

# MYERSCOUGH RESEARCH 2017/18

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RESEARCH FOR PRACTICAL APPLICATIONS



# INTRODUCTION

University Centre Myerscough is a specialist Land-based and Sports provider of Higher Education, based in the North West of England. Research is a key part of the College's mission, which states, *"To become the leading provider of education in the land-based & sports sectors and the natural choice for students, industrial partners and research, who aspire to success"*.

There are four Research Centres at Myerscough:

- **The Centre for Animal Welfare Research:** Includes the Equine Performance Group and the Welfare of Managed Animals Group
- **The Centre for Sport Health and Performance Research:** Includes the Sport Performance Research Group and the Sports Social Science Research Group
- **The Centre for Plant and Crop Science Research:** Includes the Arboriculture Research group and the Sustainable Agriculture Group
- **The Centre for Teaching and Learning Research** which is across all the teaching areas of the college



This publication outlines a selection of the research activities at University Centre Myerscough in 2017-18. It delineates the likely impact in terms of stakeholders and users of the research. Importantly, it highlights the role research plays in underpinning the education we provide and imparting a research ethos among our higher education students.

*D Elphinstone*

Dr E David Elphinstone  
Director of Research

## 2017-18 RESEARCH ACHIEVEMENTS

21	Conferences where staff or students contributed
35	Research publications
11	Peer reviewed journal publication
11	Industry publications
5	PhD completions
89%	National Student Survey results of undergraduates, who agreed, 'My learning has benefited from modules that are informed by current research', above the national upper quartile (86%)

# OSTEOARTHRITIS IN DIFFERENT SPECIES

## OVERVIEW

Osteoarthritis (OA) affects many species including humans and horses. It is a painful, disabling disease that puts a huge personal, social and economic burden on society. In the equine industry, it causes loss of performance, wastage, welfare issues and financial loss. OA is a disease of the whole joint that ultimately leads to deformity, due to abnormal bone growth, and breakdown of the cartilage lining the joint that makes a smooth load-bearing surface in healthy individuals. The causes of OA are still unknown but the cells that maintain the cartilage and the bone increase in number in the early stages of the disease.

In collaboration with the University of Aberdeen and the University of Liverpool, Myerscough Lead Researcher, Dr Rachel White has been exploring the role of a protein involved in cell proliferation and ion homeostasis in cartilage cells. The protein seems to work by controlling how acidic the environment is inside the cells. The internal acidity of the cells has a large effect on how they behave and controlling it is essential for maintaining a healthy joint. A change in the levels of the protein under investigation may affect the acidity of the cells and cause them to multiply, leading to tissue loss and joint deformity characteristic of the disease.

## RESEARCH IMPACT

New approaches for therapy could be unlocked if the protein under investigation is shown to affect cell proliferation and acidity. The protein has previously been identified as a drug target in the treatment of cancer.

## INFLUENCING EDUCATION

Dr Rachel White uses her research findings to teach several undergraduate and postgraduate modules, including Equine Biology, Equine Biomechanics and Applied Techniques for Sustaining the Equine Resource. Dr. White also draws on her research to teach students laboratory techniques and methods, and scientific communication skills required in industry. This area has inspired undergraduate students to research the effect of turmeric on horse movement

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Figure 1.  
Isolated equine chondrocytes in tissue culture



# HORSE RIDER DEMANDS AND IMPLICATIONS ON FITNESS

## OVERVIEW

The precise physiological demands of the novice equestrian athlete (horse rider), whilst mounted, are unknown (Devienne and Guezennec, 2000). Westerling, (1983); Trowbridge et al., (1995); Bojer et al., (1998) have attempted to establish the physiological demands placed on the horse rider, however, these early studies had limitations due to the difficulty obtaining accurate results in a field situation. Fitting of testing equipment safely onto the horse riders was difficult, the equipment could cause harm and damage if a fall was to occur during testing due to the placement of some of the equipment on the lower back (Meyers and Sterling, 2000).

The repetitive, rotary motions and impact of the horse whilst mounted cannot be easily mimicked (Williams and Tabor, 2017). The lack of scientific studies into the demands of horse riding reduces the ability to determine appropriate and reliable methods of quantifying fitness levels and provide relevant fitness regimes for the rider. Previous studies of fitness have focused primarily on the evaluation of fitness techniques and the ability to improve the fitness of the rider; studies such as Boden et al., (2013), who studied the effects of Pilates on the position of the horse rider. Previous research has shown that trot and canter work whilst riding can be deemed a form of moderate exercise, with a jumping effort requiring more cardiorespiratory exertions and so deemed high intensity exercise (Meyers, 2006 and Devienne and Guezennec, 2000).

Danielle's study into horse rider fitness parameters during the three common riding gaits suggest that canter is the most physiologically demanding gait ( $P < 0.05$ ), when compared with walk and trot, during a structured ridden session. Previous studies have published an increase of physiological parameters, such as  $\dot{V}O_2$ , a measure of the volume of oxygen that is used by the body to convert the energy from food intake into the energy molecules required for exercise and heart rate, as the gait speed increases. Other studies have suggested that as gait increases so does the intensity of the exercise (Westerling 1983; Devienne and Guziennec, 2000; Robert et al., 2001).

An apparent reason, suggested by Douglas et al. (2012) is that a faster gait adopts a naturally more forward seat and position, therefore creating an increase in the need for control and stability of the trunk and legs. This requirement for the control induces a higher recruitment of musculature leading to a higher intensity of exercise and an increase on the internal load experienced by an individual. This suggestion was further supported by Lovett et al. (2005), who during kinematic studies highlights the changes in rider posture throughout a variety of gaits. During the rising trot thigh activation is required along with more centre of mass changes. However, the canter riders need to stabilise the body and keep the centre of mass consistent, this requires a high level of muscle activation in the legs back and core. It has been further suggested by Douglas that the canter requires an increase in muscular contraction in order to maintain posture due to the changes in the ground reaction forces and orientation of the trunk due to motion of the canter.

The knowledge and understanding the different physiological demands of horse riders at a variety of levels from novice to professional and a range of disciplines from dressage, jumping and endurance riding. This information would be beneficial for the development of discipline specific training programmes. This study can be used as preliminary work for research in this area. Further research is needed into the attitudes of the equestrian athlete towards fitness and understanding the demands placed on their bodies during a ridden exercise. This will enable the development of suitable and manageable additional exercise regimes for the horse rider to assist in the improvement of rider fitness specific to demands and the position of the rider whilst mounted.

## RESEARCH IMPACT

The study has gained recognition in both the general sports industry along with the equine community. The research has been presented at several conferences across UK including the International Society of Performance Analysis in Sport and British Association of Sports and Exercise Science.

The research has potential to educate the general public, horse riders, riding schools and competitive horse riders. Above all, this research has the potential of reducing the occurrence of horse rider falls, injury due to the association with demands and fitness. However, ultimately horse welfare will be improved with the increased fitness of the rider.

## INFLUENCING EDUCATION

Danielle has followed her research path from undergraduate to postgraduate and is now a Lecturer in Equine studies. She has presented her research at an international conference, to undergraduate and postgraduate students, and is an inspirational role model for the students to follow

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# ARE MYCOTOXINS OF GRASS-ENDOPHYTES LINKED WITH EQUINE GRASS SICKNESS?

## OVERVIEW

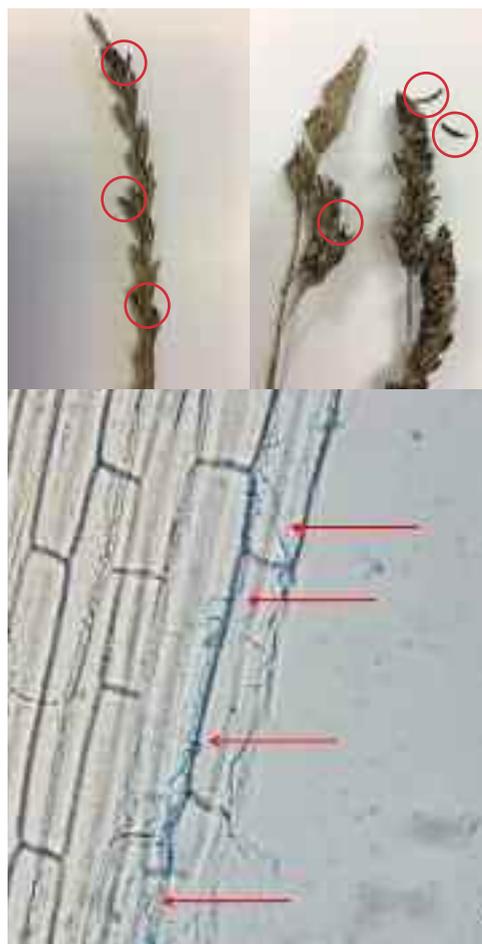
Horses, in the United Kingdom, are at risk of contracting a sickness associated with grazing of grass that is responsible for 1 to 2% annual mortality (Leng et al., 2017). The manifestation of equine grass sickness (EGS) is also attributed to neuronal degeneration with varying severity affects to the nervous systems, intestinal track and nose (rhinitis sicca). Incidence of this disease has over a 100 year history with cases largely covering the UK and numerous northern European countries. The aetiology of this disease is unknown. Risks associated with onset may include age and poor health (low serum antibody levels), although horses in good condition have also become infected.

The cause of EGS has divided researchers' opinions and remains inconclusive. The hypothesis of a bacterial (*Clostridium botulinum* type C and or D) pathogenic toxins, known as 'botulism theory' has featured as a potential causative agent since the 1920s. Recently however, evidence has suggested EGS was not associated with *C. botulinum*-derived neurotoxins (McGorum et al., 2016). Other aetiological hypotheses have focused on plant-derived toxins associated with clover (*Trifolium* spp.) (Tocher, 1923), insect vectors (Lloyd, 1934), meteorological changes (Doxley et al., 1991) and fungal toxins (Uzal, 1993, Robb et al., 1995, Robb, 1996).

The aim of this multidisciplinary research by Myerscough researchers, Dr. Jonathan Knowles and Dr. Irene Weir, in collaboration with Dr. Athanasios Rizoulis at UCLan, is to investigate for the presence of alkaloid-producing fungal species *Epichloë* and *Claviceps purpurea* in a small number of pastures associated with EGS.

It is the fungal derived toxins (mycotoxins), pertinent to grasslands that are the focus of this research. There are two species of fungi that are known to be highly toxic and associated with grasses. Firstly, *Claviceps purpurea* (Ergot) and secondly, *Epichloë* spp. These produce toxic secondary metabolites (alkaloids) that are toxic to ruminants (Craig et al., 2015; Saikkonen et al., 2016). Up to four bioactive alkaloids may exist across these fungal species, this includes ergot alkaloids and indole-diterpenes which are well known as toxic to livestock in other countries (Saikkonen et al., 2016). Although *Claviceps* and *Epichloë* are not unusual in UK grasslands, their role in any EGS or toxicosis of equine on UK grassland has not been tested.

Figure 2. Top left: Ergot (*Claviceps purpurea*) (○) infected perennial ryegrass (*Lolium perenne*). Top right: Ergot infected (○) cocks-foot grass (*Dactylis glomerata*). Bottom: Fungal hyphae (←) of *Epichloë* spp. in leaf tissue of tall fescue grass (*Lolium arundinaceum*) at 400X



## RESEARCH IMPACT

If fungal toxins are not ruled out, then the impact of this research may lead to wider research into links between fungal-endophytes of grasses and EGS. It may potentially offer improved explanation of EGS aetiology and direct new knowledge into managing pasture and horses to control or reduce fungal toxicosis from UK grasslands.

## INFLUENCING EDUCATION

This research project will strengthen the links between these universities, potentially opening new opportunities for collaborations on multidisciplinary projects that focus on the interactions between plants and microorganisms. This collaborative project combines the strengths of University Centre Myerscough (UCM) and University of Central Lancashire (UCLan) using the UCM has high technology glasshouse facilities at UCM alongside the state of the art molecular and analytical facilities at UCLan.

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# EQUESTRIAN SURFACE CERTIFICATION

## OVERVIEW

Improvements in health and welfare of sports and racing horses are essential for the future of these disciplines within today's world. The impact of horse falls and catastrophic injuries during competitions, particularly those that are televised, are of great concern to organisers, participants and spectators alike. The surfaces that horses compete on are often identified as contributory factors, but up until London 2012, international competition surfaces were not measured prior to competition with equipment that could replicate the forces produced by a horse.

RACES was part of an international team that assisted in measurement and development of the unique surface that was used for the Olympic Games at Greenwich Park. The legacy from the scientific work carried out there led to the development of the Equine Surfaces white paper, which outlined a framework for certification of arena surfaces. A subsequent meeting of worldwide footing experts was held in summer 2015 at the FEI headquarters to discuss the proposed framework. Following this meeting, Dr Sarah Jane Hobbs (from the RACES team) was commissioned by the FEI to lead the development of certification documentation for show jumping arena surfaces.

Thirty-eight separate documents that include the overall certification process, materials testing, in-situ testing, track-in-a-box testing and supplementary documents were created by Dr Hobbs and Dr Lindsay St George from the University of Central Lancashire. These documents set out standard test methods for FEI certification, which are already being used worldwide to assess and improve arena surfaces.

Figure 3. RACES team and equipment testing an equine arena surface



## RESEARCH IMPACT

Understanding, measuring and disseminating knowledge on intrinsic and extrinsic factors that influence health and wellbeing of horses and their riders are an important part of the work that RACES undertake.

The scientific knowledge used to drive the development of the Equine Surfaces white paper and subsequently the certification process is already impacting on industry, as new designs of surfaces with enhanced functional properties are emerging. In addition, anecdotal evidence suggests that arena surface maintenance at permanent venues is improving too. These improvements will ultimately benefit horse welfare and reduce injury risk for horses and riders.

## INFLUENCING EDUCATION

Dr Danielle Holt is part of the RACES team and continues to assist RACES in surface testing and analysis. She followed a research path from undergraduate to PhD, studying equestrian surfaces for both her MSc by Research and PhD. Her work was funded through a studentship provided by University Centre Myerscough and her work has been shared with current students, as well as offering inspiration for undergraduates to progress into research. Her research work investigating the response of horses to an abrupt change in surface is currently being developed into a journal publication.

Dr Lindsay St George completed her PhD at UCLan. Her PhD focused on investigating muscle activity patterns in sports horses, specifically show jumping horses. The methods were used to explore differences in elite and non-elite horses and the results may be used to inform training practices.

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# RISK FACTORS FOR HORSE FALLS DURING THE CROSS-COUNTRY PHASE OF EVENTING COMPETITION: A COMPREHENSIVE ANALYSIS

## OVERVIEW

Horse riding is a high risk sport. Numerous injuries and deaths to horses and riders occur in the cross-country phase of eventing, with 45 rider deaths documented at national or international cross-country competitions between 2007 and 2013. Cross country requires the horse and rider to jump solid, immobile fences over undulating ground, in an optimum time. This test is preceded by a dressage and show jumping test during one day events.

Research suggests that the most important cause of horse and rider fatalities and injury on the cross country is the horse falling. Statistically, the highest risk of injury / fatality is associated with a rotational horse fall, in which the horse hits and somersaults over a solid obstacle, potentially landing on the rider.

Myerscough PhD studentship, Heather Cameron-Whytock analysed data collected by British Eventing from all competitions between 2005 and 2015 using Generalised Linear Mixed Effects Model (GLMM) with a logit-link binomial error structure in STATA. This process enabled analysis of factors recorded in relation to the occurrence of a horse fall to be determined. Sample size equated to 850,000. A variety of factors were recorded including horse and rider health information, competition results, previous falls and number of starts in the last 30,60 and 90 days.

A total of 13 variables were retained in the final model. For example, for every fall the horse had experienced in its career, it was 30% ( $P<0.001$ ) more likely to experience another fall during the current event. Additionally, male riders were 35% more likely to experience a horse fall than female riders ( $P<0.001$ ).

Horses that have had several horse falls in their competition career may have insufficient skill or physiological jumping capability, making them susceptible to further falls and therefore unsuitable for the sport. Previous research in high risk sports has described increased willingness to take risk in male athletes, attributed to the male's stronger belief in their capability (scoring higher in self-efficacy tests). Male athletes have the potential to take excessive risk, as eventing is an inter-species sport where the horse cannot be fully predicted, this could have a remarkable impact on the likelihood of a fall.

## RESEARCH IMPACT

The preliminary study has gained international recognition, which generated industry-wide press coverage. The work has been presented at the FEI National Safety Officers seminar in Madrid, January 2015 and Switzerland, 2018 and has since been presented at conferences in Ireland, Denmark and the UK.

Furthermore, the project has formed links with renowned risk analysis researcher Dr Tim Parkin (University of Glasgow) and British Eventing.

There is potential for this research to educate the general public, students, horse riders and the eventing governing bodies. Above all, this research has the potential of reducing the occurrence of horse falls therefore potentially preventing the serious injury or fatality of a horse and rider.



## INFLUENCING EDUCATION

The study was undertaken by Heather Cameron-Whytock as part of her PhD studentship in collaboration with Myerscough and the UCLan Heather gained her College and University education at Myerscough, which has led to her PhD studies, which offers aspiration for inspired undergraduates.

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# IS THE THRILL OF THE RIDE WORTH THE RISK? HORSE RIDER EXPERIENCES IN BRITISH EVENTING

## OVERVIEW

Eventing is a high risk sport, with horse and rider deaths occurring at an unacceptably high rate, and thus warrants continuing research (see also Cameron-Whytock's research).

Led by Myerscough researcher, Charlotte Brigden, the Myerscough team have collaborated with Dr Hannah Butler-Coyne, a Chartered Clinical Psychologist, to investigate some of the psychological aspects of the sport.

Most studies that have been undertaken within this field have focused on estimating the risk of horse riding based on type of injury, frequency of falls and prevalence of injury (e.g. Singer et al., 2003; Murray et al., 2005). Riders' perceptions and experiences of risk, and the effects of these factors have received some attention (e.g. Thompson and Birke, 2016), but this has tended to be subsidiary and superficial. This study is unique and, to the authors' knowledge, the first to focus on developing a specific understanding of 'horse falls' from the perspective of equestrian sportspeople.

The study employed two streams of data collection; e-survey and semi-structured interview. The e-survey was completed by 95 participants from the eventing community, along with a purposive sample of seven semi-structured interviews. Qualitative (words) data were coded by three researchers, using inductive coding and were then analysed using Thematic Analysis (grouping into themes).

Results confirmed that horse falls pose a significant threat to the eventing community, as 51.96% of respondents had experienced a horse fall. This was not related to length of participation (likelihood ratio chi-square = 4.736; df = 2; P = 0.094). This suggests that more experienced riders have no lesser or greater risk of a horse fall. When asked about their level of concern relating to horse falls whilst riding, 76.53% expressed a moderate level of concern (between 1 and 6/10). More concerning, 10.20% had "no concern at all", whilst 3.06% had 10/10 level of concern.

Three main themes were devised from the qualitative responses, a number of subthemes contributing towards overall themes. Main themes related to causes of horse falls (risk factors), recovery from horse falls and improvements / prevention. There was a clear divide in attitudes to the risk, between those who conformed to the opinion "it's in the hands of the gods" compared with those who felt that better training, qualification and organisation could reduce risks.

Due to the devastating deaths that continue to occur as a result of horse falls on the cross country circuit, this study is both timely and essential. There is an apparent need for a cultural change and shift to acknowledge that safety is everyone's responsibility and that high death rates should not be tolerated as a 'part of equestrian life'.



## RESEARCH IMPACT

The study has gained international recognition through its dissemination at the Equine Cultures in Transition International Conference in Leeds 2018.

The authors are hopeful that the findings will provide direction for improvements in safety for both horse and rider whilst also identifying further areas of research.

## INFLUENCING EDUCATION

The eventing safety research projects have inspired a number of undergraduate students to develop their own research within this field.

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## REFERENCES

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# SPORT AND HEALTH RESEARCH

## OVERVIEW

This research group, led by Lead Researcher, Dr. John Fry, was commissioned by the R&A to conduct a project assessing women's, girls', and family golf participation. Research highlights that a variety of different factors that contour participation figures, including: gender, class, ethnicity, time, money, image, age, education, socialisation into particular tastes, and role models. As such, it is important to address these issues in greater detail to help secure the future of golf in challenging times.

This R&A funded project looked at various factors which affect whole family participation in golf, by drawing together all previous research conducted in the area to establish what we currently know. This included golf specific literature, in addition to wider general sports research from the UK and abroad, in order to identify key points which are transferable to the golf environment.

This unique study shed light on a variety of important aspects of golf participation by bringing together, for the first time in one place, all the academic and industry research that has been conducted surrounding family sports participation. It defined what being 'family friendly' means for golf clubs and offered practical recommendations which can easily be actioned by all involved.

The following paper along the Sport and Health theme was published in the International Journal of Golf Science in 2018; Fry, McMahon, N.E., Hall, P.J., Barron, D.J., Davies, T., Yiannaki, C., & Caroline Watkins. (2018). 'Getting back into the Swing of Things': A Qualitative Study into Barriers and Facilitators to Golf Participation for Stroke Survivors. International Journal of Golf Science.

## RESEARCH IMPACT

Myerscough's Women's, Girls', and Family Participation in Golf: An Overview of Existing Research (2018) is proving to play a key role in the R&A's strategy to grow and develop golf around the world, by enhancing its appeal and encouraging participation, thus helping to achieve the strategy objectives of the recently launched Women and Golf Charter (2018). Specifically, the report offers golf clubs and R&A affiliates worldwide a roadmap to help overcome some of the challenges the sport faces, and thus help safeguard its future, by increasing women, girls', and overall family participation, which have traditionally been an under-represented group in golf.

The Women's, Girls', and Family Participation in Golf (2018) research was described by Martin Slumbers (Chief Executive, R&A) as being "a well-researched and thought provoking report", adding that it "provides actions and guidance that can lead to tangible, positive outcomes for golf and bring more women and girls into the sport". Positive results have already been identified by a number of golf clubs in the Lancashire area, who have implemented various elements of the report and witnessed associated increases in family participation.



Figure 4. The R&A publication following a literature review



Figure 5. IMG report

## INFLUENCING EDUCATION

The research has inspired undergraduate dissertation work in this area for students on the sport related suite of degree programmes. For example, Myerscough has forged a partnership with colleagues at the University of Central Lancashire assessing the relationship between sport and health/well-being. Students are directly involved in this project by, firstly, conducting their projects on sport and well-being, and, secondly, organising an event for Parkinson's patients.

Myerscough students are central to consultancy projects with key leading sports organisations. In addition to the R&A project, students devised questionnaires as part of their studies to look at participation in golf amongst people with Parkinson's disease. Students were also involved in research to assess spectator experiences at the 2018 Ricoh Women's British Open where Myerscough students facilitated successful questionnaire completion, compiled a report and subsequently presented findings to the industry related bodies.

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# GOLF PUTTING: ESTABLISHING THE IMPACT AND MECHANISMS OF A TARGET FOCUS WITH HIGH LEVEL GOLFERS

## OVERVIEW

Myerscough PhD student, David Moffat, is investigating the possible mechanisms behind Target Focused Aiming (TFA) as opposed to focusing on the ball.

For closed and self-paced skills, technique plays an important role. As such, it is unsurprising that much research and practical instruction is dedicated to understanding how athletes move (e.g., Bartlett, 2007; Blazevich, 2012). One domain characterised by this focus is golf (e.g., Keogh & Hume, 2012), where differences between techniques are widely compared and evaluated among coaches (McHardy, Pollard, & Bayley, 2006). In contrast, however, less critical attention has been applied to the relationship between perceptual processes and the effective selection, then execution, of an appropriate motor strategy (e.g., Hatfield, Haufler, Hung, & Spalding, 2004). This is unfortunate, since there is an obvious demand on the interaction between these processes during, for example, the task of putting. In this particular context, golfers must be able to accurately identify and use several factors, including target location and distance, surface topography and speed, in determining swing parameters such as aim direction and swing velocity. Accordingly, it is interesting that recent performances of some professional golfers (e.g., Major champions Jordan Speith and Louis Oosthuizen) have demonstrated much success in using a technique that challenges the perceived wisdom to “keep your eyes over the ball during execution” (hereafter termed ball focused aiming; BFA). Rather, these golfers putt while orienting their head, neck, and visual field toward the target location during execution (TFA). Such observations of sport (cf. Collins & Kamin, 2012) present challenge to fundamental understanding that is often developed through sport (e.g., Moore, Vine, Cooke, Ring, & Wilson, 2012; Steinberg, Frehlich, & Tennant, 1995).

To further understand TFA, David is investigating how it works, is it effective, who should use it, when should it be used and how it should be coached. Accordingly, and based upon this aim David’s specific research objectives are:

1. To establish and examine the current state of empirical research, theoretical explanations and applied importance of TFA against parallel-applied mechanisms.
2. Examine and test the novel imposition of TFA with high-level golfers in a naturalistic environment under ecologically valid and competitive conditions.
3. Investigate what high-level golfers attend to in the moments before movement initiation with Electroencephalography (EEG) measures when engaging TFA as a function of task-performance.
4. To explore what would happen if high-level golfers committed to and were given a TFA training intervention for an extended period of time. Their performance, retention, transfer, perceptions and lived experiences of TFA were examined.
5. To investigate a world-renowned putting coach’s perspective of TFA.

## RESEARCH IMPACT

There is potential for this research to inform and educate the golfing world, including the golfing public, golf coaches, practitioners, elite players and the Professional Golfing Association (PGA). This research has the potential of providing high-level golfers with an alternative aiming strategy that suits both their physical and mental abilities.

## INFLUENCING EDUCATION

David has followed his research path from undergraduate to PhD. He has presented his research at several conferences and to undergraduate students. He has published two papers in international journals and is an inspirational role model for other students to follow.

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Figure 6. Shows a golfer employing TFA on the left and BFA on the right



# COULD FUTSAL HOLD THE KEY TO DEVELOPING THE NEXT GENERATION OF YOUTH SOCCER PLAYERS?

## OVERVIEW

Myerscough researcher, Christopher Yiannaki is researching the potential use of futsal as a training tool as part of his D. Prof research.

Futsal research is in its infancy, with little literature investigating the sport, and its potential transference into soccer performance. This could explain why there has been little support, policy and consideration of futsal in the Elite Player Performance Plan (EPPP - Premier League, 2011).

Research into talent transfer suggests an essential level of similarity between sports and their respective demands in order to facilitate a positive transfer. Research suggests that futsal and soccer have a high similarity, with strong potential for transference generating wide possible impact. In addition, when compared with other forms of small-sided games, it is possible that futsal may offer a higher level of transfer with subtle differences in rules, equipment, and facilities positively impacting on skill acquisition. Research into 'practice histories' of elite players demonstrating the contribution of futsal to talent development are examined through this D. Prof; specific constraints inherent to futsal are also discussed, with crucial knowledge presented on the skills acquired through participation. These points are critically addressed using current research into futsal, with gaps in knowledge identified and areas for future research suggested.

## RESEARCH IMPACT

This D.Prof. has been linked heavily with industry, working with the futsal and football governing body, The FA, this research has enjoyed high practical impact at national team level. This research has helped develop the new national game strategy as well as informing practice for the senior men's team.

The FA futsal national strategy has been informed by contemporary research in this area, bring kudos to this D. Prof. and research impact.

With the drive to optimise development pathways based on systematic sports science support for schemes such as this, the sport of futsal could play a crucial role in soccer talent development programs.

## INFLUENCING EDUCATION

Links have been established with our closest super league team, Manchester Futsal club, who have sent free tickets for the whole Football Development Centre at Myerscough. Guest lecturers have also been provided free of charge to our students.

Funding has been secured from catapult, lending research team £40,000 of equipment for free. Free equipment has also been provided by The FA for use by Myerscough. Senior futsal team assistant manager has also been a keynote speaker at Myerscough annual conference.

Following this research, a link has also been set up with a company abroad, creating work placement opportunities for students in China.

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# FITNESS ASSESSMENT IN YOUTH SOCCER

## OVERVIEW

Modern soccer is increasingly characterised by shorter and more frequent sprint efforts emphasising the need to accelerate repeatedly. However, while this change has been mirrored in the approach to training and conditioning, fitness assessment remains biased towards the assessment of high speed running and repeated sprint ability.

Myerscough researcher, Dr. David Barron undertook research to explore the validity of contemporary field-tests for modern soccer so that the value and usefulness of fitness assessment may be improved.

Initially, the acceleration and deceleration activity during collegiate competitive soccer was measured using GPS technology. Findings confirmed that acceleration and deceleration activities are an integral part of competition. In addition, wide players completed greater distances during high magnitude acceleration/decelerations justifying the inclusion of position specific training.

Further investigation during match-play found evidence of repeated acceleration activity (RAA), where players were required to perform consecutive high speed accelerations (three consecutive accelerations [ $> 1.5 \text{ m}\cdot\text{s}^{-2}$ ] interspersed with a maximum of 45 s). Interestingly, there were no meaningful differences between playing positions, showing that RAA is a generic attribute at this level of competition (all positions: 7.09 bouts [ $\pm 4.70$ ]). Findings supported the inclusion of RAA conditioning and justified the derivation of a novel field test to assess this component.

In response, the Repeated Acceleration Performance Test (RAPT) was designed to provide a method of assessing RAA capacity. Test, re-test reliability assessed over 48 hours was strong (ICC 0.94, CV 1.2%). Sensitivity was assessed following a 6-week training intervention and was negatively affected by a congested fixture period and, therefore, requires further investigation (ICC 0.25, CV 4.0%). In conclusion, RAA is a crucial element of modern competitive soccer, and the absence of a suitable field test to assess this component was addressed with the derivation and validation of the Repeated Acceleration Performance Test.



## RESEARCH IMPACT

This work yielded two peer reviewed publications adding to the field of contemporary soccer performance analysis. More recently it has achieved citations in several international high impact factor journals.

This work also provided the impetus to investigate the physical demands of small-sided soccer via a collaboratively funded and supervised postgraduate studentship in conjunction with colleagues from the University of Central Lancashire and the University of Coimbra (Portugal). Data for this project was collected using the youth team from Portuguese Primeira Liga side, Associação Académica de Coimbra, and was published shortly after completion.

## INFLUENCING EDUCATION

This work has been presented to sports students at Myerscough College and the University of Coimbra. Higher Education students actively participated in data collection exposing them to applied research and development of their transferrable skills.

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# THE EFFECTS OF ISCHEMIC POST-CONDITIONING ON THE RECOVERY FROM EXERCISE

## OVERVIEW

The work on the effects of ischemic post-conditioning on recovery from exercise has been published with Alex Bliss and Stephen Patterson of St Mary's University and the following is the abstract:

Strenuous or unaccustomed eccentric exercise of high intensity or long duration results in exercise induced muscle damage (EIMD) (Howatson and Van Someren, 2008), which can impair performance. The ability to recover quickly from strenuous training and competition is a priority for athletes and coaches. Recently, the use of intermittent vascular occlusion (OCC) has been considered as a recovery strategy. OCC involves the use of specially designed cuffs, which are applied to the proximal end of the limb(s) in order to restrict blood flow to the muscles. The most widely utilised OCC intervention has been 5-minute cycles of occlusion-reperfusion as the general consensus is that this is the minimum amount of time required to induce a significant ischemic stimulus (Bushell, et al., 2002.). Moreover, it has been suggested that three cycles is optimal (Salvador, et al., 2016). In contrast to this however, Beaven et al., 2012, demonstrated recovery benefits using a shorter OCC intervention (2x3 minutes).

The purpose of this investigation was to examine the effectiveness of different lower-limb OCC interventions on the speed of recovery from resistance-based EIMD. With institutional ethical approval, 14 male rugby academy players (mean  $\pm$  SD 17.5  $\pm$  0.7 years, stature 180  $\pm$  6.2 cm, body mass 81.9  $\pm$  11.0 kg, training age 1.7  $\pm$  0.5 years) participated in a randomised crossover study. Participants undertook strenuous full-body resistance training sessions, designed to result in EIMD, and were assigned to one of five interventions (SHAM, 1x5OCC, 2x5OCC, 3x5OCC, and 5x3OCC). Indices of muscle damage were soreness (DOMS), thigh-circumference (TC), counter-movement jump (CMJ) height, 30 cm drop jump ground contact time (CT), reactive strength index (RSI), maximal isometric voluntary contraction (MIVC), and 1RM bench press (BP). Measurements were taken pre-exercise, and 24h and 48h post-exercise. Data were analysed using repeated measures ANOVAs. The results demonstrated significant interaction effects for DOMS, with perceptions of soreness for the 3x5OCC intervention being lower ( $p = 0.019$ ) at 24h compared with SHAM. Furthermore, significant interaction effects were observed for MIVC at 48h ( $p = 0.046$ ), showing faster recovery of MIVC for the 5x3OCC and 3x5OCC compared with the 1x5OCC intervention. However, MIVC recovery was not significantly faster than the SHAM. Significant time effects for all variables were observed, suggesting that EIMD was present following the resistance sessions. In conclusion, the 3x5OCC intervention was more effective in reducing DOMS 24h post exercise than SHAM.



## RESEARCH IMPACT

Dan Orwin completed the research as part of an MSc in strength and conditioning science at St Mary's University, Twickenham. He presented a research poster at the research conference at St Mary's, and had an abstract accepted by the British Association of Sport and Exercise Sciences (BASES), where he will present his research at their Annual Conference. Dan is looking to get his study published in the Journal of Strength and Conditioning Research.

## INFLUENCING EDUCATION

The research secured external funding to purchase some blood flow occlusion cuffs which will also be used in undergraduate programmes. This research also benefitted the students in the rugby academy from a practical application and recovery perspective.

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# SUSTAINABLE AGRICULTURE

## THE INFLUENCE OF TILLAGE INTENSITY ON EXTENDED PHENOTYPES AND PREDATOR DYNAMIC OF TENUIPHANTES TENUIS

### OVERVIEW

University Centre Myerscough PhD Student, Anna Harper, in collaboration with NIAB, Nottingham Trent University and the University of Central Lancashire, is investigating *Tenuiphantes tenuis* (Linyphiidae) a common spider found in British agricultural habitats. *T. tenuis* is a pioneer species that recolonises disturbed habitats rapidly and is a key predator of cereal pests, including aphids. It has been estimated that Linyphiidae spp. can reduce peak aphid populations by 49% in a wheat crop, a significant figure as aphids cause loss of yields through direct feeding and being vectors of disease. Soil tillage is industry normal practice to ensure the correct seedbed is constructed to allow successful germination. Widespread conventional inversion tillage (use of a plough or sub-soiler) causes comparatively more disturbance to Linyphiidae spp. than that of non-inversion tillage. One approach to the latter, direct drilling, is a method of inserting seeds directly into the soil with little prior disturbance.

The research aims to analyse how different intensities of soil tillage effects *T. tenuis*' capacity to control pests through examination of their extended phenotypes; structures influenced by the fitness of an organism though outside of the physical being. In the case of *T. tenuis*, the extended phenotype is the web. Field trials are being conducted on a NIAB experimental farm investigating different tillage systems. Plots include inversion tillage and two forms of direct drilling; direct drill and direct drill managed which includes straw raking.

Early field work found that for spring barley, all direct drill sample plots had significantly greater *Sitobion avenae* (English Grain Aphid) populations found in sheet webs. This supports evidence in recent literature and shows an increased efficiency in prey capture with decreased soil cultivation. This may be due to the habitat being submitted to less disturbance allowing above ground structures to remain in place which are potential anchor points for silk threads. A relationship between height of anchor point and thread length was also found. *T. tenuis*, have preference to anchor their webs to the highest points of material within a habitat. This behaviour lends itself to learnt behaviour that a high web will intercept an increased number of prey. When winter wheat had been harvested significantly greater web area was observed in the hedges opposite the direct drill tilled plots than conventional and direct drill managed. This increased spider web activity may correlate to the direct drill offering an enhanced environment for web construction with increased upright stubble. As temperature and prey availability decreases *T. tenuis* migrate to nearest shelter once the wheat had been harvested which is likely to be the adjacent field margin, this case being the direct drill hedge. Egg sacs were identified in the direct drill hedge margins supporting the theory of migration from direct drill field site into the adjacent margin. A General Linear Model analysing egg sac dimensions and location found a significant association between material and direct drill cultivation. The vegetation complexity of the hedge may have an impact on the site of construction of an egg sac and not just the adjacent field cultivation.

In all field sampling there has been a significance difference in the mean straw mass and total upright stubble. A microcosm experiment was set up to remove other variables and analyse how *T. tenuis* interacts with the straw and stubble more closely. When only one female *T. tenuis* was added the total thread length and web area was significantly greater in the straw and stubble side than the straw alone in all three soil tillage microcosms. This was the same result when two female *T. tenuis* were added though a higher percentage of straw was utilised for anchor material than the stubble equating to a significantly lower mean anchor point height for two female *T. tenuis* than one female *T. tenuis*. This may be due to competitive behaviour of female *T. tenuis*. One complete web was built in all the microcosms of two female *T. tenuis* in the stubble side which may indicate there was a prime web location and positioning a web low to the ground may help the web to be defended.

The aphid *S. avenae*, is a vector for the Luteovirus Barley Yellow Dwarf Virus which affects winter and summer barley by depleting monosaccharides to cause stunted growth and necrosis of the leaves. *T. tenuis* has been identified as a potential biological control reducing the level of *S. avenae* in barley. DNA Barcoding including Polymerase Chain-Reaction (PCR) is an advanced method of gaining verification in *T. tenuis* prey interactions. It involves the ability to identify specific prey DNA e.g. of aphids, from DNA extracted from *T. tenuis*.

### RESEARCH IMPACT

Combined aspects of this research will gain insights into how *T. tenuis*' behaviour, thus potential for biological control, may be affected by intensity level of soil tillage and how these insights can directly be incorporated into pest management plans for UK arable agriculture.

Insecticidal chemicals are used to reduce the number of *S. avenae* in a crop by attacking their nervous system. Such chemicals are known to harm the environment by being leached into waterways and target organisms have been shown to gain resistance negating their intended use and force synthesis of new products. In untreated crops Barley Yellow Dwarf Virus causes estimated average yield losses of 8 per cent in wheat and 2 per cent in barley. The problem of *S. avenae* activity requires intervention and the biological control of *T. tenuis* may help to limit Barley Yellow Dwarf Virus outbreak and help create a sustainable environment.

### INFLUENCING EDUCATION

The research has been taken to several national and international conferences including the Annual British Ecological Society Conference and the Association of Applied Biologist Conference at the Rothamsted Institute.

Anna Harper presented a talk on starting a career in Research and what it is like being a PhD candidate to the Young Journal Conference at Bolton Academy. The principal and methodology of DNA Barcoding has also been taught by the researcher to Myerscough undergraduate students.

To find out more:

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Figure 7. Left: Barley Yellow Dwarf Virus Seen in Spring Barley Grown in the Glasshouse. Black Circled *S. avenae*. Blue Circle Web, of *T. tenuis*. Middle: Linyphiidae spp. Egg Sacs Found In Hedges of the Field Margins. Right: PCR Gel Electrophoresis. *S. avenae* DNA showing in the brightest Bands, Outside lines are the DNA size markers.





# ARBORICULTURE AND URBAN FORESTRY RESEARCH

## OVERVIEW

There are two main research themes of arboricultural research at University Centre Myerscough:

1. **Tree biomechanics; branch attachment and the effects of natural bracing in trees.**
2. **Use of plant traits to improve species selection for urban environments.**

Myerscough researcher, Dr Duncan Slater's work has enabled the production of a new anatomical model for branch attachment in trees. The key finding that 'natural bracing' (configurations of branches and stems above a branch junction) greatly affects branch junction strength and is the primary cause of bark-included junctions in trees has had broad implications for practicing arborists. The research has resulted in the development of clearer protocols for the management of trees with bark-included junctions. A series of training events and workshops have been delivered to disseminate this important research to the arboricultural industry, both in the UK and abroad.

Myerscough researcher, Dr Andrew Hiron has continued his work, with Dr Henrik Sjöman (Swedish University of Agricultural Science) to use plant traits to inform better tree selection for urban landscapes. As part of a collaboration with Lancaster University (funded by NERC), national guidance on tree species selection was published by Trees and Design Action Group (TDAG) in summer 2018, (Tree Species Selection for Green Infrastructure) it has been downloaded over 1000 times. A regular article on tree selection in the Arboricultural Association ARB Magazine also helps to disseminate this work widely within the arboricultural community.

## RESEARCH IMPACT

The tree biomechanics research strongly supports the arboriculture industry, setting criteria by which to survey and predict the strength of branch junctions and to determine if they present a significant hazard in a tree's structure. This research has produced a new model for branch attachment with potential additional applications by applying the principles of this anatomy to artificially engineered structures. The study on natural braces has resulted in the production of clearer protocols for the assessment and management of trees with bark-included junctions and this will greatly influence the training given to arborists and arboriculturists around the world.

The tree selection research has produced a tree selection tool to increase the biodiversity and survival rate of street trees based upon physiological measurements of turgor loss point (the water potential at which tree leaves lose turgor) and the vulnerability of trees to drought induced cavitation.

The arboriculture and urban forestry research at Myerscough has produced 26 peer-reviewed publications in the last five years. A number of presentations to international audiences have also been made by Dr. Hiron and Dr. Slater.

## INFLUENCING EDUCATION

This arboriculture research has resulted in two PhDs. It has inspired many undergraduate and postgraduate projects related to the research, many of which have subsequently published in peer-review journals in their own right. There has been extensive use of urban tree management findings in undergraduate and postgraduate teaching in terms of the methodology employed and the findings and recommendations arising from the work. Scientific equipment bought for the research is also of direct use and benefit for teaching and student research. Dr. Hiron and Dr. Slater's research also features in *Applied Tree Biology* (Wiley-Blackwell) co-authored by Dr Hiron. This major new text for the arboricultural industry has sold over 1000 copies in the first year and helps to deliver Myerscough College's research to global audiences.

To find out more:

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## KEY PUBLICATIONS ASSOCIATED WITH THIS RESEARCH AREA

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- BROCKBANK, W. & SLATER, D. (2016). Rootcells@ improve the establishment of *Corylus colurna* L. in a compacted car park substrate. *Arboricultural Journal* 38: 41-56.
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