Title of Article: Perspectives of applied collaborative sport science research within professional team sports

Preferred Running Head: Team sports research collaborations

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Submission Type: Original Investigation

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Abstract Word Count: 237 words
Text-Only Word Count: 4155 words
Number of Tables and Figures: Tables = 3; Figures = 1

Abstract

The purpose of the study was to examine the perspectives of both academics and practitioners in relation to forming applied collaborative sports science research within team sports. Ninety-three participants who had previously engaged in collaborative research partnerships within team sports completed an online survey which focused on motivations and barriers for forming collaborations using blinded sliding scale (0-100) and rank order list. Research collaborations were mainly formed to improve team performance (Academic: 73.6 ± 23.3; Practitioner: 84.3 ± 16.0; ES = 0.54, small). Academics ranked journal articles importance significantly higher than practitioners (Academic: Mrank = 53.9; Practitioner 36.0; z = -3.18, p = .001, p < q). However, practitioners rated one-to-one communication as more preferential (Academic: Mrank = 41.3; Practitioner 56.1; z = -2.62, p = .009, p < q). Some potential barriers were found in terms of staff buy in (Academic: 70.0 ± 25.5; Practitioner 56.8 ± 27.3; ES = 0.50, small) and funding (Academic: 68.0 ± 24.9; Practitioner: 67.5 ± 28.0; ES = 0.02, Trivial). Both groups revealed low motivation for invasive mechanistic research (Academic: 36.3 ± 24.2; Practitioner: 36.4 ± 27.5; ES = 0.01, trivial), with practitioners have a preference towards 'fast' type research. There was a general agreement between academics and practitioners for forming research collaborations. Some potential barriers still exist (e.g. staff buy in and funding), with practitioners preferring 'fast' informal research dissemination compared to the 'slow' quality control approach of academics.

Keywords: Coaching, Education, Sport Science, Barriers, Performance, Survey

Introduction

The appreciation and application of sport science support within team sports has grown exponentially over the past few decades. Support structures traditionally involved one sport science practitioner having a plethora of roles within a team, such as physical trainer, nutritionist, physical therapist and even sport psychologist. The growth within the sports science sector is concurrent to the increased financial wealth of teams (Doust, 2011), allowing investment in both support staff and technology. Since the early use of heart rate telemetry in the 1980's (Achten & Jeukendrup, 2003), the substantial growth in technology and data available to teams has led to an increase in the number of different support roles within a team. It is now commonplace for professional teams to have upwards of ~10 sport science support staff in roles across the four disciplines of sports science; physiology, biomechanics, nutrition and psychology. Practitioners typically adopt roles such as data scientist, strength and conditioning coach, sports nutritionist, sports psychologist and rehabilitation fitness coach. Combined with colleagues from other disciplines such as performance analysis and medical services, there is upwards of ~20 support staff for one team, notwithstanding the team's technical coaching staff (Eisenmann, 2017).

Team sports practitioners work within a results-based environment and as such are faced with a high amount of pressure to deliver positive outcomes that enhance team performance. Coutts (2016) recently proposed a conceptual model within applied sport science which involves both '*fast*' and '*slow*' methods of working. The '*fast*' approach is often adopted by the practitioners working at the 'coal face' in which they have to make immediate decisions that have a direct impact on practice. Whilst this approach is relatively effective, due to the applied nature of data collection and analysis, the quality control checking of the information provided is often to a lesser standard in comparison to academic researchers. This has led to a number of collaborations between teams and universities, with the academics from the latter adopting a *'slow'* approach in terms of quality control, critical analysis and validation of methods used. This concept of knowledge transfer has been defined as "the process through which one unit (e.g. group, department, or division) is affected by the experience of another" (Argote & Ingram, 2000). The successful implementation of such strategies on a long-term basis could lead to potential enhancement of the sport science support programme (Coutts, 2016).

In order to bridge the gap between both approaches, it is now commonplace for teams to employ both university research consultants and student interns within the organisation (Jones et al., 2017). The 'embedded scientist' approach allows researchers to assess which of the day-to-day performance questions need answering through scientific rigor. Bishop (2008) developed an Applied Research Model for the Sport Sciences (ARMSS) which aimed to provide a guide for those looking to undertake this collaborative approach. The ARMSS model is broken down into eight stages: 1) defining the problem, 2) descriptive research, 3) predictors of performance, 4) experimental testing of predictors, 5) determinants of key performance predictors, 6) efficacy studies, 7) examination of barriers (and motivators) to uptake, and 8) implementation studies in a real sporting setting. This approach has become more popular despite sports performance research being seen as underfunded and with underutilized impact potential (Beneke, 2013).

Despite the increase in the amount of applied research being conducted by sport scientists, there still appears to be a gap when translating into practice with key stakeholders (i.e. coaches and athletes). Reade, Rodgers and Hall (2009) examined the transfer of sport science knowledge to high-performance coaches and found that coaches still prefer informal conversations with fellow coaches to gain knowledge of sport science, rather than with sports science experts. It may also be the case that sport scientists often research what is relevant to themselves rather than the key stakeholders, recently defined as '*interesting*' as opposed to '*useful*' (Jones et al., 2017). Williams and Kendall (2007) found that coaches perceived a requirement for further research in sports psychology, which is often undervalued within the professional setting. Bishop, Burnett, Farrow, Gabbett and Newton (2006) revealed the need for sport scientists to work on the communication of results to both coaches and athletes using their terminology rather than through traditional methods (e.g. journal articles). It may be the case that some lesser experienced sport scientists have a high level of theoretical knowledge but lack the 'soft skills' that come with more experience. Therefore, despite the increase in the number of collaborations within professional team sports, the efficacy of the programme has not been examined.

Given the ever-growing competition for higher education institutions to attract prospective students to enrol upon sport degree programs, there is necessity for universities and colleges to excel in higher education league table assessed criteria. For example, the Higher Education Funding Council for England (HEFCE) and Australian Research Council (ARC) have developed frameworks designed to assess the quality of research outputs from academic institutions (ARC, 2017; HEFCE, 2017). Outputs submitted for this review process are categorised using a tier structure based on research quality (e.g. from 'world leading' to 'below national standard'). Such assessment processes have placed pressure on academics to 'publish or perish', with a particular focus on attaining higher tier research outputs. Such studies typically involve invasive, mechanistic-type research in order to be highly recognised from the research councils (e.g. 'four star' research rating). Although not empirically proven, such paradigms are likely to have important implications for the nature (descriptive or mechanistic), duration (fast or slow) and subsequent overall impact (interesting or useful) of collaborative opportunities that academics decide to pursue with team sport practitioners.

The purpose of the present study was to examine the perspectives of both academics and practitioners in relation to forming applied collaborative sport science research within team sports. Specifically, the study aimed to identify the outcomes and any potential barriers relating to collaborations.

Methods

Participants

Ninety-three participants (male = 82, female = 11) who stated that they had engaged in a collaborative research partnership within the previous eighteen months of receiving an invitation to participate, voluntarily completed the survey to examine their perspectives of applied research between July to September 2017. This was considered the time period when most team sport practitioners and academic researchers would be operational. Each invitation to participate was accompanied by a study information cover letter and participants provided informed consent. The study was approved by the institutional research ethics committee at the University of Hull.

Participants were predominantly from Europe (*n* = 71) and Australia/Oceania (*n* = 16), with others from Asia (*n* = 2), Africa (*n* = 2), and North America (*n* = 2). All respondents primarily worked within one of 11 team sports (soccer = 50, rugby union = 22, Australian rules football (AFL) = 8, rugby league = 4, other sports = 9). These represented national level (*n* =

54), domestic level (*n* = 25), regional level (*n* = 9) and governing bodies (*n* = 5). Respondents mainly worked with senior squads (*n* = 66), with others working with academy squads (5-16 years; *n* = 12) and development squads (16-23 years; *n* = 15). The majority of respondents were permanent full-time (*n* = 63) or worked as a consultant (*n* = 21), with others working part-time (*n* = 8) and as an intern (*n* = 1). Overall 43% of the sample had worked in their current role for more than five years. Most (84.9%) had been in post for longer than 12 months. A majority (*n* = 51) worked as a sport scientist, with others working as a fitness coach/strength and conditioning coach (*n* = 14), nutritionist (*n* = 11), physiotherapist (*n* = 5), managerial position (*n* = 5), sociologist (*n* = 2), talent ID scout (*n* = 2), psychologist (*n* = 1), data analyst (*n* =1) and a technical coach (*n* = 1). Sixty-three held a doctorate qualification, 23 a Master's degree, and seven a Bachelor's degree as highest qualification.

Procedure

The survey was distributed by the researchers electronically using an online platform (SurveyMonkey, California, United States). A link for the online survey was emailed to potential participants and was then accompanied by a second email invitation to those who had not previously responded during the latter weeks of this period (September 2017). This resulted in a 43% and 56% survey completion rate for academics (*n* = 57) and practitioners (*n* = 36), respectively.

Survey design

A survey consisting of 106 items was developed to gather information around academics and practitioner's perspectives to forming applied collaborative sport science research within team sports. The survey was specific to either academics or practitioners but the number of items remained equal across groups. Items were developed by the lead researcher based on previous research and experience, which was then distributed to the research team for critique and further development. Seven sections were developed for the survey: general information (Section 1: 25 items), motivations (Section 2: 17 items), formation (Section 3: 15 items), design (Section 4: 11 items), dissemination (Section 5: 17 items), overall perceptions (Section 6: 9 items) and barriers (Section 7: 13 items).

The general information (Section 1) part of the survey comprised of multiple-choice questions designed to ascertain the eligibility, suitability and additional information (e.g. area of research, funding details and number of embedded research students). Responders were required to use blinded, sliding (0-100) scales to evaluate the level of motivation (Section 2), responsibilities during collaboration formation (Section 3), research design (Section 4), preferred dissemination of findings (Section 5), overall perceptions (Section 6) and perceived barriers (Section 7) they apportion to discrete components of applied team-sport research collaboration. For each section, the slider anchors were substituted to match the context of the primary question. Such lines of enquiry were then followed by an opportunity for the responder to expand upon their perceptions within an open-text box. For section five (dissemination), respondents ranked which method of dissemination they would like to be used when receiving research findings using a rank order list (1 = Most preferred, 8 = Least preferred).

Statistical analysis

Only fully complete returned surveys were used for the data analysis (n = 93, 45.2%). Preliminary analyses screened data for outliers using Q-Q plots and normal distribution using skewness and kurtosis values. All variables demonstrated acceptably normal distribution with values reasonably close to zero (skewness < 2, kurtosis < 5), with no outliers identified (Field, 2017). Data were corrected for type 1 errors using False Discovery Rate (FDR) (Benjamini & Hochberg, 1995). Null hypotheses were rejected if $p < q$ and the 95% confidence interval did not contain zero. Chi-square analysis compared groups to determine even distribution of demographic variables within academic and practitioner groups. Independent-samples *t*-tests were used to compare responses between groups for motivation, responsibility, perceived importance of research facets, current and past research collaboration, and barriers to collaboration. Mann-Whitney tests examined the rank order variables of methods of research dissemination for practitioners and for academics. For each parametric test, 1,000 bootstrapped samples were ran to generate mean survey scores ± standard deviation (SD), mean difference (M_{diff}) with 95% confidence intervals (95% CI), accompanied by relevant effect sizes (ES) (<0.2 *trivial*, 0.2-0.6 *small*, 0.6-1.2 *moderate*, 1.2-2.0 *large* and >2.0 *very large*) (Hopkins, Marshall, Batterham, & Hannin, 2009).

Results

General information

Data from respondents showed that fifty-seven percent of respondents had participated in funded research, which tended to be equally financed (52.3 ± 36.8%). However, less than half (48.2%) declared that they used mutually agreed research contracts.

Level of motivation

High scoring motivators included *improve team performance* (Academic: 73.6 ± 23.3; Practitioner: 84.3 ± 16.0; ES = 0.54, *small*), *improve team health* (Academic: 75.8 ± 20.9; Practitioner: 80.2 ± 20.1; ES = 0.21, *small*), and *improve own knowledge* (Academic: 78.6 ± 20.9; Practitioner: 80.2 ± 20.1; ES = 0.21, *small*) and *continuing professional development* (Academic: 74.4 ± 22.5; Practitioner: 75.6 ± 21.7; ES = 0.05, *trivial*). Low scoring motivators included *Pressure from senior staff*, (Academic: 24.4 ± 25.5; Practitioner: 20.4 ± 23.4; ES = 0.16, *trivial*), *pressure from governing body* (Academic: 16.6 ± 20.2; Practitioner: 15.1 ± 18.9; ES = 0.08, *trivial*) and *additional paid work*, (Academic: 22.7 ± 23.9; Practitioner: 21.6 ± 25.1; ES = 0.05, *trivial*).

Responsibilities during collaboration formation

Figure 1 highlights that the level (0 – *academic* to 100 – *practitioner*) of perceived responsibility during collaboration formation is largely considered the responsibility of academics, with the exception of *practical skill development*. Although not statistically significantly different, practitioners typically saw responsibilities as a little more shared. Of the 14 issues, the academics rated responsibility in favour of the academic on 13 occasions. The only exception was funding, which academics (47.4 ± 18.6) rated as more equally shared than practitioners (38.8 ± 20.8).

Research design

Table 1 shows that the level (0 – *not important* to 100 *very important*) of perceived importance placed on research facets. *Player buy in* (Academic: 80.1 ± 15.8; Practitioner: 74.3 ± 19.2; ES = 0.33, *small*), *staff buy in* (Academic: 83.2 ± 18.9; Practitioner: 78.0 ± 16.1; ES = 0.30, *small*) and *application to performance* (Academic: 81.7 ± 17.7; Practitioner: 75.9 ± 23.3; ES = 0.29, *small*) were considered greatest importance. Whereas, *conducted on academic facilities* (Academic: 36.4 ± 25.5; Practitioner: 29.3 ± 20.0; ES = 0.03, *trivial*), and *invasive mechanistic research* (Academic: 36.3 ± 24.2; Practitioner: 36.4 ± 27.5; ES = 0.01, *trivial*), were seen as the least important. Academics rated *embedded research students* as more important than practitioners did (Academic 69.7 ± 22.5*;* Practitioner*:* 59.3 ± 21.1; ES= 0.48, *small*), though correcting for multiple comparisons identified that this could be a false discovery. Practitioners did show a *moderate* (ES = 0.72) difference in preference for *research that is fast* (60.8 ± 23.9) versus *slow* (44.3 ± 21.8).

Dissemination of research findings

Academics and practitioners demonstrated some variation in identifying a rank (1 – *most preferred* to 8 – *least preferred)* order of methods of perceived preference for research dissemination (Table 2). Specifically, academics ranked *journal articles* significantly higher than practitioners did (Academic: M_{rank} = 53.9; Practitioner 36.0; z = -3.18, p = .001, p < q). However, practitioners rated *one-to-one* as more preferential (Academic: M_{rank} = 41.3; Practitioner 56.1; z = -2.62, p = .009, $p < q$). There was little difference between groups when identifying player preference.

Overall perceptions of research collaboration

In general, both academics and practitioners stated little agreement (≤ 50 [0 - *strongly disagree* to 100 - *strongly agree*]) to statements relating to their perceptions of current and past collaboration. The lowest scoring area for academics was their motivation to *seek future collaborations* (19.5 ± 24.9), and that practitioners had *developed own knowledge* (29.1 ± 28.5). Both academics and practitioners showed that the completion of the survey helped them to *reflect upon research collaboration* (Academic: 38.5 ± 24.5; Practitioners: 50.3 ± 24.5; ES = 0.48, *small*).

Perceived barriers to collaboration

Perceived level (0 – *strongly disagree* to 100 – *strongly agree*) of *barriers to collaboration* showed that academics reported that *staff buy in* (Academic: 70.0 ± 25.5; Practitioner 56.8 ± 27.3; ES = 0.50*, small*), *Manager buy-in* (Academic: 68.6 ± 25.2; Practitioner: 59.9 ± 29.7; ES = 0.32, *small*) and *funding* (Academic: 68.0 ± 24.9; Practitioner: 67.5 ± 28.0; ES = 0.02, *trivial*) were the greatest barriers for them participating in collaborative research partnerships (Table 3). However, it was mutually perceived by both that *club secrecy* (Academic: 58.4 ± 26.5; Practitioner: 58.0 ± 24.7; ES = 0.02, *trivial*) and *time to dedicate* (Academic: 65.7 ± 25.0; Practitioner: 67.4 ± 22.5; ES = 0.07, *trivial*) could also act as barriers.

*****FIGURE 1 NEAR HERE*****

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Discussion

The present study examined the perspectives of both academics and practitioners in relation to forming applied collaborative sport science research partnerships within team sports. In general, there appears to be agreement in motivations between academics and practitioners for research collaborations. Potential barriers that were identified include *funding*, *time to dedicate towards the research* and *staff buy in*. Differences existed in terms of how research should be disseminated, with academics preferring more formal outputs (e.g. journal articles and conferences) compared with practitioners preference for more informal methods (e.g. one-to-one conversations and infographics). Both groups reported low motivation for conducting invasive mechanistic research, with practitioners favouring *'fast'* type research that has immediate impact on practice.

Applied sport science research aims to produce an outcome that is relevant to sport and can be applied to enhance performance (Bishop et al., 2006). In order for this to be achieved, relevant information generated from applied studies must be communicated effectively to the key stakeholders involved in the performance process (Martindale & Nash, 2013). The present study revealed that academics have a preference for research dissemination in journal articles and conference proceedings compared with practitioners who favour a more informal approach. Reade et al. (2009) found that coaches were least likely to gain sport science knowledge from academic journals due to lack of time and ability to interpret findings. Practitioners in the present study reported a higher preference toward infographics as a method of dissemination. The use of infographics is now common place on social media platforms, such as Twitter, with practitioners preferring their ease of access and simplicity in relaying information (Burke, 2017). It may be the case that academics feel pressure to disseminate findings using established methods that can be used as part of university research quality metrics, such as the Research Excellence Framework (REF). Whilst some publishers are now allowing the publication of informal methods such as infographics in their journals (see Heron et al. (2017) for example), their lack of ability to score high on the tier structure of research assessment frameworks will likely deter academics from this approach if key assessed metrics remain unchanged. One possible solution is for academics to be evaluated more clearly on their 'impact' (e.g. REF impact case studies) that results in a positive change to policy and practice.

According to the ARMSS model developed by Bishop (2008), applied research should aim to solve problems encountered in the applied setting through description, experimentation and implementation. It was found in the present study that both academics and practitioners had low motivation to conduct experimental research. By limiting this type of research, the projects may only reach stage 2 of the ARMSS model (i.e. descriptive) rather than being experimental to develop practice. Eisenmann (2017) refers to applied sciences as 'translational science' in which researchers aim to bridge the gap between the laboratory and playing field. The main barriers for preventing invasive research appeared to relate to budget restriction and player/coach buy in. Although it may be difficult to carry out laboratory-based methods in an applied setting, this should be seen as an interesting challenge for academics and practitioners rather than a hindrance. Whilst it has been acknowledged that sports performance research is underfunded (Beneke, 2013), both academics/practitioners and external bodies (e.g. sporting teams, league representatives) should both look to contribute to finding solutions in order to overcome the potential barrier of funding to enhance our understanding of sport science.

In terms of potential barriers that may exist with establishing applied collaborative research, both academics and practitioners reported that *funding* and staff *buy in* were major challenges. One of the issues that may result in a lack of staff buy in is due to the importance that non-scientific staff place on sport science as a practice. Bishop (2008) described sport science as 'using the best evidence at the right time, in the right environment, for the right individual to improve performance'. Unfortunately it may be the case that non-scientific staff within team sports see the sport science discipline as insignificant, with practitioners being marginalized in terms of their input (Eisenmann, 2017). Whilst sport science has been adopted within coach education programmes for those currently coming through the system, some 'old school' coaches may dismiss the usefulness of sport science research as it could expose a weakness in their current knowledge base. This finding was evident in the present study, with practitioners perceiving *inferior knowledge* as a greater barrier than academics (ES = 0.28, *small*). However, recent research has shown that coaches find sport science support useful, although the perception of purpose may differ between coach and practitioner (Weston, 2018). The issue around funding as a potential barrier may relate to who feels ultimately responsible for providing the finance for research projects. Fifty-seven percent of respondents had participated in funded research, which tended to be equally financed by both parties. Interestingly, only 48% of these respondents used a mutually agreed research contract. The survey also revealed that academics are seen as responsible for the majority of the research process, with practitioners taking a lead on practical skill development. Therefore, it may be speculated that some of the potential issues regarding funding may be due to a lack of ownership, with both parties having a difference in opinion in terms of who should ultimately be responsible for leading the collaborative projects. It would be recommended that both parties sign a research contract agreement when establishing collaborations to clearly outline the roles and responsibilities from both sides.

For the practitioner who works day-to-day in performance-based sport, the environment can be high paced and often demanding in terms of time commitment (Coutts, 2016). This results-based industry often causes short-sightedness amongst practitioners who are concerned about the next result in order to keep themselves in employment rather than thinking long-term. The present study supported this notion, with practitioners favouring the *'fast'* type approach to research projects rather than the *'slow'* deliberate and focused approach. Whilst the *'fast'* approach can be useful in the applied setting to get quick buy in from staff and athletes, ultimately the *'slow'* research improves the quality control of data produced which ultimately allows for long-term implementation. McCall et al. (2016) discussed the need for sports teams to adopt the 'research and development (R&D)' approach as used within the business world to generate new ideas and technology. The use of in-house research projects may potentially lead to competitive advantage with input from 'off-field brains'. However, the research conducted must be relevant to the team, rather than academics conducting research solely for personal interest reasons (Jones et al., 2017).

One of the main issues that exists is the time-frame involved from initiation of a project idea through to the final end product. Burgess (2017) describes the need for balance between using *'slow'* type research and the practical realisation of trying to implement such peer-reviewed approaches within team sports. Whilst this is a pertinent point raised, practitioners are sometimes guilty of ignoring the science component of sport science and adopting new methodologies without quality control and validation (Burke, 2017). In order to enhance the use of 'off-field brains' for collaborative research, academics must look to improve the process in which research is administrated and disseminated. For example, peer-review in scientific journals is a slow and inconsistent process that deters many practitioners from publishing their work (Smith, 2006). Improving such processes and adopting newer methods (e.g. free-access, online platforms such as Sport Performance & Science Reports (https://sportperfsci.com/)) may help to break down the stigma attached to *'slow'* type research. In addition, if practitioners and academics agree on the research objectives at the beginning of a project, this may allow for realistic expectations to be managed (i.e. allowing for '*slow'* research to be conducted, with the knowledge that the results will be worth the wait).

Whilst the information gathered from the survey provides useful insight into the perceptions and potential barriers of collaborative research, several areas still require further investigation. The sample of respondents were mainly from Europe and Australia, with the majority working in soccer and rugby union. Differences in perceptions may exist in other regions across the world. For example, Asia is an emerging team sports market in which sport science is still in its relative infancy. Sports such as soccer, rugby and AFL tend to have developed links with universities with embedded physical and data scientists. It would be interesting to have a larger sample across other team sports to see if perceptions differ depending on the sport (including level of competition). Future research should focus on strategies to overcome some of the potential barriers raised in the present study, such as funding issues and staff buy in.

In summary, the present study found that there appears to be a general agreement in motivation between academics and practitioners for forming research collaboration. However, potential barriers still exist when forming such collaborations, most notably staff buy in and funding sources. Practitioners favoured more *'fast'*, informal methods of research dissemination (e.g. one-to-one conversations and infographics) compared to academics who preferred *'slow'* scientific outputs (e.g. journal articles and conferences). Both groups were pessimistic about conducting experimental type research, mainly due to the barriers previously mentioned. Whilst difficult to conduct in the applied setting, such research can identify which interventions work with specific athletes and the potentially underlying reasons. We would recommend that both parties sign research contract agreements when establishing collaborations to outline the roles and responsibilities, whilst also managing the expectations across the research timeframe.

Acknowledgements

We would like to thank all participants for taking the time to complete and return the survey for this study.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

Achten, J., & Jeukendrup, A. (2003). Heart rate monitoring. *Sports Medicine*, *33*(7), 517–538.

Anderson, L., Orme, P., Naughton, R. J., Close, G. L., Milsom, J., Rydings, D., … Morton, J. P. (2017). Energy intake and expenditure of professional soccer players of the English Premier league: Evidence of carbohydrate periodization. *International Journal of Sport Nutrition and Exercise Metabolism*, *27*, 228–238. http://doi.org/10.1123/ijsnem.2016-0259

ARC. (2017). Excellence in Research for Australia. Retrieved from http://www.arc.gov.au/excellence-research-australia

Argote, L., & Ingram, P. (2000). Knowledge Transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes*, *82*(1), 150–169. http://doi.org/10.1006/obhd.2000.2893

Beneke, R. (2013). Sport performance research: Sexy, underfunded, and with underutilized impact potential. *International Journal of Sports Physiology and Performance*, *8*(4), 349–350.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistics Society, Series B (Methodological)*, *57*, 289–300.

Bishop, D. (2008). An Applied Research Model for the Sport Sciences. *Sports Medicine*, *38*(3), 253–263. http://doi.org/10.2165/00007256-200838030-00005

Bishop, D., Burnett, A., Farrow, D., Gabbett, T., & Newton, R. (2006). Sports-science roundtable: does sports-science research influence practice? *International Journal of Sports Physiology and Performance*, *1*(2), 161–168. http://doi.org/10.1123/ijspp.1.2.161

Bradley, W. J., Morehen, J. C., Haigh, J., Clarke, J., Donovan, T. F., Twist, C., … Close, G. L. (2016). Muscle glycogen utilisation during Rugby match play: Effects of pre-game carbohydrate. *Journal of Science and Medicine in Sport*, *19*(12), 1033–1038. http://doi.org/10.1016/j.jsams.2016.03.008

Burgess, D. J. (2017). The research doesn't always apply: Practical solutions to evidence-based training-load monitoring in elite team sports. *International Journal of Sports Physiology and Performance*, *12*(S2), 136–141. http://doi.org/10.1123/ijspp.2016-0608

Burke, L. M. (2017). Communicating Sports Science in the Age of the Twittersphere. *International Journal of Sport Nutrition and Exercise Metabolism*, *26*, 1–5.

Coutts, A. J. (2016). Working Fast and Working Slow: The Benefits of Embedding Research in High-Performance Sport. *International Journal of Sports Physiology and Performance*, *11*, 1–2. http://doi.org/10.1123/IJSPP.2015-0781

Doust, J. (2011, January 24). Sport and exercise science has become a driving force for change. *The Independent*. Retrieved from http://www.independent.co.uk/student/career-planning/sport-and-exercise-science-has-become-a-driving-force-for-change-2192287.html

Eisenmann, J. (2017). Translational Gap between Laboratory and Playing Field : New Era to Solve Old Problems in Sports Science. *Translational Journal of the American College of Sports Medicine*, *2*(8), 37–43. http://doi.org/10.1249/TJX.0000000000000032

Field, A. (2017). *Discovering statistics using IBM SPSS statistics*. SAGE.

HEFCE. (2017). Initial decisions on the Research Excellence Framework 2021. Retrieved from http://www.ref.ac.uk/publications/2017/initialdecisionsontheresearchexcellenceframework2021.html

Heron, N., Usher, R., MacLeod, D., Sarrieguil, I., Mercadel, J., & Tully, M. A. (2017).

Infographics: Winning road cycle races: a Team Sky perspective. *British Journal of Sports Medicine*, Ahead of Print. http://doi.org/10.1136/bjsports-2017-097819

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hannin, J. (2009). Progressive Statistics for Studies in Sports Medicine and Exercise Science. *Medicine & Science in Sports & Exercise*, *41*(1), 3–13. http://doi.org/10.1249/MSS.0b013e31818cb278

Jones, B., Till, K., Emmonds, S., Hendricks, S., Mackreth, P., Darrall-Jones, J., … Rock, A. (2017). Accessing off-field brains in sport; an applied research model to develop practice. *British Journal of Sports Medicine*, Ahead of Print.

Martindale, R., & Nash, C. (2013). Sport science relevance and application: Perceptions of UK coaches. *Journal of Sports Sciences*, *31*(8), 807–819. http://doi.org/10.1080/02640414.2012.754924

McCall, A., Davison, M., Carling, C., Buckthorpe, M., Coutts, A. J., & Dupont, G. (2016). Can off-field "brains" provide a competitive advantage in professional football? *British Journal of Sports Medicine*, *50*(12), 710–712. http://doi.org/10.1136/bjsports-2015-095807

Reade, I., Rodgers, W., & Hall, N. (2009). Knowledge Transfer: How do High Performance Coaches Access the Knowledge of Sport Scientists? *International Journal of Sports Science and Coaching*, *3*(3), 319–334. http://doi.org/10.1260/174795408786238470

Smith, R. (2006). Peer review: A flawed process at the heart of science and journals. *Journal of the Royal Society of Medicine*, *99*(4), 178–182. http://doi.org/10.1258/jrsm.99.4.178

Weston, M. (2018). Training load monitoring in elite English soccer: a comparison of practices and perceptions between coaches and practitioners. *Science and Medicine in Football*, Ahead of Print. http://doi.org/10.1080/24733938.2018.1427883

Williams, S. J., & Kendall, L. (2007). Perceptions of elite coaches and sports scientists of the research needs for elite coaching practice. *Journal of Sports Sciences*, *25*(14), 1577–1586. http://doi.org/10.1080/02640410701245550

Table 1. Ranked (1 = most preferred; 8 = least preferred) academic and practitioners perspectives of preferred methods of research dissemination.

Question	Academic		Practitioner		M_{diff} (95% CI)	*Effect Size*	*Qualitative*
	Mean	*SD*	Mean	*SD*			
Embedded research student	69.7	22.5	59.3	21.1	10.4 (1.8. 19.8)	*0.48*	*Small*
Application to performance	81.7	17.7	75.9	23.3	5.9 (-2.6, 15.5)	*0.29*	*Small*
Conducted on club facilities	63.3	25.5	64.0	22.4	-0.7 (-10.9, 9.1)	*0.03*	*Trivial*
Conducted on academic facilities	36.4	25.5	29.3	20.0	7.2 (-2.0, 16.0)	*0.31*	*Small*
Research is *fast*	52.4	25.8	60.8	23.9	-8.4 (-17.7, 2.0)	*0.34*	*Small*
Research is *slow*	53.7	25.1	44.3	21.8	9.3 (-0.1, 19.0)	*0.40*	*Small*
Staff buy in	83.2	18.9	78.0	16.1	5.2 (-1.8, 12.4)	*0.30*	*Small*
Player buy in	80.1	15.8	74.3	19.2	5.8 (-1.6, 13.5)	*0.33*	*Small*
Invasive mechanics research	36.3	24.2	36.4	27.5	-0.1 (-11.5, 11.2)	*0.01*	*Trivial*
Validity/reliability testing	72.2	24.0	72.2	24.9	-0.1 (-9.9, 10.4)	*0.00*	*Trivial*

* Denotes statistically significant difference for subscripted variables ($P \leq 0.05$)
Research is *fast* i.e. quick possibly descriptive.
Research is *slow* i.e. longitudinal.

Table 2. Academic and practitioner perceived importance (0 = Not important; 100 = Very important) of research collaboration facets.

Question	Preference of practitioner			Practitioner perceived preference of player		
	Academic mean rank score	Practitioner mean rank score	*z*	Academic mean rank score	Practitioner mean rank score	*z*
Journal article	53.9	36.0	**-3.2***	49.4	43.2	-1.4
Conference	51.8	39.4	-2.2	49.9	42.5	-1.5
Group (>10 people)	44.2	51.5	-1.3	46.4	48.0	-0.3
Intimate seminar (<10 people)	45.3	49.8	-0.8	45.1	49.9	-0.9
One to one	41.3	56.1	**-2.6***	43.1	53.2	-1.8
Summary report	47.9	45.6	-0.40	46.0	48.6	-0.5
Video	47.0	46.9	-0.1	47.0	47.0	-0.1
Infographic	43.7	52.3	-1.5	48.8	44.1	-0.8

* Denotes statistically significant difference for subscripted variables ($P < 0.05$)

Table 3. Academic and practitioner level of perceived (0 = Not a factor; 100 = Major factor) barriers to research collaboration.

Question	Academic (n = 57)		Practitioner (n = 36)		M_{diff} (95% CI)	*Effect Size*	*Qualitative*
	Mean	*SD*	Mean	*SD*			
Funding	68.0	24.9	67.5	28.0	0.5 (-10.1, 12.5)	0.02	*Trivial*
Time to dedicate	65.7	25.0	67.4	22.5	-1.7 (-11.2, 8.6)	0.07	*Trivial*
Senior management	62.7	27.7	52.6	31.0	10.1 (-2.2, 22.3)	0.35	*Small*
Manager buy in	68.6	25.2	59.9	29.7	8.7 (-3.0, 20.8)	0.32	*Small*
Staff buy in	70.0	25.5	56.8	27.3	13.2 (2.4, 24.3)	0.50	*Small*
Player buy in	58.7	26.0	49.2	27.9	9.5 (-2.6, 20.9)	0.35	*Small*
Inferior knowledge	36.5	24.4	42.8	20.7	-6.3 (-15.2, 3.6)	0.28	*Small*
Previous negative experience	40.4	25.9	48.6	21.3	-8.3 (-17.5, 1.9)	0.35	*Small*
Jargon	36.7	24.1	42.9	28.9	-6.2 (-16.7, 4.7)	0.23	*Small*
Lack of transparency	45.6	25.7	49.9	24.4	-4.3 (-14.1, 6.2)	0.17	*Trivial*
Own interest	48.4	30.7	56.8	24.7	-8.3 (-19.6, 2.3)	0.30	*Small*
Club secrecy	58.4	26.5	58.0	24.7	0.4 (-9.9, 10.7)	0.02	*Trivial*

Figures Captions

Figure 1. Academic (a) and practitioner (b) perceptions of responsibility (0 = Academic; 100 = Practitioner) during the formation and delivery of collaborative research partnerships within team-sports. Black squares = academics, white diamonds = practitioners.