Demonstrations in Anatomy Instruction: Do I Model or Not?
Saleem Ahmed, MBBS, FCPS; Department of Biomedical Sciences, Virginia Tech Carilion School of Medicine; Roanoke, VA, USA

OBJECTIVE: Why students in classrooms learn so little despite the many hours spent perfecting the lecture? Why, do they lose attention and focus? Why do some daydream, or read e-mails or other work, or even shop online? To spike the students’ curiosity, participation, interest, involvement, create an effective learning environment and to visualize three dimensionally hard to visualize features, we used demonstrations involving volunteer students, economical home made large scale models created from easily available materials to help students conceptualize features which are not easily understandable in cadavers.

METHODS: Difficult concepts, viz configuration of pleura, peritoneum, their foldings, recesses, reflections, thoracic and abdominopelvic structures, were demonstrated, in fifty minute lectures, using transparent plastic sheets and sleeves; cardboard boxes; plastic bottles, condoms and balloons. Students partook in these demonstrations. At the lecture’s end the students were surveyed on the demonstration’s effectiveness using audience response system.

RESULTS: The use of models and demonstrations helped 75-88% students conceptualize and better understand complex, not easy to grasp anatomical features. Also, lecture attendance improved and students had a greater degree of satisfaction as echoed by reviews.

CONCLUSIONS: Using models and demonstrations of difficult concepts, with active student role playing, not only greatly helped students understand the arrangement of complex anatomy structures/features but also brought enthusiasm, attention and engagement during the lectures. Demonstrations using inexpensive, easily reproducible models can be applied anywhere. But careful planning and rehearsal must precede their implementation since such demonstrations consume lecture time.

Level of First Author: Faculty
Poster Board # 8

Integration of an Interactive 3D e-learning Resource for Improved Neuroanatomy Education
Lauren K. Allen1, Roy Eagleson2, Sandrine de Ribaupierre1,3; 1Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University; 2Electrical and Software Engineering, Western University; 3Department of Clinical Neurological Sciences, Western University; London, ON, Canada

Neuroanatomy is one of the most challenging topics in anatomy, with many students experiencing difficulty in comprehending the complex spatial relationships. Students report having the lowest knowledge in neuroanatomy, and often have difficulty applying their knowledge in clinical settings. E-learning technologies create the opportunity for development of learner-centered educational tools, tailored to meet students’ unique learning
styles and preferences. Multimodal resources may facilitate improved learning, however this has yet to be examined fully in the literature.

An interactive 3D online learning resource was developed to complement gross anatomy laboratory instruction. The module allows students to manipulate a 3D model to view structures from any desired angle, view deep neural structures at high magnification, and view interactive labels. The study utilized a cross-over design, which divided participants into two groups. Each group initially completed anatomy knowledge and visuo-spatial ability assessments, followed by access to either the 3D e-learning module or gross anatomy laboratory. Participants completed a second anatomy knowledge assessment prior to interacting with the other learning modality. There was a final knowledge assessment and qualitative questionnaire administered following student exposure to the second learning modality. Groups were assessed to reveal potential differences in “baseline” anatomy knowledge and visuo-spatial abilities. Analysis was also performed to elucidate potential differences in learning outcomes between groups as measured by the anatomy knowledge assessments. Overall, student qualitative feedback of the 3D learning resource was positive.

**Level of First Author: Graduate Student**

**Topic Category: Anatomy Education**

**Poster Board # 12**

Instructor Perceptions of Teaching an Online Systemic Human Anatomy Course with Laboratory

**Stefanie M. Attardi**, Noah M. Mintz, John Barnett, Ken A. Rogers; 1Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University; London, ON, Canada; 2Faculty of Education, Western University; London, ON, Canada

An online section of a face-to-face (F2F) anatomy course with a prosection laboratory commenced in 2012-13. Lectures for F2F students were broadcast in live and archived format to online students using Blackboard Collaborate (BBC) virtual classroom software. Laboratories were delivered online by a teaching assistant (TA) who manipulated 3-dimensional (3D) computer models in the virtual classroom. The objectives of this study were to reveal instructor perceptions of teaching online and formulate modifications for future years to optimize the teaching experience. Instructors (4 professors; 5 TAs) who taught online in the first two years were interviewed. A content analysis of interview transcripts was undertaken to generate emergent themes. BBC was reliable and easy to use, although the software impeded the professors’ mobility in the large F2F lecture hall. Live desktop sharing of 3D models was not possible using BBC; however, the TAs found pedagogical value in the students drawing on screen captures of the 3D models. Preparation time for teaching online was longer than for F2F, although the difference was not substantial. The instructors perceived that the methods of communication (email, instant messaging and drawing in the virtual classroom) with online students were sufficient. The instructors’ primary concern was their inability to view the students’ body language to assess class engagement and their teaching effectiveness. Mandatory synchronous participation may improve the quantity of feedback through instant messaging, though it may not be feasible implement. Instructors may have to organize formative assessments of the students to obtain feedback on student learning and engagement.

Funding source: Departmental

**Level of First Author: Instructor**

**Topic Category: Anatomy Education**

**Poster Board # 11**

Different Student Perceptions of the Effectiveness of TBL between Undergraduate Health Sciences and Medical Students

**Alexander K. Ball**, Thomas Hawke, Peter Helli, and Bruce C. Wainman; Education Program in Anatomy, McMaster University; Hamilton, ON, Canada

In the fall of 2013 we substituted a didactic lecture for a Team Based Learning exercise (TBL) in an undergraduate Anatomy and Physiology course with an enrollment of 285. We also substituted a didactic lecture for an on-line video, and ran a TBL exercise during the previously scheduled lecture slot for the neuroanatomy block of an MD class with an enrollment of 160. The exercise consisted of 1) an individual readiness assessment (five multiple
choice question) test (iRAT), 2) review of the iRAT questions, 3) separation of the students into teams to discuss a case study, and 4) a team effort in answering a multiple choice question based on the case study (gRAT). The iRAT and gRAT scores were recorded using an iClicker (undergraduate) or Scantron card (MD). The results were similar for the undergraduate class over two years. 80% of undergraduate students felt that the iRAT helped keep them on task, 54% felt that the iRAT prepared them for the MCQ Midterm exam, and 42% felt that the Team activity allowed them to discuss concepts that they would not otherwise have considered. However, more than 53% of students ranked the TBL exercise as the least liked activity in either this course or any other course they have taken. The paradoxical response was attributed by undergraduate students to the stress and the time required to prepare for the exercise (54%). In contrast, the MD students ranked the TBL exercise (67%) higher than the iRAT (63%) and just as valuable as dissection (67.3%) for their learning. We conclude that factors determining how students rank the TBL learning activity include the size and makeup of the TBL groups, whether the activity is part of a summative evaluation, and the experience of the student learner.

Level of First Author: Faculty
Topic Category: Anatomy Education
Poster Board # 6

Fixation of the Upper Extremity during Embalming to Maintain Anatomical Position
Scott T. Barton1, Maria C. Savoia2, David H. Rapaport3; 1Anatomical Services, Division of Medical Education; 2Division of Medical Education; 3Division of Anatomy, Department of Surgery, University of California, San Diego; La Jolla, CA, USA

Dissection of cadavers with pronated forearms and clenched hands is challenging technically. Furthermore, it creates confusion for students when demonstrating structures with reference to anatomical position. Here we report the development of a novel device that counteracts the forearm pronation that occurs during embalming, holding it in supination. The device has been used in our facility for about two years. In the anatomy laboratory both faculty and students have found it easier to dissect the forearm and hand on treated cadavers and have had an enhanced experience relative to the control group.

Level of First Author: Faculty
Topic Category: Anatomy
Poster Board # 1

Intervening Tendon Variability of the Semispinalis Capitis Muscle
Mary Bee, Negar Mehrabi, Samantha Michalak; University of Detroit Mercy; Detroit, Michigan, USA

The semispinalis capitis muscle is found in the posterior neck of humans that extends the head and neck. The majority of anatomy textbooks and atlases depict this muscle as containing two bellies of muscle with a linear intervening tendinous band that neatly separates the muscle into upper and lower parts. After dissection of seventy-two individual muscles we found that this muscle does not appear as commonly depicted in most anatomy books with a linearly horizontal intervening tendon. Its tendon consists of multiple different parts that are commonly disconnected and lie either superior or inferior to each other in three different categories. The three main classifications include two uniform vertical bands, one vertical with one curved band, and another group. Of these groups, 54.2 percent exist in the two uniform vertical band classification, 26.4 percent falls in the one vertical one curved band classification, and 19.4 percent falls in the other classification. Morphological features of the muscle and its tendon were quantified and correlated to each other. This study provides insight into the accurate features of the semispinalis capitis, which has erroneously been depicted for many decades.

Level of First Author: Faculty
Topic Category: Musculoskeletal
Poster Board # 21

Histology of the Ovarian Ganglia and Prehypogastric Ganglion of the Aortic Plexus in Females
Tyler S. Beveridge1,2, Marjorie Johnson1,2, Nicholas Power2,3 and Brian L. Allman1,2; 1Department of Anatomy and Cell Biology, 2Schulich School of Medicine and Dentistry, Western University; ON, Canada; 3Department of Surgery, Urology Division; Department of Oncology, Surgical Oncology Division, London Health Sciences Centre; ON, Canada
The aortic plexus is a symmetrically organized network of sympathetic nerves positioned along the infrarenal abdominal aorta. Recently, we characterized the aortic plexus and its ganglia (inferior mesenteric, left/right spermatic, and prehypogastric ganglion) in males; however, the literature minimally describes its anatomy in females. In the present study, we conducted the first histological examination of the left/right ovarian ganglia, and investigated whether females, like males, exhibit a prehypogastric ganglion. The ganglia were dissected from embalmed (n=32) and fresh (n=1) human cadavers, and H&E staining confirmed the presence of a left ovarian ganglion in 31/31 specimens, a right ovarian ganglion in 29/29 specimens and a prehypogastric ganglion in 26/28 specimens. Comparable to the topographic arrangement in males, our results show that the left/right ovarian ganglia are positioned in close relation to their respective ovarian artery, whereas the prehypogastric ganglion was positioned within the right cord of the aortic plexus, inferior to the right ovarian ganglion in all specimens. Moreover, using immunohistochemistry, we found that all three constituent ganglia from the fresh cadaver stained positively for tyrosine hydroxylase, thereby confirming their sympathetic nature. Having provided the first topographical and histological characterization of the ovarian and prehypogastric ganglia in females, our future studies will seek to determine their specific function.

Level of First Author: Graduate Student
Topic Category: Anatomy
Poster Board # 4

MacAnatomy Pathology Library Project
Belle Cao, McMaster University; Hamilton, ON, Canada

The Pathology Library Project was developed to provide students and educators access to pathological specimens from any location through the use of the MacAnatomy website. Users are able to browse through the expansive gallery of specimens, a glossary of important pathological terms, and detailed descriptions of each pathology. This project was developed following a survey of the students that typically use the website about the utility of this resource. Each image is individually photographed, isolated from its background, given anatomical labelling, exported, and uploaded to the website. Having this online library will allow for further investigation to be conducted into the evaluation of the effectiveness of digital resources as learning tools for anatomy, as well as provide a useful resource for students with limited lab access.

Level of First Author: Undergraduate Student
Topic Category: Anatomy Education
Poster Board # 15

CanMEDS Competencies Transferred from the Anatomy Lab to the Clinical Setting in Medical Education
Anna Farias, Dr. Mark Awuku; Schulich School of Medicine & Dentistry-Windsor Program; Windsor, ON, Canada

Introduction: The year 2 medical learners self-assessed their CanMEDS competencies inadvertently learned during dissection sessions. The self-evaluation was graded on a Likert scale of 1-5 where 1 = strongly disagree and 5= strongly agree. The results were as follows: medical expert (ME) 4.2/5, professionalism (P) 4.3/5, and collaboration (C) 4.4/5.

Method: The same learners were asked to fill a follow-up survey after clerkship i.e. during their fourth year. The students were to grade on a Likert scale 1-5 the extent to which the competencies were beneficial in different setting within the clinic.


Conclusion: As the literature suggests and through the preliminary and follow-up studies it is evident based on student opinion that CanMEDS competencies are learned and practiced in the anatomy lab. The results if this study suggests that these skills are beneficial and retained through their clinical training. Hence as educators we need to be more cognizant of the different learning environment that foster, encourage and hone CanMEDS competencies. These observations should be recognized and probably addressed during curricular design.

Level of First Author: Faculty
Topic Category: Anatomy Education
Poster Board # 17
The Effect of Acute Noise Exposure on GABA Neurotransmission in the Auditory, Visual and Multisensory Cortices in Rats

Sarah T. Fitzpatrick, Paul V. Sirek, Ashley Schormans, Raj N. Rajakumar, Brian L. Allman; Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University; London, ON, Canada

It is well-established that high-intensity noise exposure can induce structural and physiological changes in the primary auditory cortex, such as impaired GABA neurotransmission which leads to a reduced level of GABA-synthesizing enzymes (i.e., GAD65/67). At present, however, it remains unknown how partial hearing loss affects GABA neurotransmission in areas of the cortex that process sound as well as other sensory modalities (e.g., visual stimuli). In the present study, we are using a rat model to investigate our working hypothesis that noise-induced hearing loss causes a differential effect on GAD67 levels in the various cortical areas capable of sound processing, such that the multisensory cortex will not show the same dramatic reduction as in the primary auditory cortex. Adult male rats were exposed to loud noise (0.8-20 kHz at 120 dB SPL for 2h), which caused a 27 ± 9 dB elevation of their hearing threshold 14 days following the noise exposure. Using immunohistochemistry, the level of GAD67 was compared between noise-exposed rats and age-matched controls in multiple auditory, visual and multisensory cortical areas. Consistent with our hypothesis, our preliminary findings suggest that the multisensory cortex does not experience the same degree of impaired GABA neurotransmission as the primary auditory cortex following noise-induced hearing loss.

Support: CIHR Open Operating Grant; NSERC Discovery Grant

Level of First Author: Graduate Student  Topic Category: Neurobiology

Poster Board # 25

Characterization of SEC23A and MAN1B1 Expression and Function in a Family with Craniofacial Abnormalities and Mental Retardation

Swati Gupta1, Somayeh Fahiminiya1, Tracy Wang1, Laura Dempsey Nunez1, David S. Rosenblatt1,2, William T. Gibson3, Brian Gilfix4, John J. M. Bergeron5, Loydie A. Jerome-Majewska1,2,5; 1Department of Human Genetics, McGill University; Montreal, QC, Canada; 2Department of Pediatrics, McGill University, McGill University Health Centre Glen Site; Montreal, QC, Canada; 3Department of Medical Genetics, Child and Family Research Institute; Vancouver, BC, Canada; 4Department of Medicine, McGill University; Montreal, QC, Canada; 5Department of Anatomy and Cell Biology, McGill University; Montreal, QC, Canada

SEC23A and MAN1B1 are essential genes involved in protein secretory pathway. SEC23A is an essential component of COPII-coated vesicles that transport secretory proteins from the endoplasmic reticulum (ER) to the Golgi complex and MAN1B1 is an essential enzyme required for targeting proteins into the ER-associated protein degradation pathway. Mutation in SEC23A is associated with craniolenticulosutural dysplasia (CLSD) whereas mutation in MAN1B1 is associated with congenital disorders of glycosylation (CDG)-II. Our group identified a novel missense mutation in SEC23A c.1200G>C (p.M400I) and a previously identified mutation in MAN1B1 c.1000C>T (p.R334C) using whole exome sequencing in two boys suffering from moderate global developmental delay, tall stature, obesity, macrocephaly, maloccluded teeth and intellectual disability. The parents are first cousins. We found that cells with mutation in SEC23A alone showed distended ER membranes, fewer and more compacted Golgi, and increased pro-collagen 1 secretion (a SEC23A cargo protein). Fibroblasts with heterozygous and homozygous (mutant fibroblasts) mutations in both SEC23A and MAN1B1 resembled SEC23A mutant cells, but showed decreased MAN1B1 level. Furthermore, both patients had N-glycan remodeling defects and fibroblasts from these patients had increased levels of intracellular and secreted pro-collagen1. Thus, our data support a combination of abnormal N-glycan remodeling and protein transport as the primary cause of abnormalities in these patients. We postulate that novel phenotypes found in our affected patients that were not reported in patients with mutations in either SEC23A or MAN1B1 are due to genetic interaction between these two genes.

Funding Sources: Supported by CIHR and Fonds de recherché Santé

Level of First Author: Graduate Student  Topic Category: Cell Biology

Poster Board # 18
3D Printing makes Visible Human Cadaver Sections Accessible for Blind Students
Michael Kolitsky, The University of Texas at El Paso; El Paso, TX, USA

In 1994 and 1995, the National Library of Medicine Visible Human Project produced a data set of high quality images of transverse sections of a male and female cadaver for use in the study of human anatomy. MRI and CT scan data were also obtained leading to the creation of many high quality programs for exploring human anatomy in a virtual interactive environment. These digital reconstruction programs supported the exploration and manipulation of digital human anatomical regions for basic study of anatomy as well as for advanced use in the clinical setting. It is challenging, however, for the blind or visually impaired student to make use of the digital or virtual interactive programs since they cannot see the virtual world on the monitor display. For this reason, a project was begun to make 3D prints starting with the male cadaver transverse section images from the Visible Human Project so that blind students can study by touch many of the anatomical structures that sighted students see in the digital environment. These 3D prints can also be made into tactile learning objects that can be laid on top of an iPad or tablet computer so that audio can be generated to match where the student touches the 3D print. These “talking” tactile anatomic learning objects would also be useful for sighted students categorized as kinesthetic learners who learn best when touching what they learn. How 3D prints can be made from 2D images as well as how they can be used with iPads for voice production will be explained.

Level of First Author: Faculty
Topic Category: Anatomy
Poster Board # 3

A Case Report on Deviating Short Saphenous Vein
Krupa Daniel, Ajith Mano, Naveen Bharathi, Nagaveni, Valarmathi; Department of Anatomy, Southern Medical University; Guangzhou, Guangdong Province, P.R. China

Great saphenous vein and short saphenous veins are the superficial veins of the lower limb. Variations in the superficial veins of the lower limb are uncommon. Our case report discusses anomalous course and its abnormal termination of short/small saphenous vein.

During a routine dissection with 80 cadavers, an abnormal short saphenous vein was observed in the left lower limb of an aged male cadaver. The origin of small saphenous vein from the dorsum of the foot at the lateral end of the dorsal venous arch and continues behind the lateral malleolus and courses upward along the posterior side of the leg and has to end in popliteal vein but in our continuity of dissection the short saphenous vein has bifurcated into proper short saphenous vein and accessory saphenous vein at the junction of back of leg which drains into great saphenous vein.

Proper short saphenous vein ascended upwards and deviates the normal course of anatomy and runs laterally at the junction between biceps femoris and common peroneal nerve and courses deep into the back of thigh and runs between biceps femoris and semitendinosus in the middle of thigh and therefore again the vein bifurcates and deviates deep into the thigh and drains into femoral vein and proper saphenous vein finally drains into deep femoral vein (profunda femoris vein). It proceeds superiorly and medially running alongside with profunda femoris artery to join with femoral vein at the level of ischial tuberosity instead Popliteal vein.

Importance - The knowledge of superficial veins of the lower limb is useful for clinicians during coronary bypass procedures, as these vessels are commonly used in such surgeries. The great saphenous vein is often harvested for grafts and used both in peripheral and coronary arterial surgery. It is therefore, essential for surgeons before harvesting the great saphenous vein to look for the abnormal drainage pattern of the short saphenous vein into the great saphenous vein either directly or through communication veins or with the presence of the Giacomini vein, Accessory saphenous vein. The short saphenous vein may be palpable in the popliteal fossa in patients with varicose veins. During deviation of Short saphenous vein, more attention should be paid to the surgical correction of popliteal reflux when present in limbs with venous ulceration that fail to heal by conservative measures and also consequences on venous physiology.

Level of First Author: Faculty
Topic Category: Anatomy
Poster Board # 2
Parametric Human Project
Zhi Li¹, Merry Wang², Shannon Roberts¹, Valera Castanov¹, Jacobo Bibliowicz², Jeremy Mogk², Azam Khan², Anne Agur¹; ¹Division of Anatomy, Department of Surgery, University of Toronto; Toronto, ON, Canada; ²Environment & Ergonomic Research, Autodesk Research, Autodesk Inc; Toronto, ON, Canada

The Parametric Human Project (PHP) is a not-for-profit multidisciplinary collaboration of academic and industrial researchers dedicated to the advancement of digital human modelling. The goal is to develop state-of-the-art models that enable multi-resolution visualizations of the human body and simulations of human function and motion. One of the cornerstones of this research initiative is the development of a novel 3D musculoskeletal atlas that captures complex musculo-aponeurotic architecture at the fibre bundle level. Serial micro-dissection, digitization and 3D computer modelling were used to capture and reconstruct the fibre bundle trajectory and aponeurosis/tendon morphology of individual muscles, as in situ. To date, a total of 100 muscles, including 56 of the head and neck, 39 of the upper limb and 5 of the anterior thigh have been digitized and modelled using data obtained from the same formalin embalmed cadaver. The 3D models, assembled using Autodesk® Maya®, are built on a bony skeleton that was reconstructed from high resolution CT scans of the same individual. The skeleton has been registered in its correct anatomical relationship with the muscle data, providing precise visualization of attachment sites and the course of the muscle relative to the joints. The 3D atlas can be viewed from any perspective and deconstructed to the fibre bundle level. The data are currently being used to develop realistic finite element representations of muscles, incorporating complex trajectories of individual fibre bundles. Future applications include the development of advanced biomechanical, medical and educational simulation tools and the creation of subject-specific models using a frame-based deformation field technique.

Level of First Author: Graduate Student    Topic Category: Musculoskeletal
Poster Board # 22

The Effect of Image Quality on Anatomy Learning
Chelsea Mackinnon, Lucia Cheng, Kristen Lucibello, Barbara Fenesi, Joseph Kim, Bruce Wainman; McMaster University; Hamilton, ON, Canada

The objective of the study is to determine whether image quality impacts learnability of human anatomy. Undergraduate students with no previous anatomy background undergo a learning phase where they review two paper-based instructional modules on independent anatomical material (human hand and eye). There are two versions of each module that vary in image quality, but contain identical text. One version contains low-quality images the other high-quality images. The low-quality images display a number of visual inconsistencies between the images within each module, including inconsistencies in colour usage, musculoskeletal representations, labels and fonts. Immediately following the learning phase, participants are tested on their comprehension of the modules using either 2-dimensional illustrations or anatomical specimens. Two delayed comprehension assessments are completed 24 and 72 hours later to determine long-term learning outcomes. Analysis showed that when tested directly following first exposure to hand anatomy, high-quality images produced significantly better learning, for short answer questions. Test scores for all other question types and timeframes were insignificantly different between high and low quality image groups. In the long term, image quality did not have a significant impact on learnability of anatomical material. Future investigations using additional materials and anatomical information will be able to confirm these trends.

Level of First Author: Undergraduate Student    Topic Category: Anatomy Education
Poster Board # 10

Creation, Implementation and Evaluation of a New Practical Assessment Tool in Anatomy
Rabia Malik, Khalid Ahmed, Zehra Jamil; Anatomy Section, Department of Biological and Biomedical Sciences, Aga Khan University; Karachi, Pakistan

WITHDRAWN
Level of First Author: Faculty    Topic Category: Anatomy Education
Poster Board # 14

[7]
Dissecting through Barriers: A Mixed-methods Study Evaluating the Effects of an Interprofessional Cadaveric Dissection Course

Andrew Palombella, Alisha Rebecca Fernandes, Jenn Salfi, Bruce Wainman, 
1 Faculty of Health Sciences, Education Program in Anatomy, McMaster University; Hamilton, ON, Canada; 
2 Faculty of Health Sciences, Department of General Surgery, McMaster University; Hamilton, ON, Canada; 
3 Faculty of Applied Health Sciences, Department of Nursing, Brock University; St. Catharines, ON, Canada; 
4 Faculty of Health Sciences, Department of Pathology and Molecular Medicine, McMaster University; Hamilton, ON, Canada

Healthcare delivery is reliant on a team-based approach, and interprofessional education (IPE) provides a means by which such collaboration skills can be fostered prior to entering the workplace. IPE within healthcare programs has been associated with improved collaborative behavior, patient care and satisfaction, reduced clinical error, and diminished negative professional stereotypes. An intensive interprofessional gross anatomy dissection course was created in 2009 to facilitate IPE at McMaster University. Data were collected from five cohorts over five years to determine the influence of this IPE format on the attitudes and perceptions of students towards other health professions. Each year, 28 students from the medicine, midwifery, nursing, physician’s assistant, physiotherapy, and occupational therapy programs were randomly assigned into interprofessional teams for 10 weeks. Sessions involved an anatomy and scope-of-practice presentation, a small-group case-based session, and a dissection. A before and after quantitative design measured changes in attitudes and perceptions, while focus group data elaborated on the student experience within the course. Pre- and post-matched data revealed significant improvements in positive professional identity, competency and autonomy, role clarity and attitudes toward other health professions. Qualitative analysis of intraprofessional focus group interviews revealed meaningful improvements in a number of areas including learning anatomy, role clarity, and attitudes towards other health professions.

Level of First Author: Graduate Student
Topic Category: Anatomy Education
Poster Board # 16

OVO-like 1 is a Key Transcriptional Regulator of Trophoblast Differentiation during Placental Development

Stephen J. Renaud, Damayanti Chakraborty, Clifford W. Mason, M.A. Karim Rumi, Jay L. Vivian, and Michael J. Soares; 
1 Department of Anatomy and Cell Biology, University of Western Ontario; London, ON, Canada; 
2 Institute for Reproductive Health and Regenerative Medicine, University of Kansas Medical Center; Kansas City, KS, USA

Epithelial barrier integrity is dependent on progenitor cells that either divide to replenish themselves, or differentiate into a specialized epithelium. This paradigm exists in human placenta, where cytotrophoblast cells either propagate, or undergo a unique differentiation program: fusion into an overlying syncytiotrophoblast. Syncytiotrophoblast is the primary barrier regulating exchange of nutrients and gases between maternal and fetal blood, and is the principal site for synthesizing hormones vital for human pregnancy. How trophoblast cells regulate their differentiation into a syncytium is not well understood. In this study, we reveal that the transcription factor OVO-like 1 (OVOL1), a homolog of Drosophila ovo, regulates the transition from progenitor to differentiated trophoblast cells. OVOL1 is expressed in human placenta, and was robustly induced following stimulation of trophoblast differentiation. Disruption of OVOL1 abrogated cytotrophoblast fusion, and inhibited the expression of a broad set of genes required for trophoblast cell fusion and hormonogenesis. OVOL1 was required to suppress factors that maintain cytotrophoblast cells in a progenitor state, including MYC, ID1, TP63, and ASCL2, and specifically bound to regions upstream of each of these genes. Our results reveal an important function of OVOL1 as a regulator of trophoblast progenitor cell fate during human trophoblast development.

This work was supported by NIH HD20676 and HD079850.

Level of First Author: Faculty
Topic Category: Development
Poster Board # 19
Do The “Eyes” Have It? How Eye Tracking Can Reveal Accuracy In Time-Limited Test Of Spatial Reasoning

Victoria Roach, GM Fraser, J. Kryklywy, D. Mitchell, Timothy D. Wilson; Schulich School of Medicine and Dentistry, Western University; London, ON, Canada

In effort to elucidate patterns associated with accurately completing mental rotations tasks, we set out to explore how eye movements relate to mental rotation ability (MRA) during the completion of a time-limited, adapted, electronic test of mental rotations (EMRT). The EMRT test was timed and based on the line drawings of Shepherd and Metzler. Individuals chose whether block pairs were rotations (same), or mirrored (different) images. We hypothesized that high MRA individuals would demonstrate quicker average fixation durations (AFD) during problem solving, and attend to different salient features of the EMRT while problem solving; potentially contributing to varied success on the task. Additionally, we postulated that accuracy in question response would be attributed to fewer fixations, and quicker average response times overall, regardless of MRA group. These hypotheses were confirmed, as the AFD of High MRA individuals was found to be quicker than Low MRA individuals (F(1,8) = 7.99* (p=0.022)), and that high and low MRA individuals did attend to different salient regions of the EMRT images (Fisher Exact Test: 12.47* (p = 0.018); attending to the same locations only 34% of the time. Additionally, with regard to answer accuracy, correct answers as predicted, were characterized by fewer fixations (F(1.8) = 18.12* (p=0.003)), and quicker average response times (F(1.8) = 23.89* (p = 0.001)). This suggests that the ability to perform spatial problem solving tasks quickly and efficiently is critical to success and that the ability to identify salient areas of images may be key to streamlining the problem solving process in Low MRA individuals.

Navigated Simulator for Spinal Needle Interventions

Ziad Sabaa-Ayoun, Golafoun Ameri, John S.H. Baxter, Sugantha Ganapathy, Hao Li, Jonathan McLeod, Rakesh V. Sondekkopam, Terry Peters, Elvis C.S. Chen; Robarts Research Institute, Western University, London, ON, Canada

Anesthesiologists performing a spinal needle intervention, such as an epidural anesthesia, rely on a “blind” procedure whose success depends on the anesthesiologists’ ability to locate the epidural space using tactile sensation. Current research is focused on integrating ultrasound imaging (US) as an aid in providing visualization of the spinal anatomy and the advancing needle in real time. Both procedures have limitations attributed to a lack in appropriate training tools: for example, novice operators may be unable to locate the epidural space due to their inability to interpret US images and to achieve proper hand-eye coordination. We present a navigated simulator for spinal needle interventions that combine the use of US imaging, magnetic tracking, and augmented virtual navigation (AV). We use a spine phantom that consists of four accurate tissue-mimicking layers for the skin, fat, spinal cord, and ligamentum flavum. Our phantom consists of lumbar vertebrae 2 through 5, and we are currently designing one that also contains the sacrum. Our system provides sonoanatomically correct images and accurate tactile sensation of critical tissues and osseous that can be used as an inexpensive, realistic, and interactive teaching and learning tool for medical students. This provides the training necessary for students to achieve proper hand-eye coordination and to familiarize themselves with tactile sensation that corresponds with needle advancement. Tissue thickness may also be modified above the spinous process to allow for patient-specific training scenarios. The combination of AV navigation and US imaging has the potential to minimize invasiveness and to provide real time US-guided spinal needle interventions.

The Differential Effects of Noise-Induced Hearing Loss on Auditory, Visual and Multisensory Cortical Areas

Ashley Schormans1, Marei Typlt1 and Brian L. Allman1; 1Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University; London, ON, Canada

Previous studies have identified that hearing loss results in an increased responsiveness of neurons in the central auditory system to visual and/or tactile stimuli (i.e., crossmodal plasticity). It remains relatively unknown how hearing loss affects areas of the brain that already integrate multisensory information. Thus, we investigated
whether crossmodal plasticity extends beyond the core auditory cortex. Adult male rats underwent baseline hearing testing, followed by a broadband noise exposure. Two weeks later, hearing levels were reassessed, and extracellular electrophysiological recordings were made in the lateral extrastriate visual cortex (V2L) and dorsal auditory cortex (AuD). In age-matched controls the same hearing assessment and electrophysiological recordings were completed. Computer-generated auditory, visual and combined audio-visual stimuli were delivered, and spiking activity was used to determine the response profile of each neuron sampled. In comparing noise exposed rats to controls, the proportion of visual neurons in the multisensory area (V2L), increased 38%, and the proportion of audio-visual neurons moderately decreased. This reduction in multisensory neurons in V2L was inconsistent with the crossmodal plasticity observed in AuD, where the proportion of audio-visual neurons nearly doubled. Overall, noise exposure increased the proportion of visually-responsive neurons encountered by ~20%; however, the degree and nature of crossmodal plasticity differed across the cortical areas, such that only AuD showed an increased proportion of neurons capable of processing multisensory information following the adult-onset partial hearing loss.

This work is supported by NSERC and CIHR.

Level of First Author: Graduate Student    Topic Category: Neurobiology
Poster Board # 23

Using c-Fos Immunoreactivity to Map Cortical Plasticity Induced by Acute Noise Exposure
Paul V. Sirek, Sarah T. Fitzpatrick, Ashley Schormans, Raj N. Rajakumar, Brian L. Allman; Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry; Western University, London, ON, Canada

Using in vivo electrophysiological recordings in rats, our lab has recently observed that high-intensity noise exposure causes an increase in the number of neurons in the auditory and multisensory cortices that are responsive to visual stimuli (i.e., cortical crossmodal plasticity). To extend this work, the present study evaluated our hypothesis that this noise-induced crossmodal plasticity can also be assessed by mapping the expression of the activity marker, c-Fos, across multiple cortical areas in response to visual stimuli. Adult male rats were exposed to a 120dB noise (0.8-20kHz) for two hours, and the level of hearing loss was assessed with an auditory brainstem response (average hearing loss ~22±5 dB). Fourteen days later, noise-exposed rats (and age-matched shams) were subjected to a visual stimulation protocol known to induce c-Fos activation (200 light flashes; 1-3s ITI), followed by transcardial perfusion two hours post-stimulation. Visually-responsive neurons in the noise-exposed and sham rats were confirmed with immunohistochemistry and fluorescent microscopy. Inconsistent with our previous electrophysiological studies, the molecular mapping of c-Fos did not demonstrate an increased responsiveness to visual stimulation in the auditory and multisensory cortices following noise exposure. However, these results may be confounded by the short duration (6 min) of the visual stimulation protocol, as it evoked lower levels of c-Fos than previously reported in the literature. Future work will continue to investigate whether molecular mapping represents a useful tool for studying crossmodal plasticity.

Support: CIHR Open Operating Grant; NSERC Discovery Grant
Level of First Author: Graduate Student    Topic Category: Neurobiology
Poster Board # 24

The Anatomy of E-Learning Tools: Does Software Usability Influence Learning Outcomes?
Sonya Van Nuland, Kem Rogers; Schulich School of Medicine and Dentistry, Western University, London, ON, Canada

Increasing class sizes and a reduction in laboratory hours have increased the popularity of commercial anatomy e-learning tools. It is critical to understand how the functionality of such tools can influence the mental effort required during the learning process, also known as cognitive load. Using dual-task methodology, we examined two anatomical e-learning tools to determine the effect of their design on cognitive load during two joint learning exercises (elbow and knee). A.D.A.M. Interactive Anatomy is a simplistic, 2-dimensional tool that presents static images and utilizes a sliding tab to dissect image layers, while Netters 3D Interactive Anatomy has a more complex 3-dimensional usability that allows structures to be rotated. We hypothesized that longer reaction times on a
Stroop visual observation task would indicate a higher cognitive load imposed by the anatomy software, which would interfere with learning. Undergraduate anatomy students from Western University, Canada (n=70) were assessed using a baseline anatomy knowledge test, Stroop task response times, and an anatomy post-test. Results showed that the different software packages had no influence on reaction time or post-test outcomes, however, there was a positive correlation between spatial ability and test outcome when student’s used Netters 3D Interactive Anatomy. In fact the range of test outcomes with Netters 3D Interactive Anatomy was much larger as a result of students with lower spatial ability performing significantly poorer that those with high spatial ability. In contrast, spatial ability did not impact performance in A.D.A.M Interactive Human Anatomy. This suggests that an e-learning tool, which presents static images in a low interactivity platform, such as ADAM, would benefit a broader range of learners than a tool which uses animations within a high interactivity platform, such as Netters 3D Interactive Anatomy. The results of this study could constructively inform software developers about future design considerations.

Level of First Author: Graduate Student  
Topic Category: Anatomy Education

Poster Board # 7

Evaluation of User Performance in Simulation-Based Diagnostic Cerebral Angiography Training
Oleksiy Zaika, Ngan Nguyen, Mel Boulton, Roy Eagleson, Sandrine de Ribaupierre; Schulich School of Medicine and Dentistry, Western University, London, ON, Canada

Cerebral angiography is a minimally invasive, but complex procedure used to visualize vessel structure, and requiring acquisition of both fine motor and spatial reasoning skills. Current patient-dependent training methods require significant cost, time, and pose patient risk. Simulation training can eliminate these needless risks, while providing individualized educational modules. This study assesses the benefit of simulation training in cerebral angiography using an alternating curriculum. Eight residents (4 radiology/4 neurosurgery) and 8 anatomy graduate students were evaluated on their visuospatial ability and anatomy competency. The participants were then trained on the Simbionix™ angiography simulator over 8 sessions, using either an alternating or a consistent method, in order to assess skill acquisition. Although it was found that the alternating training curriculum was not significantly better than the consistent curriculum, all groups significantly improved in total procedure time and total fluoroscopy time in just 5 sessions. Contrast injection volumes and roadmap means improved considerably (48% and 33%, respectively), however, the values were not statistically significant. It was also found that individuals with high visuospatial ability performed significantly better than those with low visuospatial ability. Future work with the simulator will also assess anatomical areas of difficulty and individual error frequency in order to better assess performance. This data can be used to tailor appropriate case exposure for trainees and create efficient medical pedagogy through individualized training in angiography.

Level of First Author: Graduate Student  
Topic Category: Anatomy Education

Poster Board # 13

Virtual Unreality and Anatomy Learning
Yu Hang (Eric) Zheng¹, Rema El-Roz², Sandra Monteiro³, Geoffrey R. Norman³, Bruce Wainman⁴; ¹Honours Bachelor of Health Sciences, Faculty of Health Sciences, McMaster University; Hamilton, ON, Canada; ²Honours Bachelor of Science, Faculty of Science, McMaster University; Hamilton, ON, Canada; ³Department of Clinical Epidemiology and Biostatistics, Faculty of Health Sciences, McMaster University; Hamilton, ON, Canada; ⁴Department of Pathology and Molecular Medicine, Faculty of Health Sciences, McMaster University; Hamilton, ON, Canada

Virtual reality (VR) and pictures given in key views have significant disadvantages compared to 3D models in learning anatomy when tested on a cadaver. The superiority of models may be due to a learning effect inherent in physically handling the model or that the 3D cadaver used for the test is most similar to the 3D model, which leads to transfer-appropriate processing (TAP). In the current study we removed the physical handling of the model by placing it on a turntable. The results showed no significant difference in the mean scores between the groups that handled the model (67%) or viewed the model on the turntable (69%), which indicates that the
physical manipulation of the model is not the cause for its learning efficacy. To test whether TAP was significant, subjects learned the pelvis on 2D (VR) and 3D (model on turntable) and were tested both on 3D (a cadaver pelvis) and 2D (pictures of a cadaver pelvis). The turntable group (3D) performed significantly better than the VR group (2D) when tested in 2D (75%) or 3D (69%). This suggests that TAP did not occur, thus neither physical handling nor TAP explains the superiority of learning from 3D models.

This research was supported by the Education Program in Anatomy at the Faculty of Health Sciences at McMaster University.

Level of First Author: Undergraduate Student

Topic Category: Anatomy Education

Poster Board # 5