ORIGINAL ARTICLE

Perspectives of applied collaborative sport science research within professional team sports

JAMES J. MALONE 1, LIAM D. HARPER 2, BEN JONES 3,4,5,6, JOHN PERRY 7, CHRIS BARNES 8, & CHRIS TOWLSON 9

1 School of Health Sciences, Liverpool Hope University, Liverpool, UK; 2 Human and Health Sciences, University of Huddersfield, Huddersfield, UK; 3 Institute for Sport, Physical Activity and Leisure, Leeds Beckett University, Leeds, UK; 4 The Rugby Football League, Leeds, UK; 5 Yorkshire Carnegie Rugby Union Club, Leeds, UK; 6 Leeds Rhinos Rugby League Club, Leeds, UK; 7 Mary Immaculate College, Limerick, Ireland; 8 CB Sports Performance Ltd, Rugeley, UK & 9 Sport, Health and Exercise Science, University of Hull, Hull, UK

Abstract

The purpose of the study was to examine the perspectives of both academics and practitioners in relation to forming applied collaborative sport 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 the team performance (Academic: 73.6 ± 23.3; Practitioner: 84.3 ± 16.0; effect size (ES = 0.54), small). Academics ranked journal articles’ importance 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 communication as more preferential (Academic: M rank = 41.3; Practitioner: 56.5; 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

Highlights

• Staff buy in and funding sources appear to be two barriers that prevent the successful implementation of sport science research collaborations.
• 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).
• The future of applied sport science research should look to develop research active practitioners through academic collaboration and challenge the ‘status quo’ to achieve the highest standards of scientific rigor.

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 and even sport psychologist. The growth within the sport science sector is concurrent to the increased financial wealth of teams (Doust, 2011), allowing investment in both support staff and technology. 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 several sport science support staff in roles across the four disciplines of sport science: physiology, biomechanics, nutrition and psychology. Practitioners typically adopt roles such as strength and conditioning coach, data scientist, sport psychologist and rehabilitation fitness coach. Combined with colleagues from other disciplines, such as performance analysis and medical services, there is upwards of ~15 support staff for one team, notwithstanding the team’s technical coaching staff (Eisenmann, 2017).

Team sport practitioners work within a result-based environment and as such are faced with a high amount of pressure to deliver positive outcomes that enhance the 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 has short-term benefits, due to the applied nature of data collection and analysis, the quality control checking of the information provided can be of a lower standard. This has led to a number of collaborations between teams and universities, with the academics 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 or department) 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 organization (Jones et al., 2017). This ‘embedded scientist’ approach combines the roles of ‘research practitioner’ in which academic principles are used on a daily basis within practice. Such approaches provide further insight into which of the day-to-day performance questions need answering through scientific rigour. 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 sport 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. 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 sport 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 such programmes has not been examined.

Given the ever-growing competition for higher education institutions to attract prospective students to enrol upon sport degree programmes, there is a necessity for institutions 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 categorized using a tier structure based on the research quality and impact (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 with public impact linked to funding opportunities. Such studies typically involve invasive, mechanistic-type research in order to be highly recognized 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 18 months of receiving an invitation to participate, voluntarily completed the survey between July and September 2017. The participants consisted of both academics (n = 57) and practitioners (n = 36). Although it must be acknowledged that participants may have been involved in both roles (i.e. as academics and practitioners), we defined each group based on their main job profession and source of income. All procedures were submitted and approved by the host institution’s Ethics Committee (ref: 1617153) and conformed to the principles of the Declaration of Helsinki. Each invitation to participate was accompanied by a study information cover letter and participants were provided informed consent.

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 were involved within one of 11 team sports (soccer = 50, rugby union = 22, Australian rules football = 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 were mainly involved with senior squads (n = 66), with others involved 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 (85%) had been in the post for longer than 12 months. A majority (n = 51) worked as a sport scientist (including within an academic supervision capacity), 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 7 with a Bachelor’s degree as the highest qualification.

Procedure

The survey was distributed by the researcher team electronically using an online platform (SurveyMonkey, California, USA). 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 and practitioners, 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. The survey was then pilot tested with a small sample of both academics and practitioners (n = 7) to establish its feasibility. This resulted in a positive response based on verbal feedback, with the use of the ‘slider scale’ function being commended in making the responses clear. In addition, the use of a progress bar within the online survey and organization of the survey by sections helped to alleviate survey fatigue based on pilot testing feedback.

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 multiple-choice questions designed to ascertain the eligibility, suitability and additional information. 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. This was followed by
an opportunity for the responder to expand upon their perceptions within an open-text box. For Section 5 (dissemination), respondents ranked which method of dissemination they would like to be used 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 0 (skewness < 2, kurtosis < 5), with no outliers identified (Field, 2017). Data were corrected for type 1 errors using false discovery rate (Benjamini & Hochberg, 1995). Null hypotheses were rejected if the 95% confidence interval did not contain 0.

Results

General information

Data from respondents showed that 57% 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 – academics 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 academics 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 I shows 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 II). Specifically, academics ranked journal articles significantly higher than practitioners did (Academic: $M_{\text{rank}} = 53.9$; Practitioner: 36.0; $z = -3.18, p = .001, p < q$). However, practitioners rated one-to-one as more preferential (Academic: $M_{\text{rank}} = 41.3$; Practitioner: 56.1; $z = -2.62, p = .009, p < q$). There was little difference between groups when identifying player preference.

Figure 1. Academic and practitioner perceptions of responsibility (0 = Academic, 100 = Practitioner) during the formation and delivery of collaborative research partnerships within team sports.

Overall perceptions of research collaboration

In general, both academics and practitioners stated little agreement ($\leq 50$ (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 ($19.5 \pm 24.9$), and that practitioners had developed own knowledge ($29.1 \pm 28.5$). Both academics and practitioners showed that the

| Questions                              | Academic | SD   | Practitioner | Mean | SD   | $M_{\text{diff}}$ (95% CI) | Effect size | Qualitative |
|----------------------------------------|----------|------|--------------|------|------|---------------------------|-------------|-------------|
| 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     |

Notes: Research is fast, i.e. quick possibly descriptive. Research is slow, i.e. longitudinal.
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).

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

| Questions                        | Preference of practitioner | Practitioner perceived preference of player |
|----------------------------------|----------------------------|-------------------------------------------|
|                                  | Academic mean rank score   | Practitioner mean rank score               | Academic mean rank score | Practitioner mean rank score |
| Journal article                  | 53.9                       | 36.0                                      | 49.4                     | 43.2                       |
| Conference                       | 51.8                       | 39.4                                      | 49.9                     | 42.5                       |
| Group (>10 people)               | 44.2                       | 51.5                                      | 46.4                     | 48.0                       |
| Intimate seminar (<10 people)   | 45.3                       | 49.8                                      | 45.1                     | 49.9                       |
| One to one                       | 41.3                       | 56.1                                      | 43.1                     | 53.2                       |
| Summary report                   | 47.9                       | 45.6                                      | 46.0                     | 48.6                       |
| Video                            | 47.0                       | 46.9                                      | 47.0                     | 47.0                       |
| Infographic                      | 43.7                       | 52.3                                      | 48.8                     | 44.1                       |

* Denotes statistically significant difference for subscripted variables (p < .05).

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 III). 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.

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

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

| Questions                  | Academic (n = 57) | Practitioner (n = 36) | $M_{diff}$ (95% CI) | Effect size | Qualitative |
|----------------------------|-------------------|-----------------------|---------------------|-------------|-------------|
| 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     |
to enhance the 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 towards infographics as a method of dissemination. The use of infographics is now commonplace on social media platforms, such as Twitter, with practitioners preferring their ease of access and simplicity in relaying information (Burke, 2017). Such methods may be useful to simplify the overall message to key stakeholders (e.g. coaches and athletes). However, as they only provide a ‘snapshot’ of the research study, practitioners and academics should critique the original research before then feeding forward. 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’ with the aim of bridging 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. Recent studies have shown that it is possible to carry out invasive research designs within the applied setting, utilizing typically viewed ‘laboratory methods’ such as muscle biopsies (Bradley et al., 2016) and doubly labelled water method (Anderson et al., 2017) with elite team sport athletes. Whilst it has been acknowledged that sport 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 a lack of importance that non-scientific staff place upon sport science as a practice (Eisenmann, 2017). Whilst sport science has been adopted within coach education programmes for those currently coming through the system, some 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. Only 48% of respondents used a mutually agreed research contract prior to commencement, with academics seen as responsible for the majority of the process. 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 type of industry can result in short-term planning amongst practitioners who may be 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 then allows for long-term implementation. McCall et al. (2016) discussed the need for sport 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’ (Buchheit, 2017). 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 possible solution may be the increased use of ‘embedded scientists’ who work as part of the team and therefore can communicate information between the key stakeholders using their own practical language. This may also help to generate contextually relevant research questions that address ‘real-world’ practical issues (Buchheit, 2017).

One of the main issues that exists is the timeframe involved from initiation of a project idea through to the final product. Burgess (2017) describes the need for balance between using ‘slow’ type research and the practical realization of trying to implement approaches. 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). Conversely, academics must look to improve the process in which research is administrated and disseminated (Buchheit, 2017). For example, peer review in scientific journals is a slow and inconsistent process that deter many practitioners from publishing their work (Smith, 2006). The promotion of relevant submission types (e.g. case studies), faster turnaround and accountability of reviewing and making content freely accessible may help with this process (Buchheit, 2017). It could also be argued that research should be disseminated in multiple ways across the continuum of science to practice, in order for all key stakeholders to feel involved (Jones et al., 2017). 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. The use of ‘embedded scientists’ allows research to be disseminated during the process, rather than waiting until the end of a research study cycle (Jones et al., 2017).

Whilst the information gathered from the present survey provides useful insight into the perceptions and potential barriers of collaborative research, several areas still require further investigation. The sample of respondents was 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 sport market in which sport science is still in its relative infancy. 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 also focus on strategies to overcome some of the potential barriers raised in the present study. It must be noted that whilst we have attempted to define academics and practitioners based on their main job role, both types sit on a continuum of practice (Jones et al., 2017). Further investigation into how people interact along this continuum would provide useful information about how we can maximize collaborative sport science research.

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 invasive 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. The future of applied sport science research should look to develop research-active practitioners through academic collaboration and challenge the ‘status quo’ to achieve the highest standards of scientific rigour.

Acknowledgements

The authors 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

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

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

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

Beneke, R. (2013). Sport performance research: Sexy, under-funded, 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

Buchheit, M. (2017). Houston, we still have a problem. *International Journal of Sports Physiology and Performance*, 12 (8), 1111–1114. http://doi.org/10.1123/ijspp.2017-0422

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(Suppl. 2), 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. California: Sage.

Heron, N., Usher, R., MacLeod, D., Sarrieuguil, 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

Higher Education Funding Council for England. (2017). Initial decisions on the Research Excellence Framework 2021. Retrieved from http://www.ref.ac.uk/publications/2017/initialdecisionsontheresearchexcellenceframework2021.html

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hannin, J. (2009). Progressive statistics for studies in sport 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*, 5(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/jsrm.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/10.1080/02604140701245550