT, K.[1] 2006. ATHLETIC CAREER TRANSITION AND TRANSFERABLE SKILLS. Career retirement of athletes is an important watershed change that is often over looked. Athletic retirement or transition is inevitable for all athletes. Athletic retirement has been overlooked because this transitional event is equated with occupational retirement that is experienced by older adults, and a misconception that only a small number of individuals who compete in elite and

professional sport are likely to be affected by this transition. It is because athletic retirement is a transition that understanding transferable skills is important. Transferable skills are the ability for an athlete to take abstract skills learned in the sporting environment and apply them to another facet of life or another career. Intuitively athletes view the learning of transferable skills as critical for adjustment in retiring from sport. The main question that emerged from the literature review is how do active female hockey players at the high school, university/college and national/elite level perceive the skills acquired in sport transferring to another career or other facets of their life?

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P14: NELSON, F.E.[1] AND BARENDREGT, R.W.[1] 2006. LATE CENOZOIC MAGNETOSTRATIGRAPHY OF SELKIRK VOLCANICS AND ASSOCIATED SEDIMENTS, WEST-CENTRAL YUKON. Brunhes, Matuyama and Mammoth age basaltic lava flows (Selkirk Volcanics - TQS) were sampled in west-central Yukon. The mean characteristic remnant magnetization (ChRM) direction of the flows sampled has a slight westerly rotation and an inclination that is statistically indistinguishable from the expected direction of the dipole field. Outcrops of TQS outside the Fort Selkirk Volcanic Complex (FSVC) were paleomagnetically sampled for the first time. The ChRM direction of basalt at the northern edge of the Northern Cordillera Volcanic Province agrees with FSVC directions, indicating that they were drawn from the same distribution; however, the ChRM of southern outcrops (near Braeburn, Yukon) are quite distinct. Early Pleistocene Fort Selkirk glaciation sequence is reversed and further constrained to the Late Matuyama between oxygen isotope stages 62 and 56 inclusive. An Ar/Ar date on the reversed basal basalts at Ne Ch'e Ddhäwa places their eruption in the Mammoth subchron of the Gauss normal chron (c. 3.25 Ma), older than previously thought.

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P15: NORMAN, E.[1] 2006. AN EXAMINATION OF THE PERCEPTIONS OF AN ALL-FEMALE PROBLEM GAMBLING COUNSELLING TREATMENT. This study explores clients' perceptions of women-only group counselling for problem gambling. The clients surveyed participated in a women-only treatment group through the Alberta Alcohol and Drug Commission (AADAC). The group was a pilot project for AADAC, in that it was the first gambling treatment group for women only; previously, only mixed (male and female) groups had been run. Therefore, this is the first known group of its kind to be conducted in Alberta or Western Canada. A qualitative, grounded theory analysis was conducted using in-depth interviews with a focus group of five

women. Themes emerged from this analysis, providing insights into effective counselling practices for women problem gamblers. The results demonstrated that the women who participated in the group found women-only groups to be helpful. Additionally, the participants reported that, if they had to participate in group treatment for problem gambling, they would prefer women-only treatment in the future. Therefore, further research and exploration of women-only treatment are recommended in order to improve problem gambling treatment for women.

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P16: QUEREL, R.[1], SIRBU, D.[1] AND JONES, S.[1] 2006. THE THIRTY METER TELESCOPE: PROJECT OVERVIEW AND SITE SELECTION CAMPAIGN. The Thirty Meter Telescope (TMT) project is a collaboration between American and Canadian public-private organizations to construct the world's largest optical telescope facility. With over 700 mirror segments spanning a total of 30 meters in diameter, the TMT's sensitivity will be unparalleled among other ground-based telescopes currently in existence. In this poster presentation, we review the project's scientific goals made possible through this increased sensitivity as well as the features of its associated astronomical instrumentation. The leading factor causing distortion to astronomical signals is atmospheric water vapour. We present the use of an Infrared Radiometer for Millimetre Astronomy (IRMA) developed at the University of Lethbridge as a real-time water vapour monitor. Over the next two years, our Astronomical Instrumentation Group will be participating in the TMT site selection campaign to assess the relative strengths of six short-listed locations. These include Mauna Kea (Hawaii), San Pedro Martir (Mexico), and four sites in northern Chile. IRMA data will be collected for 18 months at each proposed location, and subsequently analysed to provide the TMT project with an accurate representation of local atmospheric conditions. A final recommendation will be made according to the optimal blend of observing time and scientific quality.

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P17: SIKKEMA, M.[1] 2006. SELF-INJURIOUS BEHAVIOUR: A TREATMENT PLANNING GUIDES. Self-injurious behaviour (SIB) is considered to be a difficult behaviour to treat because of the positive effects such as the relief of negative emotions that most clients report feeling. However, SIB is also becoming more prevalent in the general population, even among clients with none of the traditional risk factors. This treatment guide puts forward an outline of a conceptualization that can be used to assess

and treat superficial moderate SIB. The guide examines the relevant literature including a definition and categorization of self-injury, a brief outline of concurrent disorders and behaviours, a discussion of the origins of SIB, an overview of the consequences of the behaviour, and finally an outline of the leading theoretical conceptualizations of SIB. A preferred method of treatment is chosen based on the utility of the treatment for the wide range of clients exhibiting SIB. The general goals of treatment are summarized, an assessment procedure is delineated, and a treatment plan uses the different interventions and skills required to treat SIB. Finally, evaluation of the treatment is discussed.

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P18: SIKKEMA, M.[1,2] AND MCBRIDE, D.[1] 2006. COUNSELLORS' PERCEPTIONS OF THE LIKELIHOOD OF MALE ABUSERS DROPPING OUT FROM GROUP THERAPY. Studies previously examining attrition from group therapy for partner-assaultive men have found a dropout rate from 40%-60%. There has been much study identifying a variety of predictive factors including demographics (age, marital status, employment, etc.), psychological variables (personality disorders, stage of change, etc.), group dynamics (group stages, group cohesion, etc.), and counselor-client variables (therapeutic alliance, agreement on treatment goals, etc.). The study will investigate how counselors, based on their experience, rate how well these variables predict the likelihood of the men dropping out from the group. In addition, the study will investigate how the responses of the counselors are related to their level of training, supervision, and experience both with group work and family violence counselling. The results of the study will be applied both to group work with abusive men and to the counsellor training programs with respect to family violence and group work.

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P19: SPENCER, L.D.[1] AND NAYLOR, D.A.[1] 2006. PERFORMANCE CHARACTERIZATION OF THE HERSCHEL/SPIRE IMAGING FOURIER TRANSFORM SPECTROMETER. The European Space Agency's Herschel Space Observatory is comprised of three cryogenically cooled instruments commissioned to explore the far infrared/sub-millimetre universe. The Spectral and Photometric Imaging Receiver (SPIRE) is one of these three scientific instruments on Herschel and consists of a three band imaging photometer and a two band imaging spectrometer. Canada is involved in the SPIRE project through the provision of key hardware for the instrument test facility, data analysis software, and support personnel. An imaging Fourier transform

spectrometer (IFTS) provides the medium resolution spectroscopic capabilities of SPIRE. An outline of the scientific goals of Herschel/SPIRE is presented including a discussion of how the SPIRE IFTS is suited to meet some of these objectives. The use of spectrally unresolved sources in spectral characterization tests of the SPIRE IFTS is discussed. A comparison of the theoretical and measured SPIRE IFTS Instrumental Line Shape, off-axis frequency calibration, field of view and line sensitivity, as determined from flight model instrument verification tests, is presented.

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P20: STONE, J.[1] 2006. THE MEDIAL PREFRONTAL CORTEX AND STRIATUM ARE CRITICAL TO NON-HIPPOCAMPAL MEMORY SYSTEMS FOR VISUAL DISCRIMINATIONS IN RATS. Hippocampal damage in rats can cause amnesia for picture discriminations learned before damage but rats can still learn new picture discriminations. These results are consistent with the idea that there are two visual memory systems that can acquire and retain complex picture information, one that depends upon the HPC and one that functions independently of the HPC. Here we test the idea that the mPFC and/or striatum play an essential role in the nonHPC system. Rats received lesions that included mPFC or sham lesion surgery and then were trained to resolve two picture discriminations. The task requires rats to swim to a hidden platform submerged in front of one of two computer monitors that displays a correct picture. After training, half of the rats from each group received HPC damage, yielding four groups; sham, mPFC, HPC, and combined mPFC + HPC damage rats. Retention performance was then measured. Sham and mPFC damaged rats showed very good retention. Rats with HPC damage or mPFC + HPC damage showed equivalent retrograde amnesia for both discriminations. Rats with HPC damage relearned both discriminations but rats with combined damage relearned neither. In a separate experiment we show that with pretraining, sham and HPC damaged rats readily learn picture discriminations, but HPC damage combined with either mPFC or striatal damage disrupts discrimination learning. The results support the idea that mPFC and striatum are essential for a nonHPC visual memory system, but that normally the HPC system interferes with acquisition and/or retrieval from the other system.

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P21: TAMMINGA, J.[1], KUTANZI, K.[1] AND KOVALCHUK, O.[1] 2006. DOES BORIS HAVE A ROLE IN TRANSGENERATIONAL GENOME INSTABILITY? The paternal genome has been shown to be more susceptible to genotoxic stress than the maternal genome. Consequently, inheritance of DNA damage posses a serious threat to the progeny of irradiated fathers. The molecular mechanism by which this effect is mediated has yet to be determined; however, the epigenome has been implicated in transgenerational genome instability. During gametogenesis, genes are differentially methylated in a process known as genomic imprinting. These regions of differential methylation are referred to as imprinting control regions (ICR). This process is regulated in male germ cells by two paralogous proteins, namely CTCF (CCCTC Binding Factor) and BORIS (Brother Of the Regulator of Imprinted Sites). Expression of BORIS, followed by CTCF expression, takes place with the erasure and re-establishment of methylation marks, respectively. CTCF is exclusively found in the nucleus, while BORIS can be found in both the nucleus and cytoplasm. This suggests that BORIS may be capable of selective *in vivo* occupation of maternally-imprinted ICR, protecting them from being methylated. In previous experiments in the Kovalchuk lab, it has been found that paternal IR exposure lead to profound epigenetic dysregulation in the progeny. Also, BORIS protein levels were altered in the germline of exposed males. We hypothesized that BORIS may play an important role in epigenetic programming in the germline and fertilized egg, and its dysregulation upon IR exposure may lead to the epigenetic dysregulation in the progeny. Thus, we plan to analyze the expression of BORIS and CTCF in the male germline upon radiation exposure.

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P22: UNNI, A.V.[1]; HEUNG, H.[1]; PREDOI-CROSS, A.[1]; BROWN, L.R.[2], BENNER, D.C.[3] AND DEVI, M.[3] 2006. SPECTROSCOPIC STUDY OF LINE MIXING EFFECTS IN THE $\nu_2 + \nu_3$ BAND OF METHANE. Room temperature self- and air-line mixing coefficients have been measured for transitions in the $\nu_2 + \nu_3$ band of the octad region of methane. These measurements were made by analyzing 21 laboratory absorption spectra recorded at 0.011-cm^{-1} resolution using the McMath–Pierce Fourier transform spectrometer located at the National Solar Observatory on Kitt Peak, Arizona. The spectra were obtained using three absorption cells with path lengths of 2.05, 150 and 1641 cm. The spectral line parameters were retrieved using a multispectrum nonlinear least squares technique and a speed-dependent Voigt profile with a line mixing component. The self- and air-line mixing coefficients were determined from the off-diagonal relaxation matrix elements and represent the first measurements to be reported for the $\nu_2 + \nu_3$ vibrational band.

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P23: YANG, A.[1] 2006. A DECISION SUPPORT SYSTEM USING THE ANALYTIC HIERARCHY PROCESS FOR SELECTING AN OPTIMAL CELL PHONE SERVICE VENDOR. Statistics indicate that more and more companies now bear the cell phone service costs of their employees. A current phenomenon in Canada is that over 40 per cent of the revenue of a telecom company comes from customers being on the wrong rate plan, and most companies are actually spending over 30 per cent more than they need to for the same service. To solve this problem, a decision support system (DSS) is developed to help decision makers select the optimal cell phone vendor and plans. Ninety cell plans (business plans) of four major vendors in Alberta (Fido, Rogers, Bell, and Telus) are utilized as a part of the database in this system. Non-cost issues are handled by the Analytic Hierarchy Process (AHP) and all the qualitative factors that influence this selection decision come from a survey conducted in Lethbridge. Sensitivity analysis is applied considering the scores of cost and non-cost of each vendor, thereby, an optimal vendor can be achieved. The contributions of this study are threefold: 1) it helps solve a current, complex business operations problem and brings a competitive advantage to the companies that use this system, 2) it presents an integrated methodology that can be applied to some similar research in management science, and 3) it fills a blank in operations research academically.

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P24: ZEMP, F.J.[1], KOVALCHUK, I.[1] AND KOVALCHUK, O.[1] 2006. BYSTANDER EFFECTS: SIMILAR MECHANISMS IN PLANTS AND ANIMALS? The bystander effect is a phenomenon whereby unexposed cells exhibit the molecular symptoms of stress exposure when adjacent or nearby cells are exposed to a particular stress. Bystander effects include the induction of genome destabilization, which can lead to genome rearrangements, chromosome aberrations, strand breaks, and a variety of mutations. This phenomenon, first observed in radiation exposed mammalian models, has related responses in plants exposed to a variety of stresses. The induction of genome instability and the resulting consequences lends evidence in support of an epigenetically controlled mechanism. Methylation patterns are largely generated *de novo* via small, regulatory RNAs of ~20-26 nucleotides. These small RNAs (sRNA) provide a sequence specific mechanism for DNA and histone methylation. Further, they can systemically spread to distant tissue through phloem transport in plants or through gap junctions in animals. As such, sRNA species are ideal candidates for, or regulators of, the bystander signal. The project aims to characterize the role of sRNAs in the generation of bystander

effects in plant and mammalian models. In plant and animal models, mutants impaired in sRNA production will be used to assay genomic instability in bystander tissue. Further, in the mammalian model, bystander effects will be assayed using artificial 3D human tissue precisely irradiated with microbeam technology. sRNA expression in these tissues will be analyzed using microarrays, and the results related to the epigenetic modifications we have witnessed thus far.

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P25: ZEMP, F.J.[1], KUTANZI, K.[1], KOVALCHUK, O.[1], KOVALCHUK, I.[1] AND POGRIBNY, I.[2] 2006. THE ROLE OF miRNA REGULATION IN ESTROGEN DEPENDENT BREAST TUMOUR PROGRESSION. 17β-estradiol (estrogen; E2) aberrant signalling is believed to be involved in the initiation, development, and progression of most human breast cancers. This form of breast cancer, termed E2-dependent carcinogensis, will be the cause of death for nearly 4,000 women in Canada this year. MicroRNAs (miRNAs) are small RNAs with major roles in regulating gene expression for such factors as developmental timing, tissue identity, and cellular homoeostasis. Further, tumour-specific miRNA deregulation has been observed in the malignant phenotypes of a variety of tissues. Characterizing the 'oncomirs' involved in early tissue-specific tumour progression could provide an accurate tool for disease diagnosis and prognosis. To elucidate the role of miRNAs in E2-dependent carcinogenesis, ACI rats treated with a continual dose of exogenous estrogen were harvested at 6, 12, and 18 weeks. It has been shown that the continuous exposure to elevated levels of estrogen can lead to malignant cell transformation visible in 12 and 18 week-old rats. Total RNA was extracted from the mammary tissue of treated rats and analyzed for miRNA expression using microarray chips targeting identified mouse and rat miRNAs. Several specific miRNAs, *mir-125b, mir-145, mir-21,* and *mir-155,* have previously been shown to be deregulated in a mix of human breast cancer cell lines. Our preliminary results indicate that in E2-dependent carcinogenesis, *mir-155* is also significantly down-regulated at 18-weeks. Amazingly, we found that 6 of the 7 miRNAs associated with the *mir-17-92* 'oncomir polycistron' were up-regulated in early tumour progression. Additional analysis has identified several more miRNAs significantly deregulated that are putative targets of known oncogenes, tumour suppressors, or key players in E2 signalling pathways. These preliminary results indicate a very important role of miRNA expression in E2-dependent carcinogenesis. This study was supported by the Alberta Breast Cancer Research Initiative.

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PEER-REVIEWED ARTICLES

GRADUATE STUDENTS ASSOCIATION (GSA)
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R1: COLCHICINE TREATMENT PRODUCES GENETIC IMPROVEMENT IN FENUGREEK SEED SIZE AND YIELD

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INTRODUCTION

Diploid fenugreek (*Trigonella foenum-graecum* L.) genotypes possess 2*n* = 16 chromosomes (Darlington & Wylie, 1961). The haploid chromosome number (*n*) of *Trigonella* can vary; some plants with *n* = 8, 9, 11 and 14 chromosomes have been identified (Darlington &Wylie, 1945). Extra B-chromosomes in some fenugreek lines have been reported and are known to modify the growth of some plants (Joshi & Raghuvanshi, 1968; Singh & Singh, 1976). In addition, natural and chemically induced forms of autopolyploids have been found within the species. Five fenugreek lines were identified with double trisomics (2*n*+1+1) along with primary trisomics (2*n*+1) from the progeny of natural autotetraploids (Roy & Singh, 1968).

Colchicine (a tricyclic alkaloid) was originally extracted from the plant *Colchicum autumnale* L. (or Autumn crocus belonging to the monocot family Liliaceae) that prevents microtubule polymerization by binding to tubulin (Gupta 1972). Chromosome segregation being driven by microtubules, colchicine is applied for the induction of polyploidy in plant cells during cell division to prevent chromosomal segregation (Roy & Singh 1968). Tetraploid and octaploid plants also have been produced by treating fenugreek shoot apices with colchicines (Gupta 1972).

Increased ploidy levels often result in bigger seeds which may contain higher levels of chemical constituents and other valuable traits not present in genotypes with smaller seeds; this was illustrated in our study where bigger seeds from fenugreek possessed more oil than smaller seeds (Fig. 1).

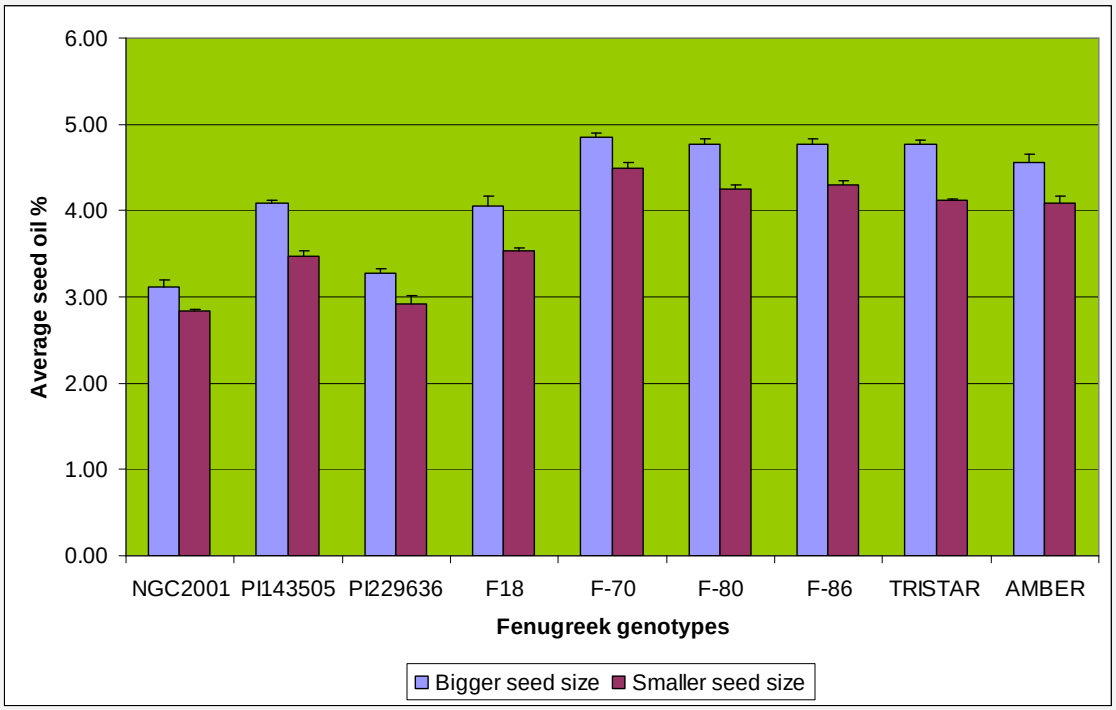

Fig. 1. Non-destructive NMR analysis of average seed oil percent between big and small seed sizes among nine world accessions of fenugreek. Error bars represent standard error from triplicate analyses of each seed sample. Means were not significantly different, t-test, p >0.05

The objective of the present study was to increase plant growth and seed size of Tristar fenugreek plants by treating them with colchicine to double the chromosome number; plants possessing a tetraploid genotype were identified among the survivors by cytogenetic analysis and selected for increased vigour, forage and seed yield.

MATERIALS AND METHODS

The Tristar fenugreek seed used in this study was obtained from the Forage laboratory of Agriculture and Agri-Food Canada, Lethbridge, AB, Canada. Tristar fenugreek seeds were placed on moist filter paper and kept at room temperature (23 ºC) for 3 d to allow germination. After 5 d, germinated seeds with roots 2-4 cm long were treated with 0.05, 0.10 and 0.20 % (W/V) colchicine (Sigma-Aldrich) mixed with 120, 200 and 400 µL of DMSO (Sigma-Aldrich) respectively to promote effective absorption.

Sets of 50 germinated seedlings each were treated for 15, 30, 45 and 60 minutes in each colchicine concentration used in the experiment. The treated seedlings were thoroughly washed (6X) with running tap water and then placed in labeled 8.5 cm diameter plastic petri plates. Treated seedlings from each treatment including the untreated controls were potted in labeled 6-inch green plastic pots containing non-sterile, soil-free mix. The greenhouse was set to a day/night cycle of 22 ^{o}C /15 ^{o}C with 16 h days. Over the next 10 weeks, growth of the surviving seedlings was monitored.

Root tips from surviving treated and control plants were collected, then placed in vials containing ice water and, incubated over crushed ice in a cold room at 5 ºC. After 28 h root tips were fixed in a 3:1 mixture of 95 % ethanol: glacial acetic acid (Sigma-Aldrich) for 24 h and then, stained in a mixture of 45 % acetic acid (Sigma-Aldrich) mixed with 2-3 drops of 1 % (W/V) acetocarmine (Sigma-Aldrich) for 1 minute, squashed and then observed under a compound microscope (Olympus).

After 120 days of growth in the greenhouse, the plants were desiccated with 0.4 % (W/V) Reglone (Syngenta Crop Protection Canada Inc.) solution along with 0.23 % (W/V) surfactant (AG-SURF) (Interprovincial Cooperative Ltd.). Plants were then allowed to dry for 10 days before separating the seed for determination of seed yield.

A t-test was done to compare mean values of different concentration within each time treatment group (p <0.05) for the different experiments conducted using the statistical package SYSTAT (version 10.2).

RESULTS AND DISCUSSION

All seedlings treated with colchicine exhibited a high level of mortality throughout the 10 weeks of growth in the greenhouse following the treatment. The highest levels of cells with doubled chromosome number ($2n$ = 32) were observed in seedlings treated for 15 minutes in 0.05 % (W/V) colchicine (Figs. 2 & 3).

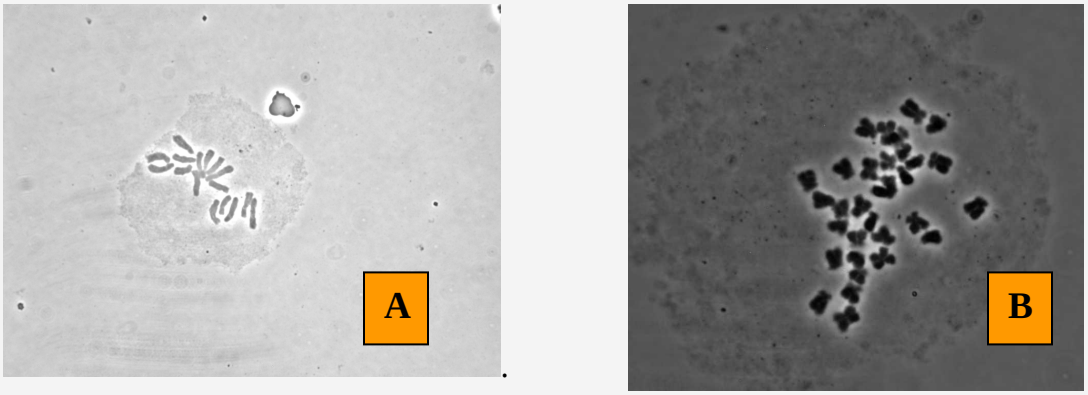

Fig. 2. A. Mitotic metaphase of a diploid ($2n$ = 16) cell of Tristar fenugreek before colchicine treatment; and B. a tetraploid ($4n$ = 32) cell after colchicine treatment

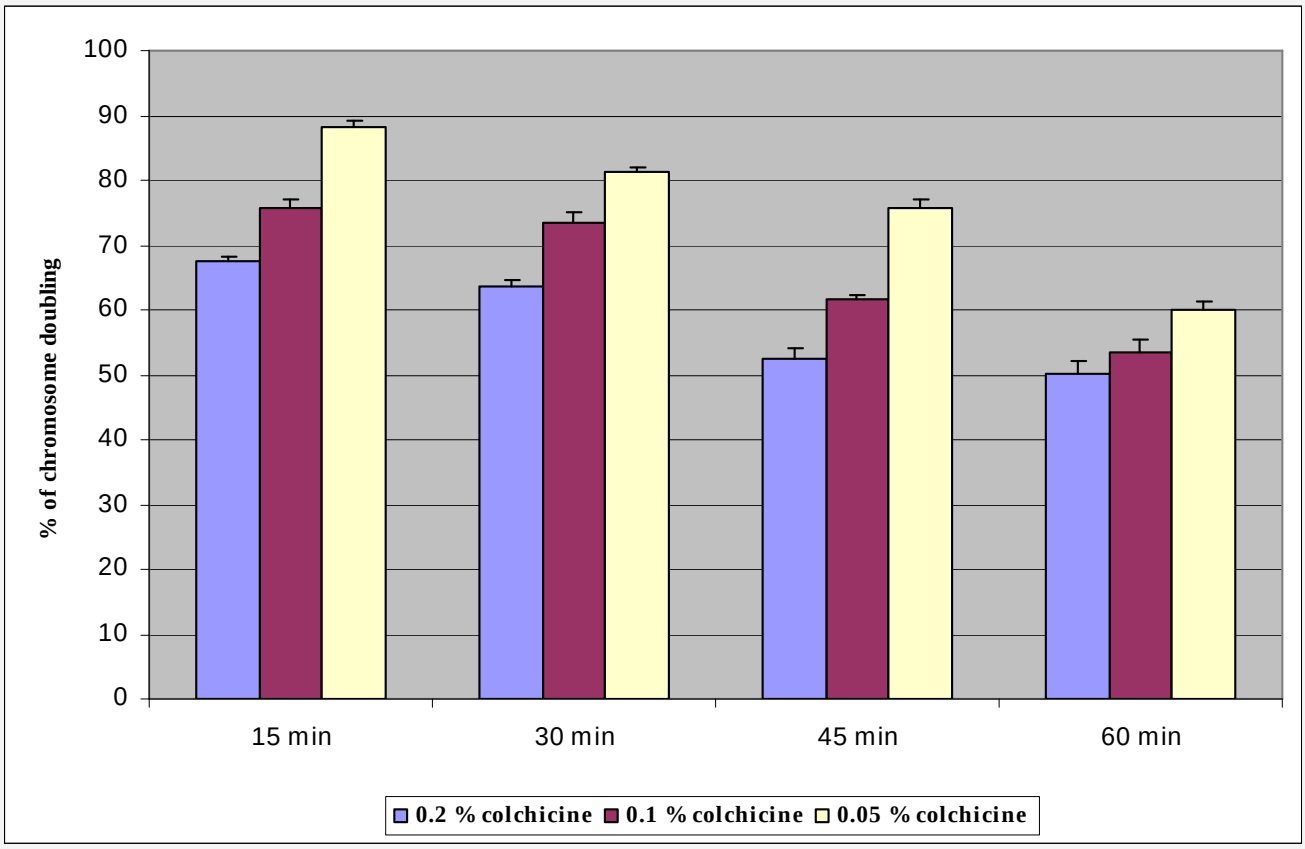

Fig. 3. Mean proportion of cells with 4*n*=32 chromosomes (± SE) in plants that were treated with 0.05, 0.1 and 0.2 % (W/V) of colchicine for 15, 30, 45 and 60 minutes after 10 weeks of growth in the greenhouse. Means within each time treatment group were significantly different from each other within that group, t-test, $p < 0.05$

The higher doses of colchicine and longer treatment durations probably caused more chromosome abnormalities and cell death than the lower treatment and exposure times (Gupta, 1972; Hadder & Wilson, 1958). All plants from the untreated control group (10 weeks old) survived; *i.e.*, no evidence of chromosome doubling or endoreduplication was observed in the control plants. The percent survival among colchicine treated plants decreased with increasing concentration and treatment duration (Fig. 4.) Interestingly, flowering and pod formation were observed in all of the surviving plants. However, all treatment combinations showed stunted growth accompanied by shriveled leaves. In some treated plants flowering and pod formation were about a week earlier than in the untreated control plants. Other surviving plants were dwarf and extremely late in flowering, with low yields.

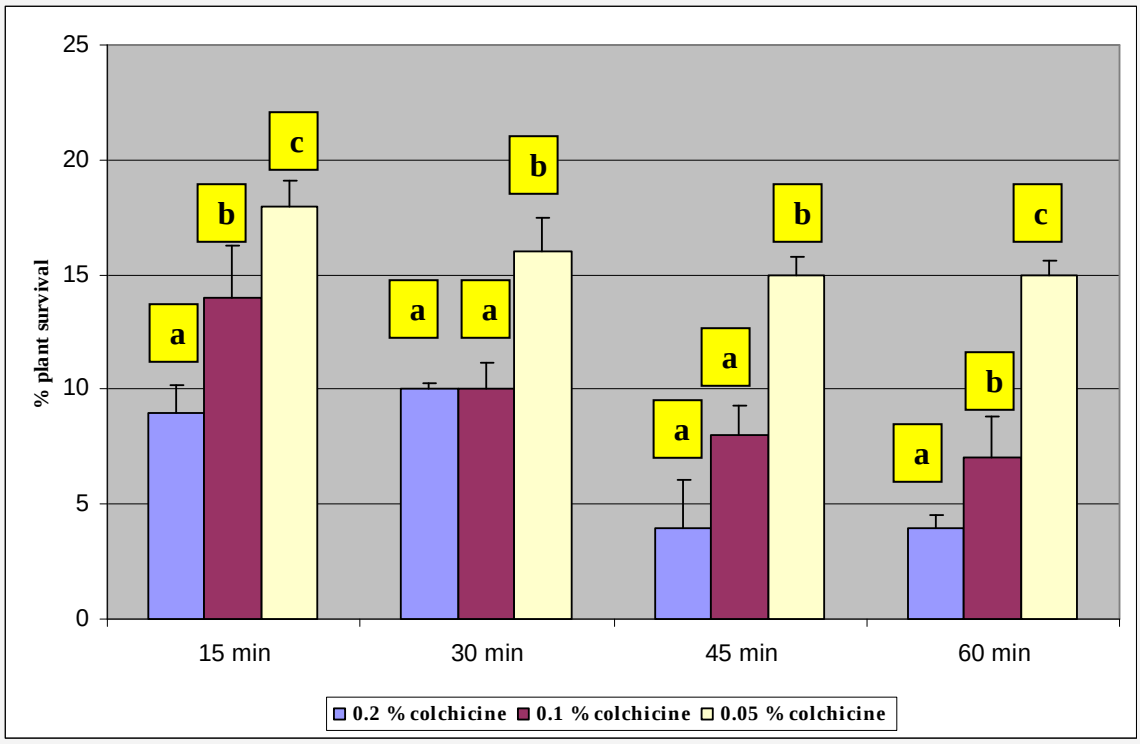

Fig. 4. Mean percent survival (± SE bars) of Tristar fenugreek seedlings after treatment with 0.05, 0.1 and 0.2 % (W/V) colchicine for 15, 30, 45 and 60 minutes after 10 weeks of growth under greenhouse conditions. Means followed by the same alphabets were not significantly different form each other, t-test, $p < 0.05$

Considerable variability in morphological and reproductive parameters was noticed among plants obtained from the colchicine treatments (Table 1). Some of these plants had larger leaves, longer pod lengths and a greater height in comparison to control Tristar plants. Chromosome doubling was observed in fenugreek seeds treated with colchicine. The tetraploid plants had a wide variation with respect to morphological and reproductive parameters. These plants have the basic germplasm for improvement of seed and forage yield in this crop. However, whether bigger seed size effectively increases constituents such as seed oil content in these plants needs to be investigated.

Table 1. Range in morphological and reproductive parameters for the top five surviving plants from each group (single plant per pot) grown in the greenhouse, after 50 seedlings were treated with 0.05, 0.10 and 0.20 % (W/V) colchicine for 15, 30, 45 and 60 min each.

Treatmen Times (min)	Height (cm.)[1]	Inter-node length (cm)	No. of nodes	Total no. of pods	No. of Single pods	No. of double pods	Pod length (cm)	Dry weight (g)[2]	Seed no.[3]	1000 seed weight (g)[4]
Control*	9.6-16.5	0.6-2.1	4-13	8-9	4-9	0-2	6.9-16.4	12.3-21.5	68-116	43.9-72.1
0.2 % Colchicine										
15	14.6-22.3	1.1-2.3	11-18	7-11	3-6	1-3	13.7-18.6	16.9-22.6	79-111	60.3-64.5
30	8.9-29.3	1.2-1.6	6-19	5-9	3-6	1-2	13.5-18.4	12.6-24.7	88-112	60.7-70.9
45	12.8-23.6	1.1-2.1	10-19	4-12	2-6	1-3	13.5-18.1	16.8-24.7	88-123	52.1-67.8
60	16.4-23.5	0.9-1.3	15-19	5-12	3-7	1-3	12.2-18.6	18.5-22.4	83-111	57.2-71.1
0.1 % Colchicine										
15	18.6-24.5	0.9-1.4	15-21	5-12	3-6	1-4	14.1-17.3	18.5-24.5	89-117	57.7-66.2
30	13.6-23.4	0.8-1.6	11-23	6-9	3-6	1-3	13.4-17.9	16.1-23.4	87-116	58.1-62.1
45	12.5-24.5	0.8-1.4	16-21	6-10	4-6	1-3	13.9-17.3	16.9-24.2	77-121	57.1-72.7
60	10.6-23.4	0.9-1.5	9-24	5-9	3-7	1-2	12.5-16.3	18.8-22.3	98-116	56.1-64.7
0.05 % Colchicine										
15	13.7-24.2	0.8-1.3	11-22	7-11	3-8	1-4	12.4-16.7	19.8-23.4	89-112	58.4-64.1
30	16.9-23.8	0.7-1.8	17-22	8-11	2-7	1-4	13.9-16.3	18.5-23.4	97-118	57.6-61.3
45	17.6-22.8	0.9-1.4	16-21	5-9	3-7	1-2	12.7-15.9	18.9-23.6	88-113	57.5-63.6
60	16.5-22.6	0.5-1.2	14-21	5-12	3-7	1-3	14.7-16.3	18.7-24.5	97-122	50.0-58.4

*Untreated control; [1] Heights of plants measured 100 days from the day of seeding after being sprayed with desiccant; [2] Above ground biomass of individual plants; [3] Number of seeds from the pods produced by an individual plant; and [4] Weight of 1000 seeds from an individual plan

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R2: FOLIAR SPRAY TO IMPROVE FENUGREEK SEED YIELD AND REDUCE MATURITY DURATION

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INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is an annual legume crop currently grown in many parts of the world for use as a spice, food flavoring and in the production of hormones (Acharya, et al. 2006; Petropoulos, 2002). The first North American forage fenugreek cultivar 'Tristar' selected for forage production in western Canada takes about 120 days to produce a good amount of mature seed in this region. Therefore, under the short growing season of western Canada (~ 100 days) this cultivar does not produce high seed yield consistently (Acharya, et al. 2006). Application of plant growth regulators and foliar sprays have been effective in improving seed and forage yield as well as chemical constituents in fenugreek (Alhadi et al., 1999; Jain & Agarwal, 1988; Ortuno et al., 1988). De and Srivastava (2003) from India reported higher yield and early maturity duration of *Vigna radiata* due to treatment with foliar sprays of different salts. We were interested in studying whether such foliar applications of hormones and other chemicals under both greenhouse and Prairie conditions could improve fenugreek seed yield and reduce maturity duration.

MATERIALS AND METHODS

Experiments were conducted at the Lethbridge Research Centre (LRC), Lethbridge, AB greenhouse in spring of 2005. For the GA_3 experiment five Tristar fenugreek plants were planted individually in six inch plastic pots containing non-sterile, soil-free mix (Cornell mix). The plants were sprayed with 90 % pure GA_3 (Sigma-Aldrich) using five concentrations (0, 30, 60, 90 and 120 ppm) at four developmental stages; i.e., at flowering, post-flowering, pod-emergence and post-pod emergence. Each treatment (concentration and growth stage of application) was replicated two times. The experiment also included two more treatments (GA_3 alone and GA_3 mixed with 0.3 % (W/V) surfactant AG-SURF (Interprovincial Cooperative Ltd)).

To assess the effects of other chemicals, two fenugreek plants were planted each in six inch diameter plastic pots containing soil-free mix. The plants were sprayed with ferrous sulphate, calcium chloride, cupric sulphate, magnesium sulphate, ammonium sulphate and ammonium molybdate (all Sigma-Aldrich products). All chemicals were

used at 10 mM concentrations mixed with 0.3 % (W/V) surfactant (AG-SURF) plus one untreated control. For this experiment spraying was done only at the 50 % flowering stage and, all of the treatments were replicated three times, including the control. All of the pots in both trials, GA_3 and foliar spray, were arranged on greenhouse benches as in a two times replicated RCBD. After 95 days in a greenhouse set to cycle with 16 h days (22 ^oC) and 8 h nights (15 ^oC) the plants were desiccated with a 0.4 % (W/V) Reglone (Syngenta Crop Protection Canada Inc.) solution along with 0.23 % (W/V) of AG-SURF as a surfactant. The sprayer used for this purpose was an E-Z Sprayer (Vaporisateur) (Wal-Mart Canada Inc.). The plants were allowed to dry for 10 days before separating the seed for yield determination. All morphological, reproductive and growth parameters of the treated plants relative to the controls were monitored and recorded. The controls were grown under greenhouse conditions for the GA_3 experiments and, were used only for visual comparison of the maturity duration (earliness) and yield attributes and were not part of the statistical analysis (most control plants did not bear any mature seed during the 95 days of the experiment).

The GA_3 and foliar spray field trials received 50 mm of irrigation four times in 2005. The seed rate used was 120 Tristar fenugreek seeds were planted in single 3 m row plots and the plots were spaced 1 m apart. The treatments were laid out in a completely randomized block design replicated twice. The concentrations of GA_3 and the stages and application methods for treatments were applied, including controls, were the same as those described for the greenhouse study. All of the plots were hand harvested in 2005. After drying the material for one week indoors, the dry weight of individual rows was recorded. Then the seeds were separated from the rest of the plant, cleaned and weighed to determine the total seed weight for each individual line used in the experiment. The data obtained from both experiments were subjected to a fixed effects model ANOVA (on square root transformed data) using Agrobase® statistical software.

RESULTS AND DISCUSSION

Effects of GA_3: Our greenhouse study indicated a significant effect of GA_3 on the growth, maturity duration and seed yield of fenugreek (Table 1). In fact all the effects (surfactant, GA_3 concentration (rate) and growth stage at which GA_3 was applied) including the interaction effects were highly significant for seed yield. All of the plants treated with GA_3 regardless of concentration matured at least a week earlier than the control groups (the control groups were desiccated on the 95th day).

Table 1. Mean square (MS), degrees of freedom (df) and probability (Pr) of F value for seed yield for plants treated with GA_3 in the greenhouse as determined by a fixed effects model ANOVA

Source	df	MS	Pr of F*
Total	63		
Replication	1		
Surfactant	1	68.0	0.000
Rate	3	43.9	0.000
Growth stage	3	27.0	0.000
Surfactant*Rate	3	44.3	0.000
Surfactant*Growth stage	3	5.2	0.000
Rate*Growth stage	9	2.8	0.000
Surfactant*Rate*Growth stage	9	5.9	0.000
Residual	31	0.4	
CV		3.4	
R^2		0.9	

* values $p < 0.05$ are significant

There was a considerable increase in the height, dry matter and seed yield of treated plants compared to the controls (Fig. 1). The effect was particularly noticeable when GA_3 was sprayed along with the surfactant. The mean seed yield for GA_3 with surfactant was 8.9 g pot^{-1} compared to 6.4 g pot^{-1} for GA_3 without surfactant. Addition of surfactant also had a major impact on the growth, maturity and dry matter yield of the plants in the greenhouse.

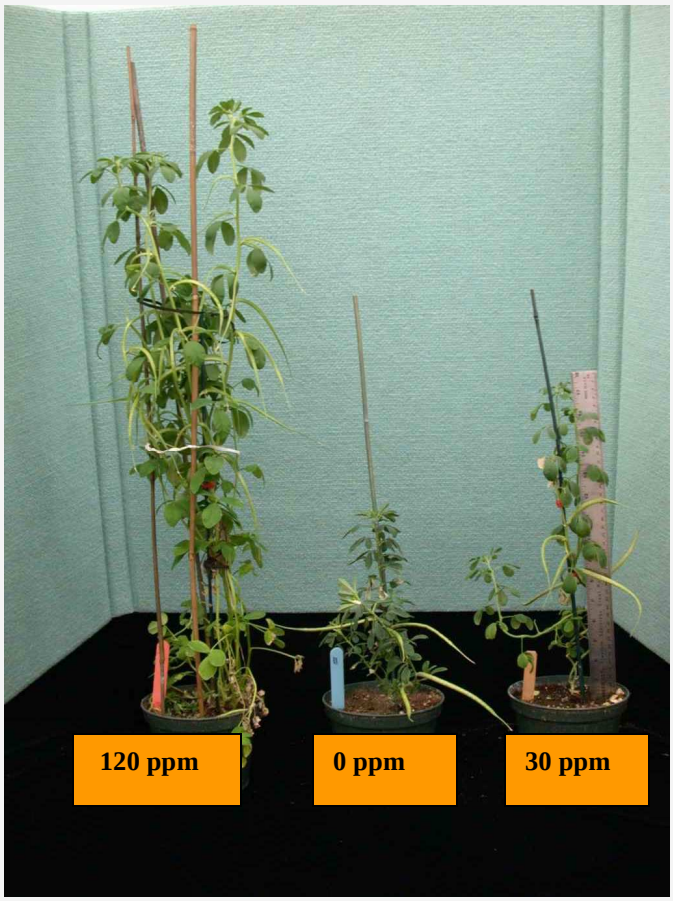

Fig. 1. Fenugreek plants treated with 120, 0 and 30 ppm GA_3 and grown in the LRC greenhouse (Spring, 2005)

This was expected as the addition of surfactant ensures proper spread and absorption of GA_3 on the plant surface improving its incorporation into the plant tissue. The stage of growth at which GA_3 was applied had a significant impact on seed yield under greenhouse conditions. GA_3 application after the post pod emergence stage produced best seed yield (Table 2).

Table 2. Mean seed yield (grams per pot) of Tristar plants grown in the greenhouse and sprayed at four growth stages (GS) with four concentrations of GA_3 plus surfactant. LSD for the experiment was 0.42 at $p = 0.05$

Growth stages (GS)	GA_3 concentrations (ppm)				Mean for GS
	30	60	90	120	
Flowering	6.9	8.6	4.9	8.2	7.1
Pod Emergence	8.1	8.8	5.0	7.4	7.3
Post Pod emergence	9.6	9.6	6.6	8.7	8.6
Pod Filling	9.4	9.9	6.7	8.5	8.6
Mean for GA_3 conc.	8.5	9.2	5.8	8.2	7.9

However, the corresponding field study did not show statistically significant differences. This may have been due to the fact that the macro and micro environmental factors in the field and that of the greenhouse were different. A lower number of replicates (two) under the field conditions could be a reason for not finding significant differences in field trials. Use of a larger number of replications (improved error control) may resolve this problem in future experiments.

Most reports on legume crop responses to GA_3 are limited to *Pisum sativum* L. (Ross et al., 1997). Shoots from these plants elongate in response to hormone treatment, possibly because of inactivation of genes suppressing an elongation-specific plant pathway (Ross et al., 1997). GA_3 is known to induce a normal growth habit (elongation) in dwarf pea varieties and single gene dwarf maize mutants and, to promote growth and elongation in crops such as rice, wild oat, wheat, lettuce and cucumber and, flowering in crops grown under non-inductive daylength conditions (Bonner & Varner, 1976). It has also been suggested that floral promotion by GA_3 may be due to its effect on stem elongation (Bonner & Varner, 1976). It is important to note that reports on studies involving GA_3 on fenugreek are scanty and are mostly restricted to plant tissue culture. Our results on the use of GA_3 as a foliar spray applied to fenugreek are preliminary and need to be confirmed. Effects of the surfactant also need to be separated from the GA_3 treatment.

Effects of chemical sprays: The results from the chemical spray experiments conducted in the greenhouse indicated a highly significant effect of the chemicals, on seed yield of fenugreek (Table 3). The treated plants matured a week and a half earlier than the control group which was desiccated on the 95^{th} day after seeding. The average height, dry weight, number of pods per plant and seed yields were not significantly different in the treated plants compared to the control.

Table 3. Mean square, degrees of freedom and probability of F value for seed yield of the Tristar fenugreek plants treated with six chemicals plus controls grown under greenhouse conditions as determined by a fixed effects model ANOVA.

Source	Df	MS	Pr of F*
Total	13		
Replication	1	0.004	0.124
Chemicals	6	0.267	0.000
Residual	6	0.001	
CV		1.9	
R^2		0.9	

*values < 0.05 are significant

The only exception to this trend was seen in plants treated with ammonium molybdate where the seed yield was lower than the control. A wide variation in the colour of the harvested seed from the plants treated with different chemicals relative to untreated Tristar seed was observed. These results indicate that foliar sprays containing GA_3 and other chemicals used under greenhouse conditions are effective in increasing seed and forage yield while reducing maturity duration of Tristar fenugreek. The seed yield from the field trial done in 2005 did not show a significant effect of the chemicals. But the treated plants matured about two weeks earlier (13 days) than the untreated controls.

Effect of some of these chemicals on maturity and seed yield performance was observed earlier in India by De & Srivastava (2003) for another legume crop *Vigna radiata*. The mean seed yield in our field trials revealed large differences among the chemical treated plants and the untreated controls. There was a 66 % difference between the cupric sulphate treatment and the control plants but, this difference was not found to be significant. This may have been due to the fact that only two replications were used under variable field conditions. Furthermore, greater variability under field conditions in comparison to the highly controlled environment of the greenhouse may have been responsible for these differences. We consider these to be preliminary findings which require confirmation from other tests using different genotypes, locations and years before spray recommendations can be made to producers as part of an agronomic package for fenugreek. Nevertheless, use of GA_3 and/or chemical sprays to induce early maturation of fenugreek in western Canada appears to show considerable promise.

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R3: THE REPRESENTATION OF MASCULINITY IN TOMSON HIGHWAY'S *DRY LIPS OUGHTA MOVE TO KAPUSKASING*

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Native Canadian Tomson Highway's award winning play *Dry Lips Oughta Move to Kapuskasing* draws attention to issues surrounding Western colonialism's influence on Native gender through the way Native masculinity- how it is formed, influenced, and a cause for concern- is represented within the play. Comparing traditional Native gender roles to the Western patriarchal Christian gender dichotomy of the North American colonizers shows us how the gender trouble that Highway demonstrates within his play operates. In his nightmare-framed play about a week in the life of an Ontario reserve, he shows multicultural audiences the dangers of assimilation to rigid Western gender structures, while leaving us with a sense of hope.

When the Americas were colonized the settlers found that many North American Native's traditional gender roles threatened and destabilized theirs. Indigenous people had less rigid roles to define proper behaviour for men and women than they did. For instance, Will Roscoe explores how prior to colonization less binary gender roles were accepted by the ideology of the tribes and often embraced. He points out that sometimes men dressed like women and did women's work, while women led men to battle and were respected as chiefs. He also gives examples of Natives who occupied both "male" and "female" roles at the same time. He states that, "The original peoples of North America, whose principles are just as ancient as those of Judeo-Christian culture, saw no threat in homosexuality or gender variance" (4). Although gender role crossing is not foreign to Western/European cultures, it was not accepted by the dominant ideology of the imperialists who colonized the Americas. The European explorers found instances of homosexuality and gender crossing immoral.

European colonizers were shocked by this and enforced their binary sex/gender roles and language of masculine/feminine on Natives in order to control and assimilate them into their more "civilized" culture. Patrick Hopkins states that "a threat to established gender categories, like most other serious threats, is often met with grave resistance, for challenging the regulatory operations of a gender system means to destabilize fundamental, social, political, and personal categories"(132). The Natives lack of a rigid gender model seriously threatened the gender dichotomy that the colonizers claimed as "natural." Thus they deemed the Indigenous peoples "unnatural."

In *Dry Lips Oughta Move to Kapuskasing* Highway demonstrates the dangers of Western culture's imposing strict gender binaries on Native people and the detrimental effect of rigid gender 'rules' on society as a whole. Highway's play gives examples of Native men and women assuming extreme polar opposites in order to try to assume the guises of popular gender. He exposes gender, as less stable, fixed, and "natural" than patriarchal culture would have us believe. Highway bends and mixes traditional Western gender roles in order to draw attention to how they are socially constructed, and he points out the grave consequences that assuming the norms of Western masculinity and their extremes have on Native males.

Dry Lips is the second instalment in Tomson Highway's Rez plays and is portraying the 'flip-side' of his first play *The Rez Sisters*, which illustrates the lives of seven Wasy Hill women with an obsession to win the biggest bingo in the world. The seven men who occupy the stage of *Dry Lips* deal with many contemporary issues surrounding Native masculinity, colonization, and assimilation. The events of the play unfold as part of Zachary Jeremiah's nightmare in which he cheats on his wife with Big Joey's girlfriend, and obsesses over his plans to build a bakery on the reserve. Meanwhile a rivalry builds between him and the hyper-aggressive Big Joey who wants to start a radio station on the reserve. Some of the men are upset by the birth of an all female hockey team on the reserve, and tensions start to build as the men quarrel with each other and deal with the devastating effects of alcoholism and Christian fanaticism. This tension heightens when a young pregnant woman is raped on the reserve and her boyfriend Simon Starblanket, who represents a traditional way of living, gets drunk an accidentally shoots himself. Although the women's hockey team is a primary focus of the play the women never appear on stage and Nanabush, the Native trickster figure, plays the only females in the work. The women that Nanabush portrays are victims of terrible crimes that stem from the Natives colonization and from the polarized gender roles that they try to assume.

Theorists often highlight gender as a system of power that has been used as a tool of maintaining colonial order. When European white men colonized the Americas, the Indigenous people of the land became "feminized." Sheila Rabillard points out how "First Nations peoples have been constructed--in a North American version of Orientalism-- as fixed and 'feminized' other."(6). Masculinity was and still is associated with power. By "feminizing" the Natives, power was taken from them and conferred on the colonizers.

Some of the men in the Native society that Highway represents appear to have tried to resist losing power by becoming "hyper-masculine" and largely taking on an exaggerated version of the masculine role in Western culture. In his research exploring heterosexual masculinity, behavioural scientist Gregory Herek defines contemporary Western masculinity as embodying, "success and status, toughness and independence, aggressiveness and dominance"(568). He states, "Being a man requires not being compliant, dependent, or submissive; not being effeminate"(568). Big Joey from *Dry Lips* in particular is an example of a hyper-masculine Native male as displayed by the "Big" in his name. However, the name Big Joey itself is an oxymoron: "big" insinuates a grown man, but the diminutive "Joey" implies a young boy. This points out that for all its effort to be dominant, the Western male role is sometimes infantile.

If the nature of colonization is to take power, Big Joey tries to take on the Western masculine gender role with a vengeance. This power is related to the domination and sexualization of women just as in patriarchal and much of Western pop culture. Big Joey presents a tough, aggressive face throughout most of the play and allows both active and passive abuse against women to occur. This violence ranges from the drunken birth of his illegitimate son in a local bar to the violent rape of a traditional Native woman with a crucifix- the crucifix is symbolic of Western Christian gender oppression- years later by the same child. Highway uses very fierce images of violence against women to illustrate how dangerous oppression and polarized genders are.

When the drunken Black Lady Halked gave birth to her and Big Joey's Foetal Alcohol Syndrome son at the tavern, she had been sitting in a dark corner drinking beer for three weeks. The bar is described as being "jam-packed with people drinkin' and singin' and smokin' cigarettes and watchin' the dancin' girl"(92). It was full of people who could have intervened, but they were all too busy watching a stripper and getting drunk. Big Joey, who was a bouncer at the bar, did nothing to stop her even though his was the greatest responsibility. In fact he ran away and vomited. Big Joey passively abuses Black Lady Halked by ignoring that he is responsible for her pregnancy and by allowing her to drink at his establishment.

When asked why he did nothing to help when his own child was born or when his son raped Patsy Pegahmagahbow, he recalls his experience at Wounded Knee, where many Natives protested, fought for their rights, and were beaten and arrested by the FBI. He raises his arms as if in battle cry and yells,

> "This is the end of the suffering of a great nation!" That was me. Wounded Knee, South Dakota, spring of '73. The FBI. They beat us to the ground. Again and again and again. Ever since that spring, I've had these dreams where blood is spillin' out from my groin, nothin' there but blood and emptiness. It's like I lost myself (119-120).

This shows that Big Joey feels castrated and thus "feminized" by his experience at Wounded Knee. He literally states that this experience deprived him of his power, which he associates with his male genitalia. Big Joey bases his role in society on being a sexed male; he believes he lost himself since he defines himself by his gender role. He goes on to say, "when I saw this baby comin' out of Caroline, Black Lady…Gazelle dancin'…all this blood…and I knew it was gonna come…I…I tried to stop it…I freaked out"(119-120). This passage illustrates that Big Joey's loss of power and the suffering of his people in society directly influence his current attitude. He has tried to become like the aggressors who beat him down. In the end though, rather than appearing dominant, controlling, and powerful, Big Joey emerges as weak and cowardly.

Through Big Joey Highway demonstrates the danger of assimilating to the dominant cultures' polar gender binary and so-called "superior" way of life. This way of life pits men as tough, controlling, and aggressive against women as sexual objects. He uses Big Joey and his handicapped son, Dickie Bird Halked, to illustrate where assuming polarized masculinity is taking Native men. Rabillard suggests " that there is a political edge to Highway's critique of the polarized genders… in *Dry Lips*, Highway more than hints at an association between opposition of the sexes and White oppression"(15).

In much of this play it is the Native women whom Highway illustrates as being most affected negatively by the hyper-masculine Native male, portrayed most strongly by Big Joey. He exposes this hypersexual masculine identity as dangerous. When telling the other men why he let Dickie Bird rape Patsy, Big Joey says, "Because I hate them! I hate them fuckin' bitches. Because they – our own women – took the fuckin' power away from us faster than the FBI ever did"(120). Big Joey demonstrates that although he resents the women for his loss of power, he primarily lost it to the FBI. This defeat symbolizes the Native people's loss of power in society and "feminization" by colonialism. Since they have lost power, some try to get it back the only way they think they can, by taking it from someone whom Western society places lower than them, Native women. Big Joey is assuming this false sense of power as a form of resistance by trying to gain power over the Native women. As Big Joey's experience proves, this form of resistance is horribly destructive as well as self-defeating.

Although Highway criticizes assimilation to the Western gender dichotomy, he also illustrates some of the male characters' resistance to it. Billingham discusses the construction of masculinity, homo-social, and homosexual relations within the play. She demonstrates that Highway's work subverts conventional Western gender roles. She notes that the issues between the male characters in the play "serve to transgress boundaries and undermine simple binaries"(364). Simple binaries like male/female, colonizer/colonized, and White/Native can be seen as imperial tools of dominance. Through his destabilizing of the gender binary in particular, Highway challenges the dominant norms of Western culture. He subverts conventional gender roles by having men bake and knit and women play hockey. Throughout the play Spooky Lacroix is knitting baby garments and Zachary is baking, while the offstage women are slamming pucks into boards and scrapping on the ice.

Through the women's hockey team and bending of gender norms Highway illustrates that even though at first change comes with some resistance, it is possible. The end of the play gathers the men at the women's hockey game, cheering enthusiastically in the stands, and knitting. By this point of the play Big Joey has had his breakdown where he blames the women for taking his power and has appeared to move past this by showing some respect for them. He even begins announcing their hockey game by saying, "There they are, the most beautiful, daring, death-defying Indian women in the world, the Wasy Wailerettes!" (124). By having the women respected as warrior-like hockey players and the men as nurturers, Highway points out that so-called "natural" gender roles are merely social constructs rather than the naturalized traits they are passed of as.

According to Herek, "Social roles and their attendant psychological identities are not 'given' by nature. Variables such as race, class, gender, and sexual orientation are human creations, based on certain observable phenomena that come to be defined in certain ways through social interaction over time" (567). If we look at gender and other markers and labels as social constructs rather than "natural" we can begin to allow for the possibility of change. Herek states that, "What has been constructed can be deconstructed and reconstructed, albeit with considerable effort"(567). Highway proves the instability of gender roles throughout the play by deconstructing and reconstructing popular Western gender norms.

Tomson Highway illustrates the hyper-masculine in Big Joey as a warning to the audience of his play. He illustrates promise with characters of more diversity and complexity than Big Joey in terms of their masculinity. He also blends gender roles when he illustrates men doing things considered "feminine" in Western culture and women doing things considered "masculine" activities. Highway's work seems to be indicating a need for the lines between different cultures and genders to be less rigid and more fluid. Whether in sex or race, having groups placed as polar opposites where one oppresses the other has a horrifying result. Not all of Highway's male characters fit neatly into the polarized gender dichotomy; this offers the people of his community and of North America hope. While tragedy occurs at the hands of some, it is averted and resolved by others. As Zachary says in his nightmare after Simon is accidentally killed, "this kind of living has got to stop. It's got to stop!" (116). When he wakes up at the end of the play, there is some relief when the audience realizes that this is only a dream. Today's readers and theatre audiences can relax only a little bit though, because the truth and possibility of the dream is frightfully real.

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R4: WHAT IS ROMAN ORNITHOMANCY? A COMPOSITIONAL ANALYSIS OF ANANCIENT ROMAN RITUAL

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Roman ornithomancy was ritualized interpretation of the flights and cries of birds. Roman ornithomancy was a politically prominent ritual enacted by the ancient Romans which has been generally overlooked in Classical scholarship. The first step toward interpreting the historical relevance of a ritual is to perform a compositional analysis of the ritual elements (CARE). In an attempt to describe what Roman ornithomancy was, the compositional elements of the ritual of Roman ornithomancy: chronology, agents, space, and objects; are identified from Livy's text, and further explored using anthropological, archaeological, and historical sources and methodological considerations. To date, a CARE has not been undertaken concerning Roman ornithomancy.

A compositional analysis of ritual elements (CARE) highlights the internal structures and dynamics of the ritual action as differentiated from non-ritual action.[1] This distinction is primarily accomplished by observation of: the order of actions, the individuals involved, what their social roles were, and what objects were required for the ritual action. A CARE aids in guiding the ancient historical interpreter through the extant evidence by suggesting what kinds of elements to notice in the sources.[2]

Interactions between gods and men were considered ubiquitous in the Roman world and
generally took place through ritual action (North 37). The Roman practice of augury is a multifaceted one, encapsulating the inauguration of public space and individuals, often incorporating Roman ornithomancy. Livy's narration of taking the auspices is the fullest extant Latin account of the ritual and will be utilized here to identify many of the compositional elements of Roman ornithomancy. The compositional elements of Roman ornithomancy, as suggested by Livy, will be explored in subsequent paragraphs. Livy's treatment of taking the auspices is translated by de Sélincourt as follows:

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[1] Compositional analysis of ritual process was pioneered in the early twentieth century by anthropologist Arnold Van Gennep in his seminal monograph, Rites of Passage (1960).

[2] Looking at the pieces of information separately ultimately illuminates the whole process, regardless of gaps in the historical record.

> Numa's name was put forward as successor to the throne, [. . .]. He was therefore summoned to the city, and there expressed the wish that the gods should be consulted on his behalf, as in the case of Romulus who at the founding of Rome had assumed power only after the omens had been duly observed. An augur [. . .] escorted Numa to the citadel, where he took his seat on a stone with his face to the south; the augur [. . .] sat on his left, holding in his right hand the smooth, crook-handled staff called the *lituus*. [. . . H]e uttered a prayer, and marking with a glance the space of the sky from the east to west and declaring the southward section to be 'right' and declaring the northward section 'left' he [. . .] transferred the staff to his left hand, [. . .] and spoke these solemn words: 'Father Jupiter, if it is Heaven's will that this man, Numa Pompilius [. . .] should reign in the city of Rome, make clear to us sure signs within those limits I have determined.' Then he named precisely the nature of the signs he hoped would be sent. Sent they were; and Numa duly proclaimed king, went down from from the hill where the auspices were taken (1:17).

Three political agents figure in Livy's telling of the story: Numa; Jupiter; and the augur. Numa was a candidate for king of Rome in approximately 710 BCE. The gods needed to be consulted before he could gain legitimate authority, so the second agent, Jupiter, was asked by the third agent, the augur, whether "Heaven's will" was being carried out by the election of Numa to the position of king. The augur accomplished this by clearly stating how the answer should present itself, so as to be recognized by the augur as an answer. Evidently, Jupiter sent the required messages and Numa's election was proclaimed legitimate by the gods.

Only an augur could legitimately interpret the *auspicia*, or divine signs. Rome implemented a college of augurs while still under the rule of kings,[3] which remained powerful well into the Imperial period. Appointment to the college was for life and, like most religious positions in Rome, often held by important political men, so it had political applications (Linderski, Augures 214). Heaven was consulted before any major decision of state and not to have done so would have been considered irresponsible.[4]

One of the major functions of the college was to preserve and transmit the *disciplina auguralis* to succeeding generations of augurs (Law 2151). The members of the college were governed by established "rules" and performed a number of functions. Remembering all the previous examples augurs recorded and transmitted would have been a task in itself, making augury not so much about the power of reason, but of memory (Linderski, Law 2241). The rules which governed augural interpretation were further compounded by the "scientific elements" related to Roman ornithomancy, which were assessed by means of empirical observation, which relates to the reality that birds

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[3] It is commonly suggested by scholars that Romulus, the first Roman king, and his twin brother, Remus, were trained to take the auspices. See, Vaahtera 100.

[4] Two examples who state this are: Flacelière, ix; Ogilvie, 55.

and their movements can reflect any number of natural phenomena.[5] Signs came not only from the species of bird observed,[6] but also from particulars of their flight (*alites*) or cries (*oscines*). [7] Specific re-creation of augural protocol in relation to Roman ornithomancy is impossible because all the works composed in antiquity concerning the systematization of the discipline have been lost, except that by Cicero (Vaahtera 41).

Durkheim states that symbolism has a paramount function within ritual; through action, actors identify and demarcate places and activities (346-7). [8] Roman ornithomancy made use of physical and social demarcations throughout the process of the ritual. In our case study, Livy tells us that the augur and the king-elect traveled to a demarcated space at the citadel, that facing south the augur stood by Numa, and that when the appropriate signs were observed within the ritual space, they descended the hill back to the city.

In 1962, M. Torelli uncovered the only extant example of an augural *templum* where the citadel at Bantia would have existed during the last century of the Republic.[9] It accords with the Livian account of where the ritual took place during the regal period of Roman history. Nine *cippi*, or posts, were placed in three rows forming a rectangular *templum*. Each *cippo* was oriented westward, so as to face the augur who would be facing southeast.[10] He would have taken the auspices from the *auguratorium*, the tenth, most westward post of a different size. Based on the inscriptions on the posts, the *templum* at Bantia was adapted specifically for the observation of birds. The evidence contained three rows of three posts, just under 10 m square. The inscriptions on the northernmost row from west to east read: C(ontraria), A(ve), A(gurium), P(estiferum); TAAR; B(ene), I(uvante), A(ve). On the centre row from west to east read: FLUS(can); SOLEI; IOVI. The southernmost row from west to east read: southwest, C(ontraria,

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5 Such as barometric pressure or time of year. R. M. Ogilvie. Romans and their Gods: In the Age of Augustus. London: Chatto & Windus, 1979: 58; C. Harrison & A. Greensmith. Birds of the World . New York: Dorling Kindersley, 1993: 16-17.

6 An example could be the spotting of a species of bird that was generally thought to be ominous, such as an owl. Unless, of course, you were an Athenian, in which case it would be considered a favorable omen.

7 Ogilvie 55; Cicero I: LIII. *Alites* interpreted the movements of birds such as eagles, hawks, and ospreys based on their speed, direction, number, and altitude. *Oscines* referred to interpretation of the cries of birds such as ravens, crows, and owls by consideration of the pitch, intonation, and frequency of calls.

8 It should be noted that the ritual of Roman ornithomancy makes effective use of temporal demarcation, which is not included in this discussion.

9 Bantia was 25 kilometers south of modern-day Venosa in southern Italy.

10 That the augur would have been facing southeast is based not only Livy, but Cicero and Varro accord with the layout and orientation of the archaeological find of the *templum* at Bantia (see, next footnote).

A(ve), EN(ebra); south, R(emore), AVE; southeast, SIN(istra), AV(e) (Linderski, "Watching" 339).

The ritual of Roman ornithomancy could be described as a transformation ritual. In the Livian telling, a man ascended the hill to the citadel as the king-elect and descended it, after a positive sign from Jupiter, as the legitimate king of Rome. Van Gennep, identifies the basic ritual sequence as separation, transition, and integration (10). According to Livy, separation of the participants of the ritual from broader society took place after the augur took Numa away from any assembly to the citadel. The transitional phase of the ritual came once the proper positions and a prayer to the gods were executed. The prayer contained an agreement of how to communicate; namely, how the birds would behave and what it would indicate. With the observation of the 'correct' signs, Numa was no longer merely a contender for the throne of Rome, but the *de facto* king. Integration would come with their return and the pronouncement that the auspices declared Numa to be the new king.

The most prominent object utilized by the augurs for the ritual of Roman ornithomancy was the *lituus*, described by Livy and Cicero, as a short, curved staff used in religious ceremonies of divination to mark out the area within which the signs could be observed.[11] Not only was the *lituus* a physical object used by the augurs, simultaneously it was a symbol that was associated with the political and religious authority that characterized the college of augurs.[12] As such, it was utilized symbolically to represent the power of the ritual by the men it affected. It appears on coinage from the late Republic to the third century CE as a symbol of membership in the college of augurs, as a symbol of political power, and as a symbol of the continuity of Roman institutions. For example, we know Pompey relied on this symbol to help solidify his military and political authority (Stewart 181), using the *lituus* as a symbol recognizable to the masses on his coinage (Crawford no. 456/1a=pl. 2. 7). Before 71 BCE Pompey held no elective office nor were his appointments or triumphs gained in a typical way. The allusion to traditional rituals on Pompey's privately issued coinage would have suggested the legitimacy of his command to a wide audience (Stewart 181).

Of the many forms of divination practiced in antiquity, few others were so connected to political power and organization as Roman ornithomancy in the Late Republican and Early Imperial periods of Roman history. In the Imperial period, the college became less effective due to political maneuvering by Augustus and subsequent emperors. The political power associated with the college increasingly came from its association with the ritual symbols rather than the ritual actions themselves. For example, the role of the college of augurs as one of legitimizing the role of a "big man" through favorable omens in the Republican period shifted to one of "legitimation by association" with the emperor in the Imperial period. The reality was that the political associations it

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[11] Livy 1:18; Cicero 1:17.

[12] Kertzer states that, "through symbolism we recognize who are powerful and who are the weak, and through the manipulation of symbols the powerful reinforce their authority." (Kertzer 3).

previously held became defunct in the imperial system where authority and divinity came to be intrinsic to the office of Emperor itself.

A compositional analysis of ritual elements (CARE) proves to be an illustrative first step to a better understanding of the role ritual played in Roman society. Roman ornithomancy was a powerful and influential ritual and symbol, which would be adapted and revitalized, contributing to a semblance of continuity, during the chaotic shift from Republic to Empire. Roman religion was a fluid concept, tolerant and integrating in nature. Roman tradition was less so. Like most traditions, precedent was of utmost importance, something for the Roman people to recognize as legitimate. The ritual of Roman ornithomancy held precedence in Roman society, and was adapted to fit the changing political climate. Roman ornithomancy was only one piece of an extremely complicated religio-socio-political system of beliefs and rites.

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R5: Experiential Therapy for Parkinson's Disease

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INTRODUCTION

More than half a century ago Donald Hebb, a famous Canadian psychologist, took some rats from his laboratory and let them run around his home freely. He then brought these animals back to the lab where they were tested on various cognitive tasks, such as finding their way out of a maze. The data showed that these animals performed significantly better than animals that remained in the standard laboratory condition. From these experiments Hebb concluded that the experience of roaming through his home enhanced the learning and memory capacity in these animals (Hebb, 1947). Since Hebb's pioneering observations numerous studies have explored the concept that experience changes brain structure and function.

The purpose of this review is to summarize the major findings that led to the suggestion that an experience-based therapy can be used to treat the functional deficits caused by brain damage. Furthermore, we will provide evidence showing that experience, also known as experiential therapy might be useful to treat symptoms and progression of Parkinson's disease.

Experience can promote brain plasticity

Hebb's original findings of improved cognitive function in rats coming from an enriched environment (his home) were investigated in more detail by a group from Berkeley. During the past four decades, Mark Rosenzweig and Marian Diamond made spectacular findings when exposing laboratory rats to an enriched environment, which provided a variety of stimulation, including toys, a rich diet and social activities (Rosenzweig et al., 1962; Rosenzweig, 2003). Using this paradigm, the researchers demonstrated that experience influences brain plasticity, including cortical thickness, dendritic structure and levels of the neurotransmitter acetylcholine. These changes in brain structure are usually associated with behavioural changes, such as improved learning abilities (Kolb et al., 2003).

While the capacity for plasticity is mainly larger in the infant brain and then declines with age, experience can modify the degree of plasticity at any age and developmental stage. For instance, experience is able to influence development and plasticity of the prenatal brain. More than 2000 years ago the Chinese culture gave recommendations on maternal behaviour that was supposed to positively influence the development of the fetus's brain and led to favorable behaviour in the child (Reser, 2006).

In turn, the infant brain shapes its connections according to environmental influences and demand; the so call "use it or lose it" effect (for review, see Black, 1998). In the adult brain, plasticity can be triggered by exposure to a new environment and new sensory stimulation (Kolb and Whishaw, 1998). In general, there are three ways experience can alter the brain. First, it can modify the unfolding of the brain structure. Second, it can modify existing brain circuitry. Finally, it can create novel circuitry (Kolb and Metz, 2003). In addition, it has been shown that different types of experience, also known as experiential therapies, promote recovery after brain damage in laboratory rodents (Whishaw et al., 1986; Kolb and Whishaw, 1998; Johansson et al., 1999). These therapies can support recovery from stroke, traumatic brain and spinal cord injury, and they are receiving increasing attention in the treatment of neurodegenerative diseases, such as Parkinson's disease.

Parkinson's disease

Parkinson's disease was first described by the physician James Parkinson in his legendary 1817 paper entitled "An Essay on the Shaking Palsy" (Parkinson, 1817). Parkinson's disease is a slow progressive neurodegenerative condition mainly affecting the elderly (Smeyne and Jackson-Lewis, 2005). The disease is characterized by death of neurons in the basal ganglia, a part of the brain that controls movement. The resulting loss of the neurotransmitter dopamine leads to symptoms including an overall decrease in movements, tremor in the limbs, and disturbed posture and balance. Non-motor symptoms such as depression might also appear at a later stage of this disease (Smeyne and Jackson-Lewis, 2005). The major issue in Parkinson's disease is that its causes are poorly understood. Suspected risk factors include exposure to environmental toxins, lifestyle and genetic predisposition (Allam et al., 2005). While Parkinson's disease has multiple triggers, no cure is yet available. While one branch of treatments target replacement of the lost dopamine, a promising line of research has focused on slowing the progression of cell death (Gorell et al., 2004). Recent advances in basic and clinical research have suggested that experiential therapies may present an interesting new treatment avenue to slow the progression of motor symptoms in Parkinson's disease (Gorell et al., 2004).

Experiential therapies in Parkinson's disease models

Experiential therapy for laboratory animals has mainly utilized environmental enrichment (Kolb and Whishaw, 1998). An enriched environment usually provides housing conditions that go beyond the fundamental requirements of animal's welfare by offering complex housing conditions that encourage the animal to engage in a variety of different behaviours. A typical complex housing facility for rats is illustrated in Figure 1. This environment allows for greater sensory stimulation, exploration of the environment and motor activity, and social interaction (Kolb et al., 2003; Dobrossy and Dunnett, 2004).

In rat models of Parkinson's disease, enriching the animals' environment can increase the survival of implanted stem cells (Dobrossy and Dunnett, 2004). These cells produce dopamine to replace some of the lost neurotransmitter and thus can promote functional recovery in the treated animals. Similarly, an enriched environment has also been shown to alleviate both behavioural symptoms and cell death in rat models of other

neurodegenerative diseases, such as Huntington's disease (Spires et al., 2004). Furthermore, an enriched environment leads to increased neurogenesis, the creation of new neurons, and an increased expression of neurotrophic factors that promote the survival of damaged neurons (Ickes et al., 2000; Pham et al., 2002). Both these consequences might be particularly important in neurodegenerative diseases because lost neurons might be replaced or damaged neurons might be rescued and thus the progression of the disease could be halted (Spires et al., 2004). These mechanisms could mediate improved behavioural function in a rat model of Parkinson's disease, which was described in a recent study by our laboratory (Jadavji et al., 2006). In this study, rats were exposed to enriched environment both before and after dopamine depletion lesion, which resembles the key features of human Parkinson's disease. Compared to animals housed in standard laboratory condition, animals housed in an enriched environment obtained more food pellets successfully while performing a skilled reaching task (Jadavji et al., 2006).

Experience and experiential therapies for patients with Parkinson's disease

Experience in humans is thought to modulate the course of neurodegenerative diseases by either delaying the onset of the disease, or by slowing the progression of symptoms once the disease occurred. The onset of Parkinson's disease, for instance, might be influenced by a number of environmental factors. A recent study reporting that certain occupational groups, such as farmers and teachers, might have an increased risk of Parkinson's disease, has received much attention (Frigerio et al., 2006). Another study has found that subjects with more than nine years of education had an increased risk of being diagnosed with Parkinson's disease later in life (Frigerio et al., 2005). Such findings, however, are controversial, as the amount of education might be positively related to increased levels of neurotrophic factors and more complex neuronal structures that might delay the onset of Parkinson's disease (Jacobs et al., 1993). Aside from occupation, another potential experiential influence to affect the risk of Parkinson's disease is physical exercise. Chen et al. (2005) demonstrated that men and women who participate in strenuous exercise during early adulthood tend to have a decreased risk of being diagnosed with Parkinson's disease and in laboratory animal models, it has been shown, that exercise causes an increase of several neurotrophic factors, including brain-derived neurotrophic factor, which protect dopaminergic cells and preserve the animal's behavioural abilities (Dobrossy and Dunnett, 2004; Chen et al., 2005).

For the treatment of patients with Parkinson's disease, it is difficult to create an enriched environment similar to that in studies using laboratory rodents. Other lifestyle factors and individual predisposition play a role, which may obscure potential enrichment influences in a patient population. Most experiential therapies are based on physical exercise. Physical therapy has become a standard regimen to improve physical capability and quality of life in patients with movement disorders (Cees et al., 2001). Palmer et al., (1986) reported that when Parkinson's patients were exposed to a twelve-week exercise program they experienced improvements in gait, tremor, grip strength and motor coordination. In addition, Comella et al., (1994) exposed Parkinson's disease patients to a four-week period of intensive physical rehabilitation program and found that all treated individuals improved when tested with the Unified Parkinson's Disease Rating Scale. This scale is used by clinicians to monitor progression of the disease over time based on

motor, general physical ability, and mood of patients (Fahn et al., 1987). Comella et al. (1994) continued to assess the patient's abilities according to the Unified Parkinson's Disease Rating Scale for a further six months after the rehabilitation program. Because the patients did not regularly exercise any more, their scores returned to baseline. This observation suggests that the improvement caused by physical activity is not sustained after cessation of the rehabilitation program (Comella et al., 1994). These findings indicate that physical exercise is more effective when enhanced levels of activity are maintained throughout lifetime and this could be due to the increased levels of neurotrophic factors that are released during exercise. Enhanced levels of activity could be achieved by the adoption of an enriched life style. In addition, it is possible that the benefits of experiential therapy can be further enhanced when combined with drug therapy to provide patients with a comprehensive treatment (Formisanoe et al., 1992).

DISCUSSION

Experience is one of the main influences on brain plasticity that affects its structure and function. One way to induce desired changes in brain structure and function is experiential therapy. An example of experiential therapy for laboratory animals is enriched environment. Enriched environment provides animals with increased sensory, motor and social stimulation. It has been shown that an enriched environment promotes compensatory and protective mechanisms that support functional improvement after dopamine depletion in animal models of Parkinson's disease. While most work characterizing the influence of experience on Parkinson's disease has used the controlled setting of animal models, empirical evidence also indicates that experience may influence the onset of this disease and the symptoms associated with it. Parkinson's disease is a progressive neurodegenerative condition that leads to major motor impairments as result of dopamine loss in the basal ganglia. The course of this disease might be influenced by experience such as occupation, education, and physical activity.

Mechanism of experiential therapies

It has been hypothesized that the beneficial effects of experiential therapies involve increased levels of neurotrophic factors such as brain-derived neurotrophic factor or glial cell line-derived neurotrophic factor (Dobrossy and Dunnett, 2003; Chen et al., 2005). The expression of both these neurotrophic factors can be increased by exercise (Adlard et al., 2005). Experiential therapies, in particular enriched environments, have been thought to increase exercise levels, therefore increasing the expression of neurotrophic factors (Dobrossy and Dunnett, 2003; Spires et al., 2004; Chen et al., 2005), which promote survival and growth of dopamine neurons and thus might protect the brain from developing Parkinson's disease.

Experiential therapy can also modulate gene expression (Kolb and Whishaw, 1998; Rampon et al., 2000). In particular, Rampon et al. (2000) showed that laboratory animals housed in an enriched environment for either three hours or fourteen days exhibit increased gene activity particularly of genes that are involved in modulating synaptic signaling, neurotransmission and plasticity. Thus, gene expression might represent another potential mechanism how experiential therapy might affect the course of Parkinson's disease.

Future of experiential therapies for Parkinson's disease

Previous studies have acknowledged the importance of identifying the active element of enriched environment in order to help develop more specific regimes for post-operative care for individuals suffering from brain damage (Dobrossy and Dunnett, 2004). A recent report by Gorell et al. (2004) hypothesized that the ideal model to delineate the risk of Parkinson's disease encompasses three factors: occupation and environment, genetic factors, and lifestyle, i.e. experience. These factors individually and collectively play a significant role in the onset of the disease. Thus, it can be assumed that future successful treatments for Parkinson's disease will use a combination of treatments to target each of these three factors. Experiential therapy will undoubtedly represent a major component in this new treatment strategy.

Fig. 1. Photograph of a complex housing facility to represent an enriched environment. Rats were able to enter three levels of the housing facility, each of which included various foods, toys and objects to manipulate.

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R6: HOW TEACHER ASSISTANTS ENHANCE THE ONLINE LEARNING ENVIRONMENT

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Preview of a Teacher Assistant Manual for an Online Graduate Counseling Course

The role of a Teacher Assistant (TA) is valuable in the face-to-face classroom but how does a TA transfer into an online learning environment? E-learning theory can be used to provide a framework for how TAs can be instrumental in building an online community. This article provides a preview of a manual created to help TAs facilitate graduate courses in an e-learning environment. This manual, currently a work in progress, is part of the author's final project, one of the final steps required to fulfill the criteria to graduate with a Master of Counseling degree.

To begin a brief overview of the context of the manual will be presented. Thereafter an explanation as to why a manual of this nature is required. This will be followed by a brief introduction to e-learning theory; specifically information surrounding facilitation and student response patterns. The article will close with an overview of the manual, including a brief description of each chapter.

Being an Online Teacher Assistant

Why Use a TA in an Online Course?

TAs are an important resource within the academic graduate community, as they provide support for both professors and students. According to Taradi and Taradi (2005), the role of a TA can be described as a montage of content expert, learning process design expert, and process implementation manager. Additionally, Palloff and Pratt (1999) emphasis that "it is critical to remember that *people* are using the machinery that make courses go. The human element, therefore, will inevitably play a role in the electronic classroom"(p. 45). They contended that a TA acts as the linking force between individuals, classrooms, and content.

The Context of the Manual

Campus Alberta Applied Psychology [CAAP]: Counseling Initiative is an equal partnership among three leading universities in Alberta: Athabasca University, the University of Calgary, and the University of Lethbridge. It offers a Master of Counseling degree. This partnership developed in response to the need for better access to graduate programming in Counseling in Canada and around the world. This initiative is committed to providing high quality, accessible, and flexible graduate education to students regardless of their location (for more information please refer to the program website: www.abcounsellored.net). CAAP is a unique institution because it provides its graduate

students with an asynchronous, online, e-learning environment with residential components. CAAP employs senior graduate students as TAs in a number of its intensive core (required) courses.

Manual Overview

The following, as shared in the presentation for University of Lethbridge Inaugural Graduate Students On-Campus Conference, is an introduction to what should be in a TA manual for online courses. The manual is a working document and is being shared as this is one of the first documents of its kind the author is aware of in the online community.

The proposed TA manual has 11 chapters. The following is a summary of some of the main sections in the manual. Copies of the manual will be available in 2007 and will be located in the final project link found in the CAAP website.

To begin, the first section of the manual will discuss online theory and its relevance to the role of a TA. This section will be extensive as TAs need to understand the unique learning environment online instruction presents. The following is a brief summary of the material which will be discussed in the manual.

CH 1: *Online Theory*

E-learning and the Role of the TA

Facilitation

A successful online leader adopts the role of facilitator, also known in the online community as an e-moderator (Salmon, 2004). An e-moderator is more than a traditional lecturer. This person supervises the electronic classroom in order to assure that student learning is taking place. Successful e-moderators monitor their electronic classroom from the following perspectives as discussed by Berg (1995): pedagogical, social, managerial, and technical. An effective e-moderator works to maintain all four aspects in their virtual environment.

Pedagogical. This perspective relates to how information is passed on to students (Collins & Berg, 1996). TAs are encouraged to share and develop knowledge through the use of questions and probes. The focus is to draw out student responses that center discussions on essential concepts, principles and skills. TAs would be wise to follow the advice of Berg (1995) to create a strong pedagogical foundation. For instance, ensure the objectives of the course are presented to the students in a clear and direct manner, have a warm and open style to relating to the students as opposed using an authoritarian style, and summarize discussions.

Social. The social focus of instruction involves developing a supportive online classroom environment (Collins & Berg, 1996). Students in a face-to-face classroom use body language to monitor how others react to them. In an e-learning environment however, immediate feedback is not available. Comments posted to a discussion forum have the potential to be disrespectful even though it was not the author's intention to convey such a message. It is very important that a TA immediately addresses negative discussion behavior as this may lead to tension and fear within the online community. If it comes to the TAs attention that a student is reacting in negative manner, it is best to address the student promptly and privately in order to provide support for the student, while intercepting a potential negative situation.

Through monitoring the e-tone (mood) of a discussion forum a TA can gain valuable insight into the cohesiveness of the group. Berg and Collins (1996) provide

many suggestions for creating a supportive e-learning environment. TAs are encouraged to model responses that demonstrate respect, tentative language and curiosity, as these qualities project an attitude of acceptance of alternative ideas.

Managerial. The managerial aspect of instruction relates to the administrative roles held by the facilitator (Collins & Berg, 1996). Berg (1995) provides a variety of suggestions for assisting students to stay on top of the work load. TAs can assist their students through making sure that students are aware of the time lines and expectations for all assignments. As well, establishing a forum where students can post their questions regarding assignments allows the TA to provide timely and responsive feedback which will benefit the whole group.

Technical. The technical aspect of instruction involves the roles of providing technical support (Collins & Berg, 1996). Students who are novice at using technology may limit their contributions due to a lack of confidence in their ability to use the system. TAs would benefit by following recommendations provided by Berg (1995) for offering technical support. TAs should not take ownership for providing answers to all technical concerns. Rather than solving all issues, a TA should direct their students towards the correct path. This stance will be beneficial in the long run, as students will need to learn to function independently in the online environment. In addition, students should be encouraged to consult and support their peers. This not only provides technical support, but also works to develop positive group cohesiveness.

Student Response Patterns

Salmon (2004) proposes that students progress through five stages, or levels of dependence, during their maturation as learners in a online learning environment. While all groups will move through the stages during the semester, it is not guaranteed that every class, nor every student, will progress to stage five. The following is a summary of each of the stages. In addition recommendations are provided for effective TA facilitation at each of the levels.

Stage one. A student at this stage is becoming initiated to the e-learning environment. “Stage one is when e-moderators can look out for any sign of life online from new students” (Salmon, 2004, p. 32). TAs are encouraged to take the initiative to contact all new students either by email, or in some cases by telephone, to assure that students have begun their journey online. The amount of time that a student remains in stage one may be influenced by their attitude towards computers, effective help, time and effort.

TAs are encouraged, early in the course, to share their feelings and experiences when they were a student as it can be normalizing and inspiration for the new students. As well, TAs can ease the apprehension online learners initially feel by providing instructions and tips for using software and encouraging students to practice using the various functions. Once a student has successfully posted their first online message, they are ready for stage two.

Stage two. Students who are functioning at stage two are learning to become familiar with the virtual learning environment. At this stage students work to develop their netiquette- communication patterns (Salmon 2004) as well as group norms (Salmon; Salmon & Giles, 1997; Collins & Berg, 1996). TAs are working to create a virtual third culture (Salmon, 2004). Mann (2001) maintains that if e-learners feel isolated, they may

distance themselves also from the topic. Therefore at stage two, TAs should provide opportunities for socialization such as providing informal chat-rooms where non-classroom content can be discussed. According to Salmon this is the point where "e-moderators should take the lead in promoting mutual respect between participants, defusing problems and Counseling any apparently alienated or offended individuals" (p. 36). Through role modeling and mediation, a TA can co-create a positive virtual environment.

Stage three. Once students have become familiar with the norms and protocols of online instruction they move into stage three where they are active in critical reflection, problem solving, and in sharing resources. At this stage TAs should acknowledge information shared by participants and allow students to the time and space to understand the material being presented to them. It is also important that TAs confirm the credibility, authenticity and verification of information offered (Salmon, 2004). Feedback of this nature motivates students to continue to pursue active thinking.

Stage four. Students working in stage four tend to; ask more questions, seek more discussion, challenge the ideas of others and provide compliments (Salmon, 2004). Organization and management is particularly crucial at this point as students can become caught up in the flurry of information. TAs, in the position of an e-moderator, have the responsibility to summarize discussions, avoid authoritative statements, stimulate debate, offer ideas and offer resources (Salmon).

Stage five. Students who progress to stage five have matured into a meta-cognitive state. TAs who facilitate a group at stage five adopt a collaborative method of instruction (Salmon, 2004). This style of learning recommends that TA foster an environment of curiosity and respectful inquiry.

CH 2: Top 10 Tips for Surviving 601

The second chapter in the manual will present a top 10 list for being an effective TA. These tips are based on the author's two years of TA experience. The following table summarizes the tips (see table 1). It was decided to use a Top 10 list as a way to engage the reader as well as to serve as a review from chapter 1. It is also a document that the TA can print off and referred to on a regular basis.

Table 1

Top Ten Tips

10) Plan Ahead: Review lesson plans ahead of time, anticipating points in the course where students will need more support. Plan on being online at least once a day during the week, and twice a day on the weekends.	**9) Use Templates:** Keeping track of student records is challenging. Submitting marks into a pre-established template of expectations allows you to quickly scan each students progress.
8) Stay Connected: Biweekly meetings (or chats) can help you stay in sync with your professor's expectations. And, to help you feel supported as the students progress through the various learning stages.	**7) Ask Questions:** Consult with your fellow TAs around topics such as APA formatting or student behavior.
6) Empower Your Students: Facilitate don't direct.	**5) Be Strict with your APA Standards:** You do a disservice to beginning students if you are slack with your APA marking as they will not have appropriate experience with what is expected at a graduate level.
4) Find a Balance: Your job as a TA is important but so is your family and other course work. Be aware if burnout.	**3) Be Patient:** New students are probably intimidated by the technology and the volume of work required of them. Take the time to walk them through their first experiences.
2) Remember What it Was Like For You: What was it like to be in 601? What did your TA do for you that you appreciated?	**1) Have fun:** If your attitude is upbeat and passionate, you will role model learning can be fun.

CH 3: Keeping the Communication Lines Open with the Professor Working with the TA

The third chapter will focus on the importance of staying in contact with the professor. For example, the manual will suggest that TAs and professors schedule a weekly chatroom meeting. While a TA and professor will exchange emails around minor questions throughout the week it may still be important for the TA and professor to schedule a weekly *chatroom visit* for the first few weeks of the term in order to make sure that both individuals are in sync. Later in a semester the team may choose to move to a bi-weekly meeting once the general pattern of responses has been established. These meeting times are beneficial for exchanging information and providing feedback. This is a time to share compliments, concerns.

CH 4: Making Use of Your TA Team and Mentor

Weldford (1996) speculates that "most new TAs seek the advice of other senior TAs in their respective courses (or at least departments) for advice and guidance" (p.7). The fourth chapter will be a reflection on mentorship; including the need for fellow TAs to support one another in an online community

CH 5: Communication Mediums

The fifth chapter will provide concrete suggestions for completing a number of tasks associated with managing an online environment. Sample topics include:

1. Creating group lists - This can be useful for sending out mass emails, as well as tracking student participation rates.
2. Appropriate response times - This is particularly important in an asynchronous environment, as there is not a standard time when all individuals need to be online. While different institutions may have different standards it is useful to suggest a response time of 48 hours. It is important to post expected response times at the beginning of the semester so that students become accustomed to waiting for a response.

CH 6: Encouraging Students to Come up With the Answers Themselves:

The seventh chapter will teach TAs how to effectively support student growth and thinking development. Part of being a graduate student is learning to become an active thinker. TAs are encouraged to elicit the following styles of responses from students in the discussion forum: (a) offering new ideas, (b) asking questions to promote critical thinking, (c) articulating their ideas in a clear, effective manner (d) exploring alternative perspectives, (e) reflecting on their own lives related to the topic, (f) critiquing various points of view, (g) summarizing and/ or (h) proposing actions (Salmon & Giles, 1996) .

CH 8: Staying On Top of the Work Load

The eighth chapter will provide TAs with sample copies of spread sheets and marking rubrics. It is useful to provide such resources for TAs in order to promote consistency.

CH 9: Typical Student Behavior Patterns

Many students new to graduate studies follow a typical posting response pattern in relation to their feelings of confidence (Young & McSporran, 2003). The ninth chapter will focus on describing typical student responses at various points throughout the term followed by recommendations on how to handle these student responses.

CH 10: The Importance of APA

APA is particularly important in an online, text-based environment. The tenth chapter will provide reasons why it is important for TA's to model appropriate APA formatting. It also provides answers to some common APA errors that first year students typically make.

CH 11: Ethical Considerations

Based on the principals of the Canadian Psychological Association (CAP) the eleventh chapter will address potential ethical dilemmas which a TA might face with students and/or professors. A potential question to explore in this section would be whether or not it would be ethically appropriate to mark a friend's paper.

CH 12: Handling Disputes Between Students and Teachers

TAs are reminded that "harassment of any kind must be stopped immediately online, as it is on campuses and in corporate environments, to ensure equality of learning

for all”(Salmon, 2004, p.121). At times a student may choose to express problems that he or she is having with the instructor of a course. As text is a more permanent form of communication than the spoke word, it is particularly important that such discontent is addressed before the emotion flares out to other students. The final chapter will focus on suggestions for handling such situations as defusing conflict in person (e.g., telephone conference call) rather than online postings.

Conclusion

As a graduate student who works as a TA, this manual is a needed resource. Based on a TA’s perspective, the ideas presented in this overview acquaint the reader with some of the issues relevant to learning. To access the full manual, please locate the manual on the Campus Alberta’s centre of distance education digital thesis & project room after July 1, 2007.

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R7: THE CONTINUOUS EFFECTS OF FORMERLY BATTERED WOMEN

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Violence and abuse suffered by women is a worldwide concern, with at least one woman in three beaten, coerced into sex, or otherwise abused by her partner in her lifetime. This statistic crosses all races, cultures and countries, showing its existence regardless differing cultural values (Hanvey & Kinnon, 1993). Relationship violence is one of the most widespread human rights abuses and public health problems today. In Canada this violation can be found cutting across socioeconomic class, religion, and ethnic lines (Pan American Health Organization, 2003). The abuse itself is more than cuts, bruises and broken bones; violence often causes psychological damage expressed as trauma. While many women receive counselling for the psychological effects of abuse in shelters and women's centres, mental disorders and for some will remain long-term, expressed as psychological trauma which has remained unresolved. This paper will be discussing the relationship between abusive relationships and psychological consequences, the effects of psychological trauma on the expression of mental disorders, as well as how the health system is dealing with trauma identification. The main purpose of the research is to answer how abused women are being treated for the trauma endured outside of the abusive relationship.

According to a world-wide study conducted by Pan American Health Organization (2003), domestic violence is a multi-causal problem influenced by social, economic, psychological, legal, cultural, and biological factors. Violence is expressed through a variety of avenues ranging from psychological to physical harm, with intentionality placed on control over a woman. Most women in the study were found to suffer from dominating control such as battery multiple times, maintaining both physical and psychological problems over extended periods of time.

Physical violence is almost always accompanied by psychological abuse. However as damaging physical abuse may be, it has been found that the psychological consequences are much more damaging. Trauma is a term often used to describe the depth of psychological harm experienced by relationship abuse, and according to Mcquaid, et al. (2001), there is a wide range of experiences that meet the definitions of trauma. Traumatic events were shown to vary in the severity, course of time and level of involvement by the victim. Psychological effects such as trauma have been increasingly recognized as major public health problem both in terms of physical and psychological

concerns (Gold, 2004; PAHO, 2003; Thompson et al., 1999). According to Gold (2004), a history of exposure to abusive trauma is not only related to impaired psychological functioning but to serious health risks as well. Mental health problems as a result of abuse include Post-Traumatic Stress Disorder (PTSD), depression, suicide and suicide attempts, anxiety, phobias/panic disorders, sexual dysfunction, low self-esteem and substance abuse (Austin, Lawrence & Foy, 1993; Brown, 2004; Campbell, Sullivan & Davidson, 1995; Cascardi, O'Leary, & Schlee, 1999; Feeny, Zoellner, & Foa, 2000; Gold, 2004; Golding, 1999; Kubant, et. Al, 2004; Koss & Herrera, 2003; Lecruiber, 2004; Mcquaid, et. Al., 2001; Neria, Bromet, & Marshall, 2002; PAHO, 2003; Roth, 1997; Scholle, Rost, & Golding, 1998; Thompson et al, 1999).

A dose-response relationship exists for many women who are currently or have been previously been in an abusive relationship with their domestic partner. This dose-response relationship refers to the connection found by many studies stating the more abusive behaviour experienced, the more mental trauma endured. Austin (1993) conducted a study proposing diagnostic levels of posttraumatic stress disorder (PTSD) had a relationship with trauma and abuse endured during a woman's violent relationship. In this study it was found that as severity and frequency of violence increases the development and severity of PTSD also increases. Golding (1999), found similar evidence through exploring a range of dose-response studies in which the relationship between intimate partner violence and mental health problems were consistently associated. The study revealed that there seems to be a dose-response relationship between severity of violence and mental disorder development, such as depression and PTSD.

Gold (2004) identified a dose-response relationship between adverse childhood experiences such as witnessing maternal battering and experience of physical or sexual abuse and the later participation of health-risk behaviours such as smoking, abusing alcohol and having multiple sexual partners. This is interesting as there have been many studies exploring the relationship between the incidence of women abused in intimate relationships and their past childhood abuse. Cloitre, Scarvalone, Difede (1997), found that traumatized women were often abused in childhood then re-victimized by their partner in adulthood. This correlation showed that there is a strong prediction for those abused in childhood to enter abusive relationships in the future. They also found that these re-traumatized women had higher levels of suicidal tendencies, with at least one suicide attempt in their lifetime. Higher levels of PTSD were also found diagnosed in re-traumatized women rather than those abused in adulthood only. Factors such as retraumatization change traditional theoretical ideas of trauma and psychological maladjustment being caused by the violent relationship alone. Multiple traumatic experiences at various points in a life-span contribute to creating an underlying foundation of trauma. Dube et al. (2002) also found dysfunctional or chaotic home life, witnessing domestic violence and experiencing childhood abuse, all of which can have a negative impact, aiding in the complexity of the dose-response relationship between violence, trauma and psychological disorder expression.

Literature has suggested that not all traumas, even the most severe in nature lead to the development of mental disorders (Mcquaid et. Al, 2001; Koss & Herrera, 2003). Whether or not a battered woman develops depression or PTSD may depend on several

variables, such as if the woman has social support or pre-trauma characteristics. Campbell, Sullivan and Davidson (1995), found that among women with abusive partners, social support may play an important role in how they are able to respond to the stress, perception, and experience of violence in the abusive relationship. Both previous and current levels of social support may help women cope with the stress in their lives, easing their psychological distress and anxieties. Koss & Herrera (2003) also stated that pre-trauma characteristics, such as personality influences a woman's perceptions of intimate violence experienced. Moreover, the severity of abuse depends on not only on the severity of abuse and frequency in creating psychological trauma, but in whom it happened to.

The mental health consequences of relationship abuse have been shown to have ripple effects expressed in the development of psychological consequences. Several studies have found that battered women suffer from a range of symptoms, such as hyper arousal, nightmares, anxiety, as well as fear, sleep and eating disorders. However, the most implicated mental disorders in research are post-traumatic stress disorder (PTSD) and depression; both are highly correlated with relationship abuse, and trauma endured (Brown, 2004). Casandri and Colleagues (1999), found that physical abuse, dominance and isolation may create or exacerbate a context of intimidation giving rise to fearfulness, subsequently expressing PTSD and major depression development. Severity of physical violence and variety of forms of psychological abuse/maltreatment employed predict the development of PTSD, depression and psychological symptoms. It was also found that PTSD and major depression often co-occur and may be related, but are believed to be separate clinical disorders in abused women. This separation was made through their findings stating that there are different predictors for experiencing PTSD and depression.

While PTSD and depression have been found co-morbidly expressed within individuals who have experienced relationship abuse, depression has itself been implicated by several studies to be highly associated with both partner violence and trauma subsequently endured (Campbell, Sullivan & Davidson, 1995; Clements & Sahney, 2000; Gold, 2004; PAHO, 2003; Scholle, Rost, & Golding, 1998). According to Gold (2004), although PTSD is the disorder most commonly associated with exposure to trauma, major depression is as or even more prevalent among trauma survivors.

Fear generation, threat of future violence, repeated and systematic physical and emotional attacks are characteristics of abusive relationships, which intentionally undermine an abused woman's self esteem and may contribute to the many characteristics of depression symptomlogy. These features of depression include: the self-view of worthlessness, inadequacy, unlovable, and deficient, as well as feeling helplessness (Cascardi, O'Leary & Schlee, 1999).Helplessness has been found as a trademark symptom of depression (Segal & Ferguson, 1999) and has been used as an indicator of the disorder by several studies involving relationship abuse. Clements and Sawhney (2000) found that in domestic violence situations, factors such as helplessness expectancies might explain passivity to violence and difficulty coping with abusive episodes. In the study battered women who attributed their cause of abuse to internal, global and stable factors were found more likely to exhibit helplessness and associated deficits, including depressed affect, poor coping skills, and impaired cognitive functioning. Many empirical studies have shown a consist relationship between intimate

partner violence and subsequent development of depression. Scholle, Rost, and Golding, (1998), found a 55% prevalence rate of physical abuse in adulthood in a sample of depressed women. Following this up Koss & Herrera (2003), reported the rates of depression among battered women ranged from 39%-83%. A meta-analysis completed by Golding (1999), found that across 18 studies measuring abused women and incidence of depression, the mean prevalence was 47.6% in comparison with the range among all women with depression being 10.2%.

Posttraumatic stress disorder (PTSD) is the most commonly identified mental disorder used to measure psychological trauma endured in abusive relationship. Physical and sexual abuse experienced in violent relationships share several characteristics involving terror and captivity at the hand of another that may increase the likelihood of PTSD. Clinical presentations reflective of the disorder include self-regulation, self-definition and adaptation style deficits which have been noted frequently among abused women who are seeking trauma treatment (Roth, et al., 1997). Guilt has also been found associated with the development and severity of PTSD as reported in the Kubant et al. (2004). Development of PTSD in trauma survivors of abuse was studied by Feeny, Zoeller, & Foa (2000), who reported that dissociation occurring during or immediately after a trauma predicts later post-trauma psychopathology. In addition, it was also identified that trauma victims of abuse exhibit more dissociative symptoms, elevated anger, emotional disengagement and avoidance for engagement with trauma-related emotions; all of which are related to general psychopathology development of PTSD.

Empirical literature has demonstrated a relationship between the severity of stress including life threat, physical injury and horror with the risk of developing PTSD. Abusive relationships fit these criteria because it often involves severe and frequent physical violence in combination with controlling/isolating behaviours by the spouse. This in turn was found likely to increase a woman's fear and perception of safety (Cascardi, O'Leary & Schlee, 1999). McQuaid (2001), reported that exposure to at least one traumatic event occurred among 68.2% of their sample with 20.0% manifesting current or partial symptomlogy of PTSD. Golding's 1999 meta-analysis examined 11 studies reporting on the relationship between spousal abuse and trauma expression of PTSD, and found that 31%-84.4% of battered women met the criteria for PTSD. The mean prevalence was 63.8% compared to the general population of women with PTSD of 1.3% to 12.3%. Golding's findings help emphasize the major impact domestic violence has on women in terms of psychological trauma expressed in a prime mental disorder such as PTSD.

Exposure to physical abuse appears to create barriers that limit women's ability to obtain mental health care from either a general medical physician or a mental health worker; although they are five times as likely to seek care for their physical problems (Scholle, Rost & Golding, 1998). This shows a marked discretion on the part of the health care system to treat the physical wounds of battery over psychological trauma. Hanvey & Kinnon (1993) found that health professionals are ill-equipped to detect, appropriately treat or refer women who are abused by their spouse. The reasons included lack of personal knowledge on the subject, social norms, the structure and philosophy of medicine, lack of skill and knowledge, and the structure of the health care system. Similar findings have subsequently been found; studies have reported physicians rarely

identify psychopathology in their patients. Reasons cited for the low levels of psychopathology identification include work load and time limitations allotted for physician consultations (Carey et al., 2003; Waalan et al., 2000). According to Gold (2004), multiple sources of evidence strongly suggest traumatic and post-traumatic stress reactions are likely to be prevalent in primary care settings. This was seen as problematic because physicians were reported rarely be trained to recognize indicators of the possible presence of trauma. Basically women with trauma symptoms are not receiving help for their psychological issues in their initial contacts with the health system.

The lack of psychological trauma identification by initial response of heath care is extremely problematic because psychopathology due to trauma is subsequently emerging at this time. Feeny, Zoellner & Foa (2000), suggested that among assault victims, engagement with the traumatic memory immediately after the assault should be encouraged to help avoid PTSD development of dissociation. It is also important to consider that lack of identification of abuse along side psychological psychopathologies such as depression and PTSD could be fatal. A study by Thompson et al. (1999), sampled a large number of women presented in the hospital emergency department. Findings reported that those who experienced prior partner abuse were more likely than non abused women to have made suicide attempts. Specifically women who had recently attempted suicide were approximately three times more likely to have experienced physical abuse and three times more likely to meet criteria for PTSD. Golding's (1999) meta-analysis found prevalence rates of suicide ranging from 4.6% to 77% which far exceeded that of the general population for women.

PAHO 2003's world study on violence against women stated that interventions must be applied on initial initiation of the health care system. In addition it was found that women will rarely reveal their situation spontaneously to medical personnel, even when seeking help for violence-related problems. This indicated the importance of the initial response of health care as being critical to immediately deal with both the violent situation at hand and psychological consequences that are co-occurring. Yet as research has previously stated, women are rarely asked if they have suffered violence even when there are obvious signs of the abuse. In Canada, screening has taken place to detect intimate partner violence, but no regular screening for psychological trauma has been systematically applied (PAHO, 2003).

Initial efforts to respond to spousal abuse has taken place mostly at the community level, through women's organizations, shelters, women's groups and counselling services. In most communities today, services to abused women are offered by a combination of these community agencies, hospitals and government health services (Hanvery & Kinnon, 1993). Counselling is often provided by centers created for women who have experienced abuse. They often find resources and facilitate referrals for dealing with psychological trauma in the formal mental health system (Koss &Herrera, 2003; Kubant, et al, 2004; Sullivan & Bybee, 1999). Sullivan and Bybee (1999) found that women who received counselling services by paraprofessionals (those with no formal training in psychological or psychiatric counselling) through women's groups and shelters for ten weeks were found to psychologically improve. It was found that these women experienced: less physical violence over time, reports of increased quality of life, higher social support, less depressive symptoms and increased effectiveness in obtaining

resources compared with women in the control conditions. This shows the effectiveness of treating trauma through counselling, even by paraprofessionals, as an effective tool for dealing with psychological consequences of abuse. However, lack of funding for these services severely limits women's access to mental health services such as counselling. It has been reported that even when mental health care is covered by workplace benefits and provided by a worksite, women are unlikely to contact mental health providers on their own (Koss & Herrera, 2003).

Rates for depression and PTSD have been well documented across a range of samples of abused women, including formally battered women. Both disorders have been found to remain with the survivor of abuse long after they have left the abusive relationship (Koss & Herrera; Sullivan & Bybee, 1999). An important study of the persistence of depression was conducted by Campbell, Sullivan & Davidson (1995), looking at formally abused women's rates and severity of depression at shelter exit, with a six month follow up. The study found 83% of women who had just left a women's shelter were depressed, over six months the rates only slightly declined. It has also been suggested that PTSD remains with formally abused women because of a failure to emotionally process the events of trauma, allowing anger and dissociation to remain (Feeny, Zoellner & Foa, 2000). However, while there is plenty of evidence pointing to the longevity of psychological trauma in its expression in mental disorders such as depression and PTSD, there is little to no research available on long term effects on abused women or applied treatment.

Previous research, including many recent publications, indicates the lack of longitudinal studies, trauma research conducted only during a crisis period and treatment-outcome studies. Campbell, Sullivan, & Davidson (1995), stated that previous research had limited understanding of women's experiences of depression by not looking at survivors of abuse longitudinally. Information of battered women's depression and PTSD over time is largely unknown (Campbell, Sullivan & Davidson, 1995; Koss & Herrera, 2003). Many research designs use shelter samples or other "in crisis" samples, which only presents a small time frame in terms of the longer period of psychological trauma which exists. This is especially concerning to many researchers because trauma exposure leads to broad spectrum of clinical symptoms and conditions that evolve over time which vary from culture to culture (Neria, Bromet & Marshall, 2002). Finally, the Kubant et al. (2004), article could not locate any published treatment-outcome study aimed at alleviating trauma induced mental disorders in formally battered women. This is incredible when it is considered that these women represent one of the largest populations of trauma victims in North America (PAHO, 2003).

In conclusion, there is plenty of research indicating that abusive relationships cause more than just short term damage; psychological trauma has serious mental health consequences. Abuse in any form can strongly effect a woman's psychological well being, often being expressed as trauma not easily resolved. This trauma is often found to be expressed by these women through several mental disorders such as anxiety, depression, and post traumatic stress disorder. While the prevalence of these disorders being expressed by abused women is high, rarely are they diagnosed by the health care system. Without the proper detection, support and treatment for trauma caused by abuse, many formerly abused women will continue to deal with the long term effects of alone.

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R8: AN EXAMINATION OF THE PERCEPTIONS OF AN ALL-FEMALE PROBLEM GAMBLING COUNSELLING TREATMENT

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INTRODUCTION

Background to the Problem

Fifteen million North Americans have experienced a gambling problem (Ciarrocchi, 2002). In Canada, over one million people are affected by gambling addictions each year; to date, 18.9 million Canadians have participated in gambling activities (Statistics Canada, 2002). These gambling activities include racetrack and off-track betting, casino games, gaming machines, cards, lotteries, bingo, non-casino gaming machines, and Internet gambling. Of the 18.9 million Canadians who gambled, 1.2 million developed a gambling problem (Statistics Canada, 2002). Hence, current estimates suggest that approximately 6.3% of Canadians are directly affected by a gambling problem. In Alberta, recent estimates suggest that over 2.2% of Albertans are problem gamblers (Cox, Yu, Afifi, & Ladouceur, et al., 2005). Problem gambling has been shown to negatively impact individuals, their families, and their communities at large (Ciarrocchi, 2002).

Significance and Purpose of the Study

Previous research documents the differences between male and female problem gamblers. Grant and Kim (2004) note that, although the differences between the two genders have been well documented, “Relatively few large treatment studies of pathological gambling have been performed that would permit direct examination of gender related differences” (p. 106). This point is echoed by Piquette-Tomei, Corbin-Dwyer, Norman, McCaslin, and Burnett (2005), who completed the first Canadian study on the perceived effectiveness of women-only group counselling for Canadian women with gambling problems. This study explored women’s experiences in a women-only counselling group for problem gambling in Saskatchewan. This study was a qualitative analysis that documented the women’s experiences of the group over a six-month period. Fourteen women participated in the study, and data was collected through journals and in-depth interviews. To date, no known studies have explored all-female group counselling for women with a self-identified gambling addiction in Alberta. According to the National Council of Welfare (1996), females in Alberta are equally at risk as males for developing a gambling problem. In order for counsellors, psychologists, and other health professionals to assist

and collaborate effectively with female problem gamblers, it is crucial to explore gender-specific treatment modalities that could potentially be a key means of service delivery for these women.

The purpose of this research is to explore the experiences and perceptions of women who are undergoing treatment for problem gambling in Alberta. Exploring women's experiences of female group counselling will increase our understanding of effective treatment for female problem gamblers in Alberta. The specific purpose of this study is to explore whether women who participate in EGRIP (Evening Gambling Recovery Intensive Program) counseling groups for problem gambling perceive women-only group counselling as beneficial in their recovery process from a gambling addiction.

METHOD

Qualitative analysis was used in this study, more specifically, grounded theory analysis. According to the grounded theory method of data analysis, data are first collected, and from the data theory is derived (Arsenault & Anderson, 2001). Data sources included individual, in-depth interviews with the women conducted by the researcher, and a follow-up focus group involving the researcher, group facilitator and group participants. From this data, themes were derived in relation to gender specific group treatment for female problem gamblers.

Participants

The clients surveyed participated in a women-only treatment group through the Alberta Alcohol and Drug Commission (AADAC). The group was a pilot project for AADAC, in that it was the first gambling treatment group only for women. Previously, only mixed (male and female) groups had been run. The pilot group consisted of five members and all five members participated in the research project.

Procedure

Telephone interviews were conducted with a pre-contact protocol. The researcher attended the first night of the group's meetings in order to introduce the study to the group members, to review and gain informed consent, and to answer in person any questions participants had regarding the study. Participants were registered, and telephone interviews were set up with each participant with the assistance of the group facilitator. The researcher called participants at the prearranged time for the telephone interview and again reviewed informed consent, after which the interviews were conducted. Once all interviews were conducted by phone, the researcher analyzed the interviews for themes.

RESULTS

Relationships

When discussing the notion of relationships in women only group counselling, the participants mentioned feeling comfortable and safe, and having an opportunity to be heard. The following are excerpts from the transcripts that highlight this theme.

Participant: I think that being a woman myself I can relate to some of the feelings that are brought up the same as I feel the other women in the group can relate to me. If I am talking to a man, because they are from a totally different planet than we are, they have totally different feelings and emotions in regards to certain things.

Participant: I would say it was more relaxed. We could relate more with each other.

Participant: I think that it [a women-only group] is better. You can be open and honest with women because we all kind of think the same, you know, and we can express things that maybe if the other gender was there we would not be able to express.

Participant: Everyone felt pretty comfortable. We got into the secure mode quicker than I think [we would] if men are involved.

Participant: It was just a really good relationship amongst the women.

Participant: [In] an all-women's group, besides being more honest and open, I think there is more of a trust there.

Learning

The second theme that arose from the transcripts was learning, as illustrated in the following excerpts. First, the participants speak about learning relapse prevention skills.

Participant: Um, I know our relapse prevention cards. Seeing the cycle of how you go from that conscious, like when you do something automatically, okay that was a really good topic, and I would often then say, "Am I doing this automatically or I am thinking about it?"

Participant: Yes, especially the positive thing, and someday I would just remind myself to read the book [skills book from group] of everything I have gone through, just a reminder.

Participants also spoke about learning in terms of psycho education.

Participant: Went through all of the various types of gamblers that there are. Um, I know for myself I could see myself in every one of the steps, into how you go from being a non or social gambler into [being a] problem or compulsive gambler.

Participant: It makes you understand, get more understanding of how things progress, of the consequences, and hopefully how to try and overcome [it].

Participants also discussed learning from other women's stories:

Participant: I learned from the women themselves, um, things they are going through that I could learn from. And I may not be having an issue with a child because I do not have

children. In learning what they went through, maybe it might be a friend that treats them like that and how they dealt with it, and because we talked about it in-group I am able to pull that experience if I ever run into that type of situation.

Facilitation

From the comments of the women interviewed, it became clear that they found it important that a facilitator could simultaneously probe and be supportive, while maintaining an active, collaborative stance.

Participant: [The facilitator] is fabulous with getting people to open up. She has got just a tremendous, tremendous way about her. She seems to have the ability. She is soft spoken and what have you, and she does not judge. She is involved herself in that, after we have our break, we all have to with a couple of words describe how we are feeling.

Participant: And the facilitator, she has been really easy to talk to. You think you can hide things from her but you cannot.

Participant: Good probing skills.

FINDINGS

The women who participated in this study all reported that they benefited from gender-specific counseling group for problem gambling and that they would choose to participate in women-only group counseling if they were to take the group again. This finding is congruent with past research regarding women's experiences of gender-specific treatment approaches for women addressing their problem gambling (Boughton & Brewster 2003; McGowan, 2003; Piquette-Tomei, 2004). This point is further supported by a needs assessment of women actively engaged in problem gambling in Ontario (Boughton & Brewster, 2002). When surveyed, 59% (n=356) of these female problem gamblers reported feeling that women-only groups would be helpful compared to 33% of women who believed that mixed-gender groups would be helpful. Furthermore, when counselors and social workers were surveyed who specifically work with female problem gamblers, 89% indicated that they viewed women-only groups as an important aspect of treatment. Only 11% of the clinicians surveyed believed that an adequate number of these groups exist. In past research, women have reported being satisfied with treatment when they experienced an understanding female facilitator, and a feeling of security in-group with others with whom they shared similar life experiences (Piquette-Tomei, 2004). Gender-specific groups that are responsive to women and address women's issues in the context of their addiction have been demonstrated to be effective in the areas of substance abuse research (Addiction Research Foundation, 1996; Health Canada, 2001; United Nations, 2004).

Three core themes emerged in terms of what was helpful in this form of group counselling: (a) relationships, (b) learning, and (c) facilitation.

Group members elaborated on the helpfulness of relationships in terms of comfort, safety, connectedness and validation in the group process. The theme of learning also emerged in terms of psychoeducation, relapse prevention, and self-awareness. The importance of facilitation became apparent as an adjunct to these processes. The themes seemed to be interwoven to create a beneficial therapeutic environment. The recurrence of these ideas throughout individual interviews and the focus group discussions suggests commonality among different individuals. Metaphorically, these core themes can be visualized as a tripod, with each core theme representing one leg of the tripod to make it stand securely. In this study relationships, learning, and facilitation all work together to create an effective women-centered group for the treatment of problem gambling.

Relationships

The theme most cited by the women in individual interviews and focus groups was the importance of relationships among the women in the group. Throughout the interviews, the women described feeling supported, heard, validated, connected and normalized by the other group members and the facilitator. The women often mentioned "comfort" as a factor that made this process work for them and that builds trust. Some participants questioned if this trust could have developed as quickly if a man had been in group. This factor was also reported in an Australian study of women's experiences of women-only support groups for problem gambling (Surgey & Seibert, 2000). McGowan (2003) found similarly in an analysis of online posts that women found female-only Gamblers Anonymous meetings very supportive.

Learning

The second theme that arose from this study is that the women found learning to be an important part of their recovery. Learning was described in many ways. Important learning topics discussed by the women included concrete skills for relapse prevention, such as self-soothing strategies and safety planning for relapse prevention.

Group members also reported that learning about the types of gamblers and the progress of problem gambling in regards to their stage of change was effective. The women also reported that learning about other women's experiences in regards to gambling, family and relationships helped them to learn about their own lives.

Facilitation

The third theme that emerged from the study is that the women found the presence of a facilitator important to the therapeutic process. A female therapist was selected by AADAC to run this group. From the material presented, women noted the importance of the facilitator's role in creating a supportive environment that fostered safety while simultaneously helping clients to explore areas related to their addiction. The women reported that the facilitator's ability and skills in participating as an active, engaged collaborator in the therapeutic process were helpful. Past research supports the notion that women group members find a female group facilitator to be very helpful. When clinicians were surveyed regarding the importance of female clinicians with gender-specific training in Ontario, over 90% reported that this is very helpful (Boughton & Brewster, 2002). Support for female counsellors who have the skills to address the specific needs

of women is also a dominant theme in substance abuse research. Nelson- Zlupko, Kauffman and Dore (1995) suggest that treatment professionals working with chemically dependent workers interact with clients in a supportive nonjudgmental approach rather then an confrontation approach. Furthermore, a study by the United Nations Office on Drugs and Crime (2004) endorses the importance of supportive female staff, and the importance of clients' having the option to contact these staff when in treatment for substance abuse.

Limitations and Suggestions for Future Study

Due to the exploratory nature of this study and the fact that the group involved represent the first pilot group of its kind in Alberta, the results are not based on large amounts of data. Therefore, it is premature to make global statements regarding future treatment practices. Rather, this study serves as a starting point of exploration into women-only group counseling for women in Alberta.

The results suggest that for some women at some points in their recovery, gender-specific counselling for problem gambling is helpful. The continuation of such research is recommended, with a focus on the promotion of gender-specific treatment for female problem gamblers. It is recommended that future research be conducted to compare the impact of women-only treatment vs. mixed-gender treatment for female problem gamblers. It is also recommended that, within the context of this work, the benefits of relationships, learning materials and facilitation that are gender specific be explored. Further research is needed to investigate whether treatment for problem gambling can be tailored to meet the unique needs of women in terms of women's roles, stress reduction, and life experiences. Also research is recommended into public awareness of and possible ways to increase awareness of problem gambling among women in Alberta.

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R9: CANADIAN ABORIGINAL TREATY LAW: THE CANONS OF CONSTRUCTION FOR TREATY INTERPRETATION

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Canadians are aware that Canada is a multicultural society, however most Canadians are unaware that First Nations are sovereign Nations, which Canada is attempting to colonize by presenting a viewpoint to the world that First Nations are a part of Canada. Most Canadians believe that First Nations are simply another minority group within Canada. This viewpoint is embedded in the assumption that the colonization of First Nations in Canada is a completed process. I argue that this assertion is false and that the evidence for this can be found in Canadian aboriginal treaty law. The courts have recognized the legal position of treaty First Nations as *sui generis*, and the courts have expressed this unique position in Canadian law through the canons of construction for treaty interpretation. I argue that the canons of construction for treaty interpretation represent an evolutionary step towards Canada recognizing First Nations as sovereign nations. A review of the canons demonstrates how the Canadian courts are shifting towards the conclusion that First Nations are sovereign.

The canons of construction for treaty interpretation were introduced into Canadian law in *R. v. Taylor and Williams* (1981), 34 O.R. (2d) 360 (Ont.C.A.). According to Isaac,

> [i]n *Taylor and Williams* the Ontario Court of Appeal set out a number of factors to be used when interpreting treaties…The Court stated that it is important to consider the history and oral traditions of the tribes concerned. Treaties should be interpreted in a manner that: (*a*) upholds the honour of the Crown, (*b*) avoids the appearance of "sharp dealings," (*c*) resolves any ambiguity in favour of the Indians, and (*d*) considers the parties' understanding of the terms of the treaty when it was signed.[13]

The first canon, that treaties are a unique type of agreement and attract special principles of interpretation finds its origins and entrenchment in Canadian law in *Simon v. The Queen*, [1985] 2 S.C.R. 387, in which the court held that treaties between Aboriginal

[13] Thomas Isaac, *Aboriginal Law: Commentary, Cases and Materials*. Third ed. Saskatoon, Saskatchewan: Purich Publishing, 2004, p. 79.

peoples and the Crown are unique or *sui generis*.[14] *R. v. Sioui*, [1990] 1 S.C.R. 1025, affirmed the *sui generis* nature of treaties as stated in *Simon* and, according to Isaac, "[p]erhaps more important is that this decision illustrates the recognition afforded by the court that Indian nations were regarded by the Europeans as 'independent nations' capable of making treaties. Treaty rights are in addition to rights recognized by the *Royal Proclamation of 1763* and other like instruments."[15] According to Leonard I. Rotman, "Justice Lamer, as he then was, stated in the *Sioui* case that a treaty exists where there is an agreement between Aboriginal peoples and the Crown that demonstrates 'the intention to create obligations, the presence of mutually binding obligations and a certain measure of solemnity.'"[16] The *sui generis* nature of treaties between Aboriginal peoples and the Crown has been reaffirmed in cases such as *R. v. Badger*, [1996] 1 S.C.R. 771, and *R. v. Sundown*, [1999] 1 S.C.R. 393. In Canadian case law, R. is an abbreviation for Regina, or the Crown, the government.

The second canon, that treaties should be liberally construed and ambiguities should be resolved in favour of the Indians, finds its earliest origins in the United States. That treaties must be construed as the Indians at the time understood them is found in *Worcester v. Georgia* (1832) 31 U.S. (6 Pet.) 515 (U.S.S.C.) where Chief Justice Marshall states:

> The language used in treaties with the Indians should never be construed to their prejudice. If words be made use of, which are susceptible of a more extended meaning than their plain import, as connected with the tenor of the treaty, they should be considered as used only in the latter sense… How the words of the treaty were understood by this unlettered people, rather than their critical meaning, should form the rule of construction.[17]

This canon was reaffirmed in *Jones v. Meehan*, 175 U.S. 1, (1899). According to Clinton et. al., "the Court stated that, a

> 'treaty must therefore be construed, not according to the technical meaning of its words to learned lawyers, but in the sense in which they would naturally be understood by the Indians.' The Supreme Court has applied this canon of construction because the Indians and the Government were not bargaining from positions of equal strength, *Choctaw Nation v. United States*, 119 U.S. 1, 28 (1886); the treaties were

[14] This case arose out of a conflict between provincial legislation and the exercise of treaty rights in the province of Nova Scotia. The exercised treaty right in question was recognized by the court as deriving from a peace and friendship treaty made in 1752. This case saw the court employ a liberal interpretation to the treaty.

[15] Thomas Isaac, *Aboriginal Law: Cases, Materials and Commentary*. Second ed. Saskatoon, Saskatchewan: Purich Publishing, 1999, p. 156.

[16] Leonard Rotman, "Taking Aim at the Canons of Treaty Interpretation in Canadian Aboriginal Rights Jurisprudence." *University of New Brunswick Law Journal* 46 (1997), p. 13.

[17] Robert Clinton, Nell Newton, and Monroe Price. *American Indian Law: Cases and Materials*. 3rd ed. Contemporary Legal Education Series. Charlottesville: The Michie Company Law Publishers, 1991, p. 844, Quoting C.J. Marshall in the *Worcester* decision.

> drawn up by representatives of the United States in a written language unfamiliar to the Indians, *Jones v. Meehan*, 175 U.S. 1, 10-11 (1899); the Indians' comprehension of treaty terms depended on interpreters employed by the Government, *id*.; and, finally, because the Indians were unfamiliar with the legal manner of expression, *id*.[18]

The rule of construction requiring that ambiguous phrases and terms should be resolved in favour of the Indians is expressed in "*Arizona v. California*, 373 U.S. 546, 599-601 (1963); *Alaska Pacific Fisheries v. United States*, 248 U.S. 78, 89 (1918); *Winters v. United States*. 207 U.S. 564, 576-77 (1908),"[19] and *Washington v. Washington State Com. Passenger Fishing Vessel Ass'n*, 443 U.S. 658 (1979).[20]

According to Isaac, in *R. v. Battisse* (1978), 84 D.L.R. (3d) 377 (Ont. Dist. Ct.) that Canadian court held that when treaties appear unfair or where the bargaining power of one group outweighs the other, ambiguities in treaties should be resolved in favour of the Indians.

In *R. v. Nowegijick*, [1983] 1 S.C.R. 29, Dickson J. referred to the 1899 U.S. decision of *Jones v. Meehan* for ambiguities found in treaties to be resolved in favour of the Indians. The canon that treaties should be liberally construed and ambiguities resolved in favour of the Indians has found further support by the Canadian courts in *R. v. White and Bob*, 6 C.N.L.C. 684, (1965), 52 D.L.R. (2d) 481 (S.C.C.), *Simon v. The Queen*, [1985] 2 S.C.R. 387, *R. v. Sioui*, [1990] 1 S.C.R. 1025, and *R. v. Badger*, [1996] 1 S.C.R. 771.

The third canon of construction for treaty interpretation in Canada is to choose from the possible interpretations to find the one that reconciles the interests of both parties at the time of the signing. The 'common intentions' goal of this canon emerged in *R. v. Sioui*, [1990] 1 S.C.R. 1025. According to Rotman, "[a]s indicated in the *Sioui* decision, when interpreting the nature of an agreement between the Crown and Aboriginal peoples, it is necessary to strive towards the common intention of the parties and not merely rely upon the understandings possessed by one of the groups."[21] Justice Lamer, in *Sioui*, states "[t]he Court must choose from among the various possible interpretations of the common intention the one which best reconciles the Hurons' interests and those of the conqueror."[22]

The fourth canon of construction in Canada requires that the court presume the honour of the Crown when searching for the common intentions of the parties involved in a treaty. According to Isaac, "*White and Bob* affirmed the legal status of Indian treaties in Canadian law and emphasized the importance of the honour of the Crown."[23]

In *R. v. Badger*, [1996] 2 C.N.L.R. 77 (S.C.C.), the court outlined a summary of the principles of treaty interpretation. The court listed only four principles and further

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[18] Ibid.
[19] Ibid. p. 845.
[20] Ibid. p. 807.
[21] Leonard Rotman, "Taking Aim at the Canons of Treaty Interpretation in Canadian Aboriginal Rights Jurispurdence," *University of New Brunswick Law Journal* 46 (1997), p.36.
[22] *R. v. Sioui*, [1990] 1 S.C.R. 1025.
[23] Supra footnote 3, p. 118.

emphasized the principle of the honour of Crown, as had been stated earlier in *R. v. White and Bob* (1965), 52 D.L.R. (2d) 481 (S.C.C.). Most recently, in *Mikisew Cree First Nation v. Canada*, [2005] 3 S.C.R. 388, 2005 SCC 69, Binnie J. stated, "[T]he honour of the Crown infuses every treaty and the performance of every treaty obligation."[24]

The fifth canon of construction requires the court to be sensitive to the cultural and linguistic differences of the parties involved in a treaty. According to Rotman,

> It is beyond dispute that Aboriginal treaties were not only written in a language that was foreign to Aboriginal peoples in Canada, but that they were written entirely by the Crown's representatives. As a result of these facts, there is a *prima facie* inference that the subtleties and nuances of language and the cultural subjectivity of interpretation may have resulted in the text of written treaties having a different meaning than the terms agreed to by the parties during their negotiations… Evolving or changing perceptions of the nature of the treaties and the rights they protect, as well as the change in the position and needs of the parties involved in the treaty-making process, have also had a profound effect upon modern interpretation of treaties.[25]

Rotman directs us to the words of *Wilson* J. in *R. v. Horseman*:

> These treaties were the product of negotiation between very different cultures and the language used in them probably does not reflect, and should not be expected to reflect, with total accuracy each party's understanding of their effect at the time they were entered into. This is why the courts must be especially sensitive to the broader historical context in which such treaties were negotiated. They must be prepared to look at the historical context in order to ensure that they reach a proper understanding of the meaning that particular treaties held for their signatories at the time.[26]

The sixth canon stipulates that the words of the treaty must be construed as the parties at the time would have naturally understood them. In *R. v. Badger*, [1996] 2 C.N.L.R. 77 (S.C.C.), Sopinka J. explains, "it is well settled that the words in the treaty must not be interpreted in their strict technical sense nor subjected to rigid modern rules of construction. Rather, they must be interpreted in the sense that they would naturally have been understood by the Indians at the time of the signing."[27] This principle had appeared earlier in *Nowegijick v. R.* (1983), 144 D.L.R. (3d) 193 (S.C.C.), and was cited recently by Binnie J. in *Mikisew Cree First Nation v. Canada*, [2005] 3 S.C.R. 388, 2005 SCC 69.

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[24] *Mikisew Cree First Nation v. Canada*, [2005] 3 S.C.R. 388, 2005 SCC 69, para. 57.
[25] Supra. Footnote 4.
[26] Ibid., quoting from *R. v. Horseman*, [1990] 1 S.C.R. 901.
[27] Sopinka, J. in *R. v. Badger*, [1996] 2 C.N.L.R. 77 (S.C.C.), para. 52.

The seventh canon identifies that a technical or contractual interpretation of the words in a treaty should be avoided. This principle can be traced back to 1832. In *Worcester v. Georgia*, Chief Justice Marshall declared:

> Is it reasonable to suppose that the Indians, who could not write, and most probably could not read, who certainly were not critical judges of our language should distinguish the word 'allotted' from the words 'marked out.'…[I]t may very well be supposed that they might not understand the term employed, as indicating that, instead of granting, they were receiving lands. If the term would admit of no other signification, which is not conceded, its being misunderstood is so apparent, results so necessarily from the whole transaction; that it must, we think, be taken in the sense in which it was most obviously used.[28]

This principle was reaffirmed in *Jones v. Meehan*, 175 U.S. 1 (1899). But it did not emerge in Canadian law until 1864 when the British Columbia Court of Appeal cited *Worcester v. Georgia* with approval in *R. v. White and Bob* (1964), 50 D.L.R. (2d) 613 (B.C.C.A.). *Nowegijick*, *Horseman*, *Sioui* and *Badger* would all later reinforce this principle in their rulings.

The eighth principle outlined in the 1999 Marshall decision directs the court not to alter the terms of the treaty by exceeding what is realistic, while still construing the language in the treaty generously. In *R. v. Sioui*, Lamer J., for the court, states that the majority in the Court of Appeal erred in adopting the position of the respondents regarding the treaty of September 5, 1760 because the position would allow for unlimited rights of the Huron in a vast area.

Lamer J. states, "[w]ith respect, I feel that adopting such a position would go beyond what General Murray intended. Even a generous interpretation of the document, such as Bisson J.A.'s interpretation, must be realistic and reflect the intention of both parties, not just that of the Hurons.[29] This principle, as stated in *Sioui*, was cited with approval in *Mikisew Cree First Nation v. Canada*, [2005] 3 S.C.R. 388, 2005 SCC 69, one of the most recent treaty rights cases in Canada.

The ninth canon requires the courts to interpret treaty rights to provide for their modern exercise as those rights are not to be seen in a static way that would freeze them at the time of the signing of the treaty. Furthermore, the court is charged with determining what practices are reasonably incidental to the exercise of treaty rights in a modern context. In *R. v. Sundown*, Wakeling J.A., in dissent, states:

> In order to determine what is reasonably incidental to a treaty right to hunt, the reasonable person must examine the historical and contemporary practice of that specific treaty right by the aboriginal group in question to see how the treaty right has been and continues to be exercised. That which is reasonably incidental is something which allows the claimant to exercise the right in the manner that his or her ancestors did, taking into

[28] Marshall, C.J. in *Worcester v. Georgia* (1832) 31 U.S. (6 Pet.) 515 (U.S.S.C.) in Rotman, p. 37.
[29] *R. v. Sioui*, [1990] 1 S.C.R. 1025.

> account acceptable modern developments or unforeseen alterations in the right. The question is whether the activity asserted as being reasonably incidental is in fact incidental to an actually practiced treaty right to hunt. The inquiry is largely a factual and historical one. Its focus is not upon the abstract question of whether a particular activity is "essential" in order for hunting to be possible but rather upon the concrete question of whether the activity was understood in the past and is understood today as significantly connected to hunting. Incidental activities are not only those which are essential, or integral, but include, more broadly, activities which are meaningfully related or linked.[30]

The interpretive principles from *Marshall* were cited with approval in the recent 2005 Federal Court decisions of *Chief Victor Buffalo et al v. Queen et al*, and *Ermineskin Indian Band and Nations v. Canada.* While the Federal Court cited the canons with approval, the Federal Court of Appeal has granted to hear the appeal of *Chief Victor Buffalo* based on Buffalo's assertion that the Federal Court Judge did not rule on the case according to the interpretive principles that he cited with approval.

The canons of construction for treaty interpretation and the cases that have employed them have demonstrated that Canadian aboriginal treaty law is evolving. The canons of construction continue to be expanded by the courts in an effort to reflect the *sui generis* nature of aboriginal treaties and this expansion of the canons also reflects that the judiciary is shifting towards acknowledging aboriginal sovereignty.

[30] *R. v. Sundown*, [1999] 1 S.C.R. 393.

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R10: SELF-INJURIOUS BEHAVIOUR: A TREATMENT PLANNING GUIDE

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INTRODUCTION

Self-injurious behaviour (SIB) is considered to be a difficult behaviour to treat because of the positive effects, such as the relief of negative emotions, that most clients report feeling. Self-injury can be defined as "intentional, self-effected, low-lethality bodily harm of a socially unacceptable nature, preformed to reduce psychological distress" (Walsh, 2006, p. 4). The manner of SIB employed by individuals is varied and limited only by the means available and imagination (Zila & Kiselica, 2001). Until recently SIB was thought to be similar to suicide (Muelenkamp, 2005); however the literature has recently begun to understand SIB as a form of self-help, quite the opposite function as suicide (Favazza, 1998). It is estimated that at least one percent of the general population participates in superficial/moderate SIB (Favazza, 1998; Muehlenkamp, 2005), although it has been seen as high as 14 percent in an adolescent sample (Ross & Heath, 2002), or even 35 percent in a college student sample (Gratz, 2001). This review will use the current literature to provide a framework from which to understand and treat SIB. Individuals engage in this behaviour for a variety of reasons; resulting in the need for a broad treatment paradigm. The treatment plan outlined in this review includes general treatment goals, an assessment guide, a number of interventions that may be used to assist in eliminating the behaviour, and finally a brief discussion about evaluating treatment. However, before discussing the treatment plan, it is important to have an understanding of the origins and consequences of SIB.

ETIOLOGY OF SIB

Walsh (2006) conceptualizes SIB as a biopsychosocial phenomenon comprised of five interrelated dimensions that explain the existence of the behaviour. The environmental dimension consists of external events such as mental illness and violence occurring in the family as well as experiences of abuse or loss. The biological component refers to genetic predisposition, chemical imbalances, and brain system dysfunction. The cognitive dimension concerns individuals' interpretations of events and beliefs. The affective domain concerns distressing emotions that flow from the distorted cognitions. The behavioural dimension includes actions that immediately precede, accompany, or follow SIB that the individual associates with the act of self-injury. No single dimension can fully explain the existence of self-injury as a behaviour in individuals (Nock & Prinstein, 2004). For most individuals, all five dimensions operate

in the genesis and maintenance of the behaviour, although the specific combination is unique for each individual (Walsh, 2006).

Aftermath & Consequences of SIB

Many family members, friends, and even clinicians do not understand the purpose of SIB and react with revulsion (Muehlenkamp, 2005). However, the behaviour is obviously exhibited for a reason; it is achieving particular results for the individual. Nock and Prinstein (2004) outline four general functions of SIB. These functions are automatic-negative reinforcement (use of SIB to achieve reduction in negative affect), automatic-positive reinforcement (use of SIB to create a desirable physiological state), social-negative reinforcement (use of SIB to avoid punishment by others), and social-positive reinforcement (use of SIB to gain attention or resources from others). In order to provide effective treatment it is important to understand the possible purposes of SIB.

General Goals of Treatment

Using Walsh's multimodal approach to treatment of SIB there are a number of important general goals for treatment. The initial goal of counselling is to create a strong therapeutic relationship with the client (Zila & Kiselica, 2001). The second goal is to diminish the occurrence of SIB by replacing the behaviour with more functional coping strategies and by replacing dysfunctional thoughts that support the behaviour. The third general goal is to resolve major triggers of SIB by addressing issues regarding body image and trauma (Walsh, 2006). Each of these goals serves to assist the client in living a healthy and normal life.

Assessment

When a counsellor is providing services to a client exhibiting SIB, it is important that a proper assessment be performed because of the complexity of the behaviour. The initial assessment needs to focus on three areas: risk of suicide, risk of repeated self-harm and other risk-taking behaviours, and the presence of chronic psychosocial problems such as depression and substance use (Zlotnick et al., 1996; Hurry, 2000; Walsh, 2006). The second part of the assessment process occurs over a number of weeks and involves generating a clear conceptualization of the SIB. As seen through the lens of the biopsychosocial model, SIB is a complex result of a number of different factors. Walsh (2006) outlines a comprehensive assessment strategy of each of the factors. The assessment begins with the behavioural aspect of the self-injury in order to evaluate the specifics of the overt behaviour and then assesses the five dimensions discussed earlier that influence the behaviour (Walsh, 2006).

PLAN FOR TREATMENT

Walsh (2006) outlines a number of different modes of treatment to be used with clients who self-injure. The different approaches include contingency management, replacement skills training, cognitive therapy, body image work, and resolution of trauma. Every client who enters treatment for assistance with SIB has a unique history, a unique etiology for the behaviour, and unique therapeutic needs. Therefore, some clients may

need only one or two of the interventions while other clients may need a combination of some or all of the interventions to make significant gains in controlling and eliminating the behaviour. Based upon the information gathered through the assessment the counsellor will have to determine, in conjunction with the client, what level of service is required (Walsh, 2006).

Contingency Management

The purpose of contingency management is to reduce the frequency of self-injury by the use of a contract between the client and counsellor. Using the baseline rates gathered in the assessment portion of treatment the counsellor challenges the client to decrease his or her level of self-injury (Walsh, 2006). A self-protection plan is outlines the past level of behaviour, a clearly stated measurable goal, identification of replacement skills, and a reward if the client succeeds in reaching the goal (Walsh, 2006). Contingency management may be all that is required by some clients. The act of recording their behaviour may disrupt the self-injury process enough to abort the entire practice (Walsh, 2006).

Replacement Skills Training

One of the most important tenets in the treatment of self-injury is replacement skills training. In order to effectively manage SIB Walsh (2006) states that clients "need to acquire skills that manage their emotional distress (or emptiness) *at least as effectively* as self-harm behaviours" (pp. 126-127, emphasis his). The role of the counsellor is to determine what purpose the SIB is serving and identify, with the client, appropriate skills that will be able to replace it (Walsh, 2006). The clients first practice the skills during the treatment sessions and then in the real world, logging their effectiveness.

Although there are many different skills that a client may utilize to manage SIB, Walsh (2006) outlines nine types of skills that he has found to be effective including negative replacement behaviours, mindful breathing, visualization, physical exercise, writing, artistic expression, playing or listening to music, communicating with others, and diversion techniques. Each of the different types of replacement behaviours provides a unique outcome designed to fulfill the need that the self-injury previously met.

Cognitive Treatment

The onset and continuance of self-injury are due in large part to dysfunctional cognitive processes (Walsh, 2006). Cognitive treatment directly targets clients' thoughts, assumptions, rules, attitudes, and core beliefs that support their SIB. The initial assessment (as described above) will outline a number of these recurrent thoughts and beliefs that must be challenged in order for healing to occur. The counsellor must consider automatic thoughts (e.g., I deserve to be hurt), intermediate beliefs (e.g., cutting is the only way to get relief), and core beliefs (e.g., I'm completely unlovable) and challenge these throughout a client's treatment (Walsh, 2006). It is important for a client to recognize the existence of recurring dysfunctional thoughts as a warning of an urge to self-injure and to begin to engage in a replacement skill (Beck, 1995).

Walsh and Rosen (1988) identify four categories of dysfunctional thought that must be challenged in order for treatment to be effective. These are a) self-injury is

acceptable; b) one's body and self are disgusting and deserving of punishment; c) action is needed to reduce unpleasant feelings; and d) overt action is necessary to communicate feelings to others. The counsellor challenges the clients to investigate the utility and veracity of their thoughts, as well as to create new thoughts that assist in achieving their specific goals (Walsh, 2006).

Body Image Work

Walsh (2006) states that the relationship between body image and SIB is very complex and important to effective treatment. Body image can be defined as "a complex set of thoughts, feelings, and behaviours related to the physical experience, size estimation, appraisal of, and satisfaction with one's own body" (Walsh, 2006, p. 167). When treating SIB it is important to consider the following six dimensions of body image: attractiveness (self-assessment of attractiveness and messages received from others), effectiveness (belief in one's physical ability), health (subjective and objective assessment of one's health), sexual characteristics (acceptance of physical changes), sexual behaviour (level of comfort with sexual activity), and body integrity (degree of comfort with one's body) (Walsh, 2006).

After discovering dimensions of body image that need to be treated, Walsh (2006) suggests two different interventions. The first is using a cognitive-behavioural approach by challenging the automatic thoughts, intermediate beliefs, and core beliefs that sustain the negative body image. The other intervention is to build positive body experiences through real life experiences. This strategy involves negotiating homework tasks that would enhance the body image in the particular dimension such as a new hairstyle, joining a gym, and purchasing flattering clothes. Challenging dysfunctional thoughts and learning to enjoy and celebrate one's body are important steps for a client in creating a positive body image.

Resolution of Trauma

It is estimated that between 40-60 percent of clients who self-injure have been sexually abused (Favazza, 1998). Most of these clients will use SIB as a coping strategy to manage symptoms similar to those of post-traumatic stress disorder (PTSD). Clients who experience these symptoms must achieve mastery over them in order to cease using SIB as a coping strategy (Walsh, 2006). The treatment strategy for PTSD involves three different types of intervention: cognitive therapy, stress inoculation training, and exposure therapy (Foa et al., as cited in Walsh, 2006). The use of cognitive therapy has previously been discussed and stress inoculation training is essentially cognitive strategies paired with replacement skills training (Walsh, 2006), also previously discussed. Therefore, only exposure therapy will be discussed in more detail.

Exposure therapy consists of five steps through which the client learns to understand and manage their reactions to triggers of the trauma. The first step is to collect information about the traumatic event. The second step, which may occur before or concurrently with the first step, is to teach breathing skills that the client can use to manage anxiety, calm physiological symptoms, and master unpleasant emotions (Walsh, 2006). The third step is to normalize the client's reactions to the trauma and explain the symptom clusters of PTSD (Walsh, 2006). The fourth step involves repeated imaginal exposure to the trauma while managing the emotions that may arise. In the fifth step the

client is exposed to real life situations that are connected to the trauma. The anxiety and negative emotion commonly associated with these experiences is reduced by exposure until the client is able to function appropriately in the world.

EVALUATION OF SUCCESS

The specific method of evaluation for the treatment plan described varies by the level of treatment a client receives. By the use of self-injury logs the counsellor can track the effectiveness of the treatment. The logs can also be used to assess the degree to which the client is using the new skills learned in counselling. Using this information, the counsellor can examine the need for a different mode of treatment. The counsellor must also continually assess the strength of the therapeutic relationship by observing the client.

CONCLUSION

The theoretical conceptualization of SIB provides an expansive view of the behaviour as it included the impact of five different dimensions. Understanding the effects of the behaviour on the different dimensions provides a potential direction for an effective intervention. Individuals who self-injure are a diverse population exhibiting behaviours that often elicit a negative reaction from many individuals, including counsellors. However, it is valuable to note that behind the mask of SIB is often a creative, energetic, and passionate individual. Walsh (2006) comments on the way that he has come to understand his clients: “Self-Injurers are some of the most inspiring people I have known. Many of them have worked so hard to overcome so much in order to move to a better, stronger place” (p. xiv).

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R11: POWER ESTIMATION USING AUTOCORRELATION COEFFICIENTS.

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INTRODUCTION

Power dissipation is an important aspect in the continued development of micro-electronic technologies. Power dissipation should be reduced in order to improve the performance of the circuits and to integrate more functions into each chip, and also to satisfy the requirement of low power computation for portable battery powered applications (K. Roy & S. Prasad, 2000). This paper describes our research on low power design for estimating switching activities by using transition probabilities and autocorrelation coefficients. The focus point of this work is trying to understand the *transition correlation*s and the *autocorrelation coefficients* of the transition correlations.

Background

Power dissipation in CMOS circuits

There are three sources of power dissipation in CMOS circuits (K. Roy & S. Prasad, 2000):

1: Leakage current which is determined by fabrication. This source is small in comparison to other sources of dissipation.

2: Power is dissipated when a short-circuit path exists for direct current flowing from the power source to the ground terminal when both the NMOST-subnetwork (n-channel enhancement mode MOS field-effect transistor) and PMOST-subnetwork (p-channel enhancement mode MOS field-effect transistor) are conducting in static CMOS circuits.

3: Logic transitions occur when a node in a circuit changes back and forth between the possible two logic levels. This results in the charging and discharging of capacitive loads. This is the dominant contribution of the power dissipation because of the high number of transitions per clock tick in the circuit, which are also referred to as switching activity. The equation describing this power dissipation is:

$$p = 0.5CV_{DD}^{2}E(sw)f_{clk} \quad (1)$$

C is the physical capacitance of the circuit, V_{DD} is the supply voltage, E (sw) (referred to as the switching activity) is the average number of transitions in the circuit per $1/f_{clk}$ time, and f_{clk} is the clock frequency (K. Roy & S. Prasad, 2000).

Transition Correlations

A transition is a change in value of a signal, *e.g.* from 0 to 1 or 1 to 0. The concept of the probability of a transition (transition probability, or tp) is used in low power design to describe the likelihood of transitions. Equation 2 defines the probability of a variable's value transiting from a given value *i* to another value *j* during a particular time interval.

$$p_{n-1}(x_{i\to j}) = p(x(n) = j \cap x(n-1) = i) \qquad \forall i, j = 0,1 \tag{2}$$

where x*(n)* refers to the value of signal *x* at a particular time period, *n*.
For any signal line *x*, the switching activity is defined as follows for the whole time sequence:

$$sw(x) = p(x_{0\to 1}) + p(x_{1\to 0}) \tag{3}$$

$x_{i\to j}$ refers to the signal *x* transiting from value *i* to value *j* (K. Roy & S. Prasad, 2000). We use Equation 2 to calculate the probability which used in the Equation 3, then Equation 3 is used to calculate the total switching activities of circuits by adding all signal's switching activity together.

The transition probabilities may be used to find the transition independence of a particular signal line *x*. In an ideal circuit, all signal lines would be transition independent, which means a signal's value is unrelated to the previous one, *e.g*. zero delay. A signal line is transition independent if the amount of transitions in the circuit is likely to be the same value with the function expression for any series of input signals.

Transition independence identifies which ordering of input signals will consume more power due to excessive switching activity. We can identify where there are transition correlations that indicate interdependent signals by using transition probabilities as follows:

$$TC^{xy}_{ij,kl} = \frac{p(x(t-\delta) = i \wedge x(t) = k \wedge y(t-\delta) = j \wedge y(t) = l)}{p(x(t-\delta) = i \wedge x(t) = k)\, p(y(t-\delta) = j \wedge y(t) = l)} \tag{4}$$

where *i, j, k, l*=0, 1 which are the value of the variable *x, y* at time t or $(t-\delta)$.

This allows us to capture the spatial correlations between signals which will create power dissipation because of unnecessary transitions (R. Marculescu, D. Marculescu & M. Pedram, 1998).

Autocorrelation Coefficients

The autocorrelation function is used to describe the relationship between Boolean functions at different times, and is defined as (Rice, 2003):

$$\beta(\tau) = \sum_{v=0}^{2^n-1} f(v) \times f(v \oplus \tau) \tag{5}$$

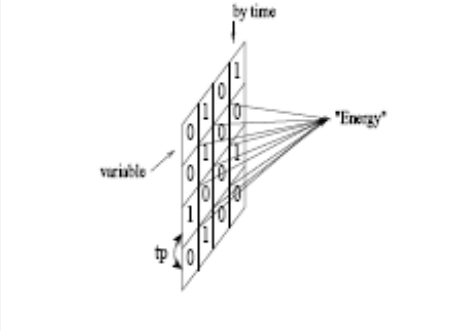
where *f* represents the output of a circuit, where *v* is the time period, and *f(v)* is the value of the output signal at time *v*.

The main use of the autocorrelation coefficients is to find patterns which may save work or time in the logic synthesis process (J. Rice, 2003). In this paper, it is used to analyze the relationship between two transition correlations.

The Relationship between TC and AC

Overview

Before explaining the method for finding an equivalent circuit with lower power dissipation, let us play a game first. As shown in the following example, we have a table which contains only 1's and 0's.



Interval	x_1	x_2	$x_3 = x_1 \cdot x_2$	x_4
0	0	1	0	1
1	0	1	0	0
2	1	0	0	1
3	0	1	0	0

Figure 2: Example of our "table game"

Each row has a constraint to characterize the relationship between the variables, x_1, x_2, …, x_n, which are given by the columns. Each column is assigned the element 1 or 0 according to the behavior, over time, of the Boolean function represented by the table. The elements can be any value in (0, 1) so long as they satisfy their row constraint. The transition probability (tp) is the probability of a transition from 0 to 1 or 0 to 1 in adjacent cells of a column. Let us refer to "energy" as the relationship among the elements in the table. The transition correlation (tc) is the correlation of transition probabilities (tp) between each adjacent pair of columns. For instance, tc_{12} means the correlation of tp_1 and tp_2 for column 1 and column 2. We should note that rearranging the ordering of columns does not change the circuit's behavior. The "energy" of the table will be different for different orderings of columns because the tc for adjacent columns will change. The best ordering of the columns in this table is the ordering that results in the minimum energy.

For the purpose of finding the minimum energy, we assume that the larger the sum of tps of the columns, the higher the "energy". The tc is used for analyzing the relationship between the tps of adjacent columns by identifying the dependencies between them, and then tp is recalculated by using the tc. To find the lowest overall tc for the table, the concept of the autocorrelation coefficients (ac) is used. The ac provides a method to identify the relationship between all pairs of tcs for a given column ordering. We make use of the ac for each ordering of columns to get the lowest overall ac value, which gives the best tc of the table, which in turn gives the minimum energy table.

The method described above illustrates the basic idea used in this paper to find the minimum switching activities of circuit, which will then reduce the power dissipation in the circuit.

Autocorrelation Coefficients of Transition Probabilities and Their Usage

The transition probabilities which have a visible effect on the switching activity are the ones from 0 to 1, or 1 to 0 as cited in R. Marculescu, D. Marculescu & M. Pedram, 1998. The remaining transition probabilities, *i.e.* from 1 to 1 and 0 to 0, can be ignored. The transition probabilities of all signal lines include both input and internal signal lines in a circuit will be computed and then used for calculating the switching activities.

The transition correlation coefficients between different signal lines are considered for the estimation of switching activities. The autocorrelation coefficients of the transition correlation coefficients of signal lines also are calculated. Although the ac coefficients may tell us that there are many transitions in a specific time interval, we must make a small change in order to find rules to separate all situations, for instance, the transition from 1 to 0 and the transition from 0 to 1. To solve this we revise Equations 5 and change the $\times$ to $\oplus$, and the $\oplus$ to + (addition) to get a new definition:

$$ac(\tau) = \sum_{v=0}^{2^n-1} f(v) \oplus f(v+\tau) \qquad (6)$$

The reason for the first change, replacing $\times$ with $\oplus$, is that we wish to identify situations where changes from 0 to 1 or 1 to 0 between time interval v and $v+\tau$. The $\oplus$ operator will identify both of these transitions, and no others. For example, for time interval 0, which means the function is compared with itself at same time which always result in 0:

$$\begin{aligned} ac(000) &= [tp(000) \oplus tp(000)] + [tp(001) \oplus tp(001)] + [tp(010) \oplus tp(010)] + [tp(011) \oplus tp(011)] \\ &+ [tp(100) \oplus tp(100)] + [tp(101) \oplus tp(101)] + [tp(110) \oplus tp(110)] + [tp(111) \oplus tp(111)] \\ &= 0 \end{aligned}$$

The example above is the desired situation, because of the result of a 0 correlation. If the tps for different time periods for the certain time interval are the same then the $\oplus$ operator returns a “0”, which means one transition occurred, otherwise it returns “1” which means no or two transitions occurred. Thus $\oplus$ can identify a single transition for certain time intervals, and addition can identify the situation when two transitions occurred during this time interval.

After doing this to get the ac results for different time periods and different time intervals, the minimum ac value (except ac for time interval 0) will be chosen. This gives the special time interval where tps for different time periods are almost the same.

When we calculate the autocorrelation coefficients of tc, the relationship of tc for each different period and same time interval for two different internal signal lines in the circuit is found. This is expressed as a number as the result of applying the ac transform. All the ac coefficients for different time periods (used by the tc computation) and for different time intervals (used by the ac computation) for the whole procedure can be obtained if we go through all the different time intervals. After all the acs of tc for each different time period and same time interval for each two different signal lines are found, we add all the acs for each pair together, which represents the correlations of this variable

ordering of circuit structure. The minimum one will be chosen, which means its structure has minimum correlation. Then the tps for signals lines are recalculated to compute the switching activities.

CONCLUSION

In this paper a method to analyze the power dissipation using the concept of the autocorrelation coefficients of transition correlation coefficients is introduced. The idea is based on catching the spatial correlations in the circuit to reduce the power dissipation by optimizing the switching activities through variable reordering. Computing the transition correlation coefficients is a method to capture the spatial correlation between signal lines. The relationship between different tcs is important as it gives a measure of how close the pattern of correlation coefficients is to itself for different variable's ordering. The smaller the ac of transition correlation coefficients we get, the closer the pattern of correlations between signals. If the tcs are smaller for this kind of pattern, then the correlations in these signals are smaller too. Experimental work based on this theory is continuing.

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R12: SPECTROSCOPIC STUDY OF LINE MIXING EFFECTS IN THE $\nu_2 + \nu_3$ BAND OF METHANE

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INTRODUCTION

Careful monitoring of greenhouse gases is important in studying atmospheric pollution and global warming. Without greenhouse gases the temperature of the Earth's surface would be several degrees colder than it is today. Certain gases absorb radiation in the infrared spectrum (Wavelengths emitted by the Earth) and re-emit some of this radiation back down to Earth. Over 99% of the solar radiation falls in the UV, visible and near IR bands (0.75-4 μm) whereas over 99% of the radiation emitted by Earth's surface is in the thermal IR band (4-50 μm). CH_4 is an important greenhouse gas with a concentration of 1.720×10^6 parts per trillion in volume. It is increasing in the atmosphere at a rate of 1.6% per year (Boudon *et al.* 2003). UN's intergovernmental panel on climate change reports that since 1750, atmospheric methane concentration has increased by 150% (Climate change2001: Working group I: The scientific basis).

The initial impetus of this work was to support the Canadian satellite instrument, Measurement Of Pollution In the Troposphere (MOPITT) which is designed to monitor the concentrations of CO_2 and CH_4 in the troposphere to 1%uncertainty. Scanning Imaging Absorption Spectrometer for Atmospheric Chromatography (SCIAMACHY) is another satellite instrument which needs improved knowledge methane line parameters. This is a continuation of the work done by Predoi-Cross *et al.* (Predoi-Cross *et al.* 2005 and 2006) who reported the self-broadening coefficients and air-broadening coefficients of CH_4 in the 4100-4635 cm^{-1} region.

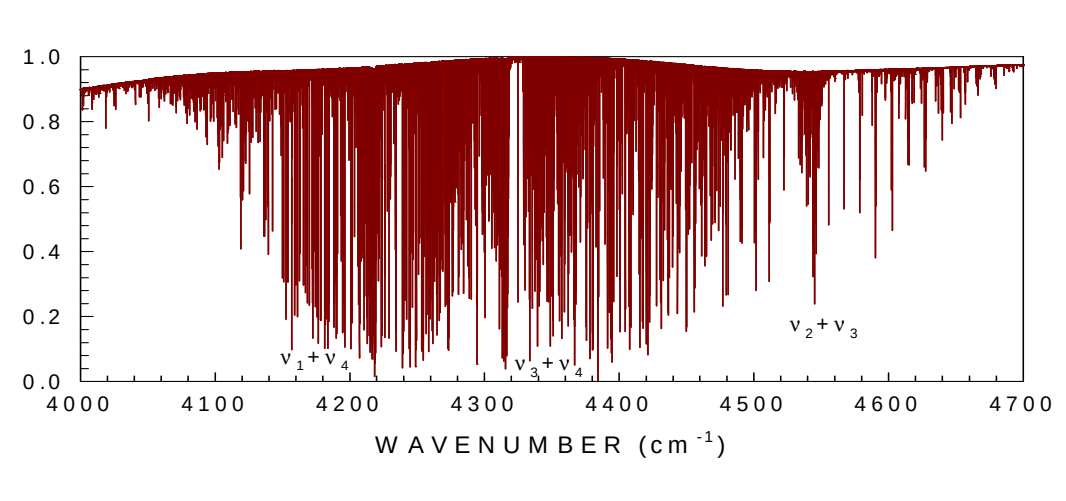
For tropospheric remote sensing involving the higher pressure regions of the atmosphere, the quality of the spectral line shape parameters become as important as the line intensity because uncertainty in line width propagates directly into atmospheric retrievals on nearly a one to one basis (Smith and Gordley 1983). For methane, the line shape issue is more complex because the commonly- used Voigt shape is inadequate for groups of transitions due to line-mixing. This study investigates the contribution from line mixing in the $\nu_2+ \nu_3$ band of methane. The molecular line shape choices impact the accuracies of atmospheric retrievals. We believe an accurate representation for methane line shapes in this spectral range can be achieved using an asymmetric speed dependent

Voigt profile. We hope that in the long term, the work presented here will encourage the implementation of better quantum mechanical models for methane calculations (Wenger and Champion 1998).

Experimental details:

This laboratory study was undertaken using the McMath Pierce Fourier Transform Spectrometer (FTS) located at the Kitt Peak national solar observatory in Arizona and analysis techniques that have repeatedly provided quality laboratory calibrations to support remote sensing applications. A total of 21 spectra were recorded at 0.01 cm^{-1} resolution with absorption path lengths from 2.05cm to 2494.0cm. The spectra include scans with pure methane and air-broadened methane at room temperature. Figure 1 shows the methane spectrum in the 4100-4700cm^{-1} region.

Methane spectrum in the octad region. The prominent bands are $\nu_1+\nu_4$ near 4220 cm^{-1}, $\nu_3+\nu_4$ near 4320 cm^{-1} and $\nu_2+\nu_3$ near 4540 cm^{-1}.



Spectral region displaying the $\nu_2+\nu_3$ Q-branch of methane

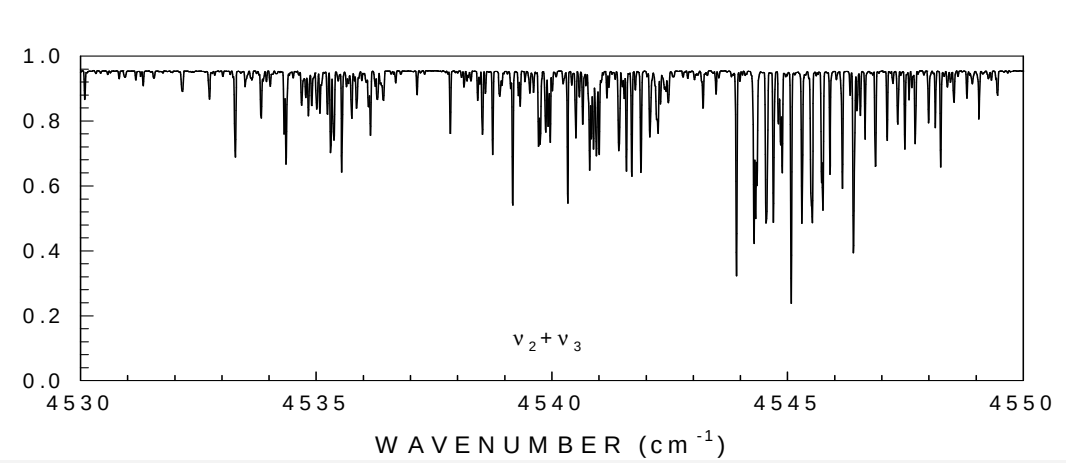


Fig. 1. Methane spectrum in the octad region

DATA ANALYSIS

The **HITRAN** (**Hi**gh resolution **Tran**smission) database (Rothman *et al.* 2005) is the most widely used collection of spectroscopic information for remote sensing applications. Since the 1970's the line parameters listed in this database have been improved every two to five years by incorporating new results from laboratory studies. The essential molecular parameters needed for interpreting spectral observations are [a] the transition frequencies (or line center positions), [b] the oscillator strengths and corresponding line intensities, [c] the energies of the lower state levels (required to calculated the intensities at different temperatures) and [d] the coefficients for pressure broadened line shapes and pressure-induced shifts for positions and their temperature dependences.

Ideally, the first three parameters are obtained from proper application of quantum mechanics and accurately calibrated by a sampling of empirical results. For line shapes, good theoretical models are still lacking for most species and so empirical results are usually incorporated. If the desired atmospheric measurements are at higher pressure (near 1 bar), the subtle effects of non-Voigt line shapes (Ciurylo and Szudy 1997) and "line mixing" (Ciurylo and Szudy 2001) are essential for the interpretation of tropospheric spectra, especially near the boundary layer. For this reason, the format of the 2004 edition of the HITRAN database (Rothman *et al.* 2005) was expanded so that the line mixing coefficients could included for CO_2. Such parameters are expected to be included for other species (CH_4: Pieroni *et al.* 2001 and Pine 2003; CO: Predoi-Cross *et al.* 2000) in future updates of the database.

Spectral Line Broadening and Line Shift Coefficients

We have used a nonlinear least-squares fitting algorithm (Benner *et al.* 1995) to analyze our infrared spectra to determine spectroscopic line parameters. At first, we fit spectra individually and then determined broadening and shift coefficients by fitting the individual halfwidths and line positions (corrected for self-broadening and temperature effects as needed) to the required linear relation of halfwidth or shift vs. pressure. The nonlinear least-squares technique was applied to fit simultaneously the same spectral interval the 21 spectra recorded with varying pressure and pathlength conditions. The fitting program was capable of taking care of two broadening gases, in this case CH_4 active gas and air as the foreign gas. The spectral line shape was assumed to be Speed Dependent Voigt (SDV) profile.

The wavenumber scales of each spectrum had to be calibrated before the fitting process. The positions of all methane lines were calibrated with respect the $2 \leftarrow 0$ transitions of CO (Pollock *et al.* 1983) present as impurity in the sample and with respect to the P7 line of the methane ν_3 band (Knight *et al.* 1980). A few water vapor lines were present in the spectra due to the residual atmospheric water vapor in the optical path outside the sample cell. The wavelength scales of selected spectra were calibrated using the positions of residual water vapor lines (Toth 1991). We estimate that the absolute accuracy in measured line center positions is about $\pm 0.0001 \text{cm}^{-1}$ for isolated methane lines.

The differences between the experimental spectra and the synthetic spectra were minimized in a non-linear least square sense, by adjusting different line parameters in the fitting program. Initial values for the parameters were taken from the HITRAN 2004 database. The baseline for each spectrum was modeled using suitable polynomial expressions. FTS instrumental line shape and phase error were adjusted in the fitting program.

The following expressions were used to determine the broadening and shift coefficients and their variation with temperature.

$$b_L(p,T) = p[b_L^0(air)(p_0,T_0)(1-\chi)\left[\frac{T_0}{T}\right]^{n1} + b_L^0(self)(p_0,T_0)\chi\left[\frac{T_0}{T}\right]^{n2}, \quad (1)$$

$$\nu = \nu_0 + p[\delta^0(air)(1-\chi) + \delta^0(self)\chi, \quad (2)$$

$$\delta^0(T) = \delta^0(T_0) + \delta'[T - T_0] \quad (3)$$

In these equations, b_L^0 and δ^0 represent the pressure-broadening and pressure-induced shift coefficients ($cm^{-1}atm^{-1}$ at 296K), respectively. $b_L(p,T)$ is the Lorentz' half width (cm^{-1}) of the spectral line at pressure p and temperature T. $b_L^0(air)$ is the Lorentz half width of the line at the reference temperature T_0 (296K) of air and $b_L^0(self)$ is that of methane. χ represents the ratio of the partial pressure of CH_4 to the total pressure in the cell. $n1$ and $n2$ are the unit less temperature dependent exponents of the pressure-broadening coefficients taken from the HITRAN database. $\delta^0(T)$ and $\delta^0(T_0)$ are the pressure-induced shift coefficients at T and T_0. δ' is the temperature dependence of the pressure-shift coefficients.

Line Mixing Results

The rotation-vibration spectra of gaseous molecules are usually described as sums of these Lorentzian line shapes. As the pressure increases, the lines start to get broadened and overlap each other. This creates interference effects resulting in intensity redistribution among lines, an interference effect termed as line mixing. The theoretical explanation of line mixing effects has been developed by Baranger (1958), Kolb *et al*. (1958), Fano (1963) and Ben-Reuven (1966). A review of the theoretical development is given by Levy *et al.* (1992).

A simple physical interpretation of line mixing is presented in Fig. 2. Let us consider two spectral lines located at their resonance frequencies such that there is no broadening mechanism in play. i_1 and i_2 (solid horizontal lines) represent the initial energy levels corresponding to these lines positions. f_1 and f_2 are the final energy states that the molecules can reach by absorbing a photon of frequency ν_1 or ν_2 respectively. As the pressure increases, the number of collisions between the molecules also increases and the energy levels are not well defined anymore. i_1', i_2', f_1' and f_2' represent these collision broadened energy levels. The increased molecular collisions are raising the probability of the molecules being in the state i or i'. A transition could then occur from an absorption of a photon corresponding to the energy difference between the levels f and i or f' and i'. Thus each transition i→f could occur through two possible paths, the direct optical transition $i_1 \rightarrow f_1$ or the sequence of the collisional transfers $i_1 \rightarrow i_2$, $i_2 \rightarrow i_2$' followed by the optical transition $i_2' \rightarrow f_2'$ and the collisional transfer $f_2' \rightarrow f_2$. The same applies to

the $i_2 \rightarrow f_2$ transition also. Because of this collisional perturbation, any transition of frequency ν can follow any of the coincidental paths $i_1' \rightarrow f_1'$ or $i_2' \rightarrow f_2'$.

The collisional processes causing line mixing can be quantified by a relaxation matrix (Ben-Reuven, 1966), W, whose off-diagonal elements represents the coupling between the transitions $i_1 \rightarrow f_1$ and $i_2 \rightarrow f_2$. The real and imaginary parts of the diagonal elements represent the Lorentz broadening coefficients and the pressure-induced line shift coefficients respectively. For N pressure broadened lines, the line shape factor, I, can be represented in matrix form (Levy *et al.*1992), as a function of wavenumber, as

$$I(\omega) = X^T(\boldsymbol{\omega} - \boldsymbol{\omega_0} - iW)^{-1}\rho X \qquad (4)$$

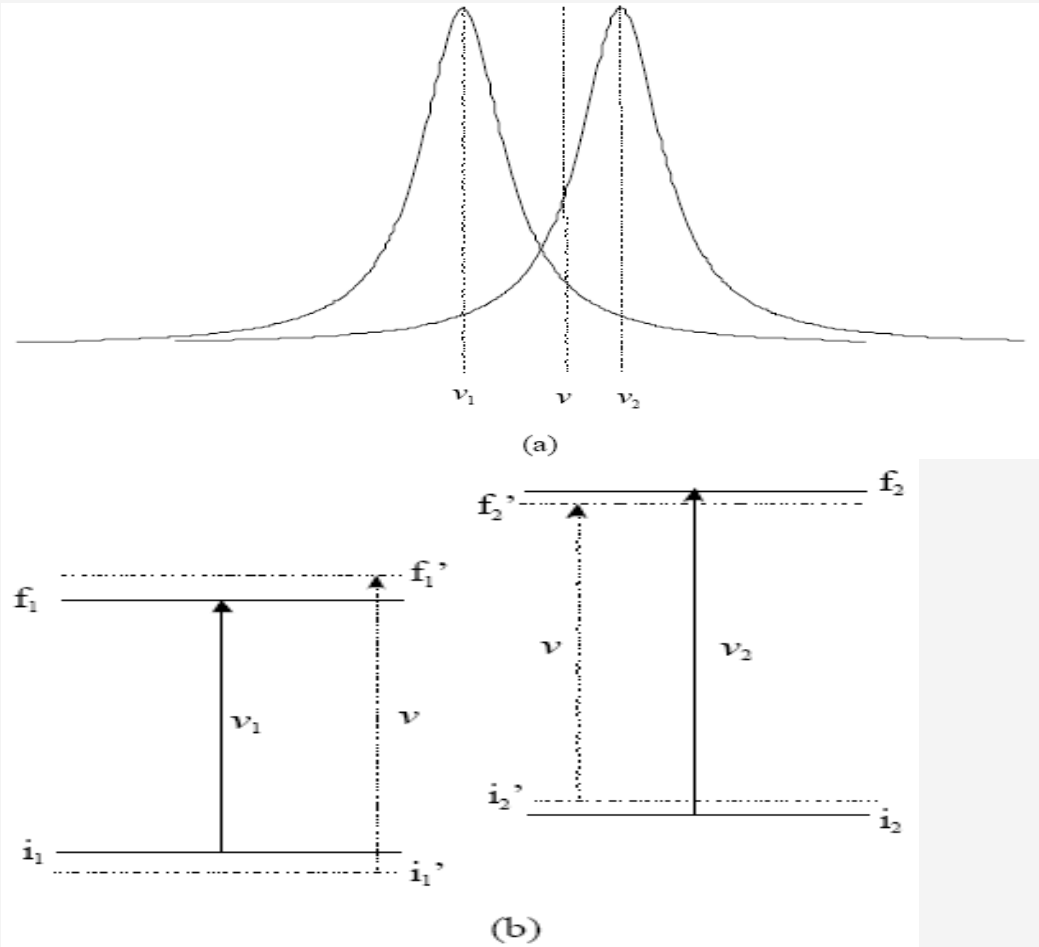


Fig. 2a. Two adjacent overlapping lines with resonant frequencies ν_1 and ν_2, allowing two probabilities of absorption for a photon of frequency ν. 2b. Perturbed energy levels (dashed horizontal lines) leading to line mixing effects

In equation 4 $\boldsymbol{\omega}$,$\boldsymbol{\omega_0}$ and ρ are N×N diagonal matrices whose diagonal elements represent the wavenumbers of each line, line positions at zero pressure and the number

density for the lower state of each line respectively. X is a 1×N matrix whose elements are related to the intensity of each spectral line as

$$X_j = \sqrt{\frac{S_j}{\rho_j}} \quad (5)$$

The T denotes the transpose of the matrix, i is square root of -1 and W is the relaxation matrix, whose diagonal elements are written as

$$W_{ii} = \alpha_{Li} + i\delta_i \quad (6)$$

where, α_{Li} are the Lorentz widths and δ_i are the pressure-induced shifts.

The off-diagonal matrix elements of W are connected by the detailed balance equation:

$$W_{jk} = W_{kj}\, \rho_j / \rho_k \quad (7)$$

The collision rate and the collision cross-section of the active molecule are determined by the average molecular speed. Thus, the collisional broadening and the Lorentzian width are dependent on the molecular speed. The commonly used Voigt lineshape model assumes that the collisional and Doppler line broadenings are uncorrelated and the change in velocity during collision can be neglected. When the correlation between the collisional broadening and the velocity of the emitters are considered, deviations from Voigt lineshape occur giving rise to asymmetries in the line profile (Berman 1972). Speed dependent Voigt (SDV) profile takes into account of these velocity changing collisions. The molecules are divided into speed classes obeying a Maxwellian distribution and a profile is calculated for each class. In a fully speed dependent profile, both the translational and collisional rates are required to be functions of speed. We assumed that the effect of speed dependent pressure shifts are negligible, since the magnitudes of the pressure shifts are very small at the pressures we studied, and only the speed dependent effect of broadening is considered. Under these assumptions, the line shape can be written as a sum of Lorentzian line shapes weighted by the Maxwellian distribution $W_M(v)$, convoluted with the translational line shape (R Berman 1997). This can be written as

$$I(\omega) = \int W(\vec{v}).I(\omega,\Gamma(v))d\vec{v} \quad (7)$$

where $I(\omega,\Gamma(v))$ is the speed independent Voigt line shape of width $\Gamma(v)$, for a speed class v. This equation was approximated as the weighted sum of speed independent Voigt line shapes, with an appropriate width for each speed class.

$$I(\omega) \approx \sum_j W(v_j).I(\omega,\Gamma(v_j)) \quad (8)$$

RESULTS

In this study we were able to retrieve the parameters for 38 transitions in the $\nu_2+\nu_3$ band. The observed selection rules for line mixing in methane are A1↔A2, E1↔E2 and F1↔F2.

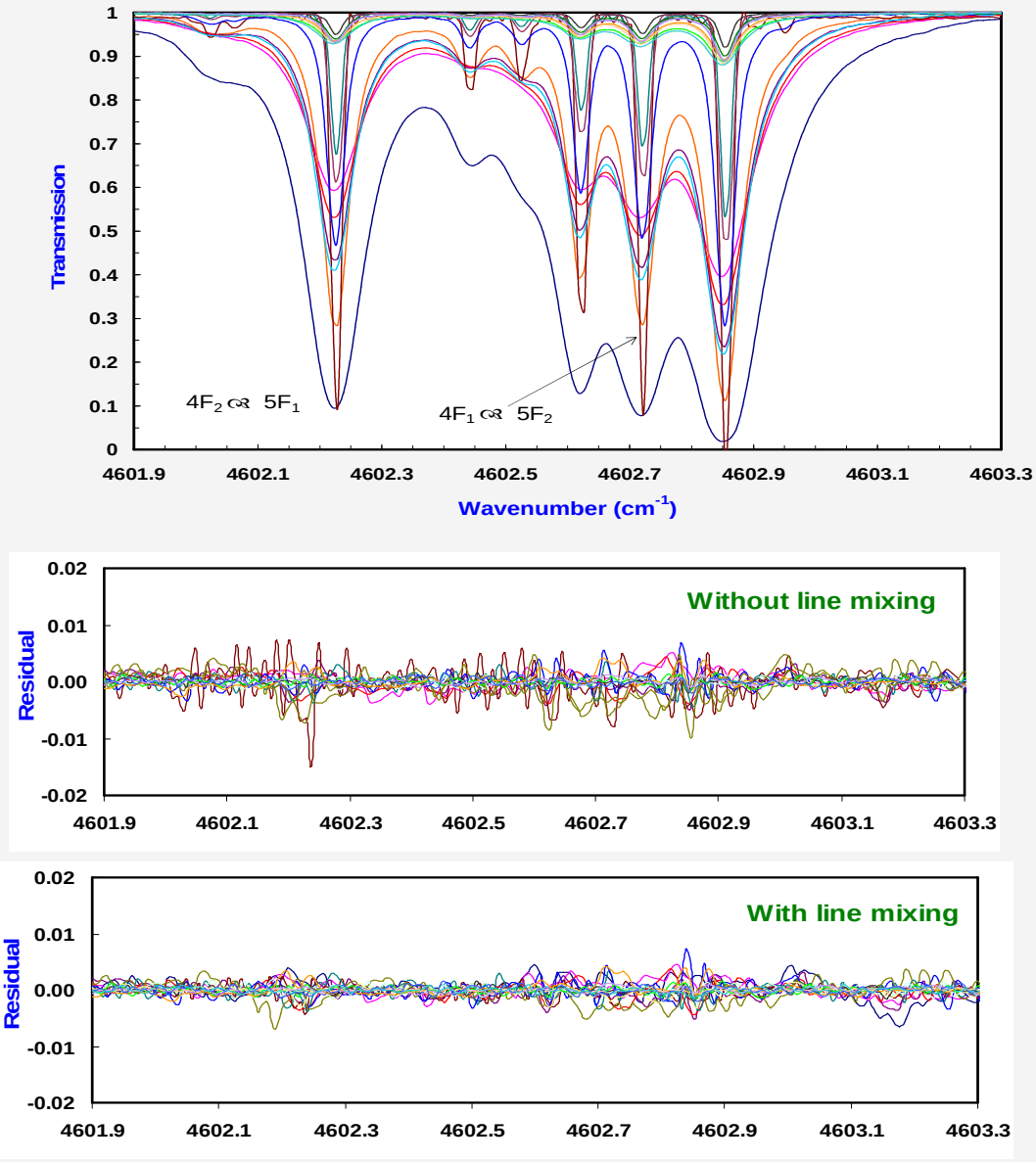


Fig. 3a. An example of the multispectrum fit of 21 spectra; 3b. Residuals of the fit without line mixing; and 3c. Residuals of the fit with line mixing

Fig 3 a represents a typical multispectrum fit for the 21 spectra in the spectral interval 4601.9 - 4603.1cm^{-1}. Fig 3b is the difference between the experimental and calculated spectra, without considering the effect of line mixing. It can be seen that the residuals are considerably reduced in fig 3c, where line mixing is taken into account while fitting the data. Figure 3 demonstrates the need for better line shapes in laboratory studies. As shown in Fig. 3, the methane spectra were modeled with a speed-dependent Voigt with line mixing. Without line mixing "extra" absorptions appeared in between the lines; this could have been falsely interpreted as "continuum effects" in an atmospheric spectrum.

Table 1 and 2 show sample results for the self line mixing coefficients and air line mixing coefficients. The first and second columns list the upper and lower state quantum numbers J (rotational quantum number), C (A1, A2, E1, E2, F1, F2) and N respectively. For infrared transitions, $\Delta J = -1, 0, +1$ denotes the selection rule. The following columns give the measured positions (cm^{-1}), intensity (cm^{-1}/(molecule cm^{-2})), self/air broadened widths ($cm^{-1}atm^{-1}$), self/air induced pressure shifts ($cm^{-1}atm^{-1}$), and the corresponding line mixing coefficients ($cm^{-1}atm^{-1}$). All the measurements are in the room temperature, 296K.

Table 1. Sample of results for self line-mixing coefficients

J′ C′ N′← J″ C″ N″	Position	Intensity	Self Broadening (cm^{-1} atm^{-1})	Self Shift (cm^{-1} atm^{-1})	Line mixing (cm^{-1} atm^{-1})
11A2 45←12A1 2	4409.94590(9)	7.519(5)E-23	0.0758(8)	-0.0158(9)	0.0390(64)
11A1 44←12A2 1	4410.58685(7)	6.013(3)E-23	0.0751(10)	-0.0133(10)	0.0390(64)
11A2 49←12A1 1	4425.36272(6)	8.423(2)E-23	0.0720(5)	-0.0197(6)	0.0129(23)
11A1 47←12A2 1	4525.74326(6)	9.710(3)E-23	0.0762(9)	-0.0166(7)	0.0129(23)
7F1 93←8F2 2	4459.46600(3)	3.541(7)E-22	0.0823(10)	-0.0177(8)	0.0113(13)
7F2 90←8F1 2	4459.49338(4)	1.527(5)E-22	0.0853(14)	-0.0126(11)	0.0113(13)

Our final set of results represent only the measurements for which the transitions showed an intensity of 1.0×10^{-23} cm^{-1}/ (molecule cm^{-2}) or greater. The maximum statistical uncertainty for the reported intensity is 8%, that for the reported broadening is 7% and for the reported shift is 11%. Line mixing coefficients were reported only if their statistical uncertainty is less than 15%.

Table 2. Sample of results for the air line-mixing coefficients

J′ C′ N′← J″ C″ N″	Position	Intensity	Air Broadening (cm^{-1} atm^{-1})	Air Shift (cm^{-1} atm^{-1})	Line mixing (cm^{-1} atm^{-1})
11A2 45←12A1 2	4409.94590(9)	7.519(5)E-23	0.0572(5)	-0.0112(5)	0.0205(29)
11A1 44←12A2 1	4410.58685(7)	6.013(3)E-23	0.0536(6)	-0.0107(4)	0.0205(29)
11A2 49←12A1 1	4425.36272(6)	8.423(2)E-23	0.0544(3)	-0.0120(3)	0.0056(10)
11A1 47←12A2 1	4525.74326(6)	9.710(3)E-23	0.0569(6)	-0.0120(3)	0.0056(10)
7F1 93←8F2 2	4459.46600(3)	3.541(7)E-22	0.0613(7)	-0.0077(6)	0.0047(10)
7F2 90←8F1 2	4459.49338(4)	1.527(5)E-22	0.0668(10)	-0.0102(6)	0.0047(10)

Though the general observed selection rules for line mixing are A1↔A2, E1↔E2 and F1↔F2, among the reported 38 transitions, we did not have E1↔E2 species transition. Generally, F species were observed to have higher widths and shifts compared to the A species.

CONCLUSION

The atmospheric remote sensing community must have reliable and accurate observations for which the uncertainties are well understood. New ground- and space-based remote sensing global networks are being set up to utilize the near infrared in order to obtain robust measurements of important carbon-bearing species (CO_2, CH_4, and CO).

Complete and accurate characterization of the molecular transitions is a necessary component of the process by which atmospheric spectra are interpreted to illuminate key environmental issues and expand our understanding of atmospheric chemistry, dynamics and climate change. Quantitative measurements of atmospheric abundances and physical conditions can be only as accurate as the line parameters used in the radiative transfer calculations because errors in the line parameters propagate directly into the error budget of the atmospheric retrievals.

This is the first experimental study of line mixing in the $\nu_2+\nu_3$ band in the octad region of methane which reports the self and air line mixing coefficients for 38 transitions. All the observed transitions are A or F type species. A speed-dependent Voigt profile including weak line mixing was used to model the data. It has been found that this model best represents our data. Future work will be analysis of other two octad bands. We believe that the atmospheric community will not have accurate remote sensing observations without suitable completeness and accuracy of the important molecular parameters provided by spectroscopic studies such as this one.

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INVITED ARTICLES

GRADUATE STUDENTS ASSOCIATION (GSA)
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I1: TRANSFORMING UNIVERSITY TEACHING THROUGH INQUIRY-BASED TEACHING DEVELOPMENT

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INTRODUCTION

Post-secondary institutions are undergoing public examination to an extent consistent with that of other social and economic institutions. Accordingly, thoughtful and creative strategies are required to respond to trends such as the commodification and democratization of knowledge, the deconstruction of conventional values, and the decentralization of human capital and decision-making. Yet as Pocklington and Tupper (2001) observe, rarely do these important deliberations in university contexts do more than allude to the central role of effective teaching as contributing to the worth of post-secondary institutions.

> Imagine that the elementary schools in your neighborhood decided to leave the teaching of kids to university students on temporary contracts. These students have little or no experience teaching. They are unable to give full attention to their pupils because they must spend part of their time working on university courses. In addition, they have morale problems because they are paid less than half the salary of a beginning full-time teacher, and their classes contain twice---often ten times---as many students….The situation imagined may seem so ridiculous as to be pointless. But it is not pointless. It pretty much describes the present-day character of teaching in Canadian universities.
>
> Pocklington & Tupper, 2001, p. 35

The types of teaching and learning characteristic of university classrooms are frequently incongruent with the sound pedagogy that must direct new policies and programs. As one example, when the Holmes Report (1986) referred to the quality of much North American university classroom instruction as *dreary*, several post-secondary

institutions responded with the claim that academics are appropriately identified on the basis of their specialized subject expertise and distinguished research record, rather than on their demonstrated teaching effectiveness. In response to the Report's further contention that very few professors "know how to teach well, and *many seem not to care*" (p. 16), many faculty development programs were initiated, yet few evolved as centers with pedagogic foci. Most demonstrated sporadic and uneven growth, and minimally fulfilled an unclear and unspecified mandate to improve teaching. In fact, when the Boyer Commission (1998, 2001) revisited its study on effective university teaching several years later, it reported that---despite clearly outlined recommendations for improvement---graduate students and new faculty continued to lack adequate preparation for their teaching roles, and most institutions had not made demonstrable gains in teaching effectiveness. University teaching and learning continues to reflect an entrenched "orthodox set of ideologies" (Rogers, 2003, p.1) synonymous with factual regurgitation or, at best, passive intellectual curiosity. Furthermore, a new irony can be observed in some programs initiated to improve teaching effectiveness when the very didactic, episodic, and technical teaching they are designed to combat are the delivery methods of choice when offering help to professors. At the expense of deeper, less cost-efficient, and more time-consuming efforts, these programs perpetuate the misunderstanding that teaching---and being taught to teach---is simply a series of knowledge disseminating activities best accomplished through transmission and passive reception.

Barriers to Change in University Classrooms

To the extent that teaching in today's diverse classroom is context-specific, agreement is evolving about the knowledge, skills, and attitudes characteristic of good university teaching. However, in circumstances void of such definitions and clarity of evaluation, Boice (1991) and several other authors (Kreber, 2001; MacKenzie, Eraut, & Jones, 1970; Palmer, 1999; Rice & Finkelstein, 1993) explore the problematics fundamental to examining teaching effectiveness in university classrooms. Student evaluations compared with perceived levels of student learning is one. Another is the differentiated point of intersection between disciplinary expertise and pedagogical understanding. A third examines the most effective levels of responsibility for learning assumed by teacher and student. While defining and demonstrating effective teaching is unquestionably a challenge, it is not a task insurmountable by well-meaning and well-informed university educators. Perhaps the most damaging incongruence of function that militates against change in postsecondary systems is the conflict---often institutionally supported--- between the two primary components of a professor's job: that is, between teaching and researching.

Reward Structures

A lingering paradox characterizes scholarly inquiry in academic contexts. The inordinate extent to which strict adherence to a scientific methodology defines the success of research activities of university professors is rarely considered when teaching and learning activities of the professoriate are being examined. Despite clear recommendations from internal and external sources, fiscally well-supported, broad-based, and sustained faculty development initiatives that employ a scholarly approach to

the improvement of tertiary teaching are the exception while research initiatives and associated funding continue to expand.

This paradox militates powerfully against the value accorded teaching in postsecondary systems. The perceived conflict between two primary components of a professor's job polarizes teaching and researching responsibilities. A clearly compartmentalized "dualistic distinction" (Rowland, 2003, p. 15) gives rise to particular practices, reward systems, and arguments that clearly support the value of one over the other. Frequently, the internal structure and values of postsecondary institutions default the most significant rewards to achievement in research rather than in teaching. The view that teaching is an activity incidental to, and in conflict with, the life of an academic underlies semantics of *research opportunities* versus *teaching loads.*

Raisons d'etre

Many faculty members report that they are ready to focus on teaching, but perceive their campuses to be inhospitable climates for that endeavor. If faculty members feel unsupported in moving away from a style of teaching that Ashby (1958) referred to as *celibate orthodoxy*, it may be that a lack of institutional support is based on fundamental differences in opinion about the reason for the existence schools of higher education. Lockhart (in Pullias et al., 1963) draws support from Ortega (1946) and Whitehead (1929) in asserting that, in order of importance, the role of teaching in universities should be primary, with search and discovery secondary. Similarly, Henderson (1969) outlines several purposes of modern postsecondary institutions, highlighting the importance of purposeful facilitation of teaching and learning above other goals. Still, in practice, most universities extol research and tolerate teaching and the contention of Peter Klapper in 1959 remains true today: *Most teachers in institutions of post-high-school level have not been prepared to teach*. Decades later former Harvard president, Derek Bok, agrees. "It's astonishing….Academia is the only professional system that doesn't instruct its newcomers in how to do what they will spend most of their time doing" (2006).

The instructional style of tertiary teachers has its genesis in past experience as well as in their memories of being a student. Referring only to these perceptions when creating a frame of reference for teaching effectiveness may result in unconscious mediocrity, at best (MacKenzie, Eraut, & Jones, 1970). Drops (1996) describes the process of relying singularly on such memories as "…[ineffective because] it gives the test first, and the lesson later" (p. 528). As noted by Edgerton (1990):

> Faculty members come to us strong in content and blissfully ignorant of anything having to do with theories of learning or strategies of teaching rooted in pedagogical knowledge. In their knowledge of their disciplines, as the old saying goes, they stand on the shoulders of giants. In their knowledge of teaching, they stand on the ground. (p. 1)

The curiosity that some tertiary teachers demonstrate about their teaching practice is genuine enough, although frequently limited (Lee, 1970). Bok (2006) agrees. "It's not that professors don't care [about teaching], but that they don't know what they're doing. Literally." He continues: "The rich irony of professors ignoring solid academic research about teaching is momentarily amusing, but ultimately frustrating." Given outdated and

misaligned reward structures, and shifting mandates in institutional purpose, it may also be understandable.

Positioning the Notion of A Scholarship of Teaching

Teaching practice that is informed by relevant research has remained the near-exclusive property of primary and secondary teachers, while the vast body of literature about human learning theory and pedagogy has remained relatively unaccessed by tertiary teachers. Improving teaching effectiveness in universities is "….not a matter of acquiring new teaching techniques as much as tapping the large, research derived knowledge base on teaching that already exists" (Biggs, 2003, p.1). Becoming acquainted with this literature and applying it purposefully with rigor and discipline to teaching practice is a process that Boyer (1990) refers to as a *scholarship of teaching*. According to Boyer, this unique kind of scholarship is defined by examining teaching practice through activities of discovery, integration, application, and instruction. It is a sense of inquiry about practice that appears to differentiate the teacher-scholar from the teacher-and-scholar. Theall and Centra (2001) assert that this is an important distinction, and a defining prerequisite for the "arena of the scholarship of discovery" (p. 20). Paulson (2001) furthers the definition by identifying three major processes characteristic of scholarship of teaching. These include *synoptic capacity* or content knowledge, *pedagogical knowledge*, and *interactive knowledge* linking content and learning. He contends that a truer definition of a scholarship of teaching lies closer to the last element, which he refers to as the "nexus" point (p. 20) characterized by practice and reflection on teaching, professional development and evaluation of teaching practice, and the pursuit of research about the learning process of tertiary students. He suggests these inter-related activities are "a form of classroom research that is solidly grounded in, well informed by, and interdependent with the existing knowledge base of traditional theory and research on teaching and learning" (p. 22). This is most apparent when faculty can be observed moving beyond technique, beyond a singular conception that sees teaching and learning problems as things in need of a solution, and coming to view teaching and learning as challenging, intriguing, perplexing, and profound. When university teachers are engaged in a process of continuous, sustained learning about teaching, they can promote the types of gains in the overall quality of teaching that are indicative of teaching and learning transformation (Mezirow, 1991). That is, faculty members who participate in scholarship of teaching development programs not only diversify their repertoire of teaching techniques and, consequently, improve their teaching practice, but may also elongate periods of teacher vitality in colleges and universities, while contributing to a renewed sense of community in which learning is not the exclusive burden of students but, rather, a privilege engaged in by all. Moreover, teaching professors may become more deeply engaged with students and colleagues (Bennis & Thomas, 2002), and empower both groups to impact the direction of professional and institutional development.

CONCLUSION

The last two decades have witnessed some of the most dramatic changes in university classrooms in more than a millennium. Institutional and class sizes have increased substantially; students no longer reflect a relatively homogeneous set of worldviews and ethnicities; access to vast amounts of information---both relevant and irrelevant--- is available to almost all, regardless of location and socioeconomic considerations; and consumer culture has re-defined how students and institutions view the purpose of education and learning. In addition, post-secondary institutions are now experiencing pressures similar to those of primary and secondary education systems to do *more with less* at the same time that students, as "clients", have begun to demand more efficient "information delivery systems" to ensure maximum "value" from their education, with a view towards improving their "marketability." In short, it may be argued that the present university classroom is not a particularly hospitable climate for tertiary teachers who have held to traditional methodologies. Nor, it may be further contended, is it any less daunting an environment for many beginning professors with little pedagogical understanding and often less formal practical instructional training. Add to this that the process of faculty development for teachers in this changing university context is frequently misunderstood and often made unnecessarily elusive, **(and?)**a situation is created that may not be conducive to the most effective teaching and learning in 21st century university classrooms.

The history of university teaching in North American universities appears to have followed a predictable path in the last 50 years. Typically, a report identifies a long list of concerns, and presents a persuasive case for major improvements in faculty teaching. Universities respond by promoting a variety of episodic interventions or temporally limited program initiatives. Over time, however, the primacy of research is reasserted as faculty development programs fall victim to budget cuts, apathy, and their own failure to produce compellingly positive results. Soon, another major report is commissioned and, invariably, the quality of university teaching is subjected to another predictable cycle of attention and neglect.

Pragmatically, researchers and teachers working together have learned a great deal about what makes teaching effective, and what is needed to improve teaching in universities. Occasionally, this knowledge is based on an existing or emerging research base. However, the practical solutions resulting from this work frequently fail to attend to and implement a larger body of educational research regarding teaching, learning, and professional development strategies for improving teaching. For example, growing evidence points out the necessity of understanding the complex essential connections between teaching and social learning, while brain-based neuroscience is recognizing the increasingly important contribution that processes of constructivism can make to the professional growth of university teachers. Yet, institutional and individual obstacles remain and perceptible changes in university teaching practices are rarely documented or recognized at the broader level of the reward structures of academe.

Teaching *is* important. Teaching *is* the primary reason why most universities receive public funding. Teaching *is* the reason why most students attend university. A purposeful focus on teaching effectiveness and teaching scholarship can contribute to Parker Palmer's (2000) musing:

> When I imagine the community of truth gathered around some great thing---from DNA to The Heart of Darkness to the French Revolution---I wonder: Could university teachers gather around the great thing called "teaching and learning" and explore its mysteries with the same respect we accord any subject worth knowing? (p.11)

Perhaps another important question to be asked and answered is *What will it take to move more universities and professors to a deep understanding of the primacy of teaching and a stronger commitment to more effective ways of improving learning through changes in practice?*

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I2: TEACHING TIPS FOR THE NEW GRADUATE STUDENTS

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GRADUATE STUDENT RESPONSIBILITIES

The School of Graduate Studies, in collaboration with the Faculty of Arts and Science, oversees the academic development of graduate students with declared majors in the Arts and Sciences. This includes the monitoring of course and thesis work, as well as the general supervisory process which is carried out by the supervisor and committee. The graduate student's experience here will include the development of various teaching skills, by way of lab instruction, tutoring, marking, leading discussion groups, assisting in new course and lab development, and other teaching related duties (see pg. 297-300 of 2006-07 calendar).

In the Faculty of Arts and Science, the Associate Dean approves the assignment of these duties based on the particulars of the Graduate Teaching Assistantship (GTA) awarded by The University of Lethbridge. The exact duties will vary within and between departments, and may be somewhat different for students holding Scholarships or Fellowships. In the development of these teaching skills, the Faculty of Arts and Science serves as your employer insofar as you sign off on a statement of work developed by the supervisor, department and faculty, and for which you are paid. We provide financial remuneration for the work in the form of a GTA in the amount of $7000/yr for two years in the case of M.A./M.Sc. degrees and 3 yrs for Ph.D. degrees.

The following list provides some further direction:

1. Ensure that a **GTA form has been completed** by the supervisor, and signed by you, the supervisor, chair, and dean. The form may apply to a course for which the supervisor is not the instructor, and may indicate your assigned duties for more than 1 semester.
2. **Discuss the teaching responsibilities** in more detail with the instructor so that you have a clear understanding of what is required and what you are responsible for (i.e. preparation, setup, monitoring, marking, release of marks for individual assignments, etc.).
3. It is not unreasonable to expect that much of (2) above will be spelled out in a **course outline** so that the undergraduate students are familiar with the procedures used in the particular department or course.

4. Where a department uses **lab coordinators**, be sure to consult with them before going to the instructor.
5. **The instructor is responsible for the break-down of how the grade is determined as well as** the actual entry of grade onto the grade sheet. This should not be carried out by a graduate student. Even though you may be aware of a student's final grade or results on an examination, it is up to the instructor to release such information to the student, although an instructor may, for example, have the graduate student enter the data into a spreadsheet or into WebCT. It should be made clear to the undergraduate students how test and lab results are to be released (preferably in the course outline).
6. **Security of written assignments, and grades** must be properly managed in consultation with lab coordinators and/or course instructors. None may be left in an unsupervised public space. Material can be sent back to the owner in a stamped self-addressed envelop or picked up by another person as long as a letter authorizing such action is included. Special needs students must be accommodated as far as is reasonably possible.
7. **Other procedures for which graduate students may be asked to provide input:**
    a. incompletes and withdrawals with cause require evidence which a graduate student may be able to verify (i.e. failure to complete assignments, missed assignments, sickness, absences, etc.).
    b. student discipline policy
    c. academic offenses: plagiarism, cheating, duplication, distribution of confidential materials (i.e. lab answer keys, assignments from previous years which may substantially overlap with this years assignment, misrepresenting other's work as one's own, etc. These alleged offenses must be communicated to the instructor.
    d. Non-academic offenses: disruption, physical abuse, harassment, and dangerous activity, misuse or misappropriation of university equipment, facilities, or services. Anyone can make such a complaint or allegation and must document it and send details to the dean (alleged academic issues) or security (all alleged non-academic offenses). Security will direct to appropriate unit heads.
8. Other questions which may arise from time to time (such as taping of lectures, ownership of graded work, posting grades), see p. 74-77 of 2006-07 calendar

GRADUATE STUDENT RIGHTS

Grad Students are entitled to a fair assignment of work in terms of both **amount** and **nature** of the work.

Graduate students, in consultation with their supervisor, must decide whether they wish to be paid a full GTA ($7000/yr) or a half GTA ($5000/yr) where they hold an NSERC postgraduate scholarship or similar source of external funding. This will be indicated in the Admission letter received from the School of Graduate Studies and will be reflected in the GTA form. A full GTA means 120 hrs/yr for 2 years, whereas a half GTA is 60 hrs/yr for 2 years. The Faculty of Arts and Science strongly discourages the assignment

of more than 60 hours of work per semester, but in special cases where both supervisor and graduate student agree, has permitted 120 hours of work to be assigned to a single semester .

The assignment of duties to graduate students is prioritized as follows: lab instruction, tutoring, marking, and other duties (see calendar, page 297-300).

All Graduate student teaching must be evaluated by procedures established within the faculty. Graduate students are entitled to receive a copy of such an evaluation.

Past experience has demonstrated that graduate student teaching is generally rewarding, and provides valuable pedagogical experience. We wish you every success as you launch into a new and exciting phase of your university education.

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I3: THEORY OF EVERYTHING

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Abstract: *We present a brief outline of some of the leading candidate theories which attempt to unify the four fundamental interactions in nature.*

It has often been said that Physics is that fundamental branch of science from which all others follow, at least in principle. Consider for example Biology, whose workings can be explained entirely in terms of chemical reactions. Chemistry on the other hand can be understood in terms of atomic and nuclear processes, which is in the realm of physics. The detailed workings of each of these disciplines are another matter altogether. Just as it needs a skilled physician, and not a scholarly biologist to cure a disease, so also masters in the field of biology, chemistry etc are absolutely essential to tackle problems in their respective fields.

So, rather that arguing about which field of science is more fundamental, let me try to concentrate on the fundamentals of one such branch of science, namely Physics. Physics deals with the understanding of the material and objective world around us, their behaviors and mutual interactions. There are four such fundamental interactions or forces in nature, in terms of which all known observable phenomena can be explained. These four interactions are *ELECTROMAGNETISM*, *WEAK NUCLEAR FORCE*, *STRONG NUCLEAR FORCE* and *GRAVITATION*. Electromagnetic forces are responsible for most of the everyday happenings that we see around us. For example, when we push a box, and it moves, it is the electrons in our hand repelling those on the surface of the box, which force manifests itself as the "push". In fact, our bodies are held together by virtue of the forces between electrons and protons in our blood, skin and bones!

Weak Nuclear forces are most often manifested as radioactivity, that which makes the radium in your watch dial glow in the dark. Strong Nuclear force is somewhat more specialized, but suffice it to say that it causes the sun to burn its fuel, and gives us heat and light. So in a sense, it is as important to life as the blood which runs in our veins.

Finally, we come to gravitation, which is all too familiar to us. It keeps us from flying off into the sky (of course, the sky or atmosphere itself is held together close to the earth by gravitation), makes water in the streams flow downwards, and keeps the earth in a steady orbit around the sun.

Now, are these four different forces really distinct from each other or is there a common bond between them? Over the past hundred or so years, this question has occupied the centre-stage of research in physics. Scientists have shown that the first three of the forces, namely Electromagnetic, Weak and Strong Nuclear forces are manifestations of an unified theory called the "STANDARD MODEL OF INTERACTIONS". Consider the proverbial elephant and the blind persons. One perceives the animal as a long flexible object, other as a thick tree-like structure, another as a long rope, and so on. But it is the same elephant after all, and the method employed to see (or feel) it determines the final outcome of what one sees (or feels). The situation is very similar with regard to the first three forces mentioned above. Depending on whether our experimental set up consists of a human and a box, or the radium dial of a watch, or the consumption of nuclear fuel by the sun, nature manifests itself as one of the above forces or a combination thereof. The Standard Model was proposed by Professors Sheldon Glashow, Abdus Salam and Steven Weinberg, for which they shared the 1979 Nobel Prize in physics.

But what about gravitation? So far, one has failed to include it in a unified scheme of description of nature. In other words, no one really knows what the relation of gravitation is to the other three forces. The blind men and women (i.e. physicists) have failed to detect any part of the elephant which reflects the properties of gravitational force. What goes wrong? Primarily, the influence of gravity is extremely weak. It requires something as huge as the sun or our earth to influence a significant gravitational force which can be measured (as opposed to a mere 100 kg human being which can exert a significant electromagnetic force). So it makes it quite difficult to perform controlled experiments involving gravity. And progress in science without steady inputs from experiments is extremely difficult, if not impossible.

This does not mean of course, that people have given up on the project. In the absence of viable experiments, they do what best can be done - in the form of proposing interesting theories, checking their internal consistencies (seeing for example that it does not predict anomalously large or small gravitational forces on something sitting on the earth, which would be plain wrong) and proposing experimental signatures of those theories which one might be able to test in the long run.

Collectively, such theories are called **QUANTUM GRAVITY**. Quantum because nature behaves in so-called Quantum Mechanical fashion at the small scale, and it is the behavior of gravitation at the small scale which is so ill-understood. By *small scale*, I mean about L=10^(-33) cm, i.e. decimal point followed by 32 zeros and a one, in centimetres. This is also known as the *Planck Length*. The field has several sub-fields, depending on what the fundamental assumptions of the approach are and the general route taken by the physicists in that sub-field to try to reach the goals. Notable among them are (a) Superstring Theory and (b) Quantum Geometry. The first approach, started by John Schwarz (Caltech), Edward Witten (Institute for Advanced Study, Princeton), Michael Green (Cambridge) and others, begins by assuming that fundamental objects in nature are strings, rather than particles, thus `smearing out' the very small distances into slightly elongated objects. The second approach, pioneered by Abhay Ashtekar (The

Pennsylvania State University), Lee Smolin (Perimeter Institute, Waterloo), Carlo Rovelli (Marseille) and others, takes a cautious route, examines each and every step in the theoretical exercise very rigorously, and tries to see what nature has in store for us at the very end, when gravitation starts influencing things at short distances.

Although, as mentioned before, measurable experimental predictions of the above theories are extremely difficult to make, there exists a *theoretical laboratory*, in which they can be tested. This laboratory consists of **Black Holes**, which are super-dense astrophysical objects predicted by Einstein's *General Theory of Relativity*. So much mass is supposed to be packed inside so little a volume inside black holes, that both Quantum Mechanics and Gravitation become important for their proper description. In other words, they are ideal testing grounds of any viable theory of Quantum Gravity! In particular, it had been proposed by Professors Jacob Bekenstein and Stephen Hawking that a black hole has entropy and temperature, which are related to its area and mass as the following:

S = A/4L^2 and T=hc^3/8*pi*GM ,

where, h=Planck constant, G=Newton's constant, M=black hole mass, A=black hole area. Note that for normal thermodynamic systems, the entropy (also known to be a measure of *disorder*) is proportional to the volume of the system. Moreover, it is also expected that the above entropy originates from a large number of fundamental microscopic degrees of freedom (or states) N, according to the following formula:

S=klog(N),

where k=Boltzmann constant. Can String Theory or Loop Quantum Gravity provide a correct description and counting of the N? This common question has dominated Quantum Gravity research for more than a decade now.

While physicists are working vigorously to develop and understand these theories, they are by no means complete, and only hints have emerged as to how gravity can be incorporated into a grand unified theory. One hopes that a satisfactory understanding will emerge in this century, and that we will be more knowledgeable about how nature works. This would also perhaps answer fundamental questions such as how our universe was formed, how the galaxies, solar systems and planets came into being, and how life itself formed and developed. That would indeed be a THEORY OF EVERYTHING. Would it enable us to see into the mind of god? May be. Would we be able to change the course of nature and this universe? May be not. The detailed interactions in nature, and between human beings is far too complicated to comprehend or influence in one stroke. We will perhaps need several hundred more years to achieve that goal. But there is always a beginning. So let us hope that there is at least some progress in humankind's quest for knowledge and understanding of the fundamentals of nature in the near future.

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I4: PUTTING PARKINSON'S DISEASE IN CONTEXT: EVIDENCE OF DYSFUNCTIONAL INFORMATION PROCESSING IN CURRENT RESEARCH AND PARKINSON'S ORIGINAL ESSAY

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INTRODUCTION

Despite greater than four centuries of anecdotal and clinical observation [Sacks, 1999] and two centuries of scientific investigation [Burch and Sheerin, 2005], Parkinson's disease (PD) insidiously persists. Scales that standardize the assessment of cardinal symptoms and simple manifestations fail to penetrate the depression, decreased function, and diminished quality of life PD patients report, partially attributable to the progressive loss of independence and control in activities of daily living [Cahn et al.., 1998; Chapuis et al., 2005; Kuopio et al., 2000]. One suggestion for improved assessment of the parkinsonian deficit is a focus on real-world functional tasks [Morris, 2000], specifically the frequent disparity between willed intention and motor execution observed among PD patients on a variety of simple and complex tasks [Rubinstein, Giladi, & Hausdorff, 2002]. The aim of this review is to provide an examination of the unique relationship between context and action observed in PD patients, based on evidence from various experimental and observational studies, including Parkinson's original report. As a prelude to the development of this argument, a brief review of some basic principles underlying context-dependent research in movement disorders are provided.

The critical role of context in behavioural analysis

For neurologically normal animals, behaviour is influenced by context. Indeed, normal behaviour can be defined as actions that are in concordance with the physical and social constraints of their external context [Dunn et al., 1994]. This interrelationship presents an unique but imperative prospect for experimentation into behaviour and movement disorders, specifically the opportunity to manipulate context as an independent variable in behavioural analyses [Teasdale & Stelmach, 1988]. For PD research, such an approach may dissociate movement impairments that are a direct result of neurological deficit from impairments that are an adaptive response to the general PD effect of diminished precision of movement [Phillips et al., 1994]. This dissociation could have important implication in the design and delivery of more effective rehabilitation therapies [Montgomery, 2004]. Equally important is the need to establish these experimental contexts as relevant to real-world tasks, to increase research validity while allowing for

transferability of the observed human performance principles to everyday tasks and situations [Czaja & Sharit, 2003]. This is critical in the study of Parkinson's disease, where spatiotemporally-constrained real-world situations can lead to disruption in movement [Fahn, 1995; Gray & Hildebrand, 2000; Stolze et al., 2004].

Prior to the execution of an action, several steps of information processing are required [Jahanshahi & Frith, 1998]. Reviewing the neuroanatomical basis of all information processing steps is beyond the scope of this paper, but the basic processing path includes sensation and sensory integration, goal setting, response selection, scheme programming, inhibition of contentious schemes, and response initiation [Le Bras et al., 1999]. For non-reflexive movements, a higher-order supervisory system is theorized to control this processing [Kropotov & Etlinger, 1999]. Norman and Shallice's model of the Supervisory Attentional System outlines the function of such a system, and links this operation with the frontal lobes and prefrontal cortex [Shallice & Burgess, 1993]. Paramount in the model is the demand on attention for information processing. Therefore, information processing capacity can be defined, at least in part, as task-available attention [Heuer & Wing, 1984]. While the remainder of this review will discuss experimental and everyday examples of information processing deficits among PD patients with specific focus on context-based manipulations of information processing, it is relevant at this point to briefly outline current models of information processing capacity experimentation used in the observation of motor behaviour disturbances in general.

Experimentation in information processing capacity

In a recent review, Wollacott and Shumway-Cook [2002] have provided an excellent exposition of current experimental studies that explore the relationship between information processing capacity and critical everyday activities, specifically posture and gait, that rely on the availability of information processing capacity. Wollacott and Shumway-Cook [2002] conclude, in part, that "applications of attention and postural control research are improving our understanding of motor control problems in patients with specific types of pathology, such as PD". This justification, combined with the previously identified imperative for ecologically-based investigation of movement disorder [Teasdale & Stelmach, 1988], lends import to a brief inspection of two general experimental methods for manipulation of information processing capacity pertinent to the study of the parkinsonian movement disorder in activities of daily living.

Concurrent demands on information processing capacity: Dual-task interference

The dual task paradigm involves the simultaneous presentation of two separate task stimuli to participants [Abernethy, 1988]. This model is predicated on Kahneman's theory of finite attentional capacity, which suggests that attention is available for various information processing demands, as a common resource pool with a finite capacity [Kahneman, 1973]. Given this instantaneous limit on information processing, the dual task methodology follows the hypothesis that task performance will decrease when the combined attention required in multiple concurrent tasks exceeds the finite information processing capacity [Abernethy, 1988]. As an example, Ho and colleagues [2002] measured the initiation and ongoing volume control of PD patients' speech while the patients were either conversing freely or reciting number sequences as a primary task. In

the secondary task, patients and control participants used a joystick and a computer monitor to perform a target-needle tracking task. The results showed that PD patients used lower mean speech volume and experienced greater ongoing volume decay and increased duration of pauses between words with the introduction of the secondary task. It is interesting to note that patients and controls had equal levels of performance on the secondary task, possibly indicative of the benefit of visual feedback in potentiating motor behaviour among PD patients [Rubinstein, Giladi, & Hausdorff, 2002]. Dual tasks models can involve any combination of motor and cognitive tasks, and measurements can be made (and inferences drawn) about the demands of tasks and the associated integrity of processing and activation systems in either psychomotor modality [Wollacott & Shumway-Cook, 2002].

Compound demands on information processing capacity: Single-task context

Manipulations of task difficulty have a longer documented history in behavioural experimentation. In a classic example, Fitts [1954] showed that decreasing the size of a target for a repetitive pointing task led to the need for a log-linear decrease in speed among neurologically normal adults, to maintain acceptable task accuracy. Extensions of this work have shown a similar relationship in experimental reaching tasks [Bootsma et al., 1994] and reaches to functional targets [Latash & Jaric, 2002]. Furthermore, the same Fitts'-type relationship has been found to exist among PD patients, but at a steeper decrement – that is, PD patients had greater decreases in velocity and acceleration magnitudes as target size decreased [Sanes, 1985; Weiss et al., 1996]. This decrement may be normalized with PD medication [Montgomery & Nuessen, 1990]. A possible analogous condition exists in the 'pop-out' paradigm, where time required to visually search and locate a target in a field of stimuli increases as either target decreases in size or target increases in feature similarity to field stimuli [Tresilian, 1998]. Moderate to severe PD patients have been shown to exhibit increased search times for 'pop-out' tasks [Berry et al., 1999]. Marteniuk and colleagues [1987] used a series of functional tasks with implicit task demand constraints (e.g. reaching for both robust (tennis ball) and fragile (light bulb) targets of equal object size) to establish that movement planning and execution are unique to task constraint, or difficulty. This finding emphasizes the importance of attention to context in preparing and executing an movement. Shallice and Burgess [1993] suggest that the Supervisory Attentional System would be active in controlling behaviour in tasks that are technically difficult, among other situations. It follows that increased attentional resources are required for planning and executing movements as task difficulty increases [Wu et al., 2005], even within a single-task paradigm. In summary, the nature of single-task demand manipulations in behavioural analysis are to increase the difficulty of a motor task, ideally in an ecologically-valid manner, without explicitly loading the system with additional tasks, or changing the skeleto-muscular contributors to task completion.

Combining information processing capacity demands

Differentiating these two experimental models for attentional manipulation and behavioural outcome also leads to the suggestion for a possible combined model, which capitalizes on the interrelationship of context and movement. As an example, a

participant population could be asked to ascend a staircase with closed risers, and could be measured on ascent initiation latency, mean velocity of ascent, and average time spent with both feet on separate treads (double support time). Given the same staircase with risers removed, we could hypothesize that the 'open' appearance of the staircase structure would lead to increased latency of ascent initiation, decreased mean velocity of ascent, and increased time spent in double support. In this example, no explicit secondary task has been added to the movement. In addition, no change has been made to the goals of the task, the set and sequence of action patterns that would most directly lead to those goals, or the end result of successful completion of the task. However, a change to the single-task context (removal of risers) has made an implicit intrusion on attention (attention diverted to some aspect or potential outcome of the open spaces between the stairs), leading to a form of attentional interference, specifically split attention between task and environment [Dunn, Brown, & McGuigan, 1994]. In this example, information processing capacity has been diverted to a stimulus that is completely or near-completely extraneous to successful completion of the task (similar to dual-task model) but which is entirely within the environmental context of the action (similar to single-task model). As a final note to this subsection, it has been shown that attentional interference appears to have an anxiety-driven bias, where, for example, individuals who fear pain experience greater attentional interference when presented with pain-related images as the visual background for a reaction time task, in comparison to either neutral or general negative images [Asmundson et al., 2005]. Following on this foundation, it can be suggested that PD patients may be particularly sensitive to attentional interference from contexts that impose spatiotemporal constraints on action, given evidence of parallel deficits in motor performance and attentional function [Fama and Sullivan, 2002]. This hypothesis is supported by qualitative [Gray & Hildebrand, 2000] and quantitative [Bennett et al., 1995] experimental results, and provides an evolving framework for the assessment [Chapuis et al., 2005] and management [Morris, 2000] of PD.

Information processing – summary

Two conclusions may be suggested from this brief methodological inspection of experimentation into context, information processing capacity, and behaviour. First, context and behaviour are inherently entwined, and movements are uniquely prepared and executed in accordance with intention and context [Marteniuk et al., 1987]. Secondly, experimental tasks that incorporate real-world contexts and quantifiable measures of behaviour can provide strong inference for the function and dysfunction of neural mechanisms that prepare and execute movement [Czaja & Sharit, 2003].

Information processing capacity in Parkinson's disease – a review

Saint-Cyr [2003] makes a novel distinction in the classification of evidence for frontostriatal function and dysfunction, dividing his review of the current literature into operational domains based in information processing and systems analysis. These domains are *CONTEXT*, *SEQUENCE*, and *CONSEQUENCE*, and it is Saint-Cyr's assertion that these categories could make 'fundamental basal ganglia processes … more clearly inferred … by isolating the various phases of information processing in time'. Based on this endorsement (and the logic behind it), a similar division will be adopted

here. However, where Saint-Cyr's work primarily focused on reviewing neurophysiological experimental data, this review will focus on motor and cognitive studies among human PD patients, a widely-observed example of intrinsic dysfunction in the BG. Where possible, explicit discussion will be made of the environmental context and/or information processing demands that are incorporated in the experimental protocol.

Context

It has been suggested that directed attention is an adaptive strategy PD patients use to plan and execute movements [Morris et al., 2000]. While the system level of incorporation of this strategy is undetermined [Bezard et al., 2003], the general hypothesis is supported by the PD-specific motor deficits observed in experimental applications of attentional interference where primary or secondary task context is enhanced to subdivide attentional resources. As previously established, context encompasses the external factors that influence the preparation and execution of behaviour [Dunn, Brown, & McGuigan, 1994]. Inherent in this definition of context are the inclusion of reciprocal internal constructs, such as behavioural set, goal identification, understanding of situational guidelines, and expected reward [Saint-Cyr, 2003]. It is the selection, maintenance, and refinement of these internal constructs that is attentionally demanding.

Bond and Morris [2000], Canning [2005], and Rochester et al. [2004] all used gait as the foundation motor task for investigations into contextual and explicit attentional interference among PD patients. In free gait (single task, self-selected speed), medicated PD patients exhibited disturbed performance parameters (decreased mean velocity, decreased step size) in comparison to neurologically normal adults in both laboratory- [Bond & Morris, 2000] and home-based comparisons [Rochester et al., 2004]. The addition of a secondary motor task, specifically carrying a tray with glasses on it, led to a further decrease in performance, uniquely among the PD group. Bond and Morris [2000] report a significant reduction of speed and stride length for PD patients with the addition of the secondary task, while Rochester et al. [2004] report similar decreases at a non-significant level. The addition of a secondary cognitive task (recall of autobiographical information) led to significant performance decreases among the home-based study group, either as an unique secondary task or in combination with the secondary motor task of tray carrying [Rochester et al., 2004]. The work of Canning [2005] indicates that this attentional interference can be subverted. When patients were asked to direct attention toward 'maintaining big steps while walking', the secondary motor task of tray-carrying provoked no evidence of attentional interference in the primary task – that is, gait performance was at similar levels as walking in the no-tray (single task) condition. This result suggests a contextual (using disproportionately large but largely non-specific cortical resources) rather than a structural (using proportionately appropriate but same specific cortical resources) interference resulting from tray carrying, a finding which is supported by the absence of gait parameter disturbances in 'empty tray' (no glasses) carrying [Bond & Morris, 2000]. Taken together, these studies show that secondary task can interfere with motor performance uniquely among PD patients, and that the interference can be created by a secondary task with high attentional demands (tray with

glasses, autobiographical recall). Furthermore, the work of Canning [2005] indicates that suitably directed attention can 'normalize' PD movements and reduce attentional interference. This finding is supported by the study of Landers et al. [2005], who found that PD patients improved postural stability when they directed their attention to reducing the rotation of a balance platform. Stallibrass and colleagues [2004] and Macht and Ellgring [1999] report improvements in gait mobility for PD patients using directed attention as a situational strategy. The improvements facilitated by therapy and training in directed attention strategies were also found to be long-lasting (6+ months) [Stallibrass et al., 2004] and multi-modal, extending beyond improvements in motor performance to increases in the affective domain and cognitive responsiveness [Macht & Ellgring, 1999].

Studies of attentional interference during PD gait have a strong foundation in functional PD deficits, specifically the transient appearance of motor blocks and freezing. Contextually-challenging situations, including narrow spaces and crowded areas, along with concurrent motor tasks, such as turning while walking, have been found to elicit disruptions in the initiation or continuation of gait among PD patients [Fahn, 1995; Giladi et al., 1992; Macht & Ellgring, 1999], possibly due to the diversion of attention from motor performance to context. Morris and colleagues [2000] have also shown that a cognitive secondary task can lead to increased postural instability and risk of falling, a result that is supported by an epidemiologic investigation of freezing and falls in PD [Bloem et al., 2004].

The previous studies suggest that the threat imposed when the consequences of an incorrect action are increased (e.g. possibility of dropping glasses in tray-carrying task, compared to carrying empty tray) may be, in part, the basis of high attentional demand in either a primary or secondary task context involving whole body motor tasks. Bertram and colleagues [2005] explored PD movement deficit as a function of primary task context threat in a reaching task. In their example, non-medicated PD patients and neurologically normal older adults reached for full drinking glasses that were either covered or uncovered. The results indicate that PD patients and controls used similar reach times in low threat conditions, but patients alone were slowed by the threat associated with reaching and grasping the uncovered glass. Bennett and colleagues [1995] also found slowed onset of reaching among PD patients when reaching for a half-full plastic glass, though comparisons are not provided to either empty or completely full glass targets. Again, these results support a threatening context-driven interference in movement preparation and execution unique among a BG-damaged group. One hypothesis alternative strengthened by these findings is that attention is diverted to accessing neural mechanisms for movement among PD patients, and that attention to threat may be disrupting this adaptation.

Analogous non-naturalistic assessments of context effects on PD movement are numerous. An unexpected restriction of whole body displacement led to decreased movement velocity and increased need for corrective submovements among non-medicated PD patients in a standing targeted reach task, indicating that rapid changing of movement context is more disruptive to patients than controls [Tunik et al., 2004]. Rand and colleagues [2000] showed that PD patients used slower whole arm movements, with more iterative corrections to movement trajectory, to move a pointer to a small target (0.03 m x 0.03 m) compared to a similar amplitude movement with no target restriction,

while Weiss and colleagues [1996] demonstrated a similar restriction on movement initiation and peak movement velocity among PD patients when elbow flexion movements were accuracy-constrained. In a comparison of medicated and non-medicated PD patients, Montgomery and Nuessen [1990] found that non-medicated patients did not increase whole arm movement speed at the same rate as medicated patients or controls, given reduced task context (increased size of targets). Fine control of grasping has also shown increased kinematic and spatial deficits among PD, indicating that tasks such as pronation, supination, grasping, and releasing may involve a contextual-challenge that exceeds or subverts that attentional control and motor output available among PD patients [Gordon, 1998; Negrotti et al., 2004; Whishaw et al., 2002].

Sequence

Complimentary to accurate representation of external and internal context is the process of appropriately sequencing a response to that context [Saint-Cyr, 2003]. Sequencing is not an exclusively discrete operation – for many functional tasks, co-ordination and co-activation of multiple segments is required for completion [Marteniuk et al., 1987]. The focus of this section will be on the wealth of studies investigating cognitive and motor sequencing deficits among the PD population.

Benecke et al. [1987] identified a progressive slowing for PD patients performing unilateral or bilateral sequential movements (i.e. movement two slower than movement one), combined with an extended pause between movements. This prolonged pause has also been observed for PD patients between movements in target-constrained experimental tasks [Rand et al., 2002; Weiss et al., 1997] and more functional movement components, such as reaching for a glass then bringing that glass towards the mouth [Bennett et al., 1995] and walking then turning [Vaugoyeau et al., 2003]. It is possible that this pause reflects separate planning of movement segments, compared to a more integrated planning strategy used by non-parkinsonian participants [Rand et al., 2002]. This loss of smooth integration can also be inferred from the more uniaxial movement patterns observed for segment end-point paths (e.g. wrist) during PD reaching [Alberts et al., 2000; Isenberg & Conrad, 1994] and from the more frequent corrective movements ('jerk') in action patterns observed among PD patients [Alberts et al., 2000; Teulings et al., 1997].

Progressive slowing of sequential actions has also been observed in more functional movements, specifically targeted reaching [Castiello et al., 2000; Gentilucci & Negrotti, 1999; Rand et al., 2002], handwriting [Van Gemmert et al., 2001], standing rise-to-toes [Frank, Horak, & Nutt, 2000], seated sit-to-stand [Bishop et al., 2005], and gait [Morris et al., 2001]. These deficits have been associated with the combined and serial processing demands of the actions, and a corresponding inability among PD patients to sequence muscle activation and inhibition appropriately [Frank, Horak, & Nutt, 2000]. For example, Agostino and colleagues [1992] showed that the time taken to trace each side of a geometric figure progressively increased for PD patients as the number of figure sides increased from two to five, while controls used equivalent movement durations to trace each side, regardless of side number. Fama and Sullivan [2002] used a series of motor sequences with increasing complexity (e.g. SIMPLE – bilaterally alternating fist/fingers spread with both elbows continuously extended; COMPLEX –

alternating unilaterally between fist on tabletop, hand edge on tabletop, hand flat on tabletop fingers spread) to establish that executive processing deficits, specifically picture sequencing, were most strongly correlated with motor sequencing deficits among PD participants. Van Spaendonck et al. [1996] also report that motor symptoms of PD, most notably rigidity, were associated with executive dysfunction, as assessed in the Wisconsin Card Sorting Task, which involves reiterative acquisition of non-verbal sorting rules, and tests a participant's ability to switch sorting rules based on feedback and internal cueing [Kolb & Whishaw, 1995].

Cognitive sequencing and set-switching deficits have been previously identified in patients with BG dysfunction, adding support to Alexander et al.'s [1986] multi-modal segregated circuit hypothesis. Zalla and associates [2000] showed that PD patients took more time than neurologically normal or prefrontal damaged participants to generate and describe an appropriate sequence of events for either a routine (i.e. 'getting ready to leave the house in the morning') or novel (i.e. 'opening a new business') activity. Further cognitive disorders in task switching, specifically in making internal changes in stimulus-identification rules such as in various forms of the Stroop task, have been repeatedly identified among PD patients [Brown & Marsden, 1988; Brown & Marsden, 1991; Richards et al., 1993; Woodward, Bub, & Hunter, 2002]. Both Brown and Marsden [1991] and Woodward and colleagues [2002] relate this resource limitation to attentional interference – in the Brown and Marsden study, resource-demanding secondary tasks (i.e. random number generation, repetitive foot tapping) resulted in an increase in response time for the primary Stroop response task, while switching stimulus rules led to greater response delay than maintaining rules or inhibiting incongruent stimuli in the work of Woodward and associates [2002]. Similar attentional resource limitations among PD patients have been revealed by measuring concurrent deficits in tasks of mental rotation [Lee et al., 1998], visual search [Rowe et al., 2002], visuomotor tracking [Hocherman, Moont, & Schwartz, 2004], speech production [Ho, Iansek, & Bradshaw, 2002], and grammatical interpretation [Grossman et al., 2002]. Attentional interference models may provide an improved experimental methodology for dissociating the cognitive effects of PD from general dementia, a frequent concomitant disorder among the PD population [Pezzoli, Canesi, & Galli, 2004; Schrag, Ben-Shlomo, & Quinn, 2002].

Conseqeunce

Objective comparison between the presented context and the performed sequence creates consequence. Repeated positive consequences lead to the learning and incorporation of the sequence (response) as a match for the context (stimulus), while negative consequences should result in correction. A full description of learning and memory as a BG function is outside the scope of this review (but see [Packard & Knowlton, 2002]), but a brief expansion is warranted.

Jog et al. [1999] provided neurophysiological evidence of this iterative refinement in a simple maze-learning paradigm with rats. In their study, striatal neurons were active during action-selection aspects of tasks during learning trials. Following behavioural asymptote, striatal activity was greatest during activation of the entire sequence, rather than during the stimulus-specific behavioural response. This transition of neural activity, from attention-demanding BG co-activation during a task to BG-activated initiation and

automatic execution of a task, is supported by the work of Agostino and colleagues [2004]. They found that prolonged practice (2+ weeks) on a targeted motor task of upper extremity reaching did not lead to continued improvements in timing for PD patients, unlike controls. They suggest that the movement failed to reach an 'automatic' execution status, a function that may require the BG. Krebs and colleagues [2001] also found deficits in procedural learning among PD patients in a targeted reach task, specifically in novel movement phases, such as following an implicit change in task demands, which further support a failure to automate task response without intact BG function. Graybiel [1998] supports this habit learning and forming function for the BG, suggesting that neural encoding of a sequence of responses for a given stimulus may provide the foundation for a system of 'action chunking' that permits simplified motor processing while creating combined movement patterns that are impervious to any interference except volitional control. Subsequent selection and execution of these action chunks (and inhibition of inappropriate chunks) may be initiated by activity in the BG [Kropotov & Etlinger, 1999]. Any consequence function of the basal ganglia may operate on multiple time scales, allowing for iterative learning or modulating of behaviours that last milliseconds to multiple seconds [Ruskin et al., 1999]. In addition, learning deficits may bear an associative relationship with other measures of dysfunction, including executive deficits [Sarazin et al., 2002] and disease duration and progression [Graham & Sagar, 1999].

Information processing themes in Parkinson's original essay

Parkinson's publication of *An essay on the shaking palsy* in 1817 was not the first identification of signs and symptoms of the neuropathology we now know as Parkinson's disease [Burch and Sheerin, 2005]. However, his work provided a detailed behavioural analysis of Parkinson's disease such as had not been previously documented [Parkinson, 1817]. The categorical and symptomological content of the essay reflect Parkinson's parallel passions for medicine, paleontology, chemistry, and geology, while the colourful style of his writing seems shaped by his early literary efforts in political and topical areas. While a full critical review of Parkinson's work, in perspective with his life and times, would take us too far in this thesis, a brief review of his seminal contribution should provide interesting insight for the reader.

In the *Shaking palsy's* preface alone, Parkinson identifies some of the features of parkinsonism that continue to confound diagnosis and treatment today, including the "stages of its progress", the "long duration" of the disorder which "requires a continuance of observation", the misinterpretation of "its characteristic symptoms as distinct and different disease", and the critical constraint of "analogy (as) the substitute for anatomical investigation".

Parkinson's case definition is no less accurate or current:

"Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forwards, and to pass from a walking to a running pace: the senses and intellects being uninjured."

Burch and Sheerin [2005] identify two classic PD symptoms not identified by Parkinson in his 1817 essay, namely rigidity and loss of affect. However, Parkinson's full essay is established through six cases (and possible undisclosed additional observation), two of whom (Cases IV and V) were observed briefly, and/or distantly [Parkinson, 1817]. It is possible that this small sample did not present loss of affect, or that it was unrecognized due to limited information on the patient's pre-parkinsonian expression. Given current clinical assessments for PD, rigidity seems less likely to go unobserved, but Parkinson's clinical observations appear to stem from observation and questioning more than direct manipulation. Yet these seem like minor limitations, given the overall quality and contribution of Parkinson's essay.

Parkinson's essay also highlights elements of the parkinsonian condition that are associated with the main themes of this introduction. Parkinson [1817] broaches the topic of *context,* and action/environment interaction, stating that "(t)he submission of the limbs to the directions of the will can hardly ever be obtained in the performance of the most ordinary offices of life." Parkinson [1817] also makes several notes of the influence of attention on overcoming PD symptoms, indicating that "(w)alking becomes a task which cannot be performed without considerable attention', but reporting positively that 'the care and exertion required to ensure (walking's) safe performance" can provide PD patients with a distraction from other symptoms. Parkinson's observations of deficits of *sequence* are restricted to walking, but he notes in several places the seemingly anomalous condition of festination, wherein:

"The propensity to lean forward becomes invincible, and patient is thereby forced to step on the toes and fore part of the feet, whilst the upper part of the body is thrown so far forward as to render it difficult to avoid falling on the face. In some cases, when this state of the malady is attained, the patient can no longer exercise himself by walking in his usual manner, but is thrown on the toes and forepart of the feet; being, at the same time, irresistibly impelled to take much quicker and shorter steps, and thereby to adopt unwillingly a running pace. In some cases it is found necessary entirely to substitute running for walking; since otherwise the patient, on proceeding only a very few paces, would inevitably fall."

Finally, Parkinson [1817] details a progressive history of PD deficit *consequence.* One striking example is his description of PD eating, which he observes as migrating from an "unsteadiness of the hand" where "the hand fails to answer with exactness to the dictates of the will" to a situation where "the fork not being duly directed frequently fails to raise the morsel from the plate; which, when seized is with much difficulty conveyed to the mouth" to a point where "(t)he power of conveying the food to the mouth is at length so much impeded that he is obliged to be fed by others", and finally, "he is not only no longer able to feed himself, but when the food is conveyed to the mouth … the food is with difficulty retained in the mouth".

Parkinson's work provides fascinating insight into the clinical approach to and concept of movement disorders that existed in his day. It also provides a foundation for understanding the human impact of this "tedious and most distressing malady".

SUMMARY

Inherent in any interaction with naturalistic daily activities is the dynamic appearance of both predictable and unpredictable contextual challenges. From the evidence of this review, it can be suggested that the behaviours that persist among PD patients, and the neural mechanisms that support them, are uniquely and intrusively impaired by challenging environmental contexts. It may be these transient disruptions in challenging contexts that lead to the motor blocks, disequilibrium experiences, and eventual loss of independence that greatly impair the quality of life among PD patients. These deficit motor responses may indicate a context-based adaptation of PD behaviour, as more stereotypical behaviour can be observed in less threatening contexts. These deficit motor responses do not appear to be functionally adaptive, as they increase injury risk and possibility of error. Therefore, it can be a conclusive and novel suggestion of this review that threatening context leads to an unique and dysfunctional alteration of many naturalistic motor behaviours among PD patients. It is unlikely this context-modified sequence is a positive volitional or automatic neural response for PD patients, as it is largely dysfunctional in the observed actions. Rather, it is suggested that the dysfunctional sequence/consequence response in the threatening context is the result of attentional interference, and that corresponding functional sequence/consequence response among PD patients in less threatening contexts are possibly planned, initiated, and controlled by neural mechanisms and resources that compensate for a damaged basal ganglia, but remain susceptible to contextual interference.

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I5: WHAT DID I GET MYSELF IN FOR? THE EXPERIENCE OF GRADUATE SCHOOL

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In an informal survey of 12 University of Lethbridge professors who were asked about the graduate student experience, the responses clustered around two nouns, excitement and commitment. Of course these were people for whom the experience had worked, who had gone on to professorial jobs, but the impressions were interesting ones nonetheless and are probably shared by graduate students on the job right now.

Professors remembered the excitement and the freedom of being asked to think; one remembered musing "What? Reading books is my work? Great!" They felt the challenge of grappling with ideas, the freedom to do so and the luxury to have the time to spend long periods at it. Several commented that graduate school was therefore the best time of their lives, the time of most intellectual growth and the time they could fully devote themselves to ideas.

Along with the freedom to think came the commitment that went with choosing and following their own course. One commented that you had to narrow your focus, by definition you could not do all that you wanted to do but had to settle on a manageable thesis. Several felt the pressure of overwhelming time commitment, one commenting "There was no life outside the work" and another remembered "long days and nights". One realized that this feeling of not having enough time to do what you wanted was something that continued into the professoriate, there were always more ideas than time to carry them out. Poverty was not a major issue for them, in their dedication they expected to have little access to extra money, just as they had little spare time.

Getting into Graduate School

When an undergraduate student comes to see me asking about getting into graduate school (I'm the advisor to the Psychology majors), my responses and advice cluster around three areas. First, I ask the student why s/he wants to go to graduate school. If the response is "Well, I have to in order to get a good job", then my answer is "Wrong reason. Now what ideas do you have, what areas do you want to work in?" This focus turns out to be a wise starting place, as graduate school is about ideas. On average, Canadian doctoral students spend nearly six years to finish graduate school (Glusyzinski & Peters, 2001), and that's a long time working on an idea. Even a Master's program, with two years of focus, is a long time. Having an idea of what you want to specialize in

and a couple of possible projects when you come in to graduate school is a good start (desJardins, 1994).

Once you have a potential area in which to work, an undergraduate should then look for who is working in the area and what kinds of things they are doing, then try getting in contact with them. Expect a low return rate, professors are busy and lead very mobile lives. Nevertheless, getting the person is often the way to get into the program. Admission decisions are not made from any central office but are "made by departments and programs, and often by individual faculty members" (Robinson & Golde,1999). Golde (2000), who takes a sociological view of the graduate community, points out that one's professor is the most crucial person in a graduate student's career, so choosing him/her wisely is a good start. Having at least two people you can work with is a big plus for a school you might go to (desJardins, 1994) though this flexibility is sometimes a lot to hope for. In addition, she points out that fellow graduate students are pretty good sources of information about advisors' personalities and interactive abilities. They can be frank where other professors have to be tactful.

When I was a graduate student, we sometimes discussed whether it would be better to attach oneself to a 'rising star' who was just getting started or to an 'established leader' who knew a lot and was a leader in the area. There are advantages and disadvantages to both. The rising star is likely to have more time to give to you, especially if s/he has no other or only one other graduate student. You might feel closer to someone more your own age. But they also might be too self-absorbed to be a good mentor, and what if their star fizzles out? Alternately, the proven leader might be committed to several grad students and a post doc or two, busy with administrative work and can find little time for you. But the other graduate students have the potential to be your mentors, and Golde (2000) sees them as the second most important influence in your graduate career. Of course, you might end up mentoring others as you become more senior, though that isn't a bad start to a research/teaching career. The senior professor also has more influence, can take you to conferences, introduce you to the right people and help you get the job you want after graduate school (Perlmutter & Porter, 2005).

The second piece of advice I give prospective graduate students is to plan their courses carefully. Planning a program means not just taking courses but selecting those that build a foundation for what you want to do, not necessarily in your major. Want to work with people with problems? Take some of the Addictions courses offered by Health Sciences. Interested in Conservation? Mix Biology and Geography, for sure, but throw in some Chemistry and get some Psychology. Conservation is in the hands of people. As well as selecting by area, take the courses that demand intellectual growth, that's what graduate school will ask of you. You will need Statistics; Vokey's Advanced Statistics and Research Design is full of people who I've advised into the class. They aren't always going to be happy in it but it gives them a jump start on graduate work. If you lean towards qualitative methodology, take the Sociology course in the area. Someone headed for graduate school should seek out courses that demand a lot of writing, those that have oral presentations, those that demand critical evaluation of research. If you don't like it, might as well find out now and write off graduate work before you begin.

The third piece of advice I give is also given by Robinson & Golde (1999) – get involved in research. Fortunately, that is easy to do at a small undergraduate university like the University of Lethbridge, but is good advice for undergraduates anywhere. I advise it because graduate schools want it. They see involvement in research, maybe even your name on a paper, as the gold standard for admission. But also getting involved in research means learning what the process is like, those six years are going to be full of it and, as desJardins (1994) advises, being a researcher is much more than "merely' coming up with brilliant ideas and implementing them".
Robinson & Golde (1999) advise it because they found that undergraduates applying for graduate school often 'waffled and flailed' but those who had contact with researchers knew how to use the system, and what to do to get to a good graduate school.

Getting on with it

One of the big problems with graduate school is that the whole process has little structure and it's not clear what one should spend his or her time on (desJardins,1994). Of course that is one of the benefits of graduate school and each person is going to be different but obviously, it makes sense to plan one's days and months both to give some structure and to work out what's best for each person.

Golde's (2000) approach to analysis of the graduate student experience is a sociological one, and she sees that the relationships that graduate students build are vital ones. She also points out that up to half of American doctoral students drop out without finishing their degree, a spectacular failure rate. The critical relationship in graduate school is, of course, that with one's professor. Little regulates this relationship, especially with the present graduate structure at the University of Lethbridge where the decision to take on a graduate student is essentially the professor's. Graduate students work out the relationship with their professor that they need–and not be shy about deciding what they need and asking for it (desJaardins, 1994). Professors can give students a lot of freedom or quite a bit of direction, they can ask for detailed information about what the students do (common in the sciences) or let them go on by themselves and report their progress every six months or so. Golde's (2000) case studies of graduate student dropouts showed that the failure to work out this relationship can wreck a graduate career.

Ideally, a graduate student supervisor should be an organizer, an inspiration and a bit of a mentor. There are a number of things a graduate student can do if this relationship doesn't work so well. One of them, of course, is to leave. Another person in the same department or another school may just be a better fit, and prof and student may see this transition at the end of a Master's or even sooner. DesJardins (1994) suggests finding a new advisor if your present one is "inaccessible or disinterested, gives you only negative feedback, doesn't have the technical background to advise you on your thesis or harasses you", all good reasons. Her advice to have picked a school with at least two faculty members you might like to work with becomes useful in this case.

Often, a graduate student whose relationship with his or her professor is less than ideal might choose not to leave. There are probably as many ideal graduate student-professor relationships as there are ideal marriages, not that many. Again, she points out that a student can look elsewhere for a mentor, in fact that there are many mentors for each individual. With many graduate students, a professor has less time but may expect

the senior ones to take some care of the juniors; the professor with whom I did my MSc had nine, and the other graduate students taught me far more than he did. My husband had a reasonable relationship with his professor, who took on many graduate students and prided herself in getting them all finished, but a genuine mentorship with another professor in his department who was never even on his committee. Especially if you need assistance in something technical that your professor doesn't know (statistics or equipment come to mind), you may need to call on other individuals to help and guide you. Reaching out for help in this way comes under the heading of what Perlmutter & Porter (2005) call building relationships, as well. It's to your benefit to have good relationships with people who may write you a recommendation or sponsor you in the future. University of Western Ontario had a requirement that graduate students do a research study with another professor than their own, for this reason and also to get one's name less exclusively linked with one individual.

The second relationship that Golde (2000) sees as important in graduate school is other graduate students. Graduate school is a time when you have deep interests in common with others, and they can grow to rich long-term relationships, including the partnership of marriage or wrecking a present marriage. Unfortunately, 'not fitting in', not being the same as others in your situation (a female in an all-male physics group, married with small children in a group of singles) may be a reason why the experience goes sour and the student drops out. One of my interviewees commented about his graduate school life that it was a time of comradeship, "we mworked hard and we played hard, and we had a great time". Other graduate students can be mentors, they can also be sounding boards if you get discouraged, and support can be reciprocal (desJardins, 1994). For every doctoral student who makes it to the defense, there are probably six people cheering! Chances are that your relationships with them will continue past the graduate career, another part of what Perlmutter & Porter (2005) call building relationships.

Of course, one of the critical aspects of a graduate career is paying for it. Asking bright men and women in their 20s to postpone good pay for this work is one thing. Asking them to go into debt for the sake of knowledge is an excessive demand we take for granted, and 44% of doctoral recipients in Canada were in debt when they finished. One of my interviewees paid off his debt when he got tenure, six years after he finished school. Canadian graduate students supported themselves in a variety of ways (Gluszynski & Peters, 2001). Much of this support comes from the university itself, which stands to gain by the presence of such excellent people. According to Gluszynsky & Peters' (2001) survey of earned doctorates, 64% of graduate students were supported by teaching assistantships, and 58% by fellowship or scholarships of the institution. Between 30 and 40% were supported by various other sources, including personal saving and family income. Scholarships or fellowships were the primary source of support for 52% of graduates and teaching or research assistantships were primary for 20%. Fellowships and research support were better in the sciences, and one of my Humanities interviewees commented that "it takes us so long to finish (82 months) on average because we don't have enough financial support."

Finding financial support is one of the steps that savvy applicants for graduate school should be doing before they even choose their school (Robinson & Golde, 1999). It is tempting to choose one's school by the financial support that it offers, and definitely

it should be part of the package. Good schools will support their graduate students, and if you have a graduate fellowships such as one from NSERC in the sciences, they will even fight for you. Such arrangements may be for a couple of years only, and that students need to look down the road, remembering the six-year average (desJardins, 1994). She suggests asking fellow graduate students and professors, consulting guides to support, taking advantage of your membership in a minority group if it helps. What of financing your graduate career with teaching assistantships? It is a double-edged sword. Being a TA gives you experience in teaching, a job you will probably be doing in the future (see Perlmutter & Porter, 2005, for making yourself marketable), and you can look for teacher training in the process. University professors are one of the few professional groups that get little explicit training for the job that takes up much of their time, but time as a TA is an apprenticeship. The other side of it is that teaching, even as a TA, is a demanding job (Freeland, 1998). Pagiamtzis (2006) estimates two hours of preparation for each hour of tutorial which can get in the way of your progress in your doctoral research. Your time committments have to reach a balance.

Looking Ahead

Graduate students get so focused on surviving that they don't remember that they are preparing for a life ahead (Perlmutter & Porter, 2005). Some of their advice has also been covered in the previous section, but it bears repeating as a background for the next step. The first piece of advice they have is publish, publish, publish. Publications are the basic measure of scholarship, though of course they have to be of good quality as well as as numerous as possible. They also advise graduate student to be "both a specialist and a generalist", not to get too confined to a tiny area of expertise so that you don't seem to know anything else but that. One of the professors that I interviewed said that he heeded this advice and changed to a somewhat different area of research after he got his Master's, and he said that was what got him his job at the University of Lethbridge. Consider having a secondary specialty that is in high demand–statistics or methodology come to mind. But don't claim to be an expert at something you are not, they point out that "hiring committees can usually detect illusionists" and besides, what if you got stuck teaching something you hated?

Building for the future should involve getting practice in teaching, first as a teaching assistant and then later for a course or two if you have or can carve out the opportunity. Of course you will know a lot about a small area, but is it grounded in the basics of your discipline, have you picked up the teaching techniques (Pagiamtzis, 2006) you will need for an academic job? In our Philosophy Department, job candidates are told what topic is being covered in the Introductory course on the week when they come for an interview, and they are simply expected to teach it (I'm glad I didn't have to do that). I was on their Hiring Committee a few years ago, and can report that we weighted the evidence of candidates' teaching competence in this situation very heavily. One of the biggest burdens of beginning academic careers is making the plans and gathering materials for teaching. With one or two behind you, you are ahead in the game.

Perlmutter & Porter (2005) also stress that graduate school is a time to form relationships. Of course, relationships get you through graduate school, but it's particularly important when building a career. Going to conferences, presenting papers,

talking to others in the area and getting feedback about your ideas will pay off big-time. If you are lucky, you have already been networking as an undergraduate, see Robinson & Golde (1999). These people may end up being Outside Reader on your doctoral defense, potential postdoctoral professors or even on granting or hiring committees that look at you prospectively. When it comes to hiring, enthusiastic letters are a dime a dozen, but a recommendation from an esteemed colleague carries a lot of weight. Canada may be a large country but it has a small academic community, chances are that in every specialty we know each other pretty well.

This advice assumes that doctoral students have plans for moving into the academic community that has been fostering them. Three quarters of nearly finished doctoral candidates had clear plans for what they would do next, and most of the 'other' category were professional school graduates (Gluszynski & Peters, 2001). For those headed to academia, some mix of research and teaching lay ahead. For graduates in the sciences, postdoctoral fellowships were a common choice, where employment was much more common for those in the humanities, reflecting the different opportunities in the two areas. Postdocs are sometimes a 'holding pattern' until you look good enough to get a starting Assistant Professor position. They give you a chance to get your doctoral work published, to learn new skills or move into a slightly different area and to get a couple of courses planned and delivered. Starting off in an Assistant Professor position before you even have your doctorate can be risky, the overwhelming job of all that teaching and associated activity (even though department often start new teachers off with one class for that first semester) can mean your research productivity suffers. Still, starting off in a Term position can be even worse, you may find yourself with three courses per semester and no chance at all to do or publish research. For an aspiring scholar it may be a dead end.

Graduate students tend to see academia as their clear future. After all, they are educated at major universities with doctoral training and an emphasis on research, shouldn't they aim for the same thing? A few years ago, Steve Zawistowski and I give a symposium on 'non-traditional' future careers for the Animal Behaviour Society, pointing out the variety of other job possibilities. One likelihood is to move into a mostly undergraduate university or a college setting, where research is secondary or even 'spare time' (University of Lethbridge is NOT one of these). There are many more of these institutions than research-heavy ones. Of course, the personality characteristics that fit you to be a teacher (outgoing, social, affiliative) are not those of a researcher (goal-oriented, introspective, solitary) (Bee & Bjorkland, 2004), and personality is one of the determining factor in what jobs we choose. Each person has to decide what is best for him or herself. Graduates from the Humanities were most likely to see teaching as their primary activity, while those from the Social Sciences might have gone into professional services and those from the sciences into 'pure' research (Gluszynski & Peters, 2001). Finding one's niche should be one of the things you do in graduate school – do you have a talent for writing and need to head in that direction, should you opt, as Steve did, for application of your expertise, where he is a senior vice-president for the SPCA in New York? The pressured life of professors isn't for everyone who comes to graduate school, watching them should help students decide if they want it. Whether the alternate choice is to drop out (Golde, 2000) or to finish and go for a non-traditional occupation, the

decision about where to go next should build over your graduate career.

Finally, actually interviewing for a job means lots of homework, too (Perlmutter & Porter, 2005). You can't afford to be isolated in your lab or library carrel. They suggest volunteering to be a student member on your Department's hiring committee so you can see how the process works. Certainly you need to research opportunities, places and people when an interview comes up. Watch others, they say. Go to doctoral defenses, talk to incoming candidates, quiz other graduate students about the process as they go through it, discuss your options with your professor, practice giving talks and being interviewed. Their 'take-home message' is one no graduate student can afford to ignore, "the career track starts immediately".

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I6: LINESHAPES FOR ATMOSPHERIC REMOTE SENSING – THE CASE OF THE OXYGEN MOLECULE

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INTRODUCTION

From a practical point of view spectral lineshapes are important because atmospheric remote sensing relies on absorption or emission spectra of atmospheric constituents to measure atmospheric parameters such as pressure, temperature, humidity or abundance of atmospheric constituents. The results of atmospheric remote sensing measurements are then used in meteorology, remote monitoring of pollutants, and determination of transmission windows for laser propagation in the atmosphere. It is hence very important to have a reliable set of laboratory spectroscopic measurements of line parameters (line positions, intensities, broadening and shift coefficients) for planetary atmospheric constituents needed to interpret the remote sensing data.

Molecular collisions perturb the spectral lineshapes. The collisions can be elastic or inelastic. The elastic collisions change the phase of the rotating molecule with respect to the electromagnetic radiation, which broadens the resulting spectral lines. Inelastic collisions transfer energy between the translation motion of the molecule and its rotation or vibration. Assuming that the molecular collisions are both binary and instantaneous, both elastic and inelastic collisions produce spectral lines that are described by a Lorentzian lineshape. Pressure broadening and Doppler broadening occur simultaneously but independently, so the Voigt lineshape profile that is most used in atmospheric work is a convolution of these two profiles.

Additional effects of molecular collisions are the pressure-induced shifting, narrowing and line mixing of spectral lines. We can imagine the pressure line shifts as being caused by perturbations of the absorber's potential energy surfaces by the collision partners. These perturbations are changing the distances between molecular energy levels and hence change the frequency of the molecular transitions. In our spectra it appears that the spectral lines are shifting as pressure increases. The limitations placed on the molecular mean path of the absorbing molecules in a bath gas of perturbing molecules are causing the collisonal narrowing of spectral lines. At elevated pressures collisional transfer of populations may occur between close spaced transitions causing a line mixing

effect. Each of these effects changes the shape and width of spectral lines and have to be taken in consideration for a thorough examination of the spectra. It has been proven that molecular collisions can modify the spectra to the extent that "collision-free" molecular parameters will not reproduce the spectra well and indirectly contribute to inaccuracies in the interpretation of remote sensing data.

In the past few years there have been several studies focused on retrieving spectral line parameters (intensities, broadening and shifting coefficients) of oxygen in the A-band (Brown and Plymate, 2000; Hill et al., 2003; Pope et al., 2000 and 2004; Schermaul and Learner, 1999; Yang et al., 2000]. However, subtle effects such as Dicke narrowing have been reported only by one group (Ritter and Wilkerson, 1987). The contribution of collision-induced absorption below the A band has been recently reported by Hartmann et al. (Tran et al., 2006). The authors provided a theoretical treatment of line mixing and collision induced absorption and line mixing and applied it to spectra recorded at pressures ranging from 20 to 200 atm.

In this paper we present a detailed spectroscopic study of oxygen in support of atmospheric remote sensing. The absorption band located at 760 nm, also known as the oxygen "A-band" is customarily used to retrieve O_2 abundance from atmospheric solar absorption spectra. Until recently, for almost three decades the retrievals of oxygen abundance were affected by the quality of spectral line parameters in this vibrational band. We have analyzed our laboratory spectra with spectral line profiles that reproduce the absorption features with high accuracy.

EXPERIMENTAL DETAILS

The absorption spectra used in this work were recorded using the Bruker high resolution Fourier Transform spectrometer at the Justus Liebig University, Giessen, Germany. The oxygen spectra were recorded under carefully controlled conditions of pressure and temperature at an unapodized resolution of 0.02 cm^{-1} using a long path absorption gas cell with path lengths of 3 and 16 m, respectively. Figure 1 presents an overview of the oxygen A-band.

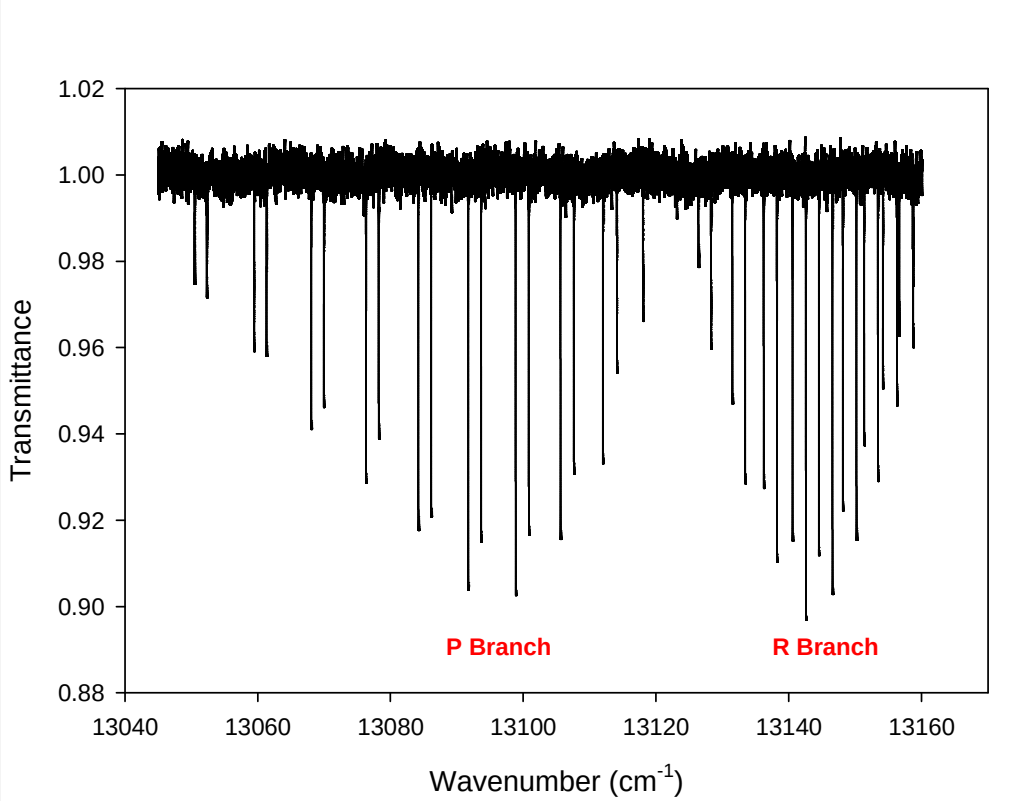

Fig. 1. Overview of the Absorption Spectrum of Oxygen in the A-Band

The oxygen molecule is a symmetric, diatomic molecule that has no permanent electric dipole. However, in a multipole expansion this molecule possesses a higher order moments. The oxygen A-band is a magnetic-dipole allowed transition that occurs between the ground electronic state X and an excited electronic state b. Samples of individual transitions in the A-band are presented in Figure 2.

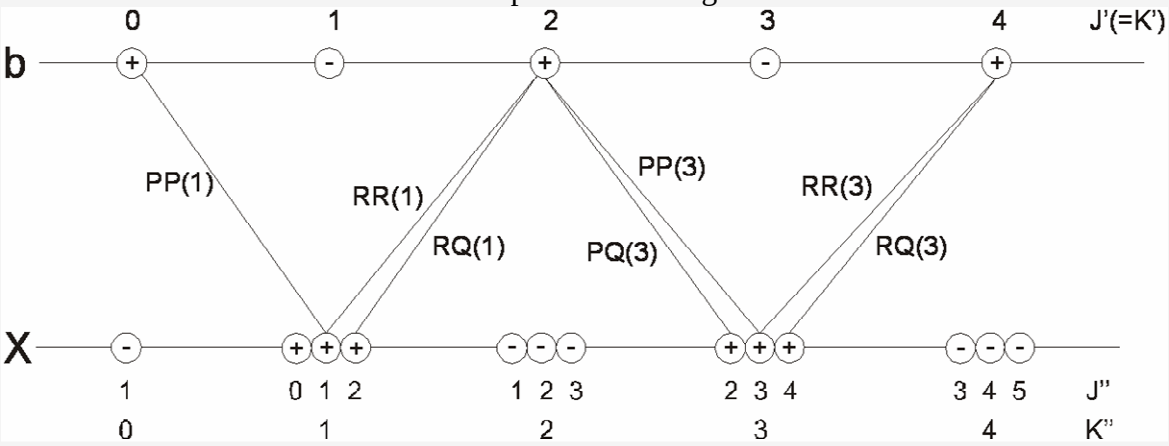

Fig. 2. Allowed Transitions for the Oxygen Molecule in the A-Band

The molecular transitions are grouped is P, and R sets according to the changes in quantum numbers J and K. The selection rules for quantum numbers J and K produce four sub-bands P^P,P^Q, R^R and R^Q.

DATA ANALYSIS AND RESULTS

The absorption spectra used in this work were recorded using the Bruker high resolution Fourier Transform spectrometer at the Justus Liebig University, Giessen, Germany. The oxygen spectra were recorded under carefully controlled conditions of pressure and temperature at an unapodized resolution of 0.02 cm^{-1} using a long path absorption gas cell with path lengths of 3 and 16 m, respectively. Fourteen oxygen spectra were simultaneously fit using a multispectrum nonlinear least-squares procedure (Hurtmans et al, 2002). Three lineshape models were used in this study to retrieve line parameters: Voigt, speed-dependent Voigt and speed-dependent hard collision (Rautian). For the transitions presented in this work, line mixing was needed to fit the spectra within the noise levels. Spectral backgrounds, zero transmission levels, and the FTS instrument function were appropriately modeled. The differences between the experimental spectra and the calculated spectra were minimized by adjusting various line parameters through nonlinear least squares. Initial values for the line positions, intensities, self-broadened widths and pressure-induced shifts were taken from the study of Brown and Plymate (2000). The oxygen spectra were calibrated internally with respect to (a) water lines (using positions from Brown and Plymate (2000)) and (b) iodine lines (using positions from Hill et al. (2003)).

The spectral line parameters were retrieved using the following expressions:

$$b_L(p,T) = p b_L^0(p_0,T_0)\left[\frac{T_0}{T}\right]^n \quad (1)$$

and

$$\nu = \nu_0 + p\delta^0 \quad (2)$$

where $b_L^0(p_0,T_0)$ is the pressure broadening coefficient (in $cm^{-1}atm^{-1}$), $b_L(p,T)$ is the Lorentz half-width at pressure p (in atm) and temperature T (in Kelvin), $p0$ is the reference pressure of 1 atm, T_0 is the reference temperature of 296 K and $\delta 0$ is the pressure-induced shift coefficients (in $cm^{-1}atm^{-1}$).

The translational motion of the absorbing molecule causes a Doppler shift of the radiation frequency in the molecule's frame which is proportional to the molecular velocity in the direction of propagation. This is an inhomogeneous effect dependent on the molecular velocity, which integrated over the distribution of velocities leads to a Gaussian line shape referred to as the Doppler profile. The Doppler profile provides a good representation of the spectral lines at very low pressures. The Doppler or Gaussian profile is given by

$$f(\nu-\nu_0) = P' \exp\left[-(\ln 2)((\nu-\nu_0)/b_D)^2\right] \quad (3)$$

where $P' = (1/b_D)[(\ln 2)/\pi]^{1/2}$ and b_D is the Doppler half-width defined as one half the full width of the line measured at half-maximum.

The Lorentz profile is also called the collision-broadened profile because it takes into account the broadening of the spectral line profiles that results at elevated pressures due to intermolecular collisions. The Lorentz profile is given as

$$f(v-v_0)=(b_L/\pi)/\left[(v-v_0)^2+b_L^2\right] \quad (4)$$

Here b_L is the Lorentz or collision-broadened half-width, defined again as one half the full width of the line at half-maximum.

The Voigt line shape is a convolution of Lorentzian and Doppler line shapes and is the simplest line shape combining translational and collisional effects. For this reason, it represents the spectral profiles well over a wide range of pressure. It is given by

$$f(v-v_0)=\frac{P'a}{\pi}\int_{-\infty}^{\infty}\frac{e^{-y^2}}{a^2+(\xi-y)^2}dy \quad (5)$$

where $a=(b_L/b_D)(\ln 2)^{1/2}$ and $\xi=\{(v-v_0)/b_D\}(\ln 2)^{1/2}$.

In a basic theoretical treatment of collisional broadening, the average molecular speed determines the collision rate and the collision cross-section of the active molecules, which in turn determine the collisional broadening, and thus the Lorentzian width. However, averaging the molecular speed before determining the width is an approximation. It is more appropriate to divide the molecules into speed classes using a Maxwellian distribution, and then calculate a profile for each class. This approach is still not fully correct, because collisions can change the speed of a molecule, so that it jumps from one class to another. Nonetheless, in practice, the speed-dependent profiles can account for speed-dependent broadening within the accuracies of this experiment.

The absorption coefficient using a Speed-Dependent Voigt Line Profile can be expressed as

$$\kappa_v = \frac{2}{\pi^{\frac{3}{2}}\alpha_D}\int_{-\infty}^{+\infty} v e^{-v^2}\tan^{-1}\left\{\frac{\nu-\nu_0+v\alpha_D}{\alpha_L\left[1+S\left(v^2-1.5\right)\right]+H}\right\}dv \quad (6)$$

As the gas pressure increases the gas molecules will begin to collide with each other. Since these collisions will occur during the interaction of the gas of interest with electromagnetic radiation, they will affect the shape of the spectral line. The most common effect on the spectral lines is collisional (pressure) broadening. Other collisional effects include the pressure line shifts, Dicke narrowing and line mixing. They all have characteristic spectral signatures so we often have to study different pressure regimes to be able to characterize them.

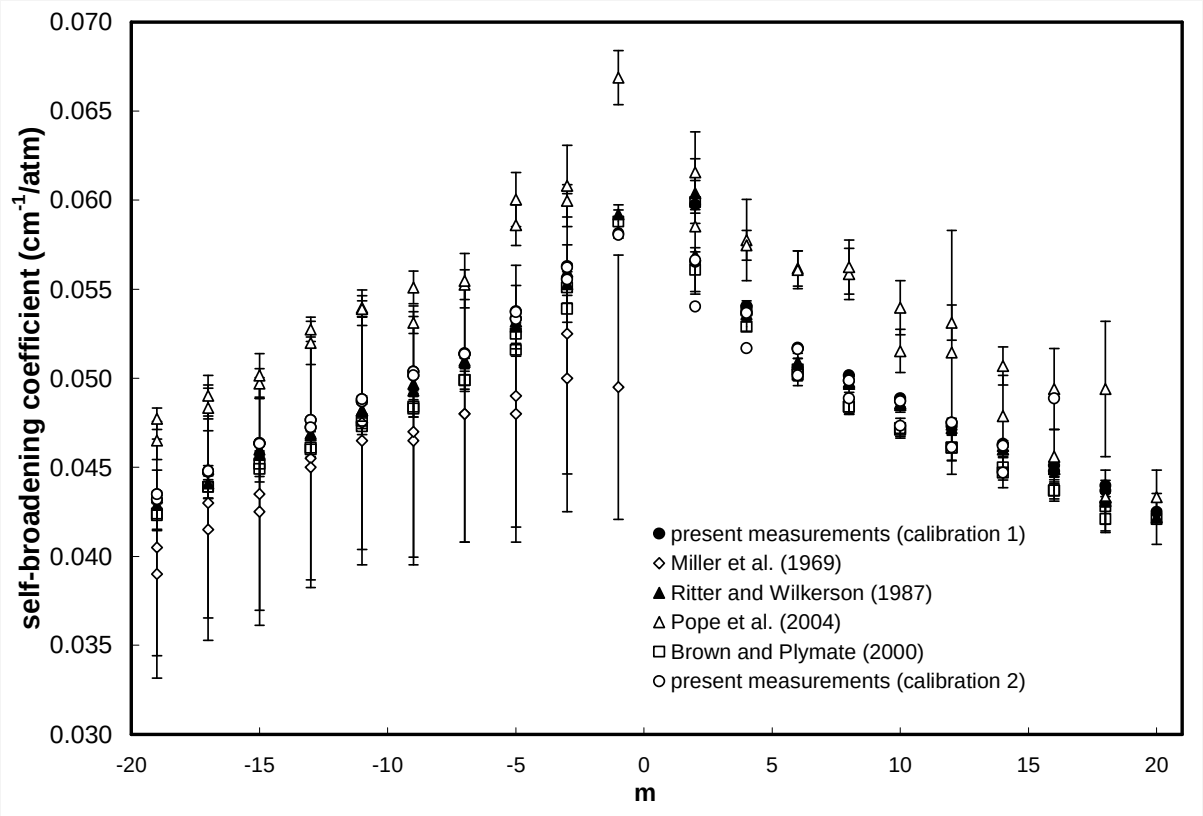

Fig. 3. Self-broadening coefficients for transitions in the oxygenA-band

In Figure 3 we present measurement results for broadening parameters retrieved using the Voigt profile. We have compared our results with datasets available in the literature. The transitions are sorted by the m quantum number, where m = – K″ for P branch transitions and m = K″+1 for R branch transitions.

As in Fig. 3 the broadening coefficients reported here fall within the range of coefficients determined by other researchers. An alternative treatment that takes into account the effect of collisions on the translational motion is the hard collision model. This model assumes that the velocity of the active molecule after the collision is independent of its velocity before the collision. Besides the Voigt profile, we have analyzed our results with a speed dependent Voigt profile and a hard collision profile. The differences between broadening parameters retrieved with the 3 profiles are shown in Figure 4.

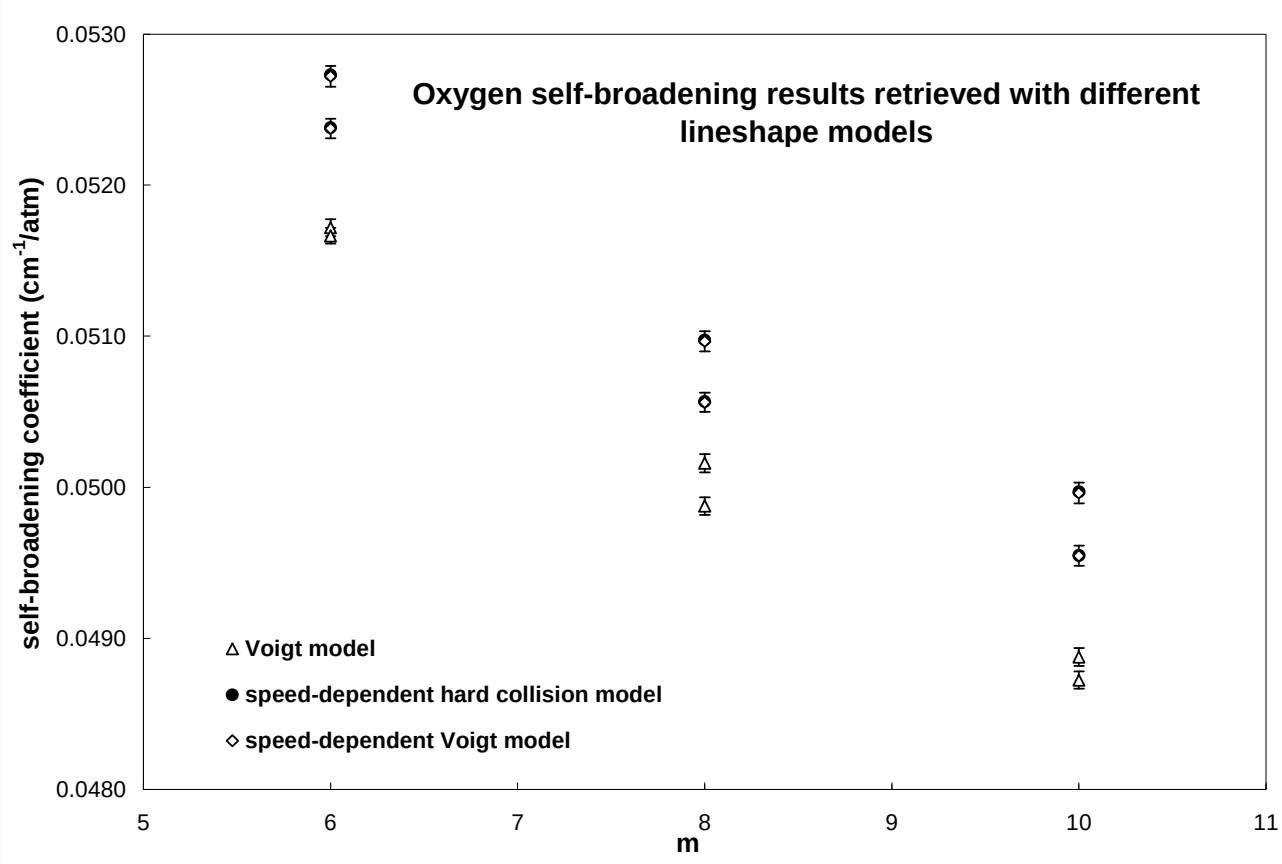

Fig. 4. Oxygen self-broadening results obtained using three different lineshape models

It can be noticed in Figure 4 that the speed-dependent Voigt and speed-dependent hard collision profile provide nearly identical broadening coefficients. The measured pressure-shift coefficients have been plotted as a function of m in Fig. 5. The O_2-induced pressure-shift coefficients agree well with the two main sets of measurements available in the

literature.

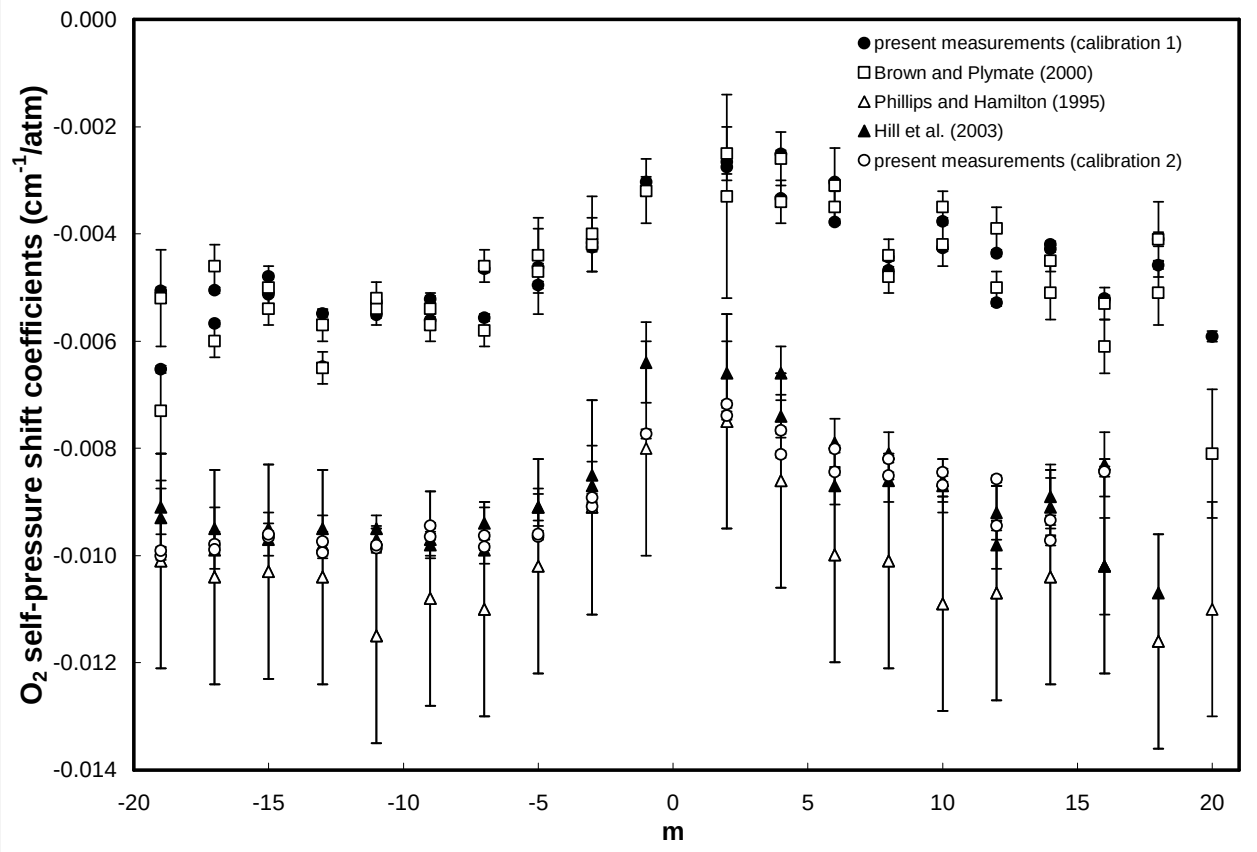

Fig. 5. Oxygen self-induced pressure shifts in the A-band

Scaling laws are expressions used to calculate the collisional rates. We assume that only inelastic collisions contribute to the width of the line. Consequently, the pressure-broadened width of a single line can then be calculated from the sum of all collision-induced depopulation rates of the rotational energy levels involved in the transition.

We follow a common practice and construct a relaxation matrix starting from the low density width of the lines and a scaling law called the exponential power gap law (EPGL) for the rates of relaxation of the rotational states. The EPGL gives the collisional transfer rate, $k_{i\ f}$, from a rotational state *i* to a higher rotational state *f* as

$$k_{i\to f}^{EPGL} = a\left|\frac{\Delta E}{B}\right|^{-b} \exp\left(-c\left|\Delta E\right|/kT\right)R\left(\Delta E\right)N_{i\to f} \qquad (7)$$

The parameters to be optimized are *a*, *b*, and *c*.

If there is no restriction on reorientation during a collision, then m can take all possible values and the spin degeneracy is:

$$N_{i\to f} = N_A = 2J_f + 1 \qquad (8)$$

Since the molecular system is in thermodynamic equilibrium, the rates of population transfer must satisfy the detailed balance condition:

$$k_{J_2 \to J_1} = k_{J_1 \to J_2} \left(\frac{2J_1 + 1}{2J_2 + 1} \right) \exp\left(\frac{E_2 - E_1}{kT} \right) \quad (9)$$

The diagonal elements of the relaxation matrix (which are in fact the broadening coefficients) have contributions due to collisions in both the upper and lower vibrational state:

$$k_{J'' \to J'} = \frac{1}{2} \left[\sum_{J \neq J''} k_{J'' \to J} + \sum_{J \neq J'} k_{J' \to J} \right] \quad (10)$$

Given the experimental values of the broadening coefficients the set of constants a,b,c and may be determined or fitted in a least squares sense. Our results for such a fit are presented below:

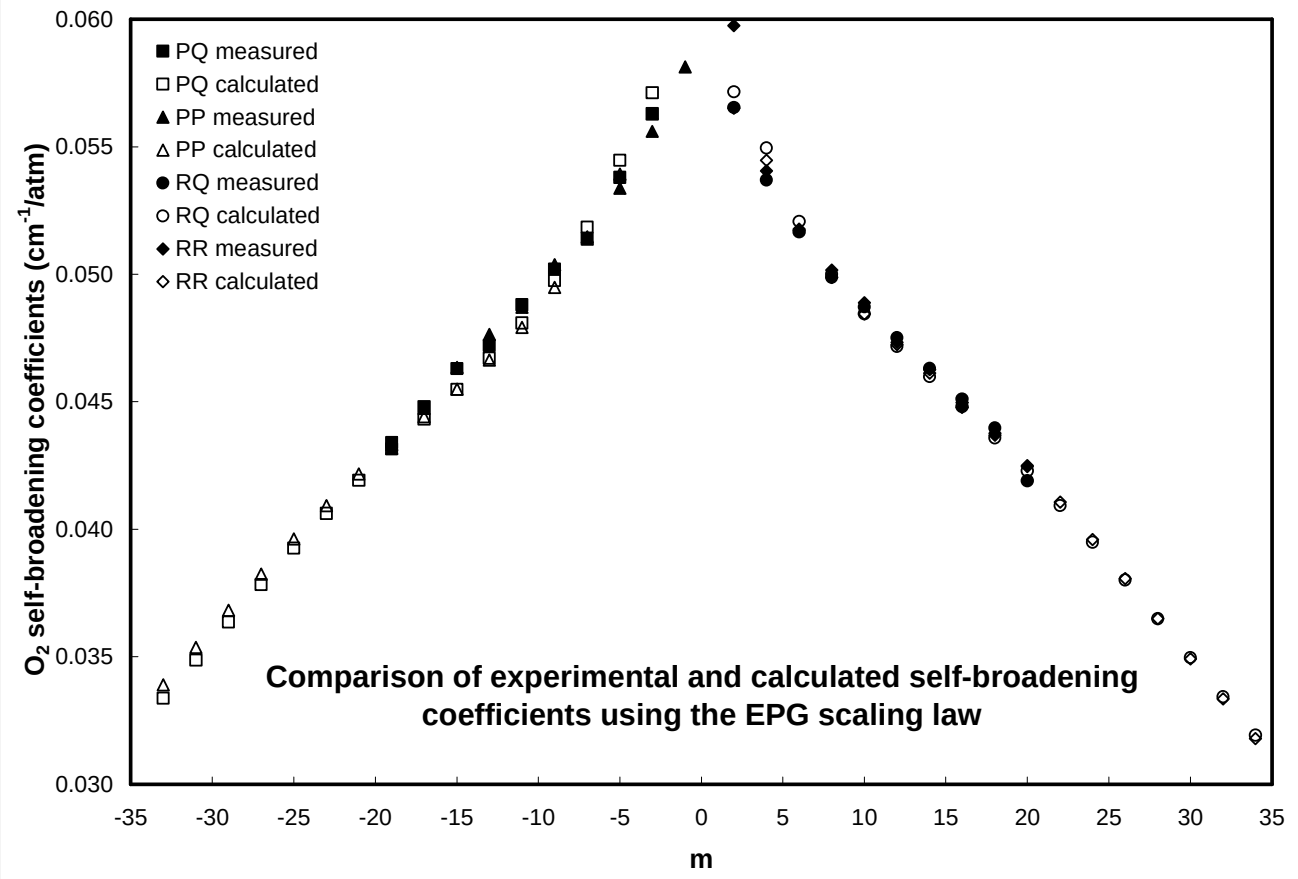

Fig. 6. Oxygen self-broadening parameters determined experimentally and with a scaling law

At elevated pressures the spectral lines overlap considerably and they cannot be considered to be isolated. A phenomenon known as line mixing (coupling) occurs and has to be taken into account. In this pressure regime the inelastic collisions transfer population from state to another, practically collisionaly coupling the states. These inelastic collisions that are mixing the states are no longer effective in broadening the

spectral lines since they only shift intensity from one section of the spectrum to another. In our study we have determined the line mixing coefficients for transitions with |m|<20. This is the first study that reports such measurements.

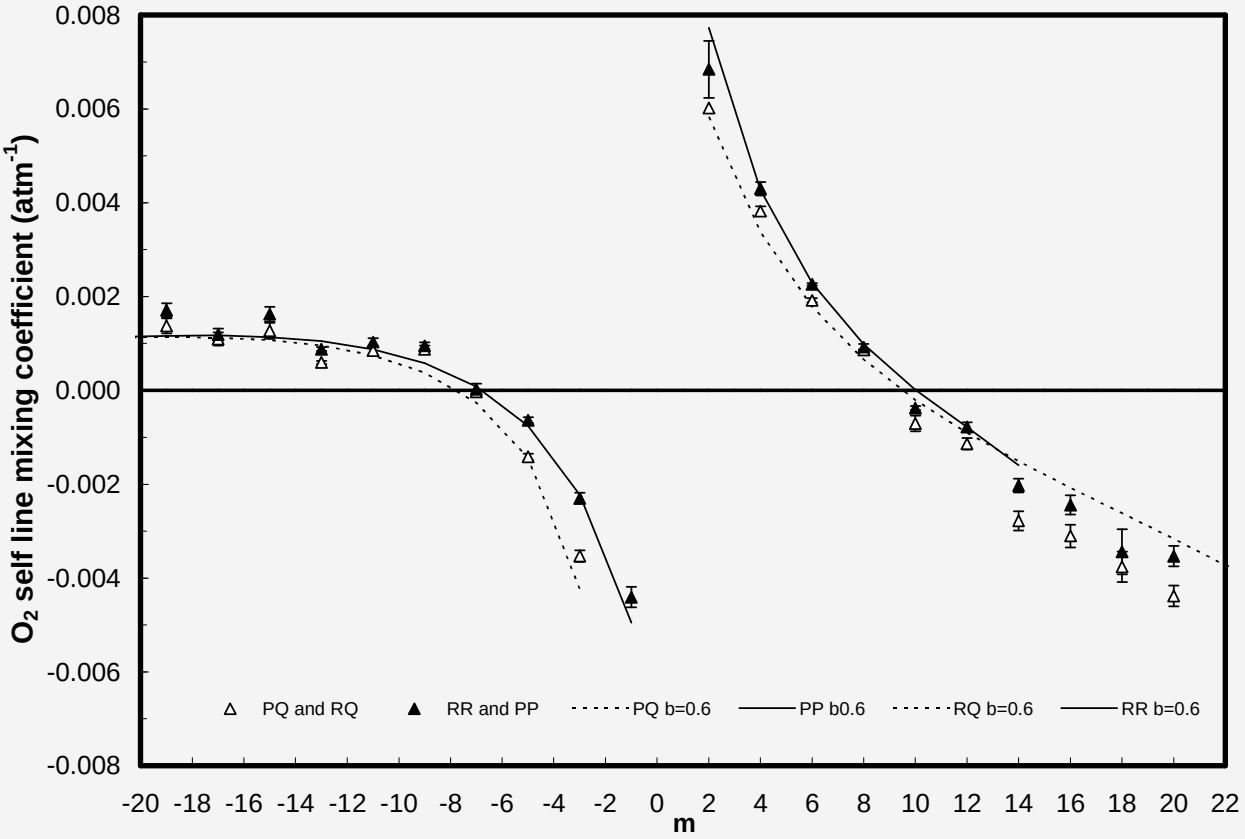

Fig. 7. Line mixing coefficients in the oxygen A-band

The off-diagonal matrix element of the relaxation matrix were calculated using the EPG scaling law and used to calculate the line mixing coefficients. As shown above the agreement with the observed values is remarkably good.

CONCLUSION

This is a major step toward a better understanding of self-broadening and self-shift in the oxygen A-band. The spectral line parameters were retrieved by fitting all spectra simultaneously. This procedure reduces random errors in the measured parameters to a minimum. The new measurements provide complete coverage of P and R branch transitions with $|m|<20$.

The experimental precision is sufficient to reveal inherent variations of the widths and shifts according to transition quantum numbers.We were able to measure for the first time the line mixing coefficients in self-broadened oxygen.

The results presented here can be used for accurate retrievals of oxygen abundance from ground-based solar atmospheric spectra, in studies of optical scattering

processes in the atmosphere, in climatology, to determine accurate measurements of ocean surface and cloud top pressure. The surface pressure is an important parameter for meteorological studies and hence for better weather prediction models. For the radiative transfer calculations spectroscopic parameters such as position, intensity, broadening and pressure induced shifts of the oxygen A-band absorption lines are required.

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I7: BALANCING MOTHERHOOD AND A CAREER IN THE SCIENCES

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1. INTRODUCTION

I had always planned to have a family and raise children. Even as a young woman, entering into my first year of Computer Science, my plan was this: get a degree, begin a career, have a family. The ordering of those steps was a logical one, not a prioritized one; it simply seemed logical to begin a career and have an income before bringing additional mouths into the world. I did not enter into Computer Science because of a passion for the field, although I have since developed one; I entered into Computer Science because I knew it would bring me a reliable income.

The progression of my life and my academic career required some modifications to my 'plan', but looking back there is very little I would now change if a time machine were to be suddenly invented. I never ever doubted that I would have a family, even when it was clear that a PhD and a life in academia was my ultimate goal. It was not until I began my career as a tenure-track Assistant Professor, and the volume of the ticking of my biological clock increased, that I started to doubt my ability to balance the three things in my life that are of the most importance to me: my children, my career, and my partner.

The purpose of this paper is to provide the reader with some insights into the challenges that a woman in science, and in particular in academia's notion of science, still has to overcome. I have tried to provide a balance of anecdotes from my own experiences with citations from the wealth of literature in this area. As we will see, there is a plethora of experiential and analytic work on women in the sciences, yet we have still not found a solution to the various problems facing us. I concentrate in particular on those that affect women who wish to balance a scientific career and a family, and make some suggestions as to how we, as a culture and society, need to change in order to find solutions to these problems.

I have divided the types of challenges that women in science face into three categories: internal challenges, or those that we face from within; external challenges in the institution, or challenges that are imposed by the institutions of science in which we work, and finally external challenges in the community, or challenges that are imposed by our culture and the people with whom we interact outside of our scientific institutions. These barriers are well documented in the literature, although they are often referred to as "self"

barriers, “institutional” barriers and “interpersonal” barriers respectively [23].

2. INTERNAL CHALLENGES

Leaving aside, for now, the question of why there are so few women choosing the sciences as a career path, I first wish to discuss some challenges facing those women in science who do reach their goal of an academic position. Internal challenges may be the most insidious of all the challenges that human beings must face. These are those little doubts and uncertainties that undermine our convictions, our sense of accomplishment, and warp our inner knowledge of what we need to feel fulfilled. There are three such challenges that I describe. The first is the biological clock that many women in science hear ticking away. Many career women feel a sense of guilt for even wanting a family, and so the temptation to put off having a child “until the time is right” competes with the biological and sometimes social pressures to have a child before it’s “too late”. The second is the impostor effect, or the feeling that one doesn’t really belong and hasn’t earned the position that one holds. The third is the feeling that we are in a race, either with our colleagues, or with some image of what is expected of us. These certainly are fostered by outside pressures, but it’s my belief that these are made overwhelming, in some cases, by our internal beliefs and the personalities and training that have helped us to reach success in our fields.

2.1 The Biological Clock

I sometimes envy those women who become accidentally pregnant. For me pregnancy (and indeed life) has always been about planning, and agonizing about whether it is the right time for a child, and more planning. As I progressed throughout my undergraduate and then graduate career the time never seemed quite right to either a) get married or b) have a child. Of course, I am somewhat old fashioned and the idea of having those two events occur in reverse order bothered me, and so a) had to occur before b). I completed my MSc., began a full-time job, and the time never seemed right. Then I met my partner, got married, and returned to school to pursue a PhD., and the time still didn’t seem right. We decided, part way through my schooling, that the time was right, and my first child was born 2 years into my doctoral studies. I don’t remember the first two months of her life, I was so worn down and tired. I returned to work when she was two months old, and I have to admit this would not have been possible if it had not been for the support of both my husband and my parents; the latter became our full-time daycare. When I began my position as an Assistant Professor at the University of Lethbridge, I had timed things just right: my daughter was becoming much more independent; the market for qualified IT people, in particular female ones, was hot; and I was months away from completing the writing of my dissertation. So I got the job and settled in, with a comment from one of my colleagues niggling at the back of my mind: “You’re not going to have any more kids, are you? ”. I had answered something negative when the question was (jokingly?) posed, but in 2003 I defended my PhD thesis and became pregnant again. At some point in my first year at the University of Lethbridge I had also been told that the more children a woman had before attaining tenure the lower her chances of successfully becoming tenured became. I’ve always enjoyed a challenge!

Clearly the timing for having children is different for everyone. However with the

varying types of birth control that are now available, the timing, and whether or not to have children is now indeed a choice for women.

Some people have advised that it is “best” to have children before starting a career; that way there are no interruptions to the climb through the ranks. For academics this either means delaying one’s schooling or having a child during that schooling. If this is the choice that is made, then a female student who chooses to have a child must, for biological reasons, be absent from classes for an extended period, and then after that period deal with the issues involved with breastfeeding – the choice of to breastfeed or not, and the social pressures to do so, accompanied by the physical difficulties of fitting it into the life of a student. There may or may not be child care available on campus, and the cost of child care may sink the student further into debt. While the life of a student may be much more flexible than that of a 9–5 office worker, there is nothing in the way of maternity or parental leave. The option of having a child while pursuing an undergraduate degree is not one that would appeal to me.

One could instead time one’s children to be born after the completion of a degree. Again, there is no maternity leave or parental leave support, leaving the family with a poorer financial situation, and when the child is old enough there is the difficulty that the primary care-giver often has overcoming this “gap” in their experience. I should note that in this situation it is traditionally the woman who acts as the primary care-giver during this early period; however more recently this role is being reversed and some men are staying home and raising their very young children – and subsequently experiencing difficulties re-entering the workforce.

Another option is to wait until one’s career is begun, or even well-established, before having children. According to Statistics Canada [1], in Canada in 2003 nearly one-half of the women who gave birth were thirty or older. This is compared to two decades ago, when three-quarters of mothers in Canada were under thirty. The trend is clear; more and more women are waiting until they are older to begin their families. Clearly this is a general trend, and not only applicable to careers in the sciences.

Some women are also choosing to either minimize the size of their families or to not have children at all. This is in some cases a choice due to personal preferences, to individual circumstances, or because they are aware of or have found out that it is difficult to balance a career in the sciences with another full-time job, that of being a parent. As stated in [18], female academics have the highest rate of childlessness among professionals, at 43 percent. I found it interesting to note that this article, intended to give a positive spin on two academics’ experiences with what they refer to as “early babies”, was written by a professor of drama and a professor in the humanities.

The problem is nicely addressed in [7], which says that according to James Turk, a sociologist and executive director of the Canadian Association of University Teachers, “At issue is the very nature of academic life with its lengthy probationary policy and its relentless work ethic... We still have a bit of a legacy of the male monastic order that characterized universities some centuries ago ... A measure of your commitment [is] that you are willing to sacrifice your life to your career. By the time they get tenure, most academics have internalized that pressure.”

There are many other factors that can be discussed in relation to this topic, such as the

uneven distribution in unpaid house duties [17, 2], the impact having children has on one's job prospects and renumeration [8], and cultural expectations for men and women surrounding child-rearing roles and images [22, 17], to name only a few.

It appears that many women considering careers in the sciences feel that they are faced with an "either/or" decision – either pursue one's academic career or have children. One woman recalls being told upon getting married in 1975 that "I would probably have children soon, which would mess up my chances of getting ahead" and Professor Patterson, now president of Trent University, decided not to have children at all, stating "I learned I couldn't do it all, mixing an administrative-academic career with home responsibilities" [7]. For those of us who have tried to do both, there is always the question of whether it has or will hurt one's career. Additionally, for female academics who do have a child, there can be a feeling that one has pushed their luck enough and to have an additional child would not be "fair". Of course, the question is "fair to whom? " – fair to the mother, who is already balancing a highly demanding career with the equally demanding task of raising a child; fair to the child, who sees less of her mother already, and would then have to share her with another child; or fair to the institution for which the mother works, and has already "allowed" her to redirect her energies away from work enough as it is.

Clearly this is affecting women; the perception that having children will hurt a woman's career is overwhelmingly present, as is the perception that men in sciences and academia in general can afford to have children, and even large families, without any negative impact on their careers. I, personally, am willing to envision a scientific and academic culture where both partners take equal part in raising children, and I think and hope that this will foster great changes in the question of 'family vs career'. However the fact remains that biologically, women will always bear the greater burden of having children.

2.2 The Impostor Effect

When I interviewed for my position at the University of Lethbridge, the feedback I received was very positive. Discussions about "when you are here" took place over lunch, and I was left with a wonderful impression. Still, when I heard that I was being offered a position I was surprised that I had been chosen. I've felt that a number of times, that internal question of "me? You really want me? ". I've been told by a number of female colleagues that this feeling of being an impostor is quite common and indeed a quick search with Google shows a bewildering number of websites referring to "the Impostor Syndrome", with a variety of workshops and programs to help overcome it. Many of us feel that we don't really deserve the status and position that we have earned, and that possibly we are where we are because of luck. Of even more detriment to the ego is the self-doubt that some female scientists have that has been caused, inadvertently, by 'equal opportunity hiring' and other such programs – they believe that they were only hired or promoted or chosen for some prestigious talk not because they are good at what they do but because they are women.

There are many reasons for this, one being a societal and cultural expectation of women to be modest and self-effacing. As Schiebinger [17] (pp. 58–59) states,

> ...society expects women, more than men, to be modest, and many internalize this imperative early in life. This is especially alarming because low self-esteem is a correlate of modesty. In a study of undergraduate students three-quarters of the women, compared with less than half of the men, cited low self-esteem as their reason for leaving science.

Further on in their careers, "A 1995 study of high-achieving women scientists showed that only half saw their own scientific ability as being above average (compared with 70 percent of the men)."

Why might this make life as a scientist more difficult than, say, life as an English Professor? According to an article by Easlea in [11] (pp. 132–158),

> ... the anthropologist Sharon Traweek claims that predominant traits manifested by [the prestigious and influential international high-energy physics] community are those of 'aggressive individualism, haughty self-confidence, and a sharp competitive edge'...

and

> ... high-energy physicist Heinz Pagels tells readers that 'a predominant feature in the conduct of scientific research is intellectual aggression' and that 'a healthy sense of ego and intellectual intolerance is crucial to the conduct of enquiry' ... the distinguished biologist Richard Lewontin ... asserts that science is a 'form of competitive and aggressive activity, a contest of man against man that provides knowledge as a side product'.

I would hope that such an attitude of aggression and egotism is not prevalent in any other area of academia; unfortunately I suspect that it is since it is in our society in general. Such a characterization, which is certainly fostered by the culture prevalent in many engineering undergraduate programs, cannot help but be responsible for the loss of many young students considering science or engineering as a career. Due to the socialization of women to be more modest and self-effacing more women than men are going to react to such a culture by saying "forget it! I don't need to be a part of this", but we certainly are losing men who disagree with it as well.

I would argue that women are affected by this emphasis on aggression and egotism all through their careers, not just when deciding whether or not to remain in a science or engineering major. Women who see themselves as lacking in comparison to their male colleagues are, for instance, less likely to try for early promotion. They may be less likely to instigate collaboratory efforts, doubting their own ability to contribute to such efforts. As a final example, women may be more likely to play-down their achievements and research results, resulting in lower grants and less recognition at their institution. For example, the CRC (Canada Research Chair) program in the sciences is finding that nearly all the prestigious chairships are going to men, despite the fact that there are qualified and deserving women in many areas [20]. The author of the article sought the advice of Shirley Neuman, vice-president and provost of the University of Toronto. She has observed that men and women behave differently when a position like a CRC comes open. She says men are more likely to assert their qualifications for the position and their entitlement to it. If an offer isn't made, the men are more likely to elicit one from another

university, while the women tend to wait for their qualifications to be recognized. Not only that, but studies have shown that women, compared to men, feel that they deserve lower pay and have a lower sense of personal entitlement [9] (p. 234), and so women may be likely to accept a lower base salary, or not fight for a promotion as hard as their male counterparts. These are all potentially career-damaging actions, and many women are not aware that they are taking these actions. I would note that I have personally identified these particular examples in my own life. However, I have had mentors and colleagues who have always been willing to advise me and encourage me, and I hope that this has helped prevent me from damaging my own career.

2.3 It's Not a Race – or is it?

I recently had an interesting discussion with my husband; I told him that as his career progressed I did not want to be the typical female married academic who let her own career slide into the background as her husband's career blossomed. However, I was very aware that our children, particularly my three-year-old, were unhappy with the fact that both her parents were at work for 8 or more hours each day. I explained to him the guilt I felt for leaving work early to support my children, and the guilt I felt on those days when I didn't leave early. His answer was one of the most useful that I have heard from many people: he stated that "It's not a race". If I wanted to ease up on research because my children needed me, then it would be likely that my promotions and raises would slow down in response. But would that really matter? Would it matter if I didn't make Associate Professor at the same time as the colleagues with whom I was hired? It's not as though I was willing to let the quality of my work suffer, only slow it down somewhat. Should this be a source of guilt, and a reason to incur penalties? I'll admit, I am by nature a competitive person, and to me it very often IS a race. However, it doesn't need to be. This, I think, goes a long way in summing up the existing culture of science; that of a competition, of a race, in which there is only one winner. This makes balancing a career in the sciences and any other type of work virtually impossible. It also seems to contradict ideas such as collaboration to maximise the sharing and building of ideas and theories; I suppose if one collaborates with people then there is the potential that they might win instead of you.

This is certainly something to be factored in to the discussion. As discussed in the previous section (2.2 The Impostor Effect) aggression, egotism and competitiveness have traditionally been a part of Western science, and indeed expected of scientists. Hagstrom [10] states that "scientists themselves have tended to regard competitive behavior as morally unworthy or at least socially important" and yet in the data he collected he states that three-fifths of the respondent scientists had been 'scooped' in the publication of a solution to a problem on which they were currently working. His data also seemed to indicate that mathematicians were least likely to feel this competition, while chemists and experimental biologists were most likely to feel it, possibly, according to Hagstrom, due to the difficulty in these fields to agree on the importance of particular problems. I raise this study since it appears to be one of few addressing this particular area, and also one that has been performed long before feminist critiques of science began raising their issues about unsympathetic cultures in science.

I close this section with a short summary: the image and culture of competition in science certainly does exist, for whatever reasons. This image contributes to a number of internal stressors, particularly for women:

- stress relating to work-family balancing and the problem of scheduling when to begin a family,
- the feeling many women have of not 'belonging', and moreover, of not deserving to belong, and
- the stress of feeling as if one is constantly in a race, and, often the stress of losing the race.

Women in science and academia consistently demonstrate motivation, organization, intelligence, and common sense, and these very attributes tell us that we do belong, and we do deserve the promotions and the chance to have a family and the opportunities that come our way. However the culture of science and the culture that we have been raised in don't often agree on this, and this internal disagreement can cause a great deal of stress.

3. EXTERNAL CHALLENGES IN THE INSTITUTION

As a woman who began a career in Computer Science in 1989, I have been very lucky. Pioneering women who have come before me have paved the road to success, leaving very few potholes behind for me to encounter. There have been a few trips and stumbles, but those women who have forged the way ahead have done an outstanding job of fighting to even the playing field.

For instance, I have never encountered (in academia – industry is another matter) an attempt to pay me a lower salary than an equally qualified male applicant (although inequities still exist here, as indicated in the Appendix), nor have I had to deal with sexual innuendos or inappropriate comments of that nature from male colleagues. However, there are still challenges imposed by the culture, and I wish to discuss some of them here. I have separated these particular challenges from the previous three as I believe that the following issues derive from external expectations, rather than internal doubts. There is certainly overlap between these and the previously discussed issues, and 'fixing' any of them requires a major change to our culture and society, in my opinion. However it is my belief that since these challenges derive from external expectations, the institutions for which we work can have a major impact on changing these expectations, and minimizing these challenges.

3.1 What Does Parental Leave Really Mean?

The idea of parental leave is a wonderful one; an extended (and sometimes paid) leave from one's employment in order to bond with a new baby and transition from an n-child family to an n+1-child family. The cares of work are to be left behind while allowing the parent to concentrate solely on the added child-rearing duties and joys. What a lovely idea! Unfortunately, the reality is that for many academics the brain is always working on the problems encountered at work; often they are not the type of problems that can be left behind. The upshot of this is that taking a parental leave often cannot be fully 'enjoyed'; there is always a research problem and the pressure to solve it in the back of one's mind. The year following my parental leave with my second daughter I had seven

papers appear in conferences – these were the result of the work I had done while on parental leave, despite the fact that I was on leave.

It is quite likely the fact that one is on leave even contributes to productivity; for a brief period of time there are no service requirements or teaching duties, and one has a very good reason to say 'no' to one's colleagues when they ask to chair a defence or give a talk. So a lot of the usual work-related requirements are suddenly absent. On the other hand one is dealing with the demands of a new baby, so it is not as if one suddenly has an abundance of free time! However, as anyone who has been a primary care-give to small children knows, it is common to develop a need for some adult-time, some time when adult conversation and adult thought can once again be engaged in. I suspect that during this time many scientists relish the chance to change gears from baby talk and diapers to solving lofty research problems and being involved in the world of journals and conferences, even if only for a brief period each day (or each week).

In Kyvik's 1990 note on studies on motherhood and scientific productivity [13] he states that these studies have found that men, on average publish 40-50% more papers than do their female colleagues. However, he also indicates that many of these studies suggest that married women with children have higher productivity than do unmarried women (assuming, that unmarried women do not have any children). and in fact, having children at younger ages seems to be positively related to productivity, not negatively related as one might expect. One suggestion is that women may have delayed beginning families until their careers and publications had reached a stage of 'critical mass' and continuing that level of productivity was easier than it might be at an earlier stage; however the positive correlation between young children and higher productivity was also present with younger women. Kyvik's own study results contradict these findings, suggesting that women with children under the age of 10 do suffer negative effects on their productivity, presumably because of the caring responsibilities for small children. One reason for this may be that previous studies have been carried out on American researchers, while Kyvik's study focused on Norwegian researchers, bringing into question sociocultural factors, or the possibility that the studies have used incomparable data sets. A subsequent paper by Kyvik [14] suggests that the differences in productivity between male and female researchers can be at least partly explained by a lower rate of collaboration by female researchers than by male, and by uneven child care responsibilities.

This phenomenon is one that I think deserves further study, and should be of great interest to our scientific institutions. Parental leave is only now becoming an option for men at some institutions, and taking either maternity or parental leave still has a certain amount of stigma attached. There is the belief that such a leave will hurt one's career, leave one's colleagues 'in the lurch', and will in general be looked upon negatively by colleagues and/or those evaluating us. Unfortunately, Kyvik's studies lend support to this. It would go a long way towards alleviating work-family stresses in baby's first year if data could be found to offset this perceived stigma to taking family-related leaves, and at the very least additional support for longer paid parental leaves should be available if it is generally true that such leaves have the possibility to increase a scientist's overall productivity. In any case, a parental leave should be made to be as stress-free as possible,

allowing a researcher to concentrate on the task at hand and free one's self of stress; research relating social support of this type to improved well-being and increased research performance is clear [16]. Indeed in [7] Dr. Sheila Brown, president of Mount Saint Vincent University in Halifax, says, "I'm not sure the clock ever stops from the individual's point of view. If you are a scholar [and a new parent] you're nonetheless probably reading or researching but not being able to bring things to fruition as quickly." Dr. Brown says she takes the long view. "Someone is not a lesser scholar for having taken a year off. Their lifetime production may be the same, it's just a different pattern." And this is exactly the point of view I think institutions should promote.

A final point to make is that parental leave, in comparison to childhood, is very short; there are additional years and years where working parents are doing double duties. This is an additional issue that needs to be considered by institutions wishing to support their employees and their families. The following section addresses some of the problems that stem from these double duties.

3.2 When Does the Job End?

As Bailyn [3] states,

> There are many wonderful things about an academic career. It provides more freedom and autonomy than most high-level endeavours, it allows one to work on things one really cares about, and the system of tenure provides a level of job security unheard of in most other occupations.

I agree with this in nearly all aspects, except for the statement about allowing one to work on things one really cares about. I'll address this in the following section. What Bailyn goes on to say is quite enlightening; she explains that the varied nature of an academic career also makes it particularly demanding. There are multiple roles to fill, along with those of our 'outside' lives, and "it is a profession with a great deal of overload". She explains that this is in terms of the relation of input, or the demands put on a person, to the timing of the output. For instance in many areas of academia it is far from unusual for there to be a two-plus year turn-around time between submitting a paper to a journal and having it published, assuming the paper is accepted. The psychological demand of having to be an expert in one's field also adds to this overload. Furthermore, bringing in outside help is unheard of – while in the business world a manager who is overloaded or working outside of their field of expertise can hire consultants or bring in extra workers.

The result of this is that for most academics, our jobs never end. We are always thinking about the lecture to be given the following day, or the submission deadline coming up, or the papers to be marked, and so on. No one authorizes overtime when it comes to crunch-time; it is expected that things will simply be done. So when can I stop being a scientist and be my children's mother? That is clearly a question that I, and only I can answer. At some point during the day I have to put my children's needs first. However, how does that appear to my colleagues? If I leave the office at 3pm each day to pick up my children from school or daycare, how do my colleagues who work until 5 or later feel? I submit that there is likely a feeling of envy, and possibly resentment. I chose academia as a career in part due to this flexibility; I prefer to get things done on my own time, whether that is between the hours of 9am and 5pm or later on in the day (or in the early hours of

the morning, when the world is peaceful and quiet). I once heard my father discussing the "big" research universities in the US (which he never bothered to name); according to him these universities would expect their new faculty to work long hours during the week and then additionally come in to the office for "brain-storming sessions". If you didn't come then you wouldn't get tenure; it was that simple. This may not be an accurate reflection of the reality of the situation, but the image is there, and it has made an impact on me.

For those of us who may not have children, or may not have children yet, the same question will apply if you wish to have a life outside of science. If you have interests and hobbies unrelated to your career, when is it appropriate to pursue them? Similarly, when is it OK to be female and stop being a scientist? In today's science culture the two are often mutually exclusive. Schiebinger [17] relates many examples both of how women have strived to minimize their femininity to fit into the role of scientist or engineer, and also how their colleagues, peers and role models reinforce this attitude (pp. 83–84).

Becoming visibly pregnant is one example of how a woman's feminist can be emphasized. This can be very difficult for women scientists, not only because of the change in appearance but also because of physical difficulties. For instance one woman recalls her first pregnancy while working as a chemist and says "I was sick every day for seven months, but I just kept going. I just didn't want people to look at me as a feminine creature." [17]. The goal for many women has been to "just keep going" with their careers despite the life changes enforced on them by a growing family. Unfortunately most of us compensate for the added time requirements of a family by removing the time for us.

> The goal for these women was to have babies without maternity leave, without a pause in productivity, without appearing to be different from their male colleagues. The result was that they did it at a high cost to themselves and their partners within institutions structured to suppress such things. Women report that they continue to produce scientific papers at the expected rate by eliminating almost everything but work and family. What went first was time for themselves – movies, novels, workouts, dinner parties. They also lost the flexibility to stay late at the lab or to engage colleagues in informal discussions [17] (emphasis mine).

In essence, for some women, the job never ends – they are constantly structuring their life around their career and their day-to-day struggle to fit in.

3.3 What is 'Real' Science?

I recall a recent discussion with a colleague about my interest in the issues surrounding women in science, and the problems I was envisioning in pursuing research in this area. I had just received comments on a research grant application which had been successful, but the comments were particularly negative about a section of my work focusing on gender differences in the use of programming languages. The message, to me, was that this was not 'real' research. I had in fact used that terminology myself; I expressed an interest to my colleague in pursuing this work but I cautioned that I could not let my 'real' research suffer.

So what constitutes, for me, working as a Computer Scientist, 'real' research and 'real' science? Why are questions that I ask surrounding minority groups and their use of languages for programming considered less valuable than the questions I am currently asking about FPGAs, autocorrelation coefficients and reversible logic? All of these questions have to do with computers and our use of them. For that matter, why are the questions I have surrounding women scientists and how they pursue their lives and careers not considered worth funding? There are researchers who have been funded for research into these types of questions; clearly this is so since there is an abundance of work on women in science. However my primary funding agency (the Natural Science and Engineering Research Council of Canada) sent me a quite clear message through my reviewer's comments: research that involves a gender question will not be viewed in a positive light.

There are many, many issues to discuss here, including:

- the question of how our language shapes and possibly restricts the questions and thoughts we form; in her article "Gender and Science: an Update" [24] (pp. 132–142) Fox-Keller touches on this, and also in [24] (pp. 99–116) Cohn provides a disconcerting example of how this can occur in her article "Sex and Death in the Rational World of Defense Intellectuals", and
- the question of how ideas couched in feminine, or 'non-hard' terms, can succeed in our traditional science; again, in [24] (pp. 132-142) Fox-Keller states

  > One question we need to ask is thus relatively straightforward: What are the particular ends to which the language of objectification, reification, and domination of nature is particularly appropriate, and perhaps even useful? And to what other ends might a different language - of kinship, embeddedness, and connectivity, of "feeling for the organism" – be equally appropriate and useful? But we also need to ask another, in many ways much harder question: How do the properties of the natural world in which we are embedded constrain our social and technical ambitions? Just what is there in the practices and methods of science that permit the realization of certain hopes but not others?

  Schiebinger also addresses this at length in her chapter entitled "Gender in the Substance of Science" [17], discussing our "inadequate knowledge of the female body", changes in the field of primatology that many attribute to the feminist movement, changes to traditional biological notions of the 'aggressive sperm' and 'passive eggs', and finally in physics, where "gender abounds in the cultures of math and physics, determining to a certain extent who gets educated, gets funded, enjoys prestige, and can build upon opportunities" and furthermore where "the culture of physics sets conditions for who has the training and the opportunity to ask questions."

Clearly the first two issues in this section are related; the question of how to balance one's work and family responsibilities without letting either go unattended is a very difficult one. However, in academia and in particular in the sciences – and, one can argue, in our society in general – the notion that mother- and fatherhood duties are more important than, or even equally important as one's work-related duties is quite foreign.

Thus we see stigma attached to those parents who choose to leave their jobs early to spend time with their children or to take parental leave during those early formative years of their children's lives. We see a similar stigma attached to individuals (particularly women, who are considered too sensitive and emotional) who take time to be with aging parents. When such statements are put into writing and seen in black-and-white lettering the stupidity of such cultural teachings is (I hope) obvious. However, the stigma remains, despite the fact that well-educated women and men who choose to be a part of their children's – and indeed their families' – lives should be congratulated and rewarded for such choices. In my opinion this is something that our institutions can begin to change, by supporting longer parental leaves, encouraging mothers and fathers to take such leaves, rewarding people who work with the community to educate and support our children and in general increasing the value of family in our society.

The final issue, however is one that deserves far more consideration, research, and attention than I have given it in the above section. The implications are truly staggering – that we, as in society as a whole, may be overlooking research questions simply because we may be trained not to look at things from a particular, "non-scientific" point of view. Not only that, but research that does not fit into "traditional" avenues is not deemed deserving of interest or funding. This strikes me as self-limiting in the worst way, and has unfortunate implications for our future. We need to remind ourselves, as Schiebinger does [17], that "the greatest physicists have been those who have asked the right questions" and that those questions have often been the non-traditional ones.

4. EXTERNAL CHALLENGES IN THE COMMUNITY

Although there are challenges to overcome in the workplace and in our society's support of families trying to achieve a balance of work and family, there is also a huge set of cultural issues to overcome. This section briefly touches on some of these as they apply to my situation.

4.1 The Culture of Science

In sections 3.2 When Does the Job End? and 2.2 The Impostor Effect I have mentioned a few of the issues surrounding the culture of science that our society has seen fit to perpetuate: a culture of aggression and competitiveness in which one must appear non-feminine, unbiased and unemotional in order to create an appearance of success. Of course, outside the institution, there is also an image to live up to: the image of a scientist.

Within the institution this image causes its own problems as we've discussed earlier, but outside the institution the notion of a woman being a scientist can make her feel like an outsider in other arenas. For instance, when having the rare opportunity to chat with the other parents picking up their children from preschool the subject of working or not often came up. When asked what I did, I found that more often than not telling people "I'm a computer scientist" would act as a very effective conversation stopper, and from then on I was not 'one of them'. This was not simply the difference between a mother working outside the home and one who did not; it was the use of the word 'scientist' that seemed to make the difference. When I began my career as an undergraduate student, my parents were told by other parents that I "didn't seem the type" (to go into Computer Science).

These are not uncommon experiences for women in science and engineering; Wyer et al. [24] relate the experience of a female engineer whose mother exclaims in surprise, on seeing pictures of her daughter's freshman class, "why some of these girls are pretty! " (p. 84).

The image of a (computer) scientist or engineer in most of western culture is that of a white or Asian male; computer scientists wear glasses and sit in front of computers while scientists in general wear white lab coats, are elderly, and have messy hair. 'Draw a Scientist Tests' (DAST) have been tested children of various ages [5, 21] and in general confirm these stereotypical images are what children are picturing. Thus going into science implies that one should or does fit these images. A female scientist clearly doesn't fit.

4.2 The Culture of Motherhood

An additional handicap in my desire to belong is that I am not only a scientist, but I am also a mother. My internal expectation of a scientist is that she must be rational, unbiased, objective, focused and dedicated to her work. My internal expectation of a mother is that she must be nurturing, kind, loving and dedicated to her children. The two are not totally incompatible, but certainly merging those two roles into one body has provided a challenge, one which I am still not sure I am adequately meeting.

The role of motherhood comes with a lot of expectations, not only of the traits a mother is expected to have. As a mother of a child entering kindergarten this year, I am finding out exactly what a mother is expected to do: she is expected to pick up and drop off her child at the required times; she is expected to drive on field trips (where I might add siblings are not welcome – so she is also expected to be able to pay childcare fees at the same time); she is expected to be able to rearrange her schedule on a day's notice to attend meetings, and to be available at all hours of the day and evening for various events and meetings. On top of these time requirements there are also financial requirements, since although our child is not required to pay fees, she still comes home every week with a request for money for some fund-raising activity or another. I personally can't see how stay-at-home mothers can possibly meet these requirements financially, or how working mothers can meet these time requirements.

A UK scientist, Kathleen Lonsdale, stated in 1970 that

> Any country that wants to make full use of all its potential scientists and technologists could do so, but it must not expect to get the women quite so simply as it gets the men. It seems to me that marriage and motherhood are at least as socially important as military service. Government regulations are framed to ensure (in the United Kingdom) that a man returning to work from military service is not penalized by his absence. Is it Utopian, then, to suggest that any country that really wants married women to return to a scientific career when her children no longer need her physical presence should make special arrangements to encourage her to do so? [15]

She is referring, in part, to the difficulties that women have in returning to a career after taking time off to raise their young children. Today more women are getting help from their partners in these early years of their children's lives, and so are taking less time

away from their careers. Moreover, they are getting more support from government (at least in Canada) which require institutions to hold a person's position, or an equal position, for them, during the time in which a parental leave is taken. However our society still finds the two incompatible; for some reason intelligent, motivated people are rewarded for having careers but not for having children. Additionally, there is an assumption that is reflected in my own statements from above: that it is a woman's job to raise children, not the man's, and he may provide help but cannot fulfill these duties by himself. Clearly this is a cultural fallacy that must change.

I close this section with a modification of Lonsdale's 1970 statement:

> Any country that wants to make full use of all its potential scientists and technologists should certainly do so, but it must not expect them to deprive themselves and society of the opportunity to procreate and be a part of their children's lives. It seems to me that marriage and parenthood are at least as socially important as military service, and indeed as important as any type of service we do for society, whether it be running a business or emptying garbage cans. In order to help our society and mankind itself evolve in an upward direction we must ensure that parents are not penalized by making the choice to serve society in this way. It should not be Utopian to suggest that any country that really wants the most brilliant minds in their country to raise happy and well-adjusted children who may one day take their places MUST make special arrangements to encourage them to do so.

5. IMPROVEMENTS - THOSE IN THE PAST AND THOSE YET TO COME

Much of the literature on the challenges women encounter in scientific careers identify quite clearly the challenges, but do not provide any possible solutions. I intend for this paper to do both.

Briefly, it is clear that progress is being made. Not even ten years ago women in some institutions had no maternity leave benefits of any sort, and parental leave that could be taken by male partners was virtually unheard of. Today we have many men staying at home with young children while their female partners are beginning their careers, and maternity and parental leaves are mandated by the Canadian government. There is encouragement, at many levels, for women to enter the sciences, as opposed to the discouragement that many women have historically encountered.

The problem is now that many of the 'easy' problems have been fixed; offering maternity and parental leave, investigations into unequal pay scales, and Women in Science programs to encourage women in these non-traditional fields. These are wonderful steps, but clearly haven't solved all of the challenges, as the furor raised by Harvard's then President Summers' remarks in January 2005 indicates [19]. So the question becomes "What next? " We are starting to see more literature addressing this problem, such as [3, 12, 6], but still recommendations tend to be vague and hard to implement.

This is understandable, since it seems clear to me that the change needs to occur 'underground', in a sense. What I mean by this is that we need to change our entire culture. We need to teach our young girls and boys that the nurturer of young children need not be the mother, but that fathers are suited and welcome to stay home with their

children. We need to change our media portrayal of scientists, show them with family, spending time with their families, and force our institutions to make this feasible by offering longer paid parental leaves and teaching reliefs to support families with young children. We need to support our families better, offering better daycare options and better government financial aid to help families in which both partners wish to pursue their careers, and we need to change our belief system to put VALUE on the act of providing a healthy work-life balance for ourselves and our families.

I suppose that the baby steps that have been taken are better than no steps at all. As Ursula Franklin describes in a video entitled "Asking Different Questions" [4], women are earthworms who work to prepare the soil for better ways of doing science, and says, "Only when these two are together – the real new thoughts and the well-prepared soil – [then] social change will come." However, to continue the metaphor, I would prefer to be a tractor, tilling the soil and leaving freshly turned fields ready for the growth of social change and the nurturing of women and men who want to ask different questions in their scientific careers.

I close this section with some concrete suggestions that I think can help women compete on this uneven playing field (and I use this sports metaphor with ironic knowledge that I am, even as I speak, continuing to perpetrate the image of a competitive culture of science):

- Institutions can and should provide more support for long distance participation in events and collaboration. One of the challenges in my own life is balancing the need for interaction at conferences and workshops with the stress the corresponding travel puts on my family. In this technological age I would propose that we harness this technology in such a way that enables parents to have an international presence without having to physically leave one's family. The infrastructure for such participation, in most cases, exists, but we must be creative and proactive in figuring out how to make it work for us. The advantages to the individuals making such efforts are numerous, including exposure in one's research area and the prestige of being a "ground-breaker" in the creative use of technology. The advantages to institutions are correspondingly numerous, and include creating more research opportunities, raising the level of recognition of the institution, and building a reputation for that institution of being on the leading-edge of new ideas.
- Women must be aggressive in forming relationships and making contacts. If a woman chooses to begin her career at a smaller, less competitive institution in order to facilitate a work-family balance then the resources available may be correspondingly lower. The creation of collaboratory relationships, where ever possible, can help mitigate this disadvantage. The key is for women to find those areas where they can build connections both within their own discipline and to other disciplines, and nurture those relationships. I don't mean to suggest that women should be more 'male' in their approach, rather that they should revel in those things that make them female – such as seeing and building connections, asking questions about how ideas fit together, and so on. Researchers must be open to forming and building on these relationships, and rewarding the instigator(s) with ideas and opportunities that will help the individual to grow their career(s).

- Institutions must also nurture this as a growing trend, and make necessary resources available and reward individuals for building these human networks. In particular I would encourage women to be the builders of such networks, while the institutions must provide the support for them in order for them to survive, and indeed grow.

Although the above suggestions do not touch on the changes needed in society, they may help women to survive the more immediate challenges. They may also help women to create networks that not only aid their career, but generate personal relationships to other women who are struggling with similar types of problems. I would hope through such steps that the ground will be made even softer for the additional social growth and changes that are needed.

6. CONCLUSIONS

I am at a stage in my life that should be very rewarding. I am being evaluated for tenure, a major achievement in any academic's life, I am being recognized by my colleagues in requests for review activities and other involvement in the research community, and I am confident and comfortable with my teaching duties. On the home front my children are entering school and expressing varying viewpoints and ideas that I hope they will continue to develop as they grow. Despite these achievements I am continually feeling as if I am underachieving. I feel that I am being a 'bad' mother because I cannot be available for all of my children's activities and I feel as if I am underachieving in my research career because I am taking time from work to be with my children when they need me. I feel like I am fighting some sort of battle, but I'm not sure who the enemy is, just that I am losing. And despite my feeling of being the only one struggling with theses issues, I know that this is simply not true; many other women have struggled against these and worse problems. Some have succeeded and some have not, but all have made some progress.

I would very much like to be able to suggest the cure-all for these problems, but the literature is very clear that there is no one single factor that will change the problems our society has with its image of science, its image of women and mothers, and with the cultural baggage that is resulting in our difficulties. However, as Ursula Franklin recommends, I can certainly contribute my efforts in the softening of the soil, to prepare it for the growth and social change that needs to take place. I hope also, with work such as this, to do two things:

1. I hope to raise the awareness that these challenges exist, and let both current and prospective academics know that many of us are struggling with these challenges, and
2. I hope to show everyone that this particular woman intends to overcome these challenges and strive to become a great scientist, a leader in her field, a role model for future academics, and a mother who is always there when her children need her.

7. AFTERWORD

My final comment is that I hesitated to publish this paper, for fear of scaring off other women who would like to pursue a career in science. After all, if we're not told that

something will be hard, sometimes we find it isn't! Similarly, if we're told a task will be difficult then it often becomes a self-fulfilling prophecy. However I finally decided that it is more important to provide others, men and women both, with this summary of my experiences so far. Sometimes we enjoy a challenge.

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Appendix I – Selected Statistics from the 2005 Canadian Association of University Teachers (CAUT) Bulletin

Full-time Canadian University Teachers by Subject, Rank and Sex, 2001-2002

	Agricultural & Biological Sciences		Education		Engineering & Applied Sciences		Fine & Applied Arts	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Full Prof.	85.3%	14.7%	70.1%	29.9%	96.0%	4.0%	76.3%	23.7%
Assoc. Prof.	71.1%	28.9%	51.9%	48.1%	86.7%	13.3%	61.6%	38.4%
Asst. Prof.	61.2%	38.8%	44.6%	55.4%	85.5%	14.5%	49.4%	50.6%
Other	40.0%	60.0%	45.2%	54.8%	76.8%	23.2%	49.3 %	50.7%
All Ranks	73.8%	26.2%	55.0%	45.0%	90.1%	9.9%	61.7%	38.3%

	Health		Humanities		Math & Physical Sciences		Social Sciences	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Full Prof.	79.8%	20.2%	78.3%	21.7%	93.9%	6.1%	82.4%	17.6%
Assoc. Prof.	62.0%	38.0%	60.5%	39.5%	85.9%	14.1%	66.0%	34.0%
Asst. Prof.	50.5%	49.5%	51.6%	48.4%	79.1%	20.9%	58.0%	42.0%
Other	26.1%	73.9%	31.5%	68.5%	65.6%	34.4%	52.5%	47.4%
All Ranks	63.1%	36.9%	62.0%	38.0%	86.7%	13.3%	69.5%	30.5%

Full-time University Teachers by Type of Appointment and Sex, 2001-2002

Tenured		Tenure Track		Other		Total	
M	F	M	F	M	F	M	F
75.2%	24.8%	60.9%	39.1%	58.4%	41.6%	70.2%	29.8%

Full-time Canadian University Teachers Appointed in 2001-2002

Agricultural & Biological Sciences		Education		Engineering & Applied Sciences		Fine & Applied Arts	
M	F	M	F	M	F	M	F
65.8%	34.2%	50.5%	49.5%	85.0%	15.0%	52.4%	47.6%

Health		Humanities		Math & Physical Sciences		Social Sciences	
M	F	M	F	M	F	M	F
46.8%	53.2%	53.0%	47.0%	80.6%	19.4%	62.1%	37.9%

Labour Force Participation of Canadian University Teachers by Presence of Children and Sex

	M	F	Total
All Canadian university professors	29,705 (64.8%)	16,105 (35.2%)	45,810
Unemployment rate	3.5%	6.3%	
All university professors with no children	14,505	8,775	
Percent of total	31.7%	19.2%	
Percent of that gender's total	48.8%	54.5%	
Unemployment rate	4.4%	5.8%	
All university professor with children	15,080	7,290	
Percent of total	32.9%	15.9%	
Percent of that gender's total	50.8%	45.3%	
Unemployment rate	2.5%	7.0%	
With children under 6 years old only	2,110	1,175	
Percent of total	4.6%	2.6%	
Percent of that gender's total	7.1%	7.3%	
Unemployment rate	6.4%	10.3%	
With children under and over 6 years old	1,850	805	
Percent of total	4.0%	1.8%	
Percent of that gender's total	6.2%	5.0%	
Unemployment rate	2.2%	6.8%	
With children over 6 years old only	11,120	5,310	
Percent of total	24.3%	11.6%	
Percent of that gender's total	37.4%	33.0%	
Percent of that gender's total	1.9%	6.3%	

Average Salaries of Canadian University Teachers by Discipline, Sex and Rank 2003-2004

	Agricultural & Biological Sciences		Education		Engineering & Applied Sciences		Fine & Applied Arts	
	M	F	M	F	M	F	M	F
Full Prof.	$107,071	$100,647	$108,819	$103,870	$112,748	$100,179	$101,782	$99,096
Assoc. Prof.	$84,935	$81,094	$85,629	$85,834	$88,698	$89,130	$84,035	$82,188
Asst. Prof.	$69,328	$69,383	$67,407	$66,050	$77,909	$72,920	$64,354	$63,394
Lecturer	$62,888	$58,012	$67,861	$69,390	$68,884	$62,156	$64,000	$56,360
All Ranks	$91,964	$81,081	$88,984	$81,211	$94,949	$82,266	$84,732	$77,163

	Health		Humanities		Math & Physical Sciences		Social Sciences	
	M	F	M	F	M	F	M	F
Full Prof.	$112,958	$106,650	$106,657	$100,338	$110,525	$102,210	$113,756	$105,428
Assoc. Prof.	$88,790	$83,827	$86,070	$81,917	$88,487	$87,924	&93,029	$87,922
Asst. Prof.	$69,551	$69,517	$61,748	$62,141	$71,232	$69,911	$76,732	$69,596
Lecturer	$74,169	$67,032	$58,713	$57,195	$67,280	$69,621	$67,400	$62,861
All Ranks	$87,720	$79,798	$87,193	$75,626	$93,493	$82,516	$96,302	$82,384

Average Salaries of Full-Time Canadian University Professors, all Disciplines

	M	F
Full Prof.	$110,591	$103,155
Assoc. Prof.	$88,841	$85,021
Asst. Prof.	$71,754	$67,304
Lecturer	$66,382	$63,667
All Ranks Combined	$92,669	$80,030

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I8: MULTIFRACTAL FORMALISM FOR FINANCIAL TIME SERIES

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I. Introduction

Multifractals are observed in turbulence as a result of self-similar hierarchical structure of energy flow from large to small scale. In finance Ghashghaie *et al*. (1996), Muller *et al*. (1997) and Schmitt *et al*. (1999) proposed a cascade of information from large to small scale and pointed on similarities with fluid turbulence. Although, financial fluctuations display intermittence at all scales, unlike turbulence with energy influx at large scales and dissipation at small scales, it was also shown in Fisher *et al*. (1997), Xu and Gençay (2003), Muller *et al*. (1997) etc. that financial time series possess multifractal statistics.

Multifractality is related to an underlying multiplicative cascading process. The analysis of the multifractal spectrum should be related to the self-similarity properties of the financial asset returns function. Generally, a function is self-similar if it can be described as a multiplicative cascade in time-scale dimensions. A cascade model describes the distribution of the volatility of returns across scales, not the fluctuation of returns. Note that multiplicative cascade model predicts strong correlations in the volatility, while previously proposed fat tail model distributions assume no correlation.

Heavy tailed distributions allocate significant probability to extreme values. Those distributions are of increasing importance in finance. The asymptotic power-laws of the distribution function at infinity and zero are related to the existence of positive and negative moments. Standard empirical estimators will fail to reflect divergence of moments in finite data sets. Infinite moments may degrade the performance of some estimators or possibly introduce systematic errors. In multifractal analysis, infinite moments may indicate phase transitions that are highly informative about the local regularity of the process. Wavelet estimator developed in Gonçalvès and Riedi (2003) exploits the connection between the existence of moments and the regularity of the real part of the characteristic function.

II. Definition of Multifractality

Statistically self-similar or multiplicative process X(t) is monofractal with Hurst exponent (H) between zero and one, if for all $\lambda>0$, $\lambda^{-H}X(\lambda t)$ is the same process as X(t). Fractional Brownian motion is too homogeneous for the representation of financial asset price processes, as the H exponent should be the same at all times.

Muzy *et al*. (2000) use the non-linearity of the scaling function as an evidence of multifractality of price fluctuations of financial time-series. Turiel and Pérez-Vincente (2002), Schmitt *et al*. (2000), Bacry *et al*. (2000) among others use the non-linearity of the scaling functional to show that the estimate of two moments is by no means sufficient for describing the entire distribution, insisting the use of multifractal analyses and models in finance. An important application of multifractal analysis is precisely to characterize all order moments for the validation of a scaling model.

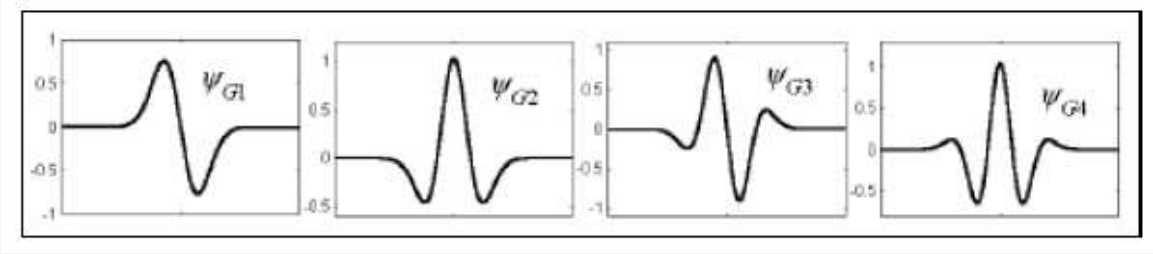
III. Wavelet-based Estimator

Wavelet transform has proved a particularly efficient tool for measuring the local regularity of a function.

The wavelet transform of f(t) is defined as

$$W(\tau, a) = \int_{-\infty}^{+\infty} f(t)\psi_{\tau,a}(t)dt,$$

where the analyzing wavelet $\psi_{\tau,a}(t)$ is a function, centered around zero. A common way to build wavelets of order n is to successively differentiate a smoothing function. A popular family of wavelets uses the Gaussian function.



Different Gaussian wavelets obtained from derivatives of the Gaussian function

The wavelet transform is well adapted tool for studying scaling processes. As wavelet coefficients are stationary and "almost" decorrelated, the q-order moment of a wavelet coefficient at scale “a” can be estimated by just averaging these coefficients of a given time series.

Wavelet coefficients possess considerable mass around zero, especially for Gaussian processes such as fBm, where negative moments provide only little information. In order to obtain information on the true Holder continuity from wavelet coefficients one has to employ the lines of maxima. The advantages of the Wavelet Transform Modulus Maxima approach in calculating the multifractal spectrum are revealed in Muzy et al. (1993). Taking local maxima of the modulus of wavelet coefficients we avoid exceptionally small value, the partition function allows for more moments of negative order to be finite since less mass is concentrated around zero.

Audit *et al*. (2002) have shown that WTMM estimator is more robust than any other wavelet based estimator for monofractal processes that can be quantified by a unique exponent H. In case of multifractal process, the scaling exponent of the q-order moments

depends on q. Then the standard estimators will not lead to the same estimation at all. Therefore, prior tests for estimating the multifractality of the process should be performed. For negative values of q some estimators are unstable and only half of the multifractal spectrum can be calculated. The WTMM method has been shown to be very stable, even for negative q's and proved to give access to the whole multifractal spectrum. Negative absolute moment based estimators could be very competitive in various situations.

For processes with positive increments such as cascades, negative order moments become very important and relevant, since they capture the probability of very small increments. In other words, negative order moments are related to the time instances t with high regularity, i.e. the smooth parts of these otherwise 'spiky' processes.

A wavelet based multifractal spectrum estimator relies on the empirical high order moments of the wavelet coefficients. The non-stationarity of the multifractional process can carry over to the wavelet coefficient series of its decomposition. The wavelet decomposition of a fBm in multifractal time is stationary at each scale. The correlation of wavelet coefficients decay fast, despite a strong dependence structure that underlies the process.

IV. Multifractal Spectrum Estimation

A multifractal formalism based on wavelet transform modulus maxima (WTMM) allows us to determine the whole singularity spectrum D(α) directly from any experimental signal (Muzy *et al*., 1991). It works in most situations and provides a unified multifractal description of self-affine distributions.

The WTMM approach is the foundation of a unified multifractal description of self-affined distributions, as shown by Muzy *et al*. (1993). There are two obvious advantages of the WTMM method to the structure function approach: (1) scale-adaptive partition prevents divergencies from showing up in the calculation of Z(q,a) for negative values of q and (2) accessibility of the entire range of singularities made possible by the choice of the number of vanishing moments, thus allowing for negative spectrum values D(α). Mandelbrot (1990) defines such negative dimensions as measuring the emptiness of empty sets. The positive D(α) are shown to define a 'typical' distribution, while the negative D(α)≥-2 characterize the sampling variability. Mandelbrot also shows that negative D(α)′s are essential for revealing the generating process, generalizing it to random multifractals.

Step 1: Compute the Wavelet Transform W(τ,a) for all translations and dilations:

A wavelet is simply a finite energy function with a zero mean. The family of wavelet vectors is obtained by translations and dilatations of the basic ("mother") wavelet atom:

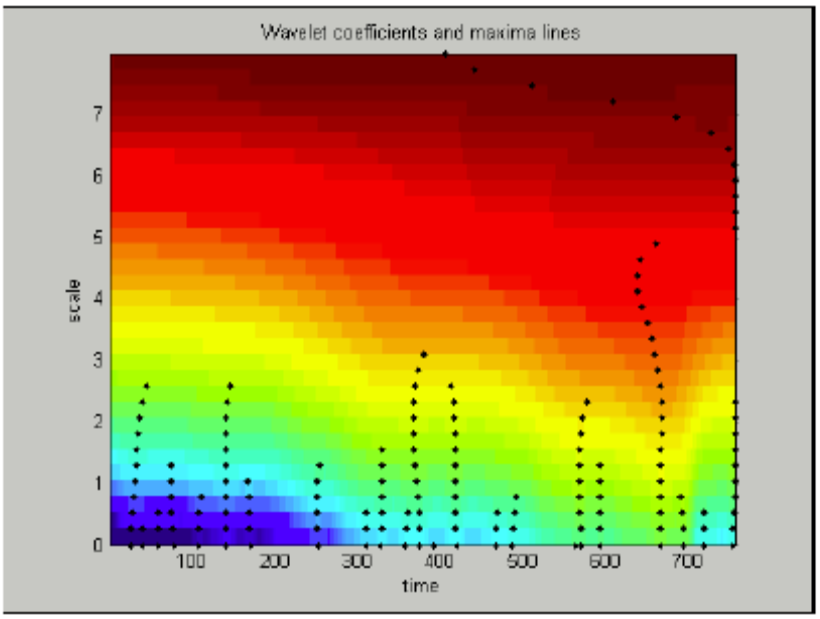
$$\psi_{\tau,a}(t) = \frac{1}{\sqrt{a}}\psi(\frac{t-\tau}{a})$$

This wavelet is centered around τ, like the windowed Fourier atom. If η denotes the frequency center of the base wavelet, then the frequency center of a dilated wavelet is ξ=η/a.

Step 2: Find Wavelet Transform Modulus Maxima (WTMM) for each scale a

The modulus maxima (largest wavelet transform coefficients) are found at each scale a as the suprema of the computed wavelet transforms such that:

$$\frac{\partial W(\tau, a)}{\partial \tau} = 0.$$



Plot of Maxima Lines.

These Wavelet Transform Modulus Maxima are positioned on connected curves, or maxima lines, like the top ridges of mountain ranges. When the analyzed signal has a local Hölder exponent h(x□)<N at point x□, there is a maxima line pointing at x□. Thus each maxima line displays the hierarchical organization of the various singularities.

Step 3: Compute the Partition Function

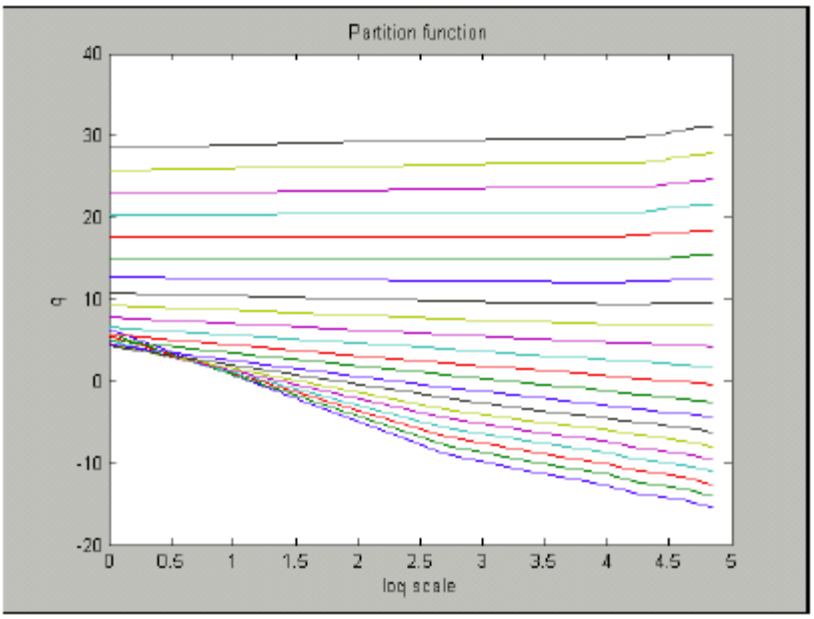
The originality of the WTMM method is in the calculation of the partition function Z(q,a) from these maxima lines. The space-scale partitioning given by the wavelet tiling or skeleton defines the particular Gibb's partition function.

A matrix containing the maxima lines (maxmap) from the previous step allows the computation of Gibbs' partition function, where a is the scale:

$$Z(q, a) = \sum_{\tau, a} \sup_{a} |W(\tau, a)|^q$$

This partition function effectively computes the moments of the absolute values of the wavelet coefficients W(τ,a). There is an analogy between the classical partitions defined for measures and the one provided by the wavelet transform used for functions. The

analyzing wavelet ψ is viewed as a (Heisenberg) box of particular shape and the scale a is its relative size. The supremum allows us to define a scale-adaptive partition preventing divergences for negative values of the moment order q.



Plot of Gibb's partition function.

Step 4: Compute the Decay Scaling Exponent τ(q)

The multifractal scaling function and asymptotic linearity of the partition function come from the fractal nature of sets of points in time with a given Hölder exponent. The slope in the double-logarithmic plot:

$$\log_2 Z(q,a) \approx \tau(q) \log_2 a + C(q)$$

allows the computation of the decay scaling exponent τ(q):

$$\tau(q) \rightarrow \underset{\alpha}{Min}[q\alpha - f(\alpha)$$

The scaling exponent τ(q) is defined by the power-law behavior of the partition function in the limit when time scale a→0. Using the property of self-similarity it is easy to find that the partition function is proportional to the scale with exponent τ(q) (Los, 2003). Thus, this exponent measures the asymptotic decay of the partition function at fine scales. In other words, the partition function is scale dependent and it is this scale dependence that is exploited to find the multifractal spectrum.

Step 5: Compute the Multifractal Spectrum $D(\alpha_L)$

The multifractal spectrum is calculated by applying a Legendre Transform the scaling function $\tau(q)$.

The general idea is best explained in one dimension. For each function f(x) we define a new function Lf(z) called the Legendre transform. We do this as follows:

Define $z=((df)/(dx))$ which relates the new variable z to the old variable x. The condition $((\partial^2 f)/(\partial x^2))\neq 0$ guarantees that we can find the inverse function x(z). Hence, we have a unique relation between x and z. Now consider the mapping

$$z \rightarrow x \rightarrow x\frac{df}{dx}(x) - f(x) \equiv \mathcal{L}f(z)$$

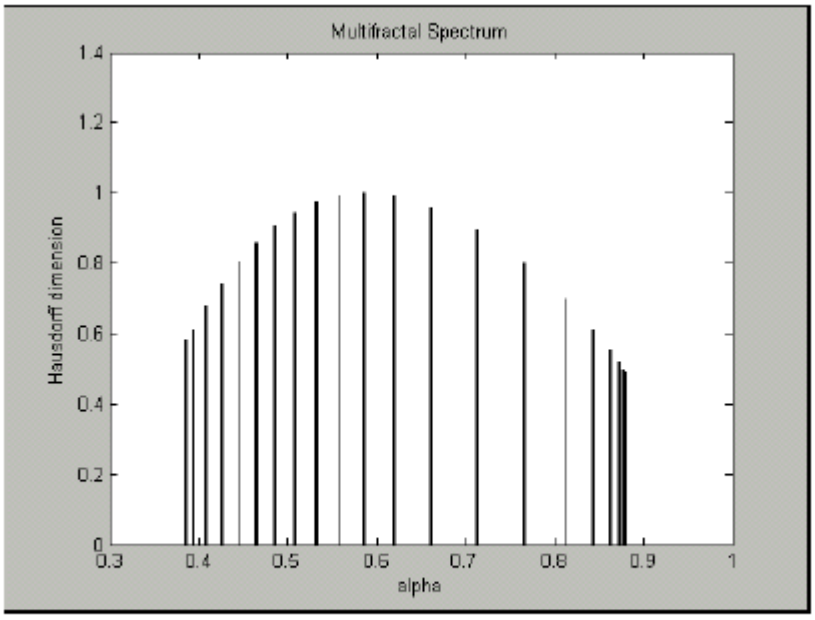
This defines the Legendre transform of the function f as change of variables, and can also be written as

$$\mathcal{L}f(z) = zx(z) - f(x(z))$$

By using both the scaling behavior of the wavelet transform $W(\tau,a)$ along the maxima lines and the definition of the singularity spectrum, we can compute the multifractal spectrum $D(\alpha_L)$ as follows:

$$D(\alpha_L) = \min_q [qH - \tau(q)]$$

From the properties of the Legendre transform we can deduct that homogeneous or monofractal functions are characterized by a linear $\tau(q)$ spectrum, with a unique slope $H=\tau(q)/q$. In contrast, a non-linear $\tau(q)$ curve is a signature of multifractal functions that display multifractal properties: there are many slope coefficients $\alpha_L=\partial\tau(q)/\partial q$, depending on where the derivative is calculated on the $\tau(q)$ curve. A graphical representation of the multifractal spectrum can be obtained by plotting for each q, a line of slope q and vertical intercept $-\tau(q)$. The lower envelope of the graph of all these lines gives the estimated spectrum.



Plot of a Multifractal Spectrum.

The WTMM approach is now the foundation of a unified multifractal description of self-affined distributions, as shown by Muzy *et al*. (1993). There are two obvious advantages of the WTMM method to the structure function approach: (1) the scale-adaptive partition (defined by the sup) which prevents divergencies from showing up in the calculation of Z(q,a) for negative values of q and (2) the accessibility of the entire range of singularities made possible by the choice of the number of vanishing moments, thus allowing for negative spectrum values $D(\alpha_L)$.

Mandelbrot (1990) defines such negative dimensions as measuring the emptiness of empty sets. The positive $D(\alpha_L)$ are shown to define a 'typical' distribution, while the negative $-2 \leq D(\alpha) < 0$ characterize the sampling variability. Mandelbrot also shows that negative $D(\alpha_L)$ are essential for revealing the generating process, generalizing it to random multifractals.

V. Parameters characterizing the multifractal spectrum

A great difficulty and source of inaccuracy in multifractal analysis stems from infinite moments: to an innocent empirical estimator of moments, divergence might not be apparent. A numerical procedure might return finite estimates of the scaling function $\tau(q)$ even if the moment of order q does not exist. This may lead to a concave estimate of $\tau(q)$, although the actual process is mono-fractal with a linear scaling function. Therefore the support of $\tau(q)$ should be restricted to the actual range of orders q with finite moments. Gonçalves and Riedi (2003) exploit the connection between the existence of moments and the regularity of the real part of the characteristic function for their wavelet based estimator of moments.

In multifractal cases the normality of the process transposes to its wavelet decomposition and all moments exist for

$$q \in (-1, +\infty)$$

In this case restricting the empirical partition function to this characteristic interval does not linearize the estimated scaling function. Schmitt *et al*. (1999) show that the non-linearity of the empirical scaling function is an argument against Brownian, fractional Brownian, Lévy, truncated Lévy and fractional Lévy models, all additive models giving straight lines or two portions of straight lines.

Schmitt *et al*. (1999) demonstrate the multifractal nature of returns and characterize fluctuation intensities with only three parameters and add tail-exponents for hyperbolic tail. Multifractal phase transition results in such extremes and allows for tail-exponent of any positive value >1. Bacry *et al*. (2001) introduce multifractal random walk alternative to classical cascade-like multifractal models. In this framework few parameters are shown to control the multifractal spectrum and the correlation structure of the increments.

In the multifractal model of Muzy *et al*. (2001), the self-similarity kernel, whose shape depends on the ratio of the scales (a/T_i), is characterized by its mean h_i and variance λ_i:

$$h_i(a) = h_i \ln(a/T_i)$$

$$[\lambda_i(a)]^2 = \lambda_i^2 \ln(a/T_i),$$

where T_i is an integrative scale. These parameters are measured from the scaling function $\tau(q)$: h_i as the slope at the origin of $\tau(q)$ as a function of q and the quadratic correction proportional to λ_i^2 as the fit of $\tau(q)$-$h_i q$. The quadratic dependence also called "multifractal", is a signature of the multi-scale structure.

The existence of a cascading process is tested in Arneodo *et al*. (1998) as the covariance of the logarithm of the returns at all scales should decrease as a logarithmic function. It was also shown that the covariance is related to λ_i^2 and the integrative scale T_i.

Muzy *et al*. (2001) extend the multifractal description into a multivariate framework to account simultaneously for correlations across times scales and between assets. Multiplicative cascade process leads to multifractality and strong deviation from normality and the corrections to the Gaussian description are more important for higher order cumulants. It complies with Sornette (1998) and Sornette *et al*. (2000) observation that these deviations are important for large risk quantified by the behavior of the tails of the portfolio return distribution. The significant time dependence of large risks implies that portfolio optimization of asset weights for all time scales simultaneously is not possible. This topic is subject to further research an alternative application of the calculated multifractal spectrum. In other words, even if chaotic patterns are not detected, the presence of multifractality and its parameter estimation will improve return volatility models since accurately modelling financial price variations is an essential step in defining risk management techniques, portfolio optimization, derivative pricing, fund management, etc.

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KEY WORDS INDEX

F.

G.

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I.

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V.

W.

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