Factors that affect development of coordination

Dr Tegan Grace recently received her PhD on “Determinants of motor coordination in children and adolescents: A longitudinal study”. Tegan has provided a summary of the main findings from her thesis study.

A growing body of evidence suggests that events occurring during gestation and birth may have a lasting effect on fetal neurological systems and therefore on postnatal motor development. Although the human brain and nervous system have shown a capacity for adaptivity (often referred to as plasticity) there is some evidence that suggests insults to the developing central nervous system in-utero can be long lasting and in some cases permanent. Developmental researchers have already identified a range of risk factors that can affect long term developmental outcomes during these early life stages. It is well established that fetal growth restriction, premature birth, small for gestational age status, maternal stress, smoking and alcohol consumption are risk factors for compromised motor development in early childhood.

However, although the antenatal period has been documented as a time of great importance for neurological developmental there are few longitudinal studies that have sought to determine how exposure to known risk factors during this time effect motor development beyond childhood. The purpose of this study was to identify risk factors during the antenatal, perinatal and neonatal period that influenced motor development outcomes at 10, 14 and 17 years.
Development of motor coordination (contd)

Potential risk factors for a poorer motor outcome, maternal smoking, alcohol and drug consumption, maternal age, parental handedness, maternal health (illness and infection), delivery mode, gestational hypertensive status, stress, socioeconomic status, percentage of optimal birth weight (a measure of whether growth potential has been met), child's sex, gestational age, parity and breastfeeding were examined.

We used the McCarron assessment for Neuromuscular Development (MAND) to assess motor development. Using the sex and age appropriate norms we calculated a Neuromuscular Development Index (NDI) which is a measure of overall motor development, incorporating scores from 10 fine and gross motor tasks. We found that maternal hypertensive disease, in particular preeclampsia, had negative long term effects on motor development outcomes. In addition a significant relationship between number of stressful events mothers experienced and motor development outcomes was revealed, suggesting increased stress led to suboptimal neurological development. Stress later in pregnancy was found to have a greater effect than earlier stress. The impact of breastfeeding duration was also investigated and a protective effect was found for those who were breastfed for six months or longer compared to those who were breastfed for less than six months.

When males and females were examined separately there were some differences in the factors that affected motor development outcomes. Maternal preeclampsia, mode of delivery and income affected both male and female motor outcomes. Lower percentage of optimal birth weight was related to a lower male NDI, whilst younger maternal age, smoking during early pregnancy and stress during later pregnancy were related to lower NDI in females.

Other factors considered in the analyses, including lower family income, male sex, maternal alcohol consumption, smoking and caesarean section delivery were also found to be negatively related to motor development outcomes. This information can be utilized to help identify potentially at risk infants and ensure optimal future neurological development. Early detection and intervention strategies may help to increase motor development outcomes in those who are exposed to the identified risks.
PhD student update: Investigating identity formation and motor competence

Amanda Timler is undertaking her PhD in the area of Human Movement. Here she describes the outline of her research project.

The PhD project I am currently undertaking focuses on motor competence skills and identity development during adolescence (specifically 14-16 year-olds) and is entitled The who.i.am study: Identity formation and motor competence in adolescents.

During adolescence, the participation in activities such as weekend sports is important for social development and future goal orientation. Those who are unable to participate in these activities may experience less social support and high association towards stress and anxiety when developing their identity. Therefore my project is examining if motor competence (high and low) influences identity development during adolescence. Additionally, the project will examine if an adolescent’s self-perceptions and parental support mediate identity development (see diagram above).

Before these four mediating factors could be examined we developed a new self-report motor competence questionnaire for 12 to 18 year-olds, called the Adolescent Motor Competence Questionnaire (AMCQ). The development of the AMCQ was based around discussions with some of AMPitup participants here at Notre Dame and the Move.grow.engage Perth collaborative research team. The AMCQ consists of 26 items covering the ecological presence of motor tasks and functional activities of daily living.

An example of one of the items is ‘I can kick a ball accurately to hit a target (e.g. football or rugby ball)’. This questionnaire has been submitted to Research in Developmental Disabilities and is currently under review.

Recently, the AMCQ has also been culturally adapted to be used in the Netherlands. Adolescents today. The next phase of my project that I am currently working on uses a mixed method explanatory design looking specifically at motor competence (high and low) and identity development. Small group interviews with adolescents have been undertaken to gather a more in-depth understanding about what factors are impacting adolescents today. Next, I will interview some parents to see if there is congruency with their adolescent’s perceptions. Once this data collection phase has been completed, my focus will shift to publishing these results and writing up my thesis for submission in December 2016!
Honours’ students in 2016

In 2016 there were 6 students who are undertaking the Bachelor of Biomedical Science Honours.

Hannah Elliott “Role of STAT3 signalling in B cells an idiopathic pulmonary fibrosis” Supervisor Dr Cecilia Prele (IRH), Prof Gerard Hoyne UNDA

Arjun Jeyadevan “Bioavailability and Neuroprotective Stability Assessment of Chemico-Physically Different Poly-Arginine Peptides” Supervisor Assoc. Prof Bruno Meloni (WANRI), Dr Ryan Anderton UNDA

Megan Bakeberg “Assessing the toxicological and pharmacokinetic properties of the poly-Arg R18 peptide; a lead stroke neuroprotective agent” Supervisors: Assoc. Prof Bruno Meloni (WANRI), Dr Ryan Anderton UNDA

“Understanding of BET inhibitor resistance in NUT Midline Carcinoma” Supervisors: Dr Stimweiss (TKI), Dr Ryan Anderton UNDA

Cian O’Connor “Exploring the role of CTGF in the bone marrow microenvironment” Supervisors: Dr Cheung (TKI), Dr Ryan Anderton UNDA

Feben Reda “An in vitro Investigation of the Mechanisms of Action of Bovine Hyperimmune Milk that may Provide Protection against ETEC” Supervisors: Dr Ching (UWA), Prof Naomi Trengove UNDA

Post Graduate Students in Health Sciences 2016

Dr Diego Milani Doctor of Philosophy (Biomedical Science)
“Neuroprotective protective potential of poly-arginine peptides in focal cerebral ischaemia models”
Supervisors: Dr Ryan Anderton, Assoc Prof. Bruno Meloni (WA Neuroscience Research Institute)

Adam Edwards Doctor of Philosophy (Biomedical Science)
“Pre-clinical assessment of poly-arginine peptides as neuroprotective agents for perinatal hypoxic-ischaemic encephalopathy (HIE)”
Supervisor Dr Ryan Anderton, Assoc Prof. Bruno Meloni (WA Neuroscience Research Institute)

Amanda Timler Doctor of Philosophy, Institute of Health Research
“The Who am I study: Identity formation and motor competence among adolescents”
Supervisors: Prof Beth Hands, Assoc Prof Fleur McIntyre

Ysabel Jacobs Doctor of Philosophy (Exercise and Sports Science)
“Genetic markers and athletic performance for Australian footballers”
Supervisors: Dr Ryan Anderton, Dr Chris Joyce, Dr Carl Woods

Carmen Papaluca Doctor of Philosophy (Exercise and Sports Science)
“The Power of Pictures: Is there an association between the types of Instagram posts and wellbeing?”
Supervisors: A/Prof F Farringdon and Prof Max Bulsara.

Gabriella MacDougall Doctor of Philosophy (Biomedical Science)
“Neuroprotective protective potential of poly-arginine peptides in focal cerebral ischaemia models”
Supervisors: Dr Ryan Anderton, Assoc Prof. Bruno Meloni (WA Neuroscience Research Institute)

Russel Montgomery Doctor of Philosophy Institute for Health Research
“Evaluating the outcomes for environmental sustainability of the Western Australian Outdoor Education ATAR course from the point of view of teachers, students and student graduates”
Supervisor Prof Gerard Hoyne, Duncan Picknoll

Sarah Harris Doctor of Philosophy (Exercise and Sports Science)
“Worth The Risk: Exploring the relationship between risk taking predisposition, injuries and negative emotional states in players at one West Australian Football League Club?”
Supervisors: A/Prof F Farringdon, Ben Piggott
Recent Staff Publications


Post graduate student update:
Sarah Harris PhD student

Worth The Risk: Exploring the relationship between risk taking predisposition, injuries and negative emotional states in players at one West Australian Football

Currently there is no formal mechanism for reporting head injuries that occur in the Western Australian Football League (WAFL). Therefore the prevalence of head injury and post –concussive symptoms in this environment is unknown. An anonymous self-report injury and post-concussion symptom reporting tool (WIRS) was developed and piloted with senior players within the WAFL. The tool was both valid and reliable. In 2015, the tool in addition to a scale to measure depressive symptoms (CESD-20) and generalised risk taking (risk propensity) was implemented at one WAFL club. The study was conducted over 22 weeks of the regular WAFL season, with players completing the surveys each fortnight at the conclusion of training. Findings from this study have been presented at numerous conferences over the past 10 months.

- Preliminary findings from the first three points of data collection indicated that post-concussion symptoms are present when a head knock is reported- *poster presentation at the Sports Medicine Australia ASICS National Conference in October 2015 at Sanctuary Cove in Queensland.*
- We reported the development, validity and reliability of the WIRS tool including the descriptive findings of the incidence of injury, from the 2015 study. *Oral presentation Sports Medicine Australia State Conference in Busselton in November 2015*
- We have identified that a significant relationship exists between the presence of depressive symptoms and the reporting of head knocks and concussion. These are important findings in the area of head trauma and sport as the majority of research focuses only on diagnosed concussions, or the retrospective reporting of depressive symptoms (commonly after retirement or family's accounts posthumously). The fact that depressive symptoms increased after recent head knocks and concussion indicates that these injuries should be closely monitored by the players and support staff. *Oral presentation 7th International Sport and Society Conference in Hawaii June 2016*
- We have found a significant relationship exists between a player's risk propensity and self-reported injuries including diagnosed concussion and head knocks. *Presentation the 18th International Conference on Sport, Exercise and Health Sciences Vancouver.*

The value of these findings is primarily an educative one; especially at the semi-professional and community level where there may be limited access to medical resources and no formal injury reporting procedures. Players, coaches, parents and support staff can benefit from being more aware of the potential negative impact of recent head knocks on mental health, regardless of a concussion diagnosis. This may lead to closer monitoring of symptoms and emotional changes in players, resulting in a supportive environment that encourages players to seek early medical assistance within or outside of the club.

The next phase of my PhD will investigate the following areas:

- The presence of post-concussion symptoms
- If there is a relationship between playing position and the incidence or type injury incurred
- If there is a relationship between post-concussion symptoms, depressive symptoms, head knocks and concussion
- If there is a relationship or interaction between fringe players (players who move fortnightly up or down from league, reserves or amateurs), and the presence of depressive symptoms or injuries
The scientist as a creative worker

The international scientific journal *Nature* is published weekly and within each issue it highlights a specific interest point in science from 50 and 100 years ago.

Here is a snippet from an article published in 1965 talking about the creativity of a scientist.

50 Years Ago

It is probable that only those who have themselves been concerned with scientific research will appreciate all the fine nuances of Sir Cyril [Hinshelwood]'s address, but the picture he paints of the scientist as a creative worker, of the need for freedom of expression and appropriate conditions of work, and of public understanding if his work is to be fully effective, is intelligible to any layman. It is no picture of a scientist working and living in some 'ivory tower', or even of Thomson's Newton, "stemming alone vast eternity's unbounded sea", but rather of a happy voyager of strange seas of thought, in company with others trained in the same or many other disciplines.

From *Nature* 4 September 1965

Post graduate student update:
Developing new treatments for neonatal brain damage

**Adam Edwards** completed a Bachelor of Biomedical Science (Hons) at the UNDA before undertaking a PhD with Associate Professor Bruno Meloni, Clinical Professor Neville Knuckey & Dr Ryan Anderton at the WA Neuroscience Research Institute at the QEII Medical Centre.

Neonatal hypoxic ischaemic encephalopathy (HIE) is a severe neurological condition that affects infants. Neonatal HIE results from a decrease in oxygen rich blood flowing to the infant’s brain, resulting in neuronal cell death. The reduction in oxygen rich blood results from a number of possible clinical conditions that include the umbilical cord wrapping around the infant’s neck, knotting of the umbilical cord, early detachment of the placenta, high maternal blood pressure, and extended labours. Neonatal HIE affects 6-8 in every 1,000 live births and has an increased incidence when an infant is born in a rural/isolated or home-birth setting. Infants who develop HIE experience a number of neurological conditions that include cerebral palsy, epilepsy, motor spasticity, behavioural and cognitive impairment.

Currently, the only approved therapy to mitigate HIE is the use of hypothermia. The infant’s core body temperature is cooled down to 35°C and this allows for some of the affected brain tissue to recover. However, the use of hypothermia carries with it a number of complications. Hypothermia can only be used in tertiary hospitals due to the use of specialised equipment, it also can lead to a number of blood and immune disorders. Additionally, hypothermia also has strict exclusion criteria, meaning not all infants who suffer HIE have access to it. Infants have to be born full term (37 weeks gestation) and have to have had to be diagnosed with HIE within 6 hours of birth to be considered for the therapy; meaning there is no therapy for pre-term infants.

Hence, due to the lack of clinically appropriate neuroprotective HIE treatments, there is an urgent need to find new treatments that are effective clinically, and widely applicable to all infants whether they be pre- or term-births, or born in the city or remote areas.
Developing new treatments for neonatal brain damage (contd)

Recent work in A/Prof Meloni’s laboratory at the WA Neuroscience Research Institute has demonstrated a peptide drug consisting of arginine amino acids is highly neuroprotective in both *in vitro* and *in vivo* models of stroke. In addition, recent *in vitro* data represent that you can increase the efficacy of the drug by increasing the arginine amino acid content. However, before potential neuroprotective agents can be used in infants suffering from HIE it must first be assessed in different animal models of HIE. Therefore, my project aims to assess the efficacy of different poly-arginine peptides in neonatal rat models. The experiments use 7-day old rat pups, at this age their brain development is similar to that of a newborn human, who undergo a common and external carotid artery occlusion followed by a hypoxic insult. Recent preliminary pilot data shows a reduction in brain cell death in animals treated with a dose of R18 (18 arginine amino acids) peptide (see Figure 1).

Excitingly, this work has won me a Young Investigator Travel Program, where I will be travelling to the Neural Control of Movement Laboratory at the University of Copenhagen, Denmark as well as the Elsass Institute of Cerebral Palsy to partake in a number of research experiments. Additionally, I will be presenting my findings at the Federation of European Neurosciences Societies in Copenhagen, Denmark. Both of these visits will take place in June/July 2016.

![Figure 1. Representative HIE coronal sections stained with TTC](image)

TTC stained 2mm coronal sections of a 7 day old pup exposed to HIE. Areas stained red/pink demonstrates live brain tissue, areas stained white demonstrate dead brain tissue.